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Class	9th	Chapter	09
Subject	Physics	Board	Punjab

CHAPTER 09: NATURE OF SCIENCE — COMPLETE SOLUTIONS

A. Multiple Choice Questions

- **9.1. Physics is a branch of:**
  - **Options:** (a) social science | (b) life science | (c) **physical science** *(Correct Answer)* | (d) biological science
  - *Explanation:* Physics deals with matter, energy, and their interactions, falling under physical sciences.
- **9.2. Which branch of science plays vital role in technology and engineering?**
  - **Options:** (a) Biology | (b) Chemistry | (c) Geology | (d) **Physics** *(Correct Answer)*
  - *Explanation:* Physics provides the foundational principles upon which most technology and engineering are built.
- **9.3. Automobile technology is based on:**
  - **Options:** (a) acoustics | (b) electromagnetism | (c) optics | (d) **thermodynamics** *(Correct Answer)*
  - *Explanation:* Internal combustion engines rely heavily on thermodynamic principles (heat and energy conversion).
- **9.4. A user friendly software application of smart phone use:**
  - **Options:** (a) laser technology | (b) **information technology** *(Correct Answer)* | (c) medical technology | (d) electronic technology
  - *Explanation:* Software applications on smartphones belong to information technology.
- **9.5. The working of refrigeration and air conditioning involves:**
  - **Options:** (a) electromagnetism | (b) mechanics | (c) climate science | (d) **thermodynamics** *(Correct Answer)*

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- *Explanation:* Refrigeration and air conditioning operate on the principles of thermodynamics (heat transfer and gas laws).

- **9.6. What is the ultimate truth of a scientific method?**
  - **Options:** (a) Hypothesis | (b) Experimentation | (c) Theory | (d) **Law / Open to Revision** *(Correct Answer)*
  - *Explanation:* In science, nothing is an absolute ultimate truth; laws and theories are always subject to testing and refinement.
- **9.7. The statement "If I do not study for this test, then I will not get good grade" is an example of:**
  - **Options:** (a) theory | (b) observation | (c) **prediction** *(Correct Answer)* | (d) law
  - *Explanation:* This is a conditional statement forecasting a future outcome based on an assumption.
- **9.8. Which of the following are methods of investigation?**
  - **Options:** (a) Observation | (b) Experimentation | (c) Research | (d) **All of these** *(Correct Answer)*
  - *Explanation:* Scientific investigation encompasses observation, experimentation, and research.
- **9.9. A hypothesis:**
  - **Options:** (a) may or may not be testable | (b) is supported by evidence | (c) **is a possible answer to a question** *(Correct Answer)* | (d) all of these
  - *Explanation:* A hypothesis is a proposed tentative explanation or answer to a scientific question.
- **9.10. A graph of an organized data is an example of:**
  - **Options:** (a) collecting data | (b) forming a hypothesis | (c) asking question | (d) **analyzing data** *(Correct Answer)*
  - *Explanation:* Plotting data on graphs helps analyze trends and patterns.
- **9.11. The colour of a door is brown. It is an example of:**
  - **Options:** (a) **observation** *(Correct Answer)* | (b) hypothesis | (c) prediction | (d) law
  - *Explanation:* Noting the color of an object is a direct sensory observation.

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B. Short Answer Questions

- **9.1. State in your own words, what is science? Write its two main groups.**
  - **Answer:** Science is the systematic study of the physical and natural world through observation and experiment. Its two main groups are **Physical Sciences** and **Biological/Life Sciences**.
- **9.2. What is Physics all about? Name some of its branches.**
  - **Answer:** Physics is the branch of science concerned with the study of matter, energy, space, time, and their interactions. *Branches:* Mechanics, Thermodynamics, Electromagnetism, Optics, Quantum Physics, Atomic Physics.
- **9.3. What is meant by interdisciplinary fields? Give a few examples.**
  - **Answer:** Interdisciplinary fields combine two or more academic disciplines or scientific branches. *Examples:* Biophysics, Biochemistry, Geophysics, Mechatronics, Medical Physics.
- **9.4. List the main steps of scientific method.**
  - **Answer:**
    1. Observation and asking a question
    2. Formulating a hypothesis
    3. Making predictions
    4. Experimentation and testing
    5. Analyzing data and drawing conclusions
- **9.5. What is a hypothesis? Give an example.**
  - **Answer:** A hypothesis is a tentative, testable explanation for a phenomenon. *Example:* "Increasing the temperature of water increases the rate at which sugar dissolves in it."
- **9.6. Distinguish between a theory and a law of Physics.**
  - **Answer:**
    - *Theory:* A well-substantiated explanation of a broad range of phenomena (explains *why*).
    - *Law:* A concise statement or mathematical equation describing a consistent natural phenomenon (describes *what*).
- **9.7. What is the basis of laser technology?**
  - **Answer:** Stimulated emission of radiation and quantum energy level transitions in atoms/molecules.
- **9.8. What is falsifiability concept? How is it important?**
  - **Answer:** Falsifiability is the principle that a scientific statement, hypothesis, or theory must be able to be proven wrong by empirical evidence. It is crucial because it separates genuine science from unscientific dogma.

C. Constructed Response Questions

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- **9.1. Is the theory of science an ultimate truth? Describe briefly.**
    - **Answer:** No, scientific theories are not dogmatic ultimate truths. They are the best available explanations supported by current evidence, but they remain open to revision or replacement as new data emerges.
- **9.2. Do you think that the existing laws of nature may need a change in future? Describe briefly.**
    - **Answer:** Yes. While physical laws are extremely robust and well-tested, scientific progress (e.g., discoveries in quantum mechanics or cosmology) may require refining or expanding current laws under extreme conditions.
- **9.3. Describe three jobs that need the use of scientific knowledge.**
    - **Answer:**
        1. *Biomedical Engineer:* Designing medical devices using physics and biology.
        2. *Meteorologist:* Analyzing atmospheric data to forecast weather.
        3. *Electrical Engineer:* Designing power distribution systems using electromagnetic theory.
- **9.4. Describe when a theory is rejected or needs modification.**
    - **Answer:** A theory is rejected or modified when repeated, reproducible experimental observations contradict its predictions and cannot be explained by auxiliary adjustments.
- **9.5. Comment on the statement. "A theory capable of being proved right but not being proved wrong is not a scientific theory."**
    - **Answer:** This refers to Karl Popper's principle of falsifiability. If a theory cannot theoretically be tested or disproven by any conceivable observation, it has no empirical content and is unscientific.
- **9.6. What has been the general reaction to new ideas about established truths?**
    - **Answer:** Historically, revolutionary new ideas (e.g., heliocentrism, relativity) often faced strong skepticism and resistance from the scientific establishment before being accepted based on overwhelming evidence.
- **9.7. If a hypothesis is not testable, is the hypothesis wrong? Explain.**
    - **Answer:** Not necessarily "wrong", but it is scientifically meaningless because science requires empirical verification. If something cannot be tested, science cannot validate or invalidate it.
- **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.**
    - **Answer:** This is the logic of falsification. Observing one white swan cannot prove all swans are white (generalization), but observing even one black swan definitively proves the prediction "all swans are white" is false.
- **9.9. What is the relationship between an experiment and a hypothesis?**

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- **Answer:** An experiment is designed specifically to test the validity of a hypothesis by gathering empirical data under controlled conditions.

- **9.10. Describe why the solution of complex problems need interdisciplinary research and collaboration.**
  - **Answer:** Complex real-world problems (like climate change or disease treatment) span multiple domains (physics, chemistry, biology, data science), requiring diverse expertise that no single discipline possesses.

D. Comprehensive Questions

- **9.1. What are the main branches of Physics? State briefly.**
  - **Answer:** Mechanics (motion and forces), Thermodynamics (heat and energy), Electromagnetism (electricity and magnetism), Optics (light), Quantum Mechanics (subatomic scale), and Relativity.
- **9.2. What is meant by interdisciplinary fields of Physics? Give three examples.**
  - **Answer:** Fields that overlap physics with other sciences. *Examples:* Astrophysics (physics + astronomy), Biophysics (physics + biology), Chemical Physics (physics + chemistry).
- **9.3. What is scientific method? Describe its main steps with examples.**
  - **Answer:** A systematic method for investigating phenomena. *Steps:* Question, Hypothesis, Experiment, Analysis, Conclusion. *Example:* Testing plant growth with varying sunlight.
- **9.4. Differentiate the terms, science, technology and engineering with examples.**
  - **Answer:**
    - *Science:* Acquiring knowledge about nature (e.g., discovering electromagnetic induction).
    - *Technology:* Applying scientific knowledge for practical tools (e.g., inventing electric generators).
    - *Engineering:* Designing and building structures, devices, and systems (e.g., building a power grid).
- **9.5. What is the scope of Physics in everyday life? Give some examples.**
  - **Answer:** Physics explains everyday phenomena and powers modern life. *Examples:* Smartphones (electronics/optics), cars (mechanics/thermodynamics), medical imaging (X-rays/MRI).

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