Self Practice Paper (SPP)

1. The equation of state of some gases can be expressed as $\left(p+\frac{a}{V^2}\right)$ (V–b) = RT Here P is the pressure, V is the volume, T is the absolute temperature and a,b,R are constants. The dimensions of 'a' are
(1) ML^5T^{-2} (2) $ML^{-1}T^{-2}$ (3) $M^0L^3T^0$ (4) $M^0L^6T^0$

2. If V denotes the potential difference across the plates of a capacitor of capacitance C, the dimensions of CV^2 are
(1) Not expressible in MLT (2) MLT^{-2}
(3) M^2LT^{-1} (4) ML^2T^{-2}

3. In the relation ;
P = $\frac{\alpha}{\beta}e^{-\frac{\alpha Z}{k\theta}}$
P is pressure, Z is distance, k is Boltzman constant and θ is the temperature. The dimensions of β will be:
(1) $[M_0 L_2 T_0]$ (2) $[ML_2 T]$ (3) $[ML_0 T_{-1}]$ (4) $[M_0 L_2 T_{-1}]$

4. The equation $\left(p+\frac{a}{V^2}\right)$ (V - b) consent. The units of a are :
(1) Dyne ×cm_5 (2) Dyne ×cm_4 (3) Dyne/cm_3 (4) Dyne/cm_2

5. If the acceleration due to gravity is $10ms^{-2}$ and the units of length and time are changed in kilometer and hour respectively, the numerical value of the acceleration is
(1) 360000 (2)72,000 (3)36,000 (4)129600

6. If the dimensions of length are expressed as $G^x C^y h^z$; where G,c and h are the universal gravitational constant, speed of light and Planck's constant respectively, then
(1) $x = \frac{1}{2}, y = \frac{1}{2}$ (2) $x = \frac{3}{2}, z = \frac{1}{2}$ (3) $y = \frac{1}{2}, z = \frac{3}{2}$, (4) $y, = -\frac{3}{2}, z = \frac{1}{2}$,

7. A highly rigid cubical block A of small mass M and side L is fixed rigidly onto another cubical block B of the same dimensions and of low modulus of rigidity η such that the lower face of A completely covers the upper face of B. The lower face of B is rigidly held on a horizontal surface. A small force F is applied perpendicular to one of the side faces of A. After the force is withdrawn block A executes small oscillations. The time period of which is given by
(1) $2\pi\sqrt{\frac{M\eta}{L}}$ (2) $2\pi\sqrt{\frac{L}{M\eta}}$ (3) $2\pi\sqrt{\frac{ML}{\eta}}$ (4) $2\pi\sqrt{\frac{M}{\eta L}}$

8. The velocity v of a particel at time t is given by v = at + $\frac{b}{t+c}$, where a, b and c are constants. The dimensions of a, b and c are respectively :-
(1) LT_{-2}, L and T (2) L_2, L and LT_2 (3) LT_2, LT and L (4) L, LT and L_2

9. A wire has a mass 0.3 ± 0.003 g, radius 0.5 ± 0.005 mm and length 6 + 0.06 cm. The maximum percentage error in the measurement of its density is
(1) 1 (2) 2 (3) 3 (4) 4

10. The SI unit of universal gas constant (R) is
(1) Watt K^{-1} mol^{-1} (2) Newton K^{-1} mol^{-1} (3) Joule K^{-1} mol^{-1} (4) Erg K^{-1} mol^{-1}

SPP Answers

1.	(1)	**2.**	(4)	**3.**	(1)	**4.**	(2)	**5.**	(4)	**6.**	(4)	**7.**	(4)
8.	(1)	**9.**	(4)	**10.**	(3)								

SPP Solutions

1. Fact

2. Fact

3. $\left[\frac{\alpha Z}{k\theta}\right]$ = $[M_0 L_0 T_0]$ ⇒ $[\alpha] = \left[\frac{k\theta}{Z}\right]$

Further, $[P] = \left[\frac{\alpha}{\beta}\right]$ ⇒ $[\beta] = \left[\frac{\alpha}{P}\right] = \left[\frac{k\theta}{ZP}\right]$

Dimensions of kθ are that of energy. Hence,

$[\beta] = \left[\frac{ML^2T^{-2}}{LML^{-1}T^{-2}}\right] = [M_0L_2T_0]$

Therefore, the correct option is (A).

5. $n_2 = n_1 \left[\frac{L_1}{L2}\right]^{-1}\left[\frac{L_1}{L2}\right]^{-2} = 10\left[\frac{\text{meter}}{\text{km}}\right]^{-1}\left[\frac{\text{sec}}{\text{hr}}\right]^{-2}$

$n_2 = 10 \left[\frac{m}{10^3 m}\right]^{-1}\left[\frac{\text{sec}}{3600\ \text{sec}}\right]^{-2} = 129600$

6. Length ∝ $G^x c^y h^z$

$L = [M^{-1}L^3T^{-2}]^x\ [LT^{-1}]^y\ [ML^2T^{-1}]^z$

By comparing the power of M.L and T in both sides we get $-x+z = 0$, $3x + y+2z = 1$ and $-2x-y-z = 0$

By solving above three equations we get

$x = \frac{1}{2}, y = -\frac{3}{2}, z = \frac{1}{2}$

7. By substituting the dimensions of mass [M], length [L] and coefficient of rigidity $[ML^{-1}T^{-2}]$ we get $T = 2\pi\sqrt{\frac{M}{\eta L}}$ is the right formula for time period of oscillations

8. $V = at + \frac{b}{t+c}$

dim of t = dim of c

[C] = [T]

dim of at = dim of v

$a = [LT_{-2}]$

dim f V = dim of $\frac{b}{t}$

$b = \perp T_{-1} \times T = [L]$

9. ∵ Density, $\rho = \frac{M}{V} = \frac{M}{\pi r^2 L}$ ⇒ $\frac{\Delta\rho}{\rho} = \frac{\Delta M}{M} + 2\frac{\Delta r}{r} + \frac{\Delta r}{L}$

$= \frac{0.003}{0.3} + 2\times\frac{0.005}{0.5} + \frac{0.06}{6}$

= 0.01 + 0.02 + 0.01 = 0.04

∴ Percentage error = $\frac{\Delta\rho}{\rho}$ ×100 = 0.04 ×100 = 4 %

10. Fact