

MATHEMATICS

EXEMPLAR PROBLEMS

Class IX

विद्यया ऽ मृतमश्नुते



एन सी ई आर टी
NCERT

राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
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FOREWORD

The National Curriculum Framework (NCF) – 2005 initiated a new phase of development of syllabi and textbooks for all stages of school education. Conscious effort has been made to discourage rote learning and to diffuse sharp boundaries between different subject areas. This is well in tune with the NPE – 1986 and *Learning Without Burden-1993* that recommend child centred system of education. The textbooks for Classes IX and XI were released in 2006 and for Classes X and XII in 2007. Overall the books have been well received by students and teachers.

NCF–2005 notes that treating the prescribed textbooks as the sole basis of examination is one of the key reasons why other resources and sites of learning are ignored. It further reiterates that the methods used for teaching and evaluation will also determine how effective these textbooks proves for making children’s life at school a happy experience, rather than source of stress or boredom. It calls for reform in examination system currently prevailing in the country.

The position papers of the National Focus Groups on *Teaching of Science, Teaching of Mathematics and Examination Reform* envisage that the mathematics question papers, set in annual examinations conducted by the various Boards do not really assess genuine understanding of the subjects. The quality of questions papers is often not up to the mark. They usually seek mere information based on rote memorization, and fail to test higher-order skills like reasoning and analysis, let along lateral thinking, creativity, and judgment. Good unconventional questions, challenging problems and experiment-based problems rarely find a place in question papers. In order to address to the issue, and also to provide additional learning material, the Department of Education in Science and Mathematics (DESM) has made an attempt to develop resource book of exemplar problems in different subjects at secondary and higher-secondary stages. Each resource book contains different types of questions of varying difficulty level. Some questions would require the students to apply simultaneously understanding of more than one chapters/units. These problems are *not* meant to serve merely as question bank for examinations but are primarily meant to improve the quality of teaching/learning process in schools. It is expected that these problems would encourage teachers to design quality questions on their own. Students and teachers should always keep in mind that examination and assessment should test

comprehension, information recall, analytical thinking and problem-solving ability, creativity and speculative ability.

A team of experts and teachers with an understanding of the subject and a proper role of examination worked hard to accomplish this task. The material was discussed, edited and finally included in this source book.

NCERT will welcome suggestions from students, teachers and parents which would help us to further improve the quality of material in subsequent editions.

New Delhi
21 May 2008

Professor Yash Pal
Chairperson
National Steering Committee
National Council of Educational
Research and Training

PREFACE

The Department of Education in Science and Mathematics (DESM), National Council of Educational Research and Training (NCERT), initiated the development of 'Exemplar Problems' in science and mathematics for secondary and higher secondary stages after completing the preparation of textbooks based on National Curriculum Framework–2005.

The main objective of the book on 'Exemplar Problems in Mathematics' is to provide the teachers and students a large number of quality problems with varying cognitive levels to facilitate teaching learning of concepts in mathematics that are presented through the textbook for Class IX. It is envisaged that the problems included in this volume would help the teachers to design tasks to assess effectiveness of their teaching and to know about the achievement of their students besides facilitating preparation of balanced question papers for unit and terminal tests. The feedback based on the analysis of students responses may help the teachers in further improving the quality of classroom instructions. In addition, the problems given in this book are also expected to help the teachers to perceive the basic characteristics of good quality questions and motivate them to frame similar questions on their own. Students can benefit themselves by attempting the exercises given in the book for self assessment and also in mastering the basic techniques of problem solving. Some of the questions given in the book are expected to challenge the understanding of the concepts of mathematics of the students and their ability to applying them in novel situations.

The problems included in this book were prepared through a series of workshops organised by the DESM for their development and refinement involving practicing teachers, subject experts from universities and institutes of higher learning, and the members of the mathematics group of the DESM whose names appear separately. We gratefully acknowledge their efforts and thank them for their valuable contribution in our endeavour to provide good quality instructional material for the school system.

I express my gratitude to Professor Krishna Kumar, *Director* and Professor G.Ravindra, *Joint Director*, NCERT for their valuable motivation and guidance from time to time. Special thanks are also due to Dr. R.P.Maurya, *Reader in Mathematics*, DESM for coordinating the programme, taking pains in editing and refinement of problems and for making the manuscript pressworthy.

We look forward to feedback from students, teachers and parents for further improvement of the contents of this book.

Hukum Singh
Professor and Head

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EXEMPLAR PROBLEMS – MATHEMATICS

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STUDENTS' EVALUATION IN MATHEMATICS AT SECONDARY STAGE

A. Introduction

The fascinating world of mathematics provides an unlimited scope to mathematicians to perceive problems pertaining to three situations visualised in the forms of concrete, abstraction and intuition. However, due to abstraction and intuition, sometimes some of the mathematical concepts become quite complicated even for teachers who are actively engaged in mathematics teaching at various stages. This needs the exhaustive training in methods/ pedagogy as well as in contents. This also needs the clarifications of mathematical concepts using instructional materials, experimentation, observation and practicals etc. to avoid the abstraction at various stages of schooling. Good mathematics instruction requires good teachers, and good teachers are those with pedagogical content knowledge who, in turn, are predominantly those with good content. Improvement of school mathematics education therefore begins with teaching teachers the mathematics they need. In other words, the most difficult demand for becoming a good teacher is to achieve a firm mastery of the mathematical content . Without such a mastery, good pedagogy is difficult. A firm mastery of the content opens up the world of pedagogy and offers many more effective pedagogical possibilities. Even best pedagogy lavished on incorrect mathematics may result in poor quality in teaching.

Mathematics as a science of abstract objects, relies on *logic* rather than on observation, yet it employs observation, simulation, and even experiments as means of discovering truth. The ability to reason and think clearly is extremely useful in our daily life, that is, developing children's abilities for *mathematisation* is the main goal of mathematics education as has been emphasised in National Curriculum Framework-2005 (NCF-2005). It is in this content that NCF-2005 has set two distinct targets for mathematics education at school level viz. *narrow* and *higher*. The narrow aim of school mathematics is to develop useful capabilities, particularly those relating to numeracy- number, number operations, measurements, decimals and percentages. The higher aim is to develop the child's resources to think and reason mathematically, to pursue assumptions to their logical conclusions and to handle abstractions. It includes a way of doing things, and the ability and the attitude to formulate and solve problems. This calls for curriculum to be ambitious in the sense that it seeks to achieve the higher aim mentioned above, rather than only the narrow aim. It should be coherent in

the sense that the variety of methods and skills available piecemeal (in arithmetic, algebra, geometry) cohere into an ability to address problems that come from other domains such as sciences and in social studies at secondary stage. It should be important in the sense that students feel the need to solve such problems.

Evaluation is a very comprehensive term which, in general, includes evaluating any object, individual, event, trend, etc. A most common type of individual evaluation is the evaluation of a student. It includes the assessments of the performance of the student in the areas of her personality development in terms of intellectual, social and emotional developments after she has been provided learning experiences through classroom processes. Besides the factors like quality of teaching curricular materials, instructional technology, school infrastructure and societal support also influence the learning and experiences. In educational terminology, these areas of personality development are called scholastic and co-scholastic areas. Due to its wider applications in various other fields, mathematics is the most important scholastic area. It is for this reason, mathematics is a compulsory subject up to the secondary stage from quite a long time. This is the stage which acts as a bridge between the students who will continue with Mathematics in higher classes. Therefore, evaluation of Mathematics at this stage requires special attention. This evaluation is done to assess whether the main aim or objectives laid down in NCF-2005 have been achieved by the students or not?

B. Purposes of Evaluation

There are various purposes of evaluation. Some of these are to know the answers for the following questions:

- (i) How has the teaching been effective?
- (ii) Which method is more suitable for teaching a particular topic or concept?
- (iii) To what extent students are ready to learn a particular topic?
- (iv) What type of learning difficulties are faced by the students?
- (v) Do the students require remedial measures?
- (vi) Which students are to be provided some enrichment materials?
- (vii) Which topics are more difficult for the student?
- (viii) Is there a need to make a change in the teaching strategy for a particular topic?
- (ix) How can the result of the evaluation can be utilised for the all round development of students?

C. Types of Evaluation

Evaluation is mainly of two types namely

(i) **Summative** and (ii) **Formative**

- (i) **Summative Evaluation:** It is done at the end of the course or a term. It involves a formal testing of the student's achievements and is used for grading, ranking and certifying the achievements of the students.
- (ii) **Formative Evaluation:** It is in-built in the teaching learning process. It is a continuous process going on throughout the course. The purpose of such evaluation is to obtain feedback so that teaching or instructional strategies could be improved. Further, on the basis of the feedback, strategies and weaknesses of the students can be assessed.

NCF-2005 has also given more stress on continuous and comprehensive evaluation in comparison to the summative evaluation. For this, a mathematics teacher may

- (i) ask some questions to know to what extent the students understand about the new concept to be taught before it is started.
- (ii) ask question at regular intervals to check the understanding of students during the presentation of a concept.
- (iii) assess students by the questions asked by them during the teaching of a chapter.
- (iv) assess the students during class work.
- (v) assess students on the basis of the home assignments given to them.
- (vi) assess students by asking some questions at the end of the chapter.
- (vii) encourage peer group members (students) to evaluate one another. This may be called as **Peer Evaluation**. This evaluation can bring out the hidden talents among the students.

Thus, whatever may be the way of evaluation, it is done through some well thought questions, which may be referred to as **good questions**.

D. Characteristics of a Good Question

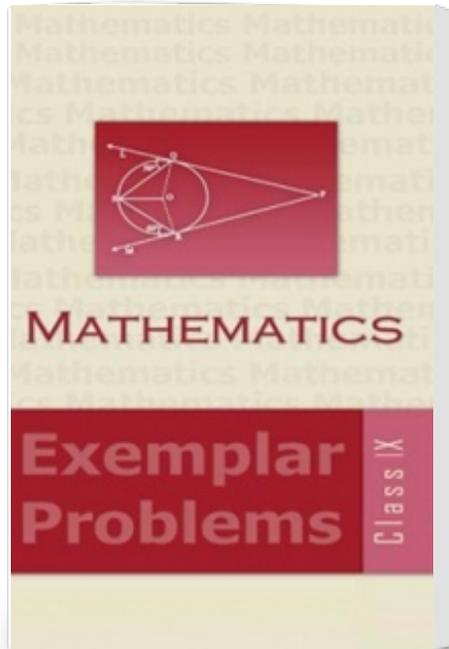
Quality of a question depends on the situation where it is to be used. In general, following are some of the characteristics of a 'good question':

- (i) **Validity:** A question is said to be valid, if it serves the purpose for which it has been framed.

Thus, for a question to be valid, it must be based on (a) a specified extent area and also on (b) a predetermined aim or objective.

In case it is not valid, it will be treated as a question 'out of course or syllabus'.

NCERT Exemplar Problems Math Textbook for Class IX



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