

Chapter	1 Measurements	Class	1 st Year	Subject	Physics
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Give Short Answers of the Following Questions

1. What are the characteristics of an ideal standard?

Ans. The ideal standard must have two principal characteristics:

- (i) It must be accessible
- (ii) It must be invariable

2. Differentiate between base quantities and derived quantities.

Ans. Base Quantities:

The minimum number of those physical quantities in terms of which other physical quantities can be defined are called base quantities.

Examples: length, mass, time etc.

Derived Quantities:

Physical quantities whose definitions are based on other physical quantities are called derived quantities.

Examples: velocity, acceleration, momentum, force etc.

3. What are supplementary units? Define them.

Ans. The units which are neither base units nor derived units are supplementary units.

Radian (rad): The radian is the plane angle between two radii of a circle which cut off on the circumference an arc, equal in length to the radius.

Steradian (sr): The steradian is the solid angle subtended at the center of a sphere by an area of its surface equal to the square of radius of the sphere.

4. Write down the two uses of dimensional analysis.

Ans. The Two Uses of Dimensional Analysis Are:

- (i) Checking the homogeneity of the equation.
- (ii) Deriving the possible formula.

5. State the principle of homogeneity of physical quantities equation.

Ans. In order to check the correctness of an equation, we are to show that dimension of the quantities on both sides if the equation is the same, irrespective of the form of the formulas. This is called the principle of homogeneity of dimensions.

For example, consider the equation $S = vt$

$$[L.H.S.] = [S] = [L]$$

$$[R.H.S.] = [vt] = [v][t] = [LT^{-1}][T] = [LT^{-1+1}] = [LT^0] \\ = [L(1)] = [L]$$

As $[L.H.S.] = [R.H.S.]$, so equation is dimensional correct

6. How many nanoseconds are in one year?

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Ans. As $1 \text{ year} = 3.1536 \times 10^7 \text{ sec}$
 And $1 \text{ second} = 10^9 \text{ nano second}$
 So $1 \text{ year} = 3.1536 \times 10^7 \times 10^9 \text{ ns}$
 $1 \text{ year} = 3.1536 \times 10^{16} \text{ ns}$

7. How many meters are there in one light year? (Speed of light = $3 \times 10^8 \text{ ms}^{-1}$)

Ans. Given Data:

$t = 1 \text{ year} = 365 \text{ days} = 365 \times 24 \text{ hours} = 365 \times 24 \times 60 \text{ min} = 365 \times 24 \times 60 \times 60 \text{ s} = 3.1536 \times 10^7 \text{ s}$
 Speed of light = $v = c = 3.0 \times 10^8 \text{ ms}^{-1}$

To Find:

Distance = $S = ?$

Calculations:

As $S = vt$ ($v = c$)

Or $S = ct$

Putting values, we get $S = 3.0 \times 10^8 \times 3.1536 \times 10^7$
 $S = 9.5 \times 10^{15} \text{ m}$

8. Using rules of significant figures, compute $\frac{5.348 \times 10^{-2} \times 3.64 \times 10^4}{1.336}$ up to appropriate significant figures.

Ans. $\frac{5.348 \times 10^{-2} \times 3.64 \times 10^4}{1.336} = 1.45768982 \times 10^3$

In multiplication, the numbers of significant figures are not more than that contained in the least accurate factor. So in appropriate significant figure, the above number is 1.46×10^3 .

9. If a precise measurement is also an accurate measurement. Explain your answer.

Ans. Precise means how close the measured values are to each other where as accurate means that how closed a measured value from true value.

So if the measurements are close to each other as well as close to the true value, then it will be precise as well as accurate.

10. How will you access the total uncertainty in case of power factor? Five an example.

Ans. Multiply the percentage uncertainty by that power.

For Example:

In the calculation of the volume of a sphere using $V = \frac{4}{3}(\pi r^3)$

% age uncertainty in $V = 3 \times$ % age uncertainty in radius r .

When the uncertainty is multiplied by power factor, then it increases the precision demand of measurement. If the radius of a small sphere is measured as 2.25 cm by a Vernier calipers with least count 0.01 cm. then the radius r is recorded as $r = 2.25 \pm 0.01 \text{ cm}$.

Absolute uncertainty in $r = \text{Least count} = \pm 0.01 \text{ cm}$

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% age uncertainty in $r = \frac{0.01\text{cm}}{2.25\text{cm}} \times 100 = 0.4\%$

Total percentage uncertainty in $V = 3 \times 0.4 = 1.2\%$

Thus volume $V = \frac{4}{3} (\pi r^3)$

$$= \frac{4}{3} \times (3.14) \times (2.25)^3$$

$$= 47.689 \text{ cm}^3 \text{ with } 1.2\% \text{ uncertainty}$$

Hence the result should be recorded as

$$V = 47.7 \pm 0.6 \text{ cm}^3$$

11. What are the dimensions and unit of $v = \sqrt{\frac{F x l}{m}}$ or $\left[\frac{F x l}{m}\right]^{1/2}$?

Ans. Dimensions of the L.H.S of the equation = $v = [LT^{-1}]$

Dimensions of the R.H.S. of the equation = $\sqrt{\frac{F x l}{m}}$

$$= \sqrt{\frac{[MLT^{-2}] [L]}{[M]}} \Rightarrow \left(\frac{[MLT^{-2}] [L]}{[M]}\right)^{1/2}$$

$$= [L^2T^{-2}]^{1/2} \Rightarrow [LT^{-1}]$$

As dimension of L.H.S. = dimensions of R.H.S.

So that equation is dimensionally correct.

12. What are base units and derived units? Give some examples of both these units.

Ans. Base Units: The minimum number of those physical quantities in terms of which other physical quantities can be defined are called base quantities. The units of these base quantities are called base units.

Examples: meter, kilogram, second, ampere, kelvin, candela, mole.

Derived Units: The SI units for measuring all other physical quantities are derived from the base and supplementary units, such units are called derived units.

Examples: Newton, joule, watt, coulomb, ampere, radian, steradian etc.

13. How many significant figures should be retained in the following?

(i) Multiplying or dividing several numbers

(ii) Adding or subtracting numbers

Ans. (i) Multiplying or dividing several numbers:

The result should retain the same number of significant figures as the number with the least significant figures.

(ii) Adding or subtracting numbers:

The result should retain as many decimal places as the least precise number in the given data.

14. How is the Vernier scale related to the main scale of a Vernier Callipers?

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What is meant by L.C. of the Vernier Callipers?

Ans. The Vernier scale is a secondary scale that slides along the main scale to allow more precise measurements. It is designed such that a certain number of its divisions match a different number of divisions on the main scale. The difference gives rise to the least count (L.C.) of the instrument.

Least Count (L.C.): The smallest measurement which can be measured with the help of Vernier calliper is called its least count or Vernier constant.

15. Write the following numbers in scientific notation. (a) 143.7 (b) 206.4×10^2

Ans. (a) 143.7: In scientific notation it can be written as 1.437×10^2

(b) 206.4×10^2 : In scientific notation it can be written as 2.064×10^4

16. Write the following numbers using correct prefixes: (a) 580×10^2 g (b) 0.45×10^{-5} s

Ans. (a) 580×10^2 g: Using correct prefixes, it can be written as

$$580 \times 10^2 \text{ g} = 580 \times 10^3 \text{ g} = 58 \text{ kg}$$

(b) 0.45×10^{-5} s: Using correct prefixes, it can be written as

$$0.45 \times 10^{-5} = 0.45 \times 10^{-5} \text{ s} = 4.5 \mu\text{s}$$

17. Kinetic energy of a body of mass m moving with speed v is given by $\frac{1}{2} mv^2$. What are the dimensions of kinetic energy?

Ans. $\text{K.E.} = \frac{1}{2} mv^2$

Mass (m) has dimensions $[M]$

Velocity (v) has dimension $[LT^{-1}]$

Then $\text{K.E.} = [M] [LT^{-1}]^2$

$$= [M] [L^2 T^{-2}]$$

This is the dimensional formula of energy or work.

18. How many significant figures are there in the following measurements?

Ans. (i) 37 km: km has 2 significant figures

(ii) 0.002953 m: 0.002953 m has 4 significant figures

(iii) 7.50034 cm: 7.50034 cm has 6 significant figures

(iv) 200.0 m: 200.0 m has 4 significant figures

19. Write the dimension of : (i) Planck's constant (ii) Angular velocity

Ans. (i) Planck's constant (h)

(ii) Angular velocity (ω)

As, $E = hf \rightarrow h = \frac{E}{f}$

As $\omega = \frac{\Delta\theta}{\Delta t}$

So,

So,

$$\text{Dimension of } h = \frac{\text{Dimension of Energy}}{\text{Dimension of frequency}}$$

$$\text{Dimension of } \omega = \frac{\text{Dimension of angular displacement}}{\text{Dimension of time}}$$

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$$[h] = \frac{[E]}{[f]}$$

$$[h] = \frac{[ML^2T^{-2}]}{[T^{-1}]}$$

$$[h] = [ML^2T^{-1}]$$

$$[\omega] = \frac{[\theta]}{[t]}$$

$$[\omega] = \frac{\text{no dimension}}{[T]} \because \text{Plane angle is dimension}$$

$$[\omega] = [T^{-1}]$$