9th Class Physics - Chapter 1

Exercise - Long Response Questions

1. Define Physics. Describe its evolutionary role in technology.

Answer: Physics is the branch of science that deals with matter, energy and their interactions. It has played an important role in the development of technology. Principles of physics are used in machines, electrical appliances, communication systems and transportation. Physics has also contributed to computers, medical equipment and space technology. Thus, the development of physics leads to advancements in technology.

2. Write different branches of Physics.

Answer: Physics has many branches dealing with different aspects of nature. Mechanics deals with motion and forces, while thermodynamics deals with heat and temperature. Optics studies light, and electromagnetism deals with electricity and magnetism. Atomic physics studies atoms, whereas nuclear physics studies atomic nuclei. Other important branches include solid-state physics, particle physics, astrophysics and geophysics.

3. What are base and derived physical quantities? Give examples.

Answer: Base quantities are independent physical quantities that are not defined in terms of other physical quantities. Examples include length, mass, time, electric current, temperature, amount of substance and luminous intensity. Derived quantities are obtained by multiplying or dividing base quantities. Examples include area, volume, speed, acceleration, force and density. Thus, derived quantities are expressed in terms of base quantities.

4. Define units, base units and derived units.

Answer: A unit is a standard quantity used to measure a physical quantity. Base units are the units of base physical quantities and are independent of other units. Examples are metre (m), kilogram (kg) and second (s). Derived units are obtained from combinations of base units. For example, the SI unit of force is newton, $N = kg\ m\ s^{-2}$.

5. What are prefixes? Explain their use in measurements.

Answer: Prefixes are words or symbols added before SI units to represent powers of ten. They are used to express very large or very small measurements conveniently. For example, kilo (k) represents 10^3, milli (m) represents 10^{-3}, and micro (μ) represents 10^{-6}. Thus, $1\ km = 10^3\ m$ and $1\ mm = 10^{-3}\ m$. Prefixes make numerical values easier to write and understand.

6. What is scientific notation? Give at least five examples.

Answer: Scientific notation expresses a number in the form $a \times 10^n$, where $1 \leq a < 10$ and n is an integer. It is useful for writing very large and very small numbers conveniently. Examples are $3000 = 3 \times 10^3$, $45000 = 4.5 \times 10^4$, and $0.002 = 2 \times 10^{-3}$. Similarly, $0.00025 = 2.5 \times 10^{-4}$ and $6{,}500{,}000 = 6.5 \times 10^6$. The exponent is positive for large numbers and negative for numbers smaller than one.

7. Describe the construction and working of vernier calipers.

Answer: A vernier caliper consists of a main scale and a sliding vernier scale, with jaws for measuring external and internal dimensions and a depth rod for measuring depth. Its commonly used least count is 0.1 mm = 0.01 cm. The object is placed between the appropriate jaws and the main-scale reading is noted just before the zero of the vernier scale. The coinciding vernier division is multiplied by the least count to obtain the fractional reading. The total measurement is the main-scale reading plus the vernier-scale reading, after applying zero correction if required.

8. What is a screw gauge? Define its pitch and least count. How is it used to measure the thickness of a copper wire?

Answer: A screw gauge is an instrument used to measure very small lengths such as the diameter of a thin wire. Its pitch is the distance moved by the spindle in one complete rotation, while its least count is pitch divided by the number of circular-scale divisions. A common screw gauge has a least count of 0.01 mm. Place the copper wire between the anvil and spindle and gently tighten it using the ratchet. Add the main-scale and circular-scale readings and apply zero correction, if necessary, to obtain the diameter.

9. What are random and systematic errors? How can they be reduced?

Answer: Random errors cause measurements to vary unpredictably when repeated under the same conditions. They can be reduced by taking several measurements and calculating their mean value. Systematic errors produce a consistent error in the same direction due to an instrument, method or experimental condition. They can be reduced by proper calibration, correcting zero error and improving the experimental method. Careful observation and correct use of instruments help reduce measurement errors.

10. Define scalar and vector quantities and justify with examples.

Answer: A scalar quantity has magnitude only, whereas a vector quantity has both magnitude and direction. Mass, time, temperature, speed and energy are scalar quantities because no direction is required to describe them. Displacement, velocity, acceleration and force are vectors because both magnitude and direction are necessary. For example, 5 m is only a magnitude, whereas 5 m east specifies both magnitude and direction. Therefore, the presence or absence of direction distinguishes vectors from scalars.

11. How can the volume of a liquid be measured using a measuring cylinder?

Answer: A measuring cylinder is used to measure the volume of a liquid directly. Place the cylinder vertically on a horizontal surface and pour the liquid into it. Allow the liquid to settle and observe the meniscus at eye level to avoid parallax error. For water and similar liquids, read the scale at the bottom of the meniscus. The corresponding scale reading gives the volume of the liquid.

12. Differentiate between precision and accuracy.

Answer: Accuracy is the closeness of a measured value to the true or accepted value. Precision is the closeness of repeated measurements to one another. A set of measurements may be precise without being accurate. Accurate measurements have very small error compared with the true value. Good measurements should be both accurate and precise.