" EFFECTIVENESS OF MATHETICS ON ACHIEVEMENT IN CHEMISTRY AT HIGHER SECONDARY LEVEL"

DISSERTATION

Submitted in partial fulfillment of the requirements for the award of the degree in

Master of Education

Submitted By

JIJISH ELIAS
Reg.No. 08311006

DEPARTMENT OF EDUCATION
GANDHIGRAM RURAL UNIVERSITY
GANDHIGRAM, DINDIGUL- 624 302

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GANDHIGRAM

Mrs. R.Jeyanthi, M.Sc., M.Ed., M.Phil (Edn),M.Phil(Che),
Lecturer in Education,
Department Of Education,
Gandhigram Rural University,
Gandhigram, Dindigul- 624 302

CERTIFICATE

This is to certify that the dissertation entitled **" EFFECTIVENESS OF MATHETICS ON ACHIEVEMENT IN CHEMISTRY AT HIGHER SECONDARY LEVEL**" submitted to Gandhigram Rural University in partial fulfillment of the requirements for the award of the degree of **MASTER OF EDUCATION** is a record of original project work done by **JIJISH ELIAS (Reg. No. 08311006)** during the period of his study in the department of Education, Gandhigram Rural University, Gandhigram, Dindigul under my supervision and guidance and the dissertation has not formed the basis for any other Degree/ Diploma/ Association/ Fellowship of similar title to any candidate of any other university.

(Mrs. R. JEYANTHI, M.Sc., M.Ed., M.Phil)

Place: Dindigul

Date:

Counter Signed

Dr. S.Armugam, M.Sc, M.Ed, Ph.D,

Coordinator, Department Of Education.

External Examiner Internal Examiner

JIJISH ELIAS
(Reg.No. 08311006)
M.Ed Scholar,
Department Of Education
Gandhigram Rural University.

DECLARATION

I hereby declare that, the dissertation entitled **" EFFECTIVENESS OF MATHETICS ON ACHIEVEMENT IN CHEMISTRY AT HIGHER SECONDARY LEVEL**" submitted to Gandhigram Rural University in partial fulfillment of the requirements for the award of the degree of **MASTER OF EDUCATION** is a record of original project work done by me under the supervision and guidance **of MRS. R.JEYANTHI, M.Sc., M.Ed., M.Phil,** Lecturer in Education, Department Of Education,Gandhigram Rural University, Gandhigram, Dindigul- 624 302 during the period of my study in the department of Education, Gandhigram Rural University, Gandhigram, Dindigul and the dissertation has not formed the basis for any other Degree/Diploma/Association/Fellowship of similar title to any candidate of any other university.

JIJISH ELIAS
(Reg.No. 08311006)

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"The LORD is my Shepherd, I shall not want" Ps 23:01

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CHAPTER I

1.0 CONCEPTUAL FRAMEWORK

1.1 INTRODUCTION

Education is the learning of knowledge, information and skills during the course of life .It is the action or process of being educated and is an integral part of human development leading to human progress. An educated organism develops into a knowledgeable, productive, value oriented individual capable of contributing his skills and knowledge for his own happiness and well being of society.

Education is a broad concept, referring to all the experiences in which students can learn something through the three parts:

- Instruction refers to the intentional facilitating of learning toward identified goals, delivered either by an instructor or other forms.
- Teaching refers to the actions of a real live instructor designed to impart learning to the student.
- Training refers to learning with a view toward preparing learners with specific knowledge, skills, or abilities that can be applied immediately upon completion

The modern concept of education is that the teacher should aim at the complete development of the child. For this the modern teacher is motivated by a desire to make his teaching more facile and interacting. To attain this aim, in addition to being a successful teacher, he should also be able to understand the psychology of his students.

For the complete development of the child, the main focus of teaching should be to bring out desirable changes in the behaviour of the learner. These changes can brought out only by using appropriate teaching strategies. According to Secondary Education Commission (1965), “Even the best curriculum and the perfect syllabus remain dead unless quickened into life by the right methods of teaching and the right kinds of teachers”.

1.2 CHEMISTRY EDUCATION

Chemistry (from Egyptian *kēme* (chem), meaning "earth") is the science concerned with the composition, structure, and properties of matter, as well as the changes it undergoes during chemical reactions. Chemistry is often called "the central science" because it connects the other natural sciences, such as astronomy, physics, material science, biology, and geology.

Chemistry is an integral part of the science curriculum both at the high school as well as the early college level. At these levels, it is often called 'General Chemistry' which is an introduction to a wide variety of fundamental concepts that enable the student to acquire tools and skills useful at the advanced levels, whereby chemistry is invariably studied in any of its various sub-disciplines.

Chemistry education (or chemical education) is a comprehensive term that refers to topics related to the study or description of the teaching and learning of chemistry in schools, colleges and universities. Topics in chemistry education might include understanding how students learn chemistry, how best to teach chemistry, and how to improve learning outcomes by changing teaching methods and appropriate training of chemistry instructors, within many modes, including classroom lecture, demonstrations, and laboratory activities. There is a constant need to update the skills of teachers engaged in teaching chemistry, and so chemistry education speaks to this need.

Although of comparatively recent growth, Chemistry has gained a secure position in the curricula of schools, technical colleges and universities , both as an essential part of general education for life and as a separate branch of science. The importance of the subject is now recognized by all educationalists. A study of the development of the subject itself and of its introduction into educational institutions reveals a steady advance to its present status.

1.3 EDUCATIONAL TECHNOLOGY:

Educational technology (also called learning technology) is the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources. The term educational technology is often associated with, and encompasses, instructional theory and learning theory. While instructional technology covers the processes and systems of learning and instruction, educational technology includes other systems used in the process of developing human capability.

Educational technology is most simply and comfortably defined as an array of tools that might prove helpful in advancing student learning. Educational Technology relies on a broad definition of the word "technology". Technology can refer to material objects of use to humanity, such as machines or hardware, but it can also encompass broader themes, including systems, methods of organization, and techniques. Some modern tools include but are not limited to overhead projectors, laptop computers, and calculators.

Those who employ educational technologies to explore ideas and communicate meaning are learners or teachers.

1.4 INDIVIDUALISED INSTRUCTION

In a developing country like India, the growing interest for a switch over from traditional method of teaching to modern methods originate from Educational Technology. Thus educational Technology became one of the crucial development taking place in the shadow of educational innovations.

Research workers are confronted by several methodological problems in conducting research in the area of teaching methods. The most comprehensive research up-to-date has been limited to examination of the teacher’s performance in the class room, ignoring the other important factor. But individualized instruction is to make each child self-initiated and self-directed (Sharma,1995). This is made possible by exploring the solution of a problem with the joint effort of teacher and student.

Individualization means the philosophy of education or method of teaching that stress the adaptation of education to individual difference (Good,1945).

According to Watson (11970), in individualized instruction 'how to learn' is the primary ingredient in education. He further points out that , individualized instructional learning only results from the students' own effort.

A variety of methods are used to prepare individualized instructional materials. They are

1. In the form of printed material

2. Films

3. Machines

4. Laboratory set up etc

Some of the techniques used for individualized instruction are,

A) The Keller Plan
B) Learning Modules
C) Audio-tutorial systems
D) Contract learning
E) Learning kit
F) Programmed learning
G) Computer Assisted Instruction.

Among these techniques, Programmed Instruction is increasingly used. In facing the challenges of several teaching strategies introduced in recent years and in coping with the variety of learners. Programmed Instruction can ensure better learning than conventional methods. Sometimes it also cave a third to two-third of the normal time spent.

1.4.1 Programmed Learning Method

1.4.1.1 WHAT IS PROGRAMMING

Whatever the presentation mode of lessons in a classroom, whether with or without a teacher, with or without electronic teaching aids, with or without something to write with, some techniques can be called “programmed", some not, A lesson plan can outline objectives, the means of communicating ideas and stimulating. The thought, and the criteria for validly testing achievement of the educational goals envisaged. The lesson is not for that reason called a "programme". A planned lesson of this sort takes on the character of a programme when it caters for active participation on the part of the student, gives knowledge of whether the student is right or wrong in the various steps of the lesson, and provides evidence that the student-has performed according to the level of achievement sought by the programmer.

Programming as a concept implies a technology of education: an attempt to systematize the learning process according to educational theories espoused by the teachers. There is an analogy possible with preparing a compiler for a computer: the goals of the activity are listed, the orders are formulated for the computer to "learn" and "obey", error routines are devised to ensure that all the information is correctly stored and satisfactorily applied to the 'materials fed into the machine on subsequent occasions. Programmed instruction attempts to furnish students with an analogous "compiler" to cope with future lessons and future situations

1.4.1.2. WHERE DID THE IDEA OF PROGRAMMING ORIGINATE?

Skinner was instrumental in generating widespread enthusiasm for programmed instruction. He saw the findings of scientific research receiving practical application everywhere except, in the field of teaching. He was not the first to try and introduce technological advances into the educational field for Pressey had described a machine which tested and taught in 1926. Pressey advocated adjunctive programmes consisting of materials and tests for student self-instruction. Skinner observed that Pressey's pioneering had been largely overlooked by teachers and championed the use

of auto-instructional devices employing "linear" programmes. This type of programming was intended to force bright and duller students alike to proceed by small steps, actively and overtly responding to stimuli presented. The behaviour emitted was considered to be reinforced when the student ascertained from the programme whether his answer was right or wrong. Overall mastery of the lesson material was claimed to result from working through to the last item or frame of the programme. Crowder widened the concept by rejecting the need for small steps, for the constant use of overt constructed responses, and for merely giving the student the right answer after each frame instead of attempting to deal with variant responses.

1.4.1.3 Linear Programme

B.F.Skinner wanted students to work at their own pace on the grounds that they would be motivated to learn once they felt they were acquiring new knowledge and making progress. The experience of making a correct response to a given stimulus would not only reinforce the student's knowledge but inspire enthusiasm to continue working through the lesson material. Lessons were cut up into small frames of information containing a blank, the student had to fill in. Frames were to develop logically one from. the other until the essential instruction was complete and an objective test could measure how much "knowledge" the student had acquired Filling in the blanks was called making constructed responses.

B.F. skinner is the originator of linear programming. It is also called a single tract programme. According to Skinner, a creature, a bird or a human being can be led to a desired behaviour by means of a carefully constructed programme consisting of small steps leading logically through the subject matter from topic to topic, provided each step is reinforced by some kind of favourable experience or reward. The increments in information which the learner is expected to absorb are small. The favourable experience or response increases the probability of the same response to occur again in the future. The process of rewarding the correct response to a stimulus increases the general tendency to give a response.

The sequence of frames and path of learning in programmed learning is systematic and linear. That is why, this type of programming is referred to as linear

programming. Hence all the learners have to proceed through the same frames and in same order.

In a linear programme, learners responses are controlled externally by the programmer sitting at a distant place. Hence linear programming is also termed as extrinsic programming. A diagrammatic representation of frames in the linear programming is given in figure 1.1

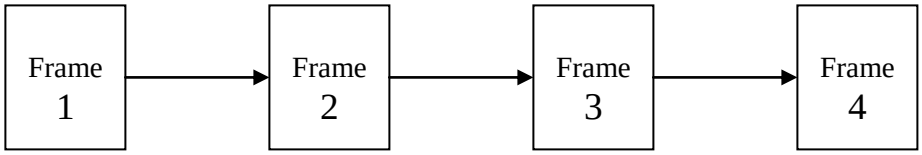


Figure 1.1 Linear Branched Programming

1.4.1.4 Branched Programme

Norman .A. Crowder was unwilling to adopt the technique of Skinner. He tested how well students understood what they read and catered for different possible answers to test questions. His approach made for lengthier frames than Skinner's, for responses of the multiple-choice type and for making further reading dependent on the choice made. Crowder expected the student to make a decision whenever an important point was reached and "scrambled" the pages of his programme to encourage students to turn to the page appropriate to the answer they chose. His "intrinsic" programmes became known for their "branching" sequences of instructional materials.

Pressey reacted less forcefully to Skinnerian programming than did Crowder. He did not give remedial instruction to those who chose wrong answers on his multiple-choice tests. Rather he asked students to keep trying at the same item, until they eventually found the right answer This response was supposed to be impressed on their minds because it alone held the key to progressing to the next item of the programme and be released from. having to revise the same item on a subsequent occasion.

There are two different kinds of branched programmes, viz, forward branching and backward branching.

Figure 1.2 gives a simple diagrammatic representation of the arrangements of frames in a backward branching technique.

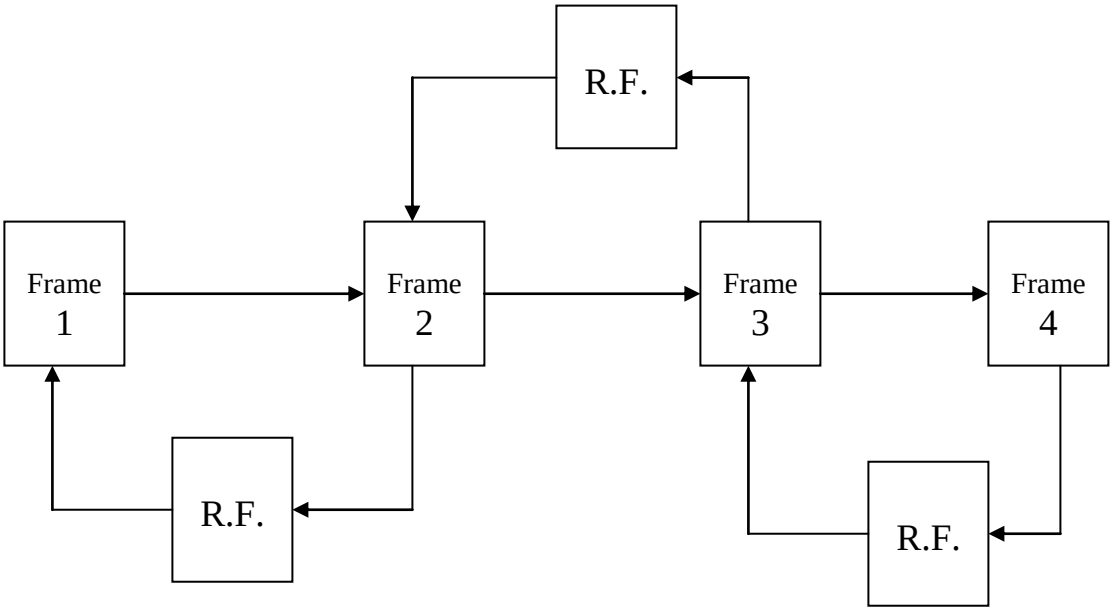


Figure 1.2 Backward Branched Programme

R.F. – Remedial Frame

In backward branching, the learner will directed to a remedial frame if he is not able to give correct response in a main frame.from the remedial frame, he has to go to the previous frame and continue his learning.

A simple representation of forward branching programmed frames given in figure 1.3.

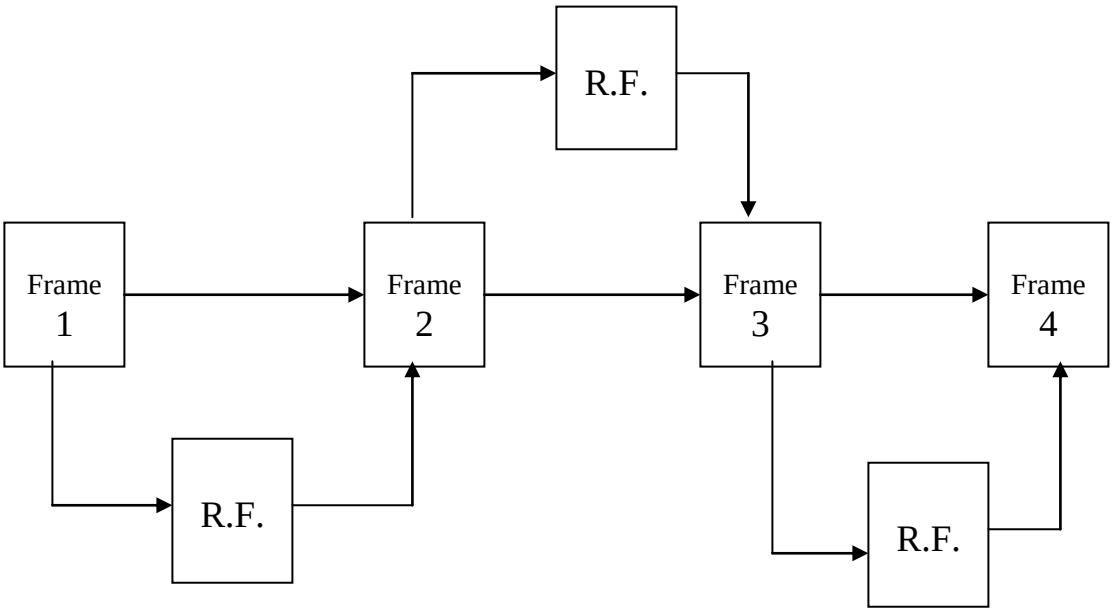


Figure 1.3 forward Branched Programme

R.F. – Remedial Frame

In forward branching, the learner will directed to a remedial frame if he is not able to give correct response in a main frame. From the remedial frame, he has to go to the next frame and continue his learning. He will go to any of the previous frames at any stages of learning but sufficient data will be given in the remedial frames it self.

1.4.1.5 Mathetics

Gilbert accepted Skinner's Behaviorism. and considered linear programming techniques inconsistent with this psychological background, His contribution was to develop a system of 'Mathetics" He planned exercises which worked back from, the objective envisaged to the problem in hand, basing his system on Skinner's principle of "chaining" Reinforcement was derived not from finding out that one's response was correct but from a self-assurance that one could not be wrong because one was "working back" from the answers.

In mathetics style, an exercise is the technical unit of learning instead of a frame of a linear style. There is no restriction on the size of the exercise. In fact that size of the exercise is kept according to the needs and requirement of the learners.

According to Harless, the goal of Mathetics is ‘to evolve a genuine technology of education by welding together the concepts of behavioral science to the effective practices and procedures that have always been utilized by good teachers.”

As a technique of teaching, mathetics may be applied to any subject, but is more suitable for teaching skills. It is a complete training system that gives the programme,

a) A guide , for determining what to teach

b) A basis for making teaching strategy decisions

c) A detailed procedure for constructing a programme.

Retrogressive chaining makes it unique among all the programming techniques. The child learns the last step first , then goes to the next one before it and thus to the introductory part. This procedure where the tasks are connected from the last to the first is called as chaining.

Mathetics is electric in nature, but is unique in application. It analyses the deficiencies and tries to make it up. It is most suited to teaching of skills. The closer the student is to reinforcement when he is being taught, the more effective that reinforcement becomes. The reinforcement here is the completion of task –each time the student performs he completes the task.

Figure 1.4 explains the mathetical programming exercises in their sequential order as a diagram.

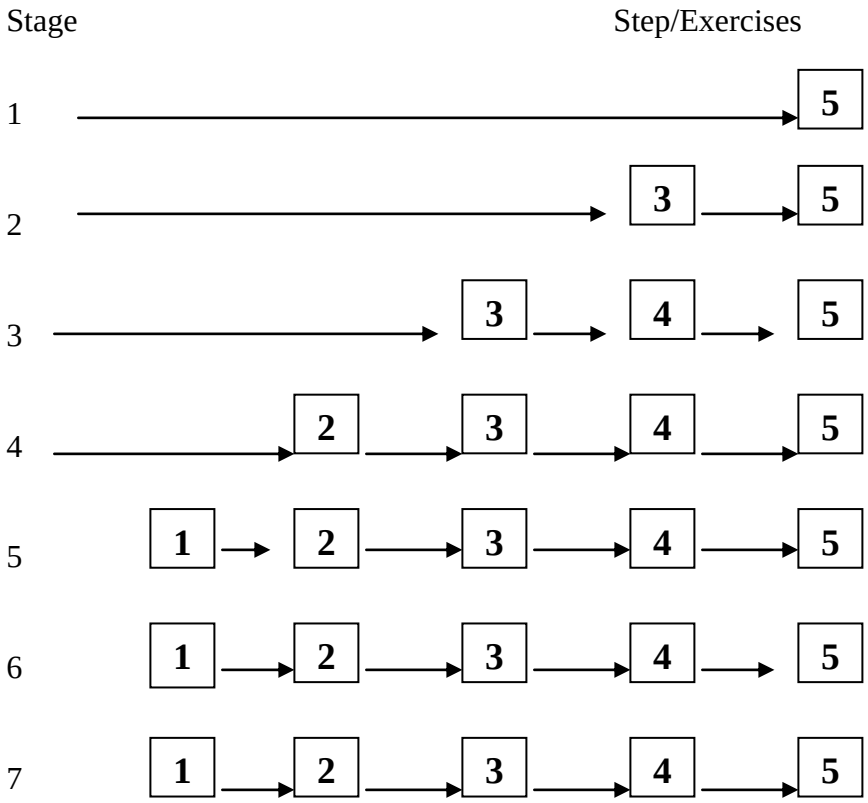


Figure 1.4 - Mathetical Programming Sequence

1.5 NEED AND SIGNIFICANCE OF THE STUDY

There are individual difference among children in terms of level of intelligence, level of understanding, attitudes, achievements etc. Therefore same type of instructional methods in class room may not suit to the class room situations. To cater to the needs of individual differences and the abilities we have to adopt innovative instructional procedure.

The National Policy on Education has emphasized the need for qualitative improvement of School Education, particularly in the areas of Science Education need to help the under Achievers.

Chemistry The Discipline of science, at higher secondary stage poses the greatest challenge to the teacher and the learner in achieving ‘zero failure’ target. The students who are weak in chemistry do not allow the schools to achieve the goal. Therefore it is imperative to plan strategies for improving the conceptual competencies

in Chemistry among the learners. To achieve this goal the teacher can adopt an innovate .

As far as chemistry teaching is concerned learning is interlocked with reading and writing. The reactions what he/she reads must write then only learning will be completed. This is the secret of success in learning chemistry.

The New Education Policy-1986 envisages a drift from the traditional lecture method to an approach that has a focus on learner. It has now been realized that teaching is not telling, memorizing is not learning, and reproducing something in the examination is not an evidence of understanding. The teaching should stress on developing habit of study throughout the life of a person. What is needed is to inculcate the spirit of inquiry in the students. The word teaching is broad, vague & ill-defined term. The word instruction is a purposeful, orderly controlled sequencing of experiences to reach a specified goal. All instruction involves teaching but all teaching cannot become instruction. Programmed Instruction is a sub-head under instruction and represents a more rigorous attempt to develop a mastery over specified goals to secure "insured learning".

New methods and techniques in education are having an increasing effect on the traditional approach of teaching and learning. Among the new approaches and innovations, one which have gained great acceptance in recent years is Programmed Instruction. It is a distinct strategy of instruction based upon the principles of efficient learning evolved by psychologists like B.F. skinner under controlled laboratory conditions. These principles emphasize the need to specify the terminal behaviour to be developed on the learner. Then it designs the instructional process so as to maximize the rate of acquisition and maintenance of terminal behaviuors. This is achieved by the application of the principles of active responding, reinforcement, gradual and successive progression and empirical validation . in such a situation , Programmed Learning is an innovative step towards automation and individualization of instruction.

A learner can learn only if he actively responds in a learning situation. In Programmed Instruction, active responding is arranged with a limited amount of

learning material with which he is ready to interact. After presenting a list of learning materials , he is required to respond to questions based on that information. In this way , he is made to pay full attention to the learning material.

There are mainly three styles of Programmed Instruction. They are Linear Programming, Branched Programming and Mathetics. Of these Linear and Branching are commonly using styles of Programmed Instruction. Various studies had conducted under this category. But Mathetics is a lesser-known programming technique based on Skinnerian Reinforcement theory which gives importance to "Mastery over the content". In our class rooms, the behaviour of a learner is not immediately reinforced. In case of Mathetics learning package, the learning material presented in each step is designed in such a manner that the learner more often, gives a correct response. In this way, maximum reinforcement are provided to the learner. Hence in terms of class room teaching, mathetics is essentially ' an attempt to provide instruction that is more individualized more tailored to each learner's unique learning abilities and needs and largely self instructional'.

Most of the students in higher secondary level are average. So for these students the Conventional Method of teaching Chemistry is not that much effective. So in order to raise the achievement of these students, new techniques should be applied.

The investigator felt that it is better to teach Chemistry by giving more importance to the pupils. A careful review of the research studies on the Methodology of Teaching indicates that a few studies have made to try out Mathetics at Higher Secondary level. And in the field of chemistry teaching, its seems that few studies were undergone. Hence a study is envisaged to find out the effectiveness of Mathetics on achievement in Chemistry at XI th level. Here comes the importance of the present study.

1.6 STATEMENT OF THE PROBLEM

The problem of the study is to, what extent

“ EFFECTIVENESS OF MATHETICS ON ACHIEVEMENT IN CHEMISTRY AT HIGHER SECONDARY LEVEL”

1.6.1 OPERATIONAL DEFINITIONS OF KEY TERMS

The terms used in the present study are defined for the sake of clarity.

1. Effectiveness

   “Use of a plan for instruction or presentation which causes desired change in learners behaviour” (Good-1945)

2. Mathetics

   Mathetics is a programming technique which lay stress on modification of behaviour through reinforcement. ”Mathetics is the systematic application of reinforcement theory to the analysis and construction of complex behavior repertories usually known as subject matter mastery, knowledge and skill. Mathetics if applied diligently, produces materials that exceed the efficiency of lesson produced by any known method” (Gilbert,1962) .

3. Achievement

   “Achievement is the knowledge attained or skills developed in school subjects, usually designated by test scores or by marks assigned by teachers or by both”.(Good,1945)

   For the present study, achievement is considered as a total score obtained by an individual as measured in the test constructed by the investigator in Chemistry of the selected topic “IUPAC Naming of Alkanes’ , covering the cognitive domain of the behaviours namely knowledge, understanding and application.

4. Chemistry

That branch of science which treats of the composition of substances, and of the changes which they undergo in consequence of alterations in the constitution of the molecules, which depend upon variations of the number, kind, or mode of arrangement, of the constituent atoms. These atoms are not assumed to be indivisible, but merely the finest grade of subdivision hitherto attained. Chemistry deals with the changes in the composition and constitution of molecules

5. Higher Secondary School

A school that is intermediate in level between elementary or secondary school and college and that usually offers general, technical, vocational, or college-preparatory curricula. In the current study, XI and XII standards of Kerala State are considered.

1.7 Tools:

1. Mathetical Programmed Material

The mathetic programme was prepared on the topic IUPAC naming of Alkanes for the students of XI^{th} standard. The programme consists of fifteen pages among thirteen were the frames. The programme was introduced to the subjects through a software, which leads to the mastery of learning.

2. Lesson plan

The investigator used two lesson plans in the constructivist method to teach the control group in the conventional method on the topic IUPAC naming of the alkanes. In the first lesson plan, naming of branchless akanes and in the second lesson, naming of branched alkanes were dealt.

3. Achievement test

The investigator constructed an achievement test on the topic IUPAC naming of alkanes in which, the knowledge, understanding and application

capacity of the learners were checked through objective type questions. This was implemented over both the control group and experimental group after the instruction.

4. IQ Test

The IQ test used in the current study was developed by Hawkins, (Journal of Education and Psychology, Sardar Patel University, April 1970)

The test used to check the intelligence level of the student. From the score. The students were equally distributed to control group and experimental group to keep the homogeneous nature of the two groups. The experimental group was taught using the Mathetical Learning Package and the control group was taught through conventional method of teaching. The effectiveness of Mathetics on Chemistry achievement was found by administrating the same achievement test as post-test to both the groups. The data thus collected were tabulated and analysed statistically.

1.8 Design and Sample

The study is based on an experiment which involved the application of the two teaching methods. Experimental method was selected for the present study. The design adopted was parallel group Pre-test-Post –test (Best,1995). The study was conducted on a sample of 30 students (two divisions of 15 students each) of XI^{th} standard of Kalladi Higher Secondary School, Kumaramputhur in Palakkad district of Kerala state.. I.Q. test was conducted in each division for equating the groups. To check the equality of the students in the field of IUPAC naming, the Chemistry Knowledge Inventory was conducted and according to the score in the Chemistry Knowledge Inventory and IQ test, the students are classified in to two groups . Then one group was selected as the experiment group and the other group as the control group. Both the groups undergone a pre-test in IUPAC nomenclature. Then the experimental group is learned IUPAC naming with the help of Mathetic programme and the control group lead in a conventional teaching method.

1.9 Limitations of the study

1. The study is limited to just one school.
2. The population chosen is restricted to pupil of standard XI .
3. It concerns itself with just one topic in Chemistry, viz naming of alkanes.
4. The magnitude of one achievement test on naming of alkanes was taken to be the sole criterion for the effectiveness of the teaching methods.
5. The Mathetic programme and achievement test were validated and checked in only one school.
6. The sizes of the material and implementation period were is very small.

Assumptions

1. Since both the methods were used by the same teacher who had no personal liking for either method, the teacher factor was assumed to have been controlled.
2. Students of both the groups belonged to the same age and the same sex and were taught in a similar school climate. Therefore the factors other than the teaching factor were assumed to have been held constant.
3. Prior to the experiment, the two groups had their instruction in the conventional way of teaching. Thus , the difference in the experimental group if any, could only be attributed to mathetic method of instruction.

1.9.1 SCOPE OF THE STUDY

The present study has made an attempt to test the effectiveness of Mathetics in Chemistry at Higher Secondary School Level. It is hoped that the study would contribute some highlights towards new approaches of teaching. It is expected that the findings of the study will help the curriculum planners to make needed changes in the content of Chemistry text book by considering new method. It will also help the teacher to understand the necessity of applying Mathetics in the teaching of

Chemistry. In short it is hoped that the result of the study would be of immense help to all those who are concerned with the field of education.

1.9.2 ORGANIZATION OF THE REPORT

The study has been reported in five chapters.

Chapter I presents a brief introduction of the problem, definition of the key terms, need and significance of the current study, brief discussion about the methodology adopted for the study and scope and limitations of the study.

A theoretical overview on Mathetics also included in this chapter along with the discussion about similar kind of teaching methods.

A survey of related studies pertaining to the study is presented in the second chapter. The topics were divided in to four main headings and discussed.

Chapter III describes the methodology adopted for the study in detail. The objectives, the hypotheses formulated in terms of objectives, the variables included , design of the study, selection of sample, tools employed for collection of data in the study and the statistical techniques needed for the study were included in this chapter.

The results of analysis made in accordance with the objectives stated and the hypotheses formulated are explained in the chapter IV. The chapter V gives a summary of procedure adopted and also attempts at the examining the tenability of the hypotheses followed by conclusions arrived at are presented in this chapter. Suggestions made for implementation and recommendations for further research are also given in the last chapter.

CHAPTER II

2.0 REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION

Review of related literature in any field of investigation has become an inevitable part of research work. Best (1977) is of strong opinion that "familiarity with the literature in any problem area helps the student to discover what is already known, what others have attempted to found out , what method of approach have been promising or disappointing and what problems remain to be solved". The investigator has made an earnest effort to find out and study the researches related to topic under investigation concluded by the various researchers and scholars.

The purpose of the study is to find out the effectiveness of mathetics – a style of programmed learning . the details of the studies which are related to the present study is given below under the following heads.

1. Studies on individualized instruction
2. studies on effectiveness of programmed learning material
3. studies on different styles of programming
4. studies on the psychological learning problems with the help of programmed learning materials.

2.2 STUDIES ON INDIVIDUALISED INSTRUCTION.

A procedure used by Corney, Valente and Shamewa (1976) found that the individualized group performed significantly better on the final exam than the traditional groups when testing a sample each of this groups ten months later found

that the sample from the individualized section was still significantly better in performance than the traditional sample.

Das (1984) conducted a study to develop self-instructional materials in Health Education and to find out the effectiveness of self learning materials as compared to the conventional method of teaching. It was found to be superior to all other methods of learning and when administered under the supervision of a teacher was found to be more effective.

Donald and Marvin(1973) investigated the effectiveness of a series of self instructional modules(SIMS) for training secondary level social studies teacher trainees to develop and ask higher level questions. The study showed that SIMS is superior to Conventional Methods for developing concepts and skills.

An instructional module was prepared , validated and found its effectiveness by Jayalakshmi(1985). The module was prepared for B.Ed students in Educational Psychology at the B.Ed level was quite effective.

Briggs (1961) compared self-pacing with automated pacing. -One group worked at its own pace ; the other group was automatically paced at the rate of about 13 seconds per item. No significant differences were found in the post-test performance of the two groups. Krumboltz (1963) studied thee effectiveness of key-word response vs. trivial-word response in Programmed Instruction vs. reading of the same material in paragraph form. On immediate and delayed post-test, the keyword and paragraph-format scored about the same, and both were significantly higher than the trivial-word group.

Jennsted(1976) conducted a study , which revealed that students under individualized instructions reviewed their course more favorable than students under traditional instructions. Individualized instruction produced superior performance only when the unit completion activities of the individualized section were similar to the behaviour of the examination instruments.

Johnson and Packer (1976) compared traditional and individualized groups in a course and on a common final examination found that individualized group performed better than the traditional group on an essay part of the examination.

Justus (1981) in her study on the effectiveness of module incorporated supervision by the teacher as a part of programme. She compared the effectiveness of module with that of the formal method of following text books in teaching biology by teaching in the experimental and control groups by this two approaches . She found that the supervised study module were an effective approach for individualized instruction.

Martin (1975) had tried many techniques of individualization , Quasi-tracking, contract learning, programmed learning and so on. Each attempt was aimed at getting every individual student to learn science and each attempt was frustratingly meaningful. So he tried a learning team composed of the teacher and either of one student with certain capacity for independent work on several students pursuing a common interest . he arrived to the conclusion that each student studies what is meaningful to him. He studies in a manner best to him as a unique individual person.

An experimental study was designed by Misegadis (1988) to find out whether the self – paced method or the traditional method provided a greater student achievement. The method in instruction did not have any effect on writing skills achievement of Barton Country Community College English composition student who were instructed in self paced method compared to those instructed in the traditional method. When respondents were grouped by scores, the tendency was to rate the traditional method more favourable than the self paced.

Shah (1984) studied the effectiveness of an individualized in service programme designed to improve vocational teacher abilities to work with disadvantaged students. The results showed that both in-service approaches (individualized and formal course) seemed to have been successful and all participants indicated improvement in their abilities to work with disadvantaged students.

2.3 STUDIES ON EFFECTIVENESS OF PROGRAMMED LEARNING MATERIAL

The first really extensive field study designed to test the effectiveness of Book Format Programme versus conventional teaching was conducted by Klaus and Lumadiane (1960) . the study was conducted on 450 subjects. A week course in Physics consisting of 3000 frames was administered to an experimental group. The control group was taught by the conventional teaching method .The result indicated that the groups using the Book Format Programme did better in the achievement test than students in the control group. Even though the scores of these students who had completed only small portions of the programme were included in the statistical analysis , the test score difference were significant.

Shihabudheen (1988) tried to find out the comparative efficiency of using Programmed Instructional materials and ordinary class room teaching procedure for Arabic instruction in primary school.

In his study he concluded that

1) Programmed Learning and traditional method was equally effective.
2) There was no difference in case of high achievement.

Desai (1974) attempted a study to adopt the techniques of programming in the teaching of language and also to analyse the reaction of pupils to programmed learning approach. Objective type pre-test and post-test were administered to the experimental group and control groups of class IX for comparing the two methods. He found that,

1. The difference between the two means of the experimental and control groups was significant at 0.01 level
2. The programmed learning approach was effective than the conventional teaching approach for students ranging from high IQs to low IQs.
3. Analysis of students reaction towards the new approach indicated that the students welcomed the new approach.

Joshi (1974) conducted a study with the purpose to prepare a programmed remedial material in Modern English Usage for the B.A. pre-university classes in Maharashtra whose medium of instruction was their mother tongue. From his study he found that

1. Learning by programmed materials was more effective, permanent and interesting than that by the conventional method of teaching and it was suitable for slow learners.
2. Programmed learning materials was formed to be a device for self study and to be useful for remedial teaching.

Trivedi (1980) made attempt to evaluate the use of Branching variety of programmed learning Material as diagnostic and remedial tool in mathematics.

The objectives of the study were,

1. To develop programmed learning material of the branching type in mathematics for classes V,VI and VII.
2. To compare the achievement of the students studying by the traditional methods of teaching with that of the students studying through programmed material.
3. To diagnose students weakness in Mathematics
4. To use programmed learning material as remedial measures.

The major findings of the study were as follows,

1. For class VI, the programmed learning material was more effective than the conventional method of teaching where as for classes V and VII , both the methods were equally effective in terms of pupil's achievement.
2. In the case of class VI , girls learnt better than boys through the use of programmed learning material where as in the case of classes V and VII , there was no difference between the mean scores of boys and girls learning through programmed learning method.

Shah (1981) conducted a study on programmed learning in Mathematics students of class V in Gujarat state with the following objectives.

1. To develop programmed learning material on various units of mathematics syllabus of class V.
2. To try the same on children of class V from two selected schools.

The finding were,

1. Programmed learning material on the selected units in Mathematics for class V was developed. The total time for completing the programmed learning material was 24 hours and 40 minutes.
2. The reactions of the students and the teachers were favourable.

Kulkarni and Dewan (1967) tried to apply the principles of programmed learning to television lessons. The TV presentation of a question followed by answers from the students and the feedback enabled the students to score much higher.

Sarkar (1969) used programmed material for industrial training in his experiments with workers of Gujarat State Fertilizers Corporation (GSFC) and found it quite effective.

Kulkarni and Mullick (1968) planned a correspondence lesson unit in statistics, both in a conventional way and the programmed way. The results were in favour of the programmed lesson.

Gupta (1968) adapted a programme in physics and found that a considerable time of subject-matter specialists could be saved if such programmes were revised on the basis of local try-outs. The cost could also be reduced by employing a representation procedure which might involve group-pacing, as is done by presenting the material through roll-up boards. Krishnamurthy applied the programme learning technique in the training of family planning workers and found it to be more fruitful and less time-consuming than any other technique.

Alter (1962) tested the subjects twice : immediately and again after a retention interval of 2 to 30 weeks. The more intelligent students performed better on the re-test than the less intelligent students.

Brooks (1961) in his Ph.D. dissertation explored the rela tion of latency of answers to errors in programmed materials. The data supported the view that longer latencies tend to go with errors. Latency was found to be more sensitive than, error rate as a measure of difficulty.

Eigen (1963) surveyed student reaction to Programmed Instruction. In general, students using the programmed text had a more favourable attitude toward Programmed Instruction than those who used the teaching machine. Students' total attitude toward accommodated teaching, however, appeared to have no relationship with how much they had learned by the method. He concluded that it was difficult, if not 'impossible, to conceive of a typical reaction to controversial statements about Programmed Instruction after a student's first exposure. Attitudes differ vastly from student to student.

Goldbeck, Shearer and others (1962) integrated programmed learning with conventional classroom teaching, They found that a few minutes a day of programmed learning integrated with conventional classroom teaching could raise student performance significantly higher than could be achieved by conventional classroom teaching alone. Furthermore, student attitudes were favourable to programmes used this way and tended to become more favourable with longer acquaintance. This experiment has added relevance for all developing ,countries like India because such an adjunctive use of programmes is going to be a practical proposition for years to come.

Hickey and Anwyll (1961) looked into the effectiveness of programmed learning in industry. They used the programme on "Procedure of Package Billing" and found a 34 per cent reduction in the average number of student hours needed to attain criterion level of performance.

Hickey and Laidlaw (1962) tried out programmed material on "Retail Sales and Ship's Store Management" with U.S. Navy Supply Officers. The student who used the adjunct programmed saved 56 per cent of the usual homework time (17 per cent of the usual overall study time) in reaching the performance criterion. The instructor's lecture hours were reduced to 54 per cent. The attitude to the programme was -generally favourable.

Angell and Lumsdaine (1962) found that when students -were tested immediately after finishing the programme, scores -for the vanishing and the non-vanishing versions of the same -programme did not differ significantly. However, scores on a -delayed retention test were significantly higher for the vanishing than for the non-vanishing treatment.

Pandey (1980), In his study attempted to see the relative effectiveness of the traditional method with out home assignment and grading , a programmed text and the traditional method with regular home assignment and grading in teaching mathematics at the primary level.

The findings of the study were as follows,

1. The group following the programmed text differed significantly from the other two groups both in respect of immediate and delayed achievement.
2. The group following the programmed text was significantly superior in retention to the subject following the traditional method with out home assignment and the traditional method with home assignment and grading.

Rao (1983) conducted a study to find out the efficiency of the Programmed Learning method over the conventional Method in the instruction of Mathematics in school education. The study was indented to determine the relation in learning in games in terms of rural-urban area , sex, general mental ability level, and special reference to Government and Private managements. The findings revealed that the

mean performance score of all the Programmed Learning groups were higher than those of the corresponding conventional learning groups.

Shah (1969) through the intensive study developed Book format Programmed Learning material on algebra for standard VIII and the experimental group studied the whole syllabus of Algebra through this programme. The findings of this study revealed that the group taught through the Book format Programmed Learning material achieved higher scores on post test as compared to the groups which were taught by teacher in the traditional way.

Chaudary (1985) conducted a study on the preparation and evaluation of PLM in Geography for the Secondary Level. The primary objectives of his study were,

1. To prepare a Programmed Learning Material on selected items of the Geography Syllabus.
2. To evaluate the programme in terms of learning induced among the readers by reading the programme.

The secondary objectives of the study were to evaluate the effectiveness of the programme for,

3. The rural and urban students separately
4. For boys and girls separately
5. For the individual institutions separately

The findings of the study were,

1. Students gained significantly in the knowledge of the subject by reading the programme.
2. The programme was equally effective in producing learning among the rural and urban population
3. The mean gains for the different institutions varied to a fair extent , but all these gains were lightly significant.

2.4 STUDIES ON DIFFERENT STYLES OF PROGRAMMING

Akhter (1994) conducted a study aimed at the application of Systems Approach in classroom instructions. It is an input-output analysis with a sample consisting of 64 students from higher secondary level selected from a private recognized school. The main material used in this study is self study material in the form of linear as well as branched programme together with a human model. The study provide evidence of stability and internal consistency of constructional materials developed for the purpose.

The investigator studied the effect of self learning materials on student achievement through systems approach. The findings were,

1. There were significant difference between the achievement of students before and after the treatment provided with PLM and visual model.
2. The programme constructed or curriculum structured on the concept of system approach was found to be more effective in increasing the clarity, observation power and the scientific attitude of the student and it is systematically planned , organized and sequentially presented in the form of learning experience and materials in carrying out the instruction function

Basu (1981) , carried out a study to make an appraisal of the relative effectiveness of multimedia Programmed Instruction and programmed class teaching on the criteria of subjects at three level of ability. The specific objectives of the study were

1. To develop instructional materials for the strategy of programmed class teaching and to study its effectiveness.
2. to develop programmed learning materials on light in school physics in four different styles, semi-programme, linear programme, branched programme and Hybrid programme.
3. To develop a multimedia programme package using each style of programme in conjunction with audio-visual media.

The following were the findings of the study,

1. There was a significant difference among the different strategy means on the criterion on overall achievement. It near found that on the criterion of overall achievement , the multimedia linear Programmed Instruction was better than the semi-Programmed Instruction. The multimedia branching Programmed Instruction and the Hybrid Programmed Instruction was better than the Branching Programmed Instruction.
2. it was found that a significant difference existed in the achievement through different strategies due to difference in ability.

Gautham (1986), conducted a study to find out achievement in relation to creative thinking and level of aspiration, while using Programmed Instructional material.

The objectives of the study were ,

1. To develop two programmes one in linear and the other in branching format , in a segment of science.

2 .To compare the efficacy of the linear and branching programme format with reference to performance on the criterion test.

3 To study the performance of the students on the criterion test in the selected unit of science, in relation to creative thinking and level of aspiration.

The major findings were,

1. Level of aspiration as a factor did not effect the performance of the students on the criterion test.
2. Both the programme format was equally good in terms of their effect on the performance of students on the criterion test in a segment of science,
3. The level of aspiration did not effect the performance of students when they were taught either through linear or branching programme style.

4. Creative thinking level of aspiration and styles of programming did not interest mutually.

Kagathala (1986) studied the effectiveness of linear programmed material and branching programmed material in the subject of commerce .

The objectives of the study were,

1. To develop a programmed learning material in commerce for Higher Secondary students of standard XI
2. To compare the achievement of learners through the linear and Branching programmes controlling personality traits such as emotional stability , SES, radicalism, general ability etc.

The findings of the study were,

1. The Branching Programmed Learning material produced better result than the Linear Programmed Learning Material.
2. The Branching Programme on controlling pre-testing and SES proved superior to the Linear Programmed Learning material.
3. The girls were benefited more by PLM than the boys when pre-achievement was controlled.
4. The male and female students did not differ significantly in achievement when they learnt the two different programmes.

Dipika Bhadresh Shah (1997) conducted a study to find out the effectiveness of mathetical learning package over traditional method. The sample consisted of 120 students. Out of that 60 for Group A and 60 for group B with in the groups , the numbers of male and female students 30-30 were also tried to maintain.

The major objectives of the study were as follows,

1. To develop mathetical exercises for the unit of “Logarithm” from the subject of mathematics of standard IXth

2. To try out the developed mathetical exercises.

3. To measure the effectiveness of mathetical exercises

4. To collect the opinions of students regarding learning through mathetical exercises.

The major findings were as follows

1. The differences between post-test achievement score of traditional group and experimental group was significant at 0.01 level in favour of experimental group and therefore, the null hypothesis of "no difference' was rejected.

2. It was obvious from the result that students learnt through mathetical exercise have scored higher scores on post test as compared to that of students learned through traditional teaching.

3. From the result, it was concluded that self instructional mathetical programme does help in achieving higher scores and provides a good deal of stimuli for learning.

4. Even in the retention test that (Taken after one month), scores of the experimental group showed significant performance at 0.01 level as compared to traditional group.

Kaur (1985), studied the performance of college students in linear and mathetical styles of programming for different levels of content with regards to pupil response on the respective criterion test.

The findings were,

3 There was no difference between the linear and mathetical style of programming on teaching information skill and information plus skill.

4 The boys performed equally as the well as the girls in the contents areas under reference.

Mishra (1996) conducted a study to find out the relative effectiveness of lecture method and Linear and Branching Programmed Instruction on the teaching of

Basket ball rules. The sample consisted of 60 Higher Secondary School Students assigned randomly into three groups of each . Experimental design was adopted. The study was conducted in two places. In the first place, Programmed Instructional materials were prepared and an achievement test was conducted. In the second place, the treatment were effected and data collected. Altogether six periods were required in each group to complete the instruction programme. The data were analyzed using one tailed t –test and analysis of covariance (ANCOVA).

The results indicated in that linear Programmed Instruction was significantly more effective compared to traditional method of teaching basket ball rules. However , branching Programmed Instruction was not significantly more effective than linear method in teaching of the same.

Sharma(1989) conducted a study "Effects of Linear and Branching instruction strategies in Social Science of Tribal High School Students" and found that students performed equally well when taught through Programmed Learning Material developed on both Style, Linear and Branching.

Beane (1962) found that, time-wise, the branching programme was more efficient than the linear programme. The -students expressed attitudes which were more favourable to -the linear programme.

Smith and Moore (1962) studied the effectiveness of Programmed Instruction by machine, programmed text book, plus. a weekly seminar vs. text book plus weekly seminar. No significant differences in achievement related to teaching machine,. programmed text book or conventional text book were found. They also studied the effectiveness of the teaching machine, programme, programmed text book, and conventional text book without supplementary class work . The machine group, scored significantly higher. than the conventional text group,, both on immediate and delayed post-tests.

Sharma (1974) studied the interaction effect among types of programming response mode and taxonomic categories. The sample consisted of 120 male and female student teachers. On the basis of that examination from high school onward

four groups formed by matched pair technique. They were assigned randomly to the four treatments , linear overt and overt responses, branching overt and overt responses. At the end of the treatment a criterion test was conducted to these groups. The criterion test consisted of 50 objective type questions. Factorial design analysis revealed that,

The linear programme appears to be effective with overt response.

2. The branching programme seems to be effective with overt response.
3. Branching programme seems to be effective for comprehension and application categories.
4. Linear programme appears to be effective for knowledge category.

STUDIES ON THE PSYCHOLOGICAL LEARNING PROBLEMS WITH THE HELP OF PROGRAMMED LEARNING MATERIAL

Suthae (1981) conducted a study to investigate the performance of Programmed Learning material in relation to some psychological characteristic. The objectives of the study were,

1. To develop Programmed Learning Material in algebra for class VIII
2. To compare the achievement in algebra of students with different study habits, learning through Programmed Learning Material and the Traditional way of teaching.
3. To compare the achievement in algebra of students with different reasoning abilities.
4. To compare the achievement of students having positive and negative attitude towards mathematics.

5. To compare the achievement of students with high and low motivation towards school learning through PLM and the traditional way of teaching.

The results of the study revealed that Programmed Learning Method was superior to the traditional way of teaching irrespective of different variables.

Singh (1975) made a study to investigate the effects of formal and thematic prompts on "Map Reading" in Geography. He also attempted to analyse the interaction effects among the prompts , intelligence and taxonomic categories. He found that thematic prompt are more effective than that of formal prompt on high and average intelligent student. He further stated the thematic prompts seemed to be more effective at comprehension category . He suggested that prompt appear to be important variables Programmed Learning Method strategy.

Ramkumar and Vijayakumari (1978) conducted a study with the objectives,

1. To find out the relationship of certain intellective factors and achievement in English, by learning of English structures through Programmed Learning Method and to identify difference , if any.
2. To find out the relation ship of certain non-intellective factors to learning of English Structures through Programmed Learning Method and to identify difference, if any.

The findings of the study were,

1. There was significant positive relationship between intelligence and learning of English Structures through Programmed Learning Method.
2. There was significant positive relationship between achievement and learning of English Structures through Programmed Learning Method.

3. There was no sex difference in learning of English Structures through Programmed Learning Method.

4. There was urban-rural difference in learning of English Structures through Programmed Learning Method.

Feldhusen and Eigen (1963) conducted a correlation study and inquired into the interrelationships among attitudes, achievement, reading, intelligence and transfer variables in Programmed Instruction. The authors concluded that the 46 attitudes of students toward Programmed Instruction are not ,consistently related to the youngsters' levels or amounts of learning."

Jnandar (1981) conducted a study on the effectiveness Programmed Learning Method in the subject, mathematics for standard VII in relation to some psychological correlations. The study revealed that Programmed Learning Method in superior to the conventional techniques.

Rao and Raghavendra (!986) made an attempt to evaluate the effect of guided discovery and expository approaches in relation to problem solving , interaction of intelligence and achievement in mathematics in terms of sex and area. The results of the study showed that there was no significant difference in achievement of mathematics in relation of the above terms.

Saraswathi Amma (1978) conducted a study under the objectives to asses the effectiveness of Programmed Learning Method as revision materials in learning certain structures in English and to find out the effectiveness of Programmed Learning Method as revision materials in relation to the sex, socio-economic status, rural-urban difference and intelligence of the pupil.

The findings were,

1. Programmed Learning Method was found to be effective as revision materials for both boys and girls.

2. Programmed Learning Method was found to be effective as revision materials in relation to sex, socio-economic status, rural-urban differences, achievement and intelligence of the pupil.

Ferster and Sapon (1958) found correlation between aptitude and achievement in a learning programme. They reported, however, that in a mean time of 47.5 minutes, the six students learned an amount of German comparable to that presented in a first semester course.

Gagne (1962) experimented on seven ninth grade boys to explore the effectiveness of the learning programme designed to transfer training from component learning sets to a new activity which incorporates the previously acquired capabilities. Six of the seven boys were brought to successful achievement through ascending hierarchies to the final task goal.

CHAPTER III

METHODOLOGY

INTRODUCTION

The investigation is carried on an experimental method. The control group and Experimental group were selected from the XI th standard students in Kerala Higher Secondary Course. They were undergone a mathetical programme and conventional method of instruction accordingly and their pre test scores and post test scores were compared to get the achievement in cghemistry.

STATEMENT OF THE PROBLEM

The problem of the study is, to what extent

" EFFECTIVENESS OF METHETICS ON ACHIEVEMENT IN CHEMISTRY AT HIGHER SECONDARY LEVEL"

3.2.1 OBJECTIVES OF THE STUDY

1. To construct a Mathetic Learning Package on the topic I.U.P.A.C . naming of Alkanes.
2. To compare the achievement of the students studying by the traditional methods of teaching with that of the students studying through Mathetics.
3. To evaluate the effectiveness of Mathetics Learning Package.

3.2.2 HYPOTHESES

1. There will be no significant difference in the performance in the achievement test by the experimental and the control group.

2. There will be no significant difference in the performance of experimental group in the pre test and post test.

3.2.3 VARIABLES

In the current situation of study, there may be a large number of variables present among the sample. They may be, Age, gender, Social Status, teaching methods, teacher, Mental ability, attitude, subject knowledge, kind of school, school environment etc.

Since the study is carried out in a single school, among boys, having same range of I.Q and chemistry achievement scores, all variables except the teaching methods assumed to be constant.

So the scores in the achievement test will be the dependent variable on the independent variable teaching method in this study.

SAMPLE AND DESIGN

The study is based on an experiment which involved the application of the two teaching methods. The design adopted was parallel group Pre-test-Post –test (Best,1995). The experiment of the study took place during the December and January months of the academic year 2008-2009, it lasted for three weeks. In the first week, the I.Q test, collection of their score in chemistry during last year and pre-test were conducted in the second week, the lessons were taught. Post test was conducted in the third week. The study was conducted on a sample of 30 students (two divisions of 15 students each) of XI^{th} standard of Kalladi Higher Secondary School, Kumaramputhur in Palakkad district of Kerala state..

Selection Of Sample

The sample was selected by multi stage random selection method. Foe that the population is fixed as the Higher Secondary School students in Kerala , with a target on XI standard students. In the first stage, one district was selected from the fourteen districts in Kerala by the lottery method. So Palakkad district was selected as

the area for study. Among the 77 higher Secondary Schools(Government and Government Aided) Kalladi Higher Secondary School was selected by Lottery method.

Since the study was limited only on XI standard Boys, who studying chemistry as one of their core subject in that school was selected.. Among those 46 boys, 32 boys were selected by lottery method . Their Score in the Chemistry paper in SSLC examination was collected to check the homogeneity in the chemistry knowledge. Since they all comes in the comparatively small range of 37 to 48, they are assumed to be homogeneous. Then the I.Q test was conducted on them and one boy who got a higher score of 18 was eliminated from the sample to keep the homogeneity of the sample, since all others having a score range 8 to 12 out of 20.

Four days before the instruction period, pre test was conducted and one boy who was not able to attend the pre test was also avoided from the sample. Thus the sample distribution was like in the table 3.1

Table 3.1 – Sample Distribution

Sample Group	Control Group	Experimental Group	Total
Number of Subjects	15	15	30

This 30 students were divided into two groups on the basis of their scores in pre-test. The sample was ranked and the students having odd number of ranks formed one group and others formed the second group. Among these two groups, one group was selected as the experimental group and the other group as the control group. Then the experimental group is learned IUPAC naming with the help of Mathetic programme and the control group lead in a conventional teaching method.

TOOLS AND MATERIALS

1. Mathetical Programmed Material

The mathetic programme was prepared on the topic IUPAC naming of Alkanes for the students of XI^{th} standard. The programme consists of fifteen pages among thirteen were the frames.

2. Lesson plan

The investigator used two lesson plans in the constructivist method to teach the control group in the conventional method on the topic IUPAC naming of the alkanes. In the first lesson plan, naming of branchless akanes and in the second lesson, naming of branched alkanes were dealt.

3. Achievement test

The investigator constructed an achievement test on the topic IUPAC naming of alkanes in which, the knowledge, understanding and application capacity of the learners were checked through objective type questions. This was implemented over both the control group and experimental group after the instruction.

4. IQ Test

The IQ test used in the current study was developed by Hawkins, (Journal of Education and Psychology, Sardar Patel University, April 1970)

The test used to check the intelligence level of the student. From the score. The students were equally distributed to control group and experimental group to keep the homogeneous nature of the two groups. The experimental group was taught using the Mathetical Learning Package and the control group was taught through conventional method of teaching. The effectiveness of Mathetics on Chemistry achievement was found by administrating the same achievement test as post-test to both the groups. The data thus collected were tabulated and analysed statistically.

The constructor of the test computed the reliability of the test using split-half method by using Spearman-Brown prophecy formula. Reliability values thus computed for the test was 0.92 which shows the high reliability of the test.

The content validity of the test was checked by experts in the field. The concurrent validity was checked by the correlation with the scores achieved by 200 students in Wechsler Intelligence Scale for Children .The coefficient of correlation was found to be 0.81 , which is significant at 0.01 level of confidence. This establishes the concurrent validity of test. The intrinsic validity of the test has been computed as the square root of its reliability value. So the intrinsic validity is 0,9591 which shows the high intrinsic validity.

PROCEDURE FOR THE STUDY.

The tools needed were Mathetical learning Package, conventional lesson plans, IQ test and achievement test in Chemistry for the pre –test and post –test. Pilot study was conducted at first in 30 students for evaluating the workability of Mathetical Learning Package. After that necessary changes were made in the learning package with the help of teachers handling the class and experts. Both the tests were checked for content validity by subject experts and the reliability was checked by test - re test method.

The sequential phases of operation of the study were as follows:

I. Academic content in Chemistry for the study were identified.
II. Criterion test on the same topic was drafted out.
III. The drafted out test under gone a pilot study and the final test was developed
IV. The final test was checked for its validity and Reliability.
V. The mathetical learning programme was drafted out and undergone validation.
VI. Entry behaviour of the sample was checked with an I.Q test and pre test.
VII. Based on the analysis of pre test results, sample was divided into control and experimental groups employing matching technique.
VIII. The selected content was taught through traditional method to the control group and the mathetic programme method to the experimental group.

IX. A post test was administered to both the group after treatment.

X. Suitable statistical techniques were employed to analyse the data collected.

DEVELOPMENT AND VALIDATION OF MATHETIC LEARNING PACKAGE

3.5.1.1 Development of Mathetic Learning Material

The construction of a programmed learning material involves three phases. they are

(i) specification phase

(ii) drafting phase and

(iii) edit tryout phase.

3.5.1.1.1. Specification Phase

The success and effectiveness of a programme depend on the first phase, that is specification of topic and others. Authors differ in specifying the steps to be followed in these three phases. From the analysis of the various suggestions given, the following steps are considered as important for clear cut specifications.

They are the specifications of the

i) unit /topic

ii) target population

iii) entering behaviour

iv) terminal behaviour and

v) construction and validation of criterion test

The selection of the topic or unit was guided by so many factors such as, familiarity of the subject matter to the programmer, the need, utility, divisibility and

logical sequence of the subject matter to be programmed, etc. in the current study the topic ‚IUPAC naming of Alkanes' was selected by the investigator which is of high importance in the Chemistry teaching and learning process. The topic comes in the unit 'Carbon and its Compounds' in the syllabus of XI standard of higher secondary course in Kerala state.

In specifying the target population, the level of the learner's skills, interests, cultural background, intellectual levels of the learner etc. shall be specified clearly. In this investigation, the investigator targets on a group of students from the XI standards of Kerala Higher Secondary Course. They may trained up to X standard in the state syllabus or in CBSE or ICSE syllabus, what ever be, will be trained up to the same extent in the field of chemistry.

To make the learning more effective, the programmer must know the entering behaviour of the target population. To check the entering behaviour of the students, the achievement test developed by the investigator was employed and then only the programme was employed on the sample. The score in the pre test of most of the children reveals that all were in the average level of achievement.

Specifying instructional objective is nothing but stating the terminal behaviour. It helps both the learner and his teacher. It also provides opportunities to the programmer to define the content carefully, to plan for the performance assessment and to provide guidance in the planning of instruction. The learner should be able to name the alkanes, what ever kind it was, is the main objective of the programme developed. It is the terminal behaviour expected by the investigator. The learners should also be able to give the structures of the compound from the IUPAC names.

Keeping in mind the above said specifications and after consulting a number of relevant text books and reference books, the course outline was prepared. It cover all the above specifications. The course outline was prepared in the form of a flowchart.

To test the student's performance at the end of the programmed course, a criterion test shall be constructed and validated.

3.5.1.1.2 Drafting Phase

After all the above said specifications and preparations are over, the second major phase of drafting the frames will be taken up. Writing the frames is a technical job. For that, one must have a thorough understanding of the science of Programmed Learning and sufficient competency over the subject in which one intends to write programmes. The nature, components, and types of frames have been discussed else where.

In the current situation, the investigator went thoroughly through the materials available on the topic and programmed materials in the related topics. Investigator consulted experts in the field of chemistry and individualized instruction to make the programme and a hard copy of the programme with 20 pages was drafted out. The draft was made according to the nature of the students achievement in the pre test and appearance of the frame in the mathetic programming mode.

3.5.1.1.3 Edit-Tryout Phase

After the completion of the preliminary draft of all the frames, it requires editing and reviewing. Editing has done with reference to accuracy and relevance of the material, style, vocabulary and content interest. This was a crucial stage in programming. Only editing can uncover many programme inadequacies, prior to testing. The main objectives of editing the frames according to Espich and Williams (1967) are :

i) to eliminate the ambiguities, pomposities and other inadequacies

ii) to improve the logical sequence of the frames

iii) to improve the technical accuracy aspect of the programme

iv) to examine the approp6ate use of the panels, maps, illustrations, etc.

In editing the frames, the continuity of the programme, the frame size, the sequence, the principles of construction of programmes, etc, were checked. The service of the co-programmers, colleagues in the discipline, experts in programming, etc, were utilized in the editing phase. The subject matter also verified by other subject experts. Checking the frames by a language expert was also done for grammatical mistakes, language forms, spelling, punctuation, etc.

3.5.1.2. Validation of Mathetic Learning Material

After the editing is over, the programme is ready for tryouts. Tryouts help the programmer in refining the programmed material he has prepared. There are three types of tryouts followed generally, in the refinement of the programmed materials. They are:

i) individual tryout
ii) group tryout
iii) field or mass tryout.

Though, each of these tryouts aim at refinement of the programme, the purpose of each of these tryouts are different. The success of the programmed material largely depends on the effective administration of these tryouts followed by proper analysis.

3.5.1.2.1. Individual Try-out

The edited frames will be first tried out with individual students of the specified target population. Here, the programmer sits face to face with the randomly selected individuals. This gives an opportunity to the programmer to study the reactions of the learner in respect to the stimulus and response part of the frames. The number of individuals to be tried out depends upon the quality of the draft frames and the degree of refinements the programmer needs. After each individual tryout, the programme gets refined. Proformas are prescribed for the use during individual tryouts.

Individual tryout is mostly an oral situation where the programmer presents the written frames to the individual one by one. The subject is expected to read and understand the content of the frames and orally gives out the answer for the question which has been asked in the frames The programmer notes down the time taken for reading the frame, answering the questions, whether the answer given was correct and other remarks about the content presented to him. On the basis of these ratings and analysis of the tryout schedule, corrections, modifications, and refinement of the frames, etc, are made immediately after the first individual tryout. After refinement, the material will be administered to the second individual. Naturally, there will be less difficulty in understanding and answering the questions by the second subject. Thus after the completion of more number of individual tryouts, the material becomes better refined. As said earlier, there is no such rule as to the number of individual tryouts to be given, but normally it may be around 10 tryouts.

3.5.1.2.2. Group Tryout

When necessary refinements and weeding out of the inadequacies of the frames on the feedback of the individual tryout are over, the programmed material is to be cyclostyled for group tryout. Group, here means a class of students of the same target population. Normally, a class may consist of 40 students. A class, as such may be taken for group tryout. Here all the members of the group will study the programmed material simultaneously, Separate answer sheets will be supplied for writing the answers to the questions asked in the frames. Sufficient time will be given for the students to read and answer the questions. The creation of a congenial atmosphere, and the establishment of the proper rapport are the requirements for group tryout. The students should be instructed about the nature of this auto-instruction material and what is expected of them along with the purpose of this tryout. The reaction of the students during the group tryout will be noted down by the programmer, so that, it may be considered for further refinement. Answer sheets of the students will be scored and analysis will be done for finding out the error rate of the frames. According to Markle (1969) error rate is the percentage of incorrect responses on a frame, a set of frames, or a whole programme tested on a group of students. The following formula may be applied for finding out the error rate.

$$\text{Error rate :} \quad \frac{\text{Total number of errors X 100}}{\text{Total number of frames X No. of individuals in the group.}}$$

In order to have more perfection, if needed, a second group of target population may be selected and programme administered and error rates found out. In programmed learning, generally, frames having more than five percent error rates are not accepted to be included in the programme. So, the frames having high error rates are either modified, refined or deleted according to the nature of the frame.

Programme density is another concept to be taken care of in the development of programmes. It provides ways to specify precisely, the composition of a programmed material and the rate at which concepts are introduced. There are two types of programme densities, such as, (i) independent density and (ii) cumulative density. The former is the density of a single frame composing a part of a programme and the later takes into account the prior appearance of specific terms on preceding frames. A Programme will have an independent density of One, if every response required by the programme is different. The programme will have minimal density, if every response that is required of the student consists of the same word. One way of finding out the programme density is by calculating the Type Token Ratio (TTR). The formula for the same will be as follows:

$$\text{TTR} = \frac{\text{Number of different responses}}{\text{Number of total responses}}$$

A good programme density denotes the uniform concentration or distribution of responses over the frames.

3.5.1.2.3. Field/Mass Tryout

After field tryout the prepared programme obtains the optimum perfection and gets validated for mass use. Therefore, the purpose of the field tryout is to find out the validity of the programme. Here, a number of groups of students of the same target population are selected based on a scientific sampling technique and the programme administered to them. When the administration is over, a criterion test already prepared and validated for that purpose will be administered. From the analysis of the test scores, the percentage of students, who will be getting the mastery level of learning in the particular topic after programmed instruction will be found. Generally, a mastery learning criteria of 90/90 will be expected out of a programmed material. It means that after studying the programmed material, at least 90 percent of students will get 90 percent of marks in the criterion test. In certain cases it may be a little less or more, viz, 85/90, 85/85 etc. Only the field tryout and criterion test administration will tell us the validity of a programmed material. If the validity of a programme is up to the expected level, it means, it can be used for the similar population of students for the expected achievement.

3.5.2. Development of a Criterion Test

A Criterion Test, in the programmed Learning terminology is nothing but a validated achievement test, constructed on the topic in which programmed material is prepared. This validated achievement test is required to measure
the validity of the programme, that is being prepared. It simply tests the terminal behaviour of the students after the programmed material is studied. Because the score of the test forms the dependent or the criterion variable, it is known as criterion test. In a completely successful programme, every learner will score 100 percent on the criterion test. Since the criterion test decides the validity of the programme, should have sufficient validity first.

The criterion test is expected to have certain characteristics;

i) it shall be constructed at the beginning, before one starts writing the frames.
ii) at least two items for each of the specific instructional objective shall be included in the test.
iii) it should test almost all teaching points.
iv) it shall not include the same examples and situations given in the programme.
v) the type of questions or items included in the criterion test shall be different from those included in the frames.
vi) questions or items in the test shall not be the same order as they occur in the programme.

A good criterion test reflects representative elements of the universe of behaviour, which has been considered as terminal behaviour. Just as the construction of other standardized tests, first selection of items for the preliminary draft should be completed. For that, the principles discussed earlier shall be followed. Sufficient care must be taken in the selection of test items. To check whether items were uniformly distributed according to the different levels of Bloom's Taxonomy,
a blue print may be prepared and verified. On the basis of the blue print, necessary modifications shall be made in the draft test. Like the programmed material, the development of the criterion test also needs tryout and refinements.

3.5.2.1 Achievement Test in Chemistry:

The test was developed by the investigator for the conduct of present investigation.

According to encyclopedic dictionary of Psychology, a test is designed to asses the amount of information or skill an individual has acquired from past learning is test of achievement. For the development of the test, the major steps followed by the investigator are

1. Planning of the test
2. Preparation of the test
3. item analysis
4. Finalizations of the test

3.5.2.1.1 Planning of the test:

For any task to be successful, careful planning is an important step. For the development of the test, the investigator planned to construct an objective type test with all items as objective type questions, either multiple choice items with four options or questions which can be answered in single words. The number of the test items fixed as 30.

As the topic of study was 'IUPAC ' nomenclature, the investigator decided that the content of the test should focus on basic information about organic chemistry and the IUPAC naming of alkanes, according to the XI standard. To get an out line of the content, investigator made thorough reading of the relevant text books and consulted experienced teachers.

3.5.2.1.2. Weightage to Content

The content areas to be tested were selected and weightage for each content were given in this step. The contents were divided in to three headings and the weightage to the areas were given according to the depth and important of contents.

Table 3.2- Weightage to content

Sl.No	Content	Score
1	Basics of Organic Chemistry	8
2	IUPAC naming of alkanes	19
3	Deriving structure from IUPAC name	3
Total		30

3.5.2.1.3. Weightage to objectives

Adequate weightage was given to all levels of cognition comes in this topics, that is Knowledge, Understanding and Application as described by Bloom and his associates. More emphasis has been given to application and undersating according to the relative of the objectives in the content.

Table 3.3- Weightage to Objectives

Sl.No	Objectives	Score
1	Knowledge	6
2	Understatnding	12
3	Application	12
Total		30

3.5.2.1.4. Blue Print of The Test:

Table 3.4- Blue Print

Objectives Content	Knowledge	Understanding	Application	Total
1	6	2	0	8
2	0	7	12	19
3	0	3	0	3
Total	6	12	12	30

3.5.2.1.5. Preparation of the Test

On the basis of above given blue print an achievement test was developed. The investigator prepared a draft test of 52 objective type questions of one mark each, so that after item analysis enough questions will remain according to blue print.

For each multiple choice question, four choices a,b,c and d were given. The students were asked to choose one option and put 'X' mark on that letter as the response in the separate response sheet provided to them. Adequate space was given for other objective type questions with question number.

A model item from the test is given below,

2. The alkane having six carbon atom is called as ……..

(A) 1-methylhexane (B) 2 –methyl hexane

(C) 2- methylpentane (D) 2-methylbutane

Answer:

2	A	B	X C	D

Thus a draft test was developed. The copy of the same , its response sheet and scoring key are given as appendices.

3.5.2.2. PILOT TESTING

A pilot test was conducted to examine the time required for the test and to see whether there exists any ambiguity in the item construction. The test was administered to 20 pupils of standard XI. All were given sufficient information about the test and were asked to follow the instruction carefully and accurately. They were allowed to ask any doubt while answering. Investigator was able to identify certain draw backs of test items and corrected them. The time required was fixed as 45 minutes as majority of pupils took 40 minutes to complete the test.

3.5.2.2.1 Tryout test

The final draft test with the 52 objective type test items were tried out on a representative sample of 37 students from standard XI. The purpose of the test was made known to the students. Even though test was provided with all the necessary guide lines about the test, additional oral information were given by the investigator so that students may respond to the test properly.

Scoring was done with the help of the scoring key. One score for each correct response, is the scoring scheme of the test. Based on the key, a window screen was constructed and used for easy scoring. 37 scored response sheets were used for item analysis, so as to make its 27% a convenient number 10.

3.5.2.2.2. Item analysis

According to Ebel(1972) the analysis of students responses to total items is called item analysis . It was done to know whether each item prepared by the investigator has the required quality. The following steps were done as suggested by Ebel and Frisbie(1991).

The 37 filled response sheets were arranged in the descending order of scores. The score obtained bye 10 subjects (27%) on the top and 10 of the lowest were taken as upper and lower groups for item analysis. The number of correct responses to each item of the test was ten noted for upper and lower groups .

3.5.2.2.3. Determining the difficulty Index

The difficulty index of an item is the percentage of students who responded to it correctly. The following formula suggested by Ebel (1972) was used to calculate the difficulty index of each item.

$$\text{Difficulty Index} \quad DI = \frac{U + L}{2N}$$

Where

U = the number of correct responses in the upper group

L= number of correct responses in the lower group

N= the number of subjects in either group

3.5.2.2.4. Discriminating Power

The discriminating power of an item analysis is its power to discriminate between the uppr and lower groups . the difference between the correct responses in the two groups will be an indication of how far it can discriminate between the two groups.

$$\text{Discriminating Power DP} = \frac{U - L}{N}$$

Where

U = the number of correct responses in the upper group

L= number of correct responses in the lower group

N= the number of subjects in either group

The difficulty index and discriminating power of 52 items were found and are given in the table 3.5

Table 3.5 – Difficulty index and Discriminating Power of Test Items.

No	U	L	DI	DP
1	7	6	0.65	0.1
2	5	3	0.4	0.2
3	7	6	0.65	0.1
4	9	5	0.7	0.4*
5	3	1	0.2	0.2
6	8	6	0.7	0.2
7	8	5	0.65	0.3*
8	9	6	0.75	0.3*
9	9	5	0.7	0.4*
10	8	3	0.55	0.5*
11	5	2	0.35	0.3*
12	9	8	0.85	0.1
13	2	6	0.4	-0.4
14	6	3	0.45	0.3*
15	5	6	0.55	-0.1
16	7	5	0.6	0.2
17	8	5	0.65	0.3*
18	8	5	0.65	0.3*
19	6	2	0.45	0.4*
20	7	4	0.55	0.3*
21	5	3	0.4	0.2
22	9	6	0.75	0.3*
23	7	8	0.75	-0.1
24	6	2	0.4	0.4*
25	6	3	0.45	0.3*
26	9	7	0.8	0.2
27	6	2	0.4	0.4*
28	5	2	0.35	0.3*

No	U	L	DI	DP
29	7	5	0.6	0.2
30	8	5	0.65	0.3*
31	8	5	0.65	0.3*
32	6	2	0.4	0.4*
33	5	4	0.45	0.1
34	9	2	0.55	0.7*
35	5	7	0.6	-0.2
36	5	2	0.35	0.3*
37	7	6	0.65	0.1
38	7	2	0.45	0.5*
39	9	5	0.7	0,4*
40	9	3	0.6	0.6*
41	7	2	0.45	0.5*
42	7	3	0.5	0.4*
43	8	5	0.65	0.3*
44	7	6	0.65	0.1
45	4	7	0.55	-0.3
46	2	3	0.25	-0.1
47	5	1	0.3	0.4*
48	3	2	0.25	0.1
49	7	2	0.45	0.5*
50	6	5	0.55	0.1
51	8	7	0.75	0.1
52	8	5	0.65	0.3*

*Selected Items

3.5.2.2.5. Selection of items For the Final test

Based on difficulty index and discriminating power calculated, each test item was evaluated for its quality. Generally items having a difficulty index between 0.4

and 0.6 are considered as better items. In the present test , the investigator selected32 items having difficulty index 0.3 to 0.75 and discriminating power 0.3 and above. These 32 items formed the final test.

3.5.2.2.5. Final test

Final test of achievement in chemistry was thus ready as per the blue print. The test was then provided with directions for taking up the test. At this time the time required for responding to the test was also fixed as 30 minutes.

3.5.2.2.6.. Validity Of the Test

The validity of a test is the accuracy with which the test is able to measure the ability or trait that the test is supposed to test. There is no such thing as a test having no validity at all or having complete validity. A test may be valid for a particular purpose but may not be valid for another. Therefore the question of validity is a relative factor. To what extent a test is valid at a point of reference is to be verified and thus the validity of a test is established.

By item analysis each item was validated. Hence what remained was to determine statistical validity of the test by correlating with another standardized test in the same subject of proven validity. As no such test was available, the investigator correlated the scores of the test of a group of 37 students with their terminal examination scores. The Pearson's Coefficient of correlation was found to be 0.61 which implies that the test has reasonable validity.

3.5.2.2.7. . Reliability of the Test

A test is considered to be reliable if it is consistent in giving the results in subsequent testing situations without any change of the variable under study. In the same way a question will be said to be reliable if the answers to it gives the true achievement or status of the students if the resulting score is free from chance errors. There are a number of ways of finding out the reliability of a test. Test retest reliability, split half

reliability, parallel form reliability, rational equivalence reliability, etc, are some of the methods. Under the test retest method, a test is administered twice with some days gap in between for the same set of students. The coefficient of correlation of the first and second scores is found out. This coefficient is the test retest reliability.

Reliability of the present test was determined by test retest method. For this , the investigator administrated the test to a group of 37 students and their scores were noted. The same test was again administered to them after 5 minutes and the scores were noted again. The coefficient of correlation between these two scores was found to be 0.72 which implies that the test is reasonably reliable.

STATISTICAL TECHNIQUES NEEDED

The main statistical techniques employed for the present study are as follows:-

Descriptive statistics

Mean, Median , Mode , Standard Deviation , Skewness and kurtosis of the scores were studied under this heading to check the normal distribution of the scores achieved by the sample

Inferential Statistics

Two tailed test of significance foe mean difference of small independent sample(t-test) was used to test the hypotheses.

CHAPTER IV

DATA ANALYSIS AND INTERPRETATION

Introduction

The data collected through out the study, viz the pre test and post test scores of both control and experimental groups were analyzed statistically and the hypotheses were checked in this chapter. The measures of central tendency helps to get an idea about the distribution of data and the significance levels were analyzed by parametric tests.

Descriptive Analysis

The measures of central tendencie, Standard deviation, skew ness and Kurtosis of the score of the sample is given in table 4.1

Table 4.1 Descriptive Statistical analysis of data

Test	Group	No of subjects	Mean	Median	Mode	S.D.	Skewness	Kurtosis
Pre - Test	Sample	30	13.73	13	13	2.1485	-0.1233	-0.0839
	Control	15	13.4	13	12	1.8822	0.2907	-0.3866
	Experimental	15	13.33	13	13	1.7182	-0.6968	0.3211
Post Test	Sample	30	22.2667	23	23	1.9815	-0.2321	-0.8222
	Control	15	21.13	21	20	1.5976	0.1146	-0.2411
	Experimental	15	23.4	24	23	1.6818	-0.6320	-0.1162

The descriptive statistics shows that the sample got a homogeneity in their distribution and all are in an average level. The mean of the score in pre test by both experimental and control group shows they are more or less equal.

The smoothened frequency curves for the sample as whole for the pre test and both the groups were given in the figures 4.1 , 4.2 and 4.3 .

Figure 4.1 - Frequency Curve of Achievement in Chemistry pre test for experimental group

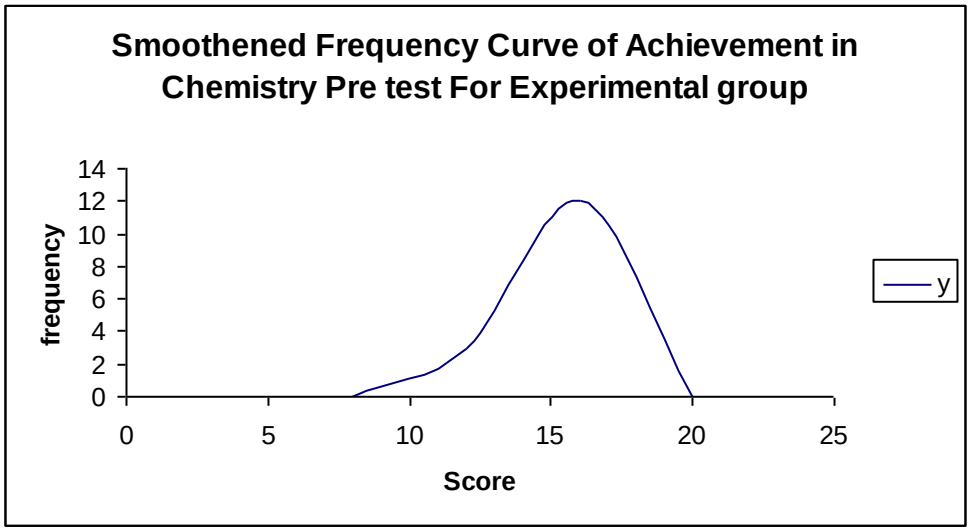


Figure 4.2 - Frequency Curve of Achievement in Chemistry pre test for control group.

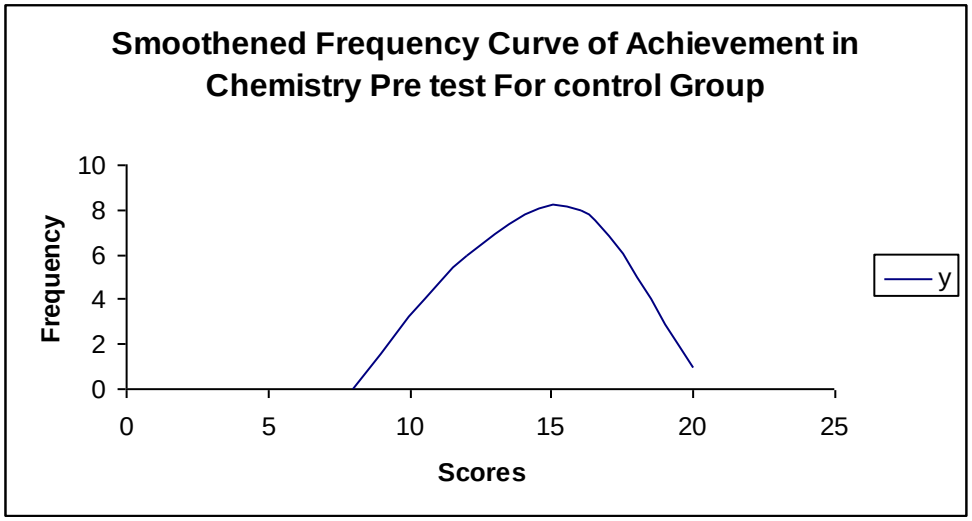
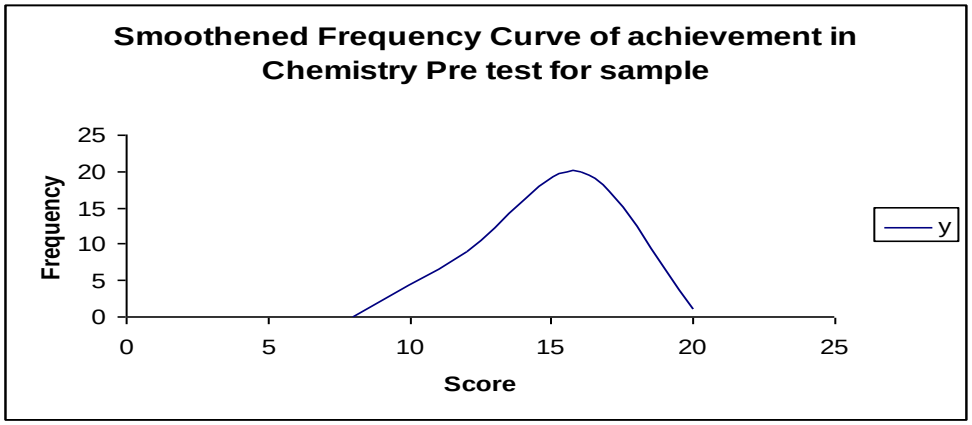


Figure 4.3 - Frequency Curve of Achievement in Chemistry pre test for whole sample.



The mean of the score in post test by experimental and control group shows that there is a difference in their achievement. But the difference is comparatively not that much large because the control group was taught through the constructivist method of teaching. Even though the experimental group having a mean score more than that of the control group.

The smoothened frequency curves for the sample as whole for the post test and both the groups were given in the figures 4.4 , 4.5 and 4.6 .

Figure 4.4 - Frequency Curve of Achievement in Chemistry post test for experimental group.

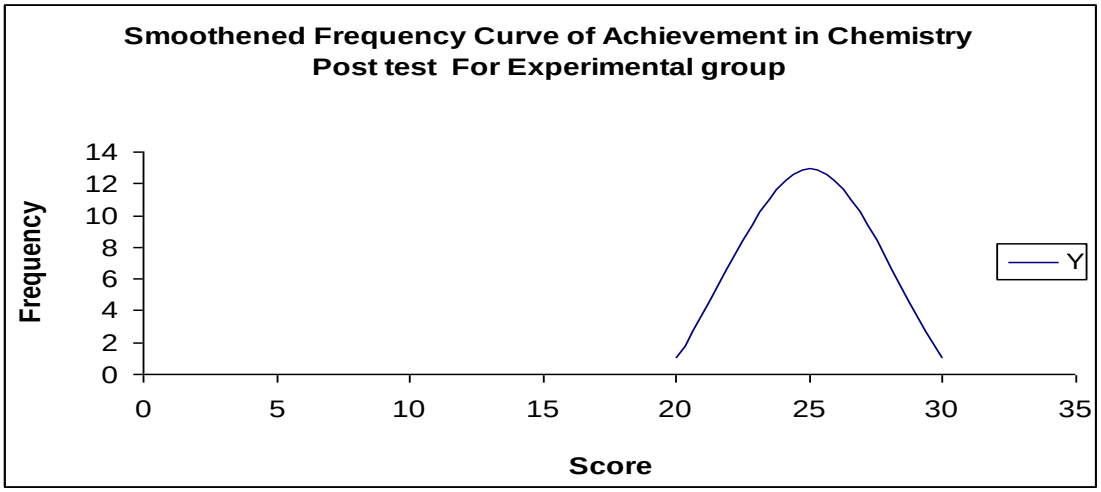


Figure 4.5 - Frequency Curve of Achievement in Chemistry post test for control group.

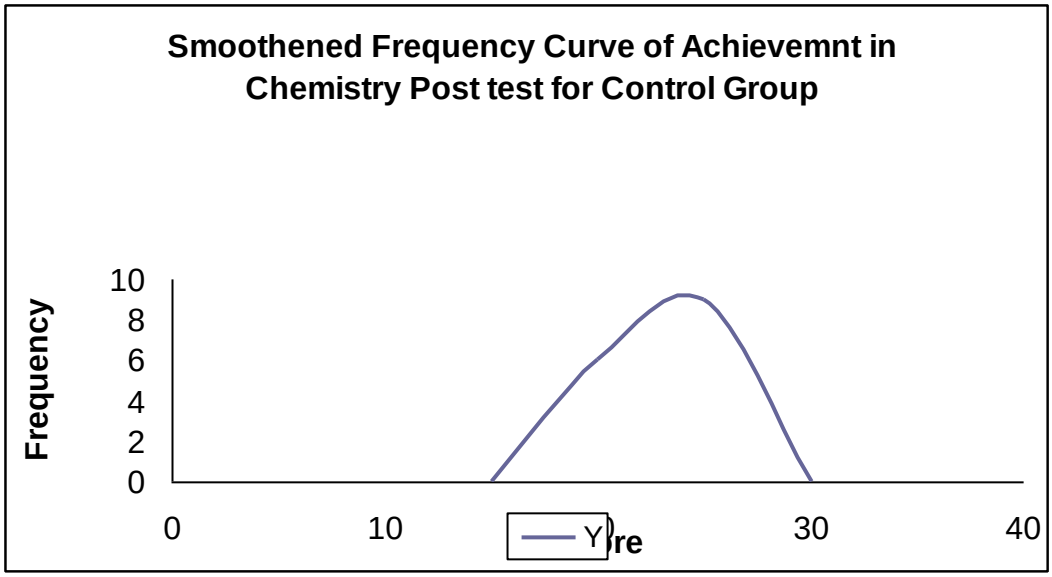


Figure 4.6 - Frequency Curve of Achievement in Chemistry post test for whole sample

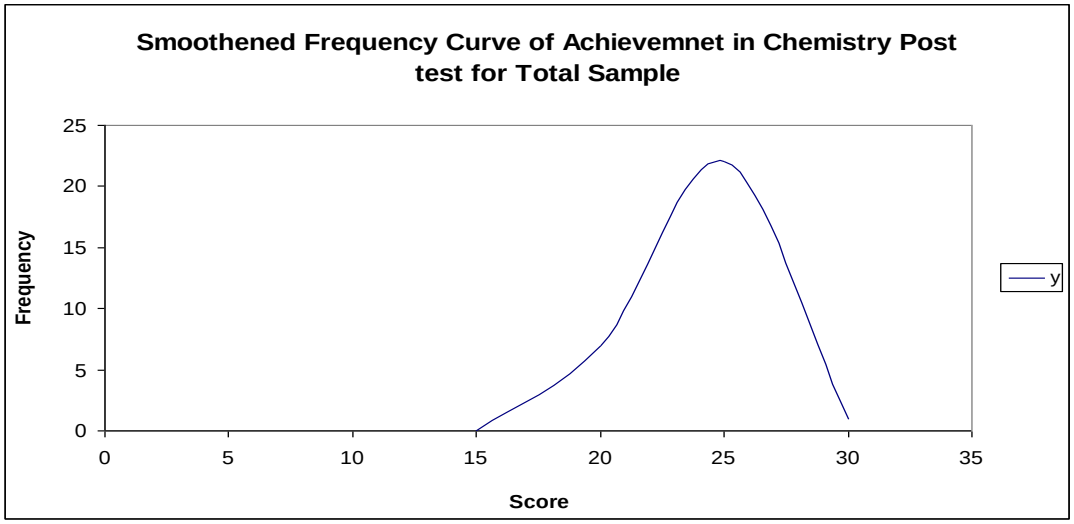
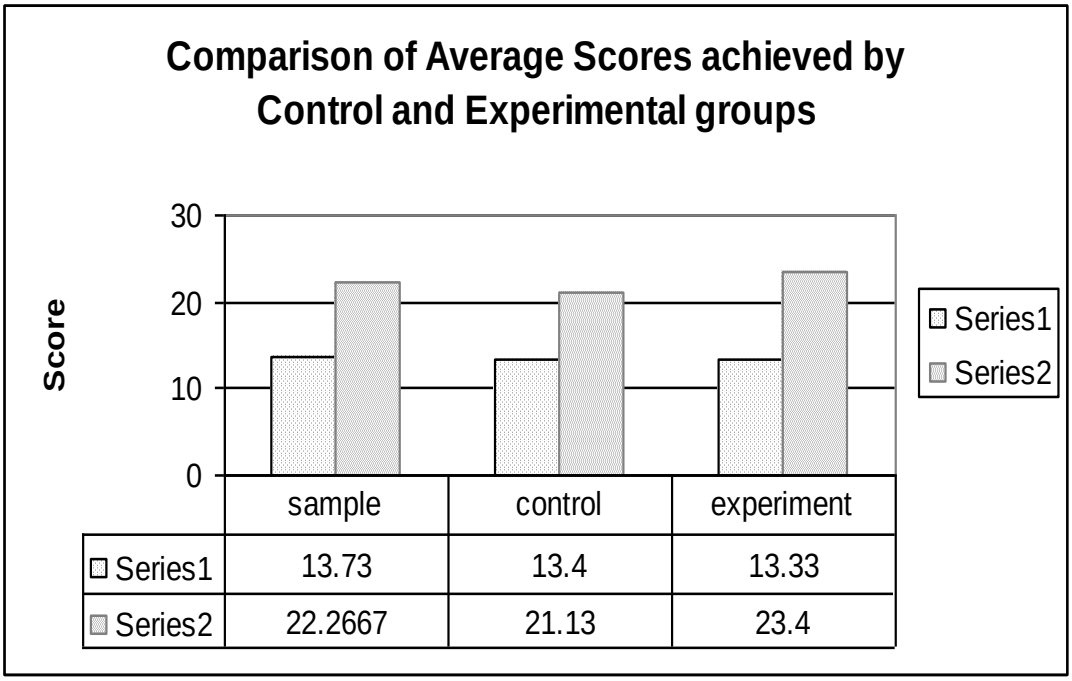


Figure 4.7 graphically compare the scores of the control and experimental groups in pre test and post test.



Testing Of Hypotheses

The first null hypotheses formulated by the investigator was

"There will be no significant difference in the performance in the achievement test by the experimental and the control group."

The alternative hypotheses for the same may be

"There is a significant difference in the performance in the achievement test by the experimental and the control group."

To test the null hypotheses the two tailed t-test for small but independent sample was used at a significant level of 5%.

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Table 4.2 - t –test analysis of experimental and control group

Group	Number	Mean	S.D.	t-value	Table value	Result at 5% level
Experimental	**15**	**23.4**	**1.6818**	**3.8147**	**2.05**	**Significant**
Control	**15**	**21.13**	**1.5976**			

From the table, the critical value of t with 28 degrees of freedom at 5% level of significance is 2.05. our computed value of t is 3.8147 which is quite larger than the critical table value 2.05 and hence is significant. Therefore, the null hypothesis can be rejected and as a result, the given difference in sample being significant, alternate hypothesis is accepted.

The second null hypotheses formulated by the investigator was :

"There will be no significant difference in the performance of experimental group in the pre test and post test."

The alternative hypotheses for the same may be

"There is a significant difference in the performance of experimental group in the pre test and post test.."

To test the null hypotheses the two tailed t-test for small but independent sample was used at a significant level of 5%.

Table 4.3- t –test analysis of pre test and post test of experimental group

Test	Number	Mean	S.D.	t-value	Table value	Result at 5% level
Pre test	**15**	**13.33333**	**1.7182**	**-16.3366**	**2.05**	**Significant**
Post test	**15**	**23.4**	**1.6818**			

From the table, the critical value of t with 28 degrees of freedom at 5% level of significance is 2.05. our computed value of t is **16.3366** which is quite larger than the critical table value 2.05 and hence is significant. Therefore, the null hypothesis can be rejected and as a result, the given difference in sample being significant, alternate hypothesis is accepted.

The high difference in this average is because before the pre test, the sample don't had an experience with that topic thoroughly. So after the exposure of the topic, they achieved a good score. The pre test and post test scores of the control group also may show a significant difference because of the same reason. It is checked in the table 4.4.

Table 4.4- t –test analysis of pre test and post test of control group

Test	Number	Mean	S.D.	t-value	Table value	Result at 5% level
Pre test	**15**	**13.4**	**1.8822**	**7.0316**	**2.05**	**Significant**
Post test	**15**	**21.13**	**1.5976**			

Chapter V

RESULTS AND DISCUSSION

Introduction

The experimental design reveals the effectiveness of the methods and impact of mathetic learning package in the field of Chemistry. According to the data analysis, the hypotheses were reformulated and the possible reasons for the results were discussed here.

RESULTS

Hypotheses

The hypotheses suggested in this investigation were,

1. There will be no significant difference in the performance in the achievement test by the experimental and the control group.
2. There will be no significant difference in the performance of experimental group in the pre test and post test.

Reformulated Hypotheses

On the basis of the statistical analysis, the hypotheses were reformulated as follows,

1. There is a significant difference in the performance in the achievement test by the experimental and the control group.
2. There is a significant difference in the performance of experimental group in the pre test and post test.

Findings

From the investigation, the following facts were found by the investigator.

- The students feel more interest towards new methods of teaching.
- The achievement of the students who learned the chemistry topics through mathetic learning package was higher than that of the students who learned through the traditional method.
- The students scored more in achievement test after conducting the lessons either by mathetical approach or by conventional method, but the mean score of students who learned through mathetical method was higher.
- The teacher was engaged in the mathetical class room, clearing the doubts of the learners and in guiding them in proper ways.
- The class room was very quite in the mathetical learning method where the learners were busy in finding the answers, reading the lessons and evaluating themselves.

Discussion on findings

Even the statistical analysis shows that mathetical learning package has good effect on the achievement of students, the mean score in the post test of control group and experimental group has a small difference only. It is because the control group was lead in a constructivist method where more interaction and discussions between the teacher and learner occurs.

The conventional class room was noisy because of the doubts of the students and the freedom used by them in the constructivist method of learning. The teacher was so busy with each student who even comes forward to the class rooms from their positions.

SUGGESTIONS FOR FURTHER STUDIES

The following suggestions are given in the light of investigation for the usage in future:

1. The study can be extended over a large number of variables like rural and urban students, male and females, aided and government schools, mathetic and other programmed learning method, mathetic and other teaching methods etc
2. The study can be elaborately done by taking more number of samples from different kinds of schools.
3. The study can be conducted without the use of computer and can be compared with the effect on computerized learning package.

SUMMARY

The investigation conducted in the achievement in Chemistry through Mathetical Learning Package Can be summarized as follows:

Chapter I presents a brief introduction of the problem, the theoretical back ground of the study area, need and significance of the current study, definition of the key terms, Different tools adopted and constructed for the investigation, brief discussion about the methodology adopted for the study and the sample selected for the purpose of study, scope and limitations of the study and the overall arrangement of the report works. This helps the readers to have an introductory idea about the kind of work done by the investigator. A theoretical overview on Mathetics also included in this chapter along with the discussion about similar kind of teaching methods.

A survey of related studies pertaining to the study is presented in the second chapter. The topics were divided in to four main headings and discussed. In the first heading, previous studies conducted on different kinds of individualized learning and individualized instruction methods are discussed. Investigator represents the findings of the researches in the field of effectiveness of programmed learning under the second heading. Studies on different modes of programming and its effectiveness discussed along with the studies on the psychological learning problems with the help of programmed learning materials were given in this chapter.

Chapter III describes the methodology adopted for the study in detail. The objectives, the hypotheses formulated in terms of objectives, the variables included ,

design of the study, selection of sample, tools employed for collection of data in the study and the statistical techniques needed for the study were included in this chapter.

Construction and validation of the mathetic learning package and its administration is discussed in this chapter along with the construction, validation and administration of the achievement test in chemistry.

The results of analysis made in accordance with the objectives stated and the hypotheses formulated are explained in the chapter IV. For the analysis, deferential statistics and t test were used. The data were presented with the help of graphs and tables.The chapter V gives a summary of procedure adopted and also attempts at the examining the tenability of the hypotheses followed by conclusions arrived at are presented in this chapter. Suggestions made for implementation and recommendations for further research are also given in the last chapter.

The findings of the study were concluded as follows;

The students feel more interest towards new methods of teaching. The achievement of the students who learned the chemistry topics through mathetic learning package was higher than that of the students who learned through the traditional method. The students scored more in achievement test after conducting the lessons either by mathetical approach or by conventional method, but the mean score of students who learned through mathetical method was higher. The teacher was engaged in the mathetical class room, clearing the doubts of the learners and in guiding them in proper ways. The class room was very quite in the mathetical learning method where the learners were busy in finding the answers, reading the lessons and evaluating themselves.

Chapter VI gives the list of references made use by the investigator during the investigation , review collection and report writing.

CHAPTER VI

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Appendix I

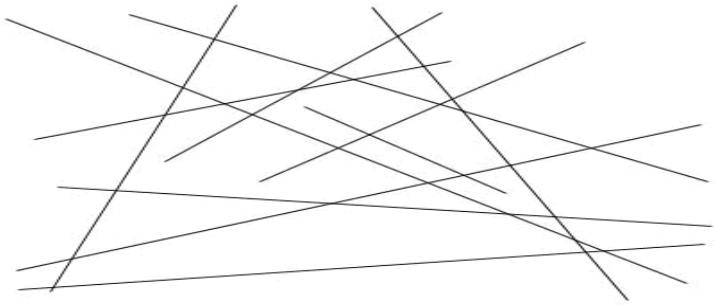
I.Q Test for Students.

Instructions:

1. **You will have 40 minutes to answer 20 questions.**.
2. Use blue/black ball point pen to answer the questions.
3. Mark the option in answer sheet (A, B, C ,D or E) as shown in the response sheet or write the numbers or digits in the column.
4. Do not write or mark anything in the question paper.
5. **You can skip questions if needed.**

question 1

How many lines appear below?



question 2

Which number is the odd one out?

5472 7869 3517 3342 4523 5849 6684

question 3

You have 68 cubic blocks. What is the minimum number that needs to be taken away in order to construct a solid cube with none left over?

question 4

Which is the odd one out?

A	Square
B	Triangle
C	Pentagon
D	Hexagon
E	Cube
F	Octagon

question 5

Choose which of the five words is the odd one out:

A	Perfect
B	Satisfactory
C	Fine
D	Suitable
E	Acceptable

Question6

Isochore is to volume as isobar is to:

A	Atmosphere
B	Current
C	Latitude
D	Pressure
E	Frequency

question 7

How many minutes is it before 12 noon, if 44 minutes ago it was three times as many minutes past 9 a.m.?

question 8

Fill the gaps with two numbers:

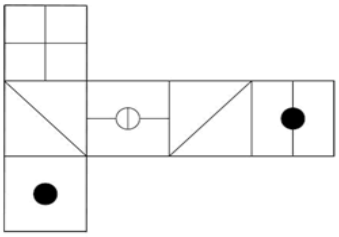
10, 20, 23, 46, 49, 98, 101, ____ , ____

question 9

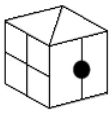
Joe has three times as many as Tom, and Tom has four times as many as Mary. Altogether they have 153. How many has each?

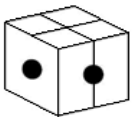
Mary has _____ Tom has _____ Joe has _____

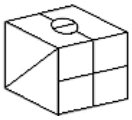
question 10

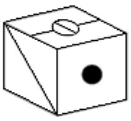


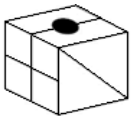
When the above is folded to form a cube, which is the only one of the following that can be produced?

A 

B 

C 

D 

E 

question 11

Choose just one word from the five words below that is most opposite in meaning to the word BRUTAL

A	Happy
B	Varying
C	Patient
D	Civil

E	Humane

question 12

Choose just the two words from the six words provided that are closest in meaning

A	Denounce
B	Abandon
C	Rectify
D	Relinquish
E	Misuse
F	Truncate

question 13

Using the five letters below only, create a nine-letter word.

NARIB

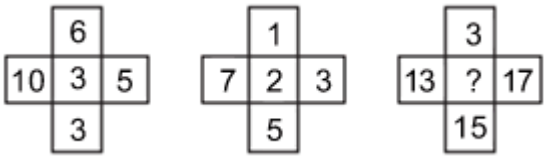
question 14

The English language has at least one nine-letter word that remains a valid word as each of its letters is successively removed, right down to a single letter. Select this word from the list below:

A	Sandblast
B	Undoubted
C	Refunding
D	Adaptable
E	Startling

question 15

What number should replace the question mark?



question 16

Which three of the pieces below, when fitted together, will form a perfect circle?

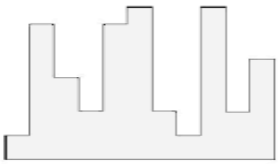
A 

B 

C 

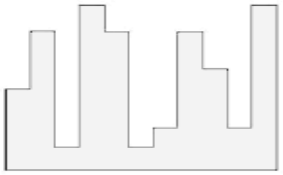
D 

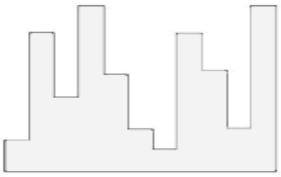
question 17

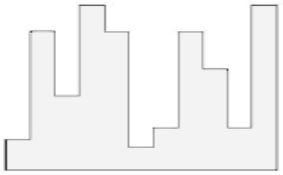


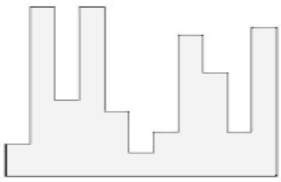
Which piece below, when fitted into the piece on the left, will form a perfect square?

A 

B 

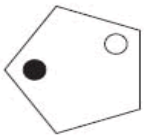
C 

D 

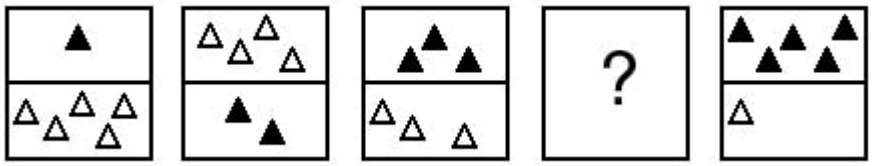
E 

question 18

The white dot moves two places anti-clockwise at each stage and the black dot moves one place clockwise at each stage. After how many stages will they be together in the same corner?



question 19



Which is missing?

A 

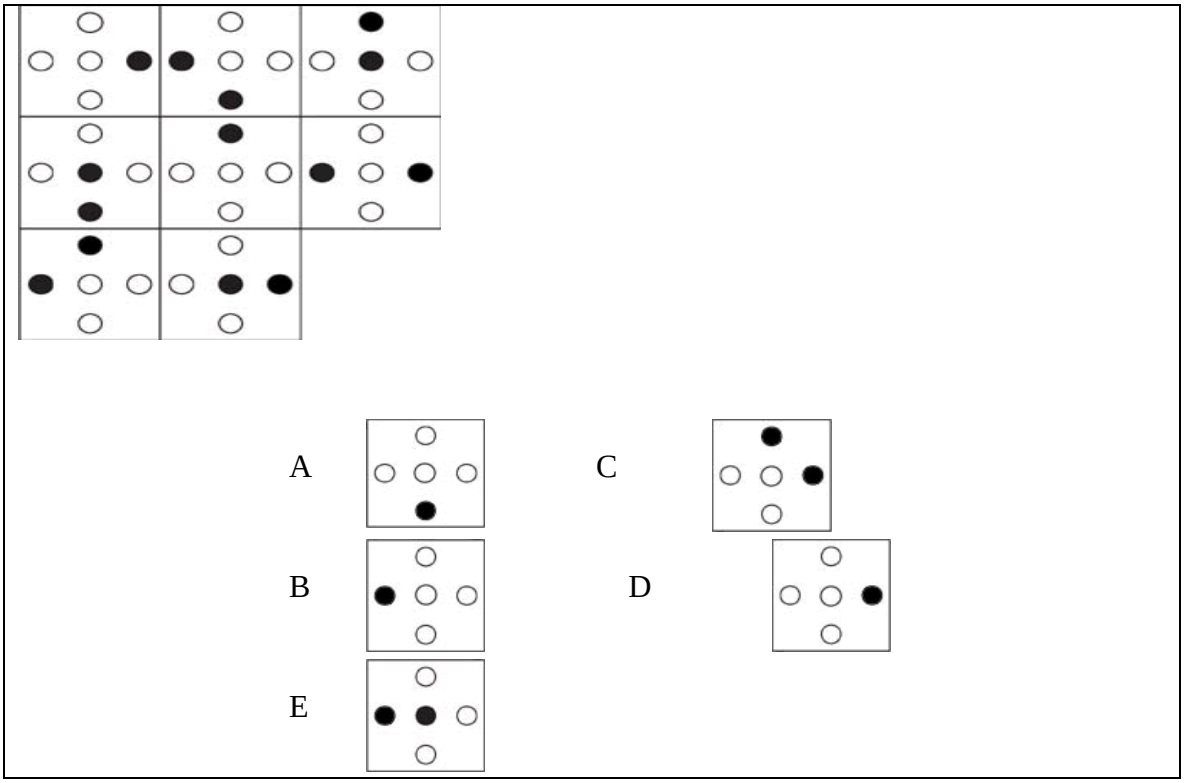
C 

B 

D 

question 20

Which is the missing tile?



Answer Key for I.Q. test

Question	Response					
01	11					
02	4523					
03	4					
04					E	
05	A					
06				D		
07	91					
08	202, 205					
09	Mary	9	Tom	36	Joe	108
10					E	
11					E	
12			D			
13	barbarian					
14					E	
15	6					
16	A	B	C			
17		B				
18	4					
19				D		
20	A					

Percentage of population	***Correct answers***	***Rating***
0.6%	18-20	Exceptional
less than 2%	15-17	Excellent
5%	13-14	Very good
9%	10-12	Good
10%	7-9	Above average
50%	5-6	Average
25%	0-4	Below average

Appendix II

Answer Sheet

Name:……..

Class: …….. Standard:……

School:…….

Give your Response with the help of a cross mark (X) as shown in example.

If your answer is B in question 21, give a cross mark as shown

21	A	B	C	D	E

Question	Response					
01						
02						
03						
04	A	B	C	D	E	F
05	A	B	C	D	E	F
06	A	B	C	D	E	F
07						
08						
09	Mary	___	Tom	___	Joe	___
10	A	B	C	D	E	F
11	A	B	C	D	E	F
12						
13						
14	A	B	C	D	E	F
15						
16	A	B	C	D	E	F
17	A	B	C	D	E	F
18						
19	A	B	C	D	E	F
20	A	B	C	D	E	F

Percentage of population	***Correct answers***	***Rating***
0.6%	18-20	Exceptional
less than 2%	15-17	Excellent
5%	13-14	Very good
9%	10-12	Good
10%	7-9	Above average
50%	5-6	Average
25%	0-4	Below average

Appendix III

Achievement Test for XI standard

Draft

Subject: Chemistry

Time: 45 minutes.

Instructions:

1. Answer all the questions.
2. Use blue/black ball point pen to answer the questions.
3. Mark the option in answer sheet (A, B, C or (D) as shown in the response sheet/ write the answer in the given space.
4. Do not write or mark anything in the question paper.
5. This is a test to check your previous knowledge only, not to asses you. So be sincere in your answering

Questions:

1. The most distributed element is _____.

(A) Sulphur (B) Iodine (C) Carbon (D) Chlorine

2. The atomic number of Carbon is ?

(A) 2 (B) 4 (C) 6 (D) 8

3. Which element is the essential constituent of living organisms?

(A) Carbon (B) Iodine (C) Sulphur (D) Chlorine

4. Diamond and graphite are the form of _____

(A) Iodine (B) Sulphur (C) Chlorine (D) Carbon

5. Existence of substance in various physical form but same chemical form is known as

(A) Allotropy (B) Isotropy (C) Geotropy (D) Autotropy

P.T.O

6. Chemistry of carbon compounds are defined as

(A) Biochemistry (B) inorganic chemistry

(C) Organic chemistry (D) Physicalchemistry

7. Examples for a good conductor which is not a metal is

(A) Diamond (B) Graphite (C) Sulphur (D) Wood

8. Fullerin is the allotropic form of _____

(A) Chlorine (B) Iodine (C) Sulphur (D) Carbon

9. Valency of Carbon is

(A) 2 (B) 4 (C) 6 (D) 8

10. The atoms or group of atoms which defines the function of a compound is called as

(A)Main group (B) subgroup (C) elementary group (D)functional group

11. An example for functional group

(A) CH_3 (B) C_2H_6 (C) –OH (D) H_2O

12. The property of Carbon to form successive bonds with other Carbon atom to form chain of varying length and shapes called as

(A) Alteration (B) Catenation (C) Anoination (D) Covalent bond

13. The compound only having Hydrogen and carbon are known as

(A) Carbohydrate (B) Hydrocarbon (C) Hydro carbonate (D) Hydrates

14. Alcohol has a functional group

(A) –COOH (B) $–H_2O$ (C) –O- (D) –OH

15. Benzene is an example for _____ compound.

(A) Aliphatic (B) Alicyclic (C) Aromatic (D) Heterocyclic

16. –COOH is the functional group of

(A) Acid (B) Alcohol (C) Ether (D) Ester

17. CH_3-CH_2-CH_3 is called as

(A)Ethylene (B) Acetylene (C) Propane (D) Propene

18. Alkanes are …….. class of organic compounds.

(A)Aliphatic (B) Aromatic (C) cyclic (D) alicyclic

19. The alkane having only one carbon atom is called as…..

(A) Ethane (B) methyne (C) methane (D) ethyne

20. The alkane having two carbon atom is called as ……

(A)ethane (B) ethylene (C)methane (D)methylene

21 . An example for hydrocarbon is

(A) Alkanes (B) Benzene (C) Amine (D) Iodine

22. The alkane having three carbon atom is called as …..

(A) ethylene (B) propane (C) 2-methylethane (D) propylene

23. The compound having similar structure arranged in order of increasing molecular weight is called as

(A) Heterologous (B) Leguminous (C) Psychologous (D) Homologous

24. The alkane having four carbon atom is called as….

(A)Propylene (B) butene (C)2-methylpropane (D) propylene

25. Butane have –--- carbon atoms

(A)1 (B)2 (C) 3 (D) 4

P.T.O

26. Compounds having the same molecular formula but differed from each other in physical or chemical properties are called as

(A)Monomer (B) polymer (C) dimer (D) isomer

27 2-methylbutane is an alkane having…….. carbon atoms

(A)2 (B)3 (C)4 (D)5

28. Pentane is an alkane having.. carbon atoms

(A)2 (B)3 (C)4 (D)5

29. One of the synonyms for two is

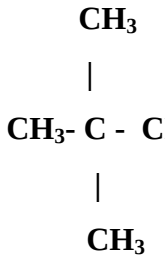
(A) Mono (B)Tetra (C) Tri (D) Di

30. Alkane having six carbon atoms is called as…

(A) butane (B)propane (C) hexane (D)propyne

31. The alkane having six carbon atom is called as

(A) 1-methylhexan (B) 2 –methyl hexane (C) 2- methylpentane (D) 2-ethylbutane

32.  has IUPAC name as….

(A) 1-methylbutane (B)2,2-dimethylproapne

(C) 1,1-dimethylpropane (D)1,2-dimethylpropane

33. The Greek number for two is

(A) Meth (B) Eth (C) Prop (D) But

34. CH_3-CH_2-CH_3 is called as

(A)Ethylene (B) Acetylene (C) Propane (D) Propene

35. The acid present in red ant

(A) Acetic (B) Lactic acid (C) formic acid (D) Ethanoic acid

36. CH_3-CH-CH_3 is having the name

|

CH_3

(A) Iso butane (B) Neo pentane (C) iso Propane (D) n-butane

37. The compound present in urine is

(A) Urea (B) Ammonia (C) Thio urea (D) Potash

38 . CH_3-CH_2-OH is called as

(A) Ethanol (B) Methanol (C) Propanol (D) butanol

39. **C H_3**

|

CH_3- CH - CH–CH_3 has the IUPAC name…….

|

CH_3

(A)2-methylbutane (B)2,3-dimethylbutane

(C)2,2-dimethylbutane (D)2,3-dimethylpentane

40. . **C H_3**

|

CH_3- C – CH_2–CH_3 has the IUPAC name……..

|

CH_3

(A)2,2-dimethylbutane (B)3,3-dimethylbutane

(C)2,3-dimethylbutene (D)1,2-dimethylbutane

P.T.O

41. **CH_3- CH - CH_2 - CH- CH_2 - CH_3** what will be the IUPAC name of this compound?

| |

CH_3 **CH_2 –CH_3**

42. Write the IUPAC name of CH_3- CH - CH -CH_2 - CH- CH_2 - CH_3

| | |

CH_3 CH_3 CH_2 –CH_3

43 Write the IUPAC name of CH_3- CH - CH_2 -CH_2 - CH- CH_2 - CH_3

| |

CH_3 CH_2 –CH_3

44. CH_3-COOH is called as

(A) Formic acid (B) Acetic acid (C) Propanoic acid (D) Methanoic acid

45 CH_3-CH_2Cl is called as

(A) Chloromethane (B) 1-Chloromethane (C) 1-Chloroethane (D) Chloropropane

CH_3

|

46 . CH_3-CH-CH-CH-CH_3 is called as

|

CH_3

(A)1,2- di methyl butane (B) 2,1-di methyl pentane

(C) 1-Chloro ethane (D) Chloro propane

47 Predict the IUPAC name of CH_3- CH - CH_2 - CH- CH_2 -CH_3

| |

CH_3 CH_2 – CH_2 - CH_3

48. .IUPAC mean,

(A) Inter national Unit for pure and analytical chemistry

(B) Inter national Union for pure and analytical chemistry

(C) International Unit for pure and applied chemistry

(D) International Union for pure and applied chemistry

49. CH_3- CH - CH– CH - CH_3 has the IUPAC name…….

CH_3 CH_3 CH_3

(A)1,2-dimethylpentane (B)2,3,4-trimethylpentane

(C)2,3,4-trmethylhexane (D)2,2,5-trimethylbutane

50. Formic acid is the ……..name of H-COOH

(A) IUPAC (B) trivial (C)Arabian (D)Systematic

51. CH_4 is named as

(A) Methane (B) Ethane (C) Methene (D) Ethene

52. Match the following.

di	prop	four
tetra	eth	three
tri	but	two

Appendix IV

Answer Sheet -Test-2

Name:……..

Class: …….. Standard:……

School:…….

Give your Response with the help of a cross mark (X) as shown in example.

If your answer is B in question 39, give a cross mark as shown

39	A	B	C	D
	X			

Question	Response			
01	A	B	C	D
02	A	B	C	D
03	A	B	C	D
04	A	B	C	D
05	A	B	C	D
06	A	B	C	D
07	A	B	C	D
08	A	B	C	D
09	A	B	C	D
10	A	B	C	D
11	A	B	C	D
12	A	B	C	D
13	A	B	C	D
14	A	B	C	D
15	A	B	C	D
16	A	B	C	D
17	A	B	C	D
18	A	B	C	D
19	A	B	C	D
20	A	B	C	D

Question	Response			
21	A	B	C	D
22	A	B	C	D
23	A	B	C	D
24	A	B	C	D
25	A	B	C	D
26	A	B	C	D
27	A	B	C	D
28	A	B	C	D
29	A	B	C	D
30	A	B	C	D
31	A	B	C	D
32	A	B	C	D
33	A	B	C	D
34	A	B	C	D
35	A	B	C	D
36	A	B	C	D
37	A	B	C	D
38	A	B	C	D
39	A	B	C	D
40	A	B	C	D

Qn	Response			
41				
42				
43				
44	A	B	C	D
45	A	B	C	D
46	A	B	C	D
47				
48	A	B	C	D
49	A	B	C	D
50	A	B	C	D
51	A	B	C	D
52				

Appendix V

LESSON PLAN -1

Name of the teacher: Jijish Elias	**Standard**: XI
Name of the School: Kalladi H.S.S. Kumaramputhur.	**Strength**: 20
Subject: Chemistry	**Date:**
Unit: Organic Compounds- Naming and Isomerism	**Period:**
Topic: Naming of chainless alkanes	**Time:** 45 minutes

CONTENT ANALYSIS

1. TERMS:

Chain Isomers, Word Root

2. FACTS:

i. The valency of carbon is four.
ii. Carbon forms covalent bonds in its compounds.
iii. Carbon atom can form single bonded, double bonded and triple bonded compounds
iv. Carbon atoms exhibit the property of Catenation.
v. Hydrocarbons contains only carbon and hydrogen
vi. Hydrocarbons are classified into alkanes, alkenes and alkynes

3. CONCEPTS

i. Isomers are the compounds having same molecular formula and different structural formula

ii. By adding –ane to the word root of the saturated hydrocarbon, one alkane's name can be derived.

4. DEFINITIONS

The saturated hydrocarbons in which single bonds alone present are called as alkanes.

PROCESS SKILLS

Observing

Communicating

Predicting

Classifying

Inferring

CURRICULAR OBJECTIVES

1. Students understand how to derive IUPAC names for chainless alkanes.
2. Gain the process skills like observing, predicting etc.
3. Apply the knowledge learnt, in daily life
4. Created right attitude towards science
5. Pupils achieve creative skills.

PRE REQUISITES

Pupil has the knowledge about isomers and hydrocarbons.

INSTRUCTIONAL AIDS

Charts, tables etc

<table>
<tr><th>CLASSROOM INTERACTION PROCEDURE</th><th>EVALUATION / RESPONSE</th></tr>
<tr><td>
Teacher starts the class with a puzzling situation in which the students are requested to find out the product masked in his hands from the clues given.

1. You are using this frequently.
2. All chemistry students need this .
3. Physics students also need this some times.
4. Elements are the basic structures of this thing.

Class continues with the discussion about Periodic Table. Pupils tabulates the need and use of Periodic Table. Similarly, they discuss about the need of handling Organic Compounds in the subject.

Students clarify the rules and regulations in the IUPAC nomenclature while discussing with the teacher.

Teacher presents the word roots needed for IUPAC nomenclature and pupils understands and learns the word roots.
<table>
<tr><td>C_1 – Meth</td><td>C_6 – Hex</td></tr>
<tr><td>C_2 – Eth</td><td>C_7 – Hept</td></tr>
<tr><td>C_3 – Prop</td><td>C_8 – Oct</td></tr>
<tr><td>C_4 – But</td><td>C_9 – Non</td></tr>
<tr><td>C_5 – Pent</td><td>C_{10} – Dec</td></tr>
</table>
Pupil discusses and learns about the stages in IUPAC nomenclature. They understands that while naming an
</td><td></td></tr>
</table>

alkane, the prefix –ane should be added in front of the word root.

Teacher gives tables and directions. Then distributes the tables to student groups.

Compound	Word root	Prefix	Name
CH_4 **$CH_3 – CH_3$** **$CH_3 - CH_2 - CH_2 - CH_3$** **$CH_3 -CH_2 –CH_2-CH_2-CH_3$** **$CH_3 -CH_2 -CH_2–CH_2-CH_2$** **. CH_3** **$CH_3 -CH_2 -CH_2–CH_2-CH_2$** **. $CH_3– CH_2–CH_2$**	Meth	ane	Methane

From the table, pupil learns more about the naming of alkanes in IUPAC system.

MORE ACTIVITIES

Find out the IUPAC naming as well as the common names if any for straight chain alkanes having ten or less carbons.

Appendix VI

LESSON PLAN -2

Name of the teacher: Jijish Elias	**Standard**: XI
Name of the School: Kalladi H.S.S. Kumaramputhur.	**Strength**: 20
Subject: Chemistry	**Date:**
Unit: Organic Compounds- Naming and Isomerism	**Period:**
Topic: Naming of branched alkanes	**Time:** 45 minutes

CONTENT ANALYSIS

1. TERMS:

Methyl, Ethyl, Propyl, di, tri

2. FACTS:

i. IUPAC names of alkanes can be derived from word roots by adding suffix - ane
ii. There are alkanes with branches also
iii. The branches may have any number of carbons
iv. While naming an alkane with branch, the position of branch should be indicated..

3. CONCEPTS

i. The word indicating the branch is prefixed to the word root.
ii. The position of carbon on which the branch is present also indicated before the prefix which belongs to a particular branch.

PROCESS SKILLS

Observing

Communicating

Predicting

Classifying

Inferring

CURRICULAR OBJECTIVES

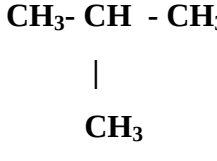
1. Students understand how to derive IUPAC names for branched alkanes.
2. Gain the process skills like observing, predicting etc.
3. Apply the knowledge learnt, in daily life
4. Created right attitude towards science
5. Pupils achieve creative skills.

PRE REQUISITES

Pupil has the knowledge about naming of straight chain alkanes.

INSTRUCTIONAL AIDS

Charts, tables etc

CLASSROOM INTERACTION PROCEDURE	**EVALUATION / RESPONSE**
Teacher starts the class with discussion about the naming of branched alkanes, and collects the views of students. Students name the compound  with the help of teacher and learns the procedure for naming of branched alkanes.	

Teacher gives tables and directions. Then distributes the tables to student groups.

Compound	carbon having branch	Name of branch	Word root	Name of compound
CH_3-CH -CH_2 - CH_3 | CH_3 CH_3-CH-CH_2-CH_2 -CH_3 | CH_3 CH_3-CH -CH - CH_3 | | CH_3 CH_3				

From the table, pupil learns more about the naming of branched alkanes in IUPAC system.

More examples are worked out.

MORE ACTIVITIES

Find out the IUPAC names .

CH_3- CH - CH_2 - CH- CH_3
\| \|
CH_3 CH_2 –CH_3

CH_3- CH - CH_2 – CH - CH_2 - CH_3
\| \|
CH_3 CH_3

Appendix VII

Mathetic Learning Package- Hard Copy

Page 1.

Introduction

This is a material which help you to learn the IUPAC naming pattern of simple organic compounds like alkanes. As you know, organic compounds are separated into two main category, viz aliphatic compounds and aromatic compounds. Aliphatic compounds are again classified into alkanes, alkenes and alkynes.

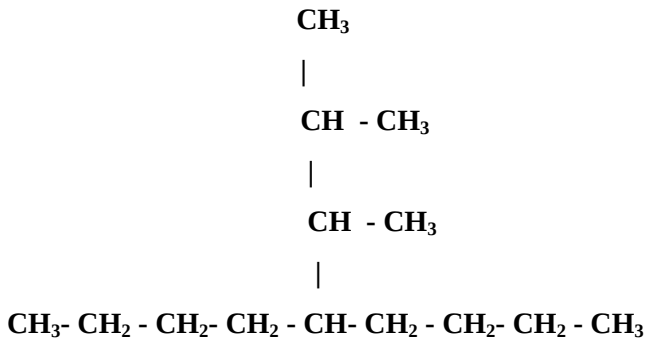
In this material, we are going to learn the naming of alkanes. You should read each page/frame carefully. In some pages/frames, you will find some gaps or blanks (……). You should fill those blanks according to your experiences in the first or previous pages. You should go only in the sequential order. If you are requested to go to any previous pages, you should go to that page, complete that task and continue your work.

All the best…..

Pleas go to next page…

Page 2:

Question: Write the IUPAC (International Union For Pure and Applied Chemistry) name for the following Alkane.

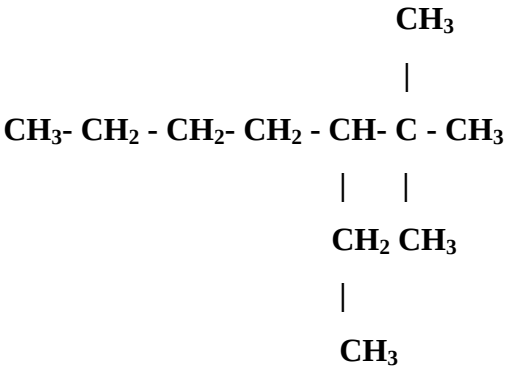


Observation	Response
1. The main chain is having 9 carbon atoms.	nonane
2. The branch is on the 5^{th} carbon	5-nonane
3. The substituent at 5^{th} carbon is complex and should be named separately. 3a. In the substituent, the main chain having three carbon atoms. 3b. There are two methyl branches. 3c. The methyl branches are at 1^{st} and 2^{nd} carbon of propyl group. 3d. Since it is a substituent branch, the position of methyl groups should be have primes	Propyl Dimethylpropyl 1,2-dimethyl propyl 1',2'-dimethylpropyl
4. Since the branch at 5^{th} carbon of main chain is 1',2'-dimethylpropyl, the name of the alkane will be **5-(1',2'-dimethylpropyl)-nonane.**	

Pleas go to Next page….

Page 3:

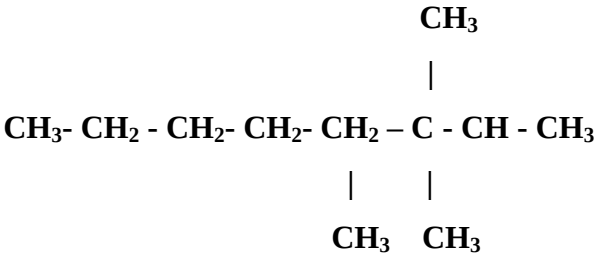
Question: Write the IUPAC name for the following Alkane.



Observation	Response
1. The main chain is having 7carbon atoms.	heptane
2. The branches are on 2nd and 3rd carbons.	2,3-heptane
3. The substituents are not complex, so named directly.	
3a. The substituent on 3rd carbon is having two carbons	3-ethyl
3b. There are two methyl branches.	Dimethyl
3c. The methyl branches are at 2nd carbon of main skeleton.	2,2-dimethyl
3d. Since ethyl group comes first in alphabetic order, it gets preference.	3-ethyl-2,2,-dimethyl
4. Since the branch is 3-ethyl-2,2,-dimethyl, the name of the alkane will be **3-ethyl-2,2,-dimethylheptane.**	

Pleas go to Next page….

Question: Write the IUPAC name for the following Alkane.

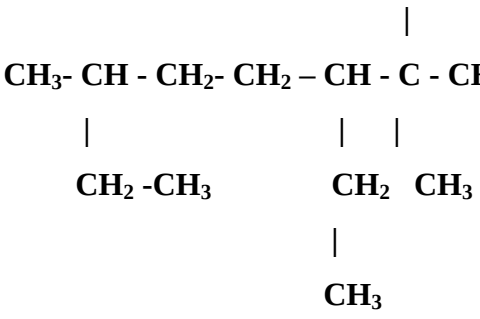


Observation	Response
1. The main chain is having 7carbon atoms.	octane
2. The branches are on 2^{nd} and 3^{rd} carbons.	2,3-octane
3. The substituents are not complex, so named directly. 3a. Ther are three methyl groups 3b. There are two methyl branches at 2^{nd} carbon. 3c. The methyl branch is present at 3^{rd} carbon also of main skeleton.	trimethyl 2,2-trimethyl 2,2,3-trimethyl
4. Since the branch is 2,2,3-trimethyl, the name of the alkane will be **2,2,3-triimethyloctane.**	

Pleas go to Next page….

Page 5:

Question: Write the IUPAC name for the following Alkane.

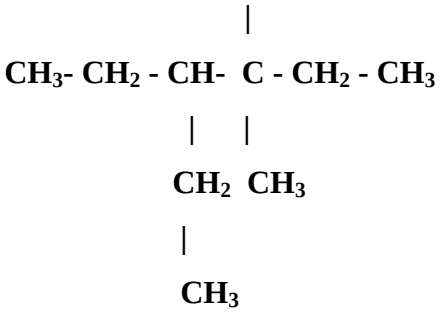


Observation	Response
1. The main chain is having 10carbon atoms.	decane
2. The branches are on 4^{th},5^{th} and 8^{th} carbons.	4,5,8-decane
3. The substituents are not complex, so named directly.	
3a. The substituent on 4^{th} carbon is having one carbons	4-methyl
3b. There are three methyl branches.	trimethyl
3c. The methyl branches are at $4^{th,}$ 4^{th} and 8^{th} carbon of main skeleton.	4,4,8-trimethyl
3d. The substituent on 5^{th} carbon is having two carbons	5-ethyl
3e. Since ethyl group comes first in alphabetic order, it gets preference.	5-ethyl-4,4,8-trimethyl
4. Since the branch is 5-ethyl-4,4,8-trimethyl, the name of the alkane will be **5-ethyl-4,4,8-trimethyldecane.**	

Pleas go to Next page….

Page 6:

Question: Write the IUPAC name for the following Alkane.

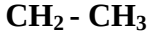


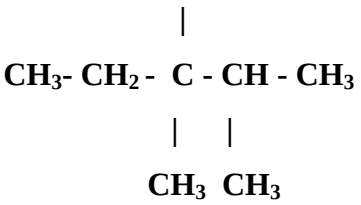
Observation	Response
1. The main chain is having 6 carbon atoms.	hexane
2. The branches are on 3rd and 4th carbons.	3,4,-hexane
3. The substituents are not complex, so named directly. 3a. The substituent on 3rd carbon is having one carbons 3b. There are two methyl branches. 3c. The methyl branches are at 3rd and 3rd carbon of main skeleton. 3d. The substituent on 4th carbon is having two carbons 3e. Since ethyl group comes first in alphabetic order, it gets preference.	 3-methyl dimethyl 3,3-dimethyl 4-ethyl 4-ethyl-3,3-dimethyl
4. Since the branch is 4-ethyl-3,3-dimethyl, the name of the alkane will be **4-ethyl-3,3-dimethylhexane.**	

Pleas go to Next page….

Page 7:

Question: Write the IUPAC name for the following Alkane.



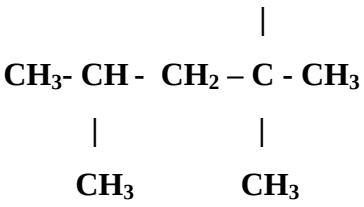


Observation	Response
1. The main chain is having …….. carbon atoms.	pentane
2. The branches are on 2nd and 3rd carbons.	2,3-pentane
3. The substituents are not complex, so named directly. 3a. The substituent on 2nd carbon is having one carbon. 3b. There are two methyl branches. 3c. The methyl branches are at 2nd and 3rd carbon of main skeleton. 3d. The substituent on 3rd carbon is having two carbons 3e. Since ethyl group comes first in alphabetic order, it gets preference.	 2-methyl ……. 2,3-dimethyl 3-ethyl 3-ethyl-3,2-dimethyl
4. Since the branch is 3-ethyl-2,3-dimethyl, the name of the alkane will be **3-ethyl-2,3-dimethylpentane.**	

Pleas go to Next page….

Page 8:

Question: Write the IUPAC name for the following Alkane.

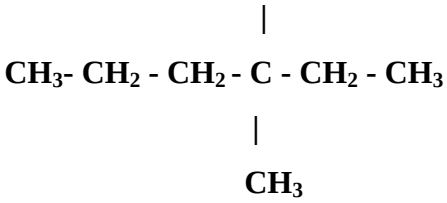


Observation	Response
1. The main chain is having 5 carbon atoms.	…….
2. The branches are on …… and ……. carbons.	
3. The substituents are not complex, so named directly. 3a. The substituent on carbon is having one carbons 3b. There are three methyl branches. 3c. The methyl branches are at 2^{nd} , 2^{nd} and 4^{th} carbon of main skeleton.	 methyl …….. 2,2,4 -trimethyl
4. Since the branch is 2,2,4--trimethyl, the name of the alkane will be **2,2.4-trimethylpentane.**	

Pleas go to Next page….

Page 9:

Question: Write the IUPAC name for the following Alkane.



Observation	Response
1. The main chain is having 6 carbon atoms.	……
2. The branches are on 3rd carbons.	
3. The substituents are not complex, so named directly. 3a. The substituent on 3rd carbon is having one carbons 3b. There are two methyl branches. 3c. The methyl branches are at 3rd and 3rd carbon of main skeleton.	…….. …… …….
4. Since the branch is 3,3-dimethyl, the name of the alkane will be **3,3-dimethylhexane.**	

Pleas go to Next page….

Page 10:

Question: Write the IUPAC name for the following Alkane.

CH_3- CH_2 – CH - CH_3

|

CH_3

Observation	Response
1. The main chain is having ……..carbon atoms.	butane
2. The branches are on ……carbons.	…….
3. The substituents are not complex, so named directly. 3a. The substituent on 2nd carbon is having ……. carbons	…….
4. Since the branch is 2-methyl, the name of the alkane will be **2-methylbutane.**	

Pleas go to Next page….

Page 11:

Question: Write the IUPAC name for the following Alkane.

CH_3

|

CH_3- C - CH_3

|

CH_3

Observation	Response
1. The main chain is having …… carbon atoms.	propane
2. The branches are on …………… carbons.	…………………………
3. The substituents are not complex, so named directly. 3a. The substituent on 2nd carbon is having …………… carbons 3b. There are two ………………….. branches. 3c. The ………………. branches are at 2nd and 2nd carbon of main skeleton.	………………………. di………………………… …………………………………………
4. Since the branch is 2.2-dimethyl, the name of the alkane will be **2,2-dimethylpropane.**	

Pleas go to Next page….

Page 12:

Question: Write the IUPAC name for the following Alkane.

CH_3

|

CH_3 - CH- C - CH_2 - CH_3

| |

CH_2 CH_3

|

CH_3

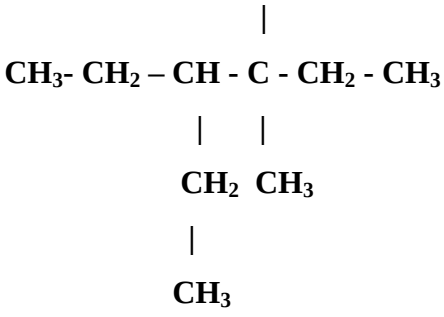
Observation	Response
1. The main chain is having 6 carbon atoms.	…….
2. The branches are on 3rd and 4th carbons.	……..
3. The substituents are not complex, so named directly. 3a. The substituent on 3rd carbon is having one carbons 3b. There are three …….. branches. 3c. The ……..branches are at 3rd ,3rd and 4th carbon of main skeleton.	…… …….. ……..
4. Since the branch is ……., the name of the alkane will be **3,3,4 -trimethylhexane.**	

Pleas go to Next page….

Page 13:

Question: Write the IUPAC name for the following Alkanes.

CH_3

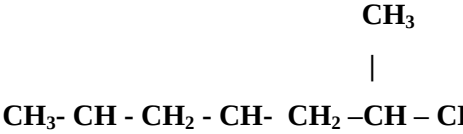


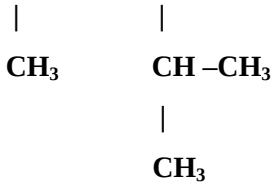
Observation	Response
1. The main chain is having 6 carbon atoms.	hexane
2. The branches are on 3rd and 4th carbons.	3,4,-hexane
3. The substituents are not complex, so named directly. 3a. The substituent on 3rd carbon is having one carbons 3b. There are two methyl branches. 3c. The methyl branches are at 3rd and 3rd carbon of main skeleton. 3d. The substituent on 4th carbon is having two carbons 3e. Since ethyl group comes first in alphabetic order, it gets preference.	 3-methyl dimethyl 3,3-dimethyl 4-ethyl 4-ethyl-3,3-dimethyl
4. Since the branch is 4-ethyl-3,3-dimethyl, the name of the alkane will be **4-ethyl-3,3-dimethylhexane.**	

Pleas go to Next page….

Page 14:

Question: Write the IUPAC name for the following Alkane.





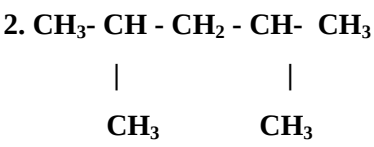
Observation	Response
1. The main chain is having …….carbon atoms.	…….
2. The branches are on 2^{nd} ,6^{th} and 4^{th} carbons.	……
3. The substituents are complex, so named as 3a. The substituent on 4^{th} carbon is having main chain of 2 carbons 3b. There is a methyl branch on substituent at 1^{st} carbon. 3c. the complex substituent is on 4^{th} carbon of main structure. 3d. The other branches are at ……. carbon of main skeleton and they are ……..groups. 3e. The substituents on main skeleton is……	ethyl 1-methylethyl 4-(1-methylethyl) …… 2,6-dimethyl-4-(1-methylethyl)
4. Since the branch is 2,6-dimethyl-4-(1-methylethyl), the name of the alkane will be **2,6-dimethyl-4-(1-methylethyl)octane.**	

Pleas go to Next page….

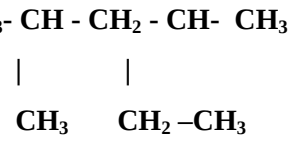
Page 15:

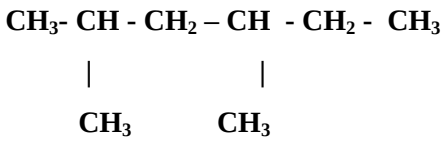
Question: Write the IUPAC name for the following Alkanes.

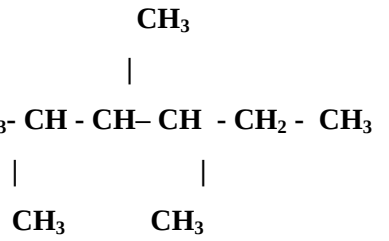
1. CH_3- CH - CH_3

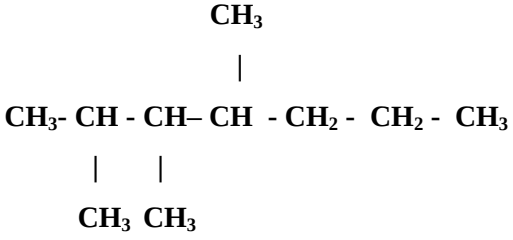
2. 

3. $CH_3 - CH_2 - CH_2 - CH_3$

4 . 

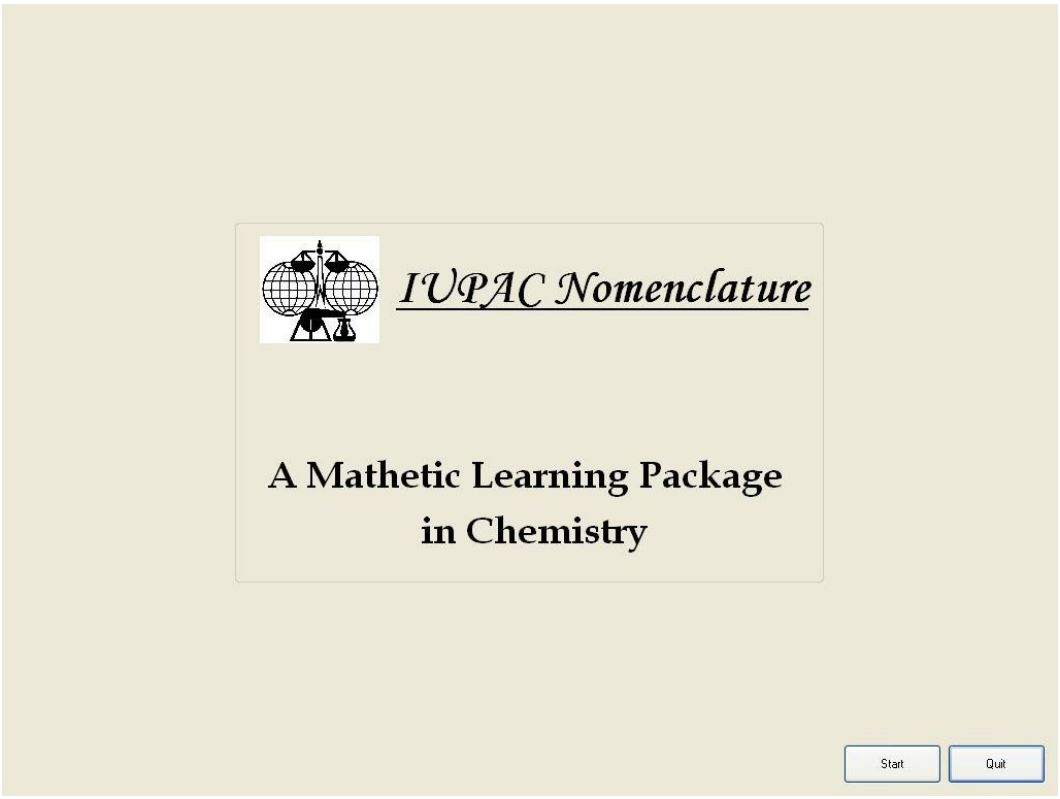
5. 

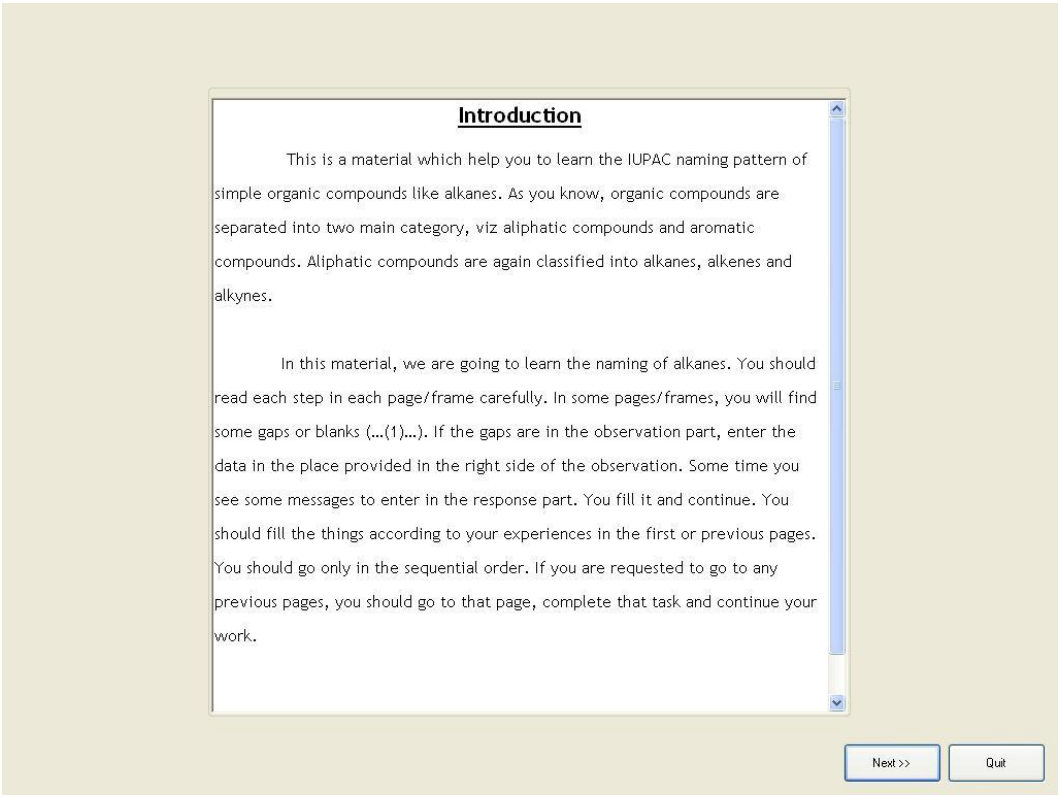
6. 

7. 

Appendix VIII

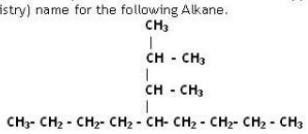
Mathetic Learning Package- Computer Shots of Soft Ware Version


IUPAC Nomenclature
A Mathetic Learning Package
in Chemistry
Start
Quit


Introduction
This is a material which help you to learn the IUPAC naming pattern of simple organic compounds like alkanes. As you know, organic compounds are separated into two main category, viz aliphatic compounds and aromatic compounds. Aliphatic compounds are again classified into alkanes, alkenes and alkynes.
In this material, we are going to learn the naming of alkanes. You should read each step in each page/frame carefully. In some pages/frames, you will find some gaps or blanks (...(1)...). If the gaps are in the observation part, enter the data in the place provided in the right side of the observation. Some time you see some messages to enter in the response part. You fill it and continue. You should fill the things according to your experiences in the first or previous pages. You should go only in the sequential order. If you are requested to go to any previous pages, you should go to that page, complete that task and continue your work.
Next >>
Quit

IUPAC Naming of Alkanes

Question: Write the IUPAC (International Union For Pure and Applied Chemistry) name for the following Alkane.



Observation

The main chain is having 9 carbon atoms

Response

nonane

Next Step

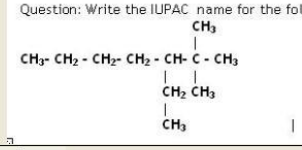
Refer Page : Go

Page : 2

Next Page | Quit

IUPAC Naming of Alkanes

Question: Write the IUPAC name for the following Alkane.



The main chain is having 7carbon atoms	heptane
The branches are on 2nd and 3rd carbons	2,3-heptane
The substituents are not complex, so named directly	
The substituent on 3rd carbon is having two carbons	3-ethyl
There are two methyl branches	Dimethyl
The methyl branches are at 2nd carbon of main skeleton	2,2-dimethyl
Since ethyl group comes first in alphabetic order, it gets preference	3-ethyl-2,2,-dimethyl
. Since the branch is 3-ethyl-2,2,-dimethyl, the name of the alkane will be 3-ethyl-2,2,-dimethylheptane	

Finished

Page 3 finished, Click Next Page to see next page

OK

Observation

. Since the branch is 3-ethyl-2,2,-dimethyl, the name of the alkane will be 3-ethyl-2,2,-dimethylheptane

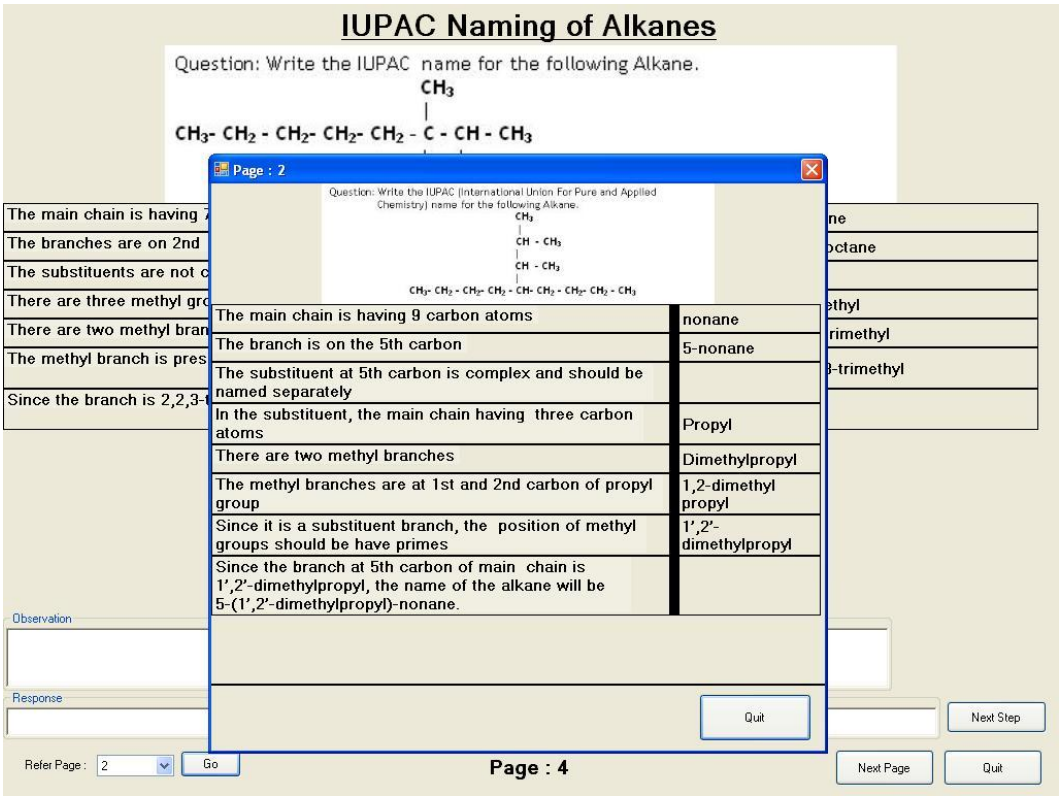
Response

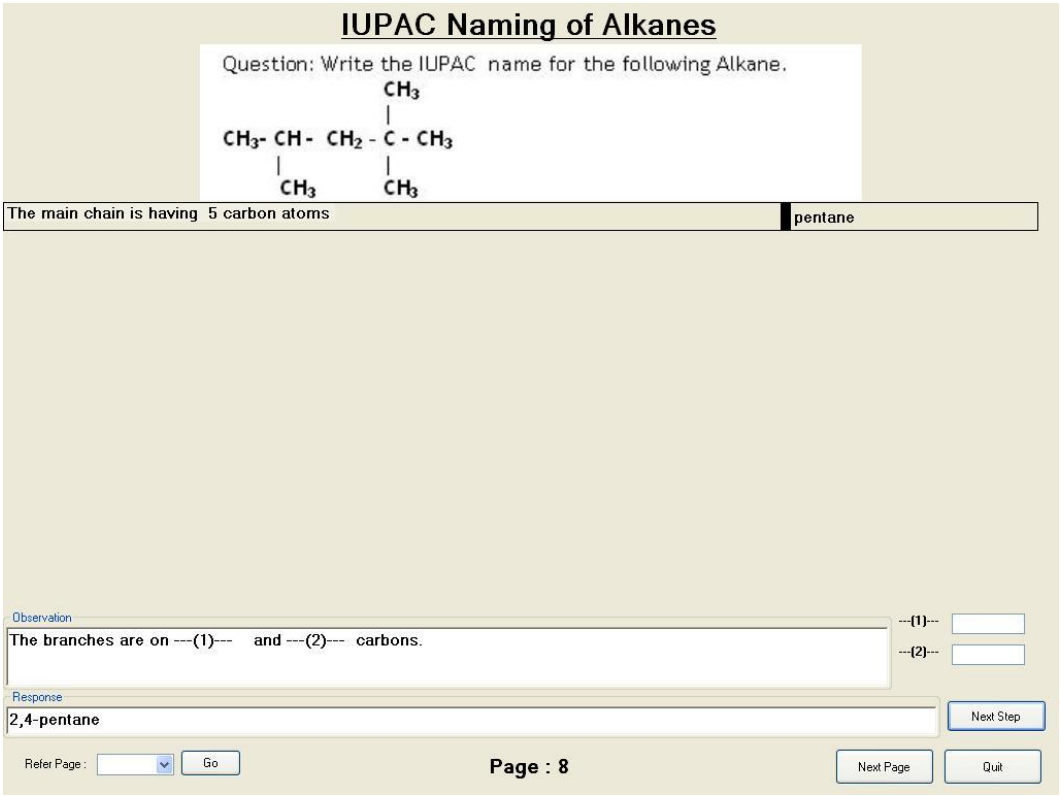
Next Step

Refer Page : Go

Page : 3

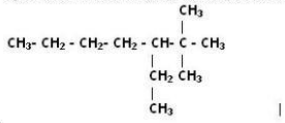
Next Page | Quit


IUPAC Naming of Alkanes
Question: Write the IUPAC name for the following Alkane.
Page : 2
Question: Write the IUPAC (International Union For Pure and Applied Chemistry) name for the following Alkane.
The main chain is having 9 carbon atoms
nonane
The branch is on the 5th carbon
5-nonane
The substituent at 5th carbon is complex and should be named separately
In the substituent, the main chain having three carbon atoms
Propyl
There are two methyl branches
Dimethylpropyl
The methyl branches are at 1st and 2nd carbon of propyl group
1,2-dimethyl propyl
Since it is a substituent branch, the position of methyl groups should be have primes
1',2'-dimethylpropyl
Since the branch at 5th carbon of main chain is 1',2'-dimethylpropyl, the name of the alkane will be 5-(1',2'-dimethylpropyl)-nonane.
Quit
Observation
Response
Next Step
Refer Page :
Go
Page : 4
Next Page
Quit


IUPAC Naming of Alkanes
Question: Write the IUPAC name for the following Alkane.
The main chain is having 5 carbon atoms
pentane
Observation
The branches are on ---(1)--- and ---(2)--- carbons.
---(1)---
---(2)---
Response
2,4-pentane
Next Step
Refer Page :
Go
Page : 8
Next Page
Quit

IUPAC Naming of Alkanes

Question: Write the IUPAC name for the following Alkane.



The main chain is having 7carbon atoms	heptane
The branches are on 2nd and 3rd carbons	2,3-heptane
The substituents are not complex, so named directly	
The substituent on 3rd carbon is having two carbons	3-ethyl
There are two methyl branches	Dimethyl
The methyl branches are at 2nd carbon of main skeleton	2,2-dimethyl
Since ethyl group comes first in alphabetic order, it gets preference	3-ethyl-2,2,-dimethyl
. Since the branch is 3-ethyl-2,2,-dimethyl, the name of the alkane will be 3-ethyl-2,2,-dimethylheptane	

Observation

. Since the branch is 3-ethyl-2,2,-dimethyl, the name of the alkane will be 3-ethyl-2,2,-dimethylheptane

Response

Next Step

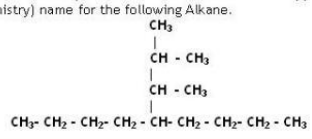
Refer Page : Go

Page : 3

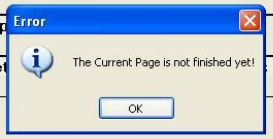
Next Page Quit

IUPAC Naming of Alkanes

Question: Write the IUPAC (International Union For Pure and Applied Chemistry) name for the following Alkane.



The main chain is having 9 carbon atoms	nonane
The branch is on the 5th carbon	5-nonane
The substituent at 5th carbon is complex and should be named separately	
In the substituent, the main chain having three carbon atoms	Propyl
There are two methyl branches	Dimethylpropyl
The methyl branches are at 1st and 2nd carbon of p	1,2-dimethyl propyl
Since it is a substituent branch, the position of met	1',2'-dimethylpropyl



Observation

Since the branch at 5th carbon of main chain is 1',2'-dimethylpropyl, the name of the alkane will be 5-(1',2'-dimethylpropyl)-nonane.

Response

Next Step

Refer Page : Go

Page : 2

Next Page Quit

Appendix IX

Achievement Test for the students of XI Standard

Subject: Chemistry

Time: 30 minutes.

Instructions:

1. Answer all the questions.
2. Use blue/black ball point pen to answer the questions.
3. Mark / write the answer in response sheet (A, B, C or D) as shown in the response sheet.
4. Do not write or mark anything in the question paper.
5. This is a test to check your achievement only. So be sincere in your answering.

Questions:

1. Diamond and graphite are the form of _____

(A) Iodine (B) Sulphur (C) Chlorine (D) Carbon

2. Fullerin is the allotropic form of _____

(A) Chlorine (B) Iodine (C) Sulphur (D) Carbon

3. Examples for a good conductor which is not a metal is

(A) Diamond (B) Graphite (C) Sulphur (D) Wood

4. Valency of Carbon is

(A) 2 (B) 4 (C) 6 (D) 8

5. The atoms or group of atoms which defines the function of a compound is called as

(A)Main group (B) subgroup (C) elementary group (D)functional group

6 CH_3-CH_2-CH_3 is called as

(A)Ethylene (B) Acetylene (C) Propane (D) Propene

7. Alkanes are …….. class of organic compounds.

(A)Aliphatic (B) Aromatic (C) cyclic (D) alicyclic

P.T.O

8. The alkane having only one carbon atom is called as…..

(A) Ethane (B) methyne (C) methane (D) ethyne

9. The alkane having two carbon atom is called as ……

(A)ethane (B) ethylene (C)methane (D)methylene

10. The alkane having three carbon atom is called as …..

(A) ethylene (B) propane (C) 2-methylethane (D) propylene

11 The alkane having four carbon atom is called as….

(A)Propylene (B) butene (C)2-methylpropane (D) propylene

12. Butane have – carbon atoms

(A)1 (B)2 (C) 3 (D) 4

13. 2-methylbutane is an alkane having…….. carbon atoms

(A)2 (B)3 (C)4 (D)5

14. Pentane is an alkane having.. carbon atoms

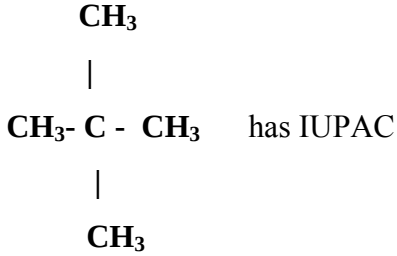
(A)2 (B)3 (C)4 (D)5

15. Alkane having six carbon atoms is called as…

(A) butane (B)propane (C) hexane (D)propyne

16. The alkane having six carbon atom is called as

(A) 1-methylhexan (B) 2 –methyl hexane (C) 2- methylpentane (D) 2-ethylbutane

17.  has IUPAC name as….

(A) 1-methylbutane (B)2,2-dimethylproapne

(C) 1,1-dimethylpropane (D)1,2-dimethylpropane

18. An example for functional group

(A) CH_3 (B) C_2H_6 (C) –OH (D) H_2O

19. Alcohol has a functional group

(A) –COOH (B) $–H_2O$ (C) –O- (D) –OH

20 **C H_3**

|

CH_3- CH - CH–CH_3 has the IUPAC name…….

|

CH_3

(A)2-methylbutane (B)2,3-dimethylbutane

(C)2,2-dimethylbutane (D)2,3-dimethylpentane

21. . **C H_3**

|

CH_3- C – CH_2–CH_3 has the IUPAC name……..

|

CH_3

(A)2,2-dimethylbutane (B)3,3-dimethylbutane

(C)2,3-dimethylbutene (D)1,2-dimethylbutane

22 **CH_3- CH - CH– CH - CH_3** has the IUPAC name……..

| | |

CH_3 C H_3 C H_3

(A)1,2-dimethylpentane (B)2,3,4-trimethylpentane

(C)2,3,4-trmethylhexane (D)2,2,5-trimethylbutane

23 . CH_3-CH_2-CH_3 is called as

(A)Ethylene (B) Acetylene (C) Propane (D) Propene

P.T.O

24 . CH_3-CH-CH_3 is having the name

CH_3

(A) Iso butane (B) Neo pentane (C) iso Propane (D) n-butane

25 . CH_3-CH_2-OH is called as

(A) Ethanol (B) Methanol (C) Propanol (D) butanol

26. Match the following.

di	prop	four
tetra	eth	three
tri	but	two

write the IUPAC names

27. **CH_3- CH - CH_2 - CH- CH_2 - CH_3**

CH_3 CH_2 –CH_3

28. **CH_3- CH - CH -CH_2 - CH- CH_2 - CH_3**

CH_3 CH_3 CH_2 –CH_3

29 CH_3- CH - CH_2 -CH_2 - CH- CH_2 - CH_3

CH_3 CH_2 –CH_3

30 CH_3- CH - CH_2 - CH- CH_2 -CH_3

CH_3 CH_2 – CH_2 - CH_3

.....

Appendix X

Answer Sheet-Test -3

Name:……..

Class: …….. Standard:……

School:…….

Give your Response with the help of a cross mark (X) as shown in example.

If your answer is B in question 21, give a cross mark as shown

21	XA	B	C	D

Question	Response			
01	A	B	C	D
02	A	B	C	D
03	A	B	C	D
04	A	B	C	D
05	A	B	C	D
06	A	B	C	D
07	A	B	C	D
08	A	B	C	D
09	A	B	C	D
10	A	B	C	D
11	A	B	C	D
12	A	B	C	D
13	A	B	C	D
14	A	B	C	D
15	A	B	C	D
16	A	B	C	D
17	A	B	C	D
18	A	B	C	D
19	A	B	C	D
20	A	B	C	D

Question	Response			
21	A	B	C	D
22	A	B	C	D
23	A	B	C	D
24	A	B	C	D
25	A	B	C	D
26				
27				
28				
29				
00				

Appendix XI

Scores of Control Group and Experimental Group

In pre test and Post Test

Group	Control		Experimental	
Sl.No.	Pre test	Post test	Pre test	Post test
1	12	18	13	23
2	13	20	13	21
3	12	20	14	25
4	10	20	13	21
5	15	21	15	24
6	12	20	12	26
7	13	21	10	20
8	14	23	14	24
9	17	21	14	24
10	15	23	13	23
11	16	24	16	25
12	15	23	15	24
13	12	20	15	25
14	12	21	10	23
15	13	22	13	23
Total	201	317	200	351
Mean	**13.4**	**21.13**	**13.33**	**23.4**