NCERT SOLUTIONS
PHYSICS XI CLASS
CHAPTER - 1
PHYSICAL WORLD

1.1 Some of the most profound statements on the nature of science have come from Albert Einstein, one of the greatest scientists of all time. What do you think did Einstein mean when he said : "The most incomprehensible thing about the world is that it is comprehensible"?

Sol. The universe appears to be very complex. But the analysis and various studies done by the scientists, time to time, show that the physical phenomenon atomic to astronomical ranges can be understood in terms of some fundamental laws. In other words the physical world become comprehensible.

1.2 "Every great physical theory starts as a heresy and ends as a dogma". Give some examples from the history of science of the validity of this incisive remark.

Sol. Dogma is an established opinion which is questioned by only a few. On the other hand, anything against the established belief, known as heresay, does cause a few ripples in the mind of the intelligent. Thomas Young's wave theory of light started as a heresay and finally ended as 'dogma' when Einstein and others replaced it by quantum theory of light.

1.3 "Politics is the art of the possible". Similarly, "Science is the art of the soluble". Explain this beautiful aphorism on the nature and practice of science.

Sol. To win over votes a politician would make every impossible thing possible. The second statement, i.e., science is the art of the soluble implies that wide range of physical phenomenon is understood in term of a few basic concepts, i.e., there appears to be unity in diversity.

1.4 Though India now has a large base in science and technology, which is fast expanding, it is still a long way from realising its potential of becoming a world leader in science. Name some important factors, which in your view have hindered the advancement of science in India.

Sol. One of the main factors which has hindered India's march towards becoming a world leader in science and technology is that the young scientists and technologies are denied the academic freedom which is so very necessary for making advances in science and technology. The management of science education in our country is bureaucratic. In addition to this, there is practically no co-ordination between the researchers and the industrialists. The industrialists are the actual consumers of new research and technology. The industrialist of this country has little confidence in the ability of the Indian scientists. They prefers to import technology from advanced countries. The indigenous technology does not find favour with the Indian scientist. Another important factor that his hindered India's progress in science and technology is 'brain drain'. There has been a large scale migration of scientists and technologists.

1.5 No physicist has ever "seen" an electron. Yet, all physicists believe in the existence of electrons. An intelligent but superstitious man advances this analogy to argue that 'ghosts' exist even though no one has 'seen' one. How will you refute his argument?

Sol. No physicist has ever "seen" an electron. But a large number of phenomenon can be explained only, on the basis of existence of atom in nature. On the other hand, there is hardly a phenomenon to establish the existence of ghosts.

1.6 The shells of crabs found around a particular coastal location in Japan seem mostly to resemble the legendary face of a Samurai. Given below are two explanations of this observed fact. Which of these strikes you as a scientific explanation?

(a) A tragic sea accident several centuries ago drowned a young Samurai. As a tribute to his bravery, nature through its inscrutable ways immortalised his face by imprinting it on the crab shells in that area.

(b) After the sea tragedy, fishermen in that area, in a gesture of honour to their dead hero, let free any crab shell caught by them which accidentally had a shape resembling the face of a Samurai. Consequently, the particular shape of the crab shell survived longer and therefore in course of time the shape was genetically propagated. This is an example of evolution by artificial selection.

[Note: This interesting illustration taken from Carl Sagan's 'The Cosmos' highlights the fact that often strange and inexplicable facts which on the first sight appear 'supernatural' actually turn out to have simple scientific explanations. Try to think out other examples of this kind].

Sol. (b) It is a scientific explanation of the observed fact.

1.7 The industrial revolution in England and Western Europe more than two centuries ago was triggered by some key scientific and technological advances. What were these advances?

Sol. In 1750 A.D. industrial revolution in England and Western Europe was triggered by some key scientific and technological advances. During this revolution efficient machines like steam engine, blast furnace (converts iron ore into pig iron) cotton gin (a machine to separate the seeds from cotton three hundred times faster than by hand) and power loom were introduced.

1.8 It is often said that the world is witnessing now a second industrial revolution, which will transform the society as radically as did the first. List some key contemporary areas of science and technology, which are responsible for this revolution.

Sol. The key areas which will transform radically the present are:
(i) super fast computers (ii) biotechnology
(iii) development of superconducting materials at room temperatures etc.

1.9 Write in about 1000 words a fiction piece based on your speculation on the science and technology of the twenty-second century.

Sol. Imagine a spaceship going to a star about 100 light year away. It is propelled by electric current, produced by electromagnetic induction, (spaceship crosses the magnetic field in space). The current is given to an electric motor consisting of superconducting wires. Thus no energy would be required to propagate the ship. Suppose, in a particular region of space, temperature is so high, that it destroys the superconducting property of the wires of the motors. This cause a panic in the space ship because no power in generated by the motor. Another split spaceship filled with matter and antimatter stored in different compartments to produce energy for the first ship comes to its rescue. And the first ship continues its onwards journey.

1.10 Attempt to formulate your 'moral' views on the practice of science. Imagine yourself stumbling upon a discovery, which has great academic interest but is certain to have nothing but dangerous consequences for the human society. How, if at all, will you resolve your dilemma?

Sol. A scientist aims at truth. A scientific discovery reveals a truth of nature. So, any discovery, good or bad for mankind, must be made public. A discovery which appears dangerous today may become useful to mankind sometimes later. In order to prevent misuse of scientific technology, we must build up a strong public opinion. Scientists should in fact take up two roles – to discover truth and to prevent its misuse.

1.11 Science, like any knowledge, can be put to good or bad use, depending on the user. Given below are some of the applications of science. Formulate your views on whether the particular application is good, bad or something that cannot be so clearly categorised:

(a) Mass vaccination against small pox to curb and finally eradicate this disease from the population. (This has already been successfully done in India).
(b) Television for eradication of illiteracy and for mass communication of news and ideas.
(c) Prenatal sex determination
(d) Computers for increase in work efficiency
(e) Putting artificial satellites into orbits around the Earth
(f) Development of nuclear weapons
(g) Development of new and powerful techniques of chemical and biological warfare.
(h) Purification of water for drinking

(i) Plastic surgery
(j) Cloning

Sol. Good applications – (a), (b), (c), (d), (e), (h), (i) and (j)
Bad applications – (f) and (g)
But applications – (c) cannot be properly characterised as some people are misusing prenatal sex determination.

1.12 India has had a long and unbroken tradition of great scholarship — in mathematics, astronomy, linguistics, logic and ethics. Yet, in parallel with this, several superstitious and obscurantistic attitudes and practices flourished in our society and unfortunately continue even today –among many educated people too. How will you use your knowledge of science to develop strategies to counter these attitudes?

Sol. In order to popularise scientific explanations of everyday phenomena, mass media like radio, television and newspaper should be used.

1.13 Though the law gives women equal status in India, many people hold unscientific views on a woman's innate nature, capacity and intelligence and in practice give them a secondary status and role. Demolish this view using scientific arguments, and by quoting examples of great women in science and other spheres; and persuade yourself and others that, given equal opportunity, women are on par with men.

Sol. Development of a human mind depends basically on its care and nutrition contents of prenatal and postnatal diet. A female or a male mind will develope equally for given conditions. Anything which can be achieved by man's mind can also be achieved by woman's mind. Various women gave out-standing contribution in the field of science and literature etc., for example Madam Curie won Noble Prize in Physics. Mother Teresa proved herself a saint. Lilawati was a great Indian Mathematician. Mrs. Indira Gandhi, Mrs. Margaret etc. are well known in politics.

1.14 "It is more important to have beauty in the equations of physics than to have them agree with experiments". The great British physicist P. A. M. Dirac held this view. Criticize this statement. Look out for some equations and results in this book which strike you as beautiful.

Sol. There is no contradiction in the given statement. A basic equation of Physics which agrees with experiment must necessarily be both simple and beautiful. The equation
$E = mc^2$ is one example of a beautiful equation.

1.15 Though the statement quoted above may be disputed, most physicists do have a feeling that the great laws of physics are at once simple and beautiful. Some of the notable physicists, besides Dirac, who have articulated this feeling, are : Einstein, Bohr, Heisenberg, Chandrasekhar and Feynman. You are urged to make special efforts to get access to the general books and writings by these and other great masters of physics. Their writings are truly inspiring !

Sol. Students are advised to go through general books on Physics; which make Physics interesting. Some of the interesting books are : Surely you are joking, Mr. Feynman by Feynman, Physics, foundations and frontiers by G. Gamow etc.

1.16 Textbooks on science may give you a wrong impression that studying science is dry and all too serious and that scientists are absent-minded introverts who never laugh or grin. This image of science and scientists is patently false. Scientists, like any other group of humans, have their share of humorists, and many have led their lives with a great sense of fun and adventure, even as they seriously pursued their scientific work. Two great physicists of this genre are Gamow and Feynman.

Sol. Scientists like other humans may be, serious and introvert, serious but extrovert, fun loving, absent minded. Students are advised to go through books by two great Physicists : Feynman and Gamow to realise this view.