

Topic :- UNITS AND MEASUREMENTS

1 (c)

$$100 \text{ W} = 100 \text{ J s}^{-1} = 10^9 \text{ erg s}^{-1}$$

2 (d)

From the given relation, $D = -\frac{n(x_2 - x_1)}{n_2 - n_1}$

$$\text{Here } [n] = \left[\frac{1}{\text{area} \times \text{time}} \right] = \frac{1}{[\text{L}^2 \text{T}]} = [\text{L}^{-2} \text{T}^{-1}]$$

$$x_2 - x_1 = [\text{L}] \text{ and } n_2 - n_1 = \left[\frac{1}{\text{volume}} \right] = \left[\frac{1}{\text{L}^3} \right] = [\text{L}^{-3}]$$

$$\text{So, } [D] = \frac{[\text{L}^{-2} \text{T}^{-1} \text{L}]}{[\text{L}^{-3}]} = [\text{L}^2 \text{T}^{-1}]$$

3 (b)

Use formula for time period in angular SHM.

4 (a)

$$\text{Electric potential } V = \frac{W}{q} = \frac{\text{joule}}{\text{coulomb}} = \frac{\text{newton} \times \text{metre}}{\text{coulomb}}$$

$$= \frac{(\text{kg} - \text{ms}^{-2}) \times \text{m}}{\text{coulomb}}$$

$$= \text{kg} - \text{ms}^{-2} \times \text{m} \times \text{coulomb}^{-1}$$

$$\therefore = [\text{ML}^2 \text{T}^{-2} \text{Q}^{-1}]$$

5 (b)

$$R = \frac{V}{I} = \left[\frac{\text{ML}^2 \text{T}^{-3} \text{A}^{-1}}{\text{A}} \right] = [\text{ML}^2 \text{T}^{-3} \text{A}^{-2}]$$

6 (b)

Heat ΔQ transferred through a rod of length L and area A in time Δt is

$$\Delta Q = KA \left(\frac{T_1 - T_2}{L} \right) \Delta t$$

$$\therefore K = \frac{\Delta Q \times L}{A(T_1 - T_2) \Delta t} \quad \dots(i)$$

Substituting dimensions for corresponding quantities in Eq. (i), we have

$$[K] = \frac{[ML^2T^{-2}][L]}{[L^2][\theta][T]}$$

$$= [MLT^{-3}\theta^{-1}]$$

7 **(b)**

$$\frac{F - 32}{9} = \frac{K - 273}{5} \Rightarrow \frac{x - 32}{9} = \frac{x - 273}{5} \Rightarrow x = 574.25$$

8 **(c)**

1 fermi = 10^{-15} metre

9 **(d)**

[Planck constant] = $[ML^2T^{-1}]$ and

[Energy] = $[ML^2T^{-2}]$

10 **(b)**

MeV-sec is not a unit of energy. While others are units of energy.

11 **(b)**

$$F = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_2}{r^2}$$

$$\Rightarrow \varepsilon_0 = \frac{|q_1||q_2|}{[F][r^2]} = \frac{[A^2T^2]}{[MLT^{-2}][L^2]} = [A^2T^4M^{-1}L^{-3}]$$

12 **(d)**

$$R_1 = (6 \pm 0.3)k\Omega, R_2 = (10 \pm 0.2)k\Omega$$

$$R_{parallel} = \frac{R_1 R_2}{(R_1 + R_2)}$$

Let $(R_1 + R_2) = x$

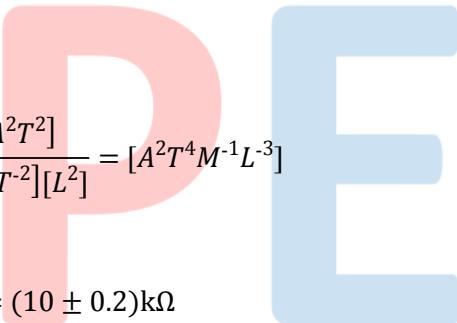
$$\Rightarrow R_p = \frac{R_1 R_2}{x}$$

Taking log of both sides

$$\ln R_p = \ln R_1 + \ln R_2 - \ln x$$

Differentiating,

$$\frac{\Delta R_p}{R_p} = \frac{\Delta R_1}{R_1} + \frac{\Delta R_2}{R_2} + \left(-\frac{\Delta x}{x} \right)$$



$$\Delta x_{\text{mean}} = \frac{0.3 + 0.2}{2} = 0.25 \Omega$$

$$R_{\text{mean}} = \frac{6 + 10}{2} = 8 \Omega$$

$$\therefore x = \frac{6 + 10}{2} = 8 \Omega$$

$$\Rightarrow \frac{\Delta x}{x} = \frac{0.25}{8}$$

$$\therefore \text{Total error} = \frac{0.3}{6} + \frac{0.2}{10} + \frac{0.25}{8}$$

$$= 0.05 + 0.02 + 0.03125 = 0.10125$$

$$\therefore \frac{\Delta R_P}{R_P} = 10.125\%$$

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(d)

$$\begin{aligned} F_m &= Bqv \text{ or } [B] = \left[\frac{F_m}{qv} \right] = \left[\frac{F_m}{Itv} \right] \\ &= \frac{[\text{MLT}^{-2}]}{[\text{A}][\text{T}][\text{LT}^{-1}]} = [\text{ML}^0 \text{T}^{-2} \text{A}^{-1}] \end{aligned}$$

Alternate

$$F = BIl \Rightarrow [B] = \left[\frac{F}{Il} \right] = [\text{ML}^0 \text{T}^{-2} \text{A}^{-1}]$$

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(d)

$$R = 8.3 \text{ J/K-mol}$$

$$n_1 u_1 = n_2 u_2$$

$$\therefore n_2 = \frac{n_1 u_1}{u_2}$$

$$= \frac{8.3 \text{ J/K - mol}}{\text{atm L/K - mol}}$$

$$= \frac{8.3 \text{ J/K - mol}}{(1.013 \times 10^5 \text{ N/m}^2)(10^{-3} \text{ m}^3)/\text{K - mol}}$$

$$= \frac{8.12}{10^2} = 0.0812$$

$$\therefore 8.3 \text{ J/K-mol} = 0.0812 \text{ atm L/K-mol}$$

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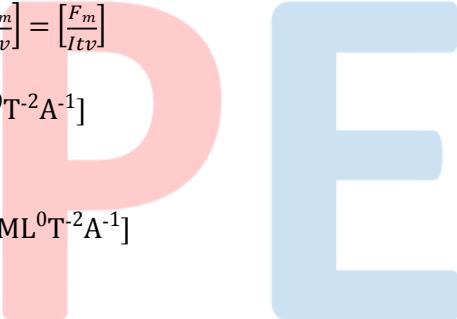
(d)

$$P = nu \therefore n \propto \frac{1}{u}$$

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(b)

From Coulomb's law



$$F = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2}$$

Or $\epsilon_0 = \frac{q_1 q_2}{4\pi F r^2}$

\therefore Units of ϵ_0 (permittivity)

$$= \frac{C^2}{N - m^2} = C^2 N^{-1} m^{-2}$$

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(d)

Work done $W = \epsilon \Delta q$

$$\therefore \epsilon = \frac{W}{\Delta q} = \frac{[ML^2 T^{-2}]}{[AT]}$$

$$\therefore [\epsilon] = [ML^2 T^{-3} A^{-1}]$$

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(a)

Maximum absolute error is $\Delta a + \Delta b$. Now work out the relative error ad finally the percentage error.

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(b)

$$\text{Potential energy} = mgh = g \left(\frac{\text{cm}}{\text{sec}^2} \right) \text{cm} = g \left(\frac{\text{cm}}{\text{sec}} \right)^2$$

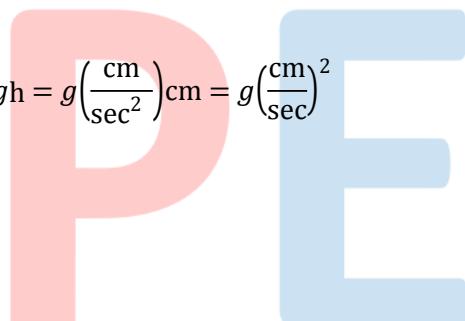
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(c)

$$\text{Resistivity, } \rho = \frac{m}{ne^2 \tau}$$

$$\therefore [\rho] = \frac{[M]}{[L^{-3}][AT][T^2]}$$

$$= [ML^3 A^{-2} T^{-3}]$$



So, electrical conductivity

$$\sigma = \frac{1}{\rho}$$

$$\Rightarrow [\sigma] = \frac{1}{[\rho]} = [M^{-1} L^{-3} A^2 T^3]$$

ANSWER-KEY

Q.	1	2	3	4	5	6	7	8	9	10
A.	C	D	B	A	B	B	B	C	D	B
Q.	11	12	13	14	15	16	17	18	19	20
A.	B	D	D	D	D	B	D	A	B	C

PE