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

SECTION - A

1. Consider the efficiency of carnot's engine is given by $\eta = \frac{\alpha\beta}{\sin\theta}\log e\frac{\beta\alpha}{kT}$, 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.

Sol. **D**

$\eta = \frac{\alpha\beta}{\sin\theta}\log\left(\frac{Bx}{kT}\right)$

k – Boltzmann constant

T – temperature

Dim of K = $[M^1L^2T^{-2}K^{-1}]$

or Dim of $\frac{\beta x}{kT}$ = $M^0L^0T^0$

$\frac{\beta[L]}{[ML^2T^{-2}K^{-1}][K]}$ = $[M^0L^0T^0]$

β = $[MLT^{-2}]$ = Force

(b) Dim of α^{-1} x = Dim of βx

= (MLT^{-2}) [L] = $[ML^2T^{-2}]$ [Energy]

(c) η is dimensionless, sin θ is also dimensionless from expression dimension of $\eta^{-1}\sin\theta = \alpha\beta$

So, dim. of $\eta^{-1}\sin\theta - \alpha\beta$

(d) Dim of $\alpha\beta$ = $M^0L^0T^0$

So, dim of α = dim of $\frac{1}{\beta}$

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) $3\hat{x} + 15\hat{y} + 7\hat{z}$

Sol. **B**

$x = 3t\hat{i}$	$y = 5t^3\hat{y}$	$z = 7\hat{j}$
$v_x = \frac{dx}{dt} = 3\hat{x}$	$y_x = \frac{dy}{dt} = 15t^2\hat{y}$	$v_z = \frac{dz}{dt} = 0$
$a_x = \frac{dv_x}{dt} = 0$	$a_y = \frac{dv_y}{dt} = 30t\hat{y}$	$a_z = 0$

$a_{net} = \vec{a}_x + \vec{a}_y + a_z$

$= 30t\hat{y}$

at t = 1 sec

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

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

Sol. **D**

A = 10 cm^2

v = 20 m/s

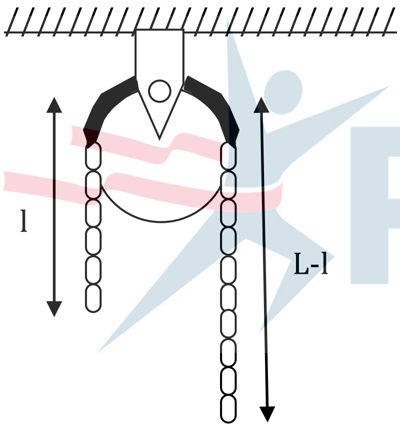
ρ = 1000 kg/m^3

Force on wall = $\rho A v^2$

= $1000 \times 10 \times 10^{-4} \times (20)^2$

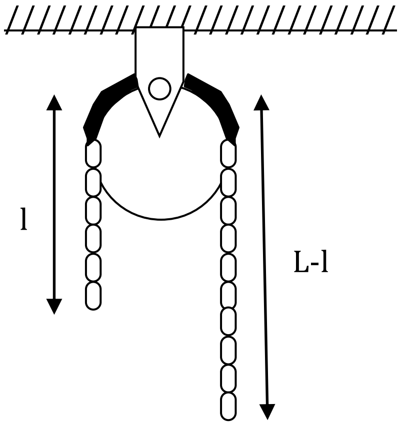
= 400 N

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 $l = \frac{L}{x}$ the acceleration of the chain is $\frac{g}{2}$. The value of x is ______.



(A) 6 (B) 2 (C) 1.5 (D) 4

Sol. **D**



Given if $\ell = \frac{L}{x}$, then $a = \frac{g}{2}$

Mass of l part

$m_1 = \frac{M}{L}.l$

Mass of L – l part

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

Apply NLM

$m_2g - m_1g = (m_1 + m_2)\frac{g}{2}$

$\left[\frac{M}{L}(L - l) - \frac{M}{L}l\right]g = \frac{Mg}{2}$

$\frac{L-l}{L} - \frac{l}{L} = \frac{1}{2}$

$L - l - l = \frac{L}{2}$

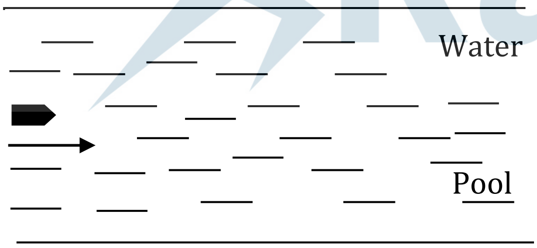
$L - 2l = \frac{L}{2} \Rightarrow 2l = \frac{L}{2}$

$l = \frac{L}{4}$

given heat $l = \frac{L}{x}$

So, x = 4

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

Sol. **A**

$k_i = 90$ J $k_f = 40$ J in 1 sec

m = 200 g = 0.2 kg

we know that

$k = \frac{1}{2}mv^2$

$v_i^2 = \frac{2k_i}{m} = \frac{2\times90}{0.2} = 900$

$v_i = 30$ m/s

$v_f^2 = \frac{2k_f}{m} = \frac{2\times40}{0.2} = 400$

$v_f = 20$ m/s

v = u + at

$20 = 30 + a \times 1 \Rightarrow a = -10\ m/s^2$

So, distance covered before stop

$v^2 = u^2 + 2as$

$0 = (30)^2 + 2(-10) \times s$

$s = \frac{900}{20} = 45$ m

Minimum length of pool.

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_F = 6400 km and g on earth 10 m/s^2)

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

Sol. **C**

$T_i = 4s$ $T_2 = 6s$

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

So, $\frac{T_1}{T_2} = \sqrt{\frac{g_2}{g_1}}$ ....(1)

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

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

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

From equation (1)

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

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

4R + 4h = 6 R

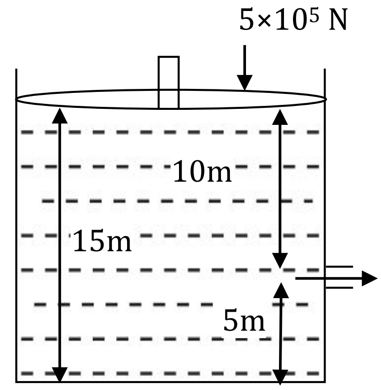
4h = 2R

h = R/2

$= \frac{6400}{2} = 3200$ km

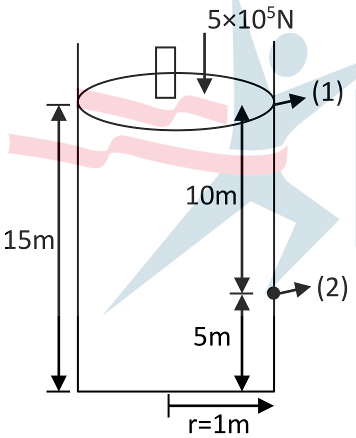
7. Consider a cylindrical tank of radius lm is filled with water. The top surface of water is at 15 m from the bottom of the cylinder. There is a hole on the wall of cylinder at a height of 5 m from the bottom. A force of 5×10^5N is applied an the top surface of water using a piston. The speed of ifflux from the hole will be :

(given atmospheric pressure $P_A = 1.01\times10^5$ Pa, density of water $\rho w = 1000$ kg/m^3 and gravitational acceleration g = 10 m/s^2)



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

Sol. **C**



Applying Boroulli equation

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

$\frac{5\times10^5}{\pi(1)^2} + 1000 \times 10 \times 10 + 0 = 0.01 \times 10^5 + 0 + \frac{1}{2} \times 1000 \times v_2^2$

$v_2 = 17.8$ m/s

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^{-1}k^{-1}.

(A) 2229 J (B) 5616 J (C) 9360 J (D) 13.104 J

Sol. **C**

$v_{rms} \propto \sqrt{T}$

$\frac{v_1}{v_2} = \sqrt{\frac{T_1}{T_2}}$

if $v_2 = 2v_1$

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

$\Rightarrow T_2 = 4T_1$

Heat supplied

$Q = nC_v\Delta T$

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

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

= 9360 Joule

R = 8.32 Jm/molk

$T_1 = 300$ K

$T_2 = 4 \times 300$

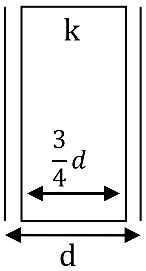
= 1200 k

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) $\frac{K}{4+K}$

Sol. **A**



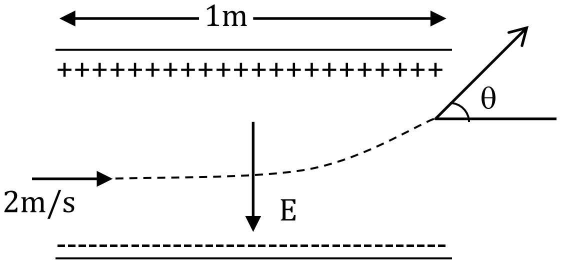
$C_0 = \frac{\varepsilon_0 A}{d}$

$C = \frac{\varepsilon_0 A}{\frac{d}{4} + \frac{3d}{4k}}$

$= \frac{4k\varepsilon_0 A}{(K+3)d}$

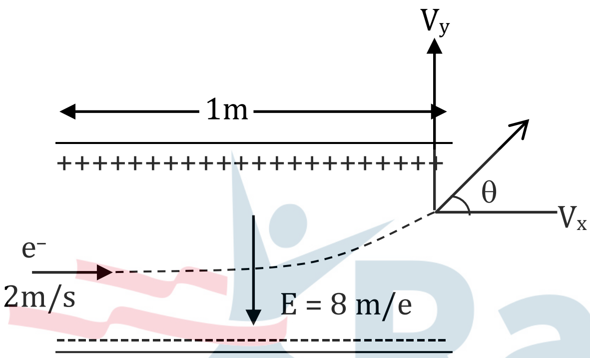
$c = \frac{4k}{3+k} C_0$

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) $\tan^{-1}(3)$

Sol. **B**



$u_x = 2\text{m/s}$ $\quad a_x = 0$

$v_x = u_x + a_2 t$

$v_x = u_x = 2\text{m/s}$

$u_y = 0 \quad a_y = \frac{eE}{m} = \frac{e}{m}\left(\frac{8m}{e}\right) = 8\text{m/s}^2$

$v_y = u_y + a_y t = 0 + 8\text{x}\ 0.5 = 4\text{m /s}$

$\tan\theta = \frac{v_y}{v_x} \Rightarrow \theta = \tan^{-1}\left(\frac{v_y}{v_x}\right)$

$= \tan^{-1}\left(\frac{4}{2}\right)$

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

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

$1 = 2xt + 0$

$t = 0.5$ sec

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 5Ω.

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

Sol. **C**

Statement-1 :- 80Ω is cut in 4 parts so resistance of each part = 20 Ω if they are in parallel

$\frac{1}{R_{eq}} = \frac{1}{20} + \frac{1}{20} + \frac{1}{20} + \frac{1}{20} = \frac{4}{20}$

$R_{eq} = 5\Omega$

Statement-2:- 2R & 3R in parallel

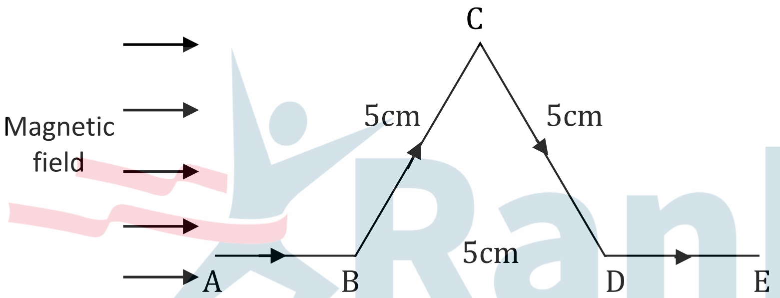
So, thermal energy developed

$E = \frac{v^2}{R}t$ $\qquad$ $E \propto \frac{1}{R}$

$\frac{E_1}{E_2} = \frac{2R}{3R} = 2:3$

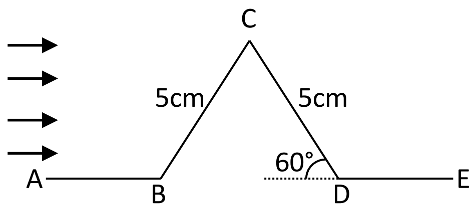
Statement I is correct and statement II is incorrect.

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.)

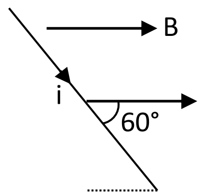


(A) 0.126 N (B) 0.312 N (C) 0.216 N (D) 0.245 N

Sol. **C**



B = 0.5 T $\qquad$ i = 10 A



Force on CD

F = iBl sin θ $\qquad$ (θ = angle between B & l)

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

$= 5 \times 5 \times 10^{-2} \times \frac{\sqrt{3}}{2}$

= 0.216 N

13. The magnetic field at the center of current carrying circular loop is B_1. The magnetic field at a distance of $\sqrt{3}$ times radius of the given circular loop from the center on its axis is B_2. The value of B_1/B_2 will be

(A) 9:4 (B) $12:\sqrt{15}$ (C) 8:1 (D) $5:\sqrt{3}$

Sol. **C**

magnetic field at center of loop

$B_1 = \frac{\mu_0 i}{2R}$

Magnetic field at x = $\sqrt{3}R$

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

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

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

$B_1 : B_2 = 8 : 1$

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 Ω (B) 10 Ω and 500 Ω

(C) 800 Ω and 0.32 Ω (D) 1.06 Ω and 500 Ω

Sol. **C**

V_p = 8 kv v_s =160 v

Power load = 80 kW power factor = unity

Primary load

$R_1 = \frac{v_p^2}{p} = \frac{(8\times10^3)^2}{80\times10^3} = 800\ \Omega$

Secondary load

$R_2 = \frac{v_s^2}{p} = \frac{(160)^2}{80\times10^3} = 0.32\ \Omega$

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 10^2 W/cm^2 (B) 8.64 x 10^{-6} W/cm^2

(C) 6.0 W/cm^2 (D) 0.06 W/cm^2

Sol. **D**

A = 36 cm^2

F = 7.2 × 10^{-9} N t = 20 min

complete absorption

energy per unit time $\frac{E}{t} = IA$

energy flux $\frac{E}{AT} = I$

$F = \frac{IA}{c}$ So, $I = \frac{F\times C}{A}$

Energy flux $I = \frac{7.2\times10^{-9}\times3\times10^8}{36} = 0.06\ \frac{W}{cm^2}$

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) $\frac{9}{7}$ (C) $\frac{3}{2}$ (D) $\frac{4}{3}$

Sol. **B**

$P = \frac{\mu_2}{f} = (\mu_1 - \mu_2)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ (For this formula refer to NCERT Part-2, Chapter-9, Page no. 328, solved example 8)

(μ_1 is refractive index of lens and μ_2 is of surrounding medium)

$1.25 = (1.5 - \mu_2)\left(\frac{1}{0.2} + \frac{1}{0.4}\right)$

$\frac{1.25 \times 0.08}{0.6} = (1.5 - \mu_2)$

$\Rightarrow \mu_2 = \frac{4}{3}$

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

Sol. **C**

E = KE + F

E – Energy of photon

KE – KE of e^-

ϕ = work function

Case-I

$E_1 = 5\phi$

$E_2 = 10\phi$

$\frac{1}{2}mv_1^2 = (KE)_1 = E_1 - \phi = 5\phi - \phi = 4\phi$

$\frac{1}{2}mv_2^2 = (KE)_2 = E_2 - \phi = 10\phi - \phi = 9\phi$

So, $\frac{v_1}{v_2} = \sqrt{\frac{4\phi}{9\phi}} = \frac{2}{3}$

18. A radioactive sample decays $\frac{7}{8}$ 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

Sol. **A**

$N = \frac{7}{8} N_0$ in t = 15 min

(N = No. of nuclei which decayed)

$N = N_0 (1 - e^{-\lambda t})$

$\frac{7}{8}N_0 = N_0 (1 - e^{-\lambda t})$

$\Rightarrow \frac{7}{8} = 1 - e^{-\lambda t}$

$e^{-\lambda t} = 1 - \frac{7}{8} = \frac{1}{8}$

$e^{\lambda t} = 8$

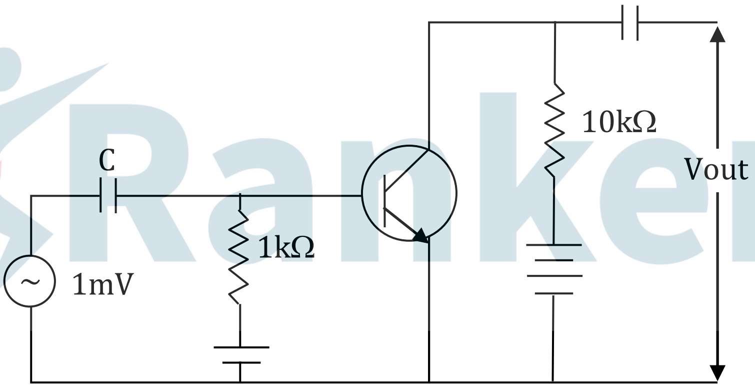
$\lambda t = \ln 8$

t = 15 min & w.KT $t_{1/2} = \frac{\ln(2)}{\lambda}$

So, $t = \frac{\ln(2^3)}{\lambda} = \frac{3\ln 2}{\lambda} = 3t_{1/2}$

$t_{1/2} = \frac{t}{3} = \frac{15}{3} = 5$ min

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

Sol. **B**

Curent gain β = 100

Voltage gain = $\beta \frac{R_0}{R_i}$

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

voltage gain = $\frac{v_0}{v_i} = 1000$

$v_0 = 1000 \times 1 \times 10^{-3}$

= 1 volt

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

Sol. **D**

Given

FM broadcast

Modulating frequency = 20 kHz = f

Deviation ratio = $\frac{\text{Frequency deviation}}{\text{modulating Frequency}} = \frac{\Delta f}{f}$

$\Rightarrow$ Frequency deviation – Δf = f × 10

$\Rightarrow$ 20 kHz × 10 = 200 kHz

$\Rightarrow$ Bandwidth = 2(f + Δf)

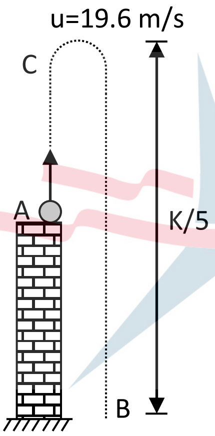
= 2(20 + 200) kHz

= 440 kHz

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 $\left(\frac{k}{5}\right)$ m. The value of k is ____. (use g = 9.8 m/s^2)

Sol. **392**



time taken to reach from A to B = 6 sec

g = 9.8 m/s^2

height of tower H

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

$-H = 19.6 \times 6 - \frac{1}{2} \times 9.8 \times 62$

= 117.6 – 176.4

H = 58.8 m

Height from A to C = y

$v^2 = u^2 + 2as$

$0 = (19.6)^2 - 2 \times 9.8 \times y \Rightarrow y = 19.6$ m

So, height from ground = H + y = $\frac{K}{5}$

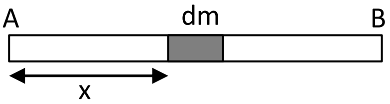
$58.8 + 19.6 = \frac{K}{5}$

K = 392

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)

Sol. **8**

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



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

$x_{com} = \frac{\int x dm}{\int dm}$

$= \frac{\int_0^L x\rho_0(1-\frac{x^2}{L^2})dx}{\int_0^L \rho_0(1-\frac{x^2}{L^2})dx}$

$= \frac{\int_0^L (x-\frac{x^3}{L^2})dx}{\int_0^L (1-\frac{x^2}{L^2})dx} = \frac{\left(\frac{x^2}{2}-\frac{x^4}{4L^2}\right)_0^L}{\left(x-\frac{x^3}{3L^2}\right)_0^L}$

$= \frac{\left(\frac{L^2}{2}-\frac{L^2}{4}\right)}{\left(L-\frac{L}{3}\right)} = \frac{\left(\frac{L^2}{4}\right)}{\frac{2L}{3}} = \frac{3L}{8}$

So, $\alpha = 8$

23. A string of area of cross-section 4 mm² 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 ______$\times 10^{-5}$

(use young's modulus 10^{11} N/m² and g = 10 m/s²)

Sol. **30**

A = 4mm² l = 0.5 m m_{body} = 2kg

$\gamma = 10^{11}$ N/m² g = 10 m/s²

strain $= \frac{stress}{\gamma}$

$= \frac{F}{A\gamma}$

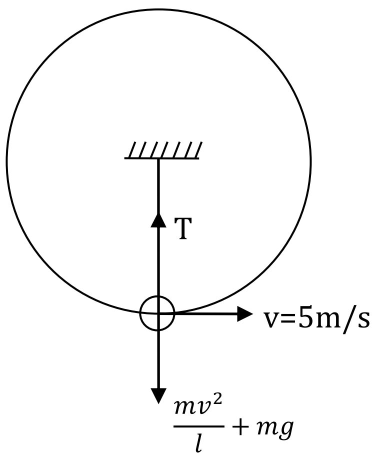
F = tension in string

$F = \frac{mv^2}{l} + mg$

$f = \frac{2\times5^2}{0.5} + 2 \times 10 = 120$ N

Strain $= \frac{120}{4\times10^{-6}\times10^{11}}$

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



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 _______ J.

Sol. **750**

Degree of freedom = 8

WD by gas = 150 J at constant pressure

Heat observed by gas = ??

$Q = \omega + \Delta U$

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

$(nR\Delta T = 150)$

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

Q = 750 Joule

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 _____.

Sol. **2**

m = 4kg

u = 4 (1 – cos 4x) given $\sin\theta \approx \theta$

So, $F = -\frac{dU}{dx} = -4\,[0 + (\sin 4x) \times 4]$

$= -16 \sin 4x$

$F = -64\,x$ → eqaution of SHM

$a = \frac{F}{m} = -\frac{64}{4}x = -16x = -\omega^2 x$

$\omega = \sqrt{16} = 4$

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

So, K = 2

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 _______ W.

Sol. 14

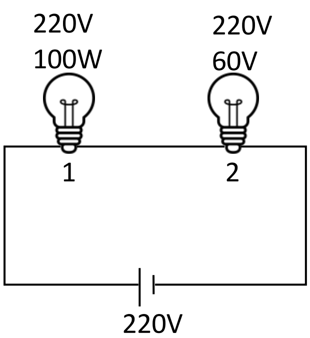
$R_1 = \frac{v^2}{p} = \frac{220^2}{100}$

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

$R_{eq.} = R_1 + R_2$

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

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



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

i in each bulb

$i = \frac{v}{R_{eq.}} = \frac{220 \times 600}{(220)^2 \times 16} = \frac{600}{220 \times 16}$

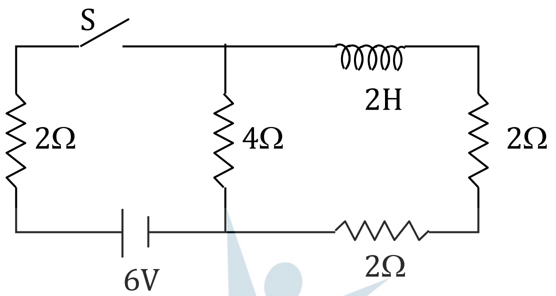
Power consumed by 100 W

$P = L^2 R_1$

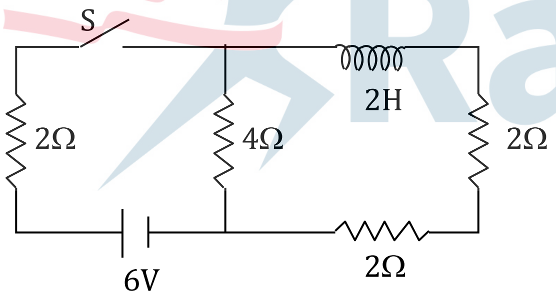
$\left(\frac{600}{220 \times 16}\right)^2 \times \frac{(220)^2}{100}$

$= \frac{600 \times 600}{16 \times 16 \times 100} = 14.06$ watt ≈ 14 watt

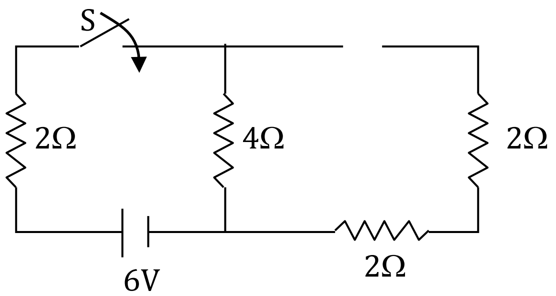
27. For the given circuit the current through battery of 6 V just after closing the switch 'S' will be _____ A.



Sol. **1**



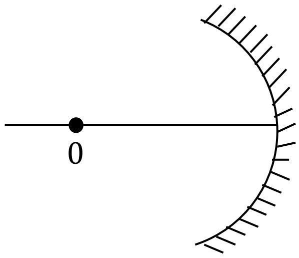
Just after closing the switch



$R_{eq} = 6\Omega$

So, $i = \frac{6v}{6\Omega} = 1$ Amp.

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 _____ cm.



Sol. **400**

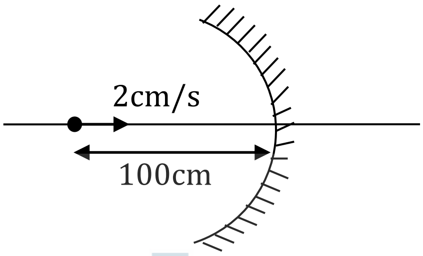
R = 200 cm

v_0 = 2 cm/s

position of object after 10 sec

u = 100 – distance covered

= 100 – 2 × 10 = 80 cm



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

u = 80 cm

sign conservation

f = -100 cm

u = -80 cm

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

$\frac{1}{v} = \frac{u-f}{fu}$

$\frac{1}{v} = \frac{-80+100}{80\times100}$

$v = \frac{80\times100}{20} = 400$ cm

29. In an experiment with a convex lens. The plot of the image distance (ν') against the object distance (μ') measured from the focus gives a curve ν' μ'=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

we know that

$f = \sqrt{v.u}$

$= \sqrt{225}$

= 15 cm

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 _______.

Sol. 5

$T = 2\pi\sqrt{\frac{l}{g}} \Rightarrow g = 4\pi^2 \frac{l}{T^2}$

$\frac{\Delta g}{g} = \frac{\Delta l}{l} + 2\frac{\Delta T}{T}$

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

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

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