PHYSICS
JEE-MAIN (August-Attempt)
31 August (Shift-1) Paper

SECTION - A

Q.1 Which of the following equations is dimensionally incorrect ?

Where t = time , h = height, s = surface tension , θ = angel, ρ = density, a, r = radius, g = acceleration due to gravity, v = volume, p = pressure, W = work done, Γ = torque, ϵ permittivity, E electric field, J = current density, L = length.

(1) $W = \Gamma\theta$ (2) $J = \epsilon \frac{\partial E}{\partial t}$ (3) $h = \frac{2s\cos\theta}{\rho r g}$ (4) $v = \frac{\pi p a^4}{8\eta L}$

Sol. **4**

(1) $W = \tau\theta \rightarrow$ dimensionally current

(2) $I_D = \varepsilon \frac{d\phi}{dt}$

$\phi = E.A$

$\frac{d\phi}{dt} = A \frac{dE}{dt}$

$I_D = \varepsilon A \frac{dE}{dt}$

$J = \frac{I_D}{A} = \varepsilon \frac{dE}{dt}$ dimensionally correct

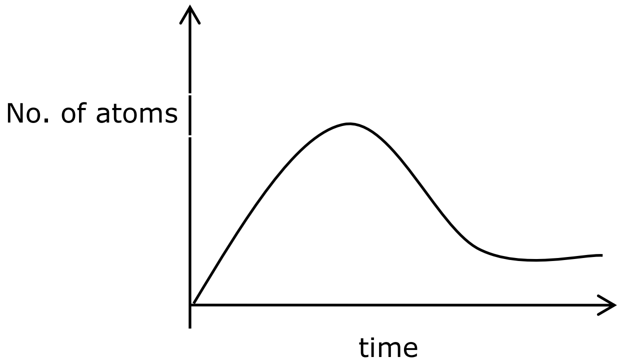
(3) $h = \frac{2s\cos\theta}{\rho r g}$ dimensionally correct

(4) $v = \frac{\pi p a^4}{8nL}$ dimensionally incorrect

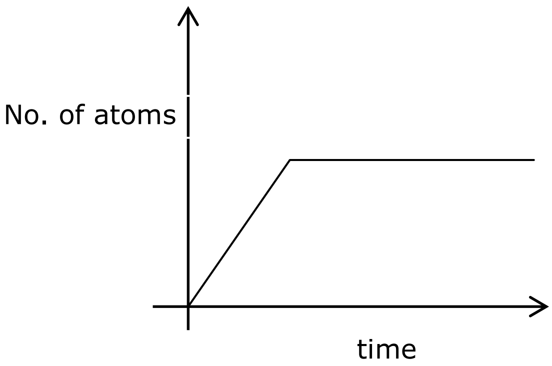
Q.2 A sample of a radioactive nucleus A disintegrates to another radioactive nucleus B, which in turn disintegrates to some other stable nucleus C. Plot of a graph showing the variation of number of atoms of nucleus B versus time is :

(Assume that t = 0, there are B atoms in the sample)

(1)



(2)



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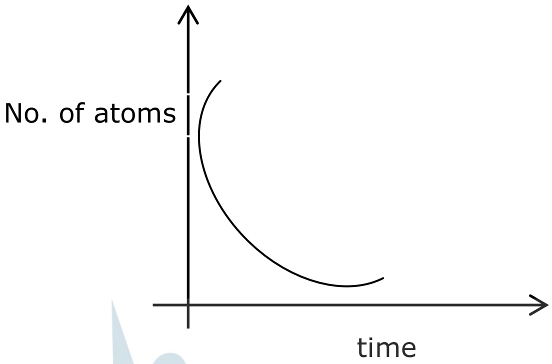

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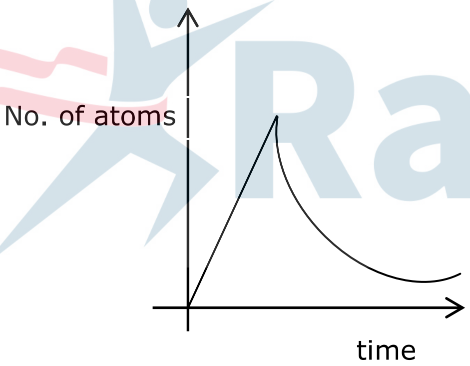
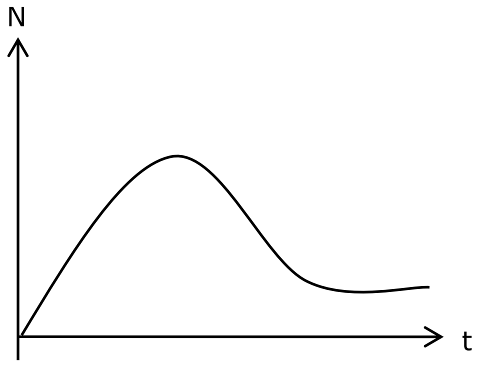


Sol. **1**

	A $\longrightarrow$	B $\longrightarrow$	C
t =0	N_0	0	0
t =t	$N_0e^{-\lambda+}$	N_B	N_C



Slope = $\frac{dN}{dt}$ = decay rate of A – decay rate of B

$\frac{dN}{dt} = \lambda N_0 e^{-\lambda +} - \lambda N$

Q.3 In an ac circuit, an inductor, a capacitor and a resistor are connected in services with $X_L = R = X_C$. Impedance of this circuit is :

(1) R (2) $R\sqrt{2}$ (3) Zero (4) $2R^2$

Sol. **1**

$X_c = X_2 = R$

$Z = \sqrt{(X_L - X_C)^2 + R^2}$

Z = R

Q.4 For an ideal gas the instantaneous change in pressure 'p' with volume 'v' given by the equation $\frac{dp}{dv} = -ap$. If $p = p_0$ at v = 0 is the given boundary condition , then the maximum temperature one mole of gas can attain is :
(Here R is the gas constant)

(1) Infinity (2) $\frac{p_0}{a\ eR}$ (3) $0^\circ C$ (4) $\frac{ap_0}{e\ R}$

Sol. **2**

$\frac{dP}{dv} = -aP$

$\int_{P_0}^{P} \frac{dP}{p} = -a\int_{O}^{V} dV$

$\ln P - \ln P_0 = -aV$

$\ln\left(\frac{P}{P_0}\right) = -aV$

$P = P_0 e^{-aV}$

By Ideal gas Equation –
PV = nRT

$P + V\frac{dp}{dv} = nR\frac{dT}{dv}$ (at $T_{max} \rightarrow \frac{dp}{dv} = 0$)

P – aVP = 0

P = + aPV

$V = \frac{1}{a}$

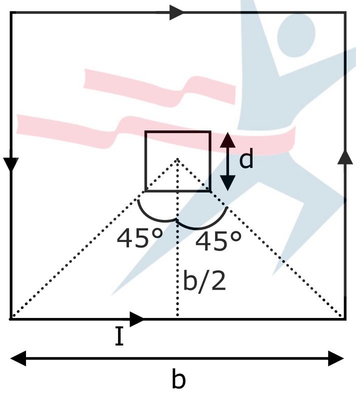
$T = \frac{PV}{nR} = \left(\frac{1}{a}\right)\frac{P_0e^{-a\left(\frac{1}{a}\right)}}{nR} = \frac{P_0e^{-1}}{anR}$

(n = 1 → one Mole gas) $T = \frac{P_0}{aeR}$

Q.5 A small square loop of side 'a' and one turn is placed inside a larger square loop of side b and one turn (b >>a). The two loops are coplanar with their centres coinciding. If a current I is passed in the square loop of side 'b' , then the coefficient of mutual inductance between the two loops is :

(1) $\frac{\mu_0}{4\pi}8\sqrt{2}\frac{b^2}{a}$ (2) $\frac{\mu_0}{4\pi}\frac{8\sqrt{2}}{b}$ (3) $\frac{\mu_0}{4\pi}8\sqrt{2}\frac{a^2}{b}$ (4) $\frac{\mu_0}{4\pi}\frac{8\sqrt{2}}{a}$

Sol. **3**



$B = \frac{\mu_0 I}{4\pi R}(\sin\alpha + \sin\beta)$

$B = \frac{\mu_0 I}{4\pi(b/2)}(\sin 45° + \sin 45°) \times 4$

$B = \frac{2\mu_0 I}{\pi b}\left(\sqrt{2}\right)$

$\phi = B.A$

$\phi = \frac{2\sqrt{2}\mu_0 I}{\pi b}a^2$

$\phi = \frac{8\sqrt{2}\mu_0 Ia^2}{4\pi b}$

Q.6 Match List – I with List – II

	List – I		List – II
(a)	Torque	(i)	MLT^{-1}
(b)	Impulse	(ii)	MT^{-2}
(c)	Tension	(iii)	ML^2T^{-2}
(d)	Surface Tension	(iv)	MLT^{-2}

Choose the most appropriate answer from the option given below :

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

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

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

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

Sol. **2**

(a) Torque $(\vec{t}) = \vec{r} \times \vec{F} = L^1(M^1L^1T^{-2}) = M^1L^2T^{-2}$ ....(ii)

(b) Surface Tension (T) = $\frac{F}{\ell} = \frac{M^1LT^{-2}}{L^1} = M^1L^0T^{-2}$ ....(iv)

(c) Impulse (I = ΔP) = MV = $M^1L^1T^{-1}$ ....(i)

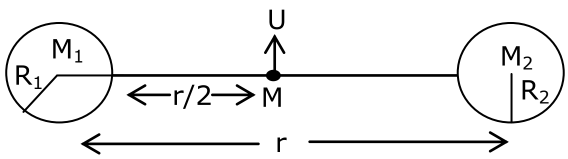
(d) Tension (T) = F = $M^1L^1T^{-2}$..................(iii)

Q.7 The masses and radii of the earth and moon are (M_1 , R_1) and (M_2, R_2) respectively. Their centres are at a distance 'r' apart. Find the minimum, escape velocity for a particle of mass 'm' to be projected from the middle of these two masses :

(1) $V = \sqrt{\frac{4G(M_1 + M_2)}{r}}$ (2) $V = \frac{1}{2}\sqrt{\frac{2G\,(M_1 + M_2)}{r}}$

(3) $V = \frac{\sqrt{2G}(M_1 + M_2)}{r}$ (4) $V = \frac{1}{2}\sqrt{\frac{4G\,(M_1+M_2)}{r}}$

Sol. **1**



$K_i + U_i = K^o{}_x + U^o{}_x$

$$\frac{1}{2}Mv^2 - \frac{GM_1M}{(r/2)} - \frac{GM_2M}{(r/2)} = 0$$

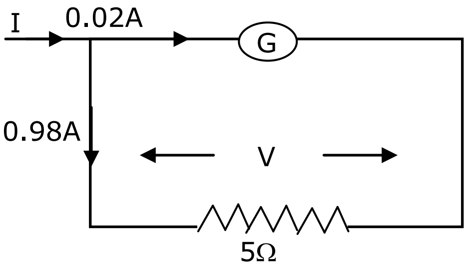
$$\frac{V^2}{2}\;\frac{2GM_1}{r} + \frac{GM_2}{r}$$

$$V = \sqrt{\frac{4G}{r}(M_1 + M_2)}$$

Q.8 Consider a galvanometer shunted with 5Ω resistance and 2% of current passes through it. What is the resistance of the given galvanometer ?

(1) 245Ω (2) 246Ω (3) 300Ω (4) 344Ω

Sol. **1**



By Ohm's Law

V = I R

$0.98 \times 5 = 0.02G$

$G = \frac{98 \times 5}{2} = 245\Omega$

Q.9 A uniform heavy rod of weight 10 kg ms^{-2} , cross-sectional area 100 cm^2 and length 20 cm is hanging from a fixed support. Young modulus of the material of the rod is 2×10^{11} Nm^{-2}. Neglecting the lateral contraction , find the elongation of rod due the its weight :

(1) 4×10^{-8} m (2) 5×10^{-10} m (3) 5×10^{-8} m (4) 2×10^{-9}m

Sol. **2**

W = Mg= 10N

$A = 100\ cm^2 = 100 \times 10^{-4}\ m^2$

$L = 20cm = 20 \times 10^{-2}$ m

$Y = 2 \times 10^{11}\ N\ m^{-2}$

Elongation of rod due to its own weight = $\frac{W\ell}{2Ay}$

$= \frac{10 \times 20 \times 10^{-2}}{2 \times 100 \times 10^{-4} \times 2 \times 10^{11}} = .5 \times 10^{-9}$m

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

Q.10 A reversible engine has efficiency of $\frac{1}{4}$. If the temperature of the sink is reduced by 58º C, its efficiency becomes double. Calculate the temperature of the sink :

(1) 280ºC (2) 382ºC (3) 174ºC (4) 180.4ºC

Sol. **174**

Case – 1

$n = 1 - \frac{T_L}{T_H}$

$\frac{1}{4} = \frac{T_H - T_L}{T_H}$

$T_H = 4T_H - 4T_L$

$T_L = \frac{3T_4}{4}$

$T_H = \frac{4T_L}{3}$

Case - 2

$2n = 1 - \frac{(T_L - 58)}{T_H}$

$2 \times \frac{1}{4} = \frac{T_H - T_L + 58}{T_H}$

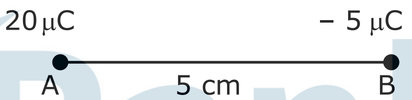
$T_H = 2T_H - 2T_L + 116$

$\frac{4T_L}{3} = 2\left(\frac{4T_L}{3}\right) - 2T_L + 116$

$\frac{4T_L}{3} - \frac{8T_L}{3} + 2T_L = 116$

$T_L = \frac{116 \times 3}{2} = 174^oC$

Q.11 Two particles A and B having charges 20μC and –5 μC respectively are held fixed with a separation of 5 cm. At what position a third charged particle should be placed so that it does not experience a net electric force ?



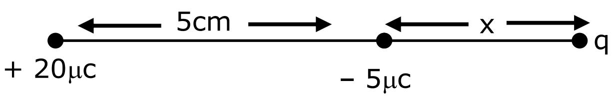
(1) At 5 cm from 20μC on the left side of system

(2) At midpoint between two charges

(3) At 1.25 cm from a –5 μC between two charges

(4) At 5 cm from –5 μC on the right side

Sol. **4**



$\vec{F}_{net} = 0$

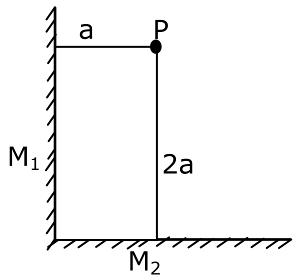
$\frac{K20 \times q}{(5+x)^2} = \frac{K5q}{x^2}$

$4x^2 = (5+x)^2$

$2x = 5 + x$

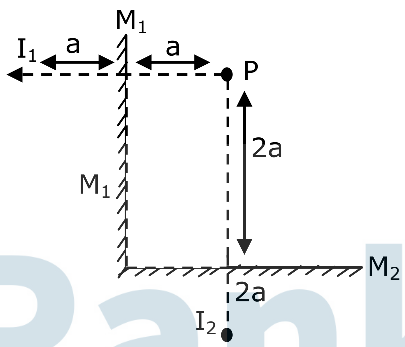
X = 5cm right of –5μc

Q.12 Two plane mirrors M_1 and M_2 are at right angle to each other shown. A point source 'P' is placed at 'a' and '2a' meter away from M_1 and M_2 respectively. The shortest distance between the images thus formed is : (Take $\sqrt{5}$ = 2.3)



(1) $2\sqrt{10}$ a (2) 2.3a (3) 3a (4) 4.6a

Sol. **4**



Distance from object of Image I_1 & I_2

$= \sqrt{(2a+2a)^2 + (a+a)^2} = \sqrt{20\ a^2}$

$= 2\sqrt{5}a$

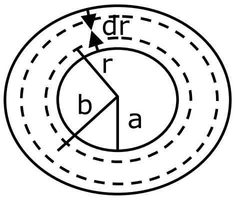
$= 4.6a \qquad (\sqrt{5} = 2.3)$

Q.13 A coil having N turns is wound tightly in the form of a spiral with inner and outer radii 'a' and 'b' respectively. Find the magnetic field at centre, when a current I passes through coil :

(1) $\frac{\mu_0 I}{8}\left[\frac{a+b}{a-b}\right]$ (2) $\frac{\mu_0 I}{8}\left(\frac{a-b}{a+b}\right)$

(3) $\frac{\mu_0 I}{4(a-b)}\left[\frac{1}{a}-\frac{1}{b}\right]$ (4) $\frac{\mu_0 IN}{2(b-a)}\log_e\left(\frac{b}{a}\right)$

Sol. No. of turns in thichkness (n) = $\frac{N}{(b-a)}dr$



Magnetic field due to this circular coil of radius r at centre.

$B = \int dB = \int \frac{n\mu_0 I}{2r}$

$B = \int \frac{N}{b-a} dr \left(\frac{\mu_0 I}{2r}\right)$

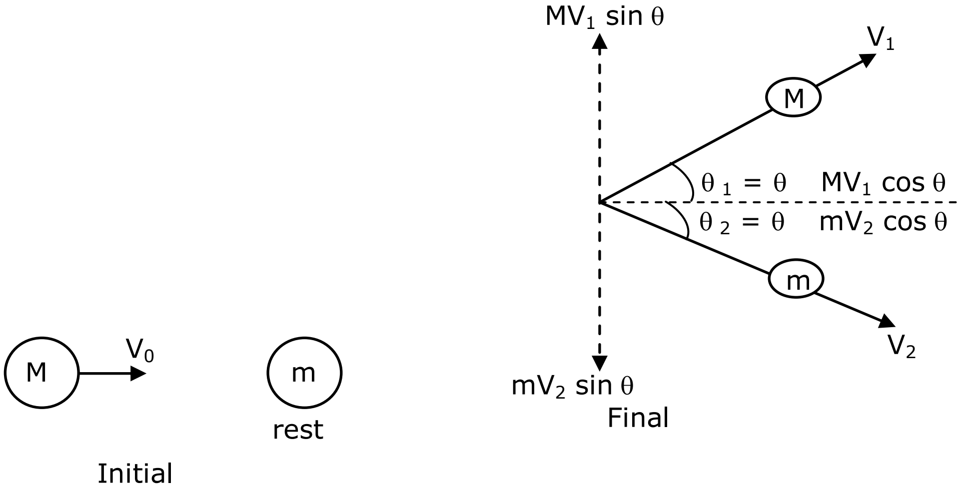
$B = \frac{N\mu_0 I}{2(b-a)} \int_a^b \frac{dr}{r} = \frac{\mu_0 NI}{2(b-a)} \log_e\left(\frac{b}{a}\right)$

$B = \frac{\mu_0 NI}{2(b-a)} \log_e\left(\frac{b}{a}\right)$

Q.14 A body of mass M moving at speed V_0 collides elastically with a mass 'm' at rest. After the collision, the two masses at angles θ_1 and θ_2 with respect to the initial direction of motion of the body of mass M. The largest possible value of the ratio M/m, for which the angles θ_1 and θ_2 will be equal , is :

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

Sol. **4**



By linear momentum conservation

In y – direction $P_i = P_f$

$0 = MV_1 = \sin\theta - mV_2 \sin\theta$

$MV_1 = mV_2$

$V_1 = \frac{mV_2}{M}$ ....(1)

In x – direction $P_i = MV_0$

$P_f = MV_1 \cos\theta + mV_2 \cos\theta$

$P_i \; P_f$

For elastic $MV_0 = MV_1 \cos\theta + mV_2 \cos\theta$ ....(2)

Collision, e = 1

Along common normal $e = \frac{V_2 - V_1}{u_1 - u_2} = \frac{V_2 - V_1 \cos 2\theta}{V_0 \cos\theta - 0}$

$1 = \frac{V_2 - V_1 \cos 2\theta}{V_0 \cos\theta}$

$V_0 \cos\theta = V_2 - V_1 \cos 2\theta$

$V_0 \cos\theta = V_2 - \frac{mV_2}{M} \cos 2\theta$

$V_0 \cos\theta = V_2 \left(1 - \frac{m}{M} \cos 2\theta\right)$ ....(3)

By Eq. (1) & (2) $MV_0 = M\left(\frac{mV_2 \cos\theta}{M}\right) + mV_2 \cos\theta$

$MV_0 = 2m V_2 \cos\theta$

$V_2 = \frac{MV_0}{2m \cos\theta}$ ....(4)

By Eq. (3) & (4)

$V_0 \cos\theta = \frac{MV_0}{2m\cos\theta}\left(1 - \frac{m}{M}\cos\theta\right)$

$2mV_0 \cos^2\theta = MV_0 - mV_0 \cos 2\theta$

$2m \cos^2\theta + m \cos 2\theta = M$

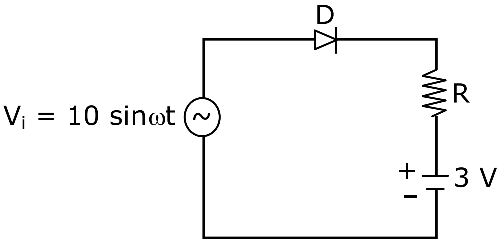
$\frac{2M\cos^2\theta}{M} + \frac{m\cos 2\theta}{m} = \frac{M}{m}$

$2\cos^2\theta + 2\cos^2\theta - 1 = \frac{M}{m}$ For $\frac{M}{m} \rightarrow \max$

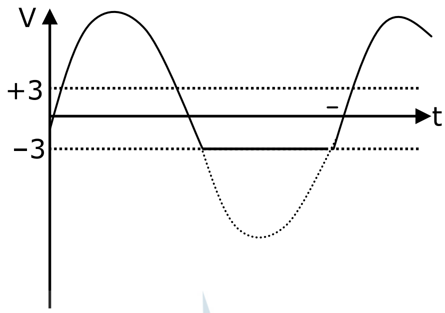
$4\cos^2\theta - 1 = \frac{M}{m}$ $\cos\theta = 1$

$\frac{M}{m} = 4 - 1 = 3$ $\theta = 0$

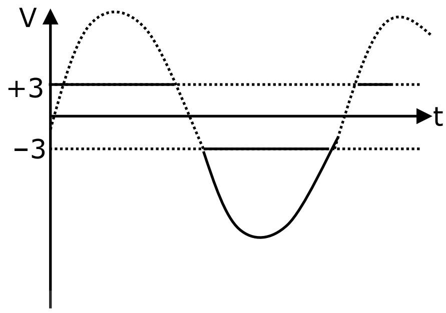
Q.15 Choose the correct waveform that can represent the voltage across R of the following circuit, assuming the diode is ideal one :



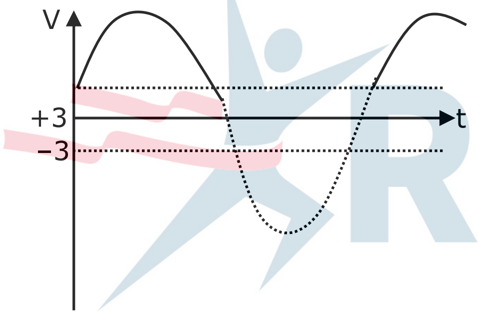
(1)



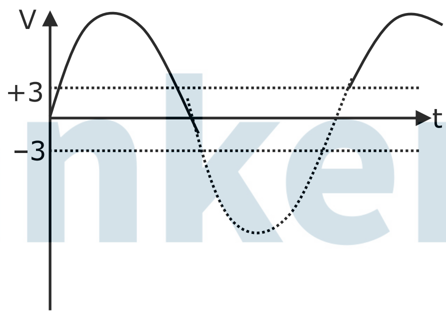
(2)



(3)



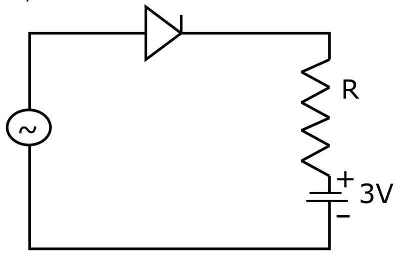
(4)



Sol. **NTA – 3**

Motion - 1

V_i = 10 sinωt



In Forward bias current will flow in reversed bias current does no flow.

Q.16 A moving porton and electron have the same de-Broglie wavelength. If K and P denote the K.E. and momentum respectively. Then choose the correct option :

(1) $K_p < K_e$ and $P_p < P_e$
(2) $K_p = K_e$ and $P_p = P_e$
(3) $K_p > K_e$ and $P_p = P_e$
(4) $K_p < K_e$ and $P_p = P_e$

Sol. **4**

$M_p > M_e$

$\lambda_e = \lambda_p$

$P = \frac{n}{\lambda}$

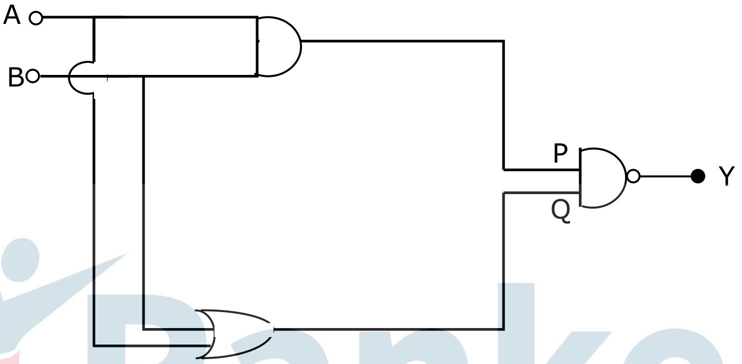
$P_e = P_p$

$h = \frac{h}{P} = \frac{h}{\sqrt{2MK}}$

$KE \propto \frac{1}{M}$

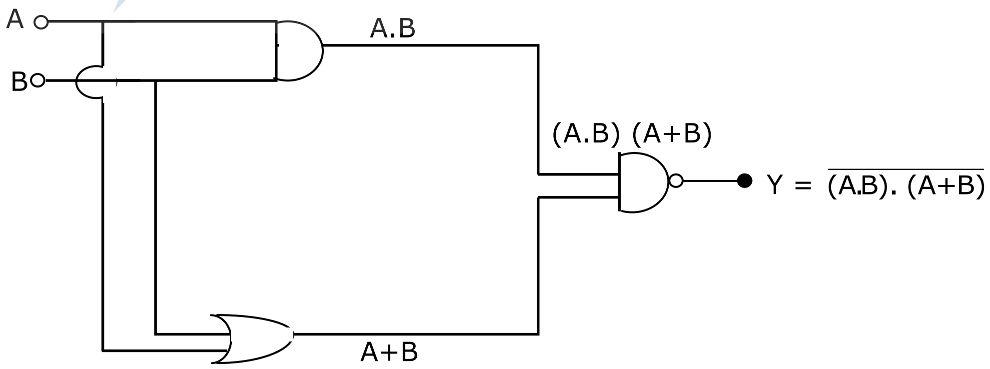
$KE_e > KE_P$

Q.17 In the following logic circuit the sequence of the inputs A, B are (0, 0), (0, 1), (1, 0) and (1,1). The output Y for this sequence will be :



(1) 0, 1, 0, 1 (2) 1, 0, 1, 0 (3) 0, 0, 1, 1 (4) 1, 1, 1, 0

Sol. **4**



By truth table

A	B	A.B	A+B	(A.B) (A+B)	$Y = \overline{(A.B).(A+B)}$
0	0	0	0	0	1
0	1	0	1	0	1
1	0	0	1	0	1
1	1	1	1	1	0

Q.18 Angular momentum of a single particle moving with constant speed along circular path :

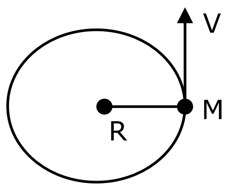
(1) change in magnitude but remains same in the direction

(2) is zero

(3) remains same in magnitude and direction

(4) remains same in magnitude but changes in the direction

Sol. **3**



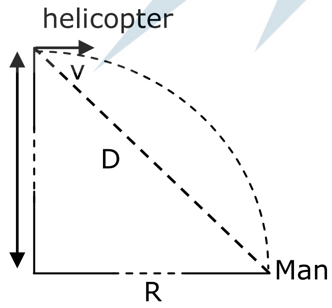
$\vec{L} = M\,(\vec{R} \times \vec{V})$

Direction and magnitude both remain same.

Q.19 A helicopter is flying horizontally with a speed 'v' at an altitude 'h' has to drop a food packet for a man on the ground. What is the distance of helicopter from the man when the food packet dropped ?

(1) $\sqrt{2ghv^2 + h^2}$ (2) $\sqrt{\dfrac{2ghv^2 + 1}{h^2}}$ (3) $\sqrt{\dfrac{2v^2h}{g} + h^2}$ (4) $\sqrt{\dfrac{2gh}{v^2} + h^2}$

Sol. **3**



$R = \sqrt{\dfrac{2h}{g}}.v$

$D = \sqrt{R^2 + h^2}$

$= \sqrt{\left(\sqrt{\dfrac{2h}{g}}.v\right) + h^2}$

$R = \sqrt{\dfrac{2h}{g}}.v$

$D = \sqrt{R^2 + h^2}$

$\sqrt{\left(\sqrt{\frac{2h}{g}}.v\right)^2 + h^2}$

$D = \sqrt{\frac{2hv^2}{g} + h^2}$

Option (3) is correct

Q.20 An object is placed at the focus of concave lens having focal length f. What is the magnification and distance of the image from the optical centre of the lens ?

(1) 1, ∞ (2) Very high, ∞ (3) $\frac{1}{2}, \frac{f}{2}$ (4) $\frac{1}{4}, \frac{f}{4}$

Sol. **3**

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

Object at Focus , u = – f

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

$-\frac{2}{f} = \frac{1}{v}$

$V = -\frac{f}{2}$

Magnification $m = \frac{v}{u} = \frac{-f/2}{-f} = \frac{1}{2}$

SECTION - B

Q.1 The electric field in an electromagnetic wave is given by

$E = (50\ NC^{-1})\ \sin\omega\,(t - x/c)$

The energy contained in a cylinder of volume V is 5.5×10^{-12} J. The value of V is_______cm^3.

(given $\epsilon_0 = 8.5 \times 10^{-12}\ C^2N^{-1}m^{-2}$)

Sol. **500**

$E = 50 \sin\omega\left(t - \frac{x}{c}\right)$

Energy $\rightarrow 5.5 \times 10^{-12}$ J

Energy density , $\frac{U}{v} = \frac{1}{2}\ \epsilon_0\ E_0^2$

$\frac{U}{v} = \frac{1}{2} \times 8.85 \times 10^{-12} \times (50)^2 = 1.1 \times 10^{-8}\ J/m^3$

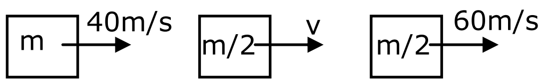
$V = \frac{5.5 \times 10^{-12}}{1.1 \times 10^{-8}}$

$V = 5 \times 10^{-4}\ m^3$

$V = 500\ cm^3$

Q.2 A block moving horizontally on a smooth surface with a speed of 40 ms^{-1} splits into two equal parts. If one of the parts moves at 60 ms^{-1} in the same direction, then the fractional change in the kinetic energy will be x : 4 where x = __________

Sol. **1**



$P_i = P_f$

$m \times 40 = \frac{m}{2} \times v + \frac{m}{2} \times 60$

$40 = \frac{V}{2} + 30$

$\Rightarrow v = 20$

$(K.E.)_I = \frac{1}{2} m \times (40)^2 = 800m$

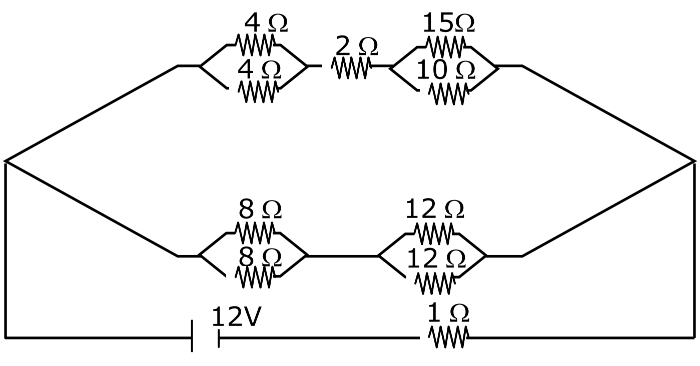
$(K.E.)_f = \frac{1}{2}\frac{m}{2}.(20)^2 + \frac{1}{2}.\frac{m}{2}(60)^2 = 1000m$

$|\Delta K.E.| = |1000m - 800m| = 200\ m$

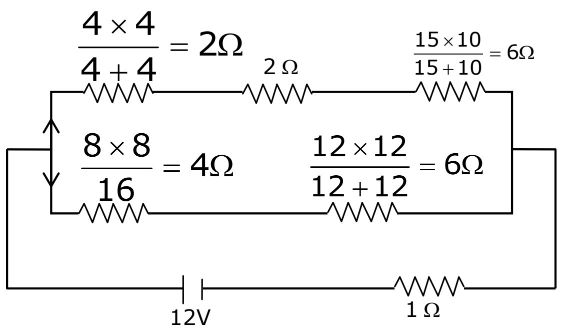
$\frac{\Delta K.E.}{(K.E.)_i} = \frac{200m}{800m} = \frac{1}{4} = \frac{x}{4}$

X = 1

Q.3 The voltage drop across 15Ω resistance in the given figure will be_______V.



Sol. **6**

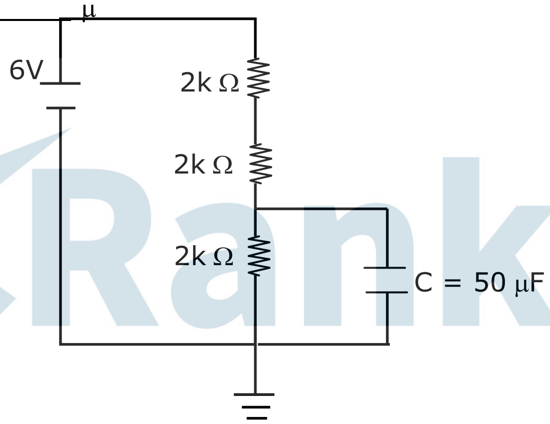


$$R = \frac{10\times10}{10\times10} = \Omega$$

$$I = \frac{V}{R_{eq}} = \frac{12}{S+1} = 2A$$

$V_{15\Omega} = 6 \times 1 = 6V$

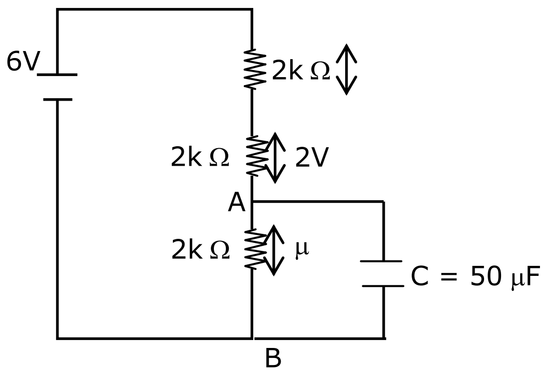
Q.4 A capacitor of 50 μF is connected in a circuit as shown in figure. The charge on the upper plate of the capacitor is____________ μ



Sol. **100**

In steady State Current is zero across capacitor p.d. across capacitor is

$I = \frac{V}{R} = 10^{-3}A$

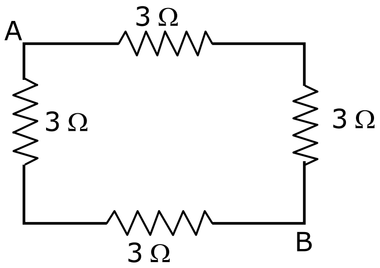


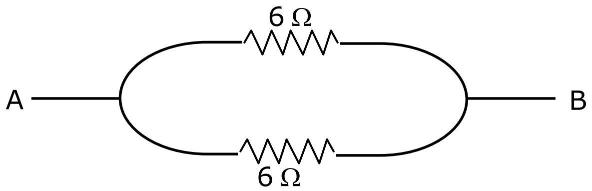
$V_{AB} = IR = 10^{-3} \times 2 \times 10^{3} = 2V$

$Q = CV = 50 \times 2 = 100\mu c$

Q.5 A square shaped wire with resistance of each side 3Ω is bent to form a complete circle. The resistance between two diametrically opposite points of the circle in unit of Ω will be

Sol. **3**





$$\text{Req} = \frac{6\times6}{6+6} = 3\Omega$$

$$R_{AB} = \frac{6\times6}{6+6} = 3\Omega$$

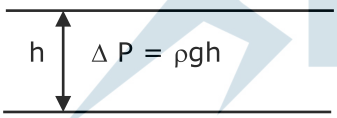
Q.6 When a rubber ball is taken to a depth of__________m in deep sea, its volume decreases by 0.5%

(The bulk modulus of rubber = 9.8×10^8 Nm^{-2}

Density of sea water = 10^3 kgm^{-3} g = 9.8 m/s^2)

Sol. **500**

given $-\frac{\Delta v}{v} = 0.5\% = \frac{0.5}{700}$



bulk modulus $(\beta) = -\frac{\Delta p}{\frac{\Delta v}{v}}$

$$\beta = \frac{\rho g h}{\left(-\frac{\Delta v}{v}\right)} = \frac{10^3 \times 9.8 \times h}{\frac{0.5}{100}}$$

$$h = \frac{9.8\times10^8\times0.5}{9.8\times10^3\times100}$$

h = 500 M

Q.7 If the sum of the heights of transmitting and receiving antennas in the line of sight of communication is fixed at 160 m, the the maximum range of LOS communication is ___________km.

(Take radius of Earth = 6400 km)

Sol. 64

$h_T + h_2 = 160$ cm

LOS = $\sqrt{2R_e h_T} + \sqrt{2R_e h_2}$

LOS = $\sqrt{2R_e}\left(h_r + (160 - h_r)\right)^{\frac{1}{2}}$

$h_T = h_r = 60$

LOS = $\sqrt{2R}\left(\sqrt{0.8} + \sqrt{0.80}\right)$

$= 2\sqrt{2 \times 6400 \times 10^3 \times .80} = 64$ KM

Q.8 A wire having a linear mass density 9.0×10^{-4} kg/m is stretched between two rigid supports with a tension of 900 N. The wire resonates at a frequency of 500 Hz. The next higher frequency at which the same wire resonates is 550Hz. The length of the wire is__________m.

Sol. 10

$f_0, 2f_0, 3f_0$

$m = 9 \times 10^{-4}$ kg/m

$T = 900$ N

$V = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{900}{9 \times 10^{-4}}} = 1000$ m/s

$f_n = \frac{nV}{2l} = 500$

$f_{n+1} = \frac{(n+1)V}{2\ell} = 550$

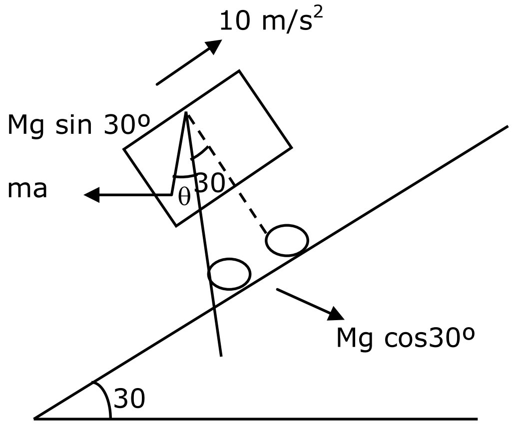
$\Delta f = f_{n+1} - f_n = f_0 = 550 - 500 = 50$ Hz

Fundamental frequency, $f_0 = \frac{1}{2\ell}\sqrt{\frac{T}{\mu}} = \frac{V}{2\ell}$

$\ell = \frac{V}{2f_0} = \frac{1000}{2 \times 50} = 10$ m

Q.9 A car is moving on a plane inclined at 30º to the horizontal with an acceleration of 10 ms^{-2} parallel to the plane upward. A bob is suspended by a string from the roof of the car. The angle in degree which the string makes with the vertical is__________.

Sol. 30



$\text{Tan}(\theta + 30^o) = \frac{Mg\sin 30^o + Ma}{Mg\cos 30^o} = \frac{5+10}{5\sqrt{3}} = \frac{1+2}{\sqrt{3}} = \sqrt{3}$

$\frac{\tan\theta + \tan 30^o}{1 - \tan 30^o \tan\theta} = \sqrt{3}$

$\tan\theta + \frac{1}{\sqrt{3}} = \sqrt{3} - \frac{\sqrt{3}}{\sqrt{3}}\tan\theta$

$2\tan\theta = \sqrt{3} - \frac{1}{\sqrt{3}} = \frac{2}{\sqrt{3}}$

$\text{Tan}\,\theta = \frac{1}{\sqrt{3}}$

$\theta = 30^o$

Q.10 A particle of mass 1 kg is hanging from a spring of force constant 100 Nm^{-1}. The mass is pulled slightly downward and released so that it executes free simple harmonic motion with time period T. The time when the kinetic energy and potential energy of the system will become equal, is $\frac{T}{x}$. The value of x is________.

Sol. **8**

K E = PE

$\frac{1}{2}kA^2 - \frac{1}{2}kx^2 = \frac{1}{2}kx^2$

$A^2 = 2x^2$

$X = \pm \frac{A}{\sqrt{2}}$

$X = A\sin\omega t$

$\frac{A}{\sqrt{2}} = A\sin\frac{2\pi}{T}t$

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

$T = \frac{T}{8}\text{sec}$

X = 8 sec