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JEE Main (2024)

MEMORY BASED PAPER SOLUTION

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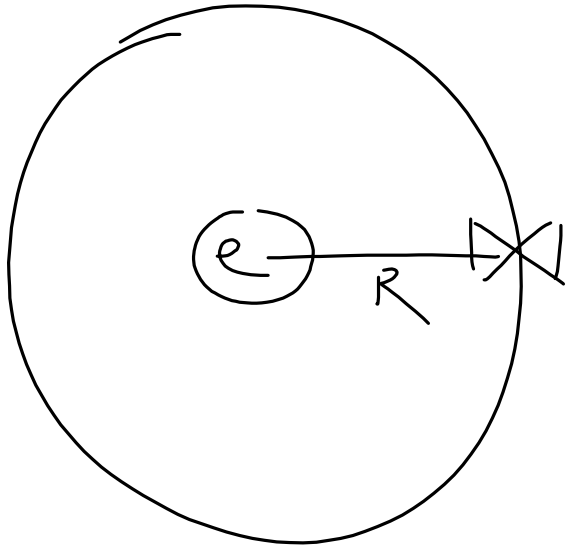
PHYSICS

Q. The ratio of KE : PE of an e^- in 5th orbit ?

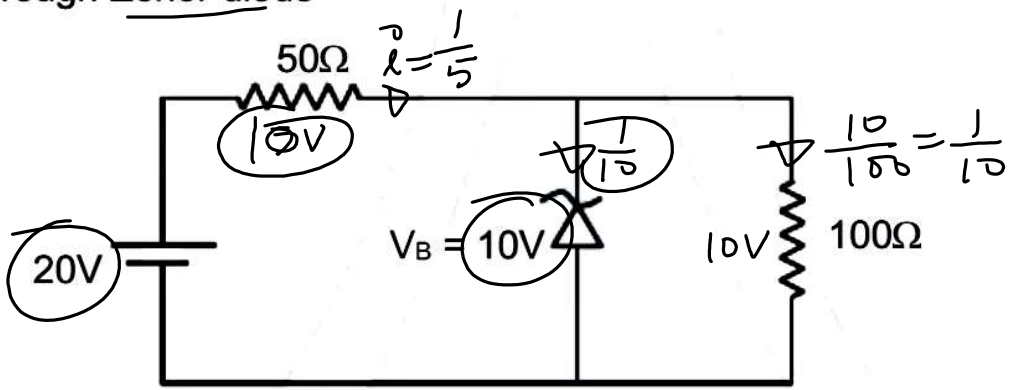
(1) $\frac{1}{2}$ (2) $-\frac{1}{2}$ (3) 2 (4) – 2

$TE = -KE = \frac{PE}{2}$

$\frac{KE}{PE} = -\frac{1}{2}$



Q. Find current through Zenor diode



(1) $\frac{1}{10}$ A (2) $\frac{1}{5}$ A (3) $\frac{1}{20}$ A (4) 1A

Q. At what temp $(V_{rms})_{H_2}$ is same as $(V_{rms})_{O_2}$ at temperature 47°C.

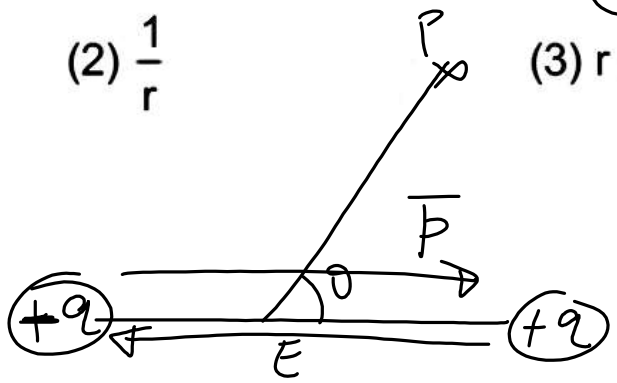
(1) 94 K (2) 293 K (3)20 K (4) 40K

$$V_{rms\,H_2} = \sqrt{\frac{3RT_{H_2}}{2\times10^{-3}}} = V_{rms\,O_2} = \sqrt{\frac{3R\times320}{32\times10^{-3}}}$$

$$T_{H_2} = 20\,K$$

Q. The electrostatic potential due to a dipole at a distance r varies as :-

(1) $\frac{1}{r^2}$ (2) $\frac{1}{r}$ (3) r (4) r^2



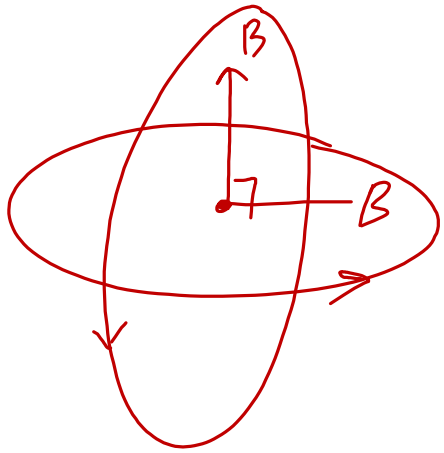
$$V_p = \frac{Kp\cos\theta}{r^2}$$

Q. If young's modulus of a wire is Y and Its length is 'L' and its cross sectional area is 'A'. If the length of the wire is doubled and cross sectional area is halved then young's modulus of the wire will be?

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

Q. Two current carrying ring of radius 'R' are mutually perpendicular and their centre coincide. Find net magnetic field at the centre.

(1) $\frac{\mu_0 I}{4R}$ (2) $\frac{\mu_0 I}{R}$ (3) $\frac{\sqrt{2}\mu_0 I}{R}$ (4) $\frac{\mu_0 I}{\sqrt{2}R}$



$B\sqrt{2}$

$\frac{\mu_0 I}{2R}\sqrt{2}$

$\frac{\mu_0 I}{\sqrt{2}R}$

Q. If work function of a material is 3eV then find maximum wavelength for which photoelectric effect takes place.

(1) 0.30 μm (2) 0.41 μm (3) 0.60 μm (4) 0.1 μm

$\phi = h\nu_0$

$\nu_0 = \frac{c}{\lambda_{max}}$

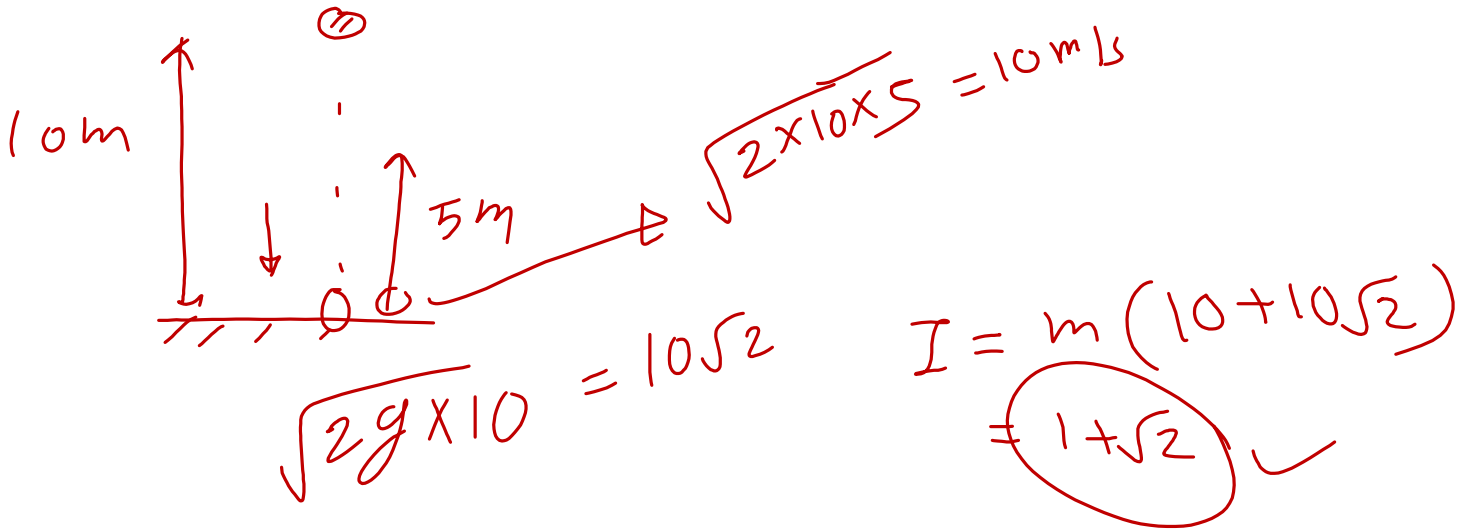
$\phi = \frac{hc}{\lambda_{max}}$

$3eV = \frac{12400\ eV\text{Å}}{\lambda_{max}}$

$12400\ \text{Å} = \lambda_{max}$

Q. A ball of mass 100 gm is dropped from a height of 10 m above the ground. It rebounds and reaches to a height of 5m above the ground. Find Impulse of force exerted on ball by the ground (in N-S)

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



Q.

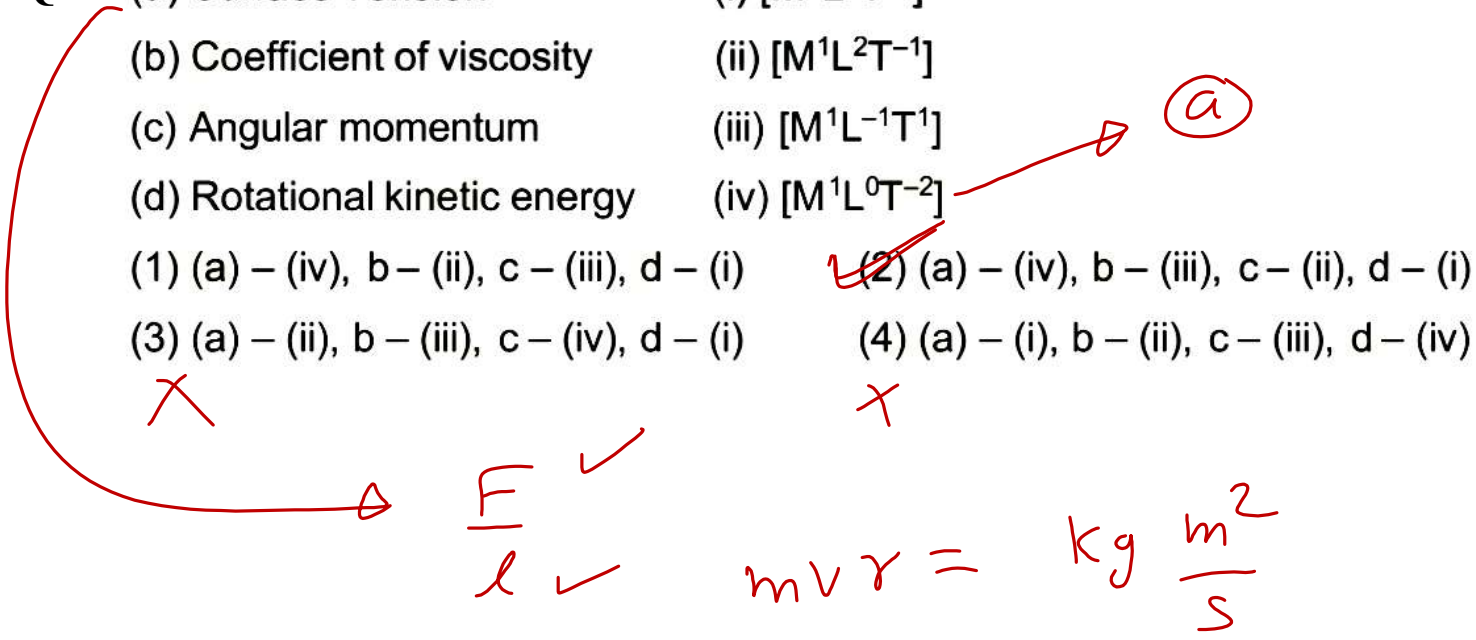
(a) Surface Tension	(i) $[M^1L^2T^{-2}]$
(b) Coefficient of viscosity	(ii) $[M^1L^2T^{-1}]$
(c) Angular momentum	(iii) $[M^1L^{-1}T^1]$
(d) Rotational kinetic energy	(iv) $[M^1L^0T^{-2}]$

(1) (a) – (iv), b – (ii), c – (iii), d – (i)

(2) (a) – (iv), b – (iii), c – (ii), d – (i)

(3) (a) – (ii), b – (iii), c – (iv), d – (i)

(4) (a) – (i), b – (ii), c – (iii), d – (iv)



Q. A particle of mass m is projected at an angle of 30° with initial velocity u. Find its angular momentum about point of projection at maximum height.

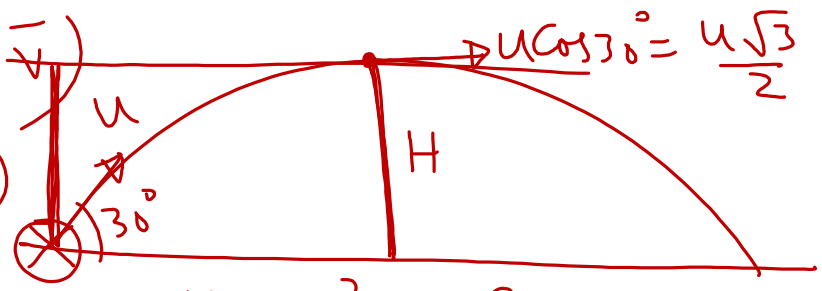
(1) $\frac{mu^3}{4g}$ (2) $\frac{\sqrt{3}}{16}\frac{mu^3}{g}$ (3) $\frac{\sqrt{2}mu^3}{2g}$ (4) $\frac{\sqrt{3}mu^3}{2g}$

$\vec{L} = \vec{r} \times \vec{p}$

$= m(\vec{r} \times \vec{v})$

$= mvr_1$

$= m$



$H = \frac{u_y^2}{2g} = \frac{u^2\sin^2\theta}{2g} = \frac{u^2}{8g}$

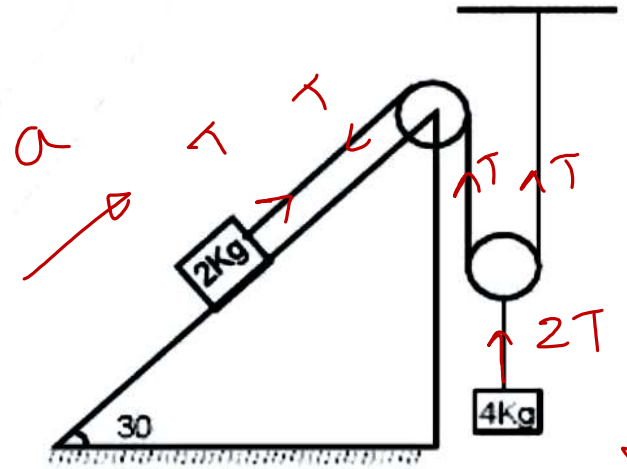
Q. If a body is released from top of smooth inclined, then its velocity after descending height of $\frac{1}{2}$ m is

(1) 20 (2) $\sqrt{10}$ (3) $2\sqrt{10}$ (4) 10

$W_y = mgh = m \times 10 \times \frac{1}{2} = 5m = \frac{1}{2}mv^2$

$v = \sqrt{10}$

Q. Find acceleration of 2 Kg block.



(1) g

(2) $\frac{g}{3}$

(3) $\frac{g}{4}$

(4) $\frac{g}{2}$

$\Sigma W_T = 0$

$Ta = 0$

$Ta - 2Ta_0 = 0$

$a = 2a_0$

$4g - 2T = 4a_0$

$2T - 2g \times \frac{1}{2} = 2a = 4a_0$

$2g = 12a_0$

$a_0 = g/6$

$a = g/3$

Q. Resistance of roster at 27°C is 60 Ω. Temperature coefficient of resistance is $\alpha = 2 \times 10^{-4}$ Per °C . Find temperature of resistance when voltage and current across resistance will be 210 Volt and 2.75 A.

(1) 1250 °C (2) 890 °C (3) 1693 °C (4) 2015 °C

$\Delta t = \frac{10^4}{6}$

$\Delta t = 167 \times 10^3$

$\Delta t = 1670$

27°C 60Ω

$\alpha = 2 \times 10^{-4}/°C$

$R = 80$ $R_0 = 60$

220 Volt

$R = \frac{210}{2.75}$

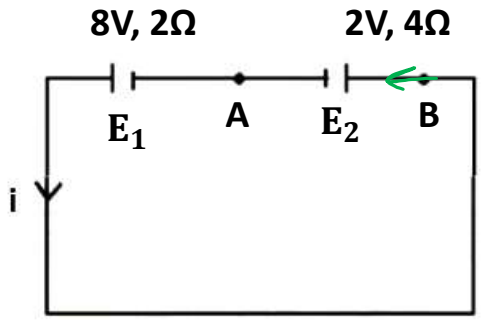
$= 80\Omega$

$R = R_0(1 + \alpha \Delta t)$

$80 = 60 + 60 \Delta t \alpha$

$\Delta t = \frac{20}{60\alpha} = \frac{1}{3\alpha}$

Q. In given electrical circuit Voltage drop across E_2 will be-



$V_B - 2V - 4V = V_A$

$V_B - V_A = 6\ Volt$

(1) 6

(2) $\frac{40}{3}$

(3) 3

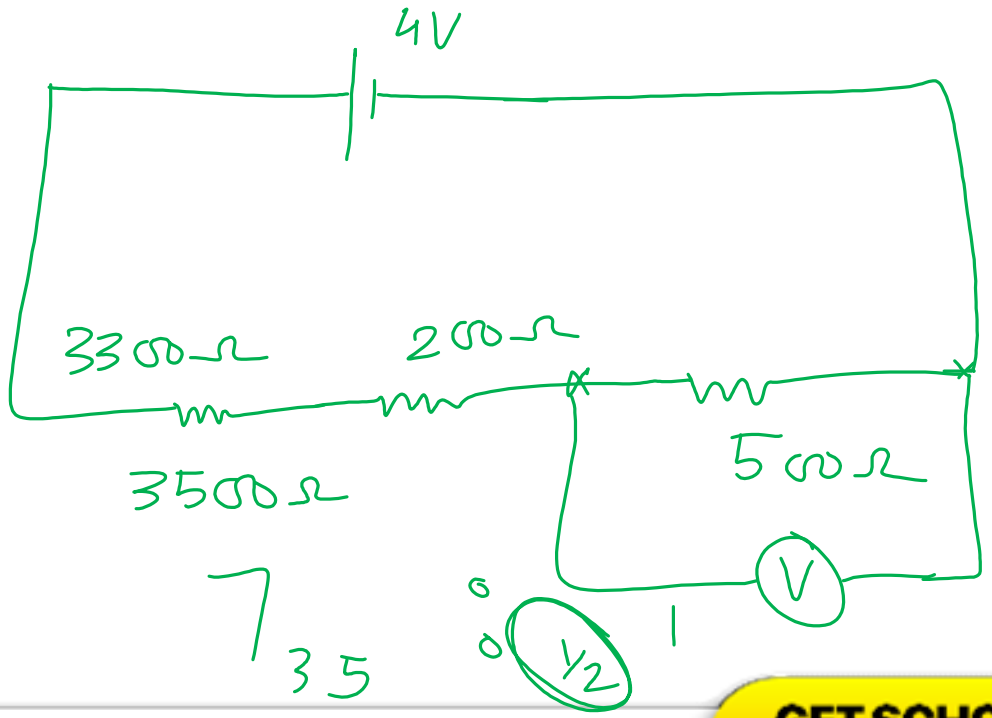
(4) 10

$6V = 6i$

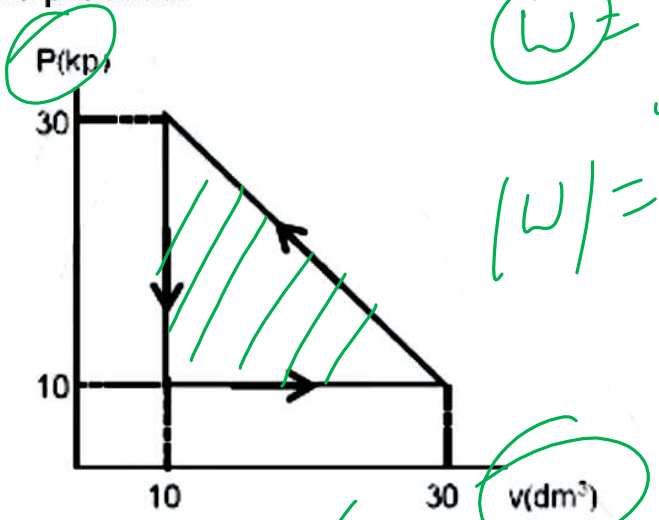
$i = 1A$

Q. In an electric circuit a resistance of 3.3 kΩ is connected with seven 100 Ω resistance in series. If all resistances are connected to a 4V battery then the reading of voltmeter connected across last 5 identical resistances will be-

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



Q. Find the work done by gas in cyclic process.



$W = \int P\,dV$

$|W| = \frac{1}{2} \times 20 \times 20 \times 10^{-3} \times 10^{+3}$

$= 200\ J$

(1) 200 J

(2) 200KJ

(3) –200J

(4) –200KJ

Q. A particle travels 125 m with change in velocity as 50 m/s in t to (t + 1) second. Find the displacement in $(t + 2)^{th}$ sec.

(1) 100 m (2) 175 m (3) 225 m (4) 275 m

$(t+1)^{th}$ sec

$a = \frac{\Delta V}{\Delta t} = \frac{50}{1}$

$100 = u + 50t$

$a = 50$

$S = u + \frac{1}{2} a [2(t+1) - 1]$

$125 = u + \frac{a}{2}(2t+1) = u + 50t + 25$

$$s' = u + \frac{1}{2}a\left[2(t+2)-1\right]$$

$$= u + 25\left[2t+3\right]$$

$$s' = u + 50t + 75$$

$$s' = 175\ m$$ ✓

$S_{n^{th}}$

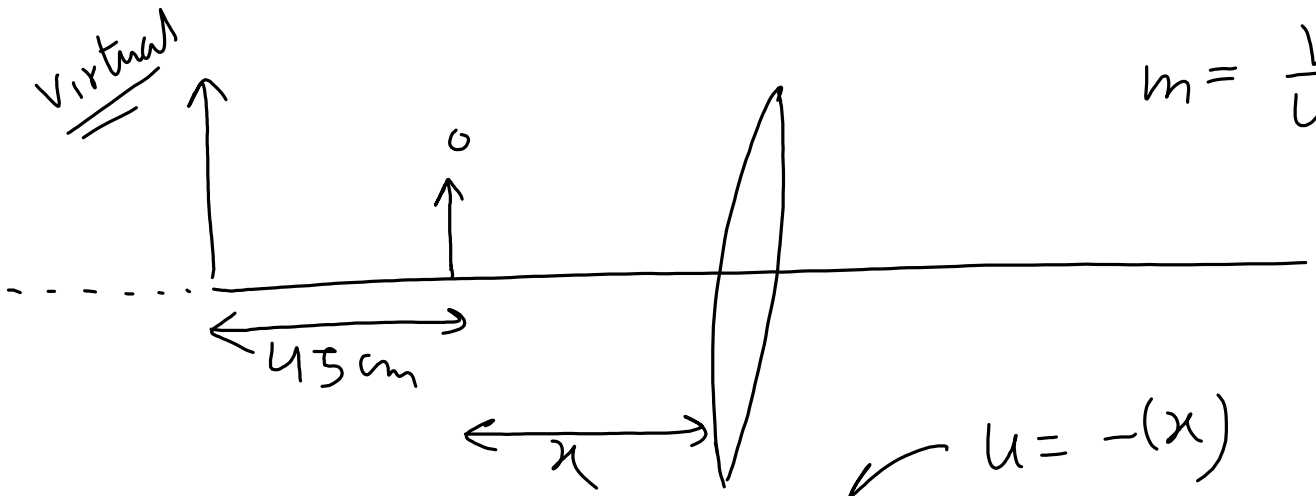
$$s = ut + \frac{1}{2}at^2$$ — $(2n-1)$

$t \rightarrow (2n-1)$

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

Q. In a convex lens the distance between object and image is 45 cm and magnification produced by lens is +2 then what would be the focal length of the lens.

(1) 30 cm (2) 45 cm (3) 60 cm (4) 90 cm



$m = \frac{V}{u} = +2 = \frac{x+45}{x}$

$x = 45$ cm

$u = -(x)$

$v = -(x+45)$

-45

-90

f

Q. If a L-R circuit power factor is $\frac{1}{\sqrt{2}}$ for $E = 25 \sin(1000t)$. Then power factor for $E = 20 \sin(2000t)$ will be.

(1) $\frac{1}{\sqrt{5}}$ (2) $\frac{1}{\sqrt{7}}$ (3) $\frac{1}{\sqrt{3}}$ (4) $\frac{1}{\sqrt{2}}$

ω $\quad$ 2ω

$\cos\phi = \frac{R}{\sqrt{5}R} = \frac{1}{\sqrt{5}}$

$X_L = 2\omega L$

$Z = \sqrt{R^2 + 4\omega^2 L^2}$

$= \sqrt{R^2 + 4R^2}$

$= \sqrt{5R^2} = \sqrt{5}R$

$\cos\phi = \frac{R}{Z} = \frac{R}{\sqrt{R^2 + \omega^2 L^2}}$

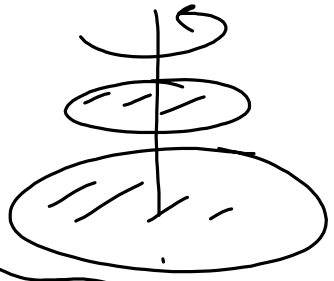
$\Rightarrow \frac{1}{\sqrt{2}} = \frac{R}{\sqrt{R^2 + \omega^2 L^2}}$

$2R^2 = R^2 + \omega^2 L^2$

$R = \omega L$

Q. A Disc of mass m and radius R is rotating with angular speed ω about axis passing through centre of mass. Another identical disc is gently placed on it. Find out loss in Kinetic energy of system

(1) $\frac{1}{2}mR^2\omega^2$ (2) $\frac{1}{4}mR^2\omega^2$ (3) $\frac{1}{6}mR^2\omega^2$ (4) $\frac{1}{8}mR^2\omega^2$

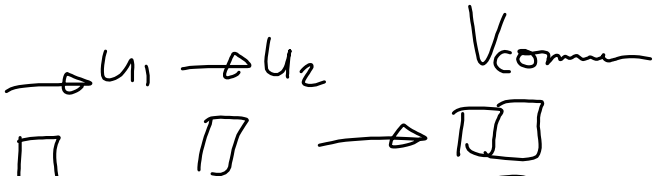


$H = \frac{1}{2}\mu\omega_{rel}^2$

$H = \frac{1}{2}\left(\frac{I_1 I_2}{I_1+I_2}\right)\omega_{rel}^2$

ω_{comm}

$\rightarrow \frac{I}{4}\omega^2$



$H = \frac{1}{2}\mu u_{rel}^2$

$\mu = \frac{m_1 m_2}{m_1+m_2}$

Loss

$$TKE = KE_{of\ com} + KE_{about\ com}$$

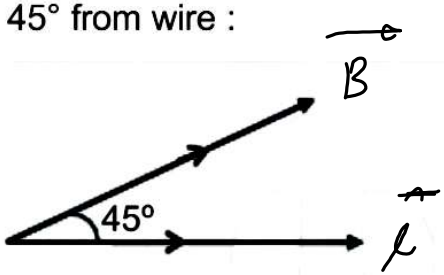
$$= \frac{1}{2} M_T V_{com}^2 + \frac{1}{2} \frac{m_1 m_2}{m_1 + m_2} (v_{rel})^2$$

$$\Downarrow$$

$$0$$

$$* \quad H = \frac{1}{2} \mu u_{rel}^2 (1 - e^2)$$

Q. If current through a wire is $\sqrt{2}$ A then find force per unit length of wire due to a magnetic field of 3.5×10^{-5} T in the direction 45° from wire :



(1) $\frac{7}{2} \times 10^{-5} \frac{N}{m}$ (2) $3.5 \times 10^{-5} \frac{N}{m}$ (3) $3.5\sqrt{2} \times 10^{-5} \frac{N}{m}$ (4) $7 \times 10^{-5} \frac{N}{m}$

$\vec{F} = i\vec{\ell} \times \vec{B}$

$F = i\ell B \sin\theta$ $\quad \theta = 45°$

$\ell = 1\,m$

Q. $E = E_0(\hat{i})\sin[(\omega t - kz)]$, then B will be

(1) $B = (E_0 c)\sin(\omega t - kz)\ \hat{j}$

(2) $B = (E_0/c)\sin(\omega t - kz)\ \hat{j}$

(3) $B = (E_0 c)\sin(\omega t - kz)\ \hat{i}$

(4) $B = (E_0/c)\sin(\omega t - kz)\ \hat{i}$

$$c = \frac{E_0}{B_0}$$

$$B_0 = \frac{E_0}{c}$$

Q. If gravitational potential at some height is 5.12×10^7 m^2/s^2 and gravitational acceleration is 6.4 m/s^2, then find the height about earth surface :

(1) 3200 km

(2) 1600 km

(3) 800 km

(4) 800 km

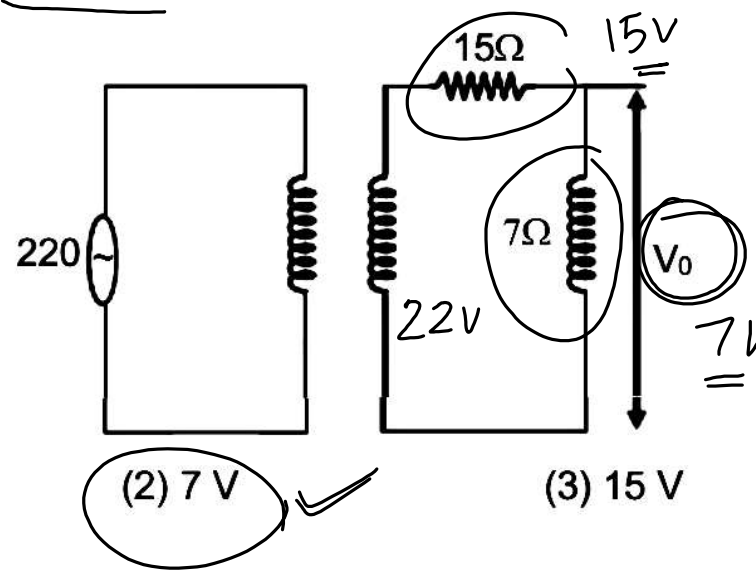
$R_e = 6400$ km

$-\frac{GM}{r} r^2 = \frac{5.12 \times 10^7}{6.4}$

$= \frac{512 \times 10^8}{64} = 8 \times 10^6$ m

8000 km from Centre of earth

Q. Primary coil has 100 turns. & no. of turns in secondary coil is 10. Then find v_0 :



(1) 22 V

(2) 7 V

(3) 15 V

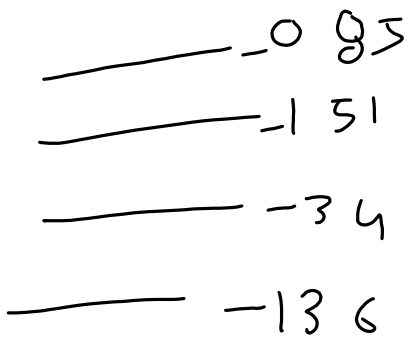
(4) 20 V

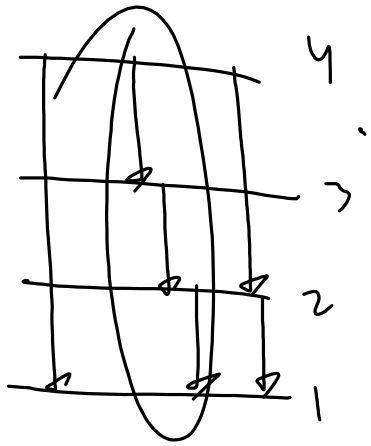
Q. If Hydrogen electron is excited to an orbit of energy – 0.85 eV in an atom then maximum possible number of transitions to lowest energy levels is ——

(1) 6 (2) 3 (3) 5 (4) 2

$TE = -13.6 \frac{Z^2}{n^2} = -0.85$

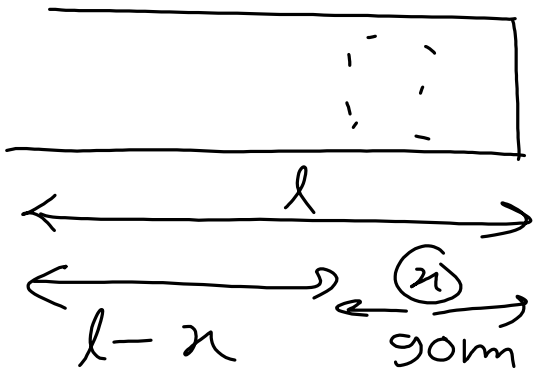
$n = 4$





Q. The fundamental frequency of close organ pipe is 50 Hz. Now some water is filled then fundamental frequency becomes 110 Hz. If the cross sectional area of the pipe is 2 cm^2 then find the amount of water added in grams. Speed of sound in air = 330 m/sec.

(1) 90 grams (2) 180 grams (3) 300 grams (4) 18 grams



$f = \frac{n}{4l} V = 50$

$n = 1, 3, 5, 7$

$\frac{50}{110} = \frac{l-x}{l}$

$50l = 110l - 110x$

$110x = 60l$

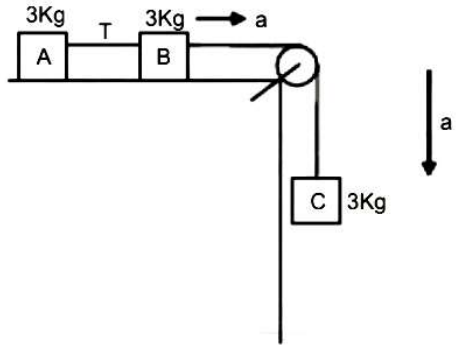
$x = \frac{6}{11} l$

$\frac{V}{4(l-x)} = 110$

$l = \frac{330}{200}$ $m = 165cm$

$= \frac{6 \times 165}{11} = 90cm$

Q. If young's modulus of all strings is 2×10^{11} N/m^2 and cross section area is 0.005 cm^2. Find the elongation in the string connected between blocks A and B, if the length of string AB is 1 m.



(1) 100 cm (2) 1 cm (3)0.1 cm (4) 0.01 cm

Q. Two capacitors of capacitance C and 2C and potential difference between plates V & 2V respectively are connected together then total energy loss is $\frac{x}{3}E$. Where E is the energy of capacitor of capacitance C and potential V. Then value of 'x' will be –

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