Units and Measurements

CHAPTER 2

TRY YOURSELF ANSWERS

1. The seven fundamental quantities are length, mass, time, electric current, thermodynamic temperature, amount of substance and luminous intensity. The fundamental units of these quantities are metre (m), kilogram (kg), second (s), ampere (A), kelvin (K), mole (mol and candela (cd) respectively.

2. $1 \text{ g cm}^{-3} = 10^3 \text{ kg m}^{-3}$

$\therefore \quad 0.6 \text{ g cm}^{-3} = 0.6 \times 10^3 \text{ kg m}^{-3} = 600 \text{ kg m}^{-3}$

3. $1 \text{ ly} = 9.46 \times 10^{15} \text{ m}$

$\therefore \quad 1 \text{ m} = \dfrac{1}{9.46 \times 10^{15}} \text{ ly} = 1.057 \times 10^{-16} \text{ ly}$

4. One mole is that amount of a substance which contains as many elementary entities as there are atoms in 0.012 kg of carbon-12 isotope. The entities may be atoms, molecules, ions etc.

5. Distances of stars are extra-ordinarily large so it is convenient to express them in light years rather than in metre or kilometre.

$1 \text{ light year} = 9.5 \times 10^{12} \text{ km} = 9.5 \times 10^{15} \text{ m}$

6. $\theta = 1.0 \text{ min} = \dfrac{1^\circ}{60} = \dfrac{1}{60} \times \dfrac{\pi}{180} \text{ rad}$

$S = \dfrac{b}{\theta} = \dfrac{2 \times 6400 \times 180 \times 60}{\pi} = 4.4 \times 10^7 \text{ km}$

$= 4.4 \times 10^{10} \text{ m} = \dfrac{4.4 \times 10^{10}}{1.5 \times 10^{11}} \text{ AU} = 0.293 \text{ AU}$

7. Optical microscopes uses visible light of wavelength ranging from 4000 Å to 7000 Å and it can not resolve particles with sizes smaller than this. So, it is inconvenient to estimate the size of a molecule using a optical microscope.

8. Atomic clock is based on the periodic vibrations produced in a cesium atom.

9. The technique of radioactive dating is used to measure long time intervals by finding the ratio of the number of radioactive atoms that have undergone decay to the number of atoms left undecayed.

10. $\text{Volume} = (\text{side})^3 = (1.2 \times 10^{-2} \text{ m})^3 = 1.728 \times 10^{-6} \text{ m}^3$

$= 1.7 \times 10^{-6} \text{ m}^3$

As the side has two significant figures, so the volume must have two significant figures.

11. The dimensions of a physical quantity are the powers to which the fundamental quantities must be raised to represent that quantity completely.

12. Speed is a scalar quantity and velocity is a vector quantity. Both have same dimensions of $[LT^{-1}]$.

13. Specific gravity, angle, strain and Poisson's ratio are dimensionless physical quantity.

14. Gravitational constant and Planck's constant are two dimensional constant.

15. Linear momentum = mass × velocity

$= [M][LT^{-1}] = [MLT^{-1}]$

Dimension of time in linear momentum is –1.

16. Angular momentum $= I\omega = [ML^2T^{-1}]$

Magnetic moment = Current × area $= [AL^2]$

$\therefore \quad \dfrac{\text{Angular momentum}}{\text{Magnetic moment}} = \dfrac{[ML^2T^{-1}]}{[AL^2]} = [MA^{-1}T^{-1}]$

17. According to this principle, a physical equation will be dimensionally correct if the dimensions of all the terms occurring on both sides of the equation are the same.

18. Let $v = k\, g^a R^b$, where k is a dimensionless constant.

$\therefore \quad LT^{-1} = [LT^{-2}]^a [L]^b = L^{a+b} T^{-2a}$

equating the powers of L and T, we get

$a + b = 1$ and $-2a = -1$

$\therefore \quad a = \dfrac{1}{2}$ and $b = \dfrac{1}{2}$, Hence, $v = kg^{1/2} R^{1/2} = k\sqrt{gR}$