Chapter 9 — Nature of Science

Constructed Response Questions (with Answers)

Class 9 Physics (New Syllabus) — Board Level

Q 9.1. Is the theory of science an ultimate truth? Describe briefly.

Ans: No. The theories and laws of Physics are man-made ideas about the way things work, so they are not final truths. They are liable to be disproved or modified with future advances in science, which bring fresh facts and new insights about the natural and physical world. A theory holds only as long as it agrees with observation and experiment.

Q 9.2. Do you think that the existing laws of nature may need a change in future? Describe briefly.

Ans: Yes. A law is formed when a theory has been tested many times and generally accepted, but it is still a man-made statement about nature. If future experiments or better instruments give results that do not agree with it, the law will have to be modified or replaced. Advances in science constantly bring fresh facts and new insights.

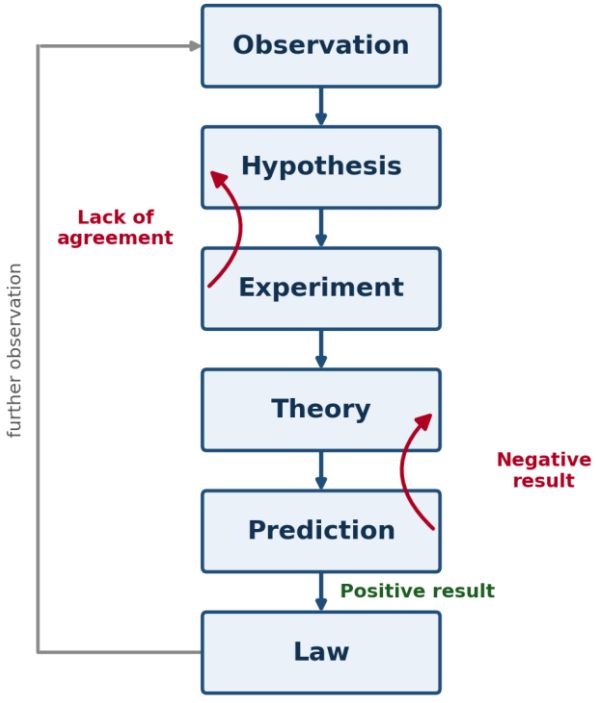
Q 9.3. Describe three jobs that need the use of scientific knowledge.

Ans: A civil engineer uses scientific knowledge to design a bridge that can withstand strong winds, earthquakes, intense weather conditions and heavy traffic. A software engineer applies information technology to design a user-friendly application of a smartphone. An aviation engineer looks for lighter material that can withstand sudden severe disturbances and extreme weather during the flight of an aeroplane.

Q 9.4. Describe when a theory is rejected or needs its modification.

Ans: After a theory is formed, predictions are made from it and experiments are designed to test those predictions over and over again. If the test results agree, the theory moves towards becoming a law. If the results do not agree, the theory is rejected, or the hypothesis on which it stands is changed and tested again.

Q 9.4 The steps of the scientific method



Q 9.5. Comment on the statement: "A theory capable of being proved right but not being proved wrong is not a scientific theory."

Ans: The statement describes falsifiability. A theory is scientific only if it makes assertions that can be disproved, that is, an experiment must exist whose result could show it to be wrong. A theory that can only be confirmed and never contradicted rests on vague, untestable claims, so it cannot be separated from a pretended belief and is not scientific.

Q 9.6. What has been the general reaction to new ideas about established truths?

Ans: New ideas that challenge established truths are generally resisted at first, since a law is accepted only after it has been tested many times. However, because the theories and laws of Physics are man-made, they are liable to be modified when fresh facts appear. Einstein's theory of relativity is an example: it altered man's views of the universe and was finally accepted.

Q 9.7. If a hypothesis is not testable, is the hypothesis wrong? Explain.

Ans: It is not necessarily wrong, but it is not scientific. A hypothesis is an assumption made in order to test its logical results by experiment, and falsifiability requires that it make assertions which can be disproved. If it cannot be tested at all, no experiment can support or reject it, so it remains outside science and can never become a theory.

Q 9.8. Explain how a small amount of data cannot prove that a prediction is always correct but can prove it is not always correct.

Ans: A prediction claims something about every similar case, so any number of agreeing results only supports it for the cases actually tested; some untested case may still disagree. But a single result that disagrees is enough to show that the prediction fails. The hypothesis is then changed or rejected, which is why experiments are repeated over and over again.

Q 9.9. What is the relationship between an experiment and a hypothesis?

Ans: A hypothesis is a proposed explanation, and an experiment is the organised repeatable process used to test the truth of that hypothesis. The hypothesis comes first and tells the experimenter what to look for. The experiment then either supports it, so that it can become a theory, or shows a lack of agreement, so that the hypothesis must be changed.

Q 9.10. Describe why the solution of complex problems needs interdisciplinary research and collaboration.

Ans: Many challenging issues such as climate change, disease prevention and sustainable energy are of diverse nature, so one discipline alone cannot address them adequately. Understanding climate change needs meteorology, oceanography, physics, chemistry and environmental sciences together, and the Covid epidemic needed biology, chemistry, physics, medical technology and data science. Combined perspectives also foster innovation, as in nanotechnology and artificial intelligence.