PHYSICS
JEE-MAIN (July-Attempt)
28 July (Shift-2) Paper Solution

$$F \cdot \Delta t = m(\Delta v)$$

$$F = BIl\sin\theta$$

$$B = \frac{\mu_0 i R^2}{2(R^2+x^2)^{3/2}}$$

$$\Delta Q = \Delta U + \Delta W$$

$$T = 2\pi\sqrt{l/g}$$

$$Y = \frac{\text{STRESS}}{\text{STRAIN}}$$

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IIT JEE PHYSICS PAPER SOLUTION
28 JULY 2022
EVENING SHIFT
QUESTIONS BASED ON
UNIT & DIMENSION, PULLEY CHAIN, CAPACITOR WITH DIELECTRIC, POC, SHM ARE TRICKY

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1. Consider the efficiency of carnot's engine is given by $\eta = \frac{\alpha\beta}{\sin\theta}\log_e\left(\frac{\beta x}{kT}\right)$ where α and β are constants. If T is temperature, k is Boltzmann constant, θ is angular displacement and x has the dimensions of length. Then, choose the incorrect option

(A) Dimensions of β is same as that of force.

(B) Dimension of $\alpha^{-1}x$ is same as that of energy

(C) Dimensions of $\eta^{-1}\sin\theta$ is same as that of $\alpha\beta$

(D) Dimensions of α is same as that of β ✓

$$\eta = \frac{\alpha\beta}{\sin\theta}\log_e\left(\frac{\beta x}{KT}\right)$$

$$k = \frac{PV}{T} = \frac{W}{T} = \frac{ML^2T^{-2}}{K} = ML^2T^{-2}K^{-1}$$

$$\frac{\beta(x)}{KT} = \text{Dimensionless}$$

$$\alpha\beta = \eta = M^0L^0T^0$$

$$\beta = \frac{KT}{x} = \frac{ML^2T^{-2}K^{-1}\,K}{L} = MLT^{-2} = \text{FORCE}$$

$$\alpha = \frac{1}{\beta}$$

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2. At time t = 0 a particle starts travelling from a height $7\hat{Z}$ cm in a plane keeping z coordinate constant. At any instant of time it's position along the $\hat{x}$ and $\hat{y}$ directions are defined as 3t and $5t^3$, respectively. At t=1s acceleration of the particle will be

(A) $-30\hat{y}$ (B) $30\hat{y}$ ✓ (C) $3\hat{x}+15\hat{y}$ (D) $3\hat{x}+15\hat{y}+7\hat{z}$

$x = 3t\,\hat{i}$, $y = 5t^3\,\hat{j}$, $z = 7\,\hat{k}$

$v_x = \frac{dx}{dt} = 3\hat{i}$, $v_y = \frac{dy}{dt} = 15t^2\hat{j}$, $v_z = \frac{dz}{dt} = 0$

$a_x = \frac{dv_x}{dt} = 0$, $a_y = \frac{dv_y}{dt} = 30t\hat{j}$, $a_z = \frac{dv_z}{dt} = 0$

$$a_{net} = a_x\hat{i} + a_y\hat{j} + a_z\hat{k}$$
$$= 0\hat{i} + 30t\hat{j} + 0\hat{k}$$

$a_{net}\Big|_{t=1sec}$ $\quad a_{net} = 0\hat{i} + 30\hat{j} + 0\hat{k}$

$$a_{net} = 30\hat{j}$$

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3. A pressure-pump has a horizontal tube of cross sectional area 10 cm^2 for the outflow of water at a speed of 20 m/s. The force exerted on the vertical wall just in front of the tube which stops water horizontally flowing out of the tube, is : [given: density of water = 1000 kg/m^3]

(A) 300 N
(B) 500 N
(C) 250 N
(D) 400 N ✓

$A = 10\ cm^2$, $v = 20\ m/sec$

$\rho = 10^3\ kg/m^3$

$F \cdot \Delta t = m(\Delta v)$

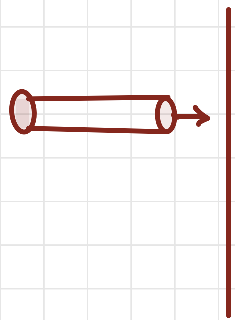
$F t = \rho (A)(l)(v - 0)$

$F = \rho A \left(\frac{l}{t}\right)(v)$

$= \rho A (v)(v) = \rho A v^2$

$= 10^3 \times 10 \times 10^{-4} \times (20)^2$

$= 400\ N$



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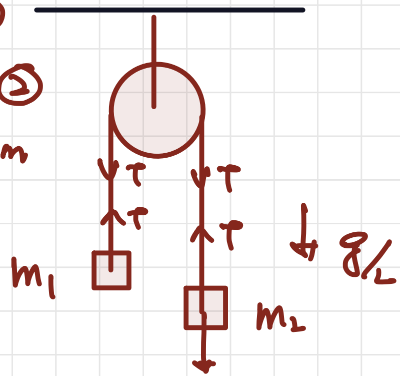
4. A uniform metal chain of mass m and length 'L' passes over a massless and frictionless pulley. It is released from rest with a part of its length 'l' is hanging on one side and rest of its length 'L - l' is hanging on the other side of the pully. At a certain point of time, when $l = L/x$ acceleration of the chain is $g/2$. The value of x is _______.

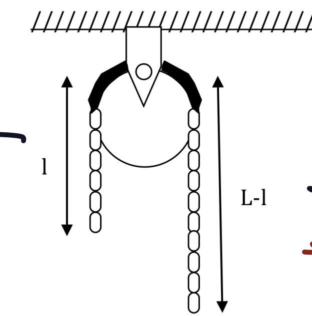
$$m_2 g - T = m_2 \left(\frac{g}{2}\right) \quad \text{—(1)}$$

$$T - m_1 g = m_1 \left(\frac{g}{2}\right) \quad \text{—(2)}$$

Add equation (1) & equation (2)

$$g(m_2 - m_1) = \frac{g}{2}(m_1 + m_2)$$





$$\frac{M}{L}(l) = m_1 \qquad \frac{M}{L}(L - l) = m_2$$

$$2m_2 - 2m_1 = m_1 + m_2$$

$$2\frac{M}{L}(L-l) - 2\frac{M}{L}(l) = \frac{M}{L}(l) + \frac{M}{L}(L-l)$$

$$2L - 2l - 2l = l + L - l$$

$$2L - 4l = L \Rightarrow L = 4l \Rightarrow l = L/4 = L/x$$

$$x = 4$$

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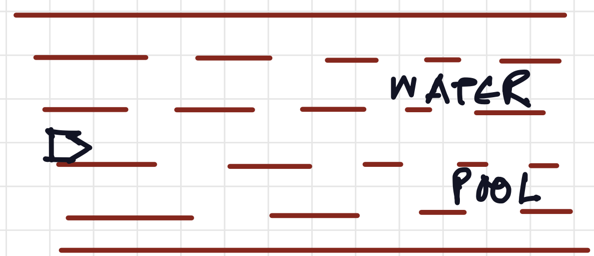
5. A bullet of mass 200 g having initial kinetic energy 90 J is shot inside a long swimming pool as shown in the figure. If it's kinetic energy reduces to 40 J within 1 s. the minimum length of the pool, the bullet has to travel so that it completely comes to rest is :

(A) 45 m (B) 90 m (C) 125 m (D) 25 m



$m = 200 \times 10^{-3} = 0.2\ kg$

$90 J = \frac{1}{2} m v^2$

$v_i^2 = \frac{90 \times 2}{m} = \frac{1800}{0.2}$ = 900

$v_i = 30\ m/sec$

$40 J = \frac{1}{2} m v_f^2$

$40 = \frac{1}{2} \times 200 \times 10^{-3} \times v_f^2$

$v_f^2 = \frac{40 \times 2 \times 10}{2} \Rightarrow v_f = 20\ m/sec$

$v_f = v_i + at$

$20 = 30 - a(1) \Rightarrow a = 10\ ms^{-2}$

$v_f^2 = v_i^2 + 2a(s)$

$0^2 = (30)^2 - 2 \times 10 \times s \Rightarrow s = \frac{900}{20}$

$= 45\ m$

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6) Assume there are two identical simple pendulum clocks. Clock - 1 is placed on the earth and Clock - 2 is placed on a space station located at a height h above the earth surface. Clock - 1 and Clock - 2 operate at time periods 4 s and 6 s respectively. Then the value of h is -
(consider radius of earth R_e = 6400 km and g on earth 10 m/s2)

(A) 1200 km
(B) 1600 km
(C) 3200 km
(D) 4800 km

$T_1 = 4\,s \quad | \quad T_2 = 6\,s$

$$T = 2\pi\sqrt{l/g}$$

$$g_1 = \frac{GM}{R^2}$$

$$g_2 = \frac{GM}{(R+h)^2}$$

$$\frac{g_1}{g_2} = \frac{(R+h)^2}{R^2}$$

$$\frac{T_1}{T_2} = \sqrt{\frac{g_2}{g_1}}$$

$$\frac{T_1}{T_2} = \sqrt{\frac{R^2}{(R+h)^2}} = \frac{R}{R+h}$$

$$\frac{4}{6} = \frac{R}{R+h} \Rightarrow 4R + 4h = 6R$$

$$4h = 2R$$

$$h = R/2 = \frac{6400}{2}$$

$$= 3200\,km$$

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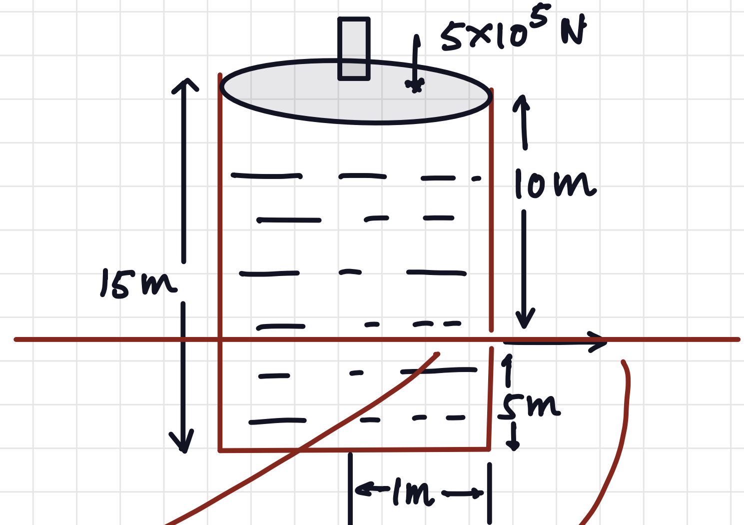
7. Consider a cylindrical tank of radius 1m is filled with water. The top surface of water is at 15 m from the bottom of the cylinder. There is a hole on the wall of cylinder at a height of 5 m from the bottom. A force of 5×10^5 N is applied an the top surface of water using a piston. The speed of ifflux from the hole will be :
(given atmospheric pressure PA = 1.01×10^5 Pa, density of water ρ_w = 1000 kg/m3 and gravitational acceleration g = 10 m/s²)

(A) 11.6 m/s
(B) 10.8 m/s
(C) 17.8 m/s
(D) 14.4 m/s



$$P_1 + \rho g h_1 + \frac{1}{2}\rho v_1^2 \qquad P_2 + \rho g h_2 + \frac{1}{2}\rho v_2^2$$

$$\frac{5\times10^5}{\pi(1)^2} + 10^3\times10\times10 + 0 = 1.01\times10^5 + 0 + \frac{1}{2}\times1000\times v_2^2$$

$v_2 = 17.8$ m/sec

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8. A vessel contains 14 g of nitrogen gas at a temperature of 27°C. The amount of heat to be transferred to the gas to double the r.m.s speed of its molecules will be :
Take R = 8.32 J mol-1k-1.
(A) 2229 J (B) 5616 J (C) 9360 J (D) 13104 J

$$v = \sqrt{\frac{3RT}{M}}, \quad v \propto \sqrt{T}$$

$$\frac{v_1}{v_2} = \sqrt{\frac{T_1}{T_2}} \Rightarrow \frac{v_1}{2v_1} = \sqrt{\frac{T_1}{T_2}} = \frac{1}{4} = \frac{T_1}{T_2}$$

$$T_2 = 4T_1$$

Heat supplied $Q = n C_v \Delta T$

$$= \frac{14}{28} \times \frac{5}{2} R \times (T_2 - T_1)$$

$$= \frac{14}{28} \times \frac{5}{2} \times 8.32 \times (1200 - 300)$$

$$= 9360 J$$

$R = 8.32 J m/molk$

$T_1 = 300 K$

$T_2 = 4 \times 300 = 1200 K$

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9. A slab of dielectric constant K has the same cross-sectional area as the plates of a parallel plate capacitor and thickness $\frac{3}{4}d$, where d is the separation of the plates. The capacitance of the capacitor when the slab is inserted between the plates will be:
(Given Co = capacitance of capacitor with air as medium between plates.)

(A) $\frac{4KC_0}{3+K}$ ✓ (B) $\frac{3KC_0}{3+K}$ (C) $\frac{3+K}{4KC_0}$ (D) $\frac{K}{4+K}$

With air

$$C_0 = \frac{\epsilon_0 A}{d}$$

$$C = \frac{\epsilon_0 A}{d - t\left(1 - \frac{1}{K}\right)}$$

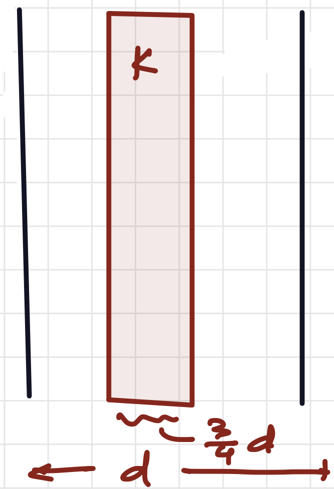
$$= \frac{\epsilon_0 A}{d - \frac{3d}{4}\left(1 - \frac{1}{K}\right)}$$

$$= \frac{\epsilon_0 A}{d\left(1 - \frac{3}{4} + \frac{3}{K}\right)}$$

$$= \frac{\epsilon_0 A}{d\left(\frac{1}{4} + \frac{3}{K}\right)} = \frac{4K\epsilon_0 A}{d(K+3)} = \frac{4K}{(K+3)}\frac{\epsilon_0 A}{d}$$

($\frac{\epsilon_0 A}{d} = C_0$)

$$= \left(\frac{4K}{3+K}\right)C_0$$



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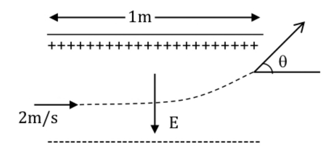
10. A uniform electric field E = (8m/e) V/m is created between two parallel plates of length 1 m as shown in figure, (where m = mass of electron and e = charge of electron). An electron enters the field symmetrically between the plates with a speed of 2 m/s. The angle of the deviation (θ) of the path of the electron as it comes out of the field will be ________.



(A) $\tan^{-1}(4)$ (B) $\tan^{-1}(2)$ ✓ (C) $\tan^{-1}(\frac{1}{3})$ (D) $\tan^{-1}(3)$

$u_x = 2\ m/sec \quad a_x = 0$

$s = u_x t + \frac{1}{2} a_x t^2$

$1 = 2(t) + 0 \Rightarrow t = \frac{1}{2} = 0.5\ sec$

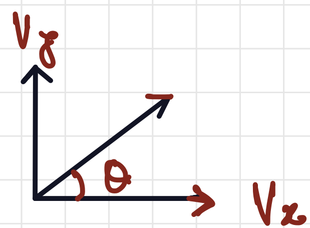
$u_y = 0, \quad V_y = u_y + a_y t \Rightarrow V_y = 0 + \frac{qE}{m}(t)$

$V_y = \frac{8m}{e}\left(\frac{e}{m}\right)(t) = 8(t) = 8 \times 0.5$
$= 4\ m s^{-1}$

$\tan\theta = \frac{V_y}{V_x}$

$= \frac{4}{2} = 2$

$\theta = \tan^{-1}(2)$



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11. Given below are two statements :

Statement I: A uniform wire of resistance 80 Ω is cut into four equal parts. These parts are now connected in parallel. The equivalent resistance of the combination will be 5 Ω

Statement II: Two resistances 2R and 3R are connected in parallel in a electric circuit. The value of thermal energy developed in 3R and 2R will be in the ratio 3:2.

In the light of the above statements, choose the most appropriate answer from the option given below

(A) Both statement I and statement II are correct
(B) Both statement I and statement II are incorrect
✓(C) Statement I is correct but statement II is incorrect
(D) Statement I is incorrect but statement II is correct

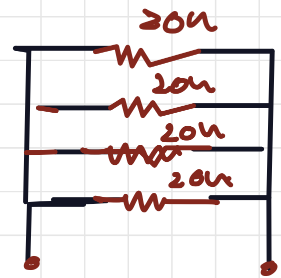
STATEMENT-1

80-ohm cut in 4 parts

each part = 20-ohm

$$\frac{1}{R_{eq}} = \frac{1}{20} + \frac{1}{20} + \frac{1}{20} + \frac{1}{20}$$

$$\frac{1}{R_{eq}} = \frac{4}{20} \Rightarrow R_{eq} = 5\text{-ohm}$$



→ CORRECT

STATEMENT-2

Thermal energy

$$H = \frac{V^2}{R}(t) \Rightarrow H \propto \frac{1}{R}$$

$$\frac{H_1}{H_2} = \frac{R_2}{R_1} = \frac{2R}{3R} = \frac{2}{3}$$

→ Incorrect

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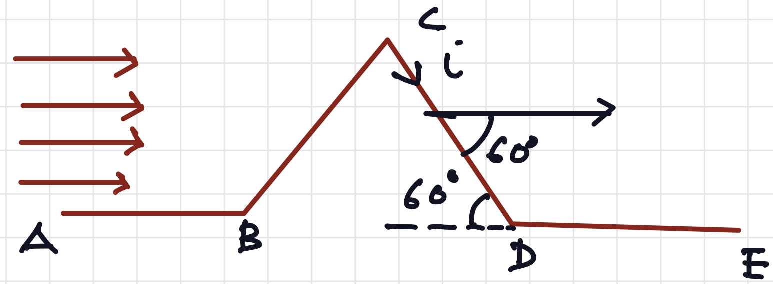
12. A triangular shaped wire carrying 10 A current is placed in a uniform magnetic field of 0.5 T, as shown in figure. The magnetic force on segment CD is (Given BC = CD = BD = 5 cm.)

(A) 0.126 N
(B) 0.312 N
(C) 0.216 N ✓
(D) 0.245 N



$B = 0.5\,T$ $\quad i = 10\,A$

force on CD

$F = BIl\sin\theta$ $\quad \theta \to B,\ l$

$F = 10 \times 0.5 \times 5 \times 10^{-2} \times \sin 60^\circ$

$= 0.216\,N$

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13. The magnetic field at the center of current carrying circular loop is B1. The magnetic field at a distance of √3 times radius of the given circular loop from the center on its axis is B_2. The value of $B1/B_2$ will be
(A) 9:4 (B) 12: √15 (C) 8:1 (D) 5: √3

$$B_1 = \frac{\mu_0 i}{2R} \quad \text{(centre of a loop)}$$

$$B_2 = \frac{\mu_0 i R^2}{2(R^2+x^2)^{3/2}} = \frac{\mu_0 i R^2}{2(R^2+3R^2)^{3/2}}$$

$$\frac{\mu_0 i R^2}{2(4R^2)^{3/2}} = \frac{\mu_0 i}{16R}$$

$$\frac{B_1}{B_2} = \frac{16}{2} = \frac{8}{1}$$

$$\frac{B_1}{B_2} = \frac{8}{1}$$

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14. A transformer operating at primary voltage 8 kV and secondary voltage 160 V serves a load of 80 kW. Assuming the transformer to be ideal with purely resistive load and working on unity power factor, the loads in the primary and secondary circuit would be

(A) 800 Ω and 1.06 ohm
(B) 10 Ω and 500 ohm
(C) 800 Ω and 0.32 Ω
(D) 1.06 Ω and 500-ohm

$V_P = 8 kV$, LOAD $= 80 \times 10^3$ watt

Primary load $R_1 = \frac{V_P^2}{P}$

$= \frac{(8 \times 10^3)^2}{80 \times 10^3} = 800$-ohm.

Secondary load $R_2 = \frac{V_S^2}{P} = \frac{(160)^2}{80 \times 10^3} = 0.32$-ohm

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15. Sun light falls normally on a surface of area 36 cm^2 and exerts an average force of 7.2 x 10^{-9} N within a time period of 20 minutes. Considering a case of complete absorption, the energy flux of incident light is

(A) 25.92 x 102 W/cm2 (C) 6.0 W/cm2

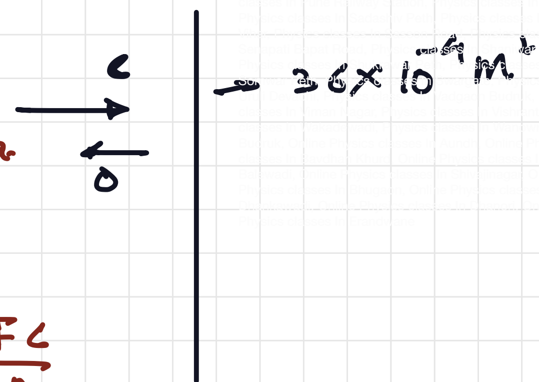
(B) 8.64 x 10-6 W/cm2. (D) 0.06 W/cm2 ✓

$A = 36 cm^2$

$f = 7.2 \times 10^{-9} N$, $t = 20 \times 60$ sec

$f \cdot \Delta t = m(c - 0)$

$f = \frac{mc}{t}$



ENERGY FLUX – Power per unit area

$\phi = \frac{P}{A} = \frac{E}{tA} = \frac{mc^2}{t(A)}$

$= \left(\frac{mc}{t}\right)\left(\frac{c}{A}\right) = \frac{Fc}{A}$

$= \frac{7.2 \times 10^{-9} \times 3 \times 10^{8}}{36} = .06 \frac{W}{cm^2}$

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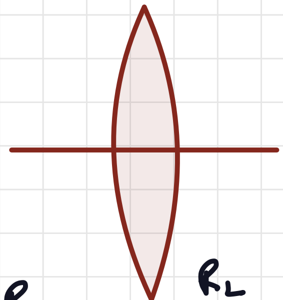
16. The power of a lens (biconvex) is 1.25m-1 in particular medium. Refractive index of the lens is 1.5 and radii of curvature are 20 cm and 40 cm respectively. The refractive index of surrounding medium:

(A)1.0 (B) 9 (C) 3 (D) 4 723

$$P = \frac{1}{f}$$

$$f = \frac{1}{P} = \frac{1 \times 100}{1.25}\ cm$$

$$= \frac{100 \times 100}{125} = 80\ cm$$



$R_1 = 20$ cm

$R_2 = -40$ cm

$$\frac{1}{f} = ({}_1\mu_2 - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{1}{80} = \left(\frac{\mu_2}{\mu_1} - 1\right)\left(\frac{1}{20} - \frac{1}{-40}\right)$$

$$\frac{1}{80} = \left(\frac{\mu_2}{\mu_1} - 1\right)\left(\frac{2+1}{40}\right)$$

$$\frac{1}{80} = \left(\frac{1.5}{\mu_1} - 1\right)\left(\frac{3}{40}\right)$$

$$\frac{1}{6} = \frac{1.5}{\mu_1} - 1$$

$$\frac{1.5}{\mu_1} = \frac{1}{6} + 1 = \frac{7}{6}$$

$$\mu_1 = \frac{(1.5)(6)}{7} = \frac{9}{7}$$

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17. Two streams of photons, possessing energies equal to five and ten times the work function of metal are incident on the metal surface successively. The ratio of maximum velocities of the photoelectron emitted, in the two cases respectively, will be

(A) 1:2

(B) 1:3

(C) 2:3

(D) 3:2

$$E = W_0 + \frac{1}{2} m v_{max}^2$$

$$5W_0 = W_0 + \frac{1}{2} m v_{1max}^2 \qquad 10 W_0 = W_0 + \frac{1}{2} m v_{2max}^2$$

$$4W_0 = \frac{1}{2} m v_{1max}^2 \quad \text{—(1)} \qquad 9W_0 = \frac{1}{2} m v_{2max}^2 \quad \text{—(2)}$$

$$\frac{4}{9} = \frac{v_{1max}^2}{v_{2max}^2} \Rightarrow \frac{v_1}{v_2} = \frac{2}{3}$$

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18. A radioactive sample decays 7/8 times its original quantity in 15 minutes. The half life of the sample is
(A) 5 min (B) 7.5 min (C) 15 min (D) 30 min

Radioactive sample left after 15 min

$1 - \frac{7}{8} = \frac{1}{8}$

$N = N_0 \left(\frac{1}{2}\right)^n$

$\frac{N_0}{8} = N_0 \left(\frac{1}{2}\right)^n \Rightarrow n = 3$

Total time $= n \, (T_{1/2})$

$15 = 3 \, (T_{1/2})$

$T_{1/2} = 5$ min

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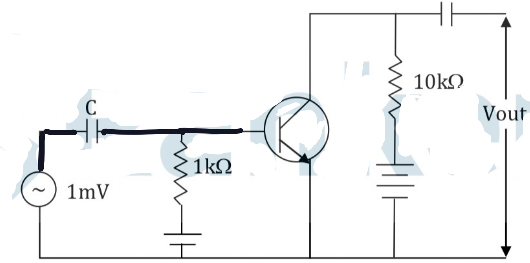
19. An n.p.n transistor with current gain β = 100 in common emitter configuration is shown in figure. The output voltage of the amplifier will be



(A) 0.1 V (B) 1.0 V ✓ (C) 10 V (D) 100 V

$\beta = 100$

Voltage gain $A_V = \beta \frac{R_o}{R_i}$

$= 100 \times \frac{10}{1} = 1000 = \frac{V_o}{V_i}$

$V_o = 1000 \times 1 \times 10^{-3}$

$= 1$ Volt

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20. A FM Broad cast transmitter, using modulating signal of frequency 20kHz has a deviation ratio of 10. The Bandwidth required for transmission is:
(A) 220 kHz (B) 180 kHz (C) 360 kHz (D) 440 kHz

Modulating frequency = 20 KHz = f

$$\text{Deviation ratio} = \frac{\text{frequency deviation}}{\text{modulating frequency}}$$

$$= \frac{\Delta f}{f} = 10$$

$$\Delta f = (10)(20)$$

$$= 200 \text{ KHz}$$

$$\text{Band width} = 2(f + \Delta f)$$

$$= 2(20 + 200) \text{ KHz}$$

$$= 440 \text{ KHz}$$

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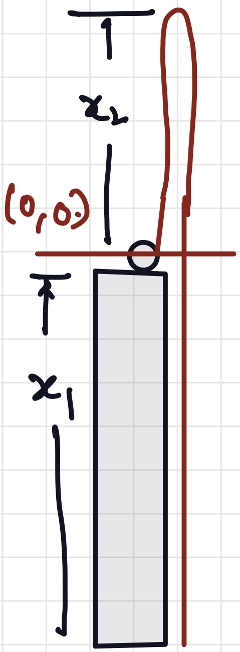
Section - B

21. A ball is thrown vertically upwards with a velocity of 19.6 ms^{-1} from the top of a tower. The ball strikes the ground after 6 s. The height from the ground up to which the ball can rise will be $(k/5)$ m. The value of k is ____. (use g = 9.8 m/s2)

Sol. 392



$$-x_1 = 19.6 \times 6 - \frac{1}{2}(9.8)(6)^2$$

$$x_1 = 19.6 \times 6 - 4.9 \times 36$$
$$= 58.8 \text{ mt}$$

For x_2

$$(0)^2 = (19.6)^2 - 2(9.8)x_2$$

$$x_2 = \frac{(19.6)(19.6)}{19.6}$$
$$= 19.6 \text{ m}$$

$$x_1 + x_2 = \frac{k}{5}$$

$$58.8 + 19.6 = k/5$$

$$k = 392$$

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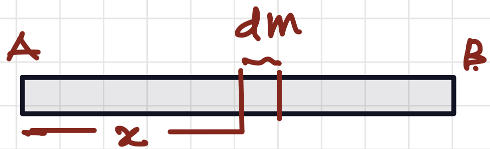
22. The distance of centre of mass from end A of a one dimensional rod (AB) having mass density $\rho = \rho_0\left(1-\frac{x^2}{L^2}\right)$ kg/m and length L (in meter) is $\frac{3L}{\alpha}$ m. The value of α is___. (where x is the distance from end A)



$$\frac{dm}{dx} = \rho = \rho_0\left(1-\frac{x^2}{L^2}\right)$$

$$x_{cm} = \frac{\int x\,dm}{\int dm}$$

$$= \frac{\int_0^L x\rho_0\left(1-\frac{x^2}{L^2}\right)dx}{\int_0^L \rho_0\left(1-\frac{x^2}{L^2}\right)dx} = \frac{\left[\frac{x^2}{2}-\frac{x^4}{4L^2}\right]_0^L}{\left[x-\frac{x^3}{3L^2}\right]_0^L} = \frac{\left(\frac{L^2}{2}-\frac{L^2}{4}\right)}{\left(L-L/3\right)} = \frac{3L}{8} = \frac{3L}{\alpha}$$

$$\alpha = 8$$

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23. A string of area of cross-section 4 mm^2 and length 0.5 m is connected with a rigid body of mass 2 kg. The body is rotated in a vertical circular path of radius 0.5 m. The body acquires a speed of 5 m/s at the bottom of the circular path. Strain produced in the string when the body is at the bottom of the circle is ___30___ $\times 10^{-5}$ (use young's modulus 10^{11} N/m^2 and g = 10 m/s^2)

$$Y = \frac{STRESS}{STRAIN}$$

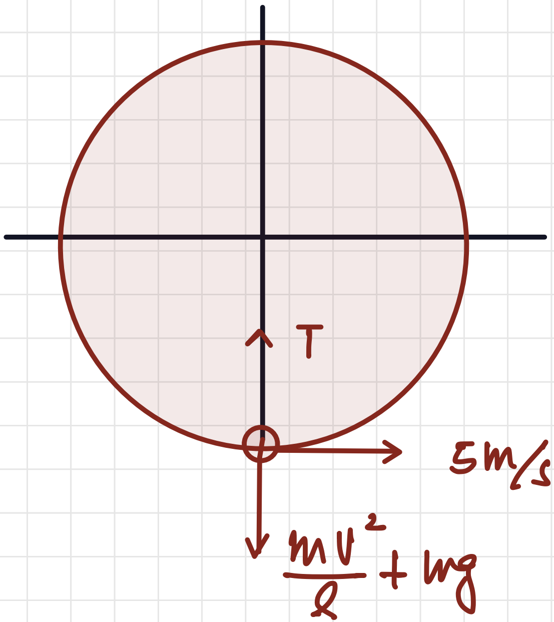
$$STRAIN = \frac{STRESS}{Y} = \frac{F/A}{Y} = \frac{F}{AY}$$

$$F = \frac{mv^2}{l} + mg = \frac{2(5)^2}{0.5} + 2 \times 10$$

$$= 120 \text{ N}$$

$$STRAIN = \frac{120}{4 \times 10^{-6} \times 10^{11}}$$

$$= 30 \times 10^{-5}$$



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24. At a certain temperature, the degrees of freedom per molecule for gas is 8. The gas performs 150 J of work when it expands under constant pressure. The amount of heat absorbed by the gas will be _750_ J.

Degree of freedom = 8

W.D by the gas = 150 J at constant pressure

Heat observed by gas = ?

$\Delta Q = W + \Delta U$

$= nR\Delta T + \frac{f}{2} nR\Delta T$

$nR\Delta T = 150$

$= 150 + \frac{8}{2} \times 150$

$Q = 750$ J

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25. The potential energy of a particle of mass 4 kg in motion along the x-axis is given by $U = 4(1 - \cos 4x)$ J. The time period of the particle for small oscillation ($\sin\theta \simeq \theta$) is $\left(\frac{\pi}{K}\right)$ s. The value of K is _____.

$$U = 4(1 - \cos 4x)$$

$$F = -\frac{dU}{dx} = -\frac{d}{dx} 4(1-\cos 4x)$$

$$= -16 \sin 4x$$

Took

$\sin 4x \simeq 4x$

$$F = -16(4x) = m(A)$$

$$-16 \times 4 (x) = m(-\omega^2 x)$$

$$\frac{16 \times 4}{4} = \omega^2 \Rightarrow \omega = 4$$

$$T = \frac{2\pi}{\omega} = \frac{2\pi}{4} = \pi/2 = \frac{\pi}{K}$$

$$K = 2$$

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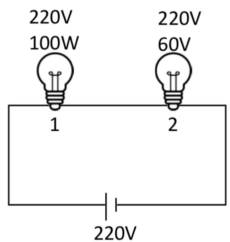
26. An electrical bulb rated 220 V, 100 W. is connected in series with another bulb rated 220 V, 60 W. If the voltage across combination is 220 V, the power consumed by the 100 W bulb will be about __14__ W.



$$R_1 = \frac{V^2}{P} = \frac{(220)^2}{100}$$

$$R_2 = \frac{(220)^2}{60}$$

$$R_{eq} = R_1 + R_2$$

$$= (220)^2\left(\frac{1}{100} + \frac{1}{60}\right)$$

$$= (220)^2\left(\frac{6+10}{600}\right)$$

$$= \frac{(220)^2 \times 16}{600}$$

$$I = \frac{V}{R_{eq}}$$

$$= \frac{220 \times 600}{(220)^2 \times 16}$$

$$= \frac{600}{220 \times 16}$$

Power consumed by 100 W

$$P = I^2 R_1$$

$$= \left(\frac{600}{220 \times 16}\right)^2 \times \frac{(220)^2}{100} = 14 \text{ watt}$$

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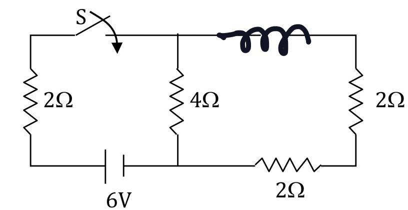
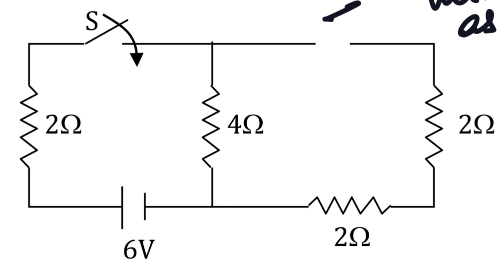
27. For the given circuit the current through battery of 6 V just after closing the switch 'S' will be _____ A.





Inductor will act as a open circuit

$I = \frac{6}{6} = 1$ Amp

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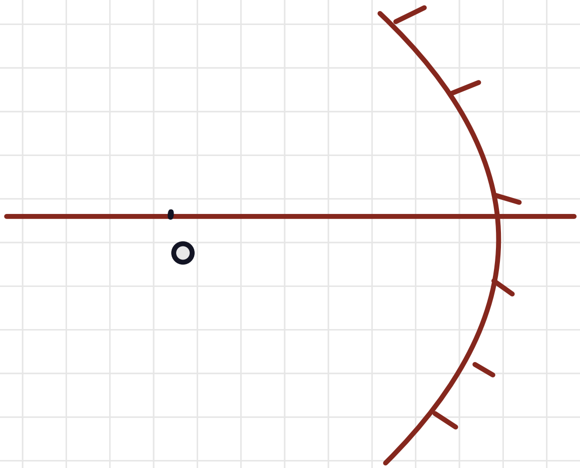
28. An object 'o' is placed at a distance of 100 cm in front of a concave mirror of radius of curvature 200 cm as shown in the figure. The object starts moving towards the mirror at a speed 2 cm/s. The position of the image from the mirror after 10 s will be at __400__ cm.



$R = 200\,cm$

$v_o = -2\,cm/s$

position of object after 10 sec

$u = 100 - \text{distance covered}$

$= 100 - 2\times10 = 80\,cm$

$f = \frac{R}{2} = \frac{200}{2} = 100\,cm$

$u = -80\,cm,\ f = -100\,cm$

$\frac{1}{f} = \frac{1}{v} + \frac{1}{u} \Rightarrow \frac{1}{v} = \frac{1}{f} - \frac{1}{u}$

$\frac{1}{v} = \frac{u-f}{fu} = \frac{(-80)+100}{80\times100}$

$v = 400\,cm$

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29. In an experiment with a convex lens. The plot of the image distance (v') against the object distance (u') measured from the focus gives a curve $v'u' = 225$. If all the distances are measured in cm. The magnitude of the focal length of the lens is ______ cm.

Sol. 15

$v'u' = 225$

$f = \sqrt{u'v'}$ — As per physics lab experiment

$= \sqrt{225}$

$= 15$ cm.

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30. In an experiment to find acceleration due to gravity (g) using simple pendulum, time period of 0.5 s is measured from time of 100 oscillation with a watch of 1 sec resolution. If measured value of length is 10 cm known to 1 mm accuracy. The accuracy in the determination of g is found to be x %. The value of x is __5%__.

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$\frac{\Delta g}{g} = \frac{\Delta l}{l} + 2\left(\frac{\Delta T}{T}\right)$$

$$= \frac{0.1}{10} \times 2\left(\frac{1}{0.5\times 100}\right)$$

$$= \frac{1}{100} + \frac{4}{100} = \frac{5}{100}$$

$$\frac{\Delta g}{g}\times 100 = \frac{5}{100}\times 100 = 5\%$$

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EVENING SHIFT

QUESTIONS

BASED ON

UNIT & DIMENSION, PULLEY CHAIN,CAPACITOR WITH DIELECTRIC, POC,SHM ARE TRICKY

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