



EXEMPLAR PROBLEMS SCIENCE

CLASS X



राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

F O R E W O R D

The National Curriculum Framework (NCF) 2005 initiated a new phase of development of syllabi and textbooks for all stages of school education. In this phase, a conscious effort has been made to discourage rote learning and to enhance comprehension. This is well in tune with the NPE-1986 and Learning Without Burden-1993 that recommend child centred system of education. The textbooks for Class IX were released in February, 2006 and for Class X in December, 2006. 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 prove for making children's life at school a happy experience, rather than source of stress or boredom. It calls for reforms 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 Reforms envisage that the question papers, set in annual examinations conducted by the various Boards do not really assess genuine understanding of the subjects. The quality of question papers is often not up to the mark. They usually seek mere information based on rote memorisation, and fail to test higher-order skills like reasoning and analysis, let alone 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 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 concept. These problems are not meant to serve merely as questions 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 examinations worked hard to accomplish this task. The material was discussed, edited and finally included in this resource book.

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

New Delhi

Prof. Yash Pal

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P R E F A C E

The Department of Education in Science and Mathematics (DESM), National Council of Educational Research and Training (NCERT), initiated the programme for the development of 'Exemplar Problems' in Science and Mathematics for secondary and higher secondary stages based on the subject textbooks developed on the bases of the NCF-2005. The present book is based on the contents of the Science Textbook for Class X published by the Council in December, 2006.

The main objective of the book on 'Exemplar Problems in Science' is to provide the teachers and students a large number of quality problems in various forms and format with varying levels of difficulty to facilitate teaching-learning of concepts in Science that are presented through the textbook for Class X. It is envisaged that the problems included in this book would help the teachers to design tasks to assess effectiveness of their 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 problems on their own. Students can benefit themselves by attempting the problems given in the book for self assessment and also in mastering the basic techniques of problem solving. Some of the problems given in the book are expected to challenge the students understanding of Science concepts and to apply them in new situations.

The problems included in this book were developed in workshop mode organised by the DESM involving practicing teachers, subject experts from universities and institutes of higher learning and the members of the Science group of the DESM whose names appear separately. I 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 especially thank Professor Krishna Kumar, **Director**, and Professor G. Ravindra, **Joint Director**, NCERT for their administrative support and keen interest in the development of the book. I acknowledge with thanks the dedicated efforts and valuable contribution of Dr. Anjni Koul, **coordinator** of this programme.

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

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INTRODUCTION

The task of building an enlightened, knowledgeable and prosperous nation rests on the shoulders of its children, the future citizens, who are to be cherished, nurtured and taken care with tenderness. Education, particularly school education has always played this important role. It has emerged as an important segment of the total educational system expected to contribute significantly to the individual, social as well as the national developmental processes. In order to effectively fulfill this role, its progress and processes including curriculum need to be continuously reviewed, restructured and updated. The present National Curriculum Framework–2005 (NCF–2005), has identified five guiding principles for curriculum planning, development and transaction —

- Connecting knowledge to life outside the school.
- Ensuring that learning shifts away from rote methods.
- Enriching the curriculum so that it goes beyond textbooks.
- Making examinations more flexible and integrating them with class room life.
- Nurturing an overriding identity informed by caring concerns within the democratic polity of the country.

Most pertinent of these guiding principles is perhaps the one pertaining to evaluation system which expects to make examination processes more flexible and to integrate them with everyday life. It can be implemented effectively only if evaluation is designed in such a manner that it can be used as a powerful means of influencing the quality of classroom instructional transactions so as to help the learners internalise the subject matter rather than make them a store house of information. However, the evaluation system, as it exists today, is such that it focuses only on cognitive learning outcomes and completely ignores the non-cognitive aspects, which are equally vital components of human personality.

CHILD AS A CONSTRUCTOR OF KNOWLEDGE

Traditionally it is believed that students learn from teachers and it is their responsibility to ensure that students learn. A teacher is classified as effective or otherwise depending on the achievements of his/her students in examinations. Actually the examination system in India occupies a central place in the entire education system that it tends to thwart any attempt to innovate teaching learning process. In order to improve the quality of school education, it is imperative that examination system ought to be debated in detail at the highest policy levels and transformed radically throughout the country. Examinations in their present form are not the real measure of student's potential because these are limited to test only one aspect i.e. content knowledge of the course that the students strive to learn over a period of one year.

NCF–2005 suggests that teaching should be learner centered where learner is placed at the centre of teaching processes. It envisages the primacy of children's experiences, their voices and their active involvement in the process of learning. Learning experiences

at school should pave the way for construction of knowledge and fostering creativity so that it becomes a source of joy and not a stress. The syllabi and textbooks developed on the basis of NCF–2005 signify an attempt to implement this basic idea. The syllabus designers have tried to address the problem of curriculum burden by restructuring and reorienting knowledge at different stages with greater consideration for child psychology. The textbooks, particularly in science, attempts to enhance this endeavour by giving higher priority and space for contemplation and wonder in the texts, and suggesting discussions in small groups and activities requiring hands on experiences, through exercises and practical work.

In the present Science Textbook for Class X, the science concepts are framed not along disciplinary lines, but rather organized around themes that are potentially cross disciplinary in nature. The themes are Materials, The world of the Living, How Things work, Natural Phenomena and Natural Resources. There are sixteen chapters in the Textbook of Science for Class X and these cover the above mentioned themes.

Chapter-1 “Chemical Reaction and Equations” deals with chemical reactions and balancing of chemical equations. Different types of reactions like combination, decomposition, displacement, double displacement, oxidation and reduction have been discussed.

Chapter-2 “Acids, Bases and Salts” deals with classification of substances into acids, bases and salts, their identification using indicators. The characteristic chemical properties have also been discussed. Importance of pH, preparing of some salts and their uses have also been highlighted.

Chapter-3 “Metals and Non-metals” discusses about properties of metals and non-metals which are the key areas of discussion. Extraction of metals from their ores have been explained in a stepwise manner. A common phenomena of corrosion of metals and its prevention has also been discussed.

Chapter-4 “Carbon and its Compounds” highlights the versatile nature of carbon and its ability to form a wide range of hydrocarbons. Nomenclature, isomerism and chemical properties of these compounds have been discussed. Concept of heteroatom and functional group has been introduced with special reference to properties and uses of ethanol and ethanoic acid. The use of carbon and its compounds is highlighted in soaps and detergents.

Chapter-5 “Periodic Classification of Elements” deals with the historical background of Classification of Elements, introduction of Modern Periodic Table and general trends in properties of elements with reference to Modern Periodic Table have been discussed.

Chapter-6 “Life Processes” highlights functions of living beings. It discusses about multi cellularity and specialisation for the division of labour, which has led to the development of various systems. Life processes covered in this chapter are nutrition,

respiration, transportation and excretion. Along with salient points of these processes, an interesting information about dental caries, blood pressure and artificial kidney is also given.

Chapter-7 “Control and Coordination” discusses the electrical and chemical coordination of various systems of animals with special emphasis on human beings. Reflex arc, structure of neuron and brain and role of nervous systems, in causing actions of muscles. Coordination in plants is discussed with reference to response to stimulus and various types of growth movements and the role of plant hormones. The chapter also deals with the endocrine system, which chemically coordinates other systems. Some examples are provided with thyroxin, adrenaline and growth hormone. The condition of diabetes, where pancreatic hormone insulin is deficient, is also cited as an example.

Chapter-8 “How do Organisms Reproduce?” deals with the importance of variation in the survival of the species. Attention of the student is also drawn to the fact that reproduction is related to the stability of the population of the species. Modes of asexual reproduction are mentioned, with special reference to their positive and negative points. Sexual reproduction where male and female reproductive systems are explained. Menstrual cycle along with the reproductive health, where methods to avoid unwanted pregnancy are mentioned. True emphasis is given to sensitise the child about female foeticide.

Chapter-9 “Heredity and Evolution” highlights on heredity and variation. Contributions of Father Gregor Johann Mendel is given. After explaining Mendel’s experiments, mechanism of sex determination is also discussed. It deals with the acquired and inherited traits, speciation, evidences of evolution and examples of artificial selection by man. Human evolution is also explained with special mention of the fact that evolution should not be equated with progress.

Chapter-10 “Light Reflection and Refraction” deals with the phenomena of reflection and refraction of light using the straight line propagation of light. It also helps the learner in the study of some of the optical phenomena in nature. This chapter also explains the reflection of light by spherical mirrors and refraction of light and their application in real life situations.

Chapter-11 “The Human Eye and the Colourful World” explains some optical phenomena in nature; functioning of human eye and defects of human eye. This chapter also discusses about dispersion of light through a prism, formation of rainbow, splitting of white light and blue colour of the sky.

Chapter-12 “Electricity” deals with the question like what constitutes electricity, how does it flow in an electric circuit, what are the factors that control or regulate the current through a circuit etc. This chapter also deals with heating effect of current and its electrical application.

Chapter-13 “Magnetic Effect of Electric Current” explains the magnetic effect of current. It explains magnetic field patterns around a straight current carrying wire, a circular loop and a solenoid, rules which help in finding direction of magnetic field lines, force on a current carrying conductor and induced current. This chapter also highlights the working of electric motor, AC, DC generators and domestic circuit and importance of fuse and earthing.

Chapter-14 “Sources of Energy” highlights the need for a good and alternate source of energy, explains the working of devices, harnessing solar, hydro, wind, nuclear, geothermal, ocean and bio energy. This chapter also explains the environmental consequences and importance of using non-conventional sources of energy.

Chapter-15 “Our Environment” explains the concept of Ecosystem along with the biotic and abiotic components. Food chain, food web and mechanism of transfer of energy from one trophic level to another is also discussed. Discussion about human activities, which have led to the degradation of environment, ozone depletion, waste management and environmental awareness are also covered.

Chapter-16 “Management of Natural Resources” deals with the unprecedented pollution of river Ganga. To reinforce the danger a graphical representation of coliform count in Ganga is also provided. The three R's of environment management – Reduce, Recycle and Reuse – are also mentioned. Various resources such as Wildlife, Water, Coal and Petroleum are discussed. Interesting incidents from real life are provided about how common people have fought against environmental degradation.

ASSESSMENT IN SCHOOL

National Focus Group Position Paper on ‘Examination Reforms’ strongly recommends a system of Continuous and Comprehensive Evaluation (CCE) in order to reduce stress on children, make evaluation comprehensive and regular, provide space for the teachers for developing creative thinking, provide a tool for diagnosis and for equipping learners with greater skill. The CCE scheme is simple, flexible and implementable in any type of school from the elite one to a school located in rural or tribal areas.

SUGGESTED TYPES OF QUESTIONS

National Focus Group Position Paper on ‘Teaching of Science’ asserts that the major deficiency in current examination system in science is that it does not really assess genuine understanding of the subject. It is mostly confined to elicit information through theoretical questions, which can often be handled by rote learning without proper understanding of the concepts. The tests rarely include questions that require students to apply their understanding of concepts to new situations or that compel them to correlate or even to interpret phenomenon that they experience in daily life or the ones that are based on experimental data. Usually it is seen that language of questions framed is vague, ambiguous and misleading. Most questions seek a direct answer.

In the present book an attempt has been made to include a few **Multiple Choice Questions (MCQ's)** in each chapter which can be used to test real understanding of the concepts. These questions are likely to help learners to develop proper discriminating power and thereby reduce guess work factor to a minimum. Efforts have been made that each one of the options given in MCQ's appear equally probable. Further, sentence structure and language used often gives sufficient clue for the correct answer defeating the very purpose for which it has been framed. Therefore, utmost care needs to be taken while framing multiple choice questions, so that, these may be used to test real understanding of concepts, which inturn would also help reduce student anxiety.

Some Open Ended Questions are given in each chapter to test the expression and the ability to formulate an argument using relevant facts. A method has to be developed in marking these questions as multiple answers, all equally appropriate, are possible. Further direct answers to such questions may not be available in text books.

The Activity Based Questions i.e., **Learning by Doing** not only increase the sense of observation among children but also help in better understanding of the concepts.

Some Challenging Questions are also framed for the children with higher mental ability. Good question setting needs drastic reforms. Good questions can be canvassed from experts in their discipline, school teachers, educators and even from students. These questions can be pooled together and can be used in the examination after careful vetting by evaluation experts. Certain conditions must be met in order to frame a good question. Unambiguous language, clarity about expected task, provision of proper data and values of constants are some of the pre-requisites for framing a good question.

Design of the two sample question papers of Science for Class X theory are given in **Appendix-I**. Definition of the SI base units is given in **Appendix-II**. Elements, their symbols, atomic number and atomic mass are given in **Appendix-III**.

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