JEE MAIN 2023
Paper with Solution

PHYSICS | 29th Jan 2023 _ Shift-1

Umeed Rank Ki Ho Ya Selection Ki, JEET NISCHIT HAI!

Most Promising RANKS
Produced by MOTION Faculties

NEET / AIIMS

- AIR-1 to 10 — 25 Times
- AIR-11 to 50 — 83 Times
- AIR-51 to 100 — 81 Times

JEE MAIN+ADVANCED

- AIR-1 to 10 — 8 Times
- AIR-11 to 50 — 32 Times
- AIR-51 to 100 — 36 Times

Nation's Best SELECTION
Percentage (%) Ratio

Student Qualified in NEET

(2022)
4837/5356 = **90.31%**
(2021)
3276/3411 = **93.12%**

Student Qualified in JEE ADVANCED

(2022)
1756/4818 = **36.45%**
(2021)
1256/2994 = **41.95%**

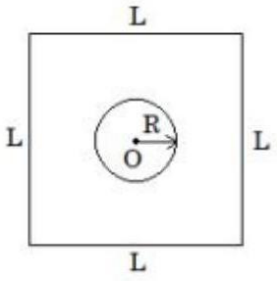
Student Qualified in JEE MAIN

(2022)
4818/6653 = **72.41%**
(2021)
2994/4087 = **73.25%**

NITIN VIIJAY (NV Sir)
Founder & CEO

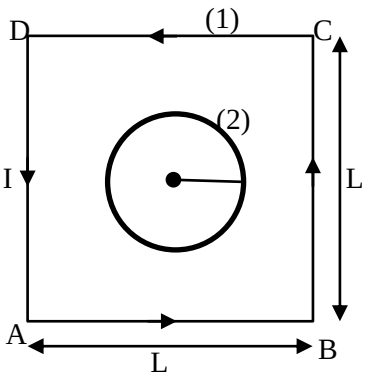
SECTION - A

1. Find the mutual inductance in the arrangement, when a small circular loop of wire of radius 'R' is placed inside a large square loop of wire of side $(L \gg R)$. The loops are coplanar and their centers coincide :



(1) $M = \frac{\sqrt{2}\mu_0 R^2}{L}$ (2) $M = \frac{2\sqrt{2}\mu_0 R}{L^2}$ (3) $M = \frac{\sqrt{2}\mu_0 R}{L^2}$ (4) $M = \frac{2\sqrt{2}\mu_0 R^2}{L}$

Sol. **(4)**



$\phi = MI$

$\phi_2 = MI_1$

$B_1A_2 = MI_1$

$$M = \frac{B_1A_2}{I_1} \quad \ldots.(1)$$

$B_1 \rightarrow$ magnetic field due to square frame

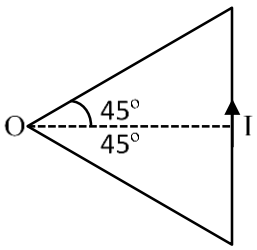
$A_2 \rightarrow$ Area of circle

$I_1 \rightarrow$ current in square frame.

$B_1 \rightarrow$

$B_1 = 4.\ B_{AB}$

$$= 4\left[\frac{\mu_0 I_1}{24\pi\frac{L}{2}}[\sin 45^\circ + \sin 45]\right]$$



$$B_1 = 2\frac{\mu_0 I_1}{\pi L}\left(\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}\right) = 2\sqrt{2}\frac{\mu_0 I_1}{\pi L}$$

$$M = \frac{B_1 \cdot A_2}{I_1}$$

$$M = \left(\frac{2\sqrt{2}\mu_0 I_1}{\pi L}\right) \times \frac{\pi R^2}{I_1} = \frac{2\sqrt{2}\mu_0 R^2}{L}$$

2. The threshold wavelength for photoelectric emission from a material is 5500A. Photoelectrons will be emitted, when this material is illuminated with monochromatic radiation from a

(A) 75 W infra –red lamp (B) 10 W infra-red lamp

(C) 75 W ultra – violet lamp (D) 10 W ultra-violet lamp

Choose the correct answer from the options given below:

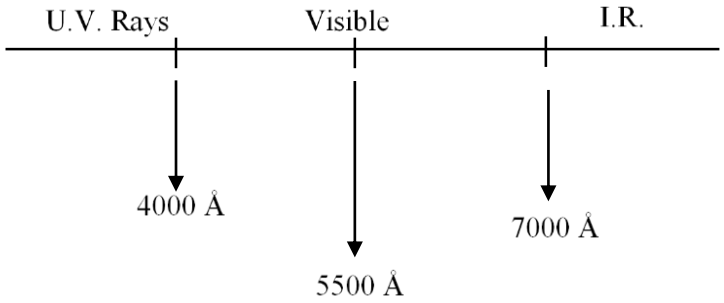
(1) B and C only (2) A and D only

(3) C only (4) C and D Only

Sol. **(4)**

$$\lambda_0 = 5500\text{Å} \rightarrow \phi_0 = \frac{12400}{5500} = 2.25\text{eV}$$

$$\phi = 3.6\times10^{-19}\text{J}$$



- P.E.E will occur if wavelength of incidence wave is less then threshold wavelength. So u. v. rays will be useful for emission.

So both U.V. rays lamps can be used.

3. Match List I with List II:

List I (Physical Quantity)	List II (Dimensional Formula)
A. Pressure gradient	I. $[M^0 L^2 T^{-2}]$
B. Energy density	II. $[M^1 L^{-1} T^{-2}]$
C. Electric Field	III. $[M^1 L^{-2} T^{-2}]$
D. Latent heat	IV. $[M^1 L^1 T^{-3} A^{-1}]$

Choose the correct answer from the options given below:

(1) A-II, B – III, C-I, D-IV (2) A-II, B – III, C-IV, D-I

(3) A-III, B – II, C-IV, D-I (4) A-III, B – II, C-I, D-IV

Sol. **(3)**

(A) Pressure gradient = $\frac{\text{Pressure}}{\text{Length}} = \frac{\text{Force}}{\text{Area}\times\text{length}}$

$= \frac{MLT^{-2}}{L^2\cdot L} = [ML^{-2}T^{-2}]$

(B) Energy density = $\frac{\text{Energy}}{\text{Volume}} = \frac{ML^2T^{-2}}{L^3} = [ML^{-1}T^{-2}]$

(C) Electric field = $\frac{\text{Force}}{\text{Charge}} = \frac{MLT^{-2}}{AT} = [MLT^{-3}A^{-1}]$

(D) Latent heat = $\frac{\text{Heat}}{\text{Mass}} = \frac{ML^2T^{-2}}{M} = [L^2T^{-2}]$

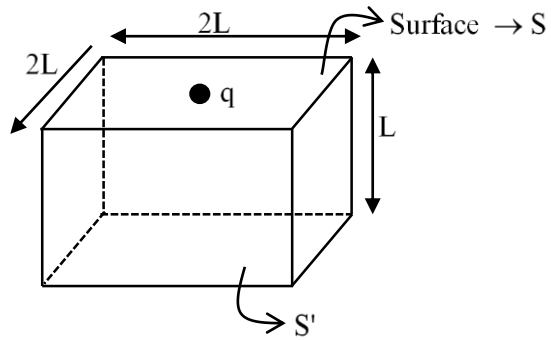
Ans : A-III, B-II, C-IV, D-I

Ans. : (3)

4. In a cuboid of dimension 2L × 2L × L, a charge q is placed at the center of the surface ' S ' having area of $4L^2$. The flux through the opposite surface to ' S ' is given by

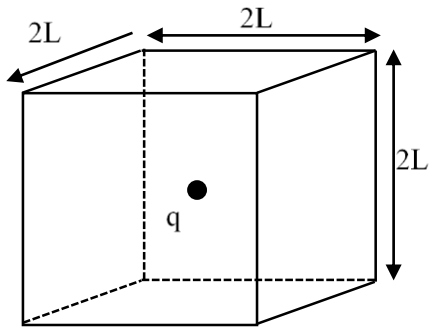
(1) $\frac{q}{12\varepsilon_0}$ (2) $\frac{q}{6\varepsilon_0}$ (3) $\frac{q}{3\varepsilon_0}$ (4) $\frac{q}{2\varepsilon_0}$

Sol. **(2)**



When smaller box is considered on the given box then charge 'q' will be at center.

So flux from surface S' = $\left(\frac{q}{\varepsilon_0}\right)\cdot\frac{1}{6}=\frac{q}{6\varepsilon_0}$



Ans : (2)

5. A person observes two moving trains, 'A' reaching the station and 'B' leaving the station with equal speed of 30 m/s. If both trains emit sounds with frequency 300 Hz, (Speed of sound: $\frac{330\text{ m}}{\text{s}}$) approximate difference of frequencies heard by the person will be:

(1) 55 Hz (2) 80 Hz (3) 33 Hz (4) 10 Hz

Sol. **(1)**

$\boxed{A} \rightarrow 30\,m/s$, Observer $\boxed{B} \rightarrow 30\,m/s$

$f_0 = 300$ Hz

V = 330 m/sec.

$$f_A = f_0\left[\frac{V}{V-V_A}\right]=300\left[\frac{330}{330-30}\right]=330Hz$$

$$f_B = f_0\left[\frac{V}{V+V_A}\right]=300\left[\frac{330}{360}\right]=275Hz$$

$$\Delta f = f_A - f_B = 330-275 = 55Hz$$

Ans. : (1)

6. A block of mass m slides down the plane inclined at angle 30° with an acceleration $\frac{g}{4}$. The value of coefficient of kinetic friction will be:

(1) $\frac{1}{2\sqrt{3}}$ (2) $\frac{\sqrt{3}}{2}$ (3) $\frac{2\sqrt{3}+1}{2}$ (4) $\frac{2\sqrt{3}-1}{2}$

Sol. **(1)**

$f_k = \mu N$

$N = mg\cos\theta$

$f_k = \mu\, mg\cos\theta$

$$a = \frac{mg\sin\theta - \mu mg\cos\theta}{m}$$

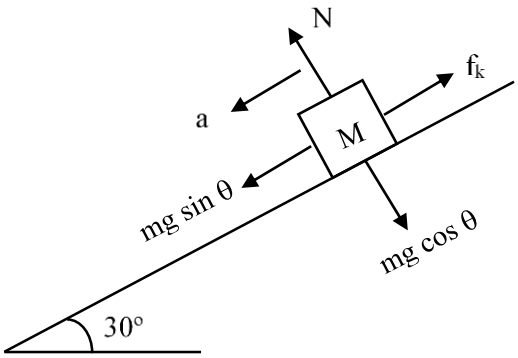
$a = g\sin 30^o - \mu g\cos 30^o$

$$\frac{g}{4} = g\left[\frac{1}{2} - \frac{\sqrt{3}\mu}{2}\right]$$

$$\frac{1}{2} = 1 - \sqrt{3}\mu$$

$$\sqrt{3}\mu = \frac{1}{2}$$

$$\boxed{\mu = \frac{1}{2\sqrt{3}}}$$



Ans. : 1

7. A bicycle tyre is filled with air having pressure of 270 kPa at 27°C. The approximate pressure of the air in the tyre when the temperature increases to 36° C is

(1) 270 kPa (2) 262 kPa (3) 360 kPa (4) 278 kPa

Sol. **(4)**

$PV = nRT$

$n \rightarrow$ const. V = const.

$P \alpha T$,

$P_1 = 270$ kpa,

$T_1 = 27^oC = 300$ K

$P_2 = ?$,

$T_2 = 36^o = 36 + 273 = 309$ K

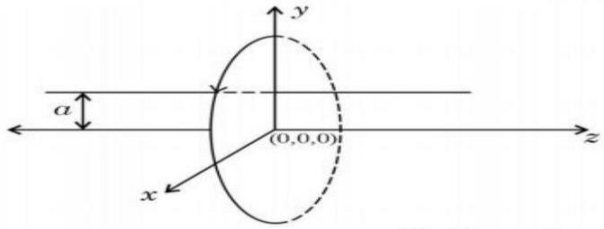
$$\frac{P_2}{P_1} = \frac{T_2}{T_1} \quad \ldots(1)$$

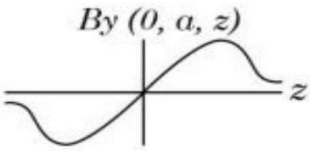
$$\frac{P_2}{270\ KPa} = \frac{309}{300}$$

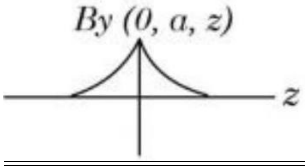
$$P_2 = \frac{103}{100} \times 270KPa \simeq 278KPa$$

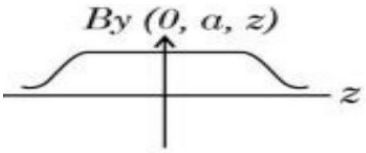
Option : (4)

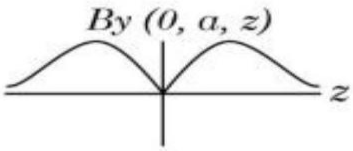
8. A single current carrying loop of wire carrying current I flowing in anticlockwise direction seen from +ve z direction and lying in xy plane is shown in figure. The plot of $\hat{j}$ component of magnetic field (By) at a distance $'a'$ (less than radius of the coil) and on yz plane vs z coordinate looks like



(1) 

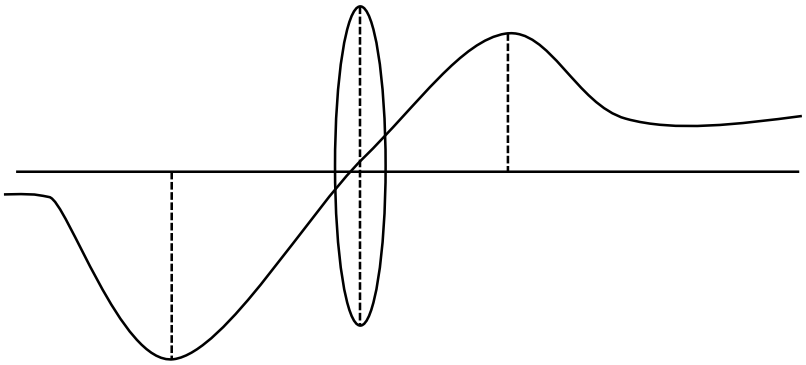
(2) 

(3) 

(4) 

Sol. **(1)**

Theory based concept



9. Surface tension of a soap bubble is 2.0×10^{-2} Nm^{-1}. Work done to increase the radius of soap bubble from 3.5 cm to 7 cm will be:

Take $\left[\pi = \frac{22}{7}\right]$

(1) 9.24×10^{-4} J (2) 5.76×10^{-4} J (3) 0.72×10^{-4} J (4) 18.48×10^{-4} J

Sol. **(4)**

$T = 2.0 \times 10^{-2}$ Nm^{-1}

$r_1 = 3.5$ cm, $r_2 = 7$ cm

$W = T\Delta A \times$ No. of air – liquid surface

$$W = 2T.4\pi\left(r_2^2 - r_1^2\right)$$

$$W = 2 \times 2 \times 10^{-2} \times 4\pi\left[49 - \frac{49}{4}\right] \times 10^{-4}$$

$$W = 16\pi \times 10^{-6} \times 49 \times \frac{3}{4}$$

$W = 1847.26 \times 10^{-6}$

$W = 18.47 \times 10^{-4}$ J

10. Given below are two statements: One is labelled as Assertion **A** and the other is labelled as Reason **R**.

Assertion A: If

dQ and dW represent the heat supplied to the system and the work done on the system respectively.

Then according to the first law of thermodynamics $dQ = dU - dW$.

Reason R: First law of thermodynamics is based on law of conservation of energy.

In the light of the above statements, choose the correct answer from the options given below:

(1) Both A and R are correct and R is the correct explanation of A

(2) A is not correct but R is correct

(3) A is correct but R is not correct

(4) Both A and R are correct but R is not the correct explanation of A

Sol. **(1)**

First law of thermodynamics is based on energy conservation

$dQ = dU + dW$

Here $dW \rightarrow$ work done on the system so volume decreases.

So $dW \rightarrow$ –ve

$dQ = dU - dW$

11. If a radioactive element having half-life of 30 min is undergoing beta decay, the fraction of radioactive element remains undecayed after 90 min. will be

(1) $\frac{1}{8}$ (2) $\frac{1}{2}$ (3) $\frac{1}{4}$ (4) $\frac{1}{16}$

Sol. **(1)**

T = 30 min.

t = 90 min

$$n = \frac{t}{T} = \frac{90\,min}{30\,min} = 3$$

$$N\ (active) = \frac{N_0}{2^n} = \frac{N_0}{2^3} = \frac{N_0}{8}$$

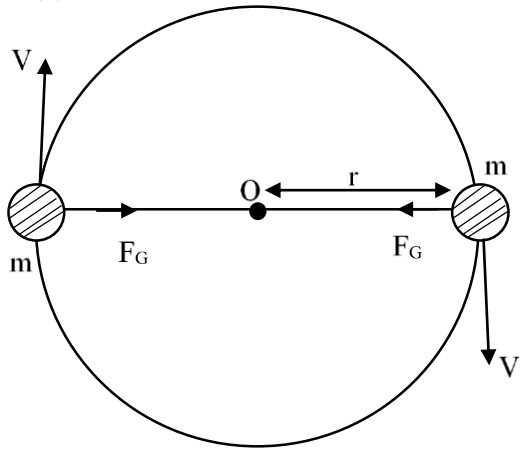
$$\boxed{\frac{N}{N_0} = \frac{1}{8}}$$

12. Two particles of equal mass 'm' move in a circle of radius 'r' under the action of their mutual gravitational attraction. The speed of each particle will be :

(1) $\sqrt{\frac{4Gm}{r}}$ (2) $\sqrt{\frac{Gm}{4r}}$

(3) $\sqrt{\frac{Gm}{r}}$ (4) $\sqrt{\frac{Gm}{2r}}$

Sol. **(2)**



$$\frac{mv^2}{r} = \frac{Gm.m}{(2r)^2}$$

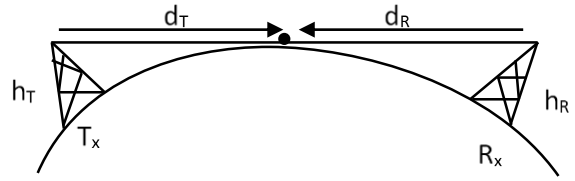
$$\frac{v^2}{r} = \frac{Gm}{4r^2}$$

$$\boxed{V = \sqrt{\frac{Gm}{4r}}}$$

13. If the height of transmitting and receiving antennas are 80 m each, the maximum line of sight distance will be:
Given: Earth's radius = 6.4×10^6 m
(1) 28 km (2) 36 km (3) 32 km (4) 64 km

Sol. **(4)**

$h_T = h_R = h = 80$ m



$d_T = \sqrt{2R.h}$ and $d_R = \sqrt{2R.h}$

Maximum line of sight = $d_T + d_R$

$= \sqrt{2Rh} + \sqrt{2Rh}$

$= 2\sqrt{2Rh} = 2\sqrt{2 \times 6.4 \times 10^6 \times 80}$

$= 2\sqrt{64 \times 16 \times 10^6}$

$= 2 \times 8 \times 4 \times 10^3$

$= 64 \times 10^3 = 64$ km

14. A car is moving on a horizontal curved road with radius 50 m. The approximate maximum speed of car will be, if friction between tyres and road is 0.34. [take $g = 10$ ms^{-2}]
(1) 17 ms–1 (2) 13 ms^{-1} (3) 22.4 ms^{-1} (4) 3.4 ms^{-1}

Sol. **(2)**

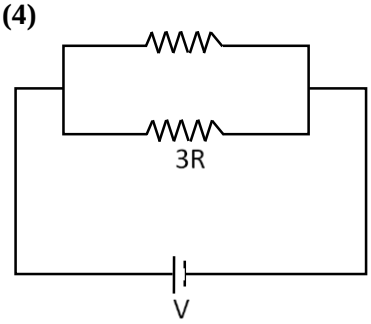
$\mu = 0.34$, R = 50 m

$V = \sqrt{\mu Rg} = \sqrt{0.34 \times 50 \times 10} = \sqrt{34 \times 5} = \sqrt{170} \simeq 13$

15. Ratio of thermal energy released in two resistors R and $3R$ connected in parallel in an electric circuit is :

(1) 1 : 27 (2) 1 : 1 (3) 1 : 3 (4) 3 : 1

Sol. **(4)**



$$H = I^2Rt = \frac{V^2}{R}.t$$

V = const.

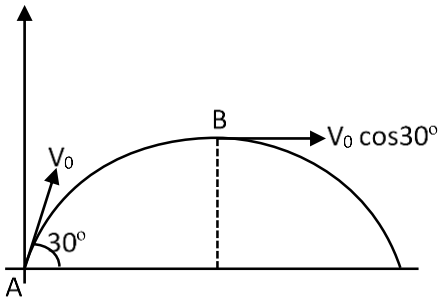
So, $H \alpha \frac{1}{R}$

$$\frac{H_1}{H_2} = \frac{3R}{R} = \frac{3}{1}$$

16. A stone is projected at angle 30° to the horizontal. The ratio of kinetic energy of the stone at point of projection to its kinetic energy at the highest point of flight will be –

(1) 1 : 2 (2) 1 : 4 (3) 4 : 1 (4) 4 : 3

Sol. **(4)**



$$K_A = \frac{1}{2}mV_A^2$$

$$K_A = \frac{1}{2}mV_0^2 \quad \ldots(1)$$

$$K_B = \frac{1}{2}m(V_0 \cos 30^o)^2$$

$$K_B = \frac{m}{2}.V_0^2\frac{3}{4} = \frac{3}{8}mV_0^2 \quad \ldots(2)$$

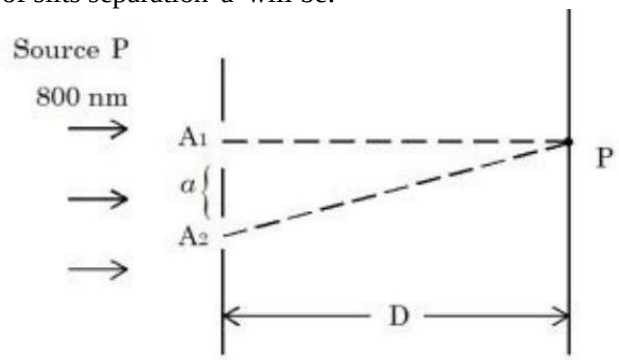
$$\frac{K_A}{K_B} = \frac{\left(\frac{mV_0^2}{2}\right)}{\left(\frac{3mV_0^2}{8}\right)}$$

$$\frac{K_A}{K_B} = \frac{4}{3}$$

17. Which of the following are true?
A. Speed of light in vacuum is dependent on the direction of propagation.
B. Speed of light in a medium is independent of the wavelength of light.
C. The speed of light is independent of the motion of the source.
D. The speed of light in a medium is independent of intensity.
Choose the correct answer from the options given below:
(1) C and D only (2) B and C only (3) A and C only (4) B and D only

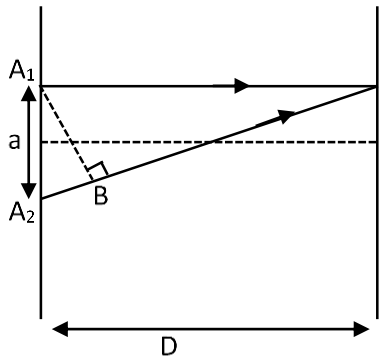
Sol. **(1)**
velocity of light depends on Refractive index of medium and independent of intensity and source.

18. In a Young's double slit experiment, two slits are illuminated with a light of wavelength 800 nm. The line joining A_1P is perpendicular to A_1A_2 as shown in the figure. If the first minimum is detected at P, the value of slits separation 'a' will be:



The distance of screen from slits D = 5 cm
(1) 0.5 mm (2) 0.1 mm (3) 0.4 mm (4) 0.2 mm

Sol. (4)



$(1^{st}\text{ minima})\left(\frac{\beta}{2}\right)$

$$\frac{\beta}{2}=\frac{a}{2}$$

$$\boxed{\beta = a}$$

$$\frac{\lambda D}{a}=a$$

$$\lambda D = a^2$$

$$a^2 = 800\times10^{-9}\times5\times10^{-2}$$

$$a^2 = 4000\times10^{-11}$$

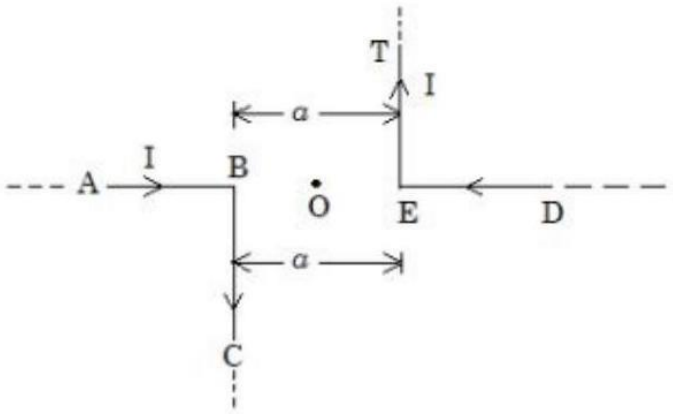
$$a = 2\times10^{-4}$$

$$\boxed{a = 0.2\text{mm}}$$

19. Which one of the following statement is not correct in the case of light emitting diodes?
A. It is a heavily doped p-n junction.
B. It emits light only when it is forward biased.
C. It emits light only when it is reverse biased.
D. The energy of the light emitted is equal to or slightly less than the energy gap of the semiconductor used.
Choose the correct answer from the options given below:
(1) A (2) C and D (3) C (4) B

Sol. **(3)**
Light emitting diode only used in forward bias
Option : 3

20. The magnitude of magnetic induction at mid point O due to current arrangement as shown in Fig will be



(1) $\frac{\mu_0 I}{\pi a}$ (2) $\frac{\mu_0 I}{2\pi a}$ (3) 0 (4) $\frac{\mu_0 I}{4\pi a}$

Sol. **(1)**
Magnetic field due to "AB" and "ED" will be zero
magnetic field due to "BC" and "ET" will be equal in amount and direction.

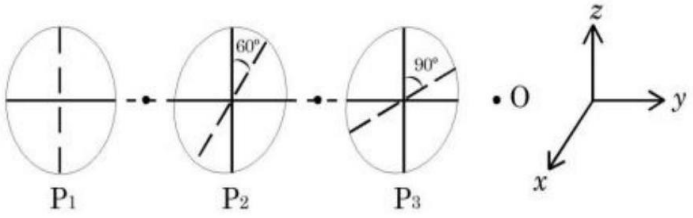
$$'B' \text{due BC} = \frac{\mu_0 I}{4\pi r} = \frac{\mu_0 I}{4\pi \frac{a}{2}} = \frac{\mu_0 I}{2\pi a} \odot \quad \ldots..(1)$$

$$'B' \text{due to TE} = \frac{\mu_0 I}{2\pi a} \odot$$

$$B_{net} \text{at point 'O'} = \left(\frac{\mu_0 I}{2\pi a} + \frac{\mu_0 I}{2\pi a}\right) = \frac{\mu_0 I}{\pi a} \odot \text{ outward}$$

SECTION – B

21. As shown in the figure, three identical polaroids P_1, P_2 and P_3 are placed one after another. The pass axis of P_2 and P_3 are inclined at angle of 60° and 90° with respect to axis of P_1.
The source S has an intensity of $256 \frac{W}{m^2}$. The intensity of light at point O is $-\frac{W}{m^2}$.



Sol. **(24)**

Intensity of source $I_0 = 256\frac{W}{m^2}$

intensity after passing P_1 is $I_1 = \frac{I_0}{2} = 128\frac{W}{m^2}$

intensity after passing P_2 is $I_2 = I_1 \cos^2\theta$

$= (128).\cos^2 60^o$

$128 \times \frac{1}{4} = 32\frac{W}{m^2}$

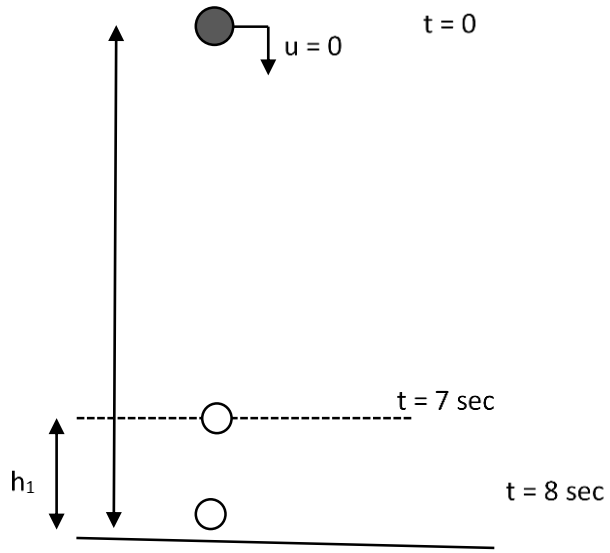
intensity after passing P_3 is $I_3 = I_2 \cos^2\theta$

angle b/w p_2 and $p_3 = 30^o$

So, $I_3 = 32\cos^2 30^o = 32 \times \frac{3}{4} = 24\frac{W}{m^2}$

22. A 0.4 kg mass takes 8 s to reach ground when dropped from a certain height 'P' above surface of earth. The loss of potential energy in the last second of fall is J.
(Take $g = 10\ m/s^2$)

Sol. 300 J



$S = ut + \frac{1}{2}at^2$

$h = 0 + \frac{1}{2}.g(8)^2 = \frac{10}{2} \times 8 \times 8 = 320m$

Distance covered in last second

$h_1 = u + \frac{a}{2}(2n-1)$

$= 0 + \frac{10}{2}[2(8)-1]$

$h_i = 5[15] = 75m$

$\Delta U_{loss} = mg\Delta h$

$\Delta U_{loss} = 0.4 \times 10 \times 75 = 300J$

Ans $\rightarrow$ 300 J

23. Two simple harmonic waves having equal amplitudes of 8 cm and equal frequency of 10 Hz are moving along the same direction. The resultant amplitude is also 8 cm. The phase difference between the individual waves is _____degree.

Sol. **120**

$A_1 = A \quad A_2 = A \quad A_{eq} = A$

$A_1^2 + A_2^2 + 2A_1A_2\cos\phi = A_{eq}^2$

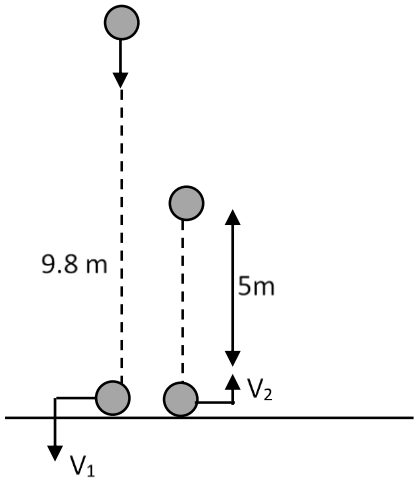
$A^2 + A^2 + 2A^2\cos\phi = A^2$

$1 + 2\cos\phi = 0 \Rightarrow \cos\phi = -\frac{1}{2}$

$\phi = 120$

24. A tennis ball is dropped on to the floor from a height of 9.8 m. It rebounds to a height 5.0 m. Ball comes in contact with the floor for 0.2 s. The average acceleration during contact is ms^{-2}
(Given g = 10 ms^{-2})

Sol. **(120m / sec^2)**



$v_1 = \sqrt{2gh} = \sqrt{2\times10\times9.8} = \sqrt{196}$

$v_1 = 14m/sec$

$v_2 = \sqrt{2gh}$

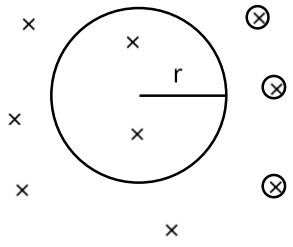
$v_2 = \sqrt{2\times10\times5} = 10m/sec.$

$a_{aug} = \frac{\Delta v}{\Delta t} = \frac{\vec{v}_2 - \vec{v}_1}{\Delta t} = \frac{10-(-14)}{0.2}$

$a_{ay} = \frac{24}{0.2} = 120m/sec^2$

25. A certain elastic conducting material is stretched into a circular loop. It is placed with its plane perpendicular to a uniform magnetic field B = 0.8 T. When released the radius of the loop starts shrinking at a constant rate of $2cms^{-1}$. The induced emf in the loop at an instant when the radius of the loop is 10 cm will be ____ mV.
(Given g = 10 ms^{-2})

Sol. **(10)**



$B = 0.8T$

$\frac{dr}{dt} = 2\text{cms}^{-1}$

$emf = \frac{d\phi}{dt} = \frac{d(BA)}{dt}$

$emf = B\frac{d}{dt}\pi r^2 = \pi B(2r)\frac{dr}{dt}$

$emf = 2\pi Br \cdot (0.02)$

$= 2\pi(0.8)(0.1)\times 0.02$

$= 32\pi \times 10^{-4}$

$= 100.48 \times 10^{-4}$

$= 10.048 \times 10^{-3}$

$= 10.04\text{mV} \approx 10\text{ mV}$

26. A solid sphere of mass 2 kg is making pure rolling on a horizontal surface with kinetic energy 2240 J. The velocity of centre of mass of the sphere will be _____ ms^{-1}

Sol. **(40)**

Mass = 2 kg

K.E = 2240 J

$\text{K.E} = \frac{1}{2}mv_0^2 + \frac{1}{2}I\omega_0^2$

$= \frac{1}{2}mv_0^2 + \frac{1}{2}\cdot\frac{2}{5}mR^2\cdot\frac{v_0^2}{R^2}$

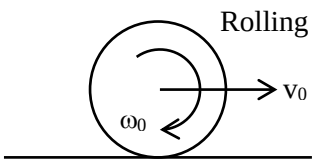
$= \frac{1}{2}mv_0^2 + \frac{mv_0^2}{5}$

$\text{K.E} = \frac{7}{10}mv_0^2$

$2240 = \frac{7}{10}\times 2\times v_0^2$

$v_0^2 = \frac{22400}{14} = 1600$

$\boxed{v_0 = 40\text{ m/sec}}$



27. A body cools from 60°C to 40°C in 6 minutes. If, temperature of surroundings is 10°C. Then, after the next 6 minutes, its temperature will be °C.

Sol. **(28)**

$60°C \xrightarrow[6\text{ min}]{} 40°C \xrightarrow[6\text{ min}]{} T \qquad T_0 = 10°C$

$\frac{\Delta T}{\Delta t} = k(T - T_0)$

$\frac{(60-40)}{6\text{min}} = k[50-10]$ …(1)

And $\frac{(40-T)}{6\text{min}} = K\left[\frac{40+T}{2} - 10\right]$ …(2)

(1) / (2)

$\frac{20}{40-T} = \frac{40}{\left(\frac{40+T-20}{2}\right)}$

$$\frac{20}{40-T}=\frac{40\times 2}{20+T}$$

$(20 + T) = (40 – T)4$

$20 + T = 160 – 4T \Rightarrow ST = 140$

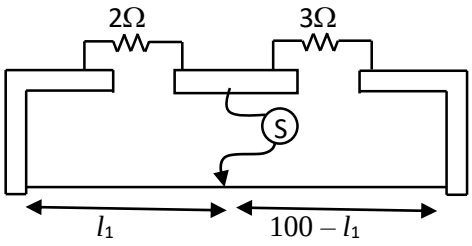
$T = \frac{140}{5} = 28°C$

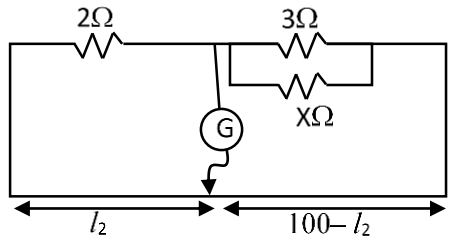
28. In a metre bridge experiment the balance point is obtained if the gaps are closed by 2Ω and 3Ω. A shunt of XΩ is added to 3Ω resistor to shift the balancing point by 22.5 cm. The value of X is -

Sol. **x = 2**

$$\frac{2}{\ell_1}=\frac{3}{100-\ell_1}$$

$200 – 2\ell_1 = 3\ell_1$





$200 = 5\ell_1$

$\boxed{\ell_1 = 40\,\text{cm}}$

Now $\ell_2 = \ell_1 + 22.5$

$\ell_2 = 40 + 22.5 = 62.5$ cm

$$\text{So, } \frac{2}{62.5}=\frac{\left(\frac{3\cdot x}{3+x}\right)}{37.5}\Rightarrow (37.5)\times 2=\frac{(62.5)(3x)}{3+x}$$

$$3+x=\frac{(62.5)}{25}x$$

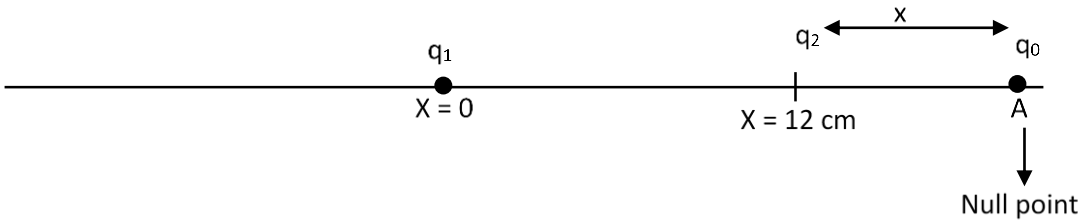
$3 + x = 2.5\,x$

$3 = 1.5x \Rightarrow \boxed{x = 2}$

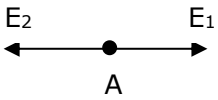
29. A point charge $q_1 = 4q_0$ is placed at origin. Another point charge $q_2 = -q_0$ is placed at = 12 cm. Charge of proton is q_0. The proton is placed on x axis so that the electrostatic force on the proton is zero. In this situation, the position of the proton from the origin is _____ cm.

Sol. **24**

$q_1 = 4q_0 \text{ and } q_2 = -q_0$



Electric field at point A will be zero.



$|\vec{E_1}| = |\vec{E_2}|$

$\frac{kq_1.q_0}{(12+x)^2} = \frac{kq_2.q_0}{x^2}$

$\frac{4q_0}{(12+x)^2} = \frac{q_0}{x^2}$

$4x^2 = (12 + x)^2$

$\pm 2x = (12 + x)$

$2x = 12 + x$ $\qquad$ $-2x = 12 + x$

$x = 12$ $\qquad$ $-3x = 12$

$x = 12$ cm $\qquad$ $x = x = -\frac{12}{3} = -4$

Position of proton from origin will be $\rightarrow 12 + 12$

$\rightarrow 24\text{cm}$

30. A radioactive element ${}^{242}_{92}X$ emits two α –articles, one electron and two positrons. The product nucleus is represented by ${}^{234}_{P}Y$. The value of P is

Sol. **(87)**

${}_{92}X^{242} \longrightarrow {}_{P}Y^{234} + 2_2\alpha^4 + {}_{-1}e^0 + 2_{+1}e^0$

Using charge conservation:

92 = P + 2(2) + (-1) + 2(1)

92 = P + 5

$\boxed{P = 87}$ Ans.

Perfect mix of
CLASSROOM Program aided
with technology for sure SUCCESS.

Continuing the legacy
for the last 16 years

MOTION LEARNING APP

Get 7 days **FREE** trial & experience Kota Learning

मोशन है, तो भरोसा है।

#RankBhiSelectionBhi

ADMISSION ANNOUNCEMENT

Session 2023-24 (English & हिन्दी Medium)

Target: JEE/NEET 2025
Nurture & प्रयास Batch
Class 10th to 11th Moving

Target: JEE/NEET 2024
Enthuse & प्रयास Batch
Class 11th to 12th Moving

Target: JEE/NEET 2024
Dropper & प्रयास Batch
Class 12th to 13th Moving

Target: PRE FOUNDATION
SIP, Evening & Tapasya Batch
Class 6th to 10th Students

MOTION®