JEE-Main-21-01-2026 (Memory Based)
[MORNING SHIFT]
Physics

Question: Two ideal springs S_1 and S_2 are connected in parallel between a rigid support and a massless plate. Their spring constants are measured as
$k_1 = (a \pm \triangle a)$, $k_2 = (b \pm \triangle b)$
where $\triangle a$ and $\triangle b$ represent maximum absolute errors. The effective spring constant of the combination and the maximum absolute error in it are:

Options:
(a) $((a + b) \pm (\triangle a - \triangle b))$
(b) $((a + b) \pm (\triangle a + \triangle b))$
(c) $((ab)/(a + b) \pm (\triangle a + \triangle b))$
(d) $((ab)/(a + b) \pm (\triangle a - \triangle b))$
Answer: (b)
Solution:

For springs in parallel:

$$k_{eq} = k_1 + k_2$$

Given:

$$k_1 = (a \pm \Delta a), \quad k_2 = (b \pm \Delta b)$$

So,

$$k_{eq} = (a + b)$$

For maximum absolute error in a sum:

$$\Delta k_{eq} = \Delta a + \Delta b$$

Hence,

$$\boxed{k_{eq} = ((a + b) \pm (\Delta a + \Delta b))}$$

Correct option: (B)

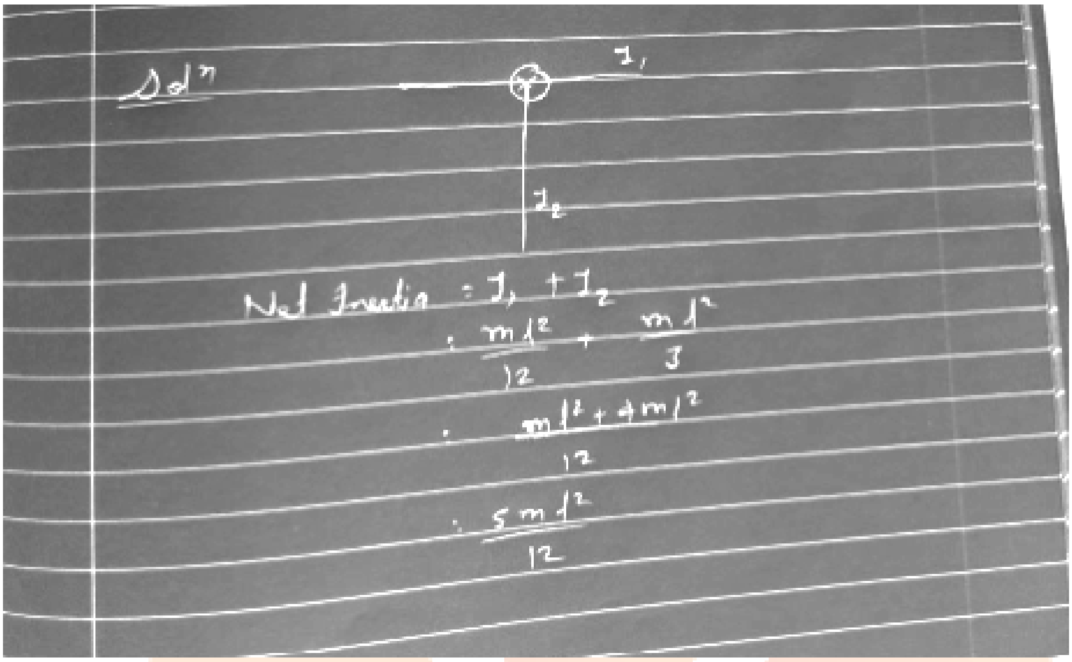
Question: Find the moment of inertia of a T shaped. Object formed by joining two rods of equal length about an axis which is passing through the junction and which is perpendicular to the object's plane. Consider mass of rod as M & length as L.
Options:
(a) $\frac{5ml^2}{12}$
(b) $\frac{3ml^2}{7}$

(c) $\frac{3ml^2}{5}$

(d) ml^2

Answer: (a)

Solution:



Sol^n

I_1

I_2

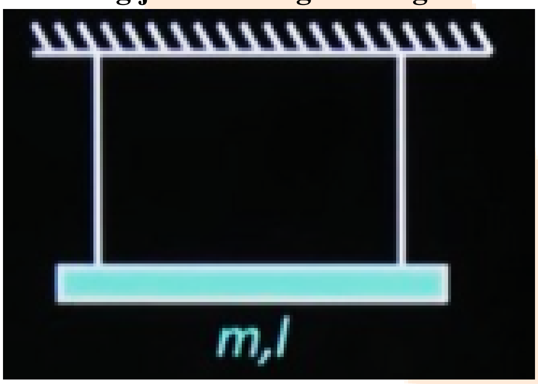
Net Inertia $= I_1 + I_2$

$= \frac{ml^2}{12} + \frac{ml^2}{3}$

$= \frac{ml^2 + 4ml^2}{12}$

$= \frac{5ml^2}{12}$

Question: A rod of mass m and length l is attached to two ideal strings. Find tension in left string just after right string is cut.



Options:

(a) $\frac{mg}{2}$

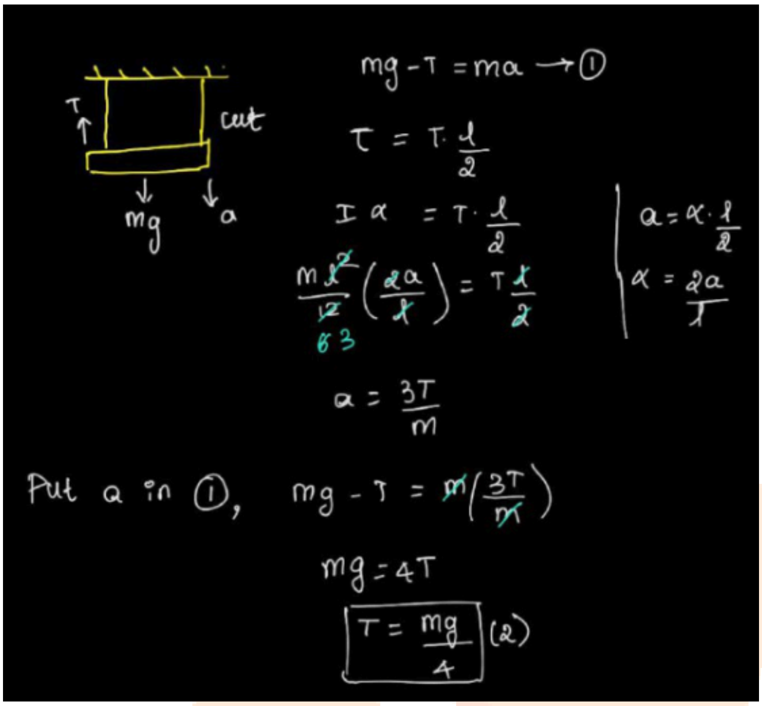
(b) $\frac{mg}{4}$

(c) $\frac{2}{3}mg$

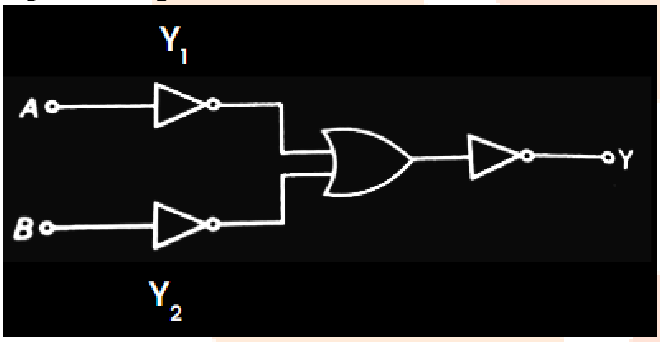
(d) $\frac{mg}{5}$

Answer: (b)

Solution:



Question: Figure shows a logic gate circuit. Identify the GATE which the circuit is representing.



Options:

(a) XOR

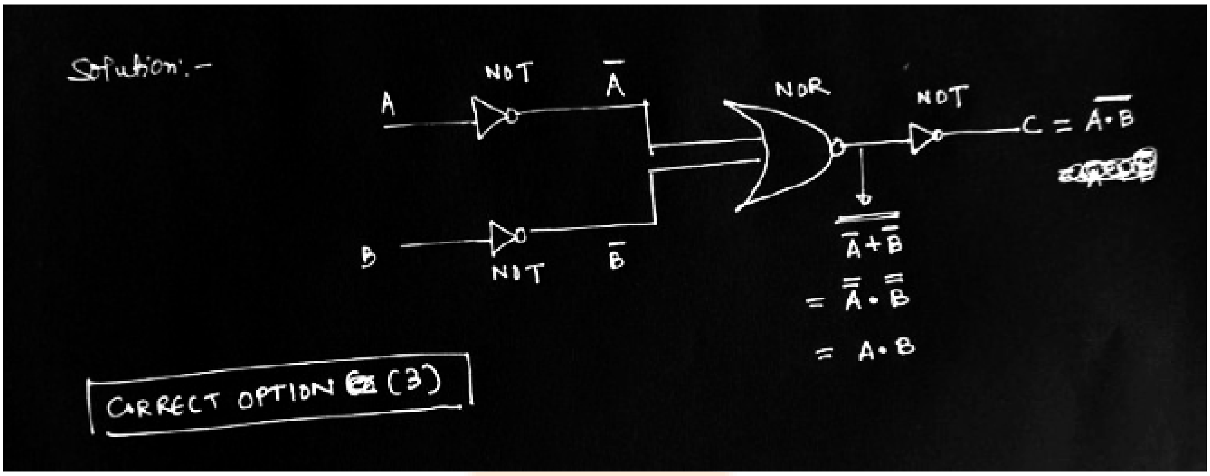
(b) NOR

(c) NAND

(d) OR

Answer: (c)

Solution:



Question: In a Certain Fluid flow the following relation holds

$\frac{A}{B}$ if $\left(P+\frac{At^2}{B}\right)+\frac{1}{2}\rho V^2=\text{constant},$ **where P is pressure, ρ is density, V is speed.**

Dimension of A/B are?

Options:

(a) ML^1T^{-4}

(b) $ML^{-1}T^{-4}$

(c) ML^2T^{-4}

(d) $ML^{-1}T^{-2}$

Answer: (b)

$$[P]=\left[\frac{At^2}{B}\right]$$

$$\left[\frac{A}{B}\right]=\frac{[\rho]}{[t^2]}=\frac{[M^1L^{-1}T^{-2}]}{[T^2]}=[M^1L^{-1}T^{-4}]$$

Question: An ideal gas sample contains 10 moles of O_2. Its molar heat capacity at constant pressure is 7 cal mol^{-1} K^{-1} and R is 2 cal mol^{-1} K^{-1}. The internal energy of the gas at temperature T K is:

Options:

(a) 50T cal

(b) 50T cal

(c) 50T cal

(d) 50T cal

Answer: (a)

Solution:

Concise Solution

For an ideal gas:

$$C_v = C_p - R = 7 - 2 = 5 \text{ cal mol}^{-1}\text{K}^{-1}$$

Internal energy:

$$U = nC_vT = 10 \times 5 \times T = 50T \text{ cal}$$

✅ **Correct option: (A) $50T$ cal**

Question: Find the heat dissipated across the wheatstone bridge circuit (about AB) in the given circuit for a time interval of 1 second.

Options:

(a) 18 J

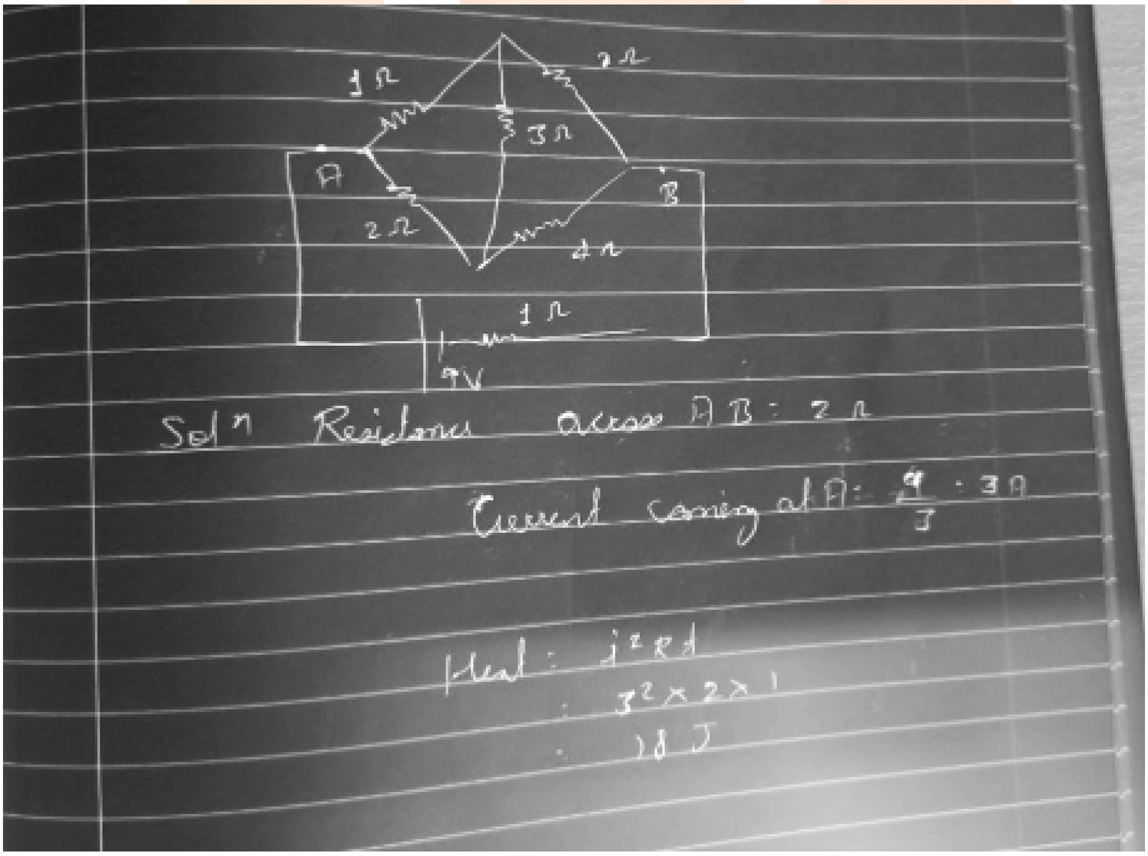
(b) 54 J

(c) 27 J

(d) 16 J

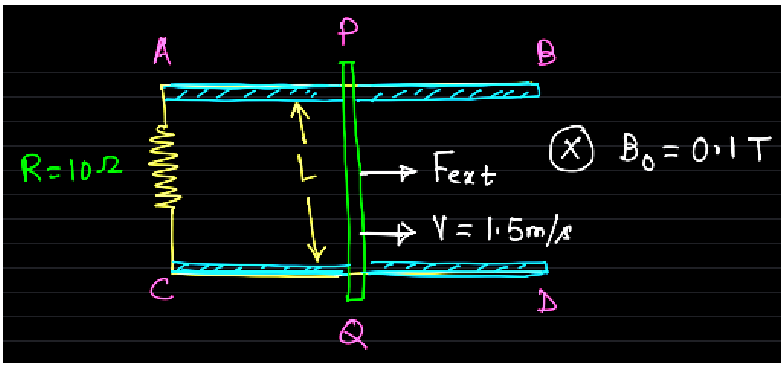
Answer: (a)

Solution:



Question: Consider two smooth parallel conducting rails AB & CD bridged by a 10 Ω resistor. A Conducting rod PQ Length L is placed over the two rails perpendicular as shown. The region consists of a uniform magnetic field of intensity 0.1 T perpendicular to the plane of figure & going inside. A constant force F_{ext} is required to pull the rod towards right so that it acquires a constant speed V = 1.5 m/A. Find the valve of F_{ext}.

Vedantu

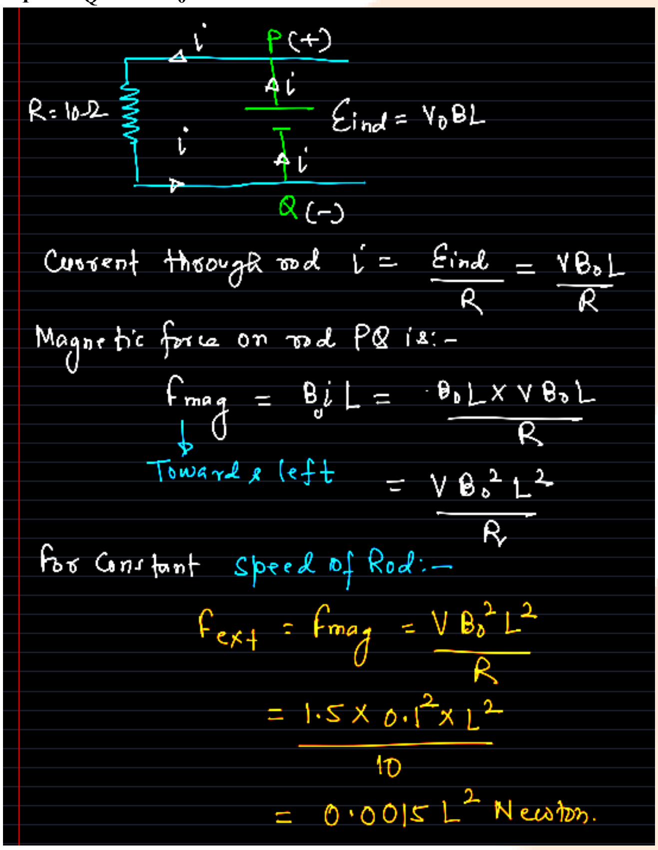


Answer: (0.0015 L^2 N)

Solution:

Motional emf across end of rod PQ is:-

$V_P - V_Q = VB_0L$ = Find



$R = 10\Omega$, P(+), Q(−), i

$\mathcal{E}_{ind} = V_0BL$

Current through rod $i = \dfrac{\mathcal{E}_{ind}}{R} = \dfrac{VB_0L}{R}$

Magnetic force on rod PQ is:-

$f_{mag} = B i L = \dfrac{B_0L \times VB_0L}{R} = \dfrac{VB_0^2L^2}{R}$

Towards left

For Constant speed of Rod:-

$f_{ext} = f_{mag} = \dfrac{VB_0^2L^2}{R}$

$= \dfrac{1.5 \times 0.1^2 \times L^2}{10}$

$= 0.0015\, L^2$ Newton.

Question: Two strings of length l_A and l_B having Linear mass densities of μ_A and μ_B. Tension in both Strings is 500 N. A transverse pulse is been generated in both of them. Find ratio of time taken by pulse in string.

Answer: ($\therefore \dfrac{t_A}{t_B} = \dfrac{L_A}{L_B}\sqrt{\dfrac{\mu_A}{\mu_B}}$)

Solution:

Ans:- $\frac{t_A}{t_B} = ?$

$t_A = \frac{L_A}{v_A}$; $t_B = \frac{L_B}{v_B}$

$v_A = \sqrt{\frac{T}{\mu_A}}$; $v_B = \sqrt{\frac{T}{\mu_B}}$

$\frac{L_A}{v_A} \times \frac{v_B}{L_B}$

$\frac{v_A}{v_B} = \sqrt{\frac{\mu_B}{\mu_A}}$

$\boxed{\therefore \frac{t_A}{t_B} = \frac{L_A}{L_B}\sqrt{\frac{\mu_A}{\mu_B}}}$ Ans

Question: A particle of mass m = 4 kg moves in the xy-plane under a time-dependent force $\vec{F}(t) = 4t^3\hat{i} - 3t^2\hat{j}$ **(SI units).**

At t = 0, the particle is at the origin and at rest. The velocity $\vec{v}$ **and displacement** $\Delta\vec{r}$ **at t = 2s are:**

Options:

(a) $\vec{v} = \left(4\hat{i} - 2\hat{j}\right)ms^{-1}, \Delta\vec{r} = \left(\frac{8}{5}\hat{i} - \hat{j}\right)m$

(b) $\vec{v} = \left(2\hat{i} - 4\hat{j}\right)ms^{-1}, \Delta\vec{r} = \left(\frac{8}{5}\hat{i} - \hat{j}\right)m$

(c) $\vec{v} = \left(4\hat{i} + 2\hat{j}\right)ms^{-1}, \Delta\vec{r} = \left(\frac{8}{5}\hat{i} + \hat{j}\right)m$

(d) $\vec{v} = \left(8\hat{i} - 4\hat{j}\right)ms^{-1}, \Delta\vec{r} = \left(\frac{16}{5}\hat{i} - 2\hat{j}\right)m$

Answer: (a)

Solution:

$$\vec{a} = \frac{\vec{F}}{m} = t^3\hat{i} - \frac{3}{4}t^2\hat{j}$$

Using $\vec{v}(0) = 0$:

$$v_x = \int t^3 dt = \frac{t^4}{4}, \qquad v_y = \int -\frac{3}{4}t^2 dt = -\frac{t^3}{4}$$

$$\Rightarrow \vec{v}(2) = (4\hat{i} - 2\hat{j}) \text{ m s}^{-1}$$

Using $\Delta\vec{r} = \int \vec{v}\, dt$ and $\vec{r}(0) = 0$:

$$\Delta x = \int \frac{t^4}{4} dt = \frac{t^5}{20}, \qquad \Delta y = \int -\frac{t^3}{4} dt = -\frac{t^4}{16}$$

$$\Rightarrow \Delta\vec{r}(2) = \left(\frac{8}{5}\hat{i} - \hat{j}\right) \text{ m}$$

Question: Find the work done in moving a satellite from an orbit whose radius is $R_{\in}$ to an orbit where radius is $3/2R_{\in}$, where mass of planet is M & mass of satellite is m and $R_{\in}$ is radius of planet.

Options:

(a) $\frac{GMm}{6R_{\in}}$

(b) $\frac{GMm}{5R_{\in}}$

(c) $-\frac{GMm}{R_{\in}}$

(d) $\frac{GMm}{R_{\in}}$

Answer: (a)

Solution:

Sol^n W = Change in total Energy

$= E_f - E_i$

$= \frac{-GMm}{2 \times \frac{3}{2} R_E} - \left(\frac{-GMm}{2 \times R_E}\right)$

$= -\frac{GMm}{3R_E} + \frac{GMm}{2R_E}$

$= \frac{-2GMm + 3GMm}{6R_E}$

$= \frac{GMm}{6R_E}$

Question: A fixed charge ‘Q’ of 1 c at origin. The work done in moving a charge of 2 μc from Point A (4, 4, 2) to point B (2, 2, 1) is _______ J.
Answer: (Ans : 3000 J)
Solution:

Ans:-

$$U = \frac{kq_1q_2}{r}$$

$$U_i = \frac{k(1)(2\times10^{-6})}{\sqrt{4^2+4^2+2^2}} = \frac{k(2\times10^{-6})}{6}$$

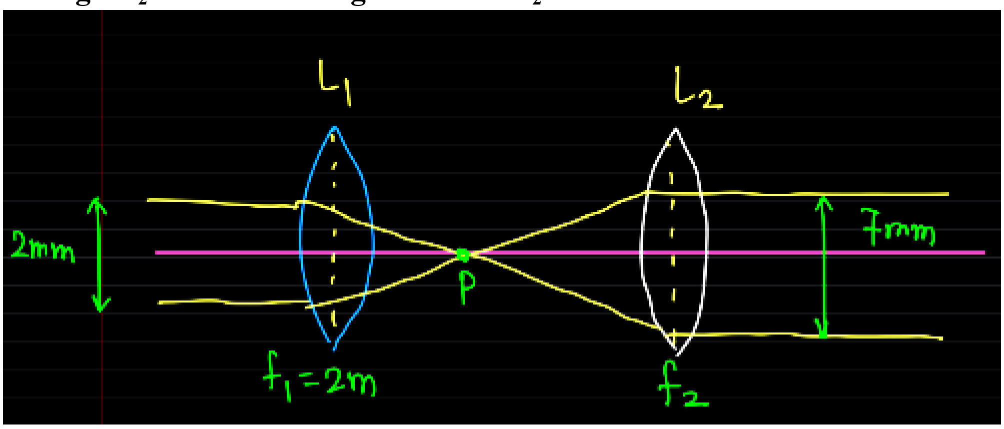
$$U_f = \frac{k(2\times10^{-6})}{\sqrt{2^2+2^2+1^2}} = \frac{k(2\times10^{-6})}{3}$$

$$W = U_f - U_i = k(2\times10^{-6})\left[\frac{1}{3}-\frac{1}{6}\right]$$

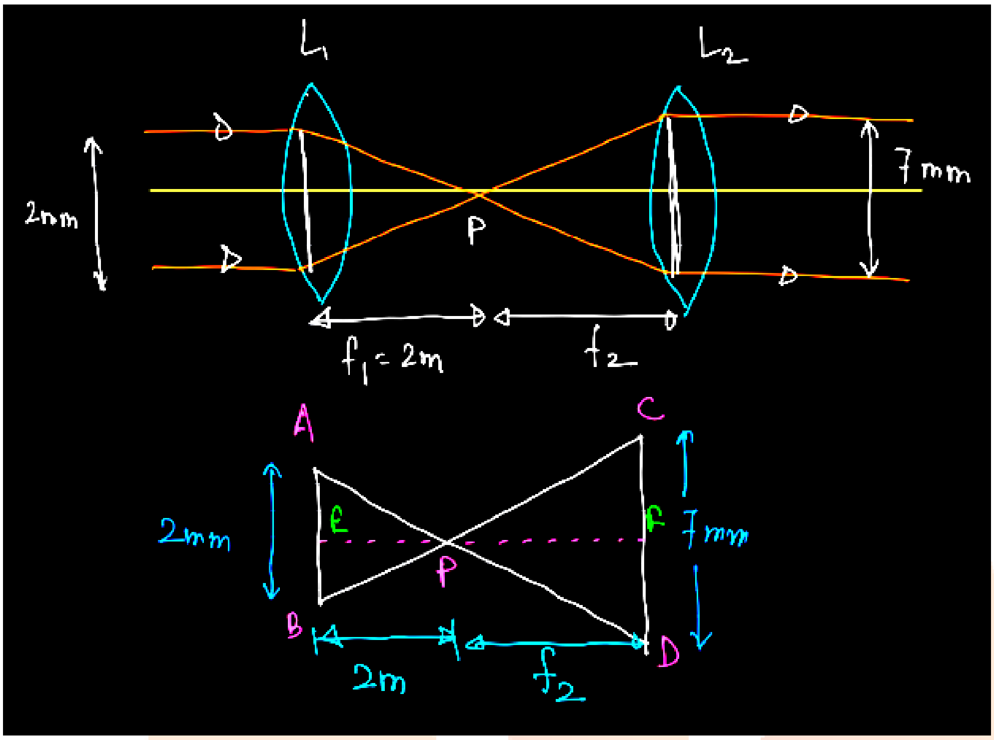
$$W = 18\times10^{3}\left[\frac{1}{6}\right] = 3\times10^{3}$$

$$\boxed{W = 3000\ J}$$

Question: Consider a system of two coaxial Convex lenses L_1 & L_2 having focal length f_1 = 2 mm & f_2 (unknown) respectively. A parallel beam of Light having diameter 2 mm is incident on L_1 & it emerges out at parallel beam of diameter 7 mm after refraction through L_2. Find focal length of Lens L_2.



Answer: (7 m)
Solution:
Point P is the Common focus of L_1 & L_2



From similar Δ:—

$$\frac{AB}{CD} = \frac{EP}{PF}$$

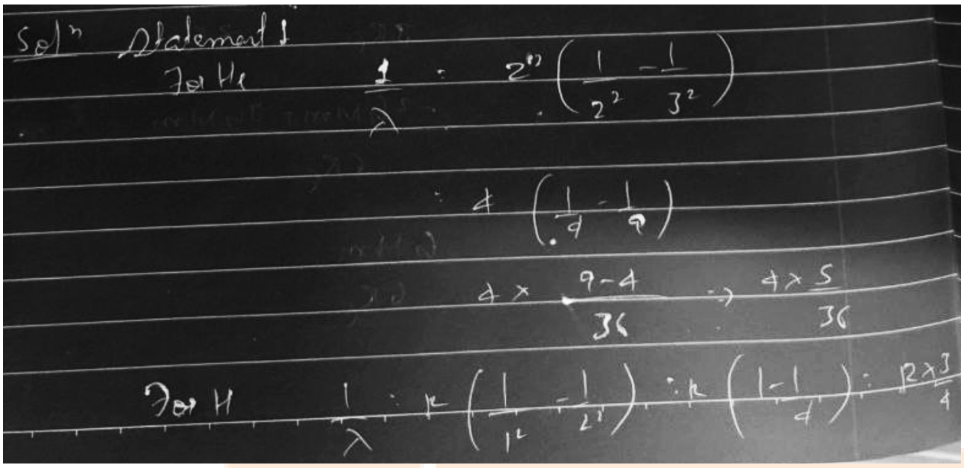
$$\Rightarrow \frac{2}{7} = \frac{2}{f_2}$$

$$\Rightarrow f_2 = 7m$$

Hence focal length of L_2 is 7m

Question: Statement 1:- During transition of on electron in an Helium ion (He^+) from orbit 3 to 2, the wavelength of the photon released in equal to the wavelength of the photon which is released in the transition from 2 to 1 in hydrogen.
Statement 2:- When a H_2 molecules dissociated into respective atom, energy is released.
Options:
(a) Statement 1 & 2 both are correct

(b) Statement 1 is correct but 2 is incorrect
(c) Statement 1 is incorrect but 2 is correct
(d) Both are incorrect
Answer: (c)
Solution:


Sol^n Statement I

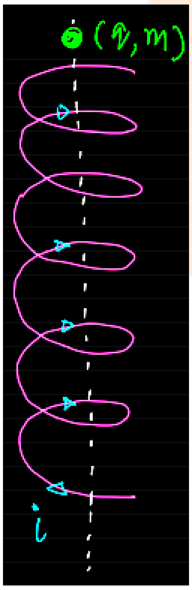
For He $\frac{1}{\lambda} = Z^2 R\left(\frac{1}{2^2} - \frac{1}{3^2}\right)$

$= 4\left(\frac{1}{4} - \frac{1}{9}\right)$

$= 4 \times \frac{9-4}{36} \rightarrow \frac{4 \times 5}{36}$

For H $\frac{1}{\lambda} = R\left(\frac{1}{1^2} - \frac{1}{2^2}\right) = R\left(1 - \frac{1}{4}\right) = \frac{R \times 3}{4}$

Question: Figure shows a long Current Carrying solenoid. A charge partide having charge q & mass m is released from one end of the solenoid in vertical plane as shown. If "a" denotes acceleration of charge while passing the solenoid & “g" denotes acceleration due to gravity then choose the Correct option.

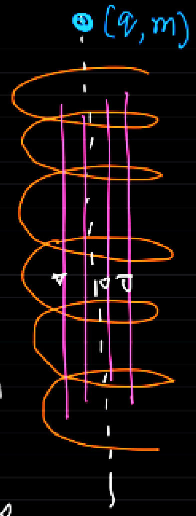


Options:
(a) a = g
(b) a = 0
(c) 0 < a < g
(d) a > g
Answer: (a)
Solution:

- Inside the long solenoid, magnetic field is uniform & parallel to axis. Since charge is released from rest initially no magnetic force can act as $V = 0$. So under gravity, charge will be accelerated with accn g. Once it acquires velocity; magnetic force is still zero as $\vec{V}$ & $\vec{B}$ are parallel by the equation

$$F = qVB \sin 0^\circ = 0$$

Hence charge will experience only gravitational force hence its accn will be equal to g.



Question: A conducting circular loop of area 1m^2 is placed perpendicular to a magnetic field which varies as B = sin(100t) If resistance of loop is 100 Ω then the average thermal energy dissipated in the loop in one period is

Options:

(a) 2π

(b) π

(c) π^2

(d) $\pi/2$

Answer: (b)

Solution:

Ans:

$$\phi = BA = (\sin 100t) \times 1$$

$$\phi = \sin 100t$$

$$e = -\frac{d\phi}{dt} = 100 \cos 100t$$

$$I = \frac{e}{R} = \frac{\cancel{100} \cos 100t}{\cancel{100}} = \cos 100t$$

Power, $P = I^2R$

$$= \cos^2(100t) \times 100 = 100 \cos^2 100t$$

$$\langle \cos^2 \rangle = \frac{1}{2} \quad \Big| \quad P_{avg} = 100 \times \frac{1}{2} = 50$$

Time Period, $T = \frac{2\pi}{\omega} = \frac{2\pi}{100} = \frac{\pi}{50}$

Average thermal energy, $E = P_{avg} \times T$

$$= 50 \times \frac{\pi}{50}$$

$$\boxed{E = \pi} \text{ Ans}$$

Question: In a double slit experiment the distance between the slits is 0.1 cm & the screen is placed at a distance of 50 cm from the slits. If one slit is covered with a glass slab of refractive index 1.5 and thickness ‘t’ then central bright fringe shift by 0.2 cm. Find the value of ‘t’.

Options:

(a) 0.0008 cm

(b) 0.0001 cm

(c) 0.0006 cm

(d) 0.0005 cm

Answer: (a)

Solution:

$$\text{Shift} = (\mu - 1)\, t\, \frac{D}{d}$$

$$0.2 = 0.5 \times t \times \frac{50}{0.1}$$

$$\frac{0.2}{250} = t$$

Question: An α-particle having K.E. = 7.7 MeV is approaching fixed gold nucleus (Z = 79). Find distance of closest approach.

Options:

(a) 20 fm
(b) 25 fm
(c) 30 fm
(d) 15 fm
Answer: (c)
Solution:

Distance of closest approach is:-

$$r_{min} = \frac{2kZe^2}{KE_i}$$

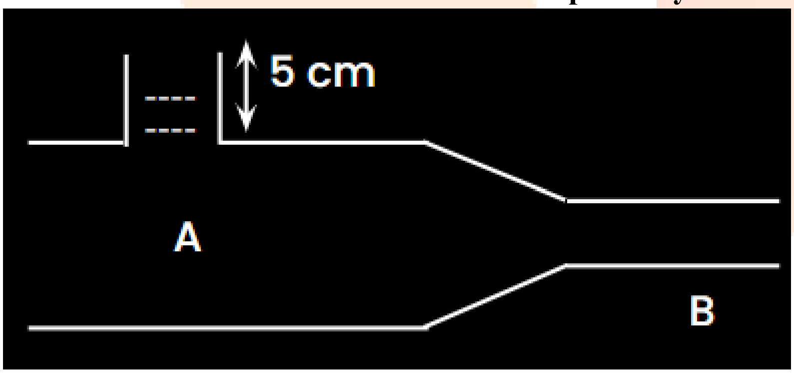
$$= \frac{2\times 9\times 10^{9} \times 79 \times (1.6\times 10^{-19})^2}{7.7\times 10^{6}\times 1.6\times 10^{-19}}$$

$$= 295.48\times 10^{9}\times 10^{-6}\times 10^{-19}\times 10^{9} \text{ nm}$$

$$= 295.48\times 10^{-7} \text{ nm}$$

No option matching.

Question: Find volume flow rate in the given venturi meter.
Cross sectional area at A & B is A & a respectively and A/a = 2; 4A : √3 m^2.



Options:
(a) 0.25 m^3/s
(b) 1 m^3/s
(c) 2 m^3/s
(d) 3 m^3/s
Answer: (a)
Solution:

Sol^n $\quad \rho g h + \frac{1}{2}\rho v_A^2 = \frac{1}{2}\rho v_B^2$

$\cancel{\rho} g h = \frac{1}{2}\cancel{\rho}(v_B^2 - v_A^2)$

$A v_A = a v_B$ $\quad = \frac{1}{2} \times (4v_A^2 - v_A^2)$

$2v_A = v_B$ $\quad gh = \frac{1}{2} \times 3v_A^2$

$\sqrt{\frac{2gh}{3}} = v_A$

$R = v_A \times \frac{\sqrt{3}}{4}$

Question: Electric field equation of a plane electromagnetic wave is given as:

$$\vec{E} = 69\sin(\omega t - kx)\hat{j}.$$

Find the direction of propagation of magnetic field vector.

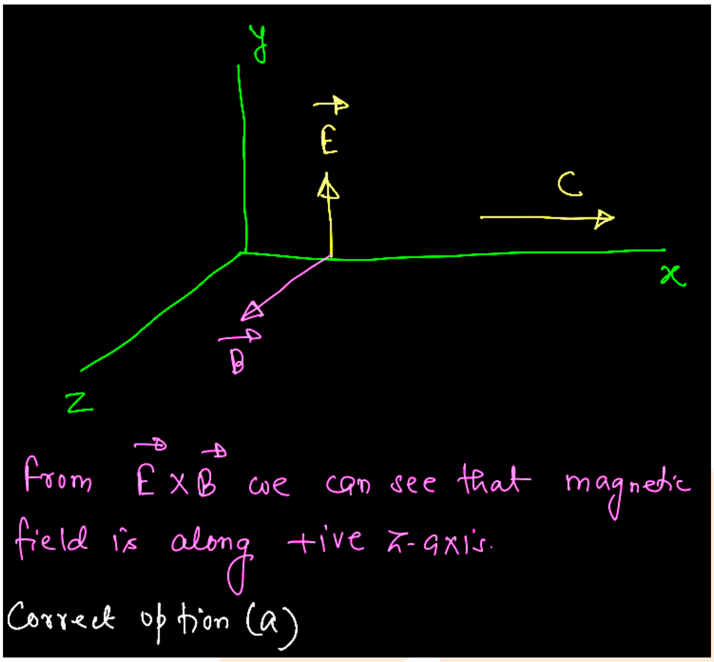
Options:

(a) Along +ve z-axis
(b) Along -ve z-axis
(c) Along -ve x-axis
(d) Along +ve y-axis

Answer: (a)

Solution:

EM wave is propagating along +ive x-axis at ωt & kx have opposite sign.
Electric field vector is oscillating along +ive y-axis.



Question: Two rods of equal length of 60 cm each are joined together end to end. Coefficient of linear expansion of rods are 24×10^{-6} °C^{-1} and 1.2×10^{-5} °C^{-1}. Their temperatures are same and equal to 30°C, which is increased to 100°C. Find final length of combination (in cm).

Options:

(a) 120.1321

(b) 120.1123

(c) 120.1512

(d) 120.1084

Answer: (c)

Solution:

$$\Delta L_{total} = \Delta L_1 + \Delta L_2$$

$$= L_1 \alpha_1 \Delta T + L_2 \alpha_2 \Delta T$$

$$= 70\left[60 \times 24 \times 10^{-6} + 60 \times 1.2 \times 10^{-5}\right]$$

$$= 70 \times 60 \times 10^{-6}\left[24 + 12\right]$$

$$\Delta L_{total} = 0.1512 \text{ cm}$$

$$\Delta T = T_2 - T_1$$

$$= 100 - 30$$

$$= 70$$

$$\therefore L_{final} = 120 + 0.1512 = 120.1512 \text{ cm}$$

$$\boxed{L_{final} = 120.1512 \text{ cm}}$$ Ans