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**#419244**

**Topic:** Scope of Physics

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"?

**Solution**

The Physical world around us is full of different complex natural phenomena so the world is in-comprehensible. But with the help of study and observations it has been found that all these phenomena are based on some basic physical laws and so it is comprehensible.

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**#419245**

**Topic:** Scope of Physics

"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.

**Solution**

Dogma is an established opinion, which is questioned by only a few, while heresy means anything, which is against the established belief, few that creates ripples in the minds the intelligent. For example, Thomas Young's wave theory of light started as a heresy and finally ended as a 'dogma', while Einstein and others replaced it by the quantum theory of light.

The statement above is true. Validity of this incisive remark can be validated from the example of moment of inertia. It states that the moment of inertia of a body depends on its energy. But according to Einstein's mass-energy relation ( $E = mc^2$ ), energy depends on the speed of the body.

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**#419246**

**Topic:** Scope of Physics

"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.

**Solution**

Science is a systematized study of observations. A scientist critically analyses these observations and comes out with certain laws. For example, Tycho Brahe worked for twenty long years to make observations on planetary motions. It is from this huge reservoir of observations that Johannes Kepler formulated his three famous laws of planetary motion. It is well known that to win over votes, politicians would make anything and everything possible even when they are least sure of the same and in Science the various natural phenomena can be explained in terms of some basic laws. So as 'Politics is the art of possible' similarly 'Science is the art of the soluble'

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**#419247**

**Topic:** Scope of Physics

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.

**Solution**

Some important factors in our view which have hindered the advancement of science in India are:

1. Proper funds are not arranged for the development of research work and laboratories. The labs and scientific instruments are very old and outdated.
2. Most of the people in India are uneducated and highly traditional. They don't understand the importance of Science.
3. There is no proper employment opportunity for the science educated person in India.
4. There are no proper facilities for science education in schools and colleges in India.

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**#419248**

**Topic:** Scope of Physics

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 ?

**Solution**

No physicist has ever seen an atom but there are practical evidences and theories like Bohr's Atomic model, Rutherford's scattering experiment, etc. which prove the presence of electron. Their size is small, but we can test their existence by various methods like hydrogen spectrum.

On the other end there is no phenomena which can be explained on the basis of existence of ghosts.

So there is no comparison between the two given cases

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**#419249**

**Topic:** Scope of Physics

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.

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#### Solution

Explanation (b) is correct is a scientific explanation of the observed fact as it is backed by the scientific theory of 'evolution by artificial selection'.

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#### #419250

**Topic:** Scope of Physics

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?

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#### Solution

More than two centuries ago, England and Western Europe started using machine that led to the industrial revolution

Some of the important inventions were

1. Steam engine
2. Electricity
3. Theory of gravitation
4. Explosives
5. Cotton Jenny
6. Power Loom
7. Blast Furnace

Steam engines helped them in the field of heat and thermodynamics, theory of gravitation in field of motion and making guns and cannons. These progresses brought about industrial revolution in England and Western Europe.

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#### #419251

**Topic:** Scope of Physics

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.

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#### Solution

Some of the key contemporary areas of science and technology which may transform the society radically are:

1. Development of super fast computers
2. Internet and tremendous advancement in information technology
3. Development in Biotechnology
4. Development of super-conducting materials at room temperature.
5. Development of robots.

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#### #419253

**Topic:** Scope of Physics

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

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#### Solution

Let us imagine a spaceship moving towards a distant star, 500 light years away. Suppose this is propelled by solar power fed into the electric motor consisting of super-conducting wires. In space, suppose there is a particular region, which has such a high temperature that destroys the super-conducting property of the electric wires of the motor. At this stage, another spaceship filled with matter and anti-matter comes to the rescue of the first ship and the first ship continues on its journey.

#419254

Topic: Scope of Physics

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 nothir but dangerous consequences for the human society. How will you resolve your dilemma ?

**Solution**

A scientist aims at truth. A scientific discovery reveals the truth of nature. So, any discovery, useful or dangerous to mankind, must be made public. Every discovery can be put both positive and negative use. It is left to the mankind to use it for the betterment of the people, society, to improve the quality of living or to use it for destruction. A discovery which appears dangerous today, may become useful to mankind sometime later. In order to prevent misuse of scientific technology, we must build up public opinion against th misuse of a scientific discovery. Scientists should in fact take up two roles - to discover truth and to prevent its misuse.

#419257

Topic: Scope of Physics

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 th 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

**Solution**

- (a) Mass vaccination against small pox to curb and finally eradicate this disease from the population. (This has already been successfully done in India).- Good  
Virus kills many people while some people are left with disabilities.
- (b) Television for eradication of illiteracy and for mass communication of news and ideas. - Good  
Good for removal of illiteracy and mass communication
- (c) Prenatal sex determination - Bad  
Can lead to gender ratio skewness and inequalities in society
- (d) Computers for increase in work efficiency - Good  
Improving the efficiency of work and globalization
- (e) Putting artificial satellites into orbits around the Earth- Good  
No. of uses like transmission etc. not possible by conventional methods
- (f ) Development of nuclear weapons - Bad  
Can result in mass destruction of people, buildings and factories.
- (g) Development of new and powerful techniques of chemical and biological warfare. - Bad  
All are methods of destroying lives and can be misused.
- (h) Purification of water for drinking - Good  
Need of the hour. Can stop many dangerous diseases and ensuring health.
- (i) Plastic surgery - Good  
For improving the disfigured parts of body.
- (j ) Cloning- Good  
With reference to medical application for curing ailments

#419259

Topic: Scope of Physics

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 ?

#### Solution

- (i) In order to popularize scientific explanations of everyday phenomena, mass media like radio, television and newspaper should be used.
- (ii) School books should include explanations regarding day-to-day experiences in life.
- (iii) Students and youngsters should be encouraged to try and offer scientific explanation for many a so-called perplexing events and beliefs.

Poverty and illiteracy are the two major factors which make people superstitious in India. So to remove the superstitious and obscurantist attitude we have to first overcome these factors. Everybody should be educated, so that one can have scientific attitude. Knowledge of science can be put to use to prove people's superstitious wrong by showing them the scientific logic behind everything happening in our world.

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#### #419260

**Topic:** Scope of Physics

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.

#### Solution

Some people in our society have the view that women do not have the innate nature, capacity and intelligence.

To demolish this view there are many examples of women who have proven their abilities in Science and other fields.

Madam Curie, Mother Teresa, Indira Gandhi, Margaret Thatcher, Rani Laxmi Bai, Florence Nightingale are some examples. So in this era women are definitely not behind men in any field.

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#### #419261

**Topic:** Scope of Physics

"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 other equations and results, which strike you as beautiful.

#### Solution

An equation which agrees with experiment must also be simple and hence beautiful. We have some simple and beautiful equations in Physics such as

$$E = mc^2 \text{ (Energy of light)}$$

$$E = h\nu \text{ (Energy of a photon)}$$

$$KE = \frac{1}{2}mv^2 \text{ (Kinetic energy of a moving particle)}$$

$$PE = mgh \text{ (Potential energy of a body at rest)}$$

$$W = F \cdot d \text{ (Work done)}$$

All have the same dimensions. One experiment shows dependency of energy on speed, the other shows dependency on frequency & displacement.

That's the beauty of equations in Physics coming from different experiments.

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#### #419263

**Topic:** Scope of Physics

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. (See the Bibliography at the end of this book.) Their writings are truly inspiring !

#### Solution

There is no doubt that great laws of physics are at once so simple and beautiful and are easy to grasp. For example, let us look at some of these :

- (i)  $E = mc^2$  is a famous Einstein's mass energy equivalence relation which has a great impact not only on the various physical phenomenon but also on the human lives.
- (ii) Planck's quantum condition i.e.  $E = h\nu$  is also a simple and beautiful equation and it is a great law of Physics.
- (iii)  $\sigma_x \cdot \sigma_p > h / 4\pi$  is Heisenberg's Uncertainty Principle which is also very simple, beautiful and interesting. It is a direct consequence of the dual nature of matter.
- (iv)  $\lambda = h/p$  is also a famous equation in Physics known as de-Broglie equation. It is again simple and beautiful.

**#419264**

**Topic:** Scope of Physics

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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 grii

This image of science and scientists is patently false. Scientists, like anyother group of humans, have their share of humorists, and many have led their lives with a great sense fun and adventure, even as they seriously pursued their scientific work. Two great physicists of this genre are Gamow and Feynman. You will enjoy reading their books listed ir the Bibliography.

**Solution**

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It is not an exercise as such but is a statement of fact. We can add the name of other scientist who were humorists along with being Physicists. They are C. V. Raman, Homi Jahangir Bhabha, Einstein and Bohr. India have several politicians like M. M. Joshi, V. P. Singh etc. who are physicists. President A. P. J. Kalam is also a great nuclear scientist.