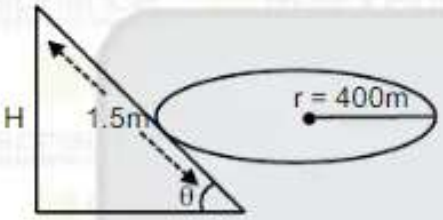
PART : PHYSICS

1. A train running at 12 m/s on track 1.5 m apart is going to cross a curve of r = 400 m. How much should be the one of rail of track lifted so that it can cross the curve.

(1) 0.0094 m (2) 0.027 m (3) 0.076 m (4) 0.053 m

Ans. **(4)**

Sol.



$$\tan\theta = \frac{v^2}{rg}$$

$$\Rightarrow \quad \frac{H}{\sqrt{(1.5)^2 - H^2}} = \frac{(12)^2}{400\times 10}$$

$$\Rightarrow \quad 1.5^2 - H^2 = (27.78)^2H^2$$

$$\Rightarrow \quad H = 0.053 \text{ m}$$

2. Statement -I $\Rightarrow$ Plank constant & Angular momentum have same dimensions

Statement -I $\Rightarrow$ Linear momentum & Moment of force has same dimension

(1) Statement I and II correct

(2) Statement I and II both incorrect

(3) Statement I correct and II incorrect

(4) Statement I incorrect and II is correct

Ans. **(3)**

Sol. (I) $E = h\nu$

$$h = \frac{E}{\nu} = \frac{Kg\ m^2s^{-2}}{s^{-1}} = Kg\ m^2s^{-1} \quad [M^1L^2T^{-1}]$$

$L = mvr = Kg\ m^2s^{-1}$ $[M^1L^2T^{-1}]$

(II) $b = mv = Kg\ ms^{-1} \Rightarrow [M^1L^1T^{-1}]$

$\tau = Fr = Kg\ m^2s^{-2} \Rightarrow [M^1L^2T^{-2}]$

Statement (I) True

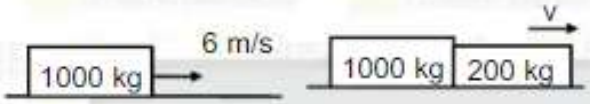
Statement (II) Wrong

3. A block of mass 1000kg has velocity 6 m/s if extra 200 kg mass is embedded in it new velocity of the combined mass ?

(1) 5 m/s (2) 3 m/s (3) 10 m/s (4) 2 m/s

Ans. **(1)**

Sol.



Before After

$P_i = P_f$

$\Rightarrow 1000 \times 6 = (1000 + 200)\, xv$

$\Rightarrow v = 5$ m/s

4. Find $\frac{\Delta v}{v}$ at 4000 m depth in ocean.

Given $B = 2 \times 10^9$ $\rho = 1000$ kg/m^3 $g = 10$ m/s^2

(1) 1×10^{-9} (2) 10×10^{-9} (3) 2×10^{-9} (4) 8×10^{-9}

Ans. **(3)**

Sol. $B = \frac{\Delta P}{\left(\frac{\Delta v}{v}\right)}$

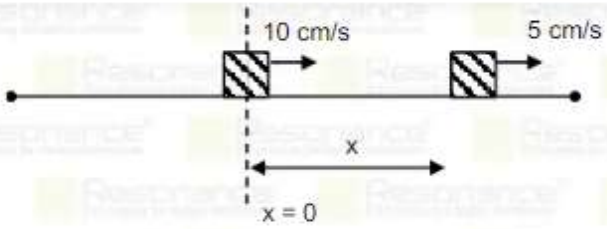
$\frac{\Delta v}{v} = \frac{\Delta P}{B} = \frac{\rho g h}{B}$

$\frac{\Delta v}{v} = \frac{1000 \times 10 \times 4000}{2 \times 10^9} = 2 \times 10^{-9}$

5. A particle doing SHM with amplitude 4 cm and maximum velocity 10 cm/s (at origin). Find position where velocity is 5 cm/s

(1) $\sqrt{12}$ cm (2) 4 cm (3) 9 cm (4) $\sqrt{16}$ cm

Ans. **(1)**



$v = \omega\sqrt{A^2 - x^2}$

at x = 0

$10 = \omega(4)$

$\Rightarrow \quad \omega = \frac{10}{4}$ rad/s

$v_x = \frac{10}{4}\sqrt{(4)^2 - x^2}$

$\Rightarrow \quad \left(\frac{5\times 4}{10}\right)^2 = 16 - x^2$

$\Rightarrow \quad x^2 = 12$

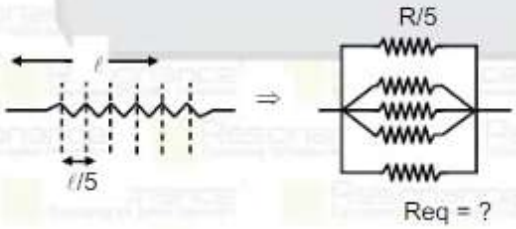
$\Rightarrow \quad x = \pm\sqrt{12}$ cm

6. Resistance of length ℓ is cut into five equal parts and those parts are kept in parallel then find new resistance?

(1) R (2) $\frac{R}{25}$ (3) 25 R (4) 5R

Ans. **(2)**

Sol.



Total resistance = R

$\because R \propto \ell$

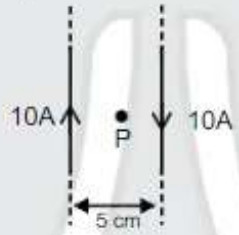
Resistance of each segment = $\frac{R}{5}$

$$\therefore \frac{1}{R_{eq}} = \frac{1}{R/5} + \frac{1}{R/5} + \frac{1}{R/5} + \frac{1}{R/5} + \frac{1}{R/5}$$

$$\frac{1}{R_{eq}} = \frac{25}{R}$$

$$R_{eq} = \frac{R}{25}$$

7. Two infinitely long parallel wires having current 10 A in opposite directions are placed 5 cm apart to each other, Find the magnetic field at mid point between the wires.

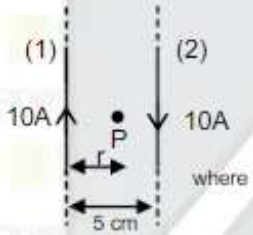


(1) 16×10^{-5} Tesla (2) 32×10^{-5} Tesla

(3) 64×10^{-5} Tesla (4) 8×10^{-5} Tesla

Ans. **(1)**

Sol.



$B = B_1 + B_2$

$$V = \frac{\mu_0 I}{2\pi r} + \frac{\mu_0 I}{2\pi r}$$

$$B = 2\,\frac{\mu_0 I}{2\pi r}$$

After putting values

$B = 16 \times 10^{-5}$ T

8. If the electron revolving in the 3rd bohr's orbit of hydrogen has radius R then what will be its radius in 4th orbit in terms of R

(1) $\frac{25}{9}$R (2) $\frac{16}{9}$R (3) $\frac{36}{9}$R (4) $\frac{9}{16}$R

Ans. **(2)**

Sol. $R = R_0\frac{n^2}{z}$

$R_3 = R = R_0\frac{n^2}{z} = R_0\frac{(3)^2}{1}$

$R_4 = R_0(4)^2$

$\frac{R_4}{R} = \frac{4^2}{3^2}$

$R_4 = \frac{16}{9}R$

9. Kinetic energies of two particles A and B of mass 4 and 25 kg are equal. Find ratio of their linear momentum.

(1) 0.2 (2) 0.4 (3) 0.6 (4) 0.8

Ans. **(2)**

Sol. $\frac{P_A}{P_B} = \sqrt{\frac{m_A}{m_B}} = \sqrt{\frac{4}{25}} = \frac{2}{5} = 0.4$

10. A proton moving with constant velocity enters in field zone having uniform magnetic field and electric field; then we can say

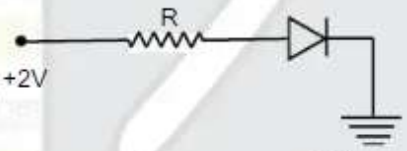
(A) $\vec{E} = 0, \vec{B} = 0$ (B) $\vec{E} = 0, \vec{B} \neq 0$ (C) $\vec{E} \neq 0, \vec{B} = 0$ (D) $\vec{E} \neq 0, \vec{B} \neq 0$

(1) A is correct (2) A and B is correct

(3) A, B and C is correct (4) A, B and D is correct

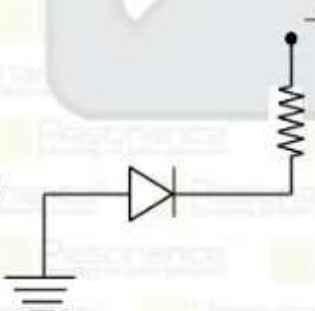
Ans. **(4)**

11. (A)

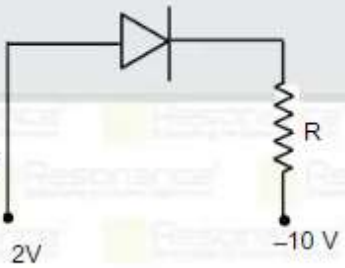


(B)

(C)



(D)



Which combination is in reversed bias

(1) A (2) B (3) C (4) D

Ans. **(2)**

12. Average K.E. of one single molecule of monoatomic gas is 0.414 eV (of ⊥ molecule). What will be is temp = ?

(1) 3000 K (2) 3200 K (3) 4292 K (4) 2500 K

Ans. **(2)**

Sol. $\frac{f}{2}kT = \frac{3}{2}kT = 0.414 \times 1.6 \times 10^{-19}$ J

$T = 3200$ K

13. Find the value of acceleration due to gravity when its diameter because half (Keeping mass of earth same), If the value of acceleration due to gravity on earth surface is 'g'.

(1) g (2) g/2 (3) 3g (4) 4g

Ans. **(4)**

Sol. Value of g at surface, $g_s = \frac{GM}{R^2}$

new value of $g = \frac{GM}{(R/2)^2} = \frac{4GM}{R^2}$

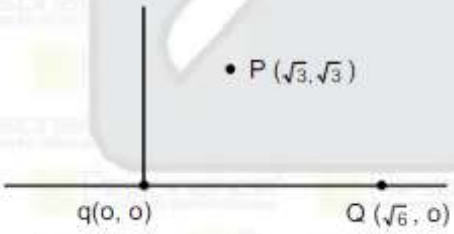
$g = 4g_s$

14. A point charge Q = 1μc is placed at origin . find potential difference between point P $(\sqrt{3}, \sqrt{3})$m and Q $(\sqrt{6}, o)$m Find $V_P - V_Q = ?$

(1) 1 (2) 0 (3) 3 (4) –1

Ans. **(2)**

Sol.



$|\vec{OP}| = \sqrt{3+3} = \sqrt{6}$

$|\vec{OQ}| = \sqrt{6}$

$V_P = \frac{KQ}{r} = \frac{Kq}{\sqrt{6}}$

$V_Q = \frac{Kq}{\sqrt{6}}$

$V_P - V_Q = 0$

15. Statement –(I) Viscosity of gases > viscosity of liquids

Statement –(II) Surface tension of liquid decrease an adding highly insoluble material.

(1) Statement I and II correct

(2) Statement I and II both incorrect

(3) Statement I correct and II incorrect

(4) Statement I incorrect and II is correct

Ans. **(4)**

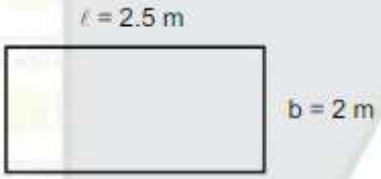
Sol. Viscosity represent resistance of flow & in liquids molecules are closely packed

Thus there viscosity is higher.

Surface tension of liquid increases on adding highly soluble material as they make bond with solvent increasing density & thus increasing intermolecular attractions.

On adding insoluble materials surface tension of substance decreases

16.



$B = 4T$

Angle between ($\vec{B}$) of magnitude 4T & area ($\vec{A}$) is 60° Find and emf induced if it is removed form magnetic field in 10s.

(1) 0 V (2) 1 V (3) 0.5 V (4) 2 V

Ans. **(2)**

Sol. $E_{avg} \left|\frac{\Delta\phi}{\Delta t}\right| = \left(\frac{BA\cos\theta}{\Delta t}\right)$

$E_{avg} = \left|\frac{4\times(2.5\times2)\times\cos60^\circ}{10}\right|$

$E_{avg} = 1V$

17. Spherometer cannot be used to measure

(1) ROC of convex surface

(2) ROC of concave surface

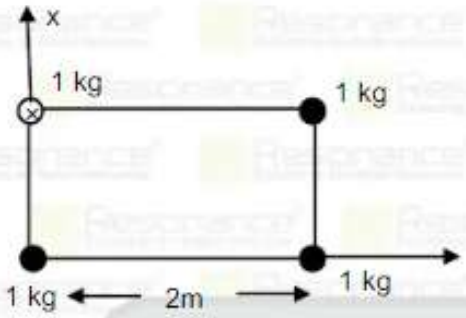
(3) Thickness of plane

(4) Specific gravity of liquid.

Ans. **(4)**

Sol. Spherometer not used to measure specific gravity of liquid.s

18.



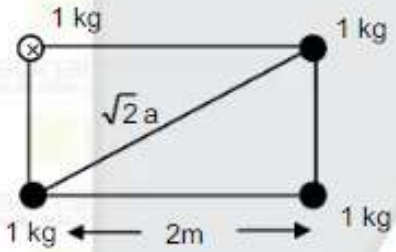
Find I_z

Four point masses of 1 kg each placed on corners of a square of side 2m, Find the MOI of system about an axis passing through any one corner and perpendicular to plane will be:

(1) 8 kgm^2 (2) 16 kgm^2 (3) 32 kgm^2 (4) 64 kgm^2

Ans. **(2)**

Sol.



$I = 2(ma^2) + m(\sqrt{2}a)^2$

$I = 2ma^2 + 2ma^2$

$I = 4ma^2$

$= 4 \times 1 \times (2)^2$

$I = 16$ kg-m^2

19. EM wave $E_0 = 200\sin(1.5 \times 10^7 x - 4.5 \times 10^{15} t)$ N/C. Find intensity

(1) 35 W/m^2 (2) 53W/m^2 (3) 62 W/m^2 (4) 42 W/m^2

Ans. **(2)**

Sol. $I = \frac{1}{2} C\varepsilon_0 E_0^2$

$= \frac{1}{2} \times 3 \times 10^8 \times 8.85 \times 10^{-12} \times (200)^2$

$Z = 53.1$ W/m^2

20. Given mass of substance as 0.08 kg its specific heat at constant volume is 0.17 kg $^{-1}$ k cal/ °C & change in temperature as 5 °C find change in internal energy for this substance?

(1) 284.2 J (2) 180.2 J (3) 254.3 J (4) 320.2 J

Ans. **(1)**

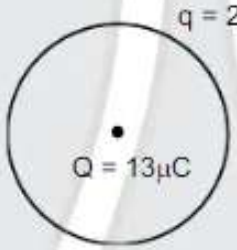
Sol. $\Delta U = mC_v \Delta t$

$= 0.08 \times 0.17 \times 10^3 \times 5$

$= 0.068 \times 10^3$ cal

$= 68$ cal $= 284.2$ J

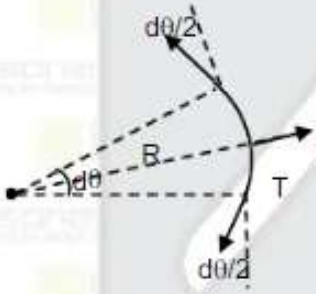
21. A point charge 13μC is placed on the center of uniformly charged ring of total charge 2 π C. Find tension in the ring.



(1) 4.25 kN (2) 3.72 kN (3) 5.78 kN (4) 12.5 kN

Ans. **(3)**

Sol.



$F_e = \left(\frac{KQ}{R^2}\right) \times \left(\frac{q}{2\pi} d\theta\right)$

$2T \sin\frac{d\theta}{2} = \frac{kQq}{R^2}\left(\frac{d\theta}{2\pi}\right)$

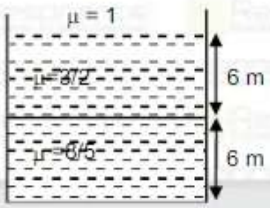
$\Rightarrow \quad T = \frac{k\theta q}{2\pi R^2}$

$\Rightarrow \quad T = \frac{9\times10^9 \times 13\times10^{-6} \times 2\pi}{2\pi(4.5)^2}$

$\Rightarrow \quad T = \frac{52}{9} \times 10^3$ N

$\Rightarrow \quad T = 5.78$ kN

22. If a beaker is filled with immiscible transparent liquid 1 and 2 of refractive index μ_1 and μ_2 having depth 6m each then the apparent depth of the bottom of beaker is.



(1) $\frac{25}{4}$ m (2) $\frac{45}{4}$ m (3) $\frac{31}{4}$ m (4) $\frac{37}{4}$ m

Ans. **(3)**

Sol. apparent depth = $\frac{t_1}{\mu_{1rel}} + \frac{t_2}{\mu_{2rel}}$

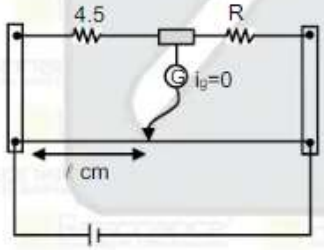
$= \frac{6}{3/2} + \frac{6}{8/5}$

$= 6\left[\frac{2}{3} + \frac{5}{8}\right]$

$= 6\left[\frac{16+15}{24}\right]$

$= \frac{31}{4}$ Ans.

23.



If ℓ = 60 cm when galvanometer shows null deflection then find R ?

(1) 4 Ω (2) 3 Ω (3) 5 Ω (4) 6 Ω

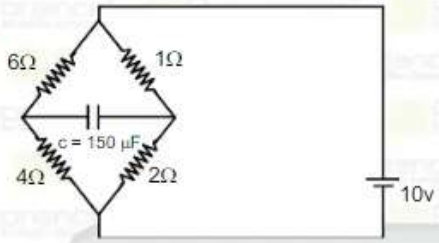
Ans. **(2)**

Sol. $\frac{4.5}{R} = \frac{60}{40}$

$4.5 \times 40 = R \times 60$

$R = 3\Omega$

24.

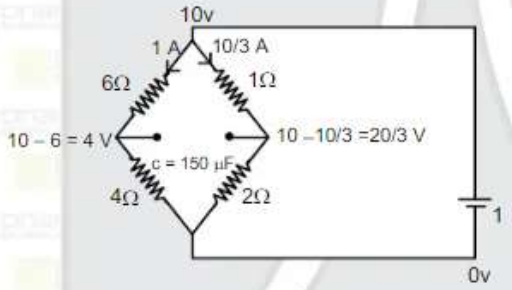


find charge on capacitor of 150 μF in steady state.

(1) 150 μC (2) 250 μC (3) 350 μC (4) 400 μC

Ans. **(4)**

Sol.



$q = C\Delta V$

$= 150\left(\frac{20}{3} - 4\right)$

$= 150 \times \frac{8}{3}$

$= 50 \times 8$

$= 400\ \mu C$

25. A Particle is moving on straight line, its displacement-time relation is given as $S = (2t^2+5)$, where S is in meters and t is in seconds. Find its velocity in m/s at t = 1 sec. _____ ?

(1) 2 (2) 4 (3) 6 (4) 8

Ans. **(2)**

Sol. $S = 2t^2+5$

$V = \frac{ds}{dt} = 4t$

$= 4(1) = 4 m/s$

26. A prism produces minimum deviation δm has refractive index $\cot\frac{A}{2}$. Here A is the angle of prism. Find δm.

(1) A/2 (2) $\pi - A$ (3) $\pi - 2A$ (1) 2A

Ans. **(3)**

Sol. $\mu = \cot\frac{A}{2}$

$$\mu = \frac{\sin\left(\frac{A+\delta_{min}}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

$\delta_{min} = \pi - 2A$

27. A hollow cylindrical conductor has length of 3.14 m while its inner and outer diameters are 4mm and 8mm respectively. The resistance of the conductor is $n\times10^{-3}$ if the resistivity of the material is $2.4\times 10^{-8}\ \Omega m$. The value of n is

Ans. **0.5**

Sol. $$R_{eq} = \frac{\rho l}{\pi\left(b^2 - a^2\right)} = \frac{2.4\times10^{-8}\times\pi}{\pi(64-16)\times10^{-6}}$$

$$= \frac{24\times10^{-3}}{48}$$

$= 0.5\times10^{-3}$ $= n\times10^{-3}$

$n=0.5$

28. A gas undergoes isothermal expansion from 30 cm^3 to 45 cm^3. Find heat absorbed by gas if external pressure is 10 k Pa ?

(1) 100 J (2) 150 J (3) 120 J (4) 200J

Ans. **(C)**

Sol. $\Delta V = 0$

There fore $\Delta Q = w$

$$= nRT\ \ell n\left(\frac{V_2}{V_1}\right)$$

$$= P_1V_1\ \ell n\left(\frac{V_2}{V_1}\right)$$

$$= 10\times10^3\times30\times10^{-3}\ \ell n\left(\frac{3}{2}\right)$$

$= 300\times0.4$

$= 120$ J

29. A particle is moving from origin with initial velocity $5\hat{i}$ m/s and constant acceleration $3\hat{i} + 2\hat{j}$ m/s^2.

When position of particle on x –axis is 84 m, its velocity is $\sqrt{\alpha}$ m/s . Find out α :

Ans. **(673)**

Sol. $x = u_x t + \frac{1}{2} a_x t^2$

$84 = 5t + \frac{3}{2} t^2$

$t = 6$sec.

$v = u + at$

$\vec{v} = 5\hat{i} + (3\hat{i} + 2\hat{j})6$

$= 23\hat{i} + 12\hat{j}$

$|\vec{v}| = \sqrt{529+144}$

$= \sqrt{673}$ m/s

$\alpha = 673$

30. Light is incident on a convex lens of focal length 40 cm. And a metal plate is placed on focus of lens & photo current is measured to be I. New photocurrent is I'. If lens is replaced by another lens of focal length of 20 cm & metal plate is kept on its focus. Find the ratio of new photo current to initial photo current ?

Ans. **1**

Sol.