

SCHOLAREYE STUDY SERIES



PHYSICS · CLASS 9

Chapter 9



Nature of Science

Complete Solved Exercise

MCQs · Short Answer · Constructed Response · Comprehensive Questions

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9.1

Physics is a branch of:

- (a) social science
- (b) life science

✓ **(c) physical science**

- (d) biological science

EXPLANATION

Physics studies matter, energy, and their interactions in the natural world. Since it deals with non-living systems and natural laws, it falls under the umbrella of physical sciences (which also includes chemistry and astronomy).

9.2

Which branch of science plays vital role in technology and engineering?

- (a) Biology
- (b) Chemistry
- (c) Geology

✓ **(d) Physics**

EXPLANATION

Engineering and technology rely heavily on the principles of physics — such as mechanics, electromagnetism, and thermodynamics — to design and build machines, structures, and electronics.

9.3

Automobile technology is based on:

- (a) acoustics
- (b) electromagnetism
- (c) optics

✓ **(d) thermodynamics**

EXPLANATION

Automobiles use internal combustion engines. These engines function by converting heat energy (from burning fuel) into mechanical work. This process of energy conversion is the core domain of thermodynamics.



9.4 A user friendly software application of smart phone use:

- (a) laser technology
- ✓ **(b) information technology**
- (c) medical technology
- (d) electronic technology

EXPLANATION

Software applications are programs that process, store, and transmit data. The field dedicated to the study and application of these systems is Information Technology (IT).

9.5 The working of refrigeration and air conditioning involves:

- (a) electromagnetism
- (b) mechanics
- (c) climate science

✓ **(d) thermodynamics**

EXPLANATION

Refrigerators and air conditioners work by transferring heat from a cooler space to a warmer environment. This process of heat transfer, phase changes, and energy conservation is governed by the principles of thermodynamics.

9.6 What is the ultimate truth of a scientific method?

- (a) Hypothesis
- ✓ **(b) Experimentation**
- (c) Theory
- (d) Law

EXPLANATION

While hypotheses, theories, and laws are essential parts of science, the scientific method ultimately relies on experimentation to provide empirical evidence to validate or falsify these ideas.

9.7

The statement "If I do not study for this test, then I will not get good grade" is an example of:

- (a) theory
- (b) observation
- ✓ (c) prediction
- (d) law

EXPLANATION

This is an "if-then" statement that forecasts a future outcome based on a condition. This is a classic example of making a prediction.

9.8

Which of the following are methods of investigation?

- (a) Observation
- (b) Experimentation
- (c) Research

✓ (d) All of these

EXPLANATION

Scientific investigation can take many forms. Observing phenomena, conducting controlled experiments, and doing background research are all valid methods used to acquire knowledge.

9.9

A hypothesis:

- (a) may or may not be testable
- (b) is supported by evidence

✓ (c) is a possible answer to a question

- (d) all of these

EXPLANATION

A hypothesis is a proposed, testable explanation for a phenomenon. While it aims to be supported by evidence later, its core definition is that it is a possible answer to a scientific question.

9.10 A graph of an organized data is an example of:

- (a) collecting data
- (b) forming a hypothesis
- (c) asking question

✓ **(d) analyzing data**

EXPLANATION

Once data is collected and organized, creating graphs and charts allows scientists to visualize trends, patterns, and relationships, which is a key part of the data analysis phase.

9.11 The colour of a door is brown. It is an example of:

✓ **(a) observation**

- (b) hypothesis
- (c) prediction
- (d) law

EXPLANATION

Noting a characteristic of an object using your senses (in this case, sight) is a direct observation. It is a simple fact gathered through perception.

B Short Answer Questions

9.1 State in your own words, what is science? Write its two main groups.

ANSWER

Science is the systematic and logical study of the natural world through observation, experimentation, and reasoning to understand how things work.

Its two main groups are:

1. **Physical Sciences:** Study of non-living things (e.g., Physics, Chemistry).
2. **Biological Sciences:** Study of living organisms (e.g., Biology, Zoology).

9.2 What is Physics all about? Name some of its branches.

ANSWER

Physics is the branch of science that deals with the study of matter, energy, and their mutual interactions. It aims to understand the fundamental laws governing the universe.

Branches include: Mechanics, Thermodynamics, Electromagnetism, Optics, Acoustics, and Quantum Mechanics.

9.3 What is meant by interdisciplinary fields? Give a few examples.

ANSWER

Interdisciplinary fields are areas of study that combine knowledge, methods, and theories from two or more different scientific disciplines to solve complex problems.

Examples: Biophysics (Biology + Physics), Physical Chemistry (Chemistry + Physics), and Geophysics (Geology + Physics).

9.4 List the main steps of scientific method.**ANSWER**

The main steps are:

1. Observation
2. Defining the problem
3. Forming a hypothesis
4. Experimentation
5. Data collection and analysis
6. Drawing conclusions
7. Communicating results

9.5 What is a hypothesis? Give an example.**ANSWER**

A hypothesis is a proposed, testable explanation for a specific observation or phenomenon, often stated as an “if-then” statement.

Example: “If a plant receives more sunlight, then it will grow taller than a plant kept in the shade.”

9.6 Distinguish between a theory and a law of Physics.**ANSWER**

A **Theory** explains *why* a natural phenomenon occurs; it is a well-substantiated explanation based on a vast body of evidence (e.g., Theory of Evolution). A **Law** describes *what* happens under certain conditions, often using mathematical equations, without necessarily explaining the underlying mechanism (e.g., Newton's Law of Gravitation).

9.7 What is the basis of laser technology?**ANSWER**

The basis of laser technology is the “stimulated emission” of electromagnetic radiation. It relies on quantum mechanics and optics to amplify light waves to produce a highly focused, coherent beam.

9.8

What is falsifiability concept? How is it important?**ANSWER**

Falsifiability is the principle that a scientific hypothesis or theory must be capable of being proven wrong through observation or experimentation. It is crucial because it sets the boundary between science and pseudoscience; a claim that cannot be tested or falsified is not considered scientific.

c Constructed Response Questions

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

ANSWER

No, the theories of science are not ultimate truths. Science is a self-correcting process. A scientific theory is the best explanation we have based on current evidence and technology. As new tools are invented and new discoveries are made, old theories can be modified, refined, or even completely replaced. For example, Newton's laws were considered ultimate until Einstein's theory of relativity expanded upon them. Therefore, scientific theories are provisional and always open to revision.

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

ANSWER

Yes, existing laws of nature might need modifications in the future. While laws like gravity work perfectly in our everyday macroscopic world, they might break down under extreme conditions (like inside black holes or at the quantum level). As our understanding of the universe deepens and our technology advances, we may discover edge cases where current laws are incomplete, leading to new, more comprehensive laws.

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

ANSWER

- 1. Medical Doctor:** Requires deep knowledge of biology, chemistry, and anatomy to diagnose and treat illnesses.
- 2. Civil Engineer:** Applies physics (mechanics, materials science) and mathematics to design safe bridges, buildings, and infrastructure.
- 3. Environmental Scientist:** Uses chemistry, biology, and geology to analyze ecosystems, monitor pollution, and develop conservation strategies.

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

A theory is rejected or modified when new experimental evidence directly contradicts its core predictions, or when a new theory emerges that better explains the existing data and makes more accurate predictions. Technology also plays a role; a theory might be modified when new instruments allow us to observe phenomena that were previously untestable.

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 statement perfectly captures the principle of falsifiability. For an idea to be considered a scientific theory, it must make specific predictions that could potentially be proven wrong by experiments. If an idea is formulated in a way that no conceivable experiment could ever contradict it (like claiming an invisible, undetectable force causes things), it is not scientific; it's pseudoscience or a belief system.

9.6 What has been the general reaction to new ideas about established truths?**ANSWER**

Historically, the general reaction of the scientific community to new ideas that challenge established truths is resistance and skepticism. Scientists are human and often attached to prevailing paradigms. However, as evidence accumulates and withstands rigorous scrutiny, the community eventually accepts the new idea, leading to a "paradigm shift" (e.g., the shift from a geocentric to a heliocentric solar system).

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

Not necessarily. A hypothesis that is not testable is not scientifically "wrong," but it is scientifically useless. Science relies on empirical evidence; if we cannot design an experiment or observation to test a hypothesis, we cannot verify its validity. Therefore, it falls outside the realm of scientific inquiry.

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 relates to the problem of induction. No matter how many times you observe something happening (e.g., the sun rising 1000 times), you can never be 100% certain it will happen again the next day (the “Black Swan” problem). However, a single counter-example (one black swan) is enough to permanently disprove a universal claim (e.g., “All swans are white”). Therefore, data can definitively falsify a prediction but can only support, not absolutely prove, a universal prediction.

9.9

What is the relationship between an experiment and a hypothesis?

ANSWER

An experiment is the tool used to test a hypothesis. The hypothesis predicts what should happen if a certain idea is true; the experiment creates controlled conditions to see if those predictions actually occur. The results of the experiment either support the hypothesis or refute it, driving the scientific process forward.

9.10

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

ANSWER

Complex real-world problems (such as climate change, cancer research, or developing sustainable energy) cannot be solved by a single discipline. Climate change, for instance, requires physicists to model temperatures, chemists to understand carbon cycles, biologists to assess ecosystem impacts, and sociologists to understand human behavior. Interdisciplinary research integrates these perspectives, leading to holistic, effective solutions.

D Comprehensive Questions

9.1 What are the main branches of Physics? State briefly.

ANSWER

- **Mechanics:** Study of motion, forces, and energy.
- **Thermodynamics:** Study of heat, temperature, and energy transfer.
- **Electromagnetism:** Study of electric and magnetic fields and their interactions.
- **Optics:** Study of light, its properties, and vision.
- **Acoustics:** Study of sound and its transmission.
- **Atomic and Nuclear Physics:** Study of the structure and behavior of atoms and nuclei.
- **Quantum Mechanics:** Study of the behavior of matter and energy at the smallest scales.

9.2 What is meant by interdisciplinary fields of Physics? Give three examples.

ANSWER

Interdisciplinary fields of physics are areas where the principles and methods of physics are applied to other scientific disciplines to study complex phenomena.

Three examples:

1. **Astrophysics:** Applying physics to understand the birth, life, and death of stars and galaxies.
2. **Biophysics:** Using physics to study biological systems, like the mechanics of blood flow or the electrical signals in nerves.
3. **Geophysics:** Applying physics to study the Earth's interior, magnetic field, and seismic activity.

9.3 What is scientific method? Describe its main steps with examples.**ANSWER**

The scientific method is a systematic, logical approach used to investigate phenomena, acquire new knowledge, or correct and integrate previous knowledge.

Steps with examples:

1. **Observation:** You notice mold growing on bread.
2. **Question:** Why does mold grow on bread?
3. **Hypothesis:** "If bread is kept in a moist environment, then mold will grow faster."
4. **Experiment:** Place one slice of bread in a sealed dry bag and another in a sealed moist bag.
5. **Data Collection / Analysis:** Observe and measure mold growth over a week.
6. **Conclusion:** The moist bread grew mold faster, supporting the hypothesis.
7. **Communication:** Share the results with others.

9.4 Differentiate the terms science, technology and engineering with examples.**ANSWER**

- **Science:** The pursuit of knowledge and understanding of the natural world (e.g., discovering the laws of electromagnetism).
- **Engineering:** The application of scientific and mathematical principles to design and build practical solutions (e.g., designing a circuit board based on electromagnetic laws).
- **Technology:** The final products, tools, and systems that result from engineering (e.g., a smartphone that uses the circuit board).

In short: Science is knowing, Engineering is designing, Technology is the product.

9.5 What is the scope of Physics in everyday life? Give some examples.**ANSWER**

The scope of physics is incredibly vast and touches every aspect of our daily lives.

- **Walking / Driving:** Involves mechanics (friction, force, motion).
- **Cooking:** Involves thermodynamics (heat transfer).
- **Using Smartphones / Computers:** Relies on electromagnetism and quantum mechanics (semiconductors).
- **Seeing:** Relies on optics (reflection, refraction of light).
- **Listening to Music:** Relies on acoustics (sound waves).



Chapter Complete

Nature of Science — fully solved with explanations

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