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JEE Main (2024)

MEMORY BASED PAPER SOLUTION

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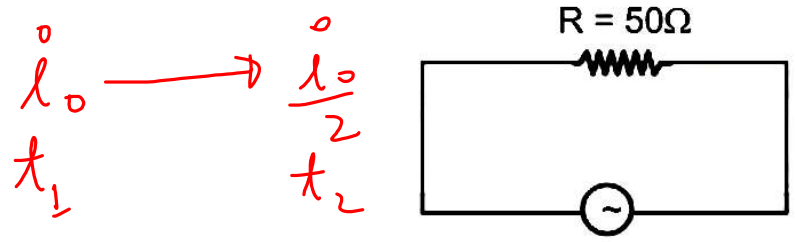
PHYSICS

Q. For a given electric circuit shown, find the time taken to change current from highest peak value to half of peak value



$i_0 \rightarrow \frac{i_0}{2}$

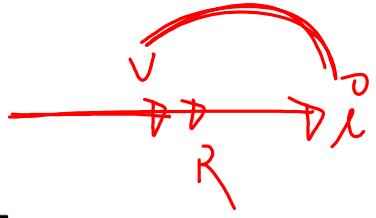
$t_1 \quad t_2$

$i = i_0 (\sin(100t))$

$V_0 = i_0 Z$

$220 = i_0 R$

$i_0 = \frac{220}{50} = \frac{22}{5}$



$Z = R$

(1) $\frac{\pi}{300}$ sec (2) $\frac{\pi}{200}$ sec (3) $\frac{\pi}{400}$ sec (4) $\frac{\pi}{100}$ sec

$t_1 = \frac{\pi}{200}$

$\frac{22}{5} = \frac{22}{5}\sin(100t)$

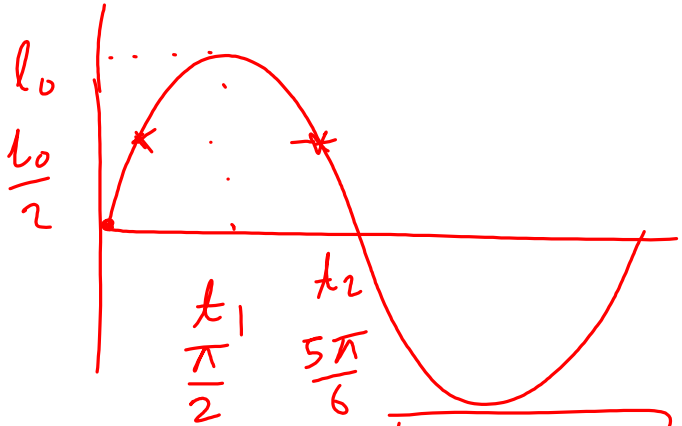
$\frac{\pi}{2} = 100t$

$i = \frac{22}{5}\sin(100t)$

$\frac{1}{2} = \sin(\omega t_2)$

$\frac{\pi}{6} = \omega t_2$

$\frac{5\pi}{6} = \omega t_1$



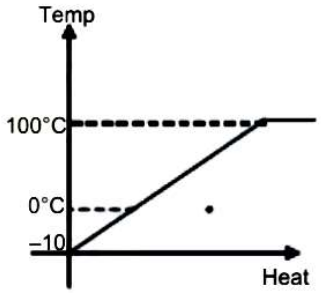
$t_2 = \frac{5\pi}{6\omega}$

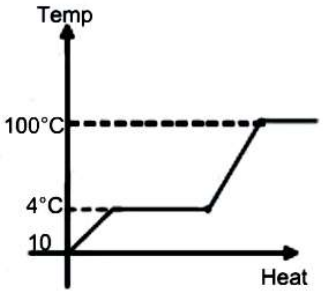
$\frac{\pi}{3} = \omega t$

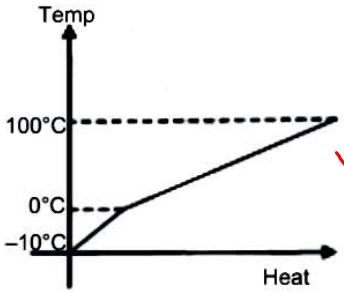
$t_2 - t_1 = \frac{5\pi}{6\omega} - \frac{\pi}{2\omega} \times 3$

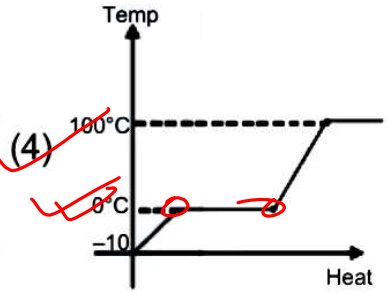
$\Delta t = \frac{\pi}{3\omega}$ sec

Q. Draw true phase diagram for true temperature versus heat supplied when ice at (–10°C) converts into stream at 100°C.

(1) 

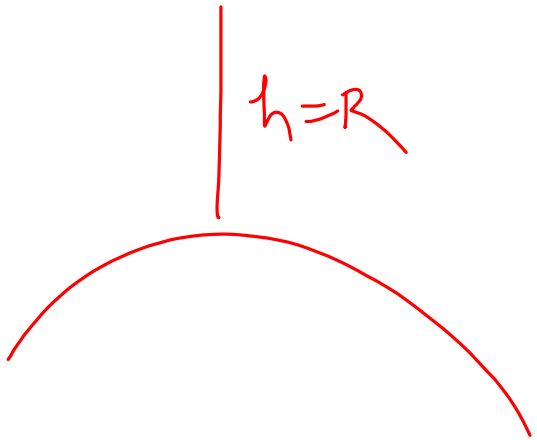
(2) 

(3) 

(4) 

Q. A simple pendulum of length ℓ = 4 m is taken to height 'R' from earth surface. Calculate the time period of oscillation of simple pendulum at given height. Given : acceleration due to gravity at earth' surface $g = \pi^2$

(1) 4 sec (2) 8 sec (3) 6 sec (4) 10 sec



$$g_h = \frac{g}{\left(1+\frac{h}{R_e}\right)^2} \qquad T = 2\pi\sqrt{\frac{l_0}{g_{eff}}}$$

$$= \frac{g}{4}$$

Q. If $m = K.c^{x}G^{\frac{-1}{2}}.h^{\frac{1}{2}}$ then find x if symbols have general meaning and k is dimensionless (m = mass, c = speed of light, G = universal gravitation constant f h = plank's constant)

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

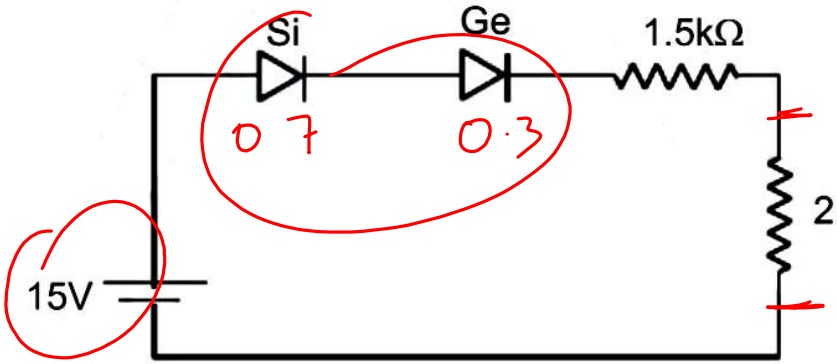
$E = h\nu$ ✓

$[E\ t] = [h]$ | $[G]$ ✓ $[h]$ ✓ | $[G_0]$ ✓ $[\mu_0]$ ✓

$F = \frac{Gm^2}{r^2}$

$C = LT^{-1}$ ✓ $[G] = \left[\frac{Fr^2}{m^2}\right]$

Q. In the given circuit find the potential difference 2.5 k Ω. Given : knew voltages for silicon and germanium P-N junction is 0.7 volt and 0.3 Volt respectively



(1) 3.25 V (2) 4.75 (3) 9.50 (4) 8.75 V

$i = \frac{15-(0.7+0.3)}{(1.5+2.5)\times 10^3}$

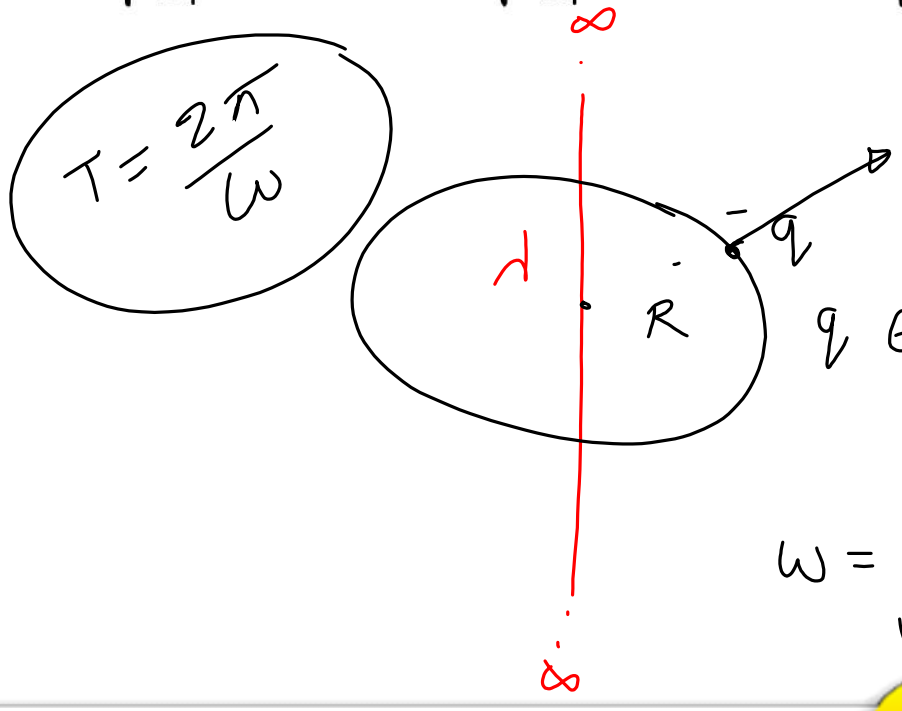
$i = 5\,mA$

$V = iR = 3.5 \times 2.5$

$= 8.75\,V$

Q. A Charge '–q' and mass 'm' is revolving in circular orbit of radius 'r' around infinite length wire with linear charge density 'λ'. Find the time period of revolution

(1) $(2\pi)^{1/2} r\sqrt{\frac{m\varepsilon_0}{\lambda q}}$ (2) $(2\pi)^{3/2}\sqrt{\frac{rm\varepsilon_0}{\lambda q}}$ (3) $(2\pi)^{3/2} r\sqrt{\frac{m\varepsilon_0}{\lambda q}}$ (4) $(2\pi)^{1/2}\sqrt{\frac{rm\varepsilon_0}{\lambda q}}$



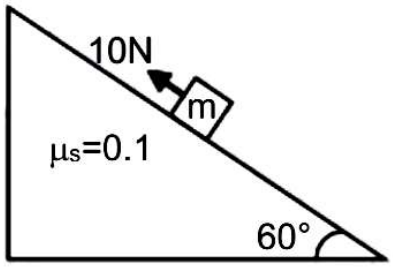
$T = \frac{2\pi}{\omega}$

$E = \frac{2k\lambda}{R}$

$qE = \frac{2}{4\pi\varepsilon_0}\frac{\lambda}{R}q = F = mR\omega^2$

$\omega = \sqrt{\frac{\lambda q}{2\pi\varepsilon_0 R^2 m}}$

Q. A 10 N Force is applied on mass 1 kg in upward direction as shown. Find the work done against friction force in taking it up by 10 m along inclined



(1) 10 J (2) 5 J (3) 20 J (4) 25 J

$0.1 \times 1 \times 10 \times 5$

$= 5\,J$

10m

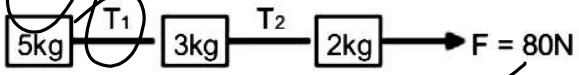
60°

$10\cos 60 = 5m = x$

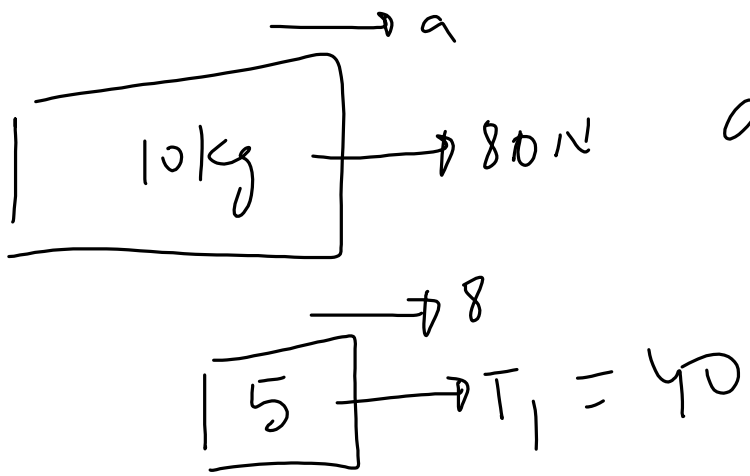
$W_f = -\mu mg x$

W against friction $= \mu mg x$

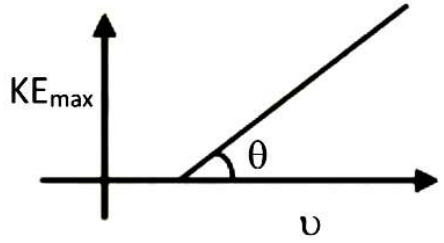
Q. Find the value of tension T_1 and T_2 respectively in the given figure?



(1) 60N, 72 N (2) 72 N, 60N (3) 40 N, 64N (4) 64N, 40 N



Q. Graph of maximum possible K.E. of photo-electron and frequency of incident photons is as shown in figure. Find slope of graph.



(1) h/e (2) h (3) e/h (4) 1/h

Q. Match the following :

A.	$\oint \vec{B}.\vec{dA} = 0$	P.	Faraday & Lens's law
B.	$\oint \vec{E}.\vec{dA} = \frac{Q_{in}}{\epsilon_o}$	Q.	Gauss law of on magnetism
C.	$\oint \vec{B}.\vec{dl} = \mu_o i_{enc}$	R.	Ampere's law
D.	$\oint \vec{E}.\vec{dl} = \frac{-d\phi_B}{dt}$	S.	gauss law of electrostatics

(1) (A – Q), (B – S), (C – R), (D – P)

~~(2) (A – S), (B – Q), (C – R), (D – P)~~

~~(3) (A – Q), (B – R), (C – S), (D – P)~~

~~(4) (A – Q), (B – S), (C – P), (D – R)~~

Q. For a given planet $R_P = \frac{R_e}{3}$ & $M_P = \frac{M_e}{6}$, Then find the escape velocity for this planet if the escape velocity for earth is 11.2 km/sec. (R_e = radius of earth and Me = mass of earth)

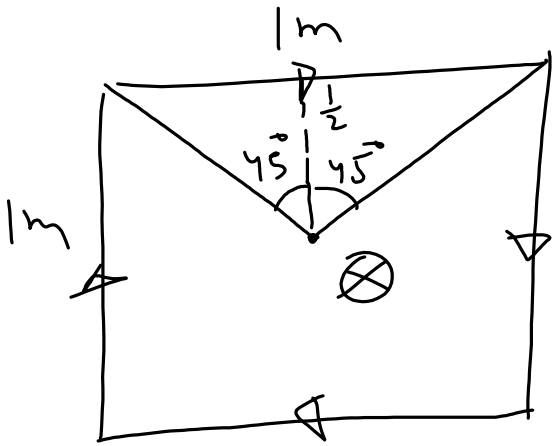
(1) 7.92 km/sec ✓ (2) 11. 2 km/sec (3) 10.3 km/sec (4) 6.9 km/sec

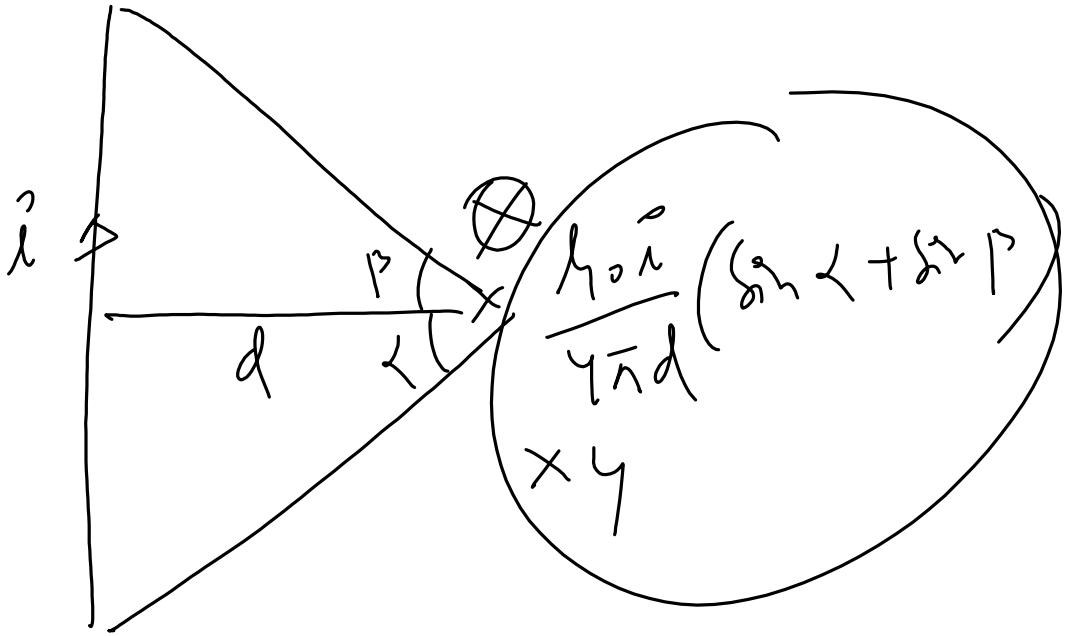
$$V_e = \sqrt{\frac{2GM}{R}} = 11.2 \text{ km/s}$$

$$V_{ep} = \sqrt{\frac{2GM/3}{R/2}} = \sqrt{\frac{GM}{R}} = \frac{11.2}{1.414}$$

Q. 5A current is passing through a square of side 1m then find the magnetic field at the centre of this square.

(1) $8\sqrt{2}\times10^{-6}\,T$ (2) $4\sqrt{2}\times10^{-6}\,T$ (3) $2\sqrt{2}\times10^{-6}\,T$ (4) $6\sqrt{2}\times10^{-6}\,T$





Q. A vector which have magnitude same as of $3\hat{i} + 4\hat{j}$ & direction along $4\hat{i} + 3\hat{j}$, is $x\hat{i} + 3\hat{j}$ then value x will be?

(1) 3 (2) 2 (3) 4 (4)10

3 4 5
6 8 10
30 40 50
5

$5 = \sqrt{x^2 + 9}$

$x = \pm 4$

$+4$

-4

Q. An electron is revolving in n^{th} orbit of He^+ ion. Its magnetic moment depends on the radius of orbit as :

(1) r (2) $r^{1/2}$ (3) $r^{3/2}$ (4) r^2

$$r = \frac{a_0 n^2}{Z}$$

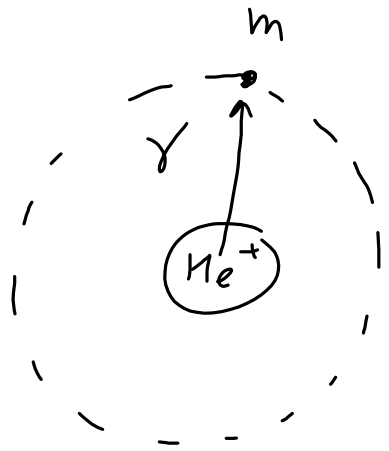
$$n \propto \sqrt{r}$$

* Gyromagnetic ratio

$$\frac{L}{\mu} = \frac{2m}{q}$$

$$\mu = \frac{q}{2m} L$$

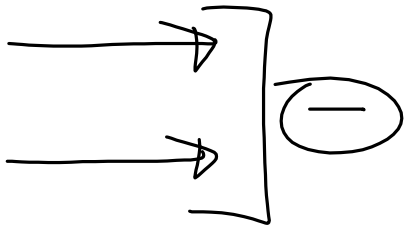
$$= \frac{nh}{2\pi} \cdot \frac{e}{2m}$$



Q. A disc of moment of inertia 4 kg/m^2 is spinning freely with ω = 10 rad/s. A second disc of moment of inertia 2 kg/m^2 and spinning with ω = 4 rad/s in same direction, slides down on the spindle and combined slowly and start spinning together. What is the loss in kinetic energy?

(1) 12 J (2) 24 J (3) 36 J (4) 48 J

$$E_{loss} = \frac{1}{2}\frac{I_1 I_2}{I_1 + I_2}(\omega_{rel})^2$$



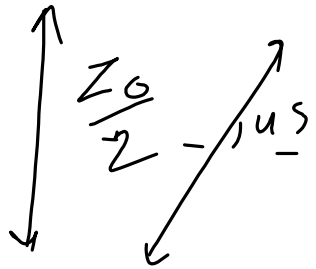
$$= \frac{1}{2}\left(\frac{4\times 2}{4+2}\right)(6)^2$$

$$= \frac{1}{2}\times\frac{48}{6}\times 6\times 6$$

$$= 24$$

Q. Two polarizers are placed at 45° angle. The intensity of final light if unpolarised light of intensity I_0 is incident on one of polarizer.

(1) $\frac{I_0}{2}$ (2) $\frac{I_0}{8}$ (3) $\frac{I_0}{4}$ ✓ (4) $\frac{I_0}{16}$

I_0  $\frac{I_0}{2}$ - unpolarised

$\frac{I_0}{2}\cos^2\theta$

$\frac{I_0}{2} \times \frac{1}{2}$

$\frac{I_0}{4}$

Q. 3 moles of monoatomic gas is mixed with 2 moles of diatomic gas. find γ_{mix}

(1) 1.32 (2) 1.42 (3) 1.52 (4) 1.72

$$\gamma_{mix} = \left(\frac{n_1 C_{p_1} + n_2 C_{p_2}}{n_1 C_{v_1} + n_2 C_{v_2}}\right)$$

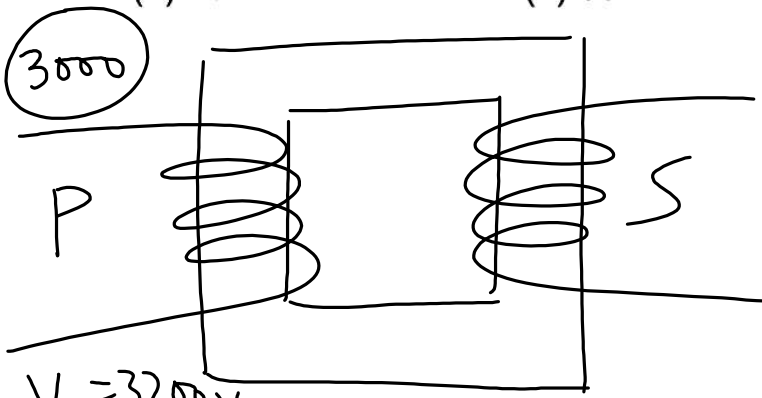
$1 < \gamma < 1.4$

$n_1 = 3$ $\quad C_p = \frac{5R}{2}$ $\quad C_v = \frac{3R}{2}$

$C_p = \frac{7R}{5}$ $\quad C_v = \frac{5R}{2}$ $\quad n_2 = 2$

Q. A step down transformer has primary voltage of V_p = 3.2 KV, number of turn in primary coil is 3000 with current 5 A. on secondary coil voltage is 320 V with number of turns Ns. If efficiency of transformer is 90% then find the current is secondary coil?

(1) 15 A (2) 30 A (3) 45 A (4) 60 A



$V_p = 3200V$

$I_p = 5A$

$V_s = 320V$

$I_s = ??$

$$\eta = \frac{P_s}{P_p} \times 100$$

$$\Rightarrow \frac{V_s I_s}{V_p I_p} \times 100 = 90$$

$$\frac{320 I_s}{3200 \times 5} = \frac{9}{10}$$

$$I_s = 45$$

Q. Heat developed in a wire of resistance R is W. If it is cut into two equal parts and connected into parallel with same source battery then heat produced in same time will be.

(1) W (2) 2 W (3) 3 W (4) 4W ✓

$P = \frac{V^2}{R}$

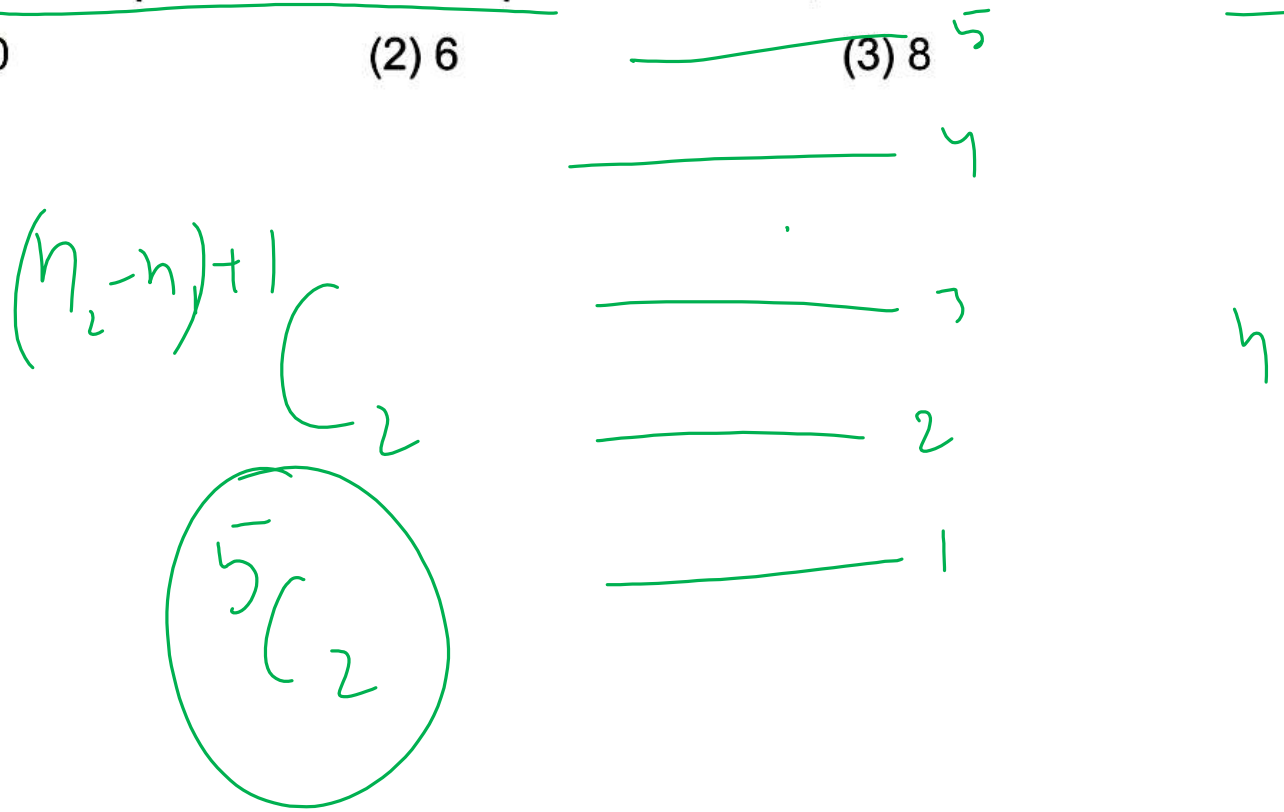
$\frac{R}{2}, \frac{R}{2}$ 3 Parallel

$\frac{R}{4}$

$P' = \frac{V^2}{R/4} = 4\frac{V^2}{R} = 4W$

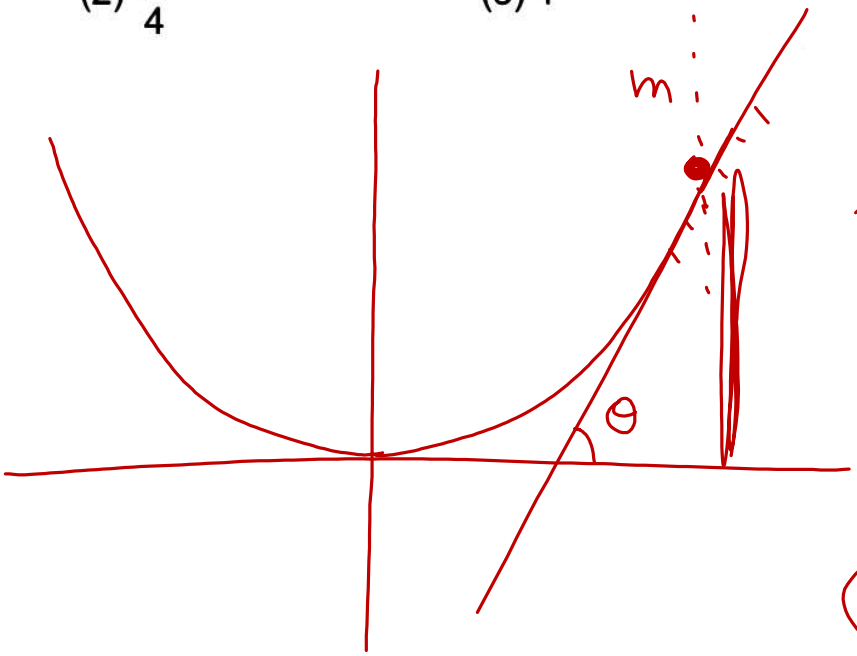
Q. Number of spectral line in the spectrum of He^+, for transition from n = 5 to 1.

(1) 10 (2) 6 (3) 8 (4) 5



Q. A mass is to be kept on the surface of curve $y = x^2 / 4$ such that it does not slip. Find the maximum height at witch it should be kept if $\mu = 0.5$

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



$\mu = \tan\theta = 0.5$

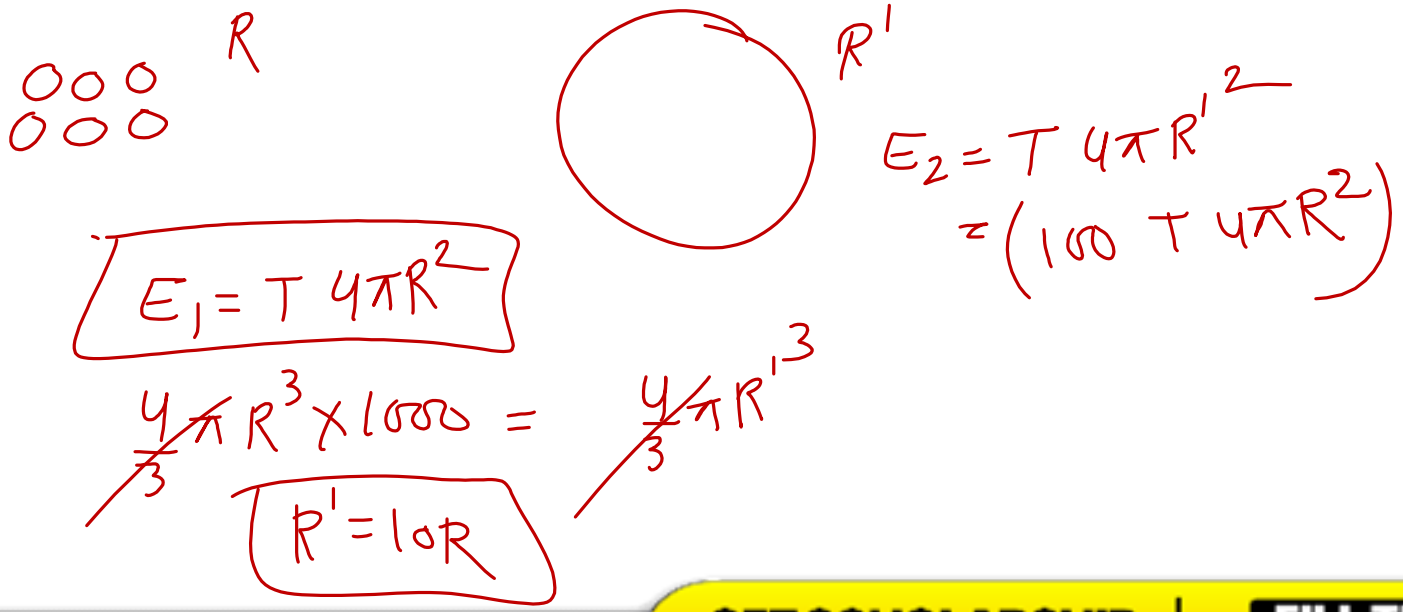
$\frac{dy}{dx} = \frac{2x}{4} = \frac{x}{2} = \frac{1}{2}$

$x = 1$

$y = 1/4$ m

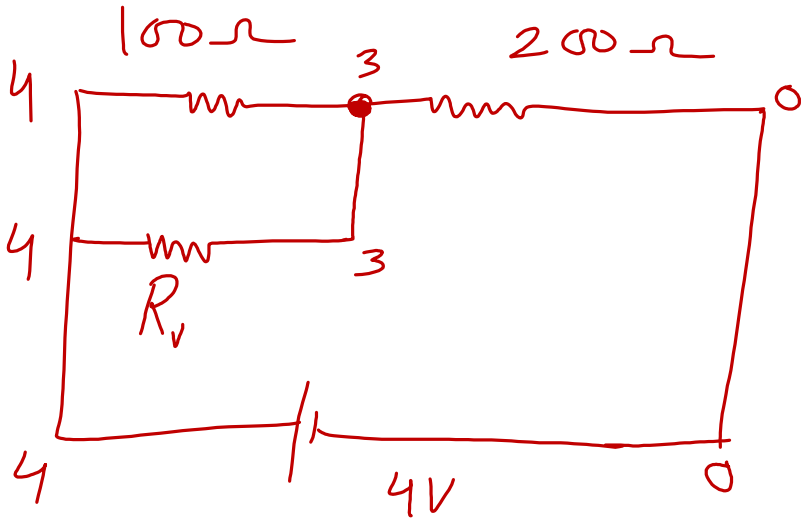
Q. 1000 drops , each have surface energy E_1 converted into 1 bigger drop of surface energy E_2 then $\frac{E_1}{E_2}$ will be

(1) $\frac{1}{110}$ (2) $\frac{1}{81}$ (3) $\frac{1}{100}$ (4) $\frac{1}{121}$



Q. A 100Ω resistance and 200 Ω resistance is connected in a series with 4v battery. A voltmeter connected across 100 Ω reads 1V. Find internal resistance of voltmeter

(1) 150 (2) 200 (3) 190 (4) 220



$$\frac{4-3}{100}+\frac{0-3}{200}+\frac{4-3}{R_V}=0$$

$$\frac{-1}{200}+\frac{1}{R_V}=0$$

$$R_V=200\Omega$$

Q. 49 main scale divisions is equal to 50 vernier scale divisions. If one main scale divisions is 0.5 mm then find the value of vernier constant

(1) 0.01 mm ✓ (2) 0.1mm (3) 0.02 mm (4) 0.2 mm

$L.C\ VC = LC\ MS - LC\ VS$

$= 0.5\ mm - \frac{49}{50} \times 0.5mm$

$= 0.5\left(\frac{1}{50}\right)mm$

$= \frac{1}{100}\ mm = 0.01mm$

$49 \times 0.5mm = 50 \times LC\ VS$

$L.C\ VS = \frac{49}{50} \times 0.5\ mm$

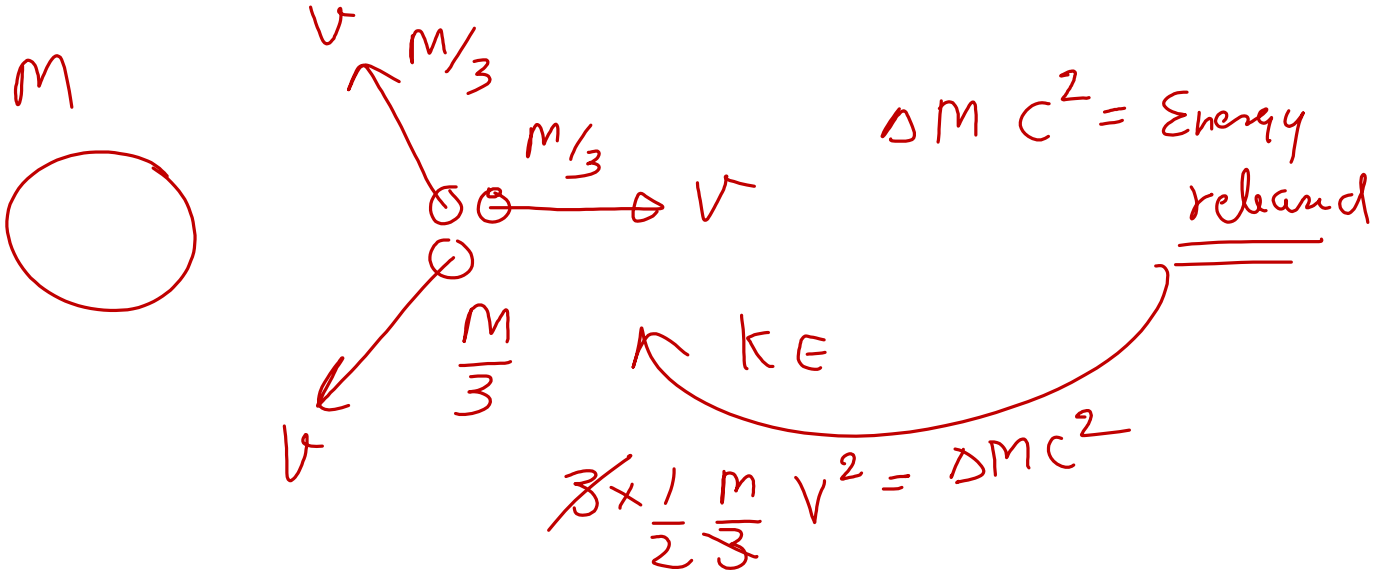
Q. A parent nuclei of mass M is splits into three daughter nuclei of equal mass. Find speed of daughter nuclei if mass defect is Δm :

(1) $\sqrt{\frac{2\Delta M}{M}}$ ✓

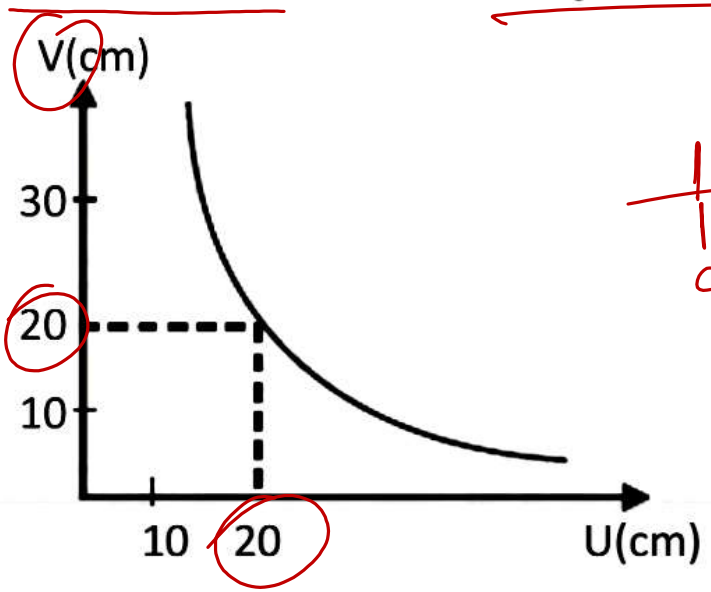
(2) $\sqrt{\frac{2\Delta MC}{M}}$

(3) $\sqrt{\frac{3\Delta M}{M}}$

(4) $\frac{2\Delta MC^2}{m}$



Q. v-u graph is given for a concave mirror. Find focal length of concave mirror.



(1) 200 cm (2) 10 cm (3) 15 cm (4) 5 cm