CLASS 9TH PHYSICS • UNIT 1

Physical Quantities & Measurements

Complete Notes, Numericals & MCQs

Colorful Study Booklet

1 Q.1. Define Science.

Ans. The field of observation and experimentation to understand the world around us is known as science. Everything in our lives is closely linked to science and the discoveries made by scientists.

2 Q.2. Physical Quantities

Ans. Physical quantities can be measured directly or indirectly using tools and instruments. They are measurable and can be expressed in numerical terms.

Examples: length, time, temperature, volume, density, etc.

Non-Physical Quantities: Non-physical quantities cannot be measured using tools and instruments. They are abstract concepts and cannot be quantified.

Examples: love, affection, fear, wisdom, beauty, etc.

3 Q.3. Base Quantities

Ans. Base quantities are fundamental physical quantities arbitrarily selected by scientists to play a key role in measurements. They provide a base for new quantities.

Examples: Length, mass, time, temperature, electric current, amount of substance, and intensity of light.

Derived Quantities: Derived quantities are those that can be described in terms of one or more base quantities.

Example: Speed is a derived quantity that depends on distance and time, which are base quantities.

4 Q.4. What is meant by measurement? Explain.

Ans. A measurement is a process of comparison of an unknown quantity with a widely accepted standard quantity. A measurement consists of two parts: a number and a unit. A measurement without a unit is meaningless.

Challenges of Early Measurement Methods: In the early days, people used their hands, arms, feet, or steps to measure lengths. However, these methods were problematic because the size of hands, arms, and steps varied from person to person, leading to inconsistencies in measurements.

Need for Standardization in Measurements: To avoid confusion caused by personal differences, a standard unit of measurement was required. A standard ensures that any person performing a measurement would arrive at the same result.

5 Q.5. What is the International System of Units (SI)? Explain.

Ans. Definition: The International Committee on Weights and Measures in 1961 recommended the use of a system consisting of seven base units known as the International System of Units (SI). This system is in use all over the world. The use of SI measurements helps all scientists to share and compare their observations and results easily.

Base Units and Derived Units: Base units cannot be derived from one another and cannot be resolved into anything more basic. However, the units of derived quantities such as speed, area, volume, force, pressure, and electric charge can be derived using the base units. These units are called derived units. For example:

Area is derived as: Length x Breadth = meter x meter = square meter = m2

Speed is derived as: Distance / Time = meter / second = m/s

6 Q.6. What are prefixes? What is their use in measurements?

Ans. The SI system is a decimal system, and prefixes are used to modify units by powers of 10. Writing large quantities, like 50,000,000 m, or small quantities, like 0.00004 m, is not convenient. Instead, prefixes make these quantities easier to express. For example:

The quantity 50,000,000 m can be written as 5 x 10^7 m OR 50 Mm

The quantity 0.00004 m can be written as 4 x 10^-5 m OR 0.04 mm

Prefixes are the words or symbols added before SI units such as milli, centi, kilo, mega, and giga are used to express quantities in a more manageable form.

7 Q.7. What is scientific notation? Explain.

Ans. Definition: Scientific notation is a short way of representing very large or very small numbers. These numbers are more conveniently expressed as powers of 10.

Simplification of Numbers: In scientific notation, the numerical part of the quantity is written as a number from 1 to 9, multiplied by whole number powers of 10.

Writing Numbers in Scientific Notation: To write numbers using scientific notation, you move the decimal point until only one non-zero digit remains on the left. Then, you count the number of places the decimal point is moved. This count becomes the power or exponent of 10. If the decimal is moved to the left, the exponent is positive. If it is moved to the right, the exponent is negative.

Examples: The average distance from the Sun to the Earth is 138,000,000 km. In scientific notation, this distance would be written as 1.38 x 10^8 km.

The diameter of a hydrogen atom is about 0.000000000052 m. In scientific notation, this would be written as 5.2 x 10^-11 m.

8 Q.8. Write a note on metre rule.

Ans. Measuring Length with a Metre Rule: Length is generally measured using a metre rule in the laboratory. The smallest division on a metre scale is 1 mm, and the smallest measurement that can be taken with a metre rule is 1 mm. This is known as the least count of the metre rule.

Procedure for Measuring Length: To measure the length of an object, the metre rule is placed in such a way that its zero coincides with one edge of the object. Then, the reading in front of the other edge gives the length of the object.

Parallax Error: One common source of error when using a metre rule is the angle at which the instrument is read. The metre rule should either be tipped on its edge or read when the person's eye is directly above the ruler. If the metre rule is read from a different angle, the object will appear to be of different lengths. This is known as parallax error.

9 Q.9. Describe construction and working of Vernier callipers in detail.

Ans. Vernier Calliper: A Vernier Calliper is an instrument used to measure small lengths with high precision, down to 1/10th of a millimetre. It is commonly used to measure the thickness, diameter, width, or depth of an object.

Construction: The Vernier Calliper has two scales:

(a) Main Scale: This scale has markings of 1 mm each.

(b) Vernier (sliding) Scale: The Vernier scale is 9 mm long and divided into 10 equal parts.

Least Count of Vernier Calliper: Least count = 1 M.S div - 1 V.S div = 1 mm - 0.9 mm = 0.1 mm

Alternatively: Least count = 1 mm / 10 = 0.1 mm.

Jaws and Depth Gauge: The Vernier calliper also has two jaws (A and B) to measure the external dimensions of an object. Jaws C and D are used to measure the internal dimensions of an object. Additionally, a narrow strip projecting from behind the main scale, known as the tail or depth gauge, is used to measure the depths of hollow objects.

Working: Measurement Using Vernier Callipers

(i) Read the main scale marking just in front of zero of the Vernier scale. It is 4.3 cm.

(ii) Find the Vernier scale marking or division which is in line with any main scale marking.

Length of object = Main scale reading + (Least count x Vernier scale reading) = 4.3 + 0.01 x 4 = 4.34 cm

Checking for Zero Error: If on joining the jaws A and B, the zeros of the main scale and Vernier scale do not exactly coincide with each other, then there is an error in the instrument called zero error. If the zero of the Vernier scale is on the right side of the zero of the main scale, then this instrument will show slightly more than the actual length, so the zero error is subtracted. If the zero of the Vernier scale is on the left side, the zero error is added.

Digital Vernier Callipers: Digital Vernier callipers have greater precision than mechanical Vernier callipers. Least count of Digital Vernier callipers is 0.01 mm.

10 Q.10. What is screw gauge? What is its pitch and least count? How is it used to measure thickness of an object?

Ans. Screw Gauge: A Screw Gauge is an instrument used to measure very small lengths, such as the diameter of a wire or the thickness of a metal sheet.

Construction: It consists of two scales: (a) Main Scale on the sleeve, which has markings of 0.5 mm each. (b) Circular Scale on the thimble, which has 50 divisions.

Pitch and Least Count: When the thimble makes one complete turn, the spindle moves 0.5 mm (1 scale division) on the main scale. This movement is called the pitch of the screw gauge.

Least count = Pitch of the screw gauge / Number of divisions on the circular scale = 0.5 mm / 50 = 0.01 mm.

Measurement Using Screw Gauge: The object that is to be measured is placed between the anvil and the spindle. The thimble is turned to move the spindle. The ratchet prevents over-tightening.

Checking for Zero Error: No Zero Error if the zero of the circular scale coincides with the horizontal line. Zero Error Below the Line means the screw gauge measures slightly more (subtracted). Zero Error Above the Line means it measures slightly less (added).

Example: Thickness = main scale reading + (circular scale reading x L.C.) = 6.5 mm + 25 x 0.01 mm = 6.75 mm

11 Q.11. Write a brief note on physical balance.

Ans. Physical Balance: A Physical Balance is used for measuring the mass of an object, based on the principle of levers. Mass refers to the quantity of matter in a body, while weight is the force by which the object is attracted to the Earth.

Steps for Using a Physical Balance:

(i) Level the Base using the levelling screws so the plumb line is exactly above the pointed mark.

(ii) Check Beam and Pointer - ensure the beam is horizontal and the pointer is at the centre of the scale.

(iii) Place the Object to be weighed on the left pan.

(iv) Place Known Weights using forceps in the right pan.

(v) Balance the Beam by adjusting weights until the pointer stays at zero.

(vi) Determine the Mass - the total of standard masses gives the mass of the object.

12 Q.12. Write a brief note on stopwatch.

Ans. Stopwatch: A stopwatch is an instrument used to measure the duration of time of an event. It contains two needles: one for seconds and another for minutes. The dial is usually divided into 30 big divisions, each further divided into 10 small divisions, each representing one tenth (1/10) of a second - the least count of the stopwatch.

Using the Stopwatch: (i) Press the knob to start. (ii) Press again to stop. (iii) Press once more to reset.

Modern Digital Stopwatches: Digital watches can measure time down to one hundredth of a second, offering higher precision.

13 Q.13. Write a brief note on measuring cylinder.

Ans. Measuring Cylinder: A measuring cylinder is a cylindrical container made of glass or transparent plastic, marked with a scale divided into cubic centimetres (cm3 or cc) or millilitres (mL). It is primarily used to find the volume of liquids and non-dissolvable solids.

Measuring the Volume of Liquids: The cylinder must be placed on a horizontal surface, and the eye must be level with the meniscus. For water, the meniscus forms a concave surface, and the reading is taken at the bottom edge. For mercury, the liquid forms a convex surface, and the reading is taken from the top edge.

Measuring the Volume of Solids: The measuring cylinder can also be used to measure the volume of solids by observing the displacement of the liquid when the solid is added.

14 Q.14. Describe displacement can method for finding volume of a solid.

Ans. Displacement Can Method: Used when the solid body cannot fit into the measuring cylinder.

(i) Place the displacement can on a horizontal table.

(ii) Fill the can with water until it starts overflowing.

(iii) Tie a thread to the solid body and gently lower it into the can.

(iv) As the solid is submerged, it displaces water, which flows out.

(v) Collect the displaced water in a beaker.

(vi) Measure the volume of the displaced water using a measuring cylinder.

15 Q.15. Describe different types of errors in measurement and how can they be minimized?

Ans. Errors in Measurement: All measurements inherit errors. There are three types:

(i) Human Errors: Occur due to personal performance limitations, such as inability to precisely estimate a pointer position, or reaction time in timing experiments.

Minimizing: proper training, avoiding distractions, using automated/digital instruments.

(ii) Systematic Errors: Influence all measurements of a type in the same way; arise from zero error, poor calibration, or incorrect scale markings.

Minimizing: comparing with a more accurate instrument, applying a correction factor.

(iii) Random Errors: Occur when repeated measurements produce different results under the same conditions, due to unpredictable factors like temperature, pressure, humidity, voltage fluctuations.

Minimizing: Taking multiple readings and calculating the average/mean value.

16 Q.16. Describe concept of uncertainty in measurement.

Ans. Uncertainty in Measurements: There is no such thing as a perfect measurement. Every measuring instrument is calibrated to a certain smallest division, which limits the degree of accuracy achievable.

Instrument Limitations and Uncertainty: If the endpoint of a line lies between 10.3 cm and 10.4 cm marks: if it does not touch/cross the midpoint, reading confined to previous division; if it touches/crosses the midpoint, reading extended to next division. Maximum uncertainty is +/-0.05 cm, representing half of the least count.

Significant Figures and Uncertainty: The uncertainty of a measured value can be conveniently indicated using significant figures.

17 Q.17. What are significant figures? Explain general rules for writing significant figures with the help of examples.

Ans. Significant Figures: In any measurement, the accurately known digits and the first doubtful digit are known as significant figures.

Rules for Determining Significant Figures:

(i) All digits from 1 to 9 are always significant. Example: 5.06 m has 3 significant figures.

(ii) Zeros between non-zero digits are significant. Example: 5.06 m, the zero between 5 and 6 is significant.

(iii) Leading zeros are not significant. Example: 0.0034 m has 2 significant figures.

(iv) Zeros to the right of a decimal point are significant. Example: 2.40 mm has 3 significant figures.

(v) In scientific notation, all digits before the exponent are significant. Example: 3.50 x 10^-5 m has 3 significant figures.

18 Q.18. Differentiate between precision and accuracy in physical measurement.

Ans. (i) Precision refers to how close together a group of measurements are to each other - the consistency or repeatability of measurements.

(ii) Accuracy refers to how close the measured value is to the accepted or true value.

Conclusion: Precision is about closeness of repeated measurements to each other, while accuracy is about how close those measurements are to the true value.

19 Q.19. Explain rounding off numbers in scientific measurement.

Ans. Rounding Numbers to Significant Figures:

(i) If the last digit is greater than 5, increase the retained digit by one.

(ii) If the last digit is less than 5, retain the digit as it is.

(iii) If the last digit is exactly 5: if the digit before 5 is odd, increase the last retained digit by one; if even, leave it unchanged.

Examples: 2.512×10^{-6} m rounds to 2.5×10^{-6} m (2 s.f.). 3.4567×10^{4} kg rounds to 3.46×10^{4} kg. 4.45×10^{2} m rounds to 4.4×10^{2} m (digit before 5 is even).

20 EXAMPLE 1.1: Solve the following

(a) 5.123×10^{4} m + 3.28×10^{4} m = $(5.123 + 3.28) \times 10^{4}$ m = 8.403×10^{4} m

(b) 2.57×10^{-2} mm - 3.43×10^{-3} mm = $(2.57 - 0.343) \times 10^{-2}$ mm = 2.227×10^{-2} mm = 2.227×10^{-5} m

21 EXAMPLE 1.2: Find the value of each of the following quantities

(a) $(4 \times 10^{3}$ kg$)(6 \times 10^{6}$ m$)$ = 24×10^{9} kg m = 2.4×10^{10} kg m

(b) 6×10^{6} m3 / 2×10^{-2} m2 = 3×10^{8} m

MULTIPLE CHOICE QUESTIONS (Exercise)

1 The instrument that is most suitable for measuring the thickness of a few sheets of cardboard is: (a) metre rule (b) measuring tape (c) vernier callipers (d) micrometer screw gauge

Ans: (d)

2 One femtometre is equal to: (a) 10^{-3} m (b) 10^{-15} m (c) 10^{9} m (d) 10^{15} m

Ans: (b)

3 A light year is a unit of: (a) light (b) time (c) distance (d) speed

Ans: (c)

4 Which one is a non-physical quantity? (a) distance (b) density (c) colour (d) temperature

Ans: (c)

5 When using a measuring cylinder, one precaution to take is to: (a) check for the zero error (b) look at the meniscus from below the level of the water surface (c) take several readings by looking from more than one direction (d) position the eye in line with the bottom of the meniscus

Ans: (d)

6 Volume of water consumed by you per day is estimated in: (a) millilitre (b) litre (c) kilogram (d) cubic metre

Ans: (b)

7 A displacement can is used to measure: (a) mass of liquid (b) mass of solid (c) volume of a liquid (d) volume of a solid

Ans: (d)

8 Two rods with lengths 12.321 cm and 10.3 cm are placed side by side, the difference in their lengths is: (a) 2.02 cm (b) 2.0 cm (c) 2 cm (d) 2.021 cm

Ans: (b)

9 Four students measure the diameter of a cylinder with Vernier Callipers. Which of the following readings is correct? (a) 3.4 cm (b) 3.475 cm (c) 3.47 cm (d) 3.5 cm

Ans: (c)

10 Which of the following measures are likely to represent the thickness of a sheet of this book? (a) 6×10^{-25} m (b) 1×10^{-4} m (c) 1.2×10^{-15} m (d) 4×10^{-2} m
Ans: (b)

11 In a Vernier Callipers, ten smallest divisions of the Vernier scale are equal to nine smallest divisions of the main scale. If the smallest division of the main scale is half millimetre, the Vernier constant is equal to: (a) 0.5 mm (b) 0.1 mm (c) 0.05 mm (d) 0.001 mm
Ans: (c)

ADDITIONAL MCQs

1 Which one of the following units is not a derived unit? (a) Pascal (b) kilogram (c) newton (d) watt
Ans: (b)

2 Amount of a substance in terms of numbers is measured in: (a) gram (b) kilogram (c) newton (d) mole
Ans: (d)

3 Which of the following is a base unit? (a) Pascal (b) coulomb (c) metre per second (d) mole
Ans: (d)

4 0.2 mm in units of metres is: (a) 0.0002 m (b) 2×10^{-4} m (c) both (a) and (b) (d) none
Ans: (a)

5 The number of significant figures in 0.00650 s are: (a) 2 (b) 3 (c) 5 (d) 6
Ans: (b)

6 Which of the following numbers show 4 significant digits? (a) 9000.8 (b) 4 (c) 5174.00 (d) 0.001248
Ans: (d)

7 The numbers having one significant digit is: (a) 1.1 (b) 6.0 (c) 7.1 (d) 6×10^{2}
Ans: (d)

8 Which of the following prefixes represents largest value? (a) mega (b) pico (c) peta (d) kilo
Ans: (c)

9 Ratio of millimetre to micrometre is: (a) 1000 (b) 0.001 (c) 1000 (d) 100
Ans: (c)

10 Micrometre can be used to measure: (a) current (b) force (c) length (d) mass
Ans: (c)

11 Least count of screw gauge is 0.01 mm. If main scale reading of screw gauge is zero and third line of circular scale coincides with datum line, then the measurement on the screw gauge: (a) 0 mm (b) 3 mm (c) 0.03 mm (d) 0.3 mm
Ans: (c)

12 The instrument best measures the internal diameter of a pipe is: (a) screw gauge (b) vernier calliper (c) metre rule (d) measuring tape
Ans: (b)

13 9.483×10^{3} m is the standard form of: (a) 94.83 m (b) 9.483 m (c) 948.3 m (d) 9483 m
Ans: (d)

SHORT QUESTIONS

22 **1.1 Is it possible to measure a non-physical quantity? If so, how?**

Answer: Non-physical quantities such as emotions, intelligence, or satisfaction cannot be measured directly using traditional instruments. However, they can be assessed indirectly through indicators, scales, or standardized tests, e.g. Intelligence via IQ tests, customer satisfaction via surveys.

23 **1.2 What is measurement? Name the two parts of it.**

Answer: Measurement is the process of comparing an unknown quantity with a generally accepted standard quantity. It consists of two parts: numbers and units of measurement.

24 **1.3 Why do we need a standard unit of measurement?**

Answer: The standard instrument provides consistent and accurate measurements, allowing everyone to understand and compare results - important for science, trade, and construction.

25 **1.4 Write the name of the 3 basic quantities and 3 derived quantities.**

Answer: Base Quantities: Length (m), Mass (kg), Time (s). Derived Quantities: Speed (m/s), Area (m2), Density (kg/m3).

26 **1.5 Which SI unit will you use to express the height of your desk?**

Answer: Centimetres (cm) or metres (m).

27 **1.6 Write the name and symbols of all SI base units.**

Answer: Length: Metre (m), Mass: Kilogram (kg), Time: Second (s), Electric current: Ampere (A), Temperature: Kelvin (K), Amount of substance: Mole (mol), Intensity of light: Candela (cd)

28 **1.7 Why is a prefix used? Name three sub-multiples and three multiples prefixes with their symbols.**

Answer: Prefixes simplify expression of very large or very small numbers. Sub-multiples: Milli (m) 10^-3, Micro (u) 10^-6, Nano (n) 10^-9. Multiples: Kilo (k) 10^3, Mega (M) 10^6, Giga (G) 10^9.

29 **1.8 What is meant by: (a) 5 pm (b) 15 ns (c) 6 um (d) 5 fs**

Answer: (a) 5 x 10^-12 m (b) 15 x 10^-9 s (c) 6 x 10^-6 m (d) 5 x 10^-15 s

30 **1.9 (a) For what purpose a Vernier Callipers is used? (b) Name its two main parts. (c) How is least count found? (d) What is meant by zero error?**

Answer: (a) Used to measure small lengths with high precision, down to 1/10th of a millimetre. (b) Main Scale and Vernier (sliding) Scale. (c) Least count = 1 mm/10 = 0.1 mm. (d) Zero error exists if zero of vernier scale does not coincide with zero of main scale - positive if vernier zero is right of main scale zero, negative if left.

31 1.10 State least count and Vernier scale reading as shown in figure and hence, find the length.

Answer: Least count = 1 mm/10 = 0.1 mm or 0.01 cm. Length = Main scale reading + Vernier scale reading x L.C = 2.6 cm + 5 x 0.01 cm = 2.65 cm.

32 1.11 Which reading out of A, B, and C shows the correct length and why?

Answer: Reading B is correct because the eye is exactly above the reading point (avoids parallax error).

ADDITIONAL SHORT QUESTIONS

Q1. Is a non-physical quantity has dimensions?

Answer: No, because it is not related to fundamental physical units and is not measurable in physical terms.

Q2. Write the unit of charge in terms of base unit ampere and second.

Answer: Ampere-second (A.s), from Q = I.t.

Q3. Express the unit of pressure "pascal" in some other units.

Answer: 1 Pa = 1 N/m2.

Q4. Which SI base unit is the only one that uses a prefix in its standard form?

Answer: The kilogram.

Q5. Express the following into scientific notation.

(a) 0.00534 m = 5.34 x 10^-3 m

(b) 2574.32 kg = 2.57432 x 10^3 kg

(c) 0.45 m = 4.5 x 10^-1 m

(d) 0.004 kg = 4.0 x 10^-3 kg

(e) 186000 s = 1.86 x 10^5 s

Q6. What are the key rules for writing SI unit symbols and prefixes correctly?

Answer: (i) Use symbols, not abbreviations (s, not sec). (ii) No plural form (10 mN, not 10 mNs). (iii) Full unit names in lowercase except Celsius. (iv) Symbols lowercase except L for litre and symbols named after scientists (N for newton). (v) Prefixes written directly before unit. (vi) Units written one space apart (N m). (vii) No compound prefixes.

Q7. Why must numbers have the same exponent for addition or subtraction, and how can you make the exponents equal?

Answer: Because the operation can only be performed on like terms; adjust the decimal point to make exponents equal.

Q8. What are the essential laboratory safety rules to follow during experiments?

Answer: (i) Handle apparatus/chemicals carefully. (ii) Check labels before use. (iii) Do not taste chemicals unless instructed. (iv) No eating/drinking/playing in lab. (v) Do not tamper with electrical fittings. (vi) Never work with electricity near water. (vii) Keep flammables away from flames. (viii) Wash hands after lab work.

Q9. Define unit. Write down two types of units.

Answer: The standard measurement of any quantity is called its unit. Two types: Base units and Derived units.

Q10. Define least count of measuring instrument. Give examples.

Answer: Least count is the smallest measurement accurately taken with an instrument. Measuring tape: 1 mm. Metre rule: 1 mm. Vernier Callipers: 0.1 mm. Micrometer Screw Gauge: 0.01 mm.

Q11. Define zero error of an instrument.

Answer: A systematic error occurring when the instrument reads a value other than zero when the true value is zero.

Q12. Write down formula for calculating least count of (a) Screw gauge (b) Vernier Callipers.

Answer: (a) Least count = Pitch/No. of divisions on circular scale. (b) Least count = 1 mm/10 = 0.1 mm.

Q13. Define pitch of screw gauge.

Answer: The distance the spindle moves in one complete turn of the thimble - 0.5 mm.

Q14. Why area is derived quantity? Explain.

Answer: Because it is calculated by multiplying two base quantities, length and width, expressed in m2.

Q15. Differentiate between base and derived units.

Answer: Base Units: fundamental, cannot be expressed in terms of other units (metre, kilogram, second, Kelvin). Derived Units: expressed in terms of base units (speed m/s, force N, energy J).

Q16. Name some repetitive processes occurring in nature that could serve as a reasonable time standard.

Answer: (i) Rotation of Earth on its axis. (ii) Revolution of Earth around the Sun. (iii) Vibration of a caesium-133 atom. (iv) Oscillation of a pendulum.

Q17. Identify Personal, Systematic, and Random Errors:

(i) Eye level may move a bit while reading meniscus -- Personal Error

(ii) Air current may cause the balance to fluctuate -- Random Error

(iii) Balance may not be properly calibrated -- Systematic Error

(iv) Some liquid may have evaporated while being measured -- Random Error

Q18. How many significant figures are there in each of the following?

(i) 1.25 x 10^2 -- 3 s.f. (ii) 12.5 cm -- 3 s.f. (iii) 0.125 m -- 3 s.f. (iv) 0.000125 km -- 3 s.f.

Q19. Differentiate between systematic and random errors.

Answer: Systematic Errors influence all measurements consistently (zero error, poor calibration) - minimized by comparison/correction factor. Random Errors vary unpredictably between repeated measurements (temperature, pressure, voltage fluctuations) - minimized by taking multiple readings and averaging.

CONSTRUCTED RESPONSE QUESTIONS

33 1.1 In what unit will you express each of the following?

(a) Thickness of a five-rupee coin -- Millimetre (mm)

(b) Length of a book -- Centimetre (cm)

(c) Length of football field -- Metres (m)

(d) The distance between two cities -- Kilometre (km)

(e) Mass of five-rupee coin -- Gram (g)

(f) Mass of your school bag -- Kilogram (kg)

(g) Duration of your class period -- Minutes

(h) Volume of petrol filled in the tank of a car -- Litre

(i) Time to boil one litre milk -- Minutes

34 1.2 Why might a standard system of measurement be helpful to a tailor?

Answer: It ensures uniformity and consistency in garments, allowing accurate measurement of fabric, seams, and sizes, preventing errors between customers, suppliers, and manufacturers.

35 1.3 A micrometer screw gauge with 1 mm main scale and 100 circular divisions - find least count and thickness of a steel rod.

Answer: Least count = 1 mm/100 = 0.01 mm. Main scale reading = 9.5 mm, Circular scale = 70. Thickness = 9.5 + 70 x 0.01 = 10.2 mm.

36 **1.4 How can the diameter of a pencil be measured using a metre scale with the same precision as Vernier Callipers?**

Answer: (i) Arrange 10 or more pencils tightly in a row. (ii) Measure total width L using the metre scale. (iii) Count number of pencils n. (iv) Diameter of one pencil = L/n.

37 **1.5 The end of a metre scale is worn out. Where will you place a pencil to find the length?**

Answer: Place it at a clear, undamaged mark (not the worn zero) and subtract that reading from the far-end reading, ensuring accurate measurement.

38 **1.6 Why is it better to place the object close to the metre scale?**

Answer: To minimize parallax error and misalignment, reducing chances of human reading error.

39 **1.7 Why is a standard unit needed to measure a quantity correctly?**

Answer: It ensures consistency, accuracy, and comparability across people and countries, avoiding confusion.

40 **1.8 Suggest some natural phenomena that could serve as a reasonably accurate time standard.**

Answer: (i) Earth's rotation. (ii) Pendulum oscillations. (iii) Atomic vibrations (caesium clocks).

41 **1.9 It is difficult to locate the meniscus in a wider vessel. Why?**

Answer: The curvature of the meniscus becomes less prominent as the vessel diameter increases, making the liquid surface flatter and harder to read precisely.

42 **1.10 Which instrument can be used to measure: (i) Internal diameter of a test tube (ii) Depth of a beaker.**

Answer: (i) Vernier Callipers (internal jaws). (ii) Vernier Callipers (depth gauge) or measuring tape for larger beakers.

COMPREHENSIVE QUESTIONS

43 **1.1 What is meant by base and derived quantities? Give the names and symbol of SI base units. -- See Q.3.**

44 **1.2 Give three examples of derived unit in SI. How are they derived from base units?**

Answer: (i) Newton (N) = kg.m/s2, from F = ma. (ii) Joule (J) = kg.m2/s2, from W = F x d. (iii) Pascal (Pa) = N/m2 = kg.m-1.s-2, from P = F/A.

45 **1.3 State the similarities and differences between Vernier Callipers and micrometer screw gauge.**

Answer: Similarities: both precision instruments with main and secondary scales, used in workshops/labs. Differences: Vernier measures internal/external/depth with least count 0.1 mm/ 0.01 cm over a larger range; Screw gauge measures external dimensions of small objects with least count 0.01 mm/0.001 cm, more precise for smaller measurements, typical range up to 25 mm.

46 **1.4 Identify and explain the reason for human errors, random errors and systematic errors in experiments. -- See Q.15.**

NUMERICAL PROBLEMS

47 **1.1 Calculate the number of seconds in a (a) day (b) week (c) month, using SI prefixes.**

Solution: (a) Day = 24x60x60 = 86,400 s = 86.4 ks

(b) Week = 7 x 86,400 = 604,800 s = 604.8 ks

(c) Month (30 days) = 30 x 86,400 = 2,592,000 s = 2.592 Ms

48 **1.2 State the answer of problem 1.1 in scientific notation.**

Solution: (a) 8.64 x 10^4 s (b) 6.048 x 10^5 s (c) 2.592 x 10^6 s

49 **1.3 Solve the following addition or subtraction in scientific notation.**

(a) 4 x 10^-4 + 3 x 10^-5 kg = 4.3 x 10^-4 kg

(b) 5.4 x 10^-6 - 3.2 x 10^-5 = -2.66 x 10^-5

50 **1.4 Solve the following multiplication or division in scientific notation.**

(a) (5 x 10^3 m) x (3 x 10^-2 m) = 1.5 x 10^2 m2

(b) 6 x 10^3 kg / 3 x 10^2 m = 2 x 10^1 kg/m

51 **1.5 Calculate: (3 x 10^2 kg) x (4.0 km) / (5 x 10^-2 s2)**

Solution: = (3x10^2 kg)x(4.0x10^3 m)/(5x10^-2 s2) = 2.4 x 10^7 kg.m/s2

52 **1.6 State the number of significant digits in each measurement.**

(a) 0.0045 m -- 2 s.f. (b) 2.047 m -- 4 s.f. (c) 3.40 m -- 3 s.f. (d) 3.420 x 10^4 m -- 4 s.f.

53 **1.7 Write in scientific notation: (a) 0.0035 m = 3.5 x 10^-3 m (b) 206.4 x 10^2 m = 2.064 x 10^4 m**

54 **1.8 Write using correct prefixes:**

(a) 5.0 x 10^4 cm = 0.5 km

(b) 580 x 10^2 g = 58 kg

(c) 45 x 10^-4 s = 4.5 ms

55 **1.9 Light year: distance covered by light in one year, speed of light = 3.0 x 10^8 m/s.**

Solution: t = 1 year = 3.15 x 10^7 s. Distance = 3x10^8 x 3.15x10^7 = 9.45 x 10^15 m.

Result: 9.45 x 10^15 m.

56 **1.10 Express the density of mercury given as 13.6 g/cm3 in kg/m3.**

Solution: 1 g = 10^-3 kg, 1 cm3 = 10^-6 m3. Density = 13.6 x 10^3 kg/m3 = 1.36 x 10^4 kg/m3.

Result: 1.36 x 10^4 kg/m3.