

A Study Of
Students' Common Errors With Special Reference To
The Efficacy Of The Objective Based Examination
System in
General Science, Secondary Examination, 1972

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1974

PREFACE

The Board of Secondary Education, Rajasthan introduced the objective based pattern of examination in the year 1965. The improved pattern of examinations has specified the weightage to be given in testing the areas of knowledge, understanding, application and skill in almost all the subjects. The design of setting the question papers has also been modernised with the result that the testing items cover all the topics of the course and the subjectivity of examiners in awarding marks is minimised to a considerable extent, if not eliminated altogether.

After experimenting with this new pattern for a number of years the Board has considered it worthwhile to evaluate as to how far this pattern has proved effective in attaining the desired goals. With a view to assessing the effectiveness of the objective-based pattern of question papers and analysing the errors committed by candidates, in terms of objectives, and other variables, the Board has taken up a comprehensive research project. The project covers a number of subjects like English, General Science, Elementary Mathematics, Physics, Chemistry and Optional Mathematics. The study is mainly based on the answer-scripts of the candidates appearing at the Boards' examinations conducted in the year 1972; the sample of answer-books being selected on the basis of the stratified sampling technique.

The findings of the study throw ample light on the efficacy of the question papers, mental processes involved in solving questions and topics and errors committed by the candidates under each mental process or step involved in solving the questions. The difficulty level, plausibility and functional value of all types of questions have been duly studied in the project.

One of the important aspects of the study is that the kernel errors committed by candidates have been spotted and the consequential errors committed by candidates in different areas of testing have been identified precisely. It is hoped that on the basis of kernel errors, a programme of remedial education in the subject will be evolved scientifically and implemented to the lasting benefit of the students. The discovery of mental processes will also go a long way in formulating and developing a sound methodology appropriate to the abilities required, in solving the problem or topic

I congratulate the Project Director Shri Prabhu Lal Pareek and the Convener Shri M. L. Sisodia on bringing out a useful report on General Science for Secondary Classes. The Board and the authors of the project will, I hope, be amply rewarded, if a concerted effort is made by teachers and curriculum framers in improving class-room teaching and evolving appropriate methodology, in terms of mental processes and kernel errors.

We express our deep sense of gratitude to the NCERT New Delhi for giving us financial assistance for undertaking this study.

B. P. Sood
Chairman

ACKNOWLEDGEMENT

I wish to express my appreciation to Messers S. L. Mathur, Snehlata Sharma and T. C. Jain of the study group in performing the various stages of data collection and scrutinising the answer-books.

I would like to express my appreciation to Shri P. L. Pareek, Academic Officer, Board of Secondary Education, Rajasthan, Ajmer and the Project Director, for his consistent interest, help and suggestions during the course of the study.

I am grateful to Shri K. L. Bordia, Ex-chairman, Board of Secondary Education, Rajasthan, Ajmer for this valuable encouragement during the course of the study.

Thanks are also due to Shri B. B. Gupta, Ex-secretary and Shri N. S. Tanwar, Secretary, Board of Secondary Education, Rajasthan, Ajmer for their interest in the project.

I am thankful to Shri G. S. Mathur, Shri M. L. Jain and Shri J. D. Mathur of the Board of Secondary Education, Rajasthan, Ajmer for their help during this research.

I am thankful to Prof. S. Loknathan, Head, Department of Physics, University of Rajasthan for allowing me to do this study.

Thanks are due to A. K. Chawla in performing the various stages of the typing of the manuscript.

The support and interest of the NGERT, New Delhi and Board of Secondary Education, Rajasthan, Ajmer is greatly appreciated.

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25th Dec., 1974.

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CHAPTER—1

Introduction

The Board of Secondary Education, Rajasthan has already introduced a number of changes in the examinations conducted by it with a view to improving their reliability, validity, objectivity and pedagogical values. This has been largely achieved by improving the quality of questions, question-papers, scoring procedures and a host of other things related to examinations. Overall options have been completely replaced by internal options in a few questions. The content coverage has been sufficiently increased. Objectivity has been built in by introducing objective type questions and by providing a detailed marking scheme for short and essay type questions (to ensure uniformity in marking by different examiners). This new scheme 1, 2 has now been in force for a number of years and it is high time to study how far it is achieving the purpose for which it was introduced. With this end in view the Academic Section of the Board of Secondary Education, Rajasthan decided to get the question papers and students answer-books in a few selected school subjects examined by a small group of teachers. This study is concerned with the assessment of the question paper (Appendix 1) and the answer-books of candidates appearing in General Science for the Secondary Examination, 1972.

1.1 The Problem :—

How far have the newly framed objectives of teaching General Science been actually tested in question paper of General Science for Secondary Examination, 1972 and how far have these objectives actually been achieved by the candidates in the main area investigated in this study? What were the significant errors made by students? What were the areas in which instruction was especially found to be poor

and to what extent did each question discriminate between the better and poorer examinees ? These specific issues constitute the scope of the study. The study in the light of the findings of the above questions, also aims at exploring the ways and means for the qualitative improvement of question papers and remedial action for dealing with the errors of students.

1.2 Delimitations :—

1. Only the question paper in General Science set for the Secondary Examination, 1972 has been analysed.
2. Only two hundred twenty four answer-books of the students selected on the basis of stratified sampling technique have been examined. Care has, however, been taken to have the same percentage of 1st, 2nd and 3rd Class students and of those who failed as in the total examination.

Thus the answer-books scrutinized were as follows :—

No. of the Answer-books of 1st Class candidates	42
No. of the Answer-books of 2nd Class candidates	62
No. of the Answer-books of 3rd Class candidates	75
No. of the Answer-books who failed	45
Total	<u>224</u>

1.3 Operational Objectives of the Study :—

- (i) To find out how far the objectives of teaching General Science were actually covered in the question paper of General Science for the Secondary Examination, 1972.
- (ii) To find out how far the newly framed objectives were actually achieved in the sample of answerbooks selected for the purpose. The sample, it is hoped, is a fair representative of the total population.
- (iii) To what extent did each question discriminate between the better and poorer examinees ?

- (iv) To find out the areas in which instruction was particularly good or particularly poor and needs improvement.
- (v) To specify the possible kinds of errors of the candidates whose answerbooks were actually scrutinized in respect of each question, and
- (vi) To make a few suggestions for the improvement of class-room teaching.

Procedure Adopted:—

The present study is an integral part of a Comprehensive Project undertaken under the guidance of Shri P. L. Pareek, Academic Officer, Board of Secondary Education, Rajasthan, Ajmer who has acted as the Director of the Project. The Project covers a wide range of subjects like General English at the Secondary and Higher Secondary stage, Elementary Mathematics, General Science, Physics, Chemistry and Mathematics for the Secondary Examination. It is also contemplated to take up the answerbooks of other major subjects for the study so that gradually the assessment of all the question papers and the errors committed by candidates therein are studied with a view to improving the quality of question papers and suggesting a remedial plan of action for dealing with students' errors.

With a view to implementing the project the study teams have constituted for each subject separately. The co-ordination of the different teams has been done by Shri P. L. Pareek, Director of the Project. The present study has been attempted by the team consisting of :

1. Dr. M. L. Sisodia, Leader of the Project
2. Shri S. L. Mathur
3. Shrimati Snehlata Sharma
4. Dr. T. C. Jain

The study team prepared a research design and evolved:—

- (i) an analysis card for data collection of multiple choice type questions (Appendix 3);
- (ii) a consolidated analysis card for multiple choice type questions (Appendix 3);
- (iii) a proforma for analysis of Essay and short answer type questions (Appendix 4);
- (iv) The study group analysed the question paper of General Science, 1972 in terms of cognitive objectives and developed a consolidated analysis card for distribution of percentage of marks in regard to objectives (Appendix 5).
- (v) The team worked out the processes involved in answering each question and developed a card noting the responses of candidates in terms of processes involved and possible errors by analysing the answer-script of each candidate (Appendix 3).

Each member of the team analysed 56 answer-books for the various categories of students for collection of data. The team later met many times to classify and consolidate the data. The report was actually drafted by the leader and edited by the Director of the Project.

Proposed Outline:—

In addition to this introductory chapter, the remaining chapters are as follows:—

Chapter—II Contains an analysis of question paper in General Science for Secondary Examination, 1972 and presents achievement of examinees in regard to objectives.

Chapter-III Attempts item analysis. This includes the results of scrutiny of answer-books in terms of processes involved in answering the questions and the specific errors committed by the students under each process or step.

Chapter-IV Summarises the findings of the present investigations. Suggestions are made for the improvement of Class-room teaching in an effective manner and its evaluation technique.

CHAPTER—2

Analysis of Question Paper of General Science, and Achievement of Examinees

2.1 Introduction:—

It is difficult to say what exactly constitutes an ideal question paper (test) that would measure students achievement in General Science in regard to instructional objectives; namely content and cognitive (intellectual activity involved) objectives objectively and effectively. However, subject experts agree that a carefully balanced pattern of essay type, short answer type and objective type questions would prove fairly effective in assessing students total performance in each subject. It is also agreed that each form of question should be able to assess one or two or more intellectual activities (knowledge, understanding, application and skill) of the students. We will first examine the General Science question paper in this light and then we will examine the achievements of examinees in the various area of study and cognitive objectives.

2.2 The Pattern of the Question Paper:—

There is one question paper in General Science for the Secondary School Examination carrying 50 marks. The analysis of the question paper (Appendix 1) reveals that all the questions can be grouped in the following four categories.

- | | | | |
|-------|------------------------|---|-----------|
| (I) | Objective Type | } | Section A |
| (II) | Very Short Answer Type | | |
| (III) | Short Answer Type | } | Section B |
| (IV) | Essay Type | | |

The first two types of questions are grouped in Section A carrying 15 marks and the remaining two types in Section

B carrying 35 marks. Section A is to be answered and returned to the Invigilators at the end of the first half hour, and Section B to be answered in the remaining two hours, This is done to check copying, because Section A has objective type questions, the answers to which can be easily copied or communicated through gestures. There is no other psychological or educational reason behind this division of the paper into two sections. There seems to be an unfair distribution of time between the two sections of the paper. Section A which carries 15 marks is allotted only half an hour, while section B, which carries 35 marks, is allotted two hours. But this may not be very serious as essay type and short answer type questions require more time to answer.

2.3 Weightage to Form of Questions:—

The following Table (2.1) gives an idea of the weightages give to the form of questions, marks allotted to each category of questions in General Science question paper, 1972

Table—2.1
Weightage to Form of Questions

Form of Questions	No. of Questions	Marks	Percentage of Marks	Time Allotted
SECTION A				
(I) Objective Type (Multiple Choice Type)	20	10	20%	} $\frac{1}{2}$ hour
(II) Very Short Answer Type	5	5	10%	
Section B				
(III) Essay Type	3	15	30%	} 2 hours
(IV) Short Answer Type	10	20	40%	

It is suggested that the present weightage to the forms of questions be continued. Objective type questions need not always be of multiple choice type.

2.4 Weightage to Objectives :—

Prof. Bloom developed a six category classification of the cognitive objectives on the basis of the intellectual activity involved in the students. But in practice it is advantageous to use four category classification system i. e. (I) knowledge (II) understanding (III) Application and (IV) skill for General Science. Therefore, it is quite necessary that questions in a question paper should test all the four cognitive objectives. In view of this the question paper of 1972 is analysed by the study group.

Table (2.2) shows the weightage given to each category of objectives in the question paper,

Table—2.2

Weightage to Objectives in terms of Marks allotted Distribution of Marks

S. Category No. of Objectives	Section A 25 Questions		Section B 13 Questions		Grand Percent- tage & Total A & B Marks	
	Multiple Choice Type	Very Short Answer Type	Total	Essay type	Total	Percentage
1. Knowledge	6	2	8(53.3%)	8(23%)	16	32%
2. Understand- ing	4	2	6(42%)	13(56.5%)	19	38%
3. Application	—	1	1(6.7%)	4(11.5%)	5	10%
4. Skill	—	—	—	10(28.4%)	10	20%
Total	10	5	15(100%)	35(100%)	50	100%

It is, however, suggested that the weightage given to the skill objective be decreased and more weightage be given to understanding objective. A practical distribution of marks

to various objectives, looking to the Indian conditions, would be as follows:

1.	Knowledge	32% of the total marks
2.	Understanding	48% of the total marks
3.	Application	10% of the total marks
4.	Skill	10% of the total marks

This will enable the student to interpret his environment and to fit himself into the modern developing Society.

2.5 Weightage to Content:—

An analysis of the General Science question paper 1972, shows that most of the topics in the syllabus have been represented in the paper. Overall options have eliminated completely but internal option within the essay type question has been allowed. The alternate question is also from the same unit of study. The weightage given in terms of marks and forms of questions to the various units of the syllabus is given in Table (2.3).

Table—2.3

Weightage to Various Units of Study in Terms of Marks and Form of Question

S. No. Study	No. of Questions				Total Marks and Questions (Marks are written in bracket)
	Section A	Section B			
	Multiple Choice Type	Very Short Answer Type	Essay Type	Short Ans. Type	
1. Matter & Energy	3(1½)	1(1)	1(5)	—	5(7½)
2. The Earth and its Mysteries	2(1)	2(2)	—	1(2)	5(5)
3. Universe	2(1)	—	—	2(4)	4(5)
4. Meteorology	—	—	1(5)	—	1(5)
5. Natural Resources	2(1)	—	—	1(2)	3(3)

6. Plants and Animals	4(2)	1(1)	—	2(4)	7(7)
7. Nutrition and Health	5(2½)	1(1)	—	1(2)	7(5½)
8. Preparation of Useful Material	2(1)	—	—	3(6)	5(7)
9. Transport and Communication	—	—	1(5)	—	1(5)
Total	20(10)	5(5)	2(10)	10(20)	38(50)

The above table denotes that all the units of the study have been given nearly equal weightage in terms of marks i. e. 10% of total marks. The three units namely (1) Matter and energy (2) Plants and Animals and (3) Preparation of useful material have been given 14% weightage and looking to the importance of these units in the study of General Science the weightage seems to be proportionate.

Table (2.4) shows the weightage in terms of marks allotted to the objectives in the various units of study.

Table—2.4

Distribution of Marks to Objectives in Various Units of Study

S. No. of Unit of Study	Marks in Cognitive Objectives				Total Marks in each Unit of Study.
	Knowledge	Under-standing	Applica-tion	Skill	
1. Matter & Energy	1	4½	—	2	7½
2. The Earth & its Mysteries	1	3	1	—	5
3. Universe	3	—	—	2	5
4. Meteorology	—	3	—	2	5
5. Natural Resources	½	½	2	—	3

6. Plants and Animals	3	2	—	2	7
7. Nutrition and Health	2½	1	2	—	5½
8. Preparation of Useful Material	5	2	—	—	7
9. Transport and Communication	—	3	—	2	5

Grand Total 16(32%) 19(38%) 5(10%) 10(20%) 50(100%)

We note from the table that marks are evenly distributed over various units of study in terms of objectives.

2.6 Arrangement of Questions:—

The analysis shows that items of similar content are not grouped together in one section of the question paper as shown in the following Table (2.5) :

Table—2.5

Unit of Study	Question No. in Section—A	Question No. in Section—B
1. Matter and Energy	12,14,17,25	3 or 3
2. The Earth & its Mysteries	2,5,21,22	5
3. Universe	1,4	4,12
4. Natural resources	15,16	11
5. Meteorology	—	1 or 1
6. Plants and Animals	3,6,8,9,23	6,13
7. Nutrition & Health	7,10,11,13,19,24	7
8. Preparation of Useful Material	18,20	8,9,10
9. Transport and Communication	—	2 or 2

The paper thus appears to the examinee fragmented and he cannot solve it in an integrated fashion : this may affect the total achievement of the students. It is suggested that items of similar content be grouped together. This will permit the students to attempt all items dealing with a given content before moving to the next. In this way the paper may appear to the examinee less fragmented and he may solve it in a more integrated fashion. Paper-setters be requested to further arrange items from a particular content according to their difficulty level. It is usually good to progress from the easy to more difficult items.

2.7 Effectiveness of Construction:—

(i) The essay and short answer type questions require the examinee to read the question, formulate his response and write the response in a sequence. Most of the essay and short answer type questions of the paper seem to be constructed well. We will discuss this point in greater details in Chapter III. (2) Effectiveness in the construction of objective type questions will be discussed in Chapter III where item analysis is attempted.

2.8 Scoring Key and Marking Scheme for the Examiners:—

Scoring Key for Section A:— Answers to questions No. 1 and 7 were wrongly given and this has affected the marking of the answer-books.

Marking Scheme for Very Short Answer Type Questions in Section A:—

The marking scheme was not proper, it should have been more detailed in terms of processes involved in answering the questions. A detailed discussion in regard to processes involved is further attempted in Chapter III.

Marking Scheme for Section B:— This is again sketchy and

needs to be in detail. This point will be again discussed in Chapter III.

Note:—Question paper of 1972, scoring key and Marking Scheme is appended (Appendix 1 and 2).

2.9 Concluding Remarks:—

From the various points of view as discussed above, we can conclude that the design of the question paper of General Science 1972 was not satisfactory in regard to coverage of objectives. A more detailed marking scheme is needed to ensure uniformity in marking by different examiners. Weightage to skill should be decreased by 10% and understanding to be increased by 47%.

We will now present the achievement of students in terms of objectives and units of study.

2.10 The Pattern of Scoring:—

Altogether two hundred twenty four answerbooks were scrutinized by the study group of four members. The sample contained the same percentages of first division, second division, third division and unsuccessful candidates as those in the Board's examination. The distribution of the candidates in the sample among the four categories was as follows :

First Division	:	42 (18 7%)
Second Division	:	62 (28%)
Third Division	:	75 (33 3%)
Candidates who failed	:	45 (20%)
Total	:	224 (100%)

In this section we propose to examine how students actually fared in two sections of the question paper under each objective and each unit of study.

2.11 The Pattern of Scoring in Section A and B:—

Graph 2.1 shows the number of students scoring above 60%, above 45% but less than 61%, above 30% but less than 6%, and above 6% but less than 31% marks in Section A, Section B and in the whole paper

We note from the graph that the achievement of students in terms of score at the examination is far better in Section A as compared to Section B. In Section A 82 students out of 224 students scored above 60% marks as compared to 22 students out of 224 students in Section B. This has affected the average performance of candidates (We find that only 32 out of 224 students could get above 60% marks in the whole question paper).

2.12 Relationship between Scores and Weightage to Objectives:—

Now let us take up the relationship between the scores and weightage given to the objectives in Section A and Section B. From Table 2.2 we notice that in Section A weightage to knowledge was 53.3% of the total marks allotted to Section A as compared to 23% of the total marks allotted to Section B. Weightage to understanding and Application in Section A was 46.7% of the marks allotted to Section A and in Section B 68% of the total marks allotted to Section B. 28.4% weightage is given to skill in Section B as compared to Zero per cent weightage in Section A. These variations of weightage to objectives in Section A and Section B may be the reason of better achievement of students in Section A as compared to Section B, because of the fact that cognitive objectives like understanding, application and skill need higher order of intellectual ability on the part of students thereby making Section B more difficult than Section A. Hence we can conclude that there is a close relationship between the weightage given to the objectives

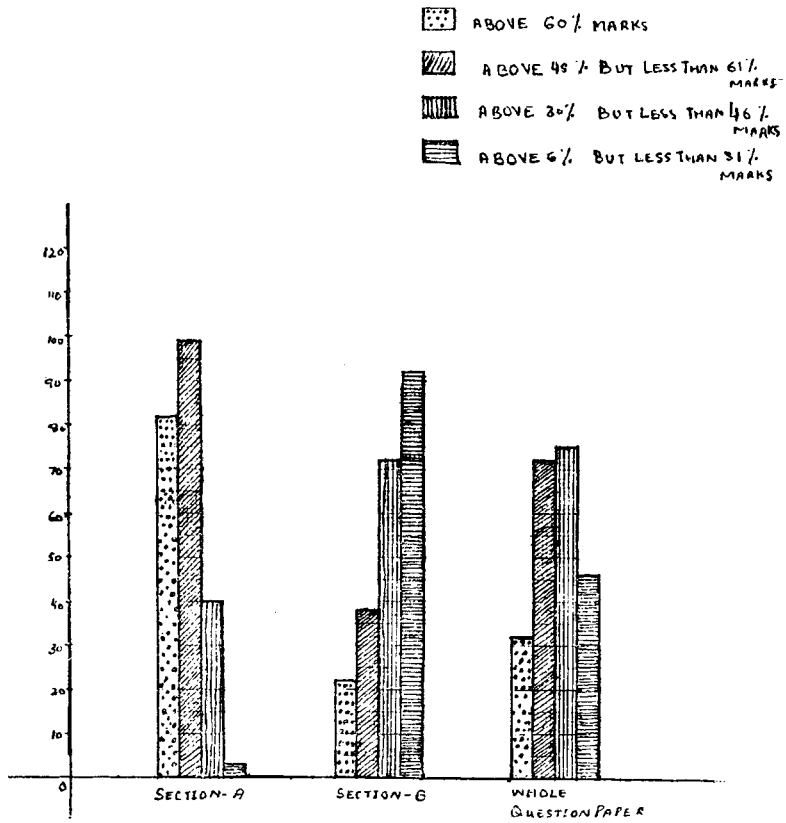


Fig 2.1 Scoring Pattern in Section A
Section B and Whole Question Paper.

and the performance of the candidates. Thus it is suggested that equal weightage to objectives be given in Section A and Section B, so that the achievements of the students may be nearly the same in both the sections. We suggest the following break up of marks for various objectives in Section A and in Section B.

Table--2 6
Suggested Weightages to Objectives in Section A and B

Category of Objectives	Marks allotted to whole Question paper	Marks allotted to Section B	Marks allotted to Section A
Knowledge	16 (32% of the total marks)	11 (32%)	5 (32%)
Understanding	24 (48% of the total marks)	17 (48%)	7 (48%)
Application	5 (10% of the total marks)	3.5 (10%)	1.5 (10%)
Skill	5 (10% of the total marks)	3.5 (10%)	1.5 (10%)
Total	50 (100%)	35 (100%)	15 (100%)

2.13 Response of the students in Multiple Choice Type Questions—

Achievement in Instructional Objectives—

In the question paper there were twenty multiple choice type questions; out of which twelve questions were asked to test knowledge and eight questions were asked to test understanding of the students in the various units of study. Tables (2.7) and (2.8), respectively, indicate the performance of the various categories of our students in the areas of knowledge and understanding.

Table—2.7
Achievement of the area of Knowledge

S. Category No. of Students	Total No.	No. of Students who answered correctly to knowledge questions											
		Q. No.											
		1	3	4	6	7	10	11	12	14	15	18	19
1. First Divisioners	42	40	41	32	29	22	40	34	42	36	21	35	31
2. Second -do-	62	55	60	31	37	33	40	45	59	46	22	42	43
3. Third -do-	75	62	70	35	45	39	62	37	54	53	18	31	58
4. Candidates who Failed	45	30	39	19	19	23	28	24	33	26	8	12	19

Table 2.7 indicates that more than 60% students who passed in the whole paper have answered 10 out of 12 questions of multiple choice type, testing knowledge objective correctly. Hence we can say that the achievement of students in this area of the objective is good.

Table—2 8
Achievement in Understanding

S. Category No. of Students	Total No. of Students in each category	No. of students who answered correctly to understanding questions							
		Q. No.							
		2	5	8	9	13	16	17	20
1. First Divisioners	42	31	28	18	30	36	40	40	16
2. Second ,,	62	32	22	27	45	31	53	59	9
3. Third ,,	75	23	26	26	27	26	54	55	18
4. Candidates who Failed	45	8	18	17	15	12	20	25	7

We find from the above Table that 5 out of 8 Multiple choice type questions testing the objective of understanding have been wrongly answered by more than 50% students who passed in the whole paper. Thus a large number of students fail to achieve this objective i. e. understanding.

2.14 Achievement in Various Units of Study :—

Table (2.9) shows the performance of the various categories of students in the various units of study.

Table—2.9

Achievement in Various Units of Study

UNITS Cate- gory of Stu- dents	Total No. of Stud- ents in each Category	Number of Students answering correctly																			
		Unit 1		2		3		4		5		6		7		8					
		Q. No. (12 14 17)		(2 5)		(1 4)		--(15 16)		(3 6 8 9)		(7 10 11 13 19)		(18 20)							
I Divisioners	42	42	36	40	31	28	40	32	21	40	41	29	18	30	22	40	34	36	31	35	16
II „	62	59	46	59	32	22	55	31	22	53	60	37	27	45	33	40	45	31	43	42	9
III „	75	54	53	55	23	26	62	35	18	54	70	45	26	47	39	62	37	26	54	31	18
Candidates who failed	45	33	26	25	8	18	30	19	8	20	39	19	17	15	23	28	24	24	12	19	27

Unit : 1 Matter and Energy—

From this unit two questions were asked to test the knowledge of the students; one question was asked to test understanding in Multiple choice type questions. We note from the table that more than 75% students, who passed in the whole paper have answered correctly these three questions. So, we can conclude that the achievement of students in this area of study is quite good.

Unit : 2 The Earth and its Mysteries—

From this Unit two questions were asked to test understanding. We notice from the above that around 50% students who passed in the whole paper have answered correctly these two questions. Therefore, we may say that students' achievement in this area of study seems to be poor.

Unit : 3 Universe—

It is noted that more than 60% students who passed in the whole paper have answered the questions from this unit correctly. These questions were asked to test knowledge. Thus it may be concluded that the achievement of students in this part is good.

Unit : 5 Natural Resources—

There were two multiple choice type questions, one testing knowledge and the other testing understanding. We find from the table that question (Q. No. 15) testing knowledge has been wrongly answered by a large majority of students who have passed in the whole paper. On the other hand, question (Q. No. 16) testing understanding has been correctly answered by a large majority of the students who have passed in the whole paper. Thus it is difficult to say whether the achievement of the students in this unit of study has been good or bad.

Unit : 6 Plants and Animals—

Four questions were asked from this Unit. Three questions were answered correctly by more than 60% students

who have passed in the whole paper. The remaining question (Q. No. 8) was answered wrongly by more than 60% students. This question was asked to test understanding of students. Students seem to have learnt the facts etc. from this unit of study but could not develop understanding.

2.15 Achievement of Students in Essay Type and Short Answer Type Questions :—

In this section we propose to examine how our various categories of students actually fared in each cognitive objective in Section B of the question paper.

Achievement in Knowledge:—

In Section B of the question paper 8 marks out of 35 marks were allotted to test the simplest cognitive behaviour namely knowledge, involving the recall of information. The following Table (2.10) gives the performance of the various categories of our students in the objective of knowledge.

Table—2.10

S. Category No. of Students	Total No. in each Category	Percentage of Students Scoring Marks			
		60% and above	45% and above but less than 60%	33% and above but less than 45%	Below 33%
1. First Divisioners	42	74%	22.5%	3.5%	—
2. Second Divisioners	62	36%	31%	29%	4%
3. Third Divisioners	75	2%	33%	35%	30%
4. Candidates who failed	45	3%	—	22%	75%

We notice from the table that around 11% candidates who passed in the whole paper have failed in this area. 25% students, who failed in the whole paper, have passed in this area and even 3% candidates (who failed) could get 60%

marks and above. 37% students scored 60% marks and above in this area as compared to 18.7% students who scored 60% and above in the whole paper.

Achievement in Understanding:—

Table 2.11 shows the performance of the various categories of our students under the objective of understanding.

Table—2.11

S. Category No. of Students	Total No. in Each Category	Percentage of Students Scoring Marks			
		60% and above	45% and above but less than 60%	33% & Below above but less than 45%	33%
1. First Divisioners	42 48%	35%	17%	—	
2. Second Divisioners	62 10%	24%	54%	12%	
3. Third Divisioners	75 0	4.5%	29%	66.5%	
4. Candidates who failed	45 0	0	0	100%	

From the table 2.11 we find that around 26% candidates who passed in the whole paper, have failed in this area. 52% students who scored 60% and above marks, in the whole paper have scored less than first class marks in this area. 66% students, who got second division marks in the whole paper, have scored less than second class marks in this area of objective. Similar is the performance of third divisioners; Thus we can conclude that in questions which do not involve memory but which really test students' ability to understand, candidates fare very badly.

Achievement in Application:—

In Section B of the question paper 4 marks out of 35 marks were allotted to test the objective of application. The following table (2 12) gives the performance of the various categories of our students under the objective.

Table—2.12

S. Category No. of Students	Total No. in each Category	Percentage of Students Scoring Marks			
		60% marks and above	45% & above but less than 60%	33% & above but less than 45%	Below 33%
1. First Divisioners	42	56%	35%	9%	—
2. Second „	62	43%	45%	10%	2%
3. Third „	75	9%	58%	19%	14%
4. Candidates who failed	75	10%	45%	24%	21%

From the scrutiny of the table 2.12 we observe that around 6% students, who passed in the whole paper, have failed in this area as compared to 11% and 33% in knowledge and understanding respectively. We may say that the performance is slightly better in this area, perhaps this is due to meagre weightage given to this area or easy nature of questions. Consequently it may not reflect the correct position.

Achievement of Skill:—

10 out of 35 marks were allotted to test skill objective. The performance is given in table 2.13.

Table—2.13

S. Category No. of Students	Total No. in Each Category	Percentage of Students Scoring Marks			
		60% and above	45% and above but less than 50%	33% and above but less than 45%	Below 33%
1. First Divisioners	42	46%	22%	25%	—
2. Second „	62	12%	20%	31%	37%
3. Third „	75	0	4.5%	33%	62.5%
4. Candidates who failed	45	0	0	3%	97%

We notice from the Table 2.13 that around 33% candidates who passed in the whole paper have failed in this area. This is a larger percentage as compared to 11%, 26% and 6% respectively in knowledge, understanding and application. 54% First divisioners got less than first class marks in this area. This clearly speaks of the poor performance of candidates in this area.

2.16 Conclusions:—

The real state of affairs is indicated here. We have clearly seen that in questions which do not involve memory work or guess work but which really test students mental ability of high order, candidates have fared badly. We will now examine in detail the question and response pattern in Chapter III to interpret whether questions were defective or any other cause can be attributed to the poor achievement of the students.

CHAPTER—3

Item Analysis and Errors

3.1 Introduction:—

In chapter II we have analysed the question paper as a whole from different angles like weightage to objectives, content, form of questions, etc. We have also examined in some detail how the candidates have fared in different areas of cognitive objectives and content, and how their performance in each area compares with their general performance. We shall now take up the item analysis in terms of processes involved in answering each question and specific errors committed by the students and suggest how they can be eliminated.

3.2 Item Analysis of Objective Type Questions:—

The analysis of students response to objective type items is a powerful tool for test improvement. Item analysis indicates (I) which item may be too easy or too difficult and (II) which may fail for other reasons to discriminate clearly between the better and poorer examinees. Item analysis sometimes, suggests why an item has not functioned effectively and how it might be improved. This type of information serves a distinctive purpose, which may be helpful to the conscientious teacher in improving both teaching and testing procedures. With this end in view we have carried out in this section the item analysis of the multiple choice type questions of section A of the General Science paper for the secondary examination 1972.

Many different processes of item analysis and many different indices of item quality have been developed by

We shall compute (I) an index of difficulty, (II) an index of discrimination and (III) study the response pattern on the item (i. e. the distribution of responses among the several alternative choices presented). The third one is done with a view to judging whether the item is functioning properly or not. (Ideally each distractor should attract some pupils, particularly those in the poorer group. If no one chooses a particular distractor, it may not be functioning properly.)

The task of obtaining information concerning the difficulty level and the discriminating power of a test question would indeed be a formidable one if this information were based upon the total group. It has been found, however, that satisfactory evidence concerning these characteristics can be obtained by considering the performance of only a portion of the group, namely, those who performed very well on the total test (the higher group) and those who performed very poorly (the lower group). For our study we have taken under high group (or upper group) all the 42 students who secured First class marks in the total test and in the lower group all the 45 students who failed in the test. Therefore, the determination of difficulty and discrimination indices, as well as item response pattern, are based in this study upon these two parts of the total group.

3.3 Difficulty Index:—

The difficulty index is computed by dividing the number of pupils passing the item by the total number of pupils in the combined high and low group; i. e. in our case this number is 87 (42+45). Therefore, item difficulty is determined using the formula.

$$\text{Difficulty Index} = \frac{R_h + R_L}{N_h + N_L} \dots\dots\dots (3.1)$$

Where R_h — number of students who answered the item correctly in higher group.

R_L — number of students who answered the item correctly in lower group.

N_h — Total number of students in higher group.

N_L — Total number of students in lower group.

We can see that the smallest possible value of the index is zero and the largest possible value is 1.00, the larger the value, the easier the item.

3. Index of Discrimination:—

While the difficulty level of an item determines in part its ability to discriminate between students of different achievement levels, items of the same difficulty level do not always discriminate equally well. The reasonably good level of discrimination is indicated by the difference in proportions of correct response between higher and lower groups. Therefore the index of discrimination is computed by using the formula —

$$\text{Discriminating index (V)} = \frac{R_h}{N_h} - \frac{R_L}{N_L} \dots\dots\dots(3.2)$$

where the symbols have the same meaning as in equation 3.1

3.5 Criteria of Grouping Questions for Item Analysis:—

We have seen in Chapter II that 12 multiple choice type questions in the paper 1972 were constructed to measure knowledge objective and 8 questions were constructed to test understanding objective. We have also seen that students fared well in questions testing knowledge as compared to questions testing understanding. Therefore we have grouped all the 20 questions in these two groups for the purpose of item analysis.

Group A:—Q. No. 1, 3, 4, 6, 7, 10, 11, 12, 14, 15, 18, 19

Group B:—Q. No. 2, 5, 8, 9, 13, 16, 17, 20

The team also analysed each question in terms of mental processes involved in arriving at correct response. These processes have been included in the item analysis data.

3.6 Item Analysis of Group A:—

Question 1:—The analysis of 1st question is given below. The correct response is marked with an asterisk.

Table—3.1

Topic or Unit of Study : Universe					Processes involved		
Objective : Knowledge							
Q. 1	The planet farthest from the Sun is (A)* Pluto (B) Neptune (C) Venus (D) Jupiter				Recalls the order of the planets.		
Response	A*	B	C	D	Omis- sion	Difficulty	Discrimi- nation
Higher Group	40	2	—	—		0 8	0 3
Lower Group	30	5	5	5			

This item is relatively easy but poor in discrimination, because 30 out of 45 in poorer group could also answer correctly. One final feature to be noted in connection with this item is that all three distractors, or incorrect options, attracted at least a few members of the lower group. This means that all of them are somewhat plausible to those who do not know the answer.

From the response pattern we can also say that boys have learnt well the facts regarding planets.

Question 3 : The third question is asked from the Unit 'Plants and Animals'. Its analysis is given in Table 3.2

Table—3.2

Topic:—Plants and Animals		Processes involved	
Objective:—Knowledge			
Q. 3	In the process of photosynthesis plants take (A)* Carbon-di-oxide (B) Nitrogen (C) Oxygen (D) Ammonia	Recalls the gas required for process of photosynthesis.	

Response	A*	B	C	D	Ommis- sion	Difficulty	Discrimi- nation
Higher Group	41	1	—	—		0.92	0.026
Lower Group	39	2	4	—			

The item in table 3.2 is too easy ($D=0.92$), and fails to discriminate ($V=0.026$). Another obvious difficulty with this question is that not one of the students in either group selected the option D. This means the distractor D is not suitable and perhaps Hydrogen in place of Ammonia might have been a better distractor.

In this light we can say that this question is too easy, poorly discriminating and all the distractors are not effective. So the item is of poor quality.

Q. No. 4 :—Table 3.3 presents the analysis of question 4 of Section A.

Table—3.3

Topic:—Universe							
Objective :—Knowledge							
Q. The planet known as morning star							
(A) Mars (B) Mercury (C) Jupiter (D)* Venus							
Response	A	B	C	D*	Ommis- sion	Difficulty	Discrimi- nation
Higher Group	2	4	4	32		0.63	0.34
Lower Group	11	8	6	19			

This is a somewhat difficult item ($D=0.63$) as compared to earlier two items. The item is rather low in terms of discriminatory (but better than first two items) power. But still it is performing adequately, since it distinguished to some extent between the high and low group. We also note that all the distractors appear to be operating effectively.

Question 6:— The analysis of this presented in Table 3.4

Topic :—Plants and Animals						
Objective :—Knowledge						
Q. Penicillin is obtained from						
(A)* Fungus (B) Algae (C) Becilli (D) Cocci						
Response	A*	B	C	D	Difficulty	Discrimination
Higher Group	29	7	6	—		
					0.55	0.22
Lower Group	19	13	8	5		

This is a more difficult item than the previous one. However, it is also not good in discriminating power. We cannot say that all the distractors appear to be operating effectively.

Question 7:— The item analysis of the question is presented in Table 3.5

Table—3.5

Topic :—Nutrition and Health							
Objective :—Knowledge					Processes involved		
Q. The main function of Vitamin C is to					Recognises the function of Vitamins		
(A)* Strengthen the bones							
(B) Help in reproductive process							
(G) Help in clotting of Blood							
(D) Keep liver healthy							
Response	A*	B	C	D	Ommis- sion	Difficulty	Discrimi- nation
Higher Group	22	3	11	5	1		
						0.52	0.022
Lower Group	23	7	9	5	1		

After looking at the index of difficulty (0.52) and the index of discrimination (0.022) of the item shown in Table 3.5, we can conclude that this is a comparatively difficult, poorly discriminating item. We also note that a good number of students in higher and lower groups were attracted to all distractors. This may perhaps mean that the question is ambiguous; or it may be that there is no correct answer; or perhaps the concept tested here was not properly covered in the course of instruction. Question No. 10 Table 3.6 represents the item analysis data of question No. 10 which is from the topic Nutrition and Health.

Table—3.6

Topic—Nutrition and Health							
Objective : Knowledge							
Q. The acid formed in dental cavities due to bacteria is							
(A) Hydrochloric acid (B) Sulphuric Acid							
(C) Nitric Acid (D) *Lactic Acid							
Response	A	B	C	D*	Ommis- sion	Difficulty	Discrimi- nation
Higher Group	2	—	—	40		0.78	0.24
Lower Group	5	9	3	28			

This item is relatively easy. However, it is discriminating to some extent. All the distractors appear to be operating effectively. Thus the question seems to be alright.

Question 11. Item analysis data given in Table 3.7 shows that this is an easy question and not doing the job of discrimination. All the distractors seem to be operating quite well.

Table—3.7

Topic—Nutrition and Health							
Objective : Knowledge							
Q. An example of the disease due to bacteria and virus is							
(A) Colour blindness (B) Anaemia							
(C) *Typhoid (D) Beri-Beri							

Recalls the name of the disease caused by virus: bacteria.

Response	A	B	C*	D	Ommis- sion	D.fficulty	Discrimi- nation
Higher Group	2	5	34	1		0.67	0.2
Lower Group	5	5	24	11			

Question 12:— This question is from the unit 'Matter and Energy' and deals with the use of Zinc rod as one of the electrodes in the electric cell. The item analysis given in Table 3.8 shows that the item is very easy and has discriminating power to some extent. All the distractors appear to be working. In my view the question, however, is faulty and needs revision.

Table—3 8

Topic—Matter and Energy							
Objective—Knowledge							
Q. Zinc is used in preparation of							
(A) *Electric cell (B) Cycle							
(C) Railway trains (D) Tools							
Response	A*	B	C	D	Omm s- sion	Difficulty	Discrimi- nation
Higher Group	42	—	—	—	—	0.86	0.29
Lower Group	33	4	1	7			

Question 14:— The item deals with the topic of Nutrition and Health. Its item analysis is given in Table 3.9

Table—3 9

Topic—Nutrition and Health							
Objective—Knowledge							
Q. The main symptom of diptheria is							
(A) *Inflammation (B) High fever							
(C) Loose motions (D) Shivering Body							

Response	A*	B	C	D	Ommis- sion	Difficulty	Discrimi- nation
Higher Group	36	2	1	3		0.73	0.29
Lower Group	26	10	4	5			

This item again is quite easy and has very little discriminating power. All the distractors appear to be operating effectively.

Question 18:—This item is from the unit preparation of useful material. The item analysis given in Table 3.11 shows that the index of difficulty is 0.54 and index of discrimination is 0.55. The item is of moderate difficulty level and has good power of discrimination. All the distractors appear to be operating effectively.

Table—3.10

Response	A*	B	C	D	Difficulty	Discrimination
Higher Group	35	2	2	3	0.54	0.55
Lower Group	12	14	12	6		

Question 15:—This question is from the Unit Natural resources. Its item analysis is given in Table 3.9. We note that this item is quite difficult, though its discriminating power, is quite good.

Table—3.11

Response	A*	B	C	D	Difficulty	Discrimination
Higher Group	50	10	10	10	0.70	0.50
Lower Group	10	10	10	10		

Topic :— Natural Resources

Objective : Knowledge

Q. On fractional distillation of petrolium, petrol is obtained from

(A) 50 C to 70 C

(B) * 70 C to 90 C

(C) 90 C to 150 C

(D) 150 C to 300 C

Response	A	B*	C	D	Omission	Difficulty	Discrimination
Higher Group	4	21	10	7			
Lower Group	9	8	17	11		0.33	0.32

Stem of the question is not proper. In place of 'petrol is obtained from' be substituted by 'petrol is obtained between the temperatures.'

Question No. 19 :— Item analysis of this question is presented in Table 3.12. This item again is of moderate difficulty level and relatively low in term of discriminating power. It, still is performing adequately, since it distinguished well between the high and low groups. Note also that all the distractors appear to be operating effectively.

Table—3.12

Topic:—Nutrition and Health							
Objective : Knowledge							
Q. The amount of sleep sufficient for adults is							
(A) 12 hours (B) 10 hours (C) 9 hours (D) * 6 hours							
Response	A	B	C	D*	Difficulty	Discrimination	
Higher Group	2	5	4	31			
Lower Group	4	10	12	19	0.58	0.33	

We can conclude from the item analysis of questions Grouped in A testing knowledge that majority of the questions were easy in nature and failed to distinguish between the better and poorer students. So, we can say that the quality of the questions except Q. No. 4,11,18,19, is poor. This also brings out an important point that our setters are not equipped well in the skill of construction of multiple choice type questions.

Item Analysis of Questions of Group B:—In this section we present the item analysis data and their interpretation for another 8 questions testing understanding of the students.

Question 2:—This question is from the Unit 'The Earth and its mysteries' and deals with the special features of metamorphic rocks. The data is presented in Table 3.13.

Table—3.13

Topic:—The Earth and its mysteries

Objective:—Understanding

Question:—The special feature of metamorphic rocks is that

- (A) They are the oldest
- (B) They are found in layer
- (C) *They are formed from other rocks
- (D) They are formed from lava of volcanoes

Processes involved

- (1) Recalls the formation of different kinds of rocks;
- (2) Discriminates the process for the formation of morphic rocks.

Response	A	B	C*	D	Omission	Difficulty	Discrimination
Higher Group	4	6	31	1	—	0.45	0.57
Lower Group	17	19	8	9	1		

It is a difficult item since fewer than half of the students in the combined high and low group marked the correct answer. The difficulty index is 0.45. The discrimination index for this item is 0.57. The item is relatively good in terms of discrimination. We also note that all the distractors appear to be operating effectively.

Question 5:—The next item is again from the unit 'The Earth and its mysteries'. The item analysis for this question is given in Table 3.14.

Table—3.14

Topic:—The Earth and its mysteries
Objective:—Understanding

Q. Stalactites and stalagmites are formed due to—

(A) Rain Water
(B) Dissolution of Calcium Carbonate in Water
(C) *Dissolution of Calcium Carbonate in Carbonic Acid.
(D) Dissolution of Calcium bicarbonate in Carbonic Acid.

Processes involved

(1) Recalls the function of underground water;
(2) Understands the process of the formation of stalactites and stalagmites.

Response	A	B	C*	D	Difficulty	Discrimination
Higher Group	1	6	28	7	0.53	0.28
Lower Group	4	15	18	8		

We find from the table that the question is of moderate difficulty level and rather bad in discrimination. All the distractors appear to be operating effectively. This question needs revision so that good discrimination may be obtained.

Question 8:—The item analysis data of this question is given in Table 3.15

Table—3.15

Topic.—Plants and Animals.
Objective:—Understanding

Q. The method of improving the breed of mangoes is known as.

(A) Budding (B,* Grafting (C) Mass Selection (D) None of the above.

Processes involved

- (1) Distinguishes between different methods of improving the varieties through artificial method;
- (2) Recognises the grafting method.

Response	A	B*	C	D	Difficulty	Discrimination
Higher Group	22	18	1	1	0.40	0.058
Lower Group	20	17	1	6		

After looking at the index of difficulty (0.40) and the index of discrimination (0.058) of the item shown in Table 3.15, one can conclude that this is a difficult, poorly discriminating item. Why is it so? Perhaps the question is too trivial or ambiguous, it may be that there is no correct answer; or perhaps the concept tested here was not properly covered in the course of study. We find that the last point seems to be valid, as 24 out of 42 higher ability students could not arrive at correct answer.

Question 9:—From the item analysis given in table 3.16 we find that this item is of moderate difficulty level and has relatively good discriminating power. From the response pattern also we can observe that all the distractors are operating well. The question is quite satisfactory in construction as well as in difficulty and discriminating power.

Table—3.16

-
- Topic:—Plants and Animals.
 Objective:—Understanding.
 Q. On studying the embryos of fish, hen, rabbit and man we find that—
- (A) *Embryos of all these living beings are similar.
 - (B) All animals have developed from Aves,
 - (C) All animals have developed from pisces.
 - (D) Man has originated from fish.

Processes involved:—

- (1) Recalls the different types and shapes of embryos;

- (2) Compares the shapes of embryos of these animals;
 (3) Interprets the shapes of these animals.

Response	A*	B	G	D	Difficulty	Discrimination
Higher Group	30	-	4	8	0.52	0.49
Lower Group	15	2	19	9		

Question 13:— In Table 3.17 the item analysis data for this question is tabulated.

Table—3.17

Topic:—Nutrition and Health

Objective:—Understanding.

Q. For cleaning the wounds of skin we should use .

- (A) Bleaching powder (B) *Dettol
 (C) Kerosene oil (D) D.D.T.

Processes involved:—

- (1) Recalls the different types of antiseptics;
 (2) Discriminate Dettol as an antiseptic for the use of washing the wounds of skin.

Response	A	B*	C	D	Difficulty	Discrimination
Higher Group	5	36	-	1	0.55	0.6
Lower Group	28	12	-	5		

We find from the table that the index of difficulty is 0.55 while the index of discrimination is 0.6. The question seems to be satisfactory, but one of the distractors seems to be not operating i.e. (C) Kerosene Oil. Although we know sometimes at initial stage we do clean with kerosene oil if no other antiseptic is available.

Question 16 :— This question is from the unit 'Natural Resources.' Its item analysis is given in Table 3.18.

Table—3.18

Topic:—Natural Resources

Objective:—Understanding.

Q. Top soil is most fertile because—

(A) it is at the top.

(B) it receives maximum rain water.

(C) it contains more manure.

(D) *it contains humus.

Processes involved:—

(1) Classifies the types of soils;

(2) Discriminates the properties of the soil.

Response	A	B	C	D*	Difficulty	Discrimination
Higher Group	1	-	1	40	0.69	0.52
Lower Group	5	5	15	20		

We find that the indices of difficulty (0.69) and validity or discrimination (0.52) for this item are quite satisfactory. We also note that all the distractors are somewhat plausible to those who do not know the answer; so, the item is quite satisfactory as also from the point of construction.

Question 17:—This question is from the Unit 'Matter and Energy' and deals with the concept of good conductor of electricity. The item analysis given in Table 3.19 reveals that it is comparatively an easy question, though its discriminating power is fairly satisfactory. All the distractors are plausible to those who do not know the answer. So, the question is satisfactory.

Table—3.19

Topic:—Matter and Energy

Objective:—Understanding

Q. Bad conductor of electricity is—

A B C D (Choices not given)

Process involved:—

Distinguishes between the properties of good and bad conductors of electricity.

Response	A	B	C	D*	Difficulty	Discrimination
Higher Group	-	1	1	40	0.75	0.41
Lower Group	9	4	6	25		

Question 20:—This item is from the Unit 'Preparation of Useful Material' and deals with the composition of aluminium alloy of used for utensils. We find from the item analysis data (Table 3.20) that the index of difficulty is 0.26 and the index of discrimination is 0.25. One can conclude that this is a difficult and poorly discriminating item.

Table—3.20

Topic:—Preparation of Useful Material

Objective:—Understanding

Q. Aluminium utensils are made of an alloy of

(A) Aluminium, Copper and Zinc

(B) *Aluminium, Copper and Magnesium

(C) Aluminium, Copper and Iron

(D) Aluminium, Copper and Shell

Response	A	B*	C	D	Difficulty	Discrimination
Higher Group	20	16	2	2	0.26	0.25
Lower Group	21	7	5	12		

3.7 Concluding Remarks:—Thus we find from the item analysis of the multiple choice type questions that a large number of questions in group A are poor in quality and do not operate properly. In group B 50% questions seem to be quite good. Therefore, we can say that the multiple choice type questions are not suitable for testing the knowledge objective. This again strengthens the point that the multiple choice type test is meant to test the higher order mental processes and not the lower order mental processes. We suggest that in future multiple choice type questions should not be included in a question paper meant to test knowledge. We can have a few questions of this type to test understanding, application i. e. higher order mental processes. By doing so, we hope to have better quality question paper.

3.8 Item Analysis of Questions other than Multiple Choice Type Questions—

Introduction—Although it is not a common practice to subject questions other than Multiple Choice Type or Selection Type to item analysis, it is certainly advantageous to examine question in the light of the responses received in order to determine the validity of the question and of the question format. If on a particular question the poorer students did as well as or better than the better pupils, the question does not contribute to the differentiation between good and poor pupils. Such a question might be ambiguous. If nearly all the students did quite well (or quite poor) on the question, the degree of difficulty reduces the possibility that the question will discriminate.

It is possible to obtain analysis data on these questions in a manner similar to that presented for multiple choice type questions. The index of difficulty would be the average number of points received on the question divided by the number of 10 possible points. Thus D may be found by the use of the formula.

$$D = \frac{R_h + R_L}{X_m(N_h + N_L)} \dots\dots\dots(3.3)$$

Where R_h , R_L , N_h and N_L have the same meaning as in question 3.1 X_m is the maximum number of value points an individual could receive on the question.

In the present case we have allotted one value point to each process involved in answering the question. Our team re-examined each question of an individual and awarded the value points irrespective of marks he obtained in the question. In this way we will know the process which the individual has missed in answering the question.

The index of discrimination may be computed by use of the formula.

$$\begin{aligned} \text{Index of Discrimination (V)} &= \frac{R_h}{(X_{\max} N_h)} - \frac{R_L}{(X_{\max}) N_L} \\ &= \frac{1}{(X_{\max})} \left(\frac{R_h}{N_h} - \frac{R_L}{N_L} \right) \dots\dots\dots 3.4 \end{aligned}$$

Now we shall first present the analysis of very short answer type questions of Section A.

3.9 Analysis of Very Short Answer Type Question: —

There were 5 such questions. Out of these two questions were asked to test knowledge objective, two questions were asked to test understanding objective and one question was asked to test application objective. Detailed analysis data, mental processes involved in answering the question and response to these processes are given in Appendix. Table 3.21 gives the calculated index of difficulty and index of discrimination for these five questions.

Table—3.21

Question No.	Objective Tested	Difficulty Index	Discrimination Index
21	Knowledge	0.62	0.70
22	Application	0.3	0.5
23	Understanding	0.75	0.44
24	Knowledge	0.5	0.46
25	Understanding	0.36	0.63

We notice from the table that Question No. 21 and 23 are comparatively easy questions, though their discriminating power is fairly good. The other questions (Q. No. 22 and 25) are too difficult and discrimination is also very good. Question No. 24 has a moderate difficulty level and fairly good discriminating power.

We observe from the answers that quite a large number of students have written irrelevant answers to these questions. The frequency of students who attempted these questions but wrote irrelevant answers in the various categories of our students is given in the Table 3.22.

Table—3 22

Category of Students	Total No. in each Category	Frequency of Students					
		Q. No.	21	22	23	24	25
First Divisioners	42		1	7	1	12	4
Second „	62		14	16	2	33	15
Third „	75		23	24	4	40	25
Candidates who failed	45		23	17	11	30	15

We observe that our best students have also indulged in writing irrelevant answers. This shows that boys have not understood or in their class these topics were not covered properly. For example in Question No. 24 in which it is required to write any one disease caused due to occupations examinees have written the disease namely (I) High blood pressure (II) Typhoid (III) Beri-beri (IV) Malaria etc. This clearly shows that there was no proper coaching in the class-room so that boys could not understand the difference between these diseases and the diseases caused due to occupations. The question was clear and specific and there was no ambiguity.

When we examine the answers to question No. 25 we find that a large number of examinees could not write

that atom is electrically neutral, although they know that electron and protons are of opposite charge and their number is equal. This again points out that there was lack of proper teaching in the class.

3 10 Analysis of Short Answer Type Question:—

In all there were 10 questions of this type in the question paper and all the questions were grouped in Section B of the paper. Each question of this type carries two marks. Question No. 4,6, 8 and 10 were asked to test knowledge objective, Question No. 5 and 9 were asked to test understanding objective, Question No. 7 and 11 were asked to test application objective and Question No. 12 and 13 were asked to test skill objective. Now we shall examine these questions in the sequence of their objectives.

3.10 (a) Analysis of Question No 4,6,8 and 10 testing Knowledge:—

We will examine questions 4,6,8 and 10 in terms of difficulty level, discriminating power, mental processes involved and the response to these mental processes by the examinees.

Question 4:—This question was asked from the Unit 'Universe' and deals with the phenomena occurring on the Earth due to the Sun. The item analysis is presented in Table 3.23

Table—3.23

Topic:—Universe

Objective:—Knowledge

Question : Mention any two phenomena occurring on the Earth due to the Sun.

Process involved : Recalls any of the two phenomenon out of the following phenomena (1) Get heat and light (2) Day and night (3) Tides (4) Seasons. Thus we allotted two value points to this question. One value point for one phenomenon.

S. No.	Category of Students	Total No. of each Category	No. of Students writing Correct Process			Index of Difficulty	Index of Discrimination
			Ist Process	2nd Process	Irrelevant answer		
1.	First Divisioners (Higher Group)	42	9	23	2		
2.	Second Divisioners	62	37	35	2	0.43	0.31
3.	Third Divisioners	75	34	15	17		
4.	Candidates who failed (Lower Group)	45	16	8	14		

After looking at the index of difficulty (0.43) and the index of discrimination (0.31) of the item shown in Table 3.23, one can conclude that this is a difficult, fairly discriminating item. But when we read the question, it appears to be quite a simple one and it is difficult to explain the response pattern of the students. We can only say that our better students (scoring 60% marks in whole paper) also have neither read the text nor developed a scientific attitude.

Question 6:—The question was from the Unit 'Plants and Animals' and asked to test knowledge of the use of vegetation for human beings. The item analysis is given in the Table 3.24.

Table—3.24

Topic:—Plants and Animals.

Objective:—Knowledge

Question:—Give any four uses of vegetation for human beings.

Process involved:—

Recalls the various uses of vegetation for human beings; out of them any four are to be attempted.

Category of Students	Total No. of Students in Each Category	Response in terms of Processes					Irrelevant Answer	Difficulty	Discrimination
		I Proc-ess	II Proc-ess	III Proc-ess	IV Proc-ess				
1. First Divisioners (Higher Group)	42	29	35	37	37	—			
2. Second Divisioners	62	57	52	54	51	—			
3. Third Divisioners	75	65	54	52	46	3	0.66	0.32	
4. Candidates who failed (Lower Group)	45	36	27	16	13	3			

This item is somewhat easy, though its discriminating power is reasonably fair. 13 students out of 45 students who failed in the whole paper could write correct answer to this question. We can say that this part of the syllabus is well covered in the class-room.

Question 8:—This question was from the topic preparation of useful material and deals with the preparation of glass. As there are five basic steps in preparing glass, we took these five steps as processes involved in answering the question. Each step is allotted one value point by team, the maximum value points being 5, its analysis is as follows (Table 3.25).

Table—3.25

Topic:—Preparation of Useful Material
 Objective:— Knowledge
 Question:—How is glass prepared ?
 Process involved : Please see the Appendix 7.

Category of Students	Total No. in each Category	No. of Students who could reach to the Process					Irrelevant Answer	Difficulty	Discrimination
		I Proc- ess	II Proc- ess	III Proc- ess	IV Proc- ess	V Proc- ess			
1. First Divisioners (Higher Group)	42	31	31	19	14	7	—		
2. Second Divisioners	62	45	37	22	12	9	5	0.28	0.4
3. Third Divisioners	75	25	22	15	8	5	14		
4. Candidates who failed (Lower Group)	45	6	8	3	3	1	13		

This item is too difficult for the group and does discriminate between better and poorer students. Only 7 students out of 42 who scored 60% and above marks in the whole paper could write correct answer in terms of the processes involved. Thus we can say that this part of the syllabus is not properly covered in the course of instruction. This was a simple recall question and no higher order of mental processes was involved in answering the question.

Question 10 :—This item is again from the Unit 'Preparation of Useful Material.' Its item analysis is given below.

Table 3.26

Topic:—Preparation of Useful Material

Objective:—Knowledge

Question:—What do you understand by polymers? Give any two of its use in Industry.

Processes involved:—See Appendix 7

Category of Students	Total No in each Category	Response in Terms of Processes							Irrelevant Answer	Diff-culty	Discrimination
		I Proc-ess	II Proc-ess	III Proc-ess	IV Proc-ess	V Proc-ess	VI Proc-ess	Irrelevant Answer			
1. First Divisioners (Higher Group)	42	15	16	9	2	26	22	2			
2. Second Divisioners	62	14	19	16	4	29	30	8			
3. Third Divisioners	75	9	6	4	1	13	9	15	0.17	0.3:	
4. Candidates who failed (Lower Group)	45	—	1	—	—	—	1	14			

From the analysis one can conclude that this item again is too difficult, though its discriminating power is fairly good. But when we read the question, it appears to be quite simple and needs the recall of the definition of Polymers and its uses. From the response pattern (which is poor) one may conclude that perhaps this part of the syllabus was not properly covered in the course of instruction.

From the study of these four short answer type questions testing knowledge one may conclude that the Unit 'Preparation of Useful Material' (two questions) and 'Universe' were not properly covered in the course of instruction.

3.10 (b) Analysis of Question No. 5 and 9 testing Understanding:—

Question 5:—This item deals with the formation of natural caves and is from the Unit 'The Earth and its mysteries'.

From the item analysis one may conclude that this is a difficult question, though its discriminating power is very good. There were a large number of students who answered it in an irrelevant manner.

Table—3.27

Topic:—The Earth and its Mysteries								
Objective:—Understanding								
Q. :—How natural caves are formed ?								
Processes involved—See Appendix 7								
Category of Students	Total No. in Each Category	Response in terms of Processes					Difficulty	Discrimination
		I Proc-ess	II Proc-ess	III Proc-ess	IV Proc-ess	Irrelevant Ans.		
1. First Divisioners (Higher Group)	42	33	25	27	29	2		
2. Second Divisioners	62	25	22	25	25	9	0.345	0.65
3. Third Divisioners	75	11	11	16	13	17		
4. Candidates who failed (Lower Group)	45	—	1	2	3	23		

Question 9:—This item is again from the Unit 'Preparation of Useful Material.' From the response pattern one may again conclude that this unit was not properly covered in the course of instruction.

Table—3.28

Topic:—Preparation of Useful Material
Objective:—Understanding

Q. :—How does soap clean dirt ?

Process involved—See Appendix

Catego- ry of Stu- dents	Total No. in Each Cate- gory	Response in Terms of Processes							Irre- lev- ant Ans.	Diffi- culty cri- mina- tion
		I Proc- ess	II Proc- ess	III Proc- ess	IV Proc- ess	V Proc- ess	VI Proc- ess	Irre- lev- ant Ans.		
1. First Divisioners (Higher Group)	42	33	32	27	14	14	27	2		
2. Second Divisioners	62	38	31	30	15	16	41	6	0.4 0.37	
3. Third Divisioners	75	32	20	18	11	9	32	16		
4. Candi- dates who failed (Lower Group)	45	14	4	5	4	4	11	19		

3.10 (c) Analysis of Question No. 7 and 11 testing Application :—

Question 7:—This item was from the Unit 'Nutrition and Health'. We find from the response pattern that both the better and poorer students could write first and last processes correctly. This indicates that students have not mastered the Unit but have picked up some points here and there. Probably students knew these facts from day-to-day experience.

Topic:—Nutrition and Health

Objective:—Application

Question:—If there is a patient of a contagious disease in a house how can the other members be protected from the disease ?

Processes involved:—See Appendix 7

Catego- ry of Students	Total No. in each Category	Response in term of processes						Diffi- culty	Disc- rimi- nation
		I	II	III	IV	V	VI		
1. First Div. (Higher Group)	42	42	20	10	9	8	24		
2. Second Div.	62	55	30	18	12	12	34	0.4	0.13
3. Third Div.	75	68	16	9	5	8	32		
4. Candi- dates who failed (Lower Group)	45	40	14	10	1	4	19		

Question No. 11:—This question was from the Unit 'Natural Resources', and asked to test application objective.

Table—3.30

Topic:—Natural Resources

Objective:—Application

Q : Mention one point of similarity and one point of difference between the formation of coal and petroleum.

Processes Involved:—

1. Formation of Coal and Petroleum at high temperature of the Earth.
2. Formation of Coal and Petroleum at high pressure inside the Earth.
3. Coal is formed by wood.
4. Petroleum is formed by sea animals and sea grass.

Category of Students	Total No. in each Category	Response in Term of Processes					Irrelevant answers	Diff- culty	Dis- crimination
		I	II	III	IV				
1. First Div. (Higher Group)	42	20	18	22	24	5			
2. Second Div.	62	22	20	22	23	9	0.29	0.42	
3. Third Div.	75	10	8	12	9	19			
4. Candidates who failed	45	7	3	3	5	17			

This item is somewhat difficult, though its discriminating power is fairly good. One may say that the question is reasonably good. A large number of third divisioners and candidates who failed wrote irrelevant answer.

3.10 (d) Analysis of question No. 12 and 13 testing Skill:—

Question No. 12:—This item is of moderate difficulty level and does not discriminate well. We find that both the categories of better and poorer students failed to draw a proportionate and labelled diagram. This points out that instruction in the area of drawing skill was not proper.

Table—3.31

Topic:—Universe

Objective:—Skill

Q : Draw a labelled diagram of a Comet

Processes Involved:—

1; Diagram of a comet 2. Cleanliness 3. Proportionate

Category of Students	Total No. in each Category	Response in Term of Processes					Irrelevant answer	Difficult	Discrimination
		I	II	III	IV				
1. First Div. (Higher Group)	42	41	30	17	14	—			
2. Second Div.	62	50	25	9	31	6	0.51	0.2	
3. Third Div.	75	61	23	11	25	3			
4. Candidates who failed (Lower Group)	45	29	22	14	11	4			

Question No. 13:—

This item is somewhat difficult and does not discriminate well (From the table 3.32). We find that both the categories of better and poorer students failed to draw a proportionate and labelled diagram.

Table—3.32

Topic:—Plants and Animals

Objective:—Skill

Q:—Draw a diagram of any one Xerophytic Plant.

Processes Involved :—

1. Diagram of any one Xerophytic Plant
2. Cleanliness
3. Proportionate
4. Labelled

Category of Students	Total No. in Each Category	Response in term of Processes					Irrelevant Answer	Difficulty	Discrimination
		I	II	III	IV				
1. First Div. (Higher Group)	42	34	26	21	12	2			
2. Second Div.	62	45	32	15	18	3	0.45	0.21	
3. Third Div.	75	33	25	13	11	10			
4. Candidates who failed (Lower Group)	45	29	17	14	4	8			

3.11 Analysis of Essay Type Question:—

Essay type questions are asked to test the skill of examinees in written expression and their ability to think out problems and organise their thoughts in a clear and logical manner. Thus there is a certain degree of freedom of response. The examinees produce answers which are neither completely right nor completely wrong. Our team developed the answer of each essay type question point by point (i. e. processes involved) in a sequential manner and scrutinized the sample copies in this light, giving one value point for each point or process written by the student, our analysis given below is based on the above lines.

In the question paper under review there were three essay type questions, each carrying 5 marks. Each question had an internal option and the alternate question was again asked from the same unit of study and tested the same cognitive objectives. We find that essay type questions in the paper were asked to test understanding objective carrying 3 marks and skill objective carrying 2 marks.

Question No. 1—

The question reads as:—

Explain, with the help of a diagram of Fortin's barometer, how atmospheric pressure is measured with it.

Or

Explain, with the help of a diagram, the working of a maximum minimum thermometer.

Both questions were from the unit of study 'Meteorology'. A majority of students in each category tried to answer the alternate question which deals with maximum and minimum thermometer.

Table 3.34 shows the analysis data for the question which deals with Fortin's barometer.

Topic:—Meteorology												
Objective:—Understanding (3 marks), Skill (2 marks)												
Question:—Explain, with the help of a diagram of Fortin's barometer, how atmospheric pressure is measured with it.												
Processes Involved : See Appendix 7												
Category of Students	Total No. in each Category	Response in terms of processes									Diffi- culty	Discri- mination
		1	2	3	4	5	6	7	8	9		
1. First Divisioners (Higher Group)	5	5	4	3	4	4	4	3	4	1	0.29	0.55
2. Second Divisioners	10	9	7	7	6	7	5	6	3	1		
3. Third Divisioners	14	10	6	3	6	8	6	6	2	3		
4. Candidates who failed	16	6	4	3	4	3	4	1	1	—		

We find that the question is too difficult, though its discriminating power is fairly good. 100% of first class, 90% of the second class, 71% of the third class students and 31% of the candidates who failed in the whole paper could draw the diagram, but the majority of the students could

not make it clean, proportionate and labelled one. Our superior students also could not do so. This may be due to the fact that the question appears to be silent regarding these points. Therefore, if the item were constructed as follows, it would have given a desired response at least by better students.

'Explain, with the help of clean, proportionate and labelled diagram of a Fortin's barometer, how atmospheric pressure is measured with it'.

On scrutiny we also find that examiners have wrongly marked the Question. This may be due to ignorance on the part of the examiners or leniency or carelessness. This has resulted in unreliable marking.

We also notice that the last process i. e. to present height of a mercury column in terms of air pressure is not known to the examinees.

From the response pattern one can conclude that this topic either was not properly covered in the instruction or the boys did not understand the topic.

The written expression and logical arrangement of the response were poor.

Table 3.35 shows the analysis for the question which deals with the working of a maximum minimum thermometer.

Table—3.35

Topic:— Meteorology

Objective:— Understanding (3 marks), Skill (2 marks)

Question:— Explain, with the help of a diagram, the working of a maximum and minimum thermometer.

Processes involved— See Appendix 7

Category of Students	No of Students in each Category	Response in Terms of Processes										Diff- culty	Disc- rimi- nation
		1	2	3	4	5	6	7	8	9	10		
1. First Div. (Higher Group)	37	27	21	12	21	17	25	19	24	16	14		
2. Second Div.	52	36	25	12	21	15	19	23	22	19	15	0.41	0.35
3. Third Div.	61	34	31	13	22	13	20	16	17	10	7		
4. Candidates who failed (Lower Group)	26	14	9	8	7	2	6	4	3	1	—		

After looking at the index of difficulty (0.41) and the index of discrimination (0.35) of the question shown in Table 3.35, one can conclude that this is a difficult, reasonably good discriminating question. We can again notice that the diagram drawn was not proportionate, not properly labelled and clean. Superior students' answers also suffer from these defects. Only 26% of the total students, who answered this question, wrote the first process. Quite a large number of students wrote irrelevant answers such as the description of the apparatus etc. and still examiners have awarded marks. Thus there is complete subjectivity in scoring.

Although a large number of students have attempted this question yet the quality of responses is poor.

Question 2:—The analysis of the question dealing with telephone is given in Table 3.36,

Table—3 36

Topic:—Transport and Communication

Objective:—Understanding (3 marks), Skill (2 marks)

Question:—Explain with the help of a diagram of transmitter and receiver, how do we talk on a telephone.

Processes Involved:—See Appendix 7

After looking at the response pattern, one may conclude that no one knows the correct answer. This is shocking. Only one may conclude that this topic was not properly covered in the course of instruction. Perhaps teachers do not know the topic or the topic may not be clear in the text-book.

Question No. 3—Similar item analysis of the question dealing with chain reaction and dealing with external combustion engine is given in appendix.

Around 5% of the total students who attempted the question dealing with chain reaction drew diagram of chain reaction. Hardly 1% students know how we get energy in an atomic reactor.

More than 50% students answered the question dealing with external combustion engine. But again quality of answer is fairly poor and one may conclude that students do not know the answer or they do not know how to write.

3.12 Conclusion:—

In conclusion, one may sum up that a majority of students do not know the answers to these essay type questions. Perhaps this may be due to poor instruction or lack of homework. Boys fail to organise their thoughts in a clear and logical manner. They do not know how to write responses in their own words.

3.13 Students' Errors and Suggestions to Eliminate them: —

In this Section we have taken up specific errors committed by the examinees and have suggested how they should be eliminated. On the basis of analysis carried out common errors and mistakes have been divided into the following categories—

1. Errors related to drawing of diagrams;
2. Errors related to misunderstanding or poor understanding of some important terms and concepts;
3. Mistakes committed on account of wrong understanding and lack of understanding of basic principles;

4. Errors in organising the response in a systematic and logical order;
5. Habit of over writing, poor hand writing, dirty working;
6. Poor expression;
7. Errors in spelling the Scientific terms;
8. Habit of repetition and negative answering;
9. Irrelevant answers.

The study on these errors and corresponding suggestions are as follows—

(1) Errors related to drawing of diagram—

In the question paper examinees were asked to draw five diagrams each carrying two marks. We expect an examinee to draw a correct, clear, proportionate and labelled diagram. From the response pattern as given in Table 3. 31, 3. 32, 3. 34, 3. 35, 3. 36, 3. 37 and appendix 9, we calculated for each question percentage of students drawing correct, clear, proportionate and labelled diagram. The results are given below—

Table—3.38

Type and Q. No.	Correct	Clear	Proportionate	Labelled
Essay Q.No. 11 Sec. B	66%	46%	35%	44%
Type Or				
„ Q. No. 1 „	63%	43%	25%	40%
„ Q. No. 2 „	24.5%	14%	8.7%	14.2%
Or				
„ Q. No. 2 „	14%	5%	6.3%	7.7%
„ Q. No. 3 „	61%	33%	27%	40%
Or				
„ Q. No. 3 „	32%	20.7%	11%	20%
Short Ans. Type } 12	80%	44.6%	22.3%	36%
Q.No. —do— } 13	63%	44.6%	28%	20%

We note from the above that majority of students who drew a correct diagram failed to draw clear, proportionate and labelled diagram. Four (Q. No. 1, 2, 3&13) out of five questions were silent regarding these points. So students might have not considered it necessary to make labelled and proportionate diagrams. Therefore, it is suggested that paper-setters should write in clear language what is required from the examinees. One may also say that both the teachers and students are not conscious of the fact that diagram should be clear, proportionate and labelled one, because our better students have also not drawn clear, proportionate and labelled diagrams. The teachers should draw on blackboard correct, clear proportionate and labelled diagrams while teaching in class-room. All the students must be encouraged to draw diagrams in homework also.

3.17 Errors related to misunderstanding and poor understanding of some important Terms and Concepts.

Such errors are largely committed due to students inability to understand the question itself, confusing two apparently similar terms and concepts. The terms and concepts required as per question are not worded out properly.

A few examples noted below have been taken from this study:—

- (a) Describing telegraph in place of telephone;
- (b) Describing telegraph in place of wireless communication;
- (c) Describing internal combustion engine in place of external combustion engine;
- (d) Describing kinds of glass in place of preparation of glass;
- (e) Describes construction of the instrument when only 'working was asked';
- (f) Explains the details of figures when only drawing of a diagram was asked.

The detailed analysis is as follows:—

- (a) The following table will show number of examinees who committed the error of describing Telegraph in place of Telephone—refer question No. 2 of Section B of the Paper:—

Category of Students	First Divisioners	Second Divisioners	Third Divisioners	Failures
(i) Total No. in Each Category	42	62	75	45
(ii) Error Committed by	8	12	20	—
(iii) Percentage of Students who Committed this Error	19.0%	19.3%	26.7%	—

Even those who are I and II divisioners have committed this error. It is a serious matter and shows how poor the learning process in the schools is. Failures have hardly attempted this question and hence the data cannot be interpreted. The failures neither know 'Telephone' nor 'Telegraph.'

- (b) The following table also proves that the term Telegraph is wrongly understood as wireless communication:—

Table—3.39

Category of Students	First Divisioners	Second Divisioners	Third Divisioners	Failures
(i) Total No. in each Category	42	62	75	45
(ii) No. of Students who Committed Error	4	6	21	—
(iii) Percentage of Students who Committed this Error	9.5%	9.7%	26.7%	—

Again it is established that good students have also committed this type of error.

Error Nos. (1) and (2) cited above if grouped together establish that this error is common amongst all grades of pupils.

- (c) Number of students who committed the error of describing internal combustion engine in place of external combustion engine, is as follows:—

Table—3 40

Category of Students	First Divisioners	Second Divisioners	Third Divisioners	Failures.
(i) Total No of Students who Attempted	14	16	30	—
(ii) No. of Students who Committed Error	2	6	12	—
(iii) Percentage	14.3%	37.5%	40%	—

This question has not been attempted by a majority of students and those who attempted have answered it wrongly.

- (d) The frequency of students, who have described in question No. 8 kinds of glass in place of preparation of the glass is as follows:—

Table—3 41

S. No.	Category of Students	First Div.	Second Div.	Third Div.	Failures
1.	Total No. of Students	42	62	75	45
2.	No. of Students who Committed Error.	—	—	17	22
3.	Percentage	—	—	22.7%	48.9%

Such a simple question has been misunderstood by pupils. This shows that simple knowledge is not properly acquired by pupils. A large number of pupils have failed in such a simple question.

- (e) The error of describing the construction in place of working of an apparatus has been the most common error. Number of students in each category is as follows:—

Category of Students	First Div.	Second Div.	Third Div.	Failures
(i) Total No. in each Category	42	62	75	45
(ii) Those who Committed Error	16	5	6	32
(iii) Percentage	38.1%	8.1%	8.0%	71.1%

The first divisioners have described construction in addition to the working of the apparatus. This shows they misunderstood the question. It is just possible that they had time enough to mention the construction of the apparatus. The Second and Third divisioners have also mistaken the question. The Failures have tried to describe the construction but it has been poorly expressed. They seem to have no knowledge of the apparatus.

- (f) In the questions where only diagram was asked, pupils have explained in words also as is evident from the table. 3.42

Table—3.42

Category of Students	First Div.	Second Div.	Third Div.	Failures
(i) Total	42	62	75	45
(ii) Those who Committed this Error	5	12	30	23
(iii) Percentage	11.9%	19.3%	40%	50.1%

This is how pupils mis-understand the questions.

(3) **Mistakes committed on account of wrong understanding or lack of understanding of basic principles.**

Quite a lot of mistakes are committed on account of lack of clear understanding of principles and laws. Some examples are noted below:—

- (a) The principle of Vernier Scale is not understood by 70% students who attempted this question, so they could not write that the correct height of Mercury column in a Fortin's barometer is.....

main scale reading + vernier scale reading.

- (b) Atmospheric pressure is equal to the weight of mercury column supported by the atmospheric pressure per square centimeter and therefore it is equal to the height of mercury column in a barometer \times density of the mercury \times acceleration due to gravity. This fact is not well understood and so 80% examinees fail to write this point.
- (c) Due to increase and decrease of temperature, the Alcohol expands and contracts respectively. This fact seems to be not known to 50% students and thus their answers to question No. 1 regarding Maximum and Minimum Thermometer were wrong.
- (d) About 45% students do not know or understand that one form of energy can be converted into another form of energy. So students answers to question No 2, were not proper.
- (e) Atom is electrically neutral, due to this fact the number of electrons and protons is equal in any atom of the element. The fact that each electron carries one unit of negative charge and proton carries one unit of positive charge was omitted.

- (f) Disintegration and Chain Reaction is due to bombardment of neutrons and not due to protons as written by some pupils. The number of students who committed errors a, b, c, d, e and f is given in Table 3.43

Category-wise Errors committed in Principle

Table—3.43

Errors.	First Divisioners.			Second Divisioners.			Third Divisioners.			Failures		
	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)
(a)	6	4	66.7%	5	3	60.0%	2	2	100%	5	5	100%
(b)	6	3	50%	5	4	80%	2	2	100%	5	5	100%
(c)	36	10	27.7%	57	22	38.6%	73	53	72.6%	40	32	80%
(d)	32	4	10%	46	17	36.9%	60	32	53.3%	15	12	80%
(e)	42	2	4.7%	62	19	30.6%	75	49	65.3%	45	34	75.5%
(f)	20	2	10%	24	8	33.3%	14	10	71.4%	4	4	100%

'Either' part of question No. 1 related to error Nos. 1 and 2 has been attempted by a few examinees as compared to the 'or' part of question (error No. 3). This shows that knowledge based on atmospheric pressure and use of Fortin's barometer was not so well known to examinees which tempted them to solve the other question. The comparative study reveals that error Nos. 1 and 2 are committed by almost all those who attempted the question. Error No. 6 proves that this content was not well understood by even first divisioners and so they attempted the other part. Those who attempted it have committed errors in principle.

4. Errors in organising the responses in a Systematic and Logical Order.

Essay type and short answer type questions where more than one processes are involved : it was noticed that pupils have not responded in a systematic manner. The sequence was neglected. In some responses the processes involved were not in logical sequence and in some other responses the proper words required to be used were not used.

Some of the illustrations from the study are as follows—

(1) In question one, while describing the use of index in Maximum & Minimum Thermometer, most pupils failed to write the words 'lower part of the index is used to read the temperature.'

(2) The order in which functions of 'D' valve of the 'engine' were to be put was missed and the students simply responded 'piston' is pushed by steam in D valve. The pupils should have mentioned that when piston moves onward the other end of the valve is closed and steam enters from the former valve and so on.

(3) While explaining the working of telephone, it was hardly mentioned that there is a cause and effect relationship between sound and electric energy i. e. the rise and fall of current is according to vibrations of sound.

(4) Functions of wireless were hardly expressed in the order expected from the examinees. Formation of modulated waves, feeble currents were omitted by even first dividers who attempted this question.

In general all the three essay type questions (six, including internal choice) were poorly attempted so far as sequence was concerned.

6. Expression of the pupils is very poor.

It has been noticed that even when the facts and terms are known to the pupils they are not able to put them in their own words to give the exact meaning which they really want to convey.

For example, a few errors of expression as noticed in the study are noted below:—

(1) Representing atmospheric pressure in terms of height of mercury column--weight of mercury per square cm.

(2) In the working of Maximum and Minimum Thermometer, reading is taken with the help of 'lower' part

of metallic index. The word lower index reads 'maximum' or minimum temperature are usually omitted.

(3) In the working of telephone, the variation in current due to variation in resistance was hardly mentioned by pupils.

(4) In the working of 'Wireless set' the electromagnetic waves are extrapolated for 'higher frequency'. This word 'higher frequency' was mentioned in the responses in much irrelevant manner.

(5) In the nuclear-fission, how 'chain reaction' is developed was not expressed in a short and concise manner.

6. Repetition of the same matter in the same language or different language also proves that the pupils lack in expressing the facts.

7. Errors in spelling the Scientific Terms:—

Though General Science teaching does not aim at testing the spelling and ability acquired in language yet it is essential that correct terminology should be known to the pupils. From the study, it was revealed that the examinees failed to give correct spelling for the following words:—

1. Seismograph. It was spelled incorrectly by even second divisioners. The unwanted spellings were Thermograph, Strosboscope. Spherograph, Geismograph, Graphmeter, Simsograph, Simograph, Siscograph.
2. Photo-synthesis was spelled as संसलेशन, संशलेवन, सीसलेसन उत्सर्जन
3. Molecule for atom,
4. Neutron is negative.
5. Particles as substance
6. Electric energy for electric current
7. Soundwaves for sound energy,
8. Disintegration as उत्सर्जन (emission).
9. Caustic for caustic soda; soda of soap for caustic soda.

8. Habit of Repetition and Negative Answering:—

This type of error was common in third divisioners and failures, probably, due to the fact they had time to sit in examination hall and did not remember the answers. The other reason can be, that pupils consider that marks are given according to the size of the answer. It is 'therefore' suggested that teachers should discourage this habit, and prepare the pupils for proper, concise answers relevant to the question. Pupil must know clearly that marks are not given according to the size of the answer.

9. Irrelevant Answers:—

Irrelevance was noticed in many questions of the paper under study. Almost all categories of students in one or the other question have given irrelevant answers. Some examples of irrelevant answers are as follows:—

- (i) For siesomograph the names responded were photograph, stethoscope, stalagtite. This illustration further reveals that pupil is neither clear about Siesmograph nor with other irrelevant names given by him.
- (ii) Reasons given for 'central part of the earth behaves as solid and liquid both, are—that temperature and pressure are equal, high boiling point of earth, plants and trees, atmospheric pressure.
- (iii) While recalling the occupational disease, one of the irrelevant answers were Malaria, Diphtheria, Small-pox, Typhoid, etc.
- (iv) Alcohol expands on cooling.
- (v) Uses of instruments (engine, maximum minimum thermometer, telephone) were expressed in place of their working.

9. Habit of over-writing, poor hand-writing and dirtiness.

It is generally observed in all walks of life that pupil are less confident, less careful and lack interest in presenting things beautifully. It was observed in this study also.

In the Multiple Choice type questions, where examinee is to write only one letter out of A, B, C and D, there were overwritings. The over-writing is so shabby that none of the letter can be ascertained. Examinees should be clearly instructed that no credit will be given for over-writing. The difficulty of over-writing in assessment becomes acute when some numerals are involved.

This habit of over-writing is to be discouraged right from lower classes during the class-room teaching.

Though answer-books are provided with lining yet examinees do not use these lines to answer the question. Proper headings, headlines, paragraph, point to point answer and systematic way of presenting the matter was hardly observed. Even first divisioners were lacking in this respect. Only 5% of the examinees can be said to have presented their answers beautifully and systematically.

This error cannot be rectified when the pupil reaches class IX but requires to be pointed out by the teachers dealing with the pupil right from the beginning.

CHAPTER—IV

Summary and Conclusions

4.1 Introduction:—

The present investigations have been mainly concerned with the analysis of the question paper of General Science for the Secondary Examination, 1972 and the study of students' responses to each question set in the paper. This is done to know how far the newly framed instructional objectives like knowledge, understanding, application and skill have been actually tested in the General Science question paper of Secondary Examination 1972; how far these objectives have been actually achieved by the examinees and what were the significant errors made by the students. This study also aimed to know the areas in which instruction was especially found poor and needs improvement and the extent to which questions discriminate between the better and poorer examinees. The other main objective of this study was to provide directions for improving the design and construction of the question paper so that it can be made more reliable in measuring the achievement of specific instructional objectives relating to particular units of syllabus in General Science. With these purposes in view two hundred twenty four answer-books of the candidates who appeared in General Science paper of the Secondary Examination, 1972 were selected. The same percentages of the first, second and third class students and those who failed were included in the sample of 224 answer-books as in the actual results of the candidates in the whole paper. In this chapter the significant results of the investigations, described in previous chapters, are summarized and some suggestions for improving the design and construction of test paper, and teaching in the class-room and its measurement, are presented.

4.2 Coverage of Objectives:—

The analysis of the question paper reveals that there was much variation in weightage (i. e. percentage of marks allotted) to various objectives in Section A and Section B of the question paper (see table 2.2) For example we find that 53.3% marks (i. e. 8 marks out of 13 marks were allotted in Section A as compared to 23% marks (i. e. 8 marks out of 35 marks) allotted in Section B to test knowledge objective. Similarly in Section B 28.4% marks (i. e. 10 marks out of 35 marks) were allotted as compared to 0% (i. e. 0 marks out of 15 marks) in Section A to test skill objective. Therefore, it is suggested that equal weightage to objectives be given in Section A and Section B.

We also notice that in the whole paper more weightage (i. e. 20% marks or 10 marks out of 50 marks) was given to test skill objective and less weightage (i. e. 38% marks or 19 out of 50 marks) was given to test understanding objective. It is, however, suggested that the weightage given to skill objective be decreased and more weightage be given to understanding objective. We recommend in the following table the distribution of marks to various objectives in section A and B and in the whole question paper for an improved question paper in General Science.

Table—4.1

Category of Objectives	Marks in Section B	Marks in Section A	Marks in whole Question paper
1. Knowledge	11 (32%)	5(32%)	16 (32% of the total marks)
2. Understanding	17 (48%)	7(48%)	24 (48% -do-)
3. Application	3.5 (10%)	1.5 (10%)	5 (10% -do-)
4. Skill	3.5 (10%)	1.5 (10%)	5 (10% -do-)

4.3 Coverage of Content:—

It is observed from the table 2.3 of chapter II that marks are evenly distributed over various units of instruction i. e. approximately required weightage has been given to various units of study. One may also notice that marks are

also evenly distributed over various units of syllabus in regard to objectives. Therefore, we recommend that the present trend be continued in the question paper.

4.4 Arrangement of Questions:—

The analysis indicates that within each section of the question paper, items of similar content are not grouped together. Thus paper appears to the examinees as fragmented and they cannot solve it in an integrated fashion. It is suggested that items of similar content be grouped together and further items from a particular content be arranged according to their difficulty level. It is usually good to progress from the easy to more difficult items.

4.5 Marking Scheme for the Examiners:—

The marking scheme lacks in details, which has resulted in subjective marking. Thus objectivity has not been built up as desired in public examinations. There were quite a good number of cases in which examiners have wrongly marked the individual questions as noted in chapter III. Therefore, we strongly suggest that more detailed marking scheme or the model answers, which may be in the shape of processes involved as done by our team, to each question be provided to examiners to avoid too much subjective marking, otherwise we will be unable to ensure uniformity in marking by different examiners.

4.6 Scoring Pattern:—

The analysis of the scoring pattern of individual students in two sections of the question papers reveals that marks scored by them in Section A were much more than in Section B. In Section A 82 students out of the 224 students secured above 60% marks as compared to 22 students out of 224 students in Section B. Only 43 out of 224 students failed in Section A as compared to 155 students out of 224 students failed in Section B.

From the table 2.7 and 2.8 of chapter II we have seen that questions testing knowledge objective in Section A have been answered correctly by more than 60% students who

passed in the whole paper. The questions testing understanding objective in Section A have been wrongly answered by more than 50% students who passed in the whole paper. Thus one can conclude that the performance is much better in questions where memory or guess work can play an important part.

4.7 Item Analysis:--

In chapter III we have presented the data of item analysis. Calculated indices of difficulty and discrimination are summarised in table 4.2 for Section A of the question paper.

Table—4.2

S. No.	Question No. and Type of Question	Objective	Difficulty Index	Discrimination Index	Remarks
1.	1(MCT)	Knowledge	0.8	0.3	Easy, poor in discriminating.
2.	3(MCT)	„	0.92	0.026	Very easy, very poor in discriminating.
3.	4(MCT)	„	0.63	0.34	Reasonably good item.
4.	6(MCT)	„	0.55	0.22	Moderate, poor in discriminating.
5.	7(MCT)	„	0.52	0.022	Moderate, very poor in discriminating.
6.	10(MCT)	„	0.78	0.24	Easy, poor in discriminating.
7.	11(MCT)	„	0.67	0.2	Easy, poor in discriminating.
8.	12(MCT)	„	0.86	0.29	Very easy, poor in discriminating.
9.	14(MCT)	„	9.73	0.29	Very easy, poor in discriminating.
10.	15(MCT)	„	0.54	0.55	Moderate, good in discriminating, good item.

11.	18(MCT)	„	0.33	0.32	Very difficult, reasonably fair in discriminating.
12.	19(MCT)	„	0.58	0.33	Easy, reasonably fair in discriminating.
13.	21(VSAT)	„	0.62	0.7	Easy, good in discriminating.
14.	24(VSAT)	„	0.5	0.46	Reasonably good item.
15.	2(MCT) Understanding		0.45	0.57	Difficult, good in discriminating.
16.	5(MCT)	„	0.53	0.28	Moderate, poor in discriminating.
17.	8(MCT)	„	0.40	0.058	Very difficult, very poor in discriminating.
18.	9(MCT)	„	0.52	0.49	Moderate, good in discriminating.
19.	13(MCT)	„	0.55	0.6	Reasonably good question.
20.	16(MCT)	„	0.69	0.52	Easy, good in discriminating.
21.	17(MCT)	„	0.75	0.4	Easy, reasonably good in discriminating.
22.	20(MCT)	„	0.26	0.25	Very poor question.
23.	23(VSAT)	„	0.75	0.44	Very easy, good in discriminating.
24.	25(VSAT)	„	0.36	0.46	Poor question.
25.	22(VSAT) Application		0.3	0.5	Very difficult, good in discriminating.

We find from the table that majority of the items are ineffective (non-discriminating) because they are too difficult or too easy. Only a few items appear to be reasonably good. Thus one can conclude that the objective type questions set in the question paper of General Science, 1972 are not proper and demand efforts to improve the questions. Hence the scores of the examinees may not give us true indication of their achievements in the subject. The present

question paper although of improved pattern, due to poor quality of the questions, is unsatisfactory.

We suggest that a large number of different type of objective type questions be prepared by subject experts and be administered to students in classes and item analysis got done. Suitable questions be pooled together in a question bank and examiners be requested to use these questions.

4.8 Short Answer Type Questions:—

In Section B of the paper there were 10 short answer type questions, each carrying two marks. Calculated indices of difficulty and discrimination for these questions are summarised in Table 4.3.

S. No.	Ques- tion No.	Objective	Diffi- culty Index	Discrimi- nation Index	Remarks
1.	4	Knowledge	0.43	0.31	Difficult, poor in discriminating.
2.	6	„	0.66	0.32	Easy, poor in discriminating.
3	8	„	0.28	0.4	Very difficult reasonably good in discriminating
4.	10	„	0.17	0.3	Too difficult, poor in discriminating.
5.	5	Understand- ing	0.345	0.65	Difficult, good in discriminating
6.	9	„	0.4	0.37	Difficult, reasonably fair in discriminating.
7.	7	Application	0.4	0.13	Difficult, very poor in discriminating.
8.	11	„	0.29	0.42	Too difficult, good in discriminating.
9.	12	Skill	0.51	0.2	Moderate, very poor in discriminating.
10.	13	„	0.45	0.21	Difficult, very poor in discriminating.

From a study of the table one can conclude that majority of the questions appear to be difficult and poor in discriminating between better and poorer examinees. Thus these questions also fail to give us a true picture of the achievements of the students. The Board's result is, therefore, misleading.

The situation regarding essay type questions is still more shocking. From the table 3.34, 3.35, 3.36 and 3.37 one will conclude that majority of the students do not know the answer of essay type questions. We also find that examinees failed to organise their thoughts in a clear logical manner.

From the study of responses to an individual question one may conclude that the students, although they might have passed in the whole paper, have done badly, in achieving the goals of General Science. The study team is of the opinion that this may be due to lack of proper teaching in the class-room. Therefore, the only real solution of the problem is the improvement of the quality of instruction in the class-room. The Board can help the teachers by providing teachers' guide and work books for the students.

4.10 Students Common Errors:—

Apart from the specific errors (See Section 3.13) involved in answering the questions of the paper, the effort to list all types of errors found in the scripts has not been very successful. While it gives a fairly good idea of the various types of errors made by the students it cannot give us any exact idea of the percentage of students making each type of error. In answering essay and short answer type questions both better and poorer students fail to organise the response in a clear and logical manner. Our good and bad students have indulged in overwriting and repetition. Majority of the students wrote the construction of the apparatus in more

detail than the working as required by the questions. Students seem to be in the habit of writing whatever they know about the topic from which the question has been asked. This problem can be solved by encouraging students to do good amount of home-work and properly correcting it.

Suggestions: --

1. The question paper should have objective, very short answer, essay and short answer type questions. The present practice should be continued, but we suggest the following breakup of questions in each category:—

	Proposed No. of Questions (Marks are given in bracket)
Section A Objective Type	20 (10)
Very Short Answer Type	5 (5)
Section B Essay Type	2 (9)
Short Answer type	13 (26)

Objective type questions may be of the following form:

(I) Completion type (II) True false type (III) Matching type (IV) Multiple choice type, and (V) Identification type.

2. We suggest that distribution of marks to various objectives in Section A, B and in the whole paper should be according to Table 4.1.

3. We suggest that multiple choice type questions should be asked to measure higher order of mental processes namely Understanding and Application.

4. The nature of the questions should be such as requires the real understanding and knowledge of the subject and not guess work.

5. We observed that most of the questions were of poor quality; so we suggest the establishment of a question bank.

6. In marking scheme each point or the process involved in answering the question should be written. Present marking scheme is sketchy.

The students, although they might have passed in the whole paper, fare very badly in achieving the goals of General Science. Real improvement in standards can come through better teaching in schools and not through doubtful measures of the so-called examination reform. In any case, the movement for examination reform does not seem to have improved the standard of General Science in our Secondary Schools. For better teaching in class-room, Board can help the teachers by providing good teachers' guide and work books for the students.

REFERENCES

1. Sharma, P. D., Improving Examination, New Delhi; Director of Extension Programmes for Secondary Education, 1963.
2. The Concept of PUBLICATION Evaluation in Education, NCERT 1960.
3. Bloom, B. S. et. all; "Taxonomy of Educational objectives," Handbook 1, Cognitive Domain David Mckay Co., New York, 1956.
4. Marshall-hales, "Class-room test construction" Addison Wesley Publishing Company, 1971.
5. Allan Lange, Irwin S. Lehmann and Willam A, Mehrens "Using Item analysis for improved Tests" Journal of Educational Measurement Vol. 4 (1967), 125-28.
6. Cox, R. C., "Item Selection Techniques and Evaluation of Instructional Objectives" Journal of Educational Measurements, 2, 1965, 181-185.
7. Frederick, B. Davis; "Item Analysis in Relation to Educational and Psychological Testing" Psychological Bulletin, 49 (1952) 97-121.
8. Warren G. Findley, "Rational for the Evaluation of Item Discrimination Statistics," Educational and Psychological Measurement, Vol. 16, 175-180, 1956.
9. Truman L. Kelley, "The selection of upper and lower groups for validation of Test Item" Journal of Educational Psychology, Vol. 30, 17-24, 1939.
10. Robert L. EBEL, "Essentials of Educational Measurement," Prentice Hall Inc. 1972.

APPENDIX—1

**SECONDARY SCHOOL, HIGHER SECONDARY
(PART I)
AND HIGHER SECONDARY EXAMINATIONS, 1972
COMPULSORY—GENERAL SCIENCE**

TIME : TWO AND A HALF HOURS

Maximum Marks : 50

Roll Number (in figures).....

(in words).....

Day and Date of Examination.....

Name of Examination.....

**(Write here Secondary School or Higher Secondary
(Part I) or Higher Secondary at which appearing.)**

Section 'A'

Time : 30 Minutes

Maximum Marks : 15

1. The planet farthest from the sun is—
(A) Pluto (B) Neptune
(C) Venus (D) Jupiter. () $\frac{1}{2}$

2. The special feature of metamorphic rock is that—
(A) They are the oldest.
(B) They are found in layers.
(C) They are formed from other rocks.
(D) They are formed from lava of volcanoes. () $\frac{1}{2}$

3. In the process of photosynthesis plants take—
 (A) Carbon-dioxide. (B) Nitrogen.
 (C) Oxygen. (D) Ammonia. () $\frac{1}{2}$
4. The planet known as morning star is—
 (A) Mars. (B) Mercury.
 (C) Jupiter. (D) Venus. () $\frac{1}{2}$
5. Stalactites and Stalagmites are formed due to—
 (A) Rain water.
 (B) Dissolution of calcium carbonate in water.
 (C) Dissolution of calcium carbonate in carbonic acid.
 (D) Dissolution of calcium bicarbonate in carbonic acid.
 () $\frac{1}{2}$
6. Penicillin is obtained from—
 (A) Fungus. (B) Algae.
 (C) Bacilli. (D) Cocci. () $\frac{1}{2}$
7. The main function of Vitamin C is to—
 (A) Strengthen the bones.
 (B) Help in reproductive process.
 (C) Help in clotting of blood.
 (D) Keep liver healthy. () $\frac{1}{2}$
8. The method of improving the breed of mangoes is known as—
 (A) Budding. (B) Grafting.
 (C) Mass selection. (D) None of the above. () $\frac{1}{2}$
9. On studying the embryos of fish, hen, rabbit and man we find that—
 (A) Embryos of all these living beings are similar.
 (B) All animals have developed from Aves.
 (C) All animals have developed from Pisces.
 (D) Man has originated from fish. () $\frac{1}{2}$
10. The acid formed in dental cavities due to bacteria is—
 (A) Hydrochloric acid. (B) Sulphuric acid.
 (C) Nitric acid. (D) Lactic acid. () $\frac{1}{2}$
11. An example of the disease caused due to bacteria and virus is—

- (A) Colour-blindness. (B) Anaemia.
(C) Typhoid. (D) Beri-beri. () $\frac{1}{2}$
12. Zinc is used in the preparation of—
(A) Electric cells. (B) Cycle.
(C) Railway trains. (D) Tools. () $\frac{1}{2}$
13. For cleaning the wounds of skin we should use—
(A) Bleaching powder. (B) Dettol.
(C) Kerosene oil. (D) D.D.T. () $\frac{1}{2}$
14. The main symptom of diphtheria is—
(A) Inflammation in throat.
(B) High fever.
(C) Loose motions.
(D) Shivering of body. () $\frac{1}{2}$
15. On fractional distillation of petroleum, petrol is obtained from—
(A) 50° C to 70° C. (B) 70° C to 90° C.
(C) 90° C to 150° C. (D) 150° C to 300° C. () $\frac{1}{2}$
16. Top soil is most fertile because—
(A) It is at the top.
(B) It receives maximum rain water.
(C) It contains more manure.
(D) It contains humus. () $\frac{1}{2}$
17. Bad conductor of electricity is—
(A) Copper. (B) Silver.
(C) Zinc. (D) Mica. () $\frac{1}{2}$
18. An example of carbonic manure is—
(A) Oil Cake Manure. (B) Ammonium Sulphate.
(C) Superphosphate. (D) Potash Sulphate. () $\frac{1}{2}$
19. The amount of sleep sufficient for adults is—
(A) 12 hours. (B) 10 hours.
(C) 9 hours. (D) 6 hours. () $\frac{1}{2}$
20. Aluminium utensils are made of an alloy of—
(A) Aluminium, Copper and Zinc.

(B) Aluminium, Copper and Magnesium. .

(C) Aluminium, Copper and Iron.

(D) Aluminium, Copper and Steel. () $\frac{1}{2}$

21. Which instrument is used for locating earthquakes ?
1
22. Why does the central core of the Earth shows qualities of a liquid as well as solid ?
1
23. Which process will not occur in plants if they do not get light ?
1
24. Mention any one disease caused due to occupations.
1
25. Why does an atom have an equal number of electrons and protons ?
1

SECTION 'B'

Time : 2 Hours

Maximum Marks : 35

1. Explain, with the help of a diagram of Fortin's Barometer, how atmospheric pressure is measured with it.

(Description = 3
(Diagram = 2

OR

Explain, with the help of a diagram, the working of a maximum minimum thermometer.

(Working = 3
(Diagram = 2

2. Explain, with the help of a diagram of transmitter and receiver, how do we talk on a telephone.

(Working = 3
(Diagram = 2

OR

Explain, with the help of a diagram Wireless Communication System.

(Description = 3
(Diagram = 2

3. How do we get energy in an atomic reactor ? Draw the diagram of chain reaction.

(Description = 3
(Diagram = 2

OR

Explain, with the help of a diagram the working of an external combustion engine.

(Description = 3

(Diagram = 2

4. Mention any two phenomena occurring on the Earth due to the Sun. 2
5. How natural caves are formed? 2
6. Give any four uses of vegetation for human beings. 2
7. If there is a patient of a contagious disease in a house, how can the other members be protected from the disease? 2
8. How is glass prepared? 2
9. How does soap clean dirt? 2
10. What do you understand by polymers? Give any two of its uses in industry? 1
11. Mention one similarity and one difference between the formation of coal and petroleum. 2
12. Draw a labelled diagram of a comet. 2
13. Draw a diagram of any one Xerophytic Plant. 2

— —

APPENDIX—2

SCORING KEY AND MARKING SCHEME

Scoring Key

Section 'A'

Q. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Correct Response																					
Marks																					

21. Seismograph

22. Due to high pressure and high temp. $\frac{1}{2}$ mark
for each factor written correctly.

1 mark

23. Photosynthesis

1 mark

24. Any one of the following diseases mentioned
correctly; Anaemia, Respiratory Diseases,
Headache, etc.

1 mark

25. So that it might be electrically neutral

1 mark

Section 'B'
MARKING SCHEME

1. Correct explanation of working of Fortin's Barometer 3 marks
 Correct diagram Pages 74-75 2 marks

Or

- Correct explanation of working 3 marks
 Correct diagram Pages 85-86 2 marks
2. Correct explanation of working 3 marks
 Correct diagram Pages 524-525 2 marks

Or

- Correct explanation of working 3 marks
 Correct diagram Pages 534-536 2 marks
3. Correct explanation of working of nuclear reactor 3 marks
 Diagram of chain reaction Pages 386-388 2 marks

Or

- Description of working an external combustion engine 3 marks
 Diagram Pages 398-401 2 marks
4. 1 mark for each correct phenomenon out of the following phenomena
 Day and night, Tides, Seasons 2 marks

Pages 16-20

5. Correct explanation 2 marks
6. $\frac{1}{2}$ mark for each correct use out of the following uses : 2 Marks
 Food, oils, clothing, medicines, drinks, wood,
 other useful things. Pages 170-172

7. 1. Keep patient in a separate room. $\frac{1}{2}$ mark
 2. Allow only attendants to go near him. $\frac{1}{2}$ mark
 3. Vaccination $\frac{1}{2}$ mark
 4. Use of disinfectants Page 272 $\frac{1}{2}$ mark } 2
8. Sodium carbonate, lime stone, glass sand are heated up to 1400° C and the molten mass is used for manufacturing glass. Page 470 2 marks
9. See explanation on page 467 2 marks
 Correct explanation
10. Explanation on page 482 1 mark }
 Correct explanation. 1 mark } 2
 $\frac{1}{2}$ mark for each correct use. Page 482
11. Both are formed due to high temperature and pressure inside the earth. 1 mark }
 Coal is formed from wood whereas petroleum is formed from sea animals and seaweeds. 1 mark } 2
 Page 235
12. Labelling of parts correctly done 1 mark }
 Diagram correctly drawn. 1 mark } 2
- Pages 21-22
13. Diagram drawn correctly. 2 marks

APPENDIX—4

PROFORMA FOR ANALYSIS OF ESSAY AND SHORT ANSWER TYPE QUESTIONS

COMPILATION OF PROCESSES AND ERRORS (Other than Multiple Choice Type Questions)

Subject..... Paper..... Section A/B Examination : Secondary/Higher Secondary

Question No. Category of Students:— First / Second / Third / Failure Name of the Evaluator.....

Roll No.	Not Attempted	Marks Obtained	Response in Terms of Processes										Irrelevant	Errors Committed										Any Other
			1	2	3	4	5	6	7	8	9	10		1	2	3	4	5	6	7	8	9	10	

FIRST CONSOLIDATION OF DATA FOR OBJECTIVE TYPE (BY INDIVIDUAL EVALUATOR) MULTIPLE CHOICE TYPE QUESTIONS

Subject..... Paper..... Examination :.....
 Name of the Evaluator / Convener:.....

Q.No.	FIRST DIVISIONER'S RESPONSES							SECOND DIVISIONER'S RESPONSES							THIRD DIVISIONER'S RESPONSES							FAILURE'S RESPONSES																	
	A	B	C	D	Omission	Over Writing	Any Other	Total	A	B	C	D	Omission	Over Writing	Any Other	Total	A	B	C	D	Omission	Over Writing	Any Other	Total	A	B	C	D	Omission	Over Writing	Any Other	Total							

CONSOLIDATION OF PROCESSES AND ERRORS (OTHER THAN MULTIPLE CHOICE TYPE QUESTIONS (INDIVIDUAL))

Subject..... Paper..... Examination :.....

Name of the Evaluator:.....

Q. No.	Category of Students	Not Attempted	Response in Terms of Processes										Irrelevant	Errors Committed										
			1	2	3	4	5	6	7	8	9	10		1	2	3	4	5	6	7	8			

APPENDIX—5

DISTRIBUTION OF THE PERCENTAGE OF MARKS WITH REGARD TO THE OBJECTIVES

PAPER : GENERAL SCIENCE

YEAR 1972-73

Total No. of Ques- tions	SECTION 'A'				Total No. of Ques- tions	SECTION 'A' (Other than M.Ch.Q.)				Total No. of Ques- tions	SECTION 'B'			
	K	U	A	S		K	U	A	S		K	U	A	S
20	1,3,4,6,	2,5,8,	—	—	5	21, 24	23, 25	22	—	13	4,6,8,	1,2,3,	7,11,	1,2,3,
	7,10,11,	9,13,									10	5,9		12,13
	12,14,	16,17,												
	15,18,	20												
	19													
Total No. of Marks					Total No. of Marks					Total No. of Marks				
10	6	4	—	—	5	2	2	1	—	35	8	13	4	10
Perce- ntage	60.00%	40%	—	—		40%	40%	20%	—		22.8%	37.2%	11.5%	28.5%

APPENDIX—6

DETAILED ANALYSIS DATA AND PROCESSES INVOLVED IN ANSWERING VERY SHORT ANSWER TYPE QUESTIONS.

In section A there were 5 questions regarding examinees to write very short answers and each question carrying one mark. Item analysis data of these questions is presented below:—

Question No. 21:—

Topic:—The Earth and its Mysteries

Objective:—Knowledge

Question : Which instrument is used for locating Earthquakes ?

Processes involved:—See Appendix 7

Category of Students	Total No. of Each Category	No. of Students writing Correct Processes			Index of Difficulty	Index of Discrimination
		Ist Answer	Irrelevant Answer	Not Attempted		
1. First Divisioners (Higher Group)	42	41	1	-		
2. Second Divisioners	62	45	14	3	0.62	0.70
3. Third Divisioners	75	49	23	3		
4. Candidates who failed (Lower Group)	45	13	23	9		

Question No. 22:—

Topic:—The Earth and its Mysteries

Objective:—Application

Question:—Why does the central core of the Earth shows qualities of a liquid as well as solid?

Processes involved:—See Appendix 7

Category of Students	Total No. in Each Category	No. of Students who could reach to the Processes						Index of Difficulty	Index of Discrimination
		I	II	III	IV	Irrelevant Ans.	Not attempted		
1. First Divisioners (Higher Group)	42	24	26	22	22	7	1		
2. Second Divisioners	62	28	30	23	21	16	2	0.3	0.5
3. Third Divisioners	75	17	18	13	12	24	6		
4. Candidates who failed (Lower Group)	45	5	3	1	1	17	8		

Question No. 23:—

Topic:—Plants and Animals

Objective:—Understanding

Question:—Which process will not occur in Plants if they do not get light?

Processes involved:—See Appendix 7

Category of Students	Total No. in Each Category	No. of Students who could reach to the Processes					Index of Difficulty	Index of Discrimination
		I	II	III	Irrelevant Ans.	Not Attempted		
1. First Divisioners (Higher Group)	42	41	39	48	1	1		
2. Second Divisioners	62	54	52	50	2	5	0.75	0.44
3. Third Divisioners	75	65	65	56	4	6		
4. Candidates who failed (Lower Group)	45	26	24	24	11	2		

Question No. 24:—

Topic:—Nutrition and Health

Objective:—Knowledge

Question:—Mention any one disease due to occupation.

Processes involved:—See Appendix 7

Category of Students	Total No. in Each Category	No. of Students writing correct Processes			Index of Difficulty	Index of Discrimination
		Ist Answer	Irrelevant	Not Attempted		
1. First Divisioners (Higher Group)	42	30	12	—		
2. Second Divisioners	62	29	33	—	0.5	0.46
3. Third Divisioners	75	28	40	—		
4. Candidates who failed (Lower Group)	45	12	30	3		

Question No. 25: —

Topic:—Matter and Energy

Objective:— Understanding

Question:—Why does an atom have an equal number of electron and protons ?

Processes involved:—See Appendix 7

Category of Students	Total No. in Each Category	No. of Students who could reach to the Processes							Index of Difficulty	Index of Discrimination
		I	II	III	IV	V	Irrelevant Ans.	Not Attempted		
1. First Divisioners (Higher Group)	42	31	28	33	28	24	4	1		
2. Second Divisioners	62	29	26	30	29	22	15	4	0.36	0.63
3. Third Divisioners	75	19	16	14	11	11	25	7		
4. Candidates who failed (Lower Group)	45	2	5	2	3	1	15	8		

APPENDIX—7
PROCESSES INVOLVED IN ANSWERING VERY
SHORT ANSWER TYPE QUESTIONS.

Q. No.	Topic	Objective	Processes Involved
21.	Changes inside Earth's surface	Knowl- edge	Recalls the name of the instru- ment used in detecting earth- quakes i. e. Seismograph.
22.	Interior layers of the Earth	Applica- tion	<ol style="list-style-type: none"> 1. Distinguishes the solid and liquid states. 2. Recalls the conditions prevail- ing at the central part of the earth i e. high pressure and high temperature. 3. Recalls the effects of high temperature and high press- ure on solids and liquids. 4. Makes hypothesis that due to high temperature and high pressure the central portion of the earth is in a molten state.
23.	Interdepend- ence of plants and animals	Under- standing	<ol style="list-style-type: none"> 1. Recalls various processes in the plants and their neces- sary conditions. 2. Distinguishes the process in relation to the conditions. 3. Locates the process wherein light is required.
24.	Diseases and their preve- nion	Knowl- edge	<ol style="list-style-type: none"> 1. Recalls the name of occupa- tional diseases such as anaemia, shivering of hands and legs, dental disease, respiratory diseases, head- ache etc.

25. Structure of Atom	Under-standing	<ol style="list-style-type: none"> 1. Recalls that atom is electrically neutral. 2. Recalls the structure of the atom. 3. Recognises that the electrons are negatively charged and protons are positively charged. 4. Recognises that the quantity of charge on protons is equal to the charge of an electron. 5. Formulates the statement that number of Electrons and Protons in an atom is equal to make the atom electrically neutral.
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Processes involved in Answering Short Answer Type Questions of Section B

Question No. 4:—

Topic:—The Universe

Objective : Knowledge

Processes involved:—Recalls the processes and writes any two out of the following:—

1. Obtaining heat and light from the Sun.
2. Formation of day and night.
3. Formation of seasons.
4. Formation of tides.

Question No. 5:—

Topic : Inner changes of the Earth

Objective : Understanding

Processes involved:—

1. Gives reasons that carbonic acid is present, dissolved in ground water.
2. Flow of this water through the cracks in stones and rocks containing calcium carbonate.

3. Calcium carbonate dissolves in this water, more and more.
4. In thousands of years these cracks take the shape of the caves.

Question No. 6:—

Topic:—Plants and Animals

Objective : Knowledge

Processes involved:—Recalls the uses out of the following and writes any four:—

1. Food 2. Oil 3. Clothes 4. Medicines
5. Drinks 6. Wood 7. Rubber 8. Paper
9. Colours 10. Gum etc.

Question No 7 :—

Topic :—Diseases and their prevention

Processes involved :—

1. Separation, 2. Only the attendant goes to the patient,
3. The attendant is kept separately, 4. If possible to send the patient to isolation hospital,
5. Vaccination, 6. Use of antibacterial substances.

Question No. 8 :—

Topic :—Useful Material and its preparation

Objective :—Knowledge

Processes involved :—

1. Use of sodium carbonate, lime stone and sand in the preparation of glass.
2. Mixture being heated in the furnace at 1400° C.
3. Mixture melts in certain period forming molten glass.
4. Molten glass is put to moulds.
5. To prepare coloured glass, use of cobalt oxide, cuprous oxide and ferric oxide.

Question No. 9 :—

Topic :—Useful Material and its preparation

Objective :—Understanding

Processes involved :—

1. Dirt sticks due to oils.
2. Molecules of soap dissolve in water.
3. Molecules of soap dissolve in oil.
4. Suspension of the molecules of soap in water and oil.
5. Around the drops of oil, water drops collect.
6. Dirt leaves oil and goes to water drops.

Question No. 10 :—

Topic :—Useful Material and its preparation

Objective :—Knowledge

Processes involved :—

1. Organic substances such as silk, cotton, rubber, wood etc. having bigger molecular formula, difficult to write as such.
2. Bigger molecules contain many smaller molecules linked in thousands.
3. Such molecules which are composed of thousands of similar simpler molecules are called 'polymers'.
4. Simplest bigger molecule 'Polythene'
5. Cites any of the two uses out of the following—

Used in preparation of .

- (i) Clothes (ii) threads (iii) combs
 (iv) buckets, bottles, tube etc. (v) laboratories
 (vi) plastic glass (vii) plastic bags
 (viii) bakelite for electric pin, switch etc.
 (ix) tyres for cars, aeroplanes etc.

Question No. 11 :—

Topic :—Natural Resources

Objective :—Application

Processes involved :—

1. Formation of coal and petroleum at high temperature inside the earth.
2. Formation of coal and petroleum at high pressure.
3. Coal is formed by wood.
4. Petroleum is formed by sea weeds and animals.

Question No. 12 :—

Topic :—The Universe

Objective :—Skill

Processes involved :—

1. Draws the diagram correctly.
2. Draws the diagram neatly.
3. Draws the diagram proportionately.
4. Labels the diagram.

Question No. 13 :—

Topic :—Classification of Plants

Objective :—Skill

Processes involved:—

1. Draws the diagram correctly of any of the following plants :—
(a) Nag phani, (b) Babool, (c) Uforbia
2. Draws the diagram neatly.
3. Draws the diagram proportionately.
4. Labels the diagram.

APPENDIX—8

PROCESSES INVOLVED IN ANSWERING ESSAY TYPE QUESTIONS

Q. No. 1 (Either)

Topic :—Atmosphere

Objective :—Skill and Understanding

Processes involved :—

1. Draws correct diagram of Fortin's Barometer.
2. Draws neat diagram of Fortin's Barometer.
3. Draws proportionate diagram of Fortin's Barometer.
4. Labels the diagram.
5. Explains working—touching mercury level to pointed end of the pointer with the help of screw.
6. Adjusting vernier scale to the upper level of mercury column.
7. Reading the height of mercury column by the help of vernier scale.
8. Adding the main scale reading to vernier reading to get height of mercury column.
9. Explains the atmospheric pressure in terms of height of mercury column.

Question No: 1 (Or)

Topic :—Atmosphere

Objective :—Skill & Understanding.

Processes involved :—

1. Draws the correct diagram of Maximum Minimum Thermometer.

2. Draws the neat diagram of Maximum Minimum Thermometer.
3. Draws the proportionate diagram of Maximum Minimum Thermometer.
4. Labels the diagram of Maximum Minimum Thermometer.
5. Explains the working of Maximum Minimum Thermometer, touching the index to the mercury column with the help of magnet.
6. On increase of temperature alcohol in the Bulb 'A' expands and presses mercury level downward.
7. Corresponding mercury rises upward in the otherside 'B' and index thrown upward.
8. On decrease of temperature alcohol shrinks in 'B' and its mercury level goes upward.
9. Reads maximum temperature with the help of index in tube 'A',
10. Reads minimum temperature with the help of index in tube 'B'.

Question No. 2 (Either)

Topic—Communication

Objective—Skill and Understanding

Processes involved:—

1. Draws correct diagram.
2. Draws neat diagram.
3. Draws proportionate diagram.
4. Labels the diagram.
5. Speech causing sound waves fall on diaphragm and vibrates it.
6. Carbon particles come in motion.
7. Change in resistance of the electric circuit.
8. Increase and decrease in the strength of current.
9. Conversion of sound energy to electrical energy—sound currents.
10. Sound currents convert to sound energy in the receiver.
11. Flow of sound currents in the magnetic coils.
12. Similar change of increase and decrease in magnetic power.

13. Attraction in diaphragm.
14. Vibrations in diaphragm
15. Formation of sound energy again.

Question No. 2 (Or):—

Topic—Communication

Objective—Skill and Understanding.

Processes involved:—

1. Draws correct diagram.
2. Draws neat diagram.
3. Draws proportionate diagram.
4. Labels the diagram.
5. Speaking on microphones in the broadcasting centre.
6. Conversion of sound waves into electrical waves.
7. Formation of modulated waves.
8. Extending these modulated waves.
9. Sending these waves in Antina.
10. Transmission of these waves from Antina.
11. Passing of these waves through aerial and producing feeble waves therein.
12. Extending feeble waves.
13. Separating modulated waves.
14. Extending modulated waves.
15. Extended modulated waves sent to loud speaker.
16. Conversion of modulated waves in sound waves.
17. Hearing, the same sound through receiver as broadcasted.

Question No. 3 (Either):—

Topic—Atomic Energy

Objective—Skill and understanding

Processes involved:—

1. Draws correct diagram of chain reaction.
2. Draws neat diagram of chain reaction.
3. Draws proportionate diagram of chain reaction.
4. Labels the diagram of chain reaction.

5. Explains the bombardment of neutrons on heavier atoms like Uranium.
6. Conversion of Uranium to Strontium and Denone.
7. Loss of mass in this conversion causes formation of energy.
8. Simultaneous formation of 2-3 free neutrons.
9. Dis-integration of other atoms by these free neutrons.
10. Again formation of energy, lighter atoms and then again free neutrons.
11. Every moment disintegration process goes on i. e. chain reaction establishes.
12. Controlling the number of free neutrons and thereby preparing atomic energy in a desired way.
13. The whole unit wherein the chain reaction takes place and energy is produced is called Atomic Reactor.

Question No. 3 (or)—

Topic—Uses of Energy

Objective—Skill and Understanding.

Processes involved—

1. Draws diagram correctly of an External Combustion Engine.
2. Draws diagram neatly of an External Combustion Engine.
3. Draws diagram proportionately of an External Combustion Engine.
4. Labels diagram of an External Combustion Engine.
5. Burning fuel in boilers and converting water into steam.
6. Steam from boiler to steam chamber is brought and pressure increased.
7. Steam goes to cylinder via slide valve from the steam chamber.
8. Movement of slide valve onward and backward in such a way that only one way is open at a time.
9. Movement of steam from left to the right side in the cylinder and thus pressing piston.
10. Movement of piston rod and contact rod from left to right.
11. Motion in fly wheel, due to piston rod and contact rod movement.

12. Central rod attached to wheel and its relation with slide valve.
 13. Movement of piston rod, central rod and slide valve causes a motion from left to right.
 14. Causing the close of steam entering in the cylinder in the former path.
 15. Steam enters from the other side into the cylinder.
 16. Accordingly piston is forced to move.
 17. Movement of piston rod from right to left.
 18. Extra steam of the cylinder comes out through valve.
 19. Piston rod, contact rod moves onward and backward, causing circular motion in the fly wheel.
 20. Piston and cylinder, since linked to fly-wheel causes continuous alternate entry of steam and push to the piston.
 21. Fly wheel causes the motion to the wheels of the engine.
-

APPENDIX—9

ITEM ANALYSIS FOR ESSAY TYPE QUESTION NO. 3

Topic—Matter and Energy

Objective—Understanding (3 marks), Skill (2 marks)

Question—How do we get energy in an Atomic Reactor? Draw the diagram of Chain Reaction.

Processes involved : See Appendix 8

Category of Students	No. of Students in each Category	Response in Terms of Processes												
		1	2	3	4	5	6	7	8	9	10	11	12	13
1. First Div.	17	16	9	11	14	15	9	3	8	10	5	7	3	4
2. Second Div.	19	11	5	2	4	10	5	1	5	3	4	4	-	2
3. Third Div.	19	8	5	2	6	7	5	5	1	-	-	1	-	-
4. Candidates who failed in the whole paper.	5	2	1	1	-	-	-	-	-	-	-	-	-	-

Question No, 3 (Or)

Topic:—Matter and Energy

Objective:—Understanding (3 marks), Skill (2 marks)

Question : Explain with the help of a diagram the working of an External Combustion Engine.

Processes involved : See Appendix 8

Category of Students	No. of Students in Each Category	Response in Terms of Processes																				
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. First Div.	25	17	10	14	12	12	13	8	10	12	10	10	9	13	14	5	7	6	2	8	4	7
2. Second Div.	43	16	13	5	9	16	17	10	10	12	11	8	4	6	6	5	9	7	2	8	2	5
3. Third Div.	56	15	8	6	8	29	16	11	7	12	11	7	5	1	4	5	7	5	3	6	2	-
4. Candidates who failed in the whole paper	40	5	3	3	3	5	2	-	-	-	2	-	-	-	-	-	-	2	2	-	-	-

Systems Unit
of Education

Date..... 3/16/82

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