AN INVESTIGATION INTO THE PROSPECTS OF RESOURCES IN PHYSICS EDUCATION IN THE SECONDARY SCHOOLS OF KERALA FOR THE DEVELOPMENT OF PRACTICAL APPLICATION AWARENESS

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Date..........

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SUBMITTED FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
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DECLARATION

I, Achamma P. Mathew, do hereby declare that this thesis, "An Investigation into the Prospects of Resources in Physics Education in the Secondary Schools of Kerala for the Development of Practical Application Awareness", has not been submitted by me for the award of a Degree, Diploma, Title or Recognition before.

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CERTIFICATE

I, Dr.P.M. Jaleel, do hereby certify that this thesis, "An Investigation into the Prospects of Resources in Physics Education in the Secondary Schools of Kerala for the Development of Practical Application Awareness" is a bonafide study and research carried out by Smt. Achamma P. Mathew under my supervision and guidance.

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Achammamathew

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CHAPTER I

INTRODUCTION

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1.1 Contextual Background

In this age of space technology science has permeated through the human life in such a way that, it has now become every man's everyday concern. It is believed that the new generation must be equipped with the scientific knowledge and attitudes to grow and live in the modern world as efficient citizens. If science is to enable a pupil to adjust himself to the various factors of his complex environment, he must be given an understanding of certain basic and important principles and laws, which are needed in solving the common problems of everyday life.

Science is a human undertaking. It is the process of seeking explanations and understanding of the natural world. It also includes the knowledge that the process produces. To the extent that it is a human understanding, it's inclusion in the curriculum is mandated. To the extent that the attitudes and ideals of science are valuable and lasting throughout students' lives, education should reflect the spirit of science. It would be a courageous venture to have science serve as the spine of the curriculum.

The ever-growing importance of science in the economy and culture of any country and the ever-growing knowledge in the field of science have set the urgent task before all countries of the world to provide modern science education to the youth so as to prepare the young people for life. "Science teaches students to think and sharpen their intellect. Its utilitarian value lies in that it can provide students with knowledge of material world and of the forces of nature, which can be helpful to them in their everyday life. It can enable the pupils to take up some definite occupations... the most characteristic feature of modern civilization is man's conquest of nature by the application of scientific knowledge" (Joshi, 1956: 21). A stage has come that the progress of a country depends on how well it applies the available scientific knowledge for practical purpose. Vaidya points out, "The strength of a modern economy depends on the strength of its industry, and industrial development in turn depends upon technology, that is upon the application of new scientific knowledge, thus all progress grows out of men's creative capacities" (Vaidya, 1971: 2).

A major criticism about the present science curriculum is that there is too little relation between what is learned in school and what is taking place outside it. School curricula and methods are frequently boring and fail to nurture properly the desire to learn. Through the philosophy of 'Basic Education', Mahatma Gandhi insisted that a required manual labour component in the curriculum would help the purpose of training the students to be productive and active members of their respective societies and consequently to contribute to the economic progress of the country. His philosophy of craft centered education has immense relevance and resemblance with the modern concept of socially useful productive work (SUPW).

In China, Mao-Zedong's views were almost the same as those of Gandhi's Basic Education. He also gave emphasis to the incorporation of manual work in the curriculum. He believed that such a scheme will increase the productive capacity of workers.

Education according to Marx, should be combined with productive work. According to him education combined with productive labour should be considered not only one of the methods of adding to the efficiency of production, but also as the only method of producing fully developed human beings. The pragmatic philosopher Dewey also has laid emphasis on work and experience. The concepts of work experience, work education and socially useful productive work are closely related and they contribute to the social and economic growth along with the overall development of the learner.

According to Washton (1961) the function of teaching science for general education is to provide pupils with common attitudes, knowledge and skills to enable them to live more effectively and intelligently in a democratic society. Discussing about the purpose of science teaching, Devito and Krocjover are of the view that "Basically there are three purposes of science teaching: to familiarise students with a basic body of knowledge, to help students develop proper attitudes toward science and the world of technology, and to assist students in acquiring the fundamental skills of science, so they will be able to function better within a scientific environment. All these are highly desirable goals; and none should be neglected. Education has among its major objectives the development of each student into a creative, innovative and independent thinker" (Devito and Krocjover, 1976 : 411).

The three underlying themes put forward by Schmidt and Rockcastle (1968) regarding the teaching of science are the following: (1) The foundation of all learning in science is first hand experiences with real things, (2) Science experiences need not involve unusual, elaborate or expensive apparatus and materials and (3) Investigating one's environment is an interesting and integral part of science education.

The Secondary Education Commission (1952-53) observes that pupils should be encouraged to explore every opportunity to develop the attitude of critical inquiry.

The classroom, the home, the city and the village, the fields and woods and streams, all offer rich resources and opportunities for science teaching that must be fully utilized by every teacher of science.

Physics education at the secondary school stage requires the effective use of educational resources. Effectiveness or efficiency is the maximisation of the use of facilities provided with minimum wastage. The major educational inputs that go into 'production function' in education are the learner's time, instructor's time, physical facilities, equipments and materials. The quality and quantity of these inputs and their relative proportion depend on the educational approach followed (Ahmed: 1940). While examining the running of a school from a series of practical case studies, Barry and Tye (1973) discuss how to weigh up available resources - time, money, space and manpower - and how to employ them effectively in carrying through a programme of action and how to continually assess results.

The writings of Piaget on matters concerned with children's' learning date back over many decades, but only comparatively recently have they received widespread study and acclaim. Jerome Bruner (1960) who may well best be remembered for his much-queried but oft-quoted statement that 'any subject can be taught effectively in some intellectually honest form to any child at any stage of development', has also made a great contribution to the study of educational theory and practice particularly for school children. Both men have emphasised the need for learning to be based on the needs of the individual, in turn, for the individual's need of resources to present and control learning situations best suited to his aptitudes and abilities.

The tendency now is to shift from the passive "I am taught" to the active "I learn". The process in the former is based on the teacher and the support he requires. In the latter, the system is based on the learner and the aids he requires. The distinction between being taught and learning should be clearly understood. So utilisation of educational resources is a very important criterion for effective learning to take place.

After the attainment of independence, a number of committees and commissions have been appointed in India to recommend changes in the system of education. The Education Commission reads: "The existing system of education is largely unrelated to life and there is a wide gulf between its content and purposes and the concern of national development. This indicates that India's educational system is too bookish and too deviated from daily life. A radical *reconstruction of education is essential for economic* development of the country. This will involve a transformation of the system to relate it more closely to the life of the people" (Education Commission, 1964-66:5). National Policy on Education (1986) of India supports this view. The large gap now existing between the High School Science Programme and the interest and needs of students will likely to grow wider unless corrective action is taken soon, so the present day science teaching is in serious need of correction (Burkman, 1972).

The role of first hand experience in the teaching-learning process has been recognized by the educators. Stressing on its importance Secondary Education Commission (1952-'53) reports: "Special emphasis must be placed on demonstrations, field trips and practical projects which may link up school science with actual life problems and situations" (1952-53 : 94).

A direct link between education and life can be forged by having science whether fundamental or social as a basic component of education and culture. Science should be taught to give an idea of the usefulness and implications of it in relation to man's everyday needs. This can be achieved by making the curriculum more utilitarian and by providing a positive bias to practical application awareness. This will enable the students to apply the knowledge gained from the classroom in real life situations and help them to acquire necessary scientific skills. This will help to realise the fact that education is not just preparation for life, it is a portion of life.

There is no doubt that an understanding and application of physical science is essential to effective living in the world today. It is our contention that it was the practical application of the new discoveries in science and technology that was largely responsible for transforming the erstwhile underdeveloped societies of the west into advanced states. "Physics is fundamental among all other sciences because it describes the forces and energies that govern the physical processes of nature. It is indeed a disciplinary medium through which one learns and teaches many of the most fundamental concepts of natural processes" (Heller, R.J., et al. 1972:114). Akhmatov (1960) of the U.S.S.R. stressed the basic place of physics in the general cultural requirements of educated men and women when he wrote that it is clear at present that it is precisely the progress of physics that determines the possibilities of development in a very wide range of sciences, from cosmology to biology and medicine. It is physics that determines to a large extent the foundations of our outlook as well as the possibilities and limits of our practical activities.

If physics education is to become practical application oriented, it will have to be in accordance with and help them to acquire necessary scientific skills. This will help to realise the fact that education is not just preparation for life, it is a portion of life.

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If physics education is to become practical application oriented, it will have to be in accordance with

with dust. They are displayed proudly to visitors or mentioned liberally when a grant is sought for more instruments. But often, no one uses them ... There is no point in asking for more and more sophisticated instruments if they are meant to be show pieces. Merely exhorting students to make maximum use of the facilities is also not enough, the teacher should show the way to the students. It is time to stop this appalling waste of resources (The Hindu Daily, April 30, 1991). The reasons for this state of affairs need to be assessed. This will pave the way for the better utilization of available resources in education.

1.2 Need and Significance of the Study

Secondary Education has a strategic position in the whole schema of education for several reasons. First, secondary education lays the foundation of all higher education. Second, it should be the terminal stage for many who, after well directed additional training have to fill the middle level working positions - technical, vocational and professional. In spite of this situational importance secondary education has always been and still remains the weakest link in the chain. So any programme for the reorganisation and improvement of the system of education must pay special attention to the secondary education.

Present educational system in India does not seem to meet the requirements of a growing economy. In schools and colleges teaching to a great extent is geared to the sole purpose of passing the examination and securing a degree or diploma. Memory is at a premium, intelligence at a discount. The system is designed to iron out independence of mind, originality and native curiosity (Robinson and Vaizy, 1962).

Physics is the most fundamental of the sciences and therefore is clearly essential to all children. But "... physics courses commonly given to the children are inadequate and unsatisfactory. They fail to convey understanding of the important concepts of physics, and they fail to show to young people anything of the approach which the professional physicist necessarily brings to his work... It is essential to make physics interesting so that the children will want to learn... It must be taught throughout the education of the child" (UNESCO, 1968: 14-15).

The emphasis of physics teaching at the secondary stage needs to be on developing the concepts through practical application oriented activities involving the use of skills in science processing. Planning of education can be based on life oriented aspects so that there will be better awareness of practical application amongst the students.

In recent years physics curricula have been criticised for containing too sterile a mixture of academic facts and concepts and not enough of issues related to recognizable everyday lives. One implication is that physics teacher should try to incorporate at least some aspects of practical applications of physics and technology into their teaching. Steward and Towse (1986) are of the view that it is necessary to encourage the students to examine some of the wider issues raised by the applications of physics in technological processes, and these issues will be economic, environmental, social, agricultural or some mixture of these. It suggests that creating an awareness of practical applications of physics is one of the major objectives of physics teaching. But it is believed that this objective is seldom realised in present day physics teaching in the State of Kerala. The following are believed to be some of the reasons for this state of affairs.

1. The classroom instruction is mainly theoretical in nature.
2. The students do not always get first-hand experience.
3. The content and learning experiences provided are isolated from the real life situations.
4. Importance is not given to practical application aspects while teaching physics theory.

5. Experiments are not conducted which will enable the students to acquire necessary skills and also to apply theoretical knowledge in practical situations.
6. The resources available for physics education are not utilized effectively.
7. In some cases the needed resources are not available at the disposal of the teachers.
8. Emphasis is not given to practical skill development.
9. Most of the physics teachers are not trained to utilise the environmental resources effectively and
10. The rigid nature of the curriculum.

Application of knowledge implies skill formation in students to do a job. Therefore teaching-learning process should provide adequate opportunities to students to acquire skills and develop confidence to apply the samein real life situations and further strengthen the human values of equity and social justice. This would imply a good deal of investigation and broad based re-framing of the science courses at secondary level to give them a practical application orientation. The purpose of this is not a mechanical addition to the content of the subjects but to make education more meaningful and purposeful and to move away from highly formalised and narrow courses based on information and rote memory. Then only the students will acquire the necessary skills and values which would enable him to have a better awareness of his self and environment, practical applications, culture, tradition, and heritage and the problems of the society.

A meaningful and purposeful interaction between theory and its application is a matter of great importance in science education. The development of the ability to recall information and of the ability to use the same information in inferential and applicational behaviour do not necessarily go hand in hand. Students may make considerable progress with the former ability and relatively little with the latter (Henry, 1947: 202). Since the facts, concepts and principles which are emphasised in teaching are really only raw materials needed for carrying on intellectual processes which govern behaviour, the incompleteness of teaching methods which place almost exclusive emphasis upon memorization and recall should be recognized.

The impact of school depends on the quantity and quality of resources, staff and programmes, and facilities that are made available to students from certain regions, localities, neighbourhoods. School resources and their utilization have a positive impact on student achievement (Guthrie et al., 1971 ; Averch et al., 1972). According to Spady (1976) methodolically adequate research evidence is scarce in this field.

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The lack of suitable teaching learning materials is pointed out to be a major difficulty confronting the science education. Inevitably this lack is most apparent in third world countries (Steward and Towse, 1986). It has been accepted that physics teaching demands a specialised room where activities or experiments are done and also the availability of equipments and materials. Most village schools in the State of Kerala lack worthwhile infrastructure of facilities to engage children creatively. But urban schools are often saddled with a lot of unused equipments. A very important question is - How many schools, for instance, possessing slide film projectors use them optimally? The impact of such a grossly undemocratic policy is that majority of children are starved of relevant practical experience. Having sufficient affluence to obtain expensive laboratory, audio-visual and other sophisticated instructional materials may not benefit student achievement if these resources are not utilised effectively.

Children understand better if they experience things. They understand principles of physics better if they see the principle at work in some equipment and then they are able to relate them to some real life situations. So it is essential that physics teachers should be trained to utilise the resources available to them effectively. He should also be trained to tap the environmental resources.

It is necessary to probe into the state affairs in this regard in the State of Kerala.

Education Commission (1964-'66) of India points out the wide spread dissatisfaction with the existing curricula and the lack of physical resources and orientation of teachers. To quote the words of the Commission, "Most of the curricular revision attempted so far has been of an ad hoc character - not generally preceded by careful research, not based on adequate expertise and not followed by such necessary supporting measures as the preparation of learning materials, the orientation of teachers or the provision of needed physical facilities" (1964-'66 : 184). It is expected that the present research will be of help to curriculum planners in the revision of physics curriculum in the State.

Modes of thought must be developed from stimulated common experience on topical excitements. Kothari(1964) holds the opinion that the basic content of physics course is almost the same in all countries. According to him the order in which various topics are presented may vary, as also the examples chosen to illustrate the different principles. It is by choosing proper examples that one can link physics with the surroundings and the daily life of the people, in other words make physics more relevant and exciting. In most developing countries textbooks which were written in advanced countries are used (either in their original form or in translation) and as such do not reveal the relevance of physics to the average pupil. There is little doubt that they succeed in providing sound knowledge of the basic principles to the pupils, yet they fail to develop in the child the capacity to correlate the principles of physics with things that happen around them.

Many up-country pupils in agrarian communities have not the background of mechanical know-how which urban pupil will have. Without experience of machines and toys they need much more help in relating physical principles to real life (Lewis, 1972). Kothari (1964) stresses the same point: the children in India have in their background hardly any activity which may be termed scientific, partly owing to the very high cost of most mechanical kits, gadgets and so on.

Great educationalists such as Dewey and Gandhi emphasised the importance of community resources in the realisation of educational objectives. They tried to identify a number of resources available locally. But the community resources available in a state like Kerala are not found tried for educational purposes to the desired extent. These resources can be treated as a part of the hidden curriculum available in a region. The potentials of these resources need to be studied.

Knowing the potentials of available regional community resources, Gandhi introduced the system of Basic Education in India. Community School introduced by Dewey also envisaged the effective use of the resources. All these suggest the necessity of examining the prospects of available resources for physics education as the unidentified resources form a part of the curriculum as mentioned earlier.

Although secondary science curriculum in Kerala has undergone a revision in 1985, the physics syllabus is still criticised for its over emphasis on theory. Most of the physics teachers still resort to traditional styles of teaching which are mainly verbal or lecture. It is said that practical application aspects are not highlighted in classrooms. Teachers complain that schools lack required resources for effective physics teaching. This seems to be true in the case of rural schools of Kerala. Although the prospects of resources in physics teaching are assumed to be quite bright it is believed that even the available resources are not utilized effectively by physics teachers. If it is so, physics education in Kerala continues to lack reality and purpose. In this context it is necessary to investigate the extent of availability and the extent of utilization of resources in physics teaching and to find out whether they exert any significant influence on the practical application awareness of secondary school pupils.

Skills and attitudes pertinent to the promotion of economic development constitute a necessary end product of education and not only the content but also the methodology and technology of education have to be formulated for the achievement of the theoretical concepts by revealing their applications in life situations. It is necessary therefore to teach physics by providing activities and making use of all the available resources. So it is worthwhile to investigate how far the present physics teaching has succeeded in creating practical application awareness among pupils.

A set of potentially influential factors for pupil achievement are generally categorised as being associated with home environment, school achievement and personality factors. The influence of factors like intelligence, socio-economic status, sex of the child, locality and management of school on the scholastic achievement of pupils have been extensively studied by many scholars. These have revealed both positive and negative influences of these factors. Therefore to study the influences of these factors on practical application awareness is a task of significance in the present context.

It is not known how far the teaching of physics in the schools of Kerala is realised in terms of theory and practical application awareness among pupils. It is necessary to investigate these aspects and also to find out whether there exists any relation between theory awareness and practical application awareness in physics among the pupils.

1.2.1 Statement of the problem

The present investigation among other things tries to examine the resource base and its utilization for physics education in the secondary schools of Kerala. It also tries to measure the extent of theory and practical application awareness among the secondary school pupils in the State. All these are directed to probe into the prospects of resources in physics education for the development of practical application awareness among pupils. Hence the problem under investigation is entitled "An Investigation into the Prospects of Resources in Physics Education in the Secondary Schools of Kerala for the Development of Practical Application Awareness".

1.3 Meaning and Definition of Key terms

1.3.1 Resources in Physics Education: Educational resources may be defined as the totality of the inputs that impact in some manner upon the student.

Within the context of this definition resources in physics education include all the inputs that impact in some manner upon the student for the learning of physics which include physical, financial, human and community resources constituted of buildings, library, laboratory, teachers, teaching aids, environmental resources, co-curricular activities, etc.

1.3.2 Prospects of Resources: For the purpose of the present study, prospects of resources is taken to mean the extent of availability and the likelihood that the resources will contribute to the realisation of certain objectives in education which among other things is practical application awareness.

1.3.3 Practical Application Awareness: According to Dictionary of Behavioural Science awareness means being conscious of something, the state of perceiving and taking account of some event, occasion, experience or object (Wolman, 1973). Again, in the Taxonomy of Educational objectives, it is observed, "though awareness is the bottom rung of the affective domain, we are not so much concerned with a memory or ability to recall an item or fact as we are that given appropriate opportunity, the learner will be merely conscious of something that he takes into account a situation, phenomena, object or state of affairs" (Krothwohl et al. 1964 : 196).

For the purpose of the present study practical application awareness is taken to mean the awareness of *those curricular experience revealed through the development* or use of practical skills at cognitive level, applications in daily life situations, information about the utilization aspects of the theory studied, etc.

1.4 Hypotheses Formulated for the Study

1. There is scarcity of educational resources available for physics education in the secondary schools of Kerala.
2. The extent of utilisation of available resources in physics education in the secondary schools of Kerala is not satisfactory.
3. There will be differences in the extent of availability of resources in urban, rural, government and private schools.
4. There will be differences in the extent of utilisation of available resources in urban, rural, government and private schools.
5. Physics theory awareness of secondary school pupils is satisfactory.

6. Physics practical application awareness in relation to theory awareness is not satisfactory.
7. There is a positive relationship between physics theory awareness and physics practical application awareness.
8. Physics practical application awareness is influenced not only by factors like intelligence quotient, socio-economic status but also by the extent of resource utilisation.
9. The effective utilisation of resources in physics education helps to develop physics practical application awareness.

1.5 Objectives of the Study

The following objectives are framed for the study:

1. To find out the extent of availability of resources in physics education in the secondary schools of Kerala.
2. To find out whether there exists any difference in the availability of resources between (a) urban and rural schools (b) government and private schools.
3. To find out the extent of utilization of resources in physics education in the secondary schools of Kerala.

4. To find out whether there exists any difference in the utilization of available resources between (a) urban and rural schools, and (b) government and private schools
5. To find out the extent of physics theory awareness of secondary school pupils in the State of Kerala.
6. To find out the extent of practical application awareness of pupils in relation to their theory awareness.
7. To find out whether there exists any relationship between physics theory awareness and physics practical application awareness among (a) the total sample (b) boys (c) girls (d) urban school students (e) rural school students (f) government school students, and (g) private school students.
8. To find out the possible influence of resource utilisation and sex, locality, management of school (taking one at a time) on physics theory awareness.
9. To find out the possible influence of intelligence and sex, locality, management of school (taking one at a time) on physics theory awareness.
10. To find out the possible influence of socio-economic status and sex, locality, management of

school (taking one at a time) on physics theory awareness.

11. To find out the possible influence of resource utilisation and sex, locality, management of school (taking one at a time) on physics practical application awareness.
12. To find out the possible influence of intelligence and sex, locality, management of school (taking one at a time) on physics practical application awareness.
13. To find out the possible influence of socio-economic status and sex, locality, management of school (taking one at a time) on physics practical application awareness.
14. To bring out the prospects of resources in physics education in the secondary schools of Kerala for the development of practical application awareness.
15. To suggest programmes for the development of practical application awareness in physics among secondary school pupils.

1.6. Methodology in Brief

The present study was conducted on a final sample of 388 physics teachers, 1016 standard IX students and 1020 standard X students from selected high schools of Kerala on the basis of stratified random sampling (Details given in Chapter III). Relevant data were collected from the subjects under study, using adequate tools and techniques like questionnaire, achievement tests, observation schedule, intelligence test and socio-economic status scale. The data thus obtained were analysed using appropriate statistical techniques.

1.7. Scope of the Study

The study is confined to the secondary schools in the State of Kerala. The data analysed may throw light on the extent of availability of resources in physics education and the extent of their utilization. This analysis is expected to give an idea of the institutional facilities available for physics education in the secondary schools of Kerala.

The actual position with reference to certain factors identified as resources - physical, financial, human and environmental - were taken up for the study. Qualifications of teachers, workload, inservice training, co-curricular activities etc. were also taken up for coverage in the investigation.

Incidentally the study is also expected to yield the concept of 'practical application awareness' in physics in the secondary schools as envisaged by curriculum makers. Using achievement tests, an attempt has been made to measure the theory awareness and practical application awareness of secondary school pupils in physics. The analysis of these tests is expected to provide an idea about the influence of utilization of resources on practical application awareness in physics and also to find out the relationship between theory awareness and practical application awareness in physics.

1.8 Limitations

It was not possible to survey all the secondary schools in Kerala personally, to have an effective evaluation of the resources needed for physics education. However as adequate a sample as possible within the limitations of time has been taken. The achievement tests to measure the theory awareness and practical application awareness were prepared and administered for Standards IX and X and not for Standard VIII. This was because general science approach was adopted upto Standard VIII and the discipline of physics in its modern form was taken up in the last two classes mentioned above. Although the study was to investigate the prospects of all resources in physics education, it concentrated mainly on the institutional resources. Detailed text book analysis, which could have yielded information about the practical application awareness in terms of study materials offered to pupils were excluded because it would have made the study unwieldy. Because of the high practical importance and applied nature of the topic and owing to the dearth of research studies in India in such areas, a broad based approach was taken up for this study. So a neatly established precision design over a narrow area was not opted for in the study.

1.9 Format of the Report

The report is presented in five Chapters, the details being as follows:

Chapter I is the introduction and as noted above, contains all the relevant sections of an introductory Chapter.

Chapter II presents the review of related literature and studies pertaining to the area under investigation. An earnest attempt is made to review all the available studies in the area concerned.

Chapter III gives a description of the method of the study, the sampling procedure attempted, the instruments with which the data were collected, the procedure employed to collect data and the statistical techniques used in the study.

Chapter IV is concerned with the analysis of data followed by its interpretations.

Chapter V summarises the study in retrospect. The implications of the study are discussed and suggestions for further research are also given.

CHAPTER II

REVIEW OF RELATED LITERATURE

CONTENTS

2.1	Resources in Education
2.1.1	Site, location, building, classroom and playground
2.1.2	Library
2.1.3	Laboratory
2.1.4	Audio-visual aids
2.1.5	Co-curricular activities
2.1.6	Environmental resources
2.1.7	Teacher and in-service programme
2.2	Practical Application Aspects
2.3	Intelligence, Socio-Economic Status, etc., and Academic Achievement
2.3.1	Socio-economic status and achievement
2.3.2	Intelligence and academic achievement
2.3.3	Sex differences and academic achievement
2.3.4	Locality of school and academic achievement
2.3.5	Management of school and academic achievement

A review of the previous researches and writings on the relevant areas directly or indirectly related to the present study is attempted below in order that it would serve as a suitable frame of reference for the present study. The materials that are available are grouped under appropriate heads and presented below.

2.1 Resources in Education

Science is so close to the life of every child that no teacher needs ever be without first hand materials for the study of science. The world above us, beneath us and around us in any part of the globe provides an inexhaustible supply of phenomena which can be used as a subject matter of science teaching, and of materials which can be used to construct scientific equipment and teaching aids.

Indian Science has made a tremendous progress since independence and every Indian can be reasonably proud of this fact. Unlike other developing countries, India had already an established structure of science education and research. But the gap between the science education abroad and in India has increased with time so far as physics education and research are concerned. With the same resources India could have achieved more. In fact, along with the utilization of available resources for physics education, the country could have insisted on getting even more resources being put into physics education and research if it had planned for the distant future rather than for immediate interests.

According to Seay (1953), resources can be thought of as being natural, technological, human and institutional. By natural resources is meant those coming from nature, such as soil, minerals, water and climate. By technological resources is meant the tools of science and invention, such as cars, bulldozers, chemical analysis, aeroplane, etc. Human resources are the people and their potential energy. From the people and their understanding come the "big ideas" that stimulate action. Institutional resources are to be found in such organisations as schools and universities, churches and synagogues, research foundations, business firms and science association.

The term resources covers a very wide range of things, including time, money, people, ideas, products, space, facilities, power and even energy. The various resources available in education can be grouped into four major categories. (1) Physical resources (2) Financial resources (3) Human resources, and (4) Community resources.

The physical resources such as fixed capital installations, movable capital facilities, consumable items, are to be put to the maximum use in all the educational institutions. The fixed capital installations include both land and buildings.

The financial resources such as fee, endowments, returns from productive work etc., are to be used most economically. It refers to all funds available to educational authorities to spend on services and goods needed for educational operations.

Human resources in education means the time, labour and energy of the learners, instructional personnel and support personnel, including planners, administrators as well as parents, is by far the most valuable and expensive of all educational resources. For instance, the time of the school board members, members of the Parent Teacher Associations, parents helping to do home work, community members serving the curricular activities are very productive. These items are often not shown in the budget and usually not included in resource estimates.

The community resources provide dynamic, interesting and real life opportunities for teaching and learning. The community opens its door for experience through its resource people, field trips, etc.

According to Krupskaya, "We should learn from Pestalozzi the correct approach to life around us, and we must learn to take from it the knowledge and skills we need" (Krupskaya, 1985 : 119). Pestalozzi lived at a time when Switzerland was still a poor country. He put forward a large number of suggestions concerning how to study in conditions of an obscure rural life and how to make use of the scanty resources that were available. The true practical workers even in the culturally most advanced countries teach the same things that Pestalozzi wanted to teach to children namely, how to make use of the world around them and how to acquire knowledge from kowledgeable persons.

Krupskaya (1985) emphasises the effective utilization of all available resources by saying use must be made of every electric power station, every railway workshop, every tractor, every sewing machine, every shop, every factory and every plant in acquainting children with modern technology in practice.

Science is not hardware. Science is in essence, a viewpoint, an ability to critically examine phenomena. From this view point each and every object of daily use is piece of scientific apparatus and every child is an explorer - a potential scientist we must look critically at our own resources and possibilities.

The value of resources depends on how skilfully they are used. Each should be used for a definite purpose, to help solve a problem, to make a scientific principle more graphic, to increase the tendency of pupils to inquire about their environment. Most educational systems or educational institutions do not consider as a major and central objective the optimal use of inputs to maximise their outcome. Ficher and Orivel (1980) observe that most countries, especially the poorest are facing budgetary difficulties which have stopped the expansion of public resources allocated to education. After a quarter century of rapid expansion of public resources allocated to education (1950-75), public authorities and public opinion are increasingly concerned with the idea of a 'good' use of these resources.

At the heart of the controversies surrounding public education is the strongly held belief that schools should have a 'positive impact' on their clientele. "The impact of school depend on the quantity and quality of resources and also their effective utilization. Impact implies 'effect', and 'effect' implies 'cause'" (Spady, 1976 : 186).

In U.S.A., many studies have examined the relationship between school resources and student achievements. Most of these studies have been summarized by Guthrie, et al. (1971) and Averch, et al. (1972).

The finding of the study by Ribich (1968) suggest that beyond a certain point schools cannot effectively utilize all of the available non-human facilities.

A review of literature and studies regarding the institutional resources such as school building, class room, playground, library, laboratory, audio-visual aids, environmental resources, in-service programme, etc., is attempted under appropriate heads.

2.1.1. Site, location, building, classroom and playground

School buildings can provide the desired physical facilities to meet the needs of the students. The notion that planning precedes building is expressed very well by Lewis and Wilson (1953) by quoting a bulletin of the Michigan Department of Public Instruction : Good buildings do not just happen. They must be planned carefully and thoroughly. School building planning should recognize the essential difference between planning for school building and planning of school building. The purpose of school building is to provide the physical assets essential to the educational programme. Planning for school buildings is the process of defining and stating the kind and extent of the educational programme to be housed in school building or buildings and, the development of a long-range building programme. Planning of school building is the process of developing a school building suitable to the educational programme described in planning for school buildings.

According to the Kerala Education Rules (KER, 1958), every school should normally have a minimum site area as specified in the following schedule.

Lower primary schools, Upper primary schools with or without primary section	4 to 8 Hectares
Secondary schools (High schools)	1.2 to 2 Hectares

The site should be located in a healthy place in the centre of a village or town. The site for the school should be large enough to cater the modern educational needs. The school site should be so selected as to keep it as far as possible from the noise and dust of the busy roads and such other distractions. The site should provide for adequate playground, gardens etc. Shady trees should be planted in such a way that it will be very useful to children. The site should be provided with compound wall or good fencing. "A good building, it must be admitted is a most vital asset for a school and a poor physical environment can become a great handicap in developing the proper espritde-corps or enduring tradition or a sense of loyalty to the institution" (Saiyidain, 1955 : 91). The school building should satisfy the triple conditions of functional efficiency, beauty and economy. School buildings are not built for the past or even for the present but they must be planned for the future.

The building constructed at times, are not properly maintained for use. It will be generally agreed that the facilities in Indian educational system, deficient as they are, are not utilized to their full advantage. It is the duty of the heads of the institutions to find out the immediate needs taking into consideration the resources and funds available. Giri (1976) studied the various problems felt by schools and stressed the importance of institutional planning as there are a thousand things to be done which requires crores of rupees which we do not have and, instead things could be done with no money or with little money. He stresses the need for maximum utilization of the material resources and human resources. The maximum utilization of physical resources is also emphasised in the Report of the Education Commission (1964-'66) by pointing out that "It is very costly to provide and maintain the physical plant of educational institutions, it becomes necessary to utilize it as fully as possible, for the longest time on each day and for all the days in the year, by making suitable administrative arrangements. Libraries, laboratories, workshops, craftsheds, etc., should be open all the year round and should be utilised for at least eight hours a day.

Teachers, students and local community members themselves should discover innumerable methods of utilizing school facilities to the maximum potential throughout the year" (1964-'66 : 40).

Oddie (1966) in his study examined the problems and expenditure involved in the optimum utilization of premises, the area required per pupil, the cost per unit of floor area and required per pupil, the cost per unit of floor area and standards of performance. He presented a methodology of building cost analysis and also dealt with questions concerning : increasing the effectiveness of existing school building, rate of investment, bulk purchase and forward programming.

In India the classroom is the most important unit in which instruction is going on. This is all the more true in the case of Kerala which is a thickly populated State of India. Kerala Education Rules (1958) is very specific in prescribing the dimensions of every classroom in upper primary and secondary school (high school or higher secondary school) should be 6m. x 6m. x 3.7m. and in a lower primary school 6m. x 5.5m. x 3m. The superficial area of the floor, the cubic content of the room and the maximum number of pupils that may be accommodated should be clearly recorded. In this context the standard prescribed for schools in England is worth mentioning. The standard prescribed by the Board of Education in England is 10 sq.ft. for every pupil under 11 years and 12 sq. ft. for those over twelve.

Effective science teaching is an interaction between children, teachers, materials and equipments and facilities. For the progress of science studies, the school should contain adequate facilities and materials. Teaching is usually done by the classroom teacher in the regular classroom and so he should also have a planning for purchasing and constructing science facilities and materials. "Flexibility is a key to a suitable science teaching facility .... This flexibility of classroom facility makes it easy for the teacher to convert any classroom into an effective learning centre" (Anderson, 1970 : 192).

According to Jacobson (1970) 'A self contained classroom' should have the following arrangements : classroom as a laboratory, a science activity centre, a centre for life science activities, work storage area, a science library, a science resource file, etc., whereas 'a science room' should have a ready accessibility, natural lighting, storage facilities for books, maps, chemicals, materials, etc., work benches, demonstration units, work areas for students, outlets for water, gas and electricity, *chalk, peg boards, clock with sweep second hand,* T.V.

antennae connection, locked storage for audio visual equipments, dark rooms, etc.

The science classroom and laboratory are the key places where intentions ought to be translated into actions and where both the teacher and the learner are involved in realizing the curriculum objectives. Schools in this century is more than a place where academic skills are taught and learned, it is a miniature community where members interact and influence the behaviour of each other. Optimizing classroom environment and facilities for students is one of the most important goals for teacher and schools. Hofstein, Yazer and Walberg (1982) in their study observe that their findings are in harmony with ideas suggested by Bloom, that the atmosphere and environment in which students encounter science affects attitudes towards science and their achievement towards science.

According to the Kerala Education Rules (1958) the maximum strength of a class shall be 40, but excess admissions upto 45 will be allowed. When there are more than 45 students a second division may be opened, when the strength exceeds 85 a third division and so on. Excess admission upto 50 in a class division may, however, be made with the permission of the Director.

In the choice of furniture - utility, strength, mobility and appearance should be considered. But there is a sharp conflict between what is desirable educationally and what is practicable economically. Although the KER suggests that every school shall be provided with a minimum of durable furniture of suitable dimensions and specifications approved by the Department, many schools of Kerala do not satisfy this condition satisfactorily.

The study conducted by Pillai (1956) was aimed to find out how far the organisational and administrative factors affect the achievement of pupils in secondary schools. The study revealed that sitting accommodation and facilities for writing in correct posture, in a large number of schools are quite unsatisfactory. In many schools furniture, library, laboratory. teachers' rooms, etc., were not provided and in certain schools the strength of the class went upto 70.

Desai (1966) conducted an evaluation of the secondary schools of Gujarat State and the study revealed that the position of physical facilities is generally satisfactory in all the schools.

The lack of proper school facilities is reported by many researchers (Bose, Banerjee, and Mukherjee, 1965 ; Mandalia and Najamuddin, 1975 ; Peter, 1984 ; and Nair 1986).

It is believed that the institutional facilities are poor in most of the Indian schools especially in rural areas. The specific objective of the investigation carried out by Govinda (1980) was to appraise the quality of existing schools in rural areas in terms of physical accommodation, playground, science equipment, library, extra-curricular activities, teachers, incentive schemes in operation and extent of wastage. His major findings are : (1) Many of the classroom were overcrowded and physical accommodation inadequate. (2) Except for a few cases there were no playgrounds or sports equipments in any of the schools (3) Facilities in terms of science teaching equipments were at an extremely poor state in most of the schools. The outcome of the study undertaken by Balakrishnan (1965) also confirms the lack of proper accommodation and facilities such as buildings, library, laboratory, store-room, games room, etc.

The playground is said to be the cradle of democracy. It is often quoted that the battle of Waterloo was won in the playground of Eton. It is on the playground that one learns to respect the rights of others and to obey the will of the majority. The child merges with a group and learns the spirit of self-sacrifice. It also helps quick thinking, practical judgement and formation of character. Hence without proper physical education, education will not be complete.

The Study conducted by Perimbamuthoo (1958) reveals the following facts regarding the physical education facilities in Kerala schools : (1) Most of the schools are without proper playgrounds. (2) Ground facilities are meagre. (3) Equipments are inadequate and often even available equipments are not properly used. (4) Often the funds allocated for purchase of physical education equipments are not utilized. Roy (1960) attempted an investigation into the provision for physical education in the schools of Howarh and the finding were in agreement with that of Perimbamutoo's.

Unnithan's (1969) study reveals that the provision of compound area, playground, garden and compound wall are far from satisfactory in most of the schools of Kerala State.

2.1.2 Library

A well-equipped and well-managed library is indeed the foundation stone of any modern educational structure. School libraries develop in pupils the ability to learn from books even without the assistance of teacher. The necessity for having many kinds of reference books for effective science learning becomes imperative. A good text book is a source of knowledge arranged systematically. It enables pupils to acquire the needed information speedily. The science teacher should get the choice to select books for his pupils, as, even the best book omit some details which is needed, for this he should be guided by the following factors: correctness of matter, purity of language, simplicity and clarity of illustrations, quality of printing, etc., in the case of textbooks and direction for fitting up the apparatus, precautions, methods of recording, lists of experiments etc., in the case of laboratory manuals (Dass, 1949).

The teacher should give directions to the pupils to use the books effectively. Some of the matters presented in the book may need some elaboration and explanation in certain cases. Much of what is presented in most textbooks in the hands of students need elaboration, summation, and alternate presentation by the teacher. Many high school students do not have the practice and discipline to study carefully textbook material with the view of mastering the subject on their own (Kutliroff, 1970).

Best materials for science courses can be obtained from different sources, provided the sources of information must be reliable and up-to-date. Nunn (1956) has classified the sources of information as the local sources, national scientific societies, information from government sources, information from private enterprises, reports of research institutions, national libraries, journals and reports from other schools.

Studies have indicated that the type of reference material used in the instruction of a science course can and does affect the learning outcomes. Yager (1965) reports that use of multi-references in the teaching of physical science can affect such learning outcomes as skill in critical thinking and ability to understand the nature of science and the men who practice science.

As far as printed educational materials are concerned Eaton (1963) and Williams (1963), found that same materials are not necessarily suitable for all students. They hypothesized that through suitable manipulation of appropriate factors, it should be possible to reproduce materials which will result in maximum learning for all students.

School libraries provide different types of books and reference materials. Vora (1975) studied the role of libraries in primary and secondary schools and the findings reveal that effective use of libraries are not taking place in the schools.

Maucall (1978) in his study provides a description of the use of libraries and library resources by academic high school students preparing papers for wide-pendent study projects. The following were some of the findings : (1) Students successfully seek information in more than one type library. (2) The students see library as places to receive assistance.

The findings of the study conducted by Barki and Bhat (1981) reveal that libraries were not put to optimal use by students and the teaching methods used by teachers did not encourage to use their institutional libraries. They also reported that the physical environment of the library was not conducive to reading in the library.

A more recent study by Al-Musalam (1988) revealed that most libraries in Kuwait still need more space, and better organisation, as well as additional equipments, books and materials. The existing conditions hinder complete utilization of libraries by students and teachers.

The science teacher is often faced with excluding the library from his/her teaching programme or developing a programme that reduces the dependence on reading and writing skills ; in this situation the students are not being encouraged to use the library resources (Havel, and Treagust, 1989).

Though a well equipped library should be the prime requisite of every school, it is pointed out that many of the Indian schools do not have adequate library and laboratory facilities. This is revealed through the studies of Murthy (1964); Bose, Banerjee and Mukerjee (1965); Rao (1968); Kalra (1976) and Govinda (1980).

2.1.3 Laboratory

All the new science-teaching programmes accept the principle that understanding comes through the pupils doing experiments themselves, so direct, first-hand experience is a must for children learning science. Talk and chalk alone give little feeling for science, encouraging an authoritarian factual approach. Good demonstrations by the teacher may help a little, but it is only when pupils come to handling the apparatus that they really accept the phenomenon concerned. The knowledge acquired in this way is something of their own, no longer something second-hand.

Since experimentation involves 'learning by doing', there can be no substitute for it. Pupil experimentation is an essential part of good sciences education. Opportunities should be provided for the pupils to perform experiments since the primary purpose of experimenting is to secure evidence which may reveal answers to many problems. Each pupil should be encouraged to observe and record exactly what he observes. This will help to develop healthy scientific attitude, appreciation and also provides training in scientific attitude, appreciation and also provides training in scientific method. Students should be encouraged by their teacher to participate in experiences which offer opportunities to develop skills in planning experiments with equipment and conducting experiments.

At the elementary level, a great deal of physics can be learnt using the most simple local resources. But the needs of secondary physics education are a little more sophisticated. The nature of physics is such that some apparatus is essential for its teaching. While stressing the importance of apparatus in physics teaching at secondary level Norman, et al. comment, "A country which starts by saying that it is a poor country which cannot provide apparatus and needs supplies of paper cut-out models to illustrate the principles of electricity should probably not attempt to teach electricity at all in its secondary schools" (Norman et al., 1972 : 173). Physics is an experimental science and it is very important that the children get personally involved so that they come to understanding. Personal involvement occurs when children do experiments themselves, and doing experiments implies the need of apparatus. So the need to provide apparatus cannot be overlooked by any one wishing to improve the quality of physics teaching.

'Hear and forget, see and remember, do and understand' is widely accepted as the ideal for physics teaching. For this to be achieved, apparatus for pupil experiments must be available in large quantity, whenever feasible experiments should be done as class experiments with pupils working individually, in pairs or at the most groups of four. It is true that sometimes this is not practicable - mainly due to two reasons. The apparatus needed may be too expensive for the school to have it in quantity and the second reason is the time factor: it may not be possible to complete the course if each pupil did experiments individually.

In most Indian schools, individual pupil experimentation is rather difficult due to lack of laboratory facilities. Where there is no facility for individual experimentation, at least facilities for group experimentation must be provided. Research evidence indicates that pupils working in pairs derive less benefit from an experiment than do pupils working individually. The difference however is not great enough to justify the added expense of providing individual sets of equipment for all experiments.

By analysing high school textbooks and laboratory workbooks in several sciences and interviews with science teachers, Pella (1961) reports the vivid functions of laboratory as follows: laboratory is a means of securing information, determining cause and effect relationship, verifying certain factors or phenomena, applying what is known, developing skill, providing drill, helping pupils learn to use scientific methods of solving problems and carrying on individual research.

Review of research on the role of the laboratory in science show that it is an excellent instructional mode (Bates, 1978; Hoftstein and Lunetta, 1982).

Various studies have been conducted to examine the effect of laboratory experiences on students' attitudes. The purpose of the study conducted by Hajji and Youseef (1983) was to assess attitudes of students and science teachers towards science laboratory work in the middle schools of Kuwait. The result of their analysis indicate that the middle school students in Kuwait find science laboratory work to be necessary, interesting and helpful to them in learning science. Girls expressed as much interest in science laboratory work as boys did. Science teachers in general seem to agree that their students are sufficiently interested in and are able to perform satisfactorily in the laboratory. The findings of the study conducted by Ben-Zvi, et al. (1976) also reveal the positive attitude of High School students towards laboratory experiences.

The science classrooms and laboratory are key places where intentions ought to be transformed into actions, and where both the teacher and the learner are involved in realizing the curriculum objectives. Since classroom environment is an important component of the teaching learning process which, aside from instruction, predicts learning, the use of learning environments measures in research studies concerning the effectiveness of laboratory work should not be overlooked. This is quite in agreement with the findings of Hofstein, Gluzman, Ben-Zvi and Samuel (1980). Their research study was aimed at examining the question, "What is the role of laboratory work in influencing students' perception of their classroom learning environment?"

Although a well equipped laboratory is a must for physics education, the laboratory facilities available in most of our schools is far from satisfactory. Kalra (1976) conducted a study to determine the conditions of laboratory facilities in Indian high schools. He concludes that there is a definite need for more and better laboratory facilities and equipments, library and other materials related to science teaching.

Studies conducted by Nair (1981) and Cherian (1987) throw light on the conditions of libraries and laboratories in the schools of Kerala. According to them the laboratory and library facilities do not seem to be encouraging.

Many studies have been conducted to investigate the laboratory facilities in Indian Schools (Bose, Banerjee, and Mukherjee, 1965; Rao, 1968; Govinda, 1980). They all report the poor and inadequate laboratory facilities and lack of good quality equipments in our schools. The condition of Kerala schools are also not an exception. This is revealed through the studies of Jacob (1969) ; Bose(1976) and Raju (1985). Proper laboratory facilities are available only in some selected urban schools. They report that most of the schools are not utilising even the available laboratory facilities although the facilities are inadequate and unsatisfactory. They hold the view that the school authorities and the government should take steps to improve the conditions of laboratories in our school so that the science education provided will be effective and meaningful to pupils. This will help in improving the quality of our science education. Without a proper laboratory and library, it is difficult to impart science education.

Rajput, Gupta and Vaidya (1978) observe that due importance to practical work is not provided to pupils. They conducted a survey to study the role of laboratories in the basic education of science as perceived by science teachers. Their findings include: (1) 68.73 per cent of schools had no water supply. (2) 91.43 per cent of schools had no gas supply. (3) 10 per cent of schools did not have laboratory. (4) Practical work was not attempted in Class IX in 55 per cent of schools in Maharashtra. (5) Main problems faced by the teachers were: lack of free time for them to arrange for practical work, poor quality of equipments and materials supplied by firms offering lowest quotations, etc.

If science apparatus is to be successfully handled by secondary school pupils, it must be simple to manipulate and should lead as directly as possible to the concepts being developed, criteria which are not always satisfied by equipments of simple design and cheap construction.

The criteria for selecting the use of science equipment is a very important aspect of science education which the science teacher has to bear in mind. An analysis of a panel-validated questionnaire survey conducted by Ricker (1963) indicated that teacher preparation to use equipment varied as did most equipment available to that teacher.

The study conducted by Peter (1984) throws light on the factors leading to wastage of resources in the school education of Kerala. The findings include improper utilization of land and physical education facilities, lack of proper library and laboratory facilities, non-effective utilization of time, and community resources, etc.

The investigation carried out by Sadhana (1986) revealed the fact that the library and laboratory facilities are not adequate. Majority of schools in Kerala are not having adequate number of required teaching aids and many of the schools are not utilizing the available aids effectively. Physical facilities like building, classrooms, playground etc., are insufficient.

2.1.4 Audio-visual Aids

To be effective, science teaching should be built around concrete experiences which makes abstract ideas meaningful. The proper use of audio-visual aids by science teachers will enrich and vitalize their instruction and help the pupils develop correct concepts. Various forms of visual and audible aids can be great assets to the teacher and can promote effective teaching of physics.

It has been said that audio-visual aids can 'bring the world to the classroom'. This means that they can bring some of the characteristics of real experience within the reach of the pupil. They are no substitute for real experiences, but they can motivate and inform, and in some cases can do even better than the real experience. A visit to a hydroelectric plant, for example, may be more impressive and motivational than seeing a film about it, but an understanding of the workings of a dynamo can perhaps be achieved more rapidly with the help of well-designed film or film loop (Ootuka et al., 1972).

Great educators like Rousseau, discouraged the use of more words in education. He advocated that nature of body, mind of a child and his surroundings should be taken into account. As a result of this, shift took place from teacher to child-centred education.

Educators especially Frobel have long noted the importance of providing a sufficient quantity of auditory, visual, muscular and other impressions to children from their early years and of systematising them, and providing opportunities for children to constantly exercise their external senses. Children seen to observe since a very early age. They should be taught to do this. The system of toys designed by Montessori intends to encourage the small children to learn to observe and exercise their senses by selecting toys rather than by the use of words (Krupskaya, 1985). The need for providing direct and concrete experiences to pupil is emphasised by modern education lists also (Piaget, 1959; Gagne, 1977 and Bruner, 1960).

The content of science is so vast that we cannot expect pupils to have direct experience. They cannot do all the experiments. The next best thing is to bring the experience to the pupil so vividly through sight and sound that he is put on the road to understanding.

Previously the emphasis was on teaching. Now the trend has been to shift the emphasis from teaching to learning. Audio-visual aids can be designed to assist in the basic aims of education, which include both learning and understanding. Some audio-visual aids do this best through information others through motivation and still others provide both.

The recent developments in educational technology and instructional media are not only innovations in the pedagogical procedures but also present a challenge to the inclined to stick to the traditional methods of classroom teaching. Teachers are becoming increasingly aware of the utility and need of the audio-visual technology in enriching the teaching-learning situation.

Audio-visual perceptions give interesting, joyous and real appreciation of the concepts. It enriches and improves everyday life, adds fullness to life and makes two important senses more acute. Harold et al. report "The researches conducted by Charles F. Hoban, James D. Finn and Edgar Dale have found that audio-visual materials in the teaching situations, can accomplish the following: (1) They supply a concrete basis for conceptual thinking and hence reduce meaningless word response of study (2) They have a high degree of interest for students (3) They make learning more permanent. (4) They offer a reality of experience which stimulates self activity on the part of the pupils (5) They develop a continuity of thought (6) They contribute to growth of meaning and hence to vocabulary development. They provides experiences not easily obtained through other *materials and contribute to the efficiency, depth and* variety of learning" (Harold, et al., 1962: 84).

Bruner (1969) has classified the devices according to the type of experience attained by pupil. Films, Television, Micro-photographic film, film strips, sound recordings and the like are the devices for vicarious experience. 'Sequential programmes' are most subtle devices used to lead the student to a sense of the conceptual structure of things he observes. PSSC and others are excellent instances for this.

Chalkboard still remain as the least expensive and most universally used visual aid. The second most important visual aids are books. Highlighting the importance of books in Physics education Ootuka, et al point out, "Any teaching of Physics will ultimately need well-prepared books, but there is frequently a lack of proper understanding of the role of book, what it should contain, how to illustrate it and how to make it appealing. Cutting the cost of illustrations is common, and at the same time the ones appearing may be useless..... There is plenty of scope in Physics books for using latest techniques in providing illustrations" (Ootuka, et al., 1972: 216).

The other commonly used audio-visual aids in the teaching of physics are slides, film strips, the overhead projector, films, film loops in cassettes, tape recorder, auto lecture, radio, television, etc. Although abundant in quantity the audio-visual aids are very heterogeneous. The proper selection and effective use of these aids is a very important task for the physics teacher.

Sound guidelines for using instructional materials are imperative if maximum values are to be achieved. Principles that teachers can use in guiding the use of materials are just as important as the materials themselves. Learning can be hindered if haphazardness and carelessness characterize the use of resources. Same painstaking care that is given to the selection of materials must also be given to their use.

The common problems reported in UNESCO-NIER workshop Report (1971) in the utilization of audio-visual aids are: (a) Insufficient in-service and pre-service training of teachers, (b) Insufficient maintenance and repair facilities (including technicians) teachers often do not ask for replacement when audio-visual aids are mislaid or broken, (c) lack of expendables, e.g. ink, special paper etc. and spare parts, (d) Lack of electricity - The rural areas of most Asian countries are not supplied with electricity, therefore there is a need for battery-operated equipment to be used in such areas, (e) lack of suitable equipments, (f) Lack of suitable software, (g) Distribution problems, (h) Poor storage facilities, and (i) Unsystematic utilization of audio-visual materials.

Ahluwalia and Aggarwal (1970) studied the extent of the use of films and filmstrips as a medium of instruction in secondary schools in Tamil Nadu. They have reported that 249 schools possessed 35 mm. film strip projectors along with 16 mm. filmstrip projectors and 227 projectors were in working order. The general feeling of the school was positive towards the advantages of the films.

In another study, Khanna (1970) surveyed the source materials in filmstrips and books on audio-visual education. It is reported that the materials were classified under the heads - art, communication, craft, film, filmstrips and slides, graphics, mechanical aids, printing, photography, puppetry, television, radio, etc.

Kozloski (1974) has reported that use of simple line drawing posters in the laboratory transmits ideas to all the students without individually stressing each point. They can be used to introduce new ideas, give directions and classify operational definitions.

An investigation by Kathy and Bruce (1983) revealed that the television scheme played a dominant role in organising the content into a meaningful whole. But they were of the opinion that the viewing experience became a mere 'active' process.

It is quite evident from the studies of Carpenter (1958) and Lawrence (1957) that the audio-visual method of teaching is more effective than the text-book method. While comparing the achievement of students taught by three different techniques - the textbook method, the pupil activity method and the audio-visual method - they observed that pupils taught by pupil activity method ranked highest, those taught by audio-visual method ranked the second and those by the text book method, the lowest. Dwyer's (1971) study also reveals the effectiveness of visual instruction in classroom teaching.

Audio-visual aids help to develop creative thinking while adding novelty to the teaching process. Sonar (1978) attempted to locate the spots in the primary school syllabus wherein filmstrip teaching can be resorted either to supplement laboratory work or to revise, present new matter, and stimulate interest. It is clear from his findings that science syllabus can be effectively taught with the help of film strips. The use of these instructional aids indicate the possibility of improvement in methodology of science teaching.

Rao (1972) conducted an investigation to trace briefly the evolution and use of audio-visual aids in instruction and to critically evaluate the various methods following to make the maximum use of these aids in classroom. The study revealed the following facts. (1) Certain progressive schools of big cities like Bombay, Poona, etc., were definitely advanced in the use of audio-visual aids than the schools in villages. (2) Maps and charts were most commonly used aids, but certain progressive schools were also using film projectors. (3) Many schools in spite of their liking for film and radio, could not afford to have them due to want of funds.

Phuleta's study (1981) regarding the utilization and comprehensibility of school Television programmes in Delhi schools revealed that only 38 per cent schools in the sample possessing Television sets were utilizing school Television Programmes.

The outcome of Golani's (1982) investigation were the following: (1) There was non availability of trained personnel in audio-visual education (2) Accommodation of equipments was a problem in many schools (3) The audio-visual aids being expensive the schools could not purchase them. Sophisticated aids were out of question.

The results of the study conducted by Joseph (1988) establishes the importance of having the maximum use of audio-visual aids in the classroom teaching for the enhancement of teaching-learning process.

2.1.5 Co-Curricular activities

Co-curriculum is the term used for out-of-class activities which include science clubs, science fairs, science congress, etc. According to Lacey (1968), the main purpose of co-curricular activities are the following : it enriches formal curriculum, provides for individual difference and interest, establishes better teacher-student relationship, provides appropriate activities for student groups, brings students together on a common basis.

Co-curricular activities can provide an outlet for the pent-up emotions of children and channellise their energies toward desirable goals. These will help in satisfying the instincts and urges of children and making them full-fledged personalities. These activities cater to the inculcation of scientific attitude, a genuine interest in science and scientific activities, supplement classroom work and laboratory work and put the syllabus on a practical bias. The students learn the things without the conscious effort on their part and persue science as a pleasant hobby and not a burden on them.

In an age of science that is affecting our daily lives and controlling the destiny of mankind, there is no lack of stimulus to the imagination of young minds. No curriculum, no course study, no text-book can ever be sufficiently up-to-date.

Educators know that the ideal solution to this problem involves an integration of the curricular activities and co-curricular activities. Teachers can utilize co-curricular activities for the purpose of strengthening the goals of instruction.

The usual way of teaching science subjects inside the class-room does not give full scope for learning. It is true that much can be learned outside the classroom as co-curricular activities. Science clubs, which have now become a part of every school, are good laboratories of students for experimentation.

Washton points out the use of science club as "Science club provides an opportunity for sharing ideas, for carrying out scientific projects and for realising the joy that comes with accomplishments which are recognised by one's peers" (1961: 43). Sharma (1982) emphasises the need of science clubs upto higher secondary stage which can provide a large number of activities and thereby, widen and deepen the interests of pupils and provide means of developing desirable ways of utilising leisure time.

Science club activities play a vital role in the identification and development of science talents. "It is important to identify the potentially talented students at the secondary school stage through science talents search, since failure to identify a child may spell disaster because the child may get wrong training and enter into wrong vocation thereby causing not only a personal but also a national wastage" (NCERT, 1967: 47).

Students should be given the opportunity to reveal their inclinations and to test and exercise their abilities in various types of activities. In this regard the school science club can play a major role. There is a vast educational literature dealing with science clubs and related activities.

The study by Clean and Dudleston (1933) revealed that pupils who were members of high school science clubs excelled non-members in scientific knowledge.

Sreekumar (1972) conducted a study to compare the science interest, science aptitude and science achievement of science club members and non-members of high school. Significant difference in the science achievement of science club members and non-members was reported and found that science club members were superior to non-members.

Varghese (1979) studied about the performance skills of members and non-members of science club and found that club members were superior to non-members in performance skills.

The studies conducted by Andrew (1980) and Sumam (1980) confirm the need for systematic planning for proper interaction between classroom learning and science club activities.

It is evident from Noorjehan's (1983) study that there is no deliberate planning for a super structure of work in the science club over the base of class room learning.

Eventhough the significance of science club activities are recognised, the way of physics learning through science club activities is yet to be properly explored. Sivadasan (1988) holds the view that there is no systematic interaction between science club and classroom activities in the teaching of science in Kerala State. He emphasises the need for linking class teaching with science club programmes.

Science fairs and exhibitions have become an integral part of science education because of their immense importance for developing in the student scientific interests, skills and expressions through their displays in the fair. The outcome of science club activities will also benefit science fairs and exhibitions. The greatest contribution of these lie in the recognition and encouragement that they give to students' participation.

The objectives of science fairs have been listed by Gupta (1981). They are: (i) To focus attention on science experiences in school (2) To stimulate a great interest in science by all pupils (3) To stimulate a greater interest in scientific investigation over and above the routine class work (4) To provide stimulation for scientific hobby pursuits (5) To offer an opportunity for display of scientific talent through exhibits and demonstrations (6) To develop the habit of extra study and provide useful means of occupying their leisure.

Careful planning is necessary for the success of any science fair or exhibition, several committees have to work individually and collectively for its success. If different schools of the same locality collectively organise a science fair it can be made more impressive to the public. This will help to bring out originality, creativity and technical skill and provide valuable experience. This will create in students a desire for scientific research and investigation. The multitude of exhibits can be stored and utilized effectively for co-curricular enrichment which form valuable resources for physics education.

Discussing about the importance of science exhibition, Ahmed writes: "The educators today are trying to make science education exhaustive. They are trying to popularise scientific knowledge and make it functional and relevant to society. It is in this perspective that the organization of science exhibition at National, State and District levels should be viewed" (Ahmed, 1979 : 11 and 12).

Varghese (1982) conducted a study on the immediate and long term values of science exhibition and it reveals that the exhibits have a very good coverage in terms of the topic prescribed in the syllabus.

Bridget (1988) studied the extent of pupil participation in science fairs. The study revealed that majority of participants had benefited through their participation with respect to knowledge, inspiration, creative thinking, skill development, etc.

Science fairs can be fun and rewarding experiences for all students and teachers. Mc Bride, Zook and Lanib (1987) studied about classroom science and mathematics fair. They conclude that the affairs provide an opportunity for all students to achieve success. Successful experiences foster positive self concept and positive attitudes towards other school activities. Although fairs are time consuming, the benefits derived from a good experience will far outweigh the effort expended.

The above discussion about Co-curricular activities provide considerable evidence to support the belief that these activities in science compare most favourably with curricular work in science in terms of educational outcomes of many kinds. These activities help to bridge the gap between theory and practice and cater to the development of practical application awareness.

2.1.6 Environmental resources

It is necessary to take into account the potentialities of science as a factor in the successful adjustment of children to the world which surrounds them. The children must be trained to see their environment as something that can be studied and utilized. If pupils are to study the environment, the teacher should himself explore the materials and situations in the local community. Such a study will reveal richer resources than one usually is aware of.

When pupils are motivated to learn science incidentally, they will find science everywhere - even outside the classroom and laboratory. Many of the materials in the environment which can be used effectively in science teaching/learning are permanently fixed and cannot be studied in the laboratory or brought into the classroom.

There are many environmental resources that can be exploited for science teaching. A study of one's own enviornment, whether farm, city, small town or sub-urban area, can be very rewarding. As local resources differ widely within a particular country as well as from one country to another, it is anticipated that each teacher will draw from it materials appropriate to the needs of his or her own pupils and the particular teaching situations. The wealth of enviornmental resources for teaching science should be revealed to teachers through pre-service and in-service programmes of education so that these resources will be utilized more effectively (Henry, 1947).

Review of literature shows that several investigators have mentioned about teaching situations or enviornmental resources of urban and rural localities (Henry, 1947; Washton, 1961; Selberg, et al. 1970; UNESCO, 1978) It is clearly the obligation of teachers and supervisors to survey school communities and nearby areas to find out what resources are available. Then these resources can be utilized effectively as part of science facilities.

Direct contact with nature and natural phenomena enables the child to meet concrete problems that concern him and stimulates reflective thoughts and manipulation of knowledge. It provides chances to apply textbook knowledge in an interpretation of local phenomena (Anderson and Kautnik, 1972).

Outdoor learning enviornments provide stimulation for factual knowledge. Further more it provides chances for children to explore and internalize the meaning of what they see and hear. They provide chances for activity, freedom to move, to explore, and to experiment which in turn will contribute directly to the discovery learning and afford chances for grasping the true spirit of science. Out of school activities are effective in breaking the monotony of classroom activities, and this way add to student motivation.

Osborn and Spofford (1970) are of the opinion that the proper utilization of outdoor study area will provide opportunity to understand the interdisciplinarity existing between different disciplines.

Blum (1981) *conducted a survey of enviornmental* issues treated in science education curricula before and after 1974. Use of resources were dealt within nearly all Enviornment Science Education Projects surveyed before 1974.

Exemmal (1974) conducted a study on the use of enviornmental and ethnic resources in the teaching of primary school botany. Her study reveals that although teachers conduct excursions, only on-fifth of them claim to have used these activities for teaching botany.

Nair (1981) and Cherian (1987) report significant correlation between the availability of enviornmental resources and the extent of their use. Their study reveal 'home' as the best enviornmental resource to facilitate physics and chemistry teaching.

One of the objectives of the investigation undertaken by Rajput and others (1980) was to identify the available community resources which can be gainfully utilized for teaching at Primary level. Manuel (1982) identified some typical resources other than textbooks which can be useful for enviornment education.

Field trip is an instructional medium that possesses potentialities for enriching and extending the educational experiences of pupils. A field trip offers opportunities for pupils to observe directly and experience what they visit. It offers an excellent link connecting the teachers to relate classroom instruction to the practice of life itself (Smith, 1961).

The general potential of a field trip to a hospital is studied by Ellis (1976) and reports that the potential lies in the possibilities it offers to demonstrate a variety of applications of physics in an interesting human context.

Gross and Pizzini (1981) found that those students who had field trips showed greater achievement and positive attitude towards the enviornment than those who had only classroom instruction.

Kern (1985) conducted a study to determine the effect of field activities on the affective responses of the students using different approaches of teaching - one traditional and other field oriented, on-site approach. The findings revealed that field oriented approach was superior to traditional approach.

Mohanty (1973) studied the efficacy of the field trips in the teaching of social studies and her conclusion was that teachers should supplement as well as enliven the learning experiences of students by arranging field trips as far as possible.

Lopez (1988) conducted a study to find out the field trip experiences that are possible and that are provided in the learning of chemistry. The study revealed that teaching of chemistry is very much formalized by confining it to the classroom and ill-equipped laboratory. The teachers are yet to know the latent potentials of field trips and how they can be exploited for chemistry teaching.

Ronen and Ganeil (1989) in their article discuss the potential benefits offered by a visit to a hospital, to encourage teachers to exploit this potential and to actually help them plan an effective and successful trip.

The foregoing discussion reveals that the enviornmental resources can be effectively utilized as a resource for physics education.

2.1.7. Teacher and in-service programme

The success of any instructional programme ultimately depends upon the class room teacher. A teacher who has not had refresher course within the past five years may flounder with the new terminology and new concept (Lee, 1967). The responsibility for helping teachers who are already on the job to meet the rapidly changing conditions of our times, to keep up with new professional developments, and constantly to grow in competence as teachers and counsellors of young people presents a tremendous challenge. If leadership to meet this challenge is lacking, teachers will tend to go on doing much as they learned to do in the beginning. They are likely to become victims of fixed habits and to lose flexibility that is so essential to their success (Henry, 1947).

The duties of a science teacher include specifying learning objectives for a variety of content area. They must have skill in planning, managing and delivering science instruction for a broad spectrum of student abilities. Science teachers must constantly administer laboratory facilities and materials to preserve a safe enviornment and hands-on inquiry experiences. Teachers have traditionally relied on in-service programmes for enhancing these and other skills. In-service education is a co-operative enterprise under leadership carried on to help young teachers establish themselves in the work of the schools and to help them as they continue in their work to keep alert and growing and adaptable to such new responsibilities as may be required of them (Henry, 1947).

The Education Commission gives emphasis to the problem of giving continuous education to teachers in service. It reads : "In all the professions there is a need to provide further training and special courses of study on a continuing basis. After initial professional preparation the need is urgent in teaching profession because of the rapid advances in all fields of knowledge and continuing evolution of Pedagogical theory and practice" (1964-'66:84).

Corey (1960) estimated the problems and issues in the field of in-service education. He emphasized planned programmes in contrast to independent attempts by teachers to improve themselves. He clearly delineated the necessity for planned programmes in in-service education for the improvement of school personnel and expressed the feeling that to depend entirely on pre-service education is impracticable.

Chaurasia (1967) emphasizes the importance of extension centers and lists some of the procedures of extension work as: (1) Experimental projects, (2) Science Clubs and Science Fairs, (3) Seminar readings, (4) Annual Conferences, (5) Training co-ordinators, (6) Intensive work with school, and (7) Assessment of Extension Centres.

According to Cottcell (1966) the major reasons for the failure of in-service education programme are : (1) Failure to recognize the real concern and problems of the faculty, (2) Inadequate supervision of the programme, (3) Poor training facilities provided, (4) Lack of knowledge about the gains, (5) Inadequate pre-publicity, and (6) Lack of Co-ordination between pre-service and in-service training.

The importance of in-service Programme to teachers was reported by Spiegel (1984). The study revealed that the group which participated in an in-service programme on student engagement rate was favoured than the other group which did not participate.

A number of research survey were conducted at different places to identify regional and state-wide categories of in-service teacher needs. They include White (1979) in South Carolina; De Graaf (1980) in Michigan; Rubba (1981) in Illinois; Zurub (1982) in Jordan; Abu Baker (1985) in Malaysia, Jbeily and Barufaldi (1985) in the Republic of Lebanon and Mecca and Klindienst (1987) in Pensylvania. They all emphasize that accurate assessment of needs and concerns expressed by classroom teacher should precede the design of in-service education. Information on reported needs of classroom teachers should be of value to a host of state and local agencies conducting in-service courses.

The purpose of the study conducted by Chang (1983) was to determine the effect of in-service training on teacher attitudes and performance in their teaching of the new elementary science curriculum.

Molina-Mercado (1984) undertook a study to determine the relative effectiveness of videotaped, audiotaped or written transmission of the content. The study revealed that television and other media are useful as instructional media for in-service training.

Al-Ghamdi (1984) examined the current status of in-service education of middle and secondary school teachers in Saudi Arabia and to develop a model for designing in-service education based on the findings and available literature in this field. He reported that teachers expressed dissatisfaction with the current in-service education because the programmes offered were not well planned and not based an actual needs.

The finding of the study by Matar (1986) showed that teachers attached greater importance to the areas of scientific knowledge, laboratory skills, and some aspects of delivering service instruction. The primary purpose of Caracheo's (1985) study was to integrate, from the literature on in-service education, evidence and information that can be used for developing new in-service activities and programmes and for fostering further research in this field.

Davis (1986) tried to identify factors influencing the outcomes of an in-service training project in the Kansas City school District. The findings revealed that a conceptualization of in-service training, including components for planning, implementation, and evaluation has not been sufficiently developed.

Many studies were conducted in Kerala regarding the in-service needs of teachers and the effects of in-service courses (Nair, 1963; Zalam, 1970; Kurup, 1974; Nair, 1975; Thankachy, 1984 and Jamuna, 1987). There is a near unanimous agreement that in-service training is not very effective as currently practised in educational settings and that a conceptualization of in-service training, including components for planning, implementation, and evaluation has not been sufficiently developed.

The studies reviewed above reveal that in-service education for teachers particularly those who are teaching physics is very useful in up-dating information on physics as a branch of knowledge and also for their professional improvement.

2.2 Practical Application Aspects

The basic aim of science learning in high schools must be to supply fundamental knowledge of science which may be brought into use in daily life, thus making it meaningful to the learner. Research studies have shown that if the material is meaningful to the learner, it is less easily forgotten and less easily interfered with. So it is the duty of a science teacher to attempt to make learning experiences of student as meaningful as possible through careful motivation and application to real life.

The present style of physics teaching in Kerala is criticised on the ground that the theory is usually divorced from practice and practical applications. Only in passing is well-intentional advice given concerning practical applications and activities. Practical studies are only aimed at illustrating particular theoretical propositions. This results in separation of instruction from life. To link theory and practice old methods have to be changed and instruction should acquire greater substance.

Dewey, Marx, Gandhi, Piaget, and Bruner have highlighted the importance of practical application awareness while emphasizing the importance of giving experience to students either through classroom situations or through life experience.

The importance of experience is advocated by many educational psychologists like Piaget, Bruner, Gagne and also by great philosophers like Dewey, Marx, Gandhi and all. To Dewey the philosophy of experience is peculiarly relevant. He says, "The heart of science has not in conclusions reached but in the method of observation, experimentation and mathematical reasoning by which conclusions are established. Yet in large measure, it is the conclusions that are taught in schools, with a medium of attention to the methods of controlled observation and testing, upon which the conclusion depend. So taught 'science' (1) becomes a body of ready-made truth about facts and principles, and (2) is divorced from everyday experiences of which science grows and into which it returns" (Dewey, 1938a : 480). To treat knowledge as an end in itself is equivalent to isolating it from activity. From an educational standpoint Dewey has helped us to arrive at a fruitful notion of experience and develop a working conception of it in relation to the school programme. He states: "The nature of experience can be understood only by noting that it includes an active and passive element particularly combined. On the active hand, experience is trying, a meaning which is explicit in the connected term experiment. On the passive, it is undergoing. When we experience something we act on it, we do something with it, then we suffer and undergo the consequences" (Dewey, 1902 : 156).

In Dewey's view theory without experience is not of much use. He writes, "An ounce of experience is better than a ton of theory, simply because it is only as an experience that any theory has vital and verifiable significance. An experience, a humble experience is capable of generating and carrying any amount of theory, but a theory apart from the experience cannot be definitely grasped even as a theory. A theory tends to become mere verbal formula, a set of catch words used to render thinking or genuine theorizing, unnecessarily and impossible" (Dewey, 1938b : 113)

Marx while underlining the intellective aspect of labour has also called attention to the fact that the process of labour vanishes within the product of labour. Work loses its constructive and creative role and gets degraded. In the polytechnical education developed by Lenin, Krupskaya and others, material production is closely woven with the production of ideas, conception and consciousness (Manuel, 1987). Krupskaya (1985) holds the view that modern production is based on the application of the laws of scientific knowledge of nature, society and production. All these must be conveyed to pupils by acquainting them in both theory and practice and by making them participate directly. Such a general basis will then make it easier for students to master any skill.

Piaget's theory of cognitive development has had a considerable influence on our thinking about education of young children for many years. His insistence on the importance of experience involving direct action upon objects as a necessary precursor to concept formation has lent support to those who advocate an activity based enviornment for children. His theory has been considered to have a particular application to the way we structure learning in certain areas of curriculum. The most immediate and obvious relevance has been to teaching in mathematics and science because so much of Piaget's work involved scientific concepts and the link between theory and practice is therefore most evident in those areas.

The extrapolation to class room activities of Piagetian theory of intellectual development suggests a way of teaching science which is in agreement with the philosophers of the newer science curricula and it also suggests a method for practising the skills. As viewed by Piaget, knowledge is the result of an active interaction between a learner and his enviornment and he stresses the necessity of direct experience along with mentally active learner.

According to Bruner (1960) who has attempted to extend Piaget's theories to classroom work, there are three modes of instruction which keep children mentally active. The inactive mode allows students to manipulate the actual objects of knowledge and is appropriate for children in the concrete stage of intellectual development. The iconic mode permits children to manipulate pictures of actual objects and is appropriate for children making the transition from the concrete to formal stage of intellectual development. The highest mode called symbolic, involves working with symbols of objects and is appropriate for students using or developing formal operations. The amount of time spent in each mode of instruction depends on the maturity, past experience and cognitive level of the learner. In any event, the pre-requisite for symbolic manipulation is experiences in the inactive and iconic modes of instruction.

Applying the above ideas to classroom, the science laboratory permits direct experience with the objects of knowledge, while ensuring discussion allows work with iconic and symbolic representations, namely, pictures or models of experiments and words which describe, analyse and verify the objects of knowledge. But both the discussion and laboratory activities are important.

Emphasising the importance of practical application in science teaching the Secondary Education Commission (1952-53) observed that the aim of science teaching was to awaken in the pupils a lively curiosity about the natural phenomena around them and to develop the capacity for the practical application of their knowledge. So formulating 'general courses' with emphasis on practical applications and observations is a need of this century. This clearly establishes a need for developing practical application awareness among the secondary school pupils.

If pupils are to have the breath of view needed to tackle the problems arising from the application of science to their everyday lives, they should be equipped to do so through science teaching. Practical application awareness should be provided a larger and more explicit place among the goals of science education. When unrelated to practical applications science education becomes purely speculative and knowledge itself becomes formal.

Physics is indeed the disciplinary medium through which one learns and teaches many of the most fundamental concepts of natural processes. In the words of Heller, "Although physics deals with the pupils' own world of moving objects, rotating wheels, electrical currents and weights and measures, the usual approach to these topics too often appears trivial and separated from 'real' issues, or too difficult because of the mathematics involved (1972 : 214). Newbury and Armstrong (1962) believe that physical science using simple, familiar equipments, often obtained from home or junk shop, has advantages no other subject possesses. A student cannot only guess or hear from someone, that a magnet will lift a coir or a nail, but he can immediately carry out tests for himself and verify if the guess, or his information is correct. He can refine his knowledge by finding out which metals are actually attracted by a magnet and which are not. This immediate and tangible proof is a source of great excitement and satisfaction to children.

The recent trends in science teaching has shown a distinct tendency of general change in emphasis from mere acquisition of assorted facts to the development of functional learning, from unrelated knowledge units to contents logically organised about problems that concern the pupils. Craig (1966) believes that the content taught is not of nearly so great importance as it is the question of 'What' science content is taught, 'how' it is taught and the 'purpose' for which it is taught.

One of the best measures of a student's mastery of an understanding is the ability to apply the principles in new situations. Ralya (1938) found that pupils often could recall the formulae and work out answers to problems and still not understand the principles involved. The importance of emphasizing applications of Physics in everyday life in the physics curriculum has been stressed by many authors. (Godman and Hobson, 1963; Schmidt and Rockcastle, 1968). A credible science methods instructor according to Shringley (1976) is one who refers to practical teaching activities in class.

Students know best about those things with which they have direct experience and know least about those things which they have memorized. Science classes in primary and secondary should consists of hand-on experiences with science materials which could function at the students' cognitive level of development. According to Wavering

(1982) the teacher should provide examples and suggest experience-broading activities. Teachers at all levels should make learning experiences as close to life situations as possible so that students can understand the uses of scientific processes and the overlap of science with society.

Many studies conducted in India throw more light on the fact that most of the students achieve only knowledge of the content matter presented to them (Knowledge of facts, principles, concepts, etc.). Thomas (1971) tries to find out how pupils fare in the higher levels of knowledge as well as in lower ones. His findings revealed that students' achievement in all the other five areas of cognitive domain except that of knowledge area, were far from satisfactory. The same was the outcome of the study conducted by Swarnamma (1967).

Driver (1988) points out that teaching programmes are being developed, for example, which present science principles in contexts which are in themselves seen to be of practical use.

Positive student attitudes concerning science classes and teachers are reported by Brunkhorst (1987) and Yager (1988). School students feel the science they study is useful and that it will be even more useful in the future. The study by Yager, et al. (1989) reveals that students who practice the use of science perhaps have more accurate and realistic perceptions of its usefulness over students who are recipients of science information in typical science classrooms.

Students experience difficulty in translating the theoretical knowledge in science they gain through classroom instruction in other practical situations and their awareness in practical application oriented aspects are not satisfactory. This has been the outcome of many research studies (Jaya, 1985; Sreedevi, 1985; Rema, 1987; Suma, 1987; Usha, 1987; Nair, 1988 and Vasanthakumaran, 1988).

A comparison of students' applied and theoretical knowledge of concepts based on the particulate nature of matter was attempted by Haidar (1988). A Two-Form instrument, called the Physical Changes Concept Test (PCCT) was developed for the study. The Application Form measured students' knowledge using everyday language. The Theoretical Form measured students' knowledge using scientific Language. The analysis revealed a significant difference between students' applied theoretical knowledge.

The above discussion points out among other things that the pupils' awareness of practical applications of the theory they have learned is not satisfactory when compared to their theoretical knowledge.

2.3 Intelligence, Socio-Economic Status, etc., and Academic Achievement

The constructs of variables of the study related to student achievements namely intelligence, socio-economic status, sex, locality and management of school are sufficiently common place and so only research studies conducted in these areas are reviewed in the ongoing discussion.

2.3.1 Socio-economic status and achievement

Good defines socio-economic status as "the level indicative of both the social and economic achievement of individuals or group" (Good, 1945 : 222). Usually the educational level, occupation and income are considered as the major components of this concept. One important factor affecting the education of the child is the level of education of the parents. Generally the educated as well as the high income groups encourage children in studies. Studies have revealed both positive and negative influences of socio-economic status when components like education and occupation of parents are taken separately.

The performance in education is a positive function of the socio-economic status of the student and his parents has been the conclusion of a number of research studies (Mathur, 1963; Warrior, 1966; Abraham, 1969; Joseph, 1969; Satyanandam, 1969; Verma, 1971; Menon, 1973; Agarwal, 1974; Dhami, 1974; Prakash, 1975; Rao, 1976; George and Tharakan, 1977, and Saini, 1977).

Chopra (1964) conducted a study to examine the relationship between socio-economic factors and achievement keeping the effect of intelligence constant. His findings reveal that on the basis of parents' education, occupation, family income, type of lodging, size of family, cultural level of home, students belonging to higher qualitative group show significantly higher achievement.

Anand (1973) established relationship between socio-economic status and academic achievement even when the influence of intelligence of nonverbal and verbal type was partialled out.

Recent studies by Khanna (1980); Panchamukhi (1981); Jayannadhan (1986) and Yadav (1988) have shown positive and significant influence of socio-economic status on student achievement.

Studies conducted abroad by Jenecks, et al. (1972) and Bronfebrenner (1974) have also shown the influence of socio-economic status on achievement when factors like education, occupation and income of parents are taken and studied separately.

Marjoribanks (1983) investigated the relations between occupational status, family learning environment and childrens' academic achievement. His findings reveal that parents' occupational status is related to childrens' school achievement.

Arochova and others (1984) investigated a selected sample of low-middle status urban children over two life decades and correlated the data of their scholastic achievement with family's status. The result showed that socio-economic status and achievement are related.

Although a number of research studies have established positive relationship between socio-economic status and academic achievement, there are certain parallel studies by Srivastava (1967); Reddy (1973); Sudama (1973); Ahluwalia and Syam (1975); Salunke (1979) and Sharma and Bhargava (1980) which did not find any significant relationship between socio-economic status and student achievement.

A recent study conducted by Anand(1989) also reveals that students' academic achievement and their parental educational and occupational status have been significantly correlated and inter-linked. Ganguly (1989) also found a significant correlation between socio-economic status and academic achievement.

In general the socio-economic status appears to correlate positively with academic achievement eventhough there are studies showing very little or negligible influence.

2.3.2 Intelligence and academic achievement

The fact that intelligence correlates with academic achievement is an unquestioned one. When schools are considered as units, rather than individual children, it is still found that the greatest single factor determining the level of attainment is intelligence. More than half the variance in attainment in reading, problem arithmetic and general information is accounted by this factor (Kemp, 1964).

There are enough evidences for a consistent dependable relationship between school achievement and intelligence. Correlation between the two varies from study to study, but the bulk of them range between coefficient 0.30 and 0.80 (Thorndike and Hagen, 1961).

A summary of 24 Studies was reported by Sadie (1949) in which a measure of intelligence was found to be related to general high school achievement.

Kapur (1961); Duwayne and Vinton (1964); Payne and Pyier (1965); Sinha (1967); Gupta (1968) and Nair (1970) also examined the relationship between intelligence and achievement and all of them obtained positive and significant relationship between the two factors and in certain cases the relationship was found to be very high.

Between 1970 and 1980 many more research studies were conducted in this area and the findings confirm the positive and significant relation of intelligence with academic achievement. (Anandavally, 1972; Thakur, 1972; Lalithamma, 1973; Mukhija, 1973; Dhami, 1974 and Acharyulu, 1978).

More recent studies conducted by Shivapa (1980); Srivastava (1980); Marek (1981); Shashidar (1981) and Singh (1981) also report positive and significant relationship between intelligence and academic achievement.

In a differential study conducted by Patil(1983), the correlation between intelligence and achievement was 0.28 after partialling out interest and aptitude factors and she concludes that intelligence seems to be positively and significantly correlated with achievement.

Lata (1986) examined the relationship of cognitive style with scholastic achievement and intelligence. The findings of the study revealed a significant high relationship between intelligence and scholastic achievement and arrived at the conclusion that intelligence scores are quite an accurate predictor of academic achievement.

In short there seems to be certain relationship between intelligence and student achievement.

2.3.3 Sex differences and academic achievement

Sex differences in school achievement has been a fertile area of study by early differencial psychologists.

These studies possibly originated from the fact that sex differences were noticed in many of the ability dimensions like intelligence, differencial aptitudes, and as such, researchers expected a corresponding differencial in the variables like school performance which are dependent on the activities.

A study by Jordan (1956) on North Carolia High School seniors revealed that the critical ratio of the differences was in favour of boys for science sections of the achievement test employed.

Edgerton and Brills (1944) found that in science talent search, boys scored higher than girls. Learned and Wood (1938) reported that the mean achievement scores in natural science was higher for males. But Prunett's (1961) study revealed that girls did better than boys in mathematics achievement.

Flanagan, et al. (1964) reported the superiority of boys in mathematics and science. Wisenthal (1965) found significant differences in achievement in favour of girls. George and Abraham (1967) compared the performance of boys and girls and reported a significant difference in favour of boys for general science and general mathematics. Nair (1968) also found significant differences in favour of boys for different achievement measures used in his study.

Anderson, et al. (1968) found boys scoring more in high school science. Nair and Ramachandran (1968) also reported sex difference in science aptitude, the mean score favouring boys.

Powel et al. (1963) found no significant difference between sexes for many of the achievement areas while Pillai's study (1969) revealed that sex differences exists in all areas allied to science achievements.

Parsley et al. (1964); Paul and Rao (1969) and Fernandez (1969) reported that performance of boys were better than girls.

The studies conducted by Keeves (1978); Murphy (1978) and Harvey (1980) found that boys perform better than girls in science.

Andrew (1980) found that girls are superior to boys in skills in scientific process. Howe (1981) conducted an investigation into sex-related differences on a task of volume and density, and a difference favouring boys was reported.

Butt (1981) reported that at the collegiate level there is no considerable difference between educational performance of girls and boys. Erickson and Erickson (1984) reported males are superior to females in academic achievement at the secondary school level.

Randolf (1984) studied eighth Graders and concluded that there is no significant difference between the performance of boys and girls.

Zerega and others (1986) reported significant difference favouring boys in science achievement.

Goldstein (1986) reported that although males demonstrated significantly greater special ability than females, there were fewer significant differences in their science achievements. Ekeocha's (1986) study revealed that males sufficiently outscored the females in physical science.

The study conducted by Haynes et al. (1988) examined the differences between high, average and low achieving Black male and female high school students on measures of learning and study behaviour. The results indicated significant differences between male and female students on measures of learning and study behaviour.

2.3.4 Locality of school and academic achievement

The school environment can influence the student achievement, motivation, attitudes, etc. The facilities available for physics teaching in urban and rural schools may differ. There is a belief that urban schools have better educational resources than rural schools. The effective utilization of educational resources may influence the students' achievement in this context the locality of the school whether it belongs to urban or rural are a is to be considered while evaluating the students' performance.

Studies comparing the performance of urban and rural schools are scarce. But differences in the achievement of students from urban and rural areas are reported by many researchers. Considering the fact that most of the urban pupils study in urban schools and rural pupils in rural schools, some studies relating to this theme are presented below.

Sheppard (1942) found that rural children were inferior to their urban counterparts in verbal tests. Studies conducted by Lehmann (1959) and Barr (1959) revealed that rural children, as a group were inferior in general ability to urban children.

Saxena (1963) compared the achievement of urban and rural students in science. He reported a significant difference in the average performance of boys of urban and rural schools, the difference being in favour of urban boys.

Studies conducted by Pavithran and Feroz (1965); Thomas (1965); Warrior (1966) and Vernon (1964) revealed that urban pupils were superior to rural pupils in their academic achievement.

Nair and Visweswaran (1966) conducted a study to compare the achievement in general science of urban and rural pupils of Coimbatore district and no statistically significant difference was found between urban and rural students. The findings of the studies conducted by Mathew (1984); Paul (1984); and Nair (1988) also revealed that there was no significant difference between urban and rural subjects in academic achievement.

The findings of the studies by Suma (1987) and Vasanthakumaran (1988) revealed that urban subjects were slightly better than rural subjects in academic achievement though not statistically significant.

From the above discussion it is evident that the locality of school is one of the factors that affect the academic achievement of students.

2.3.5 Management of school and academic achievement

School achievement is the outcome of the combined efforts of teachers, students as well as the types of school. The latter refers to the type of school management, that is, whether managed by a private organisation or a trust known as private school or managed by a local government, known as government school.

It is generally assumed that private schools offer better education than government schools. So research studies were conducted to compare the quality of education (in terms of academic achievements of students) between these two types of schools.

There are not many studies comparing the performance of private and government managed schools. The few studies carried out on this subject are unequivocal in their conclusions. There are few studies conducted by Abraham (1974); Dhami (1974); Anwar (1980); Sujatha and Yeshodara (1986) where type of management of school had been studied as one of the variables. These studies have made comparisons in terms of a few educational variables like academic achievement, personality factors and so on. The findings of these studies have been inconsistent.

The outcome of the study conducted by Sengupta and Veeraraghavan (1985) was that academic achievement of students is a function of achievement motivation and types of schools where they study.

Veeraraghavan and others (1989) conducted a study on school achievement and student motivation in different types schools namely government schools, private schools and missionary schools. The findings revealed that school achievement varied significantly in terms of the type of schools and in favour of private schools.

Petrella (1986) reported significant difference between public and private schools in all areas of the study except academic requirements and teacher misassignment.

A comparative study of some educational variables of students of private and government schools was conducted by Reddy (1990). The analysis of results revealed that academic achievement of students studying in the private schools was significantly lower than that of students from government school. She attributed this to the lower levels of facilities available in the private schools.

Eventhough the studies reviewed in this area are limited, it points out that the type of management of the school can influence students' achievement.

CHAPTER III

METHODOLOGY

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This chapter deals with the methodology of the present study. The method adopted, the data gathering instruments, the selection of sample, the procedure for data collection and the outlines of the statistical techniques employed in the analysis of data are described under appropriate heads as presented below.

3.1 Methods Adopted

The method of any study is to be determined on the basis of the objectives of the study and the data required for their realisation. 'Descriptive survey' was adopted as the major approach in the conduct of the present study.

3.2 Tools and Techniques Used

The following tools and techniques were used for collecting data relevant for the study.

3.2.1 Questionnaire

3.2.2 Achievement Tests

3.2.3 Intelligence Test

3.2.4 Socio-Economic Status Scale

3.2.5 Observation

3.2.1 Questionnaire

The questionnaire according to Barr, Davis and Johnson (1953 :65) is a "systematic compilation of questions that are submitted to a sampling population from which information is desired".

The questionnaire was used for collecting data regarding the availability and utilization of educational resources for physics education in the Secondary Schools of Kerala.

The principles in framing a good questionnaire was collected from authoritative books on research (Good, and Scates, 1954; Best, 1983; Fox, 1969) and by consultation with experts. Both 'closed-form' and 'open-end' questions were asked according to the nature of data required.

3.2.1.1 Construction of questionnaire

Questionnaire for the present consisted of eight sections.

1. General information
2. Details regarding library
3. Details regarding laboratory
4. Details regarding teaching aids
5. Co-curricular activities
6. Details regarding environmental resources

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7. Workload

8. Details regarding in-service programme.

In section I general information regarding the type of school, management of school, classroom facilities, etc. and personal data of the respondent was sought.

Section II was intended to collect data regarding library facilities and the extent of their utilization. Some of the questions in this section were presented as check-list-cum-rating items. Reference materials being a very important resource for physics education, question was included to bring out the details of availability and use of such materials.

The purpose of section III was to elicit details regarding laboratory facilities in the school. As it was essential to bring out the extent of availability and utilization of these facilities, some of the questions were presented as rating items.

Teaching aids being one of the important resources in teaching school physics, section IV was set aside the bring out the details regarding the extent of availability and utilization of such materials and equipments. This section was presented as a check-list-cum-rating item.

Section V of the questionnaire was intended to bring out information regarding the co-curricular activities which enhance school physics.

Effective use of environmental resources both human and natural, makes science teaching effective and meaningful. Environment provides abundant resources which are to be identified and utilised to impart concrete learning in physics. Section VI was included in the questionnaire to bring out the details regarding the availability and the extent of utilisation of environmental resources. Some possible local resources were listed to be checked for their uses.

Details of workload of the teacher was elicited through the seventh section.

The knowledge explosion in physics in massive and in order to cope with this, the teacher should have the information sought from any possible source, and the most efficient and feasible way is to provide periodic in-service courses. So the last section of the questionnaire was intended to collect data regarding in-service courses, like the agency which conducted the course, duration and type of the course, etc. The benefits and defects of the courses were also sought.

The questionnaire was finalised after considering the remarks of experts in the field of science education and an informal try-out was made with a few physics teachers in schools. A copy of the questionnaire used for the study is given as Appendix I.

3.2.2 Achievement Tests

Physics theory awareness and practical applications awareness in relation to theory awareness of pupils were measured using comprehensive tests developed by the investigator in collaboration with her supervising teacher.

This part of the study has been designed mainly with physics theory awareness and physics practical application awareness as the two major dependent variables. Intelligence, socio-economic status, resource utilization (in schools), sex, locality and management of school were treated as independent variables.

Two sets of tests (Teacher made) were prepared-one for the use of use of standard IX students and the other for the use of standard X students. Each set consisted of two tests namely Physics Theory Awareness Test (PTAT) and Physics Practical Application Awareness Test (PPAAT). These tests were developed on the basis of standard IX physics syllabus and standard X physics syllabus of Kerala secondary schools.

3.2.2.1 Developing draft tests

The first step in developing these tests was to analyse the physics syllabi of standard IX and standard X for identifying concepts. Based on this, two physics Theory

Awareness Tests (PTAT) were prepared - one for standard IX students and the other for standard X students. Then corresponding to each theory question, a question to measure the practical application awareness in relation to that theoretical concept was formed. Thus two Physics Practical Application Awareness Tests (PPAAT) were prepared - one for standard IX and the other for standard X. All were multiple choice items.

The preliminary draft items prepared were exposed to expert criticism. Specialists in science education belonging to Teacher Education Colleges and eminent teachers in physics education were consulted. Modifications were made on the basis of the suggestions received from experts. The original drafts were modified to yield the final draft of the tests.

The final draft form of the tests for standard IX contained a set of 47 multiple choice items for both PTAT and PPAAT with four alternatives each (included as Appendix II). The final draft form of the tests for standard X contained a set of 46 multiple choice items for both PTAT and PPAAT with four alternatives each (included as Appendix III)

3.2.2.2 Developing final tests

The tests in the final draft form were subjected to experts for evaluation for determining the curricular validity (Ross and Stanley, 1960). List of experts is included as Appendix IV. The experts were requested to rank the questions based on the extent to which (a) each question is suited to achieve the objective of the study (b) the concept is helpful in creating practical application awareness among students (c) the question is clear and unambiguous (d) both the theory and practical application awareness questions are interrelated.

The next step was to find out how many teachers and experts had given a particular rank to each question. A question was selected if at least 50 per cent of the persons have included that question in rank one. Altogether 30 questions each from Physics Theory Awareness Test (PTAT) and Physics Practical Application Awareness Test (PPAAT) were selected for use in standard IX. In the same manner another set of 30 questions each for PTAT and PPAAT were selected for use in standard X.

The final tests namely Physics Theory Awareness Test (PTAT) and Physics Practical Applications Awareness Test (PPAAT) for standard IX and two other similar types of tests for standard X in Malayalam with directions to the students were printed in four separate booklet forms. These are included as Appendices V(A), V(B), VI(A) and VI(B). The English version of the four tests are included as Appendices

VII(A), VII(B), VIII(A) and VIII(B). Score sheets were also provided to students.

3.2.2.3 Illustrative examples

a) Item from Physics Theory Awareness Test (PTAT) for standard IX

The image formed by a convex mirror compared to the object is usually,

(a) inverted and imaginary

(b) erect and smaller

(c) real and inverted

(d) larger and virtual

Explanation

Here from among the four choices, the student has to select one which is the most accurate answer. The correct answer is (b)

Scoring

The correct answer (b) is assigned one score.

b) Item from Physics Practical Applications Awareness Test (PPAAT) standard IX

The kind of mirror that a driver uses to get a maximum vision of his backside should be

(a) convex mirror

(b) concave mirror

(c) plane mirror

(d) spherical mirror

Explanation

Here from among the four choices, the student has to select one which is the correct answer. The correct answer is (a)

Scoring

The correct answer (a). Assigned one score.

c) Item from PTAT for standard X

Which of the following light has less scattering?

(a) Violet

(b) Blue

(c) Yellow

(d) Red

Explanation

Here from among the four choices, the student has to select one which is the correct answer. The correct answer is (d).

Scoring

The correct answer (d) is assigned one score.

d) Item from PPAAT for standard X.

Red lights are often used in signal lamps because

(a) red colour is easily noticeable

(b) red light is scattered more and so it is visible at a great distance

(c) red light is scattered less and so it is visible at a great distance

(d) red light has a shorter wave length and so it is visible at a great distance

Explanation

Here from among the four choices, the student has to select which is the most accurate answer. The correct answer is (c).

Scoring

The correct answer (c) is assigned one score.

3.2.3 Intelligence Test

Since verbal tests place a premium on the language ability of the subjects, a non-verbal test was used for the study. The Kerala Non-Verbal Group Test of Intelligence for secondary schools (Nair, 1968) was employed to classify subjects with three categories according to their level of intelligence - High Intelligence, Average Intelligence, and Low Intelligence.

This test is one of the most popular group tests in Malayalam for use with secondary school subjects in Kerala (Standards VIII, IX and X). It is an instrument for appraising general intelligence. The reliability and validity coefficients reported in the test manual indicate that the test is both a reliable and valid tool for measuring intelligence suitable for use with secondary school students of Kerala, on which it has been standardised.

3.2.4 Socio-economic Status Scale

An adapted and modified version of the Socio-economic Status Scale by Nair (1978) was used for the present study. The modified scale can be used both for rural and urban areas as it was administered to samples taken from both the areas. Taking into consideration the increased standard of living, the income limits were modified by the investigator in consultation with experts. This modified scale was used for collecting personal information about the pupil and for measuring the Socio-economic status of pupils. The details of categories and weightages given are presented in Table 3.1. The format of the scale is given as Appendix IX.

Table 3.1 **Categories and Weightages of Different Components of the Socio-Economic Status Scale**

Sl. No.	Education	Weigh-tage	Occupation	Weigh-tage	Income Rs.	Weigh-tage
1	Master's degree; Profession degree, etc.	10	High Profession	10	Above 3001	10
2	Bachelor's degree; Engg. diploma, etc.	10	Semi-Profession	9	2001-3000	8
3	Pre-degree, T.T.C., etc.	5	Skilled work	8	1201-2000	6
4	S.S.L.C.	3	Semi-skilled work	6	801-1200	4
5	Standard VII	2	Unskilled labour	3	501-800	2
6	Illiterate	0	Unemployment	0	Below 500	1

3.2.5 Observation

Observation was another technique employed for analysing the classroom situation.

An observation schedule prepared for the purpose was used for facilitating the recording of information about the actual classroom teaching. This was used to supplement data collected through questionnaire regarding the availability and utilisation of resources in physics education.

The observation schedule (Appendix X) contains six sections and the details of which are noted below:

1. Details of school

   (name, location, management, type, etc.)
2. Details regarding the classroom
3. Methods used and objectives realised
4. Utilization of resources
5. About the teacher
6. Participation of students

3.3 Sample for the Study

A good sample is one which will reproduce the characteristics of the population. "The purpose of any sampling procedure is to obtain a sample which will reproduce the characteristics of the population with the greatest possible accuracy" (Barr, Davis and Johnson, 1953 : 161, 162). Selection of the sample is done according to the purpose of investigation.

Different samples were used for different tools. The following are the details of the sample used to respond to each tool in the study.

3.3.1 Questionnaire

The samples for this part of the study consisted of 388 physics teachers of secondary schools of Kerala from the southern, central and northern districts of Kerala namely Thiruvananthapuram, Ernakulam, Thrissur and Kozhikode. The sample selection was done on the basis of 'stratified random sampling technique'. The actual numbers of secondary schools in the above four districts of Kerala are given in Table 3.2 (Department of Education, 1987).

Table 3.2 **Number of Schools in Thiruvananthapuram, Ernakulam, Thrissur and Kozhikode Districts**

District	Government	Private	Total
Thiruvananthapuram	114	111	225
Ernakulam	83	196	279
Thrissur	74	161	235
Kozhikode	64	101	165

In order to make the sample representative of the actual population, due consideration was given to factors such as locality of schools (urban, rural), management of schools (government, private) and sex of teachers (male, female). Details of the sample selected are given in Tables 3.3, 3.4 and 3.5.

Table 3.3 **Distribution of Sample According to Locality**

District	Urban	Rural	Total
Thiruvananthapuram	47	65	112
Ernakulam	49	56	105
Thrissur	40	57	97
Kozhikode	29	45	74
Total	165	223	388

Table 3.4 **Distribution of Sample According to Management of Schools**

District	Government	Private	Total
Thiruvananthapuram	58	54	112
Ernakulam	45	60	105
Thrissur	41	56	97
Kozhikode	33	41	74
Total	177	211	388

Table 3.5 **Distribution of Sample According to the sex of Teachers**

District	Male	Female	Total
Thiruvananthapuram	59	53	112
Ernakulam	51	54	105
Thrissur	54	43	97
Kozhikode	39	35	74
Total	203	185	388

3.3.2 Achievement Tests

Sample for the administration of Achievement Tests consisted of 1016 standard IX students and 1020 standard X students from selected secondary schools of Thiruvananthapuram, Ernakulam, Thrissur and Kozhikode districts of Kerala. Sample selection was done on the basis of 'stratified sampling technique'.

As this part of the investigation was intended mainly to measure the theory and practical application awareness in physics and also to study the influence of resource utilization on practical application awareness, schools were selected accordingly. From each district, eight schools were selected which come under High Resource

Utilization, Average Resource Utilization and Low Resource Utilization Categories. The selection of the schools of these three categories was done on the basis of the analysis of the questionnaire for physics teachers.

Schools having adequate resources and where resource utilisation was found to be to a great extent were considered to be 'High' resource utilisation schools. Schools having averages resources and where utilisation was found to be not so extensive were considered to be 'Average' resource utilisation schools. Those schools having only meagre or nil resources with poor utilisation were considered to be 'Low' resource utilisation schools. The criteria followed in the selection of schools were the following:

(a) In the selection of schools as 'High', 'Average', and 'Low' resource utilisation, the total scores obtained by each school for resource availability and utilisation were taken into consideration.

(b) The scores assigned in this regard were '2' for 'More than enough and enough', '1' for 'Not enough' and '0' for 'Nil' for the availability part.

(c) For the utilisation part the score assigned were '2' for 'Always', '1' for 'Sometimes' and '0' for 'Never'.

The schools having scores above the mean $(M+\sigma)$ were *classified as 'High' resource utilisation schools* and those having scores below the mean ($M-\sigma$) were classified as 'Low' resource utilisation schools. All the rest were considered as 'Average' resource utilisation schools.

On the basis of the above procedure 72 schools were found to have availability of resources at a satisfactory level. District-wise distribution of availability of resource in schools is given in Table 3.6.

Regarding the extent of utilisation, 52 schools were found to have high resource utilisation. This included some schools with low resource availability because in these schools the available resources though not satisfactory were found to be utilised. The details of schools according to the extent of resource utilisation is given in Table 3.7.

While selecting the schools for the administration of tests, availability and utilisation of resources were considered. Availability and utilisation of library facilities, laboratory, environmental resources, etc., were not found uniform in all the schools selected for the study.

Administration of the prepared tests on students of schools with inadequate resources may not help to obtain meaningful data. Hence it was decided to carry out the tests on students of schools which come under the categories of 'High', 'Average' and 'Low' resource utilisation. The tests were planned to be administered on about 1000 students each from standard IX and standard X. It was found that these

Table 3.6 **District-wise Distribution of Schools According to Availability of Resource by Area and Management**

District	More than enough and enough	Not enough	More than enough and enough		Not enough		More than enough and enough		Not enough	
			Urban	Rural	Urban	Rural	Government	Private	Government	Private
Thiruvanantha-puram	23	89	16	7	31	58	10	13	48	41
Ernakulam	19	86	13	6	36	50	7	12	38	48
Thrissur	16	81	11	5	29	52	6	10	35	46
Kozhikode	14	60	10	4	19	41	5	9	28	32
Total	72	316	50	22	115	201	28	44	149	167

Table 3.7 **District-wise Distribution of Schools According to Utilisation of Resource by Locality and Management**

District	High resource utilisation						Average resource utilisation						Low resource utilisation					
	Urban	Rural	Total	Government	Private	Total	Urban	Rural	Total	Government	Private	Total	Urban	Rural	Total	Government	Private	Total
Thiruvananthapuram	14	2	16	4	12	16	23	8	31	12	19	31	10	55	65	42	23	65
Ernakulam	12	3	15	3	12	15	19	9	28	12	16	28	18	44	62	30	32	62
Thrissur	11	-	11	4	7	11	15	10	25	9	16	25	14	47	61	28	33	61
Kozhikode	10	-	10	4	6	10	14	9	23	8	15	23	5	36	41	21	20	41
Total	47	5	52	15	37	52	71	36	107	41	66	107	47	182	229	121	108	229

many students would be available from about 30 schools. Accordingly it was decided to select 8 schools from each of the four districts giving a total of 32 schools for the administration of the prepared tests.

Thus in all, 32 schools from the above mentioned four districts of Kerala were selected from the three categories of schools for administering the tests. This was found to be about 9 percent of the schools where resource survey was conducted. Due consideration was given to factors like locality of schools, management of schools and sex of the subjects. For 'High' resource utilisation category schools, the sample consisted only of urban schools as resource availability and utilisation was found higher in them than rural schools. The investigator came to this conclusion after analysing the questionnaire for teachers for assessing the extent of availability and utilisation of resources for physics education. Only five schools from rural areas selected for the study were found to have high resource utilisation. This number was found to be inadequate for detailed study. The details of the sample selected are given in Tables 3.8 to 3.12. List of schools is included as Appendix XI.

Table 3.8 **Distribution of Sample According to Resource Utilisation**

District	High Resource Utilisation	Average Resource Utilisation	Low Resource Utilisation	Total
Thiruvananthapuram	3	2	3	8
Ernakulam	3	2	3	8
Thrissur	2	3	3	8
Kozhikode	2	3	3	8
Total	10	10	12	32

Table 3.9 **Distribution of Sample - High Resource Utilisation Category**

District	Urban	Rural	Total	Govt.	Pvt.	Total
Thiruvananthapuram	3	-	3	2	1	3
Ernakulam	3	-	3	1	2	3
Thrissur	2	-	2	1	1	2
Kozhikode	2	-	2	1	1	2
Total	10	-	10	5	5	10

Table 3.10 **Distribution of Sample - Average Resource Utilisation Category**

District	Urban	Rural	Total	Govt.	Pvt.	Total
Thiruvananthapuram	1	1	2	-	2	2
Ernakulam	1	1	2	2	-	2
Thrissur	1	2	3	1	2	3
Kozhikode	1	2	3	2	1	3
Total	4	6	10	5	5	10

Table 3.11 **Distribution of Sample - Low Resource Utilization Category**

District	Urban	Rural	Total	Govt.	Pvt.	Total
Thiruvananthapuram	-	3	3	2	1	3
Ernakulam	-	3	3	1	2	3
Thrissur	1	2	3	2	1	3
Kozhikode	1	2	3	1	2	3
Total	2	10	12	6	6	12

Table 3.12 **Distribution of Sample According to the Sex of Students**

Students	Girls	Boys	Total
Std IX	493	523	1016
Std X	523	497	1020

3.3.3 Intelligence Test and Socio-Economic Status Scale

The sample for the administration of these two tools was the same sample selected for the administration of achievement tests, the details of which are given above.

3.3.4 Observation

The investigator observed one physics class room each of the 32 schools selected for the administration of the achievement tests.

3.4 Procedure for Collection of Data

3.4.1 Administration of questionnaire

The investigator mailed 500 questionnaire forms to a section of the sample selected for the study with a request to the headmaster to hand over the questionnaire to any one of the physics teachers in the school without having any bias. A self-addressed and stamped envelope was provided with the form for the prompt and quick return. The

Table 3.13 **Details Regarding Distribution and Collection of Questionnaire Forms**

District	Number			Urban			Rural			Respondents	
	Distributed	Collected	Selected	Govt.	Pvt.	Total	Govt.	Pvt.	Total	Male	Female
Thiruvananthapuram	200	123	112	23	24	47	35	30	65	59	53
Ernakulam	200	114	105	22	27	49	23	33	56	51	54
Thrissur	190	104	97	16	24	40	25	32	57	54	43
Kozhikode	160	84	74	14	15	29	19	26	45	39	35
Total	750	425	388	75	90	165	102	121	223	203	185

investigator personally distributed 250 questionnaires to the rest of the sample. After reminders, and follow-up letters, 285 filled up questionnaires were received from the mailed 500 questionnaire forms. The investigator could get back only 140 filled in forms out of the 250 forms distributed personally. 37 forms were found to be defective or incomplete. After eliminating them, the actual sample was found to be 388 from the four revenue districts of Kerala: Thiruvananthapuram, Ernakulam, Thrissur and Kozhikode. Details of distribution and collection of questionnaire forms are given in Table 3.13.

3.4.2 Administration of Achievement Tests

The investigator visited the individual institutions (secondary schools) where the tests were to be conducted, and made arrangements for testing. The students who were to take the tests were informed of the content, date and time of testing. This ensured standard performance. One week's time notice was given to all subjects. The arrangements were made with the help of the Heads of the Institutions and teachers dealing with physics.

The tests were administered following the directions in the respective test manuals. Ideal condition for administering the tests were ensured in respect of timing, seating, directions, invigilation, arrangements, etc. Common procedures were followed in all schools and thus external testing conditions were kept almost identical. The investigator was present for all the test sessions. Teachers were available for help in administering the tests. Separate scoring sheets were used for scoring all the tests.

3.4.3 Administration of Intelligence Test and Socio-economic Status Scale

After administering achievements tests and collecting back the score sheets, Intelligence test was administered to the subjects. Score sheet for this was provided separately (Appendix XII). After collecting back the score sheets, socio-economic status scale forms were distributed and the subjects were asked to fill them up.

3.5 Consolidation of Data

The tabulation of data has been done very carefully. The data collected by questionnaire, achievement tests, intelligence test, socio-economic status scale and observation schedule were tabulated on separate sheets. Partially and improperly filled in questionnaires were discarded. Only 388 questionnaires could be used for final analysis.

The consolidated data from achievement tests, intelligence test, socio-economic status scale were taken to the computer section for statistical computation. The rest of the data were hand computed.

3.6 Statistical Techniques Used for Analysis

The responses of the teachers were treated statistically. Percentages were calculated.

The score sheets for PTAT, PPAAT, Intelligence Test and Socio-economic status scale forms were scored and scores subjected to statistical treatment consisted of:

1. Arithmetic mean

$$\bar{x} = A + \frac{\sum fd}{N} \times C$$

$\bar{x}$ - Arithmetic mean

A - Assumed mean

C - Class interval

f - Frequency of each class

d - Deviation of score from the assumed mean

N - Total sample

2. S.D. $$= C\sqrt{\frac{\sum fd^2}{N} - \frac{(\sum fd)^2}{N}}$$

C - Class interval

f - Frequency of each class

d - Deviation of score from the assumed mean

N - Total sample

3. Analysis of variance: Two-way classification

In single classification or one-way analysis of variance, the relationship between one independent variable and one dependent variable can be examined. When the simultaneous effect of two independent variables on a dependent variable is to be studied, a two-way analysis of variance is performed.

Intelligence Quotient (IQ) is classified into three levels (High IQ; Average IQ; and Low IQ.) depending upon the mean (M) and standard deviation (σ) of the IQ. Test scores for the whole group. Thus all subjects whose IQ score is above the mean (M+σ) have been classified as High IQ level. Similarly a subject whose IQ score is below (M-σ) can be placed in the Low IQ level. All the rest of the subjects will be classified as belonging to the Average IQ level. In the same way Socio-Economic Status (SES) score were analysed and subjects were classified as High SES level, Average SES level and Low SES level.

Sex has two levels (Male and Female), locality has two levels (urban and rural) management has two levels (government and private).

To study the influence of independent variables on the dependent variable 'Physics Theory Awareness' (PTA) of standard IX students, 9 separate two-way ANOVA were found to be necessary. In the same way to study the influence of independent variables on the dependent variable 'Physics Practical Application Awareness' (PPAA) of standard IX pupils, 9 more separate two-way ANOVA were found to the necessary.

In the same way 18 separate ANOVA were found to be necessary to study the influence of independent variables on Physics Theory Awareness (PTA) of standard X pupils and Physics Practical Application Awareness (PPAA) of standard X pupils.

4. Product-moment Correlations

Pearson's product-moment correlation method is used to calculate the relationship between PTA and PPAA of subjects.

$$\text{Coefficient of correlation } r = \frac{\dfrac{\sum x^1 y^1}{N} - C_x C_y}{x \quad y}$$

$\sum x^1 y^1$ = Sum of the product of deviation taken from the assumed means of x and y distributions

N = Total sample

x = Standard deviation of x variable

y = Standard deviation of y variable

C_x = Correlation in x variable

C_y = Correlation in y variable

CHAPTER IV

ANALYSIS

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Part III

4.3 Observation of Classroom Instruction.

This chapter is devoted to a description of the analysis of the data collected. The present study as indicated earlier was designed to explore the prospects of resources in physics education in the State of Kerala. The analysis of data is classified into three parts. Part I deals with the analysis of data relating to the nature, availability and utilization of the existing resources for physics education. Part II consists of two Sections A and B. Section A deals with the analysis of the scores of test items related to theory awareness and practical application awareness in physics of pupils of Standard IX. The influence of Socio-Economic Status (SES), Intelligence and Resource Utilization on theory and practical application awareness was separately attempted. Similar analysis of data for Standard X is dealt with in Section B. Part III deals with the analysis of data collected through observation.

PART I

4.1 Nature, Availability and Utilization of Resources

As has been pointed out earlier this section deals with the analysis of the data on the nature, availability and utilization of resources in the Secondary Schools of

Kerala State for physics education. The sample selected for the study consisted of 388 physics teachers representing 388 schools from four districts of Kerala namely Thiruvananthapuram, Eranakulam, Trissur and Kozhikode. Details regarding sample, tools used etc. are given in Chapter III (Methodology). Since the questionnaire is divided into eight sections, analysis is also attempted section-wise.

4.1.1 General information

Out of the 388 physics teachers, 203 are males and 185, females. Of the 388 schools selected, 165 are situated in urban area and the rest 223 in rural area.

Out of the 388 schools, 177 are government owned and the rest 211, aided or recognized schools known as private schools. Out of 388 schools, 64 are Boys' schools, 86 Girls' schools and 238 Mixed schools.

In India both physics and chemistry graduates are given training in teaching physical science (that is physics and chemistry) for their bachelor degree in Education. Table 4.1 gives the distribution of teachers according to their educational qualifications.

It can be seen from Table 4.1 that out of the 388 teachers responded, 302 teachers (77.84 per cent) possessed B.Sc. (physics) and B.Ed. degrees. 84 teachers (21.65 per

Table 4.1 **Distribution of Teachers on the Basis of Qualification by Area and Management**

Number and Percentage

Qualification	Urban			Rural			Total		Grand Total
	Govt.	Pvt.	Total	Govt.	Pvt.	Total	Govt.	Pvt.	
B.Sc. (Phys.); B.Ed.	67 (89.33)	76 (84.44)	143 (86.67)	76 (74.51)	83 (68.60)	159 (71.30)	143 (80.79)	59 (75.36)	302 (77.84)
B.Sc. (Chem.); B.Ed.	8 (10.67)	12 (13.33)	20 (12.12)	26 (25.49)	38 (31.40)	64 (28.70)	34 (19.21)	50 (23.70)	84 (21.65)
M.Sc. (Phys.)	-	2 (2.22)	2 (1.21)	-	-		-	2 (0.95)	2 (0.52)
Total	75 (100)	90 (100)	165 (100)	102 (100)	121 (100)	223 (100)	177 (100)	211 (100)	388 (100)

cent) possessed B.Sc. (Chem.) and B.Ed. degrees. There were only two postgraduates in physics, but they did not possess B.Ed. degrees.

The analysis of data indicates that 77.84 per cent of physics teachers had learnt physics as the main elective for their B.Sc. degree course. Yet 21.65 per cent of teachers handling physics had not taken physics as the main subject at graduation.

While 86.67 per cent of teachers of urban schools had learnt physics as the main subject at graduation, only 71.30 per cent of teachers of rural schools had learnt physics as the main subject at graduation. 28.70 per cent of teachers of rural schools had learnt chemistry as main subject at graduation, but it was only 12.12 per cent in the case of teachers of rural schools. The two postgraduate teachers belonged to urban schools.

The percentage of teachers having physics as the main subject for graduation was more in government schools (80.79 per cent) than in private schools (75.36 per cent) and those having chemistry as main subject at graduation were more in private schools (23.70 per cent) when compared to government schools (19.21 per cent).

The analysis reveals that there is no dearth of trained or fully qualified teachers for physics education in the Secondary Schools of Kerala. A close observation revealed that physics can be taught better by physics graduates as physics curriculum is revised every five years incorporating advanced or modern physics.

Table 4.2 **Opinion of Teachers on Classroom Facilities**
Number and Percentage

No.	Item	More than enough and enough	Not enough	Total
1	Seating arrangement	326 (84.02)	62 (15.98)	388 (100)
2	Lighting arrangement	337 (86.86)	51 (13.14)	388 (100)
3	Furniture	314 (80.93)	74 (19.07)	388 (100)
4	Water supply arrangements	323 (83.25)	65 (16.75)	388 (100)

Table 4.2 show the opinion of teachers regarding the classroom facilities available in their schools. 84.02 per cent of the teachers were of the opinion that the seating arrangement in classrooms in their schools were satisfactory/enough. 15.98 per cent teachers opined that this facility was not enough in their schools.

Regarding lighting arrangement, 86.86 per cent of teachers were of the opinion that it was satisfactory. 13.14 per cent opined that it was not enough in their schools.

Table 4.2.1 **Opinion of Teachers (Urban and Rural) on Classroom Facilities**
Number and Percentage

No.	Items	Urban: More than enough and enough	Urban: Not enough	Urban: Total	Rural: More than enough and enough	Rural: Not enough	Rural: Total
1	Seating arrangement	146 (88.48)	19 (11.52)	165 (100)	180 (80.72)	43 (19.28)	223 (100)
2	Lighting arrangement	158 (95.76)	7 (4.24)	165 (100)	175 (78.48)	48 (21.52)	223 (100)
3	Furniture	143 (86.67)	22 (13.33)	165 (100)	171 (76.68)	52 (23.32)	223 (100)
4	Water supply arrangements	153 (92.73)	12 (7.27)	165 (100)	170 (76.23)	53 (23.76)	223 (100)

80.93 per cent of teachers agreed that classroom furniture was enough. 19.07 per cent opined that it was not enough in their schools.

Regarding water supply arrangements 83.25 per cent of the teachers opined it to be more than sufficient or sufficient in their schools. 16.75 per cent opined that it was not enough in their schools.

The analysis of data indicates that more than 80 per cent of the schools seemed to have sufficient classroom facilities.

Table 4.2.1 gives the number and percentage of teachers (urban and rural) regarding their opinion on classroom facilities.

From the opinion of teachers, it can be seen that regarding facilities like seating arrangement, lighting arrangement, furniture and water supply arrangement, there were differences between urban and rural schools categorised as having 'More than enough and enough' of these facilities. The percentages of urban schools were more than that of rural schools regarding the above mentioned four facilities.

From the above discussion it is clear that urban schools have better class room facilities than rural schools.

Table 4.2.2 **Opinion of Teachers (Government and Private) on Classroom Facilities**
Number and Percentage

No.	Item	Government			Private		
		More than enough and enough	Not enough	Total	More than enough and enough	Not enough	Total
1	Seating arrangement	140 (79.10)	37 (20.90)	177 (100)	186 (88.15)	25 (11.85)	211 (100)
2	Lighting arrangement	154 (87.01)	23 (12.99)	177 (100)	183 (86.73)	28 (13.27)	211 (100)
3	Furniture	122 (68.93)	55 (31.07)	177 (100)	192 (91.00)	19 (9.00)	211 (100)
4	Water supply arrangements	147 (83.05)	30 (16.95)	177 (100)	176 (83.41)	35 (16.59)	211 (100)

Table 4.2.2 gives the number and percentage of teachers (government and private) regarding their opinion on class room facilities.

From the opinion of teachers it can be seen that regarding facilities - lighting arrangement and water supply arrangement, there were not much differences between government and private schools categorised as having 'More than enough and enough' of these facilities. Regarding seating arrangement, percentage of private schools was more (88.15) than that of government school (79.10). The same holds good in the case of furniture also where the percentage of private schools was 91.00 and that of government schools was 68.93.

Considering schools categorised as having 'Not enough' facilities, the percentages of government schools were more than that of private schools regarding seating arrangement and furniture. Regarding lighting arrangement and water supply arrangement, not much differences were observed between government and private schools.

From the above discussion, it is clear that regarding certain items of classroom facilities like furniture and seating arrangement the government schools were ill-equipped when compared to private schools.

4.1.2 Details regarding library

Table 4.3 gives the number and percentage of schools regarding the place where library is situated according to the opinion of teachers.

Table 4.3 **Details Regarding the Location of Library in Schools**
(Number and Percentage)

Items	No.of schools	Percentage
Room specially meant for the purpose	290	74.74
Teachers' room	82	21.13
Any one room	16	4.12

Of the 388 schools, in 74.74 per cent of schools the library was situated in the room specially meant for the purpose. In 21.13 per cent of the schools, the library was functioning in teacher's room. In 4.12 per cent of schools it was situated in any one room. From this it is clear than about 25 per cent of schools did not have a proper library room. This is a constraint for the smooth working of school libraries that form an important resource for physics education.

Table 4.4 **Details Regarding the Availability of Reading room**
(Number and Percentage)

Item	No.of schools	Percentage
Available	202	52.06
Not available	186	47.94
Total	388	100.00

Table 4.4 gives the details regarding the availability of reading room.

Out of 388 schools selected for the purpose of study 202 schools (52.06 per cent) had separate reading room. It may be noted that this facility was lacking in 186 schools (47.94 per cent). This shows that about 50 per cent of the schools did not have proper reading room attached to the library. This may be due to over emphasis and dependence on textbooks by pupils and the disinterest on the part of teachers in encouraging reading habit among their pupils.

Table 4.5 gives the details regarding the persons in charge of the libraries.

In 352 schools (90.72 per cent) out of the 388 schools selected, one of the teachers in each school was in charge of the library. In 33 schools (8.51 per cent) the Headmaster/Headmistress was holding the charge of the school library. Only in three schools (0.77 per cent) fulltime librarian was found appointed.

Table 4.5 **Details Regarding the Persons in Charge of Library**
(Number and Percentage)

Sl. No.	Person in charge	No.of schools	Percentage
1	Headmaster/ Headmistress	33	8.51
2	A full time librarian	3	0.77
3	One of the teachers	352	90.72
	Total	388	100.00

In 90 per cent of the schools one of the teachers discharged the duty of librarian. Schools with fulltime librarians were scarce and this may be one of the reasons for the ineffiecient working of most of the school libraries.

Opinion of teachers regarding the acquisition of library books is presented in Table 4.6.

It is clear from Table 4.6 that the main source for the acquisition and purchase of library books was the library fee which was followed by government grant. The third source was the contribution of books by SIE (State Institute of Education) followed by contribution of books by NCERT (National Council of Educational Research and Training).

Table 4.6 **Opinion of Teachers Regarding the Acquisition of Library Books**
(Number and Percentage)

Item	1	2	3	4	Total
a	302 (77.80)	86 (22.20)	-	-	388 (100)
b	86 (22.20)	302 (77.80)	-	-	388 (100)
c	-	-	365 (94.10)	23 (5.90)	388 (100)
d	-	-	23 (5.90)	365 (94.10)	388 (100)

a - Purchased using library fee

b - Purchased using government grant

c - Supplied by State Institute of Education

d - Supplied by NCERT

1,2,3 and 4 indicate the order of priority

77.80 per cent teachers recorded library fee as the prime source for the purchase of books while 22.20 per cent recorded government grant as the prime source. 77.80 per cent of teachers recorded government grant as the second important source while 22.20 per cent recorded library fee as the second source. 94.10 per cent of teachers recorded contribution by SIE as the third source. Again 94.10 per cent of teachers recorded contribution by NCERT as the fourth source for the acquisition of books of school library.

From the above analysis it is clear that library fee was the main source for the purchase of library books which was followed by government grant.

Table 4.7 **Opinion of Teachers Regarding Constraints in the Purchase of Library Books**

Sl. No.	Item	Urban	Rural	Govern-ment	Private	Total
1	Lack of finance	141 (85.45)	195 (87.44)	154 (87.00)	182 (86.26)	336 (86.60)
2	Non availability of required books	-	-	-	-	-
3	Lack of space for keeping books	17 (10.30)	23 (10.31)	15 (8.47)	25 (11.85)	40 (10.30)
4	Difficulty in observing formalities	7 (4.24)	5 (2.24)	8 (4.52)	4 (1.90)	12 (3.10)
5	Delay in getting list of books from teachers	-	-	-	-	-
	Total	165 (100)	223 (100)	177 (100)	211 (100)	388 (100)

Table 4.7 shows the distribution of teachers according to their opinion on the constraints in the

purchase of library books. A good percentage (86.90 per cent) of the respondents held the opinion that 'Lack of finance' was the major constraint in the purchase of books for library. 10.30 per cent of teachers held the opinion that 'Lack of space for keeping books' was a constraint in the purchase of books while 3.10 per cent recorded 'Difficulty in observing formalities' as a constraint.

87.44 per cent of rural school teachers recorded 'Lack of finance' as a major constraint for the purchase of books while 85.45 per cent of urban school teachers recorded this. There was not much difference in recordings of government and private school teachers regarding its constraint. There was not any difference between urban and rural schools regarding the constraint 'Lack of space' for keeping books. 'Difficulty in observing formalities' was pointed out by 4.24 per cent of urban school teachers while only 2.24 per cent of rural school teachers pointed out this.

It is evident from the above analysis that 'Lack of finance' was the major constraint in the purchase of books for library for all categories of schools namely urban, rural, government and private.

The foregoing analysis reveals that there is a regular flow of income in the form of library fee for the accession of books. But this amount is very meagre due to rise in prices which makes constraints in the accession of required books every year. To overcome this situation, an increase in the rate of fee cannot be effected for fear of student strikes. As library is one of the most important resources for physics education, steps have to be taken to provide sufficient funds for purchase of books.

Table 4.8 gives the number and percentage of schools regarding the extent of availability and utilization of reference books in physics for students and teachers based on the opinion of teachers.

Out of the 388 schools selected, 42.53 per cent of schools had enough reference materials in physics for students while 57.47 per cent of schools did not have enough reference materials. Regarding the extent of utilization of these materials, in 57.73 per cent of schools these materials were always made use of while in 42.27 per cent of schools these were sometimes made use of.

Regarding reference books in physics for teachers, more than half of the schools (56.19 per cent) had enough of these materials. In 43.81 per cent of the schools, they were not enough. But regarding the extent of utilization of these materials, in 68.81 per cent of schools these were always made use of while in 31.19 per cent of schools, these were only sometimes made use of.

Table 4.8 **Opinion of Teachers Regarding the Extent of Availability and Utilization of Reference Books**

(Number and Percentage)

Sl. No.	Item	Extent of availability			Extent of utilization			Total
		Enough	Not enough	Total	Always	Sometimes	Never	
1	Reference books for students in physics	165 (42.53)	223 (57.47)	388 (100)	224 (57.73)	164 (42.27)	-	388 (100)
2	Reference books for teachers in physics	218 (56.19)	170 (43.81)	388 (100)	267 (68.81)	121 (31.19)	-	388 (100)

It is evident from the above analysis that sufficient number of reference books for students and teachers were not available in many of the schools. In a good percentage of schools this facility was found utilized always, yet in one-third of schools this was found only sometimes utilized. This may be one of the reasons for the ill-functioning of many schools libraries.

Table 4.8.1 shows the number and percentage of schools regarding the extent of availability of reference books based on area and management of schools.

Of the 165 urban schools, 52.12 per cent had enough of reference materials in physics for students. Of the 223 rural schools, only 35.43 per cent had enough of reference materials for students 47.88 per cent of urban schools and 64.57 per cent of rural schools were not having sufficient reference books for students.

Again it can be observed that 48.34 per cent of private schools had enough of reference books for students while only 35.59 per cent of government schools had these books. This facility was not enough in 64.41 per cent of government schools and in 51.66 per cent of private schools.

The extent of availability of reference books in physics for teachers seemed to be better than that for students. 73.94 per cent of urban schools and 43.04 per cent of rural schools came under the 'Enough' category of

Table 4.8.1 **Extent of Availability of Reference Books in Urban, Rural, Government and Private Schools**

(Number and Percentage)

Sl. No.	Item	Urban			Rural			Government			Private		
		Enough	Not enough	Total	Enough	Not enough	Total	Enough	Not enough	Total	Enough	Not enough	Total
1	Reference books for students in physics	86 (52.12)	79 (47.88)	165 (100)	79 (35.43)	144 (64.57)	223 (100)	63 (35.59)	114 (64.41)	177 (100)	102 (48.34)	109 (51.66)	211 (100)
2	Reference books for teachers in physics	122 (73.94)	43 (26.06)	165 (100)	96 (43.04)	127 (56.94)	223 (100)	95 (53.67)	82 (46.33)	177 (100)	123 (58.29)	88 (41.71)	211 (100)

Table 4.8.2 **Extent of Utilization of Reference Books in Urban, Rural, Government and Private Schools**

(Number and Percentage)

Sl. No.	Item	Urban				Rural				Government				Private			
		A	ST	N	T.	A	ST	N	T	A	ST	N	T	A	ST	N	T
1	Reference books for students in physics	102 (61.82)	63 (38.19)	-	165 (100)	122 (54.71)	101 (45.29)	-	223 (100)	92 (51.98)	85 (48.02)	-	177 (100)	132 (62.56)	79 (37.44)	-	211 (100)
2	Reference books for teachers in physics	128 (77.58)	37 (22.42)	-	165 (100)	139 (62.33)	84 (37.67)	-	223 (100)	111 (62.71)	66 (37.29)	-	177 (100)	156 (73.93)	55 (26.07)	-	211 (100)

A - Always; ST - Sometimes; N - Never; T - Total schools. 68.29 per cent of private schools and 53.67 per cent of government schools came under this category. In more than 40 per cent of government and private schools the number of reference books for teachers were inadequate.

It is evident from the above discussion that urban schools were better equipped with reference materials for teachers and students than rural schools. But yet there were many schools both urban and rural without adequate number of reference books. Comparing government and private schools, private schools seemed to be slightly better equipped than government schools regarding reference books. This may be because private schools raised more funds for the purchase of books.

Table 4.8.2 shows the number and percentage of schools regarding the extent of utilization of reference books.

The schools were classified into three categories on the basis of the extent of utilization of reference books as 'Always', 'Sometimes' and 'Never' utilizing schools.

Of the 165 urban schools, regarding reference materials for students 61.82 per cent came under the category of 'Always' utilizing while only 54.71 per cent of the 223 rural schools came under this category. 38.19 per cent urban schools and 45.29 per cent rural schools came under the second category. There were no schools in the third category.

More private schools (62.56 per cent) came under the first category than government schools (51.98 per cent). 37.44 per cent of private and 48.02 per cent of government schools came under the second category.

Regarding the reference books for teachers, urban schools seemed to utilize this resource more than ruralschools since 77.58 per cent of urban schools came under the first category while only 62.33 per cent rural school came under this category. In the rest of the schools both in urban and rural, this resource was only utilized sometimes.

Private schools seemed to utilize this resource more when compared to government schools. 73.93 per cent of private schools came under the first category schools while only 62.71 per cent of government schools came this category. In the rest of the schools both government and private, this resource was utilized only sometimes.

Regarding the extent of utilization of reference books for students and teachers, urban schools were better when compared to rural schools. This may be because of availability of these items were more in urban schools. So also the private schools seemed to utilize this resource more than government schools. It can be concluded that the available reference materials were not found fully utilized in many of the schools.

Table 4.9 **Details Regarding the Extent of Availability and Utilization of Reference Materials in Library**

(Number and Percentage)

Sl. No.	Category	No.of schools having	Extent of availability			Total	Extent of utilization			Total
			More than enough & enough	Not enough	Nil		Always	Some-times	Never	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1	Encyclopaedia	284 (73.20)	190 (48.97)	94 (24.23)	104 (26.80)	388 (100)	188 (48.45)	96 (24.74)	104 (26.80)	388 (100)
2	Standard text books in physics	265 (68.30)	163 (42.01)	102 (26.29)	123 (31.70)	388 (100)	143 (36.86)	122 (31.44)	123 (31.70)	388 (100)
3	Applied science books	247 (63.66)	137 (35.31)	110 (28.35)	141 (36.34)	388 (100)	175 (45.10)	72 (18.56)	141 (36.34)	388 (100)
4	Advanced science books	232 (59.80)	112 (28.87)	120 (30.93)	156 (40.21)	388 (100)	94 (24.22)	138 (35.57)	156 (40.21)	388 (100)

(contd...)

Table 4.9 (Contd...)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
5	Text books for practicals	94 (24.23)	52 (13.40)	42 (10.82)	294 (75.77)	388 (100)	53 (13.66)	41 (10.57)	294 (75.77)	388 (100)
6	Books on preparation on aids	105 (27.06)	81 (20.88)	24 (6.19)	283 (72.94)	388 (100)	76 (19.59)	29 (7.47)	283 (72.94)	388 (100)
7	Science									
	(a) Malayalam journals	174 (44.85)	113 (29.12)	61 (15.72)	214 (55.15)	388 (100)	139 (35.82)	35 (9.02)	214 (55.15)	388 (100)
	(b) English journals	68 (17.53)	48 (12.37)	20 (5.15)	320 (82.47)	388 (100)	58 (17.53)	10 (2.58)	320 (82.47)	388 (100)
8	Periodicals	88 (22.68)	49 (12.63)	39 (10.05)	300 (77.32)	388 (100)	74 (19.07)	14 (3.61)	300 (77.32)	388 (100)
9	News Papers	73 (18.80)	48 (12.37)	25 (6.44)	315 (81.19)	388 (100)	60 (15.46)	13 (3.35)	315 (81.19)	388 (100)

Note: Column (3) refers to the sum of numbers and corresponding percentages in columns (4) and (5).

Table 4.9 shows the distribution of schools according to the extent of availability and utilization of books in the library. The books were classified as encyclopaedia, standard textbooks in physics, applied science books, advanced science books, textbooks for practicals, books on preparation of aids, science journals, periodicals and newspapers.

The schools were classified into three categories according to the extent of availability of books - those having 'More than enough and enough', 'Not enough' and 'Nil'. Again the schools more classified into the categories according to the extent of utilization of these materials as 'Always', 'Sometimes' and 'Never' utilizing.

Of the total 388 schools selected for the study, 284 schools (73.20 per cent) had encyclopaedia. Regarding the extent of availability 48.97 per cent of schools had enough of this item. 24.23 per cent came under the second category and 26.80 came under the third category.

Regarding the extent of utilization of encyclopaedia, 48.45 per cent of schools came under first category that is 'Always' utilizing category. 24.70 per cent came under second category and 26.80 per cent came under the third category.

As regards to standard textbooks in physics, in 68.30 per cent of schools there were available. Regarding the extent of availability, 42.01 per cent came under the first, 26.29 per cent under the second and 31.70 per cent under the third categories of schools.

Regarding the extent of utilization of these textbooks, 36.86 per cent came under the first, 31.44 per cent under the second and 31.70 per cent under the third categories of schools.

Applied science books were available only in 63.66 per cent of the schools. Regarding the extent of availability of these books 35.31 per cent came under the first, 28.35 under the second and 36.34 per cent under the third categories of schools.

Regarding the extent of utilization of applied science books, 45.10 per cent came under first, 18.56 per cent under second and 36.34 per cent under the third categories of schools.

Advanced science books were available only in 59.80 per cent of the 388 schools selected for the study. Regarding the extent of availability of these, only 28.87 per cent came under the first, 30.93 per cent under the second and 40.21 per cent under the third categories of schools.

Regarding the extent of utilization of advanced science books, only around 60 per cent of the schools came under the first and second categories while 40 per cent schools were not at all utilizing their resource.

Textbooks for practicals were available in only 24.23 per cent of schools while in 75.77 per cent of schools they were not available. Nearly 13 per cent of the schools came under the first category while 10.82 per cent came under the second category.

Regarding the extent of utilization of the above books, only one-fourth of the schools came under the first and second categories while three-fourth of the schools came under the category of never utilizing.

Books on preparation of aids were available only in 27.06 per cent of schools and the rest 72.94 per cent of schools did not possess these books. Regarding the extent of availability nearly 20 per cent schools came under the first category of schools.

Regarding the extent of utilization of the above books, only one-fourth of schools were utilizing them 'Always' or at least 'Sometimes'. The rest three-fourth of the schools were not utilizing them at all.

Science journals in Malayalam were available in 44.85 per cent of schools. About 30 per cent of schools had enough or more than enough of these journals. Science journals in English were available in only 17.53 per cent of schools which clearly shows the inadequacy of this item. Less than 20 per cent of schools were utilizing this item always or at least sometimes.

Periodicals were available only in 22.69 per cent of schools. More than 75 per cent of school libraries lack these. The extent of availability and the extent of utilization were not at all satisfactory.

Newspapers were available only in 18.80 per cent of the schools. More than 80 per cent of school libraries lack this item. As is seen from the table the extent of availability and extent of utilization were far from satisfactory.

It is evident from the above discussion that many essential reference materials for the teaching of physics were not available in most of the school libraries with the exception of books like text books in physics, advanced science books, text books for practicals, encyclopaedia etc., which were available in more than 60 per cent of schools. The extent of utilization of many of these reference materials were far from satisfactory.

Table 4.9.1 presents the distribution of urban schools according to the extent of availability and utilization of books in the library.

Of the 165 urban schools selected for the study, encyclopaedia was available in 85.45 per cent of urban schools. Regarding the extent of availability, 61.82 per cent schools came under the first category, 23.64 per cent under second and 14.55 per cent under third categories.

Table 4.9.1 **Details Regarding the Extent of Availability and Utilization of Reference Materials in Library (Urban Schools)**

(Number and Percentage)

Sl. No.	Category	No. of schools having	Extent of availability			Total	Extent of utilization			Total
			More than enough & enough	Not enough	Nil		Always	Some-times	Never	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1	Encyclopaedia	141 (85.45)	102 (61.82)	39 (23.64)	24 (14.55)	165 (100)	108 (65.45)	33 (20.00)	24 (14.55)	165 (100)
2	Standard text books in physics	125 (75.76)	85 (51.52)	40 (24.24)	40 (24.24)	165 (100)	70 (42.42)	55 (33.33)	40 (24.24)	165 (100)
3	Applied science books	140 (84.85)	82 (49.70)	58 (35.15)	25 (15.15)	165 (100)	105 (63.64)	35 (21.21)	25 (15.15)	165 (100)
4	Advanced science books	111 (67.27)	67 (40.61)	44 (26.67)	54 (32.75)	165 (100)	73 (44.24)	38 (23.03)	54 (32.73)	165 (100)

(contd...)

Table 4.9.1 (Contd...)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
5	Text books for practicals	53 (32.12)	35 (21.21)	18 (10.91)	112 (67.88)	165 (100)	20 (12.12)	33 (20.00)	112 (67.88)	165 (100)
6	Books on preparation on aids	60 (36.30)	49 (29.70)	11 (6.67)	105 (63.64)	165 (100)	31 (18.79)	29 (17.58)	105 (63.64)	165 (100)
7	Science									
	(a) Malayalam journals	90 (54.55)	62 (37.58)	28 (16.97)	75 (45.45)	165 (100)	37 (22.42)	53 (32.12)	75 (45.45)	165 (100)
	(b) English journals	45 (27.27)	32 (19.39)	13 (7.58)	120 (72.73)	165 (100)	21 (12.73)	24 (14.55)	120 (72.73)	165 (100)
8	Periodicals	49 (29.70)	33 (20.00)	16 (9.70)	116 (70.30)	165 (100)	18 (10.91)	31 (18.79)	116 (70.30)	165 (100)
9	News Papers	46 (27.88)	29 (17.58)	17 (10.30)	119 (72.12)	165 (100)	19 (11.52)	27 (16.36)	119 (72.12)	165 (100)

Note: Column (3) refers to the sum of numbers and corresponding percentages in columns (4) and (5).

Regarding the extent of utilization, 65.45 per cent schools came under the category of 'Always' utilizing. 14.55 per cent schools never utilized encyclopaedia.

Standard textbooks in physics were available in 75.76 per cent of urban schools while they were not available in 24.24 per cent of schools. Nearly half of the urban schools had enough of these books.

Regarding the extent of utilization of standard physics text books, 42.42 per cent schools came under the first category while only 33.33 per cent came under the second category.

Applied science books were available in 84.85 per cent of urban schools. About 50 per cent schools possessed sufficient numbers of these books. The rest of the schools did not possess or were not enough in number.

Regarding the extent of utilization of applied science books, more than 80 per cent of school seemed to utilize always or at least sometimes.

Advanced science books were available only in 67.27 per cent schools. Nearly 40 per cent of schools had enough or more than enough of these books. In the rest 60 per cent schools they were either not enough or nil. Regarding the extent of utilization, only 44.24 per cent schools came under the first category of 'Always' utilizing.

Only 32.12 per cent of the 165 urban schools possessed text books for practicals. About 20 per cent schools had enough or more than enough of them. The extent of utilization of this item was not at all satisfactory since about 70 per cent schools came under the third category.

Only 36.30 per cent of urban schools possessed books on preparation of aids. Regarding the extent of availability only about 30 per cent of school had enough or more than enough of them. The extent of utilization was not satisfactory.

Science journals in Malayalam were available in 54.55 per cent schools. Nearly 40 per cent of school had enough or more than enough of them. In the rest 60 per cent school were either not enough or nil. Regarding the extent of utilization 22.42 per cent came under the first category and 32.12 per cent under the second category. In the rest 45.45 per cent this item was not at all utilized because they did not possess them.

Science journals in English were available only in 27.27 per cent urban schools. From the Table it is clear that both the extent of availability and utilization were not satisfactory.

Periodicals and newspaper were available is only less than 30 per cent of schools. The extent of availability and utilization of these items were far from satisfactory.

From the above discussion it can be concluded that certain types of references materials were available in a good percentage of urban schools but certain items were not available to the required extent. Regarding most of the items, the extent of utilization was not up to the excepted level. This may be because these items were not possessed by the school libraries.

Table 4.9.2 presents the distribution of rural schools according to the extent of availability and utilization of reference materials in the library.

The classification of schools were done as in the previous cases. Of the 223 rural schools selected for the study, encyclopaedia was available only in 64.13 per cent of schools. About 40 per cent of schools had enough or more than enough of this item while in the rest of the school this item was either not enough or nil. Regarding the extent of utilization, 37.22 per cent came under first category and 26.91 under second category.

Standard physics text books were available in 62.78 per cent of rural schools. Only about 35 per cent of schools came under the first category of schools. Regarding the extent of utilization, only 34.98 per cent came under first category of schools.

Table 4.9.2 Details Regarding the Extent of Availability and Utilization of Reference Materials in Library (Rural Schools)

(Number and Percentage)

Sl. No.	Category	No.of schools having	Extent of availability: More than enough & enough	Extent of availability: Not enough	Extent of availability: Nil	Total	Extent of utilization: Always	Extent of utilization: Some-times	Extent of utilization: Never	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1	Encyclopaedia	143 (64.13)	88 (39.44)	55 (24.66)	80 (35.87)	223 (100)	83 (37.22)	60 (26.91)	80 (35.87)	223 (100)
2	Standard text books in physics	140 (62.78)	78 (34.98)	62 (27.80)	83 (37.22)	223 (100)	78 (34.98)	62 (27.80)	83 (37.22)	223 (100)
3	Applied science books	107 (47.98)	55 (24.66)	52 (23.32)	116 (52.00)	223 (100)	59 (26.46)	48 (21.52)	116 (52.00)	223 (100)
4	Advanced science books	121 (54.26)	45 (20.18)	76 (34.08)	102 (45.74)	223 (100)	62 (27.80)	59 (26.46)	102 (45.74)	223 (100)

(contd...)

Table 4.9.2 (Contd...)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
5	Text books for practicals	43 (21.08)	19 (8.52)	24 (10.76)	180 (80.72)	223 (100)	30 (13.45)	13 (5.83)	180 (80.72)	223 (100)
6	Books on preparation on aids	45 (20.18)	32 (14.35)	13 (5.83)	178 (79.82)	223 (100)	21 (9.42)	24 (10.76)	178 (79.82)	223 (100)
7	Science									
	(a) Malayalam journals	84 (37.67)	51 (22.87)	33 (14.80)	139 (62.33)	223 (100)	39 (17.49)	45 (20.18)	139 (62.33)	223 (100)
	(b) English journals	23 (10.31)	16 (7.17)	7 (3.14)	200 (89.69)	223 (100)	12 (5.38)	11 (4.93)	200 (89.69)	223 (100)
8	Periodicals	39 (17.49)	16 (7.17)	23 (10.31)	184 (82.51)	223 (100)	18 (8.01)	21 (9.42)	184 (82.51)	223 (100)
9	News Papers	27 (12.11)	19 (8.52)	8 (3.59)	196 (87.89)	223 (100)	12 (5.38)	15 (6.73)	196 (87.69)	233 (100)

Note: Column (3) refers to the sum of numbers and corresponding percentages in columns (4) and (5).

Applied science books were available only in 47.98 per cent of schools. Only one-fourth of schools had enough or more than enough of this items. In the rest of the schools either these were not enough or nil. Regarding the extent of utilization, only about 50 per cent schools came under first and second categories.

Advanced science books were available in 54.26 per cent of schools. Only about 20 per cent schools possessed this items to the required extent. Only about 55 per cent schools utilized this item always or at least sometimes.

Text books on practicals and books on preparation of aids were available only in about 20 per cent rural schools. Regarding these items, the extent of both availability and utilization were far from satisfactory.

Science journals in Malayalam were available in 37.67 per cent of schools while there in English were available only in 10.31 per cent schools. Regarding these items also the extent of both availability and utilization were not at all satisfactory. The matter is not very much different in the case of periodicals (available only in 17.49 per cent schools) and newspapers (available only in 12.11 per cent schools).

From the above analysis, it is evident that most of the rural school libraries were ill-equipped. Therefore the extent of utilization was also not at all satisfactory.

Urban schools seemed to be better equipped with reference materials when compared to rural schools.

Table 4.9.3 shows the distribution of government schools on the basis of the extent of availability and utilization of reference materials in the library.

The classification of schools were done as mentioned before regarding the extent of availability and utilization. Of the 177 government schools, 67.80 per cent schools had encyclopaedia. But 46.33 per cent of schools had enough of the item. In the rest of the schools this item was either not enough or nil.

Regarding the extent of utilization of this item, about two-third of the schools came under the first and the second categories of 'Always' utilizing and 'Sometimes' utilizing.

Standard books in physics were available in 67.23 per cent of schools. Only about 42 per cent of schools had enough or more than enough of this item. Regarding the extent of utilization, 42.37 per cent came under the first category and 24.86 per cent under the second category.

Applied science books and advanced science books were available in 60.45 per cent and 59.32 per cent of government schools. About 30 per cent of schools had enough or more than enough of these items. The extent of utilization of these items were not up to the expected level

Table 4.9.3 **Details Regarding the Extent of Availability and Utilization of Reference Materials in Library (Government Schools)**

(Number and Percentage)

Sl. No.	Category	No.of schools having	Extent of availability			Total	Extent of utilization			Total
			More than enough & enough	Not enough	Nil		Always	Some-times	Never	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1	Encyclopaedia	120 (67.80)	82 (46.33)	38 (21.47)	57 (32.20)	177 (100)	82 (46.33)	38 (21.47)	57 (32.20)	177 (100)
2	Standard text books in physics	119 (67.23)	75 (42.37)	44 (24.86)	58 (32.77)	177 (100)	75 (42.37)	44 (24.86)	58 (32.77)	177 (100)
3	Applied science books	107 (60.45)	54 (30.51)	53 (29.94)	70 (39.55)	177 (100)	63 (35.59)	44 (24.86)	70 (39.55)	177 (100)
4	Advanced science books	105 (59.32)	49 (27.68)	56 (31.63)	72 (40.68)	177 (100)	58 (32.77)	47 (26.55)	72 (40.68)	177 (100)

(contd...)

Table 4.9.3 (Contd...)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
5	Text books for practicals	40 (22.60)	21 (11.86)	19 (10.73)	137 (77.40)	177 (100)	21 (11.86)	19 (10.73)	137 (77.40)	177 (100)
6	Books on preparation on aids	43 (24.29)	32 (18.08)	11 (6.21)	134 (75.71)	177 (100)	20 (11.30)	23 (12.99)	134 (75.71)	177 (100)
7	Science									
	(a) Malayalam journals	67 (37.85)	47 (26.55)	20 (11.30)	110 (62.15)	177 (100)	32 (18.08)	35 (19.77)	110 (62.15)	177 (100)
	(b) English journals	25 (14.12)	17 (9.60)	8 (4.52)	152 (85.88)	177 (100)	13 (7.34)	12 (6.78)	152 (85.88)	177 (100)
8	Periodicals	32 (18.08)	20 (11.30)	12 (6.78)	145 (81.92)	177 (100)	17 (9.60)	15 (8.48)	145 (81.92)	177 (100)
9	News Papers	25 (14.12)	15 (8.47)	10 (5.65)	152 (85.88)	177 (100)	10 (5.95)	15 (8.48)	152 (85.88)	177 (100)

Note: Column (3) refers to the sum of numbers and corresponding percentages in columns (4) and (5).

since 40 per cent of schools came under the third category of 'Never' utilizing.

Text books for practicals and books on preparation of aids were not available sufficiently in about 75 per cent of government schools. The extent of utilization of these items were seen to be far from satisfactory.

Science journals in Malayalam were available in 37.85 per cent schools while those in English were available only in 14.12 per cent schools. The extent of availability and utilization of items were also not found to be satisfactory.

Periodicals were available in only 18.08 per cent of government schools. About 11 per cent school had sufficient numbers of this item and in the rest of the schools this item was either insufficient or nil. The extent of utilization was also poor as only 9.60 per cent schools came under the first category of 'Always' utilizing.

Newspapers were available only in 14.12 per cent of schools which clearly shows the inadequacy and the cause of poor utilization of this item in the rest of the schools.

It can be concluded that many essential reference materials for physics education were not available in adequate numbers in many government schools. Even the available materials were not made use of properly and effectively. Although effective utilization of reference

Table 4.9.4 **Details Regarding the Extent of Availability and Utilization of Reference Materials in Library (Private Schools)**

(Number and Percentage)

Sl. No.	Category	No.of schools having	Extent of availability			Total	Extent of utilization			Total
			More than enough & enough	Not enough	Nil		Always	Some-times	Never	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1	Encyclopaedia	164 (77.73)	108 (51.87)	56 (26.54)	47 (22.57)	211 (100)	89 (42.18)	75 (35.55)	47 (22.27)	211 (100)
2	Standard text books in physics	146 (69.19)	88 (41.71)	58 (27.49)	65 (30.81)	211 (100)	92 (43.60)	54 (25.59)	65 (30.81)	211 (100)
3	Applied science books	140 (66.35)	83 (39.34)	57 (27.01)	71 (33.61)	211 (100)	83 (39.34)	55 (26.07)	71 (33.61)	211 (100)
4	Advanced science books	127 (60.19)	63 (29.86)	64 (30.33)	84 (39.81)	211 (100)	62 (29.38)	65 (30.80)	84 (39.81)	211 (100)

(contd...)

Table 4.9.4 (Contd...)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
5	Text books for practicals	54 (25.59)	31 (14.69)	23 (10.90)	157 (74.41)	211 (100)	23 (10.90)	31 (14.69)	157 (74.41)	211 (100)
6	Books on preparation on aids	62 (29.38)	49 (23.22)	13 (6.16)	149 (70.62)	211 (100)	25 (11.85)	37 (17.54)	149 (70.62)	211 (100)
7	Science									
	(a) Malayalam journals	107 (50.71)	66 (31.28)	41 (19.43)	104 (49.29)	211 (100)	57 (27.01)	50 (23.70)	104 (49.29)	211 (100)
	(b) English journals	43 (20.38)	31 (14.69)	12 (5.69)	168 (79.62)	211 (100)	22 (10.43)	21 (9.95)	168 (79.62)	211 (100)
8	Periodicals	56 (26.54)	29 (13.74)	27 (12.80)	155 (73.46)	211 (100)	23 (10.90)	33 (15.64)	155 (73.46)	211 (100)
9	News Papers	48 (22.75)	33 (15.64)	15 (7.11)	163 (77.25)	211 (100)	20 (9.48)	28 (13.27)	163 (77.25)	211 (100)

Note: Column (3) refers to the sum of numbers and corresponding percentages in columns (4) and (5).

materials is an important aspect of teaching, this is not found to be taking place in many of the government schools.

Table 4.9.4 presents the distribution of private schools on the basis of the extent of availability and utilization of reference materials in the library.

The classification of schools were done as mentioned before regarding the extent of availability and utilization.

Of the 211 private schools, 77.73 per cent of schools had encyclopaedia. But only above 50 per cent of schools had enough or more than enough of this item. Regarding the extent of utilization, only 42.18 per cent schools came under the first category of 'Always' utilizing and 35.58 per cent under the second category of 'Sometimes' utilizing.

Standard books in physics were available in about 70 per cent of private schools. But only about 40 per cent of schools possessed adequate number of this item. Regarding the extent of utilization, 43.60 per cent schools came under the first category of 'Always' utilizing and 25.59 per cent came under the second category of 'Sometimes' utilizing.

Applied science books were available in 66.35 per cent private schools. But only about 40 per cent schools had enough or more than enough of these. In the rest of the schools these were either nil or not enough. Regarding the extent of utilization of this item, 39.34 per cent came under the category of 'Always' utilizing.

About 60 per cent of schools possessed advance science books. Regarding the extent of availability only 29.86 per cent came under the first category of schools. In about 30 per cent schools, the extent of utilization was found to be the satisfactory as they came under the first category.

Text books for practicals and Books on preparation of aids were available in less than 30 per cent of schools. Due to non-availability of these items in school libraries, the extent of utilization also was far from satisfactory.

Science journals in Malayalam were available in 50.71 per cent of schools. About 30 per cent schools came under 'More than enough and enough' category. In the rest of the schools these were either nil or not enough. Regarding the extent of utilization, only 27.01 per cent came under the category of 'Always' utilizing.

Only 20.38 per cent of private schools possessed science journal in English. So the extent of both availability and utilization were not found to be satisfactory. The facts were not much different in the extent of availability and utilization of items such as periodicals and newspapers.

From the above analysis it is evident that the extent of availability and utilization of reference materials were not found satisfactory in many private schools. Items such as encyclopaedia, textbooks in physics, applied science books, advanced science books etc., were available in more than 60 per cent of private schools. In many schools adequate number of these items were not available. Reference materials such as textbooks for practicals, science journals, periodicals etc., were inadequate or nil in many schools.

In general private school libraries seemed slightly better equipped with reference materials than government school libraries. But this difference was not observed in the matter of the extent of utilization of materials.

Table 4.10 **Distribution of Schools According to the Level of Interest of Students in Reading Physics Books, Science Journals, etc.**

Interest	Urban	Rural	Government	Private	Total
Satisfactory	72 (43.64)	64 (28.70)	57 (32.20)	79 (37.44)	136 (35.05)
Not satisfactory	93 (56.36)	159 (71.30)	120 (67.80)	132 (62.56)	252 (64.95)
Total	165 (100)	223 (100)	177 (100)	211 (100)	388 (100)

Table 4.10 shows the distribution of schools according to the level of interest of students in reading science books, journals, periodicals etc. by area and management of schools.

Out of the 388 schools, students belonging to 136 schools (35.05 per cent) showed interest in reading science related materials which was satisfactory. But in the rest 64.95 per cent it was not satisfactory.

Urban school students showed a satisfactory level of interest (43.64 per cent) than their rural counterparts (28.70 per cent). Again it can be seen from the Table that private school students showed a more interest (37.44 per cent) than their counterparts in government schools.

It can be concluded that majority of students was not showing much interest in reading science books and materials especially rural school students. This may be because in many schools these items were inadequate or scarce in number and students were not trained to make use of the available materials effectively. It is the duty of science teachers to inculcate in students the habit of reading science related materials and thus to create an interest in science.

Table 4.11 shows the number and percentage of teachers (urban, rural, government and private) according to their opinion on the reasons for the 'not satisfactory' nature of students' reading habits.

Table 4.11 **Opinion of Teachers, on the Reasons for the 'Not Satisfactory' Nature of Reading Habits Regarding Science Materials Among Students**

(Numbers and Percentage)

No.	Reason	Urban	Rural	Govt.	Pvt.	Total
1	No.of books are not sufficient	52 (55.91)	97 (61.00)	66 (55.00)	83 (62.88)	149 (59.13)
2	There is no library period	29 (31.18)	43 (27.04)	40 (33.33)	32 (24.24)	72 (28.57)
3	The students are not interested	3 (3.23)	7 (4.40)	4 (3.33)	6 (4.55)	10 (3.97)
4	The students are not encouraged	9 (9.68)	12 (7.55)	10 (8.33)	11 (8.33)	21 (8.33)
5	There is no person in charge of library	-	-	-	-	-
	Total	93 (100)	159 (100)	120 (100)	132 (100)	252 (100)

From Table 4.10 it is seen that out of the 388 schools, in 252 schools (64.95 per cent) the students' interest in reading science related materials were not satisfactory. So the opinion of teachers belonging to these 252 schools were analysed.

Majority of teachers (59.13 per cent) pointed out the inadequacy of the number of books to be the main reason for the 'not satisfactory' nature of students' reading

Table 4.12 **Distribution of Teachers according to their Suggestions for the Better Functioning of Library**
(Number and Percentage)

Number	Item	Urban (165)*	Rural (223)*	Government (177)*	Private (211)*	Total (388)
1	Appoint a trained Librarian	115 (69.70)	171 (76.68)	124 (70.06)	162 (76.78)	286 (73.71)
2	Collect new books every year	46 (27.88)	58 (26.01)	51 (28.81)	53 (25.12)	104 (26.80)
3	Allot library periods in the Time-table	104 (63.03)	134 (60.09)	98 (55.37)	140 (66.35)	238 (61.34)
4	Give additional benefits to those in charge of library	29 (17.58)	43 (19.28)	35 (19.77)	37 (17.54)	72 (18.56)
5	Provide facilities for students to sit and read in the library	87 (52.73)	108 (48.43)	94 (53.10)	101 (47.87)	195 (50.26)

* - Total number of responses in each category.

habits. The lack of library period was pointed out by 28.57 per cent of teachers while 3.97 per cent put the blame on students for not showing any interest in reading. 8.33 per cent teachers admitted that students were not encouraged to read.

It can be concluded that without adequate number of library books and journals related to science, it is difficult to cultivate healthy reading habits in students.

Table 4.12 gives the number and percentage of teachers according to their suggestions for the better functioning of school libraries.

Item 1, 'Appoint a trained librarian' was recorded by 286 teachers (73.71 per cent). This was followed by item 3, 'Allot library periods in the Time-table.' (61.34 per cent). Item 5, 'Provide facilities for students to sit and read in the library' was recorded by about 50 per cent to teachers. Items '2' and '4' were recorded by 26.80 per cent and 18.56 per cent of teachers respectively. The sub-sample percentages are also provided in the Table. Item '1' was recorded by 76.68 per cent of rural school teachers while only 69.70 per cent of urban school teachers recorded it. This item was recorded by 76.78 per cent private school teachers while 70.06 per cent government school teachers recorded it.

Table 4.13 **Details regarding the Type of Laboratory**
(Number and Percentage)

Number	Item	Urban	Rural	Govern-ment	Private	Total
1	There is a separate laboratory for Physics in the School	46 (27.88)	43 (19.28)	39 (22.03)	50 (23.70)	89 (22.94)
2	The Laboratory is common for Physics and Chemistry	72 (43.64)	81 (36.32)	70 (39.55)	83 (39.34)	153 (39.43)
3	The laboratory is Common for all Science Subjects	47 (28.48)	99 (44.39)	68 (38.42)	78 (36.96)	146 (37.63)
4	There is no Laboratory in the School	-	-	-	-	-
	Total	165 (100)	223 (100)	177 (100)	211 (100)	388 (100)

The above discussion leads to the conclusion that 'Appointment of trained librarians' in school libraries can improve the working of libraries to a great extent. In majority of schools teachers are only discharging the duties of librarian and they may be finding this inconvenient.

4.1.3 Details Regarding Laboratory

Effective utilization of laboratory Equipments and materials is very important aspect concerning physics education at the secondary level. Laboratory is considered to be an excellent instructional mode.

Table 4.13 shows the type of laboratory available in the 388 Schools surveyed.

Out of the 388 schools, only 89 schools (22.94 per cent) had a separate laboratory for physics. In about 40 per cent schools the laboratory was common for physics and chemistry. In the rest of the schools the laboratory was common for all science subjects. It can be further seen from the Table that the percentage of urban schools having separate laboratory for physics was more than (27.88 per cent) that of rural schools (19.28 per cent). Not much difference between government and private schools was observed regarding the type of laboratory.

Table 4.14.1 **Number and Percentage of Schools where Experiments are Demonstrated and Not Demonstrated**
(Number and percentage)

Category	Urban	Rural	Government	Private	Total
Demonstrated	108 (61.71)	131 (58.74)	114 (64.41)	125 (59.24)	239 (61.60)
Not demonstrated	67 (38.29)	92 (41.26)	63 (35.59)	86 (40.75)	149 (38.40)
Total	165 (100)	223 (100)	177 (100)	211 (100)	388 (100)

Number and percentage of schools where experiments were demonstrated and not demonstrated is presented in Table 4.14.1. Experiments were demonstrated in 239 schools (61.60 per cent) while it was not done in 149 schools (38.40 per cent). Not much difference was noticed between the sub-samples.

Table 4.14.2 presents the details regarding the room where experiments were demonstrated.

Out of the 239 schools where experiments were demonstrated, only in 20.50 per cent of schools these were done in the laboratory. In about 65 per cent of Schools, experiments were demonstrated either in classroom or in laboratory. The use of laboratory for demonstration purposes

Table 4.14.2 **Details regarding the Room where Experiments are Demonstrated**

(Number and Percentage)

Room	Urban	Rural	Government	Private	Total
Laboratory	30 (27.78)	19 (14.50)	25 (21.93)	24 (19.20)	49 (20.50)
Classroom	8 (7.41)	26 (19.85)	16 (14.04)	18 (14.40)	34 (14.23)
Library	-	-	-	-	-
Laboratory as well as classroom according to situations	70 (64.81)	86 (65.65)	73 (64.04)	83 (66.40)	156 (65.27)
Total	108 (100)	131 (100)	114 (100)	125 (100)	239 (100)

was slightly better in urban schools than in rural schools. This difference was not seen much between government and private schools.

The details regarding the extent of availability and utilization of laboratory equipment are presented in Table 4.15.

The Standard IX syllabus of Kerala contains the following chapters:

(1) Nature of Light, (2) Colour of Light, (3) Magnetism,

Table 4.15 **Details Regarding the Extent of Availability and Utilization of Laboratory Equipment**

(Number & Percentage)

No.	Category	Extent of Availability			Extent of Utilization			
		More than enough and enough	Not enough	Total	Always	Sometimes	Never	Total
	For teaching topics in:							
1	Optics	99 (25.52)	289 (74.48)	388 (100)	75 (19.33)	132 (34.02)	181 (4.65)	388 (100)
2	Heat	110 (28.35)	278 (71.65)	388 (100)	64 (16.49)	137 (35.31)	187 (48.20)	388 (100)
3	Magnetism	73 (18.81)	315 (81.19)	388 (100)	53 (13.66)	104 (26.80)	231 (59.54)	388 (100)
4	Electricity	60 (15.46)	328 (84.54)	388 (100)	43 (11.08)	102 (26.29)	243 (62.63)	388 (100)
5	Sound	67 (17.27)	321 (82.73)	388 (100)	49 (12.63)	99 (25.52)	240 (61.86)	388 (100)
6	Mechanics	58 (14.95)	330 (85.05)	388 (100)	47 (12.11)	110 (28.35)	231 (59.54)	388 (100)
7	Electronics	30 (7.73)	358 (92.27)	388 (100)	32 (8.25)	90 (23.20)	266 (68.55)	388 (100)

(4) Electrostatics, (5) Effects of Electric Current, (6) Electromagnetic Induction, (7) Power-Production and Transmission, (8) Radio-activity, (9) Energy from the Nucleus and (10) Electronics.

The standard X syllabus of Kerala contains the following chapters:

(1) Lenses, (2) Bodies in Motion, (3) Laws of Motion, (4) Forces in Nature, (5) Work, Power and energy, (6) Uniform Circular Motion, (7) Temperature and Heat, (8) Sound and (9) Electricity.

For the purpose of analysis the equipments required to teach topics in optics, heat, magnetism, electricity, sound, mechanics and electronics were clubbed separately. The extent of availability and utilization of there equipments are presented in Table 4.15. It can be seen from the Table that in more than 80 per cent of the schools, the equipment to teach topics in magnetism, electricity, sound, mechanics and electronics was not enough. About 70 per cent of schools did not possess required equipment to teach topics in optics and heat. The extent of utilization of laboratory equipment was also not found to be satisfactory. The 'Always' utilizing category of schools were less than 20 per cent.

Table 4.15.1 **Details Regarding the Extent of Availability and Utilization of Laboratory Equipment in Urban Schools**
(Number and Percentage)

No.	Category	Extent of Availability: More than enough and enough	Not enough	Total	Extent of Utilization: Always	Sometimes	Never	Total
	For teaching topics in:							
1	Optics	75 (45.45)	90 (54.55)	165 (100)	62 (37.56)	75 (45.46)	28 (16.97)	165 (100)
2	Heat	79 (47.88)	86 (52.12)	165 (100)	55 (33.33)	73 (44.24)	37 (22.42)	165 (100)
3	Magnetism	56 (33.94)	109 (66.06)	165 (100)	40 (24.24)	62 (37.58)	63 (38.18)	165 (100)
4	Electricity	47 (28.48)	118 (71.52)	165 (100)	35 (21.21)	55 (33.33)	75 (45.45)	165 (100)
5	Sound	53 (32.12)	112 (67.88)	165 (100)	34 (20.61)	61 (36.97)	70 (42.42)	165 (100)
6	Mechanics	48 (29.09)	117 (70.91)	165 (100)	30 (18.18)	69 (41.82)	66 (40.00)	165 (100)
7	Electronics	26 (15.76)	139 (84.24)	165 (100)	25 (15.15)	54 (32.73)	86 (52.12)	165 (100)

Table 4.15.2 **Details Regarding the Extent of Availability and Utilization of Laboratory Equipment in Rural Schools**
(Number and Percentage)

No.	Category	Extent of Availability			Extent of Utilization			
		More than enough and enough	Not enough	Total	Always	Sometimes	Never	Total
	For teaching topics in:							
1	Optics	24 (10.76)	199 (89.24)	223 (100)	13 (5.83)	57 (25.56)	153 (68.61)	223 (100)
2	Heat	29 (13.00)	194 (87.00)	223 (100)	9 (4.04)	64 (28.70)	150 (67.26)	223 (100)
3	Magnetism	17 (7.62)	206 (92.38)	223 (100)	13 (5.83)	42 (18.83)	168 (75.34)	223 (100)
4	Electricity	13 (5.83)	210 (94.17)	223 (100)	8 (3.59)	47 (21.08)	168 (75.34)	223 (100)
5	Sound	14 (6.28)	209 (93.72)	223 (100)	15 (6.73)	38 (17.04)	170 (76.23)	223 (100)
6	Mechanics	10 (4.48)	213 (95.52)	223 (100)	17 (7.62)	41 (18.39)	165 (73.99)	223 (100)
7	Electronics	4 (1.79)	219 (98.21)	223 (100)	7 (3.14)	36 (16.14)	180 (80.72)	223 (100)

Table 4.15.3 **Details Regarding the Extent of Availability and Utilization of Laboratory Equipment in Government Schools**
(Number and Percentage)

No.	Category	Extent of Availability: More than enough and enough	Not enough	Total	Extent of Utilization: Always	Sometimes	Never	Total
	For teaching topics in:							
1	Optics	45 (25.42)	132 (74.57)	177 (100)	30 (16.95)	61 (34.46)	86 (48.59)	177 (100)
2	Heat	55 (31.07)	122 (68.93)	177 (100)	26 (14.69)	55 (31.07)	96 (54.24)	177 (100)
3	Magnetism	24 (13.56)	153 (86.44)	177 (100)	21 (11.86)	46 (25.99)	110 (62.15)	177 (100)
4	Electricity	24 (13.56)	153 (86.44)	177 (100)	21 (11.86)	39 (22.03)	117 (66.10)	177 (100)
5	Sound	26 (14.69)	151 (85.31)	177 (100)	24 (13.56)	48 (27.12)	105 (59.32)	177 (100)
6	Mechanics	25 (14.12)	152 (85.88)	177 (100)	19 (10.73)	51 (28.81)	107 (60.45)	177 (100)
7	Electronics	9 (5.08)	168 (94.92)	177 (100)	14 (7.91)	38 (21.47)	125 (70.62)	177 (100)

Table 4.15.4 **Details Regarding the Extent of Availability and Utilization of Laboratory Equipment in Private Schools**

(Number and Percentage)

No.	Category	Extent of Availability			Extent of Utilization			
		More than enough and enough	Not enough	Total	Always	Sometimes	Never	Total
	For teaching topics in:							
1	Optics	54 (25.59)	157 (74.41)	211 (100)	45 (21.33)	71 (33.65)	95 (45.02)	211 (100)
2	Heat	55 (26.07)	156 (73.93)	211 (100)	38 (18.01)	82 (38.86)	91 (43.13)	211 (100)
3	Magnetism	49 (23.22)	162 (76.78)	211 (100)	32 (15.17)	58 (27.49)	121 (57.35)	211 (100)
4	Electricity	36 (17.06)	175 (82.94)	211 (100)	22 (10.43)	63 (29.86)	126 (59.72)	211 (100)
5	Sound	41 (19.43)	170 (80.57)	211 (100)	25 (11.85)	51 (24.17)	135 (63.98)	211 (100)
6	Mechanics	33 (15.64)	178 (84.36)	211 (100)	28 (13.27)	59 (27.96)	124 (58.77)	211 (100)
7	Electronics	21 (9.95)	190 (98.05)	211 (100)	18 (8.53)	52 (24.64)	141 (66.82)	211 (100)

the non-availability of required equipment for teaching physics.

Details regarding the extent of availability and utilization of laboratory equipment in government and private schools are presented in Tables 4.12.3 and 4.12.4. Equipment required for teaching topics in heat and sound was found to be little more in government schools than in private schools. For teaching all other topics, private schools seemed to be slightly better equipped than government school. The extent of utilization of equipment was not found to be satisfactory. In general it is found that below 20 per cent schools only utilize the laboratory facilities to a satisfactory level.

It seemed reasonable to conclude that the extent of availability of equipment in laboratory in general is not satisfactory. The same holds true in the case of utilization also. Urban schools seemed to be better equipped than rural schools though not to a satisfactory level. Most of the schools still remain to be ill-equipped.

Teachers opinion regarding the reasons for inadequacy of equipment in the laboratory are presented in Table 4.16.

Out of the 388 teachers, 265 opined (68.30 per cent) that 'Lack of adequate funds' is the reason for the inadequacy of equipment. This was followed by 'Delay in

Table 4.16 **Opinion of Teachers regarding the Reasons for Inadequacy of Equipment in Laboratory**

No.	Reasons	Urban (165)*	Rural (223)*	Gover-nment (177)*	Private (211)*	Total (388)
1	Lack of adequate funds	124	141	109	156	265 (68.30)
2	Lack of Space for storing equipment	22	48	34	36	70 (18.04)
3	Delay in repairing defective equipment	88	86	70	104	174 (44.85)
4	Formalities in purchasing them	5	11	7	9	16 (4.12)

* - Total number of responses in each category.

Number in brackets show percentages

Table 4.17.1 **Details regarding the Condition of Laboratory Equipment**
(Number and Percentage)

Number	Item	Urban	Rural	Government	Private	Total
1	Most of the equipment are in working condition	108 (65.45)	86 (38.57)	88 (49.72)	106 (50.24)	194 (50.0)
2	A few of them are in working condition	52 (31.52)	134 (60.09)	86 (48.59)	100 (47.39)	186 (47.94)
3	Most of them are not in working condition	5 (3.03)	3 (1.35)	3 (1.69)	5 (2.37)	8 (2.06)
4	Not a single one is in working condition	-	-	-	-	-
	Total	165 (100)	223 (100)	177 (100)	211 (100)	388 (100)

Table 4.17.2 **Distribution of Teachers According to their Opinion regarding the Reasons for Laboratory Equipment to be in 'Not Working Condition'**

No.	Reason	Urban (165)*	Rural (223)*	Govern-ment (177)*	Private (211)*	Total (388)
1	Lack of adequate funds	74	121	68	127	195 (50.26)
2	Inferior quality of goods	65	87	62	90	152 (39.18)
3	Careless handling by students	40	24	31	33	64 (16.49)
4	Careless handling by teachers	-	-	-	-	-
5	Lack of proper maintenance	114	162	119	157	276 (71.13)

* - Total number of responses in each category.

Number in brackets show percentages

repairing defective equipment' (44.85 per cent). About 18 per cent of teachers pointed out 'Lack of space for storing equipment' to be one of the reasons.

It is quite evident from the above discussion that the major reason for the inadequacy of equipment in the laboratories is the lack of funds. Since laboratory is a very important resource for physics teaching, it should be well-equipped with all required and essential equipment.

Details regarding the working condition of equipment in the laboratory is presented in Table 4.17.1

In 50 per cent of the schools, most of the equipment were in working condition. In 47.94 per cent of schools only a few of the equipment were in working condition. It can be seen from the Table 4.17.1 that in about 65 per cent of the urban schools, most of the equipment were in good condition but in only 38.57 per cent of rural schools it was so. This difference was not seen between government and private schools.

Teachers' opinion regarding the reasons for the 'not working condition' of the laboratory equipment is presented in Table 4.17.2.

276 teachers (71.13 per cent) out of the 388 teachers opined that the 'Lack of proper maintenance' was the reason for the equipment to be in 'not working condition'. 'Lack of adequate funds' was pointed out to be

the next important reason (50.26 per cent). 'Inferior quality of goods' as a reason was pointed out by 39.18 per cent teachers.

It can be concluded that many of the laboratory equipment are not in working condition because of the lack of proper maintenance. The reason for this may be the lack of funds required for maintenance of laboratory equipments.

Table 4.18.1 **Opinion of Teachers regarding the Use of Laboratory by Students**

(Number and Percentage)

Item	Urban	Rural	Government	Private	Total
Quite often	11 (6.67)	8 (3.59)	5 (2.82)	14 (6.64)	19 (4.90)
Rarely	74 (44.85)	118 (52.91)	72 (40.68)	120 (56.87)	192 (49.48)
Not at all	80 (48.48)	97 (43.50)	100 (56.50)	77 (36.49)	177 (45.62)
	165 (100)	223 (100)	177 (100)	211 (100)	388 (100)

Table 4.18.1 gives the opinion of teachers regarding the use of laboratory by students for practical work.

Table 4.18.2 **Opinion of Teachers regarding the reasons for 'Not Using the Laboratory' by Students**

No.	Reason	Urban (165)*	Rural (223)*	Government (177)*	Private (271)*	Total (388)
1	Lack of equipment	110	188	142	156	298 (76.80)
2	Lack of space in laboratory for conducting experiments	54	73	45	82	127 (32.73)
3	Lack of individual experimentation facility	46	46	39	53	92 (23.71)
4	The Students are not encouraged to use the laboratory	6	9	4	11	15 (3.87)
5	The authorities do not permit the use of Laboratory for fear of mishandling	-	-	-	-	-
6	Teacher only domonstrates the experiments	142	199	152	189	341 (87.87)
7	Others	23	17	19	21	40 (10.31)

Others include, 1. Lack of time 2. Lack of Practical hours

* - Total number of responses in each category.
Number in brackets show percentages.

It is found that in about 50 per cent of schools, the laboratory was used rarely by students for practical work. In 45.62 per cent schools it was 'not at all' used by students for practical work. Only in 19 schools (4.90 per cent) the laboratory was used frequently by students.

The analysis of data suggests that in majority of schools, the laboratory is not properly utilized for physics teaching. This may be because there is no regular practical work in physics for standard IX and standard X in the schools of Kerala.

The opinion of teachers belonging to urban, rural, government and private schools regarding the reasons for students 'Not using the laboratory' is given in Table 4.18.2. In addition to the six reasons already provided, two other reasons were listed by the respondents. They are:-

1. Lack of time and 2. Lack of practical hours.

341 teachers (87.87 per cent) out of 388, pointed out that 'Teacher only demonstrates the experiments' as the main reason for students not using the laboratory. This was followed by 'Lack of equipments' which was recorded by 76.80 per cent of teachers. 'Lack of space in Laboratory for conducting experiments' was recorded by 32.73 per cent.

It is reasonable to conclude that the students are not using the laboratory because the experiments are demonstrated only by teachers. As there is no prescribed practical work for standard IX and standard X students, they are not encouraged to use the laboratory frequently.

Table 4.19 **Details regarding the Time Allotted to Physics Practicals in a week**
(Number and Percentage)

Time allotted	Urban	Rural	Government	Private	Total
One or more periods	18 (10.91)	6 (2.69)	10 (5.65)	14 (6.64)	24 (6.19)
Time without affecting the normal class work	-	-	-	-	-
Nil	147 (89.09)	217 (29.31)	167 (94.35)	197 (93.36)	364 (93.81)
Total	165 (100)	223 (100)	177 (100)	211 (100)	388 (100)

The time allotted to physics practicals in a week is given in Table 4.19. From the Table it can be seen that 93.81 per cent of schools did not allot any time for physics practicals. In 24 schools (6.19 per cent) one or more periods were allotted to practicals. This may be because of the fact that practicals in physics are not prescribed for secondary schools students in the State of Kerala.

Table 4.20 Details regarding the way in which Experiments are Conducted

(Number and Percentage)

No.	Item	Urban	Rural	Govern-ment	Private	Total
1	Individually by pupils	-	-	-	-	-
2	In Groups by pupils	32 (19.39)	31 (13.90)	21 (11.86)	42 (19.91)	63 (16.24)
3	By pupils with the help of teachers	14 (8.48)	6 (2.69)	12 (6.78)	8 (3.79)	20 (5.15)
4	By teachers themselves	119 (72.12)	186 (83.81)	144 (81.36)	161 (76.30)	305 (78.61)
	Total	165 (100)	223 (100)	177 (100)	211 (100)	388 (100)

The ways in which experiments were conducted is given in Table 4.20. In most of the schools (78.61 per cent) experiments were conducted by teachers themselves. In 16.24 per cent schools experiments were conducted in groups by pupils. In none of the schools experiments were conducted individually by pupils.

From the above analysis it is clear that in most of the schools teachers are only demonstrating the experiments and students are only 'viewers.'

Table 4.21 **Distribution of Schools according to the Availability of Attendant in Laboratory**

(Number and Percentage)

Availability	Urban	Rural	Govern-ment	Private	Total
Available	8 (4.85)	-	-	8 (3.79)	8 (2.06)
Not available	157 (95.15)	223 (100)	177 (100)	203 (96.21)	380 (97.94)
Total	165 (100)	223 (100)	177 (100)	211 (100)	388 (100)

Table 4.21 gives the distribution of schools according to the availability of attendants to assist teachers and students in the laboratory.

It is seen from the Table that in 97.94 per cent of the schools attendant was not available. Attendants were available only in 8 schools, all of them were urban and belonged to private management.

From the above dissuasion it is evident that the post of attendant is not available in majority of the high schools in Kerala.

Table 4.22 shows number and percentage of teachers according to their suggestions for the better functioning of laboratory.

Table 4.22 **Distribution of Teachers according to their Suggestions for the better Functioning of Laboratory**
(Number and Percentage)

No.	Item	Urban (165)*	Rural (223)*	Government (177)*	Private (211)*	Total (388)
1	Allocate more founds for laboratory	110 (60.67)	134 (60.09)	104 (58.76)	140 (66.35)	244 (62.89)
2	Repair equipments every year	84 (50.90)	112 (50.22)	80 (45.20)	116 (54.98)	196 (50.52)
3	Provide Sufficient space in laboratory	70 (42.42)	102 (45.74)	65 (36.72)	107 (50.71)	172 (44.33)
4	Provide more opportunity for practical work	105 (63.64)	153 (68.61)	112 (63.28)	146 (69.19)	258 (66.49)
5	Encourage students to use laboratory	77 (46.67)	78 (34.98)	71 (40.11)	84 (39.81)	155 (39.95)
6	Appoint a full-time attendant to assist students and teachers in laboratory	49 (29.70)	53 (23.77)	42 (23.73)	60 (28.44)	102 (26.29)

* Total number of responses in each category.

Of the 388 teachers responded, 165 were from urban and the rest 223 were from rural schools. 177 were from government school teachers and 211 were private school teachers.

Item 4, 'Provide more opportunity for practical work' was recorded by about 66 per cent of teachers. About 63 per cent of teachers recorded item 1, 'Allocate more funds for laboratory.' About half of the teachers recorded item 2, 'Repair equipments every year.' Item '6' was the least recorded one. The sub-sample percentages are also provided in the Table 4.22. For most of the items, the percentages of private school teachers were slightly more than that of government school teachers. Not much difference is seen between the percentages of urban and rural sub-samples.

The above discussion leads to the conclusion that more opportunity for practical work should be provided to students which will enable the laboratory to function in a better way. Allocation more funds for laboratory would also help in equipping the laboratory with required and essential equipments.

4.1.4 Details Regarding Teaching Aids

For the purpose of the study the teaching aids *required for physics education are classified as non-*

Table 4.23 **Distribution of Schools according to the Extent of Availability and Utilization of Teaching Aids**

(Number and Percentage)

Category	Extent of availability				Extent of utilization			
	Enough	Not Enough	Nil	Total	Always	Sometimes	Never	Total
Non-projected aids								
1. Graphs	-	-	388 (100)	388 (100)	-	-	388 (100)	388 (100)
2. Posters	-	-	388 (100)	388 (100)	-	-	388 (100)	388 (100)
3. Maps	-	25 (6.44)	363 (93.56)	388 (100)	-	20 (5.15)	368 (94.85)	388 (100)
4. Charts	-	18 (4.64)	370 (95.36)	388 (100)	-	15 (3.87)	373 (96.13)	388 (100)
5. Models	-	12 (3.09)	376 (96.91)	388 (100)	-	8 (2.06)	380 (97.94)	388 (100)
6. Display boards	-	21 (5.41)	367 (94.59)	388 (100)	-	13 (3.35)	375 (96.65)	388 (100)
Projected aids								
1. Slides	-	80 (20.62)	308 (79.38)	388 (100)	-	62 (15.98)	326 (84.02)	388 (100)
2. Slide projectors	42 (10.82)	22 (5.67)	324 (83.51)	388 (100)	15 (3.87)	43 (11.08)	330 (85.05)	388 (100)
3. Film Strip	-	94 (24.23)	294 (75.77)	388 (100)	-	90 (23.20)	298 (76.80)	388 (100)
4. Film Strip	19 (4.90)	18 (4.64)	351 (90.46)	388 (100)	-	30 (7.73)	358 (92.37)	388 (100)
5. Filmstrip Projector	-	24 (6.19)	364 (93.81)	388 (100)	-	24 (6.19)	364 (93.81)	388 (100)

(contd...)

Table 4.23 (Contd...)

Category	Extent of availability				Extent of utilization			
	Enough	Not Enough	Nil	Total	Always	Sometimes	Never	Total
6. Sound films	32 (8.25)	12 (3.09)	344 (88.66)	388 (100)	-	36 (9.28)	352 (90.72)	388 (100)
7. Sound film projector	-	107 (27.58)	281 (72.42)	388 (100)	18 (4.64)	78 (20.10)	292 (75.26)	388 (100)
8. Microscope Slides	62 (15.98)	56 (14.43)	270 (69.59)	388 (100)	21 (5.41)	83 (21.39)	284 (73.20)	388 (100)
9. Microscope	-	41 (10.57)	347 (89.43)	388 (100)	-	32 (8.25)	356 (91.75)	388 (100)
10. Motion Picture sound film	27 (6.96)	5 (1.29)	356 (91.75)	388 (100)	-	31 (7.99)	357 (92.01)	388 (100)
11. Motion picture sound film	34 (8.76)	40 (10.30)	314 (80.93)	388 (100)	-	62 (15.98)	326 (84.02)	388 (100)
12. Epidia Scope	10 (2.58)	56 (14.43)	322 (82.99)	388 (100)	-	51 (13.14)	337 (86.86)	388 (100)
Aural aids								
1. Radio	252 (64.95)	86 (22.16)	50 (12.89)	388 (100)	115 (29.64)	221 (56.96)	52 (13.40)	388 (100)
2. Tape Recorder	75 (19.33)	108 (27.84)	205 (52.84)	388 (100)	72 (18.56)	88 (22.68)	228 (58.76)	388 (100)
3. Television	69 (17.78)	42 (10.82)	277 (71.39)	388 (100)	56 (14.43)	55 (14.18)	277 (71.39)	388 (100)
4. C.C.T.V.	-	-	388 (100)	388 (100)	-	-	388 (100)	388 (100)
5. VCR	34 (8.76)	25 (6.44)	329 (84.79)	388 (100)	-	59 (15.21)	329 (84.79)	388 (100)
Computer	48 (12.37)	23 (5.93)	317 (81.70)	388 (100)	49 (12.63)	22 (5.67)	317 (81.70)	388 (100)

projected aids, projected aids, aural aids and computer. Details regarding the extent of availability and utilization of each aid are presented in Table 4.23.

According to the extent of availability the schools were classified into three categories namely 'More than enough and enough'. 'Not enough and 'Nil.' According to the extent of utilization also the schools were classified into three categories namely 'Always' 'Sometimes' and 'Never' utilizing.

From the Table 4.23 one can see that non-projected aids like graphs and posters were not available in any of the 388 schools surveyed. Other non-projected aids like maps, charts, models and display boards were not available in more than 90 per cent of schools. The extent of utilization was not at all satisfactory because of the non-availability of these items.

Of the 12 projected aids listed, microscope slides were available in required numbers only in 62 schools. Slide projectors were available in required numbers in 42 schools. Regarding other projected aids, they were either not enough or nil.

Regarding the extent of utilization of these aids, schools coming under 'Always' utilizing category were very few. Majority of schools came under the category of 'Never' utilizing. Few schools came under the category of 'Sometimes' utilizing.

Of the aural aids, radio was the most available aid and this item was enough in 252 schools (64.95 per cent). The next available item was tape recorder which was found enough in 19.33 per cent schools. But 52.84 per cent schools came under the category of 'Nil.' Television was not available in 71.39 per cent schools but they were found enough in 17.78 per cent schools. Closed circuit Television (C.C.T.V.) was not available in any of the 388 schools. 34 schools had enough of Video Cassette Recorders (VCR) while 329 schools did not possess VCR at all.

Computer was not available in 317 schools (81.70 per cent). This item was found enough in 12.37 per cent schools. In the rest of the schools this item was found not enough.

Regarding utilization of radio, 115 schools came under, 'Always' utilizing category and 221 schools came under the second category of 'Sometimes' utilizing. 52 schools have under the third category. Regarding the utilization of television 72 came under first category, 88 under second and 228 came under the third category.

Television and VCR were found never utilized in 277 and 329 schools respectively. 317 schools came under the third category of 'Never' utilizing regarding the use of

Table 4.23.1 Distribution of Schools according to the Extent of Availability and Utilization of Teaching Aids in Urban Schools

(Number and Percentage)

Category	Extent of availability				Extent of utilization			
	Enough	Not Enough	Nil	Total	Always	Sometimes	Never	Total
Non projected aids								
1. Graphs	-	20 (12.12)	145 (87.88)	165 (100)	-	15 (9.09)	150 (90.91)	165 (100)
2. Charts	-	15 (9.09)	150 (90.91)	165 (100)	-	13 (7.88)	152 (92.12)	165
3. Models	-	10 (6.06)	155 (93.94)	165 (100)	-	6 (3.64)	159 (96.36)	165 (100)
4. Display boards	-	14 (8.48)	151 (91.52)	165 (100)	-	8 (4.85)	157 (95.15)	165 (100)
Projected aids								
1. Slides	-	54 (3.09)	111 (96.91)	165 (100)	-	41 (24.85)	124 (75.15)	165 (100)
2. Slide Projector	33 (20.00)	17 (10.30)	115 (69.70)	165 (100)	14 (8.48)	31 (18.79)	120 (72.73)	165 (100)
3. Film Strips	-	61 (36.97)	104 (63.03)	165 (100)	-	60 (36.36)	105 (63.64)	165 (100)
4. Film Strips	15 (10.82)	12 (5.67)	138 (83.51)	165 (100)	-	22 (13.33)	143 (86.67)	165 (100)
5. Sound film	-	17 (10.30)	148 (89.70)	165 (100)	-	17 (10.30)	148 (89.10)	165 (100)
6. Film Projector	25 (15.15)	6 (3.64)	134 (81.21)	165 (100)	-	26 (15.76)	139 (84.24)	165 (100)

(contd...)

Table 4.23.1 (Contd...)

Category	Extent of availability				Extent of utilization			
	Enough	Not Enough	Nil	Total	Always	Sometimes	Never	Total
7. Microscope Slides	-	82 (49.70)	83 (50.30)	165 (100)	13 (7.88)	60 (36.36)	92 (55.76)	165 (100)
8. Microscope	41 (24.85)	36 (21.82)	88 (53.33)	165 (100)	14 (8.48)	52 (31.52)	99 (60.00)	165 (100)
9. Motion picture sound films	-	32 (19.39)	133 (80.61)	165 (100)	-	28 (16.97)	137 (83.03)	165 (100)
10. Motion picture projector	20 (12.12)	4 (2.42)	141 (85.45)	165 (100)	-	26 (15.76)	139 (84.24)	165 (100)
11. Over head projector	24 (14.55)	29 (17.58)	112 (67.88)	165 (100)	-	46 (27.88)	119 (72.12)	165 (100)
12. Epidia Scope	8 (4.85)	34 (20.61)	123 (74.55)	165 (100)	-	31 (18.79)	134 (81.21)	165 (100)
Aural aids								
1. Radio	141 (85.45)	18 (10.91)	6 (3.64)	165 (100)	57 (34.55)	100 (60.61)	8 (4.85)	165 (100)
2. Tape Recorder	48 (29.09)	83 (50.30)	34 (20.61)	165 (100)	41 (24.85)	68 (41.21)	56 (33.94)	165 (100)
3. Television	42 (25.45)	32 (19.39)	91 (55.16)	165 (100)	30 (18.18)	45 (27.27)	90 (54.55)	165 (100)
4. VCR	24 (14.55)	18 (10.91)	123 (74.55)	165 (100)	-	42 (25.45)	123 (74.55)	165 (100)
Computer	37 (22.42)	15 (9.09)	113 (68.48)	165 (100)	40 (24.24)	12 (7.27)	113 (68.48)	165 (100)

Table 4.23.2 **Distribution of Schools according to the Extent of Availability and Utilization of Teaching Aids in Rural Schools**
(Number and Percentage)

Category	Extent of availability				Extent of utilization			
	Enough	Not Enough	Nil	Total	Always	Sometimes	Never	Total
Non projected aids								
1. Maps	-	5 (2.24)	218 (97.76)	223 (100)	-	5 (2.24)	218 (97.76)	223 (100)
2. Charts	-	3 (1.35)	220 (98.65)	223 (100)	-	2 (0.90)	221 (99.10)	223 (100)
3. Models	-	2 (0.90)	221 (99.10)	223 (100)	-	2 (0.90)	221 (99.10)	223 (100)
4. Display boards	-	7 (3.13)	216 (96.86)	223 (100)	-	5 (2.24)	218 (97.76)	223 (100)
Projected aids								
1. Slides	-	26 (11.66)	197 (88.34)	223 (100)	-	21 (9.42)	202 (90.58)	223 (100)
2. Slide projector	9 (4.04)	5 (2.24)	209 (93.72)	223 (100)	1 (0.45)	12 (5.38)	210 (94.17)	223 (100)
3. Film Strip	-	33 (14.80)	190 (85.20)	223 (100)	-	30 (13.45)	193 (86.55)	223 (100)
4. Film Strip projectors	4 (1.79)	6 (2.69)	213 (95.52)	223 (100)	-	8 (3.59)	215 (96.41)	223 (100)
5. Sound film	-	7 (3.13)	216 (96.86)	223 (100)	-	7 (3.13)	216 (96.86)	223 (100)
6. Film Projector	7 (3.13)	6 (2.69)	210 (94.17)	223 (100)	-	10 (4.48)	213 (95.52)	223 (100)

(cont...)

Table 4.23.2 (Contd...)

Category	Extent of availability				Extent of utilization			
	Enough	Not Enough	Nil	Total	Always	Sometimes	Never	Total
7. Microscope slides	-	25 (11.21)	198 (88.79)	223 (100)	5 (2.24)	18 (8.07)	200 (89.69)	223 (100)
8. Microscope	21 (9.42)	20 (8.97)	182 (81.61)	223 (100)	7 (3.14)	31 (13.90)	185 (82.96)	223 (100)
9. Motion picture sound films	-	9 (4.04)	214 (95.96)	223 (100)	-	4 (1.79)	219 (98.21)	223 (100)
10. Motion picture	7 (3.14)	1 (0.45)	215 (96.41)	223 (100)	-	5 (2.24)	218 (97.76)	223 (100)
11. Overhead projector	10 (4.48)	11 (4.93)	202 (90.58)	223 (100)	-	16 (7.17)	207 (92.83)	223 (100)
12. Epidia Scope	2 (0.90)	22 (9.87)	199 (89.24)	223 (100)	-	20 (8.97)	203 (91.03)	223 (100)
Aural aids								
1. Radio	111 (49.78)	68 (30.49)	44 (19.73)	223 (100)	58 (26.00)	121 (54.26)	44 (19.73)	223 (100)
2. Tape Recorder	27 (12.11)	25 (11.21)	171 (76.68)	223 (100)	31 (13.90)	20 (8.97)	172 (77.13)	223 (100)
3. Television	27 (12.11)	10 (4.48)	186 (83.41)	223 (100)	26 (11.66)	10 (4.48)	187 (83.86)	223 (100)
4. C.C.T.V.	10 (4.48)	7 (3.13)	206 (93.38)	223 (100)	-	17 (7.62)	206 (92.38)	223 (100)
Computer	11 (4.93)	8 (3.59)	204 (91.48)	223 (100)	9 (4.04)	10 (4.48)	204 (91.48)	223 (100)

computer. This may be mainly because of the non-availability of these items.

In general the availability and utilization of teaching aids for physics teaching are not satisfactory. Even the available aids are not found fully utilized.

Details regarding the availability and utilization of teaching aids in urban and rural schools are presented separately in Tables 4.23.1 and 4.23.2.

Non projected aids like graphs and posters were not available in urban and rural schools. Other non-projected aids like maps, charts, models and displays boards were also not available in majority of the urban and rural schools. about 10 per cent of the schools that come under the 'Not enough' category were mostly urban schools.

Regarding projected aids, a few schools come under the 'Enough' category of which most of them were urban schools. Of the category of schools that come under the category of 'Not enough', the percentage of urban schools was more than that of rural schools. Again from Tables 4.23.1 and 4.23.2 it can be seen that the extent of utilization of these items were not satisfactory. Comparing the percentages of schools coming under the category of 'Sometimes' utilizing, one can see that the percentages of urban schools were more than that of rural schools.

Of the aural aids, radio was possessed by a good percentage of schools. 85.45 percent of urban schools came under the category of 'Enough' while only 49.78 per cent of rural schools came under this category. In the case of other aural aids also, the number of urban schools came under this category were more than that of rural schools. Regarding the extent of utilization of these aids, some schools came under the first category of 'Always' utilizing comparing the values in Tables 4.23.1 and 4.23.2, it can be seen that the percentages of urban schools were more than the percentages of rural schools. Radio was found utilized 'Sometimes' in more than 50 per cent of urban and rural schools.

Regarding the availability of computers, 22.42 per cent of urban schools came under the first category of ''Enough' while only 4.93 per cent of rural schools came under this category. Comparing the extent of utilization in urban and rural schools, the former type of schools seemed to use this more often than the latter-type.

The analysis of data suggests that although teaching aids are not available to a required extent in schools, the availability of aids are more in urban schools them in rural schools. Regarding the extent of utilization also, the urban schools seem to utilize these more frequently them rural schools. This may be due to the non-availability of many essential teaching aids in rural schools.

Table 4.23.3 Distribution of Schools according to the Extent of Availability and Utilization of Teaching Aids in Government Schools

(Number and Percentage)

Category	Extent of availability				Extent of utilization			
	Enough	Not Enough	Nil	Total	Always	Sometimes	Never	Total
Non projected aids								
1. Maps	-	11 (6.21)	166 (93.79)	177 (100)	-	8 (4.52)	169 (95.48)	177 (100)
2. Charts	-	6 (3.39)	171 (96.61)	177 (100)	-	5 (2.82)	172 (97.18)	177 (100)
3. Models	-	6 (3.39)	171 (96.61)	177 (100)	-	4 (2.26)	173 (97.74)	177 (100)
4. Display boards	-	7 (3.95)	170 (96.05)	177 (100)	-	5 (2.82)	172 (97.18)	177 (100)
Projected aids								
1. Slides	-	32 (18.08)	145 (81.92)	177 (100)	-	24 (13.56)	153 (86.44)	177 (100)
2. Slide projector	15 (8.47)	8 (4.52)	154 (87.01)	177 (100)	5 (2.82)	14 (7.91)	158 (89.27)	177 (100)
3. Film Strip	-	41 (23.16)	136 (76.84)	177 (100)	-	39 (22.03)	138 (77.97)	177 (100)
4. Film Strip projectors	10 (5.65)	9 (5.08)	158 (89.27)	177 (100)	-	13 (7.34)	164 (92.66)	177 (100)
5. Sound film	-	10 (5.65)	167 (94.35)	177 (100)	-	10 (5.65)	167 (94.35)	177 (100)

(contd...)

Table 4.23.3 (Contd...)

Category	Extent of availability				Extent of utilization			
	Enough	Not Enough	Nil	Total	Always	Sometimes	Never	Total
6. Film Projector	13 (7.34)	6 (3.39)	158 (89.27)	177 (100)	-	14 (7.91)	163 (92.09)	177 (100)
7. Microscope slides	-	45 (25.43)	132 (74.58)	177 (100)	7 (3.95)	33 (18.64)	137 (77.40)	177 (100)
8. Microscope	32 (18.08)	25 (14.12)	120 (67.80)	177 (100)	9 (5.08)	44 (24.86)	124 (70.06)	177 (100)
9. Motion picture sound films	-	19 (10.73)	158 (89.27)	177 (100)	-	14 (7.91)	163 (92.09)	177 (100)
10. Motion picture	13 (7.34)	3 (1.69)	161 (90.96)	177 (100)	-	15 (8.47)	162 (91.53)	177 (100)
11. Overhead projector	14 (7.91)	20 (11.30)	143 (80.79)	177 (100)	-	24 (13.56)	153 (86.44)	177 (100)
12. Epidia Scope	3 (1.69)	20 (11.30)	154 (87.01)	177 (100)	-	17 (9.60)	160 (90.40)	177 (100)
Aural aids								
1. Radio	109 (61.58)	34 (19.21)	34 (19.21)	177 (100)	55 (31.03)	106 (59.89)	16 (9.04)	177 (100)
2. Tape Recorder	33 (18.64)	52 (29.38)	92 (51.98)	177 (100)	23 (12.99)	47 (26.55)	107 (80.45)	177 (100)
3. Television	28 (15.82)	23 (12.99)	126 (71.19)	177 (100)	24 (13.56)	27 (15.25)	126 (71.19)	177 (100)
4. V.C.R.	13 (7.34)	11 (6.21)	153 (86.44)	177 (100)	-	24 (13.56)	153 (86.44)	177 (100)
Computer	21 (11.86)	13 (7.34)	143 (80.79)	177 (100)	20 (11.30)	14 (7.91)	143 (80.79)	177 (100)

Table 4.23.4 Distribution of Schools according to the Extent of Availability and Utilization of Teaching Aids in Private Schools
(Number and Percentage)

Category	Extent of availability				Extent of utilization			
	Enough	Not Enough	Nil	Total	Always	Sometimes	Never	Total
Non projected aids								
1. Maps	-	14 (6.64)	197 (93.36)	211 (100)	-	12 (5.69)	199 (94.31)	211 (100)
2. Charts	-	12 (5.69)	199 (94.31)	211 (100)	-	10 (4.74)	201 (95.26)	211 (100)
3. Models	-	7 (3.32)	204 (96.68)	211 (100)	-	4 (1.90)	207 (98.10)	211 (100)
4. Display boards	-	14 (6.64)	197 (93.36)	211 (100)	-	8 (3.79)	203 (96.21)	211 (100)
Projected aids								
1. Slides	-	48 (22.75)	163 (77.25)	211 (100)	-	38 (18.01)	173 (81.99)	211 (100)
2. Slide projector	27 (12.80)	14 (6.64)	170 (80.57)	211 (100)	10 (4.74)	29 (13.74)	172 (81.52)	211 (100)
3. Film Strip	-	53 (25.12)	158 (74.88)	211 (100)	-	51 (24.17)	160 (75.83)	211 (100)
4. Film Strip projectors	9 (4.27)	9 (4.27)	193 (91.47)	211 (100)	-	17 (8.06)	194 (91.94)	211 (100)
5. Sound film	-	14 (6.64)	197 (93.36)	211 (100)	-	14 (6.64)	197 (93.36)	211 (100)
6. Film Projector	19 (9.00)	6 (2.84)	186 (88.15)	211 (100)	-	22 (10.43)	189 (89.57)	211 (100)

(contd...)

Table 4.23.4 (Contd...)

Category	Extent of availability				Extent of utilization			
	Enough	Not Enough	Nil	Total	Always	Sometimes	Never	Total
7. Microscope slides	-	62 (29.38)	149 (70.62)	211 (100)	11 (5.21)	45 (21.33)	155 (73.46)	211 (100)
8. Microscope	30 (14.22)	31 (14.69)	150 (71.09)	211 (100)	12 (5.69)	39 (18.48)	160 (75.83)	211 (100)
9. Motion picture sound films	-	22 (10.43)	189 (89.57)	211 (100)	-	18 (8.53)	193 (91.47)	211 (100)
10. Motion picture	14 (6.64)	2 (0.95)	195 (92.42)	211 (100)	-	16 (7.58)	195 (92.42)	211 (100)
11. Overhead projector	20 (9.48)	20 (9.48)	171 (81.04)	211 (100)	-	38 (18.01)	173 (81.99)	211 (100)
12. Epidia Scope	7 (3.32)	36 (17.06)	168 (79.62)	211 (100)	-	34 (16.11)	177 (83.39)	211 (100)
Aural aids								
1. Radio	143 (67.77)	52 (24.64)	16 (7.58)	211 (100)	60 (28.44)	115 (54.50)	36 (17.06)	211 (100)
2. Tape Recorder	42 (19.90)	56 (26.54)	113 (53.55)	211 (100)	49 (23.22)	41 (19.43)	121 (57.35)	211 (100)
3. Television	41 (19.43)	19 (9.00)	151 (71.56)	211 (100)	32 (15.17)	28 (13.27)	151 (71.56)	211 (100)
4. V.C.R.	21 (9.95)	14 (6.64)	176 (83.41)	211 (100)	-	35 (16.59)	176 (83.41)	211 (100)
Computer	27 (12.80)	10 (4.74)	174 (82.46)	211 (100)	29 (13.74)	8 (3.79)	174 (82.46)	211 (100)

Details regarding the extent of availability and utilization of teaching aids in government and private are given in Tables 4.23.3 and 4.23.4.

Regarding the availability of non-projected aids, none of the government or private schools came under the 'Enough' category schools. In the 'Not enough' category schools, the percentages of private schools, were slightly more than that of government schools for item like charts and display boards. Because of the scarcity of items the extent of utilization was found unsatisfactory.

Regarding the availability of projected aids the percentages of private schools, that came under the category of 'Enough' were a little more than that of government schools. Slides, slide projector, microscope, microscope slides, epidia scope and overhead projector were found available in about 20 per cent of private schools although not sufficient in numbers. But the percentages of government schools possessing these items were little less then private schools except microscope. The extent of utilization of these items was not found satisfactory because more than 80 per cent schools came under the category of 'Never' utilizing.

Comparing the availability of aural aids in private and government schools, the percentages of private schools that came under the 'Enough' category were found more than that of government schools. Radio was not available in 7.58 per cent of private schools white 19.21 per cent of government school did not possess this item. Nearly half of the urban and rural school did not possess tape recorders. Regarding other items there was not much difference between there was not much difference between these two types of schools. The difference in the availability and utilization of computers was also negligible between these two types of schools.

In general there is not much difference in the extent of availability and utilization of teaching aids between government and private schools. The availability of certain projected aids, and radio were found more in private schools and this holds true regarding the extent of utilization also.

4.1.5 Co-curricular activities

Number and percentage of schools where project works in physics are taken up and not taken up are presented in Table 4.24.1.

From the Table it can be seen that project works in physics were taken up only in 14.69 per cent of school while these were not taken up in 85.31 per cent schools. Sub-sample percentages are also presented in the Table which shows that project works were taken up in 26.06 per cent

Table 4.24.1 **Number and Percentage of Schools where Project Works in Physics are 'taken up' and 'not taken up'**

(Number and Percentage)

Item	Urban	Rural	Govern- ment	Private	Total
Project work taken up	43 (26.06)	14 (6.28)	21 (11.86)	36 (17.06)	57 (14.69)
Project work not taken up	122 (73.94)	209 (93.72)	156 (88.14)	175 (82.94)	331 (85.31)
Total	165 (100)	223 (100)	177 (100)	211 (100)	388 (100)

urban schools while these were taken up only 6.28 per cent in rural schools. The percentage of private schools taking up projects was slightly more than that of government schools.

The analysis of data suggests that projects works in physics are not taken up in majority of schools.

Teachers opinion regarding the reasons for 'not taking up' project works in physics are presented in Table 4.24.2.

Table 4.24.2 **Opinion of Teachers regarding the Reasons for 'Not taking up' project works**

(Number and Percentage)

No.	Item	Urban (122)*	Rural (209)*	Government (156)*	Private (175)*	Total (331)
1	Lack of necessary facilities for project work	84 (68.85)	175 (83.73)	101 (64.74)	158 (90.29)	259 (78.25)
2	Lack of theoretical and technical knowledge about the project work on the part of teachers	-	-	-	-	-
3	Lack of financial assistance	62 (50.82)	140 (66.99)	85 (54.49)	117 (66.86)	202 (61.03)
4	Lack of co-operation from students	49 (40.16)	61 (29.19)	46 (29.49)	64 (36.57)	110 (33.23)
5	Lack of encouragement from parents	28 (22.95)	44 (21.05)	32 (20.51)	40 (22.86)	72 (21.75)

* Total number of responses in each category.

From Table 4.24.1 it can be seen that in 331 schools project works in physics were not taken up. This consisted of 122 urban and 209 rural schools. 156 were government and the rest 175 were private schools. The opinion of teachers from these 331 schools are presented in

Table 4.24.2. Of these 331 teachers, 259 (78.25 per cent) were of the opinion that 'Lack of necessary facilities' was the reason for not taking up project works. 61.03 per cent of teachers pointed out 'Lack of financial assistance' to be the reason. 'Lack of co-operation from students' was pointed out as a reason by 33.23 per cent of teachers. it should be noted that 'Lack of theoretical and technical knowledge about project work or the part of teachers' was not pointed by any one of the teachers. The sub-sample percentages are also provided in Table 4.24.2 which shows some differences in opinion regarding item 1, 'Lack of necessary facilities' which was found recorded by more urban school teachers than rural teachers and also by more private school teachers than government school teachers.

Table 4.25.1 **Number and Percentage of Schools where Science clubs are Functioning and Not Functioning**

(Number and Percentage)

Item	Urban	Rural	Government	Private	Total
Functioning	124 (75.15)	136 (60.99)	112 (63.28)	148 (70.14)	260 (67.01)
Not functioning	41 (24.85)	87 (39.01)	65 (36.72)	63 (29.86)	128 (32.99)
Total	165 (100)	223 (100)	177 (100)	211 (100)	388 (100)

Table 4.25.1 gives the number and percentage of schools where science clubs are functioning and not functioning.

Of the 388 school selected for the study, in 260 schools (67.01 per cent) science clubs were functioning and in 128 schools (32.99 per cent) club were not functioning. Regarding sub samples, science clubs were functioning in about 75 per cent urban schools while in the case of rural schools it was about 60 per cent only. The percentage of private schools where clubs were functioning was found to be more (70.14 per cent) than that of government schools (3.28 per cent).

From the above analysis it is evident that science clubs are not functioning in more than one fourth of schools selected for the study.

Opinion of teachers regarding the reasons for science clubs 'not functioning' in schools are presented in Table 4.25.2

In addition to the reasons already listed, two more reasons were identified. They are 'Lack of space' and 'Lack of finance.' The opinion of teachers from 128 schools where science clubs were not functioning were analysed and presented in Table 4.25.2. Out of 128 schools, 41 were urban and 87 were rural; 65 were government schools and 63 were private schools (Table 4.25.1). Item 1, 'Lack of

Table 4.25.2 **Opinion of Teachers regarding the Reasons for Science Clubs 'Not Functioning' in Schools**

(Number and Percentage)

No.	Item	Urban (41)*	Rural (87)*	Government (65)*	Private (63)*	Total (128)
1	Lack of initiative on the part of teachers	10 (24.39)	21 (24.14)	15 (23.08)	16 (25.40)	31 (24.22)
2	Lack of enthusiasm on the part of students	10 (24.39)	18 (20.69)	12 (18.49)	16 (25.40)	28 (21.88)
3	Lack of interest of parents	7 (17.07)	8 (9.20)	8 (12.31)	7 (11.11)	15 (11.72)
4	Lack of encouragement form administrators	23 (56.10)	58 (66.67)	39 (60.00)	42 (66.67)	81 (63.28)
5	Others	10 (24.39)	19 (21.84)	12 (18.46)	17 (26.98)	29 (22.66)

Others include 1. Lack of space 2. Lack of finance

* Total number of responses in each category.

encouragement from administrators' as a reason was recorded by 63.28 per cent of teachers which was followed by item 4, 'Lack of initiative on the part of teachers.' Therefore the main reason for science club 'Not functioning' in many schools can be attributed to the lack of encouragement from administrators.

The activities of science clubs are presented in

Table 4.26. The analysis was done for the 260 schools where science clubs were found functioning. The 260 schools were constituted of 124 urban and 136 rural schools; 112 government and 148 private schools. The sub-sample percentages are also presented in the Table.

Table 4.26 **Distribution of schools according to the Activities of Science Club where it is Functioning**

(Number and Percentage)

No.	Activities	Urban (124)*	Rural (136)*	Government (112)*	Private (148)*	Total (260)
1	Field trips	32 (25.81)	26 (19.12)	22 (19.64)	36 (24.32)	58 (22.31)
2	Exhibitions	112 (90.32)	73 (53.68)	76 (67.86)	109 (73.65)	185 (71.15)
3	Project works	43 (34.68)	14 (10.29)	21 (18.75)	36 (24.32)	57 (21.92)
4	Visits	29 (23.39)	25 (18.38)	22 (19.64)	32 (21.62)	54 (20.77)
5	Improvisation of equipments	86 (69.35)	85 (62.50)	71 (63.39)	100 (67.57)	171 (65.77)
6	Drawing charts, models, maps etc.	64 (51.61)	51 (37.50)	56 (50.00)	59 (39.86)	115 (44.23)

* Total number in each category.

The various activities of the science clubs listed were field trips, exhibitions, project works, visits, improvisation of equipment, and drawing chart, maps, etc. 71.15 per cent of the schools conducted exhibitions as part of the activities of school science club. The next important activity of science club was found to improvisation of equipment (65.77 per cent). Drawing charts, maps, etc. were undertaken in 44.23 per cent schools. The rest of the activities were undertaken only in about 20 per cent schools. From the sub-sample percentage given in the Table it is found that urban schools science clubs seemed to be more active them rural school science clubs.

The analysis of data regarding science club activities suggests that exhibitions and improvisation of equipments are the major activities of school science clubs.

4.1.6 Details Regarding Environmental Resources

Environmental resources play a vital role in physics education at the secondary stage. Therefore their availability, utilization and various uses are studied.

(a) Engineering factories

Table 4.27 gives the number and percentage of physical science teachers on the basis of their opinion on the uses of engineering factories as an environmental resource for physics education in the secondary schools of Kerala according to area and management of schools.

Table 4.27 **Opinion of Teachers on the uses of Enginering Factories as an Environmental Resource for Physics Education**

(Number and Percentage)

Use	Urban RU	Urban NRU	Urban Total	Rural RU	Rural NRU	Rural Total	Government RU	Government NRU	Government Total	Private RU	Private NRU	Private Total	RU total	NRU total	Grand total
1. Observes methods and techniques of fabrication	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
2. Learns to improvise different apparatus	158 (95.76)	7 (4.24)	165 (100)	210 (94.17)	13 (5.83)	223 (100)	164 (92.66)	13 (7.34)	177 (100)	204 (96.68)	7 (3.32)	211 (100)	368 (94.85)	20 (5.15)	388 (100)
3. Observes various Production Processes	152 (92.12)	13 (7.88)	165 (100)	212 (95.07)	11 (4.93)	223 (100)	157 (88.70)	20 (11.30)	177 (100)	207 (98.10)	4 (1.90)	211 (100)	364 (93.81)	24 (6.19)	388 (100)
4. Observes and understands working models	97 (58.79)	68 (41.21)	165 (100)	123 (55.16)	100 (44.84)	223 (100)	100 (56.50)	77 (43.50)	177 (100)	120 (56.87)	91 (43.13)	211 (100)	220 (56.70)	168 (43.30)	388 (100)
5 Learns the different skills required for different types of work	154 (93.33)	11 (6.67)	165 (100)	201 (90.13)	22 (8.87)	223 (100)	161 (90.96)	16 (9.90)	177 (100)	194 (91.94)	17 (8.06)	211 (100)	355 (91.49)	33 (8.51)	388 (100)
6. Gets familiarised with modern development in science and technology	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
7. Helps to develop simple workng models	44 (26.67)	121 (73.33)	165 (100)	48 (21.52)	175 (78.48)	223 (100)	44 (24.86)	133 (75.14)	177 (100)	48 (22.75)	163 (77.25)	211 (100)	92 (23.71)	296 (76.29)	388 (100)

(Contd...)

Table 4.27 (Contd...)

Use	Urban			Rural			Government			Private			RU total	NRU total	Grand total
	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total			
8. Receives direct information	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
9. Gets first hand information	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
10. Can be used in co-ordinating intellectual and manual labour	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
11. Provides practical experience	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
12. Learns of repair certain equipment	53 (32.12)	112 (67.88)	165 (100)	48 (21.52)	175 (78.48)	223 (100)	44 (24.86)	133 (75.14)	177 (100)	57 (27.01)	154 (72.99)	211 (100)	101 (26.03)	287 (73.97)	388 (100)
13. Helps/can be used in bridging the gap between theory and practice	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
14. Caters to the development of creativity, self expression etc.	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)

RU - Recorded use

NPU - Not recorded use

In the discussion which follows, the percentages of total sample which identified and did not identify each use are reported. The percentages of different categories of teachers namely urban, rural, government and private are reported.

Analysis of data in Table 4.27 indicates that eight out of the 14 uses of engineering factories were pointed out by cent percent of the teachers. These were uses number 1, number 6, number 8, number 9, number 10, number 11, number 13 and number 14.

Of the 388 teachers, 368 teachers (94.85 per cent) pointed out use number 2 that is 'learns to improvise different apparatus' as a use of engineering factories while only 20 teachers (5.15 per cent) did not find this as a use. The percentage of urban, rural, government and private teachers who pointed out this use were 95.76, 94.17, 92.66 and 96.88 respectively.

Use number 5, that is 'learns the different skills required for different types of work' is recorded by 91.49 per cent of total teachers. More than 90 per cent of teachers belonging to different categories of schools namely urban (93.33 per cent), rural (90.13 per cent), government (90.96 per cent) and private (91.94 per cent) pointed out this use.

Use number 4 that is 'observes and understands working models' was recorded by only 56.70 per cent of total teachers. More than 50.00 per cent of teachers belonging to all categories namely urban, rural, government and private pointed out the use.

Regarding uses numbers 7 and 12, only 23.71 per cent and 26.03 per cent of the total sample recorded these uses while 76.29 per cent and 73.97 per cent did not record. More than 20.00 per cent of teachers belonging to different ~~categories~~ categories namely urban, rural, government and private recorded the use number 7. More than 70.00 per cent of teachers belonging to these categories did not record this use. Regarding use number 12, the percentages of teachers belonging to all categories except urban (32.12) were less than 30.00 per cent.

From the above discussion it can be concluded that most of the teachers belonging to all categories namely urban, rural and government and private were aware of most of the uses of engineering factories as an environmental resource.

Uses of engineering factories such as 'helps to develop simple working models', 'learns to repair certain equipments', etc. were not known to many of the teachers. In order to make use of engineering factories as an environmental resource for physics teaching, teachers need to be fully aware of all the identifiable uses of these.

Table 4.28 **Opinion of Physical Science Teachers on the uses of Small Scale Industrial Units as an Environmental Resource for Physics Education**

(Number and Percentage)

Use	Urban			Rural			Government			Private			RU total	NRU total	Grand total
	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total			
1. Observes methods and techniques of fabrication	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
2. Learns the skills in carpentry	72 (43.64)	93 (56.36)	165 (100)	138 (61.88)	85 (38.11)	223 (100)	81 (45.76)	96 (54.24)	177 (100)	129 (61.14)	82 (38.86)	211 (100)	210 (54.12)	178 (45.88)	388 (100)
3. Learbs to improvise different apparatus	88 (53.33)	77 (46.67)	165 (100)	134 (60.09)	89 (39.91)	223 (100)	92 (51.98)	85 (48.02)	177 (100)	130 (61.61)	81 (38.39)	211 (100)	222 (57.22)	166 (42.78)	388 (100)
4. Observes various production processes	143 (86.67)	22 (13.33)	165 (100)	192 (86.10)	31 (13.90)	223 (100)	135 (76.27)	42 (23.73)	177 (100)	200 (94.79)	11 (5.21)	211 (100)	335 (86.34)	53 (13.66)	388 (100)
5 Observes and understands working models	115 (69.70)	50 (30.30)	165 (100)	192 (86.10)	31 (13.90)	223 (100)	138 (77.97)	39 (22.03)	177 (100)	169 (80.09)	42 (19.91)	211 (100)	307 (79.12)	81 (20.88)	388 (100)
6. Learns the different skills required for different type of work	148 (89.70)	17 (10.30)	165 (100)	207 (92.83)	16 (7.17)	223 (100)	155 (87.57)	22 (12.43)	177 (100)	200 (94.79)	11 (5.21)	211 (100)	355 (91.49)	33 (8.51)	388 (100)
7. Gets familiarised with modern development in science and technology	134 (81.21)	31 (18.79)	165 (100)	195 (87.44)	28 (12.56)	223 (100)	151 (85.31)	26 (14.69)	177 (100)	178 (84.36)	33 (15.64)	211 (100)	329 (84.79)	59 (84.79)	388 (100)

(Contd...)

Table 4.28 (Contd...)

Use	Urban			Rural			Government			Private			RU total	NRU total	Grand total
	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total			
8. Helps to develop simple working models	150 (90.91)	15 (9.09)	165 (100)	192 (86.10)	31 (13.90)	223 (100)	135 (76.27)	42 (23.73)	177 (100)	207 (98.10)	4 (1.90)	211 (100)	342 (88.14)	46 (11.86)	388 (100)
9. Receives direct information	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
10. Gets first-hand information	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
11. Can be used in co-ordinating intellectural and manual labour	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
12. Provides practical experience	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
13. Learns to repair certain equipment	79 (47.88)	86 (52.12)	165 (100)	106 (47.53)	117 (52.47)	223 (100)	72 (40.68)	105 (59.32)	177 (100)	113 (53.55)	98 (46.45)	211 (100)	185 (47.68)	203 (52.32)	388 (100)
14. Helps to bridging the gap between theory and practice	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
15. Caters to the development of creativity, self expression etc.	158 (95.76)	7 (4.24)	165 (100)	215 (96.41)	8 (3.59)	223 (100)	166 (93.79)	11 (6.21)	177 (100)	207 (98.10)	4 (1.90)	211 (100)	373 (96.13)	15 (3.87)	388 (100)

RU - Record use
NPU - Not recorded use

(b) Small scale industrial units

Table 4.28 gives the number and percentage of physical science teachers on the basis of their opinion on the uses of small scale industrial units as an environmental resource for physics teaching in secondary schools according to area and management of schools.

Analysis of data in Table 4.28 indicates that six out of the 15 uses of small scale industrial units were pointed out by 100 per cent of the teachers. These are uses numbered 1, 9, 10, 11, 12 and 14.

More than 90 per cent of the total sample have recorded the uses number 6 and 15. In regard to use number 6 that is 'learns the different skills required for different types of work', of the four categories of teachers namely urban, rural, government and private, the percentage of rural school teachers (92.83) was more than that of urban (89.70) and the percentage of private teachers (94.79) was more than that of government teachers (87.57). The same is observed regarding use number 15 that is 'caters to the development of creativity, self expression, etc.' also.

From the Table, it is clear that more than 80 per cent of total teachers recorded uses number 4, number 7 and number 8 of small scale industrial units. Regarding use number 4, the percentage of private teachers was more (94.79) than that of government teachers (76.27) while the percentages of urban and rural teachers were almost same. Regarding use number 7, the percentage of rural teachers (87.44) was more than that of urban teachers (81.21) in recording the use while the percentages of government and private school teachers were almost same.

Use number 5 that is 'observes and understands working models' was recorded by 79.12 per cent of the total sample. Here one can see a noticeable difference between the urban and rural categories of teachers in recording the use with rural category recording more (86.10 per cent) than that of urban category (69.70 per cent). The percentage of private teachers (80.09) in this regard was more than that of government teachers (77.92 per cent).

Regarding uses numbers 2 and 3, more than 50 per cent of the total teachers pointed out these uses (54.12 per cent and 57.22 per cent). In these two cases, the percentages of rural school teachers were more than that of urban school teachers of pointing out these uses. Again the percentage of private school teachers were more than that of government school teachers in pointing out these uses.

Use number 13 was recorded only by 47.68 per cent of the total teachers. The percentages of urban and rural categories were almost same but the percentage of private school teachers (46.45 per cent) was more than that of government teachers(40.58 per cent) in pointing out this use.

Table 4.29 **Opinion of Teachers on the uses of Chemical Factories as an Environmental Resource for Physics Education**
(Number and Percentage)

Use	Urban			Rural			Government			Private			RU total	NRU total	Grand total
	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total			
1. Observes various production processes	134 (81.21)	31 (18.79)	165 (100)	175 (78.48)	48 (21.52)	223 (100)	128 (72.32)	49 (27.68)	177 (100)	181 (85.78)	30 (14.22)	211 (100)	309 (79.64)	79 (20.36)	388 (100)
2. Observes and understands working models	91 (55.15)	74 (44.85)	165 (100)	167 (74.89)	56 (25.11)	223 (100)	108 (61.02)	69 (38.98)	177 (100)	150 (79.09)	61 (28.91)	211 (100)	258 (66.49)	130 (33.51)	388 (100)
3. Learns the different skills required for different types of work	132 (80.00)	33 (20.00)	165 (100)	214 (95.96)	9 (4.04)	223 (100)	156 (88.14)	21 (11.86)	177 (100)	190 (90.105	21 (9.95)	211 (100)	346 (89.18)	42 (10.82)	388 (100)
4. Gets familarised with modern development in science and technology	124 (75.15)	41 (24.85)	165 (100)	186 (83.41)	37 (16.59)	223 (100)	142 (80.23)	35 (19.77)	177 (100)	168 (79.62)	43 (20.38)	211 (100)	310 (79.90)	78 (20.10)	388 (100)
5. Helps to develop simple working models	98 (59.39)	67 (40.61)	165 (100)	112 (50.22)	111 (49.78)	223 (100)	72 (40.68)	105 (59.32)	177 (100)	138 (65.40)	73 (34.60)	211 (100)	210 (54.12)	178 (45.88)	388 (100)
6. Receives direct information	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
7. Gets first-hand information	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)

(Contd...)

Table 4.29 (Contd...)

Use	Urban			Rural			Government			Private			RU total	NRU total	Grand total
	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total			
8. Can be used in co-ordinating intellectual and manual labour	125 (75.76)	40 (24.24)	165 (100)	187 (83.86)	36 (16.14)	223 (100)	135 (76.27)	42 (23.73)	177 (100)	177 (83.89)	34 (16.11)	211 (100)	312 (80.41)	76 (19.59)	388 (100)
9. Provides practical experience	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
10. Helps in bridging the gap between theory and practice	148 (89.70)	17 (10.30)	165 (100)	216 (96.86)	7 (3.14)	223 (100)	166 (93.79)	11 (6.21)	177 (100)	198 (93.84)	13 (6.16)	211 (100)	364 (93.81)	24 (6.19)	388 (100)
11. Caters to the development of creativity, self-expression, etc.	152 (92.12)	13 (7.38)	165 (100)	198 (88.79)	25 (11.21)	223 (100)	161 (90.96)	16 (9.04)	177 (100)	189 (89.57)	22 (10.43)	211 (100)	350 (90.21)	38 (9.79)	388 (100)

RU - Recorded use
NRU - Not recorded use

It is revealed from the above analysis that the teachers in general are aware of the uses of small scale industrial units as an environmental resource for physics teaching. It is observed that in most cases the private school teachers seemed to be more aware than government school teachers regarding the uses of this environmental resources.

(c) Chemical factories

Table 4.29 gives the number and percentage of physical science teachers on the basis of their opinion on the uses of chemical factories as an environmental resource for physics teaching in secondary schools according to area and management of schools.

Analysis of data in Table 4.29 indicates that 100 per cent of teachers pointed out three out of 11 uses listed. They were uses number 6, number 7 and number 9 (uses are listed in Table 4.29).

More than 90 per cent of the total sample selected for this study have pointed out the uses numbers 10 and 11. The percentage of rural teachers (96.86) was more than that of urban teachers (89.70) while percentages were almost same regarding government and private teachers in pointing out use number 10 that is 'can be used in bridging the gap between theory and practice. Regarding use number 11 that is 'caters to the development of creativity, self expression, etc.', urban school teachers' percentage (92.12) was more than that of rural school teachers' percentage (88.79) in recording this use. The percentages of government school teachers and private school teachers were almost same.

Regarding use number 3 that is 'learns the different skills required for different types of work', 89.18 per cent of the total teachers have pointed out the use. Rural teachers seemed to be more aware of this use (95.96 per cent) than urban teachers (80.00 per cent). private teachers seemed to be more aware of this use (90.05 per cent) than their government counter parts (88.14 per cent).

Uses number 8 and number 4 were recorded by 80.41 per cent and 79.90 per cent of teachers respectively. Here also the rural category recorded more than the urban category regarding both the uses. Private school teachers recorded more (83.89 per cent) than government school teachers (76.27 per cent) regarding the use number 8. Regarding use number 4 there seemed to have not much difference between these two categories of teachers.

Use number 1 was recorded by 79.64 per cent of teachers. Urban category recorded more (81.21 per cent) than rural category (78.48 per cent). Teachers from private schools seemed to have better awareness (85.78 per cent) of this particular use than teachers from government schools (72.32 per cent).

Uses number 2 and number 5 were recorded by 66.49 per cent and 54.12 per cent of teachers respectively. Regarding use number 2 rural category of teachers seemed to have better awareness (74.89 per cent) than urban category (55.15 per cent) and private school teachers seemed to have a better awareness (79.09 per cent) than government school teachers (61.02 per cent). Regarding use number 5 urban teachers seemed to have better awareness (59.39 per cent) than rural teachers (50.22 per cent). In this regard private school teachers recorded more (65.40 per cent) than government school teachers (40.68 per cent).

It can be concluded that most of the teachers belonging to different categories namely urban, rural, government and private were aware of the uses of chemical factories as an environmental resource. Private school teachers had better awareness than government school teachers in this regard.

(d) Workshops

Table 4.30 gives the number and percentage of physical science teachers on the basis of their opinion on the uses of workshops as an environmental resource for physics teaching in the secondary schools according to area and management of schools.

Table 4.30 **Opinion of Teachers on the uses of work shop as an Environmental Resource for Physics Education**

(Number and Percentage)

Use	Urban			Rural			Government			Private			RU total	NRU total	Grand total
	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total			
1. Observes methods and techniques of fabrication	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
2. Learns the skills in carpentry	108 (65.45)	57 (34.55)	165 (100)	127 (56.95)	96 (43.05)	223 (100)	104 (58.76)	73 (41.24)	177 (100)	131 (62.09)	80 (37.91)	211 (100)	235 (60.57)	153 (39.43)	388 (100)
3. Learns to improvise different apparatus	154 (93.33)	11 (6.67)	165 (100)	206 (92.38)	17 (7.62)	223 (100)	164 (92.66)	13 (7.34)	177 (100)	196 (92.89)	15 (7.11)	211 (100)	360 (92.78)	28 (7.22)	388 (100)
4. Observes various production processes	66 (40.0)	99 (60.0)	165 (100)	72 (32.29)	151 (67.71)	223 (100)	57 (32.20)	120 (67.80)	177 (100)	81 (38.39)	130 (61.61)	211 (100)	138 (35.57)	250 (64.43)	138 (100)
5 Observes and understands working models	132 (80.0)	33 (20.0)	165 (100)	147 (65.92)	76 (34.08)	223 (100)	124 (70.06)	53 (29.94)	177 (100)	155 (73.46)	56 (26.54)	211 (100)	279 (71.91)	109 (28.09)	388 (100)
6. Learns the different skills required for different topes of work	150 (90.91)	15 (9.09)	165 (100)	187 (83.86)	36 (16.14)	223 (100)	152 (85.88)	25 (14.12)	177 (100)	185 (87.68)	26 (12.32)	211 (100)	337 (86.86)	51 (13.14)	388 (100)
7. Learns the assembling of different electronic gadgets	35 (21.21)	130 (78.79)	165 (100)	49 (21.97)	174 (78.03)	223 (100)	39 (22.03)	138 (77.97)	177 (100)	45 (21.33)	166 (78.67)	211 (100)	84 (21.65)	304 (78.35)	388 (100)
8. Gets familiarised with modern development in Science and technology	144 (87.27)	21 (12.72)	165 (100)	174 (78.03)	49 (21.97)	223 (100)	135 (76.27)	42 (23.73)	177 (100)	183 (86.73)	28 (13.27)	211 (100)	318 (81.96)	70 (18.04)	388 (100)

(Contd...)

Table 4.30 (Contd...)

Use	Urban			Rural			Government			Private			RU total	NRU total	Grand total
	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total			
9. Helps to develop simple working models	134 (81.21)	31 (18.79)	165 (100)	156 (69.96)	67 (30.04)	223 (100)	123 (69.49)	54 (30.51)	177 (100)	167 (79.15)	44 (20.85)	211 (100)	290 (74.74)	98 (25.26)	388 (100)
10. Receives direct information	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
11. Gets first hand information	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
12. Can be used in co-ordinating intelle-ctual and manual labour	130 (78.79)	35 (21.21)	165	189 (84.75)	34 (15.25)	223 (100)	147 (83.05)	30 (16.95)	177 (100)	172 (81.52)	39 (18.48)	211 (100)	319 (82.22)	69 (17.88)	388 (100)
13. Provides practical experience	161 (97.58)	4 (2.42)	165 (100)	208 (93.27)	15 (6.73)	223 (100)	167 (94.35)	10 (5.65)	177 (100)	202 (95.73)	9 (4.27)	211 (100)	369 (95.10)	19 (4.90)	388 (100)
14. Learns to repair certain equipment	137 (83.03)	28 (16.97)	165 (100)	180 (80.72)	43 (19.28)	223 (100)	144 (81.36)	33 (18.64)	177 (100)	173 (81.99)	38 (18.01)	211 (100)	317 (81.70)	71 (18.30)	388 (100)
15. Helps/can be used in bridging the gap between theory and practice	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
16. Caters to the develop-ment of creativity, self expression ect.	160 (96.97)	5 (3.03)	165 (100)	206 (92.38)	17 (7.62)	223 (100)	168 (94.92)	9 (5.08)	177 (100)	198 (93.84)	13 (6.16)	211 (100)	366 (94.33)	22 (5.67)	388 (100)

RU - Recorded use
NRU - Not recorded use

Analysis of data in Table 4.30 indicated that four out of the 16 uses of workshops were pointed out by 100 per cent of teachers. They were uses number 1, number 10, number 11, and number 5 (Listed below Table 4.30).

Uses number 3, number 13 and number 16 were pointed out by 92.78 per cent, and 94.33 per cent of teachers respectively. Regarding these uses, the percentages of urban teachers who pointed out these uses were more than (93.33, 97.58 and 96.97 respectively) that of rural teachers (92.38, 93.27 and 92.38 respectively). The percentages of government school teachers and that of private school did not seem to vary much in pointing out each of these uses.

Uses 6, 8, 12 and 14 were recorded by more than 80 per cent of the teachers (86.86 per cent, 81.96 per cent, 82.22 per cent and 81.70 per cent respectively). Regarding uses numbers 6, 8 and 14 the urban category of teachers recorded more (90.91 per cent, 87.27 per cent and 83.03 per cent respectively) than rural category of teachers (83.86 per cent, 78.03 per cent and 80.72 per cent respectively). But in the case of use number 12, rural category of teachers recorded more (84.75 per cent) than urban category (78.79 per cent). Again regarding the above four uses, except in use number 12 in all the other uses private school teachers recorded more than that of government school teachers.

Uses number 5 and number 9 were recorded by 71.91 per cent and 74.74 per cent of teachers respectively. Here also the percentages of urban teachers recorded were more (80.0, 81.21) than that of rural teachers (65.92 and 69.96). The percentages of private school teachers who pointed out these uses were more (73.46, 79.15 respectively) than that of government school teachers (70.06, 69.49 respectively).

Use number 2 was pointed out by 60.57 per cent of the teachers. The urban category teachers recorded more (65.45 per cent) than rural category (56.95 per cent). Again the private school teachers recorded the use more (62.09 per cent) than government school teachers (58.76 per cent).

Uses number 4 and number 7 were pointed out only by 35.57 per cent and 21.65 per cent of teachers respectively. Regarding use number 4 the percentage of urban category was little more than that of rural category while regarding use number 7, the percentages of both categories were almost same. The percentage of private teachers (38.39) was more than their government counterparts (32.2) regarding the former use while the percentages were almost same in the case of the latter.

It can be concluded that workshop as an environmental resource for teaching physics was identified by most of the teachers irrespective of locality and type of management of schools. Most of the teachers had good

Table 4.31 **Opinion of Teachers on the uses of Colleges as an Environmental Resource for Physics Education**

(Number and Percentage)

Use	Urban			Rural			Government			Private			RU total	NRU total	Grand total
	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total			
1. Learns to improvide different appratus	71 (43.03)	94 (56.97)	165 (100)	108 (48.43)	115 (51.57)	223 (100)	82 (46.33)	95 (53.67)	177 (100)	97 (45.97)	144 (54.03)	211 (100)	179 (46.13)	209 (53.87)	388 (100)
2. Observes and under-stands working models	55 (33.33)	110 (66.67)	165 (100)	96 (43.05)	127 (56.95)	223 (100)	68 (38.42)	109 (61.58)	177 (100)	83 (39.34)	128 (60.66)	211 (100)	151 (38.92)	237 (61.08)	388 (100)
3. Gets familiarised with modern developments in science and technology	103 (62.42)	62 (37.58)	165 (100)	107 (47.98)	116 (52.02)	223 (100)	98 (55.37)	79 (46.63)	177 (100)	112 (53.08)	99 (46.92)	211 (100)	210 (54.12)	178 (45.88)	388 (100)
4. Helps to develop simple working models	107 (64.85)	58 (35.15)	165 (100)	106 (47.53)	117 (52.47)	223 (100)	101 (57.06)	76 (42.94)	177 (100)	112 (53.08)	99 (46.92)	211 (100)	213 (54.90)	175 (45.10)	138 (100)
5 Receives direct information	136 (82.42)	29 (17.58)	165 (100)	128 (57.40)	95 (42.60)	223 (100)	120 (67.80)	57 (32.20)	177 (100)	144 (68.25)	67 (31.75)	211 (100)	264 (68.04)	124 (31.96)	388 (100)
6. Gets first-hand information	145 (87.88)	20 (12.12)	165 (100)	166 (74.44)	57 (25.56)	223 (100)	137 (77.40)	40 (22.60)	177 (100)	174 (82.46)	37 (17.54)	211 (100)	311 (80.15)	77 (19.85)	388 (100)
7. Provides practical experience	132 (80.0)	33 (20.0)	165 (100)	195 (87.44)	28 (12.56)	223 (100)	152 (85.88)	25 (14.12)	177 (100)	175 (82.94)	36 (17.06)	211 (100)	327 (84.28)	61 (15.72)	388 (100)
8. Caters to the develop-ment of creativity, self-expression etc.	64 (38.79)	101 (61.21)	165 (100)	97 (43.50)	126 (56.50)	223 (100)	77 (43.50)	100 (56.50)	177 (100)	84 (39.81)	127 (60.19)	211 (100)	161 (41.49)	227 (56.51)	388 (100)

Ru - Record use NRU - Not recorded use

awareness of the uses of workshop as an environmental resource except a few uses.

(e) Colleges

Table 4.31 gives the number and percentage of teachers on the basis of their opinion about the use of colleges as an environmental resource for physics education in the secondary schools based on locality and management of schools.

It is seen from Table that uses number 6 and number 7 were pointed out by 80.15 per cent and 84.28 per cent of teachers respectively. Regarding the former use, the percentage of urban teachers was more (87.58) than the percentage of rural teachers (74.44) and the percentage of private school teachers was more (82.46) than that of government teachers (77.40) in recording this use. Regarding the latter use the percentage of rural teachers was more (87.44) than their urban counterpart (80.00) and the percentage of government school teachers was more (85.88) than the private school teachers (82.94).

Use number 5 was recorded by 68.04 per cent of teachers. In this case the urban category recorded 82.42 per cent which was notably different from that of rural category which recorded only 57.40 per cent.

Uses number 3 and number 4 were pointed out by 54.12 per cent and 54.90 per cent of the teachers respectively. In both cases the percentages of urban school teachers were more than that of rural school teachers. Again it can be seen that in these two cases the percentages of government school teachers were more than that of private school teachers.

Uses number 1 and number 8 were recorded only by 46.13 per cent and 41.49 per cent of teachers respectively while 53.87 per cent and 58.51 per cent did not record these two uses. In both cases the percentages of rural school teachers were more (48.43, 43.50) than that of urban school teacher (43.03, 38.79) in recording these uses. Regarding use number 1 the percentage of private school teachers was not much different from that of government school teachers. Regarding use number 8, the percentage of government school teachers was more (43.50) than that of private school teachers (39.81).

Use number 2 was recorded by only 38.92 per cent of teachers. Here also 43.05 per cent of the rural category recorded the use while only 33.33 per cent of urban category recorded. There was not much difference in the percentages of government and private teachers.

It can be concluded from the above discussion that although a good number of teachers were aware of the uses of

Table 4.32 Opinion of Teachers on the Uses of Power Stations as on Environmental Resource for Physics Education

(Number and Percentage)

Use	Urban			Rural			Government			Private			RU total	NRU total	Grand total
	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total			
1. Observes and understands the mode of transmission of electricity	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
2. Observes various producton process	157 (95.15)	8 (4.85)	165 (100)	215 (96.41)	8 (3.59)	223 (100)	171 (96.61)	6 (3.39)	177 (100)	201 (95.26)	10 (4.74)	211 (100)	372 (95.88)	16 (4.12)	388 (100)
3. Observes and understands working models	137 (83.03)	28 (16.97)	165 (100)	199 (89.24)	24 (10.76)	223 (100)	155 (87.57)	22 (12.43)	177 (100)	181 (85.78)	30 (14.22)	211 (100)	336 (86.60)	52 (13.40)	388 (100)
4. Learns the different skills required for different types of work	118 (71.52)	47 (28.48)	165 (100)	172 (77.13)	51 (22.87)	223 (100)	139 (78.53)	38 (21.47)	177 (100)	151 (71.56)	60 (28.44)	211 (100)	290 (74.74)	98 (25.26)	338 (100)
5 Gets familiarised with modern development in science and technology	126 (76.36)	39 (23.64	165 (100)	181 (81.17)	42 (18.83)	223 (100)	141 (79.66)	36 (20.34)	177 (100)	166 (78.67)	45 (21.33)	211 (100)	307 (79.12)	81 (20.88)	388 (100)
6. Receives direct information	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
7. Gets first hand information	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)

(Contd...)

Table 4.32 (Contd...)

Use	Urban			Rural			Government			Private			RU total	NRU total	Grand total
	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total			
8. Can be used in co-ordinating intellectual and manual labour	77 (46.67)	88 (53.33)	165 (100)	127 (56.95)	96 (43.05)	223 (100)	88 (49.72)	89 (50.28)	177 (100)	116 (43.98)	95 (45.02)	211 (100)	204 (52.58)	184 (47.42)	388 (100)
9. Observes and understands the different types of electronic connections	79 (47.88)	86 (52.12)	165 (100)	105 (47.09)	118 (52.91)	223 (100)	85 (48.02)	92 (51.98)	177 (100)	99 (46.92)	112 (53.08)	211 (100)	184 (47.42)	204 (52.58)	388 (100)
10. Provides practical experience	146 (88.48)	19 (11.52)	165 (100)	184 (82.51)	39 (17.49)	223 (100)	144 (81.36)	33 (18.64)	177 (100)	186 (88.15)	25 (11.85)	211 (100)	330 (85.05)	58 (14.95)	388 (100)
11. Helps in bridging the gap between theory and practice	127 (76.97)	38 (23.03)	165 (100)	154 (69.06)	69 (30.94)	223 (100)	131 (74.01)	46 (25.99)	177 (100)	150 (71.01)	61 (28.91)	211 (100)	281 (72.42)	107 (27.58)	388 (100)
12. Caters to the development of creativity, self expression, etc.	135 (81.82)	30 (18.18)	165 (100)	165 (73.99)	58 (26.01)	223 (100)	132 (74.58)	45 (25.42)	177 (100)	168 (79.62)	43 (20.38)	211 (100)	300 (77.32)	88 (22.68)	388 (100)

RU - Recorded use NRU - Not recorded use

colleges as an environmental resource, there were still a good number who where not aware of certain identified uses.

(f) Power stations

Table 4.32 gives the number and percentage of teachers on the basis of their opinion on the use of power station as an environmental resource for physics education in the secondary schools according to area and management of schools.

Analysis of data in Table 4.32 indicates that three out of the twelve uses were pointed out by 100 per cent teachers. These were uses number 1, number 6 and number 7.

Use number 2 was pointed out by 95.88 per cent of the total sample. There is not much difference between the percentages of urban and rural categories of teachers. So also in the case of government and private teachers.

Regarding uses number 3 and number 10, more than 80 per cent of the total sample recorded these uses (86.60 per cent and 85.05 per cent respectively). More than 80.00 per cent of teachers belonging to all the categories namely urban, rural, government and private recorded the uses.

Uses number 4, number 6, number 11 and number 12 were pointed out as uses by more than 70.00 per cent of the sample (74.74 per cent, 79.12 per cent, 72.42 per cent and

77.32 per cent respectively). More than 70.00 per cent of the teachers belonging to all the categories namely urban, rural, government and private recorded these uses except in the case of rural teachers in recording use number 11 which was only 69.06 per cent. Regarding uses numbers 4 and 5, the percentages of rural category were more (77.13, 81.17) than those of urban category (71.52, 76.36) and again the percentages of government category were more than (78.53, 79.66) private category (71.56, 78.67). Regarding uses number 11, and 12, the percentages of urban category were more (76.97, 81.82) than that of rural category (69.06, 73.99). 74.01 per cent of government teachers recorded use number 11 but only 71.09 per cent of private teachers recorded it. 79.62 per cent of private teachers recorded use number 12 but only 74.58 per cent of government teachers recorded it.

Use number 8 was recorded by 52.58 per cent of total sample while 47.42 per cent did not record this use. Here the rural school teachers recorded more (56.95 per cent) than urban school teachers (46.67 per cent). Private school teachers recorded more (54.98 per cent) than government school teachers (49.72 per cent). Use number 9 was pointed out by only 47.42 per cent of the total sample while 52.58 per cent did not point it out. There is not much difference between the percentages of sub samples.

Table 4.33 **Opinion of Teachers on the Uses of Printing Press as on Environmental Resource for Physics Education**

(Number and Percentage)

Use	Urban			Rural			Government			Private			RU total	NRU total	Grand total
	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total			
1. Observes various production processes	115 (69.70)	50 (30.30)	165 (100)	133 (59.64)	90 (40.36)	223 (100)	112 (63.28)	65 (36.72)	177 (100)	136 (64.45)	75 (35.55)	211 (100)	248 (63.92)	140 (36.08)	388 (100)
2. Observes and understands working models	125 (75.76)	40 (24.24)	165 (100)	147 (65.92)	76 (34.08)	223 (100)	129 (72.88)	48 (27.12)	177 (100)	143 (67.77)	68 (32.23)	211 (100)	272 (70.10)	116 (29.90)	388 (100)
3. Learns the difference skills required for different types of work	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
4. Gets familiarised with modern development in Science and technology	138 (83.64)	27 (16.36)	165 (100)	185 (82.96)	38 (17.04)	223 (100)	147 (83.05)	30 (16.95)	177 (100)	176 (83.41)	35 (16.59)	211 (100)	323 (83.25)	65 (16.75)	338 (100)
5 Helps to develop simple working models	101 (61.21)	64 (38.79)	165 (100)	178 (79.82)	45 (20.18)	223 (100)	128 (72.32)	49 (27.68)	177 (100)	156 (73.93)	55 (26.07)	211 (100)	279 (71.91)	109 (28.09)	388 (100)
6. Receives direct information	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)

(Contd...)

Table 4.33 (Contd...)

Use	Urban			Rural			Government			Private			RU total	NRU total	Grand total
	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total			
7. Gets first hand information	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
8. Can be used in co-ordinating intellectual and manual labour	148 (89.70)	17 (10.30)	165 (100)	207 (92.83)	16 (7.17)	223 (100)	160 (90.40)	17 (9.60)	177 (100)	195 (92.42)	16 (7.58)	211 (100)	355 (91.49)	33 (8.51)	388 (100)
9. Provides practical experience	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
10. Helps in bridging the gap between theory and practice	155 (93.94)	10 (6.06)	165 (100)	189 (84.75)	34 (15.25)	223 (100)	145 (81.92)	32 (18.08)	177 (100)	199 (94.31)	112 (5.69)	211 (100)	344 (88.66)	44 (11.34)	388 (100)
11. Caters to the development of creativity, self, expression, etc.	158 (95.76)	7 (4.24)	165 (100)	204 (91.48)	19 (8.52)	223 (100)	166 (93.79)	11 (6.21)	177 (100)	196 (92.89)	15 (7.11)	211 (100)	362 (93.30)	26 (6.70)	388 (100)

RU - Recorded use

NRU - Not recorded use

It can be concluded that although a good number of teachers where aware of the different uses of power station as an environmental resource, some of the teachers were not aware of certain uses.

(g) Printing press

Table 4.33 gives the number and percentage of teachers on the basis of their opinion on the uses of printing press as an environmental resource for physics education in the secondary schools of Kerala.

It is seen from the Table 4.33 that four out of the 11 uses of printing press were pointed out by 100 per cent of the teachers. These were uses number 3, number 6, number 7 and number 9.

Use number 11 was recorded by 93.30 per cent of the total sample followed by use number 8 which was recorded by 91.49 per cent. Regarding use number 11, 95.76 per cent of urban school teachers recorded it as a use while only 91.48 per cent of rural school teachers recorded this. Use number 8 was recorded by about 90 per cent of teachers belonging to all the categories - urban, rural, government and private.

Use number 10 was recorded favourably by 88.66 per cent of the total sample. 93.94 per cent of urban school teachers and 84.75 per cent of rural school teachers agreed to this. The private school teachers recorded more (94.31 per cent) than government school teachers (81.92 per cent).

Use number 4 was pointed out by 83.25 per cent of the total sample. About 83 per cent of teachers from all the four categories recorded this use.

Use number 5 was recorded by 71.91 per cent of teachers while use number 2 was recorded by 70.10 per cent of teachers. In the case of use number 5 rural school teachers recorded more (79.82 per cent) than urban school teachers (61.21 per cent). In the case of use number 2, the percentage of urban school teachers was more (75.76) than that of rural school teachers (65.92) and the percentage of government school teachers was more (72.88) than that of private school teachers (67.77) in recording this use.

Of the 11 uses, use number 1 was least recorded (63.92 per cent) by the teachers. The percentage of urban school teachers (69.70) was notably more than that of rural school teachers (59.64). There was not much difference between the percentage of government and private school teachers.

It can be concluded that most of the teachers were aware of the uses of printing press as an environmental resource irrespective of locality and type of management of schools.

Table 4.34 **Opinion of Teachers on the uses of science Fairs and Exhibitions as an Enviornmental Resource for Physics Teaching**

(Number and Percentage)

Use	Urban			Rural			Government			Private			RU total	NRU total	Grand total
	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total			
1. Observes methods and techniques of fabrication	94 (56.97)	71 (43.03)	165 (100)	121 (54.26)	102 (45.74)	223 (100)	98 (55.45)	79 (44.55)	177 (100)	117 (55.41)	94 (44.55)	211 (100)	215 (55.41)	173 (44.59)	388 (100)
2. Learns to improvise different apparatus	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
3. Observes various production process	74 (44.85)	91 (55.15)	165 (100)	97 (43.50)	126 (56.50)	223 (100)	83 (46.89)	94 (53.11)	177 (100)	88 (41.71)	123 (58.29)	211 (100)	171 (44.07)	217 (55.93)	388 (100)
4. Observes and understands working models	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
5 Learns the different required for different types of work	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
6. Learns the assembling of different electronic gadgets	121 (73.33)	44 (26.67)	165 (100)	164 (73.54)	59 (26.46)	223 (100)	134 (75.71)	43 (24.29)	177 (100)	151 (71.56)	60 (28.44)	211 (100)	285 (73.45)	103 (26.55)	388 (100)
7. Gets familiarised with modern developments in science and technology	138 (83.64)	27 (16.36)	165 (100)	195 (87.44)	28 (12.56)	223 (100)	152 (85.88)	25 (14.12)	177 (100)	181 (85.78)	30 (14.22)	211 (100)	333 (85.82)	55 (14.18)	388 (100)
8. Helps to develop simple working models	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)

(Contd...)

Table 4.34 (Contd...)

Use	Urban			Rural			Government			Private			RU total	NRU total	Grand total
	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total			
9. Receives direct information	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
10. Gets first hand information	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
11. Can be used in co-ordinating intellectual and manual labour	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
12. Observes and understands the different types of electric connection	102 (61.82)	63 (100)	165 (100)	130 (58.30)	93 (41.70)	223 (100)	105 (59.32)	72 (40.58)	177 (100)	127 (60.19)	84 (39.81)	211 (100)	232 (59.79)	156 (40.21)	388 (100)
13. Provides practical experience	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
14. Learns to repair certain equipments	116 (70.30)	165 (29.70)	165 (100)	107 (47.98)	116 (52.02)	223 (100)	99 (55.93)	78 (44.07)	177 (100)	124 (58.77)	87 (41.23)	211 (100)	223 (57.47)	165 (42.53)	388 (100)
15. Helps/can be used in bridging the gap between theory and practice	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
16. Caters to the development of creativity, self expression etc.	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)

RU - Recorded use NRU - Not recorded use

(h) Science fairs and exhibitions

Table 4.34 gives the number and percentage of teachers on the basis of their opinion on the uses of science fairs and exhibitions as an environmental resource for physics education in secondary schools according to area and management of schools.

Analysis of data indicates that 10 out of the 16 uses of science fairs and exhibitions listed were recorded by 100 per cent of teachers. These were uses numbers 2, 4, 5, 8, 9, 10, 11, 13, 15 and 16.

Use number 7 was recorded by 85.82 per cent of the total sample of 388 teachers. Rural school teachers recorded more than (87.44 per cent) that of urban school teachers (83.64 per cent). The percentages of government and private school teachers were almost same.

Use number 6 was recorded by 73.45 per cent of the total sample. The percentages of urban and rural categories of teachers were almost same but government school teachers recorded more (75.71 per cent) than private school teachers (71.56 per cent).

Uses numbers 1, 12 and 14 were recorded by more than 50 per cent of teachers (55.41 per cent, 59.79 per cent and 57.47 per cent respectively). Regarding uses number 1, and number 12, urban school teachers recorded more than rural school teachers. In both these cases the responses of government and private school teachers were not different. But regarding use number 14, the percentage of urban school teachers (70.30) was notably different from that of (47.98) their rural counterparts while the percentages of private and government school teachers were not much different.

Use number 3 was recorded only by 44.07 per cent of the teachers. Though there was not much difference in the percentages of urban and rural school teachers, the percentage of government school teachers was more (46.89) than that of private school teachers (41.71).

It can be concluded from the above analysis that the teachers were aware of the different uses of science fairs and exhibitions as an environmental resource for physics teaching except a few uses.

(i) Human resources

The number and percentage of teachers on the basis of their opinion on the uses of human resources as an environmental resource for physics teaching are given in Table 4.35.

Out of the eight uses (listed in Table 4.35) use number 6 was recorded by 88.92 per cent of teachers. The percentage of urban school teachers (92.73) was more than that of rural school teachers (86.10) and the percentage of government school teachers (92.09) was more than that of private school teachers (86.26).

Table 4.35 **Opinion of Teachers on the Uses of Human Resource as an Environmental Resource fo Physics Education**

(Number and Percentage)

Use	Urban			Rural			Government			Private			RU total	NRU total	Grand total
	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total			
1. Learns to improvise different apparatus	58 (35.15)	107 (64.85)	165 (100)	105 (47.09)	118 (52.91)	223 (100)	72 (40.68)	105 (59.32)	177 (100)	91 (43.13)	120 (56.87)	211 (100)	163 (42.01)	225 (57.99)	388 (100)
2. Learns the different skills required for different types of work	75 (45.45)	90 (54.55)	165 (100)	135 (60.54)	88 (39.46)	223 (100)	100 (56.50)	77 (43.50)	177 (100)	110 (52.13)	101 (47.87)	211 (100)	210 (54.12)	178 (45.88)	388 (100)
3. Gets familiarised with modern develop-ments in science and technology	84 (50.91)	81 (49.09)	165 (100)	115 (51.57)	108 (48.43)	223 (100)	97 (54.80)	80 (45.20)	177 (100)	102 (48.34)	109 (51.66)	211 (100)	199 (51.29)	189 (48.71)	388 (100)
4. Helps to develop simple working models	85 (51.52)	80 (48.48)	165 (100)	123 (55.16)	100 (44.84)	223 (100)	96 (54.24)	81 (45.76)	177 (100)	112 (53.08)	99 (46.92)	211 (100)	208 (53.61)	180 (46.39)	388 (100)
5. Receives direct information	124 (75.15)	41 (24.85)	165 (100)	147 (65.92)	76 (34.08)	223 (100)	130 (73.45)	47 (26.55)	177 (100)	141 (66.82)	70 (33.18)	211 (100)	271 (69.85)	117 (30.15)	388 (100)
6. Gets first-hand information	153 (92.73)	12 (7.27)	165 (100)	192 (86.10)	31 (13.90)	223 (100)	163 (92.09)	14 (7.91)	177 (100)	182 (86.26)	29 (13.74)	211 (100)	345 (88.92)	43 (11.08)	388 (100)
7. Learns to repair certain equipment	73 (44.24)	92 (55.76)	165 (100)	92 (41.26)	131 (58.74)	223 (100)	75 (42.37)	102 (57.63)	177 (100)	91 (43.13)	120 (56.87)	211 (100)	165 (42.53)	223 (57.47)	388 (100)
8. Caters to the development of creativity, self-expression, etc.	98 (59.39)	67 (40.61)	165 (100)	137 (61.43)	86 (38.57)	223 (100)	109 (61.58)	68 (38.42)	177 (100)	126 (59.72)	85 (40.28)	211 (100)	235 (60.57)	153 (39.43)	388 (100)

Ru - Recorded use NRU - Not recorded use

Use number 5 was recorded by 69.85 per cent of teachers followed by use number 8 which was recorded by 60.57 per cent of teachers. In both cases the government school teachers recorded more than private school teachers. Urban school teachers recorded more than (75.15 per cent) rural school teachers (65.92 per cent) in the case of use number 5.

Uses number 2, number 3 and number 4 were recorded by more than 50 per cent of teachers (54.12 per cent, 51.29 per cent and 53.61 per cent respectively). More than 40 per cent of the teachers did not record these uses. Urban school teachers recorded more than their counterparts in rural schools and government school teachers recorded more than their counterparts in private schools.

Uses number 1 and number 7 were recorded by 42.01 per cent and 42.53 per cent of teachers respectively while more than 50 per cent of teachers did not point out these uses. In both cases the private school teachers recorded slightly above the government school teachers. The percentage of rural category of teachers (47.09) was more than that of urban category (35.15) in recording use number 1. But in the case of use number 7, urban category recorded more (44.24 per cent) than rural category (41.26 per cent).

Though a good number of teachers were aware of the various uses of human resource (experts) in physics teaching there were many who were not aware of these uses.

Table 4.36 **Opinion of Teachers on the Uses of Hospitals as an Envronmeronmental Resource**

(Number and Percentage)

Use	Urban RU	Urban NRU	Urban Total	Rural RU	Rural NRU	Rural Total	Government RU	Government NRU	Government Total	Private RU	Private NRU	Private Total	RU total	NRU total	Grand total
1. Observes the functioning of medical equipment	165 (100)	-	165 (100)	223 (100)	-	223 (100)	177 (100)	-	177 (100)	211 (100)	-	211 (100)	388 (100)	-	388 (100)
2. Observes and understands working models	98 (59.39)	67 (40.61)	165 (100)	110 (53.36)	104 (46.64)	223 (100)	101 (57.06)	76 (42.94)	177 (100)	116 (54.96)	95 (45.02)	211 (100)	217 (55.93)	171 (44.07)	388 (100)
3. Learns the different skills required for different types of work	123 (74.55)	42 (25.45)	165 (100)	144 (64.57)	79 (35.43)	223 (100)	125 (70.62)	52 (29.38)	177 (100)	142 (67.30)	69 (32.70)	211 (100)	267 (68.81)	121 (31.19)	388 (100)
4. Gets familiarised with modern developments in science and technology	120 (72.73)	45 (27.27)	165 (100)	129 (57.85)	94 (42.15)	223 (100)	115 (64.97)	62 (35.03)	177 (100)	134 (63.51)	77 (36.49)	211 (100)	249 (64.18)	139 (35.82)	388 (100)
5. Receives direct information	146 (88.48)	19 (11.52)	165 (100)	209 (93.72)	14 (6.28)	223 (100)	149 (89.83)	18 (10.17)	177 (100)	196 (92.89)	15 (7.11)	211 (100)	355 (91.49)	33 (8.51)	388 (100)
6. Gets first-hand information	153 (92.73)	12 (7.27)	165 (100)	207 (92.83)	16 (7.17)	223 (100)	165 (93.22)	12 (6.78)	177 (100)	195 (92.42)	16 (7.58)	211 (100)	360 (92.78)	28 (7.22)	388 (100)
7. Can be used in co-ordinating intellectual and manual labour	71 (43.03)	94 (56.97)	165 (100)	110 (49.33)	113 (56.07)	223 (100)	82 (46.33)	95 (53.67)	177 (100)	99 (46.92)	112 (53.08)	211 (100)	181 (46.65)	207 (53.35)	388 (100)
8. Provides practical experience	79 (47.88)	86 (52.12)	165 (100)	111 (49.78)	112 (50.22)	223 (100)	88 (49.72)	89 (50.28)	177 (100)	102 (48.34)	109 (51.66)	211 (100)	190 (48.97)	198 (51.03)	388 (100)
9. Caters to the development of creativity, self-expression, etc.	76 (46.06)	89 (53.94)	165 (100)	103 (46.19)	120 (53.81)	223 (100)	82 (46.33)	95 (53.60)	177 (100)	97 (45.97)	114 (54.03)	211 (100)	179 (46.13)	209 (53.87)	388 (100)

Ru - Recorded use NRU - Not recorded use

(j) Hospitals

Table 4.36 gives the number and percentage of teachers on the basis of their opinion on the uses of the hospitals as an environmental resource for physics teaching according to area and management of schools.

Out of the nine uses of hospitals listed, only use number 1 was recorded by cent per cent of teachers.

Uses number 5 and number 6 were recorded by more than 90 per cent of the teachers. Use number 5 was recorded by 93.72 per cent of rural school teachers while only 88.48 per cent of urban teachers recorded this use. Again 92.89 per cent of private school teachers recorded this use while only 89.93 per cent of government teachers recorded.

Uses number 3 and number 4 were recorded by 68.81 per cent and 64.18 per cent of teachers respectively. In both cases urban school teachers recorded more than rural school teachers while in the case of use number 3 government school teachers recorded more (70.62 per cent) than private school teachers (67.30 per cent). This difference was not much in the case of use number 4.

Use number 2 was recorded by 55.93 per cent of the total sample while 44.07 per cent did not record. 59.39 per cent of urban teachers recorded while only 53.36 per cent of rural teachers recorded. 57.06 per cent of government teachers recorded and 54.98 per cent of private school teachers recorded.

Use numbers 7, number 8 and number 9 were recorded by less than 50 per cent of the total teachers (46.65 per cent, 48.97 per cent and 46.13 per cent respectively) while more than 50 per cent did not record these uses. Though the percentages of urban and rural teachers were almost the same in recording use number 9, percentages of rural teachers were more than their urban counterparts in recording uses numbers 7 and 8. Another fact which can be noticed is that the percentages of government and private teachers did not vary much in recording these uses.

The above analysis indicates that a considerable number of teachers did not seen to be aware of some of the uses of hospitals as an environmental resource for physics education though they seemed to be aware of a few uses.

(k) Cotton mills

Table 4.37 gives the number and percentage of teachers on the basis of their opinion on the uses of cotton mills as an environmental resource for physics education in the secondary schools.

Analysis of data indicates that five out of the 12 uses of cotton mills listed were recorded by more than 90 per cent of teachers. Use number 8 was recorded by maximum

Table 4.37 **Opinion of Teachers on the Uses of Cotton Mills as an Enviornmental Resource for Physics Education**

(Number and Percentage)

Use	Urban			Rural			Government			Private			RU total	NRU total	Grand total
	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total			
1. Observes methods and techniques of fabrication	142 (86.06)	23 (13.94)	165 (100)	202 (90.58)	21 (9.42)	223 (100)	156 (88.14)	21 (11.86)	177 (100)	188 (89.10)	23 (10.90)	211 (100)	344 (88.66)	44 (11.34)	388 (100)
2. Observes various production process	156 (94.55)	9 (5.45)	165 (100)	205 (91.93)	18 (8.07)	223 (100)	162 (91.53)	15 (8.47)	177 (100)	199 (94.31)	12 (5.69)	211 (100)	361 (93.04)	27 (5.96)	388 (100)
3. Observes and understands working models	153 (92.73)	12 (7.27)	165 (100)	208 (93.27)	15 (6.73)	223 (100)	163 (92.09)	14 (7.91)	177 (100)	198 (93.84)	13 (6.16)	211 (100)	361 (93.04)	27 (6.96)	388 (100)
4. Learns the different skills required for different types of work	122 (73.94)	43 (26.06)	165 (100)	142 (63.68)	81 (36.32)	223 (100)	123 (69.49)	54 (30.51)	177 (100)	141 (66.82)	70 (33.18)	211 (100)	264 (68.04)	124 (31.96)	138 (100)
5 Gets familiarised with modern developments in science and technology	112 (67.88)	53 (32.12)	165 (100)	154 (69.06)	69 (30.94)	223 (100)	121 (68.36)	56 (31.64)	177 (100)	145 (68.72)	66 (31.28)	211 (100)	266 (68.56)	122 (31.44)	388 (100)
6. Helps to develop simple working models	66 (40.00)	99 (60.00)	165 (100)	123 (55.16)	100 (44.86)	223 (100)	86 (48.59)	91 (51.41)	177 (100)	103 (48.82)	108 (51.18)	211 (100)	189 (48.71)	199 (51.29)	388 (100)

(Contd...)

Table 4.37 (Contd...)

Use	Urban RU	Urban NRU	Urban Total	Rural RU	Rural NRU	Rural Total	Government RU	Government NRU	Government Total	Private RU	Private NRU	Private Total	RU total	NRU total	Grand total
7. Receives direct information	159 (96.36)	6 (3.64)	165 (100)	218 (97.76)	5 (2.24)	223 (100)	175 (98.87)	2 (1.13)	177 (100)	209 (95.73)	9 (4.27)	211 (100)	377 (97.16)	11 (2.84)	388 (100)
8. Gets first-hand information	165 (100)	-	165 (100)	216 (96.86)	7 (3.14)	223 (100)	173 (97.74)	4 (2.26)	177 (100)	208 (98.58)	3 (1.42)	211 (100)	381 (98.20)	7 (1.80)	388 (100)
9. Can be used in co-ordinating intellectual and manual labour	86 (52.12)	79 (47.88)	165 (100)	84 (37.67)	139 (62.33)	223 (100)	82 (46.33)	95 (53.67)	177 (100)	88 (41.71)	123 (58.29)	211 (100)	170 (43.81)	218 (56.19)	388 (100)
10. Provides practical experience	165 (100)	-	165 (100)	202 (90.58)	21 (9.42)	223 (100)	169 (95.48)	8 (4.52)	177 (100)	198 (93.84)	13 (6.16)	211 (100)	367 (94.59)	21 (5.41)	388 (100)
11. Helps in bridging the gap between theory and practice	133 (80.61)	32 (19.39)	165 (100)	172 (77.13)	51 (22.87)	223 (100)	143 (80.79)	34 (19.21)	177 (100)	162 (76.78)	49 (23.22)	211 (100)	305 (78.61)	83 (21.39)	388 (100)
12. Caters to the development of creativity, self expresson etc. labour	105 (63.64)	60 (36.36)	165 (100)	128 (57.40)	95 (42.60)	223 (100)	113 (63.84)	64 (36.16)	177 (100)	120 (56.87)	91 (43.13)	211 (100)	233 (60.05)	155 (39.95)	388 (100)

RU - Recorded use NRU - Not recorded use

number of teachers (98.20 per cent) followed by use number 7 (97.16 per cent). There were not much difference in the percentages of urban and rural school teachers and also government and private school teachers.

Use number 10 was recorded by 94.59 per cent of the total sample. Here cent per cent of urban teachers recorded while only 90.58 per cent of rural school teachers recorded. There was not much difference in the percentages of government and private school teachers.

Uses number 2 and number 3 were recorded by 93.04 per cent of teachers. Use number 2 was recorded by 94.55 per cent of urban school teachers while only 91.93 per cent of rural school teachers record4d it as a use. Here the percentage of private school teachers was more (94.31 per cent) than that of government school teachers (91.53).

Use number 1 was recorded by 88.66 per cent of the total teachers. Rural school teachers recorded more (90.58 per cent) than urban school teachers (86.06 per cent) but the difference between the percentages of government school teachers and private school teachers was not much.

Use number 11 was recorded by 76.78 per cent of teachers. Urban sample recorded more (80.61 per cent) than rural sample (77.13 per cent). Government school teachers recorded more than (80.79 per cent) private school teachers (76.78 per cent).

About 68 per cent of teachers recorded uses number 4 and number 5. In the case of use number 4, urban sample recorded more (73.94 per cent) than rural sample (63.68 per cent) and government school teachers recorded (69.49 per cent) more than private school teachers (66.82 per cent). Regarding use number 5, not much difference was seen between urban and rural categories of teachers or between private and government categories of teachers.

Uses number 6 and number 9 were recorded only by 48.71 per cent and 43.81 per cent of teachers respectively. Regarding use number 6, 55.16 per cent of rural teachers recorded while only 40.00 per cent of urban teachers recorded. 51.18 per cent of private school teachers recorded while only 48.59 per cent of government school teachers recorded. Regarding use number 9, urban school teachers recorded more (52.12 per cent) than rural school teachers (37.67 per cent). Government school teachers recorded (46.33 per cent) more than private school teachers (41.71 per cent).

It can be concluded that most of the teachers had a good awareness of the various uses except uses number 6 and 9 of cotton mills as an environmental resource for physics teaching.

Table 4.38 **Opinion of Teachers on the Uses of Laboratories as an Enviornmental Resource for Physics Education**

(Number and Percentage)

Use	Urban			Rural			Government			Private			RU total	NRU total	Grand total
	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total			
1. Observes various production process	81 (49.09)	84 (50.91)	165 (100)	119 (53.36)	104 (46.64)	223 (100)	88 (49.72)	89 (50.28)	177 (100)	112 (53.08)	99 (46.92)	211 (100)	200 (51.55)	188 (48.45)	388 (100)
2. Observes and understands working models	121 (73.33)	44 (26.67)	165 (100)	132 (59.19)	91 (40.81)	223 (100)	115 (64.97)	62 (35.03)	177 (100)	138 (65.40)	73 (34.60)	211 (100)	253 (65.21)	135 (34.79)	388 (100)
3. Learns the different skills required for different types of work	153 (92.73)	12 (7.27)	165 (100)	192 (86.10)	31 (13.90)	223 (100)	159 (89.93)	18 (10.17)	177 (100)	186 (88.15)	25 (11.85)	211 (100)	345 (88.92)	43 (11.08)	388 (100)
4. Learns the assembling different electronic gadgets	62 (37.56)	103 (62.42)	165 (100)	74 (33.18)	149 (66.82)	223 (100)	65 (36.72)	112 (63.28)	177 (100)	71 (33.65)	140 (66.35)	211 (100)	136 (35.05)	252 (64.95)	138 (100)
5 Helps to develop simple working models	135 (81.82	30 (18.18)	165 (100)	184 (82.51)	39 (17.49)	223 (100)	147 (83.05)	30 (16.95)	177 (100)	172 (81.52)	39 (18.48)	211 (100)	319 (82.22)	69 (17.78)	388 (100)
6. Receives direct information	165 (100)	-	165 (100)	204 (91.48)	19 (8.52)	223 (100)	174 (98.31)	3 (1.69)	177 (100)	195 (92.42)	16 (7.58)	211 (100)	369 (95.10)	19 (4.90)	388 (100)
7. Gets first-hand information	165 (100)	-	165 (100)	216 (96.86)	7 (3.14)	223 (100)	173 (97.74)	4 (2.26)	177 (100)	208 (98.58)	3 (1.42)	211 (100)	381 (98.20)	7 (1.80)	388 (100)
8. Provides practical experience	165 (100)	-	165 (100)	220 (98.65)	3 (1.35)	223 (100)	175 (98.87)	2 (1.13)	177 (100)	210 (99.53)	1 (0.47)	211 (100)	385 (99.23)	3 (0.77)	388 (100)
9. Helps in bridging the gap between theory and practice	159 (96.36)	6 (3.64)	165 (100)	210 (94.17)	13 (5.83)	223 (100)	170 (96.05)	7 (3.95)	177 (100)	199 (94.31)	12 (5.69)	211 (100)	369 (95.10)	19 (4.90)	388 (100)
10. Caters to the development of creativity, self-expression, etc.	154 (93.33)	11 (6.67)	165 (100)	204 (91.48)	19 (8.52)	223 (100)	158 (89.27)	19 (10.73)	177 (100)	200 (94.79)	11 (5.21)	211 (100)	358 (92.27)	30 (7.73)	388 (100)

RU - Recorded use NRU - Not recorded use

(1) Laboratories

Table 4.38 gives the number and percentage of teachers on the basis of their opinion on the uses of laboratories as an environmental resource for physics education in the secondary schools according to area and management of schools.

Uses numbers 6, 7, 8, 9 and 10 were recorded by more than 90 per cent of the teachers. Use number 8 was recorded by 99.23 per cent of teachers. This use was recorded by 100 per cent of urban school teachers while only 98.95 per cent of rural school teachers recorded. Not much difference was observed between government and private school teachers.

Use number 7 was recorded by 98.20 per cent of the total sample. This use was recorded by 100 per cent of urban school teachers while only 96.86 per cent of rural school teachers recorded this. Not much difference was observed between government and private school teachers.

Uses numbers 6 and 9 were recorded by 95.10 per cent of the total sample. In both cases, urban school teachers recorded more (100 per cent and 96.36 per cent respectively) than rural school teachers (91.48 per cent and 94.17 per cent respectively). Again regarding these uses government school teachers recorded more (98.31 per cent and 96.06 per cent respectively) than private school teachers

(92.42 per cent and 94.31 per cent respectively).

Use number 10 was recorded by 92.27 per cent of teachers. 94.79 per cent of private school teachers recorded this use but only 89.27 per cent of government school teachers recorded. The difference in percentages between urban and rural categories of teachers was not much.

Use number 3 was recorded by 88.92 per cent of teachers followed by use number 5 recorded by 82.22 per cent. Regarding use number 3, urban category of teachers recorded more (92.73 per cent) than rural category of teachers (86.10 per cent) but this the difference was not much between government and private school teachers. Regarding use number 5, the differences in percentages between urban and rural, and government and private school teachers were not much.

Use number 2 was recorded by 65.21 per cent of the total sample. Though there was not much difference in the percentages of government and private school teachers, the percentage of urban school teachers was notably more (73.33) than that of rural school teachers (59.19).

Use number 1 was recorded by 51.55 per cent of the total sample. Rural school teachers recorded more (53.36 per cent) than urban school teachers (49.09 per cent). Private school teachers recorded more (53.08 per cent) than government school teachers (49.72 per cent).

Use number 4 was recorded only by 35.05 per cent of the teachers while 64.95 per cent of teachers did not record this use. Urban school teachers seemed to be slightly more aware of this use than their counterparts in rural schools. Government school teachers seemed to be slightly more aware of this use than their counterparts in private schools.

It can be concluded that most of the teachers were aware of the different uses of laboratories as an environmental resource for physics teaching. Here one can see that urban school teachers in general were slightly more aware of most of the uses than rural school teachers.

(m) Buildings under construction

Table 4.39 gives the number and percentage of teachers on the basis of their opinion on the uses of Buildings under construction as an environmental resource for physics education in the secondary schools of Kerala according to area and management of schools.

Analysis of data indicates that 90.98 per cent of teachers recorded use number 6. Urban school teachers recorded (94.56 per cent) more than rural school teachers (88.34 per cent). Not much difference was seen between the percentages of government and private school teachers.

Table 4.39 **Opinion of Teachers on the Uses of Buildings Under Construction as an Enviornmental Resource for Physics Education**

(Number and Percentage)

Use	Urban			Rural			Government			Private			RU total	NRU total	Grand total
	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total	RU	NRU	Total			
1. Learns the skills in carpentry	140 (84.85)	25 (15.15)	165 (100)	195 (87.44)	28 (12.56)	223 (100)	151 (85.31)	26 (14.69)	177 (100)	184 (87.20)	27 (12.80)	211 (100)	335 (86.34)	53 (13.66)	388 (100)
2. Observes and understands working models	130 (78.79)	35 (21.21)	165 (100)	184 (82.51)	39 (17.45)	223 (100)	150 (84.75)	27 (15.25)	177 (100)	164 (77.73)	47 (22.27)	211 (100)	314 (80.93)	74 (19.07)	388 (100)
3. Receives direct information	94 (56.97)	71 (43.03)	165 (100)	122 (54.71)	101 (45.29)	223 (100)	106 (59.89)	71 (40.11)	177 (100)	110 (52.13)	101 (47.87)	211 (100)	216 (55.67)	172 (44.33)	388 (100)
4. Gets first-hand information	100 (60.61)	65 (39.39)	165 (100)	124 (55.61)	99 (44.39)	223 (100)	103 (58.19)	74 (41.81)	177 (100)	121 (57.35)	90 (42.65)	211 (100)	224 (57.73)	164 (42.27)	388 (100)
5 Can be used in co-ordinating intellectual and manual labour	77 (46.67)	88 (53.33)	165 (100)	95 (42.60)	128 (57.40)	223 (100)	80 (45.20)	97 (54.80)	177 (100)	92 (43.60)	119 (56.40)	211 (100)	172 (44.33)	216 (55.67)	388 (100)
6. Observes and understands the different types of electric connections	156 (94.56)	9 (5.44)	165 (100)	197 (88.34)	26 (11.66)	223 (100)	162 (91.53)	15 (8.47)	177 (100)	191 (90.52)	20 (9.48)	211 (100)	353 (90.98)	35 (9.08)	388 (100)
7. Provides practical experience	116 (70.30)	49 (29.70)	165 (100)	158 (70.85)	65 (29.15)	223 (100)	126 (71.19)	51 (28.91)	177 (100)	148 (70.14)	63 (29.86)	211 (100)	274 (70.62)	114 (29.38)	388 (100)
8. Caters to the development of creativity, self-expression, etc.	93 (56.36)	72 (43.64)	165 (100)	128 (57.40)	95 (42.60)	223 (100)	107 (60.45)	70 (39.55)	177 (100)	114 (54.03)	97 (45.97)	211 (100)	221 (56.96)	167 (43.04)	388 (100)

RU - Recorded use NRU - Not recorded use

Use number 1 was recorded by 86.34 per cent of teachers. The percentages of rural school teachers (87.44) was slightly above that of urban school teachers (84.85). The percentages of private school teachers was slightly above (87.20) that of government school teachers (85.31).

80.93 per cent of teachers recorded use number 2. 82.51 per cent of the rural school teachers recorded this use but only 78.79 per cent of urban school teachers recorded. There was a difference in the percentages of government school teachers (84.75 per cent) and private school teachers (77.73 per cent).

Use number 7 was recorded by 70.62 per cent of teachers while 29.30 per cent did not record this use. There was not much difference between the percentages of different categories of teachers namely urban, rural, government and private.

More than 50 per cent of the teachers recorded uses number 3, number 4 and number 8. Regarding use numbers 3 and 4 urban school teachers recorded more than rural school teachers and government school teachers recorded more than private school teachers. Regarding use number 8, there was not much difference between the percentages of urban and rural school teachers. But the percentage of government school teachers (60.45) was above that of private school teachers (54.03).

Table 4.40 Details Regarding the Availability and Extent of Utilization of Environmental Resources

(Number and Percentage)

	Item	Available	Extent of Utilization			Not available	Total
			Always	Sometimes	Never		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Engineering factories	185 (47.68)	10 (2.58)	87 (22.42)	88 (22.68)	203 (52.32)	388 (100)
2	Small scale industrial units	358 (92.27)	23 (5.93)	157 (40.46)	178 (45.88)	30 (7.73)	388 (100)
3	Chemical factories	144 (37.11)	17 (4.38)	48 (12.37)	79 (20.36)	244 (62.89)	388 (100)
4	Workshops	358 (92.27)	39 (10.05)	173 (44.59)	146 (37.63)	30 (7.73)	388 (100)
5	Colleges	314 (80.93)	40 (10.31)	102 (26.29)	172 (44.33)	74 (19.07)	388 (100)
6	Powerstantions	74 (19.07)	7 (1.80)	40 (10.31)	27 (6.96)	314 (80.93)	388 (100)
7	Printing press	328 (84.54)	14 (3.61)	68 (17.53)	246 (63.40)	60 (15.46)	388 (100)
8	Science fair and exhibitions	264 (68.04)	106 (27.32)	92 (23.71)	66 (17.01)	124 (31.96)	388 (100)
9	Human resource (experts)	335 (86.34)	33 (8.51)	214 (55.15)	88 (22.68)	53 (13.86)	388 (100)
10	Hospitals	332 (85.57)	17 (4.38)	79 (20.36)	236 (60.82)	56 (14.43)	388 (100)
11	Cotton mills	214 (55.15)	5 (1.29)	88 (22.68)	121 (31.19)	174 (44.86)	388 (100)
12	Laboratories	97 (25.00)	6 (1.55)	46 (11.86)	45 (11.60)	291 (75.00)	388 (100)
13	Buildings under construction	330 (85.05)	6 (1.55)	61 (15.72)	263 (67.78)	58 (14.96)	388 (100)

Note: The figures in column (2) refers to the numbers and corresponding percentages in columns (3), (4) and (5).

Use number 5 was recorded only 44.33 per cent of teachers while 55.67 per cent did not record. Urban school teachers seemed slightly more aware (42.67 per cent) of this use than their rural counterparts (42.60 per cent). In the case of government and private categories, the former category seemed slightly more (45.20 per cent) aware than the latter category (43.60 per cent).

The analysis of data reveals that a good percentage of teachers belonging to all categories namely urban, rural, government and private were not fully aware of some of the uses of buildings under construction as an environmental resource for physics education.

Table 4.40 gives the details regarding availability and extent of utilization of environmental resources in the 388 schools surveyed.

For the purpose of analysis the schools were classified into three categories namely 'Always', 'Sometimes' and 'Never' utilizing.

It is seen from the Table that small scale industrial units and workshops were available near more than 90 per cent of schools. Colleges, printing press, human resource (experts), hospitals and buildings under construction were available in more than 80 per cent of schools. Science fairs and exhibitions were available as an environmental resource by 68.04 per cent schools. Cotton mills were available near 55.15 per cent schools. The least available environmental resource was found to be power stations (19.07 per cent).

Regarding the extent of utilization of different environmental resources, only a few schools came under the category of 'Always' utilizing except in the case of science fairs and exhibitions where 106 schools came under this category. Majority of schools came under the second and third categories of 'Sometimes' and 'Never'.

Although many of the listed environmental resources were available near schools, these were not found to be utilized to a desired extent. This may be because due importance is not attached to the utilization of environmental resources in physics education

Details regarding availability and extent of utilization of environmental resources in urban and rural schools are presented in Tables 4.40.1

Analysis of data in Table 4.40.1 indicates that availability and extent of utilization of most of the environmental resources seemed to be better in urban schools than in rural schools. Environmental resources - workshops, colleges, printing press, human resource (experts) and buildings under constructions were found available near cent percent urban schools. Of these only buildings under construction were available in cent percent rural school and

Table 4.40.1 **Details Regarding Availability and Extent of Utilization of Environmental Resources in Urban and Rural Schools**

(Number and Percentage)

Item	Extent of Utilization Urban						Extent of Utilization Rural					
	AV	A	ST	N	NAV	Total	AV	A	ST	N	NAV	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1 Engineering factories	130	8	54	68	35	165	55	2	33	20	168	223
	(78.79)	(4.85)	(32.73)	(41.21)	(21.21)	(100)	(24.66)	(0.90)	(14.80)	(8.97)	(75.34)	(100)
2 Small scale industry	154	11	60	83	11	165	204	12	97	95	19	223
	(93.33)	(6.67)	(36.36)	(50.30)	(6.67)	(100)	(91.48)	(5.38)	(43.50)	(42.60)	(8.52)	(100)
3 Chemical factories	105	15	34	56	60	165	39	2	14	23	184	223
	(63.64)	(9.10)	(20.61)	(33.94)	(36.36)	(100)	(17.49)	(0.90)	(6.28)	(10.31)	(82.51)	(100)
4 Workshops	165	25	58	82	-	165	193	14	115	64	30	223
	(100)	(15.15)	(35.15)	(49.70)		(100)	(86.55)	(6.28)	(51.57)	(28.70)	(13.45)	(100)
5 Colleges	165	30	55	80	-	165	149	10	47	92	74	223
	(100)	(18.18)	(33.33)	(48.48)		(100)	(66.81)	(4.48)	(21.08)	(41.26)	(33.18)	(100)
6 Power stations	40	5	11	24	125	165	34	2	29	3	189	223
	(24.24)	(3.03)	(6.67)	(14.55)	(75.76)	(100)	(15.25)	(0.90)	(13.00)	(1.35)	(84.75)	(100)
7 Printing press	165	14	50	101	-	165	163	-	18	145	60	223
	(100)	(8.48)	(30.30)	(61.21)		(100)	(73.09)		(8.07)	(65.02)	(26.91)	(100)
8 Science fair and	135	102	18	15	30	165	129	4	74	51	94	223
exhibitions	(81.82)	(61.82)	(10.91)	(9.09)	(18.18)	(100)	(57.85)	(1.79)	(33.18)	(22.87)	(42.15)	(100)
9 Human resource	165	21	73	71	-	165	170	12	141	17	53	223
(experts)	(100)	(12.73)	(44.24)	(43.03)		(100)	(76.23)	(5.38)	(63.23)	(7.68)	(27.77)	(100)
10 Hospitals	160	12	38	110	5	165	172	5	41	126	51	223
	(96.77)	(7.27)	(23.03)	(66.67)	(3.03)	(100)	(77.13)	(2.24)	(18.39)	(56.50)	(22.87)	(100)
11 Cotton mills	92	5	41	46	73	165	122	-	47	75	101	223
	(55.76)	(3.03)	(24.45)	(27.88)	(44.74)	(100)	(54.71)		(21.08)	(33.63)	(45.29)	(100)
12 Laboratories	79	8	42	31	86	165	18	-	4	14	205	223
	(47.88)	(3.64)	(25.45)	(18.79)	(52.12)	(100)	(8.01)		(1.79)	(6.28)	(91.92)	(100)
13 Buildings under	165	6	30	129	-	165	165	-	31	134	58	223
constructon	(100)	(3.64)	(18.18)	(78.18)		(100)	(100)		(13.90)	(60.09)	(26.01)	(100)

AV - Available A - Always ST - Sometimes N - Never NA - Not available

Note: The figures in column (2) refers to the numbers and corresponding percentages in columns (3), (4) and (5).
The figures in column (8) refers to the numbers and corresponding percentages in columns (9), (10) and (11).

Table 4.40.2 **Details Regarding Availability and Extent of Utilization of Environmental Resources in Government and Private Schools**

(Number and Percentage)

Items	Extent of Utilization Urban						Extent of Utilization Rural					
	AV	A	ST	N	NAV	Total	AV	A	ST	N	NAV	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1 Engineering factories	84 (47.46)	4 (2.26)	38 (21.41)	42 (23.73)	93 (52.54)	177 (100)	101 (47.87)	6 (2.84)	49 (23.22)	46 (21.80)	110 (52.13)	211 (100)
2 Small scale industry	164 (92.66)	11 (6.21)	66 (37.29)	87 (49.15)	13 (7.34)	177 (100)	194 (91.94)	12 (5.68)	91 (43.13)	91 (43.13)	17 (8.06)	211 (100)
3 Chemical factories	68 (38.42)	7 (3.95)	20 (11.30)	41 (23.16)	109 (61.58)	177 (100)	76 (36.02)	10 (4.74)	28 (13.27)	38 (18.01)	135 (63.98)	211 (100)
4 Workshops	171 (96.61)	18 (10.17)	82 (46.33)	71 (40.11)	6 (3.39)	177 (100)	187 (88.63)	21 (9.95)	91 (43.13)	75 (35.55)	24 (11.37)	211 (100)
5 Colleges	142 (80.23)	20 (11.30)	42 (23.73)	80 (45.20)	35 (19.77)	177 (100)	172 (81.52)	20 (9.48)	60 (28.44)	92 (43.60)	39 (18.48)	211 (100)
6 Power stations	33 (18.64)	2 (1.13)	19 (10.73)	12 (6.78)	144 (81.36)	177 (100)	41 (19.43)	5 (2.37)	21 (9.95)	15 (7.11)	170 (80.57)	211 (100)
7 Printing press	154 (87.01)	4 (2.26)	33 (18.64)	117 (66.10)	23 (12.99)	177 (100)	174 (82.46)	10 (4.74)	35 (16.59)	129 (61.14)	37 (17.54)	211 (100)
8 Science fair and exhibitions	118 (66.67)	46 (25.99)	37 (20.90)	35 (19.77)	59 (33.33)	177 (100)	146 (69.19)	60 (28.44)	55 (26.07)	31 (14.09)	65 (30.81)	211 (100)
9 Human resource (experts)	155 (87.57)	15 (8.47)	98 (55.37)	42 (23.73)	22 (12.43)	177 (100)	180 (85.31)	18 (8.53)	116 (54.98)	46 (21.80)	31 (14.69)	211 (100)
10 Hospitals	147 (83.05)	8 (4.52)	34 (19.21)	105 (59.32)	30 (16.95)	177 (100)	185 (87.68)	9 (4.29)	45 (21.33)	131 (62.09)	26 (12.32)	211 (100)
11 Cotton mills	98 (55.36)	1 (0.56)	37 (32.20)	60 (33.90)	79 (44.63)	177 (100)	116 (54.98)	4 (1.90)	51 (24.17)	61 (28.91)	95 (45.02)	211 (100)
12 Laboratories	38 (21.47)	2 (1.13)	22 (12.43)	14 (7.91)	139 (78.53)	177 (100)	59 (27.96)	4 (1.90)	24 (11.37)	31 (14.69)	152 (72.04)	211 (100)
13 Buildings under constructon	159 (89.83)	3 (1.69)	27 (15.25)	129 (78.18)	18 (10.17)	177 (100)	171 (81.04)	3 (1.42)	34 (16.11)	134 (63.51)	40 (18.96)	211 (100)

AV - Available A - Always ST - Sometimes N - Never NA - Not available

Note: The figures in column (2) refers to the numbers and corresponding percentages in columns (3), (4) and (5).
The figures in column (8) refers to the numbers and corresponding percentages in columns (9), (10) and (11).

found to be power stations (less than 20 per cent) in the case of both urban and rural schools. Regarding the extent of utilization of different environmental resources not much differences were observed between the percentages of government and private schools.

4.1.7 Workload of Teachers

The teachers work load in the school was analysed and the mean work load per week was found to be 24.72 hours. The work load in hours and frequency distribution are presented in Table 4.41.

Table 4.41 Frequency Distribution of Workload of Teachers

Workload in hours/week	Frequency
35-39	2
30-34	18
25-29	195
20-24	147
15-19	24
10-14	2
Total	388

It is seen from the Table that the workload of maximum number of teachers varied between 24 hours and 29 hours. These hours were not only devoted to physics teaching alone since some of them have to teach subjects like Chemistry and English.

Distribution of teachers on the basis of their opinion on additional hours required for laboratory work for physics education is presented in Table 4.42.

Table 4.42 **Distribution of Teachers on the Basis of Their Opinion on Additional Hours Required for Laboratory Work for Physics Education**

Additional hours required/week for laboratory work	Frequency
4-5	5
2-3	142
0-1	241
Total	388

From the Table it can be observed that most of the teachers required 1 hour to 3 hours additionally for laboratory work. The mean of additional hours required was calculated to be 1.26 hours per week for laboratory work.

Table 4.43 shows the distribution of teachers on the basis of their opinion on additional hours required for preparation, correction, etc.

Table 4.43 **Distribution of Teachers on the Basis of Their Opinion On Additional Hours Required for Preparation, Correction etc.**

Additional hours/week required for preparation, correction etc.	Frequency
2-3	173
0-1	215

Total	388

Mean - 1.21 hrs/week

Majority of teachers required one hour per week additionally for preparation, correction, etc. The mean of additional hours required was calculated to be 1.21 hours per week in this regard.

Table 4.44 **Distribution of Teachers on the Basis of their Opinion on Additional Hours Required for Utilizing Environmental Resources**

Additional hours/week required for utilizing environmental resources	Frequency
2-3	102
0-1	286

Total	388

Mean - 1.11 hrs/week

Table 4.44 shows the distribution of teachers on the basis of their opinion on additional hours required for utilizing environmental resources. The mean of additional hours required was found to be 1.11 hours per week.

Table 4.45 **Distribution of Teachers on the Basis of Extra Hours Spent**

Extra hours/week spent at school	Frequency
3	8
2	64
1	247
0	69
Total	388

Mean - 1.03 hrs/week

Distribution of teachers on the basis of extra hours spent by them for physics education is presented in Table 4.45. It is found that one extra hour was spent by 247 teachers for physics education. The mean of extra hours spent was found to be 1.03 hours per week.

4.1.8 Details Regarding In-service Programme

Many agencies are conducting in-services courses for physics teachers in Kerala. The type and duration of courses may vary from course to course.

Table 4.46 shows the distribution of teachers according to the duration of in-service training courses.

Table 4.46 **Distribution of Teachers According to the Duration of In-service Training Courses**

Duration of In-service course in days	No. of Teachers
51-60	2
41-50	20
31-40	72
21-30	108
11-20	64
0-10	262

Total	528*

Mean - 25.4 days

* 388 teachers have undergone 528 in-service courses ranging from 2 days to 56 days

The duration of different types of courses ranged from 1 day to 56 days and the mean duration of in-service training attendance of one type or other by a teacher was found to be 25.4 days.

Table 4.47 **Details of Agencies which Conducted In-service Courses and the Number of Teachers Who Attended**

No.	Agencies	Number of Teachers				Total
		Urban	Rural	Government	Private	
1	UGC	2	1	2	1	3
2	NCERT	29	36	27	38	65
3	State Institute of Education	162	218	173	207	380
4	Training College	3	5	4	4	8
5	Arts and Science College	4	3	4	3	7
6	Sastra Sahitya Parishad	2	1	1	2	3
7	Teachers' Associations	30	32	27	35	62
	Total					528

* Some teachers have undergone in-services course conducted by the agency, more than once which was also included in the number

The identified agencies which conduct in-service courses for physics teachers are University Grants Commission (UGC), The National Council for Educational Research and Training (NCERT), the State Institute of Education (SIE), Teacher's Training Colleges, Arts and

Science Colleges, Sastra Sahitya Parishad and Teachers' Associations.

Table 4.47 gives the details of agencies which conduct in-service courses and the number of teachers who attended these courses, State Institute of Education was found to be the main agency conducting in-service courses for physics teachers. Its courses were attended by the number (380) of teachers. This was followed by that NCERT (65) and Teachers' Associations (62). It is found that 388 teachers have undergone 528 in-service courses.

Table 4.48 **Details Regarding the Type of In-service Courses Conducted and the Number of Teachers Attended**

No.	Type of course	Urban	Rural	Government	Private	Total
1	Summer institute	81	77	62	96	158
2	Seminar	69	127	73	123	196
3	Workshop	44	39	42	41	83
4	Content course	37	40	34	43	77
5	Others*	10	4	6	8	14
	Total					528

1. Question setting courses
2. Lecture series
3. Evaluation courses
4. Improvisation course
5. Syllabus discussion
6. Resource persons' course

Table 4.49 **Responses of Teachers Regarding the identified Benefits of In-service Course**

(Number and Percentage)

No	Item	Urban (165)*	Rural (223)*	Government (177)*	Private (211)*	Total (388)
1	Received up-to-date information	139 (84.24)	165 (73.99)	140 (79.10)	164 (77.73)	304 (78.35)
2	Received experience in practical work	71 (43.05)	44 (19.73)	48 (27.12)	67 (31.75)	115 (29.64)
3	Exchanged ideas with other teachers	136 (82.42)	160 (71.74)	137 (77.40)	159 (75.35)	296 (76.29)
4	Revised portions once studied but forgotten	63 (38.18)	89 (39.91)	69 (38.98)	83 (39.34)	152 (39.18)
5	Obtained contacts with specialists in the field	68 (41.21)	98 (43.95)	76 (42.94)	90 (42.65)	166 (42.78)
6	Got resource materials	46 (27.88)	58 (26.01)	42 (23.73)	62 (29.38)	104 (26.80)
7	Got opportunity to get familiarised with new methods and techniques of teaching	137 (83.03)	153 (68.61)	134 (75.71)	156 (73.93)	290 (74.74)
8	Got training in the use of a.v. aids	38 (23.03)	45 (20.18)	34 (19.21)	49 (23.22)	83 (21.39)
9	Got training to utilize the environmental resources	8 (4.85)	11 (4.93)	7 (3.95)	12 (5.69)	19 (4.90)
10	Others	7 (4.24)	9 (4.04)	6 (3.39)	10 (4.74)	16 (4.12)

Others include
1 Awareness of changes in curriculum
2 Got opportunity to clear doubts

* Total number of responses in each category.

Details regarding the type of in-service courses conducted and the number of teachers attended are presented in Table 4.48.

From the Table it is found that the largest number of courses conducted were seminars (196) which was followed by Summer Institute (158), Workshops (83), Content course (77) and others (14). Among these courses summer institutes had long duration. Six other types of courses were also identified from free responses.

Responses of teachers regarding the identified benefits of in-service courses are presented in Table 4.49.

In addition to the different types of benefits already provided, two other benefits were also identified from the free responses. Among the benefits item 1, 'Received up-to-date information' got the highest agreement from teachers (78.35 per cent) followed by item 3, 'Exchanged ideas with other teachers' (76.29 per cent), item 7, 'Got opportunity to get familiarized with new methods and techniques of teaching'. Item 9, 'Got training to utilise the environmental resources' got the last rank (4.90 per cent). The details regarding the sub-sample responses are also presented in Table 4.49.

Responses of teachers regarding the defects of in-service courses are presented in Table 4.50.

In addition to the various defects already listed,

Table 4.50 **Response of Teachers Regarding the Defects of In-service Course**

(Number and percentage)

No	Item	Urban (165)*	Rural (223)*	Government (177)*	Private (211)*	Total (388)
1	The course was too short	118 (71.52)	124 (55.61)	109 (61.58)	133 (63.03)	242 (62.37)
2	The course was too long	12 (7.27)	20 (8.97)	13 (7.34)	19 (9.00)	32 (8.25)
3	Much of the time was spent to teach what we know already	92 (55.56)	113 (50.67)	103 (58.19)	102 (48.34)	205 (52.84)
4	Difficult experiments were not demonstrated	64 (38.79)	79 (35.43)	54 (30.51)	89 (42.18)	143 (36.86)
5	Due importance was not given to practical work	98 (59.39)	116 (52.02)	90 (50.85)	124 (58.77)	214 (55.15)
6	Resource persons were not available	33 (20.00)	59 (26.46)	37 (20.90)	55 (26.07)	92 (23.71)
7	The course was monotonous	46 (27.88)	68 (30.49)	51 (28.81)	63 (29.86)	114 (29.38)
8	Difficult concepts were not given due emphasis	55 (33.33)	72 (32.28)	59 (33.33)	68 (32.23)	127 (32.73)
9	Training to utilize the resource was not given	102 (61.82)	183 (82.06)	108 (61.02)	177 (83.89)	285 (73.45)
10	Training in modern methods and techniques of teaching was not given	41 (24.84)	53 (23.77)	42 (23.73)	52 (24.64)	94 (24.23)
11	The goals aimed at were not released	50 (30.30)	47 (21.08)	38 (21.47)	59 (27.96)	97 (25.00)
12	Others	10 (6.06)	15 (6.73)	9 (5.08)	16 (7.58)	25 (6.44)

Others include
1 Inadequate facilities
2 University presentation
3 More time for administrative routine

* Total number of responses in each category.

three other defects were also identified from the free responses.

Among the defects item 9, 'Training to utilize the resource was not given' got the highest agreement from respondents (73.75 per cent) followed by item 1, 'The course was too short' (62.37 per cent) and item 5, 'Due importance was not given to practical work' (55.15 per cent). The responses to item 4 and 5 indicate the need for planning and demonstration of experiments. Item 2, 'The course was too long' was recorded only by 8.25 per cent.

From the above analysis it can be concluded that the in-service courses should be carefully planned and executed so that the maximum number of teachers get the benefits of these courses.

PART II

4.2.1 Section A

This section of Part II deals with the analyses of Physics Theory Awareness Test (PTAT) scores and Physics Practical Application Awareness Test (PPAAT) scores of standard IX pupils.

To study the influence of variables (mentioned in Chapter III) on the dependent variable 'Physics Theory Awareness', nine two-way ANOVA were done. In the same way to study the influence of variables on the dependent variable 'Physics Practical Application Awareness', nine more two-way ANOVA were done. In the discussion that follows, Physics Theory Awareness will be referred as PTA and Physics Practical Application Awareness as PPAA.

4.2.1.1 Analysis of Physics Theory Awareness Test (PTAT) Scores of Standard IX Students

(1) Influence of Intelligence and Sex on Physics Theory Awareness (PTA)

The effect of sex and intelligence on physics theory awareness was studied using two way ANOVA. The summary of analysis of variance data is presented in

Table 4.51.2. The F-values were computed using conventional procedures to find out whether the influence of variables studied are significant or not.

Table 4.51.1 **Mean and Variance for PTA Scores - Classified by 3 Levels of IQ and Sex**

Sex	Low IQ	Average IQ	High IQ
Male	10.32 (9.27)	16.66 (15.98)	20.02 (18.94)
Female	11.37 (13.79)	16.97 (16.40)	19.51 (22.45)

(Figures in brackets show variance)

Table 4.51.2 **ANOVA for PTA Scores - Classified by IQ and Sex**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Sex adj.	7.04	1	7.04	0.42
Intelligence adj.	8379.55	2	4189.77	247.23*
Interaction	69.33	2	34.67	2.05
Within	8448.88	5	-	-
Error	17116.53	1010	-	-
Total	25565.41	1015	-	-

* - Significant at 0.01 level.

It is seen from Table 4.51.1 that the mean scores for subjects classified by sex and level of intelligence show differences among various intelligence levels (Low, Average and High). But this is not seen very much between sex.

The ANOVA results reported in Table 4.51.2 establish this further. The difference in mean score among intelligence levels is significant at 0.01 level (F-value 247.23). This leads to the conclusion that the means of PTA scores differ significantly among three levels of IQ. Therefore it may be concluded that IQ exerts a significant influence on PTA. Since the difference in mean scores between sex is not significant (F-value 0.42) it can be legitimately concluded that sex exerts no significant influence on PTA. This leads to the conclusion that there is no significant difference in the performance of male and female children. The interaction of sex and intelligence is not significant (F-value 2.05). Thus it may be concluded that intelligence and sex when combined, together do not influence the PTA of pupils.

(2) Influence of Intelligence and Locality of School on PTA

It is evident from Table 5.52.1 that the mean scores for subjects classified by locality and level of intelligence show differences among various intelligence levels (Low, Average and High). The mean scores for urban and rural school subjects also differ.

Table 4.52.1 **Mean and Variance for PTA Scores - Classified by 3 Levels of IQ and Locality of School**

Locality	Low IQ	Average IQ	High IQ
Urban	11.50 (12.56)	17.85 (14.76)	21.15 (19.60)
Rural	10.33 (10.71)	15.84 (15.61)	18.09 (16.85)

(Figures in brackets show variance)

Table 4.52.2 **ANOVA for PTA Scores - Classified by IQ and Sex**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Locality adj.	1224.27	1	1224.27	77.94*
IQ adj.	7949.71	2	3974.86	253.05*
Interaction	103.51	2	51.75	3.29**
Within	9700.26	5	-	-
Error	15865.13	1010	-	-
Total	28565.41	1015	-	-

** - Significant at .05 level * - Significant at 0.01 level

The ANOVA results reported in Table 4.52.2 further establish this. The difference in mean scores among the three intelligence levels is significant at 0.01 level (F-value 253.05) and 80 it may be concluded that there is a significant effect of IQ on the PTA. The F-ratio of 77.94 for locality is also significant at 0.01 level. This indicates that the urban and rural subjects differ in their performance regarding PTA. The interaction of locality and IQ is significant at 0.05 level (F-value 3.290. Thus it may be concluded that the intelligence and locality when combined, together affect the performance of subjects significantly.

(3) Influence of Intelligence and Management of Schools of PTA

Table 4.53.1 **Mean and Variance for PTA Scores - Classified by 3 Levels of IQ and Management of School**

Management	Low IQ	Average IQ	High IQ
Government	11.00 (10.12)	16.88 (15.03)	19.88 (22.55)
Private	10.71 (13.76)	16.74 (17.33)	19.68 (18.65)

Table 4.53.2 **ANOVA for PTA Scores - Classified by IQ and Management of Schools**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Management adj.	8.43	1	8.43	0.50
Intelligence adj.	8373.03	2	4186.51	246.07*
Interaction	0.72	2	0.36	0.02
Within	8381.66	5	-	-
Error	17183.75	1010	-	-
Total	25565.41	1015	-	-

* - Significant at 0.01 level.

From Table 4.53.1 it is seen that the mean scores for subjects classified by management and level of intelligence show differences among the three intelligence levels (Low, Average and High). However this difference is not very much between managements.

This is supported by the ANOVA results reported in Table 4.53.2. The F-value of 246.07 is significant at 0.01 level which shows that the difference in mean scores among intelligence levels is significant. So it may be concluded that there is a significant influence of IQ on PTA. The

F-value of 0.50 for management is not significant at 0.01 on 0.05 levels. This indicates that management exerts no significant influence of PTA. Hence it may be concluded that there is no significant difference between government school children and private school children regarding PTA. With a non-significant interaction of intelligence and management (F-value 0.02), it can be concluded that intelligence and type of management when combined, together do not affect PTA of pupils.

(4) Influence of Socio-Economic Status (SES) and Sex on PTA

The effect of socio-economic status and sex was studied using two-way ANOVA. The summary of analysis data is presented in Table 4.54.2.

Table 4.54.1 **Mean and Variance for PTA Scores - Classified by 3 Levels of SES and Sex**

Sex	Low SES	Average SES	High SES
Male	15.42 (23.77)	16.83 (23.10)	18.90 (23.71)
Female	15.26 (24.73)	16.25 (20.97)	19.30 (22.12)

Table 4.54.2 **ANOVA for PTA Scores - Classified by SES and Sex**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Sex adj.	0.22	1	0.22	0.01
SES adj.	2240.28	2	1120.14	48.53*
Interaction	13.78	2	6.89	0.30
Within	2254.06	5	-	-
Error	23311.35	1010	-	-
Total	25565.41	1015	-	-

* - Significant at 0.01 level.

Table 4.54.1 gives the mean scores for subjects classified by sex and levels of socio-economic status (Low, Average and High). It is observed that the mean scores for subjects show differences among the three levels of SES. However this is not seen very much between sex.

The ANOVA results presented in Table 4.54.2 further establish these facts. While the difference in mean scores among SES levels is significant at 0.01 level (F-value 48.53), the same is not significantly different between sex (F-value 0.01). Therefore it can be concluded that socio-economics status exerts a significant influence on PTA while sex of the child exerts no significant influence on PTA. With a non-significant interaction of sex and SES (F-value 0.30), it can be concluded that when sex and SES when combined, together do not affect PTA significantly.

(5) Influence of Socio-Economic Status (SES) and Locality of School on PTA

Table 4.55.1 **Mean and Variance for PTA Scores - Classified by 3 Levels of SES and Locality of School**

Locality	Low SES	Average SES	High SES
Urban	16.87 (24.23)	17.50 (23.21)	19.88 (24.78)
Rural	14.01 (20.48)	15.15 (18.31)	18.10 (18.97)

Table 4.55.2 **ANOVA for PTA Scores Classified by SES and Locality of School**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Locality adj.	1382.65	1	1382.65	63.76*
SES adj.	1975.65	2	987.83	45.56*
Interaction	42.06	2	21.03	0.97
Within	3664.78	5	-	-
Error	21900.63	1010	-	-
Total	25565.41	1015	-	-

* - Significant at 0.01 level

Table 4.55.1 shows the mean scores of subjects classified by locality and levels of socio-economic status (Low, Average and High). The mean scores of subjects show differences among the three levels of SES. The difference in mean scores of urban subjects and rural subjects also differ.

The ANOVA results reported in Table 4.55.2 throw more light on these facts. The difference in mean scores among the three levels of socio-economic status is significant at 0.01 level (F-value 45.56). This leads to the conclusion that SES exerts a significant influence on PTA. The difference in mean scores between locality is also significant at 0.01 level (F-value 63.76). So it can be concluded that locality of school exerts a significant influence on PTA. This leads to the conclusion that the performance of urban and rural children differ significantly regarding PTA. With a non-significant interaction of locality and SES (F-value 0.97), it may be concluded that to SES and locality when combined, together do not affect the PTA of pupils.

(6) Influence of Socio-Economic Status (SES) and Management of School on PTA

Table 4.56.1 **Mean and Variance for PTA Scores - Classified by 3 Levels of SES and Management of School**

Management	Low SES	Average SES	High SES
Government	15.52 (24.43)	16.45 (22.69)	19.15 (22.03)
Private	15.13 (23.97)	16.13 (21.39)	19.03 (23.85)

Table 4.56.2 **ANOVA for PTA Scores Classified by SES and Management of School**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Management adj.	21.08	1	21.08	0.91
SES adj.	2253.24	2	1126.62	48.83*
Interaction	2.95	2	1.48	0.06
Within	2264.10	5	-	-
Error	23301.31	1010	-	-
Total	25565.41	1015	-	-

* - Significant at 0.01 level

From Table 4.56.1 it is clear that the means for physics theory awareness scores of subjects differ for all the three levels of SES (Low, Average and High), while this is not seen very much between managements.

These facts are further confirmed by the ANOVA results reported in Table 4.56.2. The influence of SES is significant at 0.01 level (F-value 48.83) and so it can be concluded that SES exerts a significant influence on PTA. The influence of management is not significant (F-value 0.91) and so it can be concluded that management does not exerts a significant influence on PTA. Therefore it can be inferred that there is no significant difference in the performance of government school children and private school children regarding PTA. The interaction of socio-economic status and type of management is not significant (F-value 0.06). So it leads to the conclusion that SES and type of management when combined, together do not affect PTA of pupils.

(7) Influence of resource utilization and sex on PTA

It is evident from Table 4.57.1 that the means for PTA scores of subjects differ for all the three levels of resource utilization (Low, Average and High). But the means of PTA scores do not differ very much between sex.

Table 4.57.1 **Mean and Variance for PTA Scores - Classified by 3 Levels of Resource Utilization and Sex**

Sex	Low Resource utilization	Average Resource utilization	High Resource utilization
Male	14.81 (22.01)	17.06 (19.95)	18.94 (25.45)
Female	15.14 (22.20)	16.56 (20.28)	19.03 (24.62)

Table 4.57.2 **ANOVA for PTA Scores - Classified by Resource Utilization and Sex**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Sex adj.	0.1	1	0.01	0.0003
Resource utilization adj.	2779.94	2	1389.97	61.69*
Interaction	30.28	2	15.14	0.67
Within	2810.22	5	-	-
Error	22755.19	1010	-	-
Total	25565.41	1015	-	-

* - Significant at 0.01 level.

These facts are made more clean by the ANOVA results presented in Table 4.57.2. The difference in mean scores among resource utilization levels is significant at 0.01 level (F-value 61.69). This leads to the conclusion that resource utilization exerts a significant influence on PTA. The difference in means between sex is not significant (F-value 0.0003). So it can be legitimately concluded that the PTA is not significantly influenced by the sex of the children. The male and female children perform in the same way. The interaction of sex and resource utilization is also not significant (F-value 0.67) which leads to the conclusion that sex and resource utilization when combined, together do not affect the PTA.

(8) Influence of Resource Utilization and Locality of School on PTA

Table 4.58.1 **Mean and Variance for PTA Scores - Classified by 2 Levels of IQ and Locality of School**

Locality	Low Resource Utilization	Average Resource Utilization
Urban	14.73 (18.70)	17.37 (22.26)
Rural	15.01 (22.76)	16.44 (18.29)

Table 4.58.2 **ANOVA for PTA Scores - Classified by Resource Utilization and Locality of School**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Locality adj.	26.33	1	26.33	1.23
Resource utilization adj.	479.19	1	479.19	22.54*
Interaction	45.70	1	45.70	2.15
Within	661.03	3	-	-
Error	14772.53	695	-	-
Total	15436.56	698	-	-

* - Significant at 0.01 level

It is seen from Table 4.58.1 that the mean scores for subjects classified by locality and level of resource utilization show difference among the 'Low Resource Utilization' level and 'Average Resource Utilization' level. This is not seen very much between the mean scores of urban and rural school subjects. Here as has been pointed out in Chapter III Methodology only two levels of resource utilization were considered as there were no rural schools classified under 'High Resource Utilization' category in the sample selected. However the mean score for PTA of urban school subjects coming under 'High Resource Utilization' level was 19.01 which was more than that of subjects from schools coming under 'Low' and 'Average' Resource Utilization levels (14.73 and 17.37 respectively).

The ANOVA results reported in Table 4.58.2 establish these facts further. While the difference in mean scores among the two levels of resource utilization (Low and Average) is significant (F-value 22.54), the same is not significantly different between localities (F-value 1.230. So it may legitimately concluded that resource utilization exerts a significant influence on PTA. But there is no significant influence of locality on PTA. The interaction of locality and resource utilization is not significant which means that the combined influence of these two on PTA is not significant.

(9) Influence of Resource Utilization and Management of School on PTA

Table 4.59.1 **Mean and Variance for PTA Scores - Classified by 3 Levels of Resource Utilization and Management of School**

Management	Low Resource Utilization	Average Resource Utilization	High Resource Utilization
Government	15.17 (22.51)	16.59 (17.71)	19.24 (26.16)
Private	14.77 (21.67)	17.05 (22.51)	18.72 (23.78)

Table 4.59.2 **ANOVA for PTA Scores - Classified by Resource Utilization and Management of Schools**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Management adj.	7.28	1	7.28	0.32
Resource utilization adj.	2779.31	2	1389.66	61.74*
Interaction	46.53	2	23.27	1.03
Within	2833.75	5	-	-
Error	22731.66	1010	-	-
Total	25565.41	1015	-	-

* - Significant at 0.01 level.

It is clear from Table 4.59.1 that the means for PTA scores of subjects differ for all the three levels of resource utilization (Low, Average and High). However the means of PTA scores do not differ very much between managements.

The ANOVA results reported in Table 4.59.2 throw more light on these facts. It can be observed that while the difference in mean scores among resource utilization levels is significant at 0.01 level (F-value 61.74), the same is not significantly different between managements (F-value 0.32). This leads to the conclusion that resource utilization exerts a significant influence on PTA while management of school exerts no significant influence on PTA. With a non-significant interaction (F-value 1.03) of resource utilization and management of school, it can be concluded that the combined influence of these two variables on PTA is not significant.

4.2.1.2 Analysis of Physics Practical Application Awareness Test (PPAAT) Scores of Standard IX Students

(1) Influence of Intelligence and Sex on Physics Practical Application Awareness (PPAA)

The effect of sex and intelligence on physics practical application awareness was studied using two way ANOVA. The summary of analysis data is presented in Table 4.60.1.

Table 4.60.1 **Mean and Variance for PPAA Scores - Classified by 3 Levels of IQ and Sex**

Sex	Low IQ	Average IQ	High IQ
Male	6.18 (8.60)	11.83 (12.35)	14.49 (13.87)
Female	7.00 (11.32)	11.57 (11.23)	13.87 (18.99)

It is clear from Table 4.60.1 that the mean scores of subjects classified by sex and level of intelligence show differences among the three intelligence levels (Low, Average and High). However this is not seen very much between sex.

Table 4.60.2 **ANOVA for PPAA Scores Classified by IQ and Sex**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Sex adj.	10.44	1	10.44	0.80
IQ adj.	6042.39	2	3021.20	232.31*
Interaction	54.86	2	27.43	2.11
Within	6126.20	5	-	-
Error	13135.02	1010	-	-
Total	19261.22	1015	-	-

* - Significant at 0.01 level.

This is made more clear by the ANOVA results reported in Table 4.60.2. The difference in mean scores among intelligence levels is significant at 0.01 level (F-value 232.31). This leads to the conclusion that the means of PPAA scores differ significantly for all the three levels of IQ. It is therefore concluded that IQ exerts a significant influence on PPAA. Since the difference in mean scores between sex is not significant (F-value 0.80), it can be legitimately concluded that sex exerts no significant influence on PPAA. The performance of male children is not significantly different from that of female children. The interaction of sex and intelligence is not significant (F-value 2.11). So it may be concluded that these two when combined, together do not affect PPAA significantly.

(2) Influence of Intelligence and Locality of Schools on PPAA

Table 4.61.1 **Mean and Variance for PPAA Scores - Classified by 3 Levels of IQ and Locality of School**

Locality	Low IQ	Average IQ	High IQ
Urban	7.64 (9.45)	13.20 (12.77)	15.93 (18.23)
Rural	5.74 (9.14)	10.32 (6.96)	12.06 (5.87)

It is evident from Table 4.61.1 that the mean scores for subjects classified by locality and level of intelligence show differences among the three intelligence levels (Low, Average and High). The difference in mean scores is also seen between urban and rural school subjects.

Table 4.61.2 **ANOVA for PPAA Scores Classified by IQ and Sex**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Locality adj.	2328.19	1	2328.19	218.47*
IQ adj.	5586.71	2	2793.35	262.12*
Interaction	108.90	2	54.45	5.11*
Within	8498.00	5	-	-
Error	10763.22	1010	-	-
Total	19261.22	1015	-	-

* - Significant at 0.01 level

This is supported by the ANOVA results reported in Table 4.61.2. The difference in mean scores among the three levels of intelligence is significant at 0.01 level (F-value 262.12). This leads to the conclusion that IQ exerts a significant influence on PPAA. The difference in mean scores between urban and rural school subjects is also significant at 0.01 level (F-value 218.47). Therefore it can be concluded that locality also exerts a significant influence on PPAA. The interaction of IQ and locality is also significant at 0.01 level (F-value 5.11). Thus it may be concluded that intelligence and locality when combined, together influence PPAA of students significantly.

(3) Influence of Intelligence and Management of Schools on PPAA

From Table 4.62.1 it is evident that the mean scores for subjects classified by management and level of intelligence show differences among the three intelligence levels (Low, Average and High). However this is not seen very much between managements.

Table 4.62.1 **Mean and Variance for PPAA Scores - Classified by 3 Levels of IQ and Management of School**

Management	Low IQ	Average IQ	High IQ
Government	6.74 (8.70)	11.68 (10.55)	14.26 (16.71)
Private	6.46 (11.72)	11.73 (13.07)	14.13 (16.07)

This is supported by the ANOVA results reported in Table 4.62.2. The F-value of 231.96 is significant at 0.01 level which shows that the difference in mean scores among intelligence levels is significant. So it may be concluded that there is a significant influence of intelligence on PPAA. The F-value of 0.08 is not significant and this leads to the conclusion that management exerts no significant influence on PPAA. The interaction of intelligence and management is not significant (F-value 0.15). So it can be concluded that intelligence and management when combined, together do not influence the PPAA of pupils.

Table 4.62.2 **ANOVA for PPAA Scores - Classified by IQ and Management of Schools**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Management adj.	0.98	1	0.98	0.08
IQ adj.	6061.07	2	3030.54	231.96*
Interaction	3.99	2	1.99	0.15
Within	6065.88	5	-	-
Error	13195.34	1010	-	-
Total	19261.22	1015	-	-

* - Significant at 0.01 level.

(4) Influence of Socio-Economic Status and Sex on PPAA

The effect of sex and socio-economic status on PPAA was studied using two-way ANOVA and summary of analysis data is presented in Table 4.63.2.

Table 4.63.1 **Mean and Variance for PPAA Scores - Classified by 3 Levels of SES and Sex**

Sex	Low SES	Average SES	High SES
Male	10.53 (19.32)	11.34 (15.42)	13.94 (18.25)
Female	10.16 (16.30)	11.11 (18.33)	13.54 (15.47)

Table 4.63.2 **ANOVA for PTA Scores - Classified by SES and Sex**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Sex adj.	25.76	1	25.76	1.49
SES adj.	1828.37	2	914.18	53.06*
Interaction	1.45	2	0.72	0.04
Within	1858.77	5	-	-
Error	17402.45	1010	-	-
Total	19261.22	1015	-	-

* - Significant at 0.01 level.

Table 4.63.1 shows the mean scores of subjects classified by sex and levels of socio-economic status (Low, Average and High). The mean scores of subjects show differences among the three levels of SES. However there is not much difference in the mean scores of boys and girls.

This is further established by the ANOVA results reported in Table 4.63.2. While the difference in mean scores among SES levels is significant at 0.01 level (F-value 53.060 the same is not significantly different between sex. This leads to the conclusion that the means of PPAA scores differ significantly for all the three levels of SES and therefore SES exerts a significant influence on PPAA. Since the difference in mean scores between sex is not significant (F-value 1.49), it can be legitimately concluded that sex exerts no significant influence on PPAA. The interaction of sex and SES is not significant (F-value 0.04). So it may be concluded that the combined influence of sex and SES on PPAA is not significant.

(5) Influence of Socio-Economic Status and Locality of Schools on PPAA

Table 4.64.1 shows the mean scores of subjects classified by locality and levels of socio-economic status (Low, Average and High). The mean scores for subjects show differences among the three levels of SES. This is also noticeable between urban and rural school subjects.

Table 4.64.1 **Mean and Variance for PPAA Scores - Classified by 3 Levels of SES and Locality of School**

Locality	Low SES	Average SES	High SES
Urban	11.96 (18.45)	12.91 (19.16)	15.11 (20.96)
Rural	8.96 (13.16)	9.64 (9.41)	12.04 (6.67)

Table 4.64.2 **ANOVA for PTA Scores - Classified by SES and Locality of School**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Locality adj.	2490.78	1	2490.78	168.44*
SES adj.	1519.95	2	759.98	51.39*
Interaction	3.47	2	1.73	0.12
Within	4325.81	5	-	-
Error	14935.41	1010	-	-
Total	19261.22	1015	-	-

* - Significant at 0.01 level

The ANOVA results presented in Table 4.64.2 further establish this. The influence of SES is significant at 0.01 level (F-value 51.39) which indicates that SES exerts a significant influence on PPAA. The difference in mean scores between locality is also significant at 0.01 level (F-value 168.44). So it can be concluded that locality also exerts a significant influence on PPAA. Therefore it can be inferred that the performance of urban and rural school pupils differ significantly in this respect. The interaction of SES and locality is not significant (F-value 0.12) which leads to the conclusion that these two when combined together do not affect the PPAA of pupils.

(6) Influence of Socio-Economic Status and Management of Schools on PPAA

Table 4.65.1 **Mean and Variance for PPAA Scores - Classified by 3 Levels of SES and Management of School**

Management	Low SES	Average SES	High SES
Government	10.53 (18.29)	11.27 (16.57)	13.76 (14.83)
Private	10.14 (17.30)	11.19 (17.04)	13.73 (18.86)

From Table 4.65.1 it is evident that the means of PPAA scores differ for all three levels of socio-economic status (Low, Average and High). But this is not seen very much between managements.

Table 4.65.2 **ANOVA for PPAA Scores - Classified by SES and Management of School**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Management adj.	6.28	1	6.28	0.36
SES adj.	1837.03	2	918.51	53.26*
Interaction	5.47	2	2.74	0.16
Within	1843.31	5	-	-
Error	17417.91	1010	-	-
Total	19261.22	1015	-	-

* - Significant at 0.01 level

The ANOVA results presented in Table 4.65.2 further establish these facts. The difference in mean scores among SES levels is significant at 0.01 level (F-value 53.26). This leads to the conclusion that SES exerts a significant influence on PPAA. Since the difference in mean scores between management is not significant (F-value 0.36), it can be legitimately concluded that management of school exerts no significant influence on PPAA. The interaction of

SES and management is also not significant (F-value 0.16). This leads to the conclusion that SES and management when combined, together do not influence the performance of children significantly regarding PPAA.

(7) Influence of Resource Utilization and Sex on PPAA

It is seen from Table 4.66.1 that the mean scores for subjects classified by sex and levels of resource utilization show differences among low and average resource utilization levels (Low, Average and High). Though there is not much difference is seen in the mean scores for subjects classified by the 'Low' and 'Average' resource utilization levels, one can see considerable difference in the mean score for subjects classified under the 'High' resource utilization level. However this is not seen very much between sex.

Table 4.66.1 **Mean and Variance for PPAA Scores - Classified by 3 Levels of IQ and Sex**

Sex	Low Resource utilization	Average Resource utilization	High Resource utilization
Male	9.42 (10.76)	11.88 (12.22)	14.75 (20.84)
Female	9.33 (11.08)	11.23 (10.49)	14.38 (21.90)

Table 4.66.2 **ANOVA for PPAA Scores - Classified by Resource Utilization and Sex**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Sex adj.	32.00	1	32.00	2.22
Resource utilization adj.	4667.13	2	2333.56	161.97*
Interaction	13.28	2	6.64	0.46
Within	4709.36	5	-	-
Error	14551.86	1010	-	-
Total	19261.22	1015	-	-

* - Significant at 0.01 level.

The ANOVA results reported in Table 4.66.2 throw more light on these facts. While the difference in mean scores among resource utilization levels is significant at 0.01 level (F-value 161.97) the same is not significantly different between sex (F-value 2.22). So it may be concluded that resource utilization exerts a significant influence on PPAA. But the influence of sex is not significant. With a non-significant interaction of resource utilization and sex, it may be concluded that these two when combined, together do not affect the PPAA of pupils.

(8) Influence of Resource Utilization and Locality of School on PPAA

Table 4.67.1 **Mean and Variance for PPAA Scores - Classified by 2 Levels of Resource Utilization and Locality of School**

Locality	Low Resource Utilization	Average Resource Utilization
Urban	9.33 (10.26)	12.21 (13.06)
Rural	9.38 (11.04)	11.13 (9.92)

Table 4.67.2 **ANOVA for PPAA Scores - Classified by Resource Utilization and Locality of School**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Locality adj.	50.96	1	50.96	1.59
Resource utilization adj.	660.56	1	660.56	59.43*
Interaction	38.96	1	38.96	3.51
With in	924.87	3	-	-
Error	7725.43	695	-	-
Total	8650.29	698	-	-

* - Significant at 0.01 level

It is seen from Table 4.67.1 that the mean scores for subjects classified by locality and level of resource utilization show differences among the 'Low' 'Average' Resource Utilization levels. This is not seen very much between the urban and rural school subjects. Here only two levels of resource utilization were considered because there were no rural schools classified under 'High Resource Utilization' category in the sample selected. However the mean score for PPAA of urban school subjects coming under 'High Resource Utilization' level was found to be 14.59 which was more than that of subjects from schools coming under 'Low' and 'Average' Resource Utilization levels (9.33 and 12.21 respectively).

The ANOVA results reported in Table 4.67.2 make it clearer. The difference in mean scores among the two levels of resource utilization (Low and Average) is significant (F-value 59.43). So it can be concluded that resource utilization exerts a significant influence on PPAA. Since the difference in mean scores is not significantly different between localities, it can be inferred that locality dies not have significant influence in PPAA. The interaction of locality and resource utilization is not significant (F-value 3.51). So the combined influence of these two variables on PPAA is not significant.

(9) Influence of Resource Utilization and Management of School on PPAA

Table 4.68.1 **Mean and Variance for PPAA Scores - Classified by 3 Levels of Research Utilization and Management of School**

Management	Low Resource Utilization	Average Resource Utilization	High Resource Utilization
Government	9.41 (10.40)	11.61 (10.44)	14.56 (20.87)
Private	9.34 (11.45)	11.53 (12.54)	14.58 (21.94)

Table 4.68.2 **ANOVA for PPAA Scores - Classified by Resource Utilization and Management of Schools**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Management adj.	0.53	1	0.53	0.04
Resource utilization adj.	4663.80	2	2331.90	161.36*
Interaction	0.47	2	0.23	0.02
With in	4665.08	5	-	-
Error	14596.14	1010	-	-
Total	19261.22	1015	-	-

* - Significant at 0.01 level.

It is seen from Table 4.68.1 that the mean scores for subjects classified by management and levels of resource utilization show difference among the three resource utilization levels (Low, Average and High). The mean scores for subjects classified under the 'High' Resource Utilization level is more than that for the subjects classified under the 'Low and Average' Resource Utilization levels. However the means of PPAA scores do not differ very much between managements.

The ANOVA results reported in Table 4.68.2 support the above observations. The F-value of 161.36 is significant at 0.01 level which shows that the difference in mean scores among the resource utilization levels is significant. Hence it may be concluded that the resource utilization exerts a significant influence in PPAA. The F-value of 0.04 for management is not significant which indicates that there is no significant difference between the performance of government school children and private school children regarding PPAA. With a non-significant interaction, (F-value 0.02), it may be concluded that resource utilization and management when combined, together do not exert a significant influence on PPAA.

4.2.1.3 Relationship Between Physics Theory Awareness (PTA) and Physics Practical Application Awareness (PPAA) (for Standard IX)

The relationship between PTA and PPAA was studied by correlating the scores obtained in the two tests PAT and PPAAT using Person's Product Moment Coefficient of Correlation. The 'r' value, was calculated for the total sample. 'r' values were calculated separately by correlating the scores of boys, girls, pupils belonging to urban schools, rural schools, government schools, private schools, 'Low Resource Utilization' schools, 'Average Resource Utilization' schools and 'High Resource Utilization' schools. These are presented in Table

From Table 4.69 it can be noticed that the mean score of standard IX pupils for PPAA was less than that for PTA. This seems to be true in the case of all the groups studied.

The mean score for PPAA of pupils from 'High' Resource Utilization schools was more than that of pupils from 'Average' and 'Low' Resource Utilization schools. Comparing the performance of pupils from 'Average' and 'Low' Resource Utilization schools in PPAA, the pupils from latter schools performed better. Regarding PTA also, the mean score of pupils from 'High' Resource Utilization schools was more than that of the other two types.

Table 4.69 **Mean, Standard Deviation and Coefficient of Correlation of PTA scores and PPAA scores**

Group	Mean and S.D. for PTA scores	Mean and S.D. for PPAA scores	'r' value
Total sample	16.81 (5.02)	11.69 (4.35)	0.85
Boys	16.80 (5.03)	1.85 (4.38)	0.85
Girls	16.82 (5.00)	11.52 (4.33)	0.84
Urban	18.08 (5.05)	13.35 (4.60)	0.86
Rural	15.53 (4.64)	10.03 (3.36)	0.81
Government	16.89 (5.00)	11.71 (4.27)	0.83
Private	16.72 (5.03)	11.66 (4.44)	0.85
Low Resource Utilization	14.97 (4.70)	9.38 (3.30)	0.80
Average Resource Utilization	16.82 (4.49)	11.57 (3.39)	0.80
High Resource Utilization	18.98 (5.01)	14.57 (4.63)	0.89

(Standard deviation values given in brackets)

It can be further noticed from Table 4.69 that the 'r' value obtained by correlating the scores for PTA and PPAA is very high ('r' value 0.85) for the total sample.

This shows that there is a high positive relationship between PTA and PPAA. This is further confirmed by the high correlation coefficients obtained when the scores for PTA and PPAA were correlated for different groups. For 'High' Resource Utilization group the 'r' value obtained was 0.89 which shows a very high correlation between PTA and PPAA.

From the above discussion it is evident that pupils' PPAA is not satisfactory compared to their PTA. Pupils from 'High' Resource Utilization schools have a better PPAA than pupils from 'Average' and 'Low' Resource Utilization schools. It also emerges that there exists a high positive relationship between Physics Theory Awareness (PTA) and Physics Practical Application Awareness (PPAA).

4.2.2 Section B

This section of Part II deals with the analyses of Physics Theory Awareness Test (PTAT) scores and Physics Practical Application Awareness Test (PPAAT) scores of standard X pupils.

4.2.2.1 Analysis of Physics Theory Awareness Test (PTAT) Scores of Standard X Students

(1) Influence of Intelligence and Sex on Physics Theory Awareness (PTA)

The effect of sex and IQ on physics theory awareness was studied using two way ANOVA. The summary of analysis of variance data is presented in Table 4.70.2. The F-values were computed using conventional procedures.

Table 4.70.1 **Mean and Variance for PTA Scores - Classified by 3 Levels of IQ and Sex**

Sex	Low IQ	Average IQ	High IQ
Male	12.94 (11.39)	17.38 (18.01)	21.68 (18.78)
Female	13.11 (9.38)	17.18 (16.99)	21.40 (16.09)

Table 4.70.2 **ANOVA for PTA Scores - Classified by IQ and Sex**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Sex adj.	8.17	1	8.17	0.49
IQ adj.	8095.67	2	4047.83	244.61*
Interaction	5.27	2	2.64	0.159
Within	8112.59	5	-	-
Error	16779.56	1014	-	-
Total	24892.16	1019	-	-

* - Significant at 0.01 level.

It is seen from Table 4.70.1 that the mean scores for subjects classified by sex and level of intelligence show differences among various intelligence levels (Low, Average and High). However this is not seen very much between sex. This is further established by the ANOVA results reported in Table 4.70.2. While the difference in mean scores among intelligence levels is significant at 0.01 level (F-value 244.6), the same is not significantly different between sex. This leads to the conclusion that the means of Physics Theory Awareness (PTA) scores differ significantly for all the three levels of IQ. It is therefore concluded that IQ exerts a significant influence on physics theory awareness. Since the difference in mean scores between sex is not significant (F-value 0.49), it can be legitimately concluded that sex exerts no significant influence on physics theory awareness. This leads to the conclusion that the male child and female child perform in the same way. The interaction of sex and IQ is also not significant (F-value 0.16) that IQ of sex. So it can be concluded that the interaction effect of IQ and sex on PTA is not significant.

(2) Influence of Intelligence and Locality of School on PTA

The effect of locality (urban/rural) and IQ on physics theory awareness was studied and the data is presented in Tables 4.71.1 and 4.71.2.

Table 4.71.1 **Mean and Variance for PTA Scores - Classified by 3 Levels of IQ and Locality of School**

Locality	Low IQ	Average IQ	High IQ
Urban	13.7 (8.75)	18.08 (17.08)	22.72 (16.43)
Rural	12.40 (11.04)	16.41 (16.51)	20.12 (14.97)

Table 4.71.2 **ANOVA for PTA Scores - Classified by IQ and Locality of School**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Locality adj.	939.80	1	939.80	60.34*
IQ adj.	7875.06	2	3937.53	252.82*
Interaction	60.57	2	30.29	1.94
Within	9099.53	5	-	-
Error	15792.63	1014	-	-
Total	24892.16	1019	-	-

* - Significant at 0.01 level

From Table 4.71.1 it is seen that the mean scores for subjects classified by locality and levels of intelligence show differences among various intelligence levels (Low, Average and High). The mean scores also differ for urban and rural school subjects. The ANOVA results reported in Table 4.71.2 further establish these facts. The difference in mean scores among the three intelligence levels is significant at 0.01 level (F-value 252.82) and so it may be concluded that there is a significant effect of IQ on performance. The F-ratio of 60.34 for locality is also significant at 0.01 level. This indicates that the urban and rural school pupils differ in their performance. The interaction of locality and IQ is not significant (F-value 1.94). Thus it may be concluded that intelligence and locality when combined, do not influence the performance significantly.

(3) Influence of Intelligence and Management of Schools on Physics Theory Awareness (PTA)

Table 4.72.1 **Mean and Variance for PTA Scores - Classified by 3 Levels of IQ and Management of School**

Management	Low IQ	Average IQ	High IQ
Government	13.03 (10.41)	17.43 (17.09)	21.48 (16.31)
Private	13.02 (10.31)	17.13 (17.88)	21.61 (18.61)

Table 4.72.2 **ANOVA for PTA Scores - Classified by IQ and Management of Schools**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Management adj.	3.64	1	3.61	0.22
IQ adj.	8089.21	2	4044.60	244.43*
Interaction	10.48	2	5.24	0.32
Within	8113.28	5	-	-
Error	16778.88	1014	-	-
Total	24892.16	1019	-	-

* - Significant at 0.01 level.

The effect of management (government/private) and IQ on physics theory awareness was studied and the data is presented in Tables 4.72.1 and 4.72.2.

From Table 4.72.1 it is evident that the mean scores for subjects classified by management and level of intelligence show differences among the three intelligence levels (Low, Average and High). However this difference is not much between managements. This is supported by the ANOVA results reported in Table 4.72.2. The F-value of 244.43 is significant at 0.01 level which shows that the difference in mean scores among intelligence levels is significant. So it may be concluded that there is a significant effect of intelligence on performance. The F-value of 0.22 for management is not significant. This indicates that management exerts no significant influence on performance. The interaction of management and intelligence is not significant (F-value 0.32).

(4) Influence of Socio-Economic Status (SES) and Sex on Physics Theory Awareness (PTA)

The summary of the analysis of variance data to study the effect of sex and SES on physics theory awareness is presented in Table 4.73.2.

Table 4.73.1 **Mean and Variance for PTA Scores - Classified by 3 Levels of SES and Sex**

Sex	Low SES	Average SES	High SES
Male	16.58 (21.56)	16.82 (19.53)	21.68 (19.69)
Female	16.23 (18.06)	17.01 (20.00)	20.96 (19.30)

Table 4.73.2 **ANOVA for PTA Scores - Classified by SES and Sex**

Source	um of squares	Degrees of freedom	Mean square	F-value
Sex adj.	9.88	1	9.88	0.50
SES adj.	4752.76	2	2376.38	120.02*
Interaction	51.43	2	25.72	1.30
Within	4815.84	5	-	-
Error	20076.31	1014	-	-
Total	24892.16	1019	-	-

* - Significant at 0.01 level.

It is evident from Table 4.73.1 that the mean scores for subjects classified by sex and level of socio-economic status show differences among the three levels of SES (Low, Average, High). However this is not seen very much between sex. This is further established by the ANOVA results reported in Table 4.73.2. The difference in mean scores among socio-economic status levels is significant at 0.01 level (F-value 120.02). This leads to the conclusion that socio-economic status exerts a significant influence on physics theory awareness. But the difference in mean scores between sex is not significant (F-value 0.50). So it is concluded that sex exerts no significant influence on physics theory awareness. This leads to the conclusion that the performance of a male child is not different from that of a female child. The interaction of sex and SES is also not significant (F-value 1.3). So it can be concluded that the combined influence of SES and sex on PTA is not significant.

(5) Influence of Socio-Economic Status (SES) and Locality of School on PTA

Table 4.74.1 **Mean and Variance for PTA Scores - Classified by 3 Levels of SES and Locality of School**

Locality	Low SES	Average SES	High SES
Urban	17.10 (17.72)	17.69 (20.03)	22.24 (20.20)
Rural	15.79 (20.80)	15.92 (17.88)	19.99 (16.10)

It is evident from Table 4.74.1 that the mean scores of subjects classified by locality and levels of socio-economic status (SES) show differences among the three levels (Low, Average and High). The difference in mean score is also seen between urban and rural subjects. This is further established by the ANOVA results reported in

Table 4.74.2. The difference in mean scores among the socio-economic status levels is significant at 0.01 level (F-value 115.29). This leads to the conclusion that socio-economic status exerts a significant influence on physics theory awareness. The difference in mean scores between locality is also significant at 0.01 level (F-value 41.98). So it may be concluded that locality also exerts a significant influence on performance. This leads to the conclusion that the performance of urban child is different from that of a rural child. The interaction of locality and socio-economic status is not significant (F-value 0.87) which shows that socio-economic status and locality when combined, together do not affect the performance significantly.

Table 4.74.2 **ANOVA for PTA Scores - Classified by SES and Locality of School**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Locality adj.	799.21	1	799.21	41.98*
SES adj.	4389.83	2	2194.92	115.29*
Interaction	33.17	2	16.58	0.87
Within	5586.91	5	-	-
Error	19305.25	1014	-	-
Total	24892.16	1019	-	-

* - Significant at 0.01 level

(6) **Influence of Socio-Economic Status (SES) and Management of School on PTA**

The influence of management and socio-economic status on PTA was studied and summary of data is presented in Tables 4.75.1 and 4.75.2.

From Table 4.75.1, it is clear that the means of physics theory awareness scores differ significantly for the three levels (Low, Average and High), while this is not seen very much between managements.

Table 4.75.1 **Mean and Variance for PTA Scores - Classified by 3 Levels of SES and Management of School**

Management	Low SES	Average SES	High SES
Government	16.71 (18.72)	17.15 (20.55)	21.06 (19.61)
Private	16.07 (20.72)	16.54 (18.51)	21.56 (19.51)

This observation is further confirmed by the ANOVA results reported in Table 4.75.2. The effect of SES is significant at 0.01 level (F-value 120.40). So it can be legitimately concluded that SES exerts significant influence on PTA. The effect of management is not significant (F-value 1.02). So it can be inferred that the performance of government school pupils is not significantly different from that of private school pupils. The interaction of management and socio-economic status is not significant (F-value 1.73).

Table 4.75.2 **ANOVA for PTA Scores Classified by SES and Management of School**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Management adj.	20.11	1	20.11	1.02
SES adj.	4761.05	2	2380.52	120.40*
Interaction	68.33	2	34.16	1.73
Within	4842.97	5	-	-
Error	20049.19	1014	-	-
Total	24892.16	10109	-	-

* - Significant at 0.01 level

(7) Influence of resource utilization and sex on PTA

The influence of sex and resource utilization was studied and the summary of analysis of variance data is presented in Table 4.76.2.

It is clear from Table 4.76.1 that the mean scores for subjects classified by sex and level of resource utilization show differences among the three resource utilization levels (Low, Average and High). Though there is not much difference in the mean scores for subjects coming from schools of 'Low' and 'Average' Resource Utilization levels, one can see considerable difference in the mean score for subjects coming from schools of 'High Resource Utilization' level. However this is not seen very much between sex.

Table 4.76.1 **Mean and Variance for PTA Scores - Classified by 3 Levels of Resource Utilization and Sex**

Sex	Low Resource utilization	Average Resource utilization	High Resource utilization
Male	16.70 (23.86)	17.67 (21.10)	20.44 (24.18)
Female	16.69 (20.56)	17.69 (20.39)	20.01 (23.39)

Table 4.76.2 **ANOVA for PTA Scores - Classified by Resource Utilization and Sex**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Sex adj.	4.20	1	4.20	0.19
Resource utilization adj.	2225.76	2	1112.88	49.83*
Interaction	9.90	2	4.95	0.22
Within	2447.31	5	-	-
Error	22644.85	1014	-	-
Total	24892.16	1019	-	-

* - Significant at 0.01 level.

This is made more clear by the ANOVA results reported in Table 4.76.2. While the difference in mean scores among resource utilization levels is significant at 0.01 level (F-value 49.83), the same is not significant between sex (F-value 0.19). So it can be concluded that the resource utilization exerts a significant influence on PTA while sex exerts no significant influence on PTA. The interaction of resource utilization and sex is found to be non significant (F-value 0.22). So it can be concluded that sex and resource utilization when combined, together do not exerts a significant influence on PTA.

(8) Influence of Resource Utilization and Locality of School on PTA

Table 4.77.1 **Mean and Variance for PTA Scores - Classified by 2 Levels of Resource Utilization and Locality of School**

Locality	Low Resource Utilization	Average Resource Utilization
Urban	16.81 (22.29)	17.88 (21.45)
Rural	16.67 (22.11)	17.49 (19.94)

Table 4.77.2 **ANOVA for PTA Scores - Classified by Resource Utilization and Locality of School**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Locality adj.	11.93	1	11.93	0.55
Resource utilization adj.	125.09	1	125.09	5.80*
Interaction	1.651	1	1.651	0.77
Within	190.161	3	-	-
Error	14750.78	693	-	-
Total	15140.94	696	-	-

* - Significant at 0.01 level

It is seen from Table 4.77.1 that the mean scores for subjects classified by locality and level of resource utilization show differences among the 'Low Resource Utilization' level and 'Average Resource Utilization' level. There is not much difference between the mean scores of urban and rural school subjects. Here only two levels of resources utilization were considered because there were no rural schools classified under 'High Resource Utilization' category in the sample selected (pointed out in Chapter III). However the mean score for PTA for urban school subjects coming under 'High Resource Utilization' level was 20.21 which was more than that of subjects from schools, coming under 'Low Resource Utilization' and 'Average Resource Utilization' levels (16.81 and 17.88 respectively).

The ANOVA results reported in Table 4.77.2 establish this observation further. While the difference in mean scores among these two levels of resource utilization (Low and Average) is significant (F-value 5.80), the same is not significantly different between localities. So it may be legitimately concluded that resource utilization exists a significant influence on PTA. But there is no significant influence of locality on PTA. The interaction of locality and resource utilization is not significant, which indicates that the combined influence of these two variance on PTA is not significant.

(9) Influence of Resource Utilization and Management of School on PTA

Table 4.78.1 **Mean and Variance for PTA Scores - Classified by 3 Levels of Research Utilization and Management of School**

Management	Low Resource Utilization	Average Resource Utilization	High Resource Utilization
Government	16.71 (20.16)	17.87 (20.10)	20.47 (23.09)
Private	16.68 (24.19)	17.48 (21.34)	19.99 (24.45)

Table 4.78.2 **ANOVA for PTA Scores - Classified by Resource Utilization and Management of Schools**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Management adj.	20.09	1	20.09	0.90
Resource utilization adj.	2239.72	2	1119.86	50.18*
Interaction	10.22	2	5.11	0.23
Within	2263.53	5	-	-
Error	22628.63	1014	-	-
Total	24892.16	1019	-	-

* - Significant at 0.01 level.

The influence of management and resource utilization was studied using ANOVA and the summary of analysis data is presented in Table 4.78.2.

It is evident from Table 4.78.1 that the means of PTA scores differ for all the three levels of resource utilization (Low, Average and High). But the means of PTA scores do not differ very much between managements.

This is further established by the results reported in Table 4.78.2. While the difference in mean scores among resource utilization levels is significant at 0.01 level (F-value 50.18), the same is not significantly different between managements (F-value 0.90). This leads to the conclusion that resource utilization exerts a significant influence on PTA while management exerts no significant influence on PTA. The interaction of management and resource utilization is also not significant (F-value 0.23).

4.2.2.2 Analysis of Physics Practical Application Awareness Test (PPAAT) Standard X Students

(1) Influence of Intelligence and Sex on Physics Practical Application Awareness (PPAA)

The effect of sex and intelligence on physics practical application awareness was studied using two-way ANOVA and the summary of analysis of data is presented in Tables 4.79.1 and 4.79.2.

Table 4.79.1 **Mean and Variance for PPAA Scores - Classified by 3 Levels of IQ and Sex**

Sex	Low IQ	Average IQ	High IQ
Male	7.66 (6.60)	11.49 (13.89)	14.86 (19.64)
Female	7.64 (4.42)	11.33 (13.72)	14.80 (17.07)

It is seen from Table 4.79.1 that the mean scores for subjects classified by sex and level of intelligence show difference among the three intelligence levels (Low, Average, High). However this is not seen very much between sex.

Table 4.79.2 **ANOVA for PPAA Scores - Classified by IQ and Sex**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Sex adj.	2.79	1	2.79	0.20
IQ adj.	5643.23	2	2821.61	198.59*
Interaction	0.90	2	0.45	0.03
Within	5648.70	5	-	-
Error	14407.16	1014	-	-
Total	20055.86	1019	-	-

* - Significant at 0.01 level.

This is made more clear by the ANOVA results reported in Table 4.79.2. The difference in mean scores among intelligence levels is significant at 0.01 level (F-value 198.89). This leads to the conclusion that the means of PPAA scores different significantly for all the three levels of IQ. It is therefore concluded that IQ exerts a significant influence on physics practical application awareness since the difference in mean scores between sex is not significant (F-value 0.20), it can be legitimately concluded that sex results no significant influence on PPAA. The performance of the male children is not significantly different from the performance of female children. The interaction of sex and intelligence is not significant (F-value 0.03).

(2) Influence of Intelligence and Locality of Schools on PPAA

Table 4.80.1 **Mean and Variance for PPAA Scores - Classified by 3 Levels of IQ and Locality of School**

Locality	Low IQ	Average IQ	High IQ
Urban	8.40 (4.84)	12.75 (14.51)	16.72 (20.23)
Rural	6.95 (5.04)	9.93 (8.88)	12.55 (6.56)

The effect of intelligence and locality of school on PPAA is studied using two-way ANOVA. The summary analysis data is presented in Tables 4.80.1 and 4.80.2.

It is seen from Table 4.80.1 that the mean scores for subjects classified by locality and level of intelligence show differences among the three intelligence levels (Low, Average and High). The difference in mean scores is also seen between urban and rural subjects.

Table 4.80.2 **ANOVA for PPAA Scores - Classified by IQ and Locality of School**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Locality adj.	2395.52	1	2395.52	205.68*
IQ adj.	5353.46	2	2676.73	229.82*
Interaction	205.28	2	102.64	8.81*
Within	8245.81	5	-	-
Error	11810.05	1014	-	-
Total	20055.86	1019	-	-

* - Significant at 0.01 level

The ANOVA results reported in Table 4.80.2 further establish these facts. The difference in mean scores among the three levels of intelligence is significant at 0.01 level (F-value 229.82). This leads to the conclusion that IQ exerts a significant influence on PPAA. The difference is mean scores between locality is also significant at 0.01 level (F-value 205.68). Therefore it can be concluded that locality also exerts a significant influence on PPAA. The interaction of locality and IQ is significant at 0.01 level (F-value 8.81). This indicates that the combined influence on IQ and locality on PPAA is significant.

(3) **Influence of Intelligence and Management of Schools on PPAA**

Table 4.81.1 **Mean and Variance for PPAA Scores - Classified by 3 Levels of IQ and Management of School**

Management	Low IQ	Average IQ	High IQ
Government	7.52 (5.79)	11.43 (13.76)	14.72 (17.95)
Private	7.76 (5.15)	11.39 (13.86)	14.95 (18.72)

Table 4.81.2 **ANOVA for PPAA Scores - Classified by IQ and Management of Schools**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Management adj.	2.15	1	2.15	0.15
IQ adj.	5647.17	2	2823.59	198.77*
Interaction	4.49	2	2.24	0.16
Within	5651.66	5	-	-
Error	14404.20	1014	-	-
Total	20055.86	1019	-	-

* - Significant at 0.01 level.

It is evident from Table 4.81.1 that the mean scores for subjects classified by management and level of intelligence show differences among the three intelligence level (Low, Average and High). However this is not seen very much between sex.

This is further established by the ANOVA results reported in Table 4.81.2. While the difference in mean scores among intelligence levels is significant at 0.01 level (F-value 198.77), the same is not significantly different between sex. This leads to the conclusion that the means of PPAA scores differ significantly for all the three levels of IQ. Therefore it can be concluded that IQ exerts a significant influence of PPAA. Since the difference in mean scores between managements is not significant (F-value 0.15) it may be legitimately concluded that management exerts no significant influence on PPAA. This leads to the conclusion that male children and female children perform in the same way. The interaction of sex and IQ is not significant (F-value 0.16). Thus it may be concluded that intelligence and management when combined, together do not affect the performance of the children significantly.

(4) Influence of Socio-Economic Status and Sex on PPAA

Table 4.82.1 **Mean and Variance for PPAA Scores - Classified by 3 Levels of SES and Sex**

Sex	Low SES	Average SES	High SES
Male	10.49 (14.63)	10.89 (14.51)	15.09 (19.74)
Female	10.42 (13.96)	10.95 (14.02)	14.71 (19.24)

Table 4.82.2 **ANOVA for PTA Scores - Classified by SES and Sex**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Sex adj.	3.58	1	3.58	0.22
SES adj.	3842.61	2	1921.31	120.26*
Interaction	8.70	2	4.35	0.27
Within	3885.89	5	-	-
Error	16199.97	1014	-	-
Total	20055.86	1019	-	-

* - Significant at 0.01 level.

Table 4.82.1 shows the mean scores of objects classified by sex and levels of socio-economic status (Low, Average and High). The mean scores for subjects show differences among the three levels of SES. It is seen that there is not much difference between the mean scores of subjects classified by the low SES subjects and average SES subjects. But the mean scores of subjects classified by the high SES show difference from the other two levels. However there is not much difference in the mean scores of boys and girls at each level.

This is again made clear by the ANOVA results reported in Table 4.82.2. The effect of SES is significant at 0.01 level (F-value 120.26). This leads to the conclusion that the means of PPAA scores differ significantly for the three levels of SES. Therefore it can be concluded that socio-economic status exerts a significant influence on PPAA. The difference in mean scores between sex is not significant (F-value 0.22). This leads to the conclusion that the performance of male children and female children are not significantly different from each other. With a non-significant interaction of sex and SES (F-value 0.27), it is concluded that the combined influence of SES and sex on PPAA is not significant.

(5) Influence of Socio-Economic Status and Locality of Schools on PPAA

Table 4.83.1 **Mean and Variance for PPAA Scores - Classified by 3 Levels of SES and Locality of School**

Locality	Low SES	Average SES	High SES
Urban	11.73 (15.83)	12.14 (16.04)	16.55 (21.11)
Rural	9.35 (10.34)	9.58 (8.89)	12.55 (7.88)

Table 4.83.2 **ANOVA for PTA Scores - Classified by SES and Locality of School**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Locality adj.	2175.88	1	2175.88	158.59*
SES adj.	3322.42	2	1666.21	121.44*
Interaction	124.16	2	62.08	4.53**
Within	6143.66	5	-	-
Error	13912.20	1014	-	-
Total	20055.86	1019	-	-

*-Significant at 0.01 level; **-Significant at 0.05 level

It is evident from the Table 4.83.1 that the mean scores of objects classified by locality and level of socio-economic status (SES) show differences among the three SES levels (Low, Average and High). This difference is also noticeable between urban and rural subjects

The ANOVA results reported in Table 4.83.2 also establish this. The effect of SES is significant at 0.01 level (F-value 121.44). This indicates that SES exerts a significant influence on PPAA. The difference in mean scores between locality is also significant at 0.01 level (F-value 158.59). So it may be concluded that locality also exerts a significant influence on PPAA. Therefore it is inferred that the performance of urban school pupils is significantly different from that of rural school pupils. The interaction of locality and SES is significant at 0.05 level (F-value 4.63). This indicates that the combined influence of SES and locality of school on PPAA is significant.

(6) Influence of Socio-Economic Status and Management of Schools on PPAA

From Table 4.84.1, it is clear that the means of PPAA scores differ significantly for all the three levels of socio-economic status (Low, Average and High). But this is not seen very much between managements (Government/private).

Table 4.84.1 **Mean and Variance for PPAA Scores - Classified by 3 Levels of SES and Management of School**

Management	Low SES	Average SES	High SES
Government	10.81 (15.91)	10.96 (15.15)	14.59 (19.01)
Private	10.08 (12.31)	10.88 (13.34)	15.22 (14.84)

Table 4.84.2 **ANOVA for PPAA Scores - Classified by SES and Management of School**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Management adj.	0.60	1	0.60	0.04
SES adj.	3844.21	2	1922.11	120.75*
Interaction	70.72	2	35.36	2.22
Within	3914.94	5	-	-
Error	16140.92	1014	-	-
Total	20055.86	1019	-	-

* - Significant at 0.01 level

This is further made clear by ANOVA results reported in Table 4.84.2. The effect of SES is significant at 0.091 level (F-value 120.75). To it may be concluded that SES exerts a significant influence on PPAA. The effect of management is not significant (F-value 0.04). So it can be inferred that the performance of government school pupils is not significantly different from that of private school pupils regarding PPAA. The interaction of management and SES is also not significant (F-value 2.22) which leads to the conclusion that management and SES when combined together do not affect the PPAA of pupils significantly.

(7) Influence of Resource Utilization and Sex on PPAA

It is observed from Table 4.85.1 that the mean scores of subjects classified by sex and level of resource utilization show differences among the three levels of resource utilization (Low, Average and High). Though there is not much difference in the mean scores for subjects coming from schools of Low and Average resource utilization levels, one can see considerable difference in the mean score for subjects coming from school of 'High resource utilization' level. But this is not seen very much between sex.

Table 4.85.1 **Mean and Variance for PPAA Scores - Classified by 3 Levels Resource of Utilization and Sex**

Sex	Low Resource utilization	Average Resource utilization	High Resource utilization
Male	9.95 (10.72)	10.96 (10.54)	15.62 (21.80)
Female	10.11 (10.22)	11.05 (10.63)	15.33 (23.06)

Table 4.85.2 **ANOVA for PPAA Scores - Classified by Resource Utilization and Sex**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Sex adj.	0.0031	1	0.0031	0.0002
Resource utilization adj.	5590.53	2	2795.27	196.14*
Interaction	9.67	2	4.83	0.34
Within	5604.78	5	-	-
Error	14451.08	1014	-	-
Total	20055.86	1019	-	-

* - Significant at 0.01 level.

This is further established by the ANOVA results reported in Table 4.85.2. While the influence of resource utilization is significant at 0.01 level (F-value 196.14), the influence of sex is not significant (F-value 0.0002). So it can be concluded that resource utilization exerts a significant influence on PPAA, while sex exerts no significant influence on PPAA. The interaction of sex and resource utilization is also not significant (F-value 0.34). So it can be concluded that resource utilization and sex when combined, together do not affect PPAA of pupils.

(8) Influence of Resource Utilization and Locality of School on PPAA

Table 4.86.1 **Mean and Variance for PPAA Scores - Classified by 2 Levels of Resource Utilization and Locality of School**

Locality	Low Resource Utilization	Average Resource Utilization
Urban	10.08 (10.14)	11.22 (10.40)
Rural	10.02 (10.53)	10.79 (10.68)

Table 4.86.2 **ANOVA for PPAA Scores - Classified by Resource Utilization and Locality of School**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Locality adj.	10.04	1	10.04	0.95
Resource utilization adj.	112.72	1	112.72	10.66*
Interaction	4.73	1	4.73	0.45
Within	172.85	3	-	-
Error	7329.36	693	-	-
Total	7502.21	696	-	-

* - Significant at 0.01 level

From Table 4.86.1 it is seen that the mean scores for subjects classified by locality of school and level resource utilization show differences among the 'Low' and 'Average' Resource Utilization levels. This is not seen very much between urban and rural school subjects. Here only two levels of resource utilization were considered because there were no rural schools classified under 'High Resource Utilization' category in the sample selected. However the mean score for PPAA of urban school subjects coming under 'High Resource Utilization' level was found to be 15.46 which was more than that of subjects from schools coming under 'Low' and 'Average' Resource Utilization levels (10.08 and 11.22 respectively).

The ANOVA results reported in Table 4.86.2 make it more clear. The differences in mean scores among the two levels of resource utilization (Low and Average) is significant (F-value 10.66). But the difference in mean scores of subjects is not significantly different between localities. So it can be concluded that resource utilization exerts a significant influence on PPAA. But the influence of locality of school on PPAA is not significant. The interaction of of resource utilization and locality is not significant (F-value 0.45). So resource utilization and locality when combined, together do not affect PPAA of pupils significantly.

(9) Influence of Resource Utilization and Management of School on PPAA

Table 4.87.1 **Mean and Variance for PPAA Scores - Classified by 3 Levels of Research Utilization and Management of School**

Management	Low Resource Utilization	Average Resource Utilization	High Resource Utilization
Government	10.06 (9.60)	11.00 (10.32)	15.60 (23.03)
Private	10.01 (11.36)	11.01 (10.88)	15.36 (21.83)

Table 4.87.2 **ANOVA for PPAA Scores - Classified by Resource Utilization and Management of Schools**

Source	Sum of squares	Degrees of freedom	Mean square	F-value
Management adj.	2.00	1	2.00	0.14
Resource utilization adj.	5597.11	2	2798.55	196.30*
Interaction	2.50	2	1.25	0.09
Within	5599.61	5	-	-
Error	14456.25	1014	-	-
Total	20055.86	1019	-	-

* - Significant at 0.01 level.

It is clear from Table 4.87.1 that the means of PPAA scores differ significantly for the three levels of resource utilization (Low, Average and High). The mean scores for subjects coming from school of 'High Resource Utilization' level is more than that for the subjects coming from school of 'Low' and 'Average' Resource Utilization levels. But the means of PPAA scores do not differ very much between managements.

The ANOVA results reported in Table 4.87.2 makes this more clear. While the difference in mean scores among resource utilization levels is significant at 0.01 level (F-value 196.30) the same is not significantly different between managements (F-value 0.14). Therefore it may be concluded that resource utilization exerts a significant influence on PPAA while the type of management exerts no significant influence on it. This leads to the conclusion that the performance of government school pupils and that of private school pupils is the same. With a non significant interaction of management and resource utilization (F-value 0.09) it may be concluded that resource utilization and management when combined, together do not affect PPAA of pupils significantly.

4.2.1.3 Relationship Between Physics Theory Awareness (PTA) and Physics Practical Application Awareness (PPAA) (for Standard X)

The relationship between PTA and PPAA was studied by correlating the scores obtained in the two tests PTAT and PPAAT using Person's Product Moment Coefficient of Correlation. The 'r' value, was calculated for the total sample. 'r' values calculated for the different groups are presented in Table 4.88.

From Table 4.88 it can be seen that the mean score of standard X pupils for PPAA was less than that for PTA. This seems to be true in the case of all the groups studied (boys, girls, urban pupils and rural pupils etc.).

Table 4.88 **Mean, Standard Deviation and Coefficient of Correlation of PTA scores and PPAA scores**

Group	Mean and S.D. for PTA scores	Mean and S.D. for PPAA scores	'r' value
Total sample	18.07 (5.00)	12.00 (4.46)	0.85
Boys	18.22 (5.05)	12.09 (4.50)	0.85
Girls	18.01 (4.81)	11.96 (4.36)	0.84
Urban	19.11 (4.96)	13.55 (4.74)	0.87
Rural	16.99 (4.66)	10.32 (3.31)	0.82
Government	18.23 (4.84)	12.03 (4.41)	0.84
Private	17.98 (5.04)	12.01 (4.46)	0.85
Low Resource Utilization	16.67 (4.70)	10.05 (3.24)	0.82
Average Resource Utilization	17.71 (4.55)	11.02 (3.25)	0.82
High Resource Utilization	20.23 (4.88)	15.48 (4.74)	0.92

(Standard deviation values given in brackets)

The mean score for PPAA of pupils from 'High' Resource Utilization schools was more than that of pupils from 'Average' and 'Low' Resource Utilization schools.

Comparing the performance of pupils from 'Low' and 'Average' Resource Utilization schools in PPAA, the pupils from latter type of schools performed better. Regarding PTA also the mean score of pupils from 'High' Resource Utilization schools was more than that of the other two types.

It can be further observed from Table 4.88 that the 'r' values obtained by correlating the scores for PTA and PPAA is very high ('r' value 0.85) for the total sample. This shows that there is a high positive relationship between PTA and PPAA. This is further confirmed by the high correlation coefficients obtained for the different groups under consideration. For 'High' Resource Utilization group the 'r' value obtained was 0.92 which shows a very high correlation between PTA and PPAA.

From the above discussion it can be concluded that pupils' PPAA is not satisfactory compared to their PTA. Pupils from 'High' Resource Utilization schools have a better PPAA than pupils from 'Average' and 'Low' Resource Utilization schools. It also emerges that a high positive relationship exists between PTA and PPAA. The analysis of standard IX Tests Scores also confirms these results.

Table 4.89 Number of Classes According to the Availability of Physical Facilities Classified by Levels of Utilization of Resources

No.	Item	Resource utilization High				Resource utilization Average				Resource utilization Low			
		Good	Satisfactory	Poor	Total	Good	Satisfactory	Poor	Total	Good	Satisfactory	Poor	Total
1	Furniture	8	2	-	10	2	8	-	10	1	4	7	10
2	Seating arrangement	9	1	-	10	3	6	1	10	-	4	8	12
3	Electricity	7	3	-	10	2	6	2	10	-	3	9	12
4	Water Supply	5	5	-	10	-	6	4	10	-	3	9	12

Table 4.90 Number of Classes According to the Methods of Instruction Followed by Teachers

No.	Item	Resource utilization High				Resource utilization Average				Resource utilization Low			
		Good	Satisfactory	Poor	Total	Good	Satisfactory	Poor	Total	Good	Satisfactory	Poor	Total
1	Lecture method	5	1	-	6	5	3	-	8	2	5	4	11
2	Lecture cum demonstration method	2	1	-	3	-	2	-	2	-	1	-	1
3	Discussion method	-	1	-	1	-	-	-	-	-	-	-	-
4	Problem solving method	-	-	-	-	-	-	-	-	-	-	-	-
5	Project method	-	-	-	-	-	-	-	-	-	-	-	-
	Total				10				10				12

Table 4.91 Details Regarding the Realisation of Objectives in Classrooms Classified by Levels of Utilization of Resources

No.	Item	Resource utiliza-tion High	Resource utiliza-tion Average	Resource utiliza-tion Low	Total
1	Imparting knowledge	10	10	12	32
2	Developing Scientific Skills	7	5	3	15
3	Developing abilities involved in problem solving, improvisation, etc.	-	-	-	-
4	Inculcating scientific attitudes	2	-	-	2
5	Developmenting interest in scientific activities, literature, etc.	6	4	3	13
6	Imparting training in scientific method	2	-	-	2
7	Providing training for better living	-	-	-	-
8	Providing applications of scientific principles	5	3	2	10
9	Helping to develop power of observation	3	.1	-	4

The method used by most of the teachers whose classes came under observation was lecture. Lecture cum demonstration method was employed by six teachers and discussion method was found used only one teacher. Advanced methods such as problem solving and project methods were not found used by teachers.

Table 4.91 gives the details regarding the attainment of certain instructional objectives.

It was found that all the teachers gave more emphasis to item 1, 'Imparting knowledge'. This was followed by item 2, 'Developing scientific skills'. The next instructional objectives realised was 'Developing interest in scientific activities, literature etc.' It was observed that certain objectives of teaching physics were not at all realised through classroom instruction.

Details regarding the use of laboratory, audio-visual aids, etc., are presented in Table 4.92.

It can be confirmed from the Table that 'High' resource utilization schools were utilizing the resources more frequently than the 'Average' category. In majority of 'Low' category schools, the utilization of resources were found to be 'Poor'. This may be due to the non-availability of these items.

Regarding the qualifications of teacher, all teachers were graduates in either physics or chemistry with a degree in Education. Of the 32 teachers, 24 were physics

Table 4.92 Number of Classes According to the Use of Resources

No.	Item	Resource utilization High			Resource utilization Average			Resource utilization Low		
		Good	Satisfactory	Poor	Good	Satisfactory	Poor	Good	Satisfactory	Poor
1	Laboratory	3	5	-	-	2	2	-	1	3
2	Audio-visual aids	2	5	2	3	3	1	-	2	-
3	Improvised aids	-	3	2	-	1	2	-	-	-
4	Reference books	1	5	2	-	1	2	-	-	-

Table 4.93 Number of Teachers According to Their Teaching Abilities Exhibited in Classrooms

No.	Item	Resource utilization High	Resource utilization Average	Resource utilization Low	Total
1	Presenting the content with mastery	8	6	3	17
2	Maintaining classroom communication	5	3	3	11
3	Using proper aids	7	4	3	14
4	Linking theory to practice	5	3	2	10
5	Using environmental resources	-	-	-	-
6	Creating scientific interest	4	3	2	9
7	Questioning	6	3	2	11
8	Demonstrating experiments	6	3	2	11
9	Motivating learners	9	5	4	8

Table 4.94 Number of Students According to Their Level of Participation in Learning Process in Classroom

No.	Item	Resource utilization High				Resource utilization Average				Resource utilization Low			
		Good	Satisfactory	Poor	Total	Good	Satisfactory	Poor	Total	Good	Satisfactory	Poor	Total
1	Listening	7	3	-	10	4	6	-	10	3	7	2	12
2	Answering	7	3	-	10	3	6	1	10	-	4	8	12
3	Remaining active	3	5	2	10	1	6	3	10	-	5	7	12
4	Rapport with teachers	5	3	2	10	2	4	4	10	1	5	6	12
5	Communication	3	5	2	10	1	5	4	10	1	4	7	12
6	Showing interest	4	5	1	10	3	4	3	10	3	4	5	12

graduates and the rest of them were chemistry graduates.

Details regarding the teacher qualities are given in Table 4.93.

Most of the teachers whose classes observed were found to have ability in presenting the content with mastery, motivating learners and using proper aids. Teachers belonging 'High' resource utilization schools were found to be better regarding their ability in the three areas than the teachers belonging to 'Average' and 'Low' categories. Most of the teachers were not found to have the ability regarding questioning, demonstrating experiments, linking theory to practice, etc., at the time of observation.

Details regarding student. Participation in classes observed are given in Table 4.94.

As can be seen from the Table majority of students from 'High' utilization category schools were found to have 'Good' or 'Satisfactory' responses with regard to listening, answering, remaining active, etc. Regarding the students from 'Average' category schools, the majority, exhibited 'satisfactory' responses. The participation of majority of students from 'Low' utilization category schools were not found satisfactory except in listening.

On the whole it can be concluded that classroom instruction in 'High' resource utilization schools were found better than 'Average' and 'Low' resource utilization schools.

CHAPTER V

SUMMARY OF THE STUDY, CONCLUSIONS AND SUGGESTIONS

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5.1 The Study in Retrospect

The present study has been designed to investigate the availability and utilization of resources in physics education in the secondary schools of Kerala and to see how they influence the practical application awareness of secondary school pupils in the State. It was presumed that the outcome of the study would be of help in developing models for the maximum use of resources for the development of practical application awareness among pupils. The study was designed to realise the following objectives.

5.1.1 Objectives of the study

The objectives of the study are:

1. To find out the extent of availability of resources in physics education in the secondary schools of Kerala.
2. To find out whether there exists any differences in the availability of resources between (a) urban and rural schools, and (b) government and private schools.
3. To find out the extent of utilization of resources in physics education in secondary schools of Kerala.

4. To find out whether there exists any difference in the utilization of available resources between (a) urban and rural schools, and (b) government and private schools.
5. To find out the physics theory awareness of secondary school pupils in the State of Kerala.
6. To find out the practical application awareness of pupils in relation to their theory awareness.
7. To find out whether there exists any relationship between physics theory awareness and physics practical application awareness among (a) the total sample (b) boys (c) girls (d) urban school students (e) rural school students (f) government school students and (g) private school students.
8. To find out the possible influence of resource utilization and sex, locality, management of school (taking one at a time) on physics theory awareness.
9. To find out the possible influence of intelligence and sex, locality, management of school (taking one at a time) on physics theory awareness.
10. To find out the possible influence of socio-economic status and sex, locality, management of school (taking one at a time) on physics theory awareness.
11. To find out the possible influence of resource utilization and sex, locality, management of school

(taking one at a time) on physics practical application awareness.

12. To find out the possible influence of intelligence and sex, locality, management of school (taking one at a time) on physics practical application awareness.
13. To find out the possible influence of socio-economic status and sex, locality, management of school (taking one at a time) on physics practical application awareness.
14. To bring out the prospects of resources in physics education in the secondary schools of Kerala for the development of practical application awareness.
15. To suggest programmes for the development of practical application awareness in physics among secondary school pupils.

5.1.2 Hypotheses for the study

The hypotheses formulated for the present study are:

1. There is scarcity of educational resources available for physics education in the secondary schools of Kerala.
2. The extent of utilization of available resources in physics education in the secondary schools of Kerala is not satisfactory.

3. There will be differences in the extent of availability of resources in urban, rural, government and private schools.
4. There will be differences in the extent of utilization of available resources in urban, rural, government and private schools.
5. Physics theory awareness of secondary school pupils is satisfactory.
6. Physics practical application awareness in relation to theory awareness is not satisfactory.
7. There is positive relation between physics theory awareness and physics practical application awareness.
8. Physics practical application awareness is influenced not only by factors like intelligence quotient and socio-economic status but also by the extent of resource utilization.
9. The effective utilization of resources in physics education helps to develop physics practical application awareness.

5.1.3 Methodology in brief

The present study was conducted on a final sample of 388 physics teachers, 1016 standard IX students and 1020 standard X students from selected high schools of Kerala on the basis of stratified random sampling. Relevant data were collected from the subjects under study, using adequate tools and techniques such as questionnaire, achievement tests, observation, intelligence tests and socio-economic status scale. The data thus obtained were analysed using appropriate statistical techniques.

5.2 Major Findings

The important findings that have emerged from the study are presented under appropriate heads.

5.2.1 Availability and utilization of resources in physics education

a. General information

1. The analysis of data revealed that 77.84 per cent of teachers had physics as the main subject for their first degree (B.Sc.). 86.67 per cent of urban school teachers had learnt physics as the main subject for graduation while it was 71.30 per cent in the case of rural school teachers. 80.79 per cent of government school teachers had learnt physics as the main subject for graduation while it was 75.36 per cent in the case of private school teachers.

2. More than 80 per cent of the schools surveyed were found to have sufficient classroom facilities. Analysis of data revealed that urban schools were better regarding classroom facilities than rural ones. Regarding certain items like furniture and seating arrangement private schools were found better than government schools.

b Library

1. In about 75 per cent of the schools the libraries were functioning in the rooms meant for the purpose. The rest 25 per cent schools lack proper library rooms.
2. About 50 per cent of the schools did not have proper reading rooms attached to the libraries.
3. In 90.72 per cent of schools, teachers were found to be holding the additional charge of school libraries since there were no librarians.
4. Library fee (a nominal amount of Rs 2 collected from each student) was found to be the main source for the purchase of library books.
5. 'Lack of finance' as a constraint in the purchase of books for library was recorded by more than 85 per cent of teachers belonging to urban, rural, government and private schools.

6. The extent of availability of reference books in physics for teachers was found to be better than that for students. There were many schools without adequate number of relevant reference books both for teachers and students. Regarding the availability of these items urban schools were found to be better than rural schools and private schools were found to be better than government schools.
7. Regarding the extent of utilization of reference books urban schools were found to be better than rural ones and private schools were found to be better than government schools.
8. From the analysis of data it was revealed that many essential reference materials for the teaching of physics were not found available in most of the school libraries with the exception of items like textbooks in physics, advanced science books, textbooks for practicals and encyclopaedia. These books were found available in more than 60 per cent of schools surveyed.
9. The extent of utilization of the available reference materials was found not satisfactory.
10. Only certain types of reference materials were found available in adequate number in urban schools while other items were inadequate in number.

11. Most of the rural school libraries were found to be ill-equipped regarding reference materials.
12. In general the availability of reference materials seemed to be better in private schools than in government schools though many of the schools of both categories lack essential reference materials for physics education.
13. 'The insufficiency of books in the library was pointed out by 59.13 per cent of respondents to be a major reason for the 'not satisfactory' level of reading habit among students.
14. 'Appointment of trained librarian' was the most favoured suggestion for the improvement of library and this was recorded by 73.71 per cent of physics teachers.

c Laboratory

1. It is found that only 22.94 per cent of schools had separate laboratories for conducting experiments for demonstration purposes in physics. 40 per cent of the schools were found to have common laboratories for physics and chemistry.
2. the experiments were demonstrated in 61.60 per cent of schools.

3. The equipments required to teach topics in magnetism, electricity, sound, mechanics and electronics was found "Not enough" in more than 80 per cent of the schools. About 70 per cent of schools did not possess required equipment to teach topics in optics and heat.
4. Regarding the extent of utilization of laboratory, the 'Always' utilizing category of schools were less than 20 per cent which is far from satisfactory.
5. Urban school laboratories were found to be better equipped than rural school laboratories.
6. 37.56 per cent of urban schools were found to be 'Always' utilizing equipment to teach topics in optics and 33.33 per cent of these schools were found to be 'Always' utilizing equipment to teach topics in heat. The rural schools which came under the category of 'Always' utilizing were less than 10 per cent regarding these two items.
7. In regard to the availability of equipment in government and private schools, the private school laboratories seemed to be slightly better equipped than government school laboratories.
8. The extent of utilization of equipment was found not satisfactory in both government and private schools. It may be noted that below 20 per cent of schools were

found to utilize the laboratories to a satisfactory level.

9. 'Lack of funds' was found to be the major reason for the inadequacy of equipment in the laboratories and this was recorded by 68.30 per cent teachers.
10. The available equipment was found to be in working condition only in about 50 per cent of the total number of schools. 'Lack of proper maintenance' was pointed out by teachers as the main reason for the equipment to be in 'not working condition'.
11. Teachers were demonstrating the experiments in 87.87 per cent of schools.
12. Most of the teachers (66.49 per cent) suggested that more opportunity for practical work should be provided to students which would help to improve the functioning of laboratories.

d Teaching aids

1. The extent of availability of teaching aids was found not satisfactory in most of the schools.
2. The extent of utilization of the available teaching aids was found not satisfactory in most of the schools.
3. Of the different audio aids 'radio' was found available in 64.95 per cent of schools. Regarding the extent of

utilization of this item, 29.69 per cent schools came under 'Always' utilizing category and 56.96 per cent under 'Sometimes' utilizing category.

4. Though not satisfactory, the extent of availability and utilization of teaching aids were found better in urban schools than in rural schools.
5. In general not much difference was found between government and private schools regarding the availability and utilization of teaching aids. The extent of availability and utilization of certain projected aids and 'radio' were found more in private schools than in government schools.

e Co-curricular activities

1. Project works in physics were not taken up in majority of the schools surveyed (85.31 per cent). 'Lack of necessary facilities' was pointed out to be the major reason for this state of affairs.
2. Of the 388 schools surveyed, science clubs were found functioning in 67.01 per cent schools while in the remaining schools clubs were not found functioning.
3. The percentage of urban schools (75.15 per cent) where science clubs were found functioning was more than that of rural schools (60.99 per cent).

4. The percentage of private schools (70.14 per cent) where science clubs were found functioning was more than that of government schools (63.28 per cent).
5. The analysis of data regarding the activities of service clubs revealed that science exhibitions and improvisation of equipments were the major activities of school science clubs (71.15 per cent and 65.77 per cent respectively).
6. The science clubs of urban schools were found to be engaged in more activities than rural school clubs. But this difference was not seen very much between private and government schools.

f Environmental resources

1. The analysis of data regarding the various uses of the environmental resources such as engineering factories, small scale industrial units, chemical factories, etc., revealed that most of the teachers in general seemed to have a good awareness of many of the identified uses of these items. But it is found that a good number of teachers were not fully aware of some of the important identified uses of environmental resources like hospitals, buildings under construction, etc.

2. Regarding the availability of identified environmental resources, small scale industrial units and workshops were found available near 90 per cent of the schools. Hospitals, printing press, human resources (experts) and buildings under construction were found available near more than 80 per cent of the schools. The least available resource in this regard was found to be power station (19.07 per cent).
3. In majority of the schools, the environmental resources were not found to be utilized to the desired extent except science fairs and exhibitions.
4. Environmental resources - workshops, colleges, printing press, human resources (experts) and buildings under construction were found available near cent per cent of urban schools. Of these only buildings under construction were found available near cent per cent rural schools and for other items the percentages varied between 66 and 87.
5. With regard to the extent of utilization of environmental resources - printing press, Cotton mills, laboratories and buildings under construction, none of the rural schools came under the category of 'Always' utilizing but a few urban schools came under this category.

6. The most available environmental resource was found to be workshops in the case of government schools (96.61 per cent) while it was found to be small scale industrial units in the case of private schools (91.94 per cent).

7. The extent of utilization of environmental resources was found to be unsatisfactory in most of the government and private schools.

g Workload of teachers

1. The work load of majority of teachers was found to vary between 24 and 29 hours per week and the mean work load was found to be 24.72 hours per week.

2. The means of additional hours required for laboratory work, preparation for teaching and correction of students' written work, and utilization of environmental resources are found to be 1.26, 1.21 and 1.11 hours per week respectively.

h In-service programmes

1. The duration of different types of in-service courses ranged from one day to 56 days.

2. State Institute of Education is found to be the main agency conducting in-service programmes for physics teachers and these programmes were attended by the largest number of teachers (380). This was followed by the programmes of National Council of Educational Research and Training (65).
3. The largest number of courses conducted are found to be seminars (196) followed by summer institutes (158).
4. Among the identified benefits of in-service courses, 'Received up-to-date information' got the highest agreement from teachers (78.35 per cent), followed by 'Exchanged ideas with other teachers' (76.29 per cent). The item, 'Got training to utilize the environmental resources' ranked last (4.90 per cent).
5. Regarding the defects of the in-service courses, the item 'Training to utilize the resources was not given' got the highest agreement from teachers (73.75 per cent) followed by the item 'The course was too short' (62.37 per cent).

5.2.2 Physics Theory Awareness (PTA) of Standard IX Students

1. IQ is found to exert significant influence on PTA of boys and girls (F-value 247.23; $p < .01$).

2. Sex of the students is found to exert no significant influence on PTA of students (F-value 0.42; $p < .05$).
3. The combined influence of IQ and sex on PTA is found to be not significant (F-value 2.05; $p > .05$)
4. IQ is found to exert significant influence on PTA of urban and rural students (F-value 77.94; $p < .01$).
5. Locality of the school (Urban/Rural) is found to exert a significant influence on PTA (F-value 77.94; $p<.01$).
6. The combined influence of IQ and locality on PTA is found to be significant (F-value 3.29; $p < .05$).
7. IQ is found to exert significant influence on PTA of government and private school (F-value 246.07; $p <.01$).
8. Management of school (Government/Private) is found to exert no significant influence on PTA (F-value 0.50; $P > .05$).
9. The combined influence of IQ and management on PTA is found to be not significant (F-value 0.02; $p > .05$).
10. SES is found to exert significant influence on PTA of boys and girls (F-value 48.53; $p < .01$).
11. The combined influence of SES and sex on PTA is found to be not significant (F-value 0.30; $p > .05$).
12. SES is found to exert significant influence on PTA of urban and rural students (F-value 45.56; $p < .01$).
13. The combined influence of SES and locality on PTA is found to be not significant (F-value 0.97; $P > .05$).

14. SES is found to exert significant influence on PTA of government and private school students (F-value 48.83; $p < .01$).

15. The combined influence of SES and management of school on PTA is found to be not significant (F-value 0.06; $P > .05$).

16. Resource utilization is found to exert significant influence on PTA of boys and girls (F-value 61.69; $P < .01$).

17. The combined influence of resource utilization and sex of the student on PTA is found to be not significant (F-value 0.67; $p > .05$).

18. Resource utilization is found to exert a significant influence on PTA of urban and rural school students (F-value 22.543; $p < .01$).

19. The combined influence of resource utilization and locality on PTA is found to be not significant (F-value 2.15; $P > .05$).

20. Resource utilization is found to exert significant influence on PTA of government and private school pupils (F-value 61.74; $p < .01$).

21. The combined influence of resource utilization and management of school on PTA is found to be not significant (F-value 1.03; $p > .05$).

10. SES is found to exert significant influence on PPAA of boys and girls (F-value 53.06; $p < .01$).
11. The combined influence of SES and sex on PPAA is found to be not significant (F-value 0.04; $P > .05$).
12. SES is found to exert significant influence on PPAA of urban and rural school students (F-value 51.39; $P < .01$).
14. The combined influence of SES and locality on PPAA is found to be not significant (F-value 0.1223; $P > .05$).
15. SES is found to exert significant influence on PPAA of government and private school students (F-value 53.26; $p < .01$).
16. The combined influence of SES and management of school on PPAA of students is found to be not significant (F-value 0.16; $P > .05$).
17. Resource utilization is found to exert significant influence on PPAA of boys and girls (F-value 161.97; $P < .01$).
18. The combined influence of resource utilization and sex of the student on PPAA is found to be not significant (F-value 0.46; $p > .05$).
19. Resource utilization is found to exert significant influence on PPAA of urban and rural school students (F-value 59.43; $p < .01$).

20. The combined influence of resource utilization and locality of school on PPAA is found to be not significant (F-value 3.51; p > .05).
21. Resource utilization is found to exert significant influence on PPAA of government and private school students (F-value 161.36; p < .01).
22. The combined influence of resource utilization and management of school on PPAA is found to be not significant (F-value 0.02; P > .05).

5.2.4 Relationship between PTA and PPAA of standard IX students

1. Pupils' PPAA is found to be not satisfactory compared to their PTA (Mean for PTA was 16.81 and Mean for PPAA was 11.69 for the total sample).
2. The mean score for PTA of students from 'High' resource utilization school was found to be more (Mean 18.98) than that of 'Average' (Mean 16.82) and 'Low' (Mean 14.97) resource utilization schools.
3. The mean score for PPAA of students from 'High' resource utilization school was found to be more (Mean 14.57) than that of 'Average' (Mean 11.57) and 'Low' (Mean 9.35) resource utilization schools.
4. A high positive correlation is found to exist between PTA and PPAA ('r' value for total sample 0.85).

5.2.5 Physics Theory Awareness (PTA) of Standard X Students

1. IQ is found to exert significant influence on PTA of (a) boys and girls (F-value 224.61; $p < .01$), (b) urban and rural school students (F-value 252.82; $p < .01$), and (c) government and private school students (F-value 244.43; $p < .01$).
2. Sex of the student is not found to exert significant influence on PTA (F-value 0.49; $p > .05$).
3. The combined influence of IQ and sex of the student on PTA is found to be not significant (F-value 0.16; $P > .05$).
4. Locality of the school (Urban/Rural) is found to exert significant influence on PTA of students (F-value 60.34; $p < .01$).
5. The combined influence of IQ and locality of school on PTA of students is found to be not significant (F-value 1.94; $P > .05$).
6. Management of school (Government/Private) is not found to exert significant influence on PTA of students (F-value 0.32; $p > .05$).
7. The combined influence of IQ and management of school on PTA is found to be not significant (F-value 0.32; $P > .05$).

8. SES is found to exert significant influence on PTA of (a) boys and girls (F-value 120.02; $p < .01$), (b) urban and rural school students (F-value 115.29; $p < .01$), and (c) Government and private school students (F-value 120.40; $p < .01$).
9. The combined influence of SES and sex on PTA is found to be not significant (F-value 1,30; $p > .05$).
10. The combined influence of SES and locality of school on PTA is found to be not significant (F-value 0.87; $p > .05$).
11. The combined influence of SES and management of school on PTA is not found significant(F-value 1.73; $p > .05$).
12. Resource utilization is found to exert significant influence on PTA of (a) boys and girls (F-value 49.83; $p < .01$), (b) urban and rural school students (F-value 5.80; $p < .01$), and (c) government and private school students (F-value 50.18; $p < .01$).
13. The combined influence of resource utilization and sex on PTA is found to be not significant (F-value 0.22; $p > .05$).
14. The combined influence of resource utilization and locality of school on PTA is found to be not significant (F-value 0.77; $p > .05$).

15. The combined influence of resource utilization and management of school on PTA is found to be not significant (F-value 0.23; $p > .05$).

5.2.6 Physics Practical Application Awareness (PPAA) of Standard X Students

1. IQ is found to exert significant influence on PPAA of (a) boys and girls (F-value 198.59; $p < .01$), (b) urban and rural school students (F-value 229.82; $p < .01$), and (c) government and private school students (F-value 198.77; $p < .01$).
2. Sex of the student is not found to exert significant influence on PPAA of students (F-value 0.20; $p > .05$).
3. The combined influence of IQ and sex on PPAA is found to be not significant (F-value 0.03; $p > .05$).
4. Locality of the school (Urban/Rural) is found to exert significant influence on PPAA of students (F-value 205.68; $p < .01$).
5. The combined influence of IQ and locality of school on PPAA is found significant (F-value 8.81; $p < .01$).
6. Management of school (Government/Private) is not found to exert significant influence on PPAA of students (F-value 0.15; $p > .05$).

7. The combined influence of IQ and management of school on PPAA is found to be not significant (F-value 0.16; $p > .05$).
8. SES is found to exert significant influence on PPAA of (a) boys and girls (F-value 120.26; $p < .01$), (b) urban and rural school students (F-value 121.44; $p < .01$), and (c) government and private school students (F-value 120.75; $p < .01$).
9. The combined influence of SES and sex on PPAA is found to be not significant (F-value 0.27; $p > .05$).
10. The combined influence of SES and management of school on PPAA is found significant (F-value 4.53; $p < .05$).
11. The combined influence of SES and management of school on PPAA is found to be not significant (F-value 2.22; $p > .05$).
12. Resource utilization is found to exert significant influence on PPAA of (a) boys and girls (F-value 196.14; $p < .01$), (b) urban and rural school students (F-value 10.66; $p < .01$), and (c) government and private school students (F-value 196.30; $p < .01$).
13. The combined influence of resource utilization and sex of the student on PPAA is found to be not significant (F-value 0.0002; $p > .05$).
14. The combined influence of resource utilization and locality of school on PPAA is found to be not significant (F-value 0.45; $p > .05$).

15. The combined influence of resource utilization and management of school on PPAA of students is found to be not significant (F-value 0.09; $p > .05$).

5.2.7 Relationship between PTA and PPAA of Standard X Students

1. Pupils' PPAA is found to be not satisfactory compared to their PTA (Mean for PTA was 18.07 and Mean for PPAA was 12.00 for the total sample).
2. The mean score for PTA of students from 'High' resource utilization school was found to be more (Mean 20.23) than that of 'Average' (Mean 17.71) and 'Low' (Mean 16.67) resource utilization schools.
3. The mean score for PPAA of students from 'High' resource utilization school was found to be more (Mean 15.48) than that of 'Average' (Mean 11.02) and 'Low' (Mean 10.05) resource utilization schools).
4. A high positive correlation is found to exist between PTA and PPAA ('r' value for the total sample 0.85).

5.2.8 Observation of classroom instruction

1. In general physical facilities in classroom were found either 'Good' or 'Satisfactory' in all the 'High'

resource utilization schools, 'Satisfactory' in most of the 'AVerage' resource utilization schools and either 'Satisfactory' or 'Poor' in most of the 'Low' resource utilization schools.

2. The method of instruction followed by most of the teachers whose classes came under observation was found to be lecture.
3. Regarding the emphasis given for the realisation of objectives of teaching physics it was observed that all the teachers gave more emphasis to the objective 'Imparting knowledge' followed by 'Developing Scientific skills.'
4. Regarding the utilization of resources, it was observed that 'High' resource utilization category schools were found to utilize the resources more frequently than 'Average' and 'Low' resource utilization categories of schools.
5. Students participation in classroom was found to be better in 'High' resource utilization category schools than in 'Average' and 'Low' categories of schools.

5.3 Tenability of the Hypotheses

The findings of the study indicate that all the hypotheses formulated for the study are substantiated.

5.4 Conclusions and Suggestions

The major conclusions that are arrived at in the present study are noted below:

The present study brought to light the inadequacy of institutional resources for physics education in most of the secondary schools of Kerala.

The extent of utilization of the available resources in physics education in majority of the schools is found to be unsatisfactory.

In general, the extent of availability and utilization of resources in physics education are found to be better in certain urban schools than in rural schools whereas certain private schools are found to be slightly better than government schools.

Physics Practical Application Awareness (PPAA) of secondary school students in relation to their Physics Theory Awareness (PTA) is not found satisfactory. Students from 'High' resource utilization schools are found to have better Physics Practical Application Awareness than students from 'Average' and 'Low' resource utilization schools.

Utilization of resources in schools is found to exert significant influence on Physics Theory Awareness and Physics Practical Application Awareness.

Intelligence and socio-economic status of student are found to exert significant influence on Physics Theory Awareness and Physics Practical Application Awareness. There exists a high positive correlation between Physics Theory Awareness and Physics Practical Application Awareness.

On the basis of the findings reported in this study and the conclusions drawn, the following suggestions are made:

1. At least the minimum resources required for physics education should be made available to all the secondary schools in the State of Kerala
2. As it is very costly to maintain the physical plant of educational institutions, emphasis should be laid on the intensive utilization of existing resources. Steps should be taken to ensure full utilization of institutional facilities - laboratories, libraries, teaching aids, workshops, etc.
3. The physics curriculum should be modernised giving stress on experimental work and study of applications to local environment and industry.
4. The physics instruction in the secondary schools should be re-oriented to create more practical application awareness to students.
5. The role of libraries and laboratories should be expanded in future physics curriculum revision.

6. Development of laboratory workshops and facilities for servicing and fabrication of certain simple scientific apparatus should be provided which will help the functioning of school science club in a useful and meaningful way.
7. Work experience should be introduced as an integral part of school science education which will help to reduce the bookish character of present school education. This will also help to link theory to practice.
8. Practical work in physics should be enforced in standards IX and X as part of school curriculum.
9. Schools in which individual or group laboratory facilities are not available, demonstration experiments performed by the teacher or by selected students under the supervision of the teacher can form an integral part of physics education.
10. To make the physics education at the secondary stage more meaningful, realistic and useful, it should be linked to practical application in agriculture, industry, etc.
11. In schools where trained librarians are not available or not posted, management of the library should be entrusted to a responsible person who should be free from other duties.

12. As far as possible trained physics graduates should teach physics at the secondary school stage.
13. Teachers should be given training to plan and utilize the environmental resources found available near the schools. Rural school students will be greatly benefited by this because most of the rural schools lack necessary resources for physics education.
14. Physics teachers should be trained to improvise teaching aids so that they can help students in improvising aids which will help to develop practical application awareness among students. These aids can be utilized for teaching when sophisticated aids are found lacking.
16. Planned and co-ordinated programme of in-service education for physics teachers should be organised by concerned agencies based on the actual needs of the physics teachers. This should include the training to utilize the resources for developing practical application awareness among students.

Suggestions for Further Research

The findings of this study suggest certain areas for further research.

1. Experimental studies can be conducted with practical application awareness as the experimental factor.

2. Studies can be conducted to find out how for the present secondary school physics curriculum is linked to practical applications in industry, agriculture, minining, etc., in various regions of the country.
3. An investigation can be carried out to find out the prospects of resources in physics education for the development of productivity oriented instructional strategy.
4. It will be useful to conduct studies similar to this study in other areas of science.
5. It may be recalled that the present study was conducted using samples selected from only one state. The findings may not be comparable to identical populations in other states of India with dissimilar resource availability and utilization. So it is useful to conduct similar studies in other states of India for comparative purposes.

The study has convincingly and conclusively revealed that availability and utilization of resources contribute to theory awareness and practical application awareness in physics among school students. The study further revealed that institutional resources for physics education are not adequate in most of the secondary schools of Kerala especially in schools of rural areas. Again, resource utilization is found to exert significant influence on students' awareness in theory and practical applications in physics. Based on the findings of the studies related to this area, steps may be taken to provide needed resources for physics education which in turn will help to develop practical application awareness among secondary school pupils.

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APPENDICES

APPENDIX - I

UNIVERSITY OF KERALA

DEPARTMENT OF EDUCATION

TRIVANDRUM-14

Dear Teacher,

I am a research fellow in the Department of Education, University of Kerala involved in a research programme concerning the identification of resources in physics Education at the secondary school level. A questionnaire has been prepared towards collecting the basic data essential for this study. I request you to help me in this venture by answering these questions, incorporating all the details asked for. I also assure you that the data collected from you will be kept confidential and used only for research purpose.

Thanking you,

yours sincerely,

Achamma P. Mathew

Instructions

Please respond to the following questions by putting tick marks (√) in the appropriate columns or boxes. For some questions different possible answers in the form of statements are given. Please mark 1, 2, 3.........etc. according to your preference. For others, please follow the instructions given along with the questions.

I. GENERAL INFORMATION.

1 Name of the respondent :

2 Sex : Male ☐ / Female ☐

3 Name of the School :

4 Whether : (a) Urban ☐ / Rural ☐

(b) Government ☐ / Aided ☐ Recognised ☐

(c) Boys ☐ / Girls ☐ / Mixed ☐

5 Educational qualifications :

(a)	B. Sc (phy)	☐	(e)	B. Sc (chem)	☐
(b)	B. Sc (phy) ; B. Ed	☐	(f)	B. Sc (chem) ; B. Ed	☐
(c)	M. Sc. (phy) ; B. Ed	☐	(g)	M. Sc (chem) ; B. Ed	☐
(d)	M. Sc. (phy) ; M. Ed	☐	(h)	M. Sc (chem) ; M. Ed	☐

6 Class room facilities

	More than enough	enough	not enough
a Seating arrangement			
b lighting arrangement			
c furniture			
d water supply arrangements			
any other			

II DETAILS REGARDING LIBRARY

1 The library is situated in

a) the room specially meant for the purpose ☐
b) teacher's room ☐
c) in any one room. ☐

2 A separate reading room is

a) available ☐
b) not available ☐

3 The person in charge of the library is

a) Headmaster | Headmistress ☐
b) a full time librarian ☐
c) one of the teachers ☐

4 The books in the library are

a) purchased using library fee ☐
b) purchased using government grant ☐
c) supplied by State Institute of Education ☐
d) supplied by N C E R T ☐
e) supplied by organisations such as UNESCO,UNICEFetc. ☐
f) supplied by any other voluntary organisations ☐
g) Any other (specify) ... . ☐

----

5 The constraints in the purchase of library books are

a) lack of finance ☐
b) non availability of required books ☐
c) lack of space for keeping books ☐
d) difficulty in observing formalities ☐
e) delay in getting the list of books from teachers ☐
f) Any other (specify) ☐

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	extent of availability			Extent of utilization		
	more than enough	enough	not enough	always	some times	never
6 A The reference books for students in Physics are						
B The reference books for teachers in Physics are						

7 Details of reference materials in the School library.

Given below are a few categories of reference materials essential for the teaching of Physics. Please indicate the number in the first column and also the extent of availability and utilization by putting tick marks (√) in the appropriate columns.

Categories	Number	Extent of availability			Extent of utilization		
		more than enough	enough	not enough	always	sometimes	never
1 Encyclopaedia							
2 Standard text books in physics							
3 Applied science books							
4 Advanced science books							
5 Text books for practicals.							
6 Books on preparation of Aids							
7 Science Journals 1) Malayalam 2) English							
8 Periodicals (weeklies containing science articles)							
9 Newspapers (containing science articles)							
10 Any other (specify):							

8 A The interest of students in reading Physics books, science journals, periodicals etc are

(a) satisfactory ☐

(b) not satisfactory. ☐

B. If' not satisfactory', the reasons are

(a) the number of books are not sufficient ☐
(b) there is no library period ☐
(c) the students are not interested ☐
(d) the students are not encouraged ☐
(e) there is no person in charge of the library ☐
(f) Any other (specify) ☐

____

____

9 Given below are a few suggestions for the better functioning of your school library. Please indicate your preference by marking 1, 2, 3..... ..... etc

a) Appoint a trained librarian ☐
b) Collect new books every year ☐
c) Allot library periods in the time table ☐
d) Give additional benefit to those who are in charge of the library. ☐
e) Provide facilities for students to sit and read in the library ☐
f) Any other (specify) .... ☐

____

____

III DETAILS REGARDING LABORATORY

1 Please put a tick mark (√) against the statement which is true in the case of your school.

a) There is a separate laboratory for Physics in the School. ☐
b) The laboratory is common for Physics and Chemistry. ☐
c) The laboratory is common for all science subjects ☐
d) There is no laboratory in the School ☐

2 A The experiments are

a) demonstrated ☐
b) not demonstrated ☐

B The experiments are demonstrated in

a) the laboratory ☐
b) the class room ☐
c) the library ☐
d) the laboratory as well as in the classroom according to situations ☐
e) Any other room (specify) ☐

____

____

3 Given below are a few of the equipments required for the teaching of Physics. Please indicate their number in the first column and also indicate the extent of availability and utilization by putting tick marks in the appropriate columns.

	Number	Extent of availability			Extent of utilization		
		more than enough	enough	not enough	always	some-times	never
1 Ammeter							
2 Balance with weight box							
3 Balance (spring)							
4 Barometer							
5 Calorimeter							
6 Camera							
7 Capillary tube							
8 Cell-Storage							
9 Cell-Leclanche							
10 Cell-voltaic							
11 Cell-Dry							
12 Centri fuge							
13 Condenser							
14 Commutator							
15 Davey's safety Lamp							
16 Prisms							
17 Electroscope							
18 Electric Bell							
19 Galvanometer							
20 Glass slab							
21 Hand lens							
22 Heater (immersion)							
23 Hydrometer							
24 Inclined plane							
25 Induction coil							
26 Key-tap							
27 Key-Plug							
28 Lens-concave							
29 Lens-convex							
30 Lens holder							
31 Magnet-bar							
32 Magnetic needle pivoted							
33 Compass needle							
34 Manometer							
35 Metre scale							
36 Mirror-concave							
37 Mirror-convex							
38 Microscope-simple							
39 Microscope-compound							
40 Microscope-binocular							
41 Micrometer							

	Number	Extent of availability			Extent of utilization		
		morethan enough	enough	not enough	always	sume-time	never
42 Pendulum bobs							
43 Periscope							
44 Prism-equilateral							
45 Prism-right angled							
46 Pulleys.							
47 Resistance box							
48 Regulator of electric fans							
49 Resonance tube							
50 Rheostat							
51 Screw-jack							
52 Screw-gauge							
53 Specific gravity bottle.							
54 Spectrometer							
55 Soldering iron							
56 Stethoscope							
57 Steam chamber							
58 Stove-electric							
59 Stove-kerosene							
60 Stop-watch							
61 Telephone model							
62 Thermometer-Centigrade							
63 Thermometer-Sensitive							
64 Thermopile							
65 Thermocouple							
63 Transformer							
67 Turning fork							
68 Vernier Calipers							
69 Voltameter							
70 Waterbath							
71							
72							
....							
List of Models							
1 Dynamo							
2 Flywheel							
3 Serew jack							
4 Wedge							
List of tools							
1 Hammer							
2 Cork Screw							
3 Chissel with handle							
4 Hand saw							
5 Hand drill							
6 Spanner							
7 Soldering iron							

4. If the equipments is not sufficient, the reasons are

a) lack of adequate funds ☐
b) lack of space in storing the equipments ☐
c) delay in repairing defective equipments ☐
d) formalities in purchasing them ☐
e) Any other (specify) ☐
....
....

5. A. Regarding the required equipments in the laboratory for the teaching of Physics.

a) most of them are in working condition ☐
b) a few of them are in working condition ☐
c) most of them are not in working conditon ☐
d) not a single one is in working condition ☐

B. If most of them are not in working condition, the reasons are

a) lack of adequate funds ☐
b) inferior quality of goods ☐
c) careless handling by students ☐
d) careless handling by staff members ☐
e) lack of proper maintenance ☐
f) Any other (specify) ☐
....
....

6. A. Students use the laboratory for practical work
a) quite often ☐
b) rarely ☐
c) not at all ☐

B. If 'not using often' the reasons are
a) lack of equipments ☐
b) lack of space in laboratory for conducting experiments ☐
c) lack of individual experimentation facility. ☐
d) the students are not encouraged to use the laboratory. ☐
e) the authorities do not permit to use the laboratory for fear of mishandling ☐
f) teacher only demonstrates the experiments ☐
g) Any other (specify) ☐
....
....

7. The time alloted to Physics practicals in a week is
a) One or more periods ☐
b) Without affecting the normal classroom work ☐
c) Nil ☐
d) Any other alternate arrangement (specify) : ☐
....
....

IV DETAILS REGARDING TEACHING AIDS

Given below are a few teaching aids required for the teaching of Physics. Please indicate the numbers of available and required aids in the first and second columns respectively and also indicate the extent of availability and utilization by putting tick marks (√) in the appropriate columns.

Types	Number available in School	Number required	Extent of availability			Extent of utilization		
			more than enough	enough	not enough	always using	Sometimes using	not at all using
I Non projected aids.								
1 Graphs								
2 Posters								
3 Maps								
4 Charts								
5 Models								
6 Display boards								
7								
8								
9								
II Projected aids								
1 Slides								
2 Slide projectors								
3 Film Strip								
4 Film Strip Projector								
5 Sound films								
6 Film projector								
7 Microscope Slides								
8 Microscope								
9 Motion picture Sound film								
10 Motion picture projector								
11 Overhead projector								
12 Epidia Scope								
13.....................								
14.....................								
Aural aids								
1 Radio								
2 Tape recorder								
3 Television								
4 C. C. T. V.								
5 V. C. R.								
6								
7								
Computer								

8. The experiments in Physics are conducted
   - (a) individually by pupils ☐
   - (b) in groups by pupils ☐
   - (c) by pupils with the help of teachers ☐
   - (d) by teachers themselves ☐

9. To assist the teachers and students in the laboratory, an attendant is
   - (a) available ☐
   - (b) not available ☐

10. Given below are a few suggestions for the better functioning of your school laboratory, Please indicate your preference by marking 1,2,3...... .. etc.
    - (a) Allocate more funds for laboratory ☐
    - (b) Repair equipment every year ☐
    - (c) Provide sufficient space in laboratory ☐
    - (d) Provide more opportunity for practical work ☐
    - (e) Encourage students to use the laboratory ☐
    - (f) Appoint a full time attendant to assist the students and teachers in laboratory ☐
    - (g) Any other (specify) ☐
      .... ☐
      .... ☐

V. CO-CURRICULAR ACTIVITIES

1. A. Project works in Physics are
   - (a) taken up ☐
   - (b) not taken up ☐

   B. If 'not' the reasons are
   - (a) lack of necessary facilities for project work ☐
   - (b) lack of theoretical and technical knowledge about the project work on the part of teachers. ☐
   - (c) lack of financial assistance ☐
   - (d) lack of co-operation from students ☐
   - (e) lack of encouragement from parents ☐
   - (f) Any other (specify) ☐
     .... ☐
     .... ☐

2. A. Science Club in your school is
   - (a) functioning ☐
   - (b) not functioning ☐

   B. If 'not functioning', the reasons are
   - (a) lack of initiative on the part of teachers
   - (b) lack of enthusiasm on the part of students ☐
   - (c) lack of interest of parents ☐
   - (d) lack of encouragement from administrators ☐
   - (e) Any Other (specify) ☐
     .... ☐
     .... ☐

3. Please put tick mark (√) against the activities conducted/taken part by your school Science Club.

(a) Field trips ☐	(d) Visits ☐
(b) Exhibition ☐	(e) Improvisation of equipments ☐
(c) Project works ☐	(f) Drawing charts, models, maps etc. ☐
(g) Any other (Specify)	

VI DETAILS REGARDING ENVIRONMENTAL RESOURCES

Given below is a list of some of the environmental resources and their uses. Please indicate their ɔs, their availability and extent of utilization by putting tick marks (√) in the appropriate columns.

	Observes methods and techniques of fabrication	Observes and understands the mode of transmission of electricity	Learn the skills in carpentry	Observes the functioning of medical equipments	Learns to improvise different apparatus	Observes various Production Processes.	Observes and understands working models	Learns the different skills required for different types of work.	Learns the assembling of different electronic gadgets	Gets familiarised with modern developments in science & technology
Engineering factories										
Small scale industrial units										
Chemical factories										
Workshops										
Colleges										
Power stations										
Printing press										
Science Fair and Exhibitions										
Human resource (experts)										
ı. Hospitals										
. Cotton mills										
l. Laboratories										
}. Buildings ınder construction										
ı. Any other (Specify)										
____________										
____________										

	Helps to develop simple working models.
	Receives direct information
	Gets first hand information.
	Can be used in co-ordinating intellectual and manual labour
	Observes and understands the different types of electric connection
	Provides practical experience
	Learns to repair certain equipments
	Helps/can be used in bridging the gap between theory and practice
	Caters to the development of creativity, self expression etc.
	Any other (Specify)
	Availability
	Extent of utilization: always
	Extent of utilization: some times
	Extent of utilization: Never

VII WORK LOAD.

Class	No. of Periods of work per week	Additional periods required		
		for laboratery experimentation	for preparation, correction etc.	for utilizing enviornmental resources
Std VIII				
Std IX				
Std X				

2 If extra hours are spent, how many periods a week? ....

VIII DETAILS REGARDING THE IN-SERVICE PROGRAMME.

1 Please give the following information regarding the inservice programmes attended by you.

Agency	Duration	Type	Details in brief
U G C			
NCERT			
State Institute of Education			
Training College			
Arts and Science College			
Sastra Sahitya Parishad			
Teachers' Associations			
Any Other.			

2 Given below are some of the benefits of the in-service programmes. Please indicate the benefits you have received by ticking the items.

1 Received up to date information ☐

2 Received experience in practical work ☐

3 Exchanged ideas with other teachers ☐

4 Revised portions once studied but forgotten ☐

5 Obtained contacts with specialists in the field ☐

6 Got resource materials. ☐

7 Got opportunity to get familiarised with new methods and techniques of teaching ☐

8 Got training in the use of a. v. aids ☐

9 Got training to utilise the environmental resources. ☐

10 Any Other (specify)

.... ☐

.... ☐

3 Given below are some of the possible defects of the in-service programmes. Indicate your agreement by ticking the items.

1 The course was too short. ☐

2 The course was too long. ☐

3 Much of the time was spent to teach what we know already ☐

4 Difficult experiments were not demonstrated ☐

5 Due importance was not given to practical work ☐

6 Resource persons were not available ☐

7 The course was monotonous ☐

8 Difficult concepts were not given due emphasis ☐

9 Training to utilize the resources was not given ☐

10 Training in the modern methods and techniques of teaching was not given ☐

11 The goals aimed at were not realised ☐

12 Any other : (specify)

.... ☐

.... ☐

Draft form of Theory Awareness and Practical Application Awareness Test items for Std.IX

1. A. A convex lens (with focal length F) can be used as a magnifier when the object lies

   a. between Fand 2F
   b. at F
   c. close to the lens and inside the focal point F.
   d. at 2F

   B. If the object is kept between the optic centre and principal focus of a convex lens, an erect, virtual and magnified image is obtained this principle is made use of in (a) telescope (b) magnifying glass (c) camera (d) compound microscope.

   If the student is thorough with the image formation by a convex lens, he can apply it in the construction of some simple equipments where convex lens is used for e.g., magnifying glass.

2. A. Which of the following is preferably used in a photographic camera?
   a) Concave lens
   b) Convex lens
   c) Double concave lens
   d) Double convex lens

   B. The inside of a photographic camera is blackened to

   a) avoid refraction
   b) avoid dispersion
   c) avoid both reflection and refraction
   d) avoid reflection from walls.

   If the student knows the working of a camera, he may be able to explain why the inside of it is blackened.

A - Theory Awareness Test items.
B - Practical Application Awareness Test items.

3. A. Which of the following statements is true regarding longsightedness?

   i) Longsightedness is caused when the eyeball becomes smaller.

   ii) Longsightedness is caused when the focal length of eyelens is large.

   a. only because of (i)
   b. only because of (ii)
   c. because of either (i) or (ii)
   d. not because of (i) or (ii)

   When the student is aware of the cause of longsightedness, he may be able to suggest how it can be remedied.

   B. A person sees distant objects comfortably but wears spectacles while reading a book. What type of lenses are used in his spectacles?

   a. Concave b) Convex
   c. Planoconvex d) Planoconcave

4. A. The image formed by a convex mirror compared to the object is usually,

   a. inverted and imaginary
   b. erect and smaller
   c. real and inverted
   d. larger and virtual

   B. The kind of mirror that a driver uses to get a maximum vision of his backside should be

   a. Convex mirror b. Concave mirror. c. plane mirror d. spherical mirror.

   A thorough knowledge about the image formation in the case of a concave mirror will help the student to utilise this knowledge in explaining why this is preferred in rear glass in automobiles.

5. A. Spherical aberation can be corrected by using

   a. a combination of lenses
   b. cylindrical lenses
   c. a small lens opening
   d. a thin lens

   B. Parabolic reflectors are used in automobile headlights principally to minimise

   a. dispersion b. diffraction
   c. spherical aberation
   d. absorption

An understanding of the spherical aberation and how it can be remedied will equip the student in explaining why reflectors in automobiles are parabolic.

6. A. When the object is placed at the focus of a concave mirror, the image is formed

   a. between F and mirror
   b. between F and 2F
   c. beyond 2F
   d. at infinity

   B. In a torch, the light source is placed at the

   a. focus of concave mirror
   b. pole of concave mirror
   c. radius of curvature of concave mirror
   d. none of the above

A proper understanding about the image formation using concave mirror will help the student in improvising some common and simple equipments for e.g., a torch light.

7. A. For shortsightedness rays from distant objects are brought to focus at a point

   a. on the retina
   b. inbetween eyelens and retina
   c. behind the retina
   d. in front of the retina

   B. Shortsightedness can be remedied using

   a. Converging lens (b)diverging lens. (c) double convex lens (d) planoconvex lens

When the student is aware of the reason for shortsightedness, he can suggest a remedy for this, that is by using a diverging lens of suitable focal length.

8. A. Which of the following law supplies the definition of force	
a) Newton's Ist Law b) Newton's IInd Law c) Newton's IIIrd Law d) Law of gravitation	A proper understanding of Newton's first Law will help the student in explaining or finding out the reasons for some of our daily actions for e.g., beating a dirty carpet to remove dust.
B. A dirty carpet can be cleaned by beating. This is in accordance with	
a) Newton's Ist Law b) Newton's IInd Law c) Newton's IIIrd Law d) Law of gravitation	
9. A. Small insects float on water in ponds and in open tanks. This is possible due to	
a. viscosity (b) surface tension (c) adhesion d. cohesion	A proper knowledge about the surface tensional force will help the student to apply this in daily life situations like the use of soaps and detergents for cleaning.
B. Soaps and detergents help in cleaning the clothes because they	
a. increase the surface tension b. reduce the surface tension c. absorb the impurities, dust etc. d. change the chemical composition of the solution.	
10. A. If the diameter of a capillary tube is doubled, the rise of water in the capillary tube	
a. will be decreased b. will be increased c. will not change d. cannot be anticipated	An understanding of the action of capillarity will help the student to apply

B. During summer, farmers usually keep the top soil layer loose. This is

a. to increase the soil fertility
b. to increase the capillary rise of water to the surface of soil
c. to retain soil water in the top layers.
d. to reduce the capillary rise of waterto the surface of soil.

it in many situations for e.g. to keep the top soil layer loose in summer which is of great use in agriculture.

11. A. The force of attraction between unlike molecules is referred to as

a. surface tension b.viscosity
c. cohesion d. adhesion

B. When we perspire, our clothes cling to the body because of

a. evaporation b. friction
c. adhesion d. cohesion

A knowledge about adhesion will help the student to explain the reason why clothes cling to the body when we perspire.

12. A. A liquid will not wet the surface of a solid if the angle of contact is

a. acute b. zero c. obtuse d.45°

B. Coatings used on raincoats are waterproof because

a. water is absorbed by the coating.
b. adhesive forces become greater.
c. water is scattered away by the coating.
d. angle of contact increases.

When a student is thorough with the different angles of contact, he can apply it in explaining some of the techniques of water proofing.

13. A. The rise of water in plants is due to

a. osmosis b. capillarity
c. atmospheric pressure
d. diffusion

B. Clay is not dry when compared to sandy soil because of

a. the nature of the particles
b. osmosis c. the environment
d. capillarity action

A proper understanding of the capillary action will help the student to explain why clay is preferred in certain purposes to keep the things wet.

14. A. Surface tension exists

a. only in the bulk of liquid
b. only on the surface of the liquid
c. both on the surface and bulk of liquid
d. only along the lines of contact with the container.

B. When oil is spread on stagnant water, mosquitoes cannot breed because

a. surface tension increases and oxygen supply is cut off
b. surface tension decreases and oxygen supplyis cut off
c. viscosity increases
d. viscosity decreases

If the student has an understanding how surface tension takes place, he can utilise this in explaining some daily life situations.

15. A. Surface tension

a. increases uniformly with temperature
b. does not change with temperature
c. decreases with temperature
d. increases at random with temperature

B. Hot water is preferred for cleaning purpose than cold water because

a. cohesion is decreased
b. cohesion is increased
c. surface tension is increased
d. surface tension is decreased

If the student has a proper understanding of the effect of temperature on surface tension, he can utilise this in many life situation for e.g. the use of hot water for cleaning.

16. A. Friction

    a. can be completely avoided
    b. can be minimised
    c. cannot be minimised
    d. remains the same.

When a student understands about frictional forces, it would help him to think logically why rubber soles are used in the manufacturing of tennis shoes.

B. Tennis shoes should have rubber soles rather than leather soles because

    a. rubber sole is lighter than that of leather
    b. rubber can be easily washed and cleaned
    c. rubber gives a better appearance
    d. rubber provides more friction than leather.

17. A. It is easier to roll a body than to slide it along because

    a. more than limiting friction
    b. more than sliding friction
    c. less than sliding friction
    d. same as sliding friction

A clear idea about the rolling friction will equip the student in explaining some common experiences in daily life for e.g., why one has to exert more force if the tube of the cycle is not fully inflated.

B. A cyclist has to apply more force when the tube of the cycle is not fully inflated because of

    a. increase in limiting friction
    b. increase in rolling friction
    c. decrease in rolling friction
    d. decrease in limiting friction

18. A. The suitable method to minimise friction is the use of

    a. ball and roller bearings
    b. lubrication
    c. polishing
    d. all the above

An understanding about the ways of

B. Which of the following statement/s are true regarding friction

1. It causes wastage of energy
2. It causes unnecessary wear and tear
3. It helps in the smooth running of machine

a. 1 and 2 are correct
b. 2 and 3 are correct
c. 1 and 3 are correct
d. 1, 2, 3 are correct

reducing friction, will help him a great deal in his everyday life.

19. A. Weightlessness experienced in space ships while orbiting the earth is a result of

a. inertia b. acceleration c. zero gravity d. centre of gravity

If a student is aware of the reason of weightlessness experienced in spaceship, he can use this knowledge in explaining many situations - it will help him to think logically and creatively and predict certain situations.

B. A body weighs 5 Newtons on the earth. An astronaut in a spaceship tries to weigh it with the help of a spring balance. He will observe that

a. the spring stretches in accordance with Hook's law
b. the body weighs more than 5 N
c. the body weighs less than 5 N
d. the spring does not stretch at all.

20. A. Centrifugal force is directed

a. away from the centre
b. towards the centre
c. along the tangent drawn to the circle
d. along the circumference of the circle.

A proper understanding of the centrifugal force will help the

B. Fat can be separated from the milk in a cream separator because of a. centrifugal force b. centripetal force c. cohesive force d. gravitational force	student to understand and explain the principles involved in the manufacture of cream separators and many other similar equipments.
21.A. A body moving in a circular path, tends to move along the tangent to the circular path in the absence of a. centrifugal force b. gravitational force c. frictional force d. centripetal force	
B. The devices like dryer which is used to dry clothes employ the principle of a. circular motion b. rotational motion c. translational motion d. frictional force	The principle and techniques of a dryer will be clear to a student, if he is thorough with circular motion.
22. A. Which of the following is the best non conductor? a. Air (b) paper c. vacum (d) glass	
B. Wood, plastics, ebonite etc. are used for making the handles of pressure cookers, electric ion etc. because they a. conduct heat (b) conduct electricity (c) conduct heat and electricity (d) do not conduct heat and electricity.	If the student can identify and categorise non conductors, he can utilise this knowledge in the explaining, Why handles are attached to certain household articles.

23. A. The size of a solid increases when

    a. heat energy is given
    b. electric energy is given
    c. mechanical energy is given
    d. sound energy is given

    B. When a metallic pendulum expands

    a. it gains time
    b. it loses time
    c. it neither gains nor loses
    d. it stops

If a student knows the effect of heat on solid, he can apply it in certain daily situation why a clock goes faster in summer.

24. A. Lubricants are introduced between twosolid surfaces for reducing

    a. elastic force (b) electrostatic force (c) magnetic force (d) frictional force

    B. Oil is sprayed on moving parts of sewing machine, clock etc. for

    a) preventing damage
    b) reducing friction
    c) increasing friction
    d) completely eliminating friction

Knowledge of minimising friction can be used in explaining many common situations.

25. A. A liquid of large surface tension

    a) can wet a surface easily
    b) can wet a surface slowly
    c) cannot wet a surface easily
    d) can be used for washing purpose

    B. Soap water can wet a surface more easily than pure water because it has

    a) high surface tension (b) low surface tension (c) no surface tension (d) moderate surface tension.

An understanding of surface tension helps the student to utilise it in daily life activities.

26\. A. When liquid ammonia evaporates temperature

a. increases
b. decreases
c. remains constant
d. changes irregularly

If the student is equipped with the fact that liquid CO_2 on evaporation produces cooling, he can utilise this knowledge in understanding the working of a refrigerator.

B. Liquid ammonia is used as a refrigerent because

a. it is a good solvent
b. it is very cheap
c. it evaporates by increasing the temperature.
d. it evaporates by decreasing the temperature.

27\. A. One of the following statements which is correct concerning insulators is

a) they are good conductors
b) they are bad conductors
c) they absorb heat
d) they radiate heat

The fact that wool is a bad conductor will enable the student in explaining why we use sweaters in winter.

B. Woollen dresses are used in winter season because

a) they conduct heat easily
b) they conduct heat slowly
c) they absorb heat
d) they do not conduct heat

28\. A. Which of the following energy is absorbed easily by black rough surfaces.

a) light energy (b) chemical energy (c) heat energy d) radiant energy

If the student is aware of the fact that black

B. It is uncomfortable to wear a black shirt or blouse during hot season because it absorbs

a) radiant energy
b) heat energy
c) light energy
d) chemical energy

Surfaces absorb heat energy, he will be able to explain why a black dress is uncomfortable during hot season.

29.A. When pressure on the surface of a liquid increases

a) its volume increases
b) its volume decreases
c) its boiling point decreases
d) its boiling point increases

B. In a pressure cooker food is cooked faster because

a) boiling point of water is lowered
b) boiling point of water is raised
c) it absorbs heat energy quickly
d) it retains heat for a long time.

If the student knows about the effect of pressure on boiling point he can utilise this knowledge in explaining the principles of a pressure cooker.

30.A. A virtual image larger than the object may be produced by

a) convex mirror (b) concave mirror (c) plane mirror
d) convex lens

B. For shaving and make up mirrors, we prefer concave mirrors because

a) they produce real image
b) they produce virtual magnified image when the object is placed between f and 2f.
c) they produce virtual magnified image when the object is placed between pole and focus.
d) None of the above.

If the student is aware of the formation of images by concave mirrors, he can utilise this in discriminating the types mirrors for various purposes.

31. A. The capacity for doing work is known as

a. heat capacity of the body
b. energy of the body
c. sp. heat of the body
d. power of the body

When a student is able to define energy, he will understand the applications of this concept.

B. If in your city electricity costs 50 paise per kilowatt hr. you pay for

a. electric charge b. power
c. electric energy d. electric current.

32. A. In oil lamps, the oil rises up in the wicks due to

a) the pressure differences
b) the property of viscosity
c) the property of capillarity
d) the temperature difference

If the capillary action is clear to a student, he can apply it in techniques of soldering of metals.

B. Soldering of two metals is possible on account of the

a. property of viscosity
b. property of elasticity
c. property of surface tension
d. property of osmosis

33. A. Machines are used to

a. create energy (b) do work with less expenditure of energy
c. multiply force (d) multiply force and speed at the same time.

If a student is aware why exactly a machine is used, he can apply this and explain the lever mechanism in some common machines.

B. Machanism of a typewriter is a combination of levers of

a. first and second order
b. third and first order
c. second and third order
d. none

34. A. Mechanical energy can be converted into

a) sound energy (b) electrical energy (c) heat energy (d) all of the above

B. Light energy can be converted to electrical energy using a

a) dynamo (b) electric bulb (c) electric motor (d) solar cell.

If the principle of conversion of energy is clear, the students can apply it and explain what type of energy change take place in a solar cell.

35. A. If the object lies at the principal focus, then the image is formed at infinity. This is true in the case of

a) convex lens (b) convex mirror
c) concave mirror
d) concave lens

B. Rays from the head light of a car is made parallel by

a) convex mirror behind it
b) concave mirror behind it
c) concave mirror in front of it
d) concave lens in front of it

If the student is thorough with the formation of images using a mirror, he can understand and explain where a particular mirror must be placed so as to receive a desired image.

36. A. In a telescope the focal length of the eyepiece lens

a) will be smaller than that of the objective lens
b) will be larger than that of the objective lens
c) will be same as that of the objective lens
d) will be almost same as that of the objective lens.

B. In a terrestrial telescope the final image will be formed at

a) 100 cm. (b) infinity
c) least distance of distinct vision (d) none of the above

If the student is clear how the lens are arranged in a telescope, where will be able to use this knowledge in explained where and how the image is formed.

37. A. Centrifuge machines depend for their working on

    a. centripetal force
    b. centrifugal force
    c. gravitational force
    d. electrostatic force

    B. A centrifuge is used to

    a. dry clothes
    b. separate cream from milk
    c. to pump water
    d. to separate particles from suspension

If the student knows the principle of working a centrifuge machine, he can point out the use value of that particular machine.

38. A. It takes more time to cook vegetables, meat etc. at the top of mountainsbecause

    a) the atmospheric pressure is decreased
    b) the atmospheric pressure is increased.
    c) temperature is lower on the mountain
    d) the quantity of oxygen is reduced.

    B. Water is boiling in a flask over a burner - to reduce its boiling temperature one must

    a) reduce the surrounding temperature
    b) supply heat from a less intense source
    c) connect the mouth of the flask to an evacuating system.
    d) connect the mouth of the flask to a compressor.

When the student is aware of the effect on atmospheric pressure on boiling point, he can utilise this knowledge in situations where boiling point has to be reduced.

39. A. When eells are connected in series

    a. the current is increased
    b. the potential difference is decreased
    c. the potential difference is increased
    d. the resistance is unchanged.

    B. The battery used in automobile are made up of cells connected in

    a) parallel (b) series
    c) combinatio n of parallel and series (d) alternatively parallel and series.

If a student has a proper understanding about the series connection of cells, he can utilise this knowledge effectively in improvising electrical equipments and also to understand the working of some electrical equipments where series connections are made use of.

40. A. Decreasing the thickness of a wire

    a) makes the resistance zero
    b) causes no change in resistance
    c) decreases its resistance
    d) increases its resistance

    B. Ordinary electric bulbs make use of thin and long tungsten wire because it has

    a) low resistance (b) high resistance (c) zero resistance (d) low melting point.

A proper idea regarding the effect of reducing the thickness of wire onits resistance will help the student to understand the reason why thin long wire is used in ordinary electric bulbs.

41. A. The melting point of an impure substance will be

    a. greater than that of the pure substance
    b. same as that of the pure substance
    c. less than that of the pure substance
    d. greater or less than that of the pure substance

When the student is aware of the fact that melting point of impure substance is less than pure

B. In cold countries salt is sprinkled on the roads for removing snow because

a. when salt is dissolved the melting point of ice increases
b. when salt is dissolved the temperature of surroundings increases
c. when salt is dissolved the melting point of ice decreases
d. the increase in pressure causes the increase in melting point of ice.

substance he can utilise this knowledge in situations where the melting point of pure substance is to be reduced.

42. A. Which of the following are semi-conductors?

a. Boron and phospherous
b. copper and aluminium
c. cadmium and nickel
d. silicon and germanium

B. Most of the diodes and transistors are made up of silicon and germanium because they are

a. good conductors
b. good insulators
c. semi conductors
d. super conductors

A thorough knowledge about the semi-conductors will equip the students to understand why silicon and germanium are preferred in the manufacture of diodes and transistors.

43. A. A sound heard by reflection and clearly distinguished from the original sound is

a) echo (b) resonance
c) reverberation (d)beats

B. The property of sound which helps in using sound waves for measuring the depth of the sea is

a) wave motion (b) vibration
c) reflection (d) reverberation

An understanding about how echo is produced will enable the student in utilising this in certain practical applications for example how the depth of the sea can be measured.

44. A. Bats produce which of the following waves to detect obstacles on their way?

a) Electromagnetic 'parasonic)
b) Infrasonic (c) supersonic
d) ultrasonic

B. What kind of waves are used in sonar to detect objects under water.

a) Electromagnetic (b)ultrasonic
c) supersonic (d) infrasonic

If the student is aware of the fact bats detect obstacles on their way using ultrasonic waves, this can be utilized in other practical uses of ultrasonic.

45. A. When a loud sound is produced in a closed room, a continuous rolling of sound persists for sometime. This phenomenon is known as

a) resonance (b) echo
c) forced bivration (d)reverberation.

B. The walls of cinima halls are generally covered with sound absorbing materials. This is done so to reduce

a) resonance (b) reverberation
c) forced vibration (d) echo

If the student has a proper understanding of reverberation, he will be able to suggest what measures can be taken to reduce reverberation in big halls.

46. A. When the frequency of the forcing body is equal to the natural frequency of the forced body, there occurs the phenomenon of

a) resonance (b) echo
c) reverberation (d) beats

B. Why do some bronze vessels vibrate when there is a loud noise?

a. Because of the intensity of sound
b. The frequency of the vessel
c. The noise contains many frequencies of which one is equal to the natural frequency of the vessel.
d. The vessel can vibrate with all the frequencies in the noise.

A proper understanding of the phenomenon of resonance, will help the student to explain some daily life experiences for example, the vibration of bronze vessels when there is a loud noise.

47. A. Certain metals when cooled to very low temperature near absolute zero, they lose their resistance completely, These are called

a. Semiconductors
b. conductors
c. insulators
d. superconductors

B. Electricity can be transmitted distant places without loss of electrical energy with the use of
a. semiconductors
b. conductors
c. insulators
d. superconductors.

A thorough understanding of the superconductivity will help the student to realise the use of superconductors in different situations.

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APPENDIX - III

Draft form of Theory Awareness and Practical Application Awareness Test items for Standard X

1.A. Which of the following has larger wave length?

a. Red light (b) Violet light
c. Ultra violet (d) Infra red

B. Very distant objects can be photographed effectively by making use of

(a) ultra violet (b) infra red
(c) x-rays (d) gamma rays

If a student is aware of the wave length of different colours in the spectrum, he will be able to apply it in techniques related to photography.

2.A. Sun-burn is caused by the

(a) ultra violet rays
(b) infra red rays
(c) x-rays (d) gamma rays

B. Which of the following radiation present in sunlight helps our skin to produce vitamin D in our body?

(a) Infra red (b) Cosmic rays
(c) X-rays (d) Ultra violet

If the student knows about the properties of ultra-violet rays, he will be able to understand about the production of vitamin D in our body.

3.A. Which of the following light has less scattering?

(a) Violet (b) Blue
(c) Yellow (d) Red

B. Red lights are often used in signal lamps because

(a) red colour is easily noticeable (b) red light is scattered more and so it is visible at a great distance. (c) red light is scattered very little and so it is visible at a great distance. (d) red light has a shorter wave length and so it is visible at a great distance.

If the student knows about the principles of scattering, he can apply it in explaining why red lights are used in signal lamps.

A - Theory Awareness Test items
B - Practical Application Awareness Test items.

4. A. Which of the following radiation has greater frequency?

a. Radio waves (b) micro waves
c. Infra red (d) X-rays

B. The frequency of long wave radio when compared to the frequency of short wave radio is

a. more (b) same (c) less
d. cannot be anticipated

A thorough knowledge about the frequency of different radiations will help the student in differentiating a long wave radio and short wave radio.

5. A. The deviation taking place at the surface of separation of the media known as

a. refraction (b) reflection
c. dispersion (d) scattering

B. Rainbow is formed because of

a. diffraction of light at the edges of raindrops.
b. reflection of light from sky.
c. refraction of light through rain drops.
d. interference of light in thin films of water in air.

If the principles of reflection is clear to a student, he can apply it in various situations to explain some common physical phenomena like the formation of rainbow etc.

6. A. Which of the following is correct in the order of decreasing wave length.

a. infra red waves, radio waves, micro waves, x-rays, visible light.

b. x-rays, visible light, infra red, microwaves, radio waves.

c. x-rays, infra red, visible light, radio waves, x-rays

d. radio waves, micro waves, infra red, visible light, x-rays.

B. Microwave relay tower is made use of in the care of

a. radio broadcasting
b. Television (c) X-rays
d. Gamma rays

If a student has a good understanding of the different wave length associated with a spectrum, he will be able to identify which tower is made use of in Television relays.

7. A. The most suitable alloy for making high resistance wires is a. Alnico (b) Inwar c. Canthol (d) Nichrome B. The heating coils in household appliances like electric iron, heater, etc., are made up of a. Alnico (b) Nichrome c. Copper (d) phospher bronze	If the student has a proper idea about the type of alloy having high resistance, he can utilise this knowledge in identifying the alloys used in many household heating appliances.
8. A. Which of the following has highest sp. heat? a. sand (b) copper (c) aluminium d. water B. Water is used in automobile radiators because of its a. high heat capacity b. low heat capacity c. high cooling effect d. availability in plenty	If a student is aware of the fact that water has the highest sp. heat when compared to many others, like sand, copper, etc., he can apply this in explaining why water is preferred in some apparatus like automobile radiators.
9. A. In the transformers at the distributing stations the number of turns in the primary are a. less than the number of turns in secondary b. equal to the number of turns in secondary c. greater than the number of turns in secondary d. none B. The device used to convert A.C. from high voltage to low voltage a. AC dynamo (b) motor c. step up transformer d. step down transformer	If the student understands the working of an instrument, he will be able to identify its varioususes.

10. A. Which of the statement is true regarding a step-up transformer

   a. The number of turns in the primary are greater than that in the secondary.
   b. The number of turns in the secondary are greater than that in the primary.
   c. The input A.C. is more than the output A.C.
   d. The input A.C. is same as the output A.C.

   B. In a transformer, the voltage can be stepped up or down to a desired level by

   a. Varying the thickness of insulated Cu wires
   b. Keeping the number of turns of Cu wires constant
   c. adjusting the input A.C.
   d. suitably varying the number of turns in the two coils.

If the student is aware of the fact that the number of coils decide the output voltage in a transformer, this can be applied in the construction of transformers.

11. A. A transformer is a device for

   a. increasing an alternating voltage
   b. decreasing an alternating voltage
   c. increasing or decreasing an alternating voltage
   d. increasing or decreasing the resistance.

   B. A transformer can be used with

   a. a.c. only (b) d.c. only
   c. both a.c. and d.c. (d) none

When the student is thorough with the purpose of a transformer, it will help him to realise that it can be used only with a.c.

12. A. The safety fuse wire is made up of a material of

   a. low resistance and very high melting point
   b. low resistance and very low melting point
   c. high resistance and very high melting point
   d. high resistance and very low melting point

If the student has a proper understanding about the material used for fuse wire,

B. An alloy of tin and lead is often used as a material for fuse wire. The reason is that

a. it is a very good conductor of electricity
b. it has high melting point
c. it melts easily if very high current is passed
d. it has low resistance

he can give a proper explanation why an alloy of tin and lead is preferred for fuse wire.

13. A. Which of the following is a safety device by which maximum limit of the current to be passed through an electric circuit can be controlled?

a. Choke (b) Fuse (c) Switch
d. Voltage stabiliser

B. A 15 amp. plug fuse is provided in an electrical circuit in an industry. It acts as a

a. load on the lines (b) step up transformer (c) step down transformer (d) safety device

If the student is thorough with the use of the fuse in a circuit, he can explain the purpose of using a 15 amp. plug fuse is provided in an electrical circuit.

14. A. The 'heating element' in electrical appliances is made up

a. high resistance and high melting point
b. high resistance and low melting point
c. low resistance and high melting point
d. low resistance and low melting point

B. Nichrome wires or tapes are used in household electric heating appliances because they have/are

a. high resistance and low melting point
b. high resistance and high melting point
c. the best conductors of electricity
d. low resistance and becomes hot very fast.

When the student is aware of the properties of heating elements used in heating appliances, he can utilise this in explaining why nichrome wires or tapes are used in heating appliances.

15. A. Three-pin plugs are used in household electric circuits

    a. to control the current
    b. to control the voltage
    c. to ensure better safety
    d. to attach the plug more tighly.

    B. An electric iron should be used with a three-pin plug because

    a. it ensures a longer life of the iron
    b. it provides a better insulation to the iron
    c. it ensures better safety by earthing
    d. it is more convenient to use a three pin plug.

An understanding of the use of three-pin plugs in electric circuit, will equip the student to explain the use of earthing.

16. A. The device used to convêrt mechanical energy into electrical energy is

    a. transformer (b) motor
    c. induction coil (d) dynamo

    B. In the Hydroelectric power stations the device which is used to generate electricity is

    a. transformer (b) motor
    c. dynamo (d) induction coil

If the student has a proper understanding about the function of dynamo, it will enable him to identify situations where dynamo can be made use of

17. A. Decreasing the thickness of a wire

    a. increases its resistance
    b. decreases its resistance
    c. causes no change in resistance
    d. makes the resistance zero

If the student is thorough with the effect of decreasing the thickness of wire on resis-

B. Ordinary electric bulbs make use of thin and long tungston wire because it has

a. low resistance (b) high resistance (c) zero resistance (d) low melting point

tance, it will enable him to explain why electric bulbs make use of thin and long wire.

18. A. The phenomenon associated with the change of magnetic flux linked with a circuit is

a. electricity (b) magnetiam
c. electromagnetic induction
d. induced magnetism

B. The generator works on the principle of

a. electromagnetic induction
b. induced magnetism
c. induced electricity
d. Coulomb's law of electrostatics.

When the student is aware of the fact that electromagnetic induction is associated with the change of magnetic flux in a circuit, he can utilize this knowledge in explaining the working of a generator.

19. A. Which of the following are semiconductor?

a. Boron and phospherous
b. Copper and aluminium
c. Cadmium and strontium
d. Silicon and germanium

B. Most of the diodes and transistors are made of silicon and germanium because they are

a. good conductors
b. good insulators
c. semi conductors
d. super conductors

If the student has a knowledge of different semiconductors, he can utilise this in explaining why Si and Ge are preferred in diodes and transistors.

20. A. Certain metals when cooled to very low temperature near absolute zero, they lose their resistance completely. These are called

a. conductors (b) super conductors (c) semi-conductors (d) none of the above.

A thorough understanding of the superconductors will help the child

B. Electricity can be transmitted to distant places without loss of electrical energy with the use of

(a) semi conductors (b) conductors (c) super conductors (d) very thick copperwires.

to realise the use of superconductors in different situations.

21. A. The rays that can pass through the body are

a. X-rays (b) alpha rays c. beta rays (d) gamma rays

B. X-rays can be used for taking photos of inner organs and bones becuase

a. they destruct the germs
b. they can pass through the body
c. they can be handled easily
d. they can be produced easily.

When the student is thorough with the properties of X-rays, it will enable him to utilize the knowledge in daily life situation namely of use of x-rays for medical purposes.

22. A. Energy stored in a dry cell is

a. mechanical (b) electrical c. chemical (d) heat

B. The cell in which carbon rod is used as the positive electrode and zinc container as negative electrode is

a. dry cell (b) voltaic cell c. acid accumulator (d) alkali accumulator

A proper understanding of the dry cell, will help the child to identify this particular cell from many other type of cells.

23. A. The conduction of electricity through an electrolyte, together with the resulting chemical changes is known as

a. photoelectric effect
b. heating effect
c. electrolysis
d. refrigeration

When the student is thorough with the process of electrolysis, he can explain

B. Alternating current cannot be used in

a. heating (b) electrolysis
c. air conditioning
d. refrigeration

processes where A.C. cannot be made use of.

24. A. When current is passed through copper sulphate solution during electrolysis, the copper ions are deposited

a. on the cathode (b) on the anode (c) remains in the electrolyte (d) on the copper rod

B. If an aluminium chain has to be electroplated with gold, it should be used

a. as the cathode
b. as the anode
c. be kept in the electrolyte
d. connected between anode and cathode

A proper understanding about the chemical action during electrolysis will enable the student to do electroplating.

25. A. The capacity for doing work is known as

a. heat capacity of the body
b. sp. heat of the body
c. power of the body
d. energy of the body

B. If in your town electricity costs 50 paise per kilowatt hr. you pay for

a. electric energy (b) electric charge (c) power (d) electric current

If the concept of work is properly understood by student, it will enable him to understand the fact that we can paying for the electric energy consumed.

26. A. Which of the following material is used to make temporary magnets?

a. Hard steel (b) Alnico
c. Steel (d) soft-iron

If the student understands the use of

B. The most suitable material for the core of a powerful electromagnet is

a. Alnico (b) soft iron
c. Steel (d) tungsten

soft iron for making temporary magnets, he can suggest the most suitable material for making powerful electromagnets.

27. A. The split rings are incorporated in the construction of

a. a.c. dynamo (b) d.c. dynamo
c. electric motors
d. transformer

B. Which of the following can be made use of in electroplating

a. a.c. dynamo (b) a.c. dynamo
c. step up transformer
d. step down transformers

If the student is thorough with the action of split rings in d.c. dynamo, he can suggest the use of it in electroplating.

28. A. Which of the following retains a major part of the magnetism?

a. Electromagnet
b. Temporary magnets
c. Permanent magnets
d. The core of a transformer

B. A telephone receiver makes use of a

a. electromagnet
b. temporary magnet
c. permanent magnet
d. natural magnet

If the student is aware of the function of permanent magnet, he will be in a position to say why it is used in telephone receivers.

29. A. The process by which a composite light is split into its component colours is known as

a) refraction b. dispersion
c) diffraction d. polarisation
(scattering)

B. Soap film exhibits brilliant colours in sun light due to

a. dispersion of light
b. scattering of light
c. diffraction of light
d. interference of light

If the student is clear about the concept of dispersion, he will be able to explain why brilliant colours are seen on soap film in sunlight

30. A. What will be the colour obtained by mixing blue and yellow.

a) yellow b. white
c. bluish yellow d. green

B. A painter wants some bright green colour for the grass in his painting. Which of the two colours should be mixed?

a. Blue and red (b) Blue and yellow (c) Yellow and red (d) Blue and white

If the student is having a clear idea about the primary colours and secondary colours, he will be able to predict which colours should be mixed to obtain a certain colour.

31. A. For which of the following colour scattering is least

a. violet b. blue
c. yellow d. red

B. A boy uses coloured light to give some signal to a person standing at a great distance. Which of the following colour is best suited.

a. Red (b) Yellow (c) Orange
d. Green

If the student has a proper understanding about the scattering of different colours, he will be able to suggest which colour light is better to give signal to a person standing at a great distance.

32. A. Which of the following reflects all the lights falling on it?

a. white wall (b) black paper
c. green leaf (d) blue sari

B. A diary note is written on white paper in red ink. We cannot read it in the red light because

a. white paper absorbs red light
b. white paper reflects red light
c. red colour is scattered more
d. red colour is scattered less

If the student understands the fact that white colour reflects all the light falling on it, he will be able to explain why a diary note written on white paper in red ink cannot be read in red light.

33. A. Which of the following alloy has the highest permeability?

a. Nichrome (b) Inwar
c. Alnico (d) Magnalium

B. Which of the following is most suitable for making permanent magnets in loud speakers.

a. Soft iron b. Nickel
c. Tungsten d. Alnico

A clear idea about the permeability of a material will help the student to suggest the use of the alloy Alnico for manufacturing permanent magnets.

34. A. An instrument in which electrical energy in one circuit is transferred into another without any electrical contact is

a. transformer (b) induction coil (c) AC dynamo (d) motor

B. If we have to use a household appliance which work only on 110 V in our home, which of the following instrument should be made use of?

a. Step-up transformer
b. Step-down transformer
c. Electric motor
d. High resistance wire

A correct idea about the purpose for which a transformer is used, will enable the student to use the device in solving problems in daily life.

35. A. The supply of electricity for domestic purpose is obtained from

a. step-up transformer
b. step-down transformer
c. induction coil
d. dynamo

B. To light a 6 volt bulb from a 230v supply, the device required is

a. electric motor (b) dynamo
c. step-up transformer
d. step-down transformer

A proper understanding of the working of transformer will help the student to use it in daily life situations.

36. A. Which of the following is to be connected with the phase wire?

a. Fuse (b) Main switch
c. Switch d. Plug

B. Which of the following breaks connection with phase and neutral lines.

a. Fuse (b) Switch
c. Plug (d) Main Switch

If the student is clear about the connections of a switch, he will be able to differentiate between a switch and main switch.

37. A. In lightening conductor, the principle made use of is that charge gets accumulated at

a. everywhere (b) nowhere
c. flat ends (d) pointed ends.

B. The lightening conductor protects the building from lightening by

a. not permitting the lightening to fall at the building at all.
b. driving away the charged particles
c. forcing lightening to fall on other buildings in the neighbourhood.
d. conducting the electric charge to the ground when lightening strikes the building.

The fact that charge gets accumulated at the points will help the student to understand the function and working of a lightening conductor.

38. A. A charged object will attract a neutral object because of

a. electrostatic induction
b. electromagnetic induction
c. mutual induction
d. magnetic induction

B. A device to detect electric charge in a body is

a. Electroscope b. Voltmeter
c. Ammeter d. Galvanometer

When a student is thorough with the principles of eletrostatic induction he can suggest instruments to detect electric charge.

39.A. The purpose of providing petrol trucks with metal chains hanging from the rear and dragging on the ground is to

a. give extra strength for the truck
b. help to reduce the spark formed due to friction
c. serve the purpose of a safety device
d. use when need arises

If the purpose of using metal chains in petrol trucks is known to the student, he will apply it in other similar situations.

B. The occupants of modern steel frame buildings are not harmed when the buildings are struck by lightening because

a. these buildings are stronger
b. these drive away the charged particles
c. lightening does not fall on steel frame the buildings
d. steel frames being good conductors they allow the charge to flow to the earth.

40. A. When the resistance of a conductor is decreased, the heat developed will

a. decrease (b) increase
c. become zero (d) not change

B. What change occurs in the heating effect of a certain electric circuit in which the total resistance is made half?

a. The heating effect is doubled
b. The heating effect is reduced to half
c. No effect
d. The heating effect is increased four times.

If the relation between the resistance of the conductor and heat generated is clear to the student, he will be able to understand about the heating effect in case the resistance is made half.

41\. A. If the length of a conductor is made half, its resistance

a. increases (b) does not change
c. decrease to half
d. decreases to one-fourth

B. A portion of a heater coil is broken off and if the rest is joined to form the coil, then the resistance of the coil

a. will decrease and power consumption will increase.
b. will decrease and power consumption will decrease.
c. will increase and power consumption will increase
d. will increase and power consumption will decrease.

If the student is thorough with the effect of decreasing length on resistance, he will be able to apply it in daily life situations.

42\. A. When the thickness of a wire increases, its resistance

a. increases (b) decreases
c. does not change d. becomes zero

B. There are 4 nichrome wires of diameters 2mm, 3 mm, 4 mm, and 5 mm and all four have the same length. Which one will give more heat if connected to the same source?

a. 2 mm diameter wire
b. 3 mm diameter wire
c. 4 mm diameter wire
d. 5 mm diameter

When the fact that as the thickness of a wire increases, the resistance decreases is clear to a student he will be able to select proper material for giving more heat.

43\. A. Fuse wire is included in an electric circuit to

a. increase the current
b. to decrease the current
c. to check the excessive flow of current
d. to check the excessive flow of voltage.

If the student is clear about the purpose of fuse in

B. What should be done if in a domestic electric circuit the rated fuse wire burns frequently?

a. Use a thicker fuse wire than the rated one
b. Use a thinner fuse wire than the rated one
c. connect directly without using fuse wire
d. get the circuit checked for short circuiting.

a circuit, he will be able to apply it in daily life situations for example, what to do if the fuse wire burns frequently.

44. A. Which of the following instrument is used to develop very high potential from a direct current source.

a. Transformer b. Dynamo
c. Motor d. Induction coil

B. Which of the following instrument finds its application in the self-ignition system of motor car?

a. Induction coil (b) Dynamo
c. Motor (d) Transformer

If the student is clear about the use of induction coil, he will be able to identify situations where induction coils are used.

45. A. In which of the following controlled fission takes place?

a. nuclear bomb (b) atomic bomb (c) nuclear reactor (d) hydrogen bomb

B. Which of the following is used in a Nuclear reactor to slow down neutrons?

a. Plutonium-239
b. heavy water
c. entiched uranium
d. Cadmium

If the students knows about atomic fission, he can understand the working of nuclear reactors.

46. A. Of the different colours of white light, which colour has the greatest wavelength?

    a. Red
    b. Violet
    c. Yellow
    d. Green

    B. Which colour is most suitable to give signal to a person positioned at a great distance?

    a. Red
    b. Yellow
    c. Orange
    d. Green

A thorough understanding about the wavelength of different colours will help the student in identifying the use of colour lights.

Appendix IV

List of Experts

1. Dr. K.R. Sivadasan,
   Professor, Department of Education,
   University of Kerala,
   Trivandrum.

2. Prof. Madhava Kurup,
   Principal,
   Government Training College,
   Calicut.

3. Prof. Kesavan Nair,
   Government Training College,
   Trivandrum.

4. Dr. P.N. Gopalakrishnan Nair,
   Prof. of Physical Science,
   S.N.M. Training College,
   Moothakunnam,
   Ernakulam District.

5. Dr. Sreekantan Nair,
   Principal and Professor of Physical Science,
   Farook Training College,
   Calicut.

6. Dr. K. Anandan Nair,
   Prof.of Physical Science,
   Peet Memmorial Traning College,
   Mavelikara.

7. Dr. P.J. Poulose,
   Professor of Physics,
   M.A. College of Arts and Science,
   Kothamangalam,
   Ernakulam District.

8. Dr. P. Viswanathan Nair,
   Lecturer in Science Education,
   Department of Education,
   University of Kerala,
   Trivandrum.

9. Dr. C.G. Sukumaran Nair,
   Scientist, V.S.S.C.,
   Trivandrum.

10. Smt. Susamma George,
    Lecturer in Physical Science,
    Mount Carmel Training College,
    Kottayam.

UNIVERSITY OF KERALA
DEPARTMENT OF EDUCATION

THEORY AWARENESS TEST IN
PHYSICS FOR STANDARD IX

നിർദ്ദേശങ്ങൾ

1 ഊർജ്ജതന്ത്രത്തിലുള്ള അറിവു പരിശോധിക്കുന്നതിനുള്ള ടെസ്റ്റാണിത്.

2 ഈ ടെസ്റ്റിൽ 30 ചോദ്യങ്ങൾ ഉണ്ട്, അവയ്ക്ക് 45 മിനിട്ടിനുള്ളിൽ ഉത്തരങ്ങൾ എഴുതേണ്ടതാണ്.

3 ഓരോ ചോദ്യത്തിനും a, b,c, d എന്നീ നാല് ഉത്തരങ്ങൾ വീതം കൊടുത്തിരിക്കുന്നു. അവയിൽ ഏററവും അനുയോജ്യമായ ഉത്തരത്തെ സൂചിപ്പിക്കുന്ന അക്ഷരം ഈ ടെസ്റ്റ്ബുക്ക്ലെററിനോടൊപ്പം തരുന്ന പേപ്പറിൽ എഴുതുക.

4 ടെസ്ററ്ബുക്ക്ലെററിൽ ഒന്നുംതന്നെ എഴുതാതിരിക്കാൻ ശ്രദ്ധിക്കുക.

5 ഉത്തരങ്ങൾ എഴുതാൻ തുടങ്ങുന്നതിനുമുമ്പ് ഉത്തരക്കടലാസിൽ നിങ്ങളുടെ പേരും സ്കൂളിൻെറ പേരും എഴുതുക.

6 ഉത്തരങ്ങൾ എഴുതിയശേഷം ഉത്തരക്കടലാസും ടെസ്ററ്ബുക്ക്ലെററും തിരികെ ഏൽപ്പിക്കണം.

1 താഴെപ്പറയുന്ന പ്രസ്താവനകളിൽ ഏതാണ് ദീർഘദൃഷ്ടിയ്ക്ക് കാരണമായിട്ടുള്ളത് ?

A) ലെൻസിൻെറ പവറിനെ അപേക്ഷിച്ച് നേത്രഗോളത്തിന് നീളം കുറവായിരിക്കും

B) നേത്രഗോളം സാധാരണമെങ്കിലും ലെൻസിൻെറ പവർ കുറവായിരിക്കും

(a) A. ശരി
(b) B. ശരി
(c) Aയും Bയും ശരിയല്ല
(d) Aയും Bയും ശരി

2 ഒരു കോൺവെക്സ് മിറർ മൂലമുണ്ടാന്ന പ്രതിബിംബം വസ്തുവിനെ അപേക്ഷിച്ച്

(a) മിഥ്യയും തലകീഴായതുമാണ്
(b) ചെറുതും നിവർന്നതുമാണ്
(c) യഥാർത്ഥവും തലകീഴായതുമാണ്
(b) വലുതും മിഥ്യയുമാണ്

3 വസ്തു കോൺകേവ് മിററിൻെറ ഫോക്കസ്സിൽ ആയിരിക്കുമ്പോൾ പ്രതിബിംബം ഉണ്ടാകുന്നത്

(a) Fനും മിററിനും ഇടയ്ക്ക്
(b) Fനും 2Fനും ഇടയ്ക്ക്
(c) 2Fനും അപ്പുറം
(d) ബഹിർഗ്ഗമന രശ്മികൾ സമാന്തരമാണ്

4 കുളത്തിലേയും ടാങ്കുകളിലേയും ജലത്തിൻെറ ഉപരിതലത്തിൽ ചെറുപ്രാണികൾ സുരക്ഷിതമായി നടക്കുന്നു. ഇതിനു കാരണം

(a) ശ്യാനത (viscosity)
(b) പ്രതലബലം
(c) കൊഹീഷൻബലം
(d) അഡ്ഹീഷൻ ബലം

5 ഹ്രസ്വദൃഷ്ടിയിൽ അകലെയുള്ള വസ്തുക്കളിൽനിന്നും പ്രകാശരശ്മികൾ കേന്ദ്രീകരിക്കുന്നത്

(a) റെറ്റിനയിൽ
(b) നേത്രലെൻസിന്റെയും റെറ്റിനയുടെയും ഇടയ്ക്ക്
(c) റെറ്റിനയുടെ പിന്നിൽ
(d) റെറ്റിനയുടെ മുന്നിൽ

6 ഒരു ക്യാപ്പിലറി ട്യൂബിന്റെ (ലോമികയുടെ) വ്യാസം ഇരട്ടിപ്പിച്ചാൽ, കേശികത്വംമൂലം അതിൽകൂടിയുള്ള ജലവിധാനത്തിന്റെ ഉയർച്ച

(a) കൂടുന്നു
(b) കുറയുന്നു
(c) വ്യത്യാസപ്പെടുന്നില്ല
(d) മുൻകൂട്ടി പറയാൻ പറ്റുകയില്ല

7 സസ്യകാണ്ഡങ്ങളിലൂടെ ജലം മുകളിലേയ്ക്ക് ഉയരുന്നത്

(a) വ്യതിവ്യാപനം (osmosis) മൂലമാണ്
(b) കേശികത്വംമൂലമാണ്
(c) അന്തരീക്ഷമർദ്ദം മൂലമാണ്
(d) അന്തർവ്യാപനം (diffusion) മൂലമാണ്

8 പ്രതലബലം അനുഭവപ്പെടുന്നത്

(a) ദ്രാവകത്തിൽ മൊത്തമായാണ്
(b) ദ്രാവകോപരിതലത്തിൽ മാത്രമാണ്
(c) ദ്രാവകത്തിൽ മൊത്തമായും ഉപരിതലത്തിൽ കൂടിയുമാണ്
(d) ദ്രാവകം ഉൾക്കൊണ്ടിരിക്കുന്ന പാത്രത്തിന്റെ വശങ്ങളിലൂടെയാണ്

9 ഊഷ്മാവ് കൂടുമ്പോൾ പ്രതലബലം

(a) അതിനനുസൃതമായി കൂടുന്നു
(b) വ്യത്യാസം വരുന്നില്ല
(c) കുറയുന്നു
(d) ക്രമരഹിതമായി കൂടുന്നു

10 ഘർഷണബലം

(a) മുഴുവനായും ഇല്ലാതാക്കാം
(b) കുറയ്ക്കാം
(c) കുറയ്ക്കാൻ പറ്റുകയില്ല
(d) എപ്പോഴും ഒരേപോലെയാണ്

11 ഘർഷണം കുറയ്ക്കാൻ താഴെപ്പറയുന്നവയിൽ ഏറ്റവും അനുയോജ്യമായ മാർഗ്ഗം ഏത് ?

(a) ബെയറിങ്ങുകൾ ഉപയോഗിച്ച്
(b) ലൂബ്രിക്കേഷൻ മൂലം
(c) മിനുസപ്പെടുത്തൽമൂലം
(d) മുകളിൽപ്പറഞ്ഞതെല്ലാം ഉപയോഗിച്ച്

12 അപകേന്ദ്രബലം പ്രവർത്തിക്കുന്ന ദിശ

(a) വൃത്ത കേന്ദ്രത്തിൽനിന്നും അകന്ന്
(b) വൃത്തകേന്ദ്രത്തിലേയ്ക്ക്
(c) വൃത്തകേന്ദ്രത്തിന്റെ സ്പർശനരേഖയിലൂടെ
(d) വൃത്തപരിധിയിലൂടെ

13 ഇസ്തിരിപ്പെട്ടി, പ്രഷർകുക്കർ, തുടങ്ങിയവയുടെ കൈപിടി തടിയോ പ്ലാസ്റ്റിക്കോ ഉപയോഗിച്ചു നിർമ്മിക്കുന്നത് അവ

(a) താപത്തെ പ്രവഹിപ്പിക്കുന്നതു കൊണ്ടാണ്
(b) വൈദ്യുതിയെ പ്രവഹിപ്പിക്കുന്നതുകൊണ്ടാണ്
(c) താപത്തേയും വൈദ്യുതിയേയും പ്രവഹിപ്പിക്കുന്നതു കൊണ്ടാണ്
(d) താപത്തേയും വൈദ്യുതിയേയും പ്രവഹിപ്പിക്കാത്തതു കൊണ്ടാണ്

14 ലോഹനിർമ്മിതമായ പെൻഡുലം വികസിക്കുമ്പോൾ

(a) സമയലാഭമുണ്ടാകുന്നു
(b) സമയനഷ്ടമുണ്ടാകുന്നു
(c) സമയലാഭമോ നഷ്ടമോ ഉണ്ടാകുന്നു
(d) പെൻഡുലം നിന്നുപോകുന്നു

15 തുന്നൽമെഷീൻ, ക്ലോക്ക് മുതലായവയുടെ ചലിക്കുന്ന യന്ത്രഭാഗങ്ങൾക്കിടയിൽ എണ്ണ പുരട്ടുന്നത്

(a) കേടുപാടുകൾ തടയാനാണ്
(b) ഘർഷണം കുറക്കുവാനാണ്
(c) ഘർഷണം കൂട്ടുവാനാണ്
(d) ഘർഷണം ഇല്ലാതാക്കുവാനാണ്

16 ദ്രാവക അമോണിയ റഫ്രിജിറേറ്ററുകളിൽ ഉപയോഗിക്കുന്നതിനു കാരണം

(a) ഇത് നല്ല ലായനിയായതിനാലാണ്
(b) ഇത് സുലഭമായതിനാലാണ്
(c) ഇത് ബാഷ്പീകരിക്കുമ്പോൾ പരിസരോഷ്മാവ് കൂടുന്നതിനാലാണ്
(d) ഇത് ബാഷ്പീകരിക്കുമ്പോൾ പരിസരോഷ്മാവ് കുറയുന്നതിനാലാണ്

17 ശൈത്യകാലങ്ങളിൽ കമ്പിളിവസ്ത്രങ്ങൾ ഉപയോഗിക്കുന്നതിനു കാരണം അവ

(a) താപം എളുപ്പത്തിൽ സംവഹനം ചെയ്യുന്നതിനാലാണ്
(b) താപം സാവധാനത്തിൽ സംവഹനം ചെയ്യുന്നതിനാലാണ്
(c) താപം ആഗിരണം ചെയ്യുന്നതിനാലാണ്
(d) താപം സംവഹനം ചെയ്യാത്തതിനാലാണ്

18 പ്രഷർകുക്കർ ഉപയോഗിച്ച് ഭക്ഷണം വേഗത്തിൽ പാകം ചെയ്യാൻ കഴിയുന്നതിനു കാരണം ഇവ ഉപയോഗിക്കുമ്പോൾ

(a) ദ്രാവകത്തിന്റെ ക്വഥനാങ്കം (Boiling point) കുറയുന്നു
(b) ദ്രാവകത്തിന്റെ ക്വഥനാങ്കം (Boiling point) കൂടുന്നു
(c) താപോർജ്ജം വേഗം ആഗിരണം ചെയ്യുന്നു
(d) താപം അധികസമയം നിലനിറുത്തുന്നു

19 രണ്ടു ലോഹങ്ങൾ തമ്മിൽ വിളക്കിച്ചേർക്കൽ സാധ്യമാകുന്നത് (Soldering) താഴെപ്പറയുന്നവയിൽ ഏതുമൂലമാണ് :

(a) ശ്യാനതമൂലം
(b) സ്ഥിതിസ്ഥാപകശക്തി (elasticity) മൂലം
(c) പ്രതലബലം മൂലം
(d) അഡ്ഹിഷൻ ബലംമൂലം

20 പ്രകാശോർജ്ജത്തെ വൈദ്യുതോർജ്ജമായി മാററുന്നത് താഴെ കൊടുത്തിരിക്കുന്നവയിൽ ഏതു ഉപയോഗിച്ചാണ്?

(a) ഡയനാമോ
(b) ഇലക്ട്രിക് ബൾബ്
(c) മോട്ടാർ
(d) സോളാർ ബാററി

21 ഒരു ഭൗമദൂര ദർശിനിയിലെ അന്തിമ പ്രതിബിംബമുണ്ടാകുന്നത്

(a) 100 cm ൽ
(b) അനന്തതയിൽ (at infinity)
(c) സ്പഷ്ടമായി കാണാൻ കഴിയുന്ന ഏററവും കുറഞ്ഞ ദൂരത്തിൽ (least distance of distinct vision)
(d) മുകളിൽ പറഞ്ഞ രീതിയിൽ ഒന്നും അല്ല

22 ഒരു സെൻട്രിഫ്യൂജ് ഉപയോഗിക്കുന്നത്

(a) വസ്ത്രം ഉണക്കുവാനാണ്
(b) പാലിൽനിന്നും കൊഴുപ്പ് വേർതിരിക്കുന്നതിനാണ്
(c) വെള്ളം പമ്പ് ചെയ്യുവാനാണ്
(d) ഒരു ദ്രവത്തിൽ നിന്നും ചെറുകണികകളെ വേർതിരിക്കുന്നതിനാണ്

23 മോട്ടോർ വാഹനങ്ങളിലെ ബാററികളിലെ സെല്ലുകളുടെ ക്രമീകരണം

(a) സമാന്തരരീതിയിലാണ്
(b) ശ്രേണീ രീതിയിലാണ്
(c) സമാന്തരരീതിയും ശ്രേണീ രീതിയും സമ്മിശ്രമായാണ്
(d) ഒന്നിടവിട്ട് സമാന്തരമായും ശ്രേണീ രീതിയുമായാണ്

24 ശൈത്യരാജ്യങ്ങളിൽ റോഡിൽനിന്നും ഐസ് നീക്കം ചെയ്യാൻ ഉപ്പ് വിതറുന്നതിനുകാരണം

(a) ഉപ്പ് ലയിക്കുമ്പോൾ ജലത്തിന്റെ ഊഷ്മാവ് ഉയരുന്നതാണ്
(b) ഉപ്പ് ലയിക്കുമ്പോൾ ജലത്തിന്റെ ഊഷ്മാവ് കുറയുന്നതാണ്
(c) ഉപ്പ് ലയിക്കുമ്പോൾ പരിസരോഷ്മാവ് ഉയരുന്നതാണ്
(d) മർദ്ദക്കൂടുതൽ ഐസിന്റെ ദ്രവണാങ്കം കുറയ്ക്കുന്നതാണ്

25 ശബ്ദതരംഗങ്ങൾ ഉപയോഗിച്ച് സമുദ്രത്തിന്റെ ആഴം കണക്കാക്കാൻ സഹായിക്കുന്നത് ശബ്ദത്തിന്റെ

(a) തരംഗചലനമാണ്
(b) കമ്പനമാണ്
(c) പ്രതിഫലനമാണ്
(d) അനുരണനമാണ്

26 പൊടിപിടിച്ച് വൃത്തികേടായ ഒരു പരവധാനി (carpet) നിലത്ത് അടിച്ച് വൃത്തിയാക്കാം. ഇത് താഴെ പ്പറയുന്നവയിൽ ഏത് നിയമമനുസരിച്ചാണ്?

(a) ന്യൂട്ടന്റെ 1-ാം നിയമം
(b) ന്യൂട്ടന്റെ 2-ാം നിയമം
(c) ന്യൂട്ടന്റെ 3-ാം നിയമം
(d) ഗുരുത്വാകർഷണ നിയമം

27 വൈദ്യുതോർജ്ജം നഷ്ടമുണ്ടാവാതെ വളരെ അകലെയുള്ള സ്ഥലങ്ങളിലേയ്ക്ക് വൈദ്യുതി കൊണ്ടുപോകാൻ താഴെപ്പറയുന്നവയിൽ ഏത് ഉപയോഗപ്രദമായിരിക്കും ?

(a) അർദ്ധചാലകങ്ങൾ
(b) ചാലകങ്ങൾ
(c) വിദ്യുത്രോധികൾ
(d) അതിചാലകങ്ങൾ

28 സിനിമാശാലകളിലേയും വലിയ ഹാളുകളിലേയും ഭിത്തികൾ ശബ്ദം ആഗിരണം ചെയ്യാൻ കഴിവുള്ള വസ്തുക്കൾ കൊണ്ട് ആവരണം ചെയ്ത്

(a) ശബ്ദത്തിന്റെ ആവൃത്തി കുറയ്ക്കാം
(b) അനുകരണനം കുറയ്ക്കാം
(c) അനുനാദം കുറയ്ക്കാം
(d) പ്രണോദിത കമ്പനം കുറയ്ക്കാം

29 വർത്തുള പാതയിൽക്കൂടി സഞ്ചരിക്കുന്ന ഒരു വസ്തു സ്പർശനരേഖയിൽക്കൂടി സഞ്ചരിക്കുന്നത്

(a) ഘർഷണ ബലം ഇല്ലാതാകുമ്പോഴാണ്
(b) അപകേന്ദ്ര ബലം ഇല്ലാതാകുമ്പോഴാണ്
(c) അഭികേന്ദ്ര ബലം ഇല്ലാതാകുമ്പോഴാണ്
(d) പ്രതലബലം ഇല്ലാതാകുമ്പോഴാണ്

30 സഞ്ചാര പാതയിലുള്ള തടസ്സങ്ങൾ മനസ്സിലാക്കാൻ വാവലുകൾ പുറപ്പെടുവിക്കുന്നത്

(a) വൈദ്യുതകാന്ത തരംഗങ്ങളാണ്
(b) അൾട്രാസോണിക് തരംഗങ്ങളാണ്
(c) ഇൻഫ്രാസോണിക് തരംഗങ്ങളാണ്
(d) സൂപ്പർ സോണിക് തരംഗങ്ങളാണ്

UNIVERSITY OF KERALA
DEPARTMENT OF EDUCATION
PRACTICAL APPLICATION AWARENESS TEST IN PHYSICS FOR STANDARD IX

നിർദ്ദേശങ്ങൾ

1 ഊർജ്ജതന്ത്രത്തിലുള്ള അറിവു പരിശോധിക്കുന്നതിനുള്ള ടെസ്റ്റാണിത്.

2 ഈ ടെസ്റ്റിൽ 30 ചോദ്യങ്ങൾ ഉണ്ട്, അവയ്ക്ക് 45 മിനിട്ടിനുള്ളിൽ ഉത്തരങ്ങൾ എഴുതേണ്ടതാണ്.

3 ഓരോ ചോദ്യത്തിനും a, b,c, d എന്നീ നാല് ഉത്തരങ്ങൾ വീതം കൊടുത്തിരിക്കുന്നു. അവയിൽ ഏറ്റവും അനുയോജ്യമായ ഉത്തരത്തെ സൂചിപ്പിക്കുന്ന അക്ഷരം ഈ ടെസ്റ്റ്ബുക്ക്ലെറ്റിനോടൊപ്പം തരുന്ന പേപ്പറിൽ എഴുതുക.

4 ടെസ്റ്റ്ബുക്ക്ലെറ്റിൽ ഒന്നുംതന്നെ എഴുതാതിരിക്കാൻ ശ്രദ്ധിക്കുക.

5 ഉത്തരങ്ങൾ എഴുതാൻ തുടങ്ങുന്നതിനുമുമ്പ് ഉത്തരക്കടലാസിൽ നിങ്ങളുടെ പേരും സ്കൂളിന്റെ പേരു എഴുതുക.

6 ഉത്തരങ്ങൾ എഴുതിയശേഷം ഉത്തരക്കടലാസും ടെസ്റ്റ്ബുക്ക്ലെറ്റും തിരികെ ഏൽപ്പിക്കണം.

1) ഒരു വ്യക്തിയ്ക്ക് ദൂരെയുള്ള വസ്തുക്കളെ വ്യക്തമായി കാണാൻ സാധിക്കുന്നുണ്ടെങ്കിലും വായിക്കുന്ന സമയത്ത് കണ്ണട ഉപയോഗിക്കുന്നു. ഏതുതരം ലെൻസാണ് ആ വ്യക്തിയുടെ കണ്ണടയിൽ ഉപയോഗിക്കുന്നത്?

   a) കോൺകേവ്
   b) കോൺവെക്സ്
   c) പ്ലാനോകോൺവെക്സ്
   d) പ്ലാനോകോൺകേവ്

2) വണ്ടി ഓടിക്കുമ്പോൾ പിന്നിലുള്ള കാര്യങ്ങൾ കാണുന്നതിന് ഡ്രൈവർ ഉപയോഗിക്കുന്നത്

   a) കോൺവെക്സ് മിറർ
   b) കോൺകേവ് മിറർ
   c) പ്ലെയിൻ മിറർ
   d) സ്ഫെരിക്കൽ മിറർ

3) ഒരു ടോർച്ചു ലൈറ്റിൽ പ്രകാശ സ്രോതസ്സിന്റെ സ്ഥാനം

   a) കോൺകേവ് മിററിന്റെ ഫോക്കസിലണ്
   b) കോൺകേവ് മിററിന്റെ ധ്രുവത്തിലാണ്
   c) കോൺകേവ് മിററിന്റെ വക്രതാവ്യാസാർത്ഥത്തിലാണ് (radius of curvature)
   d) മുകളിൽ കൊടുത്തിരിക്കുന്നപോലെ ഒന്നും അല്ല

4) സോപ്പും സോപ്പുപൊടിയും തുണികൾ വൃത്തിയാക്കാൻ സഹായിക്കുന്നതിനു കാരണം ഇവ

   a) ജലത്തിന്റെ പ്രതലബലം കൂട്ടുന്നു
   b) ജലത്തിന്റെ പ്രതലബലം കുറയ്ക്കുന്നു
   c) പൊടി, മലിന പദാർത്ഥങ്ങൾ മുതലായവയെ വലിച്ചെടുക്കുന്നു
   d) ലായനിയുടെ രാസഘടനയിൽ വ്യത്യാസം വരുത്തുന്നു

5 ഹ്രസ്വദൃഷ്ടി പരിഹരിക്കാനുപയോഗിക്കുന്നത്.

(a) കോൺവെക്സ് ലെൻസ്
(b) കോൺകേവ് ലെൻസ്
(c) ഡബിൾ കോൺവെക്സ് ലെൻസ്
(d) ഡബിൾ കോൺകേവ് ലെൻസ്

6 വരണ്ട കാലാവസ്ഥയുള്ളപ്പോൾ മേൽമണ്ണ് ഇളക്കിയിടാറുണ്ട് ഇത്.

(a) മണ്ണിന്റെ ഫലപുഷ്ടി വർദ്ധിപ്പിക്കുവാനാണ്.
(b) ഭൂനിരപ്പിലേക്ക് ജലം കൊണ്ടുവരുന്നതിനാണ്
(c) ഭൂനിരപ്പിലുള്ള ജലത്തെ നിലനിറുത്തുന്നതിനാണ്
(d) ഭൂനിരപ്പിലേക്ക് ജലം ഉയരുന്നത് തടയുവാനാണ്

7 കളിമൺ പ്രദേശത്തിന് ചരൽപ്രദേശത്തെ അപേക്ഷിച്ച് വരൾച്ച കുറവാണ് കാരണം

(a) അതിലെ കണികളുടെ സ്വഭാവം മൂലം
(b) വ്യതിവ്യാപനം മൂലം
(c) പരിതസ്ഥിതി മൂലം
(d) കേശികത്വം മൂലം

8 കെട്ടിക്കിടക്കുന്ന ജലോപരിതലത്തിൽ എണ്ണകലർത്തിയിട്ടുണ്ടെങ്കിൽ കൊതുകുകൾ പെരുകുന്നില്ല കാരണം

(a) പ്രതലബലം കൂടുകയും ഓക്സിജൻ വിതരണം ഇല്ലാതാകുകയും ചെയ്യുന്നു
(b) പ്രതലബലം കുറയുകയും ഓക്സിജൻ വിതരണം ഇല്ലാതാകുകയും ചെയ്യുന്നു
(c) വ്യതിവ്യാപനം കൂടുന്നു
(d) വ്യതിവ്യാപനം കുറയുന്നു

9 വസ്തുക്കൾ വൃത്തിയാക്കുന്നതിന് തണുത്ത വെള്ളത്തേക്കാൾ ഉത്തമം ചൂടുവെള്ളമാണ്. ഇതിനു കാരണം

(a) കൊഹിഷൻ കൂടുന്നു
(b) കൊഹിഷൻ കുറയുന്നു
(c) പ്രതലബലം കൂടുന്നു
(d) പ്രതലബലം കുറയുന്നു

10 ടെന്നീസ് ഷൂസുകളുടെ അടിഭാഗത്ത് തുകൽ ഉപയോഗിക്കുന്നതിനേക്കാൾ ഉത്തമം റബ്ബർ ഉപയോഗിക്കുന്നതാണ്. കാരണം

(a) റബ്ബർ അടിത്തോലിന് തുകലിനേക്കാൾ ഘനം കുറവാണ്
(b) റബ്ബർ കാഴ്ചക്ക് കൂടുതൽ ഭംഗിയുള്ളതാണ്
(c) റബ്ബർ വൃത്തിയാക്കാൻ എളുപ്പമാണ്
(d) റബ്ബർ ഘർഷണബലം കൂട്ടുവാൻ സഹായിക്കുന്നു

11 താഴെപ്പറയുന്ന പ്രസ്താവനകളിൽ ഘർഷണത്തെ സംബന്ധിച്ച് ശരിയായവ ഏത്?

A. ഇത് ഊർജ്ജ നഷ്ടത്തിന് കാരണമാക്കുന്നു
B. ഇത് അനാവശ്യമായ തേയ്മാനങ്ങൾ ഉണ്ടാകുന്നു
C. ഇത് യന്ത്രങ്ങളുടെ സുഗമമായ പ്രവർത്തനത്തിന് സഹായകമാകുന്നു

(a) A യും B ശരി
(b) B യും C ശരി
(c) A യും C ശരി
(d) A യും B യും C യും ശരി

12 കൊഴുപ്പ് വേർതിരിക്കുന്ന യന്ത്രമുപയോഗിച്ച് പാലിൽനിന്നും കൊഴുപ്പ് വേർതിരിക്കുന്നത്

(a) അപകേന്ദ്രബലം മൂലമാണ്
(b) അഭികേന്ദ്ര ബലം മൂലമാണ്
(c) കൊഹിഷൻ ബലം മൂലമാണ്
(d) ഗുരുത്വാകർഷണ ബലം മൂലമാണ്

13 താഴെപ്പറയുന്നവയിൽ ഏററവും നല്ല കുചാലകം

(a) വായു
(b) പേപ്പർ
(c) ശൂന്യത
(d) ഗ്ലാസ്സ്

14 ഒരു ഖര പദാർത്ഥത്തിന്റെ വലിപ്പം കൂടുന്നത് താഴെപ്പറയുന്നവയിൽ ഏത് ഊർജ്ജഫലമായാണ് ?

(a) താപോർജ്ജം
(b) വൈദ്യുതോർജ്ജം
(c) യാന്ത്രികോർജ്ജം
(d) ശബ്ദോർജ്ജം

15 രണ്ടു ഖര പദാർത്ഥങ്ങൾക്കിടയിൽ എണ്ണ പുരട്ടുന്നതുമൂലം കുറയുന്നത്

(a) ഇലാസ്ററിക് ബലമാണ്
(b) സ്ഥിതിവൈദ്യുതാകർഷണബലമാണ്
(c) കാന്തബലമാണ്
(d) ഘർഷണബലമാണ്

16 ദ്രാവക അമോണിയ ബാഷ്പീകരിക്കുമ്പോൾ പരിസരോഷ്മാവ്

(a) കൂടുന്നു
(b) കുറയുന്നു
(c) സ്ഥിരമായി നില്ക്കുന്നു.
(d) കൂടുകയും ശേഷം കുറയുകയും ചെയ്യുന്നു.

17 ഒരു വിദ്യുത്രോധിയെ സംബന്ധിച്ച് താഴെ പറയുന്നവയിൽ ശരിയായ പ്രസ്താവന ഏത് ?

(a) അതു നല്ല ചാലകമാണ്
(b) അത് നല്ല ചാലകമല്ല
(c) അത് താപം ആഗിരണം ചെയ്യുന്നു.
(d) അത് താപം വികിരണം ചെയ്യുന്നു.

18 ഒരു ദ്രാവകോപരിതലത്തിൽ മർദ്ദം കൂടുമ്പോൾ അതിന്റെ

(a) വ്യാപ്തം കൂടുന്നു.
(b) വ്യാപ്തം കുറയുന്നു.
(c) ക്വഥനാങ്കം (boiling point) കുറയുന്നു
(d) ക്വഥനാങ്കം (boiling point) കൂടുന്നു.

19 എണ്ണവിളക്കുകളിലെ തിരികളിലൂടെ എണ്ണ മുകളിലേയ്ക്ക് ഉയരുന്നത് താഴെ കൊടുത്തിരിക്കുന്നവയിൽ ഏതിന്റെ ഫലമായാണ് ?

(a) മർദ്ദവ്യത്യാസം
(b) ശ്യാനത (Viscosity)
(c) കേശികത്വം.
(d) ഊഷ്മ വ്യത്യാസം

20 യാന്ത്രികോർജ്ജത്തെ താഴെപ്പറയുന്നവയിൽ ഏതുതരമായിമാററാം ?

(a) ശബ്ദോർജ്ജമായി
(b) വൈദ്യുതോർജ്ജമായി
(c) താപോർജ്ജമായി
(d) മുകളിൽ പറഞ്ഞവയെല്ലാമായി

21 ഒരു ദൂരദർശിനിയിലെ ഐപീസ് ലെൻസിൻെറ ഫോക്കസ് ദൂരം ഒബ്ജക്ടീവ് ലെൻസിൻെറ
(a) ഫോക്കസ്ദൂരത്തെക്കാൾ കുറവായിരിക്കും
(b) ഫോക്കസ് ദൂരത്തെക്കാൾ കൂടുതലായിരിക്കും
(c) ഫോക്കസ് ദൂരത്തിന് തുല്യമായിരിക്കും.
(d) ഫോക്കസ് ദൂരത്തിന് ഏകദേശം തുല്യമായിരിക്കും.

22 ഒരു സെൻട്രിഫ്യൂജിൻെറ പ്രവർത്തനം താഴെകൊടുത്തിരിക്കുന്നവയിൽ ഏതിനെ ആസ്പദമാക്കിയാണ് ?
(a) അഭികേന്ദ്രബലം
(b) അപകേന്ദ്രബലം
(c) ഗുരുത്വാകർഷണബലം
(d) സ്ഥിതിവൈദ്യുതബലം

23 സെല്ലുകൾ ശ്രേണീരീതിയിൽ ക്രമീകരിച്ചാൽ
(a) കറണ്ട് കൂടുന്നു
(b) പൊട്ടെൻഷ്യൽ വ്യത്യാസം കൂടുന്നു
(c) പൊട്ടെൻഷ്യൽ വ്യത്യാസം കുറയുന്നു
(d) പ്രതിരോധത്തിന് മാററം വരുന്നില്ല

24 ഒരു അശുദ്ധ പദാർത്ഥത്തിൻെറ ദ്രവണാങ്കം ശുദ്ധ പദാർത്ഥത്തിൻെറ
(a) ദ്രവണാങ്കത്തെക്കാൾ കൂടുതലായിരിക്കും.
(b) ദ്രവണാങ്കത്തേക്കാൾ കുറവായിരിക്കും
(c) ദ്രവണാങ്കത്തിന് തുല്യമായിരിക്കും
(d) ദ്രവണാങ്കത്തേക്കാൾ കൂടിയോ കുറഞ്ഞോ ഇരിക്കും

25 ഒരു ശബ്ദത്തിൻെറ പ്രതിഫലനം മൂലമുണ്ടാകുന്നതും, ആദ്യശബ്ദത്തിൽ നിന്നും വ്യക്തമായി വേർതിരിച്ച് കേൾക്കാവുന്നതുമായ ശബ്ദമാണ്
(a) പ്രതിധ്വനി
(b) അനുനാദം
(c) അനുരണനം
(d) ബീററ്സ്

26 ബലത്തിൻെറ നിർവ്വചനത്തിന് സഹായകമായ നിയമം ഏത് ?
(a) ന്യൂട്ടൻെറ 1–ാം നിയമം
(b) ന്യൂട്ടൻെറ 2–ാം നിയമം
(c) ന്യൂട്ടൻെറ 3–ാം നിയമം
(d) ഗുരുത്വാകർഷണ നിയമം

27 ചില ലോഹങ്ങളെ ആബ്സൊല്യൂട്ട് സീറോയ്ക്ക് (കേവലപൂജ്യം) അടുപ്പിച്ചുള്ള ഒരു ഊഷ്മാവ് വരെ തണുപ്പിക്കുമ്പോൾ അവയുടെ പ്രതിരോധം ഇല്ലാതാകുന്നു. ഇവയാണ്
(a) ചാലകങ്ങൾ
(b) അർദ്ധചാലകങ്ങൾ
(c) വിദ്യുത്രോധികൾ
(d) അതിചാലകങ്ങൾ

28 അടച്ചിട്ട മുറികളിൽ വെച്ച് ഉച്ചത്തിൽ ശബ്ദം പുറപ്പെടുവിച്ചാൽ അത് തുടർച്ചയായി പ്രതിധ്വനിക്കുകയും മുഴക്കം അനുഭവപ്പെടുകയും ചെയ്യുന്നു. ഈ പ്രതിഭാസമാണ്
a) അനുരണനം
b) അനുനാദം
c) സ്വാഭാവിക കമ്പനം
d) പ്രണോദിത കമ്പനം

29 വസ്ത്രങ്ങൾ ഉണക്കാനും മററും സഹായിക്കുന്ന ഡ്രൈയർപോലെയുള്ള ഉപകരണങ്ങൾ നിർമ്മിക്കുന്നതിന് പ്രയോജനപ്പെടുന്നത്

(a) വർത്തുള ചലനമാണ്
(b) ഭ്രമണചലനമാണ്
(c) കമ്പനമാണ്
(d) പരിക്രമണചലനമാണ്

30 സമുദ്രങ്ങളുടെ ആഴം അളക്കുന്നതിനും സമുദ്രത്തിനടിയിൽ കിടക്കുന്ന വസ്തുക്കളുടെ സ്ഥാനം നിർണ്ണയിക്കുന്നതിനും മൽസ്യസങ്കേതങ്ങൾ കണ്ടെത്തുന്നതിനും മററും ഉപയോഗിക്കുന്നത്

(a) വൈദ്യുതകാന്ത തരംഗങ്ങളാണ്
(b) ഇൻഫ്രാസോണിക് തരംഗങ്ങളാണ്
(c) അൾട്രാസോണിക് തരംഗങ്ങളാണ്
(d) സൂപ്പർസോണിക് തരംഗങ്ങളാണ്

APPENDIX - VI (A)

UNIVERSITY OF KERALA

DEPARTMENT OF EDUCATION

THEORY AWARENESS TEST IN PHYSICS

STANDARD X

നിർദ്ദേശങ്ങൾ

1 ഉർജ്ജതന്ത്രത്തിലുള്ള അറിവ് പരിശോധിക്കുന്നതിനുള്ള ഒരു ടെസ്റ്റാണിത്.

2 ഈ ടെസ്റ്റിൽ 30 ചോദ്യങ്ങൾ ഉണ്ട്. അവയ്ക്ക് 45 മിന്നിട്ടിനുള്ളിൽ ഉത്തരങ്ങൾ എഴുതേണ്ടതാണ്.

3 ഓരോ ചോദ്യത്തിനും a, b, c, d എന്നീ നാല് ഉത്തരങ്ങൾ വീതം കൊടുത്തിരിക്കുന്നു. അവയിൽ ഏറ്റവു അനുയോജ്യമായ ഉത്തരത്തെ സൂചിപ്പിക്കുന്ന അക്ഷരം ഈ ടെസ്റ്റ് ബുക്ക്ലെറ്റിനോടൊപ്പം തരുന്ന പേപ്പറിൽ എഴുതുക.

4 ടെസ്റ്റ്ബുക്ക്ലെറ്റിൽ ഒന്നുംതന്നെ എഴുതാതിരിക്കാൻ ശ്രദ്ധിക്കുക.

5 ഉത്തരങ്ങൾ എഴുതാൻ തുടങ്ങുന്നതിനുമുൻപ് ഉത്തരക്കടലാസിൽ നിങ്ങളുടെ പേരും സ്കുളിന്റെ പേരും എഴുതുക.

6 ഉത്തരങ്ങൾ എഴുതിയശേഷം ഉത്തരക്കടലാസും ടെസ്റ്റ്ബുക്ക് ലെറ്റും തിരികെ ഏൽപ്പിക്കണം,

1 താഴെപ്പറയുന്നവയിൽ ഏറ്റവും കൂടുതൽ തരംഗദൈർഘ്യം ഉള്ള പ്രകാശ രശ്മി ഏത്?

(a) ചെമപ്പ്
(b) വയലറ്റ്
(c) അൾട്രാവയലറ്റ്
(d) ഇൻഫ്രാറെഡ്

2 ഏറ്റവും കുറവ് വിസരണം ഉള്ള പ്രകാശരശ്മി

(a) വയലറ്റ്
(b) നീല
(c) മഞ്ഞ
(d) ചെമപ്പ്

3 താഴെപ്പറയുന്നവയിൽ ഏതു മൂലമാണ് 'സൺബേൺ' ഉണ്ടാകുന്നത്?

(a) അൾട്രാവയലറ്റ് വികിരണങ്ങൾ
(b) ഇൻഫ്രാറെഡ് വികിരണങ്ങൾ
(c) എക്സ് കിരണങ്ങൾ
(d) ഗാമാ കിരണങ്ങൾ

4 ധവളപ്രകാശത്തിലെ ഏറ്റവും കൂടുതൽ തരംഗദൈർഘ്യമുള്ള വർണ്ണമാണ്

(a) ചെമപ്പ്
(b) വയലറ്റ്
(c) മഞ്ഞ
(d) പച്ച

5 ഉയർന്ന പ്രതിരോധ ശേഷിയുള്ള കമ്പികൾ നിർമ്മിക്കുവാൻ ഉപയോഗിക്കുന്ന ലോഹസങ്കരമേത്?

(a) ആൾനിക്കോ
(b) ഇൻവാർ
(c) ക്യാൻന്തോൾ
(d) നിക്രോം

6 ഫ്യൂസ് വയർ നിർമ്മിക്കുവാൻ ഉപയോഗിക്കുന്ന വസ്തു

(a) കുറഞ്ഞ പ്രതിരോധവും ഉയർന്ന ദ്രവണാങ്കവുമുള്ളതാണ്.
(b) കുറഞ്ഞ പ്രതിരോധവും കുറഞ്ഞ ദ്രവണാങ്കവുമുള്ളതാണ്
(c) ഉയർന്ന പ്രതിരോധവും ഉയർന്ന ദ്രണാങ്കവുമുള്ളതാണ്
(d) ഉയർന്ന പ്രതിരോധവും കുറഞ്ഞ ദ്രവണാങ്കവും

7 ഒരു വൈദ്യുത സർക്കീട്ടിൽ കൂടി അമിതമായി വൈദ്യുതി പ്രവഹിച്ച് നാശനഷ്ടങ്ങൾ ഉണ്ടാകാതെ സൂക്ഷിക്കുന്നതിനുള്ള ഒരു ഉപായമാണ്

(a) ചോക്ക് (choke)
(b) ഫ്യൂസ്
(c) സ്വിച്ച്
(b) വോൾട്ടേജ് സ്ററബിലൈസർ

8 വൈദ്യുത തപനോപകരണങ്ങിൽ 'ഹീററിങ്ങ് എലിമെൻറ്' ഉണ്ടാക്കാനുപയോഗിക്കുന്ന വസ്തു

(a) ഉയർന്ന പ്രതിരോധവും ഉയർന്ന ദ്രവണാങ്കവുമുള്ളതായിരിക്കണം
(b) ഉയർന്ന പ്രതിരോധവും കുറഞ്ഞ ദ്രവണാങ്കവുമുള്ളതായിരിക്കണം
(c) കുറഞ്ഞ പ്രതിരോധവും ഉയർന്ന ദ്രവണാങ്കവുമുള്ളതായിരിക്കണം
(d) കുറഞ്ഞ പ്രതിരോധവും കുറഞ്ഞ ദ്രവണാങ്കവുമുള്ളതായിരിക്കണം

9 ഒരു ചാലകത്തിൻെറ നീളം നേർ പകുതിയായിക്കുറച്ചാൽ, അതിൻെറ പ്രതിരോധം

(a) കൂടുന്നു
(b) മാററംവരുന്നില്ല
(c) പകുതിയായി കുറയുന്നു
(d) നാലിലൊന്നായി കുറയുന്നു

10 ഒരു കമ്പിയുടെ വണ്ണം വർദ്ധിപ്പിക്കുമ്പോൾ, അതിൻെറ പ്രതിരോധം

(a) കൂടുന്നു
(b) കുറയുന്നു
(c) മാററം വരുന്നില്ല
(d) ഇല്ലാതാകുന്നു

11 വൈദ്യുത സർക്കീട്ടിൽ ഫ്യൂസ് വയർ ഉൾപ്പെടുത്തിയിരിക്കുന്നത്

(a) കറൻറ് കൂടുവാനാണ്
(b) കറൻറ് കുറയ്ക്കുവാനാണ്
(c) കറൻറിൻെറ അമിത പ്രവാഹം നിയന്ത്രിക്കുവാനാണ്
(b) വോൾട്ടേജിൻെറ അമിത പ്രവാഹം നിയന്ത്രിക്കുവാനാണ്

12 ഒരു വസ്തുവിൻെറ പ്രവൃത്തി ചെയ്യാനുള്ള കഴിവാണ് അതിൻെറ

(a) താപധാരിത
(b) വിശിഷ്ടതാപം
(c) പവർ
(d) ഊർജ്ജം

13 വൈദ്യുത വിശ്ലേഷണ വേളയിൽ കോപ്പർ സൽഫേറ്റ് ലായനിയിലൂടെ വൈദ്യുതി കടത്തി വിടുമ്പോൾ, കോപ്പർ അയോണുകൾ നിക്ഷേപിക്കപ്പെടുന്നത്

(a) കാഥോഡിൽ

(b) ആനോഡിൽ

(c) ഇലക്ട്രോലൈറ്റിൽ

(d) ചെമ്പ്കമ്പിയിൽ

14 താഴെ കൊടുത്തിരിക്കുന്നവയിൽ തത്ക്കാലിക കാന്തം ഉണ്ടാക്കുന്നതിന് ഉപയോഗിക്കുന്ന വസ്തു ഏത് ?

(a) കാഠിന്യമുള്ള ഉരുക്ക്

(b) ആൽനിക്കോ

(c) ഉരുക്ക്

(d) പച്ചിരുമ്പ്

15 താഴെപ്പറയുന്നവയിൽ ഏതാണ് അതിനു ലഭിച്ച കാന്ത ശക്തിയുടെ ഭൂരിഭാഗവും നഷ്ടപ്പെടാതെ സൂക്ഷിക്കുന്നത് ?

(a) വൈദ്യുത കാന്തം

(b) തത്ക്കാലികകാന്തം

(c) സ്ഥിരകാന്തം

(d) ഒരു ട്രാൻഫോർമറിന്റെ കോർ

16 മിന്നൽ രക്ഷാകവചത്തിൽ ഉപയോഗിക്കുന്ന തത്വം താഴെപ്പറയുന്നവയിൽ ഏത് ?

(a) ചാർജ്ജിന്റെ സാന്ദ്രത എല്ലായിടത്തും ഒരുപോലെ കേന്ദ്രീകരിക്കുന്നു.

(b) ചാർജ്ജിന്റെ സാന്ദ്രത എവിടേയും കേന്ദ്രീകരിക്കുന്നില്ല.

(c) ചാർജ്ജിന്റെ സാന്ദ്രത പരന്ന അഗ്രങ്ങളിൽ കേന്ദ്രീകരിക്കുന്നു.

(d) ചാർജ്ജിന്റെ സാന്ദ്രത കൂർത്ത മുനകളിൽ കേന്ദ്രീകരിക്കുന്നു.

17 പെട്രോൾ ട്രക്കുകളുടെ പിന്നിൽ തറയിൽ ഉരസിക്കൊണ്ട് പോകത്തക്ക വിധം ചങ്ങലകൾ തൂക്കിയിട്ടിരിക്കുന്നതിന്റെ കാരണം.

(a) ട്രക്കുകൾക്ക് കൂടുതൽ ശക്തി കൊടുക്കുവാൻ

(b) ഘർഷണം കൊണ്ടുള്ള സ്പാർക്ക് കുറക്കുവാൻ

(c) സുരക്ഷിതത്വത്തിനുള്ള ഒരു ഉപാധിയായി

(d) എന്തെങ്കിലും ആവശ്യം വരുമ്പോൾ ഉപയോഗിക്കുന്നതിന്

18 താഴെക്കൊടുത്തിരിക്കുന്നവയിൽ ഏററവും കൂടുതൽ വിശിഷ്ട താപം ഏതിനാണ് ?

(a) മണൽ

(b) ചെമ്പ്

(c) അലുമിനിയം

(d) വെള്ളം

19 താഴെക്കൊടുത്തിരിക്കുന്ന പ്രസ്താവനകളിൽ സ്റ്റെപ്പ്അപ് ട്രാൻസ്ഫോർമറിനെക്കുറിച്ച് ശരിയായത് ഏത്?

(a) പ്രൈമറി കോയിലിലെ ചുരുളുകളുടെ എണ്ണം സെക്കൻഡറി കോയിലിലുള്ളതിനേക്കാൾ കൂടുതലാണ്.

(b) സെക്കൻഡറി കോയിലിലെ ചുരുളുകളുടെ എണ്ണം പ്രൈമറി കോയിലിലുള്ളതിനേക്കാൾ കൂടുതലാണ്.

(c) പ്രൈമറിയിൽകൂടി കടത്തിവിടുന്ന വൈദ്യുതി സെക്കഡറിയിലുള്ളതിനേക്കാൾ കൂടുതലാണ്.

(d) പ്രൈമറിയിൽകൂടി കടത്തിവിടുന്ന വൈദുതി സെക്കൻഡറിയിലുള്ളതിന് സമമാണ്.

20 ഗാർഹിക വൈദ്യുത സർക്കീട്ടുകളിൽ ത്രീപിൻ പ്ലഗ്ഗുകൾ ഉപയോഗിക്കുന്നത്

(a) വൈദ്യുതിയുടെ പ്രവാഹം നിയന്ത്രിക്കുവാനാണ്.

(b) വോൾട്ടേജ് നിയന്ത്രിക്കുവാനാണ്.

(c) സുരക്ഷിതത്വം ഉറപ്പുവരുത്തുന്നതിനാണ്.

(d) കൂടുതൽ ബലമായി പിടിച്ചിരിക്കുന്നതിനാണ്.

21 താഴെപ്പറയുന്നവയിൽ അർത്ഥ ചാലകങ്ങൾ ഏവ?

(a) ബോറോൺ, ഫോസ്ഫറസ്

(b) കോപ്പർ, അലുമിനിയം

(c) സിലിക്കോൺ, ജർമേനിയം

(d) കാഡ്മിയം, സ്ട്രോൺഷിയം

22 ശരീരകോശങ്ങൾക്ക് കൂടുതൽ കേടുപാടുകൾ വരുത്താതെ അതിലൂടെ തുളച്ച് കയറുവാൻ കഴിവുള്ള രശ്മിയാണ്

(a) എക്സ് കിരണങ്ങൾ

(b) ആൽഫാ കണങ്ങൾ

(c) ബീററാ കണങ്ങൾ

(d) ഗാമാകണങ്ങൾ

23 താഴെപ്പറയുന്നവയിൽ ന്യൂക്ലിയർ ഫിഷൻ നിയന്ത്രണം നടക്കുന്നത്

(a) ന്യൂക്ലിയർ ബോംബിൽ

(b) ആററം ബോംബിൽ

(c) ഹൈഡ്രജൻ ബോംബിൽ

(d) ന്യൂക്ലിയർ റിയാക്ററിൽ

24 താഴെപ്പറയുന്നവയിൽ ആവൃത്തി കൂടുതലുള്ള വികിരണം

(a) റേഡിയോ തരംഗങ്ങൾ

(b) മൈക്രോതരംഗങ്ങൾ

(c) ഇൻഫ്രാറെഡ്

(d) അൾട്രാ വയലററ്

25 വൈദ്യുതസ്പർശനം കൂടാതെ വൈദ്യുതോർജ്ജം ഒരു സർക്കീട്ടിൽ നിന്നും മറെറാരു കോയിലിലേയ്ക്കി മാററാൻ ഉപയോഗിക്കുന്നത്

(a) ട്രാൻസ്ഫോർമർ

(b) ഇൻഡക്ഷൻകോയിൽ

(c) A.C. ഡയനാമോ

(d) മോട്ടോർ

26 നീലയും മഞ്ഞയും തമ്മിൽ ചേർക്കുമ്പോൾ ഉണ്ടാകുന്ന വർണ്ണം

(a) മഞ്ഞ

(b) വെള്ള

(c) നീലകലർന്ന മഞ്ഞ

(d) പച്ച

27 താഴെപ്പറയുന്നവയിൽ സാധാരണയായി ഏതാണ് ഫേസ് വയറുമായി ബന്ധിപ്പിക്കപ്പെടുന്നതും വേർപെടുത്തപ്പെടുന്നതും

(a) ഫ്യൂസ്

(b) സ്വിച്ച്

(c) പ്ലഗ്ഗ്

(d) മെയിൻ സ്വിച്ച്

28 ഒരു D. C. സ്രോതസ്സിൽ നിന്നും വളരെ ഉയർന്ന വോൾട്ടേജ് ഉണ്ടാക്കുന്നതിനുപയോഗിക്കുന്നത്

(a) ട്രാൻസ് ഫോർമർ
(b) ഡയനാമോ
(c) മോട്ടോർ
(d) ഇൻഡക്ഷൻ കോയിൽ

29 താഴെപ്പറയുന്നവയിൽ ഏതു ലോഹസങ്കരത്തിനാണ് ഏററവും കൂടുതൽ പെർമിയബിലിററി?

(a) നിക്രോം
(b) ഇൻവാർ
(c) ആൽനിക്കോ
(d) മാഗ്നാലിയം

30 ഗാർഹികോപയോഗത്തിനാവശ്യമായ വൈദ്യുതി ലഭിക്കുന്നത്

(a) സ്റെറപ്അപ്പ് ട്രാൻസ്ഫോർമർ
(b) സ്റെറപ് ഡൗൺ ട്രാൻസ്ഫോർമർ
(c) ഇൻഡക്ഷൻ കോയിൽ
(d) ഡയനാമോ

UNIVERSITY OF KERALA

DEPARTMENT OF EDUCATION

PRACTICAL APPLICATION AWARENESS TEST IN PHYSICS FOR STANDARD X

നിർദ്ദേശങ്ങൾ

1 ഊർജ്ജതന്ത്രത്തിലുള്ള അറിവ് പരിശോധിക്കുന്നതിനുള്ള ഒരു ടെസ്റ്റാണിത്.

2 ഈ ടെസ്റ്റിൽ 30 ചോദ്യങ്ങൾ ഉണ്ട്. അവയ്ക്ക് 45 മിനിട്ടിനുള്ളിൽ ഉത്തരങ്ങൾ എഴുതേണ്ടതാണ്.

3 ഓരോ ചോദ്യത്തിനും a, b, c, d എന്നീ നാല് ഉത്തരങ്ങൾ വീതം കൊടുത്തിരിക്കുന്നു. അവയിൽ ഏററവു അനുയോജ്യമായ ഉത്തരത്തെ സൂചിപ്പിക്കുന്ന അക്ഷരം ഈ ടെസ്ററ് ബുക്ക്ലെററിനോടൊപ്പം തരുന്ന പേപ്പറിൽ എഴുതുക.

4 ടെസ്റ്റ്ബുക്ക്ലെററിൽ ഒന്നുംതന്നെ എഴുതാതിരിക്കാൻ ശ്രദ്ധിക്കുക.

5 ഉത്തരങ്ങൾ എഴുതാൻ തുടങ്ങുന്നതിനുമുൻപ് ഉത്തരക്കടലാസിൽ നിങ്ങളുടെ പേരും സ്കൂളിന്റെ പേരും എഴുതുക.

6 ഉത്തരങ്ങൾ എഴുതിയശേഷം ഉത്തരക്കടലാസും ടെസ്റ്റ്ബുക്ക് ലെററും തിരികെ ഏൽപ്പിക്കണം,

1 വളരെ അകലെ സ്ഥിതിചെയ്യുന്ന വസ്തുക്കളുടെ ഫോട്ടോ എടുക്കുവാൻ താഴെപ്പറയുന്ന പ്രകാശരശ്മികളിൽ ഉത്തമമായത് ഏത്?

(a) അൾട്രാവയലററ്

(b) ഇൻഫ്രാറെഡ്

(c) എക്സ് കിരണങ്ങൾ

(d) ഗാമാ കിരണങ്ങൾ

2 ചെമപ്പ് വർണ്ണ രശ്മികളാണ് സിഗ്നൽ ലൈററുകൾക്ക് കൂടുതൽ അനുയോജ്യം ഇതിനു കാരണം

(a) ചെമപ്പ് എളുപ്പത്തിൽ കാണാവുന്ന വർണ്ണമായതിനാൽ.

(b) ചെമപ്പ് രശ്മിക്ക് വിസരണം കൂടുതൽ ആയതിനാൽ അത് വളരെ അകലെനിന്നുതന്നെ കാണാവുന്നതാണ്.

(c) ചെമപ്പ് രശ്മിക്ക് വിസരണം കുറവായതിനാൽ അത് വളരെ അകലെനിന്നുതന്നെ കാണാവുന്നതാണ്.

(d) ചെമപ്പ് രശ്മിക്ക് തരംഗദൈർഘ്യം കറവായതിനാൽ അത് വളരെ അകലെനിന്നുതന്നെ കാണാവുന്നതാണ്:

3 സൂര്യപ്രകാശത്തിലെ ഏതു വികിരണം മൂലാണ് മനുഷ്യന്റെ ത്വക്കിൽ വിററാമിൻ D യുടെ ഉൽപ്പാദനം നടക്കുന്നത് ?

(a) അൾട്രാവയലററ്

(b) ഇൻഫ്രാറെഡ്

(c) എക്സ്കിരണങ്ങൾ

(d) കോസ്മിക് കിരണങ്ങൾ

4 അകലെയുള്ള ഒരു വ്യക്തിക്ക് വർണ്ണരശ്മി ഉപയോഗിച്ച് സിഗ്നൽ കൊടുക്കുന്നതിന് താഴെ കൊടുത്തിരിക്കുന്നവയിൽ ഉത്തമമായത് ഏത് ?

(a) ചെമപ്പ്
(b) മഞ്ഞ
(c) ഓറഞ്ച്
(d) പച്ച

5 ഇലക്ട്രിക് അയെൺ, ഹീററർ മുതലായ വീട്ടുപകരണങ്ങളിൽ ഉപയോഗിക്കുന്ന ഹീററിങ് കോയിൽ ഉണ്ടാക്കുന്നതിന് ഏററവും ഉത്തമമായത്

(a) ആംനിക്കോ
(b) നിക്രോം
(c) ചെമ്പ്
(d) ഇൻവാർ.

6 ഫ്യൂസ് വയർ ഉണ്ടാക്കുവാൻ ലെഡും ടിന്നും ചേർന്ന ലോഹസങ്കരമുപയോഗിക്കുവാൻ കാരണം

(a) ഇത് വൈദ്യുതിയുടെ ഒരു നല്ല ചാലകമാണ്
(b) ഇതിൻെറ ദ്രവണാങ്കം വളരെ കൂടുതലാണ്
(c) ഇതിലൂടെ അമിതമായി വൈദ്യുതി പ്രവഹിച്ചാണ് എളുപ്പത്തിൽ ഉരുകിപ്പോകുന്നു
(d) ഇതിൻെറ പ്രതിരോധം വളരെ കുറവാണ്

7 ഒരു വ്യവസായ സ്ഥാപനത്തിലുള്ള വൈദ്യുത സർക്കീട്ടിൽ ഒരു 15 ആമ്പയർ പ്ളഗ്ഫ്യൂസ് ഉപയോഗിക്കുന്നു. ഇതിൻെറ പ്രവർത്തനം

(a) വൈദ്യുതോർജ്ജം കൂട്ടുവാനുള്ള ഒരു ഉപാധിയായിട്ടാണ്
(b) സ്റെറപ്പ് അപ്പ് ട്രാൻസ്ഫോർമറായിട്ടാണ്
(c) സ്റെറപ്പ്ഡൌൺ ട്രാൻസ്ഫോർമറായിട്ടാണ്
(d) ഒരു സുരക്ഷിതോപായമായിട്ടാണ്

8 ഗാർഹിക തപനോപകരണങ്ങളിൽ ഹീററിങ് എലിമെൻറായി നിക്രോം വയറുകളോ ടേപ്പുകളോ ഉപയോഗിക്കുന്നതിനുകാരണം

(a) ഇവയ്ക്ക് ഉയർന്ന പ്രതിരോധവും കുറഞ്ഞ ദ്രവണാങ്കവുമുള്ളതിനാലാണ്
(b) ഇവയ്ക്ക് ഉയർന്ന പ്രതിരോധവും ഉയർന്ന ദ്രവണാങ്കവുമുള്ളതിനാലാണ്
(c) ഇവ വൈദ്യുതിയുടെ ഏററവും നല്ല ചാലകങ്ങളായതിനാലാണ്
(d) ഇവയുടെ പ്രതിരോധം കുറവും വേഗം ചൂടാവുകയും ചെയ്യുന്നതിനാലാണ്

9 ഒരു ഹീററർകോയിലിൻെറ നടുവിൽ നിന്നും ഒരു കഷണം കമ്പി മുറിച്ചുമാററിയശേഷം ബാക്കി ഭാഗങ്ങൾ തമ്മിൽ ചേർത്ത് വെച്ചാൽ, അതിൻെറ ഫലമായി

(a) പ്രതിരോധം കുറയുകയും പവറിൻെറ ഉപയോഗം കൂടുകയും ചെയ്യുന്നു
(b) പ്രതിരോധം കുറയുകയും പവറിൻെറ ഉപയോഗം കുറയുകയും ചെയ്യുന്നു
(c) പ്രതിരോധം കൂടുകയും പവറിൻെറ ഉപയോഗം കൂടുകയും ചെയ്യുന്നു
(d) പ്രതിരോധം കൂടുകയും പവറിൻെറ ഉപയോഗം കുറയുകയും ചെയ്യുന്നു.

10 യഥാക്രമം 2mm, 3mm, 4mm. 5mm വീതം വ്യാസമുള്ളതും ഒരേ നീളമുള്ളതുമായ 4 നിക്രോം വയറുകളെ ഒരേ സ്രോതസ്സിലെയ്ക്ക് ബന്ധിപ്പിച്ചാൽ ഏതിൽ നിന്നായിരിക്കും കൂടുതൽ താപം ലഭിക്കുന്നത് ?

(a) 2mm വയറിൽ നിന്നും
(b) 3mm വയറിൽ നിന്നും
(c) 4mm വയറിൽ നിന്നും
(d) 5mm വയറിൽ നിന്നും

11 ഒരു ഗൃഹ വൈദ്യുത സർക്കീട്ടിൽ അനുയോജ്യമായ ഫ്യൂസ് വയർ ഉപയോഗിച്ചിട്ടും അത് കൂടെക്കൂടെ ഉരുകി പൊട്ടിപ്പോകുന്നു. ഇങ്ങനെ സംഭവിക്കുമ്പോൾ എന്തു ചെയ്യണം ?

(a) വണ്ണം കൂടിയ ഫ്യൂസ് വയർ ഉപയോഗിക്കണം
(b) വണ്ണം കുറഞ്ഞ ഫ്യൂസ് വയർ ഉപയോഗിക്കണം
(c) ഷോർട്ട് സർക്കീട്ടോ താങ്ങാവുന്നതിൽ കൂടുതൽ വൈദ്യുതോർജ്ജമോ മറ്റോ ഉണ്ടായിട്ടുണ്ടോ എന്ന് പരിശോധിക്കണം
(d) ഫ്യൂസ് വയർ ഉപയോഗിക്കാതെ നേരിട്ട് കണക്ഷൻ കൊടുക്കണം

12 ഒരു കിലോവാട്ട് ഔവറിന് (1 K W H) നിങ്ങളുടെ നഗരത്തിൽ 50 P യാണ് ചാർജ്ജ്. ഇതിൽ അടയ്ക്കുന്ന താഴെ പറയുന്നവയിൽ ഏതിനു വേണ്ടിയാണ് ?

(a) വൈദ്യുതോർജ്ജത്തിന്
(b) വൈദ്യുത ചാർജ്ജിന്
(c) പവറിന്
(d) ഇലക്ട്രിക് കറന്റിന്

13 വൈദ്യുത വിശ്ലേഷണ പ്രക്രിയയിലൂടെ ഒരു അലുമിനിയം മാലയിൽ സ്വർണ്ണം പൂശുന്നതിന് മാല

(a) കാഥോഡ് ആയി ഉപയോഗിക്കണം
(b) ആനോഡ് ആയി ഉപയോഗിക്കണം
(c) ഇലക്ട്രോലൈറ്റിൽ ഇട്ടിരിക്കണം
(d) ആനോഡും കഥോഡുമായി ബന്ധിപ്പിച്ചിരിക്കണം

14 വൈദ്യുത കാന്തങ്ങളുടെ കോറുകൾക്ക് ഏറ്റവും ഉത്തമമായ വസ്തു

(a) അൽനിക്കോ
(b) പച്ചിരുമ്പ്
(c) ഉരുക്ക്
(d) ടങ്സ്റ്റൺ

15 ടെലിഫോൺ റിസീവറിൽ ഉപയോഗിക്കുന്നത്

(a) വൈദ്യുതകാന്തമാണ്
(b) തത്ക്കാലിക കാന്തമാണ്
(c) സ്ഥിരകാന്തമാണ്
(d) സ്വാഭാവികകാന്തമാണ്

16 മിന്നൽ രക്ഷാകവചം കെട്ടിടങ്ങളെ മിന്നലിൽ നിന്നും രക്ഷിക്കുന്നത്

(a) ഒട്ടുംതന്നെ മിന്നൽ അവയിൽ പതിയാൻ അനുവദിക്കാതെ
(b) ചാർജ്ജിന്റെ കണികകളെ അകലേയ്ക്ക് പായിച്ച്
(c) ചുറ്റുപാടുമുള്ള കെട്ടിടങ്ങളിലേക്ക് മിന്നലിനെ തിരിച്ചുവിട്ട്
(d) ഇലക്ട്രിക് ചാർജ്ജിനെ ഭൂമിയിലേയ്ക്ക് കടത്തിവിട്ട്

17 ആധുനിക ഉരുക്ക് നിർമ്മിതമായ കെട്ടിടങ്ങളിൽ താമസ്സിക്കുന്നവർക്ക് മിന്നലേല്ക്കാതിരിക്കാൻ കാരണം

(a) ഇവ വളരെ ശക്തിയുള്ളതാണ്
(b) ഇവ ചാർജ്ജിന്റെ കണികകളെ പായിച്ചുകളയുന്നു.
(c) ഇവയിൽ മിന്നൽ പതിക്കുന്നില്ല
(d) ഇവ ഇലക്ട്രിക് ചാർജ്ജിനെ ഭൂമിയിലേയ്ക്ക് കടത്തിവിടുന്നു

18 മോട്ടോർ വാഹനങ്ങളുടെ റേഡിയേറററുകളിൽ വെള്ളം ഉപയോഗിക്കുന്നതിനുകാരണം

(a) അതിന്റെ വിശിഷ്ടതാപം കൂടുതലാണ്
(b) അതിന്റെ വിശിഷ്ടതാപം കുറവാണ്
(c) അതിന് തണുപ്പിക്കാനുള്ള കഴിവ് കൂടുതലാണ്
(d) അത് സുലഭമായി കിട്ടുന്നതിനാലാണ്

19 ഒരു ട്രാൻസ്ഫോർമറിൽ വോൾട്ടേജ് അവശ്യാനുസരണം കൂട്ടുകയും കുറയ്ക്കുകയും ചെയ്യുന്നത്

(a) ചെമ്പുകമ്പികളുടെ വണ്ണം വ്യത്യാസപ്പെടുത്തികൊണ്ടാണ്.

(b) ചെമ്പുകമ്പികളുടെ എണ്ണം സ്ഥിരമാക്കിവെച്ചുകൊണ്ടാണ്

(c) പ്രൈമറിയിൽ കൂടി കടത്തി വിടുന്ന വൈദ്യുതി ക്രമപ്പെടുത്തിയാണ്

(d) രണ്ടുകോയിലുകളിലുമുള്ള കമ്പിച്ചുരുളുകളുടെ എണ്ണം ക്രമപ്പെടുത്തിയാണ്.

20 ഇലക്ട്രിക്ക് അയേണുകൾ പ്രവർത്തിപ്പിക്കുമ്പോൾ ത്രീപിൻ പ്ലഗ്ഗുകൾ ഉപയോഗിക്കണം എന്നുപറയുന്നതിന് കാരണം.

(a) ഇത് അയണിനെ കൂടുതൽ കാലം പ്രവർത്തനയോഗ്യമാക്കുന്നു

(b) നല്ല ഇൻസുലേഷൻ ഉറപ്പു വരുത്തുന്നു.

(c) എർത്തിങ്ങ് മൂലം കൂടുതൽ സുരക്ഷിതത്വം ഉറപ്പു വരുത്തുന്നു.

(d) ഇത് കൂടുതൽ സൗകര്യപ്രദമാണ്

21 ഡയോഡുകളും ട്രാൻസിസ്റററുകളും ഉണ്ടാക്കുന്നതിന് ജർമേനിയവും സിലിക്കോണും. കൂടുതലായി ഉപയോഗിക്കുന്നതിന് കാരണം ഇവ

(a) നല്ല ചാലകങ്ങളാണ്

(b) നല്ല വിദ്യുത്രോധികളാണ്

(c) അർത്ഥചാലകങ്ങളാണ്

(d) അതിചാലകങ്ങളാണ്

22 ശരീരത്തിലെ ആന്തരിക അവയവങ്ങളുടേയും അസ്ഥികളുടേയും ഫോട്ടോ എടുക്കുവാൻ എക്സ്കിരണങ്ങൾ ഉപയോഗിക്കുന്നതിന് കാരണം ഇവ

(a) രോഗാണുക്കളെ നശിപ്പിക്കുന്ന

(b) ശരീരത്തിലൂടെ കടന്നുപോകുന്നു

(c) കൈകാര്യം ചെയ്യുവാൻ എളുപ്പമാണ്

(d) നിർമ്മിക്കുവാൻ എളുപ്പമാണ്

23 ചെയിൻ റിയാക്ഷൻ നടക്കുമ്പോൾ ന്യൂട്രോണുകളുടെ വേഗത കുറയ്ക്കാൻ ഉപയോഗിക്കുന്നത്

(a) പ്ലൂട്ടോണിയം 239
(b) ഘനജലം
(c) സമ്പുഷ്ട യുറേനിയം
(d) കാഡ്മിയം

24 തരംഗദൈർഘ്യം കൂടുതലുള്ള റേഡിയോയുടെ (long wave radio) ആവൃത്തി തരംഗദൈർഘ്യം കുറവുള്ള റേഡിയോയെ (short wave radio) അപേക്ഷിച്ച്

(a) കൂടുതലാണ്
(b) കുറവാണ്
(c) വ്യത്യാസമില്ല
(b) മുൻകൂട്ടി പറയാൻ സാധിക്കുകയില്ല

25 110 V ൽ പ്രവർത്തിക്കുന്ന ഒരു വൈദ്യുത വീട്ടുപകരണം നമ്മുടെ വീടുകളിൽ പ്രവർത്തിപ്പിക്കുന്നതിന് താഴെ കൊടുത്തിരിക്കുന്നവയിൽ ഏതിന്റെ സഹായമാവശ്യമാണ് ?

(a) സ്റ്റെപ്പ് അപ്പ് ട്രാൻസ് ഫോർമർ
(b) സ്റ്റെപ്പ് ഡൗൺ ട്രാൻസ് ഫോർമർ
(c) ഇലക്ട്രിക് മോട്ടോർ
(d) പ്രതിരോധം കൂടുതൽ ഉള്ള കമ്പി

26 ഒരു വ്യക്തിയ്ക്ക് പെയിന്റ് ചെയ്യുന്നതിനാവശ്യമായ പച്ച നിറം കിട്ടുന്നതിന് അയാൾ താഴെ കൊടുത്തിരിക്കുന്നവയിൽ ഏതു വർണ്ണങ്ങൾ തമ്മിൽ ചേർക്കണം ?

(a) നീലയും ചുവപ്പും
(b) നീലയും മഞ്ഞയും
(c) മഞ്ഞയും ചുവപ്പും
(d) നീലയും വെള്ളയും

27 ഫേസ്, ന്യൂട്രൽ എന്നീ ലൈനുകൾ തമ്മിലുള്ള ബന്ധം വേർപെടുത്തുന്നത്

(a) ഫ്യൂസ്
(b) സ്വിച്ച്
(c) പ്ലഗ്ഗ്
(d) മെയിൻ സ്വിച്ച്

28 മോട്ടോർ വാഹനങ്ങളുടെ സെൽഫ് ഇഗ്നീഷ്യൽ സിസ്റ്റത്തിൽ ഉപയോഗിക്കുന്ന ഉപകരണം

(a) ഇൻഡക്ഷൻ കോയിൻ
(b) ഡയനാമോ
(c) മോട്ടോർ
(d) ട്രാൻസ്ഫോർമർ

29 ലൌഡ് സ്പീക്കറുകളിലെ സ്ഥിരകാന്തങ്ങളുണ്ടാക്കുന്നതിന് ഏററവും ഉത്തമമായത്

(a) പച്ചിരുമ്പ്
(b) നിക്കൽ
(c) ടങ്സ്ററൻ
(d) ആൽനിക്കോ

30 230 V. ഉള്ള സ്രോതസ്സിൽ നിന്നും 6 v ന്റെ ഒരു ബൾബ് പ്രകാശിപ്പിക്കണമെങ്കിൽ താഴെപ്പറയുന്നവയിൽ ഏത് ഉപയോഗിക്കണം?

(a) ഇലക്ട്രിക് മോട്ടോർ
(b) ഡയനാമോ
(c) സ്റ്റെപ്പ് അപ്പ് ട്രാൻസ്ഫോർമർ
(d) സ്റ്റെപ്പ് ഡൗൺട്രാൻസ്ഫോർമർ

APPENDIX - VII(A)

UNIVERSITY OF KERALA

DEPARTMENT OF EDUCATION

THEORY AWARENESS TEST IN PHYSICS FOR STANDARD IX

INSTRUCTIONS

1. This is a test to measure the physics theory awareness in physics.
2. This test contains 30 questions which are to be answered within 45 minutes.
3. Each item has four answers indicated by a, b, c and d, out of which you have to choose the most appropriate answer.
4. Be careful not to write anything on the test booklet.
5. Write your name and name of the school on the sheet provided before you start answering the questions.
6. After answering the questions, return the answer sheet and the test booklet.

''''''

1. Which of the following statements is true regarding long-sightedness?

   A. Longsightedness is caused when the eyeball becomes smaller.

   B. Longsightedness is caused when the focal length of eye lens is large.

   (a) A is the correct.
   (b) B is the correct.
   (c) Both A and B are not correct
   (d) Both A and B are correct.

2. The image formed by a convex mirror compared to the object is usually,

   (a) inverted and imaginary
   (b) rect and smaller
   (c) real and inverted
   (d) larger and virtual

3. When the object is placed at the focus of a concave mirror, the image is formed

   (a) between F and mirror
   (b) between F and 2F
   (c) beyond 2F
   (d) at infinity

4. Small insects float on water in ponds and in open tanks. This is possible due to

   (a) viscosity
   (b) surface tension
   (c) adhesion
   (d) cohesion

5. For shortsightedness rays from distant objects are brought to focus at a point

   (a) on the retina
   (b) in between eyelens and retina
   (c) behind the retina
   (d) in front of the retina

6. If the diameter of a capillary tube is doubled, the rise of water in the capillary tube.

   (a) will be increased
   (b) will be decreased
   (c) will not change
   (d) cannot be anticipated

7. The rise of water in plants is due to

   (a) osmosis
   (b) capillarity
   (c) atmospheric pressure
   (d) diffusion

8. Surface tension exists

   (a) in the bulk of the liquid
   (b) only on the top surface of the liquid
   (c) both on the surface and bulk of the liquid
   (d) only along the lines of contact with the container.

9. Surface tension

(a) increases uniformly with temperature
(b) does not change with temperature
(c) decrease with temperature
(d) increases at random with temperature

10. Frictional force

(a) can be completely avoided
(b) can be minimised
(c) cannot be minimised
(d) remains same

11. Friction can be minimised by

(a) using ball and roller bearings
(b) lubricating
(c) polishing
(d) all the above

12. Centrifugal force is directed

(a) away from the centre
(b) towards the centre
(c) along the tangent drawn to the circle
(d) along the circumference of the circle

13. Which of the following is the best non-conductor?

(a) air
(b) paper
(c) vaccum
(d) glass

14. The size of a solid increases when

(a) heat energy is given
(b) electric energy is given
(c) mechanical energy is given
(d) sound energy is given

15. Lubricants are introduced between two solid surfaces for reducing

(a) elastic force
(b) electrostatic force
(c) magnetic force
(d) frictional force

16. When liquid ammonia evaporates, temperature

    (a) increases
    (b) decreases
    (c) remains constant
    (d) increases and then decreases

17. Which of the following statement is correct concerning an insulator?

    (a) It is a good conductor
    (b) It is a bad conductor
    (c) It absorbs heat
    (d) It radiate heat

18. When pressure on the surface of a liquid increases

    (a) its volume increases
    (b) Its volume decreases
    (c) its boiling point decreases
    (d) its boiling point increases

19. In oil lamps, the oil rises up in the weeks due to the

    (a) pressure difference
    (b) property of viscosity
    (c) property of capillarity
    (d) temperature difference

20. Mechanical energy can be converted into

    (a) sound energy
    (b) electrical energy
    (c) heat energy
    (d) all of the above

21. In a telescope the focal length of the eyepiece lens will be

    (a) smaller than that of the objective lens
    (b) larger than that of the objective lens
    (c) same as that of the objective lens
    (d) almost same as that of the objective lens.

22, The working of a centrifuge machine is based on

(a) centripetal force
(b) centrifugal force
(c) gravitational force
(d) electrostatic force

23. When cells are connected in series

(a) the current is increased
(b) the potential difference is increased
(c) the potential difference is decreased.
(d) the resistance is unchanged.

24. The melting point of an impure substance will be

(a) greater than of the pure substance
(b) less than that of the pure substance
(c) same as that of the pure substance
(d) greater or less than that of the pure substance.

25. A sounf heard by reflection and clearly distinguished from the original sound is

(a) echo
(b) resonance
(c) reverberation
(d) beats

26. Which of the following law supplies the definition of roce?

(a) Newton's Ist Law
(b) Newton's IInd Law
(c) Newton's IIIrd Law
(d) Law of gravitation

27. Certain metals when cooled to very low temperature near absolute zero, they lose their resistance completing. These are called conductors.

(a) conductors
(b) semiconductors
(c) insulators
(d) super conductors

28. When a loud sound is produced in a closed room, a continuous rolling of sound persists for sometime This phenomenon is known as

(a) reverberation
(b) resonance
(c) natural vibration
(d) forced vibration

29. A body moving in a circular path, tends to move along the tangent to the circular path in the absence of

(a) frictional force
(b) Centrifugal force
(c) centripetal force
(d) surface tension

30. Bats produce which of the following waves to detect obstancles in their way?

(a) Electromagnetic
(b) Infrasonic
(c) Ultrasonic
(d) supersonic

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UNIVERSITY OF KERALA

DEPARTMENT OF EDUCATION

PRACTICAL APPLICATION AWARENESS TEST IN PHYSICS FOR STANDARD IX

INSTRUCTIONS

1. This is a test to measure the practical application awareness in physics.
2. This test contains 30 questions which are to be answered within 45 minutes.
3. Each item has four answers indicated by a, b, c and d, out of which you have to choose the most appropriate answer.
4. Be careful not to write anything on the test booklet.
5. Write your name and name of the school on the sheet provided before you start answering the questions.
6. After answering the questions, return the answer sheet and the test booklet.

.....

1. A person sees distant objects comfortably but wears spectacles while reading a book what type of lenses are used in his spectacles?

   (a) Concave lens
   (b) Convex lens
   (c) Planoconvex lens
   (d) Planoconcave lens.

2. The kind of mirror that a driver uses to get a maximum vision of his backside should be

   (a) Convex mirror
   (b) Concave mirror
   (c) Plane mirror
   (d) Spherical mirror

3. In a torch, the light source is placed at the

   (a) focus of concave mirror
   (b) pole of concave mirror
   (c) radius of curvature of concave mirror
   (d) none of the above.

4. Soaps and detergents help in cleaning the clothes because they

   (a) increase the surface tension of water
   (b) reduce the surface tension of water
   (c) absorb the impurities, duct etc.
   (d) change the chemical composition of the solution.

5. Shortsightedness can be remedied using

   (a) convex lens
   (b) concave lens
   (c) double convex lens
   (d) double concave lens

6. During summer, farmers usually keep the top soil layer loose. This is

   (a) to increase the soil fertility
   (b) to increase the capillary rise
   (c) to retain soil water in the top layers
   (d) to reduce the capillary rise of water to the surface of soil.

7. Clay is not dry compared to sandy soil because of

   (a) the nature of the particles
   (b) osmosis
   (c) the environment
   (d) capillarity action

8. When oil is spread on stagnant water, mosquitoes cannot breed because

   (a) surface tension increases and oxygen supply is cut off
   (b) surface tension decreases and oxygen supply is cur off
   (c) viscosity increases
   (d) viscosity decreases

9. Hot water is preferred for cleaning purpose than cold water because

(a) cohesion is decreased
(b) cohesion is increased
(c) surface tension is increased
(d) surface tension is decreased

10. Tennis shoes should have rubber soles rather than leather soles because

(a) rubber sole is lighter than that of leather
(b) rubber can be easily washed and cleaned
(c) rubber gives a better appearance
(d) rubber provides more friction than leather.

11. Which of the following statement/statements is/are true regarding friction?

A. It causes wastage of energy
B. It causes unnecessary wear and tear
C. It *helps in the smooth running of the machine*

(a) A and B correct
(b) B and C correct
(c) A and C correct
(d) A, B and C correct

12. Fat can be separated from milk, in a cream separator because of

(a) centrifugal force
(b) centripetal force
(c) cohesive force
(d) gravitational force

13. Wood, plastics, ebonites, etc., are used for making the handles of pressure cookers, electric ion, etc. because they

(a) conduct heat
(b) conduct electricity
(c) conduct heat and electricity
(d) do not conduct heat and electricity.

14. When a metallic pendulum expands

    (a) it gains time
    (b) it loses time
    (c) it neither gains or loses
    (d) it stops

15. Oil is sprayed on moving parts of sewing machine, clock, etc., for

    (a) preventing damage
    (b) reducing friction
    (c) increasing friction
    (d) completely eliminating friction

16. Liquid ammonia can be used as a refrigerent because

    (a) it is a good solvent
    (b) it is easily available and cheap
    (c) it evaporates by increasing the temperature around
    (d) it evaporates by decreasing the temperature around

17. Woollen dresses are used in winter season because

    (a) they conduct heat easily
    (b) they conduct heat slowly
    (c) they absorb heat
    (d) they do not conduct heat

18. In a pressure cooker food is cooked faster because

    (a) boiling point of liquid is lowered
    (b) boiling point of liquid is raised
    (c) it absorbs heat energy quickly
    (d) it retains heat for a long time.

19. Soldering of two metals is possible on account of the property of

    (a) viscosity
    (b) elasticity
    (c) surface tension
    (d) adhesion

20. Light energy can be converted into electrical energy using a

    (a) dynamo
    (b) electric bulb
    (c) electric motor
    (d) solar cell

21. In a terrestrial telescope, the final image will be formed at

    (a) 100 cm.
    (b) infinity
    (c) least distance of distinct vision
    (d) none of the above

22. A centrifuge is used to

    (a) dry clothes
    (b) separate cream from milk
    (c) pump water
    (d) to separate particles from suspension

23. The batteriês used in automobiles are made up of cells connected in

    (a) parallel
    (b) series
    (c) combination of parallel and series
    (d) alternatively parallel and series

24. In cold countries salt is sprinkled on the roads for removing snow because

    (a) when salt is dissolved the melting point of water increases
    (b) when salt is dissolved the melting point of water decreases
    (c) when salt is dissolved the temperature of surroundings increases
    (d) the increase in presuure causes the decrease in melting point of ice.

25. The property of sound which helps in using sound waves for measuring the depth of the sea is

    (a) wave motion
    (b) vibration
    (c) reflection
    (d) reverberation

26. A dirty carpet can be cleaned by beating it. This is in accordance with

    (a) Newton's Ist law
    (b) Newton's IInd law
    (c) Newton's IIIrd law
    (d) Law of gravitation

27. Electricity can be transmitted to distant places without loss of electrical energy with the use of

    (a) semi conductor
    (b) conductors
    (c) insulators
    (d) super conductors

28. The walls of cinema halls are generally covered with sound absorbing materials. This is done to reduce

    (a) frequency of sound
    (b) reverberation
    (c) resonance
    (d) forced vibration

29. The devices like dryer which is used to dry clothes employ the principle of

    (a) circular motion
    (b) rotational motion
    (c) vibration
    (d) translational motion

30. The kind of sound waves used to measure the depths of oceans and to locate other vessels or schools of fish at sea are

    (a) electromagnetic
    (b) Infrasonic
    (c) ultrasonic
    (d) supersonic

APPENDIX - VIII (A)

UNIVERSITY OF KERALA
DEPARTMENT OF EDUCATION

THEORY AWARENESS TEST IN PHYSICS FOR STD.X

DIRECTIONS

1. This is a test to measure the theory awareness in physics.
2. This test contains 30 questions which are to be answered in 45 minutes.
3. Each question has four answers indicated by a, b, c and d, out of which you have to choose the most appropriate answer.
4. Be careful not to write anything in the test booklet.
5. Write your name and name of school on the sheet provided before you start answering the questions.
6. After answering the questions, return the answer sheet and test booklet.

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1. Which of the following has the greater wave length?

   (a) Red light
   (b) Violet light
   (c) Ultra violet
   (d) Infra red

2. Which of the following has less scattering?

   (a) Violet
   (b) Blue
   (c) Yellow
   (d) Red

3. Sun-burn is caused by the

   (a) ultra violet radiation
   (b) infra red radiation
   (c) X-rays
   (d) gamma rays

4. Of the different colours of the white light, which colour has the greatest wave length?

   (a) Red
   (b) Violet
   (c) Yellow
   (d) Green

5. The most suitable alloyfor making high resistance wires is

   (a) alnico
   (b) inwar
   (c) canthol
   (d) nichrome

6. Safety fuse wire is made up of a material of

   (a) low resistance and high melting point
   (b) low resistance and low melting point
   (c) high resistance and high melting point
   (d) high resistance and low melting point

7. Which of the following is a safety device by which maximum limit of the current to be passed through an electric circuit can be controlled?

   (a) Choke
   (b) Fuse
   (c) Switch
   (d) Voltage stabiliser

8. The 'heating element' in household electric heating appliances is made up of a material of

   (a) high resistance and high melting point
   (b) high resistance and low melting point
   (c) low resistance and high melting point
   (d) low resistance and low melting point

9. If the length of a conductor is made half, its resistance.

   (a) increases
   (b) does not change
   (c) decreases to half
   (d) decreases to one-fourth

10. When the thickness of a wire increases, its resistance

    (a) increases
    (b) decreases
    (c) does not change
    (d) becomes zero

11. Fuse wire is included in an electric circuit to

    (a) increase the current
    (b) decrease the current
    (c) to check the excessive flow of current
    (d) to check the excessive flow of voltage

12. The capacity for doing work is known as

    (a) heat capacity of the body
    (b) sp. heat of the body
    (c) power of the body
    (d) energy of the body

13. When current is passed through copper sulphate solution during electrolysis, the copper ions are deposited.

    (a) on the cathode
    (b) on the anode
    (c) remains on the electrolyte
    (d) on the copper rod

14. Which of the following material is used to make temporary magnets?

    (a) Hard steel
    (b) Alnico
    (c) Steel
    (d) Soft iron

15. Which of the following retains a major part of the magnetism?

    (a) Electromagnet
    (b) Temporary magnet
    (c) Permanent magnet
    (d) The core of a transformer

16. In lightening conductor, the principle made use of is that charge gets accumulated at

    (a) everywhere
    (b) no where
    (c) the flat ends
    (d) the pointed ends

17. The purpose of providing petrol trucks with metal chains hanging from rear and dragging on the ground is to

    (a) give extra strength for the truck
    (b) help to reduce the spark due to friction
    (c) serve the purpose of a safety device
    (d) use when need arises

18. Which of the following has highest sp. heat?

    (a) sand
    (b) copper
    (c) aluminium
    (d) water

19. Which of the statement is true regarding a step-up transformer?

    (a) the number of turns in the primary coil are greater than that in the secondary.

    (b) The number of turns in the secondary are greater than that in the primary.

    (c) The input A.C. is more than output A.C.

    (d) The input A.C. is same as the output A.C.

20. Three-pin plugs are used in household electric circuits

    (a) to control the current
    (b) to control the voltage
    (c) to ensure better safety
    (d) to attach the plug more tightly

21. Which of the following are semi conductors?

    (a) Boron and phospherous
    (b) Copper and aluminium
    (c) Silicon and germanium
    (d) Cadmium and strontium

22. The rays that can pass through the body without causing too much damage are

    (a) X-rays
    (b) alpha rays
    (c) beta rays
    (d) gamma rays

23. In which on the following controlied nuclear fission takes place

    (a) nuclear bomb
    (b) atom bomb
    (c) hydrogen bomb
    (d) nuclear reactor

24. Which of the following has greater frequency?

    (a) Radio waves
    (b) Micro waves
    (c) Infra red radiation
    (d) Ultra violet radiation

25. An instrument in which electrical energy in one circuit is transferred into another without any electrical contact is

    (a) transformer
    (b) induction coil
    (c) A.C. dynamo
    (d) motor

26. What will be the colour obtained by mixing blue and yellow.

    (a) yellow
    (b) white
    (c) bluish yellow
    (d) green

27. Which of the following is connected commonly with the phase wire?

    (a) Fuse
    (b) Switch
    (c) Plug
    (d) Main Switch

28. Which of the following instrument is used to develop very high potential from a direct current (D.C.) source?

(a) Transformer
(b) Dynamo
(c) Motor
(d) Induction coil

29. Which of the following alloy has the highest permeability?

(a) Nichrome
(b) Inwar
(c) Alnico
(d) Magnalium

30. The supply of electricity for domestic purposes is obtained from

(a) step-up transformer
(b) step-down transformer
(c) Induction coil
(d) Dynamo

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UNIVERSITY OF KERALA

DEPARTMENT OF EDUCATION

PRACTICAL APPLICATION AWARENESS TEST IN PHYSICS FOR STANDARD X

DIRECTIONS

1. This is a test to measure the practical application awareness in physics.
2. This test contains 30 questions which are to be answered in 45 minutes.
3. Each question has four answers indicated by a, b, c, and d, out of which you have to choose the most appropriate answer.
4. Be careful not to write anything in the test booklet.
5. Write your name and name of school on the sheet provided before you start answering the questions.
6. After answering the questions, return the answersheet and test booklet.

......

1. Very distant objects can be photographed effectively by making use of

   a. ultra violet rays
   b. infra red rays
   c. x-rays
   d. gama rays

2. Red lights are often used in signal lamps because

   a. red colour is easily noticeable
   b. red light is scattered more and so it is visible from a great distance
   c. red light is scattered very little and so it is visible from a great distance
   d. red light has a shorter wave length and so it is visible from a great distance.

3. Which of the following radiation present in sunlight helps owe skin to produce vitamin D in our body?
   (a) Ultra violet
   (b) Infra red
   (c) X-rays
   (d) Cosmic rays

4. Which colour light is most suitable to give signal to a person positioned at a great distance?
   (a) Red
   (b) Yellow
   (c) Orange
   (d) Green

5. The heating coils in household appliances like eletric iron, heater, etc., are made up of
   (a) alnico
   (b) nichrome
   (c) copper
   (d) inwar

6. An alloy of tin and lead is often used for making fuse wire. The reason is that
   (a) it is a very good conductor of electricity
   (b) it has very high melting point
   (c) it melts easily if very high current is passed
   (d) it has low resistance

7. A 15 ampere plug fuse is provided in an electrical circuit in an industry. It acts as a
   (a) load on the lines
   (b) step-up transofmer
   (c) step-down transformer
   (d) safety device

8. Nichrome wires or tapes are used in household electric heating appliances because they have/are
   (a) high resistance and low melting point.
   (b) high resistance and high melting point.
   (c) good conductors of electricity.
   (d) low resistance and becomes hot very fast.

9. A portion of a heater coil is broken off and if the rest is joined to form the coil, then the resistance of the coil

   (a) will decrease and power consumption will increase
   (b) will decrease and power consumption will decrease
   (c) will increase and power consumption will increase
   (d) will increase and power consumption will decrease

10. There are 4 nichrome wires of diameters 2 mm, 3 mm., 4 mm and 5 mm., and all four have the same length. Which one will give more heat if connected to the same source?

    (a) 2 mm. diameter wire
    (b) 3 mm. diameter wire
    (c) 4 mm. diameter wire
    (d) 5 mm. diameter wire

11. What should be done if in a domestic electric circuit the rated fuse wire burns frequently?

    (a) Use a thicker fuse wire than the rated one.
    (b) Use a thinner fuse wire than the rated one.
    (c) Get the circuit checked for short circuiting.
    (d) Connect directly without using fuse wire.

12. If in your town electricity costs 50 paise per kilo watt hour, you pay for

    (a) electric energy consumed
    (b) electric charge
    (c) power
    (d) electric current

13. If an aluminium chain has to be electroplated with gold, it should be used

    (a) as the cathode
    (b) as the anode
    (c) kept in the electrolyte
    (d) connected between cathode and anode

14. The most suitable material for the core of a powerful electromagnet is

    (a) alnico
    (b) soft iron
    (c) steel
    (d) tungsten

15. The telephone receiver makes use of a
    (a) electromagnet
    (b) temporary magnet
    (c) permanent magnet
    (d) natural magnet

16. The lightening conductor protects the building from lightening by
    (a) not permitting the lightening to fall at the building at all
    (b) driving away the charged particles
    (c) forcing lightening to fall on other buildings in the neighbourhood
    (d) conducting the electric charge to the ground when lightening strikes the building.

17. The occupants of modern steel frame buildings are not harmed when the buildings are struck by lightening because
    (a) these buildings are stronger
    (b) these drive away the charged particles
    (c) lightening does not fall on steel frame buildings
    (d) steel frames being good conductors, they allow the charge to flow to the earth.

18. Water is used in automobile radiators because of its
    (a) high heat capacity
    (b) low heat capacity
    (c) high cooling effect
    (d) availability in plenty

19. In a transformer, the voltage can be stepped up or down to a desired level by
    (a) varying the thickness of insulated copper wires
    (b) keeping the number of turns of copper wires constant
    (c) adjusting the input A.C.
    (d) suitably varying the number of turns in primary and secondary.

20. An electric iron should be used with a three-pin plug because

(a) it ensures a longer life of the iron
(b) it provides a better insulation to the iron
(c) it ensures better safety by earthing
(d) it is more convenient to use a three-pin plug.

21. Most of the diodes and transistors are made of silicon and germanium because they are

(a) good conductors
(b) good insulators
(c) semi conductors
(d) super conductors

22. X-rays can be used for taking photos of inner organs and bones because they

(a) destruct the germs
(b) can pass through the body
(c) can be handled easily
(d) can be produced easily

23. The material used to slow down the neutrons in a chain reaction is

(a) Plutonium-239
(b) heavy water
(c) enriched uranium
(d) cadmium

24. The frequency of long wave radio when compared to that of short wave radio.

(a) is more
(b) is less
(c) is same
(d) cannot be anticipated

25. If we have to use a household appliance which work only on 110V in our hone; which of the following instrument should be made use of?

(a) step-up transformer
(b) step-down transformer
(c) Electric motor
(d) High resistance wire

26. A painter wants some bright green colour for his painting.Which of the two colours should be mixed?

    (a) Blue and red
    (b) Blue and Yellow
    (c) Yellow and red
    (d) Blue and white

27. Which of the following breaks connection with phase and neutral lines?

    (a) Fuse
    (b) Switch
    (c) Plug
    (d) Main switch

28. Which of the following instrument finds its application in the self-ignition system of Motor cars?

    (a) Induction coil
    (b) Dynamo
    (c) Motor
    (d) Transformer

29. Which of the following is most suitable for making permanent magnets in loud speakers?

    (a) Soft iron
    (b) Nickel
    (c) Tungsten
    (d) Alnico

30. To light a 6 volt bulb from 230 volt supply, the device required is

    (a) electric motor
    (b) dynamo
    (c) step-up transformer
    (d) step-down transformer

• • • • • • •

SOCIO—ECONOMIC SCALE DATA SHEET

1) പേര് (ആൺകുട്ടി / പെൺകുട്ടി)

2) വയസ്സ് 3) സ്റ്റാൻഡേർഡ് 4) സ്കൂൾ

5) ജാതി 6) മതം

7) മൂത്തകുട്ടികളുടെ എണ്ണം 8) ഇളയകുട്ടികളുടെ എണ്ണം

9) കുടുംബാംഗങ്ങളെക്കുറിച്ചുള്ള വിവരം [താഴെ തന്നിരിക്കുന്ന കോളങ്ങളിൽ 1 മുതൽ 7 വരെയുള്ളവ വിദ്യാഭ്യാസ നിലയെക്കുറിച്ചുള്ളതാണ്. അതിൽ ആവശ്യമുള്ള കോളത്തിൽ ✓ അടയാളപ്പെടുത്തുക]

അംഗങ്ങൾ	അക്ഷരാഭ്യാസം ഇല്ല (1)	Std. I to IV (2)	Std. V to VII (3)	Std. VIII to X (4)	Pre-University, Pre-Degree, T.T.C. Intermediate (5)	B.A., B.Sc., B.Com. Engg. Diploma (6)	M.A., M.Sc., M.Ed., B.L., B.Sc., (Engg.) M. Sc. (Engg), M.B.B.S., B.Sc., (Tech), Ph. D. etc. (7)	ജോലിയുണ്ടെങ്കിൽ ജോലിയുടെ പേരെഴുതുക (9)	പ്രതിമാസ വരുമാനം ആകെ എത്ര രൂപയെന്ന് എഴുതുക (9)
പിതാവ് (രക്ഷകർത്താവ്)									
മാതാവ്									
സഹോദരി / സഹോദരന്മാർ 1) 2) 3)									
കുടുംബത്തിലെ മററ് അംഗങ്ങൾ 1) 2)									

APPENDIX X

OBSERVATION SCHEDULE

I DETAILS OF THE SCHOOL

1.	Name of the School	:
2.	Location of the School	: Urban/Rural
3.	Management of the School	: Government/Private
4.	Type of the School	: Boys/Girls/Mixed
5.	Date of visit	:

II DETAILS REGARDING THE CLASSROOM

6. Standard :
7. Strength :
8. Physical facilities in the Classroom:-

	Good	Satisfactory	Poor
a. Furniture			
b. Seating arrangement			
c. Electricity			
d. Water supply			

III METHODS USED AND OBJECTIVES REALISED

9. The broad methods/techniques adopted by the teacher at the time of visit are:-

	Good	Satisfactory	Poor
a. Lecture method			
b. Lecture cum demonstration method			
c. Discussion method			
d. Problem solving method			
e. Project method			
f. Any other (Specify)			

10. Instructional objectives realised:-

a. Imparting knowledge

b. Developing scientific skills

c. Developing abilities involved in problem solving, improvisation, etc.

d. Inculcating scientific attitudes

e. Developing interest in Scientific activities, literature, etc.

f. Imparting training in Scientific method

g. Providing awareness of the applications of Scientific principles

h. Developing power of observation

IV UTILIZATION OF RESOURCES

11. Utilization of resources at the time of visit:

	Good	Satisfactory	Poor
a. Laboratory			
b. Audio-visual aids			
c. Improvised aids			
d. Reference books			

V ABOUT THE TEACHER

12. Qualification : Physics/Chemistry
B.Sc./M.Sc.
B.Ed./M.Ed.

13. The teacher has the ability in:-
    a. Presenting the content with mastery
    b. Maintaining classroom communication
    c. Using proper aids
    d. Linking theory to practice
    e. Using environmental resources
    f. Creating Scientific interest
    g. Questioning

h. Demonstrating experiments

i. Motivating learners

VI PARTICIPATION OF STUDENTS

14. The students have/are:-

	Good	Satisfactory	Poor
a. Listening			
b. Answering			
c. Remaining active			
d. Report with teacher			
e. Communicating			
f. Showing interest			
g. Any other (Specify)			

15. General comment on classroom instruction

	Good	Satisfactory	Poor

List of Schools

1. Model H.S., Thycaud, Trivandrum-14.

2. Cotton Hill Girls H.S., Vazhuthacaud, Trivandrum-10.

3. Holy Angels Convent H.S., General Hospital Junction, Trivandrum-1.

4. St. Joseph's Boys H.S., General Hospital Junction, Trivandrum-1.

5. Thiruvallam B.N.V. Boys High School, Thiruvallam, Trivandrum-17.

6. Thiruvallam B.N.V. Girls High School, Thiruvallam, Trivandrum-17.

7. Mithirmala Boys H.S., Mithirmala (P.O.), Trivandrum District.

8. Kannyakulangara Girls H.S., Vembayam (via), Nedumangad, Trivandrum District.

9. St. Alberts H.S., Cochin-18.

10. Parur North H.S. for Boys, N Parur (P.O), Ernakulam District.

11. St. Theresa's Girls H.S., Cochin-31.

12. Ernakulam Girls H.S., Cochin-11.

13. South Ezhippuram Girls H.S., Ezhippuram (P.O), Ernakulam District.

14. Kuttamassery H.S., Thottumbhagam, Ernakulam District.

15. Karukutty S.J. H.S. for Boys, Karukutty, Ernakulam District.

16. Karukutty S.J.H.S. for Girls, Karukutty, Ernakulam District.

17. Kuriachira St. Paul's H.S., Trichur 680006.

18. Model Girls H.S. Trichur-680001.

19. Trichur St. Thomas College H.S., Trichur-680001.

20. Wadakkancherry Girls H.S., Wadakkancherry, Trichur District.

21. Puttenchira H.S., Puttenchira, Trichur District.

22. Poomala H.S., Poomala, Trichur District.

23. Pazhanji H.S., Pazhanji, (via) Kunnamkulam, Trichur District.

24. Thozhiyur St. George H.S., Thozhiyur, Trichur District.

25. Calicut Model H.S., Calicut-1.

26. Providence Girls H.S., Calicut-1.

27. St. Joseph's Boys H.S., Calicut-1.

28. Calicut Girls H.S., Nadakkave, Calicut-11.

29. Parayamcheri Boys H.S., Puthiya, Calicut District.

30. Maranchatty Mary Girls H.S., Koombara, Calicut District.

31. Kunnamangalam H.S., Kunnamangalam, Calicut District.

32. Peringalam H.S., Peringalam, Calicut District.

APPENDIX XII

KERALA NONVERBAL GROUP TEST OF INTELLIGENCE

RESPONSE SHEET

Name............................(boy/girl)   Age......

Standard..............(School)............................

	Test I	Test II	Test III	Test IV
1	A B C D E	A B C D	A B C D	A B C D
2	A B C D E	A B C D	A B C D	A B C D
3	A B C D E	A B C D	A B C D	A B C D
4	A B C D E	A B C D	A B C D	A B C D
5	A B C D E	A B C D	A B C D	A B C D
6	A B C D E	A B C D	A B C D	A B C D
7	A B C D E	A B C D	A B C D	A B C D
8	A B C D E	A B C D	A B C D	A B C D
9	A B C D E	A B C D	A B C D	A B C D
10	A B C D E	A B C D	A B C D	A B C D
11	A B C D E	A B C D	A B C D	A B C D
12	A B C D E	A B C D	A B C D	A B C D
13	A B C D E	A B C D	A B C D	A B C D
14	A B C D E	A B C D	A B C D	A B C D
15	A B C D E	A B C D	A B C D	A B C D
16	A B C D E	A B C D	A B C D	A B C D
17	A B C D E	A B C D	A B C D	A B C D
18	A B C D E	A B C D	A B C D	A B C D
19	A B C D E	A B C D	A B C D	A B C D
20	A B C D E	A B C D	A B C D	A B C D