AN INVESTIGATION INTO THE TEACHING LEARNING SYSTEM OF PHYSICAL SCIENCE IN THE SECONDARY SCHOOLS OF WEST BENGAL

A THESIS SUBMITTED TO THE UNIVERSITY OF KALYANI FOR THE FULFILMENT OF DEGREE OF DOCTOR OF PHILOSOPHY IN EDUCATION

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CERTIFICATE

This is to certify that the research work entitled "The investigation into Teaching-Learning System of Physical Science in the Secondary Schools of West Bengal", submitted by Sri Nirmal Kr. Mitra in fulfilment of the requirements for the award of Ph.D degree in education under the department of education, University of Kalyani is based on the results of an important research work accomplished by him. No part of this work has been submitted for any other degree. He has completed the research work under my guidence.

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CHAPTER-I

1.1 Introduction :

One of the most important agencies set up by each civilized nation in its efforts to preserve and improve itself is a system of education. The schools of a society are established to help its young people to understand that society's beliefs, ways of life, and values, and to prepare them to take a constructive part in its activities and further development.

Teaching originated at the dawn of civilization, as the first mission of man. With the passage of time the process of teaching has undergone several changes. The quality of classroom teaching in the schools depends upon the quality of education of teachers and the quality of education of teachers depends upon the knowledge of subject matter on the one hand and knowledge of pedagogy on the other hand. The knowledge of pedagogy and its application in class teaching is also undergoing change in this changing world.

The Sophists in the West and the Gurus in the East, as they taught learners, developed techniques of teaching, which were mainly subject-centered. The teachers had to explore within the knowledge areas of the subjects. Thus, incidentally, new knowledge areas, such as the Vedangas of the East and Grammer, Rhetoric and Logie in the West, evolved.

In the post Renaissance Europe we find a magnificent development of teaching methods which gave rise to a shift from "Subject-Centricism" to Pupil-Centricism. Comenius, Pestalozzi and Herbert, gave the fundamental idea of Psychologising the teaching-learning process, i.e. to teach according to the learner's individual ability, interest, aptitude, etc.

Finally we come to our own age, the age which is industrial, atomic and space age followed by the concept of globalisation and also the age of the rapid social change. The challenge of this age is to prepare young people for diversity. To achieve this goal, the most efficacious methods of teaching have to be evolved, so that the vast amount of knowledge can be learnt in the shortest possible time.

The traditional explanation of the term teaching, which equates teaching with telling is not acceptable to the educators of to-day. Teaching, by a traditional teacher, as conventionally understood, is the act of disseminating information to the learners in the classroom.

Eminent educationists has defined teaching from different angles. These definitions are classified into four types.

a) Teaching as imparting knowledge or skill

b) Teaching as doing anything and everything that may lead to learning.

c) Teaching as a social act of influence.

d) Teaching as the act of developing a purposeful psychological environment.

Keeping in view the above four types definitions of teaching a number of contemporary researches have been conducted, throughout the world, especially on the teaching-learning system. In connection with the revolutionary change in the twentieth century teaching method have also changed significantly. On the one hand old methods of teaching have been discarded and on the other hand new methods of teaching have emerged.

New paradigms, many kinds of teaching model have been developed on the basis of these research findings. The traditional techniques of teaching have been replaced by new techniques. The pupils may also be benefitted from these new techniques, if we can faithfully implement these teaching models in our class-room communications. Thus the destiny of India can be shaped better in her class-rooms. Before this, the researcher should emperically verify how far these teaching models prescribe different approaches to the instructional process to bring about changes in the behaviour of the learners.

Models were used in several context in our daily life. In teaching also the use of model is very old. Socrates, the ancient greek philosopher, used his own model of question answer techniques, the ancient Indian teachers developed their own models of teaching to affect desirable changes in the behaviour of the learners. Recently several models of teaching have been developed specially in Western Countries. These models prescribe different approaches to the instructional process to bring about changes in the behaviour of the learners.

One of the most comprehensive definitions, given by Bruce Joyce & Marsha Weil, is that "a model of teaching can be defined as an instructional design which, describes the process of specifying and producing particular environmental situation which cause the students to interact in such a way that a specific change occurs in their behaviour."

Models of teaching can help a teacher to build up his capacity to teach more children and create a richer and more diverse environment for them. They can help curriculum makers, plan learning centres and curricula which offer to

children a variety of educational alternative. They can help material makers to create more interesting and effective instructional materials and learning sources. They may stimulate the development of new educational forms – the educational opportunities which will replace the schools today.

In the present day teachnig & learning system is not originated only on cognitive factors. But different sources including school environment, Social Communication, Socio-Economic Status, Cultural Pattern and other different functions can influence the teaching-learning system.

In this regard T/L system is very important aspect for quality education. But to develop proper academic environment the system of teaching & learning must be improved as a whole. It includes infrastructure to evaluation. On this basis the problem have been selected. We are interested to investigate the different variables in this context to improve the T/L system. For example in many educational institutions T/L system have been developed on the basis of technology and their system working successfully. But in our country system specialy stands for different essential components as a sub-system of education. Therefore T/L system is a dynamic concept on the basis of our social pattern and available resources which may guide our learners.

1.2 Objectives of Teaching Physical Science : A Background Study

We teach science, partly because of its usefulness, partly because of its discipline and partly because of its cultural values. We live, move, and have our own being in a world in which science has become, of better or for worse, an inseparable element. Daily contact with the modern world makes some acquaintance with the facts and conclusions of science almost imperative.

According to Kothari Commission Report (1964-66)

"Science education, became an integral part of school education, and ultimately some study of science should become a part of all courses in the humanities and social sciences at the University stage, even as the teacing of sciences can be enriched by the inclusion of some elements of humanities and social sciences. The quality of science teaching is to be developed considerably so as to achieve its ability of problem solving, analytical skills and ability to apply them to the problems of material equipments and social living besides permitting the spirit of enquiry and experimentation."

Science is an intimate part of the environment, living things, the earth, the

sky, air and water, heat and light and forces such as gravity. Hence, science is so close to the life of every boy and girl that it must be blended with education.

Narendra Vaidya Observes :

"Fundamental to the conquest of nature by the Scientist has been his method of approach to the unknown. Facts and understandings bring the scientists to the frontier, but it is scientific methodology that extends the frontier of knowledge."

H.N. Sannders Opinions :

"The purpose of teaching science is not to instill a knowledge of facts, important as this may be. It is to develop skill in critical thinking and an appreciation of scientific methods to encourage desirable attitudes and interests and to stir the imagination".

Teaching and learning Magazine :

In modern concept Teaching-Learning system is rather replaced by the modern technology, reflected through Teaching and Learning Magazine, Educators Outlook by Gale Riedel (2003). Here system represented as technological device supported by the following documents :

Educators Outlook by Gale Riedel (2003)

"Our school Washington Elementary, boosts 1200 PCs tied to 12 servers. There are some 500 staff users and 3800 student users in our centrally managed system. So you can imagine all of the different problems we may face regarding our network management.

Recently, we faced a problem that seems relatively minor but has broad-reaching implications. Namely how to work with students in a computer lab to show them how to do something on their computers without having them take individual turns or having everyone gather around one 15 inch computer screen trying to watch what the teacher was doing. So we decided to see what options were out there that would give our teachers the ability to work with the students in the most effective way possible and allow the students the ability to follow along weigh out being lost, thus receiving the teaching that they need."

1.3 Different Commission & Committee Proposed their recommendations on Science education for its upliftment either in academic dimension or its others developmental technique. Some recommendation are given below.

COMMITTEE ON PLAN PROJECTS PANEL FOR SCIENCE EDUCATION IN SECONDARY SCHOOLS, 1964

Report on Science Education in Secondary Schools : New Delhi, G. I. Press, 1964

Main Recommendations :

The following are some of the recommendations made by the panel :

1. The Education Department of each State should frame proposals for the new academic year well in advance of the start of the academic session furnishing full details. This will help schools to complete formalities and procure science equipment in time for the new session.

2. When science teaching is introduced in a high school, a minimum amount of Rs. 10,000 may be earmarked for setting up a reasonably well-equipped laboratory for Physics and Chemistry. In case Biology is also introduced an additional amount of Rs. 300 should be provided.

3. For Middle schools, a sum of Rs. 4,000 for science equipment is considered essential.

4. Each middle and high school should have a workshop attached to it for which a grant of Rs. 1,000 should be sanctioned separately.

5. Adequate facilities should be provided to science teachers and students for working on hobbies during school hours and in spare time. Refresher courses and workshops should be arranged for teachers periodically.

6. The creation of a separate branch of Science Education in each State Department of Education under a Special Officer would strengthen the steps being taken at various levels for improvement of science teaching. The report has six appendices dealing with various aspects of science equipment and apparatus required for High Schools and Middle Schools.

After post independence (1947) to impart science education was rather difficult in India. Because before independence science education was limited in a particular section. But after independence separate educational strategy had been taken where mass education was an emergent need.

Therefore a balance had to maintain between the need and demand on science education on that time. In 1964 the report was basically on the above reason specially framed on the basis of socio-economic condition. Science education was encouraged on the secondary schools in India in the above report.

EDUCATION COMMISSION, 1964-66

Report : 1964-66, Education and National Development : Delhi, Manager of Publications, 1966

Main Recommendations :

The Report is divided into three parts. The first part covers chapters I-VI and deals with general aspects of educational reconstruction common to all stages and sectors of education. The second part covers chapters VII-XVII and deals with the different stages and sectors of education. The third and last part covering two chapters, i.e. chapters XVIII and XIX, deals with educational planning, administration and finance. The Report makes recommendations about various sectors and aspects of education, some of which are as follows :

1. Work-experience and social service should be introduced as integral parts of general education at more or less all levels of education.
2. Secondary education should be vocationalised.
3. Mother-tongue has a pre-eminent claim as medium of instruction at school and college stages. Moreover, the medium of education in school and higher education should generally be the same. The regional language should, therefore, be adopted as the media of education in higher education.
4. The teaching and study of English should continue to be promoted right from the school stage. English will serve as a link language in higher education for academic work and intellectual inter-communication.
5. The Central and State Governments should adopt measures to introduce education in moral, social and spiritual values in all institutions under their control.
6. Secondary schools should be of two types – high schools providing a course of 11-12 years.

7. Education, as distinguished from pedagogy, should be recognised as an independent academic discipline.

8. Duration of training courses should be two years for primary teachers who have completed the secondary school course. It should be one year for the graduate students.

9. Science and mathematics should be taught on a compulsory basis to all pupils as a part of general education during the first ten years of schooling.

10. No single stage of education need be designated as basic education, but its essential principles should be retained to guide and shape the educational system at all levels.

11. External examinations should be improved by orienting question papers to objectives rather than to acquisition of knowledge, by improving the nature of questions, adopting scientific scoring of scripts.

12. Internal assessment should be comprehensive and evaluate all aspects of student growth.

13. Some centres of advanced study and a small number of major universities should be set up with the view to achieving highest international standards.

14. Education for agriculture, and research in agriculture and allied sciences should be given a high priority in the scheme of educational reconstruction.

15. The Ministry of Education, in collaboration with the Asian Institute of Educational Planning, should under. According to Indian Parliamentary & Scientific committee 1961 science education should be imparted on the basis of practical orientation & Vocation based. Science education in Secondary level would be on the general basis.

INDIAN PARLIAMENTARY AND SCIENTIFIC COMMITTEE, 1961

Report : Delhi, Publications Division, 1964

Main Recommendations

1. Science education in the primary schools should be introduced in the form of nature study. Not less than 25% of the lessons in the different languages readers could be devoted to science subjects in the form of stories, explaining the phenomena in nature as well as the lives of great scientists who have contributed to the making of the modern world. Such lessons should not, however, lack in literary presentation and grace to stimulate creative talent of the pupil. Use of visual aids, visits to botanical and zoological gardens and other methods of instructions have to be employed as far as feasible. Besides, in the reorganisation of syllabus for primary schools some science teaching has to be introduced in an elementary form.

2. General Science courses could be started in the middle schools, i.e. classes VI, VII and VIII.

3. At the High School stage science should be compulsory for all students, but it has to take the form of separate subjects as mathematics, physics, chemistry, biological sciences, etc. along with the other humanistic subjects. Certain guidance in this connection could be offered by the way in which courses have been prescribed in the U.S.S.R. While formulating the courses it should be seen that there is a balance between the courses in science and courses in humanistic subjects and the one does not outweigh the other. This should remove defects of earlyspecialisation. Everyone who leaves the Hish School should be equipped with elements of science as well as of humanistic culture. Whether he goes into employment or further courses in higher education or junior colleges instruction or in courses of vocational education in the trade schools, polytechnics or various other branches of vocational training which will expand as our economy progresses.

4. A decision will have to be taken regarding the nature of the higher secondary stage. If the trend is to follow the recommendations of the Sampurnanand Committee, it will be possible to have new institution of junior colleges or intermediate collegs attached to the colleges or high schools or independent with a 2-year curriculum consisting of the 11th

and 12th classes. In that case, specialisation in science could be started at this stage for those students who would go in for professional courses of medicine, agriculture, engineering or degree courses like B. Sc. and M. Sc. in science itself. The courses will have to be, perhaps, of the same nature as adopted for the VI form in U. K. where boys spend at least 2 years, but very often 3 years in doing courses at advances level for admission to the universities and other institutions of higher training.

5. Specialisation at an early stage of school education should be avoided and courses of instruction should be so framed as to enable those who come out of the high school at the age of 16 plus or 17 after completing 10 years of schooling either to pursue an occupation or train.

In 1961 recomaindations on science education was very significant. Reports regarding laboratory and equipments revealed the following facts for improment of science education :

1. Functional environments for science education.
2. Laboratory and equipment for faciliatating science education.
3. Details infrastructural environments for laboratories.
4. Socio-economic condition to be considered for improving Practical laboratories.
5. Details about size, shape and other conditions for maintaining a good laboratory.

COMMITTEE ON PLAN PROJECTS : PANEL FOR SCIENCE LABORATORIES AND EQUIPMENT, 1961

Report on Science Laboratories and Equipment in High/Higher Secondary Schools : New Delhi, 1962

Main Recommendations

1. Since the main function of a laboratory is to impart scientific education in an efficient way, its design should, therefore, be based on functional requirements.
2. The Panel considers that in the interest of economical distribution of lay-out and services, it would be advisable to locate the laboratories for

Chemistry and Home Science on the ground floor and those for Physics and Biology on the first floor over these laboratories if the school buildings have a double-storeyed structure. For a single-storeyed structure, the grouping of Home Science with Chemistry and of Biology with Physics may still be kept intact. Both Chemistry and Home Science laboratories require special lay-outs for water and drainage which will be best arranged if they are both on the ground floor and adjacent to each other.

3. The Panel is of the view that all the four laboratories, viz. Physics, Chemistry, Biology and Home Science could be of the same size, i.e. 10.0 m x 6.0 m = 60 sq. m. (32' x 20' - 640 sq. ft.) with a space of 6.0 m = 60 m x 3.7 m = 22.2 sq. m. (20' x 12' - 240 sq. ft.) provided for ancillaries for each laboratory. The Panel feels that the space requirement of 60 sq. m. for a batch of 24 students is the minimum that could be recommended for each laboratory.

4. The factor of light, apart from affecting visual and physical comfort of students, involves the question of economy also in respect of the size and type of windows and of the disposition of light fittings. The chief purpose of lighting is to provide comfortable visual observation for laboratory work and the conservation of vision of the young workers. It is desirable to make maximum use of day-light by proper location of doors, windows and skylights. Windows are best placed at a standard height of 1.2 m (4 ft.) from the finished floor level, as this would give a good distribution of light over the work tables whose height may vary between 85 cm. and 90 cm. (2'-9" and 3'). To save on capital as well as recurring expenses artificial lighting needs to be provided only for occasional work. Windows and doors should be so disposed as to provide as evenly distributed illumination as possible. A window area of 20 per cent of the floor area is considered to be adequate for general laboratory work. In terms of lumens per sq. ft. is considered to be adequate. The following reflectance standares are recommended for obtaining a desirable brightness level inside the laboratories :

   Ceilings — 85% of the total amount of light received by the surface.

   Walls — 60% of the total amount of light received by the surface.

   Floors — 15% to 30% of the total amount of light received by the surface.

5. Light and colour are closely inter-related so that in determining a suitable colour scheme inside the laboratory, the reflectance value should always be taken into account. White is not considered suitable for laboratory

walls as it causes glare and shows dirt very prominently. Light cream or silver grey be preferable.

6. Work table is the most important item of laboratory furniture and needs careful consideration. The Panel, after careful consideration of the functional requirements, makes the following recommendations :

(a) Size of the work table need not be the same for all the four laboratories since the work carried out differs in each case.

(b) Work tables in the Physics, Chemistry and Home Science laboratories need not have drawers or closed cupboards. Biology tables, however, may preferably be provided with drawers. In Physics laboratory the work tables may me provided with 2 ft. wide intermediate shelves about I foot above the floor level.

(c) Provision for tables should be made for 24 students in each laboratory.

7. The Committee strongly recommended that accommodation such as storage and balance room must form an essential part of the laboratory itself and should be well-planned in the same manner as the laboratory.

8. The Penel feels that laying down of specifications and standards for equipment and apparatus will greatly improve the quality of instruments at present being supplied to schools and recommends that the necessity for making these specifications may be brought to the notice of the Indian Standares Institution and the Central Scientific Organisation with the request that they may expedite the laying down of standards of at least those items of science apparatus which are already being manufactured in the country.

9. The Panel made a detailed study of the cost involved in equipping the various laboratories and recommended that the procurement of equipment and apparatus for a school which was to introduce science subjects afresh may be spread over a period of three to four years. In the case of a school which is already imparting instruction in these subjects, the requirements will vary with reference to the available equipment and need for future development within the limits of the Panels list.

In 1970's the examination situation was not proper. Some malpractices were reported in different parts of India from where West bengal, is not an exception. But presently in 2005-2006 the situation has been changed overall. The situation in the examination hall presently is almost fair.

Actually we are not interested about the examination situations of the hall but simultaneonsly we cannot avoid it because in West Bengal in secondary schools evaluation technique is based on summative approach where examination environment and other technical factors are very important.

COMMITTEE ON EXAMINATIONS, 1970

Report : New Delhi, National Council of Educational Research and Training, 1971

Summary of Recommendations

1. *Legislation*

The State and Central Governments should immediately take suitable measures to get amending legislation passed in the relevant laws pertaining to the following matters :

(a) Empowering the Board / University to grant autonomous status to well established institutions.

(b) Empowering the examining authorities to check students and prohibit those with weapons from entering the examination halls.

(c) Making the assembly of persons within a certain distance from an examination hall a cognisable offence.

(d) Making the indulgence in malpractices by employees and authorities of the universities / boards a cognisable offence.

(e) Empowering the examining authorities to take out insurance for the invigilators and examiners.

(f) Making the assault on an examiner or an invigilator or other person connected with examination, a cognisable offence.

2. *Conduct of Examination*

(a) Paper-setters should be appointed at least six months prior to the commencement of a Public Examination and they should be given at least eight weeks to draft questions. The papers should be finalised at a meeting of the paper-setters.

(b) Where the number of candidates in Public Examination is very large, there should be decentralisation with separate examination for each group of 10,000 school students or 1,000 college students.

(c) A Public Examination should be conducted in the institution in which the students study. The majority of the invigilators and superintendents should be drawn from the institution concerned.

(d) Admission to the centre of a Public Examination should be through one main entrance. Only bonafide candidates with identity cards should be admitted in the examination centre after thorough checking.

(e) Model answers should always be prepared and supplied by the paper-setters.

(f) Copies of the question papers set should be made available to the teachers in the schools and colleges on the day of the examination but after it is over, so that the teachers could comment on the paper to the authorities quickly.

(g) The method of spot evaluation at a central place to which all the examiners are called, should be adopted.

(h) The result should be declared subject-wise and furnished in the form of grades. The 'raw' marks given on the candidates passing in the minimum number of subjects.

(j) The certificate issues by an examining authority should have two columns, viz. one giving the result of Public Examination and the other giving the result of the internal assessment by the teachers.

(k) For the awarding of prizes and scholarships to a candidate who stands first in an examination or in a subject, a separate test should be conducted and admission to the same limited to those who secure the highest grade in the Public Examination.

(l) There should not be too many Public Examinations. There should be one at the end of the upper primary / middle school stage, another at the end of the secondary stage and the third at the first degree stage. All others should be internal assessments only.

3. *Use of Examination Results*

(a) A recruitment to the services should be made on the basis of tests / examinations conduced by the Public Service Commissions and the maximum age for appointment for clerical posts be reduced to 19 years.

(b) Admission to colleges including professional colleges should be on the basis of an entrance test conducted specifically for assessing the aptitude of a student for a particular course. Eligibility to appear at these tests should alone be determined by the results of the Public Examination.

4. *Budgeting for Education*

In future, both the Central and State Governments should make funds separately for guidance and studies and research on examinations.

5. *Research*

There should be continued study and research on examinations, both at the State and Central levels and in the boards / universities in a coordinated manner. Necessary funds for the same should be provided on a priority basis.

6. *Novel Ideas*

Novel ideas for the organisation and conduct of Public Examinations should be encouraged.

COMMITTEE ON SCHOOL BUILDINGS, 1970

Report : New Delhi, Ministry of Education, Government of India, 1972

Main Recommendations

1. The committee has estimated that Rs. 90 crores will be required for the additional buildings for the primary and secondary schools started during the Fourth Plan. The Committee has also estimated that Rs. 250 crores will be required for clearing the blacklog of school buildings required for primary and secondary schools started before the commencement of the Fourth Plan. The Committee has assumed that 50 per cent of the amount required for the construction of school buildings will be available through popular contribution. The Committee urge the Government of India to set apart Rs. 10 crores per annum for the next ten years as grants to the State Governments specifically for construction of school buildings. If necessary, half of this amount may be given as loan and the rest as grant.

2. In order to mobilise local resources for school buildings, the following steps are recommended :

(i) The committee strongly recommends that the funds collected by the different States through lotteries may be utilised for educational purposes including the capital costs on buring the sale of the lottery tickets.

(ii) Local people may be asked to donate one or two rooms at the time of birthdays, marriages and such other occasions and if so desired, the name of the donor could be inscribed on the room / rooms donated by him / her.

(iii) Public meetings may be arranged and an appeal could be made by a number of speakers for donations for the construction of school buildings.

(iv) A drive should be made to get the religious institutions to donate some buildings as a part of their programme.

(v) Other avenues like staging plays and organising exhibitions may also be explored for the purpose of raising funds for school buildings.

(vi) Contributions in kind, e.g. surplus cement and surplus food for paying for the labour in kind may also be accepted.

3. The Committee recommends that the programme of construction of school buildings may be planned in the following order of priorities :

(i) Buildings for those schools where classes are held in the open (Information received from States / Union Territories at Annexure X);

(ii) Places where classes are conducted in tents;

(iii) Schools having rented accommodation;

(iv) Repairs, maintenance and improvments (additional rooms, etc.) in existing schools.

The possibility of providing tents to schools where classes are being held in the open till buildings can be provided should also be explored.

Though the examination committee report on 1957 was for higher education appointed by U.G.C. but some recommendations may be fruitful on secondary level also. Specially the formative approach in evaluation system may be introduced in the present secondary level to upgrade the present system.

EXAMINATION COMMITTEE, 1957

Report : New Delhi, U. G. C.

Summary of Recommendations

1. No reform in the system of examinations will reduce the failure rate in our universities and colleges, unless the prevailing admission procedures are improved. We have therefore, to see that only those candidates are admitted to universities who can profit by higher education. One of the feasible ways by which this could be done is to introduce in the School Leaving Examination two additional papers, one to test competence in the use of the language of the university and one to test intellectual maturity, for those who wish to enter the university.

2. Teaching work should be done not only through lectures but through tutorials, seminars, etc. It will be desirable to hold periodical short tests on the work done in the tutorials and to maintain a record of the assessments made. This should be regularly evaluated. Each university may decide what weightage should be given to this. In order to make room for tutorials, lectures may be cut down (it should be possible to reduce them by 50 per cent) and the teaching work divided between tutorials and lectures.

3. The U. G. C. should encourage seminars, discussions and conferences of university and college teachers for defining the objectives of teaching and examinations in different subjects at various levels. A clear conception of the aims of teaching will facilitate good teaching and bring about a greater conformity between examinations and teaching.

4. Research should be undertaken in regard to both the educational and technical aspects of examinations. Topics which may be taken up for research in this connection are indicated in the report. It should be possible for the departments of education in universities to undertake such work as a part of their normal activities. Perhaps the newly created National Council of Educational Research and Training would also be able to assist in this. There should be arrangement in the University Grants Commission to coordinate the research work of the different universities and to disseminate information and conclusions with regard to the studies undertaken.

SECONDARY EDUCATION COMMISSION, 1952-53

Report : Madras, India, Ministry of Education, 1953

Terms of Reference

Under the Terms of Reference, the Government was asked :

A. To suggest measures for its reorganization and improvement with particular reference to;

(i) The aims, organization and content of secondary education;

(ii) Its relationship to primary, basic and higher education;

(iii) The inter-relation of secondary schools of different types; and

(iv) Other allied problems.

Summary of Recommendations

1. *Aims and Objectives of Secondary Education*

The Commission have said in their report : "As political, social and economic conditions change and new problems arise, it becomes necessary to re-examine carefully and study clearly the objectives which education at each stage should keep in view. Moreover, this statement must take into account not only the facts of the existing situation but also the direction of its development and the nature and type of the social order that we envisage for the future to which education has to be geared."

In the Commission's opinion, the most outstanding and educationally relevant facts in the Indian situation were :

(1) The adoption of the goals of democracy and socialism necessitating the development among the people of a broad, national and secular outlook;

(2) The extreme poverty of the country and urgency for promoting its economic growth; and

(3) The absence of educational facilities needed for developing all aspects of the human personality and the neglect of cultural pursuits and activities.

On the basis of this analysis, the Commission recommended that secondary education should be reoriented to the following aims and objects :

(a) *Development of qualities essential for creative citizenship :* This includes the development in the students of secondary schools of those habits, attitudes and qualities of character which are essential for creative citizenship in a democratic society. Among these qualities, which are to be fostered through curricular and co-curricular activities in secondary schools, are :

(i) The capacity for clear thinking (allied which is the capacity for clearness in speech and writing);

(ii) The scientific attitude of mind;

(iii) A receptivity to new ideas;

(iv) A respect for the dignity and worth of every individual;

(v) The ability to live harmoniously with one's fellowmen through the cultivation of discipline, cooperation, social sensitiveness tolerance; and

(vi) A sense of true patriotism.

(b) *The promotion of vocational efficiency :* This involves not only the creation of a new attitude to work and an appreciation of the dignity of manual labour but also the development of the students' technical skill and efficiency through greater emphasis on craft and productive work and the diversification of courses at the secondary stage.

(c) *Development of personality :* This implies cultivation of the students' literary, artistic and cultural interests for a fuller development of their personalities. This means the provision of subjects like art, craft, music, dancing and hobbies in the secondary school curricula.

(d) *The training for leadership :* The training of persons who, on completion of the Secondary stage, would be able to assume the responsibilities of leadership at the intermediate level.

2. *Methods of Teaching*

Inculcation of values, attitudes and work habits : The methods of teaching in schools should aim not merely at the imparting of knowledge in an efficient manner, but also at inculcating desirable values and proper attitudes and habits of work in the students.

They should, in particular, endeavour to create in the students a genuine attachment to work and a desire to do it as efficiently, honestly and thoroughly as possible.

Activity and project methods : The emphasis in teaching should shift from verbalism and memorization to learning through purposeful, concrete and realistic situations and, for this purpose, the principles of Activity Method and Project Method should be assimilated in school practice.

Teaching methods should provide opportunities for students to learn actively and to apply practically the knowledge that they have acquired in the classroom. Expression Work of different kinds must, therefore, form part of the programme in every school subject.

Emphasis on clear thinking and expression : In the teaching of all subjects special stress should be placed on clear thinking and clear expression both in speech and writing.

Training pupils in techniques of study : Teaching methods should aim less at imparting the maximum quantum of Knowledge possible, and more on training students in the techniques of study and methods of acquiring knowledge through personal effort and initiative.

Instruction to suit different student abilities : Attempt should be made to adopt methods of instruction to the needs of individual students as much as possible so that dull, average and bright students may all have a chance to progress at their own pace.

Group projects and activities : Students should be given an adequate opportunity to work in groups and to carry out group projects and activities so as to develop in them the qualities necessary for group life and cooperative work.

3. *Examinations and Evaluation*

Reviewing the defects of examinations at the Secondary stage, the Education Commission said :

"The examinations today dictate the curriculum instead of following it, prevent any experimentation, hamper the proper treatment of subjects and sound methods of teaching, foster a dull uniformity rather than originality, encourage the average pupil to concentrate too rigidly upon too narrow a field and thus help him to develop wrong values in education. Pupils assess education in terms of success in examinations. Teachers, recognizing the importance of the external examination to the individual pupils, are constrained to relate their teaching to an examination which can test only a narrow field of the pupil's interests and capacities and so inevitably neglect the qualities which are more important though less tangible."

(a) *External examination — introduction of objective type tests :* The number of external examinations should be reduced and the element of subjectivity in the essaytype tests should be minimized by introducing objective tests and also by changing the type of questions.

(b) *School records for assessment of all-round progress :* In order to find out the pupil's all-round progress and to determine his future, a proper system of school records should be maintained for every pupil indicating the work done by him from time to time and his attainments in the different spheres.

(c) In the final assessment of the pupils due credit should be given to the internal tests and the school records of the pupils.

(d) *Symbolic marking to replace numerical marking :* The system of symbolic rather than numerical marking should be adopted for evaluating and trading the work of the pupils in external examinations and in maintaining the school records.

(e) *One public examination—final comprehensive certificate :* There should be only one public examination at the completion of the Secondary School course.

(f) The Certificate awarded should contain, besides the results of the public examination in different subjects, the results of the school tests in subjects not included in the public examination as well as the gift of the school records.

(g) The system of compartmental examinations should be introduced at the final public examination.

(h) *Board of secondary education to be set up :* There should be a Board of Secondary Education consisting of not more than 25 members with the Director of Education as its chairman to deal with all matters of education at the Secondary stage and to lay down general policies.

A Sub-committee of the Board should deal with the conduct of examinations.

4. *Buildings and equipment*

School buildings—space per pupil : Normally, in designing buildings for schools, care should be taken to see that an area of not less than 10 sq. ft. is provided per student in the classroom.

Optimum strength of class and school : The optimum mumber of boys to be admitted to any class should be 30 and the maximum should not in any case exceed 40; the optimum number in the whole school should be 500 while the maximum should not exceed 750.

Research regqured on school buildings, furniture and equipment : In the type design of schools as well as the furniture, etc., research should be carried on to improve functional effciency and to adjust them to Indian conditions.

An Expert Committee should be appointed to lay down carefully the amount and the kind of equipment required for various types of diversified courses and workshops.

Land for educational purposes : The State Governments and the Centre should, wherever possible, assign lands to schools for playgrounds, buildings or agricultural farms and other necessary purposes without any charge.

Exemption from customs duty for equipment and books : In order to popularize progressive teaching methods and facilitate their introduction, "Experimental" and "Demonstration" schools should be established and given special encouragement where they exist, so that they may try out new methods freely wigthout being fettered by too many departmental restrictions.

5. *Teachers*

Guide material for teachers : Suitable literature for the guidance and inspiration of teachers should be produced by the Education Departments of all States and either the office of the Director of Education or one of the training colleges should be adequately equipped for the purpose.

Special committee to review the scales of pay : A special committee should be set up to review the scales of pay of teachers of all grades and recommend such scles of pay that will meet in a fair and just manner the varying cost of living.

National Policy On Education 1979 suggests that "the present system of education must be reorganized is the light of Contemporary Indian reatlities and requircments."

Secondary Education is very important for the continuation among secondary (10th grade), Higher secondary (12th grade) & primary education. National policy on Education 1979 rightly comments "The entire educational

system has to be seem as one chain."

It is true that after independence number of secondary schools have been increased rapidly in India supported by the following informations—

* No of schools in 1950-51 — 7300 (Secondary Level)
* No of schools in 1982-83 — 52, 279

Ref :
Challenge of Education 1986.

But the system of teaching and learning simultaneonsly not upgraded according to the requirements. For giving Quality education the system has to be improved overall. We are trying to investigate in this study to find out the real situation of teaching & learning in West Bengal on Physical Science. Finally we try to give an alternative measeres for the improvement of the system.

COURSE STRUCTURE

Secondery Level 2006

Literature group		Science group			Humanities	
Bengali	English	Physical Sc.	Life Sc.	Math	History	Geography
Marks distributs :						
200	100	100	100	100	100	100

Apart from additional paper (containing 100 marks) all papers are compulsory. Scoring standard is based on 800 marks other than additional paper.

1.4 New Syllabi 2006

West Bengal Board of Secondary Education
Instruction for Framing Questions & Marks Distribution

Subject : Physical Science

1. There will be four groups vig. A, B, C, D in the Physical Science question paper.

2. Gyoup A will be compulsory. Ten questions are to be answered and each question will carry 1 mark. The nature of questions will be very short answer type. Thirteen questions are to be set taking at least four questions from each of (i) common to both Physics and Chemistry Section (IX and X), (ii) Physics Section (IX and X both) and (iii) Chemistry Section (IX and X both).

3. Ten questions are to be answered, taking at least two from group B and at least three each from Group C and Group D. Each question will carry 8 marks, which may be divided (4+2+2) or (3+3+2).

4. There will be four questions in group B from question 2 to 5. All questions are to set from the section of the syllabus common to both Physics and Chemistry (IX and X both) — questions should be set covering the whole syllabus. A question may be set from different chapters of class IX and X or both.

5. There will be six questions in Group C from question 6 to 11. All questions will be set from Physics sections of IX and X both of the Physical Science syllabus—questions should cover the whole syllabus. A question may be set from different chapters of class IX and X or both.

6. There will be six questions in Group D from question 12 to 17. All questions will be set from Chemistry sections of IX and X of Physical Science syllabus—questions should cover the whole syllabus. A question may be set from different chapters of class IX and X or both.

7. It is desirable the questions should be 40% knowledge based, 30% understanding based, 20% application based, 10% skill based.

8. For the external examinees ten questions out of fifteen are to be answered. Questions should cover the whole syllabus. Each question will carry 10 marks.

The basic objective of this curriculum is to give general awareness of science. Besides this some features are given below : During the past few decades there have been tremendous changes in its content, methodology and applications. Side by side with the increase of scientific knowledge; many social and pedagogical issues have emerged on the scene. Students at the secondary level should be competent enough to face the challenges before the society and must be equipped with problem-solving abilities and life skills.

1. The course units have been arranged in a logical sequence. The fundamental principles of physical science which are supposed to proved the basis for interpreting facts have been included and the course units are numbered in the sequence in which they are to be covered.

2. The revised curriculum will be able to develop among the young students an interest to study physical science as a discipline, apprise them with the interfaces with other disciplines of science, To a great extent this curriculum will be able to eliminate from the minds of the young students the fear of memorizing facts with out knowing their various aspects used in day-to-day life.

3. The course has been made self-contained and it broadly covers the fundamental of physical science providing scope for cultivating problem solving ability in the students, though some background knowledge in chemistry at the secondary school science level is assumed.

4. Under the existing time frame, the revised curriculum of Secondary level will not only serve as a link of continuits between the Secondary and the H. S. level, but also it will maintain the equivalence and uniformity in the standards at the National level.

1.5 System : Meaning and Concept

* A system has certain functions to perform.

* A system has many components / parts each of these may have a different function to perform but all of these together contribute to the function(s) of the system.

* The components of a system are interrelated and interdependent.

Thus a system may be defined as an entity which consists of interrelated

and interdependent components, and works towards the attainment of certain functions.

Ref. Indira Gandhi National Open
University Study Material–2005
(B.Ed)

System Meaning and Concept

"As deliberately designed synthetic Organisms Comprised of interrelated and interacting components which are employed to function in an integrated fashion to attain predetermined purposes"

Ref : Innovations in Teaching-Learning
Process by S. S. Chauhen
Page No.-47, 2001

Long man's Dictionary of Contemporary English Edited by paul proeter defines.

System as a group of related parts working together : an ordered set of ideas, methods.

According to Oxford dictionary compiled by Betty Kirk Patrick - 2002.

System refers to structure, organization, order and arrengement of a particular dimension.

The advanced learner's Dictionary of current English defines that "Group of things or parts working together in a regular relation."

Banghart (1969) defines system as "an integrated assembly of interacting elements, designed to carry out Co-operatively a predlter mined function."

R. L. Ackoof (1971) defines "A system is the set often interrelated and interdependent elements."

Crawford Robb (1973) : "System is a systematic organisation of the elements that operates in a unique way."

Robert Davis – defines as "A learning system is an original combination of people, materials, facilities, equipment and procedures which interact to achieve the goal."

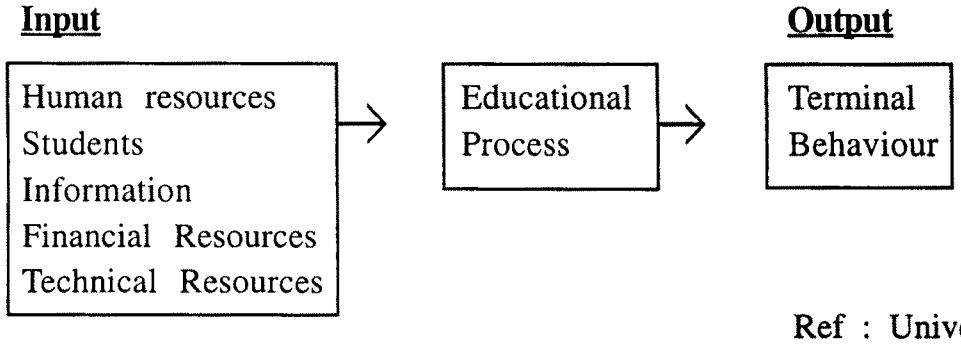
Hickey (1960)! "A system is an assemblage of objects united by some form of regular interaction or interdependence, which collectively Contribute towards an important and complex function."

Johnson, Kast, Rosenzweigh (1964) define a system as "an organised or complex whole, an assemblage or combination of things or parts for many a complex or unitary whole."

A.K. Jalaluddin (1981) : " A system may be defined as a dynamic, complex, integrated whole consisting of self-regulating pattern of interelated and interdependent elements organised to achieve the pre-determined and specified objectives."

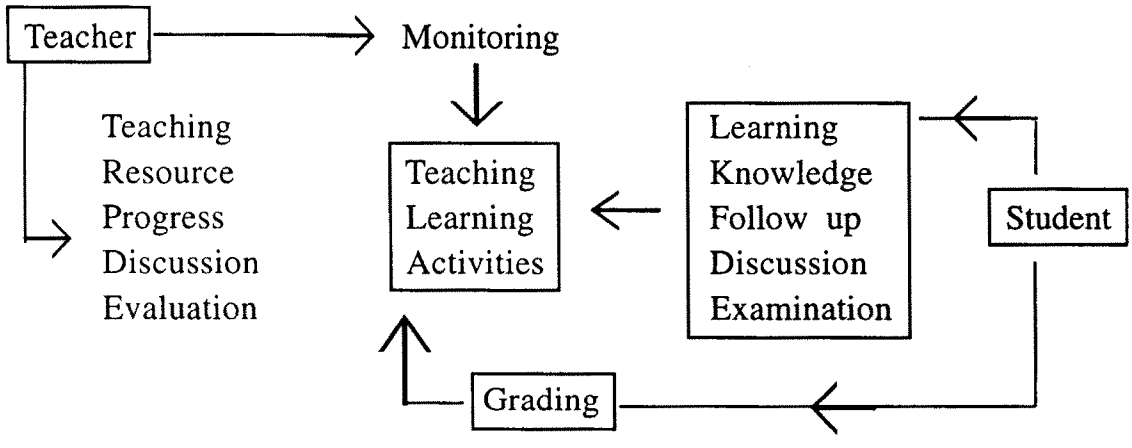
Ref : J. C. Agarwall

The 'System' model of the educational process :



Ref : University News

Model at the Interactive Teaching-Learning System by young-sheng-chen (2004)



From background study it reveals the following aspects :

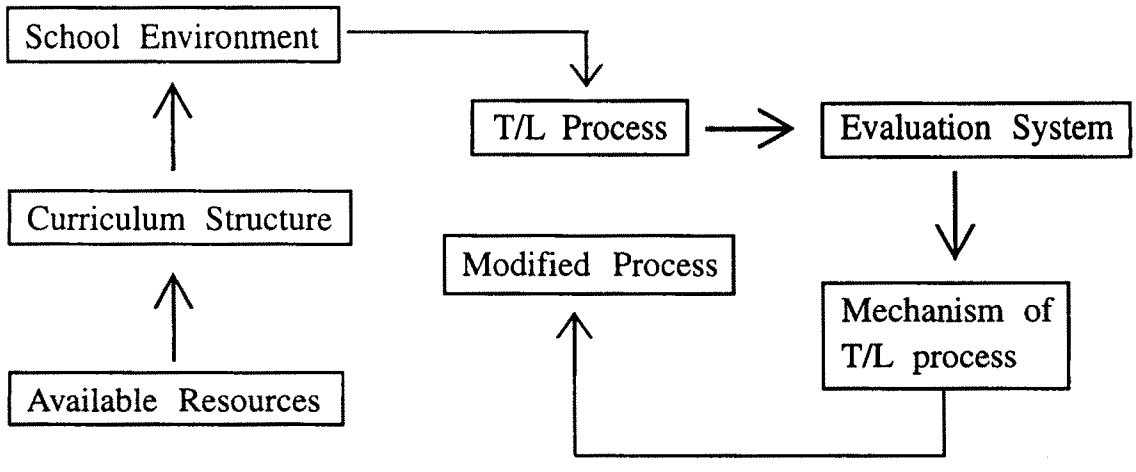
(1) Real situation of Teaching & Learning in West Bengal.

(2) Analysis of examination system to understand the true picture of evaluation techniques followed in West Bengal Secondary Schools.

(3) Mechanism of Teaching Learning system on the basis of realistic mode.

(4) An alternative model of Teaching-Learning system is given below :

Teaching-Learning System



Any teaching learning system should be based on situational factors, availibility of Resource persons, infrastructural facilities, curriculum structure, teaching learning process & Examination pattern are different sub systems of Teaching-Learning system.

Investigation has been conducted through survey on the basis of Input including school environment, curriculum structure & availibility of resources in secondary schools of West Bengal on the basis of a standerdised Questionnaire.

Remedial solution has been given on the last chapter by giving a suggested model namely Interest diversification model after investigating the input & the output. By compaing the input & the product finally conclusion has been made.

Teaching Learning System (2002) by Roy Lee Foley

The process of system dynamics for a teaching-learning system consists of five stages.

* **The first stage :** It is the description or mapping of the system. It is the most important and the least straightforward of the stages in our analysis. It requires taking various bits of information about teaching-learning systems in the real world and turning them into a unified theory.

* **Second stage :** The formulation and construction of a simulation model is performed. The system description is translated and converted into the level and rate equations of a system dynamics model by providing the requisite parameters. Creating the simulation model requires that the rather general and incomplete description of the first stage be made explicit.

* **Third stage :** Simulation of the model, will start after the equations of the previous stage pass the logical criteria of an operable model, such as all variables being defined, and consistent units of measures. The first simulations at this stage will raise questions that cause repeated returns to the both prior stage until the model becomes adequate for the purpose under consideration.

* **forth state :** Some policy alternatives are chosen for testing.

* **Fifth stage :** Proposed policy changes will be tried to the model to maintain or obtain sustainable improvement in performance while considering the feasibility of implementing these changes in its real world. If the model is relevant and persuasive, then the process can be concluded for the necessary evaluations.

The Parameters of Teaching Learning System

Many parameters and situations are considered in this study. Below are some examples.

1. **Types of learning :** Different types of learning are generally accepted and required in any educational process. They include : rote learning (memorizing), closed problem solving (understanding and comprehending), open problem solving (creative thinking), and skill development. Other types and sub-types have also been defined.

2. **Teaching System :** Different types of teaching systems are generally considered. They include : traditional teaching (Professors, instructors, graduate students as TA's and RA's and lecturers, lectures, textbook, lecture notes, overhead and slide projectors lab, etc.), computer driven overhead, interactive software, testing and marking software, interactive distance video, all students with computers, and improvements to internet to remove paper requirements.

3. **Subject Matter :** Different types of subject matter can be generally considered. But learning materials extracted from an introductory course

in Industrial Engineering taught to the second year Engineering students at University of Manitoba is chosen for the purpose of the study. The subject learning materials require a quantity of mathematics, physics, chemistry, analytic, geometric, memory, dexterous and other abilities.

4. **Student Type :** A student description requires at least three groups of parameters. They are : 'ability to learn' relative to subject type and learning type, 'poor knowledge' about the subject (and also general background knowledge), and 'desire to learn'. The ability to learn is not considered essentially fixed because certain learning skills may still be learned. The prior knowledge (and or background knowledge) of the student can typically be adjusted by remedial programs if they have the basic ability to learn in the subject. Some types of desire (motivation) e.g. basic interest in subject, tend to be intrinsic while other types, e.g. seeing a relation between the subject and a future profession, can be adjusted to some extent by the structure and style of the teaching process.

Ref. : Website, Teaching Learning system.

1.6 OBJECTIVES OF OUR STUDY

* To study the present Teaching Learning System of Physical Science in Secondary Schools of West Bengal.
* To study the school environment of West Bengal regarding Teaching Learning System of Physical Science.
* To study the curriculum structure of Secondary level schools in West Bengal Board.
* To study the Teaching Learing process of Secondary Level Schools of West Bengal.
* To study the evaluation process of secondary curriculum in West Bengal.
* To study the mechanism of Teaching Learning system.

1.7 STATEMENT OF THE PROBLEM

"An Investigation into the Teaching-Learning System of Physical Science in the Secondary Schools of West Bengal."

1.8 METHODOLOGY

Type of Research : The Research is basically descriptive type Survey Research. Both discriptive and inferential statistics have been used for conducting the study.

1.9 TOOLS USED :

1. Standardized Questionnaire of Teaching-Learning System.
2. Assembled Questions of Xth Grade examination conducted by West Bengal Board of Secondary Education for last four years.
3. Interest Diversification Model of Teaching.

1.10 LIMITATIONS :

* Actually the investigation is vast and expensive too. We are trying hard to investigate the position of Teaching-Learning System of West Bengal from North to South and East to West almost every district of West Bengal. But we are limited our attention to the West Bengal Board of Secondary Education. We cannot reach directly to the ICSE and CBSE or other Boards though they are not large enough in comparison to West Bengal Board.
* The study is limited within the components of teaching learning system based on academic environment not on the basis of tecnological device since very few institution used webbased technology or computers as an instructional strategy in educational atmosphere of West Bengal. What we observed on that basis we develop our system.
* The Research is comprehensive in nature. It may be more particularised but then mechanism of Teaching-Learning System may be difficult to predict.

CHAPTER II

COMPONENTS OF TEACHING LEARNING SYSTEM

CHAPTER — II

2.1 Introduction :

Teaching-Learning system is a complex procedure depends on the multidimensional components. It is true that Teaching and Learning is basically bipolar process. But the nature of Teaching & Learning may vary in different population not in the same fashion. In West Bengal what we observe in different schools that school environment are in diversified mode. Some places are there where academic situation is satisfactory. But there are some places where the picture is not appreciable. From our observation we find that Teaching-Learning system specially function of four components which are mentioned below :

Teaching-Learning system :

* School Environment.
* Curriculum Structure.
* Teaching & Learning Process.
* Evaluation technique

2.2 Review of Related Studies :

According to Ferreria Learners attitude depends on available facilities in school environment, infrastructure, building condition & other facilities (1995). In 1970 prushansky talking about the physical settings & atitude of learning human development causes from the academic atmospheric condition. Their feelings, attitudes, values, expectances, desires came from their school surroundings.

Mayburry Explains How Environment & non cognitive factors affected the Learning in 1992.

In 1988 christopher observed that pleasant surroundings have had a better feelings or make a better attitude. School environment is a touchy matter to the learners. Their achievement & attitude both depends upon these factors. In 1972 according to Lovin the children were very much interested about their school building & similary shows positive response towards bright & comfortable surroundings.

In 1982 Chan founded that pupils housed in a modern school building have a positive relationships with their attitude

In 1976 creamer also showed the effectiveness of school facilities. Lewin

in 1976 showed the influence of open-space classrooms is more effective than closed-space classrooms.

According to Bronfenbrenner (1989), young people need to have adults who are 'Crazy' about them. Unfortunately, in our most troubled schools teachers aren't crazy about students, and students aren't crazy about teachers, instead they are driving each other crazy. In these schools, support networks are weak or nonexistent for both children and teachers. Teachers may resent what they perceive as inadequate encourage, assistance, and the resources to do their job. Students may feel that nobody at school knows or cares about them.

In the domain of self concept Bowers and Burkett in 1989 shown that self concept scale of students in a modern facility were significant by higher than the student of score of those who housed in older facilities.

School environment significantly related to the fllowing factors :

1. Effective principal leadership (Teddile & Stringfield) 1993.
2. A safe and orderly setting (Bryk & Thum) 1989.
3. Extracurricular Activities (Landers & Landers) 1978.
4. Size & impersonality of schools (Eberts & Stone) 1988.
5. Needs of the students (Gattfredson & Cottfredson) 1985.
6. School Contexts (Landers & Landers) 1978.

Some schools have a warm, friendly ambience, while others have a cold, foreboding environment that permeates classrooms and offices. It seems probable that school and classroom climate would influence student performance, and the research to classroom climate would influence student performance and the research to support this conclusion (e.g. Hill, Foster and Gendler, 1990; Fraser and Fisher 1982; Moos. 1979). To provide a warm school climate, school administration and support services in poor area must be especially sensitive to the needs of students with responsibilities or problems outside school (e.g., working students, teen mothers). Students with emotional problems may never have their difficulties treated because many schools have inadequate psychological services (Tuma, 1989).

Highly mobile students may particularly suffer from inadequate administrative and support practices. Migrant children, for example, may lose academic credits or experience delays in enrollment due to lack of communication and coordination between schools. School staff may be unaware

of migrant students' needs and may fail to provide adequate guidance. Consequently, migrant children's academic progress may suffer, discouraging student persistence (Morse, 1988; Philips, 1985). Homeless children may suffer similar difficulties in school. These children face and array of problems that may interfere with learning and attendance : poor nutrition, lack of a quite place to study, inadequate clothes and school supplies, dangerous surroundings, peer ridicule and the stress of constant moves. Schools are often not prepared to address these problems. Homeless children may have difficults enrolling in school because they lack prerequisite records or a permanent address, and once in school they may not receive adequate encouragement and assistance (Molnar, Rath and Klein 1990; Nichols-Pierce, 1992).

Instructional practices and materials if fails to engage and challenge students, and for which classroom climate and intellectual development may suffer. Teachers may spend most of their time demanding attentiveness or trying to maintain order. The entire class, including the teacher, may watch the clock, longing to be put out of their misery. Teacher burnout and student disciplinary attendance problems are likely outcomes.

Interest is a significant determinant of how people attend to and persist in processing information (for a review of research see Hidi 1990). Children are more likely to learn material that stimulates their interest. The lack of active learning experiences may help explain why students' interest in challenging subjects tends to decline. A survey of black seventh graders' science interests finds that although most students express curiosity about various science topics, and show strong interest in science discussions, filed trips, and experiments, they report that they never or seldom have input into selecting class topics or projects (Anderson, Pruitt and Courtney, 1989). Reyes and Laliberty (1992) hypothesize that the limited literacy skills of many Hispanic children may result from their assignment to classes that emphasize basic skills and passive learning rather than cultivating higher order proficiencies.

The "basic skills" approach to teaching literacy 'dooms' students to a curriculum that lacks interest and relevance (p. 264). Consequently, students have little motivation to learn. Other studies suggest that active learning in combination with "Scaffolding" (building upon the cultural knowledge that children bring to the classroom) may enhance the learning of young people of colour (Guitierrx 1992, Lee, 1992; Peterson, 1991).

Co-operative learning has been proposed as a way of enhancing academic engagement and fostering positive relations between students of diverse backgrounds (Slavin, 1990; Cohen, 1984; Skon, Johnson, and Johnson, 1981).

In Co-operative settings, group efforts are rewarded, thus students have an incentive to resolve differences and work together. At any rate, complete harmony among students and teachers is not a likely outcome of student engagement – indeed, one of the definitions of 'engagement' is to enter into conflict. The expression of intellectual differences between students and teachers can stimulate curiosity, improve reasoning skills, and enhance creativity (Johnson and Johnson, 1979). Conflict in the classroom can be constructive if it occurs within a structured learning environment in which problem solving, rather than personal attack, is the goal.

If schools are too accommodating to low performance, they may limit the usefulness of school attendance. Continuation schools, for examples, may be more responsive to students needs (e.g. offering daycare to young mothers) and thus often may be more attractive to students than comprehensive schools; however, they may offer limited opportunities for academic challenge (Kelly, 1989). Studying a school that has a lower dropout rate than would have been predicted by its demographics, Miller, Leinhardt, and Zigmond (1988) find that the school's warm, accommodating environment enhances engagement and thus increases the school's holding power – but it does not encourage achievement.

According to Foley 2003 Teaching Learning Process is interactive in nature. In one way interactions all the information moved to the knowledge base to the individnal. One way interaction which is passive in nature would include : (a) reading (b) listening (c) watching a video taped presentation.

In two way interaction the individual is able to develop the knowledge base & in return the knowledge base will also produce some response.

Similarly interaction is also possible with the living world. Specially with teachers & trainers. In this situation the relationship between teacher & students are very important for developing knowledge & skills.

* Teaching Learning process includes : (1) Cognitive (2) Behavioral (3) Experimental dimension.

* Teaching learning basically dual & complementary process but to model an educational system more concentration is given on learning side.

* Learning is the function of students interaction with method & subject matter.

* Learning is possible through instruction and organised experience.

An Interactive Teaching Learning system is very important in todays' world when the Teaching Learning system is mainly learner centric. Here interaction

is the methodology which helps learners for their better performance.

According to yung sheng chen (2004) : The main components of classroom based instruction include :

(a) Instructor teaching the key contents in a textbook.

(b) Students paying attention to follow the guidence.

(c) Examinations for evaluating the learning performance of students.

Teaching and Learning framework

According to Denise Bradley (2003) – Teaching Learning framwork include following steps.

* Teaching and Learning strategy
* Teaching & learning priorities.
* Future plans
* Statement on progress
* Teaching and research on Educations.

Learning Strategy

Dimension	Content	Source
Organized study methods	Consistent work, well-organized and regular	Lancaster 1
Achievement motivation	Competitive approach equivalent to the 'hope for success' found in cluster analyses and interviews	Lancaster 1
Fear of failure	Motivation fed by anxiety, as flund in cluster analyses and interviews	Lancaster 1
Disillusioned attitudes to study	Showing little involvement in work; cynical and disenchanted with their university exprience	Lancaster 1

Syllabus-boundness	Relies on clear instructions, structure and defined syllabus to guide studying	Parlett (1970) as modified in Lancaster 1
Sociability	Involvement in social life at University – interest in people	Lancaster 1
Deep approach	Looks for meaning; interacts actively; links with real life	Marton
Surface approach	Relies on rote learning; conscious of exam demands	Marton
Comprehension learning	Uses analogies in building up descriptions of topics, emphasizing the outlines of ideas and inter-connections	Pask
Operation learning	Relies on step-by-step, logical approach emphasizing factual details	Pask
Strategic approach	Tries to obtain cues from lecturers or previous papers about likely examination questions; tries to impress staff – likes to be noticed	Miller and Parlett (1974) modified by Ramsden (1979)
Intrinsic motivation	Interested in learning for its own sake	Biggs
Extrinsic motivation	Sees university as a way of obtaining necessary qualifications	Biggs
Internality	Uses internal standards of truth	Biggs
Openness	Sees university as place where values are questioned	Biggs.

Ref. : Noel Entwistle 2000

Related literature bave been extracted directly on indirectly from different research findings based on teaching-learning system of physical science. Besides this teaching & learning conponents sometimes they are extracted from science based other subjects. Specially for curriculum planning, teaching-learning models, teaching-learning process, evaluation teaching, other available resources. Sometimes it looks not releavent. But for considering T/L system, we focusing our attention in a free mind to collect the data. Different findings are given below :

In 1994 Kishore Lalit and Puri H.S. in their study showed the process-based learning of physics. The main purpose of such a project is to transfer scientific attitude and temper among students. The study is a comprehensive in nature and will be helpful for proferssional preparation of teachers.

Major Findings : (1) The scientific attitude of the teachers showed a significant improvement after the treatment of investigatory projects in physics. (2) The understanding of science of the teachers showed a significant improvement after the implementation of investigatory project in physics. (3) While the high and middle groups showed significant improvement in the scientific attitude the low group showed no significant change in their scientific attitude after the treatment. (4) The middle and low groups showed significant improvement in the understanding of science while the high group showed no significant improvement in their understanding of science. (5) The inservice programme yielded fruitful results. [0025]

In 1995 Maharajan S. D. showed the development of environmental studies in science curriculum for primary schools of Nepal. The main reomendations are—

Major Findings : (1) The curriculum was evaluated by experienced primary school teachers, teacher educators and experts from India and Nepal. Some of its subunits were field tested in Nepal by the researcher to see the feasibility of the curriculum. The final version of the curriculum was reformulated on the of the curriculum from this group. (2) On the basis of the researcher's observation and the result of the pre-test and post-test on sample sub-units of the curriculum in the classroom situation, it was found that the proposed EVS curriculum was functional but required more extensive evaluation for the whole range of units. [0046]

Nayak Ram Sahw showed in 1996 Interest of boys and girls towords science in schools.

Major Findings are : (1) Compared to the boys, the girls interest for science

appeared negative in students. (2) In connection with the nature of science the inferences derived in the study reflected the impact of curriculum changes introduced in schools. (3) At the secondary stage, there was a bifurcation in two major streams of science and humanities. [0035]

Rajgapalan Malathi in 1995 observed the Formal Reasoning of piaget in science among school students and investigate the relationship between formal reasoning and aspects like Intelligence, socio-economic status, medium of instruction, age and class.

Major Findings are : (1) All the four socio-econimic status groups, both the medium-of-instruction groups and both the sex groups differed significantly. (2) The successive age groups or the pupils in successive grades did not show significant differences in performance. But the differences became significant when larger differences in age or grade were considered. (3) Pupils studying through English medium did show better ability in formal reasoning. (4) The medium as such did not influence the development of formal reasoning. (5) IQ and gender contributed significantly to formal reasoning. (6) Socio-economic status and gender seemed to influence formal reasoning with greater significance as compared to other aspects like age, grade and medium of instruction. (7) The formal reasoning ability of boys was higher than that of girls. (8) A higher level of socio-economic status led to higher score in formal reasoning. (9) The medium of instruction did not influence the development of formal reasoning. (10) The test of formal reasoning that had been devised (in English and Tamil) was useful in identifying the pupil's formal reasoning at five levels. [0161]

A study conducted by A. B. Saxena related to the curriculum planning and construction by identifying the misconceptions of the entire curriculum in 1994.

Major Findings are : (1) In school-A out of seven units under study, four units showed significantly higher gain scores of experimental group. Two units showed that control group gained significantly more than the experimental group. (2) In school-B only five units could be taught with the prescribed strategy. Out of the five units, only in one unit experimental group gained significantly more in comparison to control group. In one unit the gains of experimental and control groups were not significantly different. For the other units, no definite trends could be seen. (3) Continuity of using the strategy played an important role in terms of gains. (4) Concept mapping was mentioned as one of the elements of the conceived strategy. It was found that the students took time to learn drawing the concept map. [0021]

Singh Ram D, Ahluwalia, Sudarshan P and Verma Sunil K. 1994 observes the attitude of high school students towards mathematics on different intelligence levels.

Major Findings are : (1) The students of high intelligence group had more favourable attitude towards mathematics compared to the students of both average and low intelligence groups. (2) The students of average intelligence had a more favourable attitude towards mathematics than the students of low intelligence. (3) The males did not have a more favourable attitude towards mathematics than females. (4) The students of age 13+ showed more favourable attitude towards mathematics compared to the students of ages 14+ and 15+ but the students of age 14+ did not have more favourable attitude towards mathematics compared to the students of age 15+. (5) In the age range of 13+ to 15+ students of lower age showed morefavourable attitude towards mathematics. [0139]

In 1995 Sumangala V. showed the relationship between different psychological components and academic achievement in mathematics.

Major Findings are : (1) mathematics Aptitude and its components viz., Numerical Ability, Numerical Reasoning, Ability to use Symbols, Spatial Ability and Abstract Reasoning, Attitude towards Mathematics and Self-Concept in Mathematics discriminated significantly between high and low achievers in Mathematics. (2) The relation among the independent variables, Mathematical. Aptitude and its component viz. Numerical Ability, Numerical Reasoning Ability to use Symbols. Spatial Ability and Abstract Reasoning. Attitude towards Mathematics and Self Concept in Mathematics with Achievement in Mathematics were significant and positive. (3) Regarding the extent of relationships. (3) Regarding the extent of relationships, relation of Achievement in Mathematics with Mathematics Aptitude, ability to use Symbols. Reasoning and Attitude towards Mathematics were substantial whereas those with other variables were low. (4) Achievement in Mathematics was related not only to Cognitive Variables like Intelligence, Aptitude, etc. but also to the affective variables like Attitude towards Mathematics and Self-Concept in Mathematics. [0100]

Scheerens & Basker : Components of Effectiveness Enhancing Factors (1997)

Factors		Components
Achievements, orientation high expectations	*	Clear focus on the mastering of baisc subject
	*	High expectations (school level)
	*	High expectations (teacher level
	*	records on pupil achievement
Educational leadership	*	General leadership skills
	*	School leader as information provider
	*	Participative decision-making
	*	School leader as coordinator
	*	Meta-controller of classroom process
	*	Time spent on educational and administrative leadership
	*	counsellor and quality controller of classroom teachers
	*	initiator and facilitator of staff professionalization
Consensus and cohesion among staff	*	types and frequency of meeting and consultations
	*	contents of cooperation
	*	satisfaction about co-operation
	*	indicators of successful cooperation
Curriculum quality / opportunity to learn	*	setting cocurricular priorities
	*	choice of methods and textbooks
	*	application of methods and testbooks
	*	opportunity to learn
	*	satisfaction with the curriculum
School climate		(a) Orderly atmosphere—
	*	the importance given to an orderly climate
	*	rules and regulations
	*	punishment and reward
	*	absenteeism and drop-out

	*	good conduct and behaviour of pupils
	*	satisfaction with orderly school climate
		(b) Climate in terms of effectiveness orientation and good internal relationship
	*	proprieties in an effectiveness – enhancing school climate
	*	perception on effectiveness–enhancing conditions
	*	relationships between pupils
	*	relationships between teacher and pupils
	*	relationships between staff
	*	relationships : the role of the head teacher
	*	pupils engagement
	*	appraisal of roles and tasks
	*	job appraisal in terms of facilities, conditions of labour, tasks load and general satisfaction
	*	facilities and building
Evaluative potential	*	evaluation emphasis
	*	monitoring pupils' progress
	*	use of pupils progress
	*	school process evaluation
	*	use of evaluation outcomes
	*	keeping records on pupil performance
	*	satisfaction with evaluation activities
Parental involvement	*	emphasis on parental involvement in school policy
	*	contact with parents
	*	satisfaction with evaluation activities
Classroom climate	*	relationship within the classroom
	*	order
	*	work attitude
	*	satisfaction

Effective learning time
* importance of effective time
* time
* monitoring of absenteeism
* time at school
* time at classroom level
* classroom management
* homework

Singh Basant Bahadur 1994 Effectiveness of U.G.C. countrywide classroom programmes on models of teaching with talk-back and with interactive mode. Bharatiya Shiksha Shodh Patrika. Vol. 13(1), 43-48.

Major Findings : (1) The adjusted mean achievement on the test of group with talk-back and with interactive mode differed significantly. (2) The interactive group was likely to perform significantly better than the group with talk-back. [0137]

Another important dimension of Teaching-Learning system is teaching strategies. Innumerable research have been conducted in this aspect. Information processing model has been upgraded from various research corners. Existing different models have been compared with the traditronal one on different subjects.

Major Findings : (1) Concept attainment model of teaching was found effective in developing reasoning ability, scientific creativity as well as fostering favourable attitude of the students towards science whereas it could not foster inquisitiveness, persistency or problem awareness among them. (2) Inductive thinking model was found to promote reasoning ability, scientific creativliy, problem awareness ability as well as attitude of the students towards science favourable but could not bring significant enhancement in inquisitiveness or persistency ability among them. (3) Inquiry training model of teaching was found effective in developing reasoning ability, scientific creativity, problem awareness ability and attitude of the students towards science favourably. However, this model could not bring significant gain in inquisitiveness or persistency. (4) Concept attainment model, inductive thinking model or inquiry training model did not differ in effectiveness in terms of enhancing reasoning ability or scientific creativity. (5) Inductive thinking model and inquirytraining model of teaching had been rated better than concept attainment model in fostering problem awareness ability. However, inductive thinking model and inquiry training model didn't differ in fostering ability to see the problems. (6) Concept attainment model, inductive thinking model or inquiry training model did not differ in promoting attitude of the students towards science. [0016]

According to ACER[1] (Australian Council For Educational research) following points are relevant to explain Teaching learning system.

* positive relationship with learning
* development of a positive self-concept
* sense of self-discipline and self-worth
* student's living skills becoming a productive and confident member of the adult world in time.
* the development of appropriate value systems; and
* the preparation of the student for the next stage of learning (McGaw et al, 1992)

The system of Education — By Throsby & Gannicott (1990)[2] States that :

* trained teachers make a difference
* class size is not relevant
* the provision of instructional materials is one of the most cost-effective ways of raising the quality of education
* education is most effective if initial instruction uses the mother tongue
* lavish buildings and equipment will not raise quality
* curriculum reform will not necessarily raise educational quality
* examinations are a useful way of monitoring school quality
* healthy well-fed children learn better
* amount of learning time affects educational outcomes
* quality depends on good decentralized education management

Lonis Chhen, Lawrence Manion and Keith morris on (1999) in their book 'A Guide To Teaching Practice' mention the following teaching-learning strategies—

* establish clear expectations of pupil behaviour in the classroom and secure appropriate standards of discipline;
* create and maintain a purposeful, orderly and supportive environment for their pupils' learning;
* maintain pupils' interest and motivation;

Ref. 1 to 2 : An Explorative Study on School Effectiveness by Aduri Khatun supervised by Prof. P.C. Biswas 2004 A dissertation paper, University of Kalyami.

* present learning tasks and curriculum content in a clear and stimulating manner;
* teach whole classes, groups and individuals, and determine the most appropriate learning goals and classroom contexts for using these and other teaching strategies;
* use a range of teaching techniques, and judge when and how to use them;
* employ varing forms of curriculum organisation, and monitors their effectiveness
* communicate clearly and effectively with pupils through questioning; instructing, explaining and feedback.
* manage effectively and economically their own and their pupils time;
* make construction use of information technology and other resources fro learning;
* train pupils in the individual and collaborative study skills necessary for effective learning.

(Page No. 24)

Mohan Raju, P. 1992. A study of factors contributing to the teaching profession. Ph.D., Edu. Uniu. of Delhi.

Major Findings : (1) More committed teachers were found significantly different from less committed teachers on "Work-related Personality" (Factor I); and on all its six constituent variables. (2) On the factor "perceived characteristics of the profession' (Factor II), more committed teachers were found to have scored significantly higher than less committed teachers; and also more committed teachers were significantly higher on all six constituent variables. (3) Scores on Factor III ("professional choice satisfaction") and on its constituent variables were found significantly more for more committed teachers than for less committed teachers. The constituent variables were choice satisfaction and opportunity for other jobs. (4) Less committed teachers were found to have significantly lower scores than more committed teachers on "professional satisfaction and importance" (Factor IV) and on its constituent variables. (5) More committed teachers expressed a significantly higher "desire to improve skills" (Factor V) compared to less committed teachers. (6) More committed teachers were distinguished by having higher scores on "perceived characteristics of the profession" (Factor II; "work related personality characteristics" (Factor I), "desire for skill improvement" (Factor V) and "Perceived Characteristics of the Profession". (7) Results of multiple regression analysis revealed that 4 out of the 5 predictor factors were found significant. They were perceived

characteristics of the profession, work-related personality, professional satisfaction and importance and desire for skill improvement. Among the psychosocial variables external expectations was the most contributing variable followed by the variables perceived status, intrinsic motivation, interest in the profession, desire to improve skills, social support, choice satisfaction poerceived challenges. [0013]

Singh. Ajit and Kumar, Anil. 1996. Perception of teachers. The Primary Teacher, Vol. 21(1), 1-5.

Major Findings : (1) More than 80% of the teachers in both the districts reported that interest in teaching young children was the reason for them to join the teaching profession. (2) Most of the teachers perceived an improvement in their social status. (3) More than 60% of the teachers from both the districts reported that their economic status was moderate. (4) About 80% teachers in both the districts reported that they could meet the needs of their family to some extent only. (5) About three-fourths of the female teachers in Wyanad district and one-half female teachers in Mallapuram perceived their professional status to be either very high or high. About half of the male teachers in Wyanad and half on the female teachers in Mallapuram Perceived their social status as moderate. (6) About 17% teachers from Wyanad District improved their qualification up to Graduation, B.Ed., etc. after their appointment as primary school teachers. But the percentage of such teachers was very low in Mallapuram District. (7) None of the sampled teachers in both the districts got any teacher award. (8) The percentage of teachers who received promotion was also quite low in both the districts. (9) Majority of the teachers in both the districts reported that their promotional prospects were bleak. [0032]

Sundararajan, S. and Nelliappan, N.O. 1994. Problems impeding effective role performance by higher secondary teachers. Experiments in Education, Vol. 22(1), 15-20.

Major Findings : (1) Between the male and the female teachers, significant difference was found in respect of the six problem areas, except in the problem area "Pupils". (2) In the areas of "Facilities", "Pupils" and "Parents", there was significant difference between the teachers working in the government schools and the Teachers working in the private schools. (3) In respect of all the sub samples, there was no significant difference between any one pair of them. (4) Male teachers experienced greater problems in all the six areas than the women teachers and only in respect of the problems connected with the pupils there was no significant difference between them. (5) Similarly the teachers working

in government schools experienced greater problems in the three areas of Facilities, Pupils and Parents than the teachers working in private schools. [0105]

Some components regarding teaching and learning are finely sourced from satisfaction with Teaching Questionnaire by D. Galloway, K. Baswell, F. Parckhurst, C. Boswell and K. Green, Presented below :

Rank	Item	Fairly Satisfied Percent of teachers (N=296)	Corelation with overall Satisfaction
1.	Your relationship with pupils.	95.9	0.331
2.	Your relationship with other teachers	94.3	0.245
3.	Your freedom to select teaching methods	87.5	0.308
4.	The time tabling of the programme activities	87.2	0.276
5.	Your freedom to select subject matter for your class(es)	84.8	0.200
6.	The number of hours you teach each week	83.4	0.286
7.	Your relationship with senior staff in the school	81.8	0.184
8.	Your allocation to teaching a particular class / unit	81.8	0.149
9.	The level of pupil achievement in your class(es)	81.1	0.347
10.	The general behaviour of pupils in your class(es)	80.7	0.406

[Vol. 27, Feb. 1985, Page No. : 46 Harvard Educational Review]

According to Ron Edmonds Teaching-Learning system including the following points :

1. Strong leadership at the building level.
2. "Best practice" teaching.
3. An organizational climate that supports good work by teachers.

4. Curriculum that fosters an "instructional emphasis" or an "academic press."
5. A pupil progress measurement system that is geared more to the next lesson's teaching than the next grade's promotion.

Ana Helvia Quintero proclaims the open system of education should include teaching and learning system. Here the system is rathir flexible in all dimensions reflected from the following presentation in her writing on Harvard educational review August 1989 Page No. : 358.

The educational situation more closely resembles an open system, full of contingencies and surprises. Flexibility in organisations should therefore be developed to allow teachers and principals the organiszational space to deal with new problems and opportunities. The programs initiated by our project promote co-ordination among the various school subjects, requring communication among teachers, as well as some co-operative plaining of activities.

Since the rigidity of the usual school time schedule does not provide space for such communication, we need a more flexible time schedule to facilitate the diversity in teaching strategieo and activities both in and outside the classroom that our programs encourage.

2.3 PRESENT EVALUATION SYSTEM OF PHYSICAL SCIENCE AT SECONDARY LEVEL SCHOOL IN WEST BENGAL

Actually the recent development at measuring educational instrument and evaluation may be regarded as an extension and improvement of old practices. At present examinations are the usual means adopted in evaluating the achievement of the students.

As per the recommendation of Kothari Commission (1964), the structure of secondary education in West Bengal is reorganized in 1974 and school education of ten year's duration is introduced instead of eleven year's school education. At the end of class-X, West Bengal Board of Secondary Education conducts an external examination namely Madhyamik Examination to mark the termination of the first ten years of general school education. The examination is conducted on different subjects, Physical Science is one of them. In Madhyamik Examination, oral tests are also introduced along with the written tests. There are nine compulsory papers in the examination and each paper carries an hundred full marks. Ninety marks are allotted for written test and ten marks for oral test. The topics of the question papers are confined both to the syllabus of class (IX) and (X) and even to some items of class (VIII).

The system of examinations has always, had its criticize. Education commissions and committees hitherto appointed by the Government of India have strongly felt the need of reforming examinations in Indian education from time to time. All the expert bodies have recommended that each Board or University should set up an examination research unit to analyse the examinations conducted under its supervision. The work of the unit should be to design the structures of examinations, to study tabulated marks for better scaling, to assist the paper-setters, in devising appropriate question items, and to make recommendations for better administration of examinations. They also pointed out that the reforms of examinations should be based on research evidence gathered, not merely through descriptivestatistics such as frequency distributions, ... means and standard deviations of marks, but through correlational analysis of the individual questions of the existing external examinations.

There is no doubt that several attempts had been made from time to time for reformation of the examination system. In West Bengal, according to the recommendation of Kothari Commission, the Secondary Education was reorganized in 1974. All the four factors of examination namely, the syllabus, the method of teaching, the question paper and the method of assessment had undergone a lot of changes for the improvement of the evaluation system. In the present set-up of question papers of Madhyamik Examination of West Bengal Board of Secondary Education, a lot of objective type items and short answer-type questions are included instead of the essay-type questions of the traditional examination system. But inspite of all the attempts, there are various types of criticisms for the question papers in Physical Science set in the Secondary Examination. Some are of the opinion that the questions set for the examination are not satisfactory and a group comments that the questions are hard enough. Sometimes it is also uttered that it is not at all difficult for the ordinary students to score 60% marks or above. The teachers the students and the gurardians did not agree as regards the difficulty level or discriminating power of the items set in the question papers. There are other comments also. But it is not possible on the part of the investigator to discuss overall the criticisms. For this the present investigation into the question papers from a few specific angles.

A review of institutions in the country have been undertaking sustained studies in the area of examinations and evaluation during the last twenty years. Buch and lele in the M.S. University of Baroda, Gayen at IIT, Harper at the Ewing Christian College, Allahabad, Taylor at Gwahati University and Bokil at the Maharastra State Board of Secondary Education have undertaken commendable studies. The U.G.C. has supported willing universities in setting

up examination research and reform units. A substantial amount of work has been done with the grants received from the NCERT and UGC in a number of universities. About two hundred studies are available in the area of examination and achievement testing both at Ph. D. and at project levels. A review of these studies indicates definite trends of research in this area.

In the sub-area of examinations the eleven studies conducted by Harper (1962-70), Gayen et al. (1962-70) and Chauhan (1967) are related to the general aspects of examinations. The five studies conducted by Gayen et al. (1962-70) at IIT, Kharagpur have concentrated on the measurement of achievement in different subjects like English, Sanskrit, Hindi, Bengali, Physics, Chemistry, Geography, General Science, Biology, History, Civics and Economics on the basis of following objectives.

(a) Percentages of failures, passes and non-attempts for alternative question items; (b) Grouping of items and balancing of alternatives; (c) difficulty values and discriminating powers of the question-items; (d) relationship of marks in a particular item with the total marks, (e) comparative study of scores on one paper of a subject with another and with the total marks on the subject as a whole; (f) content analysis of the syllabuses and the question papers; (g) comparative performance of candidates in the three subjects; and (h) comparison of the internal and the external assessments of student's performance.

Gayen et. al. (1962-70) found the reliability and validity of most of the present examination systems to be very low and this was because performance of students was assessed in a single final examination, by a large number of examiners, on a set of questions mostly of the essay type and comparatively small in number from which, again, students were given option to select alternatives. Three students by harper are (i) Research in Examinations (ii) Chance in the traditional examinations and (iii) objective and traditional examination. In the study 'Chance' in the traditional examinations', it is pointed out that chance plays a role in determining the achievement level of pupil.

Chauhan (1967) in his study of University Examination found that of the students who fail, a large proportion fails not because of not knowing the subject matter but because of some external factors like defective question papers, carelessness of examiners in evaluating answer books and evaluation by incapable examiners. In a similar context, Malhotra (1972), while studying the effectiveness of question papers of matriculate examinations, found that the question papers had many defects with respect to difficulty level, coverage and weightage. As regards the type of questions used in our examinations, Lele et al. (1962) analyzed the question papers and found out only one fifth of the

total questions were good, whereas the rest were poor discriminators. Lele et al. (1963) found that in essay type examinations, teachers and students did not agree as regards the difficulty level of the questions and that the selection of question on the part of students varied with the nature, clarity and difficulty level of questions. Hill (1964) found that it was beyond the competence of even the most skilled paper setter to make each question in every question paper function exactly as he wished it to. Taylor (1963) observed that an examiner's mark had neither the sanctity as he wished it to. Taylor (1963) observed than an examiner's mark had neither the sanctity nor the precision which were usually attached to it. Different examiners showed a large variation in the mean and standard deviation of their evaluation.'

The focus of those above studies have been mentioned earlier. Gayen et. al. Have been taken the results of School Final Examination and the old Higher Secondary Examination of West Bengal Board of Secondary Examination. But the purpose of this investigator has been bit different from those mentioned earlier.

CURRICULUM EVALUATION AS A COMPONENT OF TEACHING – LEARNING SYSTEM

The process of evaluation is undertaken in order to determine the strengths and weakness of an existing or an under-construction curriculum so that improvement can be made in curriculum design. Evaluation results are primarily a function of judging the effectiveness of the curriculum.

An integral part of curriculum development process is evaluation. Evaluation means both assessment of students to find how much of the intended curriculum has been transacted and also what actually happens in a classroom as experienced by the students when they are involved in learning activities. These experiences of the students need not be confined to the four walls of a classroom and within the stipulated time frame of a rigid school schedule. These could also include activities which form part of hidden curriculum like wearing a school uniform, standing up when the teacher enters the class and help in each other in organizing an exhibition in the school. Thus we are interested in looking at evaluation not just as the evaluation of activities inside the classroom but also as the evaluation of the school as a whole developing system. There are differing views on this among teacher, parents and school authorizes. There are

some schools where entire emphasis is on the end examination and all activities are geared towards that. There are other schools where emphasis is on the realization of hidden curriculum and over all development of the child.

Exiting educational programmers are criticized not only form the point of view of their content but also from the point of view of the mode in instruction. All though there is research evidence to prove that memorizing factual information contributes very little to the intellectual development of a learner.

2.4 CURRICULUM OBJECTIVES

Curriculum is required to flow certain objectives on the fulfillment of which depends its success. These objective are all related to the learner's development. These concerns the cognitive, affective and psychomotor aspects of development. Cognitive objectives include knowledge, comprehension, application, analysis, synthesis and evolution. Affective objectives contain attention, interest attitude and values. The Psychomotor objects include imitation, manipulation, precision, articulation and naturalization. All these refer to different categories and dimensions of behaviour-development.

General Guiding Principles of Curriculum Construction of Xth Grade in W. B. 2006

A curriculum construction depends upon certain guiding principles. These are :

1. Dynamism is the first significant point without which curriculum becomes static and dead. Only a dynamic curriculum is capable of meeting all the challenges of education successfully. Dynamism is the very vital aspect of a curriculum enabling it to cope up with the ever changing needs and complexities of both life and education. So the curriculum should be a dynamic one.
2. Flexibility is another important point to be noted. It must not be closed and mechanically rigid. It need to be open responsive and receptive allowing it to react rightly under all circumstances.
3. The Curriculum should not be merely the theoretical study of certain branches of knowledge, unrelated to child's life interest. Beside books various experiences and activities should be included.

4. The needs of the child should not be worked out in an artificial abstract and schematic manner from the adult point of view. Curriculum should be formed to meet the needs, the abilities and interest of the children.

5. The curriculum should be organized with an eye to meet the social demands. It will help to make a happy home, for becoming a good productive citizen, for utilizing leisure for a acquiring vocational efficiency.

6. To meet social and economic needs of the students, there must be the scope for vocational preparation.

7. Curriculum should be wide and comprehensive, irrelevant subjects or portions of a subject should be given up. The subject matter should be carefully arranged.

8. The curriculum should present a compact and comprehensive life environment at each stage of development and there should be proper integration between the curriculum of successive stages.

9. Curriculum should prepare the individual not only for the life of work but also for the life of leisure, by exploring and developing the recreational resources. Rightly under all circumstances.

10. Only a coordinated and balanced curriculum is called a satisfactory curriculum. It should not over emphasize some elements and neglect others. It should not suffer from looseness and lack of planning.

11. An ideal curriculum submits itself to continuous evaluation and ensures its further improvement. It goes on examination itself all the time for necessary correction and modification.

SOURCES OF CURRICULUM EVALUATION

There are several sources form where meaningful information can be collected regarding a given school curriculum. Major sources are discussed below :

Students : The students of a particular course are the primary and most important source of information regarding how relevant the intended curriculum is and how it is being implemented.

Teachers : Curriculum review of evaluation should be done by the teachers in the school. The teachers, are the part of the curriculum in the sense that they transact the curriculum in the class. They can give valuable information regarding the implementation of the curriculum.

Subject experts : To get balanced information on the implementation of a curriculum, especially from the discipline pint of view, it would be worthwhile to consider the views of other subject experts in the field as relevant and reliable. The subject experts could be form other systems like a practitioner in the field or even a self-employed person. The experts will provide valuable information on the filed condition which would be of tremendous value for the purpose of curriculum evaluation.

Curriculum experts : Curriculum experts can provide information regarding the development of a curriculum so that it becomes more meaningful form the student's point of view. The curriculum experts are a good source of information for curriculum evaluation.

Policy makers : Policy makers occupying responsible positions in apex bodies like Central Board of Secondary Education (CBSE), National Council of Educational Research and Training (NCERT), National Open School (NOC) AND State Board of Secondary Education are also excellent sources of information for curriculum evalution. By virtue of their position they are better informed about the current and the envisaged changes in government policies regarding economy, industry, agriculture and education. All these areas have direct or indirect implications for school curriculum.

Community : The local community where the products (educated / trained persons) of a particular course are to be absorbed can be yet another important source of information for curriculum evolution. The requirements of the local community can make the curriculum relevant and need-based or otherwise. A curriculum revised on the basis of needs and requirements of the community will be able to serve the cause of the community better in producing better socialized and more responsible citizens.

Dropouts sample : Those students who have dropped out of a particular course can be yet another valuable source of information for curriculum evaluation. These students can pin-point the curricular factors that might have been responsible for heir withdrawal from the course. A diagnostic lest administered on these dropouts can provide valuable information regarding the misconception generated by the present curriculum. This feed back will help in modifying or improving the curriculum.

Employers and entrepreneurs : The opinion of the employers who have to absorb the products needed by them, will reflect on the strengths and weaknesses of the curriculum. Those who are self-employed, even in the unorganized service sector can provide valuable information on the strengths and weaknesses of a particular curriculum. Such information can help in making the curriculum socially relevant and useful.

IMPORTANCE OF CURRICULUM EVALUATION

The followings are the main purpose of curriculum evaluation :

To develop a new curriculum : If we wish to develop a new curriculum for a vocational course at the secondary stage, it would be worthwhile to evaluate a current curriculum from a different system before adopting it to our emerging requirements. The usual practice would be to prune and exiting curriculum to suit our new requirements because at times the decisions in the planning process can be quite arbitrary. Such a process leads to the risk of overloading the curriculum. To make objective decisions on the developments of the new curriculum, evaluation of the exiting curriculum is necessary.

To review a curriculum under implementation : It may be required by policy planners and decision makers to get an immediate feed back on the implementation of a curriculum in order to make amendments if required for effective realization of all the bojectives related to it. A curriculum evaluation exercises would be necessary for this purpose.

To remove 'dead wood' and up date an existing curriculum : It is essential to remove obsolete ideas and practices from a curriculum and include current development in the curriculum. In order to make objective decisions about inclusion or deletion of content or practices a curriculum evaluation exercise would again be necessary.

To find out the effectiveness of a curriculum : To know the effectiveness of a curriculum in terms of the achievement of its immediate as well as long term objectives, a curriculum evaluation exercise would be essential.

Curriculum evaluation can help teachers and decision – maker take objective decisions on curriculum, and its developments and implementation. This indeed is the major purpose of any curriculum evaluation exercise. The results of evaluation can be used to improved future educational effort, other wise there is little sense in carrying out any curriculum evaluation activity.

The administrator , policymak ers, teachers, parents and each student are concerned with the ways in which a particular school curriculum is being implemented. They have reasons enough for making it accountable. It is the curriculum evaluation gains importance because of these reasons. Students and does not improve his ability to solve problems, most text books are still crammed with factful information that students are required to memorized questions are also directed towards testing the memory power of the students. Both these aspects determine to a large extent the activities of a teacher in a classroom.

As a result teacher devote most of their time in a classroom in explaining difficult issues contained in test book. The test books or the examination do not provide much opportunity for mental faculties like, analysis, synthesis, discovery, problem solving ability, creativity. It is the process of evaluation which can provide a away to improve the system. Thus, curriculum evaluation is the collection and provision of evidence, on the basis of which decisions can be taken about the suitability, efficiency, effectiveness and educational value of curricula.

NEED FOR CURRICULUM EVALUATION

In order to develop an sufficient and effective curriculum what should we do? We should evaluate the existing curriculum and modify it to make it more relevant. Thus the need for evaluating a curriculum emerges from the field. In any content area there would be developments taking places periodically and if the current changes are not incorporated, the students would be unable to know the reality. In order to incorporate recent developments and to fit them in to the structure of the course one requires to analysis curriculum systematically. This scientific analysis if followed up logically leads to curriculum evaluation.

A particular curriculum may look good on paper but the actual output in terms of the quality of the product may not be judged very well by the consumers. For example, the post-secondary institutions (consumers or recipients of the secondary school products) may have several complaints about the way in which a particular content is taught at the secondary level. How do we improve the effectiveness of the curriculum implementation so as to reach the expected level of the post second institution? A curriculum evaluation exercise would help us to modify curriculum and improve its effectiveness.

To improve the efficiency of a curriculum, it is necessary to analyses the out puts of and the inputs into the educational system and make the necessary modification as revealed by the analysis. This can be accomplished by carrying out a curriculum evaluation.

GUIDENCE OF FRAMING CURRICULUM

These are as follows :

* A curriculum is always preplanned : It is not a act of activities developed on the spot or spontaneously.

* Any curriculum has four bases viz : Social forces, knowledge of human development as provided by the accepted theories, the nature of learning, and the nature of knowledge and cognition. Thus a curriculum is meant for education in a particular society and for children of a particular age group. A curriculum that has been developed for girl student of grade Xth may quite irrelevant for boys of grade Xth preparing for a particular vocational stream.

* The goals of a curriculum are reflected in the set of educational objectives that accomany it. These objectives are the end and the given curriculum is a means to achieve them.

* A curriculum facilitates planning of instruction by teachers. Because of their intimate knowledge of chilfren, and also how various educational objectives can be attained by chilfren, teachers can plan a set of learning experiences that flow from a given curriculum. the quality and relevance of learning experiences determines the effectiveness of curriculum implementation.

* The teacher plan the same set of learning experiences for all students of his class. However, they differ in terms of the learning experiences and their level and quality of participation. Their individual differences and variation in their social background are responsible for these results. Because of these, every lerner has an actual curriculum which is different from the actual curriculum of other learners in the same class.

* Because of the gap between the intended curriculum, and the transacted curriculum as reflected by the individual learner's actual curriculum the teacher role assumes very importance. A teacher should bot only provide flexible arrangement but also meaningful alternatives in learning. These demand professional decisions from teachers in terms of the objective, bases and criteria of the given curriculum.

2.5 EVALUATION OF THE PHYSICAL SCIENCE AT THE SECONDARY LEVEL IN WEST BENGAL

We are living in the age of science and technology. Great basic discoveries are announced with increasing frequencies. Development of scientific knowledge with in the individual is an aim of science teaching. Science teaching helps the children to learn better understanding, so that the learner may faces this scientific society. Science teaching is responsible for developing attitude and skills of the learner to take proper and fruitful decision concerning their future.

It is generally accepted that some knowledge of Physical Science in an important part of liberal education. It help the puoils to observe and think clearly, critically and carefully. It introduces the pupil to a knowledge of scientific facts needed note only for many trades and profession, but also to enable the pupil to lead happy, well behaved and sueful life. It also help the pupil keep them selves in front of important development in the world.

Afer publication of mudalior commission Report the emphasis on science education has been establish at the secondary and higher secondary level. Up to six decades to 20th century science was optional subject of 50 marks and additional subjects of 100 marks at the Matriculation or S. F. examination. Now there are two compulsory subjects Physical Science and Life Science and additional subjects like Physics, Chemistry, Biology etc. at the S. F. stage. At the higher secondary level in West Bengal, Physics, Chemistry, Biology, Mathematics, Statistics, have been listed as the compulsory subjects for the students of science group. The students who opt for higher education in technical or professional schemes like Engineering, Medical, Pharmacy etc are to be appear in the Joint Entrance Examination. In the Joint Entrance Examination for Engineering and Technical courses compulsory subjects are Physics, Chemistry and Mathematics. For Medical Entrance Examination, the subjects are Physics, Chemistry and Bioilogy. The students who aspire to join the Poly-technique courses are to face Joint Entrance Examination having Physics, Chemistry and Mathematics. For better achievement in Joint Entrance Examination for both Engineering and Medical stream, understanding about physical science is important factor for enrollment in this professional stream. So the subject Physical Science curriculum because better teaching-learning process depends upon the better curriculum. New concept and ideas are being added every day to the syllabus of Physical Science. New concepts and New inventions are replacing the old one. So, it is a question whether the present curriculum of Physical Science at the secondary level in West Bengal Board of Secondary Education is justified up to the mark or not. The answer depends upon the enquiry and evaluation of curriculum.

Educational measurement is not a new idea rather it has root in the remote past. From ancient times, teachers have laways endeavered to measure the results of their teaching efforts as indicated by the progress of their pupils towards desired educational goals. A well-defined aim enables the worker to direct his efforts towards the accomplishment of the particular task. It is by the use of the proper instruments for measuring results that the worker is able to know what he has accomplished. It is necessary for parents and teachers to know how pupils are progressing and grade them according to their attainments. Parents and society wish to assess the work and progress of the institution where there children are being educated, and authorities consider it necessary to assess the work of the teachers and schools has to be evaluated from time to time.

From the background study it is clear that teaching-learning system of physical science associated to multifacets dimensions. Four basic components are—

* School Environment
* Curriculum structure
* Teaching-learning process
* Evaluation technique.

According to Asian Regional workshop on the Progress of Intigrated Science Teaching, 1970 under the guidence of UNESCO, "Science Teaching has been one of the best vehicles we have for educating the child".

Different recommendations have been made by UNESCO on science teaching including from. Design and production of school science are given below :–

* Development of Science Curriculum
* Training of Teachers
* Improvement of Evaluation

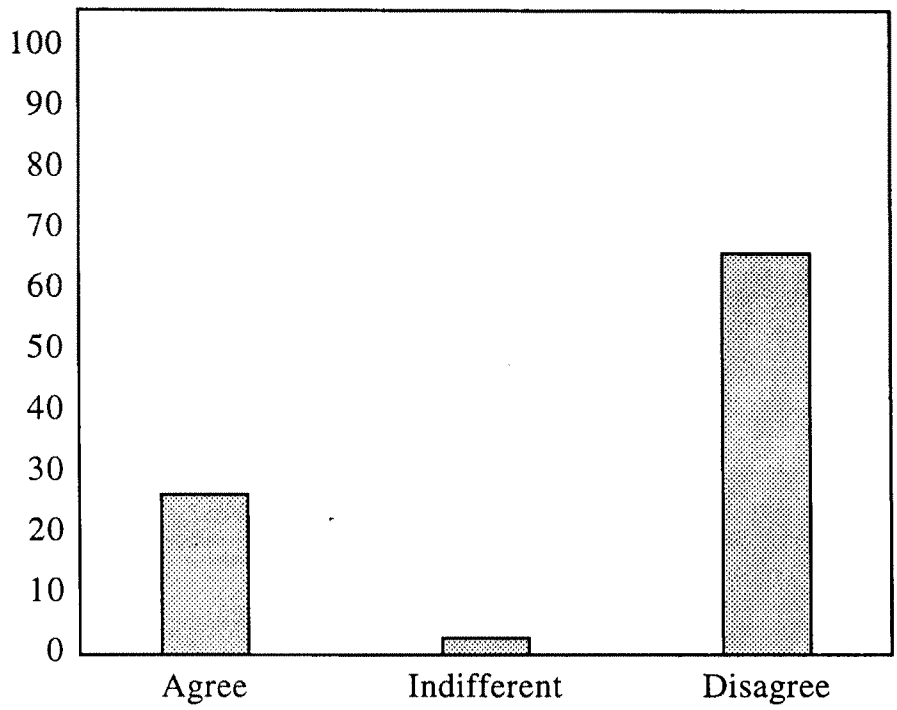
In 1976 a regional seminar held on life long Education Organiged by UNESCO, from which following recommendation is very important —

"The concept of life long education should therefore act as on emergizing force for the reform of Education systems, and as an organizing principle by which the various components and types of education are brought together in a coherent strategry for educational action."

Therefore we are concentrating our attention for the all round development of teaching-learning system of physical science by Suggesting diffent components of Teaching and learning. Moreover we are investigating the real situation of teachng & learning of different Xth grade schools of West Bengal by applying a standerdised questionnaire. Different components of physical science have been presented through graphical percentage method which will be helpful to understand the actual situation of teaching & learning.

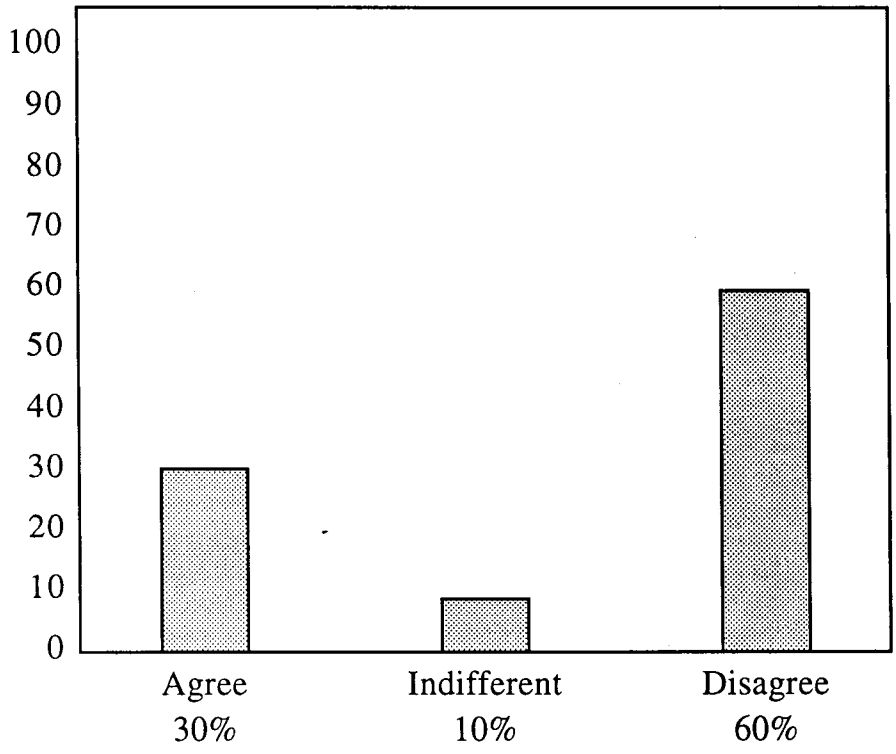
GRAPHICAL PERCENTAGE RESPONSE OF STUDENTS AND TEACHERS TOWARDS SYSTEM OF PHYSICAL SCIENCE AT SECONDARY LEVEL SCHOOL IN WEST BENGAL

2.1 Present curriculum of Physical Science at secondary level in West Bengal Board is satisfactory



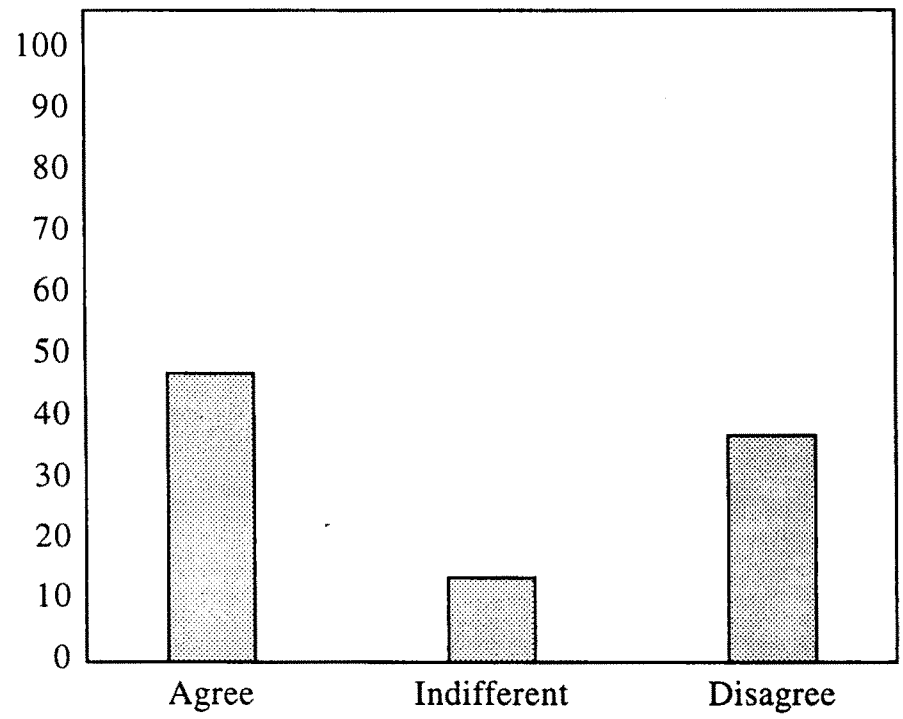
From the graph, it is clear that 27.5% of the students and teachers are showing agree ness towards the statement, 67.5% are showing disagree ness. Hence from the graph, it can be said that the above statement is not satisfactorily made, at secondary level.

2.2 Infrastructure is satisfactory for teaching physical science



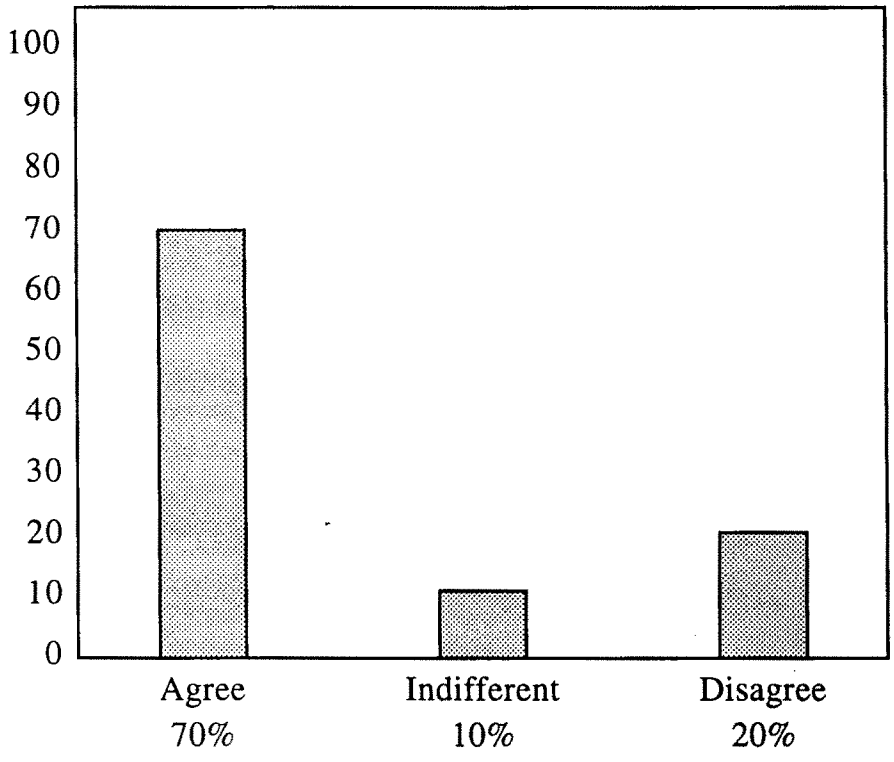
Infrastrueture is very important factor affecting teaching-learning system. In reality the situation is not well accepted supported by the graphical presentation.

2.3 The content of the Physical Science Curriculum at secondary level in West Bengal Board of Secondary Education is sufficient to create scientific temper among the students



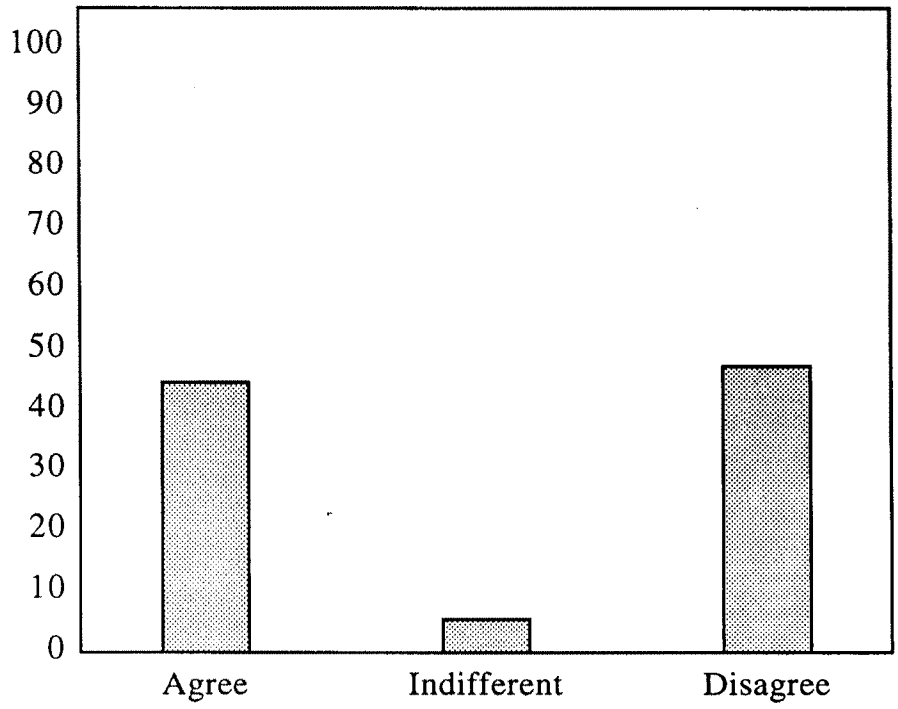
From the graph, it is understood that 48% of the students and teachers are showing agree ness towards the item, and 38% showing disagree ness. It indicates that the statement is true.

2.4 Teaching learning process is based on Student-Teacher Relationship



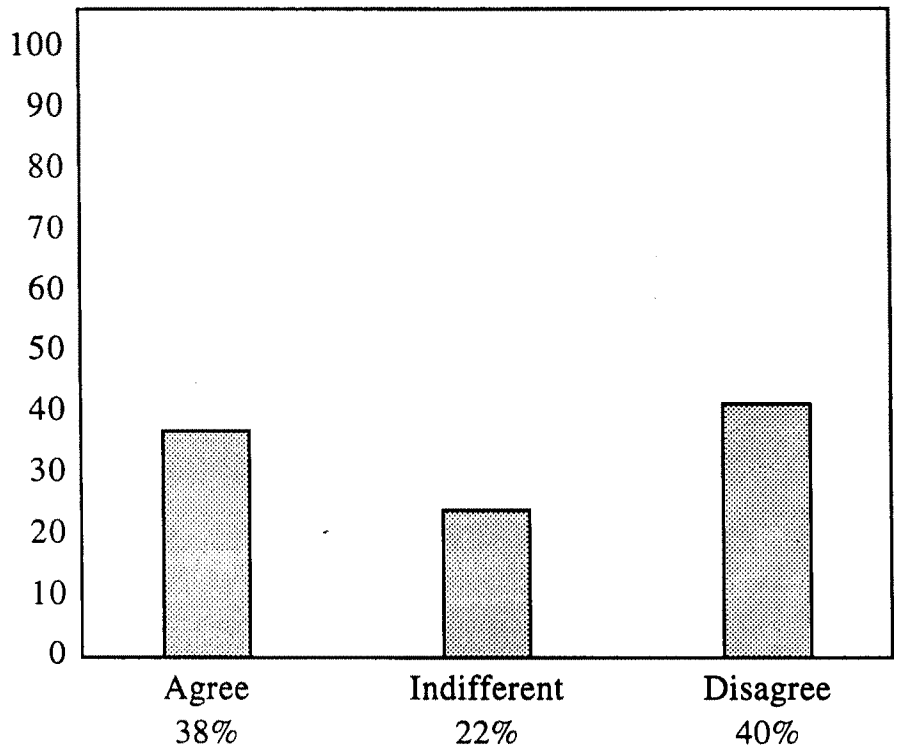
The above statement is agreed by 70% of students that is to have a better teaching-learning process Relationship between student & teacher specially mentionable.

2.5 "Curriculum of Physical Science at the secondary stage communicate the course between secondary and Higher Secondary curriculum."



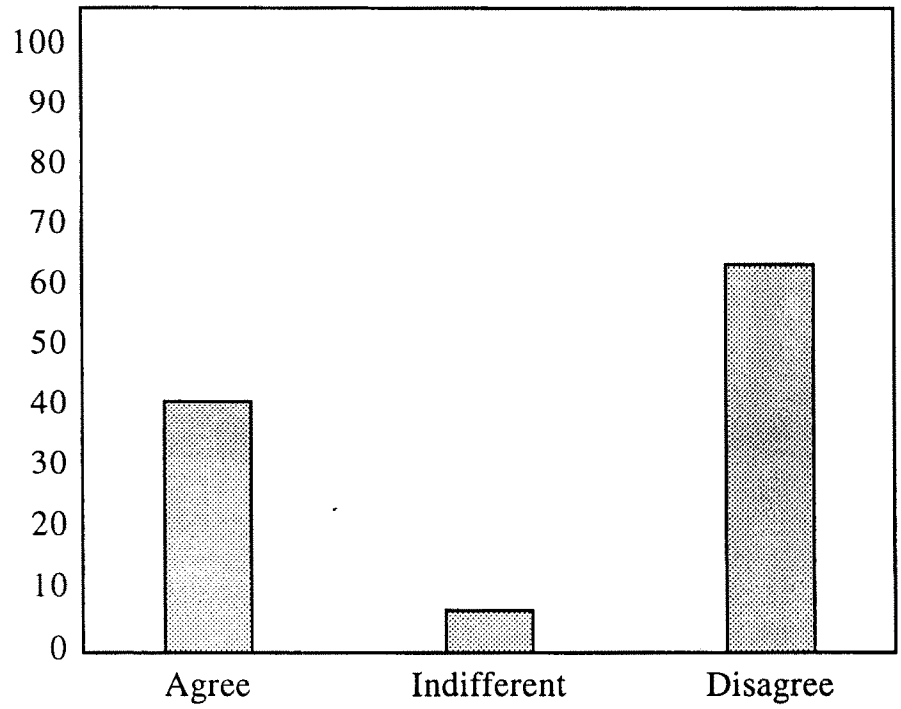
From the graph, it is clear that 43% students and teachers showing agree ness towards the item, and 47% showing disagree ness towards the item. Hence, it can be said that the curriculum need some modification.

2.6 Co-curricular activities are giving importance in T/L process



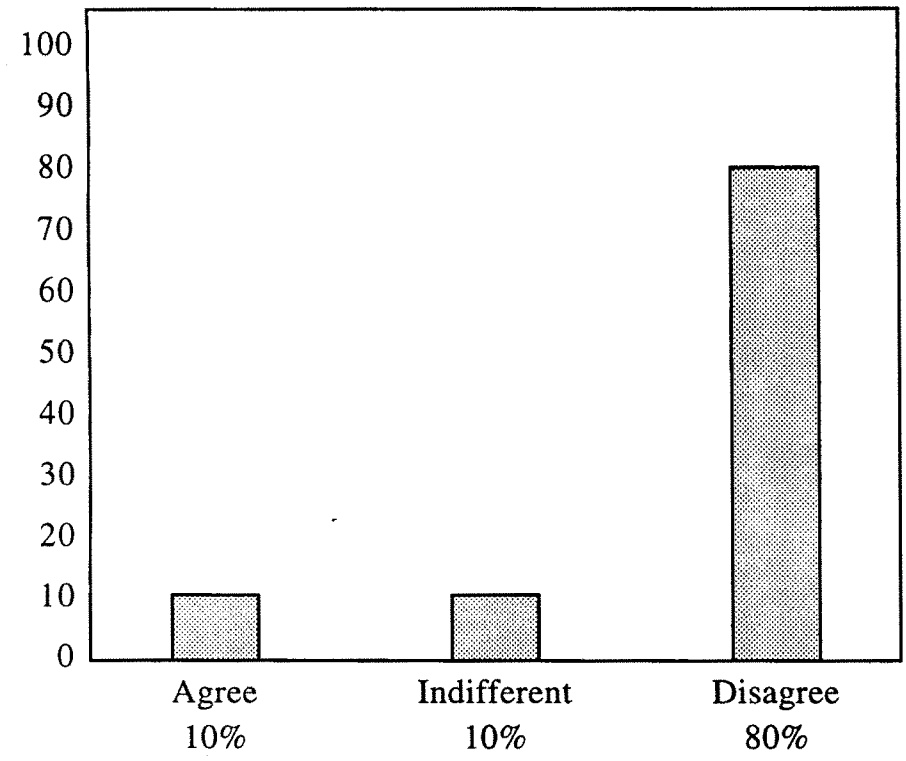
In teaching-learning system co-curricular activity plays an important role. In West Bengal graphically it is observed that co-curricular activity is not uniformly applied in teaching and learning.

2.7 The presentation of content of the Chemistry curriculum at the secondary level in West Bengal Board of Secondary Education create interest among the students.



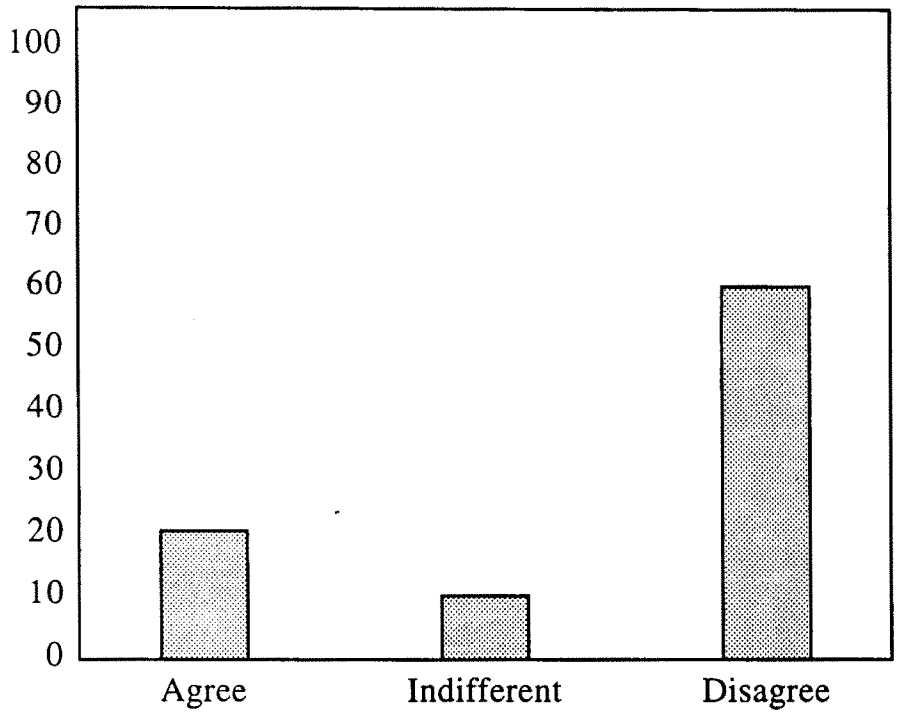
From the graph, it is clear that, 61.5% students and teachers are showing agree ness, 8% showing disagreeness. That is the item is true which means the content of Physical Science create interest among the students in secondary level.

2.8 Teaching Aids used logicaly and in the properway —



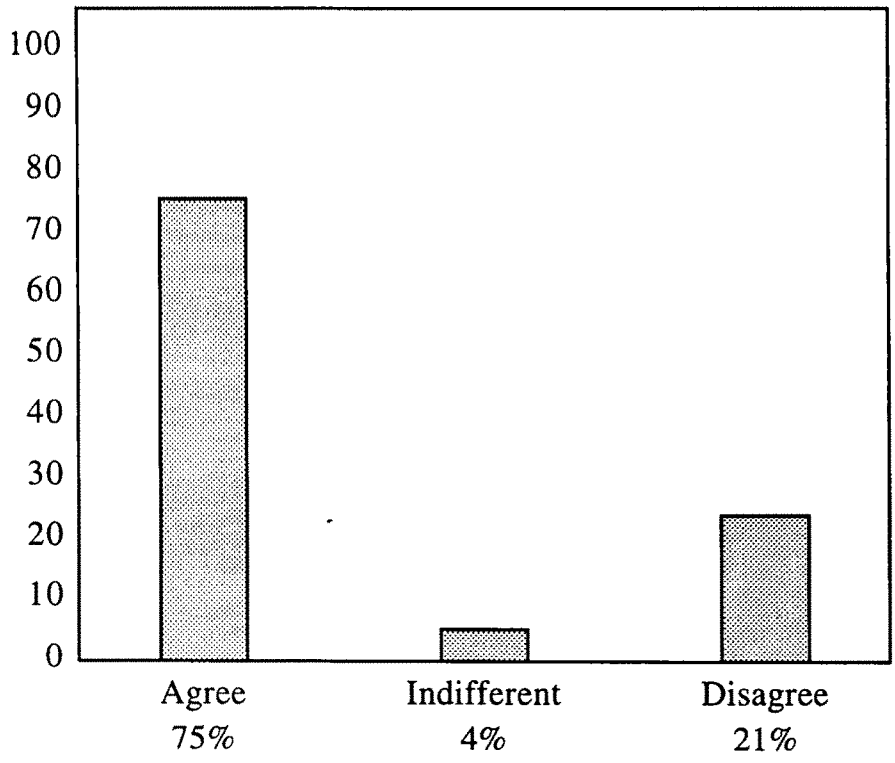
Teaching Aids are very important for teaching-learning process but not used logically in classroom situation resulting the teaching is monotonus and not effective sometimes.

2.9 The curriculum of Physical Science at Secondary Level in West Bengal is similar standard with those of Other English medium Board.



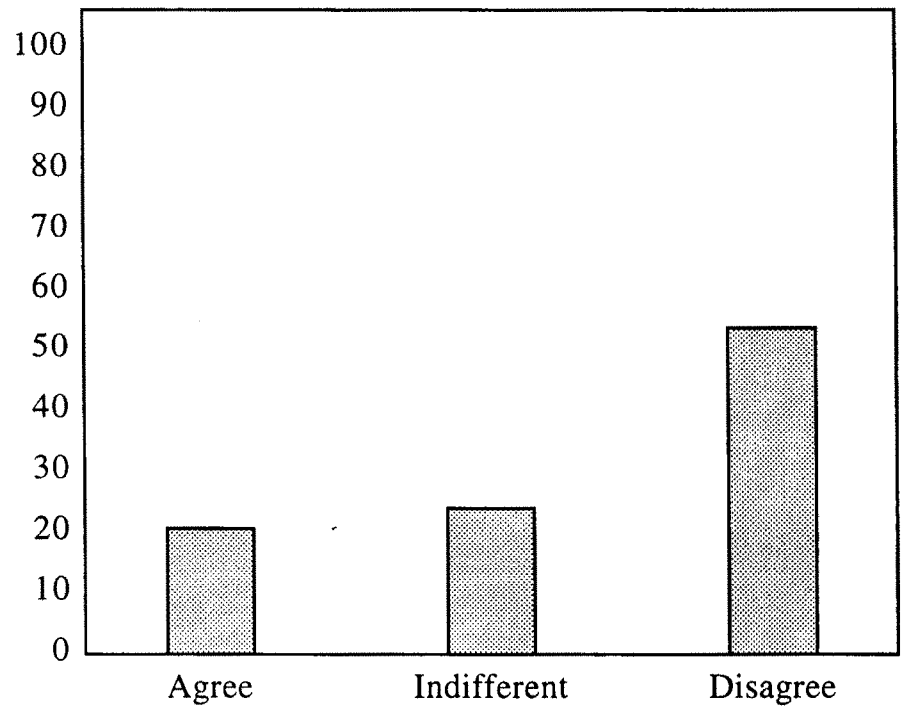
From the graph, it is evident that, 22% showing agreeness, and 64.5% showing disagreness. That is the curriculum of Physical Science at the secondary stage in West Bengal Board of Secondary Education is not similar with those of other boards.

2.10 Learners Attitude towords school is positive.



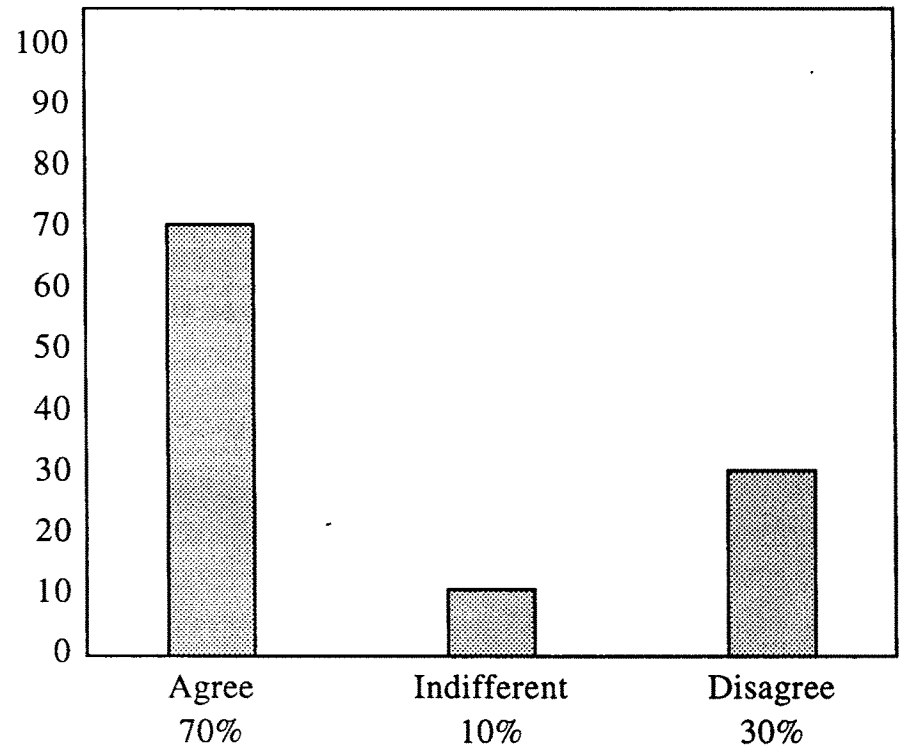
Positive attitude of learners is a significant dimension towards their institution. It will help them for academic betterment.

2.11 The curriculum is the same standard with those of any other country out side India



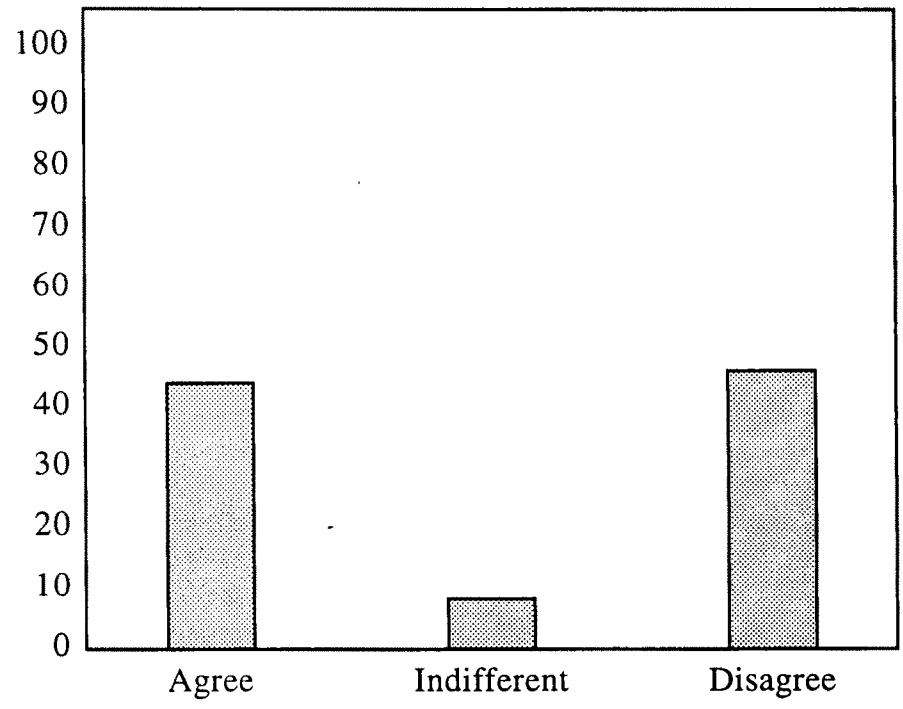
From the graph, it is seen that, 22.5% showing agreeness, and 51.5% showing disagreeness. Hence the cruuiculum of Physical Science at secondary stage in West Bengal Board of Secondary Education is not at par with those of any other country out side India.

2.12 Student Teacher Relationship is Satisfactory



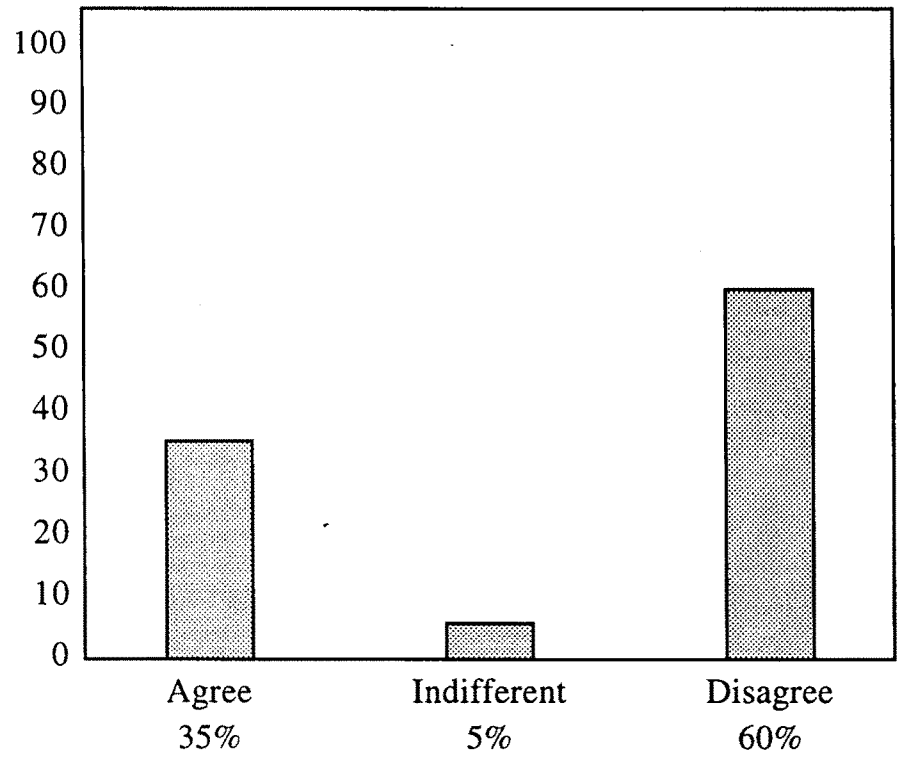
In West Bengal it is observed that the relationship between student and teacher is very much satisfactory which creats a healthy school environment.

2.13 The curriculum helps the student for in-depth study of Physical Science in West Bengal Secondary Board



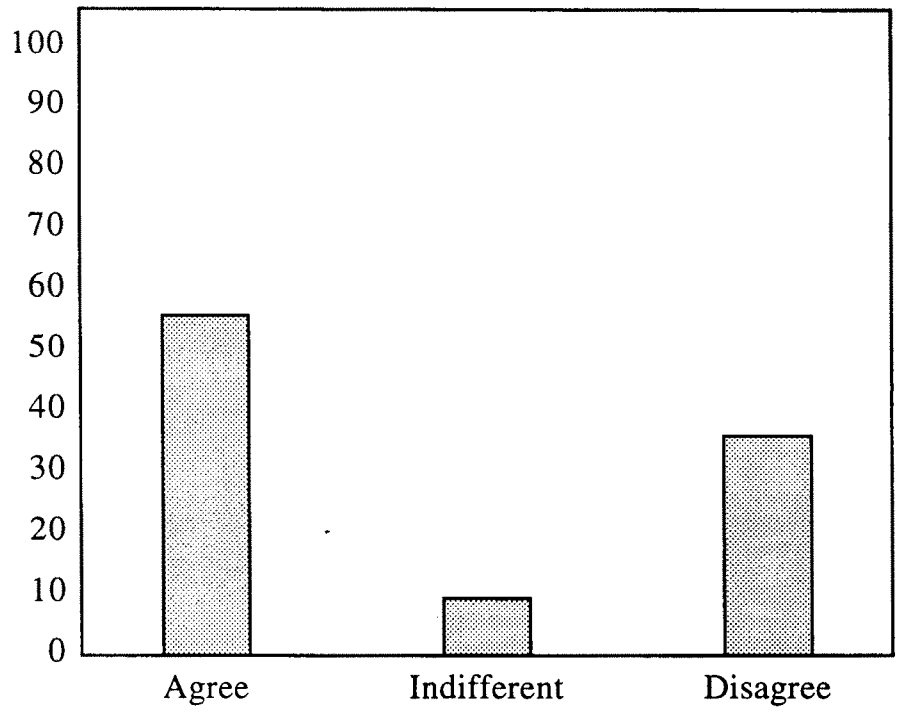
From the graph, it can be found that 44.5% showing agreeness, and 43% showing disagreeness. Hence we can conclude that the knowledge of Chemistry help the student indepth study to some extent.

2.14 Learners can enjoy the classroom climate :



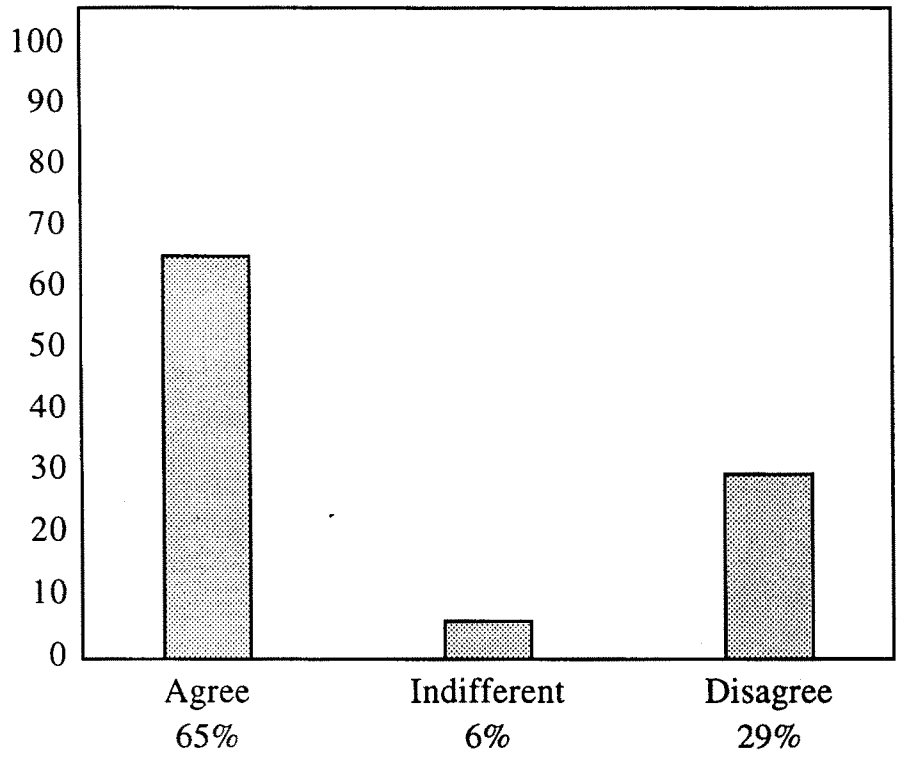
Classroom climate is not well supported by teaching-learning components reflected from the above results.

2.15 The curriculum of Chemistry at the Secondary stage of education brings fatigue among the students.



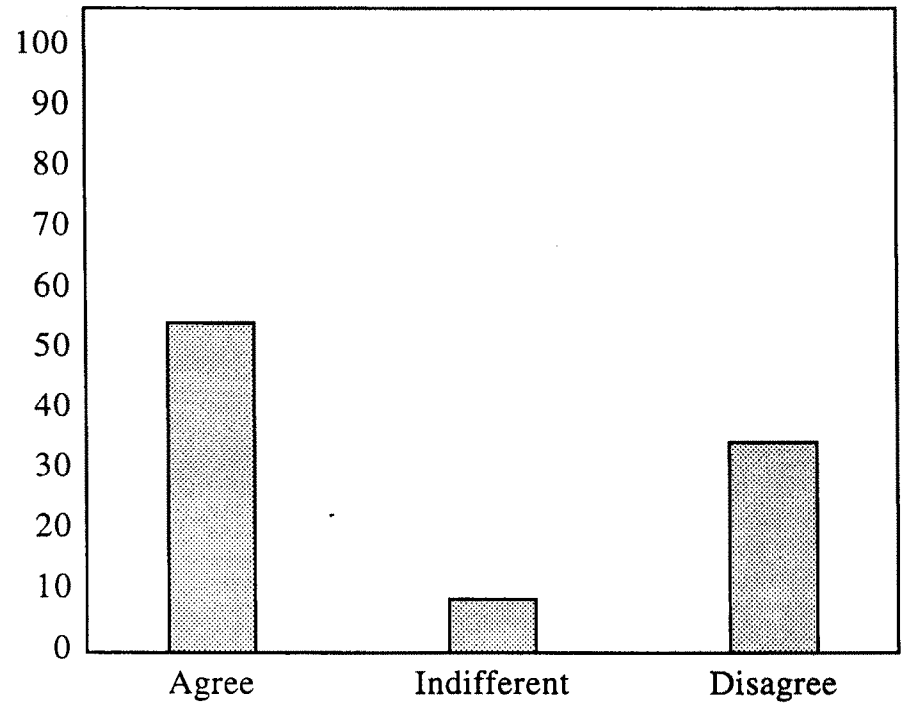
From the graph, it is clear that, 55.5% showing agreeness, and 30.5% showing disagreeness. Hence we can say, the curriculum does not bring fatigue among the students.

2.16 Work culture in our school is appreciable :



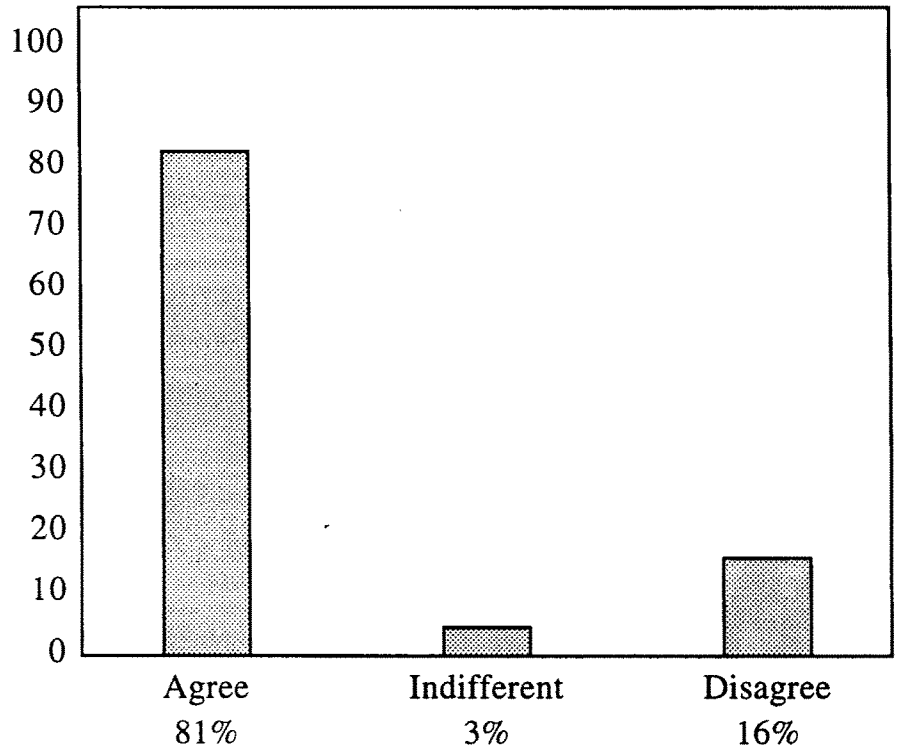
Work Culture is highly appreciated mostly because the teachers co-operative attitude & better student-teacher relationship.

2.17 The curriculum of Physical Science at the Secondary stage has no scope to develop creativity among the students



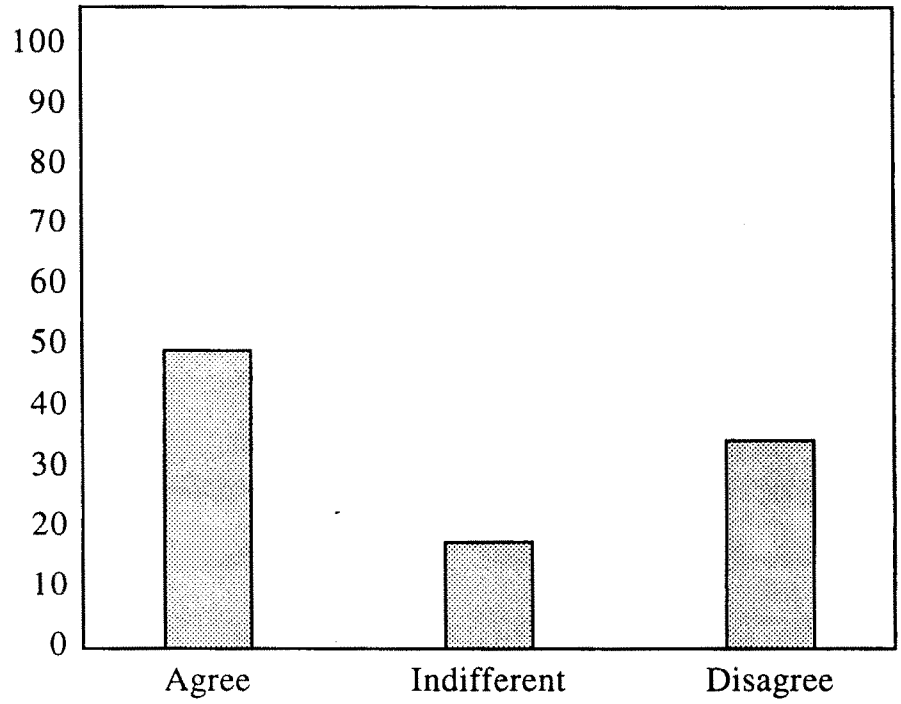
From the graph, we find that 53.5% showing agreeness, and 33% showing disagreeness. That is the curriculum help to nurture creativity among the students.

2.18 Classroom management is well controlled :



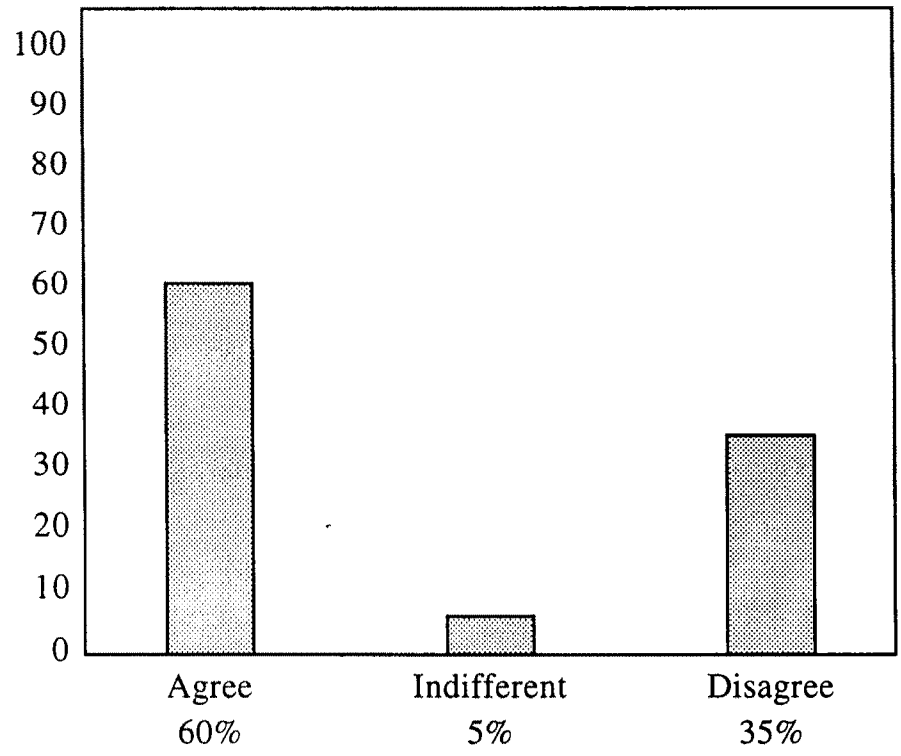
Most of the learners agreed that the classroom are well controlled and managed by the teachers and administration.

2.19 The curriculum helps to develop problem solving ability among the students



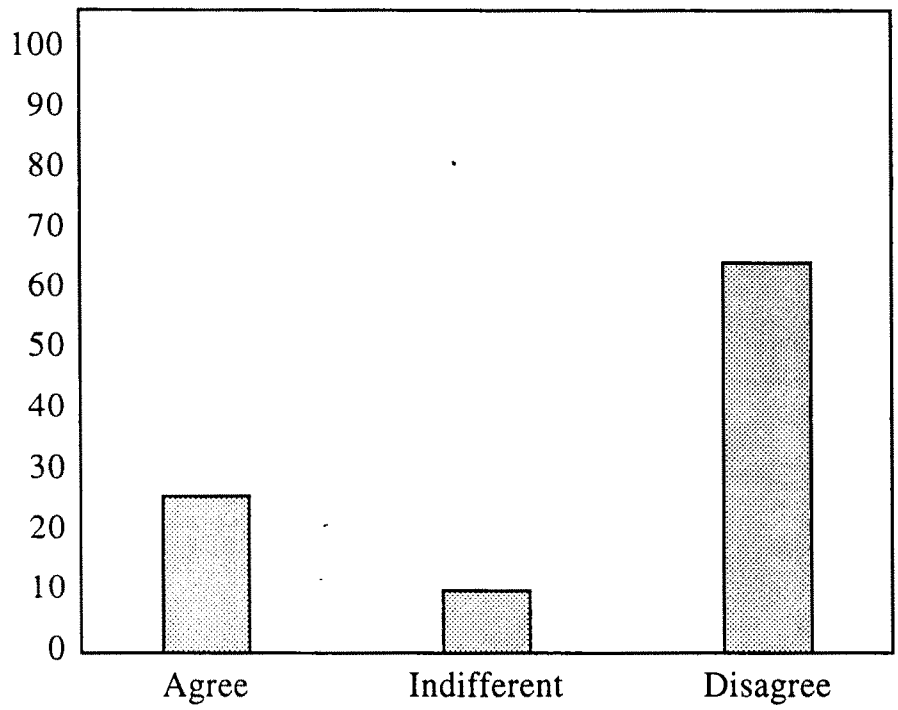
From the graph, it can be found that, 49% showing agreeness, and 33% showing disagreeness. Hence the curriculum help to develop problem solving ability among the students.

2.20 Teacher used to explain physical science topic very nicely



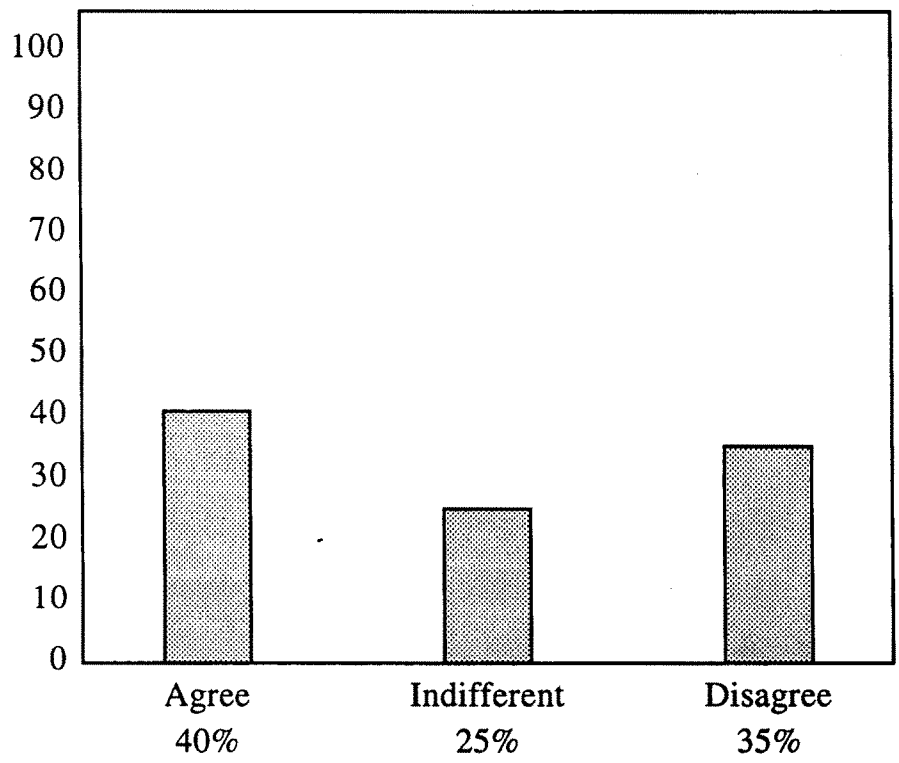
More than fifty percent students give their views that the teacher demonstrate their lessons satisfactorily.

2.21 The curriculum develops thinking ability and imagination power among the students



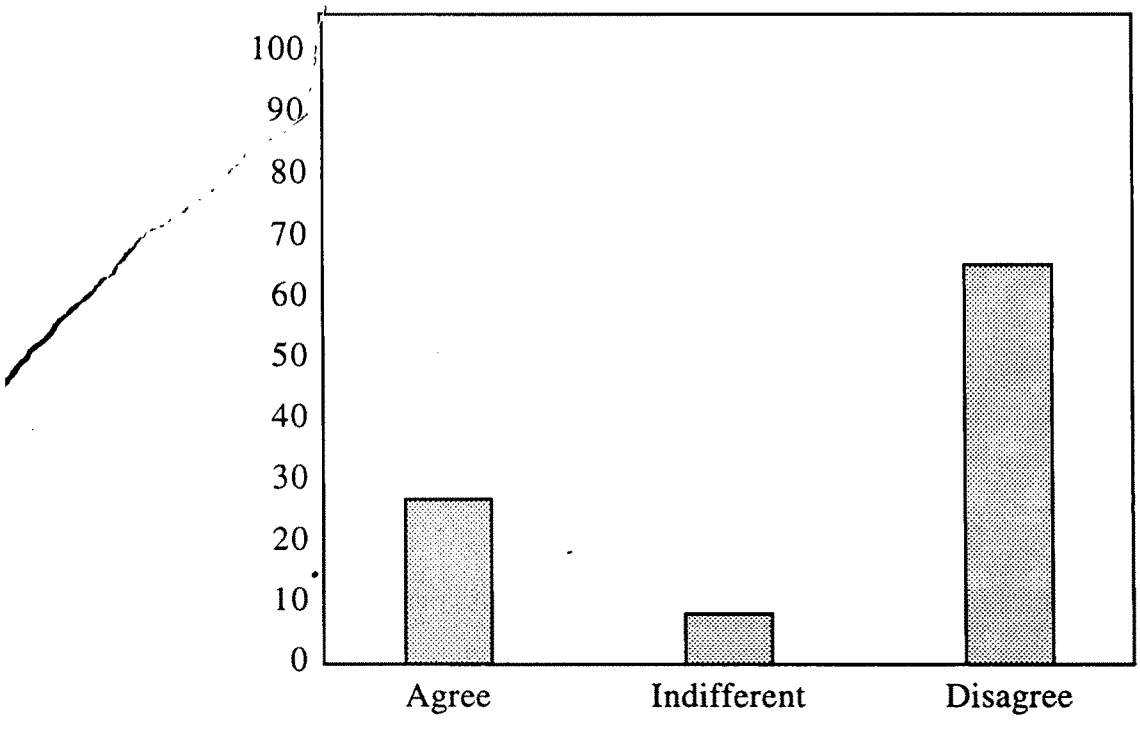
From the graph, it is seen that 62% showing disagreeness, and 26.5% showing agreeness. That is the curriculum help the student in developing thinking ability and imagination power.

2.22 Learners are interested in physical science teaching.



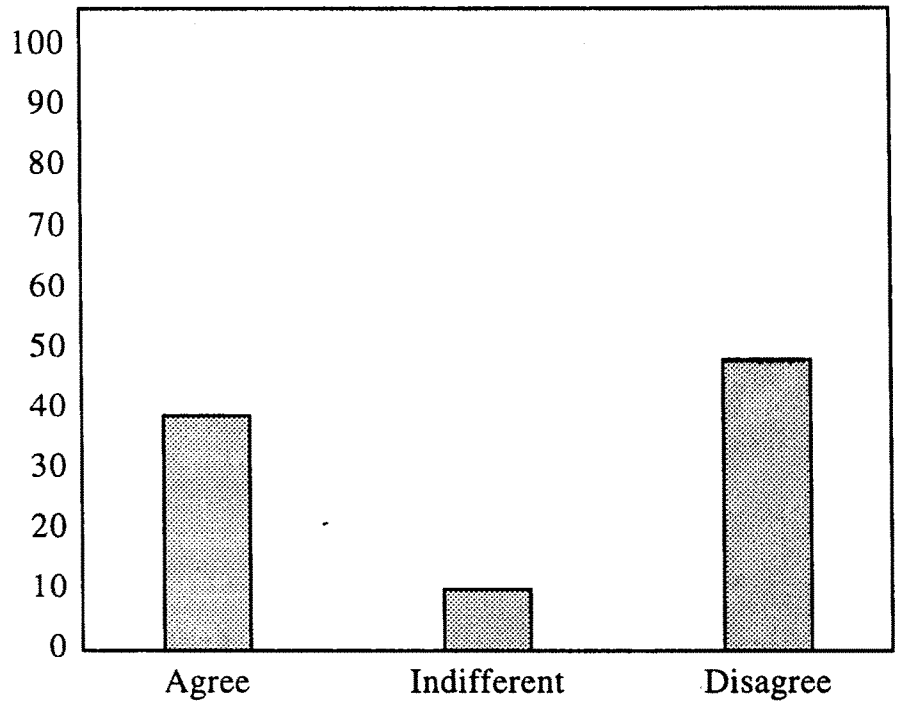
Interest is the very important dimension for considering effective teaching. From the available informations it is clear that 40% of the students are interested in science teaching but others are not getting interested from the teaching – learning situation.

2.23 The curriculum represents the real combination of theoretical and practical aspects.



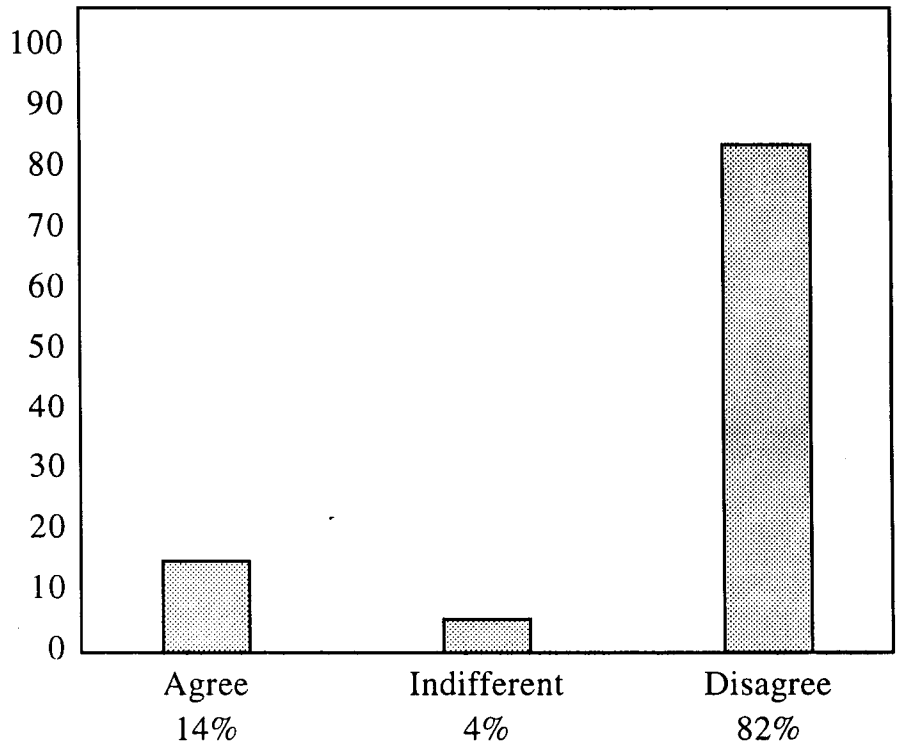
From the graph, it is clear that 60.5% showing agreeness, and 28.5% showing disagreeness towards the item. Hence the curriculum represents a true combination of theoretical and practical aspects.

2.24 The content is just enough to discreate high intelligent and low intelligent students.



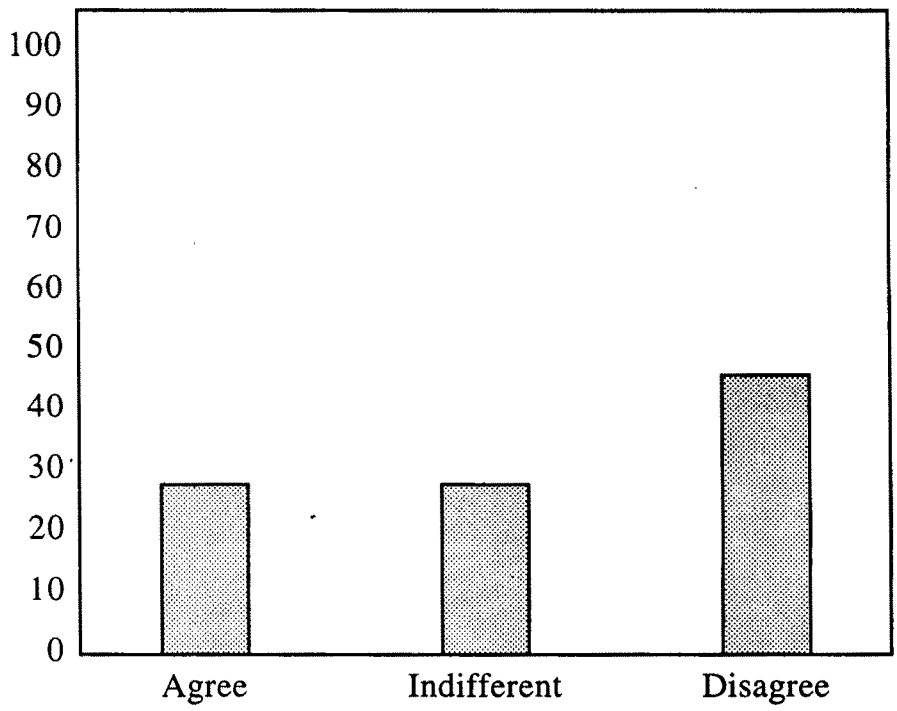
From the graph, it is clear that 39% showing agreeness, and 49% showing disagreeness. That is the curriculum require some addition and alteration for the high intellectual students.

2.25 Remedial Teaching is given to the learners.



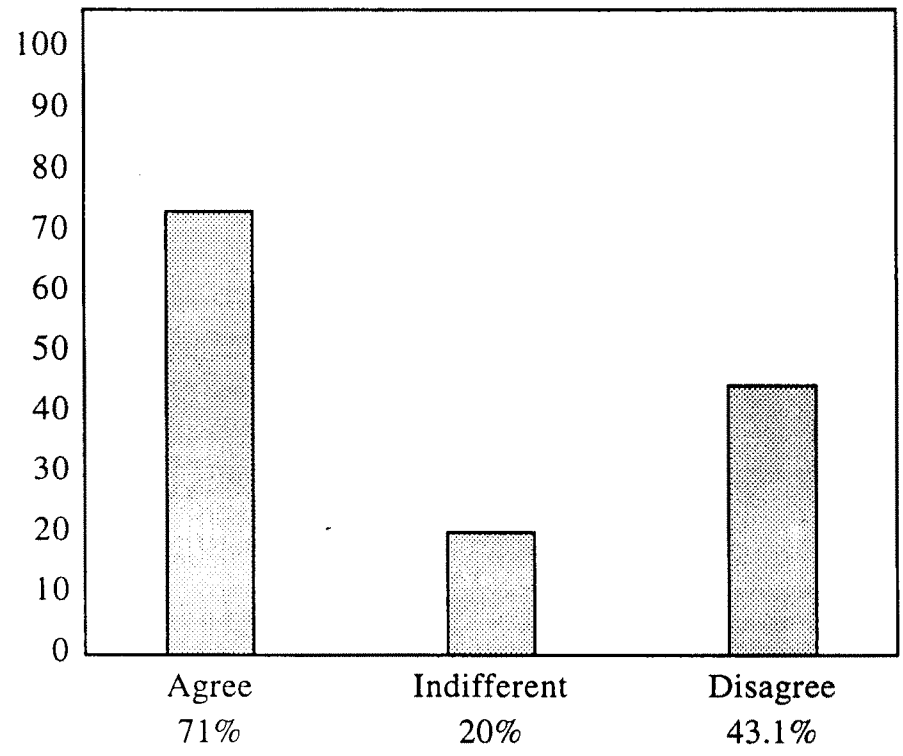
Weaker students are not getting proper support from the school, because most where no Remedial Teaching is accomodated.

2.26 The method of teaching is appropriate



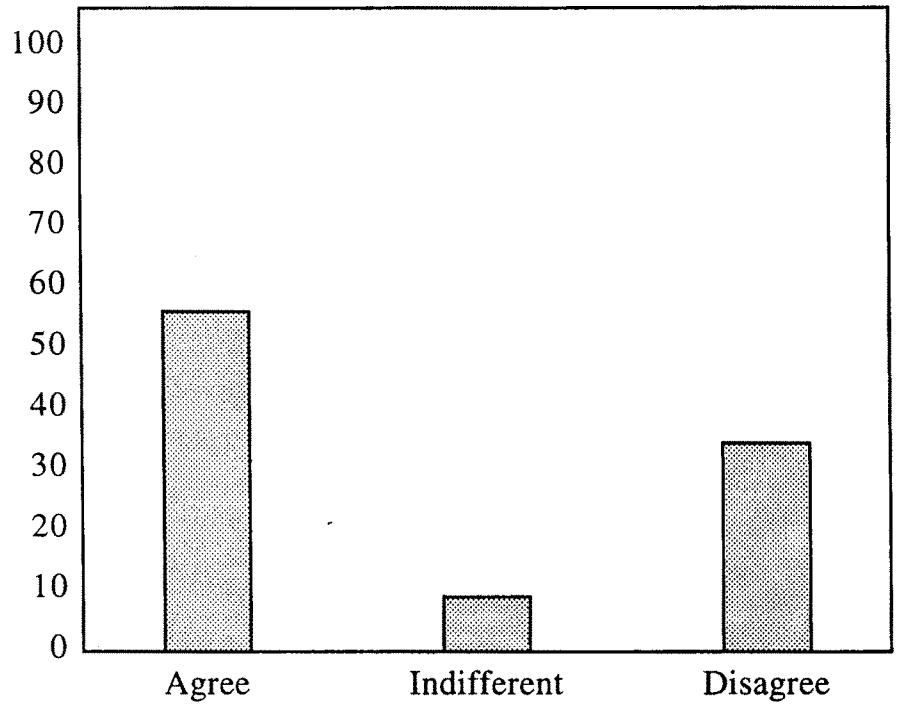
It is clear from the graph that, 28% showing agreeness, and 44.5 showing disagreeness. Hence, the method of teaching Chemistry at secondary level need some modification.

2.27 Evaluation process is systematic



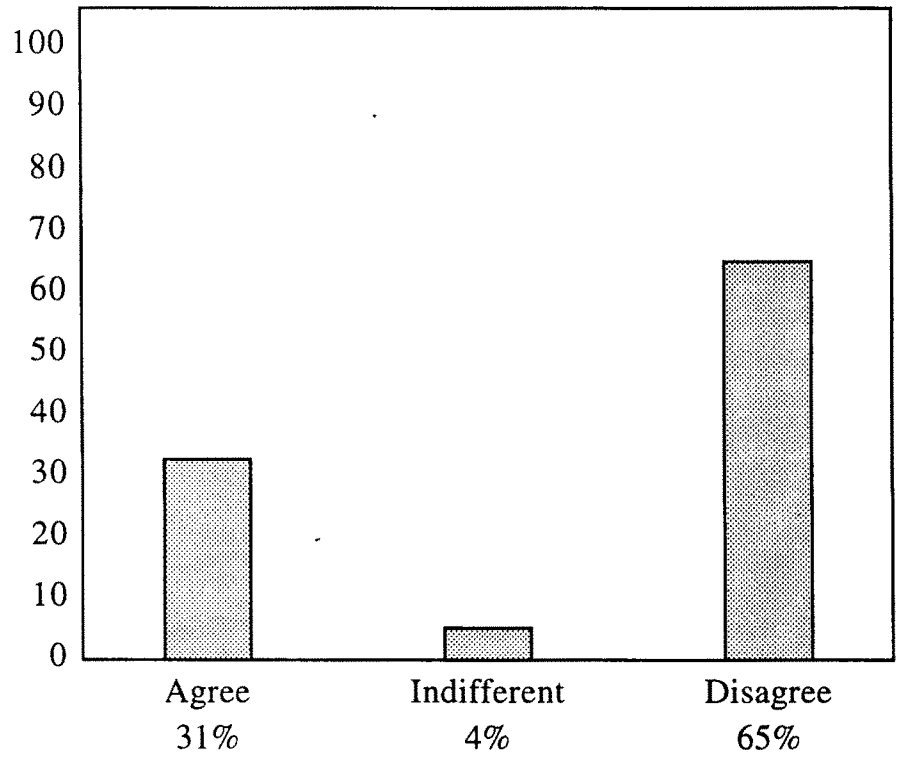
Most of the learners consider that the evaluation process is systematic. Basically in West Bengal sumnative approach is followed. Learners are evaluated by two exams, one is Half yearly examinations & Another is Annual examinations though the last one is the determining one.

2.28 The method of teaching encourages the students.



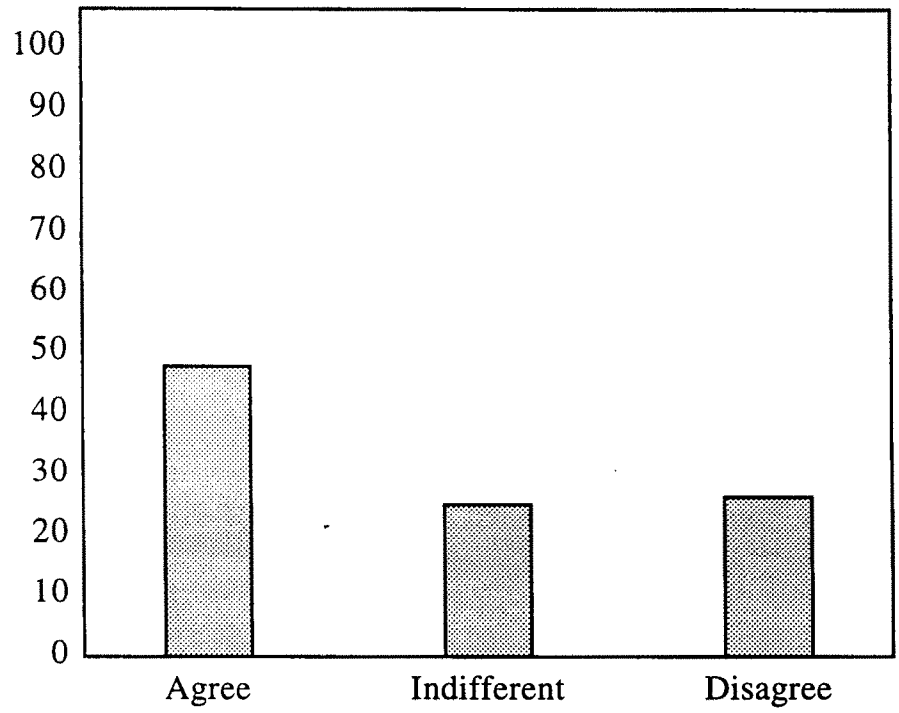
From the graph, it can be said that 56.5% showing agreeness, and 32% showing disagreeness. It can be concluded that the method of teaching encourage the student perfectly.

2.29 Learners are continously evaluated



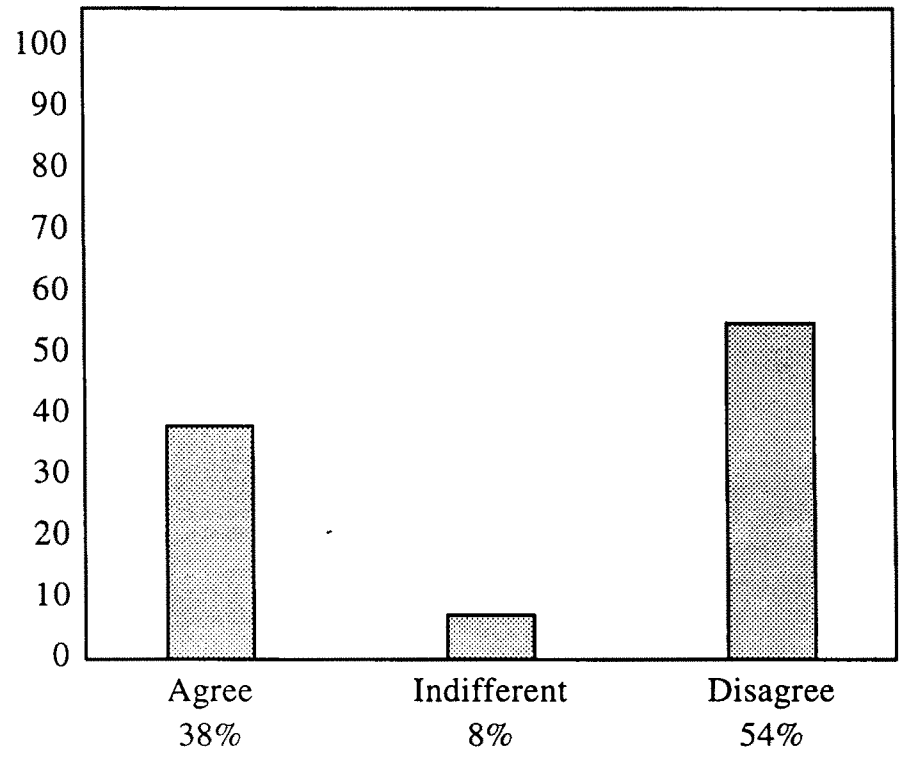
Statistics revealed that learners are not continuously evaluated. Science Curriculum in West Bengal are evaluated by summative approach and therefore learners are giving their opinion in disfavour of the statement.

2.30 Values like cooperation, sympathetic actions can be developed through the curriculum.



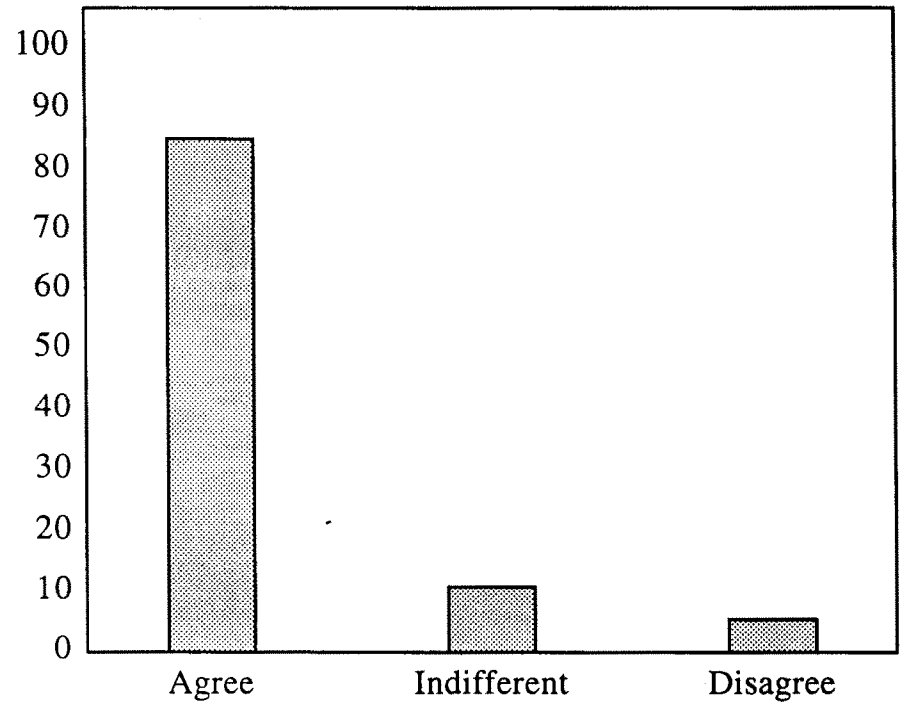
From the graph, it is clear that 48.5% showing agreeness, 26% showing neutrality and 25.5% showing disagreeness. Hence it can be concluded that the curriculum helps to develop values among the students.

2.31 Evaluation process is effective



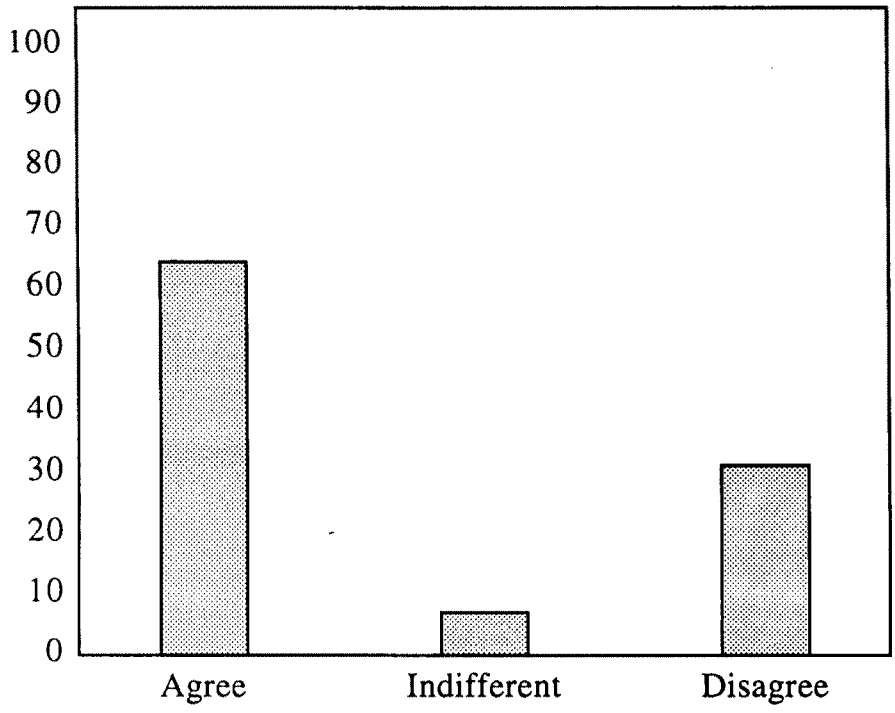
54% of the students in secondary level schools of West Bengal disagreed about the effectiveness of evaluation process.

2.32 Workshop, inter-school test, quiz, Seminar and such type of activity should include to develop interest among the students in Physical Science curriculum.



From the graph, it is clear that, 84.5% showing agreeness, 10% showing neutrality and 5.5% showing disagreeness towards the item. We can conclude that inter-school test, quiz etc are necessary to develop interest among the students.

2.33 The knowledge of Physical Science will help the students for their further study



From the graph, it is clear that, 62.5% students and teachers are showing agree ness, and 30.5% showing disagreeness.

Calculation :

2.7 Tools used : A standardised questionnaire is used for taking information and its analysis.

Initially a pilot study have been made with 78 items. After item analysis & item verification 60 items have been accepted.

2.8 Population : All the schools of secondary level have been considered as population in West Bengal.

Sample : Following schools have been selected from various parts of West Bengal as sample of the present study—

Sl. No.	Name of the school from which sample is selected	District
1.	Jetia Girls' High School	North 24 Parganas
2.	Malancha High School (Co-educational)	North 24 Parganas
3.	Shibpur Prasanna Kumari Balika Sikshalaya	Howrah
4.	Tiljala Brojanath Vidyapith (Boys)	South 24 Parganas
5.	Halisahar Rabindra Vidyamandir (Co-educational)	North 24 Parganas
6.	Chinsurah Balika Bani Mandir	Hooghly
7.	Nimtala Ragaswar High School (H.S.) (Co-Edu.)	Nadia
8.	Chalsa Gayanath Vidyapith (H.S.)	Jalpaiguri
9.	Khalboalia High School (H.S.) (Co-Edu.)	Nadia
10.	Lalbagh Shingh High School	Murshidabad
11.	Maharaja manindra Chandra High School	Murshidabad
12.	Bagmari High School	Murshidabad
13.	Tentulia Balika Vidyalaya	North 24 Parganas
14.	Ramchandrapur Balika Bidyalaya	North 24 Parganas
15.	Gangagharpur Girls' School	Jalpaiguri

16.	Mitelli High School	Jalpaiguri
17.	Deultpur High School	Howrah
18.	Gangadharpur Vidyamandir	Howrah
19.	Kanthi High School	Midnapur
20.	Tamluk High School	Midnapore
21.	Kulti Boys High School	Bardwan

2.9 Reliablity : The Questionnaire is highly reliable. Mainly Test-Restest method is used for calculating reliablity. The reliability coefficient is found to be 0.86.

Validity : Validity is calculated from reliability index and content validity is highly maintained.

2.10 Hypotheses : The type of research is discriptive survey type. Both discriptive & inferential statistics hare been used for conducting the study. To conduct the study following hypotheses are listed below :

Hypotheses :

HO_1 : There is no significant relationship between high & Low group of school infrastructure and Academic achievement.

HO_2 : There is no significant relationship between attitude towards school & Academic achievement

HO_3 : There is no significant difference between student teacher relationship and Academic achievement

HO_4 : There is no significant relationship between classroom climate and Academic achievement

HO_5 : There is no significant relationship between cocurricular activities and Academic achievement

HO_6 : There is no significant relationship between work culture and Academic achievement

HO_7 : There is no significant difference between boys & girls on the basis of school environment

HO_8 : There is no significant difference between urban & rural schools for school environment

HO_9 : There is no significant relationship between Teaching aids & Academic achievement

HO_{10} : There is no significant relationship between classroom management and Academiic achievement

HO_{11} : There is no significant relationship between attitude & Academic achievement in Teaching-Learning process.

HO_{12} : There is no significant relationship between explanation & academic achievement in Teaching-Learning process.

HO_{13} : There is no significant relationship between development of interest & Academic achievement in Teaching-Learning process.

HO_{14} : There is no significant relationship between reinforcement & Academic achievement in Teaching-Learning process.

HO_{15} : There is no significant relationship between organisation of content & Academic achievement

HO_{16} : There is no significant relationship between the way of introducing the lesson & Academic achievement

HO_{17} : There is no significant relationship between Remedial Teaching & Academic achievement

Ho_{18} : There is no significant difference between rural school students and urban school students towards the Content of the Physical Science curriculum at Secondary level in West Bengal.

Ho_{19} : There is no significant difference between rural school students and urban school students towards the development of interest in Physical Science curriculum at Secondary level in West Bengal.

Ho_{20} : There is no significant difference between rural school students and urban school students towards the Continuity in Physical Science curriculum at Secondary level in West Bengal.

Ho_{21} : There is no significant difference between rural school students and urban school students towards the consistency in Physical Science curriculum at Secondary level in West Bengal.

Ho_{22} : There is no significant difference between rural school students and urban school students towards the Future Prospects of the Physical Science curriculum at Secondary level in West Bengal.

Ho_{23} : There is no significant difference between rural school students and urban school students towards the Frustration due to the Physical Science curriculum at Secondary level in West Bengal.

Ho_{24} : There is no significant difference between rural school students and urban school students towards the Creativity in Physical Science curriculum at Secondary level in West Bengal.

Ho_{25} : There is no significant difference between rural school students and urban school students towards the Problem Solving Ability in Physical Science curriculum at Secondary level in West Bengal.

Ho_{26} : There is no significant difference between rural school students and urban school students towards the Method of Teaching Physical Science curriculum at Secondary level in West Bengal.

Ho_{27} : There is no significant difference between rural school students and urban school students towards the Examination System in Physical Science curriculum at Secondary level in West Bengal.

Ho_{28} : There is no significant difference between rural school students and urban school students towards the 'Value' education offered by the Physical Science curriculum at Secondary level in West Bengal.

Ho_{29} : There is no significant difference between rural school students and urban school students towards the generation of comprehensiveness in Physical Science curriculum at Secondary level in West Bengal.

HO_{30} : There is no significent difference in systematic evaluation in Urban & Rurul areas.

HO_{31} : There is no significant difference in evaluation system at Urban and rural area on the basis of continuous evaluation.

HO_{32} : There is no significant difference between Urban & Rural areas on the basis of effectiveness of evaluation system.

2.11 CALCULATION : SCHOOL ENVIRONMENT

Table – 2.1

Significance Mean difference in the measures of school environment and Academic achievement.

Sl. No.	School environment	Position	Academic achievement Mean	SD	CR
1.	Infrastructure	High	25.65	10.12	2.94*
		Low	19.06	9.65	
2.	Attitude towards school	High	28.15	10.74	3.50*
		Low	19.06	9.65	
3.	Student – Teacher Relationship	High	14.05	4.484	3.92*
		Low	12.48	3.73	
4.	Classroom climate	High	21.40	14.25	2.52*
		Low	17.25	9.42	
5.	Co-curricular activities	High	25.60	12.35	1.00
		Low	23.15	13.07	
6.	Work Culture	High	16.00	7.52	0.45
		Low	15.48	4.27	

Significant at 0.01 Level

Table – 2.2

ANOVA (Srata & Gender wise)

Strata (Sex)	Boys	Girls
Urban	100 students	100 students
Rural	100 Students	100 students

Table – 2.3

ANOVA Table for the Scope of School Environment

Source of variance	Sum of squares	d.f.	Mean squares	F Value
Sex	712	1	71	3.89*
Strata	95.8	1	952.8	5.205*
Sex x Strata : (Interaction)	169.56	1	169.56	0.926
Within	72481.23	396	183.03	

Table – 2.4

Values showing significance of Relationship between Academic Achievement and school environment

School Environment	Infrast ructure	Attitude towards school	Student Teachers relationship	Classroom climate	Co-curricular activities	Work culture
x^2 (df=1)	6.94*	7.38*	7.46*	6.80*	3.26	1.21

* Significant at 0.01 level

Table – 2.5 TEACHING LEARNING PROCESS

Significance Mean difference in the measures of Teaching Learning Process and Academic achievement.

Sl. No.	Teaching Learning Process	Position	Mean	SD	Academic achievement
1.	Teaching Aids	High	14.75	5.22	6.00*
		Low	22.07	7.39	
2.	Classroom Management	High	12.95	4.76	0.639
		Low	12.45	3.56	

3.	Development of Positive Attitude	High Low	2.75 19.1	13.04 12.99	1.86*
4.	Explanation	High Low	20.05 21.15	6.76 6.36	0.87
5.	Development of Interest	High Low	17.10 19.45	12.79 9.81	3.49*
6.	Reinforcement	High Low	25.15 19.5	8.32 10.13	3.25*
7.	Organisation of content	High Low	23.70 22.6	7.49 7.69	0.75
8.	Introduction of Lesson	High Low	8.75 19.5	10 9	0.396
9.	Remedial Teaching	High Low	18.40 24.99	11.24 13.8	2.72*

Table – 2.6

Values showing significance Relationship between Academic Achievement and Teaching Learning Process

Teaching Learning process	Teaching aids	Attitude	Interest	Reinforcement	Remedial teaching
X^2 (df=1)	6.12*	9.81*	7.38*	7.15*	6.86*

* Significant at 0.01 level

Table – 2.7 CALCULATION : EVALUATION TECHNIQUE

Significence Mean difference in the measures of Evaluation technique

Sl. No.	Evaluation technique	Position	Mean	SD	CR
1.	Systematic	Urban	20.00	5.10	3.02*
		Rural	14.75	5.90	
2.	Continuous	Urban	21.7	2.13	5.07*
		Rural	18.9	3.27	
3.	Effective	Urban	21.15	3.55	2.61*
		Rural	23	3.43	

* Significant at .01 level

Values showing significance Relationship between Academic Achievement and Evaluation technique.

	Systematic	Continuous	Effective
Evaluation Technique x^2 (df-1)	5.28*	6.49*	6.22*

* Significant at 0.01 level.

Table – 2.8

CALCULATION : CURRICULUM STRUCTURE

Hypotheses testing regarding curiculum structure

Ho_{18} There is no significant difference between rural school students and urban school students towards the Content of the Physical Science curriculum at Secondary level in West Bengal.

Type of School	N	Mean	Mean difference	Std Error Difference (SE_D)	't'
Rural	100	10.323	1.455	0.743	1.958
Urban	100	8.868			
			Not significant		

The findings revealed here statistically insignificant 't' value (t=1.958, not significant) which indicates the acceptance of Null hypothesis and establishes the uniformity among the two types of school students (rural and urban) towards the 'Content' dimension of 'Curriculum Evaluation'.

Ho_{19} There is no significant difference between rural school students and urban school students towards the development of interest towards the Physical Science curriculum at Secondary level in West Bengal.

Type of School	N	Mean	Mean difference	Std Error Difference (SE_D)	't'
Rural	100	7.823	0.250	0.406	0.614
Urban	100	7.573			
			Not significant		

The findings revealed here statistically insignificant 't' value (t=0.614, not significant) which indicates the acceptance of Null hypothesis and establishes the uniformity among the two types of school students (rural and urban) towards the 'Interest' dimension of 'Curriculum Evaluation'.

Ho_{20} There is no significant difference between rural school students and urban school students towards the Continuity in Physical Science curriculum at Secondary level in West Bengal.

Type of School	N	Mean	Mean difference	Std Error Difference (SE_D)	't'
Rural	100	3.117	0.708	0.345	2.049
Urban	100	2.409			
			Significant		

The findings revealed here statistically insignificant 't' value (t=2.049, significant at 0.05 level) which indicates the rejection of Null hypothesis and establishes the difference between the two types of school students (rural and urban) in relation to Continuity dimension in Curriculum Evaluation.

Ho_{21} There is no significant difference between rural school students and urban school students towards the Consistency in Physical Science curriculum at Secondary level in West Bengal.

Type of School	N	Mean	Mean difference	Std Error Difference (SE_D)	't'
Rural	100	7.824	1.397	0.581	2.404
Urban	100	3.426			
			Significant		

The findings revealed here statistically insignificant 't' value (t=2.404, significant at 0.05 level) which indicates the rejection of Null hypothesis and establishes the difference between the two types of school students (rural and urban) in relation to Consistency dimension in Curriculum Evaluation.

Ho_{22} There is no significant difference between rural school students and urban school students towards the Future Prospects of the Physical Science curriculum at Secondary level in West Bengal.

Type of School	N	Mean	Mean difference	Std Error Difference (SE_D)	't'
Rural	100	10.677	0.644	0.884	0.728
Urban	100	10.333			
			Not significant		

The findings revealed here statistically insignificant 't' value (t=0.728, not significant) which indicates the acceptance of Null hypothesis and establishes the uniformity among the two types of school students (rural and urban) towards the Future Prospect dimension of Curriculum Evaluation.

Ho_{23} There is no significant difference between rural school students and urban school students towards the Frustration due to the Physical Science curriculum at Secondary level in West Bengal.

Type of School	N	Mean	Mean difference	Std Error Difference (SE_D)	't'
Rural	100	3.029	0.168	0.321	0.522
Urban	100	3.197			

Not significant

The findings revealed here statistically insignificant 't' value (t=0.522, not significant) which indicates the acceptance of Null hypothesis and establishes the uniformity among the two types of school students (rural and urban) towards the Frustration dimension of Curriculum Evaluation.

Ho_{24} There is no significant difference between rural school students and urban school students towards the Creativity in Physical Science curriculum at Secondary level in West Bengal.

Type of School	N	Mean	Mean difference	Std Error Difference (SE_D)	't'
Rural	100	3.235	0.432	0.325	1.331
Urban	100	2.803			

Not significant

The findings revealed here statistically insignificant 't' value (t=1.331, not significant) which indicates the acceptance of Null hypothesis and establishes the uniformity among the two types of school students (rural and urban) towards the Creativity dimension of Curriculum Evaluation.

Ho_{25} There is no significant difference between rural school students and urban school students towards the Problem Solving Ability in Physical Science curriculum at Secondary level in West Bengal.

Type of School	N	Mean	Mean difference	Std Error Difference (SE_D)	't'
Rural	100	7.029	1.079	0.535	2.016
Urban	100	5.950			

* Significant at 0.05 level

The findings revealed here statistically insignificant 't' value (t=2.016, significant at 0.05 level), which indicates the rejection of Null hypothesis and establishes the difference between the two types of school students (rural and urban) in relation to Problem Solving Ability dimension of Curriculum Evaluation.

Ho_{26} There is no significant difference between rural school students and urban school students towards the Method of Teaching Physical Science curriculum at Secondary level in West Bengal.

Type of School	N	Mean	Mean difference	Std Error Difference (SE_D)	't'
Rural	100	6.824	1.512	0.471	3.210
Urban	100	5.312			

** Significant at 0.01 level

The findings revealed here statistically significant 't' value (t=3.210, significant at 0.01 level), which indicates the rejection of Null hypothesis and establishes the difference between the two types of school students (rural and urban) in relation to Method of Teaching dimension in Curriculum Evaluation.

Ho_{27} There is no significant difference between rural school students and urban school students towards the Examination System in Physical Science curriculum at Secondary level in West Bengal.

Type of School	N	Mean	Mean difference	Std Error Difference (SE_D)	't'
Rural	100	12.500	0.927	0.867	1.069
Urban	100	11.573			

Not significant

The findings revealed here statistically insignificant 't' value (t=1.069, not significant), which indicates the acceptance of Null hypothesis and establishes the difference between the two types of school students (rural and urban) in relation to Method of Teaching dimension in Curriculum Evaluation.

Ho_{28} There is no significant difference between rural school students and urban school students towards the 'Value' education offered by the Physical Science curriculum at Secondary level in West Bengal.

Type of School	N	Mean	Mean difference	Std Error Difference (SE_D)	't'
Rural	100	3.471	0.250	0.989	0.253
Urban	100	3.721			

Not significant

The findings revealed here statistically significant 't' value (t=0.253, not significant), which indicates the acceptance of Null hypothesis and establishes the uniformity among the two types of school students (rural and urban) towards th 'Value' dimension of 'Curriculum Evaluation'.

Ho_{29} There is no significant difference between rural school students and urban school students about comprehensiveness in Physical Science curriculum at Secondary level in West Bengal.

Type of School	N	Mean	Mean difference	Std Error Difference (SE_D)	't'
Rural	100	3.941	0.758	0.309	2.453
Urban	100	3.183			

** Significant at 0.05 level

The findings revealed here statistically significant 't' value (t=2.453, significant at 0.01 level), which indicates the rejection of Null hypothesis and establishes the difference between the two types of school students (rural and urban) in relation to 'Curiosity' dimension in 'Curriculum Evaluation'.

For the testing of the fourteenth hypothesis which was Null in nature, 't' value was calculated between the mean scores of college students and mean scores of school students. Here degrees of freedom 148. The tabulated value of 't' at 0.05 level of significance is 1.98 and at 0.01 level of significance is 2.61.

2.12 Interpretation of the Results

1. Infrastructure of school environment is significantly related to the academic achievement and hence the teaching learning system of physical science. Therefore hypothesis one is rejected.

2. It is observed that students performance are keenly related to their attitude towards school and therefore HO_2 is rejected.

3. Student teacher relationship has also greater impact towards the output of learners capability which we have from the statistical findings and therefore HO_3 is rejected.

4. Classroom climate of school environment will have to have a close relation towards the terminal performance of the learners and therefore H_4 is rejected.

5. Co-curricular activities of school environment and its relation to academic achievement is accepted in hypothesis five.

6. Generally we have a concept of work culture which have a significant relationship with the Academic achievement is rejected in our hypothesis no. 6.

7. From ANOVA it is observed that Urban School environment and Rural school environment differ significantly.

8. In Gender wise study of school environment it shows the significant difference and therefore H_8 is rejected.

9. Hypothesis regarding the mean difference of High Group and Low group of school environment is significant from 't' test.

   Therefore, it is concluded that school environment has a positive input on the academic advancement of learners specially on the dimensions of infrastructure, attitude towards school, student teacher relationship and classroom climate supported by the parametric statistics on the basis of assumed normal distribution and homogeneity, and so also further verified and supported by the distribution free X^2 test.

10. In Teaching-Learning process application of Teaching Aids helps the students for their academic betterment supported by the significant relationship between teaching and learning process and academic Achievement. Hence HO_9 is rejected

11. Development of Attitude and interest are also playing Key role for the Academic achievement in Teaching-learning Process.

12. Reinforcement in different ways also can give the enhancement of the performance of learners supported by 't' test.

13. In any Teaching Learning process many students are facing problems according to their individual ability & other factors too may promote their Academic Achievement through remedial Teaching.

14 From the findings it can be interpreted that the two types of schools (rural and urban) showing uniformity towards the dimensions – Content, Interest, Future Prospect, Frustrations, Creativity, Examination System and value pattern supported by the hypothesis No. HO_{18}, HO_{19}, HO_{22}, HO_{23}, HO_{24}, HO_{27} and HO_{28} .

15. It can also be interpreted that there are differences between the two schools in relation to the following dimensions – Continuity, Consistency, Problem Solving Ability, Curiosity in the Curriculum.

16. There is no gender sensitivity towards the present consideration of curriculum at Secondary Level School in West Bengal.

17. Urban schools & Rural schools differ significantly in respect to systematic & continuous evaluation. That is there is a difference between systematic & continuous evaluation in Urban & Rural areas supported by the hypothes No. HO_{30}, HO_{31} and HO_{32} .

18. From the critical ratio it is also interpreted that Urban & Rural areas differ significantly in respect to effective evaluation. On the basis of hypothesis testing and other available informations we are now potential to suggest a teaching learning system through which a school may be guided, by the significant factors reflected in our result mentioned earlier.

CHAPTER III

PRESENT EVALUATION SYSTEM OF PHYSICAL SCIENCE AT SECONDARY LEVEL SCHOOLS IN WEST BENGAL

3.1 PRESENT EVALUATION SYSTEM OF PHYSICAL SCIENCE AT SECONDARY LEVEL SCHOOLS IN WEST BENGAL

Actually the recent development in measurement of educational instrument and evaluation may be regarded as an extension and improvement of old practices. At present examinations are the usual means adopted in evaluating the achievement of the students.

As per the recommendation of Kothari Commission (1964), the structure of secondary education in West Bengal is reorganized in 1974 and school education of ten year's duration is introduced. At the end of class-X, West Bengal Board of Secondary Education conducts an external examination namely Madhyamik Examination to mark the termination of the first ten years of general school education. The examination is conducted on different subjects, Physical Science is one of them. In Madhyamik Examination, oral tests are also introduced along with the written tests. There are nine compulsory papers in the examination and each paper carries one hundred full marks. Ninety marks are allotted for written test and ten marks for oral test. The topics of the question papers are confined both to the syllabus of class Nine (ix) and Ten (x) and even to some items of class Eight (viii).

The system of examinations has always, had its criticize. Education Commissions and committees hitherto appointed by the Government of India have strongly felt the need of reforming examinations in Indian education from time to time. All the expert bodies have recommended that each Board or University should set up an examination research unit to analyse the examinations conducted under its supervision. The work of the unit should be to design the structures of examinations, to study tabulated marks for better scaling, to assist the paper-setters, in devising appropriate question items, and to make recommendations for better administration of examinations. They also pointed out that the reforms of examinations should be based on research evidence gathered, not merely through 'descriptive statistics such as frequency distributions, means and standard deviations of marks, but through 'correlational analysis of the individual questions of the existing external examinations'.

There is no doubt that several attempts had been made from time to time for reformation of the examination system. In West Bengal, according to the recommendation of Kothari Commission, the Secondary Education was reorganized in 1974. All the four factors of examination namely, the syllabus, the method of teaching, the question paper and the method of assessment had undergone a lot of changes for the improvement of the examination system. The present investigator is interested with the study of the third factor *i.e.* with

the evaluation of question papers. In the present set-up of question papers of Madhyamik Examination of West Bengal Board of Secondary Education, a lot of objective type items and short answer-type questions are included instead of the essay-type questions of the traditional examination system. But inspite of all the attempts, there are various types of criticisms for the question papers in Physical Science set in the Secondary Examination. Some are of the opinion that the questions set for the examination are not satisfactory and a group comments that the questions are hard enough. Sometimes it is also uttered that it is not at all difficult for the ordinary students to score 60% marks or above. The teachers, the students and the guardians did not agree as regards the difficulty level or discriminating power of the items set in the question papers. There are other comments also. But it is not possible on the part of the investigator to discuss overall the criticisms within limited time period. For this the present investigation into the question papers from a few specific angles.

The purpose of this study is to investigate the difficulty level of the questions, discriminating powers of the items, yearwise performance of the students and repetition of questions from year to year.

3.2 SAMPLE

a) **Area :** The test was applied on students living in urban areas.

b) **Class :** The test was applied on the students of class Ten (x) who completed the syllabus of class Nine (ix) in Physical Science according to West Bengal Board of Secondary Education.

c) **Number of Schools :** Tow boys' schools, one co-educational school and one girl's school had been taken for administration of the test.

d) **Number of students :** The test was administered on two hundred eleven students (one hundred fifty two boys and fifty nine girls). Out of them, hundred students were randomly selected for analysis and interpretation of data.

e) **Sex :** Out of hundred students, seventy boys were randomly selected from one-hundred fifty two boys and thirty girls were randomly selected from fifty nine girls.

A sample design is a definite plan completed and determined before any data are collected for obtaining a representative sample from a given population.

To study a whole population in order to arrive at generalization would be impracticable, if not possible. Fortunately, the process of sampling makes it

possible to draw valid inferences or generalizations on the basis of careful observation of variable within a relatively small proportion of the population.

Sampling tools save an investigator time, money, and energy and enable him to probe problems that are too unwisely to be tackled by conventional methods. To obtain a sample representative of its population, four main techniques have been devised; random, stratified or quota, incidental and purposive.

Nature of the sample under investigation

The sample under the present investigation is a stratified sample. The investigator considered two stratification on in terms of rural urban area and in selection of schools.

The schools also were not selected at random. Two boys' school, one girls' school and one co-educational school were selected for administering the test.

As the schools situated in semi-urban and rural area were not available in due time period, the schools of urban area were for the sake of working facilities.

The size of the sample

In order to make a study comprehensive and to avoid sampling error *i.e.* the variation, which may be attributed to chance elements, a large sample is necessary. But as the time is short because of school administration and work is survey in nature, the investigator has to remain satisfied by taking two hundred and eleven (211) students only.

Selection of the sample

The students were selected from two schools of Halisahar (Dist. 24 parganas). One Co-ed school from Nadia District and one girls' school from North 24 Parganas District. The investigator administered the test on all the students of Class-X present in the classroom of those institutions. Among them the number of boys were one hundred and fifty-two and the number of girls were fifty-nine only. After administering the test, the investigator selected following (Using Fischer's Table) seventy boys from one fifty-two boys and thirty girls from fifty-nine girls for analysis and interpretation of data.

As equal number of boys and girls were not available for administering the test, only thirty girls were selected.

3.3 AREA OF CONTENT

The test items were confined to the syllabus in Physical Science of West Bengal Board of Secondary Education taught in class-IX.

Selection of question papers : The question papers of consecutive four years (2001, 2002, 2003 and 2004) had been taken into consideration.

The present investigator admits that if the test was administered with the items confined both to the class (ix) and class (x) syllabuses of Physical Science, the survey was conducted on a limited number of students of class (x) from four schools of Urban areas and with question papers of consecutive four years only.

The system of examinations is open to much criticisms and yet examinations are indispensable. It is the integral part of the total system of education. So the study of evaluation and examinations is very essential for bringing about fruitful reforms in the system of education and examination.

For drawing up a consistent programme of examination reform, it is necessary as a first step to review the position through statistical analysis of all the four factors of examination and education as mentioned earlier. The present investigator is interested with the study of question papers and attempted to study the appropriateness of the question items from the viewpoint of their power of discrimination, difficulty value, repetitions questions etc. attempts have also been made to study yearwise performance of his sample. The present investigator will determine.

i) The difficulty value of the questions set in the question papers that is "to what extent the candidates achieve correctness of response to the item.

ii) The discriminating value of the questions set in the questionpapers.

iii) The repetitions of questions from year to year.

iv) The performance of sample in four consecutive years, is not possible to the investigator to make a thorough investigation on question papers from every point of view. But there is no doubt that properly constructed question papers can be very serviceable as a measuring tool of achievement of the students. The present investigator hopes that his findings and observations on question papers may be of particular interest to teachers, paper setters and examiners to evaluate the system.

The subject by its very nature offers ample opportunity for continuous research involving the past, the present, and the future systems of education and examination.

3.4 STATEMENT OF HYPOTHESES

From those considerations in view, the researcher formulated the following hypotheses:

1) The questions are not set in order of graded difficulty.

2) The questions are set in such a way that most of them cannot separate the high achievers from the low achievers.

3) Every year questions carrying 50% marks (approximate) are repeated from the question papers of the last three years.

4) The question paper does not vary in standard from year to year *i.e.*

   i) The students answering 2001 question paper do not vary significantly in answering 2002 question paper.

   ii) The students answering 2001 question papers do not vary significantly in answering 2003 question paper.

   iii) The students answering 2001 question papers do not vary significantly in answering 2004 question paper.

   iv) The students answering 2002 question papers do not vary significantly in answering 2003 question paper.

   v) The students answering 2002 question papers do not vary significantly in answering 2004 question paper.

   vi) The students answering 2003 question papers do not vary significantly in answering 2004 question paper.

ASSUMPTIONS FOR FRAMING THOSE HYPOTHESES

1) The researcher framed the hypothesis no. 1 and 2 after studying the related literature and taking into consideration the opinions of the experienced persons in the field of examinations.

2) After making a thorough look into the question papers, the investigator formulated by hypothesis no. 3.

3) The experienced persons, the guardians and the students opined that the standard of question papers very from year to year. But researcher's idea is different from them on the issue, so he formulated the hypothesis no. 4.

3.5 DEFINITION OF RELATED TERMS

(1) **Urban Area :** An urban area, according to 1971 census included all municipal towns, cantonments and any other areas being administered by local bodies such as – Town Committees, Union Committees etc. and any other place which satisfied the following empirical criteria *viz.* (1) a population of not less than 5000 persons. (2) a density of at least 1000 persons per square mile, (3) three-fourth of the occupation of the working population should be outside of agriculture, and (4) the place should have a few pronounced urban characteristics and amenities like location of educational, medical or public institutions, offices or trading centres in it.

(2) **Madhyamik Examination :** This Examination is conducted by the West Bengal Board of Secondary Education to mark the termination of the first ten years of general school education.

(3) **Question paper :** The tool for measuring the achievement of the students in the written test of any individual subject taught in the school.

(4) **High Achiever :** The students who obtained upper 27% marks in the test are called high achievers in this test.

(5) **Low Achiever :** The students who obtained lower 27% marks in the test are called low achievers in the test.

3.6 SELECTION OF TOOL

The question papers of Madhyamik Examination of West Bengal Board of Secondary Education are the tool for measuring the performance of the students in Physical Science.

The investigator selected the question papers of Madhyamik Examination in Physical Science of the last four consecutive years (2001, 2002, 2003, 2004 as it is difficult to study with more question papers within the limited time period.

3.7 CONTENT AREA SELECTED

The whole content area of the question papers in Physical Science of Madhyamik Examination is confined both to the syllabus of class-IX and class-X. But the investigator has selected only those items that correspond to the syllabus of class-IX as recommended by the West Bengal Board of Secondary Education.

The items that have been set from the syllabus of class-X as recommended by West Bengal Board of Secondary Education have been excluded as the students who have completed the syllabus of class-X have not been available in the schools and there are difficulties to administer the test on the students who have been allowed in the test examination at a particular time and at a particular place.

SEPARATION OF ITEMS THAT CORRESPOND TO THE SYLLABUS OF CLASS-IX

The investigator made a thorough look on the syllabus of class-IX in Physical Science as recommended by West Bengal Board of Secondary Education and there after the separated the questions corresponding to the syllabus of class-IX. For example, the questions that confined to syllabus of class IX were separated from the question paper of Madhyamik Examination and were printed on a paper and this paper was named as group A. In a similar way Group-B, Group-C and Group-D question papers were made ready from the question papers of Madhyamik Examination on 2001, 2002, 2003, 2004 respectively. It had been observed that in each group there were 20-25 items (approximately) carrying approximate 55 marks in total.

OPINIONS OF THE EXPERIENCED PERSONS ON SELECTION OF ITEMS

The original question papers and the prepared question papers were presented to some experienced teachers who are the examiners in Physical Science of Madhyamik Examination of West Bengal Board of Secondary Education. They were requested to judge whether the items of the prepared questions paper actually correspond to the syllabus of class-IX and whether the item that were excluded from the test actually correspond to the syllabus of class-X.

3.8 ADMINISTRATION OF THE TEST

The investigator administered the test on two consecutive days in every school. As the number of schools was four, eight days were taken for administration of the whole test. Group-A and Group-B test were administered on the first day and Group-C and Group-D test were administered on the same group of students on second day. The tests were administered on all the students

present in the classroom question papers and answering sheets were supplied to all the students.

Time allowed for answering the questions was three hours per day (from 11 a.m. to 2 p.m.). The students were asked to start at the same time. They were instructed to try each item. They were asked to complete the answers within the scheduled time limit. The tests were taken in a calm and quite atmosphere. The teachers of the schools rendered co-operation for the peaceful administration of the tool.

When the scheduled time was over, the answer scripts were collected from the students.

Afterwards the answer scripts of those who were absent in any one of the four group tests were cancelled. Only the answer-scripts of those who appeared on every group test were taken into consideration.

SCORING-PROCEDURE

After the administration of the test, the scoring of answer paper was made. The answers of questions were sub-divided into parts as far as possible to facilitate the procedure of scoring. The answer-scripts of the students were examined against scoring key. A scoring key consisting of right answers was made before hand. Marking was made on the basis of all or none principle. This meant that no partial credit was given to any answer of any student. Each correct answer was credit with full marks. The item that was either incorrectly answer or not attempt by an individual was given zero or no credit.

Then students' performance charts consisting of one hundred students for each of the four consecutive years were prepared so as to compute the analysis more easily.

The test scores obtained by the students in consecutive four years have been shown in Table-1.

FINDING OUT OF THE DIFFICULTY VALUES OF THE TEST ITEMS

The difficulty values of test items were considered to be very important aspect of a test. If response to a test item be classified as either correct or incorrect, the difficulty value may be defined as the ratio of the number of correct answers to the total number of students participating in the test.

DISCRIMINATING VALUES OF TEST ITEMS

The discriminating value is how far an item discriminates the high achievers from low achievers. Out of the various methods adopted by the psychometricions, the investigator, here, in this study used the method adopted by Johnson by taking into account the difference of upper 27 per cent of the total group and lower 27 per cent of the total group responding to an item.

The researcher computed the upper lower index of each item with the help of the formula:

$$ULI = \frac{R_U - R_l}{f}$$

Where ULI = Upper-lower index;

R_u, R_l = Numbers giving right answers in upper and lower groups, respectively;

f = Number of examinees in each group;

THOROUGH ENQUIRY IN THE QUESTION PAPERS REGARDING REPETITIONS OF QUESTIONS

A thorough enquiry is made by the investigator to study repetitions of the questions in the question-paper of every year, which is shown in Table-20.

YEARWISE DIFFERENCE IN PERFORMANCE

Year to year difference in performance of the subjects is studied by the investigator.

STATISTICAL CALCULATION

To interpret the data collected in the research work, the investigator uses the mean, median, standard deviation, skewness, kurtosis and the 't' test for testing whether there is significant difference between the groups.

CHOICE OF STATISTICAL TEST

Conditions (1) Independence of the observations, (2) Normality of population distributions and (3) homogeneity of the groups required for 't' test are to be satisfied by the conditions. Since the sizes of the groups to be compared are equal, the conditions (2) and (3) however need not be satisfied. Thus under the assumption of independence of observation the 't' test may be applied for analysis of data.

't' Test

The 't' test helps us to determine whether two groups differ significantly in mean performance and enables us to say with confidence that there is a difference between the means of the population from which the samples were drawn. The equation of the 't' test is stated as follows:

$$t = \frac{M_1 - M_2}{\sqrt{\frac{a_1^2}{N_1} + \frac{a_2^2}{N_2}}}$$

Where M_1 and M_2 represent two sample means of group A and group B and a_1 and a_2 are the standard deviation of the two samples respectively.

Where a difference is to be taken significant or not depends upon the probability that the given differences could have arisen "bychance".

Experimenters have for convenience chosen arbitrary standards, called levels of significance of which .05 and .01 levels are most often used.

SAMPLE

The population of the sample is the Learners of secondary Level students in West Bengal. We are selecting our sample specially Xth Grade students of the following schools.

Sl. No.	Name of the school from which sample is selected	District
1.	Jetia Girls' High School	North 24 Parganas
2.	Malancha High School (Co-educational)	North 24 Parganas
3.	Shibpur Prasanna Kumari Balika Sikshalaya	Howrah

4.	Tiljala Brojanath Vidyapith (Boys)	South 24 Parganas
5.	Halisahar Rabindra Vidyamandir (Co-educational)	North 24 Parganas
6.	Chinsurah Balika Bani Mandir	Hooghly
7.	Nimtala Ragaswar High School (H.S.) (Co-Edu.)	Nadia
8.	Chalsa Gayanath Vidyapith (H.S.)	Jalpaiguri
9.	Khalboalia High School (H.S.) (Co-Edu.)	Nadia
10.	Lalbagh Shingh High School	Murshidabad
11.	Maharaja manindra Chandra High School	Murshidabad
12.	Bagmari High School	Murshidabad
13.	Tentulia Balika Vidyalaya	North 24 Parganas
14.	Ramchandrapur Balika Bidyalaya	North 24 Parganas
15.	Gangagharpur Girls' School	Jalpaiguri
16.	Mitelli High School	Jalpaiguri
17.	Deultpur High School	Howrah
18.	Gangadharpur Vidyamandir	Howrah
19.	Kanthi High School	Midnapur
20.	Tamluk High School	Midnapore
21.	Kulti Boys High School	Bardwan

3.9 PRESENTATION AND ANALYSIS OF DATA TEST SCORES IN PHYSICAL SCIENCE

The test has been applied on two hundred and eleven students. Among them seventy boys are randomly selected from one hundred and fifty two boys and thirty girls are randomly selected from fifty nine girls. The scores obtained by the students are given in Table No. 1.

The frequency distribution of the students have been shown in Table No. 2, 3, 4, 5.

Table – 3.1 : Presentation of the Test Scores of the students in Physical Science of the four consecutive years.

CN	2001 (X)	2002 (X)	2003 (X)	2004 (X)
009	49	47	17	42
0035	14	20	20	17
026	21	14	11	30
012	34	12	35	21
005	5	16	27	20
054	11	15	43	15
032	22	27	19	9
064	7	16	15	31
051	10	25	38	46
042	18	29	36	30
102	14	26	21	29
030	22	17	23	22
016	11	5	33	15
106	11	5	33	15
123	7	7	23	26
135	20	6	12	32
171	31	12	26	42
031	27	13	22	29
058	23	12	29	27
190	15	22	31	19
082	26	24	16	33

CN	2001 (X)	2002 (X)	2003 (X)	2004 (X)
126	10	16	39	4
143	22	11	44	48
075	28	13	40	25
061	22	23	44	16
105	16	24	7	27
089	6	29	24	34
099	5	24	33	20
108	11	20	42	17
178	9	16	20	30
204	28	18	25	37
003	19	25	39	29
104	33	5	34	12
053	11	21	35	34
038	19	8	15	20
098	15	20	13	33
019	17	46	29	17
066	15	10	22	31
150	12	16	28	36
079	37	17	24	16
156	30	10	30	35
160	17	10	41	19
085	5	24	24	23
147	8	17	16	17
008	5	11	24	21
101	23	13	33	16
048	26	14	10	15
113	11	11	20	11
120	12	7	32	20
023	17	6	30	12
184	36	21	39	11
169	32	23	18	22
159	20	23	37	13

CN	2001 (X)	2002 (X)	2003 (X)	2004 (X)
001	22	11	19	29
037	21	21	34	25
029	43	18	17	31
077	31	20	6	30
121	15	21	16	25
006	24	5	28	31
010	24	6	32	24
059	10	15	47	32
034	19	5	19	21
081	16	13	29	16
103	24	9	27	34
125	13	26	45	23
148	17	19	30	32
015	19	37	21	16
040	25	33	46	27
063	29	26	35	24
086	15	10	32	23
109	6	11	16	14
132	25	21	23	20
154	8	18	30	10
013	9	22	32	21
045	20	21	25	27
068	6	10	24	32
091	24	22	37	30
137	12	13	15	10
161	15	28	39	7
002	47	6	17	19
027	12	16	37	35
052	21	22	31	38
074	8	21	18	28
100	16	19	29	20
131	19	36	5	39
153	14	27	34	33

CN	2001 (X)	2002 (X)	2003 (X)	2004 (X)
090	18	25	27	22
190	12	14	20	25
164	21	27	28	37
177	16	24	35	22
146	18	12	26	34
108	17	11	36	33
017	17	20	34	15
197	5	15	30	39
065	13	20	15	34
182	23	43	25	32
183	13	19	21	28
203	23	9	26	35
195	13	13	20	28
039	16	22	25	17

Table – 3.2 : Frequency distribution of test scores of the students in Physical Science in 2001.

Scores	f
45-49	2
40-44	1
35-39	2
30-34	6
25-29	7
20-24	22
15-19	24
10-14	21
5-9	15
Total (N) =	100

Mean (M) = 18.45 Quartile Deviation (Q) = 5.515

Median (Mn) = 17.42 Skewness (Sk) = 1.66

Standard deviation (SD) = 8.63 Kurtosis (Ku) = 0.245

All calculations and formula are given in the Appendix.

Table – 3.3 : Frequency distribution of test scores of the students in Physical Science in 2002.

Scores	f
45-49	1
40-44	2
35-39	2
30-34	1
25-29	13
20-24	21
15-19	21
10-14	25
5-9	14
Total (N) =	100

Mean (M) = 17.65 Quartile Deviation (Q) = 5.665

Median (Mn) = 16.88 Skewness (Sk) = 0.765

Standard deviation (SD) = 8.11 Kurtosis (Ku) = 0.285

Table – 3.4 : Frequency distribution of test scores of the students in Physical Science in 2003.

Scores	f
45-49	5
40-44	4
35-39	15
30-34	17
25-29	17
20-24	17
15-19	18
10-14	4
5-9	3
Total (N) =	100

Mean (M) = 27.10 Quartile Deviation (Q) = 7.355

Median (Mn) = 26.85 Skewness (Sk) = 0.40

Standard deviation (SD) = 9.565 Kurtosis (Ku) = 0.309

All Calculations are given in Appendix

Table – 3.5 : Frequency distribution of test scores of the students in Physical Science in 2004.

Scores	f
45-49	2
40-44	2
35-39	8
30-34	23
25-29	19
20-24	18
15-19	16
10-14	9
5-9	3
Total (N) =	100

Mean (M) = 24.80 Quartile Deviation (Q) = 6.605

Median (Mn) = 25.29 Skewness (Sk) = - 1.3125

Standard deviation (SD) = 8.84 Kurtosis (Ku) = 0.296

Difficulty-Indices

Each item of the question papers of 2001, 2002, 2003 and 2004 are analyzed in terms of difficulty value.

In Table No. 6, 7, 8 & 9 statements of difficulty values of the items in the question papers of 2001, 2002, 2003 and 2004 have been shown respectively.

Table – 3.6 : Difficulty values of the items in 2001.

Item No.	Difficulty values	Item No.	Difficulty values
1 (a)	77.78	2 (b)	81.48
1 (b)	66.67	2 (c)	9.26
1 (c)	22.22	2 (d)	31.48
1 (d)	59.26	2 (e)	35.18
1 (e)	59.26	3 (a)	40.74
1 (f)	48.15	3 (b)	22.22
1 (g)	59.26	3 (c)	3.70

Item No.	Difficulty values	Item No.	Difficulty values
1 (h)	61.11	3 (d)	12.96
1 (i)	57.41	3 (e)	3.70
2 (a)	72.22	4 (a)	61.11
4 (b)	88.89	6 (a)	16.67
4 (c)	29.63	7 (a)	55.56
5 (a)	29.63	7 (b)	55.56
5 (b)	16.67		

Table – 3.7 : Difficulty values of the items in 2002.

Item No.	Difficulty values	Item No.	Difficulty values
1 (a)	40.74	3 (c)	20.37
1 (b)	90.74	4 (a)	7.41
1 (c)	59.26	4 (b)	22.22
1 (d)	33.33	4 (c)	0
2 (a)	16.67	5 (a)	33.33
2 (b)	42.59	5 (b)	27.78
2 (c)	44.44	6 (a)	77.78
2 (d)	88.89	6 (b)	61.11
2 (e)	9.26	6 (c)	31.48
3 (a)	24.07	7 (a)	62.96
3 (b)	7.41	7 (b)	7.41

Table – 3.8 : Difficulty values of the items in 2003.

Item No.	Difficulty values	Item No.	Difficulty values
1.a (i)	83.33	2 (d)	0
1. a (ii)	100.00	3.	61.11
1. a (iii)	83.33	4 (a)	83.33
1. a (iv)	66.67	4 (b)	87.04
1. a (v)	62.96	4 (c)	27.78
1. a (vi)	61.11	5 (a)	29.63
1b (i)	59.26	5 (b)	40.74

Item No.	Difficulty values	Item No.	Difficulty values
1b (ii)	81.48	6 (a)	50.00
1b (iii)	53.70	6 (b)	70.37
Ib (iv)	44.44	6 (c)	40.74
1b (v)	66.67	7 (a)	72.22
2 (a)	50.00	7 (b)	27.78
2 (b)	33.33	7 (c)	24.07
2 (c)	5.56		

Table – 3.9 : Difficulty values of the items in 2004.

Item No.	Difficulty values	Item No.	Difficulty values
1 (a)	46.30	3 (c)	0
1 (b)	74.07	4 (a)	3.70
1 (c)	25.93	4 (b)	50.00
1 (d)	29.63	4 (c)	20.37
1 (e)	27.78	5 (a)	42.59
1 (f)	25.93	5 (b)	7.40
1 (g)	35.19	6 (a)	18.52
1 (h)	70.37	6 (b)	92.59
1 (i)	11.11	7 (a)	85.19
2 (a)	68.52	7 (b)	25.93
2 (b)	40.74	7 (c)	42.59
2 (c)	1.86	8a (i)	25.93
2 (d)	85.19	8a (ii)	25.93
2 (e)	29.63	8a (iii)	61.11
3 (a)	77.78	8b (i)	31.48
3 (b)	20.37	8b (ii)	

From the studies of the difficulty values of items of the question papers of Madhyamik Examination of West Bengal Board of Secondary Examination in the years 2001, 2002, 2003 and 2004, it is evident that the questions are not set in order of graded difficulty which leads to the retention of hypothesis H_1.

Discriminating Indices :

The discriminating values of the items in the question papers of 2001, 2002, 2003 and 2004 have also been found out and shown in Table No. 10, 11, 12, 13 respectively. It contains serial number of the items, the number of successful students in upper 27% group, number of successful students in lower 27% group, and discriminating value of each item.

Frequency distribution of difficulty values and discriminating values of the items for every year has been shown in Table No. 14 and Table No. 15.

Table – 3.10 : Discriminating values of item in 2001.

Item No.	U. Gr.	L. Gr.	Discriminating values
1.a	24	18	0.22
1.b	25	11	0.52
1.c	8	4	0.15
1.d	19	13	0.22
1.e	21	11	0.37
1.f	18	8	0.37
1.g	22	10	0.44
1.h	20	13	0.26
1.i	20	11	0.33
2. a	27	12	0.56
2. b	24	20	0.15
2.c	5	0	0.18
2.d	17	0	0.63
2.e	16	3	0.48
3.a	22	0	0.81
3.b	12	0	0.44
3.c	2	0	0.07
3.d	7	0	0.26
3.c	2	0	0.07
1.a	25	8	0.63
4.b	27	21	0.22
4.c	15	1	0.52

Item No.	U. Gr.	L. Gr.	Discriminating values
5.a	13	3	0.37
5.b	8	1	0.26
6.a	9	0	0.33
6.b	3	0	0.11
7.a	22	8	0.52
7.b	22	8	0.52

Table – 3.11 : Discriminating values of item in 2002.

Item No.	U. Gr.	L. Gr.	Discriminating values
1. a	14	8	0.22
1. b	27	22	0.19
1. c	25	7	0.66
1. d	15	3	0.44
2. a	7	2	0.19
2. b	18	5	0.48
2. c	18	6	0.44
2. d	25	23	0.07
2. e	4	1	0.11
3. a	13	0	0.48
3.b	4	0	0.15
3. c	9	2	0.26
4. a	4	0	0.15
4. b	12	0	0.44
4. c	0	0	0
5. a	13	5	0.30
5. b	13	2	0.41
6. a	27	15	0.44
6. b	27	5	0.78
6. c	17	0	0.63
7. a	24	10	0.52
7. b	4	0	0.15

Table – 3.12 : Discriminating values of item in 2003.

Item No.	U. Gr.	L. Gr.	Discriminating values
1. a	25	20	0.19
1. a	27	27	0
1. a	24	21	0.11
1.a	23	13	0.37
1. a	25	9	0.59
1. a	20	13	0.26
1. b	23	9	0.52
1. b	27	17	0.37
1. b	22	7	0.56
1.b	23	1	0.81
1.b	25	11	0.52
2. a	21	6	0.56
2. b	15	3	0.44
2. c	3	0	0.11
2. d	0	0	0
3.	18	15	0.11
4. a	26	19	0.26
4. b	26	21	0.19
4. c	14	1	0.48
5. a	22	0	0.81
5. b	22	0	0.81
6. a	19	8	0.41
6. b	26	12	0.52
6. c	20	2	0.67
7. a	24	15	0.33
7. b	15	0	0.56
7. c	13	0	0.48

Table – 3.13 : Discriminating values of item in 2004.

Item No.	U. Gr.	L. Gr.	Discriminating values
1. a	16	9	0.26
1. b	22	18	0.15
1. c	8	6	0.07
1. d	9	7	0.07
1. e	12	3	0.33
1. f	7	7	0
1. g	13	6	0.26
1. h	27	11	0.59
1.i	3	3	0
2. a	26	11	0.56
2. b	21	1	0.74
2. c	1	0	0.04
2. d	26	20	0.22
2. e	15	1	0.52
3. a	27	15	0.44
3. b	11	0	0.41
3. c	26	2	0.89
4. a	0	0	0
4. b	2	0	0.07
4.c	20	7	0.48
5. a	11	0	0.41
5. b	21	2	0.70
6. a	4	0	0.15
6. b	10	0	0.37
7.a	27	23	0.15
7. b	27	19	0.30
7. c	7	7	0
8. a (i)	13	0	0.11
8. a (ii)	11	3	0.30
8. a (iii)	11	3	0.30
8. b (i)	22	11	0.41
8.b (ii)	13	4	0.33

U. Gr. – Denotes upper group; i.e. upper 27% of the total sample, L. Gr.- Denotes lower group; i.e. lower 27% of the total sample. Total number of students involved in the test being 100.

From the table No. 10, 11, 12 and 13 of Discriminating values, it is evident that most of the items have not been able to discriminate the high achievers from the low achievers which leads to acceptance of 2nd Hypothesis (H_2).

Table – 3.14 : Frequency distribution of difficulty values of the items in 2001, 2002, 2003 and 2004.

Difficulty values	f (2001)	f (2002)	f (2003)	f (2004)
1.00-1.04	0	0	1	0
. 95-.99	0	0	0	0
. 90 - .94	0	1	0	1
. 85 - .89	1	1	1	2
.80 - .84	1	0	4	0
. 75 - .79	1	1	0	1
.70 - .74	1	0	2	3
. 65 - .69	1	0	2	1
.60 - .64	2	2	3	1
.55 - .59	6	1	1	0
.50-.54	0	0	3	2
.45 - .49	1	0	0	1
.40 - .44	1	3	3	3
.35-.39	1	0	0	2
.30 - .34	3	3	2	3
.25-.29	0	1	2	5
.20-.24	2	3	1	2
.15 - .19	2	1	0	2
.10-.14	1	0	0	1
.5-.09	2	4	1	0
0 – .04	2	1	1	1
Total No. of items	**N = 28**	**N = 22**	**N = 27**	**N = 32**

Table – 3.15 : Frequency distribution of discrimination values of the items in 2001, 2002, 2003, 2004.

Difficulty values	f (2001)	f (2002)	f (2003)	f (2004)
1.00-1.04	0	0	0	0
. 95-.99	0	0	0	0
. 90 - .94	0	0	0	0
. 85 - .89	0	0	0	1
.80 - .84	1	0	2	0
. 75 - .79	0	1	0	0
.70 - .74	0	0	0	2
. 65 - .69	0	1	1	0
.60 - .64	2	1	0	0
.55 - .59	1	0	5	2
.50-.54	4	1	3	1
.45 - .49	1	2	2	1
.40 - .44	2	5	2	4
.35-.39	3	0	2	1
.30 - .34	2	1	1	5
.25-.29	3	1	2	2
.20-.24	3	1	0	1
.15 - .19	3	5	2	3
.10-.14	1	1	3	1
.5-.09	2	1	0	2
0 – .04	0	1	2	3
Total No. of items	**N = 28**	**N = 22**	**N = 27**	**N = 32**

Table – 3.16 : Comparative study of difficulty values and discriminating values in 2001.

Item No.	Difficulty Values	Discriminating Values	Item Values	Difficulty Values	Discriminating Values
1. (a)	77.78	0.22	3. a	40.74	0.81
1. b	66.67	0.52	3. b	22.22	0.44
1. c	22.22	0.15	3. c	3.70	0.07
1. d	59.26	0.22	3. d	12.96	0.26
1. e	59.26	0.37	3. e	3.70	0.07
1. f	48.15	0.37	4. a	61.11	0.63
1. g	59.26	0.44	4. b	88.89	0.22
1. h	61.11	0.26	4. c	29.63	0.52
1.i	57.41	0.33	5. a	29.63	0.52
2. a	72.22	0.56	5. b	16.67	0.26
2. b	81.48	0.15	6. a	16.67	0.33
2. c	9.26	0.18	6. b	5.56	0.11
2. d	31.48	0.63	7. a	55.56	0.52
2. e	35.18	0.48	7. b	55.56	0.52

Table – 3.17 : Comparative study of difficulty values and discriminating values in 2002 .

Item No.	Difficulty values	Discriminating values
1. a	40.74	0.22
1. b	90.74	0.19
1. c	59.26	0.66
1. d	33.33	0.44
2. a	16.67	0.19
2. b	42.59	0.48
2. c	44.44	0.44
2. d	88.89	0.07
2. e	9.26	0.11
3. a	24.07	0.48

Item No.	Difficulty values	Discriminating values
3. b	7.41	0.15
3. c	20.37	0.26
4.a	7.41	0.15
4. b	22.22	0.44
4. c	0	0
5. a	33.33	0.30
5. b	27.78	0.41
6. a	77.78	0.44
6. b	61.11	0.78
6. c	31.48	0.63
7. a	62.96	0.52
7. b	7.41	0.15

Table – 3.18 : Comparative study of difficulty values and discriminating values in 2003.

Item No.	Difficulty values	Discriminating values	Item No.	Difficulty values	Discriminating values
1. a (i)	83.33	0.19	2. d	0	0
1. a (ii)	100.00	0	3.	61.11	0.11
1. a (iii)	83.33	0.11	4. a	83.33	0.26
1. a (iv)	66.67	0.37	4. b	87.04	0.19
1. a (v)	62.96	0.59	4. c	27.78	0.48
1. a (vi)	61.11	0.26	5. a	29.63	0.59
1. b (i)	59.26	0.52	5. b	40.74	0.81
1. b (ii)	81.48	0.37	6. a	50.00	0.41
1. b (iii)	53.70	0.56	6. b	70.37	0.52
1. b (iv)	44.44	0.81	6. c	40.74	0.67
1. b (v)	66.67	0.52	7. a	72.22	0.33
2. a	50.00	0.56	7. b	27.78	0.56
2. b	33.33	0.44	7. c	24.07	0.48
	2. c	5.56	0.11		

Table – 3.19 : Comparative study of difficulty values and discriminating values in 2004.

Item No.	Difficulty values	Discriminating values
1. a	46.30	0.26
1. b	74.07	0.15
1. c	25.93	0.07
1. d	29.63	0.07
1. e	27.78	0.33
1. f	25.93	0
1. g	25.19	0.26
1. h	70.37	0
1.i	11.11	0
2. a	68.52	0.56
2. b	40.74	0.74
2. c	1.86	0.04
2. d	85.19	0.22
2. e	29.63	0.52
3. a	77.78	0.44
3. b	20.37	0.41
3. c	51.85	0.89
4. a	0	0
4. b	3.70	0.07
4. c	50.00	0.48
5. a	20.37	0.41
5. b	42.59	0.70
6. a	7.40	0.15
6. b	18.52	0.37
7. a	92.59	0.15
7. b	85.19	0.30
7. c	25.93	0

8. a (i)	42.59	0.11
8. a (ii)	25.93	0.30
8. a (iii)	25.93	0.30
8. b (i)	61.11	0.41
8. b (ii)	31.48	0.33

From the comparative study of the table 16, 17, 18, 19 giving difficulty values and the discriminating values of the items, it is evident that the items that have medium difficulty values could discriminate the high achievers from the low achievers more distinctly (having higher discriminating values) a few exception.

The higher the numerical value of the index of difficulty the easier the item and lower in the discriminating power of the item.

Exactly what the expected value of index of discrimination would be for any level of item difficulty depends on other characteristics of the item and the test.

Repetitions of questions

Repetitions of questions in the question paper from last year, alternate year and three years earlier, have been studied by the investigator which have been shown in Table No. 20.

Table – 3.20 : Repetitions of questions from last three years

Repetition from last year	Repetition from alternate year	Repetition from three years earlier
10%	20%	25%

From the study of repetitions in the question papers, it is evident that questions carrying 55% marks are repeated in the question papers of last three years.

Determination of statistics of scores of obtained by the students in the test :

The statistics of the tests showing mean, median, standard deviation, quartile deviation, Skewness, Kurtosis have been shown in Table No. 21.

Table – 3.21 : Statistics of the scores relating to the measures of central tendency and variability.

	2001	2002	2003	2004
Mean (M)	18.45	17.65	27.10	24.80
Median (Mdn.)	17.42	16.88	26.85	25.29
Standard Deviation (SD)	8.63	8.11	9.565	8.84
Quartile deviation	5.515	5.565	7.355	6.605
Skewness	1.66	0.765	0.40	-1.3125
Kurtosis	0.145	0.285	0.309	0.296

For comparing the investigator presented the distribution of scores of the students year-wise. All these distributions had been shown in Tables 22, 23, 24, 25, 26 & 27 respectively.

Table – 3.22 : Presentation of the distributions of scores of the students in 2001 and 2002 in test in Physical Science.

	2001			2002		
Scores	**f**	**Cum. f**	**Cum f%**	**f**	**Cum. f**	**Cum f%**
45-49	2	100	100	1	100	100
40-44	1	98	98	2	99	99
35-39	2	97	97	2	97	97
30-34	6	95	95	1	95	95
25-29	7	89	89	13	94	94
20-24	22	82	82	21	81	81
15-19	24	60	60	21	60	60
10-14	21	36	36	25	39	39
5-9	15	15	15		14	14
		N = 100			**N = 100**	

Table – 3.23 : Presentation of the distribution of scores in the test of Physical Science in 2001 and 2003.

	2001			2003		
Scores	**f**	**Cum. f**	**Cum. f%**	**f**	**Cum. f**	**Cum. f%**
45-49	2	100	100	5	100	100
40-44	1	98	98	4	95	95
35-39	1	98	98	4	91	95
30-34	6	95	95	17	76	76
25-29	7	89	89	17	59	59
20-24	22	82	82	17	42	42
15-19	24	60	60	18	25	25
10-14	21	36	36	4	7	7
5-9	15	15	15	3	3	3
		N = 100			**N = 100**	

Table – 3.24 : Presentation of the distribution of scores in the test of Physical Science in 2001 and 2004.

	2001			2004		
Scores	**f**	**Cum. f**	**Cum. f%**	**f**	**Cum. f**	**Cum. f%**
45-49	2	100	100	2	100	100
40-44	1	98	98	2	98	98
35-39	2	97	97	8	96	96
30-34	6	95	95	23	88	88
25-29	7	89	89	19	65	65
20-24	22	82	82	18	46	46
15-19	24	60	60	16	28	28
10-14	21	36	36	9	12	12
5-9	15	15	15	3	3	3
		N = 100			**N = 100**	

Table – 3.25 : Presentation of the distribution of scores in the test of Physical Science in 2002 and 2003.

	2002			2003		
Scores	**f**	**Cum. f**	**Cum. f%**	**f**	**Cum. f**	**Cum. f%**
45-49	1	100	100	5	100	100
40-44	2	99	99	4	95	95
35-39	2	97	97	15	91	91
30-34	1	95	95	17	76	76
25-29	13	94	94	17	59	59
20-24	21	81	81	17	42	42
15-19	21	60	60	18	25	25
10-14	25	39	39	4	7	7
5-9	14	14	14	3	3	3
		N = 100			**N = 100**	

Table – 3.26 : Presentation of the distribution of scores in the test of Life Science in 2002 and 2004.

	2002			2004		
Scores	**f**	**Cum. f**	**Cum. f%**	**f**	**Cum. f**	**Cum. f%**
45-49	1	100	100	2	100	100
40-44	2	99	99	2	98	98
35-39	2	97	97	8	96	96
30-34	1	95	95	23	88	88
25-29	13	94	94	19	65	65
20-24	21	81	81	18	46	46
15-19	21	60	60	16	28	28
10-14	25	39	39	9	12	12
5-9	14	14	14	3	3	3
		N = 100			**N = 100**	

Table – 3.27 : Presentation of the distribution of scores in the test of Physical Science in 2003 and 2004.

	2003			2004		
Scores	**f**	**Cum. f**	**Cum. f%**	**f**	**Cum. f**	**Cum. f%**
45-49	5	100	100	2	100	100
40-44	4	95	95	2	98	98
35-39	15	91	91	8	96	96
30-34	17	76	76	23	88	88
25-29	17	59	59	19	65	65
20-24	17	42	42	18	46	46
15-19	18	25	25	16	28	28
10-14	4	7	7	9	12	12
5-9	3	3	3	3	3	3
		N = 100			**N = 100**	

Finding out of the difference in performance of the students in comparison to different years.

Year-wise difference in performance of the students is studied and it is tested whether there is significant difference between the performance of the students from year to year, which is shown in Table-28.

Table – 3.28 : Year to year difference in performance of the subject Physical Science

Year	Statistics		Value	Level of significance
2001-2002	$N_1 = 100$	$N_2 = 100$	0.675	Not significant
	$M_1 = 18.45$	$M_2 = 17.65$		
	$s_1 = 8.63$	$s_2 = 8.11$		
2001-2003	$N_2 = 100$	$N_1 = 100$	6.714	Significant at .01 level
$M_2 = 18.45$	$M_1 = 27.10$			
	$s_2 = 8.63$	$s_1 = 9.565$		

2001-2004				
	$N_2 = 100$	$N_1 = 100$	5.14	Significant at .01 level
$M_2 = 18.45$	$M_1 = 24.80$			
	$s_2 = 8.63$	$s_1 = 8.84$		
2002-2003	$N_2 = 100$	$N_1 = 100$	7.54	Significant at .01 level
	$M_2 = 17.65$	$M_1 = 27.10$		
	$s_2 = 8.11$	$s_1 = 9.565$		
2002-04	$N_2 = 100$	$N_1 = 100$	5.96	Significant at 0.01 level
	$M_2 = 17.65$	$M_1 = 24.80$		
	$s_2 = 8.11$	$s_1 = 8.84$		
2003-04	$N_1 = 100$	$N_2 = 100$	1.77	Not Significant at 0.01 level
	$M_1 = 27.10$	$M_2 = 24.80$		
	$s_1 = 9.565$	$s_2 = 8.84$		

3.10 RESULTS

1. From the study of the performance of the students in 2001 and 2002, it is found that there is no significant difference between the performances of the students in the two years which leads to retention of hypothesis 4.1 ($H_{4.1}$).
2. From the study of performances of the students in 2001 and 2003, it is evident that there is a significant difference between the performances of the students in the two years. Therefore, hypothesis 4.2($H_{4.2}$) is rejected.
3) From the study of performances of the students in 2001 and 2004, it is evident that there is a significant difference between the performance of the students in the two years. Therefore, hypothesis 4.3 is rejected ($H_{4.3}$).
4) From the study of performances of the students in 2002 and 2003, it is evident that there is a significant difference between the performance of the students in the two years. Therefore, hypothesis 4 is rejected ($H_{4.4}$).
5) From the study of performances of the students in 2002 and 2004, it is evident that there is a significant difference between the performance of the students in the two years. Therefore, hypothesis 4 (v) is rejected ($H_{4.5}$).
6) From the study of performances of the students in 2003 and 2004, it is evident that there is no significant difference between the performance of the students in the two years which leads to the retention of hypothesis 4 (vi); ($H_{4.6}$).

These studies in general lead to the conclusion that there is a variation in standard of question papers in different years. Therefore, hypothesis (4) is rejected (H_4).

CHAPTER IV

MECHANISM OF TEACHING – LEARNING SYSTEM

Chapter – IV

4.1 What is diversification of Interest

According to Ray Lee Foley (2002) teaching-learning system includes different subsystems of which a model of teacing and learning is mostly significant.

Before suggesting an alternative model we investigate different teaching – learning components in West Bengal by conducting survey then analyze the information & finally select the model namely interest Diversification Model.

[Ref. : Research Project Diversification of interest and its impact on Education by Dr. Dibyendu Bhattacharyya.]

The basic feature of this model is to increase the interest of learners academic field by multiplication & then substitute & shifting the interest into the other domain.

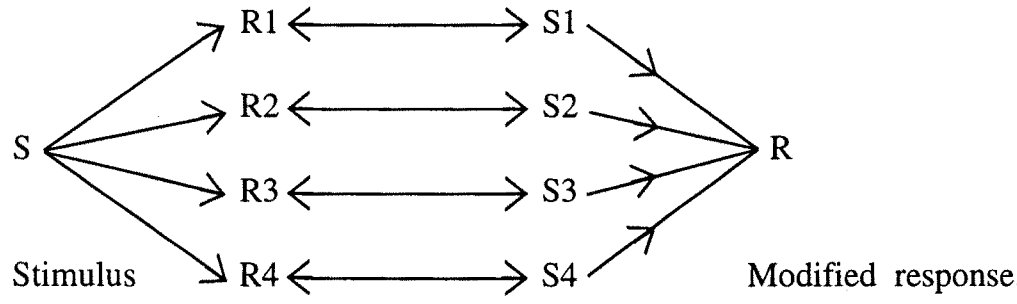
Diversification of interest basically stands for multi-dimensional approach of interest related to teaching and learning where one stimulus could be responded in many ways. If stimulus is many then how one stimulus will be bonded with multifarious interest of the learners in a particular teaching-learning situation. As a result some responses are connected well to the particular stimulus but others are isolated with the main-stimulating agent. Therefore, in these types of connection diversification of Interest is very much significant for the betterment of correlating stimulus in various ways.

In learning situation diversification is to be explained in the following pattern :

1. General Example

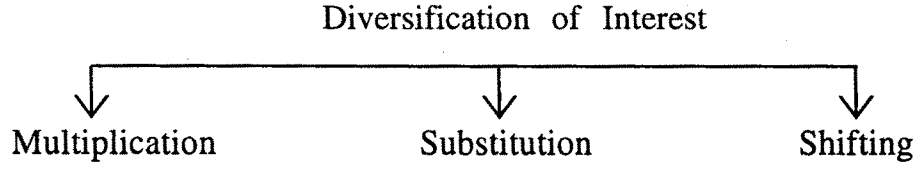
S ⟷ R

2. In case of Diversification :



Diversification
through development of interest

That is how in a teaching-learning system one stimulus is diversified in different responses. Here for one stimulus four responses are generated. For each response the teacher has to provide four stimulus. Now their responses are modified to R. The way in which responses are modified to connect with a stimulus in various way is called diversification. To explain diversification we can classify diversification of interest in three categories.



Here diversification is made by implementing multiplication, substitution & shifting to convert different responses to modified one.

A. Multiplication of Interest

Suppose a student is interested in Mathematics and specially in Arithmatic part. Now the question is how his/her interest could be enhanced? Generally for diversification we use multiplication as a process of decentralise of one's interest according to the choice of the student. Therefore Learners can enable to multiply interest on the basis of their wishes.

B. Substitution of Interest

Substitution is one of the important components for diversification. Here substitution refers to substitute one interest to another. It is a spontaneous

process. Naturally through substitution diversification is rather easy to execute. As for example a student has interest in science subjects could diversify Interest in social studies and language through substitution.

For example a student whatever the category he or she belongs academically at least have had some interest to a particular discipline. Some students have interest on science subjects, others are interested in social studies or language group, which refers that their interest is substituted by one or many disciplines. If we agree that one student is interested only in science subjects, that means the student is isolated his/her interest from other disciplines. In this respect for greater achievement their Interest will have to diversify from one interest zone to different interest zone. That is why substitution is important in teaching-learning system.

C. Shifting of Interest is then possible when learners can apply a concept.

Shifting is also more important and applicable when substitution is rather difficult. Suppose a student is isolated from academic atmosphere and become interested in non-academic activities. In this regard diversification will be followed non-academically. In this condition shifting of interest have had an urgent need for remedial measures. Here the non-academic activities could be shifted to academic activities on the basis of particular effort.

Shifting is specially related to those diversification pattern were one stimulus has been isolated to a particular response. For example we can explain shifting in the following way :

I. In general what happens

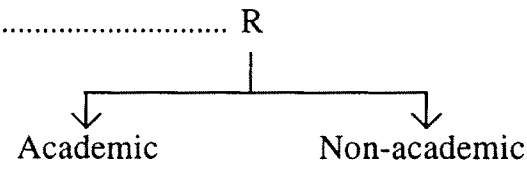
S $\longleftrightarrow$ R

II. In Shifting

S Isolated R

Now for shifting one's response has been analysed in detail to find out his/ her interest zone, whether in academic part or non-academic part.

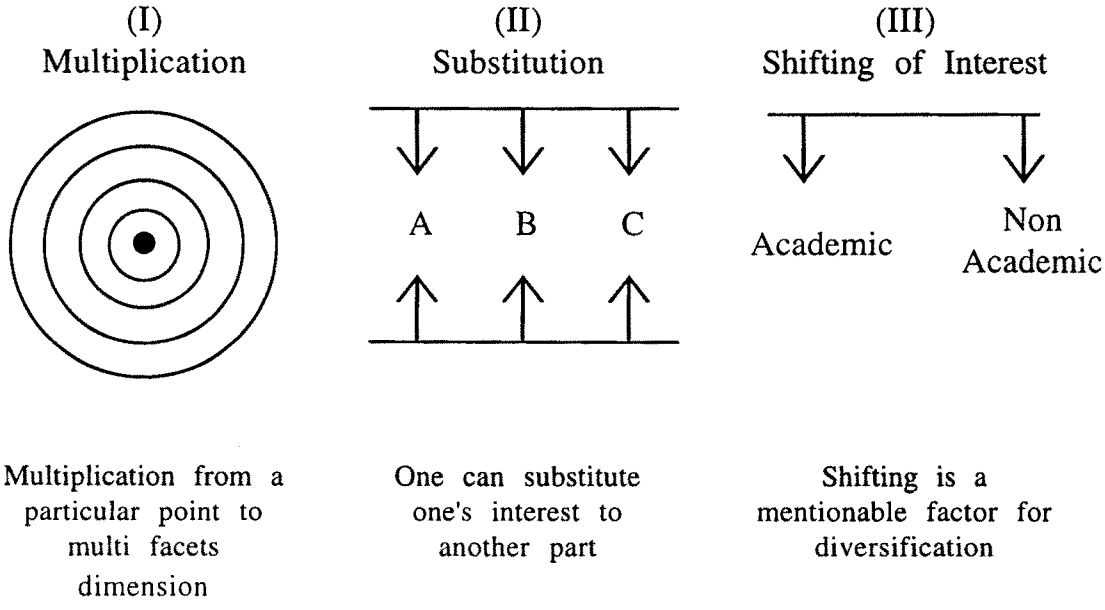
III. * Identification of Interest Zone



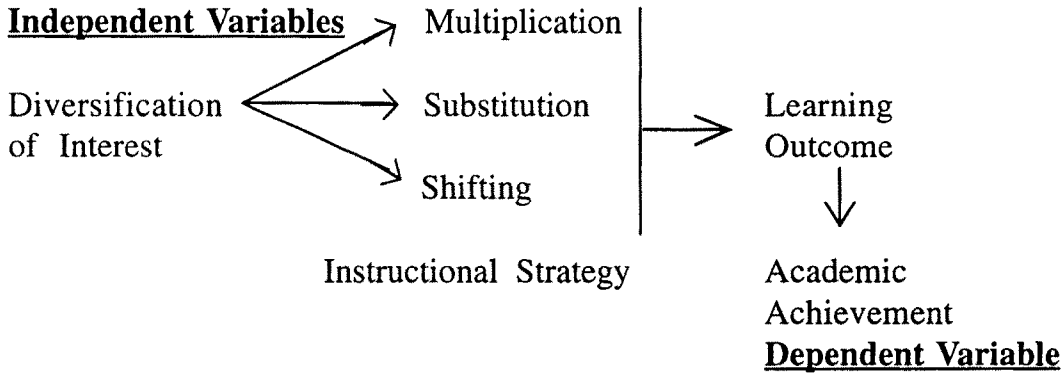
IV. Diversification is to be allowed on the basis of students nature and standard.

V. Shifting his/her interest from one section to a particular desirable condition on the basis of situational factor.

Diagrammatic presentation of diversification of interest



The variables



4.2 Instructional Strategy

Lesson plan on the basis of Interest Diversification Model will be the basic instrument for applying operational variables.

Suggested steps of Interest Diversification Model

Phase – One : Development relationship with learners through interaction to generate a positive attitude towards the teacher & the subjects.

Phase – Two : To find out the interest zone of the student at their horizontal surface area to knowledge.

Phase – Three : Multiplication of surface area where the learners' interest are selected.

Phase – Four : Substitution of interest in different dimension of a subject.

Phase – Five : Shifting of interest.

Phase – Six : To develop vertical surface area of knowledge

Phase – Seven : Evaluation

Phase – Eight : Reinforcement of interest and academic achievement.

Traditional Teaching Method

As regards planning of a lesson different suggestions have been given by Educationists. The present system is mainly guided by Herbertian five steps principles. The steps are given below :

i) **Preparation :** This is the first stage of a lesson. Teacher will prepare the mental set of the learners to create attention and interest of the learners. Pravious knowledge of the learners will be re-vised and re-evaluated. Some questions of the type known to unknown are thrown to create interest for the new lesson.

ii) **Presentation :** Content of the whole lesson are divided on some small parts with the help of questions, explanation and teaching aids, teacher presents the lesson.

(iii) Assimilation : Teacher helps the learner to assimilate new knowledge with the previous one. New knowledge are being added upon the foundation of previous experience.

iv) Generalisation : In this step teacher generalizes some principles for application of the new knowledge. Thus, stage of acquiring new knowledge is being completed.

v) Evaluation (Adaptation) : How far the teacher has acquired or assimilated his/her day's lesson will be evaluated and at the same time his/her ability to apply this knowledge in a new situation is also being evaluated.

The teacher will have to play the main role in a classroom.

4.3 OBJECTIVES OF THE MODEL

The present study is taken to achieve the following objectives:

i) To develop teaching materials on the basis of Interest Diversification Model.

ii) To perform the experiment and compare the effectiveness of Interest Diversification Model with Traditional Teaching Method in teaching physical science.

iii) To find out whether the achievement of students differ significantly due to variation in instructional treatments given.

iv) To develop criterion tests for the assessment of outcomes after completion of experiment.

Comparison between Interest Diversification Model & Tradional Teachers Model

i) Treatments : Based on the nature of the problem the instructional treatments is delimited into two, namely, Interest Diversification Model and Traditional Teaching.

ii) Sample : Sample of this study is delimited to 120 pupils of Class-VIII taken from two schools, such that in each school only 60 pupils.

iii) Content matters : The content area is delimited to only two units of the syllabus of physical science of class VIII under the West Bengal Board of Secondary Education.

4.4 NULL HYPOTHESES

OH_1 : There is no significant difference between the two treatments – Interest Diversification Model and Traditional method of teaching on the criterion of achievement in Physical Science.

OH_2 : There is no significant difference between the two schools (H.R.V.M. & H.M.H.S.) on the criterion of achievement in Physical Science.

OH_3 : There is no significant difference effects of school factor on the treatment in respect of achievement in criterion test in Physical Science.

OH_4 : There is no significant difference between boys and girls on the criterion of achievement in Physical Science.

OH_5 : There is no significant effects of sex factor on the treatment in respect of achievement in criterion test on Physical Science.

OH_6 : There is no significant interaction effect of treatment and school on the criterion of achievement in Physical Science.

$\grave{O}H_7$: There is no significant interaction effect of treatment and sex on the criterion of achievement in Physical Science.

$\grave{O}H_8$: There is no significant interaction effect of school and sex on the criterion of achievement in Physical Science.

$\grave{O}H_9$: There is no significant interaction effect of treatment, school, sex on the criterion achievement in Physical Science.

4.5 DEVELOPMENT OF RELATED INSTRUMENTS (For ENTRY LEVEL TEST)

At first, the investigator selected 'achievement' as an independent variable with a desire to utilise the Entry Level Test as initial measures.

To develop this test, the researcher followed the following steps:

(a) Selection of the content area.

(b) Preparation of the entry level objectives.

(c) Development of measuring instruments.

Selection of the Content Area

The researcher has chosen several units from the syllabus of Physical Science for Class-VII & VIII under W.B.B.S.E. as content area to prepare the Entry Level Test. The reasons behind this selection were :

(i) to measure the readiness of the students for new instructional items already chosen as content area for the criterion test, and

(ii) to measure their entry level achievement.

The units are the following :

UNIT	SUB-UNITS	
AIR		
1	1.1	Air has weight, what air is composed of Oxygen, Hydrogen, small quantities of Carbondioxide etc.
	1.2	Elementary ideas of elements and simple compounds-Mechanical mixture.
	1.3	Separation of their constituents, separation by magnets, distillation etc.
Matter		
2	2.1	Different states of matter (solids, liquids and gases), physical properties of matter.
	2.2	Elementary ideas of Physical and Chemical changes.
	2.3	Atoms and molecules

Gravitation

3.1 Earth attracts all bodies

Force of gravitation

Magnets

4 4.1 Simple explanation of the unit

Defining the pre-requisite knowledge and skill in behavioural terms of entry level behaviour

The description of entering behaviour lack two characteristics of terminal behaviour. They do not describe the conditions under which the performance must occur, and they do not specify a standard of acceptability. Although a statement of entering behaviour would include all the characteristics of a terminal behaviour, the list of entering behaviour on the units (preparation & study of the simple properties of gases like 'Hydrogen, oxygen & Carbon-di-oxide and Magnets) selected simply do not do so.

For each terminal behaviour, attempt has been made to identify the corresponding entry-level behaviour.

The entering behaviour on the units (i) preparation & study of the simple properties of gases like H_2, O_2, Co_2 and (ii) Magnets is given below :

(1) The learner defines 'what is air'?

(2) He explains 'Air' as a mixture of several gases.

(3) He states the name of the constituent gases and their percentages in respect of volume in the air.

(4) He explains that the air has weight.

(5) He detects oxygen as important element in breathing.

(6) He indicates the statement – "The Hydrogen gas is lighter than the air'.

(7) He explains carbon-di-oxide as an important constituent in photosynthesis to prepare simple carbohydrate food by the green plants.

(8) Given an example explaining a gas baloon filled with Hydrogen gas in close contact with fire, he indicates the possible danger of taking a flight with a baloon filled with Hydrogen gas.

(9) He states the percental ratio of volume and weight of Hydrogen-gas in the compound water.

(10) He identifies the simple nature of Hydrogen, Oxygen and Carbon-di-oxide as daily concern.

(11) He defines an atom.

(12) He states the participation of an atom in chemical reactions.

(13) He states the name of the lightest atom.

(14) He identifies different types of matter and also explains their nature.

(15) He explains elementary ideas of elements.

(16) He defines 'Compound': He compares mixture with compounds.

(17) He states the characteristics of a mixture.

(18) Given an example explaining the change of state of the into water and (water) vapour respectively, he defines the physical properties of a matter.

(19) He compares physical property with chemical property.

(20) Given two examples defining two different types of changes: one temporary and other permanent, he indicates the difference between physical and chemical change.

(21) Given some examples explaining different changes, he identifies 'which one is physical change' and 'which one is chemical change'.

(22) He states the process of distillation to separate the constituents of a solution composed of sugar and water.

(23) Given some examples regarding the procedure of separation of a mixture by magnets, he explains the use of magnet.

(24) Given an explanation showing two poles – 'N' and 'S' a magnet, he defines simply the term 'Magnet'.

(25) He also states simple properties of magnet.

(26) He indicates that the earth attracts all bodies.

(27) He defines simply the term 'gravitation'.

(28) Given an explanation defining occurrence of tides due to attraction of the Sun and the Moon, he explains the gravitational force.

Development of Measuring Instruments

Development of Achievement Test

In the present experiment, entry level achievement can be measured by the scores obtained in the (Entry Level) achievement test. So the researcher has constructed the achievement test by going through the following stages :

a) Planning of the achievement test

To lay out a plan for constructing the achievement test, firstly, the content area has been carefully judged and entry level objectives have been identified. Secondly, the behavioural outcomes in terms of knowledge, comprehension, skill and application have been worked out. Finally, types of items have been selected. Here, the researcher to avoid any biasness in the test, has preferred mainly the objective and short answer type items. Hence he has framed a test blue print for the preparation of the test items.

b) Preparation of the test Blue-Print

In order to build the content validity in the achievement test, it is necessary that the test items in the test should represent an adequate sampling of the behaviour domain.

To accomplish this the researcher has discussed with the subject experts. The entire procedure of assigning relative weightage upon the entry-level objectives-knowledge, understanding application and skill as well as subject matter domain have been selected (Table 4.1).

Table 4.1 : The relative weigtage assigned to both subject matter and objective domains

Content	Assigned weightage in %	Objective	Assigned weightage in %
1.1	27.5%	Knowledge	36%
1.2	17%		
1.3	9.5%		
2.1	6%	Understanding	37%
2.2	8.5%		
2.3	7%		
3.1	7.5%	Application	17%
3.2	3.5%		
4.1	13.5		
		Skill	10%
Total	**100%**	**Total**	**100%**

It has been found necessary to develop the test, by including test items from each sub-unit, in such a way that correct preparation of items from a given sub-unit, may match the weightage given to a particular objective. In test literature, the procedure outlined is known as "developing a test Blue Print". It is the most systematic way of setting up the specification in terms of a two-way table, with objectives across the top and sub-units in the left-hand column. A blue print has been developed for the preparation of the entry-level achievement test.

c) Preparation of the items (Entry level Test)

The researcher has prepared 57 items, for the written test, the items are of various types – multiple choice, true-false, analogy, matching and short answer types.

Table in the Appendix, shows the correspondence between a entry level objective and the test items.

d) Scoring principle of achievement test (Entry Level)

The papers answered by the pupils have been scored. Some questions are credited with full marks (ranging from 1 to maximum 4.5 for each correct answer, and if wrong, zero. Some questions are also credited with partial scores (ranging ·5; 1, 1·5, 2, 2·5, 3, 3·5, 4, 4·5) depending upon the quality of the answer. For this purpose, the researcher has prepared a model answer to each of such questions to determine the number of points (scores) to be assigned to it and to the parts within it, validated by some experts of the subject, Physical Science.

e) Item-Analysis

As the test is of criterion-reference type, therefore, no item analysis was attempted. Item analysis would remove some items from the test, and thus, certain behaviour domain would be lost.

f) Reliability of the test

Among the four methods of computing reliability (such as test-retest method, Kuder-Richardson Technique, method of using parallel forms, split-half method), test-retest method was selected for determining the reliability of the test.

Test-retest Method

The same test was re-administered on thirty percent of students (36 students) of the original sample, i.e., thirty six students were selected randomly from the original sample.

To reduce memory effect re-test was done after three weeks from the day of first administration.

Reliability co-efficient of the test was found to be .86.

Table 4.2 : Blue Print of Entry Level Test

Unit	Sub-unit	Knowledge		Understanding		Appl.	Skill	Total
		O.T.	SA	O.T.	SA			
	1.1	7 (7)	2 (5)	3 (3)	-	2 (8)	1 (4 $^{1}/_{2}$)	15 (27 $^{1}/_{2}$)
1	1.2	5 (5)	1 (2 $^{1}/_{2}$)	2 (2)	3 (7 $^{1}/_{2}$)	-	-	11 (17)
	1.3	1 (1)		2 (2)		1 (2)	1 (4 $^{1}/_{2}$)	5 (9 ½)
	2.1	-	1 (2)	1 (1)	1 (3)	-	-	3 (6)
2	2.2	-	-	4 (4)	1 (2 $^{1}/_{2}$)	1 (2)	-	6 (8 $^{1}/_{2}$)
	2.3	2 (2)	1 (2)	-	1 (3)	-	-	4 (7)
	3.1	2 (2)	1 (2 $^{1}/_{2}$)	-	1 (3)	-	-	4 (7 ½)
3	3.2	1 (1)	-	-	1 (2 $^{1}/_{2}$)	-	-	2 (3 ½)
4	4.1	3 (3)	1 (2)	-	1 (2 ½)	2 (6)	-	7 (13 ½)
		21 (21)	7 (16)	12 (12)	9 (24)	6 (18)	2 (9)	57 (100)

* Digits outside the brackets indicate no. of items

** Digits inside the brackets indicate score of the items.

g) Validity of the test

Validity is the most important characteristic of a test. The validity of a test means the efficiency with which it measures what it attempts to measure. The researcher has determined the validity of the test scores by the following method.

Establishing the Content Validity

To test the validity of the test, judgements have been accepted from the experts. Firstly, they have judged the weightage of the sub-units and objectives of the content (Table 4.1) on the basis of that weightage, finally the content validity is established logically by building the test blue-print (Table 4.2) which shows that the test has been developed by including items which were adequate representative of the behaviour domain sampled as given in the list of entry level objectives and as is evident in the table in the Appendix F (a).

4.6 DEVELOPMENT OF RELATED INSTRUMENTS (FOR FINAL TEST)

To collect relevant and adequate data and to test the hypotheses mentioned earlier, the following devices were developed.

(a) Development of Instructional Instrument,

(b) Development of Measuring Instrument

Selection of the content area

Two topics : (i) Preparation and study of simple properties of gases like oxygen, Hydrogen, Carbon-di-oxide; (ii) Magnets, as it occurred in the syllabus for class VIII prescribed by the West Bengal Board of Secondary Education have been selected as the content for the experiment.

The rationale behind choosing these topics was the following :

(i) One of the most remarkable aims of teaching Physical Science is to create interest about the physical environment around us.

(ii) Since Interest Diversification Model favours the teaching of these topics, which satisfy the curiosity of these topics & since the topics mentioned above fulfil this requirement, these have been included in this experiment.

(iii) Pupils in school are very much familiar with magnets, and are fully aware of elements like Oxygen, Hydrogen and Carbon. Educators feel that they should develop interest for knowing these correctly, develop an attitude of applying these phenomena in daily life and therefore, they should indicate a spirit of intrinsick motivation. It was felt that spirit of interest can best be cultivated by teaching them through Interest Diversification Model, because in teaching through this model there is scope for arousing their curiosity and stimulating their thinking as well.

For the present experiment, the researcher has divided the content area into two units. Each unit is divided into several sub-units as following:

Unit-1

(Preparation and study of simple properties of gases-like Oxygen, Hydrogen & Carbon-dioxide)

The Sub-units are :

1.1 Oxygen gas	a) Preparation of Oxygen
	b) Properties of Oxygen
1.2 Hydrogen gas	a) Preparation of Hydrogen
	b) Properties of Oxygen
1.3 Carbon di-oxide gas	a) Preparation of Carbon-di-oxide
	b) Properties of Carbon-di-oxide

Unit-2
(Magnets)

The sub-units are :

2.1 General idea of Magnet and its different types

2.2 Several definitions regarding magnets

2.3 General properties

2.4 Preparation of Artificial Magnet

2.5 Magnetic Induction

2.6 Elementary Theory of Magnetism :

(a) Molecular Theory

(b) Explanation of molecular theory by Magnetic Induction

2.7 TERRESTRIAN MAGNETISM AND USE OF MAGNETIC COMPASS

3.2.2 Terminal Objectives

The terminal objectives in behavioural terms were developed by the researcher on the same units (i) preparation and study of simple properties of gases like Oxygen, Hydrogen & Carbon di-oxide and (ii) Magnets
The terminal objectives are given below :

1. The learner states the name of the chemical reagents for Hydrogen gas preparation in the laboratory.
2. He explains the process to collect the Hydrogen gas in the gas-zar.
3. He identifies the precautional measures during laboratory preparation of the Hydrogen gas.
4. He explains the nature of the collection of oxygen gas in the gas-zar.
5. He states the name of the chemical reagents for oxygen-gas preparation in the laboratory.
6. He signifies the use of Manganese-di-oxide (Mno_2) for the preparation of oxygen gas in the laboratory. He explains the function of a catalyst.
7. He states the name of the chemical reagents for the Carbon-di-oxide gas preparation in the laboratory.
8. He explains the nature of the gas and identifies the process to collect the gas in the gas-zar.
9. He gives chemical equation of the Carbon-di-oxide gas preparation process.
10. He explains why diluted sulphuric acid is not used in the Carbon-di-Oxide gas preparation in the laboratory.
11. He explains why concentrated sulphuric acid is not used in the laboratory preparation of Hydrogen gas from metals.
12. He identifies the Hydrogen gas and also explains how to identify.
13. Given some examples explaining the chemical properties of Hydrogen gas, he states chemical equation of each process.
14. He states the name of the absorber of Hydrogen gas and also explains the term 'Antardhriti'.

15. He compares general Hydrogen with nescent Hydrogen.
16. Given some examples explaining their characteristics in respect of oxygen, he classifies different types of oxides.
17. He identifies the preparation of different acids from oxides stating O_2 as 'Acid-producer gas'.
18. He states the name of the oxygen gas absorber.
19. Given some gas-zars full of different gases, he identifies the oxygen gas and also explains how to identify.
20. He explains oxidation and reduction.
21. He states the intrinsic nature of Carbon-di-oxide gas against fire and also separates it from Nitrogen gas with proper explanation.
22. He identifies different chemical properties of Carbon-di-oxide as well as physical properties.
23. He defines the term 'Dry Ice'.
24. He states the name of the Carbon-di-Oxide absorber.
25. He signifies Carbon-di-oxide as an essential element in photosynthesis.
26. He draws the figure of oxygen gas preparation in the laboratory.
27. He identifies the Carbon-di-Oxide gas and also explains how to identify.
28. Given the figures showing different magnets, he explains 'Natural and Artificial Magnets'.
29. He compares magnetic particles with non-magnetic particles.
30. He states different terms & definitions of Magnet.
31. He explains the properties of Magnet.
32. Given an example explaining iron particles attracted by the magnetic pole, he states the property of attraction towards magnetic particles.
33. He explains how to magnetise a body.
34. Given an example showing a piece of iron in close contact with a powerful Magnet contained a number of alpins, he explains magnetic induction.
35. He explains the statement-"Every molecule of a magnet is also a complete magnet".

36. He defines the simple molecular theory of magnetism.

37. He explains 'magnetic induction' in respect of molecular theory.

38. He explains terrestrian magnetism.

39. He states and explains the practical implementation of a magnetic compass.

40. He simply explains 'electro-magnet'.

41. As the best proof of magnetism, he signifies that repulsion is better than attraction.

Development of Instructional Instrument

Two forms of Instructional instruments have been developed for the present study :

(a) Lesson plans on Interest Diversification Model of Teaching.

(b) Lesson plans on Traditional Method of Teaching.

VALIDATION OF THE LESSON PLANS

After the completion of the draft, the researcher has made a thorough editing and review of the draft, for several times on the basis of the comments of three experts on the subject and educational technology.

To establish the construct validity of the lesson plan, the researcher has prepared lesson plan according to the strategy of Interest Diversification Model, as it integrates the processes of the chief learning outcomes of Interest Diversification Model into a single, meaningful form of lesson plan splendidly. Syntax, social system and support system have been carefully inbuilt into the lesson plan as is evident from a careful scrutiny particularly of the social system in each of the lesson plan cited in the Appendix.

Development of Lesson Plans based on Traditional Method

After a few modification in this method following steps are being actually practiced now-a-days.

(i) Objectives

After giving the lesson what will be the behavioural changes of the learners are mentioned for the stage.

(ii) Preparation

Some questions of the type known to unknown, concrete to abstruct, and simple to complex are thrown to evaluate his previous knowledge and thereby create his interest for the days lesson.

(iii) Presentation

In this step teacher splits up the content into small parts and delivers his lesson through explanation, demonstration, and questioning.

(iv) Evaluation

Through question-answer techniques teacher evaluates the learner's attainment regarding the days lesson and also his capacity for applying this knowledge in a new situation.

The same division of the content area as it has been shown in page 35 was considered for preparing the lesson plans in traditional method of teaching.

3.2.5 Development of Measuring Instruments

3.2.5.1 Development of Achievement Test

In order to evaluate the understanding of the subject matter through the two different treatments – Interest Diversification Model and Traditional Teaching, achievement test was found necessary.

So, the researcher has constructed the achievement test by going through the following stages.

(a) Planning of the achievement test

To lay out a plan for constructing the achievement test, firstly, the content area has been carefully judged and all the concepts and terminal objectives have been identified. Secondly, the behavioural outcomes in terms of knowledge, comprehension, skill and application have been worked out. Finally, types of items have been selected. In order to maintain objectivity, mainly the objective type of test items and a few short answer type items were included in the test.

(b) Preparation of the test blue-print

In order to build the content validity in the achievement test, it is necessary that the test items in the test should represent an adequate sampling of the behaviour domain determined as a token of pupil's success (terminal objectives).

The researcher determined the weightage to be given to an objective or to an item in course of developing the test blue-print. It has been found necessary to develop the test, by including test items from each sub-unit, in such a way that correct proportion of items from a given sub-unit may match the weightage given to a particular objective.

In test literature, the procedure outlined is known as 'developing a test Blue-print'. It is the most systematic way of setting up the specification in terms of two-day table, with objectives across the top and sub-units in the left hand column.

(c) Preparation of the items

The researcher has prepared 70 items for the written test. The items are of various types-multiple choice, true-false, completion analogy and recall, matching and short answer types. Table in the Appendix, shows the correspondence between a terminal objective and the test items.

(d) Scoring principle of achievement test

The papers answered by the pupils have been scored. Some questions are credited with full marks (ranging from 1 to maximum) for each correct answer, and if wrong, zero. Some questions are also credited with partial scores (ranging .5, 1, 1.5, 2, 2.5, 3) depending upon the quality of the answer. For this purpose, the researcher has prepared a model answer to each of such questions to determine the number of points (scores) to be assigned to it and to the parts within it, validated by some experts of the subject, Physical Science.

Table 4.3 The relative weightage assigned to both subject matter and objective domains

Content	Assigned weightage in %			Objectives	Assigned weightage in %
Sub-unit	1.1	a	21%	Knowledge	36%
		b			
Sub-unit	1.2	a	21%		
		b			
Sub-unit	1.3	a	16%		
		b			

Content		Assigned weightage in %	Objectives	Assigned weightage in %
Sub-unit	2.1	9%	Understanding	34%
Sub-unit	2.2	3%		
Sub-unit	2.3	7%		
Sub-unit	2.4	6%	Application	20%
Sub-unit	2.5	6%		
Sub-unit	2.6 a	5%	Skill	10%
	b	2%		
Sub-unit	2.7	4%		
Total		**100%**	**Total**	**100%**

Table 4.4 : Blue Print of Final Test

Unit	Sub-unit		Knowledge		Understanding		Application	Skill	Total
			O.T.	S.A.	O.T.	S.A			
	1.1	a	3 (3)	1 (2)	—	—	1 (3)	—	5 (8)
		b	4 (4)	—	3 (3)	1 (2)	2 ($3\frac{1}{2}$)	—	10 ($12\frac{1}{2}$)
	1.2	a	2 (2)	—	—	1 (2)	1 (2)	—	4 (6)
		b	4 (4)	1(2)	2 (2)	2 (4)	2 (3)	—	11 (15)
	1.3	a	2 (2)	—	—	1 (2)	—	—	3 (4)
		b	2 (2)	1(2)	4 (4)	—	4 ($6\frac{1}{2}$)	—	11 ($14\frac{1}{2}$)
	2.1		1 (1)	—	—	2 (4)	1 (2)	2 (2)	6 (9)
	2.2		1 (1)	1(2)	—	—	—	—	2 (3)
	2.3		1 (1)	1(2)	2 (2)	1 (2)	—	—	5 (7)
	2.4		—	2(4)	—	1 (2)	—	—	3 (6)
	2.5		1 (1)	—	1(1)	2 (4)	—	—	4 (6)
		a	1 (1)	—	1 (1)	2 (4)	—	1(1)	3 (3)
	2.6								
		b	—	—	—	—	—	1 (2)	1 (2)
	2.7		—	—	1 (1)	—	1 (3)	—	2 (4)
	Total		**22 (22)**	**7 (14)**	**14 (14)**	**11 (22)**	**11 (20)**	**5 (8)**	**70 (100)**

* Digits outside the brackets indicate no. of items

** Digits inside the brackets indicate scores of the items.

(e) Item analysis

In criterion-referenced testing the teacher is primarily concerned with how many items of a set of specific objectives a particular student has mastered. Criterion-referenced testing does not aim for a wide range of scores because the purpose is to have all students master the objectives. Gronland (1973) states: if none of the students (or only a few) can answer an item before instruction but all of them can answer it after instruction, both the test items and the instruction have been effective.

Criterion-referenced testing is a part of individualised programs like project PLAN and other mastery learning programs when the instructional intent is to raise almost all students to a specified level of achievement. Presently, classroom instruction through IDM uses this testing to greatest advantage when the learning outcomes are cumulative and progressively more complex.

As the test is of criterion-reference type, therefore, no item analysis was attempted. Item analysis would remove some items from the test, and thus, certain behaviour domain would be lost.

f) Reliability of the test

Among the four methods of computing reliability (such as test-retest method, Kuder-Richardson Technique, method of using parallel forms, split half method), test-retest method was selected for determining the reliability of the test.

Test retest Method

The same test was re-administered on thirty percent of students (36 students) of the original sample i.e. thirty-six students were selected randomly from the original sample.

To reduce memory effect re-test was done after three weeks from the day of first administration.

Reliability co-efficient of the test was found to be .90.

(g) Validity of the test

Validity is the most important characteristic of a test. The validity of a test means the efficiency with which it measures what it attempts to measure.

The researcher has determined the validity of the test scores by the following method.

Establishing the content validity

"Content validity involves essentially the systematic examination of the test content to determine whether it covers a representative sample of the behaviour domain to be covered. Such a validation procedures is commonly used in evaluating achievement test".

To test the validity of the test, judgements have been accepted from the experts. Firstly, they have judged the weightage of the sub-units and objectives of the content (Table 4.3). on the basis of that weightage, finally, the content validity of test is established logically by building the test blue-print (Table 4.4) which shows that the test has been developed by including items which were adequate representative of the behaviour domain sampled as given in the list of terminal objectives and as is evident in the Table in Appendix F (b).

Methodology

Experimentation is the methodology of the present investigation. Hence, in present study, the researcher deliberately manipulated the independent variables, i.e. teaching methods in order to observe the change in the dependent variable, i.e., pupil's performance – due to this manipulation under highly controlled condition.

The subjects were divided into two groups.

On the basis of the Entry Level Achievement Test, each group was randomly divided against into two-treatment groups- i.e. experimental and control. After the administration of the Final Test, the data of the Entry Level Test and Final Test were analysed by the "CO-VARIANCE"- statistical design as it is most accurate statistical procedure to control the extraneous factors.

Population

The population of this study is the Class VIII pupils (both boys and girls) under the West Bengal Board of Secondary Education from Nadia & 24 Parganas District having Bengali as the medium of instruction.

Sample

The present experiment had been conducted upon a sample of pupils of secondary schools under the Board of Secondary Education, West Bengal. To make the sample adequate and representative, the following measures had been taken.

(a) Sampling of the School

Assuming, no basic difference of the teaching outcome between the sexes, among the socio-economic conditions of the families, and urban, and semi-urban and rural areas, the researcher randomly selected by lottery the pupils of class-VIII of (i) Halisahar R.V.M. and (ii) Malancha High School under 24 Parganas (N) district as the sample of the investigation.

(b) Sampling of Subject (student)

There were 98 pupils in Class-VIII, studying in (i) H.R.V.M. in the academic session 2003 of whom 60 pupils in this class were randomly selected as the sample for the experiment. 30 pupils were selected for each treatment group-experimental and control group.

In the same way, the investigator also randomly selected 60 pupils in class-VIII, out of 120 pupils, studying in Malanch High School in the same session as the sample for the experiment. 30 pupils were selected for each treatment group according to the methodology of the present study.

Variables of the Study

Variables are the conditions or characteristics that the experimenter manipulates, controls or observes. In conducting this experiment, the following variables were identified.

A) Independent Variable

In this study Independent variables are – (i) Teaching methods; (ii) School and (iii) Sex.

B) Dependent Variable

Dependent variable is pupil's achievement.

C) Intervening Variables

Intervening variables are – (i) Teacher variable, (ii) Age, (iii) Size of the class, (iv) Previous experience and (v) other contamination effects, such as Motivation, Fatigue, Anxiety etc.

To control the variables the following measures had been taken –

i) School Variables

The school is considered as an independent variable. In the present study the school variation was assessed in the design of the study by the researcher.

ii) Sex

It is also taken as an independent variable. The researcher had taken sex variation into consideration to assess in the design of the study.

iii) Teacher Variables

The investigator himself had taught all the groups. Thus the effect of the teacher variable is minimised.

iv) Previous Experience

'Previous experiences' was an important variable to influence the performance of the students. To avoid this variable the researcher considered an Entry Level Achievement Test as initial measures of their performance on the specific content area of Physical Science of Class-VIII prescribed by W.B.B.S.E.

v) Contamination Effects

(a) The pupils of all the groups had been requested by the investigator not to discuss among themselves or other groups about the subject matter taught or the mode of representation.

(b) The investigator had requested the pupils not to take any coaching in their homes, particularly in this content area. But receiving coach behind treatment had not been fully controlled.

(c) Pupils had also been requested not to do any homework from any other books, but there is no restriction to study the class notes.

4.7 PROCEDURE OF THE STUDY

Administration of the Entry Level Test

The Entry Level Test (prepared by the researcher) was administered on the students in both the schools during school hours.

Firstly, the investigator established a raport with the students and gave direction for answering test items, though written direction was given in the first page.

Hence, the students start answering the test-items (as early as possible) within the time limit as allotted by the researcher.

Scoring of the Test

The answer scripts were examined following the scoring key. Some questions are credited (ranging from 1 to maximum for each correct answer, and if wrong, 0 (zero). Some questions are also credited with partial scores (ranging 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5) depending upon the quality of the answer. According to the model answer to each of such questions (prepared by the researcher and validated by some experts of the subject, Physical Science) was used to determine the number of points (scores) to be assigned to it and to the parts within it. The marks obtained by each student in the whole test were summed up. The scores obtained by the students in the Entry Level Test were arranged in a tabular form in the column of the Appendix.

Formation of Treatment Groups

Thirty students from section A were assigned randomly to treatment group I and another thirty students from section B were assigned randomly to treatment group II. Thus 60 students were assigned to two treatment groups in each school.

Table-4 (1)

Name of School	Treatment - I	Treatment - II
H.R.V.M.	30	30
M.H.S	30	30
Total	**60**	**60**

Experimentation

(i) The Experiment in school (One)

At the beginning of the experiment, the treatment to be administered to a group was determined randomly. The result was Interest Diversification Model for the treatment group-I, and Traditional Method of teaching for the treatment group – II.

Secondly, each class period of 40 minutes from 1 p.m. to 1.40 p.m. and

2.10 p.m. to 2.50 p.m. on each day. Finally, a total of 28 periods arranged for the whole experiment. In this school, treatment group I was considered as 'experimental group' and treatment group II was considered as 'Control group'.

(ii) The Experiment in Schools (Two)

In the same way, at first, the treatment to be administered to a group was determined randomly. The result was Interest Diversification Model for the Treatment Group-II, and traditional method of teaching for the Treatment Group-I.

Secondly, each class period of 40 minutes from 12.30 p.m. to 1.10 p.m. and 2.20 p.m. to 3 p.m. on each day. Finally, a total of 28 periods arranged for the whole experiment.

In this school, treatment group I was considered as 'Control Group', and Treatment Group-II was considered as 'Experimental Group'.

For the treatment of experimental group Interest dusification model was followed. 10 subunits of the selected content area have been presented by the researcher on the basis of the lesson plans.

For the treatment of control, traditional method of teaching was followed. 10 subunits of the selected content area have been presented by the researcher on the basis of the lesson plants.

Administration of the Criterion Test as Final Test

After the completion of teaching method in both the treatment groups, the researcher has administered the criterion test to evaluate the outcome of learning achieved by the students of all treatment groups.

Data Collection

The answer scripts were examined following the scoring key. Then the marks obtained by each student has been collected and are arranged in tabular forms for further analysis.

4.8 ANALYSIS AND INTERPRETATI ON OF DATA

ORGANIZATION OF DATA AND DESCRIPTIVE STATISTICS

Organisation of Data

The collected data has little meaning to the investigator until they are arranged in some systematic way. Therefore, it is the first task to organise the collected data :

Frequency distribution of Entry Level Test, and criterion test scores have been presented in the following tables :

Table : 4.5

Frequency distribution of Entry Level Test Scores

Scores	Frequency
72-76	4
67-71	11
62-66	14
57-61	13
52-56	17
47-51	12
42-46	7
37-41	17
32-36	11
27-31	11
22-26	3
i = 5	N = 120

Table : 4.6

Frequency distribution of Criterion Test Scores

Scores	Frequency
72-76	7
67-71	9
62-66	5
57-61	11
52-56	9
47-51	12
42-46	9
37-41	18
32-36	18
27-31	12
22-26	6
17-21	4
i = 5	N = 120

The distribution of the scores of these two tests may be normal or non-normal.

The normal curve may be fitted to the observed data and the agreement of the theoretical frequencies with the actual ones may be marked.

Johnson and Jackson propose two measures i.e. skewness and kurtosis, to find out whether a particular distribution is normal or not.

The value of skewness is zero when the distribution is normal.

If KU = .263, the distribution is normal.

The Distribution of Entry Level Test Scores

To test the nature of the distribution on Entry Level Test Scores, the investigator computed skewness and kurtosis of the distribution.

The results obtained are presented in the table given below :

Table : 4.7

Mean, Median, S.D., Q, P_{10}, P_{40}, Sk and KU of the Entry level Test scores

N	M	Mdn.	S.D.	Q	P_{10}	P_{40}	Sk	KU
120	49.67	51.08	13.65	11.57	30.59	67.86	- .31	0.310

The above table shows that Entry Level Test scores distribution is slightly negatively skewed and closely this distribution approaches the normal form of course, it is pletikurtic.

The Distribution of Criterion Test Scores

Regarding "the distribution of criterion test scores", the investigator computed skewness and kurtosis of this distribution. The result obtained are presented in the table given below :

Table – 4.8

Mean, Median, S.D., Q, P_{10}, P_{40}, Sk and KU of the Entry level Test scores

N	M	Mdn.	S.D.	Q	P_{10}	P_{90}	Sk	KU
120	45.5	42.61	15	11.84	27.33	68.72	.58	0.286

The above 'Table' shows that the criterion test scores distribution is positively skewed and slightly pletikurtic.

Transformation of Raw-scores into T-scores

The scores obtained after the administration of the Entry Level test and Criterion test on a sample of one hundred twenty students have been given in tables in the appendix.

It was shown that the nature of these two distributions are non-normal. Hence the investigator expressed the obtained raw scores of all these two test scores in T-scores because it was impossible to carry out parametric test and to compare these two test scores which are non-normally distributed.

In order to transfer the raw scores of these two tests to T-scores the following procedure was taken. At first, each obtained raw score was transferred into Z score and then converted into T-score. Then each Z-score was converted into T-score by using the formula (T-score = 10 Z + 50). The transformed scores of these two tests have been given in appendix.

EXPERIMENTAL DESIGN

In order to reach valid conclusions about the effect of independent variable on the dependent variable by testing hypotheses the researcher analyse the scores on the criterion test by means of a suitable experimental design.

To find out the effects of Teaching methods on pupil's achievement., an experiment involving three factors was performed.

The first factor was treatment (A). It has two levels 'A_1' and 'A_2', A_1 denotes Interest Diversification Model and A_2 denotes traditional teaching method.

The second factor of the experiment was school, which was represented by 'S'. It has two levels – S_1 and S_2, S_1 means H.R.V.M. and S_2 means H.M.H.S.

The third factor of the experiment was sex. It has two levels also – 'B' and 'G'. 'B' means 'boys' and G means 'girls'.

Taking the above three factors, the present study may be considered as 3-factor experiment.

Thus, the design of the experiment is '2 x 2 x 2 – FACTORIAL DESIGN' involving eight independent groups in all.

But the experimenter was unable to equate two groups i.e. experimental and control group initially by person to person matching due to lack of school authority's permission. To avoid this problem of equating the experimental and control group, the experimenter used "ANCOVA ON A 2 X 2 X 2 – FACTORIAL DESIGN" to test the hypotheses instead of "ANOVA ON A 2 X 2 X 2 FACTORIAL DESIGN". 2 x 2 x 2 – treatment combinations involved in this experiment are illustrated in the following Table-4.9.

Table : 4.9

Showing Treatment Combination

			A	
			A_1	A_2
	S_1	B_1	$A_1S_1B_1$	$A_2S_1B_1$
S		G_1	$A_1S_1G_1$	$A_2S_1G_1$
	S_2	B_2	$A_1S_2B_2$	$A_2S_2B_2$
		G_2	$A_1S_2G_2$	$A_2S_2G_2$

A = Treatment,	A_1 = Interest Diversification Model	S = School
A_2 = Traditional Teaching Method	S_1 = H.R.V.M.	S_2 = H.M.H.S.
B_1 = Boys of H.R.V.M.	B_2 = Boys of H.M.H.S.	
G_1= Girls of H.R.V.M.	G_2 = Girls of H.M.H.S.	

There are 15 observations in each treatment combination, the criterion scores and covariates of the 15 observations for each treatment combination are shown in the respective cell of Table.

Rationale of "ANCOVA ON A FACTORIAL DESIGN"

Main logic behind this technique is that 'ANCOVA' is the extension of analysis of variance to test the significance between means of final experimental data by taking into account the correlation between dependent variable and covariable or pertinent control variable by adjustment of initial mean difference between groups.

John Best stated that analysis of covariance is the method of analysis which helps a researcher to equate the pre-experimental status by some relevant variables like intelligence or previous acquired subject.

Computation of 'ANCOVA'

The scores of the students on the entry level test (pre-treatment performance) was considered as Covariate (X-variable) and the scores on the criterion test (Post-treatment performance) was considered as Y variable.

The correlation between the Entry Level Test and Final test scores has been determined and the value of the correlation co-efficient is .71. The method of determining correlation co-efficient has been given in Appendix.

Table : 4.10

Treatment A_2 = Traditional teaching method

- A_1 = Interest Diversification Model X = Covariates scores
- Y = Criterion Scores S_2 = H.M.V.S.
  S_2 = H.R.V.M.

Treatment

A_2 = Traditional teaching method

- A_1 - Interest Diversification

X = Covariates scores

- Criterion Scores

S_1 = H.R.V.M.

S_2 = H.M.H.S.

		A_1		A_2		Total	
		X	Y	X	Y		
S_1	B_1	67 61 57 63 55 60 64 60 66 68 58 54 56 62 60 $X_1 = 911$	64 63 54 68 66 54 66 62 58 66 55 48 66 61 60 $Y_1 = 911$	63 66 59 55 65 60 60 40 55 63 60 53 41 55 36 $X_5 = 831$	56 66 42 51 58 51 57 38 54 54 66 41 64 58 56 $Y_5 = 812$	Y = 1723 X - 1742	$X_{S_1} = 3405$
	G_1	64 52 52 63 57 60 49 58 47 53 65 52 60 53 52 $X_2 = 837$	68 62 50 65 70 70 48 57 45 58 65 46 69 52 52 $Y_2 = 877$	60 63 47 59 58 56 65 49 52 59 57 39 66 47 49 $X_6 = 826$	60 60 46 59 60 34 68 34 46 68 38 38 58 42 57 $Y_6 = 768$	Y = 1645 X = 1663	$Y_{S_1} = 3368$
	B_2	42 52 52 37 53 41 55 47 36 49 39 41 38 54 34 $X_3 = 670$	49 52 54 46 50 44 52 43 44 58 42 43 46 53 42 $Y_3 = 718$	42 54 52 44 49 40 54 52 38 56 42 52 41 49 42 $X_7 = 707$	44 47 38 56 32 44 48 36 41 47 42 47 47 42 31 $Y_7 = 642$	Y = 1360 X = 1377	$X_{S_2} = 2579$
S_2	G_2	37 30 49 43 35 43 34 33 50 33 36 52 32 34 47 $X_4 = 588$	45 38 48 52 40 45 39 39 44 34 46 53 42 44 47 $Y_4 = 656$	49 41 33 47 36 42 38 40 43 43 41 43 36 43 39 $X_8 = 614$	43 41 34 46 36 39 35 44 40 46 40 42 38 43 36 $Y_8 = 603$	Y = 1259 X = 1202	$Y_{S_2} = 2619$
		X = 3006 $A_1\overline{X} = 50.1$	Y = 3162 $A_1\overline{Y} = 52.7$	X = 2978 $A_2\overline{X} = 49.63$	Y = 2825 $A_2\overline{Y} = 47.08$	11971	11971

Calculation of 'X'

	S_1		S_2	
	B_1	G_1	B_2	G_2
A_1	911	837	670	588
A_2	831	826	707	614

Only for Interaction calculation = $\dfrac{[(a + d) - (b + c)]^2}{120}$

A X S =

A

S	A_1	A_2
S_1	1748	1657
S_2	1258	1321

A X Sex =

A

Sex	A_1	A_2
B	1581	1538
G	1425	1440

S X Sex =

S

Sex	S_1	S_2
B	1742	1377
G	1663	1202

Calculation of 'Y'

S

A	S_1		S_2	
	B_1	G_1	B_2	G_2
A_1	911	877	718	656
A_2	812	768	642	603

Only for Interaction calculation = $\dfrac{[(a + d) - (b + c)]^2}{120}$

A X S =

A

S	A_1	A_2
S_1	1788	1580
S_2	1374	1245

A X Sex =

A

Sex	A_1	A_2
B	1629	1454
G	1533	1371

S X Sex =

S

Sex	S_1	S_2
B	1723	1360
G	1645	1259

CALCULATION OF - X

Step-I :

$$\text{Correlation term C} = \frac{(\Sigma X)^2}{N}$$

$$= \frac{(5984)^2}{120}$$

$$= 298402.13$$

Step - 2 : Total sum of square

$$SS_{X\,(T0)} = SS_T - C$$

$$SS\ X\ (T_O) = 310012 - 298402.13$$

$$= 11609.87$$

Step -3 : Total sum of square between

$$SS_T\ (be) = \frac{(\Sigma X_1)^2 + (\Sigma X_2)^2 + (\Sigma X_3)^2 + (\Sigma X_4)^2 + (\Sigma X_5)^2 + (\Sigma X_6)^2 + (\Sigma X_7)^2 + (\Sigma X_8)^2}{15} - C$$

$$= \frac{(911)^2 + (837)^2 + (670)^2 + (588)^2 + (831)^2 + (826)^2 + (707)^2 + (614)^2}{15} - C$$

= 304987.73 - 298402.13 = 6585.60

Step- 4 : Sum of square between 'A' factor

$$SS_{XA} = \frac{(\Sigma X_1 + \Sigma X_2 + \Sigma X_3 + \Sigma X_4)^2 + (\Sigma X_5 + \Sigma X_6 + \Sigma X_7 + \Sigma X_8)^2}{60} - C$$

$$= \frac{(3006)^2 + (2978)^2}{60} -- 298402.13$$

= 298408.67 - 298402.13 = 6.54

Step-5 : Sum of square between : 'S' factor

$$SS_{XS} = \frac{(\Sigma X_1 + \Sigma X_5 + \Sigma X_2 + \Sigma X_6)^2 + (\Sigma X_3 + \Sigma X_7 + \Sigma X_4 + \Sigma X_8)^2}{60} - C$$

$$= \frac{(3405)^2 + (2579)^2}{60} - 298402.13$$

= 304087.77 - 298402.13 = 5685.64

Step-6 : Sum of square between Sex-factor

$$SS_{XSex} = \frac{(\Sigma X_1 + \Sigma X_5 + \Sigma X_3 + \Sigma X_7)^2 \quad + \quad (\Sigma X_2 + \Sigma X_6 + \Sigma X_4 + \Sigma X_8)^2}{60} - C$$

= 298939.77 - 298402.13 = 537.64

Step - 7 : Sum of square of interaction between (A X S)

$$SS_{X\ (AXS)} = \frac{[(a + d) - (b + c)]^2}{120}$$

$$= \frac{[1748 + 1321) - (1657 + 1258)]2}{120}$$

$$= \frac{23716}{120}$$

$$= 197.63$$

Step - 8 : Sum of square of interaction between (A X Sex)

$$SS_{X\ (A\ X\ Sex)} = \frac{[(1581 + 1440) - (1538 + 1425)]^2}{120}$$

$$= \frac{3364}{120}$$

$$= 28.03$$

Step - 9 : Sum of square of interaction between (S X Sex)

$$SS_{X\ (S\ X\ Sex)} = \frac{[(1742 + 1202) - (1377 + 1663)]^2}{120}$$

$$= \frac{9216}{120}$$

$$= 76.8$$

Step-10 : Sum of square of interaction between (A X S X Sex)

$SS_{X\ (A\ X\ S\ X\ Sex)} = SS_{T\ (be)} - (SS_{XA} + SS_{XS} + SS_{XSex}) - SS_{XSex}) - (SS_{X\ (A\ X\ S)} + SS_{X(A\ X\ Sex)} + SS_{X(S\ X\ Sex)})$

$= 6585.60 - (6.54 + 5685.64 + 537.64) - (197.63 + 28.03 + 76.8)$

$= 6585.60 - 6532.28 = 53.32$

Step-11 : Sum of square within

$SS_{X\ (with)} = SS_{X\ (TO)} - SS_{T\ (be)}$

$= 11609.87 - 6585.60 = 5024.27$

Calculation of Y

Step-1 : Correction term,

$$C = \frac{(\Sigma y)^2}{N}$$

$$= \frac{(5987)^2}{120}$$

$$= 298701.41$$

Step-2 : Total sum of square

$SS_{Y\ (TO)} = SS_{T} - C$

$SS_{Y\ (TO)} = 310895 - 298701.41 = 12193.59$

Step-3 : Total Sum of square between

$$SS_{T(BC)} \frac{(\Sigma Y_1)^2 + (\Sigma Y_2)^2 + (\Sigma Y_3)^2 + (\Sigma Y_4)^2 + (\Sigma Y_5)^2 + (\Sigma Y_6)^2 + (\Sigma Y_7)^2 + (\Sigma Y8)^2}{15} - C$$

$$= \frac{(911)^2 + (877)^2 + (718)^2 + (656)^2 + (812)^2 + (768)^2 + (642)^2 + (603)^2}{15} - 298701.41$$

$= 304656.73 - 298701.41 = 5955.32$

Step-4 : Sum of square between A factor

$$SS_{YA} = \frac{(\Sigma Y_1 + \Sigma Y_2 + \Sigma Y_3 + \Sigma Y_4)^2 + (\Sigma Y_5 + \Sigma Y_6 + \Sigma Y_7 + \Sigma Y8)^2}{60} - C$$

$$= \frac{(3162)^2 + (2825)^2}{60} - 298701.41$$

$= 299647.82 - 298701.01 = 946.41$

Step - 5 : Sum of square between S factor

$$SS_{YS} = \frac{(\Sigma Y_1 + \Sigma Y_5 + \Sigma Y_2 + \Sigma Y_6)^2 + (\Sigma Y_3 + \Sigma Y_7 + \Sigma Y_4 + \Sigma Y_8)^2}{60} - C$$

$= 303376.42 - 298701.41 = 4675.01$

Step - 6 : Sum of square between 'Sex' factor

$$SS_{YSex} = \frac{(\Sigma Y_1 + \Sigma Y_5 + \Sigma Y_3 + \Sigma Y_7)^2 + (\Sigma Y_2 + \Sigma Y_6 + \Sigma Y_4 + \Sigma Y_8)^2}{60} - C$$

$= 298968.42 - 298701.41 = 267.01$

Step - 7 : Sum of square of interaction between (A X S)

$$SS_{Y(A \times S)} = \frac{[(1788 + 1245) - (1580 + 1374)]^2}{120}$$

$$= \frac{6241}{120}$$

$$= 52.0083 = 52.01$$

Step - 8 : Sum of square of interaction between (A X Sex)

$$SS_{Y(A \times Sex)} = \frac{[(1629 + 1371) + (1454 + 1533)]^2}{120}$$

$$= \frac{169}{120}$$

$$= 1.4083 = 1.41$$

Step - 9 : Sum of square of interaction between (S X Sex)

$$SS_{Y(S \times Sex)} = \frac{[(1723 + 1259) - (1360 + 1645)]^2}{120}$$

$$= \frac{529}{120}$$

$$= 4.4083 = 4.41$$

Step -10 : Sum of square of interaction between (A x S x Sex)

$SS_{Y\ (A \times S \times Sex)} = SS_{Y\ (be)} - (SS_{YA} + SS_{YS} + SS_{Y\ Sex}) - (SS_{Y\ (A \times S)} + SS_{Y\ (A \times sex)} + SS_{Y\ (S \times Sex)})$

$= 5955.32 - (946.41 + 4675.01 + 267.01) - (52.01 + 1.41 + 4.41)$

$= 5955.32 - 5946.26 = 9.06$

Step-11 : Sum of square within

$SS_{Y(with)} = SS_{Y(TO)} - SS_{T\ (be)}$

$= 12193.59 - 5955.32 = 6238.27$

Step- 12 :

$$= SP_{TO} = \Sigma XY - \frac{\Sigma X \times \Sigma Y}{N}$$

= 307180 - 298551.73 = 8628.27

Step-13

$SP_{Among} = (\Sigma X_1 \times \Sigma Y_1)/n_1 + (\Sigma X_2 \times \Sigma Y_2)/n_2 + (\Sigma X_3 \times \Sigma Y_3)/n_3 + (\Sigma X_4 \times \Sigma Y_4)/n_4 + (\Sigma X_5 \times \Sigma Y_5)/n_5 + (\Sigma X_6 \times \Sigma Y_6)/n_6 + (\Sigma X_7 \times \Sigma Y_7)/n_7 + (\Sigma X_8 \times \Sigma Y_8)/n_8 - (\Sigma X \times \Sigma Y)/N$

= (911 x 911)/15 +(837 x 877)/15 + (670 x 718)/15 +(588 x 650)/15 +(831 x 812)/15 +(820 x 768)/15 +(707 x 642)/15 +(614 x 603)/15 -(5984 x 5987)/120

= 304268.93 - 298551.73 = 5717.2

Step-14

$SP_E = SP_{TO} - SP_{Among}$

= 8628.27 - 5717.2 = 2911.07

Step=15

$$SP_A = \frac{(\Sigma X_1 + \Sigma X_2 + \Sigma X_3 + \Sigma X_4) \times (\Sigma Y_1 + \Sigma Y_2 + \Sigma Y_3 + \Sigma Y_4)}{n_1 + n_2 + n_3 + n_4} + \frac{(\Sigma X_5 + \Sigma X_6 + \Sigma X_7 + \Sigma X_8) \times (\Sigma Y_5 + \Sigma Y_6 + \Sigma Y_7 + \Sigma Y_8)}{n_5 + n_6 + n_7 + n_8} - \frac{\Sigma X \times \Sigma Y}{N}$$

= 298630.37 - 298551.73 = 78.64

Step=16

$$SP_S = \frac{(\Sigma X_1 + \Sigma X_5 + \Sigma X_2 + \Sigma X_6) \times (\Sigma Y_1 + \Sigma Y_5 + \Sigma Y_2 + \Sigma Y_6)}{n_1 + n_5 + n_2 + n_6} + \frac{(\Sigma X_3 + \Sigma X_7 + \Sigma X_4 + \Sigma X_8) \times (\Sigma Y_3 + \Sigma Y_7 + \Sigma Y_4 + \Sigma Y_8)}{n_3 + n_7 + n_4 + n_8} - \frac{\Sigma X \times \Sigma Y}{N}$$

$$= \frac{3405 \times 3368}{60} + \frac{2579 \times 2619}{60} - 29851.73$$

$$= 303707.05 - 298551.73$$

$$= 5155.62$$

Step=17

$$SP_{Sex} = \frac{(\Sigma X_1 + \Sigma X_5 + \Sigma X_3 + \Sigma X_7) \times (\Sigma Y_1 + \Sigma Y_5 + \Sigma Y_3 + \Sigma Y_7)}{n_1 + n_5 + n_3 + n_7} + \frac{(\Sigma X_2 + \Sigma X_6 + \Sigma X_4 + \Sigma X_8) \times (\Sigma Y_2 + \Sigma Y_6 + \Sigma Y_4 + \Sigma Y_8)}{n_2 + n_4 + n_6 + n_8} - \frac{\Sigma X \times \Sigma Y}{N}$$

$$= \frac{3083 \times 3119}{60} + \frac{2904 \times 2865}{60} - 298551.73$$

= 160264.62 + 138666 - 298551.73 = 378.89

Step=18

$$SP_{A \times S (Among)} = \frac{1748 \times 1788}{30} + \frac{1657 \times 1580}{30} + \frac{1258 \times 1374}{30} + \frac{1321 \times 1245}{30} - \frac{5987 \times 5984}{120}$$

= 303887.4 - 298551.73 = 5335.67

Step=19

$SP_{A \times S} = SP_{A \times S\ (Among)} - SP_A - SP_S$

$= 5335.67 - 78.64 - 5155.62 = 101.41$

Step - 20

$$SP_{A \times Sex\ (Among)} = \frac{1581 \times 1629}{30} + \frac{1538 \times 1454}{30} + \frac{1425 \times 1533}{30} + \frac{1440 \times 1371}{30} - \frac{5987 \times 5984}{120}$$

$= 299015.50 - 298551.73$

$= 463.77$

Step - 21

$SP_{A \times Sex} = SP_{A \times Sex\ (Among)} - SP_A - SP_{Sex}$

$= 463.77 - 78.64 - 378.89$

$= 6.24$

Step - 22

$$SP_{S \times Sex(Among)} = \frac{1742 \times 1723}{30} + \frac{1377 \times 1360}{30} + \frac{1663 \times 1645}{30} + \frac{1202 \times 1259}{30} - \frac{5987 \times 5984}{120}$$

$= 304104.63 - 298551.73$

$= 5552.90$

Step - 23

$SP_{S \times Sex} = SP_{S \times Sex\ (Among)} - SP_S - SP_{Sex}$

$= 5552.90 - 5155.62 - 378.89$

$= 18.39$

$SP_{A \times S \times Sex} = SP_{Among} - (SP_A + SP_S + SP_{sex}) - (SP_{A \times S} + SP_{A \times Sex} + SP_{S \times Sex})$

$= 5717.2 - (78.64 + 5155.62 + 378.89) - (101.41 + 6.24 + 18.39)$

$= - 21.99$

4.11 : ANOVA TABLE

Source of variance	SS_X	SS_Y	SP
A	6.54	946.41	78.64
S	5685.64	4675.01	5155.62
Sex	537.64	267.01	378.89
A x S	197.63	52.01	101.41
A x Sex	28.03	1.41	6.24
S x Sex	76.8	4.41	18.39
A x S x Sex	53.32	9.06	- 21.99
Error	5024.27	6238.27	2911.07
Total	**11609.87**	**12193.59**	**8628.27**

Step-25

$$SS^*_{YA} = SS_{YA} - \frac{(SP_A + SP_E)^2}{SS_{XA} + SS_{XE}} + \frac{(SP_E)^2}{SS_{XE}}$$

$$= 946.41 - \frac{(78.64 + 2911.07)^2}{(6.54 + 5024.27)} + \frac{(2911.07)^2}{5024.27}$$

$$= 856.36$$

Step-26

$$SS^*_{YS} = SS_{YS} - \frac{(SP_S + SP_E)^2}{SS_{XS} + SS_{XE}} + \frac{(SP_E)^2}{SS_{XE}}$$

$$= 4675.01 - \frac{(5155.62 + 2911.07)^2}{5685.64 + 5024.27} + \frac{(2911.07)^2}{5024.27}$$

$$= 285.87$$

Step-27

$$SS^*_{YSex} = SS_{YSex} - \frac{(SP_{Sex} + SP_E)^2}{SS_{XSex} + SS_{XE}} + \frac{(SP_E)^2}{SS_{XE}}$$

$$= 267.01 - \frac{(378.89 + 2911.07)^2}{(537.64 + 5024.27)} + \frac{(2911.07)^2}{5024.27}$$

$$= 7.63$$

Step-28

$$SS^*_{YAXS} = SS_{YA \times S} - \frac{(SP_{A \times S} + SP_E)^2}{SP_{XA \times S} + SS_{XE}} + \frac{(SP_E)^2}{SS_{XE}}$$

$$= 52.01 - \frac{(101.41 + 2911.07)2}{197.68 + 5024.27} + \frac{(2911.07)^2}{5024.27}$$

$$= 0.83$$

Step-29

$$SS^*_{Y\,A \times Sex} = SS_{Y\,A \times Sex} - \frac{(SP_{A \times Sex} + SP_E)^2}{SP_{X\,A \times Sex} + SS_{XE}} + \frac{(SP_E)^2}{SS_{XE}}$$

$$= 1.41 - \frac{(6.24 + 2911.07)^2}{(28.03 + 5024.27)} + \frac{(2911.07)^2}{5024.27}$$

$$= 3.57$$

Step-30

$$SS^*_{Y\,S\,x\,Sex} = SS_{Y\,S\,x\,Sex} - \frac{(SP_{S\,x\,Sex} + SP_E)^2}{SS_{X\,S\,x\,Sex} + SS_{XE}} + \frac{(SP_E)^2}{SS_{XE}}$$

$$= 4.41 - \frac{(18.39 + 2911.07)^2}{(76.8 + 5024.27)} + \frac{(2911.07)^2}{5024.27}$$

$$= 8.75$$

Step - 31

$$SS^*_{Y\,A\,x\,Sex\,x\,S} = SS_{Y\,A\,x\,S\,x\,Sex} - \frac{(SP_{A\,x\,S\,x\,Sex} + SP_E)^2}{SS_{X\,A\,x\,S\,x\,Sex} + SS_{XE}} + \frac{(SP_E)^2}{SS_{XE}}$$

$$= 9.06 - \frac{(-21.99 + 2911.07)^2}{(53.32 + 5024.27)} + \frac{(2911.07)^2}{5024.27}$$

$$= 51.18$$

Step - 32

$$SS^*_{Y\,(TO)} = SS_{Y\,(TO)} - \frac{(SP_{TO} + SP_E)^2}{SS_{X\,TO} + SS_{XE}} + \frac{(SP_E)^2}{SS_{XE}}$$

$$= 12193.59 - \frac{(8628.27 + 2911.07)2}{(11609.87 + 5024.27)} + \frac{(2911.07)^2}{5024.27}$$

$$= 5875.27$$

Step-33

$SS^*_{YE} = SS_{Y}{}^*_{TO} - SS_{YA}{}^* - SS_{YS} - SS_{Y}{}^*_{Sex} - SS_{Y}{}^*_{Axs} - SS_{Y}{}^*_{A\,x\,Sex} - SS_{Y}{}^*_{S\,x\,Sex} - SS_{Y}{}^*_{A\,x\,S\,x\,Sex}$

$= 5875.27 - (856.36 + 285.87 + 7.63 + .83 + 3.57 + 8.75 + 51.18)$

$= 5875.27 - 1214.19 = 4661.08$

TABLE 4.12

ANCOVA (2 x 2 x 2 FACTORIAL ANALYSIS)

Source of (SS^*_Y) variance	df	SS^*	MS^*	F
A	1	856.36	856.36	20.39**
S	1	285.87	285.87	6.80*
Sex	1	7.63	7.63	.18
A x S	1	.83	.83	.02
A x sex	1	3.57	3.57	.08
S x Sex	1	8.75	8.75	.21
A x S x Sex	1	51.18	51.18	1.23
Error	111	4661.08	41.99	-
Total	118	5875.27		

** Significant at .01 level, * Significant at .05 level.

Correlation and regression

Step – 34

$$R_{total} = \frac{SP_{TOTAL}}{\sqrt{11609.87 \times 12193.59}}$$

$$= \frac{8628.27}{\sqrt{11609.87 \times 12193.59}}$$

$$= 0.73$$

$$r_{Among)} = \frac{SP_{among}}{\sqrt{SS_X\,(bet) \times SS_{Y(bet)}}}$$

$$= \frac{5717.2}{\sqrt{6585.60 \times 5955.32}}$$

$$= .91$$

$$r_{within} = \frac{SP_{with}}{\sqrt{SS_X \text{ with} \times SS_{Ywith}}}$$

$$= \frac{2911.07}{\sqrt{5024.27 \times 6238.27}}$$

$$b_{total} = \frac{SP_{TO}}{SS_{X\,TO}}$$

$$= \frac{8628.27}{11609.87}$$

$$= .74$$

$$b_{bet} = \frac{SP_{bet}}{SS_{X\ bet}}$$

$$= \frac{5717.2}{6585.60}$$

$$= .86$$

$$b_{within} = \frac{SP_{with}}{SS_{Xwith}}$$

$$= \frac{2911.07}{5024.27}$$

$$= .58$$

Calculation of adjusted Y means

$My^* = My - b\ (M_X - GM_X)$

For group A_1 :

$My^*A_1 = My - b(M_X - GM_X)$

$= 52.7 - .58\ (50.1 - 49.87) = 52.56$

$A_2 : My^*A_2 = My - b\ (M_X - GM_X)$

$= 47.08 - .58\ (49.63 - 49.87) = 47.22$

$MY^*A_1 - My^*A_2 = (52.56 - 47.22) = 5.34$

Where

b= regression

M_x = Mean of X

GM_X= Grant mean of total Pretest

For group S_1 :

$MY^*S_1 = My - b(M_X - GM_X) = 56.13 - .58\ (56.75 - 49.87) = 52.14$

$S_2 : MY^*S_2 = My\text{-}b(Mx\text{-}GMx) = 43.65 - .58(42.98\text{-}49.87) = 47.65$

$MY^*S_1\text{-}MY^*S_2 = (52.14 - 47.65) = 4.49$

Step-35 : Significance of differences among adjusted Y means:

Standard error of difference between two adjusted means

$$= \sqrt{MS^*W \left[\frac{1}{N_1} + \frac{1}{N_2}\right]}$$

$$= \sqrt{41.99 \left[\frac{1}{60} + \frac{1}{60}\right]}$$

$= 1.18$

For df = 111, $t_{.05}$ = 1.66, $t_{.01}$ = 2.36 (Table D)

Significant difference at .05 level = 1.66 x 1.18 = 1.96

Significant difference at .01 level = 2.36 x 1.18 = 2.78

A_1 = differ significantly from A_2 at .01 level

S_1 - differ significantly from S2 at .01 level

$MS'_W = MS_{Error}$ = p. 98 = 41.99

To find out the significant effect of school variation on treatment (Interest Diversification Model), the investigator calculated 't-value'. The obtained result is given below in the table 5.2.5.

S1	**S2**
M_1 = 59.5	M2 = 45.83
G_1 = 7.3	G_2 = 5.07
N_1 = 30	N_2 =30

df = 30 + 30 - 2 = 58

't' = 8.87, * Significant at .01 level

S_1 = H.R.V.M.

M_1 = Mean of the Experimental group of the school (S_1)

G_1 = Standard deviation of the experimental group of the school (S_1)

N_1 = Total number of students of the experimental group in the school (S_1)

S_2 = H.M.H.S.

M_2 = Mean of the experimental group of the school (S_2)

G_2 = Standard deviation of the experimental group of the school (S_2)

N_2 = Total number of students of the experimental group in the school (S_2)

4.9 INTERPRETATION OF THE RESULTS

1. Main Effect for Factor - A

As the difference between two adjusted means for two levels of factor A i.e. A_1 and A_2 was significant at .01 level, the null hypothesis (OH_1) was rejected. In other words, there is significant difference between two treatment groups (control and experimental) in respect of criterion test scores.

2. Main Effect for Factor-S

As the difference between two adjusted means for two levels of factor S, i.e., S_1 and S_2 was significant at .01 level, the null hypothesis (OH_2) was rejected.

In other words, there is significant difference between students belonging schools (i.e. K.U.E.H.S. and L.V.A.V) in respect of their criterion test scores.

3) Effect for S factor on the Treatment (ITM)

As the obtained t-value was significant at .01 level, the OH_3- "There is no significant effect of school factor on the treatment (ITM) in respect of achievement in criterion test in Physical Science", was rejected.

In other words, there was real significant effects of school factor on the achievement of criterion test in Physical Science due to treatment (Inquiry Training Model).

4) Main Effect for Factor-Sex

As the F-ratio for the factor-sex was not significant at .05 level, the O_{H4} was retained.

In other words, there was no significant difference (in the mean score of criterion test scores of two levels) between 'boys' and 'girls' in respect of criterion test scores.

5) **Effect for sex-factor on the treatment (MDM)**

As the obtained F-ratio was to significant at 0.05 level, the OH5 - "There is no significant effects of sex factor on the treatment (Interest Diversification Model) in respect of achievement in Criterion test in "Physical Science", was retained. In other words, there was no real significant effects of sex factor on the achievement of criterion test due to treatment (Interest Diversification Model).

6) Interaction Effect for Axs :

7) As the F-ratio for AXS, interaction effect was not significant at 0.05 level, the well hypothesis (OH6) was retained.

8) In other words, there was no significant effect due to treatment and school on the criterion test scores.

7. Interaction Effect for A x Sex

As the F-ratio for A x Sex interaction effect was not significant at .05 level, the OH_7 was retained.

In other words, there was no significant interaction effect due to treatment and sex on the criterion test scores.

8. Interaction Effect for S x Sex

As the F-ratio for A x S x Sex interaction effect was not significant at .05 level, the null hypothesis (OH9) was retained.

9. Interaction Effect for A x S x Sex

As the F-ratio for A x S x Sex interaction effect was not significant at .05 level, the null hypotheses (O_{H9}) was retained. In other words, there was no significant interaction effect due to treatment, school and sex on the criterion test scores.

CHAPTER V

SUMMARY AND CONCLUSION

CHAPTER V

5.1 INTRODUCTION

Teaching-Learning System is a very Signigicant aspect in educational domain. It means the systematic study of different components of Teaching and learning. It includes School environment, Teaching Learning process, Curriculum structure and Evaluation Technique which are the various subsystems comprises the system. We foc using our attention to investigate the various components of Teaching-Learning system at seeondary level to visualise the system through the subject physical science at Secondary Level. The subject is the combination at two halves of which 50 marks are alloted in chemistry and other fifty marks for physics. To internalize the scientific temper & to develop positive attitude towards the subject physical science an integrated approach is essential. For this reason we try to investigate the teaching learning system in respect to school environment, curriculum structure, Teaching learning process and evaluation technique. After investigating the teaching-learning situation in West Bengal and evaluating the examination system we finally prescribed a model which one is Interest Diversification Model for further improvement.

OBJECTIVES OF OUR STUDY

* To study the present Teaching Learning System of Physical Science in Secondary Schools of West Bengal.
* To study the school environment of West Bengal regarding Teaching Learning System of Physical Science.
* To study the curriculum structure of Secondary level schools in West Bengal Board.
* To study the Teaching Learing process of Secondary Level Schools of West Bengal.
* To study the evaluation process of secondary curriculum in West Bengal.
* To study the mechanism of Teaching Learning system.

METHODOLOGY

Type of Research : The Research is basically descriptive type Survey Research. Both descriptive and inferential statistics have been used for conducting the study.

TOOLS USED :

1. Standardized Questionnaire of Teaching-Learning System.
2. Assembled Questions of Xth Grade examination conducted by West Bengal Board of Secondary Education for last four years.
3. Interest Diversification Model of Teaching.

Population : All the schools of secondary level have been considered as population in West Bengal.

Sample : Following schools have been selected from various parts of West Bengal as sample of the present study—

Sl. No.	Name of the school from which sample is selected	District
1.	Jetia Girls' High School	North 24 Parganas
2.	Malancha High School (Co-educational)	North 24 Parganas
3.	Shibpur Prasanna Kumari Balika Sikshalaya	Howrah
4.	Tiljala Brojanath Vidyapith (Boys)	South 24 Parganas
5.	Halisahar Rabindra Vidyamandir (Co-educational)	North 24 Parganas
6.	Chinsurah Balika Bani Mandir	Hooghly
7.	Nimtala Ragaswar High School (H.S.) (Co-Edu.)	Nadia
8.	Chalsa Gayanath Vidyapith (H.S.)	Jalpaiguri
9.	Khalboalia High School (H.S.) (Co-Edu.)	Nadia
10.	Lalbagh Shingh High School	Murshidabad
11.	Maharaja manindra Chandra High School	Murshidabad

12.	Bagmari High School	Murshidabad
13.	Tentulia Balika Vidyalaya	North 24 Parganas
14.	Ramchandrapur Balika Bidyalaya	North 24 Parganas
15.	Gangagharpur Girls' School	Jalpaiguri
16.	Mitelli High School	Jalpaiguri
17.	Deultpur High School	Howrah
18.	Gangadharpur Vidyamandir	Howrah
19.	Kanthi High School	Midnapur
20.	Tamluk High School	Midnapore
21.	Kulti Boys High School	Bardwan

Reliablity : The Questionnaire is highly reliable. Mainly Test-Restest method is used for calculating reliablity. The reliability coefficient is found to be 0.86.

Validity : Validity is calculated from reliability index and content validity is highly maintained.

FINDINGS :

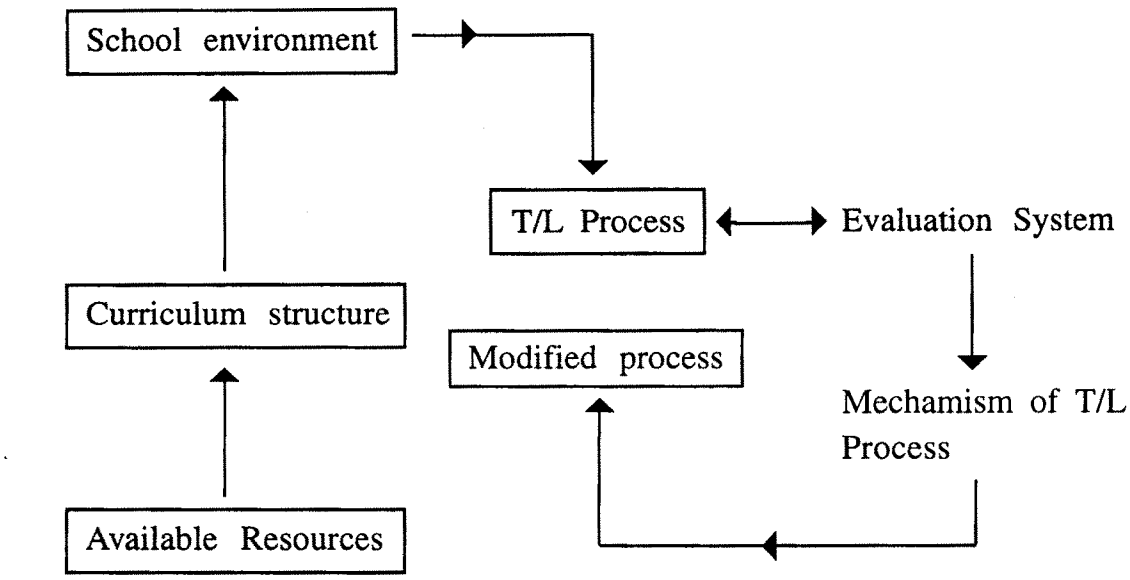
5.2 Teaching Learning System

To investigate the teaching learning system of physical science in West Bengal Secondary Schools the present study can able to find out the system of physical science including different components as a subsystem reflected in the chapter No. 2.

The system has been explained in different dimensions. After investigating the system we have to explain the evaluation system in West Bengal in detail in a separate chapter because evaluation at teaching learning is the ultimate outcome of the total system.

The system is given below :

Teaching Learning System



I. Components of T/L System :

From the background study, survey & experts view we have selected the Teaching-Learning system with four essential components. They are (1) School Environment (2) Curriculum structure (3) Teaching-Learning process and (4) Evaluation Technique. From the components of Teaching-Learning System in chapter II thirty two hypothses have been framed & its interpretation of the results are mentioned below —

Interpretation of the Results :

1. Infrastructure of school environment is significantly related to the academic achievement and hence the teaching learning system of physical science. Therefore hypothesis one is rejected.
2. It is observed that students performance are keenly related to their attitude towards school and therefore HO_2 is rejected.
3. Student teacher relationship has also greater impact towards the output of learners capability which we have from the statistical findings and therefore HO_3 is rejected.
4. Classroom climate of school environment will have to have a close relation towards the terminal performance of the learners and therefore H_4 is rejected.

5. Co-curricular activities of school environment and its relation to academic achievement is accepted in hypothesis five.

6. Generally we have a concept of work culture which have a significant relationship with the Academic achievement is rejected in our hypothesis no. 6.

7. From ANOVA it is observed that Urban School environment and Rural school environment differ significantly.

8. In Gender wise study of school environment it shows the significant difference and therefore H_8 is rejected.

9. Hypothesis regarding the mean difference of High Group and Low group of school environment is significant from 't' test.

   Therefore, it is concluded that school environment has a positive input on the academic advancement of learners specially on the dimensions of infrastructure, attitude towards school, student teacher relationship and classroom climate supported by the parametric statistics on the basis of assumed normal distribution and homogeneity, and so also further verified and supported by the distribution free X^2 test.

10. In Teaching-Learning process application of Teaching Aids helps the students for their academic betterment supported by the significant relationship between teaching and learning process and academic Achievement. Hence HO_9 is rejected

11. Development of Attitude and interest are also playing Key role for the Academic achievement in Teaching-learning Process.

12. Reinforcement in different ways also can give the enhancement of the performance of learners supported by 't' test.

13. In any Teaching Learning process many students are facing problems according to their individual ability & other factors too may promote their Academic Achievement through remedial Teaching.

14 From the findings it can be interpreted that the two types of schools (rural and urban) showing uniformity towards the dimensions – Content, Interest, Future Prospect, Frustrations, Creativity, Examination System and value pattern supported by the hypothesis No. HO_{18}, HO_{19}, HO_{22}, HO_{23}, HO_{24}, HO_{27} and HO_{28} .

15. It can also be interpreted that there are differences between the two schools

in relation to the following dimensions – Continuity, Consistency, Problem Solving Ability, Curiosity in the Curriculum.

16. There is no gender sensitivity towards the present consideration of curriculum at Secondary Level School in West Bengal.

17. Urban schools & Rural schools differ significantly in respect to systematic & continuous evaluation. That is there is a difference between systematic & continuous evaluation in Urban & Rural areas supported by the hypothes No. HO_{30}, HO_{31} and HO_{32} .

18. From the critical ratio it is also interpreted that Urban & Rural areas differ significantly in respect to effective evaluation. On the basis of hypothesis testing and other available informations we are now potential to suggest a teaching learning system through which a school may be guided, by the significant factors reflected in our result mentioned earlier.

5.3 Evaluation Teachnique :

Regarding evaluation technique it can be said that the present evaluation technique is to be more systematic and scientific. We critically evaluate the last 4 years Questions of Secondary Level exam. and our findings are given below:

From tables 6, 7, 8 and 9 in chapter three it is evident that the questions are not set in order of graded difficulty which leads to the retention of hypothesis (1).

From tables 10, 11, 12, and 13, it is evident that the questions are set in such a way that most of them cannot separate the high achievers from the low achievers which leads to the retention of hypothesis (2).

It may be due to the fact that the questions setters have not followed the procedures of standardization of tests. They had no 'blue-print' or 'format' of the test classifying the test items into knowledge, skill, understanding and application items. In fact, the present question-setters of the Board of Secondary Education make a compromise between the primitive and the modern systems, they invent a new system of questioning which lacks both the ends and unfurls a paradoxical method. They possibly are acquainted with the term content validity; so, they select questions from every chapter or making a complete question of 9 marks taking more than one chapter. And in this way they believe that the questions have been set covering the whole content area. The questions are both short-answer type questions and objective type questions. This phenomenon of newly evolved pattern leads possibly to the retention of hypothesis (1) and (2). This study reveals one point that hypothesis (1) and (2)

are integrally inter-related; if one is established, the other follows the same track.

In the persuit of hypothesis no. (3) it has been found (Table-20) that 10% marks have been repeated from the last year 20% marks from three years earlier loading to the fact that 35% marks can easily be attained by solving the question papers of the last three years. Incidentally, if any school is interested to prepare the students only with the questions of the last five years, there is every reason to believe that the students of that school would exhibit a brilliant performance in the examination of the board. The papers are so framed that it is found very easy for a student to get the pass marks through stereotyped questions. A large majority of students take selective preparation to secure good marks in the examination without learning the subjects in a through going manner. And if this be the situation with most other subjects, we must definitely be horrified about the show making brilliance of our students. And we all should start thinking a new the procedure of evaluation of the West Bengal Board of Secondary Education.

From the Table-28, it is evident that hypotheses-4 (I, vi) have been retained while hypothesis-4 (ii, iii, iv, v) have rejected leading to a general conclusion that there is variation in standard of Evaluation in different years taking in mind that the standard of students does not vary significantly from year to year when such a large area as that of West Bengal is considered, which leads to the general conclusion that there is variation on in standard of the Evaluation from year to year.

It may be due to fact that the same question setter set questions in 2001 and 2002, while another question setter set questions in 2003 and 2004. It may be that it was the instruction of the Board to set question easier in 2003 and 2004. It may be that the atmosphere of education has substantially improved both in schools and at home in 2003 and 2004. Moreover, the question-setters could not maintain the standard of difficulty value and discriminating value from year to year.

5.4 Mechanism of Teaching Learning System :

The present study has intended (a) to test the effectiveness of Interest Diversification Model in teaching Physical Science in the present day school condition of West Bengal and also (b) to know if any method of teaching is more suitable to a particular type of school than the other, and (c) to find out whether there is any effect of sex factor on the achievement through any particular teaching method.

Relative effectiveness of the Interest Diversification and the Traditional method of teaching

Hence adjusted mean score of experimental group under the treatment of Interest Diversification Model was greater than the adjusted mean score of control group under the treatment of Traditional teaching method, it can be inferred that Interest Diversification Model has better efficiency than the Traditional teaching method.

The question may arise, why Interest Diversification Model shows the better efficiency than traditional method of teaching? The plausible answer may be that the Interest Diversification Model of teaching is well rationalised and designed which helps students to acquire abilities of scientific attitude through development of Interest which are essential to learn any Science matter easily, and it fits well to the learning style of the students. Besides these, Interest Diversification Model is the process of specifying and producing particular environmental situation, which cause the students to interact in such a way that a specific change occurs in their behaviour. On the other hand Traditional method is not psychology-based and so it cannot provide such effective classroom environment that the students can confront with materials and able to assimilate the information.

The effects of school variation on the achievement in respect of criterion test scores of the students under two treatment groups

As the adjusted mean score of the criterion test scores of the students of H.R.V.M. was greater than that of the students of H.M.H.S., so it is evident that the students of H.R.V.M. under both treatment group (control group and rimental group) shows better performance in respect of criterion test scores than the students of H.M.H.S. under both treatment groups.

Effect of school variation on the treatment (Interest Diversification Model) in respect of achievement in criterion test

As the effect of school variation on the treatment (IDM) was significant at .01 level, it can be concluded that the school factor has a significance effect on teaching Physical Science through Interest Diversification Model.

The effects of sex variation on the achievement in the respect of criterion test scores of the students under two treatment groups

As there was no significant difference between the mean scores of criterion test scores of boys and girls, so it can be concluded that there was no real difference among the boys and girls in respect of their criterion test scores.

Effect of school variation on the treatment (Diversification Model) in respect of achievement in criterion test

As the effect of sex variation on the treatment was not significant at .05 level, it can be concluded that the sex factor has no significant effect on the teaching in Physical Science through Interest Diversification Model.

Interaction effect of treatment & School on the achievement in respect of criterion test scores

As the interaction effect of treatment and school was not significant. So, it is evident that there is no significant interaction effect on the achievement of the students in respect of criterion test scores.

Interaction effect of treatment & sex on the achievement in respect of criterion test scores

As the interaction effect of treatment and sex was not significant, so, it is evident that there is no significant interaction effect due to treatment and sex on achievement of the students in respect of criterion test scores.

Interaction effect of school and sex on the achievement in respect of criterion test score

As the interaction effect of school and sex was not significant, so, it is evident that there is no significant interaction effect due to school and sex on the achievement of the students in respect of criterion test scores.

Interaction effect of treatment, school and sex on the achievement in respect of criterion test score

As the interaction effect of treatment, school and sex was not significant, so it is evident that there is no significant interaction effect due to treatment, school and sex on the achievement of the students in respect of criterion test scores.

From the above discussion, it is evident that the Interest Diversification Model is more effective instructional strategy for teaching in Physical Science at secondary school level in existing classroom situation than the Traditional teaching method.

Though school may appear as an important factor in the selection of this model, the Interest Diversification Model of teaching has a wide scope of application, in Indian Context, within present limited resources. So, it may

accelerate a revolutionary change in our teaching-learning situation, if it is implemented faithfully.

School is also an important factor in the achievement of Physical Science in general.

But the sex is not an important factor affecting the acheevement in Physical science at secondary school level as well as the treatment through Interest Diversification.

5.5 CONCLUSION :

Investigation of Teaching Learning system of Physical Science in West Bengal is actually a very difficult Job. But whether in theoretical side & whether in practical part we trying hard to have a conclusion. In theoretical aspect we showed the systems of Physical Science in Teaching and Learning and its different components. How the different components are related to teaching and learning that has also been reflected to chapter no. 2. Results showed that besides academic atmosphare, surrounding factors are also significantly related to Academic Achievement of Learners. Most of the schools of West Bengal do not follow any particular or common type to teaching & learning because the situational factors, Variation of availibility of resources. We therefore in 4th chapter presented an alternative model Interest Diversification Model to substitute the traditional method. Experiment proves that Interest Diversification Model will be better than traditional method. In another chapter we are giving importance for investigation of evaluation technique in West Bengal secondary schools because there should be a balance between the teaching learning system of Physical Science and the ultimate out come of Evaluation system in secondery schools in West Bengal. Statistics showed that present evaluation system is to be improved and to be more systematic. Under this circumstances we shifted our ideas from cognitive to affective domain in classroom teaching where we can diversify interest of learners through (1) multiplication (2) substitution & (3) shifting and then convert learners interest in cognitive domain. An equillilrium is observed between cognitive and affective domain here. Diversificantion of interest is resulted through this equillibrium on the basis of situational factors & availibility of resources and other components of teaching & learning system.

CHAPTER VI

- **APPENDICES**
- **BIBLIOGRAPHY AND REFERENCES**

APPENDIX — A

TEACHING — LEARNING SYSTEM

Chapter-VI

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APPENDIX — B

ঃ গবেষণার বিষয় ঃ

An Investigation into the Teaching Learning System of Physical Science in the Secondary Schools of West Bengal.

প্রশ্নপত্র

কল্যাণী বিশ্ববিদ্যালয়ে শিক্ষা বিভাগে পিএইচ.ডি. (Ph.D) গবেষণা কাজের জন্য
প্রশ্নপত্রটি শিক্ষার্থীদের কাছে প্রদত্ত হল।

গবেষক ঃ নির্মল কুমার মিত্র
গবেষণা নির্দেশক ঃ ডঃ দিব্যেন্দু ভট্টাচার্য্য

প্রয়োজনীয় নির্দেশনা — প্রতিটি প্রশ্নের জন্য দুটি পছন্দের তালিকা দেওয়া আছে।
তোমার পছন্দমত উত্তরটির পাশে " ✓ " দাও।

শিক্ষার্থীরা প্রতিটি প্রশ্ন পড়ে তাদের নিজস্ব সঠিক মতামত স্পষ্টভাবে জানাতে হবে।
স্বাভাবিক কারণেই এই মতামতের গোপনীয়তা অবলম্বন করা হবে এবং
কেবলমাত্র গবেষণা কাজে ব্যবহার করা হবে।

ছাত্র / ছাত্রীর নাম ..... শ্রেণী ..... রোল নং .....

বিদ্যালয়ের নাম .....

জেলা .....

১। ভৌতবিজ্ঞান পড়ানোর সময় শিক্ষকগণ বিভিন্ন প্রাসঙ্গিক ছবি বা চার্ট ব্যবহার করেন।

হ্যাঁ না

২। বিদ্যালয়ে প্রতিবছর বিজ্ঞান সেমিনার / প্রদর্শনী সংগঠিত হয়।

হ্যাঁ না

৩। ভৌতবিজ্ঞান পঠন-পাঠনে শিক্ষকদের পাঠদান যথেষ্ট উন্নত নয়।

হ্যাঁ না

৪। রসায়নের ক্লাসে শিক্ষকদের উপস্থাপনা আমাকে অনুপ্রাণিত করে না।

হ্যাঁ না

৫। ভৌতবিজ্ঞান বিষয়ে পিছিয়ে পড়া ছাত্রদের জন্য বিদ্যালয়ে বিশেষ ব্যবস্থা আছে।

হ্যাঁ না

৬। আমাদের বিদ্যালয়ে ভালো পাঠাগার নেই।

হ্যাঁ না

৭। বিদ্যালয়ের পাঠাগার থেকে নিয়মিত বই দেওয়া হয়।

হ্যাঁ না

৮। ভৌতবিজ্ঞানের রেফারেন্স বই বিদ্যালয় পাঠাগার থেকে দেওয়া হয়।

হ্যাঁ না

৯। বিজ্ঞান বিভাগের মধ্যে ভৌতবিজ্ঞান বিষয়টি আমি বেশী পছন্দ করি।

হ্যাঁ না

১০। ভৌতবিজ্ঞান পাঠ্যসূচীর রসায়ন বিভাগ আমার বেশী ভালো লাগে।

হ্যাঁ না

১১। মাধ্যমিকে ভৌতবিজ্ঞানের পাঠক্রম ও উচ্চমাধ্যমিকের পদার্থ ও রসায়নবিদ্যার পাঠক্রমের সঙ্গে সমতা ও ধারাবাহিকতা নেই।

হ্যাঁ না

১২। ভৌতবিজ্ঞানের পদার্থবিদ্যা অংশের পাঠক্রম বেশীরভাগ অংশই মুখস্থ বিদ্যাভিত্তিক যুক্তিভিত্তিক নয়।

হ্যাঁ না

১৩। ভৌতবিজ্ঞানের পাঠক্রমে ব্যবহারিক প্রয়োগ খুবই কম।

হ্যাঁ না

১৪। ভৌতবিজ্ঞান পঠনের ক্ষেত্রে শিক্ষকরা ছাত্রদের নিয়মিত পরামর্শ দান করে থাকেন।

হ্যাঁ না

১৫। ভৌতবিজ্ঞান পাঠক্রমে গাণিতিক ব্যাখ্যার সুযোগ খুব কম আছে।

হ্যাঁ না

১৬। পদার্থবিদ্যা অংশের প্রশ্নের মূল্যমান (নাম্বার) খুবই কম হওয়ার ফলে পাঠক্রমের গভীরে ছাত্র / ছাত্রীরা যায় না।

হ্যাঁ না

১৭। ভৌতবিজ্ঞানের রসায়ন অংশের পাঠক্রমের গভীরতা কম হওয়ার ফলে ছাত্রী / ছাত্রীরা বুঝতে পারে।

হ্যাঁ না

১৮। পঃ বঃ পর্ষদের ভৌতবিজ্ঞানের পাঠক্রম অন্যান্য বোর্ডের পাঠক্রম থেকে আলাদা।

হ্যাঁ না

১৯। ছাত্র / ছাত্রীদের ভৌতবিজ্ঞানের পাঠক্রম প্রতিযোগিতামূলক নয়।

হ্যাঁ না

২০। সরল ও সাবলিল ভাষায় শিক্ষকমহাশয় শ্রেণীতে ভৌতবিজ্ঞান পাঠদান করেন।

হ্যাঁ না

২১। ভৌতবিজ্ঞানের পাঠক্রমের বেশীরভাগ অংশই শ্রেণীতে পড়ানো হয় না।

হ্যাঁ না

২২। ছাত্ররা ভৌতবিজ্ঞানের পাঠক্রম বহির্ভুত বিভিন্ন শিক্ষামূলক অনুষ্ঠানে যোগদান করে।

হ্যাঁ না

২৩। ভৌতবিজ্ঞানের অঙ্কের প্রশ্নে বেশীরভাগ ছাত্ররা পারদর্শী নয়।

হ্যাঁ না

২৪। ভৌতবিজ্ঞানের মৌখিক পরীক্ষার পরিবর্তে আন্তমূল্যায়ন পদ্ধতি বিশেষ কার্যকরী।

হ্যাঁ না

২৫। বেশীরভাগ বিদ্যালয়ের ভৌতবিজ্ঞানের ল্যাবরেটরি নেই।

হ্যাঁ না

২৬। আমাদের বিদ্যালয়ে মাসিক / সাপ্তাহিক ভৌতবিজ্ঞান পরীক্ষার ব্যবস্থা আছে।

হ্যাঁ না

২৭। আমি বাড়িতে অন্যান্য বিষয়ের তুলনায় ভৌতবিজ্ঞান আগ্রহ সহকারে পড়ি।

হ্যাঁ না

২৮। যেহেতু ভৌতবিজ্ঞানের নম্বর বেশী ওঠে তাই ভৌতবিজ্ঞান আমার ভালো লাগে।

হ্যাঁ না

২৯। রসায়ন বিভাগ আমার একেবারেই ভালো লাগে না।

হ্যাঁ না

৩০। বাৎসরিক পরীক্ষা পদ্ধতি বিজ্ঞানসম্মত নয়।

হ্যাঁ না

৩১। পরীক্ষা পদ্ধতি সেমিস্টার বা পর্বভিত্তিক হওয়া উচিত।

হ্যাঁ না

৩২। পরীক্ষা পদ্ধতিতে ভালো ছাত্র ও সাধারণ ছাত্রদের মধ্যে পার্থক্য করা কঠিন।

হ্যাঁ না

৩৩। ভৌতবিজ্ঞান প্রশ্নে তথ্যমূলক প্রশ্নের সংখ্যা বেশী।

হ্যাঁ না

৩৪। ভৌতবিজ্ঞান পড়ানোর সময় শিক্ষকগণ বিভিন্ন চার্ট, মডেল, লেন্স ইত্যাদি ব্যবহার করেন।

হ্যাঁ না

৩৫। রসায়নের গ্যাস প্রস্তুতি পড়ানোর সময় শিক্ষকগণ বিভিন্ন পরীক্ষাগুলি হাতে কলমে দেখান না।

হ্যাঁ না

৩৬। শ্রেণীতে ছাত্রদের লিটমাস কাগজ দেখানো হয়।

হ্যাঁ না

৩৭। আমাদের শ্রেণীতে ছাত্রসংখ্যা ৬০-এর বেশী।

হ্যাঁ না

৩৮। তোমাদের ভৌতবিজ্ঞান শিক্ষক সংখ্যা ৪ জনের বেশী।

হ্যাঁ না

৩৯। ভৌতবিজ্ঞান পড়ানোর সময় ছাত্রদের সঙ্গে শিক্ষক আলোচনা / বিতর্ক কিংবা পারস্পরিক ক্রিয়া-প্রতিক্রিয়া করেন না।

হ্যাঁ না

৪০। উচ্চমাধ্যমিকের মত মাধ্যমিকের ভৌতবিজ্ঞানেও পাঠক্রম (সিলেবাস) ভিত্তিক আলাদা বই হওয়া উচিত।

হ্যাঁ না

৪১। আমাদের প্রতিদিন ভৌতবিজ্ঞানের ক্লাস হয়।

হ্যাঁ না

৪২। আমি সারাদিন গড়ে ৪ ঘন্টা ভৌতবিজ্ঞান পড়ি।

হ্যাঁ না

৪৩। আমাদের বিদ্যালয়ে কমপিউটার আছে।

হ্যাঁ না

৪৪। শ্রেণীতে ভৌতবিজ্ঞান পড়ানোর সময় কমপিউটারের মাধ্যমে বিষয়গত কিছু দেখানো হয়।

হ্যাঁ না

৪৫। ভৌতবিজ্ঞানের আলোক অধ্যায় আমার ভালো লাগে না।

হ্যাঁ না

৪৬। আলোক অধ্যায় পড়ানোর সময় আমাদের লেন্স বা দর্পন দেখানো হয়।

হ্যাঁ না

৪৭। ভৌতবিজ্ঞান পড়ানোর সময় মাঝে মাঝে আমাদের ল্যাবরেটরিতে নিয়ে যাওয়া হয়।

হ্যাঁ না

৪৮। পরবর্তীকালে আমি বিজ্ঞান নিয়ে পড়ব কারণ বিজ্ঞান আমার খুব প্রিয় বিষয়।

হ্যাঁ না

৪৯। রসায়নের যোজ্যতা অধ্যায় আমার খুব কঠিন লাগে।

হ্যাঁ না

৫০। রসায়নের সমতা বিধান খুবই সহজ ব্যাপার।

হ্যাঁ না

৫১। নিউটনের গতিবিষয়ক অধ্যায়ের অঙ্কগুলি খুবই সহজ।

হ্যাঁ না

৫২। রসায়নে বিক্রিয়ক ও বিক্রিয়াজাত পদার্থের মধ্যে সমীকরণ গঠনে ছাত্র / ছাত্রীরা পারদর্শী নয়।

হ্যাঁ না

৫৩। তড়িৎ বিজ্ঞান অধ্যায় ব্যবহারিক জীবনে বেশী কাজে লাগে বলে আমাদের ভালো লাগে।

হ্যাঁ না

৫৪। তাপ ও উষ্ণতা পড়ানোর সময় আমাদের শ্রেণীতে থার্মোমিটার দেখানো হয়েছে।

হ্যাঁ না

৫৫। আমাদের শ্রেণীতে ভর পরিমাপের জন্য সাধারণ তুলাযন্ত্রের ব্যবহার দেখানো হয়নি।

হ্যাঁ না

৫৬। ভৌতবিজ্ঞান পড়ার ক্ষেত্রে গৃহশিক্ষক থেকে বিদ্যালয় শিক্ষক বেশী উৎসাহিত করেন।

হ্যাঁ না

৫৭। আমার ভৌতবিজ্ঞানের গৃহশিক্ষক নেই।

হ্যাঁ না

৫৮। ভৌতবিজ্ঞানের পঠনে পারিবারিক সহযোগিতা বিশেষভাবে আমাকে সাহায্য করে।

হ্যাঁ না

৫৯। ভৌতবিজ্ঞান শিক্ষকের সাথে আমাদের সম্পর্ক খুব ভালো হওয়ায় পঠন-পাঠন বেশ উন্নতমানের।

হ্যাঁ না

৬০। কাজের সংস্থান বেশী থাকার জন্য ভবিষ্যতে আমি ভৌতবিজ্ঞান নিয়ে পড়তে চাই।

হ্যাঁ না

An Investigation into the Teaching Learning System of Physical Science in the Secondary Schoos of West Bengal.
(English Version)

Questionnaire

(The tool have been prepared for collecting data from different schools in West Bengal for Ph.D. Degree)

Reasearcher : Nirmal Kumar Mitra
Supervisior : Dr. Dibyendu Bhattacharyya

Students are Requested to give '✓' marks for their correct choice and their opinion will be kept confidential.

Name ..... Roll No. .....

Name of the School .....

Class ..... District .....

1. Teaching aids are used in physical science teaching.

   Yes No.

2. Science Seminar is usually conducted in every year.

   Yes No.

3. The methodology of teaching physical science is not satisfactory.

   Yes No.

4. Learners are not getting interest from chemistry classes.

   Yes No.

5. Remedial teaching is given for backward students.

   Yes No.

6. The school has no well equipped library.

   Yes No.

7. Library issued books in regular way.

   Yes No.

8. Reference books are issued from library.

   Yes No.

9. I like physical science most among science subjects.

   Yes No.

10. I prefer chemistry in physical science curriculum.

    Yes No.

11. No continuity exists between secondary Science Curriculum & Higher secondary Science Curriculum.

    Yes No.

12. Most of the curriculum in physical science is not logically cited.

    Yes No.

13. Physical science curriculum should be practical based.

    Yes No.

14. Teachers are used to give remedial teaching for the betterment of students.

    Yes No.

15. There is a little scope in explaining physical science curriculum.

    Yes No.

16. There is no scope of in-depth study in physical science.

Yes No.

17. Students understand chemistry due to very easy syllabus.

Yes No.

18. The 10th grade curriculum differs from other boards.

Yes No.

19. The curriculum of Physical Science is not competent.

Yes No.

20. The lecture of teachers are appreciable.

Yes No.

21. Most of the curriculum is not covered in allotted classes.

Yes No.

22. Learners participate different educational programme as a cocurricular activities.

Yes No.

23. Secondary level students have less problem solving ability in physical science.

Yes No.

24. The existing oral exam should be replaced by internal assessment.

Yes No.

25. Most of the school has no laboratory.

Yes No.

26. Monthly & Weekly tests have been conducted in evaluating physical science achievement.

Yes No.

27. I prefer to read physical science than any other subject.

Yes No.

28. I like physical science as it is highly scoring.

Yes No.

29. I dislike chemistry.

Yes No.

30. External exam. is not scientific.

Yes No.

31. Semestar process can replace the present method.

Yes No.

32. No proper discrimination is made from exem. system.

Yes No.

33. In physical science question paper most of the questions are information based.

Yes No.

34. Different chart, model & other Teaching Aids are used by teachers.

Yes No.

35. No Demonstration is performed during theoretical classes.

Yes No.

36. Litmus paper have been used during class teaching.

Yes No.

37. No. of students is more than 60 in a class.

Yes No.

38. Number of teachers in our school is more them four.

Yes No.

39. Teacher interact with the students during demonstration.

Yes No.

40. In physical science curriculum, Physics & Chemistry curriculum should be separated.

Yes No.

41. Classes are held regularly.

Yes No.

42. I read physical science almost 4 hours per day.

Yes No.

43. Our school have computer.

Yes No.

44. Computer assistance have been used during teaching science.

Yes No.

45. I don't like the chapter light.

Yes No.

46. Laboratory equipments are shown in classroom teaching.

Yes No.

47. Sometimes science classes are conducted in the laboratory.

Yes No.

48. I favour science & shall choice science as my future career.

Yes No.

49. I feel difficulty in valency chapter of chemistry.

Yes No.

50. Balancing is very much easy to me.

Yes No.

51. Problems regarding Newton Laws of Motion are very easy.

Yes No.

52. Students are not skilled in writing equation.

Yes No.

53. Electricity chapter is very easy to me.

Yes No.

54. Thermometer has been domestrated during classroom instructions.

Yes No.

55. No balance have been shown during teaching in mass & weight.

Yes No.

56. Private tutor is better than school teacher.

Yes No.

57. I have no private tutor.

Yes No.

58. Family Cooperation is very important for learning physical science.

Yes No.

59. We have a good relation with the physical science teacher.

Yes No.

60. In future I want to study with science due to greater voacaional opportunity.

Yes No.

APPENDIX — C

ASSEMBLED QUESTIONS OF MADHYAMIK EXAMINATION

Madhyamik Pariksha — 2001

Physical Science

Attempt all Questions.

Figures in the margin indicate full marks for each questions.

Group — A

3. (a) Between mass and weight of a substance, which will differ in Calcutta and Darjeeling and why? Between mass and weight which is measured with which type of balance? 2+1

   (b) A little ash only remains as a residue on burning a heap of straw. Explain whether mass is conserved in this case. 2

   (c) Between pure water and salted water which one will have a higher boiling point? Why is salt added sometimes to the snow on a road deposited due to severe cold in cold regions? Why does a hot road in summer get cooled on washing with water? 1+2+1

4. (a) Which energy is converted into which other forms of energy in the following cases? During photosynthesis, in an electric bell in an electrolytic cell. 3

   (b) Give one example each, from your practical experience, of the conversion of kinetic energy to potential energy and vice-versa. 2

   (c) How many protons and nutrons are there in the atom $^{141}_{57}X$? How many molecules are present in 4.5 gram of water? 2+1

   (d) Why is fog formed over the water of a pond in winter at dawn? 1

Group — B

5. (a) State Newton's second law of motion. Explain the motion of Jet Plane from Newton's third law of motion. 2+2

   (b) What is "no work force"? Convert one kilogram-meter to joule. 1+1

   (c) A body of mass 147 gm. at rest is subjected to a force of 15 gm-wt. What is the acceleration of the body? What will be the velocity of the body after 2 sec.? 2+1

6. (a) Determine the mechanical advantage of a first class lever. Give two examples of such class of lever. 2+1

(b) What is momentum? What is its unit in M.K.S. System? Give one example of the weightlessness of a body. 1+1+1

(c) At what temperature is the reading on Fahrenheit scale five times the reading on centrigrade scale? What do you mean by fundamental interval of thermometer? 2+1

8. (a) State the two laws of refraction of light. 2

(b) How does a ray of light change its direction when it enters a rarer medium from a denser medium? Define critical angle. 1+1

(c) What are the differences between a real and a virtual image? What is a pure spectrum? Describe one method of forming a pure spectrum. 2+1+2

Group — C

11. (a) What is a saturated solution? How can it be known with the help of a simple experiment that a solution is saturated or not? Give an example of a case in which the solubility decreases with increase in temperature. 2+1+1

(b) Which is to be used as anode material in the electrolytic cell for electroplating of an article with copper? Which is to be taken as the electrolyte? 1+1

(c) You are supplied separately with a little chalk powder and graphite powder. How will you identify them with the help of a physical property? 1

(d) Ammonium chloride and quick lime separately added to water. With reasons, what type of change takes place in each case. 2

13. Describe the laboratory method for the preparation of ammonia gas. Mention the following points :

(a) Starting chemicals, condition of reaction, balanced equation of the reaction, drying, collection of the gas produced. 6

(b) How would you prove that there is carbon in carbon dioxide? 2

(c) Suggest a possible method for controlling the increase in the amount of carbon dioxide in air. 1

Madhyamik Pariksha — 2002

Physical Science

Attempt all Questions.
Figures in the margin indicate full marks for each questions.

Group — A

1. (a) Whose unit is Mili-litre? What is the unit of length in the SI system? 1+1

   (b) How will you determine the volume of a solid body by a measuring cylinder? 2

   (c) What is the difference between the mass and weight of a substance? Which instrument is used to measure the weight of a substance? 2+1

   (d) What changes in the mass and weight of a substance will be observed if for some reason the acceleration due to gravity becomes Zero? 2

4. (a) What is meant by latent heat? Why does one feel cold when methylated spirit is poured on the palm? 2+1

   (b) How is dew formed? Why is the clouded sky not suitable for dew formation?

   (c) Give one example each of conversion of electrical energy to mechanical energy and chemical energy to sound energy. 2

Group — B

5. (a) Write the difference between speed and velocity. What is the unit of acceleration in M.K.S. system? 2+1

   (b) What is one dyne and one Newton. What is the relation between them. 2+1

   (c) A constant force acting on a body of mass 0.5 kg. produces an acceleration of 2 m/sec. Calculate the magnitude of the force applied in Newton. 3

6. (a) Explain the working principle of a second class lever with a diagram. Give one example of a second class lever. 2+1

(b) Define work and power. What are the units of work and power in M.K.S. system? 2+2

(c) State Newton's first law of motion. 2

8. (a) State the laws of reflection of light. 2

(b) What is total internal reflection of light? Why is this reflection called total? Give an example of total internal reflection. 2+1+1

(c) Show with a diagram the position of focus of a convex lens. What is meant by focal length of a convex lens? 1+2

Group — C

11. (b) Write down the name of an element which possesses properties both of an metal and nonmetal. Write down the name of a nonmetals which is a conductor of electricity. 1+1

(c) Write down the chemical formula : 1+1

(i) Sodium Aluminate.

(ii) Ferric sulphate. 1+1

(d) What is the purpose of coating iron articles? 1

3. (a) How would you prepare oxygen in the laboratory at ordinary temperature? Mention the following points : 5
Starting chemicals, balanced equation, collection.

(b) For various reasons, the balance of the quantity of oxygen and carbon dioxide in air is not being maintained. What are the measures you would suggest for keeping their amounts in air at appropriate levels? 2

(c) What is dry ice? Mention one of its uses. 1+1

Madhyamik Pariksha — 2003

Physical Science

Attempt all Questions.

Figures in the margin indicate full marks for each questions.

Group — A

1. (a) What do you mean by Fundamental unit and Derived unit? Among the following whose units are fundamental and whose units are derived? — Mass, weight, velocity, and acceleration? 2+2

   (b) Write down the units of length and force in C.G.S. system. 2

   (c) What is meant by Energy? Give an example of conversion of sound energy to mechanical energy. 2+1

3. (a) state the law of conservation of mass with an example. 2+2

   (b) What are meant by atomic number and mass number of atom of an element? What is meant by $^{16}O_8$? Show its electronic configuration. 2+1+1

   (c) What will be the final temperature when 80 calorie of heat is supplied to 1 gm. of ice at $0^{\circ}C$? 1

Group — B

5. (a) State Newton's third law of motion. Why is backward kick given by a gun after firing? 2+2

   (b) What do you mean by acceleration and momentum? The initial velocity of a body of mass 20 gram is 10 cm./sec and after 5 secs. its velocity becomes 40 cm./sec. Find the magnitude of the force acting on the body. 2+3

6. (a) What are meant by upper fixed point and lower fixed point in the Celsius Scale? What is fundamental interval? The temperature of a body is increased by 36° in Fahrenheit Scale. What will be the value of this increase in Celsius scale? 2+1+2

(b) What is meant by mechanical advantage of a machine? To what class of lever the handle of a tubewell belongs? Explain. 1+2

(c) What is meant by 1 calorie of heat? 1

7. (a) What is diffused reflection? Explain why image is not seen in diffused reflection. 2+2

(b) Explain whether the image formed by a plane mirror is real or virtual. 2

(c) What is meant by dispersion of light? 1

(d) Write down the couditions for the formation of pure spectrum. 2

Group — c

11. (a) What are meant by Solute and Solvent? Explain with examples. How can it be known whether a solution is saturated or not at room temperature? How can a saturated solution be made unsaturated? 2+1+1

(b) Write two differences between metallic and non-metallic elements. 2

(c) Give examples of one endothermic and one exothermic change. 2

(d) Identify the oxidising agent and the reducing agent in the following reaction : 1

$MnO_2 + 4Hcl = Mncl_2 + cl_2 + 2H_2O$.

13. (a) Describe the laboratory method of preparation of carbon dioxide gas mentioning the following points :
Starting materials, Condition of reaction, balanced equation and collection of the gas. 5

(b) Write down an example of reducing property of hydrogen sulphide with balanced equation. 2

(c) What happens when ammonia gas is brought in contact with hydrogen chloride? Give balanced equation of the reaction. 1+1

Madhyamik Pariksha — 2004

Physical Science

Attempt all Questions.
Figures in the margin indicate full marks for each questions.

Group — A

1. (a) Write down two differences between mass and weight. Which instrument may be used to measure the weight of a body? 2+1

   (b) Mention two conditions of sensitivity of a common balance. 2

   (c) State the law of conservation of energy. Give one example. 2+1

   (d) Give an example of conservation of electric energy to heat energy. 1

2. (a) Which of the following are vector quantities and which are scalar quantities? 2

   (b) Name the fundamental constituent particles of an atomic nucleus? 1

   (c) Describe the structures of the atoms of the two isotopes $^{2}_{1}H$ and $^{3}_{1}H$.

   (d) What is latent heat? Mention two differences between boiling and evaporation. 2+2

Group — B

5. (a) What is meant by negative acceleration? 2

   (b) State Newton's second law of motion. 2

   (c) What are action and reaction? Do they act on the same body? 2+1

   (d) A force of 100 Newton acts on a bodyof mass 25 kg. Find outthe acceleration produced on the body. 2

6. (a) What is Kinetic energy? Define S.I. unit of power. 2+1

   (b) To which class of lever does the human arm belong? Explain. 2

(c) Mention two differences between heat and temperature. 2

(d) Calculate the amount of heat given out when the temperature of a piece of iron mass 60 gram in lowered from 200°C to 100°C. [specific heat of iron = 0·12]. 2

7. (a) What is the velocity of light in vacuum? 1

(b) What is regular reflection of light? If the angle of incidence is 60°, what will be the angle of reflection? 2+1

(c) What is the focal length of a convex lens? Show with a diagram. 2+1

(d) Mention two differences between real and virtual images. 2

Group — C

11. (a) Mention two differences between physical change and chemical change. State with reasons, whether the following two changes are Physical or Chemical Changes : (i) melting of ice. (ii) combustion of magnesium in air. $2+^{1}/_{5}+^{1}/_{5}$

(b) Which of the following substances is a metal and which is a non-metal?

Carbon di-oxide, Sulphur, Common stat, Tungsten. 1

(c) Write chemical formulas of : (i) ammonium carbonate (ii) aluminium hydroxide. 2

(d) Name one non-metallic conductor of electricity. 1

13. (a) Describe the laboratory method of preparation of ammonia gas mentioning the following points :

Starting chemicals, condition of reaction, balanced chemical equation and collection of gas. 5

(b) Is the aqueous salution of carbon di-oxide acidic, alkaline neutral? How will you demonstrate? 1+1

(c) What would happen when hydrogen sulphide gas is passed through chlorine water? Give balanced chemical equations. 1+1

Madhyamik Pariksha — 2001

Physical Science

নিম্নলিখিত প্রশ্নগুলির উত্তর দাও

'ক' বিভাগ

3. (a) কলকাতা এবং দার্জিলিং-এ কোন বস্তুর ভর ও ওজনের কোনটি পৃথক হবে এবং কেন? ভর এবং ওজন এদের কোনটি কি ধরনের তুলায় পরিমাপ করা হয়? 2+1

(b) একগাদা খড় বাতাসে পোড়ালে সামান্য ছাই মাত্র অবশিষ্ট থাকে। এক্ষেত্রে ভরের সংরক্ষণ হল কিনা ব্যাখ্যা কর। 2

(c) বিশুদ্ধ জল আর লবণ মিশ্রিত জল কোনটির স্ফুটনাঙ্ক উচ্চতর? শীতপ্রধান অঞ্চলে প্রচণ্ড ঠাণ্ডায় রাস্তায় বরফ জমে গেলে অনেক সময় বরফে লবন যোগ করা হয় কেন? গ্রীষ্মে তপ্ত রাস্তা জল দিয়ে ধুলে রাস্তা ঠাণ্ডা হয় কেন? 1+2+1

4. (a) নীচের ক্ষেত্রগুলিতে কোন শক্তি কোন শক্তিতে রূপান্তরিত হয়?
সালোক সংশ্লেষ কালে, বৈদ্যুতিক ঘন্টায়, তড়িৎ কোষে। 3

(b) গতি শক্তি স্থিতি শক্তিতে এবং স্থিতি শক্তি গতি শক্তিতে রূপান্তরের বাস্তব অভিজ্ঞতা থেকে একটি করে উদাহরণ দাও। 2

(c) $^{141}_{57}X$ পরমাণুটিতে কয়টি প্রোযন এবং কয়টি নিউট্রন আছে? 4.5 গ্রাম জলে অনুর সংখ্যা কত? 2+1

(d) শীতকালে ভোরে পুকুরের জলের উপরে কুয়াশা জমতে দেখা যায় কেন? 1

'খ' বিভাগ

5. (a) নিউটনের দ্বিতীয় গতিসূত্রটি বিবৃত কর। নিউটনের তৃতীয় গতিসূত্র থেকে জেট প্লেনের গতির ব্যাখ্যা দাও। 2+2

(b) কার্যহীন বল কাকে বলে? এক কিলোগ্রাম-মিটারকে জুলে রূপান্তরিত কর। 1+1

(c) 147 গ্রাম ভরের একটি স্থির বস্তুর উপর 15 গ্রাম-ভার বল প্রয়োগ করা হল বস্তুটির ত্বরণ কত? 2 সেকেণ্ড পরে বস্তুটির বেগ কত হবে? 2+1

6. (a) প্রথম শ্রেণী লিভারের যান্ত্রিক সুবিধা নির্ণয় কর। ঐ শ্রেণীর লিভারের দুটি উদাহরণ দাও। 2+1

(b) ভরবেগ কাকে বলে? এম.কে.এস. পদ্ধতিতে এর একক কি? কোন বস্তুর ভারহীন অবস্থার একটি উদাহরণ দাও। 1+1+1

(c) কোন উষ্ণতায় ফারেনহাইট স্কেলের পাঠ সেলসিয়াস স্কেলের পাঠের পাঁচগুণ হবে? থার্মোমিটারের প্রাথমিক অন্তর বলতে কি বোঝ? 2

8. (a) আলোকের প্রতিসরণের সূত্র দুটি বিবৃত কর। 2

(b) আলোক রশ্মি ঘনতর মাধ্যম থেকে লঘুতর মাধ্যমে প্রবেশ করলে কিভাবে দিক পরিবর্তন করে? সঙ্কট কোণের সংজ্ঞা দাও। 1+1

(c) সদ্ ও অসদ্ প্রতিবিম্বের মধ্যে পার্থক্য কি? বিশুদ্ধ বর্ণালী কি? বিশুদ্ধ বর্ণালী গঠনের একটি পদ্ধতি বর্ণনা কর। 2+1+1

'গ' বিভাগ

11. (a) সম্পৃক্ত দ্রবণ কাকে বলে? একটি দ্রবণ সম্পৃক্ত কিনা সহজ একটি পরীক্ষার মাধ্যমে কিভাবে তা জানা যাবে? তাপমাত্রা বাড়ালে দ্রাব্যতা কমে যায় এমন একটি উদাহরণ দাও। 2+1+2

(b) কোন বস্তুর উপর কপার দ্বারা তড়িৎ লেপনে তড়িৎ বিশ্লেষণ পাত্রে অ্যানোড হিসাবে কী ব্যবহার করতে হবে? তড়িৎ বিশ্লেষ্য হিসাবে কি নিতে হবে? 1+1

(c) তোমাকে পৃথকভাবে কিছুটা চক পাউডার এবং কিছুটা গ্রাফাইট পাউডার দেওয়া হল। একটি ভৌত ধর্মের সাহায্যে কিভাবে ওদের সনাক্ত করবে? 1

(d) অ্যামোনিয়াম ক্লোরাইড এবং পোড়াচুন পৃথকভাবে জলে যোগ করা হল। কোন ক্ষেত্রে কি ধরনের পরিবর্তন হয় যুক্তিসহ লেখ। 2

13. (a) অ্যামোনিয়া গ্যাসের পরীক্ষাগার প্রস্তুতি বর্ণনা কর। নীচের বিষয়গুলি উল্লেখ কর। 6
প্রারম্ভিক রাসায়নিক সমূহ, বিক্রিয়ার শর্ত, সমিত সমীকরণ, উৎপন্ন গ্যাসের শুষ্কিকরণ, সংগ্রহ।

(b) কিভাবে প্রমাণ করবে যে কাবন ডাই-অক্সাইডে কার্বন আছে? 2

(c) বাতাসে কার্বন ডাই-অক্সাইডের পরিমাণ বৃদ্ধি নিয়ন্ত্রণে সম্ভাব্য একটি উপায়ের সুপারিশ কর। 1

Madhyamik Pariksha — 2002

Physical Science

নিম্নলিখিত প্রশ্নগুলির উত্তর দাও

'ক' বিভাগ

1. (a) মিলিলিটার কিসের একক? SI পদ্ধতিতে দৈর্ঘ্যের একক কি? 1+1

(b) মাপনী চোঙের সাহায্যে কঠিন বস্তুর আয়তন কিভাবে নির্ণয় করবে? 2

(c) কোন বস্তুর ভর ও ভারের মধ্যে পার্থক্য কি? বস্তুর ভার কোন্ যন্ত্রের সাহায্যে মাপা যায়? 2+1

(d) কোন কারণে অভিকর্ষজ ত্বরণ লুপ্ত হলে ভূ-পৃষ্ঠের কোনো বস্তুর ভর ও ভারের কি পরিবর্তন দেখা যাবে? 2

4. (a) লীনতাপ কাকে বলে? হাতের তালুতে মেথিলেটেড স্পিরিট ঢাললে ঠাণ্ডা লাগে কেন? 2+1

(b) শিশির কিভাবে উৎপন্ন হয়? মেঘাচ্ছন্ন আকাশ শিশির জমার পক্ষে উপযোগী নয় কেন? 2+2

(c) তড়িৎ শক্তি থেকে যান্ত্রিক শক্তি ও রাসায়নিক শক্তি থেকে শব্দ শক্তির রূপান্তরের একটি করে উদাহরণ দাও। 2

'খ' বিভাগ

5. (a) দ্রুতি ও বেগের মধ্যে পার্থক্য লেখ। এম্.কে.এস্. পদ্ধতিতে ত্বরণের একক কি? 2+1

(b) এক ডাইন ও এক নিউটনের সংজ্ঞা দাও। এদের মধ্যে সম্পর্ক কি? 2+1

(c) 0.5 কিলোগ্রাম ভরের কোন বস্তুর ওপর একটি নির্দিষ্ট বল ক্রিয়া করে 2 মিটার / সেকেণ্ড^2 ত্বরণ সৃষ্টি করল। প্রযুক্ত বলের মান নিউটন এককে নির্ণয় কর। 3

6. (a) চিত্রের সাহায্যে দ্বিতীয় শ্রেণীর লিভারের কার্যনীতি ব্যাখ্যা কর। ঐ শ্রেণীর লিভারের একটি উদাহরণ দাও। 2+1

(b) কার্য ও ক্ষমতার সংজ্ঞা দাও। এম্.কে.এস্. পদ্ধতিতে কার্য ও ক্ষমতার একক কি? 2+2

(c) নিউটনের প্রথম গতিসূত্রটি বিবৃত কর। 2

8. (a) আলোকের প্রতিফলনের সূত্রগুলি বিবৃত কর। 2

(b) আলোকের অভ্যন্তরীণ পূর্ণ প্রতিফলন কাকে বলে? ঐ প্রতিফলনকে পূর্ণ বলা হয় কেন? অভ্যন্তরীণ পূর্ণ প্রতিফলনের একটি উদাহরণ দাও। 2+1

(c) চিত্রের সাহায্যে উত্তল লেন্সের ফোকাসের অবস্থান দেখাও। উত্তল লেন্সের ফোকাস দূরত্ব কাকে বলে? 1+2

'গ' বিভাগ

11. (a) ধাতব এবং অধাতব উভয় প্রকার ধর্ম বর্তমান এমন একটি মৌলের নাম লেখ। তড়িতের পরিবাহী এমন একটি অধাতুর নাম লেখ। 1+1

(b) রাসায়নিক সংকেত লেখ ঃ (i) সোডিয়াম অ্যালুমিনেট (ii) ফেরিক সালফেট। 1+1

(c) লোহার জিনিসের উপর দস্তার প্রলেপ দেবার উদ্দেশ্য কি? 1

13. (a) পরীক্ষাগারে সাধারণ তাপমাত্রায় কিভাবে অক্সিজেন প্রস্তুত করবে? নীচের বিষয়গুলি উল্লেখ কর ঃ প্রারম্ভিক রাসায়নিকসমূহ, সমিত সমীকরণ, সংগ্রহ। 5

(b) বিভিন্ন কারণে বাতাসে অক্সিজেন ও কার্বন ডাই-অক্সাইডের পরিমাণের ভারসাম্য রক্ষিত হচ্ছে না। বাতাসে এদের পরিমাণ যথাযথ রাখতে তুমি কি কি ব্যবস্থার সুপারিশ করবে? 2

(c) শুষ্ক বরফ কি? এর একটি ব্যবহার উল্লেখ কর। 1+1

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নিম্নলিখিত প্রশ্নগুলির উত্তর দাও

'ক' বিভাগ

1. (a) মৌলিক ও লব্ধ একক কাকে বলে? ভর, ভার, বেগ এবং ত্বরণ — এগুলির কোন্‌টির একক মৌলিক, কোনটির লব্ধ? 2+2

   (b) দৈর্ঘ্য ও বল-এদের সি.জি.এস. পদ্ধতিতে একক লেখ। 2

   (c) শক্তি কাকে বলে? শব্দ শক্তির যান্ত্রিক শক্তিতে রূপান্তরের একটি উদাহরণ দাও। 2+1

3. (a) একটি উদাহরণসহ ভরের নিত্যতা সূত্রটি বিবৃত কর। 2+2

   (b) মৌলের পরমাণুর পারমাণকি সংখ্যা ও ভর সংখ্যা কাকে বলে? ${}^{16}_{8}O$ এর অর্থ কি? এর ইলেকট্রন বিন্যাস দেখাও। 2+1+1

   (c) $0^{\circ}C$ তাপমাত্রার এক গ্রাম বরফকে 80 ক্যালরি তাপ দিলে চূড়ান্ত তাপমাত্রা কত হবে? 1

'খ' বিভাগ

5. (a) নিউটনের দ্বিতীয় গতিসূত্রটি বিবৃত কর। বন্দুক থেকে গুলি ছুঁড়লে বন্দুক পিছনের দিকে ধাক্কা দেয় কেন? 2+2

   (b) ত্বরণ ও ভরবেগ কাকে বলে? 20 গ্রাম ভরের একটি বস্তুর প্রাথমিক বেগ 10 সে.মি. / সেকেণ্ড এবং 5 সেকেণ্ড পরে এর বেগ হল 40 সে.মি. / সেকেণ্ড। বস্তুর ওপর ক্রিয়াশীল বলের মান নির্ণয় কর। 2+3

6. (a) সেলসিয়াস স্কেলে ঊর্ধ্ব স্থিরাঙ্ক ও নিম্ন স্থিরাঙ্ক বলতে কি বোঝায়? প্রাথমিক অন্তর কাকে বলে? একটি বস্তুর তাপমাত্রা ফারেনহাইট স্কেলে 36° বৃদ্ধি পেল। সেলসিয়াস স্কেলে ঐ বৃদ্ধির পরিমাণ কত হবে? 2+1+2

   (b) কোন যন্ত্রের যান্ত্রিক সুবিধা বলতে কী বোঝায়? টিউবওয়েলের হাতল কোন্ শ্রেণীর লিভার? ব্যাখ্যা কর। 1

   (c) এক ক্যালরি তাপ বলতে কী বোঝায়? 2+2

7. (a) বিক্ষিপ্ত প্রতিফলন কাকে বলে? বিক্ষিপ্ত প্রতিফলনে প্রতিবিম্ব দেখা যায় না কেন ব্যাখ্যা কর। 2+2

(b) সমতল দর্পন দ্বারা গঠিত বিম্ব সদ্ না অসদ্ ব্যাখ্যা কর। 2

(c) আলোকের বিচ্ছুরণ কাকে বলে? 1

(d) বিশুদ্ধ বর্ণালী গঠনের শর্তগুলি লেখ। 2

'গ' বিভাগ

11. (a) দ্রাব ও দ্রাবক কাকে বলে? উদাহরণসহ ব্যাখ্যা কর। ঘরের তাপমাত্রায় একটি দ্রবণ সম্পৃক্ত কিনা কীভাবে জানা যায়? সম্পৃক্ত দ্রবণকে কীভাবে অসম্পৃক্ত দ্রবণে পরিণত করা যায়? 2+1+1

(b) ধাতব ও অধাতব মৌলের মধ্যে দুটি পার্থক্য উল্লেখ কর। 2

(c) একটি তাপগ্রাহী ও একটি তাপমোচী পরিবর্তনের উদাহরণ দাও। 2

(d) নীচের বিক্রিয়ায় জারক ও বিজারক পদার্থকে চিহ্নিত কর ঃ 1

(i) $MnO_2 + 4HCl = MnCl_2 + Cl_2 + 2H_2O$

13. (a) নিম্নলিখিত বিষয়গুলি উল্লেখ করে পরীক্ষাগারে কার্বন হাই-অক্সাইড গ্যাসের প্রস্তুতি বর্ণনা করঃ প্রারম্ভিক রাসায়নিকসমূহ, বিক্রিয়ার শর্ত, সমিত সমীরকণ এবং গ্যাসের সংগ্রহ। 5

(b) হাইড্রোজেন সালফাইড-এর বিজারণ ধর্মের একটি উদাহরণ সমিত সমীকরণসহ লেখ। 2

(c) অ্যামোনিয়া গ্যাসকে হাইড্রোজেন ক্লোরাইডের সংস্পর্শে আনলে কি ঘটে? বিক্রিয়ার সমিত সমীকরণ দাও। 1+1

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'ক' বিভাগ

1. (a) ভর ও ভারের মধ্যে দুটি পার্থক্য লেখ। বস্তুর ভার কোন যন্ত্রের সাহায্যে মাপা যায়? 2+1

   (b) সাধারণ তুলাযন্ত্রের সুবেদিতার দুটি শর্ত উল্লেখ কর। 2

   (c) শক্তির নিত্যতা সূত্রটি বিবৃত কর। একটি উদাহরণ দাও। 2+1

   (d) তড়িৎ শক্তি থেকে তাপ শক্তিতে রূপান্তরের একটি উদাহরণ দাও। 1

2. (a) বেগ, ত্বরণ, ভর ও দ্রুতির মধ্যে কোনগুলি ভেক্টর রাশি ও কোনগুলি স্কেলার রাশি? 2

   (b) পরমাণুর কেন্দ্রের মূল উপাদান গণাগুলির নাম লেখ। 1

   (c) ${}_{1}^{2}H$ ও ${}_{1}^{3}H$ এই সমস্থানিক দুটির পরমাণুর গঠন বর্ণনা কর। 2

   (d) লীনতাপ কাকে বলে? স্ফুটন ও বাষ্পায়নের মধ্যে দুটি পার্থক্যের উল্লেখ কর। 2+2

'খ' বিভাগ

5. (a) ঋণাত্মক ত্বরণ কাকে বলে? 2

   (b) নিউটনের দ্বিতীয় গতিসূত্রটি বিবৃত কর। 1

   (c) ক্রিয়া ও প্রতিক্রিয়া কাকে বলে? এরা কি একই বস্তুর উপর ক্রিয়া করে? 2+1

   (d) 100 নিউটন বল 25 কিলোগ্রাম ভরবিশিষ্ট বস্তুর উপর ক্রিয়া করে। ঐ বস্তুতে উৎপন্ন ত্বরণের মান নির্ণয় কর। 2

6. (a) গতি শক্তি কাকে বলে? ক্ষমতার এস.আই. (S.I.) এককের সংজ্ঞা দাও। 2+1

   (b) মানুষের বাহু কোন শ্রেণীর লিভার? ব্যাখ্যা কর। 2

   (c) তাপ ও তাপমাত্রার মধ্য দুটি পার্থক্য উল্লেখ কর। 2

   (d) 60 গ্রাম ভরের এক খণ্ড লোহার তাপমাত্রা $200^{\circ}C$ হতে $100^{\circ}C$-এ কমালে কত তাপ বর্জিত হবে নির্ণয় কর। (লোহার আপেক্ষিক তাপ = 0.12) 2

7. (a) শূন্য মাধ্যমে আলোর গতিবেগ কত? 1

(b) আলোকের নিয়মিত প্রতিফলন কাকে বলে? আপাতন কোণ 60° হলে, প্রতিফলন কোণ কত হবে? 2+1

(c) উত্তল লেন্সের ফোকাস দূরত্ব কাকে বলে? চিত্রের সাহায্যে দেখাও। 2+1

(d) সদ্ ও অসদ্ প্রতিবিম্বের মধ্যে দুটি পার্থক্যের উল্লেখ কর। 2

'গ' বিভাগ

11. (a) ভৌত ও রাসায়নিক পরিবর্তনের মধ্যে দুটি পার্থক্য উল্লেখ কর। নীচের পরিবর্তন দুটি ভৌত না রাসায়নিক পরিবর্তন যুক্তিসহ লেখ ঃ

(i) বরফের গলন

(ii) বায়ুতে ম্যাগনেসিয়ামের দহন। $2+1^{1}/_{2}+1^{1}/_{2}$

(b) নিচের পদার্থগুলির মধ্যে কোনটি ধাতু ও কোনটি অধাতু?

কার্বন ডাই-অক্সাইড, গন্ধক, খাদ্যলবন, টাংস্টেন। 1

(c) রাসায়নিক সংকেত লেখ ঃ

(i) অ্যামোনিয়াম কার্বোনেট

(ii) অ্যালুমিনিয়াম হাইড্রক্সাইড 2

(d) একটি অধাতব তড়িৎ পরিবাহীর নাম কর। 1

13. (a) নিম্নলিখিত বিষয়গুলি উল্লেখ করে পরীক্ষাগারে অ্যামোনিয়া গ্যাসের প্রস্তুতি বর্ণনা কর।
প্রারম্ভিক রাসায়নিকসমূহ, বিক্রিয়ার শর্ত, সমিত রাসায়নিক সমীকরণ এবং গ্যাসের সংগ্রহ। 5

(b) কার্বন ডাই-অক্সাইডের জলীয় দ্রবণ আম্লিক, ক্ষারীয় না প্রশম? কী ভাবে দেখাবে? 1+1

(c) ক্লোরিন জলে হাইড্রোজেন সালফাইড গ্যাস চালনা করলে কী ঘটবে? সমিত রাসায়নিক সমীকরণ দাও। 1+1

APPENDIX – D

LESSON PLAN

Lesson Plan on Interest Diversification Model

Name of the Teacher :

Subject :

School :

Today's Lesson :

Class :

Age of the Learner :

Phase — I

Multiplication	Teaching Point	Teacher's Role	Students Response
Teaching point should be one but Questions to be presented in interactive way and in multiple dimension on the basis of learning point, teaching Aids, availibility of Resources. Teacher's role is to initiate Learners' interest to the content. Here content should be presented on the surface level.	Valency	* Do you know what is valency? * Very Good. * Now you can say whether the combination of atoms are same or different? * Yes, actually the Question is hard but you can campare this Capacity with human being. Suppose do you say the capacity in cricketer is Similiar or different? * Why * Because all the crickters performance are not same, like	Yes, Valency is the capacity of one element to combine with other different elements. Different Silence Silence

Multiplication	Teaching Point	Teacher's Role	Students Response
		you not scoreing the same marks in Exam. in comparision with other friends. * Then what is Valency?	Valency is the capacity of atoms to combine with each other.

** Here the teacher is to control over the situation and take presure over the matter & try to present the matter in a very lucid way so that students involvement, attention & interest may be aroused.

Phase — II

Substitution	Teaching Point	Teacher's Role	Students Response
Substitution stands for substitute one teaching point to Another teaching point	Valency Classification of Valency Identification of Valency and so on on the basis of time management	Subject matter to be presented in interactive way.	

Phase — III

Shifting	Teaching Point	Teacher's Role	Students Response
Shifting from horizontal surface area of content to the vertical or indepth or Application based teaching point. shifting may be. from Cognitive — Non cognitive and Cognitive — to cognitive. Noncognitive — Cognitive domain.	* Application of Valency * Balenced euqation	Content to be presentive in interactive way.	

পাঠ পরিকল্পনা

বিদ্যালয় ঃ

বিষয় ঃ ভৌত-বিজ্ঞান

শ্রেণী ঃ অষ্টম

সাধারণ পাঠ ঃ বায়ু

শিক্ষার্থী সংখ্যা ঃ ৩০ জন

শিক্ষার্থীর গড় বয়স ঃ ১৪ বৎসর

সময় ঃ ৪০ মিনিট

তারিখ ঃ

শিক্ষক ঃ

অদ্যকার পাঠ ঃ অক্সিজেন গ্যাস প্রস্তুতি

রোল নং ঃ

প্রত্যক্ষ ঃ পরীক্ষাগারে অক্সিজেন গ্যাস প্রস্তুতি সম্পর্কে ছাত্র-ছাত্রীদের অবহিত করা।

পরোক্ষ ঃ শিক্ষার্থীদের ভৌতবিজ্ঞান পাঠে আগ্রহ ও চিন্তাশক্তির বিকাশ ঘটানো। বিজ্ঞান-সুলভ দৃষ্টিভঙ্গী গড়ে তোলা।

উপকরণ ঃ শ্রেণীকক্ষের সাধারণ উপকরণ, চার্ট

অনুসৃত পদ্ধতি ঃ শিক্ষক মহাশয় শিক্ষার্থীদের সক্রিয় সহযোগিতায় প্রশ্নোত্তরের মাধ্যমে অদ্যকার পাঠ-উপস্থাপন করবেন।

শিক্ষার্থীদের পূর্বজ্ঞান পরীক্ষার জন্য এবং অদ্যকার পাঠে আগ্রহী করে তোলার জন্য শিক্ষক নিম্নরূপ প্রশ্ন করবেন —

১। মানুষ তথা প্রাণীদের শ্বাসকার্যের জন্য বায়ুমণ্ডলের কোন গ্যাস দরকার হয়?

২। বায়ুমণ্ডলে এই গ্যাসের আয়তনগত শতকরা হার কত?

৩। পরীক্ষাগারে কিভাবে এই গ্যাস প্রস্তুত করা হয় বলতে পারবে?

পাঠঘোষণা ঃ আজ আমরা 'পরীক্ষাগারে অক্সিজেন গ্যাস প্রস্তুতি' সম্পর্কে জানব — এই বলে শিক্ষক পাঠঘোষণা করবেন এবং কথাটি বোর্ডে লিখে দেবেন।

বিষয়	পদ্ধতি
বায়ুর মধ্যে অক্সিজেন মৌল-রূপে অবস্থান করে, তা তোমরা জান। এখন এই অক্সিজেন গ্যাস পরীক্ষাগারে প্রস্তুত করার জন্য কি নীতি গৃহীত হয়। তা বলবো পটাশিয়াম ক্লোরেটকে উত্তপ্ত করলে তা বিয়োজিত হতে থাকে। এখন যদি শুধু পটাশিয়াম ক্লোরেটকে উত্তপ্ত করা হয় (প্রায় $610^{\circ}C$), তাহলে পটাশিয়াম ক্লোরাইড এবং অক্সিজেন উৎপন্ন হয়। কিন্তু যদি পটাশিয়াম ক্লোরেটকে উত্তপ্ত করা হয়, তাহলে মাত্র $240^{\circ}C$ তাপমাত্রায় পটাশিয়াম ক্লোরাই ও অক্সিজেন উৎপন্ন হয়। এখন প্রশ্ন হল — কেন এই পার্থক্য হচ্ছে।	পরীক্ষাগারে অক্সিজেন গ্যাস প্রস্তুতির নীতিটি কি?
	শুধু পটাশিয়াম ক্লোরেটকে উত্তপ্ত করলে কত তাপমাত্রা দেরকার হয়?
হ্যাঁ ম্যাঙ্গানিজ-ডাই-অক্সাইড থাকার জন্যইঋ এত অল্প তাপে বিক্রিয়াটি সম্পন্ন হচ্ছে। এখানে ম্যাঙ্গানিজ-ডাই-অক্সাইড (MnO_2) অনুঘটকের কাজ করে। এই বিক্রিয়ায় ম্যাঙ্গানীজ-ডাই-অক্সাইডের কোন পরিবর্তন হয় না, অথচ উপস্থিত থেকে বিক্রিয়াটিকে দ্রুত করে। অনুঘটক ইল-এর ধরনের রাসায়নিক পদার্থ যা রাসায়নিক বিক্রিয়ায় উপস্থিত থেকে বিক্রিয়ার বেগ বাড়ায় বা কমায়, অথচ, বিক্রিয়াশেষে নিজে অপরিবর্তিত থাকে। বিক্রিয়ার রাসায়নিক সমীকরণটি হল — $2KclO_3 + [MnO_2] \text{ —— } 2Kcl + 30_2 \_ [MnO_20$	ম্যাঙ্গানীজ ডাই অক্সাইড ব্যবহার করা হয় কেন?
	অনুঘটক কাকে বলে?
	বিক্রিয়ার শেষে ম্যাঙ্গানীজ ডাই-অক্সাইডের কোন পরিবর্তন হবে কি?
তোমরা ছবিটার দিকে তাকাও। এখানে চারভাগ ওজনের পটাশিয়াম ক্লোরেটের সঙ্গে প্রায় এক ভাগ ওজনের বিশুদ্ধ ম্যাঙ্গানীজ-ডাই-অক্সাইড ভাল করে মিশিয়ে মিশ্রণটিকে শক্তকাচের সেস্টটিউবের মধ্যে অর্ধেকটা ভর্তি করা হল। এবার, টেস্টটিউবটির মধ্যে দিয়ে একটি নির্গম নল টেস্টটিউবটির মধ্যে সামান্য প্রবেশ করানো হল। নির্ণয়-নলের শেষ প্রান্তটি একটি জল ভর্তি গ্যাস দ্রোণীর মধ্যে ডোবানো হল। এবার লক্ষ্য করা — টেস্টটিউবটিকে ক্ল্যাম্পের সাহায্যে দন্ডের সঙ্গে এমনভাবে আটকানো হল যেন ট্রে-টিউবটির সামনের দিকটা নিচের দিকে একটু হেলানো থাকে। এখন টেস্টটিউবকে বার্ণার দিয়ে সমানভাবে উত্তপ্ত করা হল। দেখা গেল, নির্গম নলের শেষ প্রান্তে গ্যাস বেরুচ্ছে। একটু পরে, টেস্টটিউবের ভেতরের সব বাতাস বেরিয়ে যাওয়ার পর একটি জলভর্তি গ্যাসজারকে নির্গম নলের শেষ প্রান্তের উপরে উপুড় করে রাখা হল।	মিশ্রণটিতে পটাশিয়াম ক্লোরেট ও ম্যাঙ্গানীজ ডাই অক্সাইডের অনুপাত কত হবে?
	টেস্টটিউবে মিশ্রণ ভর্তি করার সময় কি লক্ষ্য করতে হবে?
	ক্ল্যাম্পের সঙ্গে টেস্টটিউব আটকানোর সময় কি লক্ষ্য রাখা দরকার?
অক্সিজেন গ্যাস বায়ুর চেয়ে সামান্য ভারী এবং জলে খুব সামান্য দ্রাব্য। তাই জলের নিম্ন অপসারণ দ্বারা গ্যাসজারে এই গ্যাস জমা হয়। গ্যাসজারটি অক্সিজেন গ্যাস দ্বারা ভর্তি হলে পর গ্যাসজারের মুখটি জলের নিজে রেখেই ঢাকনি দিয়ে বন্ধ করে গ্যাসজারটিকে জলের বাইরে এনে সোজাভাবে রাখা হল।	মিশ্রণটি কিভাবে উত্তপ্ত করা প্রয়োজন?

বিষয়	পদ্ধতি
এখন বিশেষ কতগুলি সতর্কতা নেওয়া দরকার। যেমন, মিশ্রটিকে ভাল করে মেশাতে হবে। MnO_2-র মধ্যে যেন কোন চারকোল অশুদ্ধি না থাকে, তা পরীক্ষা করে দেখতে হবে। মিশ্রটিকে সমভাবে উত্তপ্ত করতে হবে। প্রবল বেগে গ্যাস বের হলে বার্ণার সরিয়ে নিতে হব।	পরীক্ষাগারে অক্সিজেন গ্যাস কি পদ্ধতিতে সংগৃহীত হয়?
টেস্টটিউবটিকে নির্গম-নলের দিকে একটু কাত্ করে রাখতে হবে যেন উৎপন্ন গ্যাস বেরিয়ে যাওয়ার পথ পায়। এবং গরম টেস্টটিউবের মধ্যে জল ঢুকে বিস্ফোরণ না ঘটে।	MnO_2-এর মধ্যে সাধারণত কি অশুদ্ধি বিপজ্জনক হতে পারে?
টেস্টটিউবে রাখা মিশ্রণ-এর উপরের দিকে কিছুটা জায়গা খালি রাখতে হবে। আর একটা কথা, এই MnO_2 ছাড়াও CUO এবং Fe_2O_3 অনুঘটক হিসেবে ব্যবহার করা যেতে পারে।	টেস্টটিউবটি নির্গম নলের দিকে কাত করে রাখা হয় কেন?
এইভাবে পরীক্ষাগারে অক্সিজেন গ্যাস প্রস্তুত করার নীতি, পদ্ধতি, সংগ্রহের উপায়, সতর্কতামূলক ব্যবস্থাদি সম্পর্কে তোমরা অবহিত হলে।	MnO_2 ছাড়া অন্য কি অনুঘটক ব্যবহার করা যেতে পারে?

★ পটাশিয়াম ক্লোরেটকে খুব উত্তপ্ত করলে (610^oC তাপমাত্রায়) পটাশিয়াম ক্লোরাইড এবং অক্সিজেন উৎপন্ন হয়।

★ পটাশিয়াম ক্লোরেটের সঙ্গে ম্যাঙ্গানীজ-ডাই-অক্সাইডের মিশ্রণ করে উত্তপ্ত করলে অল্প তাপে (240^oC তাপমাত্রায়) পটাশিয়াম ক্লোরাইড এবং অক্সিজেন উৎপন্ন হয়। $2KclO_3 + [MnO_2] \text{ —— } 2Kcl + 30_2 + [MnO_20$

★ MnO_2 এখানে অনুঘটক রূপে থেকে বিক্রিয়াকে দ্রুত করে।

★ চারভাগ পটাশিয়াম ক্লোরেটের সঙ্গে এক ভাগ ম্যাঙ্গানীজ-ডাই-অক্সাইড মিশ্রিত করা হয়।

★ শক্ত টেস্টটিউবের অর্ধেকটা মিশ্রণ দিয়ে ভর্তি করা হয়।

★ টেস্টটিউবটি নির্গম নলের দিকে সামান্য হেলানো অবস্থায় রাখা হয়।

★ জলের নিম্ন অপসারণ পদ্ধতিতে গ্যাসটি গ্যাসজারে সংগৃহীত হয়।

★ মিশ্রণটিকে সমভাবে উত্তপ্ত করা দরকার।

★ পরীক্ষার পর নির্গম নলটিকে জলের উপর রাখতে হবে। তা না হলে গরম টেস্টটিউবের মধ্যে জল ঢুকে ওকে ফাটিয়ে দেবে।

★ ম্যাঙ্গানীজ-ডাই-অক্সাইডের মধ্যে যেন কোন চারকোল অশুদ্ধি না থাকে, লক্ষ্য রাখতে হবে।

শিক্ষার্থীদের নবলব্ধ জ্ঞান পরীক্ষা করার জন্য শিক্ষক নিম্নরূপ প্রশ্ন করবেন ঃ

১। পরীক্ষাগারে অক্সিজেন গ্যাস প্রস্তুতির জন্য ম্যাঙ্গানীজ-ডাই-অক্সাইড ব্যবহার করবো কেন?

২। কোন্ পদ্ধতিতে পরীক্ষাগারে অক্সিজেন গ্যাস সংগ্রহ করা হয়?

৩। টেস্টটিউবটি নির্গম নলের দিকে হেলানো অবস্থায় রাখা হয় কেন?

৪। ম্যাঙ্গানীজ-ডাই-অক্সাইড সাধারণত কি ধরনের অশুদ্ধি আছে কিনা লক্ষ্য রাখতে হয়? কেন?

শিক্ষার্থীদের বাড়ি থেকে লিখে আনার জন্য কয়েকটি প্রশ্ন দেওয়া হবে।

১। অনুঘটক বলতে কী বোঝ?

২। পরীক্ষাগারে অক্সিজেন প্রস্তুতির নীতিটি লেখ। সমীকরণ দাও।

৩। পরীক্ষাগারে অক্সিজেন গ্যাস প্রস্তুতির একখানি চিত্র অঙ্কন করে বিভিন্ন অংশ চিহ্নিত কর।

৪। পরীক্ষাগারে অক্সিজেন গ্যাস প্রস্তুতির সময় প্রয়োজনীয় সতর্কতামূলক ব্যবস্থাগুলোর উল্লেখ কর।

APPENDIX – E

ENTRY LEVEL TEST

প্রাক্-অভীক্ষা (Entry Level Test)

বিষয় — প্রকৃতি বিজ্ঞান

সময় ঃ ১ ঘঃ ১০ মিঃ পূর্ণমান — ১০০

নাম —

বিদ্যালয় — ক্রমিক নং —

শ্রেণী — তারিখ —

প্রিয় ভাই,

কল্যাণী বিশ্ববিদ্যালয়ের শিক্ষাতত্ত্ব বিভাগ থেকে একটি গবেষণা কার্যের প্রয়োজনে তোমাদের কাছে প্রকৃতি-বিজ্ঞানের পূর্বপঠিত কয়েকটি বিষয়ক প্রশ্ন নিয়ে এসেছি। তোমাদের প্রত্যেকের দেওয়া উত্তর এই গবেষণা কার্যে সমান গুরুত্বপূর্ণ।

★ লেখা শুরু করার পূর্বে নির্দেশগুলি পড় ঃ

ভাল করে পড়ে দেখ কি করতে হবে। পরে উত্তর দাও।

প্রত্যেকটি প্রশ্নের উত্তর দেবে।

এই পরীক্ষার ফল বিদ্যালয়ের কোন পরীক্ষার ফলকে কোন ভাবেই প্রভাবিত করবে না। বরং এই পরীক্ষা যদি ঠিকমতো দিতে পার, তাহলে তোমার বিষয়টি সম্বন্ধে একটি পরিচ্ছন্ন ধারণা জন্মাবে এবং এই ধারণা তোমার ভবিষ্যৎ পরীক্ষার ফলকে আরো উন্নত করতে অবশ্যই সাহায্য করবে।

যে প্রশ্নটি পারবে, না, সেটির জন্য বেশি সময় নষ্ট না করে পরবর্তী প্রশ্নের সঠিক উত্তর দিতে চেষ্টা কর।

লেখা শুরু করতে বলার আগে কোনমতেই শুরু করবে না।

★ নিজে উত্তর কর, কাউকে বিরক্ত করবে না।

(ক) নিচের প্রতিটি প্রশ্নের একাধিক উত্তর দেওয়া আছে। এদের মধ্যে যেটি সঠিক তাতে (✓) চিহ্ন দাও ঃ

১। আজকের এই পৃথীবিকে বেষ্টন করে যে বর্ণহীন গন্ধহীন, স্বাদহীন অদৃশ্য পদার্থ সব সময় বিরাজমান, তাকে বলে সৌরমণ্ডল / বায়ুমণ্ডল জলমণ্ডল।

২। বায়ুর প্রধান দুটি উপাদান হল — অক্সিজেন, হাইড্রোজেন / অক্সিজেন, নাইট্রোজেন / হাইড্রোজেন, কার্বন-ডাই-অক্সাইড।

৩। কোন্ গ্যাস শ্বাসকার্যে সাহায্য করে? — হাইড্রোজেন / কাবর্ন-ডাই-অক্সাইড / অক্সিজেন।

৪। কোন্ গ্যাসটি সবচেয়ে হাল্কা — অক্সিজেন / হাইড্রোজেন / কার্বন-ডাই-অক্সাইড।

৫। বায়ুতে অক্সিজেনের শতকরা পরিমাণ — ০.০৪ / ২০.৬০ / ৭৭.১৬।

৬। বায়ুতে কার্বন-ডাই-অক্সাইডের শতকরা পরিমাণ — ০.৪০ / ২০.৬০ / ০.০৪।

৭। হাইড্রোজেন ভরা গ্যাস বেলুনে চড়া উচিত নয়, কারণ — বেলুনটি আগুনের সংস্পর্শে জ্বলে ওঠে / বেশিক্ষণ বাতাসে ভাসতে পার না / বেলুনটি দ্রুত ফেটে যায়।

৮। বায়ুমণ্ডলের কোন্ গ্যাস সবুজ উদ্ভিদের খাদ্য তৈরির কাজে লাগে — অক্সিজেন / নাইট্রোজেন / কার্বন-ডাই-অক্সাইড।

৯। এদের মধ্যে কোন্‌টি গ্যাসীয় মৌল? — সোনা / পারদ / হাইড্রোজেন।

১০। দুই বা ততোধিক মৌলিক পদার্থ, নির্দিষ্ট ওজনে রাসায়নিক বিক্রিয়ার দ্বারা পরস্পর যুক্ত হয়ে যে নতুন ধর্মাবিশিষ্ট পদার্থ উৎপন্ন করে তার নাম — মৌলিক পদার্থ / যৌগিক পদার্থ / মিশ্র পদার্থ।

১১। কোন্‌টি যৌগিক পদার্থ? — জল / সরবত / ধোঁয়া।

১২। জলে হাইড্রোজেন আর অক্সিজেনের অনুপাত — ২ : ১ . ১ : ২ / ৩ : ২।

১৩। বালি ও লোহার মিশ্রণ সহজে পৃথক করতে — মিশ্রণকে উত্তপ্ত করতে হবে / চুম্বক ধরতে হবে / দ্রবণ তৈরি করে ছাঁকতে হবে।

১৪। মিছরী ও জলের মিশ্রণে তৈরি শরবত এটা কি ধরনের পরিবর্তন — ভৌত / রাসায়নিক / কোনোটি নয়।

১৫। কোন্ মৌলিক পদার্থের পরমাণু সবচেয়ে হালকা? — হাইড্রোজেন / নাইট্রোজেন।

১৬। পৃথিবীর প্রত্যেক পদার্থই অপর পদার্থকে আকর্ষণ করে — এই আকর্ষণের মূলে যে বল আছে তার অভিকর্ষ বল / মহাকর্ষ বল / অভিকেন্দ্রিক বল।

১৭। পৃথিবী তার কেন্দ্রের দিকে সকল বস্তুকে আকর্ষণ করে, এই আকর্ষণী বলের নাম — মহাকর্ষ বল / অভিকর্ষ বল / কেন্দ্রতিগ বল।

(খ) নিচের উক্তিগুলির মধ্যে কোন্‌টি সঠিক এবং কোন্‌টি ভুল নির্দেশ কর ঃ

১। পৃথিবীপৃষ্ঠে বায়ু আছে, কিন্তু চাঁদে বায়ু নেই।

২। বায়ুর ওজন নেই।

৩। গন্ধক ও লোহাচুরের মিশ্রণ পৃথক করতে চুম্বক ব্যবহার করা হয়।

৪। জলে হাইড্রোজেন ও অক্সিজেনের ওজনের অনুপাত ২ ঃ ১।

৫। ভৌত পরিবর্তন স্থায়ী, কিন্তু রাসায়নিক পরিবর্তন অস্থায়ী।

৬। ধ্রুবতারা অতীতের দিক্ নির্ণয় যন্ত্র।

৭। সূর্য ও চন্দ্রের আকর্ষণের ফলে ভূ-পৃষ্ঠে সমুদ্রের জল দৈনিক দুইবার পর্যায়ক্রমে স্ফীত ও অবনমিত হয়। এই স্ফীত হওয়াকে জোয়ার এবং ইহার পরবর্তী অবস্থাকে ভাটা বলে।

৮। বায়বীয় পদার্থে বা গ্যাসে অণুগুলির পারস্পরিক আকর্ষণ সবচেয়ে বেশি।

৯। জলে উত্তপ্ত করলে বাষ্পে পরিণত হয়, বাষ্পকে ঠান্ডা করলে আবার জল এবং আরো অধিক ঠান্ডা করলে বরফে পরিণত হয়। এটি ভৌত পরিবর্তন।

১০। চিনির জলীয় দ্রবণ হইতে পাতন প্রক্রিয়ায় চিনি ও জলকে পৃথক করা যায়।

১১। পোড়াচুনে জল দেওয়া হলে হিস্ হিস্ শব্দে কিছু তাপ সৃষ্টি হয়। একটি ভৌত পরিবর্তন।

১২। দগ্ধ ম্যাগনেসিয়াম ও বায়ুর অক্সিজেনের মিলনে সাদা ম্যানগেনিয়াম অক্সাইড তৈরি হয়। এটি রাসায়নিক পরিবর্তন।

১৩। অণু রাসায়নিক বিক্রিয়ায় অংশগ্রহণ করে।

১৪। চুম্বকের দুইটি মেরু আছে — উত্তর সন্ধানী মেরু ও দক্ষিণ সন্ধানী মেরু।

১৫। পৃথিবীতে মৌলিক পদার্থের সংখ্যা — ১০৫

১৬। একটি চুম্বকের ভারকেন্দ্র সূতো বেঁধে ঝুলিয়ে দিলে সর্বদা উত্তর-দক্ষিণ মুখী হয়ে স্থির থাকে।

(গ) নিচের প্রশ্নগুলির উত্তর দাও ঃ

১। পদার্থের ভৌতধর্ম বলতে কী বোঝ?

২। বায়ু মিশ্রপদার্থ কেন?

৩। একটি সাধারণ হাইড্রোজেন অণু কয়টি হাইড্রোজেন পরমাণু নিয় গঠিত?

৪। চুম্বকের দ্বারা কি ধরনের মিশ্রনের উপাদান পৃথক করা হয়? উদাহরণ দিয়ে দেখাও।

৫। লোহায় মরিচা পড়া — কি ধরনের পরিবর্তন? কেন?

৬। একটি দণ্ড চুম্বকের আকর্ষণ কোথায় সবচেয়ে বেশি?

৭। প্রাচীনকালে দিগ্ নির্ণয়ে কেন ধ্রুবতারার সাহায্য নেওয়া হতো?

(ঘ) 'ক' ও 'খ' এর মধ্যে সামঞ্জস্য বিধান কর ঃ

	'ক'		'খ'
১।	বাতাসের কার্বন-ডাই-অক্সাইড দরকার হয় —	১।	মহাকর্ষ বল,
২।	হাইড্রোজেনও অক্সিজেনের যৌগ হল —	২।	সবুজ উদ্ভিদের সালোক সংশ্লেষ প্রক্রিয়ার জন্য।
৩।	পৃথিবী পৃষ্ঠে জোয়ারের কারণ হল —	৩।	জল
৪।	মহাকর্ষ সূত্র আবিষ্কার করে —	৪।	নিউটন
৫।	লোহায় মরিচা পড়া —	৫।	গন্ধব, কাঠ, সোনা, তামা
৬।	চুম্বক আকর্ষণ করে না —	৬।	একটি রাসায়নিক পরিবর্তন
৭।	বায়ুর ওজন —	৭।	১৪.৪
৮।	মিশ্র পদার্থের উপাদানগুলির —	৮।	স্বর—স্বর বৈশিষ্ট্য বজায় থাকে।

(ঙ) নিচের প্রতিটি প্রশ্নের এক জোড়া করে শব্দ দেওয়া আছে, উহাদের পার্থক্য নির্ণয় কর ঃ

১। মিশ্র পদার্থ ও যৌগিক পদার্থ।

২। ভৌত ধর্ম ও রাসায়নিক ধর্ম।

৩। অণু ও পরমাণু।

৪। অভিকর্ষ ও মহাকর্ষ।

(চ) নিচে কয়েকটি উক্তি দেওয়া আছে, উহাদের যথাযথ যুক্তগ্রাহ্য প্রমাণ দাও ঃ

১। অক্সিজেন জ্বলতে সাহায্য করে, হাইড্রোজেন নিজে জ্বলে, আবার কার্বন-ডাই-অক্সাইড আগুন নেভাতে ব্যবহৃত হয়।

২। বায়ু কতকগুলি গ্যাসের মিশ্রণ।

৩। চুম্বকের আকর্ষণী ধর্ম আছে।

(ছ) ১। চিত্রের সাহায্যে দেখাও কিভাবে লোহাচুর ও গন্ধকের মিশ্রণ পৃথক করবে।

২। বায়ুর ওজন আছে চিত্রসহ নির্দেশ কর।

THE SCORING KEY AND STRUCTURE OF ENTRY LEVEL TEST

Sl. No.		Marks	Question
A.	1.	1	Knopwledge
	2.	1	"
	3.	1	"
	4.	1	"
	5.	1	"
	6.	1	"
	7.	1	Understanding
	8.	1	Knowledge
	9.	1	"
	10.	1	"
	11.	1	Understanding
	12.	1	Knowledge
	13.	1	Understanding
	14.	1	"
	15.	1	Knowledge
	16.	1	"
	17.	1	"
B.	1.	1	Understanding
	2.	1	"
	3.	1	"
	4.	1	Knowledge
	5.	1	Understanding

	6.	1	Knowledge
	7.	1	"
	8.	1	Understanding
	9.	1	"
	10.	1	Knowledge
	11.	1	Understanding
	12.	1	"
	13.	1	Knowledge
	14.	1	"
	15.	1	"
	16.	1	"
C.	1.	2	"
	2.	2	Understanding
	3.	2	Knowledge
	4.	2	Application
	5.	2	"
	6.	2	Knowledge
	7.	2	Application
D.	1.	$2^1/_2$	Understanding
	2.	$2^1/_2$	Knowledge
	2.	$2^1/_2$	"
	4.	$2^1/_2$	"
	5.	$2^1/_2$	Understanding
	6.	$2^1/_2$	"
	7.	$2^1/_2$	Knowledge

	8.	$2^1/_2$	Understanding
E.	1.	3	Understanding
	2.	3	"
	3.	3	"
	4.	3	"
F.	1.	4	Application
	2.	4	"
	3.	4	"
G.	1.	$4^1/_2$	Skill
	2.	$4^1/_2$	Skill

THE SOCRING KEY OF THE ENTRY LEVEL TEST
(ANSWER)
Class – VIII

ক.

১। বায়ুমণ্ডল
২। অক্সিজেন, নাইট্রোজেন
৩। অক্সিজেন
৪। হাইড্রোজেন
৫। ২০.৬০
৬। ০.০৪
৭। বেলুনটি আগুনের সংস্পর্শে জ্বলে ওঠে
৮। কার্বন-ডাই-অক্সাইড
৯। হাইড্রোজেন
১০। যৌগিক পদার্থ
১১। জল
১২। ২ ঃ ১
১৩। চুম্বক ধরতে হবে
১৪। ভৌত
১৫। হাইড্রোজেন
১৬। মহাকর্ষ বল
১৭ অভিকর্ষ বল

খ.

১। সঠিক
২। ভুল
৩। সঠিক
৪। ভুল
৫। ভুল
৬। সঠিক
৭। সঠিক
৮। ভুল
৯। সঠিক
১০। সঠিক
১১। ভুল
১২। সঠিক
১৩। ভুল
১৪। সঠিক
১৫। সঠিক
১৬। সঠিক

গ.

১। যে ধর্ম পদার্থের বাহ্যিক অবস্থা ও গুণের পরিচয় দেয়, সেই ধর্মকে ভৌতধর্ম বলে।

২। বায়ু মিশ্রপদার্থ, কারণ ঃ

(ক) বায়ুর উপাদানগুলির যে কোন ওজন অনুপাতে মিলিত হয়ে বায়ু গঠন করে,

(খ) বায়ুর উপাদানগুলিকে সাধারণ ভৌত উপায়ে সহজে পৃথক করা যায়।

(গ) বায়ুতে উপাদানগুলির স্ব স্ব ধর্ম বজায় থাকে।

৩। একটি হাইড্রোজেন অণু দুটি হাইড্রোজেন পরমাণু নিয়ে গঠিত।

৪। চৌম্বক পদার্থ মিশ্রিত আছে এমন কোন মিশ্রণ চুম্বক দ্বারা আলাদা করা যায়। উদাহরণ — বালি এবং লোহাচুর-এর মিশ্রণ থেকে লোহাচুর সহজেই পৃথক করা যায়।

৫। লোহায় মরিচা পড়া — একটি রাসায়নিক পরিবর্তন। কারণ —

(ক) মরিচা চুম্বক দ্বারা আকৃষ্ট হয় না, অর্থাৎ মরিচায় লোহার ধর্ম বজায় থাকে না।

(খ) পরিবর্তনের কারণ সরিয়ে নিলেও মরিচা থেকে পুনরায় লোহা ফিরে পাওয়া যায় না।

৬। একটি দন্ড-চুম্বকের আকর্ষণ তার দুই মেরুতে সবচেয়ে বেশি।

৭। প্রাচীনকালে দিক নির্ণয়ে ধ্রুবতারার সাহায্য নেওয়া হত, কারণ —

(ক) ধ্রুবতারা সারা বছর উত্তর-আকাশে একটি নির্দিষ্ট স্থানে স্থিরভাবে আবস্থান করে।

(খ) তখনও বিশেষতঃ রাতের বেলা দিগ্-নির্ণয়ের অন্য কোন সহজ ব্যবস্থা ছিল না।

(ঘ)

ক		খ
১	—	২
২	—	৩
৩	—	১
৪	—	৪
৫	—	৬
৬	—	৫
৭	—	৭
৮	—	৮

(ঙ) ১।

মিশ্র পদার্থ	যৌগিক পদার্থ
১. দুই তা ততোধিক পদার্থ যে কোন ওজন অনুপাতে মেশালে মিশ্র পদার্থ উৎপন্ন হয়।	১. উপাদানগুলির ওজনের অনুপাত সবসময় স্থির থাকে।
২. উদাপানগুলিকে সহজ উপায়ে পৃথক করা যায়।	২. উপাদানগুলিকে সহজ উপায়ে পৃথক করা যায় না।
৩. উপাদানগুলির স্ব স্ব ধর্ম বজায় থাকে।	৩. উপাদানগুলির নিজস্ব ধর্ম লোপ পায় এবং সম্পূর্ণ ভিন্ন ধর্ম নিজস্ব নতুন পদার্থে পরিণত হয়।

৪. মিশ্রণ তৈরি করার সময় তাপের তারতম্য হতে পারে, আবার নাও হতে পারে।	৪. এই পদার্থ উৎপন্নে তাপের তারতম্য হবেই। অর্থাৎ হয় তাপ উৎপন্ন হবে, নাহয় তাপ শোষিত হবে।

(চারটির মধ্যে যেকোন দুটি লিখলে 2 নং পাবে। তিনটি লিখলে 2.5 এবং চারটি লিখলে 3 পাবে।)

২। শুধু কাকে বলে লিখলে $1^1/_2$ পাবে। উদাহরণ দিলে 2, পুরোটা লিখলে 3 নম্বর পাবে।

৩। একটি লিখলে 1, দুটি লিখলে 2, তিনটি 2.5, সবগুলো অর্থাৎ চারটি লিখলে পুরো নম্বর পাবে।

৪। সংজ্ঞা লিখলে $2^1/_2$ নম্বর পাবে। উদাহরণ দিলে ?? নম্বর পাবে।

(চ) ১। শুধু অক্সিজেন লিখলে 1, ২টো লিখলে 2.5, তিনটে লিখলে 3.5। (যদি কার্বন-ডাই-অক্সাইডের ক্ষেত্রে স্বচ্ছ চুনজলের মধ্যে চালনা করে নাইট্রোজেন নয় প্রমাণ দেখায়, তাহলে পুরো নম্বর পাবে)

২। শুধু কতগুলি গ্যাসের মিশ্রণ লিখে নাম উল্লেখ করলে মাত্র এক নম্বর। পরীক্ষা দ্বারা প্রমাণ দিলে — যদি শুধু অক্সিজেন দেয়, তাহলে 1.5 নম্বর, অক্সিজেন ও জলীয় বাষ্প দেয় 2 নম্বর, অক্সিজেন, জলীয় বাষ্প আর নাইট্রোজেন দেয়, তাহলে 3 নম্বর। এগুলোর সঙ্গে যদি কার্বন-ডাই-অক্সাইড দেয় তাহলে পুরো 4 নম্বর।

৩। লোহাচুনের কাছে চুম্বক ধরলে লোহাচুর চুম্বকে আকৃষ্ট হয় লিখলে মাত্র এক নম্বর। পরীক্ষার আকারে লিখে দিলে 2.5 নম্বর। আর যদি সিদ্ধান্ত টেনে শেষে করে, তাহলে পুরো নম্বর পাবে।

(ছ) ১। চুম্বকে যদি মেরুর চিহ্ন না দেয়, তাহলে .5 পাবে। মেরুর চিহ্ন দিয়ে আকৃষ্ট লোহাচুরের নাম উল্লেখ করলে 2.5 নম্বর। এর সঙ্গে মিশ্রণটির উপাদান এবং পুরো পরীক্ষাটির নামকরণ থাকলে পুরো নম্বর পাবে।

২। প্রদত্তভাবে শুধু ছবি এঁকে দিলে কোন নম্বর নেই। ছবির সঙ্গে চিহ্নিত অংশ এবং কোনটা বায়ুপূর্ণ, কোনটা বায়ুহীন লিখলে 1.5 নম্বর মাত্র। যদি প্রদত্ত ব্যাখ্যার মতো একটির ওজন W এবং একটির W_1 লিখে বায়ুর ওজন দেখানো হয় বা সুনির্দিষ্টভাবে বোঝা যায়, তবে পুরো নম্বর।

APPENDIX – F

FINAL TEST

প্রান্তিক অভীক্ষা (Final Test)

প্রকৃতি বিজ্ঞান

নাম ———————————————— ক্রমিক সংখ্যা ————————

বিদ্যালয় ————————————————————————————

শ্রেণী ———————————— তারিখ ————————————

প্রিয় ভাই ও বোনেরা,

কল্যাণী বিশ্ববিদ্যালয়ে শিক্ষাতত্ত্ব বিভাগ থেকে একটি গবেষণা কার্য্যের প্রয়োজনে তোমাদের কাছে প্রকৃতি-বিজ্ঞানের পঠিত কয়েকটি বিষয়ে প্রশ্ন নিয়ে এসেছি। তোমাদের প্রত্যেকের দেওয়া উত্তর এই গবেষরা কার্য্যে সমান গুরুত্বপূর্ণ।

★ **লেখা শুরু করার আগে নির্দেশগুলি পড় ঃ**

☐ আগে ভাল করে পড়ে দেখ কি করতে হবে, পরে উত্তর দাও।

☐ অবশ্যই প্রত্যেকটি প্রশ্নের উত্তর দেবে।

☐ এই পরীক্ষার ফল তোমার বাৎসরিক পরীক্ষার ফলকে কোনভাবেই প্রভাবিত করবে না, বরং এই পরীক্ষা যদি ঠিকভাবে দিতে পার, তাহলে তোমার বিষয়টি সম্বন্ধে একটি পরিচ্ছ ধারণা জন্মাবে এবং এই ধারণা তোমার ভবিষ্যৎ পরীক্ষার ফলকে আরও উন্নত করতে অবশ্যই সাহায্য করবে।

☐ যে প্রশ্নটি পারবে না, সেটির জন্য বেশী সময় নষ্ট না করে পরবর্তী প্রশ্নের উত্তর দিতে চেষ্টা কর।

☐ লেখা শুরু করতে বলার আগে কোন মতেই শুরু করবে না।

★ **নিজে উত্তর কর, কাউকে বিরক্ত করবে না।**

'ক' বিভাগ

I. নীচের প্রতিটি প্রশ্নের একাধিক উত্তর দেওয়া আছে। এদের মধ্যে যেটি সঠিক তাতে '✓' চিহ্ন দাও ঃ

১।	পরীক্ষাগারে অক্সিজেন প্রস্তুত করার জন্য বিকারক পদার্থ হিসাবে ব্যবহৃত হয় —	পটাসিয়াম ক্লোরেট ও ম্যাঙ্গানিজ ডাই অক্সাইড / জিংক ও লঘু সালফিউরিক অ্যাসিড / ক্যালসিয়াম কার্বনেট ও লঘু হাইড্রোক্লোরিক অ্যাসিড।
২।	অক্সিজেন গ্যাস পরীক্ষাগারে সংগ্রহ করা হয় —	জলের উর্ধ্ব অপসারণ / জলের নিম্ন অপসারণ / বায়ুর উর্ধ্ব অপসারণ পদ্ধতিতে।
৩।	পরীক্ষাগারে হাইড্রোজেন গ্যাস প্রস্তুত করার জন্য যে সকল বিক্রিয়ক পদার্থ ব্যবহৃত হয় সেগুলি হ'ল —	বিশুদ্ধ জিংকের ছিবড়া ও গাঢ় সালফিউরিক অ্যাসিড / অবিশুদ্ধ জিংকের ছিবড়া ও লঘু সালফিউরিক অ্যাসিড / পটাসিয়াম ক্লোরেট।
৪।	পরীক্ষাগারে হাইড্রোজেন গ্যাস সংগ্রহ করা হয় —	বায়ুর উর্দ্ধ অপসারণ / জলের নিম্ন অপসারণ / জলের উর্দ্ধ অপসারণ প্রক্রিয়ায়।
৫।	কার্বন ডাই-অক্সাইড গ্যাস পরীক্ষাগারে প্রস্তুতির জন্য যে সকল দ্রব্য ব্যবহার করা হয়, সেগুলি হল —	পটাসিয়াম ক্লোরেট / ক্যালসিয়াম কার্বনেট ও লঘু হাইড্রোক্লোরিক অ্যাসিড / ক্যালসিয়াম কার্বনেট ও গাঢ় সালফিউরিক অ্যাসিড।
৬।	কার্বন ডাই-অক্সাইড গ্যাস পরীক্ষাগারে সংগ্রহ করা হয় —	জলের উর্দ্ধ অপসারণ / বায়ুর নিম্ন অপসারণ / বায়ুর উর্দ্ধ অপসারণ পদ্ধতিতে।
৭।	অক্সিজেন পূর্ণ গ্যাসজারে শিখাহীন জলন্ত পাটকাঠি প্রবেশ করালে কাঠিটি তীব্র ভাবে জ্বলে ওঠে, সুতরাং অক্সিজেন গ্যাস —	দহন সহায়ক / দাহ্য / দহন বিরোধী।
৮।	ধাতুর সঙ্গে বিক্রিয়ায় অক্সিজেন —	আম্লিক / ক্ষারীয় / প্রশম অক্সাইড উৎপন্ন করে।
৯।	অক্সিজেন গ্যাসের শোষক হল —	প্যালাডিয়াম / ক্ষারীয় পটাসিয়াম পাইরোগ্যালেট / অনার্দ্র ক্যালসিয়াম ক্লোরাইড।
১০।	হাইড্রোজেন পূর্ণ গ্যাসজারে জ্বলন্ত পাটকাঠি ধরলে পাটকাঠি নিভে যায় কিন্তু গ্যাসটি নীল শিখায় জ্বলে, তাই হাইড্রোজেন গ্যাস —	দহন বিরোধী / দাহ্য / দহন সহায়ক।
১১।	আগুন নেভানোর কাজে কার্বনডাই অক্সাইড গ্যাস ব্যবহার করা হয়, সুতরাং এটি একটি—	দাহ্য / দহন সহায়ক / দহন বিরোধী।

১২। হাইড্রোজেন গ্যাসের শোষক হল —	ক্ষারীয় পটাসিয়াম পাইরোগ্যালেট / অনার্দ্র ক্যালসিয়াম ক্লোরাইড / প্যালাডিয়াম।
১৩। কোন পদার্থের সাথে হাইড্রোজেনের যুক্ত হওয়াকে বলে —	জারণ / বিজারণ / কোনোটিই নয়।
১৪। কার্বন ডাই-অক্সাইড গ্যাসে শোষকের নাম —	সোডিয়াম হাইড্রোক্সাইড / প্যালাডিয়াম / অনার্দ্র ক্যালসিয়াম ক্লোরাইড।

II. নীচের উক্তিগুলির কোন্‌টি সত্য এবং কোনটি মিথ্যা লেখ ঃ

১। পটাসিয়াম ক্লোরেট থেকে অক্সিজেন গ্যাস প্রস্তুতের সময় ম্যাঙ্গানিজ ডাই-অক্সাইড অনুঘটকের কাজ করে। সত্য / মিথ্যা

২। নাইট্রিক অক্সাইড (NO) হল উভধর্মী অক্সাইড। সত্য / মিথ্যা

৩। অক্সিজেন ও হাইড্রোজেন গ্যাসের মিশ্রণে আগুন দিলে বিস্ফোরণ-সহ বিক্রিয়া ঘটে। সত্য / মিথ্যা

৪। একটি অক্সাইডকে জলে দ্রবীভূত করে নীল লিটমাস দিলে লাল হয়। অক্সাইডটি আম্লিক। সত্য / মিথ্যা

৫। কোন পদার্থর সাথে অক্সিজেন যুক্ত হওয়াকে বলে বিজারণ। সত্য / মিথ্যা

৬। কার্বন ডাই-অক্সাইড জলে দ্রবীভূত হয়ে কার্বনিক অ্যাসিড তৈরী করে। সত্য / মিথ্যা

৭। লেমোনেড এর ছিপি খুললে বেরিয়ে আসে কার্বন ডাই-অক্সাইড। সত্য / মিথ্যা

৮। $550^{o}C$ উষ্ণতায় 200 বায়ুমণ্ডল চাপে নাইট্রোজেনের সঙ্গে হাইড্রোজেনের বিক্রিয়ায় অ্যামোনিয়া উৎপন্ন হয়। সত্য / মিথ্যা

৯। জ্বলন্ত ম্যাগনেসিয়ামকে কার্বন ডাই-অক্সাইড পূর্ণ গ্যাসজারে প্রবেশ করালে নিভে যাবে। সত্য / মিথ্যা

III. নীচের প্রশ্নগুলির উত্তর দাও ঃ

১। পটাসিয়াম ক্লোরেট থেকে অক্সিজেন গ্যাস প্রস্তুতির সময় ম্যাঙ্গানিজ ডাই-অক্সাইড যোগ করার কারণ কি?

২। ধাতু থেকে হাইড্রোজেন গ্যাস প্রস্তুতির সময় উলফ্ বোতলটি বায়ু নিরুদ্ধ রাখা হয় কেন?

৩। ধাতু থেকে হাইড্রোজেন গ্যাস প্রস্তুতির সময় গাঢ় সালফিউরিক অ্যাসিড ব্যবহার না করার কারণ কী?

৪। 'অন্তর্ধৃতি' কি?

৫। পরীক্ষাগারে কার্বন ডাই-অক্সাইড গ্যাস প্রস্তুতিতে ক্যালসিয়াম কার্বনেটের সঙ্গে লঘু সালফিউরিক অ্যাসিড ব্যবহার করা হয় না কেন?

৬। 'শুষ্ক-বরফ' কি?

IV. নীচের প্রতিটি প্রশ্নের একজোড়া করে শব্দ দেওয়া আছে, উহাদের পার্থক্য নির্ণয় কর ঃ

১। জারণ ও বিজারণ।

২। দাহ্য ও দহন সহায়ক।

৩। জায়মান হাইড্রোজেন ও সাধারণ হাইড্রোজেন।

V. নীচের শব্দগুলির মধ্যে প্রথম দুটির ভেতর যে সম্বন্ধ রয়েছে, তৃতীয় শব্দটির সহিত সেই সম্পর্ক বজায় রেখে চতুর্থ শব্দটিকে শূন্যস্থানে বসাও ঃ

১। অক্সিজেন ঃ অ্যাসিড উৎপাদক ঃ ঃ হাইড্রোজেন ঃ

২। (ধাতু + অক্সিজেন) ঃ অক্সাইড ঃ ঃ (ধাতু + হাইড্রোজেন) ঃ

VI. নিম্নলিখিত ক্ষেত্রে কি ঘটে সমীকরণসহ উল্লেখ কর ঃ

১। উত্তপ্ত কপার অক্সাইডের উপর দিয়ে হাইড্রোজেন গ্যাস চালনা করা হল।

২। ক্যালসিয়াম কার্বনেটের সঙ্গে লঘু হাইড্রোক্লোরিক অ্যাসিডের বিক্রিয়া ঘটানো হল।

৩। কার্বন ডাই-অক্সাইড পূর্ণ গ্যাসজারে ম্যাগনেসিয়াম ফিতা প্রবেশ করানো হল।

৪। সালফারকে অক্সিজেনের মধ্যে পোড়ানো হল। উৎপন্ন গ্যাসকে জলে দ্রবীভূত করে নীল লিটমান দ্রবণ যোগ করা হল।

৫। স্বচ্ছ চুনজলের মধ্যে — (ক) মৃদু কার্বন ডাই-অক্সাইড চালনা করা হল। (খ) পরে অতিরিক্ত কার্বন ডাই-অক্সাইড চালনা করা হল।

৬। হাইড্রোজেন ও ক্লোরিন গ্যাসের মিশ্রণকে সূর্যালোকে রাখা হল।

VII. নীচে যে উক্তিগুলি দেওয়া আছে, উহাদের যথাযথ বৈজ্ঞানিক ব্যাখ্যা দাও ঃ

১। অক্সিজেন অ্যাসিড উৎপাদক গ্যাস।

২। কার্বন ডাই-অক্সাইড গ্যাস সবুজ উদ্ভিদের খাদ্য তৈরী করতে প্রয়োজন হয়।

VIII. চিত্রসহ নির্দেশ কর ঃ

পরীক্ষাগারে অক্সিজেন গ্যাস প্রস্তুতির প্রয়োজনীয়তা চিত্র অঙ্কন করে দেখাও।

'খ' বিভাগ

১। নীচের প্রতিটি প্রশ্নের একাধিক উত্তর দেওয়া আছে। এদের মধ্যে যেটি সঠিক তাতে '✓' চিহ্ন দাও ঃ

(ক)	এদের মধ্যে যেটি চুম্বক দ্বারা আকর্ষিত হয় না —	লোহা / নিকেল / সোনা।
(খ)	একটি চুম্বকের মাঝখানে আকর্ষণী ক্ষমতা একেবারে নেই। এই অঞ্চলটিকে বলে —	চৌম্বক মধ্যতল / উদাসীন অঞ্চল / কুরীবিন্দু।
(গ)	চুম্বকের বিপরীত মেরু পরস্পরকে —	আকর্ষণ করে / বিকর্ষণ করে / অভিকর্ষণ করে।
(ঘ)	শক্তিশালী চুম্বকের কাছে একটি লোহার দণ্ড আনলে দণ্ডটির নিকট-প্রান্তে —	সম-মেরুর সৃষ্টি হয় / বিপরীত মেরুর সৃষ্টি হয় / কোন মেরু সৃষ্টি হয় না।
(ঙ)	একটি দণ্ড-চুম্বককে ক্ষুদ্র ক্ষুদ্র খণ্ডে বিভক্ত করলে প্রতিটি খণ্ডে —	শুধু উত্তর মেরু থাকে / শুধুদক্ষিণ মেরু থাকে / উত্তর ও দক্ষিণ মেরু — দুইই থাকে।

২। নীচের উক্তিগুলির কোন্‌টি সত্য এবং কোনটি মিথ্যা নির্দেশ কর ঃ

(ক) আকর্ষণের চেয়ে বিকর্ষণই চুম্বকত্বের শ্রেষ্ঠ প্রমাণে। সত্য / মিথ্যা

(খ) একটি চুম্বকের প্রত্যেকটি অণুই চুম্বক। সত্য / মিথ্যা

(গ) অচৌম্বক পদার্থের মধ্য দিয়ে চুম্বক ক্রিয়া করে না। সত্য / মিথ্যা

(ঘ) যে চুম্বকের প্রভাবে কোন চৌম্বক পদার্থের চুম্বকত্ব প্রকাশ পায়, সেই পদার্থটি সরিয়ে নিলেও চৌম্বক পদার্থটির চৌম্বকত্ব নষ্ট হয় না। সত্য / মিথ্যা

(ঙ) নৌ-কম্পাসে চুম্বকের আকর্ষণী ধর্মকে কাছে লাগিয়ে অনায়াসেই দিক্ নির্ণয় করা যায়। সত্য / মিথ্যা

৩। নীচের প্রশ্নগুলির উত্তর দাও ঃ

(ক) তড়িৎ-চুম্বকের শক্তি বৃদ্ধি করার উপায়গুলি কি কি?

(খ) 'আকর্ষণের আগে আবেশ হয়' — যুক্তিপূর্ণ ব্যাখ্যা দাও।

৪। নীচের প্রতিটি প্রশ্নের একজোড়া করে শব্দ দেওয়া আছে, উহাদের পার্থক্য নির্ণয় কর ঃ

(ক) কৃত্রিম চুম্বক ও প্রাকৃতিক চুম্বক।

(খ) চৌম্বক পদার্থ ও অচৌম্বক পদার্থ।

৫। নীচের শব্দগুলির মধ্যে প্রথম দুটির ভেতর যে সম্বন্ধ রয়েছে তৃতীয় শব্দটির সহিত সেই সম্পর্ক বজায় রেখে চতুর্থ শব্দটিকে শূন্যস্থানে বসাও ঃ

(ক) চন্ড চুম্বক ঃ কৃত্রিম ঃ ঃ লোড্‌স্টোন ঃ

(খ) উত্তর-মেরু-উত্তর-মেরু ঃ বিকর্ষণ ঃ ঃ উত্তর-মেরু-দক্ষিণ-মেরু ঃ

৬। 'ক' ও 'খ' এর মধ্যে সামঞ্জস্য বিধান কর ঃ

'ক'	'খ'
ক। যে তাপমাত্রায় চুম্পক তার চুম্বকত্ব হারায়, তাকে বলে	ক। ঘর্ষণ প্রণালী।
খ। কৃত্রিম উপায়ে চুম্বক তৈরীর একটি পদ্ধতি হল	খ। আবেশকারী চুম্বকের মেরুশক্তির উপর।
গ। আবিষ্ট চুম্বকের চৌম্বকত্বের পরিমাণ নির্ভর করে	গ। কুরীবিন্দু।
ঘ। চুম্বকের একটি বিশেষ ধর্ম হল	ঘ। অন্তরিত তারের পাক-সংখ্যা বৃদ্ধি করা।
ঙ। তড়িৎ চুম্বকের শক্তি বৃদ্ধি করার একটি উপায় হল	ঙ। দিগ্‌দর্শী ধর্ম।

৭। নীচে যে উক্তিটি দেওয়া আছে, তার যুক্তিগ্রাহ্য প্রমাণ দাও ঃ

(ক) 'পৃথবী নিজেই একটি বিরাট চুম্বক'।

৮। নিম্নলিখিত চিত্রগুলি অঙ্কন কর এবং উত্তর ও দক্ষিণ মেরু নির্দেশ কর।

(ক) দণ্ড চুম্বক

(খ) অশ্বখুরাকৃতি চুম্বক

(গ) প্রান্তীয় চুম্বকত্ব

(ঘ) আবেশের ফলে অনুচুম্বকগুলির বিন্যাস।

THE SCORING KEY AND STRUCTURE OF FINAL TEST

Group – A

Sl. No.	Marks	Question
1)		
1.	1	Knowledge
2.	1	,,
3.	1	,,
4.	1	,,
5.	1	,,
6.	1	,,
7.	1	Understanding
8.	1	Knowlkedge
9.	1	,,
10.	1	Understanding
11.	1	,,
12.	1	Knowledge
13.	1	,,
14.	1	,,
2)		
1.	1	Knowledge
2.	1	,,
3.	1	,,
4.	1	Understanding
5.	1	Knowledge
6.	1	Understanding
7.	1	Knowledge
8.	1	,,
9.	1	Understanding

3)

1.	2	Knowledge
2.	2	Application
3.	2	Understanding
4.	2	Knowledge
5.	2	Understanding
6.	2	Knowledge

4)

1.	2	Understanding
2.	2	„
3.	2	„

5)

1.	1	Understanding
2.	1	„
3.	1	„

6)

1.	$1\frac{1}{2}$	Application
2.	$1\frac{1}{2}$	„
3.	$1\frac{1}{2}$	„
4.	$1\frac{1}{2}$	„
5.	$1\frac{1}{2}$	„
6.	$1\frac{1}{2}$	„

7)

1.	2	Application
2.	2	„

8)

1.	3	Skill

Group – B

Sl. No.	Marks	Question
1)		
1.	1	Knowledge
2.	1	,,
3.	1	,,
4.	1	,,
5.	1	Understanding
2)		
1.	1	,,
2.	1	Knowledge
3.	1	Understanding
4.	1	Understanding
5.	1	,,
3)		
1.	2	Application
2.	2	Understanding
4)		
1.	2	,,
2.	2	,,
5)		
1.	2	,,
2.	2	,,

6)

1.	2	Knowledge
2.	2	„
3.	2	Understanding
4.	2	Knowledge
5.	2	„

7)

1.	3	Application

8)

1.	1	Skill
2.	1	„
3.	1	„
4.	2	„

APPENDIX – G

SCORING KEY OF FINAL TEST

THE SCORING KEY OF THE ACHIEVEMENT TEST

UNIT (I) PREPARATION & STUDY OF SIMPLE PROPERTIES OF GASES LIKE HYDROGEN, OXYGEN AND CARBON-DI-OXIDE (II) MAGNETS

CLASS VIII

'ক' বিভাগ

১। (১) পটাশিয়াম ক্লোরেট ও ম্যাঙ্গানিজ-ডাই-অক্সাইড।

(২) জলের নিম্ন-অপসারণ পদ্ধতিতে।

(৩) অবিশুদ্ধ জিহবের ছিবড়া ও লঘু সালফিউরিক অ্যাসিড।

(৪) জলের নিম্ন অপসারণ পদ্ধতিতে।

(৫) ক্যালসিয়াম কার্বনেট ও লঘু হাইড্রোক্লোরিক অ্যাসিড।

(৬) বায়ুর উর্ধ্ব-অপসারণ পদ্ধতিতে।

(৭) দহন-সহায়ক।

(৮) ক্ষারীয় অক্সাইড উৎপন্ন করে।

(৯) ক্ষারীয় পটাশিয়াম পাইরোস্যালেট।

(১০) দাহ্য।

(১১) দহন-বিরোধী।

(১২) প্যালাডিয়াম।

(১৩) বিজারণ।

(১৪) সোডিয়াম হাইড্রক্সাইড।

২। (১) সত্য (৬) সত্য

(২) মিথ্যা (৭) সত্য

(৩) সত্য (৮) সত্য

(৪) সত্য (৯) মিথ্যা

(৫) মিথ্যা

৩। (১) পরীক্ষাগারে অক্সিজেন প্রস্তুতির সময় পটাসিয়াম ক্লোরেটের সঙ্গে ম্যাঙ্গানীজ-ডাই-অক্সাইড মিশিয়ে উত্তপ্ত করলে কম উষ্ণতায় (240°C) $KClO_3$ দ্রুত বিয়োজিত হয়ে O_2 উৎপন্ন করে। বিক্রিয়ায় MnO_2-র কোন রাসায়নিক পরিবর্তন ঘটে না। MnO_2 এখানে $KClO_3$-এর বিয়োজনকে দ্রুত করে মাত্র।

(২) হাইড্রোজেন বায়ুর অক্সিজেনের সঙ্গে মিলে বিস্ফোরক গ্যাস-মিশ্রণ-উৎপন্ন করে। যান্ত্রিক ব্যবস্থা বায়ু-নিরুদ্ধ না করা হলে উৎপন্ন H_2-এর সঙ্গে বায়ুর O_2 মিশে যেতে পারে। ফলে আগুনের সংস্পর্শে বিস্ফোরণ ঘটে দুর্ঘটনা ঘটার সম্ভাবনা থাকে। তাই H_2 গ্যাস প্রভৃতিতে যন্ত্র-পাতি (উলফ্ বোতল)টি বায়ুনিষিদ্ধ রাখা হয়।

(৩) গাঢ় H_2SO_4 একটি জারক অ্যাসিড। গাঢ় H_2SO_4 এবং ধাতুর বিক্রিয়ায় উৎপন্ন জায়মান হাইড্রোজেন গাঢ় H_2SO_4 দ্বারা জারিত হয়ে জলে পরিণত হয় এবং H_2SO_4 বিজারিত হয়ে SO_4 উৎপন্ন করে। তাই ধাতু থেকে হাইড্রোজেন গ্যাস প্রস্তুতির সময় গাঢ় H_2SO_4 ব্যবহার করা হয় না।

(৪) সাধারণ উষ্ণতায় বা উত্তপ্ত অবস্থায় কতকগুলি ধাতু, যথা ঃ প্যালাডিয়াম, প্লাটিনাম, আয়রণ, প্রভৃতি হাইড্রোজেন গ্যাস শোষণ করতে পারে। ধাতুর এইভাবে গ্যাস শোষণ করার ক্ষমতাকে অন্তধৃতি বলে।

(৫) মার্বেল বা $CaCO_3$-এর সংস্পর্শে লঘু H_2SO_4 জলে প্রথমে CO_2 উৎপন্ন হলেও অল্প-সময়ের মধ্যেই মার্বেল পাথরের উপর উৎপন্ন অদ্রাব্য ক্যালসিয়াম সালফেটের একটি পাত্‌লা আস্তরণ পড়ে যায়। ফলে $CaCO_3$ আর অ্যাসিডের সংস্পর্শে আসতে পারে না এবং বিক্রিয়াটি বন্ধ হয়ে যায়। অথাৎ CO_2-এর উৎপাদন বন্ধ হয়।

(৬) একটি নির্দিষ্ট উষ্ণতার চেয়ে কম উষ্ণতায় চাপ প্রয়োগ করে CO_2 গ্যাসকে তরলে পরিণত করা যায়। এই তরল CO_2-কে খোলা বাতাসের মধ্যে দ্রুত বাষ্পীভূত হতে দিলে ওর উষ্ণতা অনেক কম। তখন অবশিষ্ট তরল CO_2 জমে কঠিন CO_2-এ পরিণত হয়। এই কঠিন CO_2 বরফের মত সাদা, কিন্তু বরফের চেয়ে অনেক বেশি ঠাণ্ডা, এবং এতে জল থাকে না। একেই 'ড্রাই-আইস' বা 'শুষ্ক বরফ' বলে। (কঠিন CO_2কে বরফ বলে)।

১। জারণ ঃ

যে রাসায়নিক প্রক্রিয়ায় কোন মৌল বা যৌগের সঙ্গে অক্সিজেন যুক্ত হয় বা কোন যৌগ থেকে হাইড্রোজেন অপসারিত হয়, সেই প্রক্রিয়াকে জারণ বলে। হাইড্রোজেন সালফাইডের সঙ্গে লাল কার্বন ব্রোমিন জলের বিক্রিয়ায় বর্ণহীন হাইড্রোজেন 'ব্রোমাইড এবং সালফার উৎপন্ন হয়। এখানে H_2S থেকে H_2 অপসারিত হয়ে S-এ পরিণত হয়। সুতরাং H_2S-এর জারণ হয়েছে।

বিজারণ ঃ

(১) যে প্রক্রিয়ায় কোন মৌল বা যৌগের সঙ্গে হাইড্রোজেন যুক্ত হয় বা কোন যৌগ থেকে অক্সিজেন অপসারিত হয়, তাকে বিজারণ বলে।

(২) এই বিক্রিয়ায় ব্রোমিন-এর সঙ্গে হাইড্রোজেন যুক্ত হয়ে বর্ণহীন হাইড্রোজেন ব্রোমাইড (HBr) উৎপন্ন হয়েছে। সুতরাং ব্রোমিন-এর বিজারণ ঘটেছে।

২। দাহ্য ঃ

(১) যে পদার্থ পুড়ে তাপ এবং আলোক উৎপন্ন করে, তাকে দাহ্য পদার্থ বলে।

(২) যেমন, কাঠ, কাগজ, কয়লা, প্রভৃতি। হাইড্রোজেন গ্যাস একটি দাহ্য গ্যাস।

দহন-সহায়ক ঃ

(১) যে পদার্থ দহনে সাহায্য করে, যাদের ছাড়া দহন হয় না, তারে দহন-সহায়ক (পদার্থ) বলে।

(২) যেমন, অক্সিজেন — একটি দহন-সহায়ক গ্যাস।

৩। জায়মান হাইড্রোজেন ঃ

(১) রাসায়নিক বিক্রিয়ার ফলে যখন কোন যৌগ থেকে হাইড্রোজেন উপিন্ন হয়, তখন সদ্য উৎপন্ন হাইড্রোজেন পরমাণুগুলি মুক্ত অবস্থায় থাকে — এই সদ্যজাত হাইড্রোজনকে জায়মান হাইড্রোজেন বলে।

(২) এটি বেশি সক্রিয়।

(৩) সক্রিয়তার উদাহরণ ঃ হলুদ বর্ণের ফেরিক ক্লোরাইড দ্রবণে এক টুকরো জিংক ও লঘু H_2SO_4 যোগ করলে সদ্যজাত হাইড্রোজেন নির্গত হয়, যা ফেরিক ক্লোরাইডকে বর্ণহীন ফেরাস ক্লোরাইডে পরিণত করে। ফলে দ্রবণের হলুদ বর্ণ বর্ণহীন হয়।

৪। সাধারণ হাইড্রোজেন ঃ

(১) সদ্য উৎপন্ন হাইড্রোজেন পরমাণুগুলি কিছুক্ষণের মধ্যেই (দুটি করে হাইড্রোজেন পরমাণু পরস্পর যুক্ত হয়ে) হাইড্রোজেন অণুতে পরমাণু হয়। একেই সাধারণ হাইড্রোজেন বলে।

(২) অপেক্ষাকৃত কম সক্রিয়।

(৩) হলুদ বর্ণের ফেরিক ক্লোরাইড দ্রবণে সাধারণ H_2 গ্যাস চালনা করলে দ্রবণের বর্ণের কোন পরিবর্তন হয় না। অর্থাৎ কোন বিক্রিয়া হয় না।

৫। (১) জল উৎপাদক;

(২) প্যালাডিয়াম;

(৩) হাইড্রাইড

৬। (ক) উত্তপ্ত কণার অক্সাইডের উপর দিয়ে (শুষ্ক) হাইড্রোজেন গ্যাস চালনা করলে CaO বিজারিত হয়ে লাল বর্ণের দাতব কপার উৎপন্ন হয়। $CaO + H_2 = Ca + H_2O$

(২) সাধারণ তাপমাত্রায় ক্যালসিয়াম কার্বনেটের সঙ্গে লঘু হাইড্রোক্লোরিক অ্যাসিডের বিক্রিয়ায় কার্বন-ডাই-অক্সাইড উৎপন্নদ হয়। $CaCO_3 + 2Hd = Cad_2 + CO_2 + H_2O$

(৩) কার্বন-ডাই-অক্সাইড পূর্ণ গ্যাসজারে জ্বলন্ত ম্যাগনেসিয়াম ফিতা প্রবেশ করালে ম্যাগনেশিয়াম আরো উজ্জ্বলভাবে জ্বলতে থাকে। ফলে ম্যাগনেসিয়াম জারিত হয়ে ম্যাগনেসিয়াম অক্সাইড উৎপন্ন হয়। এবং কার্বন-ডাই-অক্সাইড বিজারিত হয়ে কালো কার্বন কণা (C) উৎপন্ন করে। $2Mg + CO2 = 2MgO + C$

(৪) সালফারকে অক্সিজেন গ্যাসজারে পোড়ানো হলে, কার্বন ঝাঁঝালো গন্ধবিশিষ্ট সালফার-ডাই-অক্সাইড গ্যাস উৎপন্ন হয়। উৎপন্ন গ্যাসকে জলে দ্রবীভূত করলে সালফিউরিক অ্যাসিড উৎপন্ন

হয়। ফলে নীল লিটমাস দ্রবণ যোগ করা হলে তা লাল হয়ে যাবে।

(৫) (১) স্বচ্ছ চুনজলের মধ্যে দিয়ে CO_2 গ্যাস জালনা করলে প্রথমে অদ্রাব্য সাদা ক্যালসিয়াম কার্বনেট উৎপন্ন হয়। ফলে চুনজল ঘোলা হয়ে যায়।

$S + O_2 = SO_2$; $SO_2 + H_2O = H_2SO_3$

(২) কিন্তু এর মধ্যে অতিরিক্ত CO_2 গ্যাস চালনা করলে, অদ্রাব্য ক্যালসিয়াম কার্বনেট দ্রাব্য ক্যালসিয়াম-বাই-কার্বনেটে পরিণত হয়, ফলে ঘোলা চুনজল পুনরায় স্বচ্ছ হয়।

$Ca(OH)_2 + CO_2 = CaCO_3 + H_2O$

(৬) হাইড্রোজেন ও ক্লোরিন গ্যাসের মিশ্রণকে আলোতে রাখলে গ্যাস দুটি যুক্ত হয়ে হাইড্রোজেন ক্লোরাইড গ্যাস উৎপন্ন হয়। $H_2 + Cl_2 = 2HCl$

(৭) (১) অধাতুর সঙ্গে অক্সিজেনের বিক্রিয়া ঘটে আম্লিক অক্সাইড উৎপন্ন হয়। এই আম্লিক অক্সাইড জলে দ্রবীভূত হলে অ্যাসিড উৎপন্ন হয়, যা নীল লিটমাসকে লাল করে। এইভাবে অক্সিজেন থেকে অ্যাসিড উৎপন্ন হয় বলে — অক্সিজেনকে অ্যাসিড উৎপাদক বলে। যেমন, সালফার-এর সঙ্গে O_2-এর বিক্রিয়ায় SO_2 (আম্লিক অক্সাইড) উৎপন্ন হয়। SO_2 জলে দ্রবীভূত হয়ে সালফিউরাস অ্যাসিড উৎপন্ন করে। $H_2O + SO_2 = H_2SO_3$

(২) এক বিশেষ শারীরবৃত্তীয় প্রক্রিয়ায় সবুজ উদ্ভিদ তার ক্লোরোফিলযুক্ত কোষে সূর্যালোকের উপস্থিতিতে পরিবেশ থেকে শোষিত জল ও কার্বন ডাই-অক্সাইডের রাসায়নিক বিক্রিয়ার ফলে শর্করা জাতীয় সব খাদ্য উৎপন্ন করে এবং অক্সিজেন পরিত্যাগ করে। এই প্রক্রিয়াকে সালোক সংশ্লেষ বলে। এই প্রক্রিয়ায় বায়ুমণ্ডলের কার্বন ডাই-অক্সাইড থেকে কার্বন অর্থাৎ অঙ্গার নিয়ে শর্করা জাতীয় খাদ্য উৎপন্ন হয়।

$$6CO_2 + 12H_2O \xrightarrow{\text{সূর্যালোক}} C_6H_{12}O_6 + 6H_2O + 6O_2$$

(কার্বন ডাই-অক্সাইড) (জল) ক্লোরোফিল (গ্লুকোল)

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২। (ক) সোনা

(খ) উদাসীন অঞ্চল

(গ) আকর্ষণ করে

(ঘ) বিপরীত মেরুর সৃষ্টি হয়

(ঙ) উত্তর ও দক্ষিণ মেরু — দুইই থাকে

২। (ক) সত্য

(খ) সত্য

(গ) মিথ্যা

(ঘ) মিথ্যা

(ঙ) মিথ্যা

৩। (ক) তড়িৎ-চুম্বকের শক্তি বৃদ্ধি করার উপায়গুলি হ'ল—

(১) যদি নরম লোহাকে জড়ানো অন্তরিত তারের মধ্য দিয়ে তড়িৎ-প্রবাহ মাত্রা বাড়ানো হয়।

(২) যদি অন্তরিত তারের পাক-সংখ্যা বাড়ানো হয়।

(খ) একটি দন্ড-চুম্বককে কোন লোহার খন্ডের (চৌম্বক পদার্থ) কাছে আনলে লোহাটি ঐ চুম্বক দ্বারা আকৃষ্ট হয়। এই এই আকর্ষণের পিছনে দুটি ঘটনা ঘটে।

(১) লোহার দন্ডটির কাছে চুম্বকটিকে আনলে আবেশের ফলে ঐ লোহার দন্ডের নিকটপ্রান্তে বিপরীত মেরুর সৃষ্টি হয় এবং দূরপ্রান্তে সমমেরুর সৃষ্টি হয়। যেমন — চুম্বকটির উত্তরমেরুকে লোহার দন্ডটির কোন প্রান্তের কাছে আনলে ঐ প্রান্তে দক্ষিণ মেরু এবং দূর প্রান্তে উত্তর মেরু সৃষ্টি হয়। এইভাবে পদার্থটি ঐ অবস্থায় অস্থায়ী চুম্বকে পরিণত হয়।

(২) এখন বিপরীত মেরু পরস্পরকে আকর্ষণ করে, তাই লোহায় সৃষ্ট ঐ বিপরীত মেরুকে দন্ড-চুম্বকের মেরু আকর্ষণ করে। তাই বলা হয়, আকর্ষণের আগে আবেশ হয়।

৪। (ক)

	<u>কৃত্রিম চুম্বক</u>	<u>প্রাকৃতিক চুম্বক</u>
১।	কৃত্রিম চুম্বকের জ্যামিতিক আকার আছে।	প্রাকৃতিক চুম্বকের কোন নির্দিষ্ট আকার থাকে না।
২।	কৃত্রিম চুম্বকের দুটি মেরু থাকে এবং এরা সাধারণতঃ চুম্বকের দুই প্রান্তে অবস্থান করে।	প্রাকৃতিক চুম্বকে একের বেশী সংখ্যক মেরু থাকতে পারে।
৩।	কৃত্রিম চুম্বকের চৌম্বক শক্তি একটা নির্দিষ্ট সীমার মধ্যে বাড়ানো বা কমানো যায়।	প্রাকৃতিক চুম্বকের মেরুর শক্তি পরিবর্তন করা যায় না।
৪।	কৃত্রিম চুম্বকের চৌম্বকত্ব অস্থায়ী।	প্রাকৃতিক চুম্বকের চৌম্বকত্ব স্থায়ী।

(খ)

	<u>চৌম্বক পদার্থ</u>	<u>অচৌম্বক পদার্থ</u>
১।	যে পদার্থ চুম্বক দ্বারা আকৃষ্ট হয়।	যে পদার্থ চুম্বক দ্বারা আকৃষ্ট হয় না।
২।	যেমন, লোহা, নিকেল, কোবাল্ট।	তামা, সোনা, কাচ, কাঠ ইত্যাদি।
৩।	চৌম্বক পদার্থকে কৃত্রিম চুম্বকে পরিণত করা যায়।	কৃত্রিম চুম্বকে পরিণত করা যায় না।
৪।	চৌম্বক পদার্থের অণুগুলিই হল এক-একটি ছোট চুম্বক।	অচৌম্বক পদার্থের অণুগুলি চুম্বক নয়।

৫। (ক) প্রাকৃতিক

(খ) আকর্ষণ

৬।

ক		খ
১	—	৩
২	—	১
৩	—	২
৪	—	৫
৫	—	৪

৭। ১। একটি দন্ড-চুম্বককে তার ভারকেন্দ্র থেকে পাকহীন সূতার সাহায্যে যুক্ত অবস্থায় ঝুলিয়ে দিলে সর্বদা উত্তর-দক্ষিণ মুখ করে দাঁড়ায়। চুম্বক শলাকার ক্ষেত্রেও একই ফল লক্ষ্য করা যায়। চুম্বকের ধর্ম হল — একটি চুম্বকের উত্তর মেরু অন্য একটি চুম্বকের উত্তর মেরুকে বিকর্ষণ করবে এবং দক্ষিণ মেরুকে আকর্ষণ করে। সুতরাং এই ঘটনা দ্বারা ধরে নেওয়া যায় — নিশ্চয়ই কোন শক্তিশালী চুম্বকের আকর্ষণে চুম্বক-দণ্ড বা শলাকার উত্তরসন্ধানী মেরুটি উত্তর দিকে এবং দিক্ষণসন্ধানী মেরুটি দক্ষিণ দিকে মুখ করে স্থির থাকে। অথচ, একটি পিতলের দণ্ডকে তার ভারকেন্দ্রে (অচৌম্বক পদার্থ) অনুভূমিক অক্ষের উপর অবাধে ঘুরতে পারে এই অবস্থায় ঝুলিয়ে দিলে — দেখা যাবে মোট পৃথিবীর যেকোন জায়গায় অনুভূমিক অবস্থায় আছে।

২। একটি চুম্বক ফলাকাকে পৃথিবীর উত্তর মেরুর কাছে নিয়ে গেলে শলাকার উত্তর-সন্ধানী মেরুটি সোজা নীচের দিকে এবং দক্ষিণসন্ধানী মেরুটি উপরের দিকে মুখ করে থাকে। এর দ্বারা বোঝা যায় — শলাকার উত্তরসন্ধানী মেরুটি আকৃষ্ট হচ্ছে এবং দক্ষিণসন্ধানী মেরুটি বিকর্ষিত হচ্ছে। দক্ষিণ মেরুর কাছে নিয়ে গেলে এর ঠিক বিপরীত ঘটনাটি ঘটে।

৩। একটি বড় প্রাকৃতিক চুম্বককে পৃথিবীর আকারের মতো তৈরী করে ওর গায়ে একটি ছোট চুম্বক শলাকাকে অবাধে ঝুলিয়ে বিভিন্ন জায়গায় রাখলে দেখা যায়, পৃথিবীর বিভিন্ন জায়গায় ঝুলন্ত চুম্বক শলাকা রাখলে যেমন আচরণ করে, এই শলাকাটিও ঠিক ঐরকম আচরণ করছে।

৪। মাটির নীচে কোন চৌম্বক পদার্থ পুঁতে রাখলে ভূ-চুম্বকের প্রভাবে ঐ চৌম্বক পদার্থের মধ্যে সামান্য চৌম্বক ধর্ম প্রকাশ পায়। পৃথিবীর উত্তর গোলার্ধে রাখা (উল্লম্বভাবে) লোহার দণ্ডের নিচপ্রান্তে উত্তরসন্ধানী মেরু এবং দক্ষিণ গোলার্ধে অনুরূপভাবে রাখা লোহার দণ্ডের নিচপ্রান্তে দক্ষিণ সন্ধানী মেরুর সৃষ্টি হয়।

একটি ইস্পাত দণ্ডকে ভূ-চুম্বকের উত্তর ও দক্ষিণমুখী করে ভূ-পৃষ্ঠের সমান্তরালে অনেকদিন রেখে দিলে ইস্পাত-দণ্ডটি দুর্বল চুম্বকে পরিণত হয়। এই ঘটনাগুলি প্রমাণ করে যে, পৃথিবী নিজেই একটি বিরাট চুম্বক।

৮। ১। দণ্ড-চুম্বক;

২। অশ্বক্ষুরাকৃতি চুম্বক;

৩। চৌম্বক পদার্থে অণু-চুম্বকের বদ্ধমুখ শৃঙ্খল;

৪। আবেশের ফলে অণুচুম্বকগুলির বিন্যাস।

(প্রতিটি ক্ষেত্রেই চিত্রসহ উত্তর ও দক্ষিণ মেরু নির্দেশ করতে হবে)

ক — বিভাগ

৩। ৬। যদি শুধু লেখে — কঠিন কার্বন-ডাই-অক্সাইডকে শুষ্ক বরফ বলে, তবে 1 নম্বর পাবে।

৪। ১। শুধু সংজ্ঞা দিলে। 1.5 নম্বর। উদাহরণ দিলে, তবে পুরো নম্বর পাবে।

২। শুধু কাকে বলে লিখলে 1 নম্বর। উদাহরণ দিলে তবে পুরো নম্বর পাবে।

৩। সংজ্ঞা দিলে 1 নম্বর। সক্রিয় বিনা উল্লেখ করলে 1.5, সক্রিয়তার উদাহরণও যদি দেয়, তাহলে পুরো নম্বর পাবে।

৬। সব প্রশ্নের ক্ষেত্রে শুধু কি ঘটে লিখলে .5 পাবে। এর সঙ্গে সমীকরণ দিলে তবে পুরো নম্বর পাবে। তবে (৫)নং প্রশ্নে — (১)-এর জন্য লিখলে (কি ঘটে) .5, এর সঙ্গে সমীকরণ দিলে মোট 1 পাবে। (২) এক্ষেত্রেও একইরকম হবে।

৭। ১। শুধু কারণ ব্যাখ্যা করলে 1.5 নম্বর পাবে। এর সঙ্গে উদাহরণ দিলে পুরো নম্বর।

২। শুধু ভাষায় লিখে ব্যাখ্যা করলে, সালোকসংশ্লেষ প্রক্রিয়ার উল্লেখ করলে, 1.5 নম্বর। সমীকরণ দিলে তবে পুরো নম্বর।

৮। শুধু ছবি আঁকলে, কোন নম্বর নেই।

সঠিক চিহ্নিতকরণ করলে ও চিত্র সঠিক হলে ঃ

(ক) টেস্টটিউবে বিকারকের নাম।
(খ) বিভিন্ন অংশের বা যন্ত্রাংশের নাম।
(গ) উৎপন্ন গ্যাসের নাম।

তবে 2.5 নম্বর।

আর এর সঙ্গে যদি চিত্রে কি দেখানো হচ্ছে অর্থাৎ সমগ্র চিত্রটির নামকরণ লেখা হয়, তবে পুরো 3 নম্বর পাবে।

খ — বিভাগ

৩। (ক) যদি একটি উপায় দেয়, তবে 1 নম্বর, ২টি দিলে 2 পাবে।

(খ) দুটি ধাপের মধ্যে শুধু চৌম্বক আবেশের উল্লেখ করলে .5 নম্বর।
যদি আবেশ এর সঙ্গে বিপরীত মেরুর মধ্যে আকর্ষণ উল্লেখ করে 1.5 পাবে। উপযুক্ত সিদ্ধান্ত টানলে পুরো 2 নম্বর।

৪। (ক) যে কোন একটি পার্থক্য দিলে 1, ২টো দিলে 1, তিনটে দিলে 1.5, চারটে দিলে পুরো 2 নম্বর।

(খ) যে কোন দুটো দিলে 1, চারটে দিলে 2 নম্বর।

৭। যে কোন একটি দিলে 1.5 নম্বর। ২টি দিলে 2.5 তিনটি দিলে পুরো নম্বর।

৮। ৪। যে কোন একটি চিত্র দিলে এবং চুম্বকের মেরু যদি চিহ্নিত না থাকে। কোন নম্বর নেই। বিন্যাসএ অনু-চুম্বকগুলির মেরুনির্দেশ ও চুম্বকটির উপযুক্ত মেরুনির্দেশ থাকে, তাহলে 1.5। পুরো নম্বরই পাবে।

APPENDIX – H

OBJECTIVES OF ENTRY LEVEL TEST-SCORES & FINAL TEST SCORES

Table 1 — Shows the correspondence between an entry level objective and the test items.

Entry level objectives	No. of test-items	Type of questions
1	1	M. C. Type
	1	T. F. Type
2	1	S. A. Type
	1	S. A. Type
3	1	M. C. Type
	1	,,
	1	,,
4	1	Matching Type
	1	S. A. Type
	1	T. F. Type
5	1	,,
6	1	M. C. Type
7	1	,,
	1	Matching Type
8	1	M. C. Type
9	1	,,
	1	T. F. Type
10	1	S. A. Type
11	1	,,
12	1	T. F. Type
	1	Comparison Type
13	1	M. C. Type
14	1	,,
15	1	,,
	1	T. F. Type
16	1	Matching Type
	1	Comparison Type
	1	Matching Type

17	1	S. A. Type
	1	Matching Type
18	1	T. F. Type
	1	S. A. Type
19	1	Comparison Type
20	1	T. F. Type
	1	Matching Type
21	1	S. A. Type
	1	T. F. Type
	1	,,
	1	M. C. Type
22	1	T. F. Type
23	1	S. A. Type
	1	,,
	1	T. F. Type
	1	M. C. Type
24	1	T. F. Type
	1	M. C. Type
	1	Matching Type
25	1	S. A. Type
	1	T. F. Type
	1	S. A. Type
	1	T. F. Type
26	1	M. C. Type
27	1	M. C. Type
	1	Matching Type
	1	Comparison Type
28.	1	T. F. Type
	1	Matching Type

M. C. Type = Multiple choice Type

T. F. Type = True False Type

S. A. Type = Short Answer Type

Table II — **Shows the correspondence between a terminal objective & the test items.**

Terminal objectives	No. of test-items	Type of questions
1	1	M. C.
2	1	M. C
3	1	T. F.
	1	S. A.
4	1	M. C
5	1	M. C
6	1	T. F.
	1	S. A.
7	1	M. C
8	1	M. C
9	1	S. A.
10	1	S. A.
11	1	S. A.
12	1	M. C
13	1	S. A.
	1	S. A.
14.	1	M. C
	1	S. A.
15	1	Comparison
16	1	T. F.
	1	Completion Type
17	1	S. A.
	1	T. F.
	1	Completion Type
18	1	M. C
19	1	M. C

20	1	Comparison
	1	T. F.
	1	M. C.
21	1	S. A.
22	1	T. F.
	1	T. F.
	1	T. F.
	1	S. A.
23	1	S. A. Type
	1	Comparison
	1	Comparison
	1	T. F.
24	1	M. C.
	1	Analogy
25	1	M. C.
	1	S. A. Type
26	1	S. A. Type
	1	M. C.
27	1	S. A. Type
28	1	Recall Type
	1	Recall Type
	1	Analogy
	1	Comparison
29	1	Comparison
30	1	Matching
	1	M. C.
31	1	Analogy
	1	Matching
	1	M. C.

32	1	Matching
	1	T. F.
33	1	Matching
34	1	T. F.
	1	M. C.
	1	T. F.
	1	Matching
35	1	T. F.
	1	M. C.
36	1	Recall Type
37	1	Recall Type
38	1	S. A. Type
39	1	T. F.
40	1	S. A. Type
	1	Matching
41	1	S. A. Type

S. A. Type = Short Answer Type

M. C. Type = Multiple Choice Type

T. F. Type = True-False Type.

APPENDIX – I

ENTRY LEVEL TEST SCORES & FINAL TEST SCORES IN DERIVED FORM (T-SCORE)

Entry Level Test Scores			Final Test Scores		
Code No.	Raw Score	T Score	Code No.	Raw Score	T Score
1	69	64	1	73	68
2	68	63	2	68	65
3	49	49	3	43	48
4	54	53	4	58	58
5	64	60	5	74	69
6	53	52	6	63	62
7	73	67	7	67	64
8	67	63	8	73	68
9	59	57	9	75	70
10	60	58	10	56	57
11	70	65	11	68	65
12	69	64	12	69	66
13	54	53	13	48	52
14	74	68	14	70	66
15	58	56	15	70	66
16	65	61	16	65	63
17	56	55	17	69	66
18	63	60	18	64	62
19	53	52	19	46	50
20	61	58	20	53	55
21	66	62	21	62	61
22	64	60	22	76	70
23	59	57	23	52	54
24	64	60	24	51	54
25	72	66	25	57	58
26	46	47	26	38	45
27	55	54	27	43	48
28	64	60	28	60	60
29	47	52	29	39	46

Code No.	Raw Score	T Score	Code No.	Raw Score	T Score
30	53	52	30	48	52
31	67	63	31	54	56
32	57	55	32	47	51
33	64	60	33	56	57
34	68	63	34	52	54
35	38	41	35	66	64
36	72	66	36	70	66
37	70	65	37	58	58
38	36	40	38	28	38
39	63	60	39	70	66
40	57	55	40	58	58
41	62	59	41	34	42
42	63	60	42	47	51
43	57	55	43	51	54
44	63	60	44	60	60
45	62	59	45	59	59
46	70	65	46	72	68
47	62	59	47	72	68
48	71	66	48	58	58
49	67	63	49	60	60
50	60	58	50	61	60
51	49	49	51	21	34
52	59	57	52	28	38
53	45	47	53	33	42
54	46	47	54	40	46
55	58	56	55	22	34
56	47	52	56	39	46
57	35	39	57	28	38
58	54	53	58	32	41
59	48	49	59	56	57

Code No.	Raw Score	T Score	Code No.	Raw Score	T Score
60	30	36	60	54	56
61	39	42	61	36	44
62	42	44	62	54	56
63	48	49	63	35	43
64	46	47	64	40	46
65	55	54	65	43	48
66	58	56	66	41	47
67	38	41	67	41	47
68	55	54	68	41	47
69	33	38	69	23	35
70	48	49	70	19	32
71	53	52	71	25	36
72	39	42	72	33	42
73	40	43	73	40	46
74	31	36	74	27	38
75	38	41	75	32	41
76	30	36	76	34	36
77	48	49	77	34	42
78	36	40	78	37	44
79	37	41	79	30	40
80	40	43	80	35	43
81	52	52	81	28	38
82	36	40	82	36	44
83	27	33	83	21	34
84	39	42	84	29	39
85	33	38	85	32	41
86	52	52	86	42	47
87	40	43	87	31	40
88	40	43	88	33	42
89	39	42	89	17	31

Code No.	Raw Score	T Score	Code No.	Raw Score	T Score
90	35	39	90	24	36
91	32	37	91	38	45
92	40	43	92	48	52
93	39	42	93	44	49
94	32	37	94	39	46
95	28	34	95	29	39
96	27	33	96	22	34
97	25	32	97	33	42
98	22	30	98	27	38
99	56	55	99	49	52
100	29	35	100	31	40
101	26	33	101	29	39
102	31	36	102	39	46
103	49	49	103	58	58
104	34	38	104	40	46
105	53	52	105	49	52
106	54	53	106	45	50
107	28	34	107	37	44
108	46	47	108	35	43
109	35	39	109	34	42
110	55	54	110	50	53
111	48	49	111	43	48
112	40	43	112	38	45
113	47	52	113	51	54
114	50	50	114	36	44
115	53	52	115	50	53
116	46	47	116	42	47
117	37	41	117	37	44
118	31	36	118	37	44
119	38	41	119	35	43
120	28	34	120	34	42

The School (One) : H.R.V.M.

Control Group

Code No. For Boys			Code No. For Girls		
31	32	33	44	45	46
34	35	36	47	48	49
37	38	39	50	51	52
40	41	42	53	54	55
43	58	60	56	57	59

Experimental Group

Code No. For Boys			Code No. For Girls		
7	8	12	1	2	3
14	15	16	4	5	6
17	18	20	9	10	11
21	23	24	13	19	22
25	27	28	26	29	30

The School (Two) : H.M.H.S.

Control Group

Code No. For Boys			Code No. For Girls		
61	62	65	63	64	69
66	67	68	73	74	75
70	71	72	76	78	79
77	81	82	80	83	84
85	86	89	87	88	90

Experimental Group

Code No. For Boys			Code No. For Girls		
93	94	99	91	92	95
103	104	105	96	97	98
106	108	109	100	101	102
110	113	117	107	111	112
118	119	120	114	115	116

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