JEE(Advanced) – 2018 TEST PAPER - 1 WITH SOLUTION

(Exam Date: 20-05- 2018)

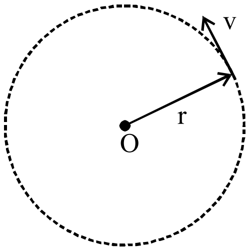
PART-1 : PHYSICS

1. The potential energy of a particle of mass m at a distance r from a fixed point O is given by V (r) = $kr^2/2$, where k is a positive constant of appropriate dimensions. This particle is moving in a circular orbit of radius R about the point O. If v is the speed of the particle and L is the magnitude of its angular momentum about O, which of the following statements is (are) true ?

(A) $v = \sqrt{\frac{k}{2m}}R$ (B) $v = \sqrt{\frac{k}{m}}R$ (C) $L = \sqrt{mk}R^2$ (D) $L = \sqrt{\frac{mk}{2}}R^2$

Ans. (B,C)

Sol.



$$V = \frac{kr^2}{2}$$

F = – kr (towards centre) $\left[F = -\frac{dV}{dr}\right]$

At r = R,

$kR = \frac{mv^2}{R}$ [Centripetal force]

$$v = \sqrt{\frac{kR^2}{m}} = \sqrt{\frac{k}{m}}R$$

$$L = m\sqrt{\frac{k}{m}}R^2$$

2. Consider a body of mass 1.0 kg at rest at the origin at time t = 0. A force $\vec{F} = (\alpha t\hat{i} + \beta\hat{j})$ is applied on the body, where α = 1.0 Ns^{-1} and β = 1.0 N. The torque acting on the body about the origin at time t = 1.0 s is $\vec{\tau}$. Which of the following statements is (are) true?

(A) $|\vec{\tau}| = \frac{1}{3}Nm$

(B) The torque $\vec{\tau}$ is in the direction of the unit vector $+\hat{k}$

(C) The velocity of the body at t = 1 s is $\vec{v} = \frac{1}{2}(\hat{i} + 2\hat{j})ms^{-1}$

(D) The magnitude of displacement of the body at t = 1 s is $\frac{1}{6}m$

Ans. **(A,C)**

Sol. $\vec{F} = (\alpha t)\hat{i} + \beta\hat{j}$ [At t = 0, v = 0, $\vec{r} = \vec{0}$]

$\alpha = 1,\ \beta = 1$

$\vec{F} = t\hat{i} + \hat{j}$

$m\frac{d\vec{v}}{dt} = t\hat{i} + \hat{j}$

On integrating

$m\vec{v} = \frac{t^2}{2}\hat{i} + t\hat{j}$ [m = 1kg]

$\frac{d\vec{r}}{dt} = \frac{t^2}{2}\hat{i} + t\hat{j}$ [$\vec{r} = \vec{0}$ at t = 0]

On integrating

$\vec{r} = \frac{t^3}{6}\hat{i} + \frac{t^2}{2}\hat{j}$

At t = 1 sec, $\vec{\tau} = (\vec{r} \times \vec{F}) = \left(\frac{1}{6}\hat{i} + \frac{1}{2}\hat{j}\right) \times (\hat{i} + \hat{j})$

$\vec{\tau} = -\frac{1}{3}\hat{k}$

$\vec{v} = \frac{t^2}{2}\hat{i} + t\hat{j}$

At t = 1 $\vec{v} = \left(\frac{1}{2}\hat{i} + \hat{j}\right) = \frac{1}{2}(\hat{i} + 2\hat{j})\,\text{m/sec}$

At t = 1 $\vec{s} = \vec{r}_1 - \vec{r}_0$

$= \left[\frac{1}{6}\hat{i} + \frac{1}{2}\hat{j}\right] - [\vec{0}]$

$\vec{s} = \frac{1}{6}\hat{i} + \frac{1}{2}\hat{j}$

$|\vec{s}| = \sqrt{\left(\frac{1}{6}\right)^2 + \left(\frac{1}{2}\right)^2} \Rightarrow \frac{\sqrt{10}}{6}\,\text{m}$

3. A uniform capillary tube of inner radius r is dipped vertically into a beaker filled with water. The water rises to a height h in the capillary tube above the water surface in the beaker. The surface tension of water is σ. The angle of contact between water and the wall of the capillary tube is θ. Ignore the mass of water in the meniscus. Which of the following statements is (are) true?

(A) For a given material of the capillary tube, h decreases with increase in r

(B) For a given material of the capillary tube, h is independent of σ.

(C) If this experiment is performed in a lift going up with a constant acceleration, then h decreases.,

(D) h is proportional to contact angle θ.

Ans. **(A,C)**

Sol. $\frac{2\sigma}{R} = \rho g h$ [R → Radius of meniscus]

$h = \frac{2\sigma}{R\rho g}$ $R = \frac{r}{\cos\theta}$ [r → radius of capillary; θ → contact angle]

$h = \frac{2\sigma\cos\theta}{r\rho g}$

(A) For given material, $\theta \rightarrow$ constant

$h \propto \frac{1}{r}$

(B) h depend on σ

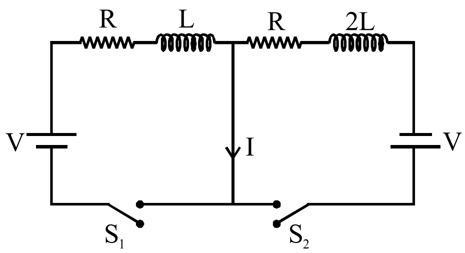
(C) If lift is going up with constant acceleration,

$g_{eff} = (g + a)$

$h = \frac{2\sigma\cos\theta}{r\rho(g+a)}$ It means h decreases

(D) h is proportional to $\cos\theta$ Not θ

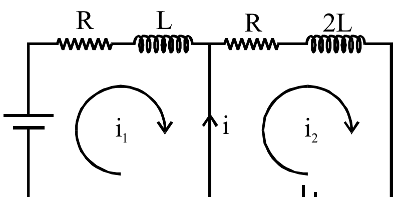
4. In the figure below, the switches S_1 and S_2 are closed simultaneously at t = 0 and a current starts to flow in the circuit. Both the batteries have the same magnitude of the electromotive force (emf) and the polarities are as indicated in the figure. Ignore mutual inductance between the inductors. The current I in the middle wire reaches its maximum magnitude I_{max} at time $t = \tau$. Which of the following statement(s) is (are) true?



(A) $I_{max} = \frac{V}{2R}$ (B) $I_{max} = \frac{V}{4R}$ (C) $\tau = \frac{L}{R}\ell n2$ (D) $\tau = \frac{2L}{R}\ell n2$

Ans. (B,D)

Sol.



$i_{max} = (i_2 - i_1)_{max}$

$\Delta i = (i_2 - i_1) = \frac{V}{R}\left[1 - e^{-\left(\frac{R}{2L}\right)t}\right] - \frac{V}{R}\left[1 - e^{\left(-\frac{R}{L}\right)t}\right]$

$\frac{V}{R}\left[e^{-\left(\frac{R}{L}\right)t} - e^{-\left(\frac{R}{2L}\right)t}\right]$

For $(\Delta i)_{max}$ $\frac{d(\Delta i)}{dt} = 0$

$$\frac{V}{R}\left[-\frac{R}{L}e^{-\left(\frac{R}{L}\right)t}-\left(-\frac{R}{2L}\right)e^{-\left(\frac{R}{2L}\right)t}\right]=0$$

$$e^{-\left(\frac{R}{L}\right)t}=\frac{1}{2}e^{-\left(\frac{R}{2L}\right)t}$$

$$e^{-\left(\frac{R}{2L}\right)t}=\frac{1}{2}$$

$$\left(\frac{R}{2L}\right)t=\ell n2$$

$$t=\frac{2L}{R}\ell n2 \rightarrow \text{time when i is maximum.}$$

$$i_{max}=\frac{V}{R}\left[e^{-\frac{R}{L}\left(\frac{2L}{R}\ell n2\right)}-e^{-\left(\frac{R}{2L}\right)\left(\frac{2L}{R}\ell n2\right)}\right]$$

$$|i_{max}|=\frac{V}{R}\left|\left[\frac{1}{4}-\frac{1}{2}\right]\right|=\frac{1}{4}\frac{V}{R}$$

5. Two infinitely long straight wires lie in the xy-plane along the lines $x = \pm R$. The wire located at $x = +R$ carries a constant current I_1 and the wire located at $x = -R$ carries a constant current I_2. A circular loop of radius R is suspended with its centre at $(0, 0, \sqrt{3}R)$ and in a plane parallel to the xy-plane. This loop carries a constant current I in the clockwise direction as seen from above the loop. The current in the wire is taken to be positive if it is in the $+\hat{j}$ direction. Which of the following statements regarding the magnetic field $\vec{B}$ is (are) true ?

(A) If $I_1 = I_2$, then $\vec{B}$ cannot be equal to zero at the origin (0, 0, 0)

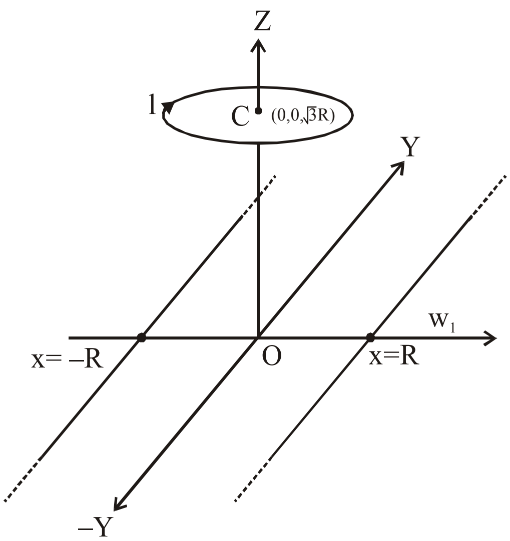
(B) If $I_1 > 0$ and $I_2 < 0$, then $\vec{B}$ can be equal to zero at the origin (0, 0, 0)

(C) If $I_1 < 0$ and $I_2 > 0$, then $\vec{B}$ can be equal to zero at the origin (0, 0, 0)

(D) If $I_1 = I_2$, then the z-component of the magnetic field at the centre of the loop is $\left(-\frac{\mu_0 I}{2R}\right)$

Ans. (A,B,D)

Sol.

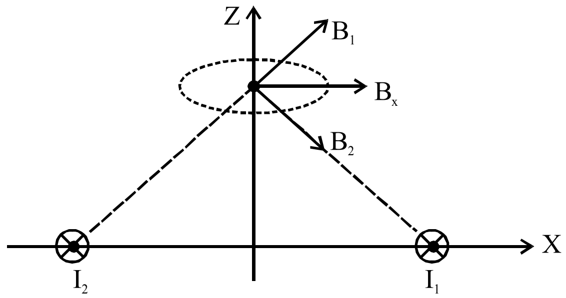


(A) At origin, $\vec{B}=0$ due to two wires if $I_1 = I_2$, hence $\left(\vec{B}_{net}\right)$ at origin is equal to $\vec{B}$ due to ring, which is non-zero.

(B) If $I_1 > 0$ and $I_2 < 0$, $\vec{B}$ at origin due to wires will be along $+\hat{k}$ direction and $\vec{B}$ due to ring is along $-\hat{k}$ direction and hence $\vec{B}$ can be zero at origin.

(C) If $I_1 < 0$ and $I_2 > 0$, $\vec{B}$ at origin due to wires is along $-\hat{k}$ and also along $-\hat{k}$ due to ring, hence $\vec{B}$ cannot be zero.

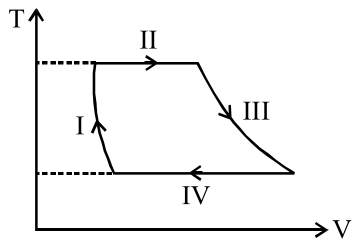
(D)



At centre of ring, $\vec{B}$ due to wires is along x-axis,

hence z-component is only because of ring which $\vec{B}=\frac{\mu_0 i}{2R}(-\hat{k})$

6. One mole of a monatomic ideal gas undergoes a cyclic process as shown in the figure (whre V is the volume and T is the temperature). Which of the statements below is (are) true ?



(A) Process I is an isochoric process

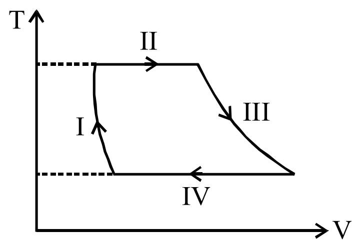
(B) In process II, gas absorbs heat

(C) In process IV, gas releases heat

(D) Processes I and II are not isobaric

Ans. (B,C,D)

Sol.



(A) Process-I is not isochoric, V is decreasing.

(B) Process-II is isothermal expansion

$\Delta U = 0,\ W > 0$

$\Delta Q > 0$

(C) Process-IV is isothermal compression,

$\Delta U = 0,\ W < 0$

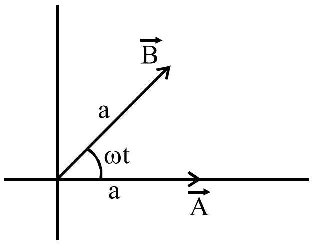
$\Delta Q < 0$

(D) Process-I and III are NOT isobaric because in isobaric process $T \propto V$ hence isobaric T–V graph will be linear.

7. Two vectors $\vec{A}$ and $\vec{B}$ are defined as $\vec{A} = a\hat{i}$ and $\vec{B} = a(\cos\omega t\hat{i} + \sin\omega t\hat{j})$, whre a is a constant and $\omega = \pi/6$ rad s^{-1}. If $|\vec{A}+\vec{B}| = \sqrt{3}|\vec{A}-\vec{B}|$ at time $t = \tau$ for the first time, the value of τ, in seconds, is _____.

Ans. 2.00 sec

Sol.



$$|\vec{A}+\vec{B}| = 2a\cos\frac{\omega t}{2}$$

$$|\vec{A}-\vec{B}| = 2a\sin\frac{\omega t}{2}$$

So $2a\cos\frac{\omega t}{2} = \sqrt{3}\left(2a\sin\frac{\omega t}{2}\right)$

$$\tan\frac{\omega t}{2} = \frac{1}{\sqrt{3}}$$

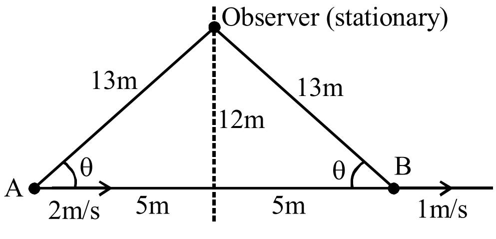
$$\frac{\omega t}{2} = \frac{\pi}{6} \Rightarrow \omega t = \frac{\pi}{3}$$

$\frac{\pi}{6}t = \frac{\pi}{3}$ $\qquad$ t = 2.00 sec

8. Two men are walking along a horizontal straight line in the same direction. The man in front walks at a speed 1.0 ms^{-1} and the man behind walks at a speed 2.0 ms^{-1}. A third man is standing at a height 12 m above the same horizontal line such that all three men are in a vertical plane. The two walking men are blowing identical whistles which emit a sound of frequency 1430 Hz. The speed of sound in air is 330 ms^{-1}. At the instant, when the moving men are 10 m apart, the stationary man is equidistant from them. The frequency of beats in Hz, heard by the stationary man at this instant, is _____

Ans. 5.00 Hz

Sol.



$$\cos\theta = \frac{5}{13}$$

$$f_A = 1430\left[\frac{330}{330-2\cos\theta}\right] = 1430\left[\frac{1}{1-\frac{2\cos\theta}{330}}\right] = 1430\left[1+\frac{2\cos\theta}{330}\right]$$ (By bionomial expansion)

$$f_B = 1430\left[\frac{330}{330+1\cos\theta}\right] = 1430\left[1-\frac{\cos\theta}{330}\right]$$

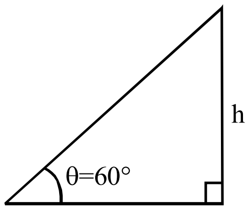
$$\Delta f = f_A - f_B = 1430\left[\frac{3\cos\theta}{330}\right] = 13\cos\theta$$

$$= 13\left(\frac{5}{13}\right) = 5.00\text{Hz}$$

9. A ring and a disc are initially at rest, side by side, at the top of an inclined plane which makes an angle 60° with the horizontal. They start to roll without slipping at the same instant of time along the shortest path. If the time difference between their reaching the ground is $(2-\sqrt{3})/\sqrt{10}\text{s}$, then the height of the top of the inclined plane, in meters, is _____. Take g = 10 ms^{-2}.

Ans. 0.75m

Sol. $a_c = \dfrac{g\sin\theta}{1+\dfrac{I_C}{MR^2}}$



$$a_{ring} = \frac{g\sin\theta}{2}$$

$$a_{disc} = \frac{2g\sin\theta}{3}$$

$$\frac{h}{\sin\theta} = \frac{1}{2}\left(\frac{g\sin\theta}{2}\right)t_1^2 \Rightarrow t_1 = \sqrt{\frac{4h}{g\sin^2\theta}} = \sqrt{\frac{16h}{3g}}$$

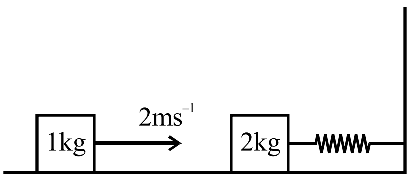
$$\frac{h}{\sin\theta} = \frac{1}{2}\left(\frac{2g\sin\theta}{3}\right)t_2^2 \Rightarrow t_2 = \sqrt{\frac{3h}{g\sin^2\theta}} = \sqrt{\frac{4h}{g}}$$

$$\Rightarrow \sqrt{\frac{16h}{3g}} - \sqrt{\frac{4h}{g}} = \frac{2-\sqrt{3}}{\sqrt{10}}$$

$$\sqrt{h}\left[\frac{4}{\sqrt{3}} - 2\right] = 2-\sqrt{3}$$

$$\sqrt{h} = \frac{(2-\sqrt{3})\sqrt{3}}{(4-2\sqrt{3})} = \frac{\sqrt{3}}{2} \Rightarrow h = \frac{3}{4} = 0.75\text{m}$$

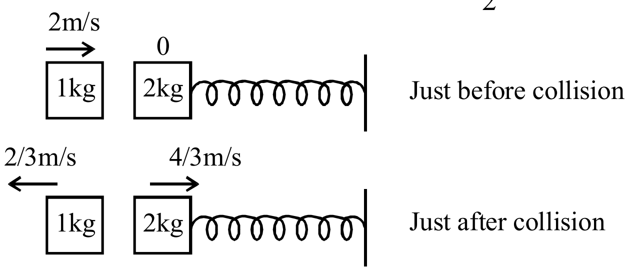
10. A spring-block system is resting on a frictionless floor as shown in the figure. The spring constant is 2.0 N m^{-1} and the mass of the block is 2.0 kg. Ignore the mass of the spring. Initially the spring is in an unstretched condition. Another block of mass 1.0 kg moving with a speed of 2.0 m s^{-1} collides elastically with the first block. The collision is such that the 2.0 kg block does not hit the wall. The distance, in metres, between the two blocks when the spring returns to its unstretched position for the first time after the collision is _____.



Ans. 2.09 m

Sol. $T = 2\pi\sqrt{\dfrac{m}{k}} = 2\pi \sec$

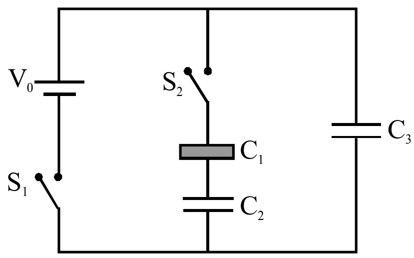
block returns to original position in $\dfrac{T}{2} = \pi \sec$



$d = \dfrac{2}{3}(\pi) = \dfrac{2}{3}(3.14) = 2.0933\text{m}$

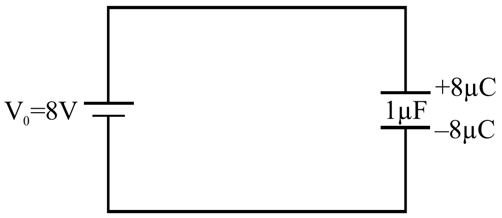
d = 2.09 m

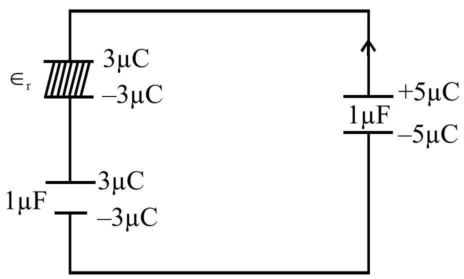
11. Three identical capacitors C_1, C_2 and C_3 have a capacitance of 1.0 μF each and they are uncharged initially. They are connected in a circuit as shown in the figure and C_1 is then filled completely with a dielectric material of relative permittivity $\in_r$. The cell electromotive force (emf) V_0 = 8V. First the switch S_1 is closed while the switch S_2 is kept open. When the capacitor C_3 is fully charged, S_1 is opened and S_2 is closed simultaneously. When all the capacitors reach equilibrium, the charge on C_3 is found to be 5μC. The value of $\in_r$.



Ans. 1.50

Sol.



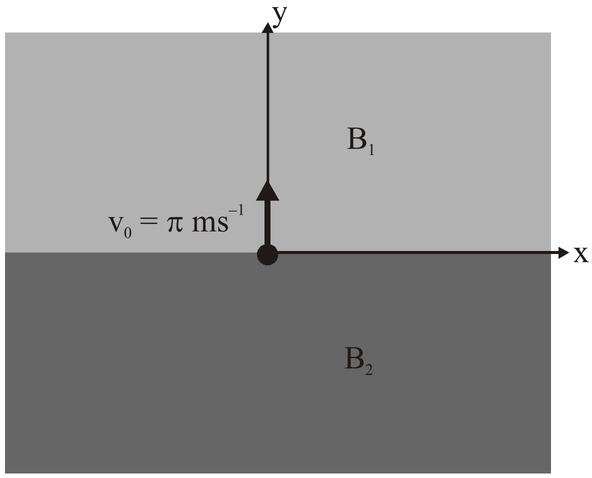


Applying loop rule

$\dfrac{5}{1} - \dfrac{3}{\in_r} - \dfrac{3}{1} = 0 \qquad \dfrac{3}{\in_r} = 2$

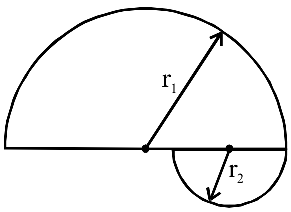
$\in_r = 1.50$

12. In the x-y-plane, the region y > 0 has a uniform magnetic field $B_1\hat{k}$ and the region y < 0 has a another uniform magnetic field $B_2\hat{k}$. A positively charged particle is projected from the origin along the positive y-axis with speed $v_0 = \pi ms^{-1}$ at t = 0, as shown in the figure. Neglect gravity in this problem. Let t = T be the time when the particle crosses the x-axis from below for the first time. If $B_2 = 4B_1$, the average speed of the particle, in ms^{-1}, along the x-axis in the time interval T is _______.



Ans. 2.00

Sol. (1) Average speed along x-axis



$$\langle v_x \rangle = \frac{\int |\vec{v}_x| dt}{\int dt} = \frac{d_1 + d_2}{t_1 + t_2}$$

(2) We have,

$$r_1 = \frac{mv}{qB_1}, r_2 = \frac{mv}{qB_2}$$

Since $B_1 = \frac{B_2}{4}$

$\therefore$ $r_1 = 4r_2$

Time in $B_1 \Rightarrow \frac{\pi m}{qB_1} = t_1$

Time in $B_2 \Rightarrow \frac{\pi m}{qB_2} = t_2$

Total distance along x-axis $d_1 + d_2 = 2r_1 + 2r_2 = 2\ (r_1 + r_2) = 2\ (5r_2)$

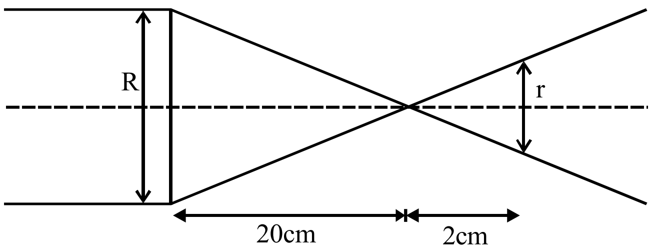
Total time $T = t_1 + t_2 = 5t_2$

$\therefore$ Average speed = $\frac{10r_2}{5t_2} = 2\frac{mv}{qB_2} \times \frac{qB_2}{\pi m} = 2$

13. Sunlight of intensity 1.3 kW m^{-2} is incident normally on a thin convex lens of focal length 20 cm. Ignore the energy loss of light due to the lens and assume that the lens aperture size is much smaller than its focal length. The average intensity of light, in kW m^{-2}, at a distance 22 cm from the lens on the other side is _________.

Ans. 130

Sol.



$$\frac{r}{R}=\frac{2}{20}=\frac{1}{10}$$

$\therefore$ Ratio of area = $\frac{1}{100}$

Let energy incident on lens be E.

$\therefore$ Given $\frac{E}{A}=1.3$

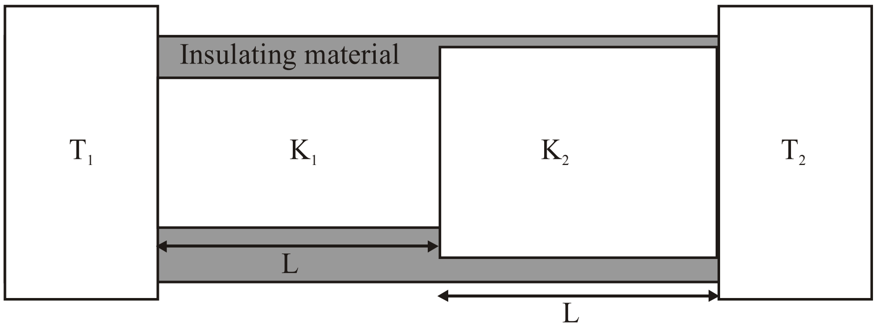
So final, $\frac{E}{a}=??$

$E = A \times 1.30$

Also $\frac{a}{A}=\frac{1}{100}$

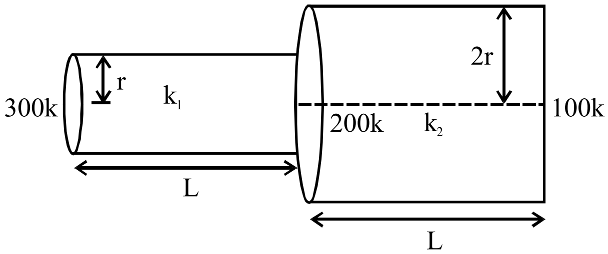
$\therefore$ Average intensity of light at 22 cm = $\frac{E}{a}=\frac{A\times1.3}{a}=100\times1.3=130\text{kW}/\text{m}^2$

14. Two conducting cylinders of equal length but different radii are connected in series between two heat baths kept at temperatures T_1 = 300 K and T_2 = 100 K, as shown in the figure. The radius of the bigger cylinder is twice that of the smaller one and the thermal conductivities of the materials of the smaller and the larger cylinders are K_1 and K_2 respectively. If the temperature at the junction of the two cylinders in the steady state is 200 K, then K_1/K_2 = _________.



Ans. 4.00

Sol.



We have in steady state,

$$\left(\frac{\frac{200-300}{L}}{k_1\pi r^2}\right)+\left(\frac{\frac{200-100}{L}}{k_2\pi(2r)^2}\right)=0$$

$$\Rightarrow \frac{k_1\pi r^2\times 100}{L}=\frac{100k_2\pi\times 4r^2}{L}$$

$$\Rightarrow \frac{k_1}{k_2}=4$$

PARAGRAPH "X"

In electromagnetic theory, the electric and magnetic phenomena are related to each other. Therefore, the dimensions of electric and magnetic quantities must also be related to each other. In the questions below, [E] and [B] stand for dimensions of electric and magnetic fields respectively, while [$\in_0$] and [μ_0] stand for dimensions of the permittivity and permeability of free space respectively. [L] and [T] are dimensions of length and time respectively. All the quantities are given in SI units.

(There are two questions based on Paragraph "X", the question given below is one of them)

15. The relation between [E] and [B] is :-

(A) [E] = [B][L][T] (B) $[E] = [B][L]^{-1}[T]$ (C) $[E] = [B][L][T]^{-1}$ (D) $[E] = [B][L]^{-1}[T]^{-1}$

Ans. (C)

Sol. We have $\frac{E}{C} = B$

$\therefore$ [B] = $\frac{[E]}{[C]} = [E]L^{-1}T^{1}$

$\Rightarrow [E] = [B]\ [L][T^{-1}]$

PARAGRAPH "X"

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(There are two questions based on Paragraph "X", the question given below is one of them)

16. The relation between $[\in_0]$ and $[\mu_0]$ is :-

(A) $[\mu_0] = [\in_0][L]^2[T]^{-2}$

(B) $[\mu_0] = [\in_0][L]^{-2}[T]^2$

(C) $[\mu_0] = [\in_0]^{-1}[L]^2[T]^{-2}$

(D) $[\mu_0] = [\in_0]^{-1}[L]^{-2}[T]^2$

Ans. (D)

Sol. We have,

$$C = \frac{1}{\sqrt{\mu_0 \in_0}}$$

$$\therefore [C^2] = \left[\frac{1}{\mu_0 \in_0}\right]$$

$$\Rightarrow L^2T^{-2} = \frac{1}{[\mu_0][\in_0]}$$

$\Rightarrow [\mu_0] = [\in_0]^{-1}[L]^{-2}[T]^2$

PARAGRAPH "A"

If the measurement errors in all the independent quantities are known, then it is possible to determine the error in any dependent quantity. This is done by the use of series expansion and truncating the expansion at the first power of the error. For example, consider the relation z = x/y. If the errors in x, y and z are Δx, Δy and Δz, respectively, then

$$z \pm \Delta z = \frac{x \pm \Delta x}{y \pm \Delta y} = \frac{x}{y}\left(1 \pm \frac{\Delta x}{x}\right)\left(1 \pm \frac{\Delta y}{y}\right)^{-1}.$$

The series expansion for $\left(1 \pm \frac{\Delta y}{y}\right)^{-1}$, to first power in Δy/y, is $1 \mp (\Delta y / y)$. The relative errors in independent variables are always added. So the error in z will be

$$\Delta z = z\left(\frac{\Delta x}{x} + \frac{\Delta y}{y}\right).$$

The above derivation makes the assumption that $\frac{\Delta x}{x} << 1, \frac{\Delta y}{y} << 1$. Therefore, the higher powers of these quantities are neglected.

(There are two questions based on Paragraph "A", the question given below is one of them)

17. Consider the ratio $r = \frac{(1-a)}{(1+a)}$ to be determined by measuring a dimensionless quantity a. If the error in the measurement of a is Δa(Δa/a << 1), then what is the error Δr in determining r ?

(A) $\frac{\Delta a}{(1+a)^2}$ (B) $\frac{2\Delta a}{(1+a)^2}$ (C) $\frac{2\Delta a}{(1-a^2)}$ (D) $\frac{2a\Delta a}{(1-a^2)}$

Ans. (B)

Sol. $r = \left(\frac{1-a}{1+a}\right)$

$$\frac{\Delta r}{r} = \frac{\Delta(1-a)}{(1-a)} + \frac{\Delta(1+a)}{(1+a)}$$

$$= \frac{\Delta a}{(1-a)} + \frac{\Delta a}{(1+a)}$$

$$= \frac{\Delta a(1+a+1-a)}{(1-a)(1+a)}$$

$$\therefore \Delta r = \frac{2\Delta a}{(1-a)(1+a)} \frac{(1-a)}{(1+a)} = \frac{2\Delta a}{(1+a)^2}$$

PARAGRAPH "A"

If the measurement errors in all the independent quantities are known, then it is possible to determine the error in any dependent quantity. This is done by the use of series expansion and truncating the expansion at the first power of the error. For example, consider the relation z = x/y. If the errors in x, y and z are Δx, Δy and Δz, respectively, then

$$z \pm \Delta z = \frac{x \pm \Delta x}{y \pm \Delta y} = \frac{x}{y}\left(1 \pm \frac{\Delta x}{x}\right)\left(1 \pm \frac{\Delta y}{y}\right)^{-1}.$$

The series expansion for $\left(1 \pm \frac{\Delta y}{y}\right)^{-1}$, to first power in Δy/y, is $1 \mp (\Delta y / y)$. The relative errors in independent variables are always added. So the error in z will be

$$\Delta z = z\left(\frac{\Delta x}{x} + \frac{\Delta y}{y}\right).$$

The above derivation makes the assumption that $\frac{\Delta x}{x} << 1, \frac{\Delta y}{y} << 1$. Therefore, the higher powers of these quantities are neglected.

(There are two questions based on Paragraph "A", the question given below is one of them)

18. In an experiment the initial number of radioactive nuclei is 3000. It is found that 1000 ± 40 nuclei decayed in the first 1.0 s. For $|x| << 1$, In (1 + x) = x up to first power in x. The error Δλ, in the determination of the decay constant λ, in s^{-1}, is :-

(A) 0.04 (B) 0.03 (C) 0.02 (D) 0.01

Ans. **(C)**

Sol. $N = N_0 e^{-\lambda t}$

$\ell nN = \ell nN_0 - \lambda t$

$$\frac{dN}{N} = -d\lambda t$$

Converting to error,

$$\frac{\Delta N}{N} = \Delta\lambda t$$

$\therefore \Delta\lambda = \frac{40}{2000 \times L} = 0.02$ (N is number of nuclei left undecayed)