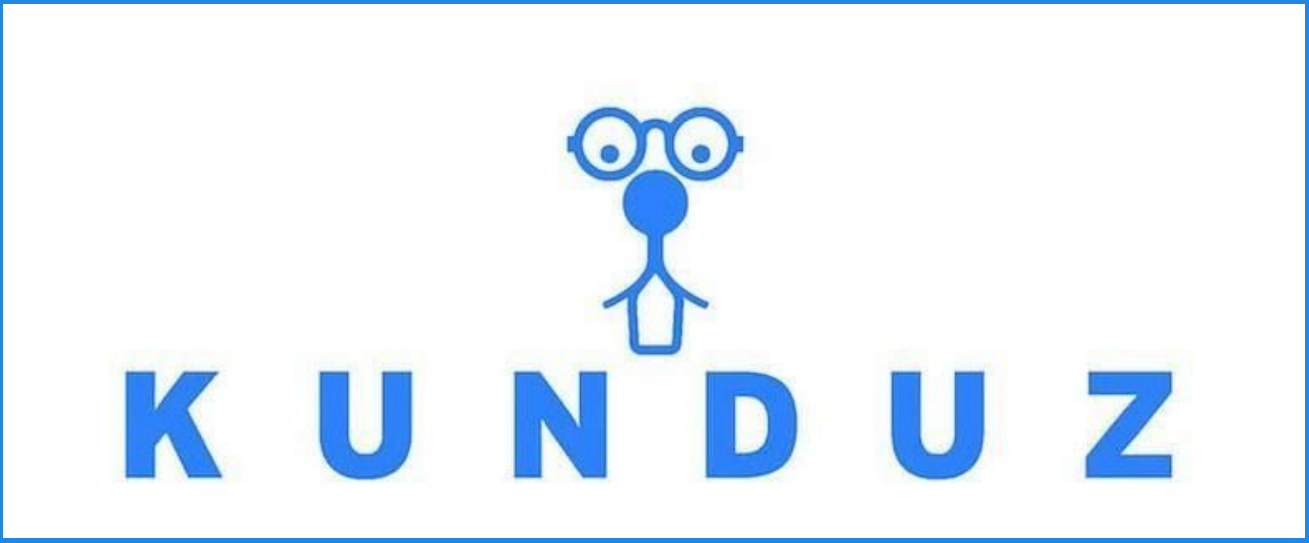
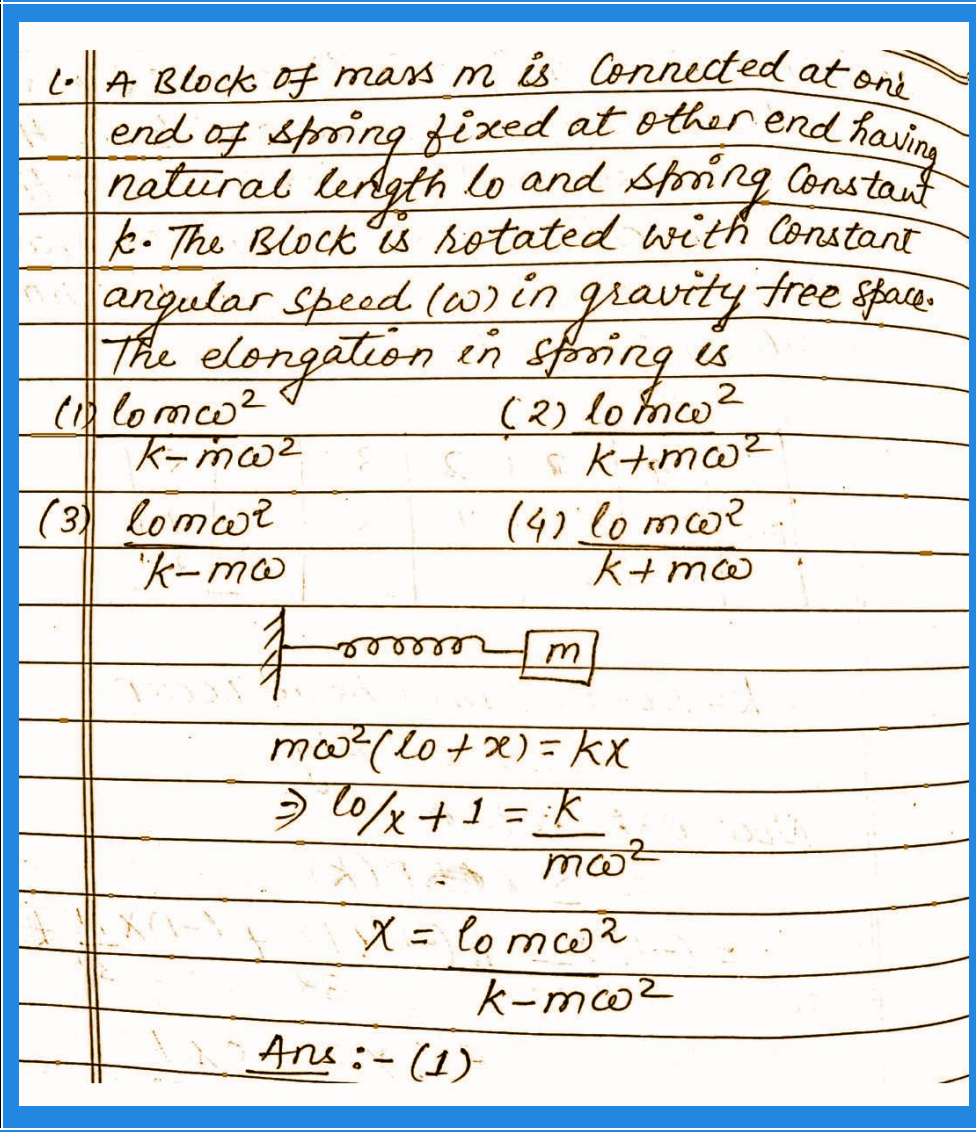


Jan 8 2020 shift 1 Physics prepared by KUNDUZ tutors

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Question no.	Questions and Answers
1	

1. A Block of mass m is connected at one end of spring fixed at other end having natural length l_0 and spring constant k. The Block is rotated with constant angular speed (ω) in gravity free space. The elongation in spring is

(1) $\frac{l_0 m\omega^2}{k-m\omega^2}$ (2) $\frac{l_0 m\omega^2}{k+m\omega^2}$

(3) $\frac{l_0 m\omega^2}{k-m\omega}$ (4) $\frac{l_0 m\omega^2}{k+m\omega}$

$m\omega^2(l_0+x) = kx$

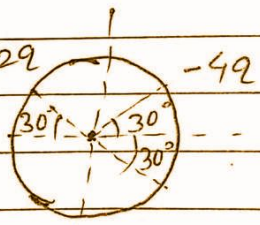
$\Rightarrow l_0/x + 1 = \frac{k}{m\omega^2}$

$x = \frac{l_0 m\omega^2}{k-m\omega^2}$

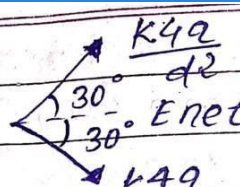
Ans :- (1)

2

2. 3 charges are placed on circumference of circle of radius d as shown in figure. The electric field along x-axis ~~of~~ at centre of circle is :-



(1) $\frac{q}{4\pi\epsilon_0 d^2}$ (2) $\frac{q\sqrt{3}}{4\pi\epsilon_0 d^2}$ (3) $\frac{9\sqrt{3}}{\pi\epsilon_0 d^2}$ (4) $\frac{9\sqrt{3}}{2\pi\epsilon_0 d^2}$



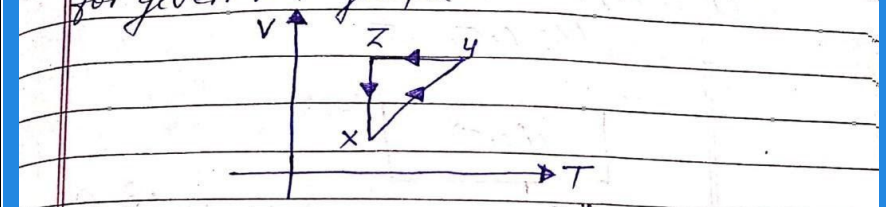
$E_{net} = \frac{4kq}{d^2} \times 2\cos 30^\circ$

$= \frac{9\sqrt{3}}{\pi\epsilon_0 d^2}$

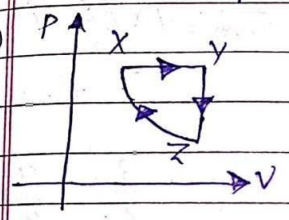
Ans :- (3)

3

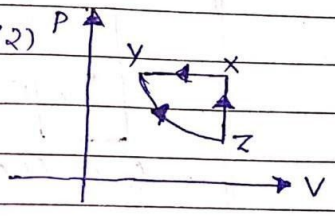
3. Choose the correct P-V graph of ideal gas for given V-T graph.



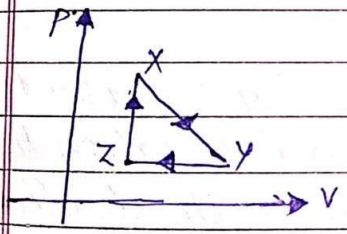
(1)



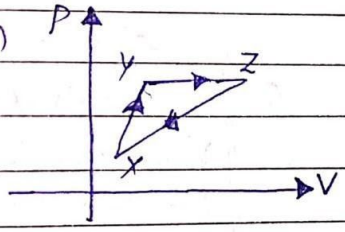
(2)



(3)



(4)



X-Y → Isobaric

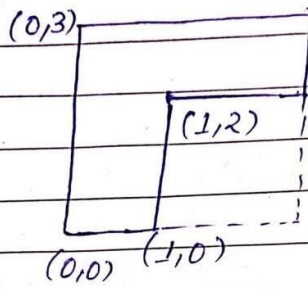
Y-Z → Isochoric

Z-X → Isothermal

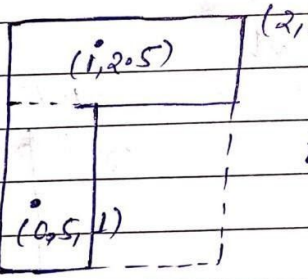
Ans :- (1)

4

4. Find the Coordinates of Centre of mass of the Lamina, shown in figure.



(1) 0.75, 1.75 (2) 0.75, 1.5 (3) 0.5, 1.75
(4) 0.5, 1.5



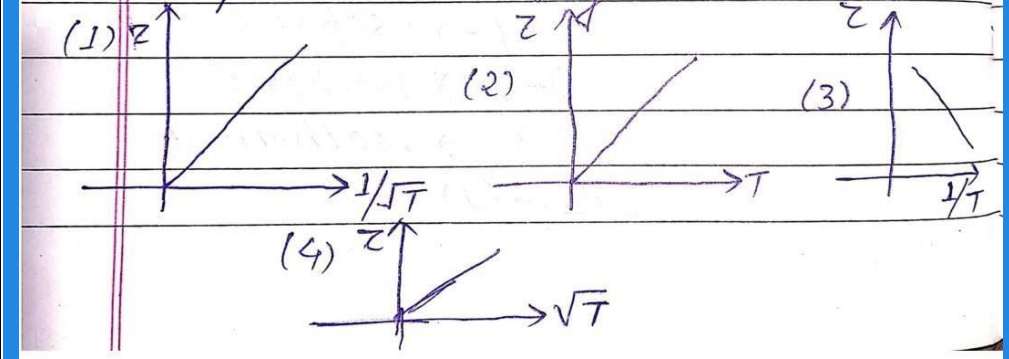
$$\vec{r}_{cm} = \frac{1\times\left(\frac{\hat{i}}{2}+\hat{j}\right)+1\times\left(\hat{i}+\frac{5}{2}\hat{j}\right)}{2}$$

$$\vec{r}_{cm} = \frac{3}{4}\hat{i} + \frac{7}{4}\hat{j}$$

Ans – (1)

5

5. Which graph correctly represents variation between relaxation time(τ) of gas molecules with absolute temperature (T) of gas.



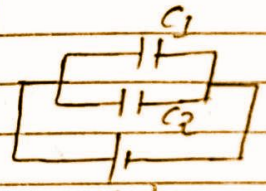
Sol:- $\tau \propto \frac{1}{\sqrt{T}}$

Ans:- (1)

6

6. If two capacitors C_1 & C_2 are connected in parallel then equivalent is 10 μF. If both Capacitance are connected across 1 V battery then energy stored by C_2 is 4 times of C_1. Then the equivalent capacitance if they are connected in series is :-

(1) 1.6 μF (2) 16 μF (3) 4 μF (4) 1/4 μF



$C_1 + C_2 = 10\ \mu F$ --- (i)

$4\left(\frac{1}{2} C_1 V^2\right) = \frac{1}{2} C_2 V^2$

$\Rightarrow 4C_1 = C_2$ --- (ii)

from equation (i) & (ii)

$C_1 = 2\ \mu F$

$C_2 = 8\ \mu F$

If they are in series

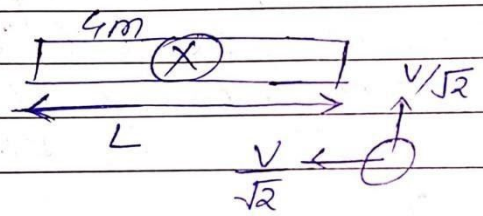
$$C_{req} = \frac{C_1 C_2}{C_1 + C_2} = 1.6\ \mu F$$

Ans – (1)

7

7. A rod of mass $4m$ and length L is hinged at the mid point. A ball of mass 'm' moving with speed v in the plane of rod strikes at the end of an angle of $45°$ and sticks to it. The angular velocity of system after collision is

(1) $\frac{3\sqrt{2}v}{7L}$ (2) $\frac{\sqrt{2}v}{7L}$ (3) $\frac{\sqrt{2}v}{3L}$ (4) $\frac{3v}{7L}$



$L_{0i} = L_{0f}$

$\Rightarrow \frac{mv}{\sqrt{2}} \times \frac{1}{2} = \left[\frac{4mL^2}{12} + \frac{mL^2}{4}\right] \times \omega$

$\omega = \frac{6v}{7\sqrt{2}L} = \frac{3\sqrt{2}v}{7L}$

Ans:- (1)

8

8. Two photons of energy 4ev & 4.5 eV incident on two metals A & B respectively. Maximum kinetic energy for ejected electron is T_A for A and $T_B = T_A - 1.5$ eV for metal B. Relation between de-Broglie wavelength of ejected electron of A & B are $\lambda_B = 2\lambda_A$. The work function of metal B is –

(1) 3eV (2) 1.5eV (3) 4.5eV (4) 4eV

Relation Between De-Broglie wavelength and K.E. is

$$\lambda = \frac{h}{\sqrt{2(KE)m_e} \Rightarrow \lambda \propto \frac{1}{\sqrt{KE}}}$$

$$\frac{\lambda_A}{\lambda_B} = \frac{\sqrt{KE_B}}{\sqrt{KE_A}}$$

$$\Rightarrow \frac{1}{2} = \sqrt{\frac{T_A - 1.5}{T_A}}$$

$T_A = 2\ eV$

$\therefore KE_B = 2 - 1.5 = 0.5\ eV$

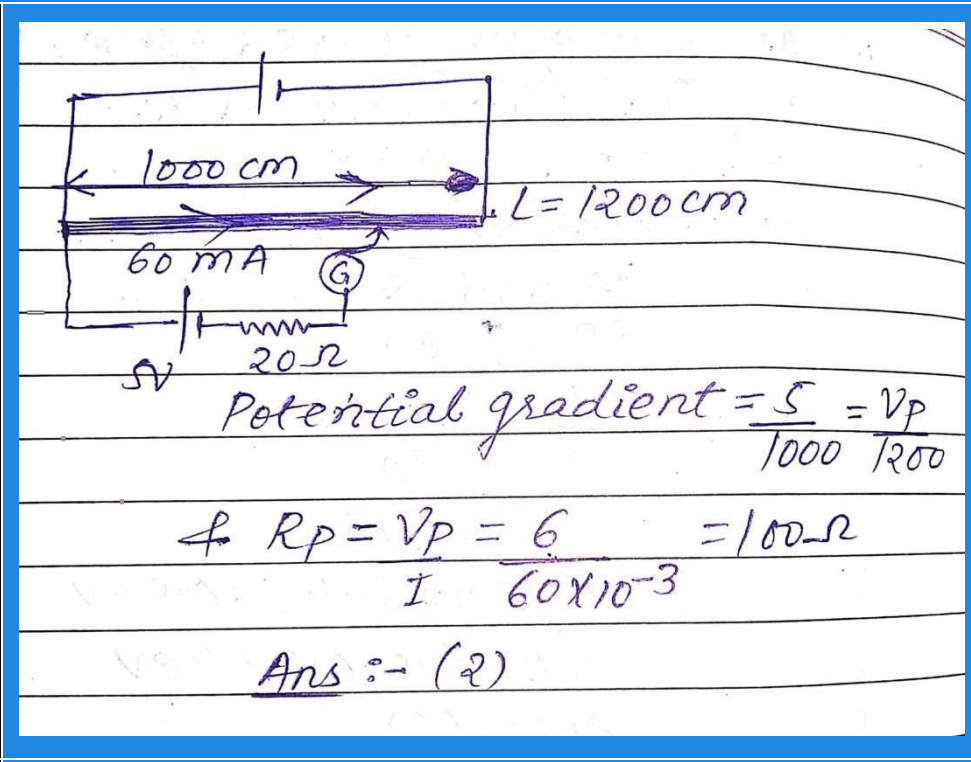
$\phi_B = 4.5 - 0.5 = 4\ eV$

Ans :- (4)

9

9. There is a potentiometer wire of length 1200 cm and 60 mA Current is flowing in it. A battery of emf 5V & internal resistance of 20 Ω is balanced on potentiometer wire with Balancing length 1000 cm. The resistance of Potentiometer wire is

(1) 80 Ω (2) 100 Ω (3) 120 Ω (4) 60 Ω



Potential gradient $= \frac{5}{1000} = \frac{V_P}{1200}$

$\therefore R_P = \frac{V_P}{I} = \frac{6}{60 \times 10^{-3}} = 100\Omega$

Ans :- (2)

10

10. A telescope has magnification 5 and length of tube 60 cm then the focal length of eye piece is :-

(1) 10 cm (2) 20 cm (3) 30 cm (4) 40 cm

$m = \frac{f_o}{f_e}$

$5 = \frac{f_o}{f_e}$

$f_o = 5 f_e$

$f_o + f_e = 60$

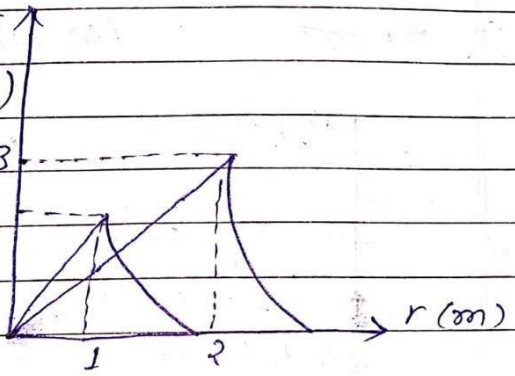
$6 f_e = 60$

$f_e = 10$

Ans :- (1)

11

11. Two spherical bodies of mass m_1 & m_2 are having 1m & 2m respectively. The gravitational field of the two bodies with their radial distance is shown below. The value of $\frac{m_1}{m_2}$ is -



(1) 1/6 (2) 1/3 (3) 1/2 (4) 1/4

$$3 = \frac{Gm_2}{2^2}$$

$$\Rightarrow 2 = \frac{Gm_1}{1^2}$$

$$\therefore \frac{3}{2} = \frac{1}{4}\frac{m_2}{m_1}$$

$$\frac{m_1}{m_2} = \frac{1}{6}$$

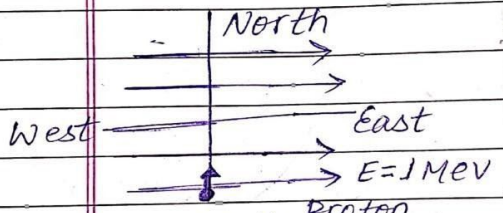
Ans :- (1)

12

12. When proton of KE = 1.0 MeV moving in South to North direction enters the magnetic field (from west to East direction), it accelerates with $a = 10^{12}\ m/s^2$. The magnitude of magnetic field is -

(1) 0.71 mT (2) 7.1 mT

(3) 71 mT (4) 710 mT



$\because K.E = 1.6 \times 10^{-13}$

$= \frac{1}{2} \times 1.6 \times 10^{-27} \times V^2$

$V = \sqrt{2} \times 10^7$

$\therefore Bqv = ma$

$B = \frac{1.6 \times 10^{-27} \times 10^{12}}{1.6 \times 10^{-19} \times \sqrt{2} \times 10^7}$

$= 0.71 \times 10^{-3}\ T$

So 0.71 mT

Ans :- (1)

13

13. If electric field around a surface is given by $|\vec{E}| = Q_{in}/\varepsilon_0 |A|$ where 'A' is the normal area of surface and Q_{in} is the charge enclosed by the surface. This relation of gauss law is valid when

(1) Surface is Equipotential.

(2) Magnitude of electric field is Constant.

(3) Magnitude of electric field is Constant & surface is Equipotential.

(4) for all gaussian surfaces.

Magnitude of electric field is constant & the surface is equipotential.

Ans :- (3)

14

14. Stopping potential depends on planks Constant (h), current (I), universal gravitational Constant (G) and speed of Light (C). Choose the correct option for the dimension of stopping potential (V).

(1) $hI^{-1}G^{1}C^{5}$ (2) $h^{-1}I^{1}G^{-1}C^{6}$

(3) $h^{0}I^{1}G^{1}C^{6}$ (4) $h^{0}I^{-1}G^{-1}C^{5}$

$V = k(h)^{a}(I)^{b}(G)^{c}(C)^{d}$

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

$[I] = A$ $[G] = M^{-1}L^{3}T^{-2}$

$[C] = LT^{-1}$ $[V] = ML^{2}T^{-3}A^{-1}$

$ML^{2}T^{-3}A^{-1} = (ML^{2}T^{-1})^{a}(A)^{b}(M^{-1}L^{3}T^{-2})^{c}$

$ML^{2}T^{-3}A^{-1} = M^{a-c}L^{2a+3c+d}T^{-a-2c-d}(LT^{-1})^{d}$

A^{b}

$a - c = 1$ --- (1)

$2a + 3c + d = 2$ --- (2)

$-a - 2c - d = -3$ --- (3)

$b = -1$ -- (4)

on solving

$c = -1$

$a = 0$

$d = 5, b = -1$

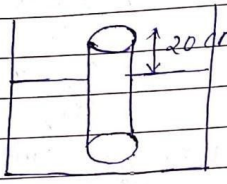
$V = k(h)^{0}(I)^{-1}(G)^{-1}(C)^{5}$

Ans :- (4)

15

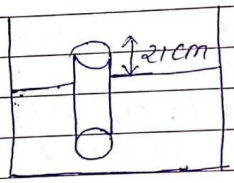
15. A cylinder of height 1 m is floating in water at 0°C with 20 cm height in air. Now temperature of water is raised to 4°C, height of cylinder in air becomes 21 cm. The ratio of density of water at 4°C to the density of water at 0°C is –

(1) 1.01 (2) 1.03 (3) 2.01 (4) 1.04



$mg = A(80)\rho_{0°C}\,g$

$mg = A(79)\rho_{4°C}\,g$



$\frac{\rho_{4°C}}{\rho_{0°C}} = \frac{80}{79}$

$= 1.01$

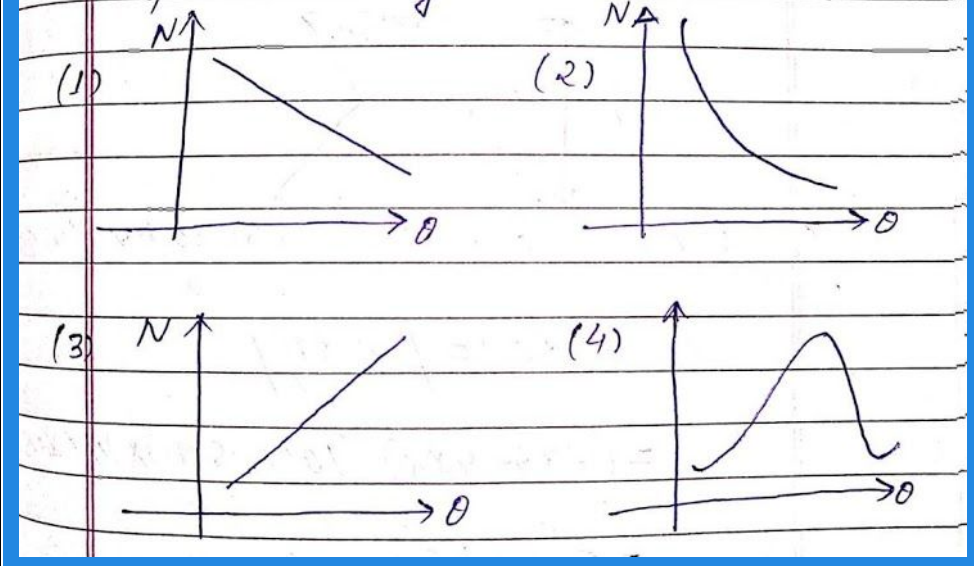
Ans :- (1)

$N \propto \frac{1}{\sin^4(\theta/2)}$

So, (2)

16

16. Number of the α-particle deflected in Rutherford's α-scattering experiment varies with angle of deflection. Then the graph between the two is best represented by



$N \propto \frac{1}{\sin^4(\theta/2)}$

So, (2)

17

17. If relative permittivity and relative permeability of a medium are 3 & 4/3 respectively. The critical angle for this medium is.

(1) 45° (2) 60° (3) 30° (4) 15°

$$V = \frac{1}{\sqrt{\mu\varepsilon}}$$

$$n = \sqrt{\mu_r \varepsilon_r} = 2$$

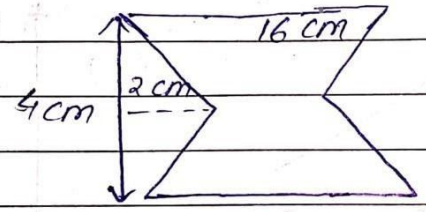
$$\sin C = 1/2$$

$$C = 30°$$

Ans :- (3)

18

18. The given loop is kept in a uniform magnetic field perpendicular to plane of loop. The field changes from 1000 G to 500 G in 5 seconds. The average induced emf in loop is



(1) 56 μV (2) 28 μV (3) 30 μV (4) 48 μV

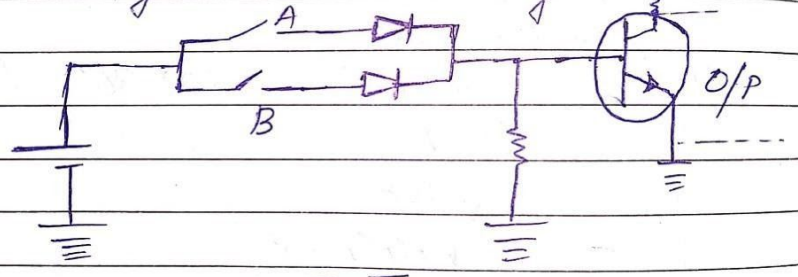
$$\varepsilon = \left|\frac{-d\phi}{dt}\right| = \left|\frac{-A\,dB}{dt}\right|$$

$$= \frac{(16\times4 - 4\times2)(1000-500)\times10^{-4}\times10^{-4}}{5}$$

$$= 56\times10^{-6}\,V$$

19

19. Choose the Correct Boolean expression for the given Circuit diagram:



(1) $A \cdot B$ (2) $\overline{A} + \overline{B}$

(3) $A + B$ (4) $\overline{A} \cdot \overline{B}$

first part of figure shown OR gate and Second part of figure shown NOT gate

So Y_P = OR + NOT = NOR gate

$Y = \overline{A+B} = \overline{A} \cdot \overline{B}$

Ans :- (4)

20

20. A solid sphere of density $\rho = \rho_0\left(\frac{1-r^2}{R^2}\right)$; $0<r\leq R$ just floats in a liquid then density of liquid is - (r is distance from centre of sphere)

(1) $2/5\,\rho_0$ (2) $5/2\,\rho_0$ (3) $3/5\,\rho_0$ (4) $\rho_0 5$

$$\rho = \rho_0\left(1-\frac{r^2}{R^2}\right) \quad 0<r\leq R$$

$$mg = B$$

$$\int \rho\,(4\pi r^2 dr) = \rho_L \frac{4}{3}\pi R^3$$

$$\int \rho_0\left(1-\frac{r^2}{R^2}\right) 4\pi r^2 dr = \rho_L \frac{4}{3}\pi R^3$$

$$\int \rho_0\, 4\pi\left(r^2-\frac{r^4}{R^2}\right) dr = \rho_0\, 4\pi\left(\frac{r^3}{3}-\frac{r^5}{5R^2}\right)_0^R$$

$$= \rho_L \frac{4}{3}\pi R^3$$

$$2/5\,\rho_0 = \rho_L$$

Ans:- (1)

21

21. Two masses each coith mass 0.10 kg are moving coith velocities 3 m/s along x axis and 5 m/s along y-axis respectively. After an elastic collision one of the mass moves coith a velocity $4\hat{i}+4\hat{j}$. The energy of other mass after collision is X/10 then x is.

For elastic collision

$$KEi = KEf$$

$$\frac{1}{2}m \times 25 + \frac{1}{2}m \times 9 = \frac{1}{2}m \times 32 + \frac{1}{2}mv^2$$

$$34 = 32 + v^2$$

$$KE = \frac{1}{2} \times 0.1 \times 2 = 0.1\,J = \frac{1}{10}$$

$$X = 1$$

22

22. A Plano Convex lens of radius of curvature 30 cm and refractive index 1.5 is kept in air. find its focal length (in cm).

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$R_1 = \infty$$

$$R_2 = -30\ cm$$

$$\frac{1}{f} = (1.5-1)\left(\frac{1}{\infty} - \frac{1}{-30}\right)$$

$$\frac{1}{f} = \frac{0.5}{30}$$

$$f = 60\ cm$$

23

23. Position of two particles A and B as a function of time are given by $x_A = -3t^2 + 8t + c$ and $y_B = 10 - 8t^3$. The velocity of B with respect to A at $t = 1$ is $\sqrt{V}$. Find V.

$$x_A = -3t^2 + 8t + c$$

$$\vec{v_A} = (-6t + 8)\hat{i}$$

$$= 2\hat{i}$$

$$y_B = 10 - 8t^3$$

$$\vec{v_B} = -24t^2\hat{j}$$

$$\sqrt{V} = |\vec{v_B} - \vec{v_A}| = |-24\hat{j} - 2\hat{i}|$$

$$\sqrt{V} = \sqrt{24^2 + 2^2}$$

$$V = 580.$$

24

24. An open organ pipe of length 1 m contains a gas whose density is twice the density of atmosphere at STP. Find the difference between fundamental and second harmonic frequencies if speed of sound in atmosphere is 300 m/s.

$$v = \sqrt{\frac{B}{\rho}}$$

$$\frac{v_{pipe}}{v_{air}} = \frac{\sqrt{B/2\rho}}{\sqrt{B/\rho}} = \frac{1}{\sqrt{2}}$$

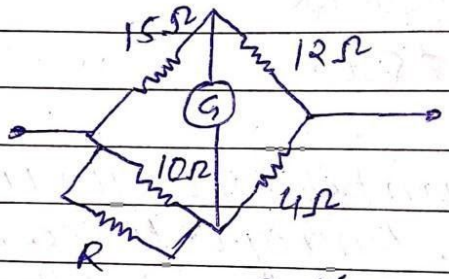
$$v_{pipe} = \frac{v_{air}}{\sqrt{2}}$$

$$f_n = \frac{(n+1)\, v_{pipe}}{2\ell}$$

$$f_1 - f_0 = \frac{v_{pipe}}{2\ell} = \frac{300}{2\sqrt{2}} = 106.05 \text{ Hz}$$

25

25. four resistors of 15Ω, 12Ω, 4Ω and 10Ω given in cylic order to form a wheat stone Bridge. what resistance (in Ω) should be connected in parallel across the 10Ω resistor to balance the wheat stone Bridge.



$$2\,\frac{10R}{10+R} \times 12 = 15 \times 4$$

$$2R = 10 + R$$

$$R = 10\Omega$$

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