THE SMART STUDY NOTES

CLASS 9th New PHYSICS

Chapter 1: Physical Quantities and Measurements

Additional Short Questions and Answers

Introduction:

1. What kind of world do we live in?
Ans. We live in a physical world where we observe many natural phenomena and objects.
2. Give examples of natural phenomena observed in our world.
Ans. Examples include the Sun, stars, moon, oceans, plants, winds, and rains.
3. Why have people always been curious about natural phenomena?
Ans. People have always been curious to understand the reality behind natural happenings and the laws governing them.
4. What is science?
Ans. Science is the field of observation and experimentation that helps us understand facts and laws about the world around us.
5. How do scientists investigate facts and laws?
Ans. Scientists investigate facts and laws through observation and experimentation.
6. Why is everything in our lives closely linked to science?
Ans. Science helps us understand natural laws, develop technology, and improve daily life.
7. What is the primary concern of scientists?
Ans. The primary concern of scientists is to make accurate and reliable measurements.
8. Why is making accurate measurements important in science?
Ans. Accurate measurements help in obtaining reliable scientific results and discoveries.
9. What have scientists been investigating to improve?
Ans. Scientists have been investigating methods and instruments to improve the accuracy of measurements.

1.1 Physical and Non-Physical Quantities

10. Measurement:
Ans. The process of determining the value of a physical quantity using appropriate instruments.
11. Unit:
Ans. A standard quantity used to express a measurement (e.g., meter for length, second for time).
12. Instrument:
Ans. A tool used to measure physical quantities, such as a ruler for length or a thermometer for temperature.
13. What are physical quantities?
Ans. Quantities that can be measured using instruments, such as length and temperature.
14. What are non-physical quantities?
Ans. Qualities that cannot be measured with instruments, such as love and beauty.
15. Give two examples of physical quantities.
Ans. Length, time.
16. Give two examples of non-physical quantities.
Ans. Wisdom, affection.
17. How is the length of an object measured?
Ans. Using a ruler or measuring tape.
18. How is temperature measured?
Ans. Using a thermometer.
19. What is the importance of physical quantities in physics?
Ans. They form the basis of laws and principles in physics.
20. Can non-physical quantities be measured with instruments?
Ans. No, they are described qualitatively.
21. How can non-physical quantities be analyzed?
Ans. Through surveys, predetermined criteria, or indices.
22. Why are physical quantities important?
Ans. They help in scientific analysis, calculations, and understanding natural phenomena.
23. What tool is used to measure time?
Ans. A clock or stopwatch.
24. What is the unit of length in the SI system?

Ans. Meter (m).
25. What is the unit of time in the SI system?
Ans. Second (s).
26. What is the difference between physical and non-physical quantities?
Ans. Physical quantities can be measured with instruments, while non-physical quantities cannot.
27. Can beauty be measured directly?
Ans. No, it is a non-physical quantity.

1.2 Base and Derived Physical Quantities

28. What is a physical quantity?
Ans. A physical quantity is a measurable feature of an object, such as length, mass, time, or temperature.
29. What are base quantities?
Ans. Base quantities are fundamental physical quantities that are arbitrarily selected and do not depend on other quantities, such as length, mass, and time.
30. What are derived physical quantities?
Ans. Derived physical quantities are those that can be expressed in terms of one or more base quantities, such as speed (distance/time) and density (mass/volume).
31. Give an example of a derived quantity.
Ans. Speed is a derived quantity because it depends on distance (length) and time.
32. Why do we need a standard unit for measurement?
Ans. A standard unit ensures that measurements remain consistent and avoid confusion when measured by different people.
33. How was length measured in ancient times?
Ans. In the past, people used hands, arms, feet, or steps to measure length.
34. Why were ancient measurement methods unreliable?
Ans. Because different people have different hand, arm, and foot sizes, which led to variations in measurements.
35. What is a measurement?
Ans. Measurement is the process of comparing an unknown quantity with a widely accepted standard quantity.
36. What are the two parts of a measurement?
Ans. A measurement consists of a number and a unit.
37. Why is a measurement without a unit meaningless?
Ans. Without a unit, the numerical value of a measurement has no standard reference and cannot be compared.
38. Why was there a need to standardize measurement units globally?
Ans. Different countries used different units, causing difficulties in trade, business, and scientific exchanges, which led to the need for a universal system.
39. How does a standard unit help in trade and business?
Ans. A standard unit ensures accuracy and consistency, making international trade and business transactions smoother.
40. What is the purpose of measuring physical quantities?
Ans. measuring physical quantities helps in understanding and analyzing the properties of different objects and phenomena in the physical world.
41. What is an example of a base quantity?
Ans. Time is an example of a base quantity as it is fundamental and does not depend on other quantities.
42. What is the role of physical quantities in physics?
Ans. Physical quantities help describe and analyze material objects in terms of measurable properties.

1.3 International System of Units (SI)

43. What is the International System of Units (SI)?
Ans. The SI system is a globally accepted system of measurement that consists of seven base units, ensuring standardization in scientific and everyday measurements.
44. When and by whom was the SI system recommended?
Ans. The International Committee on Weights and Measures recommended the SI system in 1961.
45. Why is the SI system important?

Ans. It allows scientists and professionals worldwide to share and compare their observations accurately, ensuring uniformity in measurements.
46. How many base units are there in the SI system?
Ans. There are seven base units in the SI system.
47. Why are SI unit values fixed?
Ans. SI unit values are fixed with reference to international standards to maintain accuracy and consistency across all measurements.
48. How does the SI system help in international trade and science?
Ans. It eliminates confusion caused by different measurement systems, making scientific research, trade, and communication more efficient worldwide.

Derived Units

49. What are derived units?
Ans. Derived units are units that can be expressed in terms of base units. They are used for derived physical quantities like speed, area, volume, force, and pressure.
50. How are derived units formed?
Ans. Derived units are formed by combining base units. For example:
Area = Length × Breadth = m × m = m^2
Speed = Distance / Time = m/s
51. Give two examples of derived quantities and their SI units.
Ans. Force → Newton (N)
Pressure → Pascal (Pa)
52. Why are base units different from derived units?
Ans. Base units are fundamental and cannot be broken down further, while derived units are formed by combining base units.
53. What is the SI unit of electric charge?
Ans. The SI unit of electric charge is coulomb (C).
54. What is the SI unit of plane angle?
Ans. The SI unit of plane angle is radian (rad).

SI Prefixes

55. What are SI prefixes?
Ans. SI prefixes are symbols or words added before SI units to represent large or small values in powers of 10.
56. Why are SI prefixes used?
Ans. They simplify the writing of very large or very small numbers, making them easier to express and understand.
57. Give two examples of SI prefixes.
Ans. Kilo (k) → Represents 10^3 (1,000)
Milli (m) → Represents 10^{-3} (1/1,000)
58. How can we express 50,000,000 m using SI prefixes?
Ans. 50,000,000 m = 5×10^7 m
59. Convert 0.00004 m into scientific notation.
Ans. 0.00004 m = 4×10^{-5} m.
60. What is the meaning of "milli" in SI units?
Ans. "Milli" means one-thousandth (1/1000) or 10^{-3} of a unit.
61. How do prefixes help in measurements?
Ans. They allow measurements to be expressed in a more compact and meaningful way, making calculations easier.

1.4 Scientific Notation

62. What is scientific notation?
Ans. Scientific notation is a short way of writing very large or small numbers using powers of 10.
63. Why is scientific notation used?
Ans. It makes large and small numbers easier to read, compare, and use in calculations.
64. How is a number written in scientific notation?
Ans. The number is written as a value between 1 and 9, multiplied by 10 raised to a power (exponent).
65. How do you determine the exponent in scientific notation?
Ans. If the decimal moves to the left, the exponent is positive.
If the decimal moves to the right, the exponent is negative.

Section 1.5 Length Measuring Instruments

66. Define "least count" of a measuring instrument.
Ans. The smallest measurement that can be taken accurately with the instrument.
67. What is the least count of a metre rule?
Ans. 1 mm (or 0.1 cm).
68. How can parallax error be avoided when using a metre rule?

Ans. By keeping the eye directly perpendicular to the scale while taking readings.

Vernier caliper:

69. What is the function of the main scale in a Vernier caliper?

Ans. It provides the primary measurement in millimeters (1 mm divisions).

70. Why is a Vernier caliper more precise than a metre rule?

Ans. Its least count (0.1 mm) is smaller than that of a metre rule (1 mm).

71. Who invented the Vernier caliper?

Ans. Pierre Vernier, a French scientist, in 1631.

72. What error occurs due to viewing the scale from an angle?

Ans. Parallax error.

73. Which instrument is suitable for measuring the length of a football ground?

Ans. Measuring tape.

Measurement Using Vernier Callipers

74. How is zero error corrected if the Vernier zero is to the right of the main scale zero?

Ans. Subtract the zero error from the observed measurement.

Micrometer Screw Gauge:

75. What is "pitch" in a screw gauge?

Ans. The distance moved by the spindle during one full rotation of the thimble (0.5 mm in the given example).

76. If the Vernier zero is left of the main scale zero, how is zero error corrected?

Ans. Add the zero error to the observed measurement.

77. Name the scales on a micrometer screw gauge.

Ans. Main scale (on the sleeve) and circular scale (on the thimble).

78. Define zero error in Vernier calipers.

Ans. The error that occurs when the zeros of the main and Vernier scales do not coincide when the jaws are closed.

79. Why is a micrometer screw gauge used?

Ans. To measure very small lengths (e.g., wire diameter, sheet thickness) with high precision (up to 0.01 mm).

80. If a Vernier caliper has a zero error of +0.03 mm, how is the observed reading adjusted?

Ans. Subtract 0.03 mm from the observed reading.

81. What is the purpose of the circular scale in a screw gauge?

Ans. To measure fractional parts of the main scale divisions (improves precision).

82. What happens if the Vernier caliper's zero error is not corrected?

Ans. The final measurement will be inaccurate (either too high or too low).

83. Name the part of a screw gauge that moves when the thimble is rotated.

Ans. The spindle.

Checking for Zero Error / Measurement Using Screw Gauge

84. How is zero error identified in a micrometer screw gauge?

Ans. If the zero of the circular scale does not align with the horizontal reference line when the anvil and spindle are closed, there is a zero error.

85. What correction is applied if the circular scale's zero is below the reference line?

Ans. The zero error is subtracted from the observed measurement.

86. What does it mean if the circular scale's zero is above the reference line?

Ans. The instrument will show a reading less than the actual value, and the zero error must be added to the observed measurement.

87. What is the reference line used to check zero error in a screw gauge?

Ans. The horizontal line on the main scale (sleeve).

88. Why is zero error correction critical in precision instruments?

Ans. It ensures accurate readings by compensating for instrumental misalignment.

89. What is the significance of the circular scale in a screw gauge?

Ans. It measures fractional parts of the main scale divisions, improving precision.

1.6. Mass Measuring Instruments

90. What is the difference between mass and weight?

Ans. Mass is the measure of the quantity of matter in a body, while weight is the force by which the body is attracted towards the Earth.

91. Name the instrument used to measure mass in laboratories.

Ans. Physical balance.

92. What is the principle of a physical balance?

Ans. It is based on the principle of levers.

93. How is the base of a physical balance leveled before use?

Ans. By adjusting the leveling screws until the plumb line is exactly above the pointed mark.

94. How the mass of an object is measured using a physical balance?

Ans. By placing the object on the left pan and adding known standard masses to the right pan until the pointer remains at zero or oscillates equally on both sides.

95. What is the function of the balancing screws on a physical balance?

Ans. To make the beam horizontal and center the pointer on the scale.

1.7 Time Measuring Instruments

96. How is a stopwatch reset after taking a reading?

Ans. By pressing the knob again to bring the needles back to the zero position.

97. What is the advantage of using a digital stopwatch over a mechanical one?

Ans. It can measure up to one-hundredth (1/100) of a second, providing higher precision.

98. What is the purpose of the plumb line in a physical balance?

Ans. To ensure the balance is perfectly leveled before use.

99. How is the least count of a mechanical stopwatch determined?

Ans. By dividing one second into ten small divisions, each representing 0.1 seconds.

100. What is the role of forceps in using a physical balance?

Ans. To handle and place standard masses (weights) on the right pan.

1.8 Volume Measuring Instruments

101. What is the purpose of a measuring cylinder?

Ans. To measure the volume of liquids and non-dissolvable solids.

102. How is the volume of a liquid read correctly in a measuring cylinder?

Ans. By placing the cylinder on a horizontal surface and keeping the eye level with the meniscus of the liquid.

103. What is the meniscus of a liquid?

Ans. The curved surface of a liquid in a container, which can be concave (water) or convex (mercury).

104. How is the volume of a solid measured using a measuring cylinder?

Ans. By noting the rise in the liquid level after immersing the solid in the cylinder and calculating the difference in readings.

105. What is the displacement can method used for?

Ans. To measure the volume of a solid that does not fit into a measuring cylinder.

106. Describe the steps to measure the volume of a solid using a displacement can.

Ans. 1. Fill the displacement can with water until it overflows.

2. Lower the solid into the can, allowing the displaced water to overflow.

3. Collect the displaced water in a beaker and measure its volume using a measuring cylinder.

107. Why is it important to keep the eye level with the meniscus when taking a reading?

Ans. To avoid parallax error and ensure accurate measurement.

108. What is the difference between concave and convex meniscus?

Ans. A concave meniscus curves downward (e.g., water), while a convex meniscus curves upward (e.g., mercury).

109. What precaution should be taken while using a measuring cylinder?

Ans. Ensure the cylinder is placed on a horizontal surface and the eye is level with the meniscus.

110. How the volume of a metallic ball is measured using a measuring cylinder?

Ans. By immersing the ball in the cylinder filled with water and measuring the rise in water level.

111. What is the significance of the displacement can in volume measurement?
Ans. It allows measurement of the volume of large or irregularly shaped solids that cannot fit into a measuring cylinder.
112. What is the role of a beaker in the displacement can method?
Ans. To collect and measure the volume of water displaced by the solid.
113. How does the shape of the meniscus affect the reading in a measuring cylinder?
Ans. For water (concave meniscus), the reading is taken at the bottom edge, while for mercury (convex meniscus), the reading is taken at the top edge.
114. What is the historical method used by ancient Chinese to estimate volume?
Ans. They estimated the volume of grains by sounding their containing vessels.

1.9 Errors in Measurements

115. Name the three types of experimental errors.
Ans. Human errors, systematic errors, and random errors.
116. Define human errors.
Ans. Errors caused by personal limitations or mistakes, such as incorrect eye alignment while reading a scale or delayed reaction time in timing experiments.
117. How can human errors be minimized?*
Ans. Through proper training, using digital instruments, and following correct procedures.
118. What causes systematic errors?
Ans. Faulty instrument calibration, zero errors, or incorrect markings on the instrument.
119. How are systematic errors corrected?
Ans. By comparing the instrument with a more accurate one and applying a correction factor.
120. What are random errors?
Ans. Unpredictable fluctuations in measurements due to sudden changes in environmental conditions (e.g., temperature, humidity).
121. How can the effect of random errors be reduced?
Ans. By taking multiple readings and calculating their average.
122. Give an example of a human error in liquid measurement.
Ans. Liquid evaporation during measurement due to improper handling.
123. Why are systematic errors considered consistent?
Ans. They affect all measurements equally due to a specific cause (e.g., instrument fault).
124. What is the role of averaging in reducing random errors?
Ans. Averaging minimizes the impact of unpredictable fluctuations across multiple readings.
125. How does environmental variation contribute to errors?
Ans. It introduces random errors by unpredictably altering measurement conditions (e.g., temperature changes).

1.10 Uncertainty in a Measurement

126. Define uncertainty in measurement.
Ans. Uncertainty refers to the inevitable doubt or margin of error in a measured value due to instrument limitations or estimation.
127. How is uncertainty calculated for a metre rule calibrated in millimetres?
Ans. Uncertainty = ± half of the least count. For a metre rule with 1 mm divisions, uncertainty is ±0.05 cm.
128. What convention is followed if a measurement endpoint lies between two divisions?
Ans. If the endpoint does not cross the midpoint of the smallest division, use the previous division; if it crosses, use the next division.

1.11 Significant Figures

129. What are significant figures?
Ans. The digits in a measurement that are reliably known, including the first doubtful digit.
130. State the rules for determining significant figures involving zeros.
Answer: Zeros between digits are significant (e.g., 5.06 has 3 sig figs). Leading zeros are not significant (e.g., 0.0034 has 2 sig figs). Trailing zeros after a decimal are significant (e.g., 2.40 has 3

sig figs). In scientific notation, all digits before the exponent are significant (e.g., 3.50×10^{7} has 3 sig figs).
131. Differentiate between accurate digits and doubtful digits.
Ans. Accurate digits are reliably known, while the doubtful digit is the first estimated value with a margin of error.
132. Why are significant figures important in scientific measurements?
Ans. They reflect the precision and reliability of the measurement, avoiding overestimation of accuracy.
133. How does scientific notation clarify significant figures?
Ans. It explicitly shows all significant digits before the exponent (e.g., 2.40×10^{3} has 3 sig figs).
134. What is the role of averaging in reducing measurement uncertainty?
Ans. It minimizes random errors by balancing out fluctuations across multiple readings.
135. Explain the term "least count" in the context of uncertainty.
Ans. The smallest measurement an instrument can directly measure, determining its precision.
136. Why is the first doubtful digit still considered a significant figure?
Ans. It represents the best estimate within the instrument's precision, providing a complete

1.12 Precision and Accuracy

137. Define precision and accuracy in measurements.
Ans. Precision: How close multiple measurements are to each other.
Accuracy: How close a measurement is to the true or accepted value.
138. How is the analogy of arrows hitting a target used to explain precision and accuracy?
Ans. Precision: Arrows clustered closely (even if off-target). Accuracy: Arrows near the bullseye (even if spread out). Both: Arrows clustered near the bullseye.
139. How does the least count of an instrument relate to precision?
Ans. Smaller least count = higher precision.

1.13 Rounding off the Digits

140. Round 4.45$10^{7}$m to 2 significant figures using the odd-even rule.
Ans. 4.4 10^{7}m}\) (since 4 is even, the digit remains unchanged).
141. Why is 4.452 10^{7}m rounded to 4.5 10^{7}m for 2 significant figures?
Ans. It is closer to (4.5 10^{7}m than 4.4$10^{7}m$.
142. Name a device used to measure the age of ancient remains.
Ans. Radioactive decay clock.
143. How does the number of significant figures reflect accuracy?
Ans. More significant figures = higher accuracy.
144. State the rule for rounding off when the last digit is exactly 5.
Ans.
- If the preceding digit is "odd", round up.
- If the preceding digit is "even", keep it unchanged.

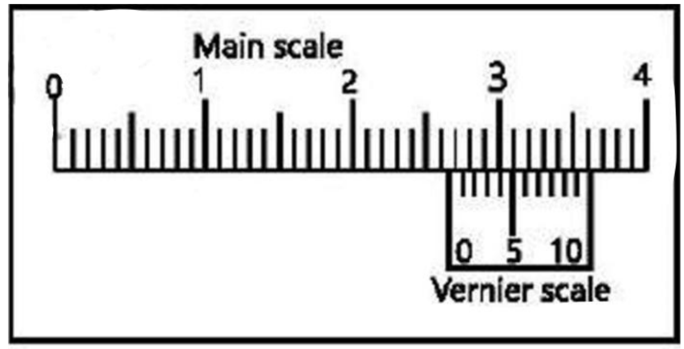
145. Give an example of a precise but inaccurate measurement.
Ans. Repeated measurements clustered far from the true value (e.g., arrows grouped away from the bullseye).
146. What distinguishes a pendulum clock from a radioactive decay clock?
Answer:
- Pendulum clock: Measures hours/minutes for daily use.
- Radioactive decay clock: Measures ages of ancient remains (in years).

EXERCISE SHORT QUESTIONS

Answer to Short Questions (Page 25, Section B):

1.1 Can a non-physical quantity be measured? If yes, then how?
Ans. No, non-physical quantities (e.g., love, fear) cannot be measured using instruments. They are qualitatively assessed through pre-determined criteria, indices, or surveys, not numerically quantified.
1.2 What is measurement? Name its two parts.
Ans. Measurement is the process of comparing an unknown quantity with a standard. Its two parts are:
A) Numerical value B) Unit

1.3 Why do we need a standard unit for measurements?
Ans. Standard units ensure consistency and avoid confusion caused by varying personal or regional measurement systems. They enable global scientific communication and trade.
1.4 Write the name of 3 base quantities and 3 derived quantities.
Ans. Base: Length (m), Mass (kg), Time (s)
Derived: Speed (m/s), Area (m^2), Force (N)
1.5 Which SI unit will you use to express the height of your desk?
Ans. Metre (m).
1.6 Write the name and symbols of all SI base units.
Ans. 1. Length: metre (m) 2. Mass: kilogram (kg)
3. Time: second (s) 4. Temperature: kelvin (K)
5. Electric current: ampere (A)
6. Luminous intensity: candela (cd)
7. Amount of substance: mole (mol)
1.7 Why prefix is used? Name three sub-multiple and three multiple prefixes with their symbols.
Ans. Purpose: To simplify large or small numbers using powers of ten.
Sub-multiples: milli (m, 10^{-3}), micro (μ, 10^{-6}), nano (n, 10^{-9})
Multiples: kilo (k, 10^3), mega (M, 10^6), giga (G, 10^9)
1.8 What is meant by:
(a) 5 pm: 5 picometers = $5\text{x}10^{-12}$ m
(b) 15 ns: 15 nanoseconds = $15\text{x}10^{-9}$ s
(c) 6 μm: 6 micrometers =$6\text{x}10^{-6}$ m
(d) 5 fs: 5 femtoseconds = $5\text{x}10^{-15}$s
1.9 (a) Purpose of Vernier Callipers:
To measure small lengths (e.g., diameter, thickness) with high precision (up to 0.1 mm).
(b) Two main parts:
Main scale
Vernier (sliding) scale
(c) Least count calculation:
Least Count = 1 , MSD- 1 , VSD} = 1 , mm - 0.9 , mm = 0.1 , mm}
(d) Zero error:
Error due to misalignment of the main and Vernier scales when jaws are closed. It is subtracted/added to readings for correction.
1.10 State least count and Vernier scale reading:
Least count: 0.1 mm (assuming 10 Vernier divisions = 9 main scale divisions).
Vernier reading: If the main scale reads 4.3 cm and the 4th Vernier division aligns:
Length = 4.3, cm + 4x0.01 ,cm = 4.34 , cm



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