11th Physics - Unit 1 - One Marks Solutions

1. NATURE OF PHYSICAL WORLD AND MEASUREMENT

1. One of the combinations from the fundamental physical constants is $\frac{hc}{G}$. The unit of this expression is.

Solution

$$\frac{hc}{G} \Rightarrow \frac{[N m s] [m s^{-1}]}{N m^2 kg^2} \Rightarrow kg^2$$

2. If the error in the measurement of radius is 2% then the Error in the determination of volume of the sphere will be

Solution Volume of the sphere $V = \frac{4}{3}\pi r^3$

$$V \propto r^3$$

$$\frac{\Delta V}{V} \times 100 = 3 \frac{\Delta r}{r} \times 100$$

$$\frac{\Delta V}{V} \times 100 = 3 \times 2\%$$

$$= 6\%$$

3. If the length and time period of an oscillating pendulum have errors of 1% and 3% respectively then the error in measurement of acceleration due to gravity is

Soln $T = k\sqrt{\frac{l}{g}} \Rightarrow T^2 \propto \frac{l}{g} \Rightarrow g = \frac{l}{T^2}$

$$\frac{\Delta g}{g} \times 100 = \frac{\Delta l}{l} \times 100 + 2\frac{\Delta T}{T} \times 100$$

$$= 1\% + [2 \times 3\%]$$

$$= 7\%$$

4) The length of a body is measured as 3.51 m, if the accuracy is 0.01 m, then the percentage error in the measurement is

Soln Percentage error $= \frac{\Delta a_m}{a_m} \times 100\%$

$= \frac{0.01}{3.51} \times 100\%$

$= 0.28\%$

5) Which of the following has highest no. of significant figures?

a) $0.007\ m^2$ ⇒ significant 1

b) $2.64 \times 10^{24}\ kg$ ⇒ significant 3

c) $0.00060.32\ m^2$ ⇒ significant 4

d) $6.3200\ J$ ⇒ significant 5

Soln: Correct Answer : d. 6.3200 J

6) If $\pi = 3.14$, then the value of π^2 is

Soln: $\pi^2 = 3.14 \times 3.14$

$\pi^2 = 9.8596$

Here the least no. of significant digits in the measured values is three. Hence the resultant when rounded off to three significant digits.

$\pi^2 = 9.86$

7. Which of the following pairs of physical quantities have same dimension?

[a] force and power [MLT^{-2} and ML^2T^{-3}]

[b] torque and energy [ML^2T^{-2} and ML^2T^{-2}]

[c] torque and power [ML^2T^{-2} and ML^2T^{-3}]

[d] force and torque [MLT^{-2} and ML^2T^{-2}]

ANSWER : [b] Torque and energy

8. The dimensional formula of planck's constant h is

Soln: $E = h\nu \Rightarrow h = \frac{E}{\nu}$

Dimensions of energy $[ML^2T^{-2}]$

Dimensions of frequency $[T^{-1}]$

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

9. The velocity of a particle v at an instant t is given by $v = at + bt^2$. The dimensions of b is

Soln: $v = u + at$

Comparing both eq

$$at + bt^2 = u + at$$

$$bt^2 = u + at - at$$

$$bt^2 = u \Rightarrow b = ut^{-2}$$

Applying Dimension

$$b = [LT^{-1}][T^{-2}] = [LT^{-3}]$$

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10. The dimensional formula for gravitational constant G is

Soln: $F = G\frac{m_1 m_2}{d^2} \Rightarrow G = \frac{F \cdot d^2}{m_1 m_2}$

Applying Dimension,

$$G = \frac{[MLT^{-2}][L^2]}{[M^2]} \Rightarrow G = [M^{-1}L^3T^{-2}]$$

11. The density of a material in CGS system of units is 4g cm^{-3}. In a system of units in which unit of length is 10 cm and unit of mass is 100g, then the value of density of material will be

Soln: $\rho_1[M_1^a L_1^b T_1^c] = \rho_2[M_2^a L_2^b T_2^c]$

$$\rho_2 = \rho_1\left[\frac{M_1}{M_2}\right]^a\left[\frac{L_1}{L_2}\right]^b\left[\frac{T_1}{T_2}\right]^c$$

Dimensions of Density is $[ML^{-3}T^0]$

$M_1 = 1g$; $M_2 = 100g$; $a = 1$; $b = -3$

$L_1 = 1\ cm$; $L_2 = 10\ cm$; $\rho_1 = 4\ g\ cm^{-3}$

$$\rho_2 = 4\left[\frac{1g}{100g}\right]^1\left[\frac{1\ cm}{10\ cm}\right]^{-3}$$

$$\rho_2 = 4[10^{-2}][10^{-1}]^{-3}$$

$$\rho_2 = 4 \times 10^{-2} \times 10^3$$

$$\rho_2 = 4 \times 10$$

$$\rho_2 = 40$$

12. If the force is proportional to square of velocity, then the dimension of proportionality constant is.

Soln:: $F \propto v^2$

$$F = k v^2 \Rightarrow k = \frac{F}{v^2}$$

Applying Dimensions,

$$k = \frac{[MLT^{-2}]}{[LT^{-1}]^2} \Rightarrow k = \frac{[MLT^{-2}]}{[L^2T^{-2}]}$$

$$k = [MLT^{-2}][L^{-2}T^2] \Rightarrow k = [ML^{-1}T^0]$$

13) The dimension of $[\mu_0 \varepsilon_0]^{-1/2}$ is

Soln:: unit of μ_0 is NA^{-2}

unit of ε_0 is $C^2 m^{-2} N^{-1}$

$$[\mu_0 \varepsilon_0]^{-1/2} = [NA^{-2} \cdot C^2 m^{-2} N^{-1}]^{-1/2}$$

$$= [C^2 m^{-2} A^{-2}]^{-1/2}$$

$I = \frac{q}{t}$, $A = \frac{C}{s}$

$$= [C^2 m^{-2} C^{-2} \cdot s^2]^{-1/2}$$

$$= [m^{-2} s^2]^{-1/2}$$

$$= [m s^{-1}]$$

This is unit of velocity.

[OR]

The speed of light is defined as the inverse of the square root of the product of permittivity by permeability: $c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$ $\Rightarrow$ ANSWER : Velocity

14) Planck's constant [h], speed of light in vaccum [c] and Newton's Gravitational constant [G] are taken as three fundamental constants. Which of the following combinations of these has the dimension of length?

$$\frac{\sqrt{hG}}{c^{3/2}} = \frac{[hG]^{1/2}}{[c]^{3/2}}$$

Applying Dimensions,

$$\frac{[hG]^{1/2}}{[c]^{3/2}} = \frac{[[ML^2T^{-1}][M^{-1}L^3T^{-2}]]^{1/2}}{[LT^{-1}]^{3/2}} = \frac{[L^5T^{-3}]^{1/2}}{[LT^{-1}]^{3/2}}$$

$$= [L^{5/2} T^{-3/2} L^{-3/2} T^{3/2}]$$

$$= [L^{\frac{5-3}{2}}] \Rightarrow [L]$$

ANSWER : [a] $\frac{\sqrt{hG}}{c^{3/2}}$

15) A length-scale [l] depends on the permittivity [ε] of a dielectric material, Boltzman constant [k_B], the absolute temperature [T], the no. per unit volume [n] of certain charged particles, and the charge [q] carried by each of the particles. Which of the following expression for l is dimensionally correct?

Answer : [b] $l = \sqrt{\frac{\varepsilon k_B T}{nq^2}}$

Soln:-

$$l = \left[\frac{\varepsilon \ k_B \ T}{n q^2} \right]^{1/2}$$

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We know $C^2 N^{-1} m^{-2}$

unit of $\varepsilon = C^2 N^{-1} m^{-2}$

unit of $k_B = N m K^{-1}$

unit of $T = K$

unit of $n = m^{-3}$

unit of $q^2 = C^2$

$$l = \left[\frac{\varepsilon \ k_B \ T}{n \ q^2} \right]^{1/2} = \left[\frac{C^2 N^{-1} m^{-2} \cdot N m K^{-1} \cdot K}{m^{-3} \cdot C^2} \right]^{1/2}$$

$$l = \left[\frac{m^{-1}}{m^{-3}} \right]^{1/2}$$

$$l = \left[m^{-1} \cdot m^3 \right]^{1/2}$$

$$l = \left[m^2 \right]^{1/2}$$

$$l = [m]$$

The dimension of length, [L]

So Dimensionally correct.

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