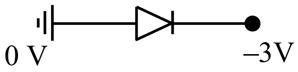
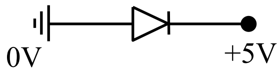
PHYSICS

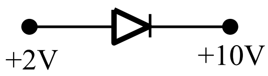
27th Jan Shift - 1

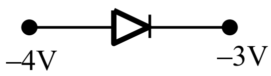
SECTION-A

1. Which among the following is forward biased:

(1) 

(2) 

(3) 

(4) 

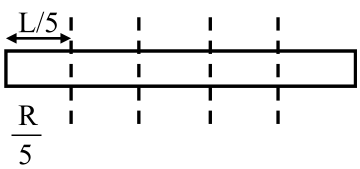
Ans. **(1)**

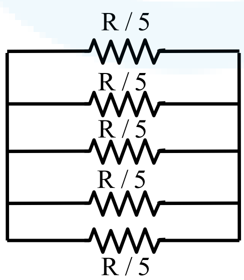
Sol. **Basic theory.**

2. A uniform and homogeneous rod has resistance R. If rod is cut into 5 equal parts and connected in parallel find equivalent resistance ?

Ans. $\frac{R}{25}$

Sol.





$\Rightarrow \quad \frac{R}{25}$ Answer

3. Acceleration due to earth on the surface is g_0. If mass of earth remains same but radius is half, then find the acceleration on the surface for new system :

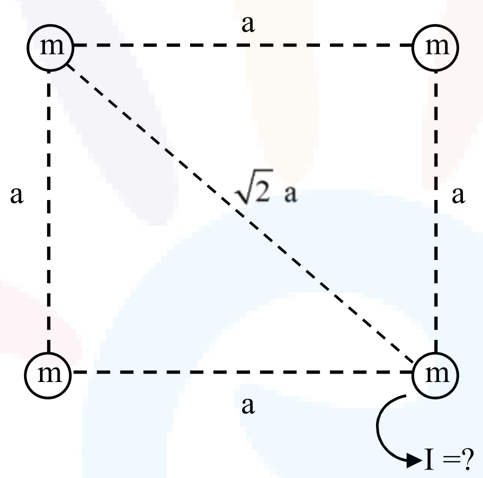
(1) $\frac{g_0}{2}$ (2) g_0 (3) $2\ g_0$ (4) $4\ g_0$

Ans. **(D)**

Sol. $g_0 = \frac{Gm}{R^2}$

$$g = \frac{Gm}{(R/2)^2} = \frac{4Gm}{R^2} = 4g_0$$

4. Find moment of inertia about an axis passing though one corner and perpendicular to the plane.



Ans. $4\ ma^2$

Sol. $I = ma^2 + ma^2 + m\left(\sqrt{2}\,a\right)^2 + 0 = 4\ ma^2$

5. Two particles having mass 4g & 25g have same kinetic energy. Find ratio of their momentum?

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

Ans. **(1)**

Sol. **$KE_1 = KE_2$**

$$\frac{P_1^2}{2m_1} = \frac{P_2^2}{2m_2}$$

$$\frac{P_1}{P_2} = \sqrt{\frac{m_1}{m_2}} = \sqrt{\frac{4}{25}} = \frac{2}{5}$$

6. An object of mass 1000 kg is moving with 6 m/s. Find speed of object is mass 200 kg is added to it ?

(1) 4 m/s (2) 5 m/s (3) 8 m/s (4) 6 m/s

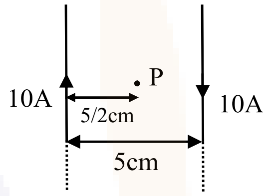
Ans. **(2)**

Sol. Linear momentum is conserved.

$1000 \times 6 = 1200\ (v_f)$

$\therefore \quad v_f = 5$ m/s

7. Two very long wire having current as shown. Find the magnetic field at point 'P' (in micro tesla).



Ans. **160**

Sol. $\mathbf{B} = \dfrac{\mu_0 I}{2\pi D} \times 2$

$\mathbf{B} = \dfrac{2 \times 10^{-7} \times 10}{\frac{5}{2} \times 10^{-2}} \times 2$

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

$B = 160\ \mu T$

8. If the electron revolving in the third Bohr's orbit of hydrogen species has radius R, then what will be its radius in fourth orbit in terms of R.

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

Ans. **(B)**

Sol. $\mathbf{R} = \dfrac{kn^2}{Z}$

$\dfrac{R}{R'} = \dfrac{\frac{k3^2}{Z}}{\frac{k4^2}{Z}}$

$\Rightarrow \quad \dfrac{R}{R'} = \dfrac{9}{16}$

$\Rightarrow \quad R' = \dfrac{16}{9} R$

9. A charge of magnitude $10^{-6}\mu C$ is placed at origin in x-y co-ordinate system. Find the potential difference between the two point $\left(\sqrt{3}, \sqrt{3}\right)$ and $\left(\sqrt{6}, 0\right)$. (Axis are in meters)

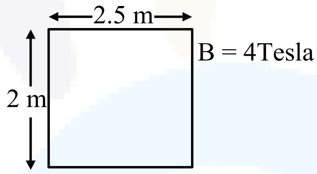
(1) $3\sqrt{3}\times 10^{3}\,V$ (2) $\dfrac{3}{\sqrt{3}}\times 10^{3}\,V$

(3) 0V (4) $2\sqrt{3}\times 10^{3}\,V$

Ans. **(3)**

Sol. Same radial distance from origin Hence Potential is same at the two given point. Thus potential difference is zero

10. Magnetic field having magnitude 4 Tesla makes an angle 60º with perpendicular to loop and loop has been removed from magnetic field region within 10 seconds. Find average induced emf in loop in 10 seconds in Volts?

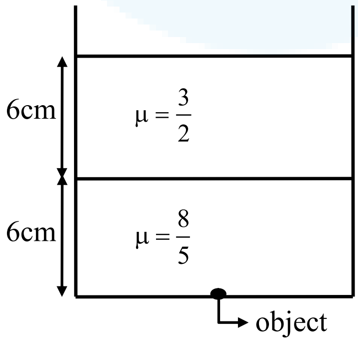


Ans. 1

Sol. $e_{avg} = \dfrac{\Delta\phi}{\Delta t} = \dfrac{BA\cos\theta}{10}$

$= 4\times 2\times \dfrac{5}{2}\times \dfrac{\cos 60}{10} = 1$ volt

11. Find apparent depth of the object shown in figure ?



Ans. $\dfrac{31}{4}$

Sol. Apparent depth $= \dfrac{6}{3/2} + \dfrac{6}{8/5} = 4 + \dfrac{15}{4} = \dfrac{31}{5}$cm

12. An EM wave is given by

$E = 200 \sin [1.5 \times 10^7 t - 0.05 x]$ N/C

Find the intensity of wave. [$\varepsilon_0 = 8.85 \times 10^{-12}$ SI units]

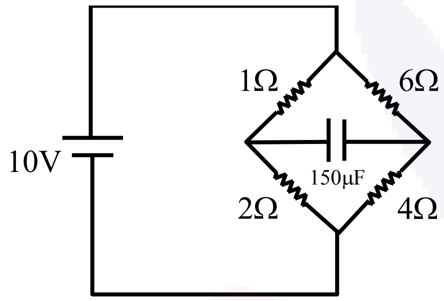
Ans. **53.1**

Sol. $\mathbf{I} = \frac{1}{2}\varepsilon_0 E_0^2 . C_{mid}$

$\mathbf{I} = \frac{1}{2} \times 8.85 \times 10^{-12} \times [200]^2 \frac{1.5 \times 10^7}{0.05}$

$\mathbf{I = 53.1\ W/m^2}$

13.

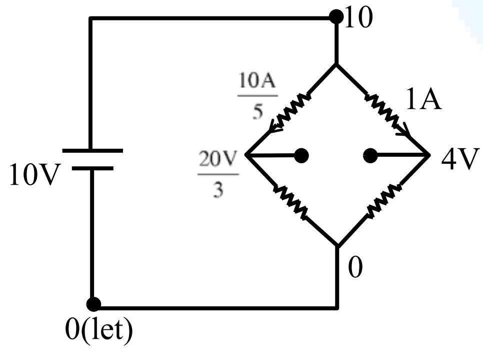


Find charge on capacitor at steady state?

(1) 200 μC (2) 300 μC (3) 400 μC (4) 500 μC

Ans. **(3)**

Sol.



$\therefore \Delta V)_{capacitor} = \left|4 - \frac{20}{3}\right| = \frac{8}{3}$ V

$\therefore q = \frac{8}{3} \times 150 = \boxed{400\mu C}$

14. A particle performs SHM with an amplitude 4 cm. Speed of particle at mean position is 10 cm/sec. Find position from mean where speed is 5 cm/sec

(1) 2 cm (2) $2\sqrt{3}$ cm (3) 0.5 cm (4) $\sqrt{3}$ cm

Ans. **(2)**

Sol. 10 cm/s = $A\omega$ ...(i)

5 cm/s = $\omega\sqrt{A^2 - x^2}$ ...(ii) using (i) and (ii)

$\mathbf{x} = \frac{\sqrt{3}A}{2} = 2\sqrt{3}$ cm

15. Given :

m = 0.08 kg

$s_v = 0.17$ kcal/kg-°C

$\Delta T = 5°C$

Find change in internal energy (in Joule) of gas.

Ans. **284**

Sol. $\Delta U = ms_v\Delta T$

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

$\Delta U = 68$ cal

$\Delta U = 284.24$ Joule

16. A gas undergoes isothermal expansion from 30 dm^3 to 45 dm^3. Find heat absorbed by gas if external pressure is 10 kPa?

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

Ans. **(C)**

Sol. $\Delta V = 0$

$\therefore \Delta Q = w$

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

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

$= 10 \times 10^3 \times 30 \times 10^{-3}\ \ell n\left(\frac{3}{2}\right)$

$= 300 \times 0.4$

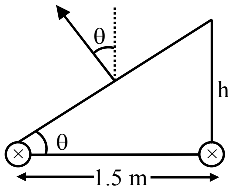
$= 120$ J

17. A banked road of radius 400 m is there with base separation between the rails is 1.5 m, if speed of a car for safe turning is 12 m/s, then find height of one rail w.r.t to second rail?

(1) h = 0.054 m (2) h = 0.1 m (3) h = 0.001 m (4) h = 0.2 m

Ans. **(1)**

Sol.



$N\cos\theta = mg$

$N\sin\theta = \dfrac{mv^2}{r}$

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

$\dfrac{h}{1.5} = \dfrac{12\times12}{400\times10}$

$h = \dfrac{12\times12}{4000}\times\dfrac{3}{2} = \dfrac{54}{1000}$

$h = 0.054$ m

18. 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 is 84 m, its velocity is $\sqrt{\alpha}$ m/s. Find out α :

Ans. **673**

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

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

$t = 6$ sec.

$\vec{v} = \vec{u} + \vec{a}t$

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

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

$= 529 + 144$

$= \sqrt{673}$ m/s

$\alpha = 673$

19. **Statement-1 :** Angular momentum and Plank constant have same dimensions.

Statement-2 : Moment of force and linear momentum have same dimensions.

(1) Both statements are true

(2) Both statements are false

(3) Statement 1 is true and 2^{nd} is false

(4) Statement 2 is true and 1^{st} is false

Ans. **(3)**

Sol. $\mathbf{L} = \frac{nh}{2\pi}$, $\quad F = \frac{dp}{dt}$

$[L] = M^1L^2T^{-1}$

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

$[\tau] = M^1L^2T^{-2}$

$[P] = M^1L^1T^{-1}$

20. A proton is moving in gravity free space with constant velocity v and goes undeviated. What can be the possible conditions.

(A) $E = 0, B = 0$

(B) $E = 0, B \neq 0$

(C) $E \neq 0, B = 0$

(D) $E \neq 0, B \neq 0$

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

Ans. **(1)**

21. $\mathbf{S_1} \rightarrow$ Viscosity coefficient of gas is less than liquid.

$\mathbf{S_2} \rightarrow$ Surface tension decreases if insoluble impurities are added.

(1) S_1 is true, S_2 is true

(2) S_1 is false, S_2 is false

(3) S_1 is true, S_2 is false

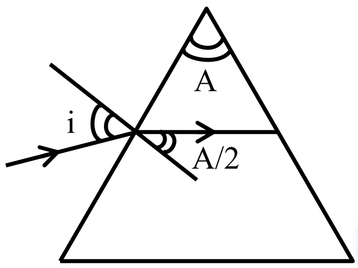
(4) S_1 is false, S_2 is true

Ans. **(1)**

22. There in a prism of apex angle of 'A'. Its refractive index is equal to Cot $\frac{A}{2}$, then find minimum angle of deviation?

Ans. 2

Sol.



$$1 \sin i = \mu \sin\frac{A}{2}$$

$$\sin i = \left(\cot\frac{A}{2}\right)\sin\frac{A}{2}$$

$$\sin i = \cos\frac{A}{2} = \sin\left(\frac{\pi}{2} - \frac{A}{2}\right)$$

$$i = \frac{\pi}{2} - \frac{A}{2}$$

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

Alternate Solution

$$n = \frac{\sin\frac{A+\delta_{min}}{2}}{\sin\frac{A}{2}}$$

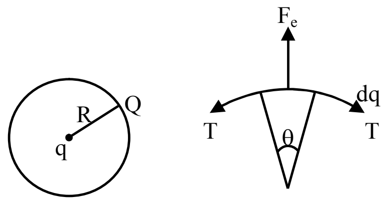
$$\frac{\cos\frac{A}{2}}{\sin\frac{A}{2}} = \frac{\sin\frac{A+\delta_{min}}{2}}{\sin\frac{A}{2}}$$

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

23. A point charge q is placed at a centre of a charged ring of total charge Q. Find tension in the ring.

Ans. $\frac{KQq}{2\pi R^2}$

Sol.



$$\frac{kqdq}{R^2} = 2T\sin\left(\frac{\theta}{2}\right) \qquad \theta \simeq \text{small}$$

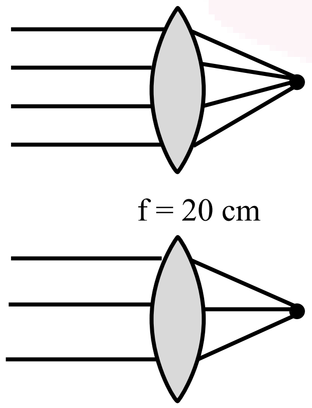
$$\frac{kqQ\theta}{2\pi R^2} = T\theta \qquad \text{Also } \frac{Q}{dq} = \frac{2\pi}{\theta}$$

$$T = \frac{KQq}{2\pi R^2}$$

24. Light in incident on a convex lens of focal length 40 cm. And a metal plate is placed on focus of lens & photo current is measure to be I. Find new photocurrent if lens is replaced by another lens focal length of 20 cm & metal plate is kept on its focus?

Ans. I'= I

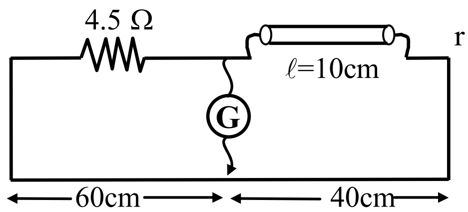
Sol.



25. In meter bridge experiment there is a resistance in right slot of length 10 cm and radius of cross section is $\sqrt{7} \times 10^{-4}$ m. In left slot these is a resistance of 4.5 Ω. If balance length from left is 60 cm. If unknown resistivity is $x \times 10^{-7}$. Find 'x'.

Ans. **66**

Sol.



$$\frac{60}{40} = \frac{4.5}{R} \qquad \Rightarrow \qquad R = 3\Omega$$

$$R = \frac{\rho \ell}{A}$$

$$3 = \rho \times \frac{1}{10 \times \pi \times 7 \times 10^{-8}} \Rightarrow \qquad \rho = 21\pi \times 10^{-7} = 21 \times \frac{20}{7} \times 10^{-7} = 66 \times 10^{-7} = x \times 10^{-7}$$

$x = 66$

26. Spherometer can't be used for measurement of :

(1) Radius of curvature of convex mirror

(2) Radius of curvature of concave mirror

(3) Thickness of capacitor plates

(4) Specific rotation of liquid

Ans. (4)

Sol. Spherometer is used to measure radius of curvature of any spherical surface and any small thickness.