# JEE-Main-28-06-2022-Shift-2 (Memory Based)

# Physics

**Question:** A body of mass 2 kg moving with speed 4 m/s encounters a region from x=0.5 to x=1.5 where F=-kx. Find the final velocity of the body. Given k=12

**Options:**

(a) 5 m/s

(b) 2 m/s

(c) 4 m/s

(d) 6 m/s

**Answer: (b)**

**Solution:**

$$a = -\frac{kx}{m}$$

$$v\frac{dv}{dx} = -\frac{12x}{m}$$

$$vdv = -\frac{12x}{m}dx$$

$$\left[\frac{v^2}{2}\right]_4^v = -\frac{12}{2}\left(\frac{x^2}{2}\right)_{0.5}^{1.5}$$

$$\frac{v^2}{2} - \frac{16}{2} = -6\left(\frac{2.25-0.25}{2}\right)$$

$$v^2 - 16 = -12$$

$$v^2 = -12 + 14 = 4$$

$$v = 2m/s$$

**Question:** A ladder rest slantly with its base 3 m from the floor The wall is frictionless. Length of ladder is √34 m Mass of ladder is 10kg. Find the ratio of reaction force by wall to reaction force by floor on ladder

**Options:**

(a) 3/10

(b) 9/10

(c) 5/10

(d) 7/10

**Answer: (a)**

**Solution:**

$$N_G = mg = 10 \times 10 = 100N$$

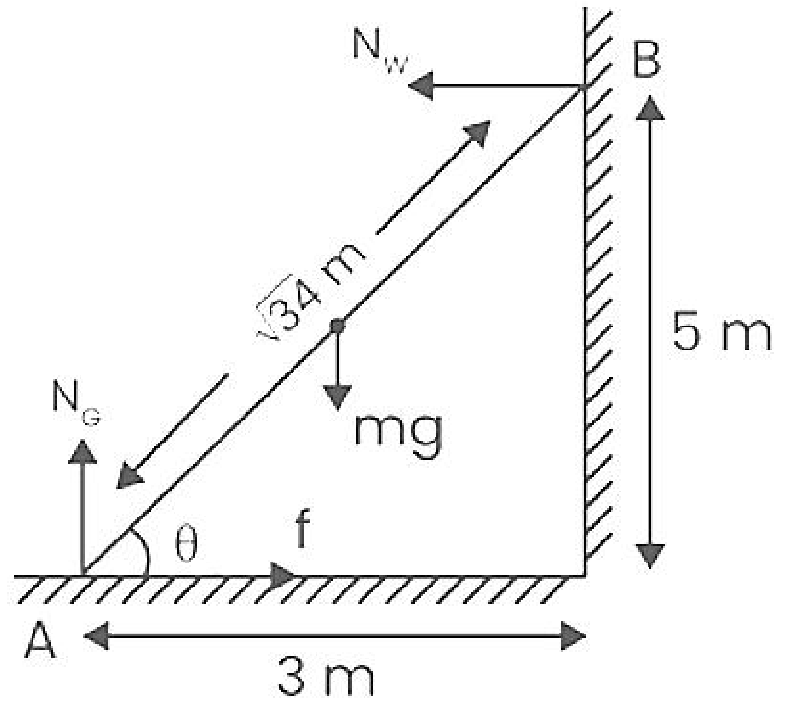
Taking moments about bottom point of ladder

$$N_w \times 5 = mg \times \frac{\sqrt{34}}{2}\cos\theta$$

$$N_w \times 5 = 100 \times \frac{\sqrt{34}}{2} \times \frac{3}{\sqrt{34}}$$

$$N_w = 30N$$

$$\frac{N_w}{N_G} = \frac{30}{100} = \frac{3}{10}$$




**Question:** If all the oxygen molecules dissociate into atoms and temperature is doubled then $V_{rms}$ becomes____ times the original

**Options:**

(a) 4

(b) 3

(c) 2

(d) None of these

**Answer: (c)**

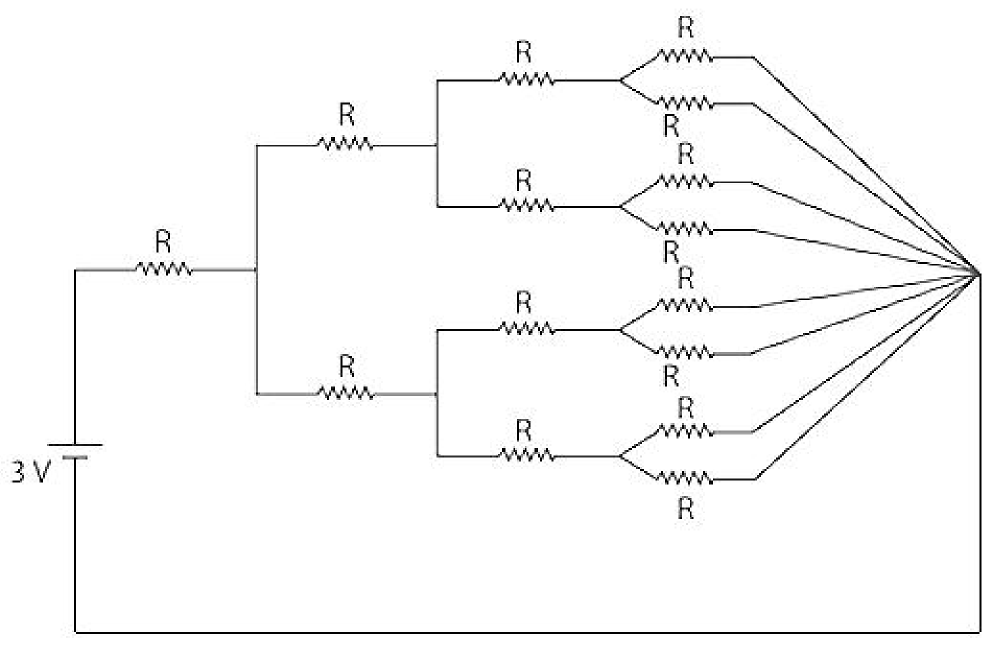
**Solution:**

$$V_{rms} = \sqrt{\frac{3RT}{M}}$$

$$(V_{rms})_0 = \sqrt{\frac{3R(2T)}{M/2}}$$

$$= 2\sqrt{\frac{3RT}{M}} = 2V_{rms}$$

**Question:** $I = \frac{a}{5}, R = 1\Omega$ , Find a.




**Options:**

(a) 14
(b) 8
(c) 12
(d) 2
**Answer: (b)**
**Solution:**
Starting from right most resistors

$R \| R$

$R_A = \frac{R}{2}\Omega$

$R + \frac{R}{2} = \frac{3R}{2}\Omega$

$\frac{3R}{2} \| \frac{3R}{2}$

$R_B = \frac{3R}{4}\Omega$

$R + \frac{3R}{4} = \frac{7R}{4}\Omega$

$\frac{7R}{4} \| \frac{7R}{4}$

$R_C = \frac{7R}{8}\Omega$

$R_{eq} = R + \frac{7R}{8} = \frac{15R}{8}\Omega = \frac{15}{8}\Omega$

$I = \frac{V}{R} = \frac{3}{15} \times 8 = \frac{8}{5}A$

$\Rightarrow a = 8$

**Question:** In YDSE slab of thickness t and RI 1.5 is inserted in front of one of the slits. As a result intensity at the central maxima remains the same. What is the minimum value of thickness required?
**Options:**
(a) $2\lambda$
(b) $4\lambda$
(c) $8\lambda$
(d) None of these
**Answer: (a)**
**Solution:**

Shift $= \frac{D}{d}(\mu - 1)t$

$= \frac{D\lambda}{d}$

$\Rightarrow t = \frac{\lambda}{\mu - 1} = 2\lambda$

**Question:** If resistance of a resistor is 2 Ω at 10°C and it is 3 Ω at 30°C find the temperature coefficient of resistance
**Options:**
(a) $0.24 \times 10^{-2} / °C$

(b) $4.4\times10^{-2}$ / °C
(c) $2.5\times10^{-2}$ / °C
(d) None of these
**Answer: (c)**
**Solution:**

$$R_t = R_0\left(1+\alpha\Delta T\right)$$
$$3 = 2\left(1+\alpha\left(30-10\right)\right)$$
$$3 = 2+40\alpha$$
$$1 = 40\alpha$$
$$\alpha = \frac{1}{40} = 2.5\times10^{-2} / {}^\circ C$$

**Question:** Particle moves along the straight line such that it moves 1/3rd distance with speed $v_1$ the next 1/3rd distance with speed $v_2$ and remaining 1/3rd distance with speed $v_3$. Then its average speed throughout motion is
**Options:**
(a) $\frac{v_1v_2+v_2v_3+v_3v_1}{v_1+v_2+v_3}$
(b) $\frac{v_1v_2v_3}{v_1v_2+v_2v_3+v_3v_1}$
(c) $\frac{v_1+v_2+v_3}{3}$
(d) $\frac{3v_1v_2v_3}{v_1v_2+v_2v_3+v_3v_1}$
**Answer: (d)**
**Solution:**
Average speed = total distance covered / total time taken
Let the total distance = 3x
Time taken to cover first one third $\left(x\right)=t_1=\frac{x}{v_1}$
Time taken to cover second one third $\left(x\right)=t_2=\frac{x}{v_2}$
Time taken to cover third one third $\left(x\right)=t_3=\frac{x}{v_3}$
Average speed $=\frac{3x}{\frac{x}{v_1}+\frac{x}{v_2}+\frac{x}{v_3}}$
$$=\frac{3x}{x\left(\frac{v_3v_2+v_1v_3+v_1v_2}{v_1v_2v_3}\right)}$$
$$=\frac{3v_1v_2v_3}{v_1v_2+v_2v_3+v_1v_3}$$

**Question:** A water drop of radius 1 μm in falls through air. Force of buoyancy and density of air is negligible. If the coefficient of viscosity of air is $2.0\times10^{-5}kgm^{-1}s^{-1}$. Find terminal velocity of water drop.

**Options:**

(a) $3.4\times10^{-4}m/J$

(b) $2.4\times10^{-4}m/J$

(c) $1.4\times10^{-4}m/J$

(d) $1.1\times10^{-4}m/J$

**Answer: (d)**

**Solution:**

$$V_T=\frac{2}{9}\frac{r^2(\gamma-6)g}{\eta}$$

$$V_T=\frac{2}{9}\frac{r^2\gamma g}{\eta}$$

$$V_T=\frac{2}{9}\times\frac{(1\times10^{-6})^2\times1\times10^3\times10}{2.0\times10^{-5}}$$

$$V_T=\frac{1}{9}\times10^{-12+3+1+5}=1.1\times10^{-4}m/J$$

**Question:** Two capacitors of capacities 5μF and 10μF connected and the switch is kept open. Initially potential on 5μF capacitor is 30V and 10μF capacitor is uncharged. Find the charge on the 10μF capacitor once the switch is closed.

**Options:**

(a) 300 $\mu C$

(b) 100 $\mu C$

(c) 200 $\mu C$

(d) 400 $\mu C$

**Answer: (b)**

**Solution:**

$$V=\frac{C_1V_1+C_2V_2}{C_1+C_2}$$

$$V=\frac{5\times30}{5+10}=10V$$

$$Q=10\times10=100\mu C$$

**Question:** Two bodies of equal mass has force of attraction F, then find the the force of attraction when one third of mass of one body is transferred to another

**Options:**

**(a)** $\frac{1}{9}F$

**(b)** $\frac{8}{9}F$

**(c)** $\frac{5}{9}F$

**(d)** $\frac{7}{9}F$

**Answer: (b)**
**Solution:**

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

$$F_f = \frac{G\left(m - \frac{1}{3}m\right)\left(m + \frac{1}{3}m\right)}{r^2}$$

$$= G\frac{\frac{8}{9}m^2}{r^2} = \frac{8}{9}F_i = \frac{8}{9}F$$

**Question:** A coil is placed in a time varying magnetic field. If the no. of turns are halved and the radius of wire is doubled. (Assume the coil to be short circuited) Then the power dissipated:

**Options:**

**(a)** $4P_i$

**(b)** $1P_i$

**(c)** $7P_i$

**(d)** $3P_i$

**Answer: (a)**
**Solution:**

$N_i = n \quad N_f = \frac{n}{2}$

$r_i = r \quad r_f = 2r$

Total length of wire $= n(2\pi R) =$ where R is radius of loop finally if n becomes half, radius of loop has to double

$\therefore$ New $emf = -\left(\frac{n}{2}\right)\left(\pi(2R)^2\right)\frac{dB}{dt}$

New Power $= \frac{\left[-\frac{n}{2}\pi\left(4R^2\right)\frac{dB}{dt}\right]^2}{\rho\frac{l}{\pi(2r)^2}}$

Old power $= \frac{\left[-n\pi(R)^2(dB/dt)\right]^2}{\rho\frac{l}{\pi r^2}} \therefore P_f = 4P_i$

**Question:** $K_1$ and $K_2$ are $KE_{\max}$ of $\lambda_1$ and $\lambda_2$ Falling a metal If $\lambda_1 = 3\lambda_2$ Find relation of $K_1$ and $K_2$

**Options:**

**(a)** $3K_1 < K_2$

**(b)** $4K_1 < K_2$

(c) $5K_1 < K_2$

(d) $2K_1 < K_2$

**Answer: (a)**

**Solution:**

Kinetic energy of the photoelectrons $K = \frac{hc}{\lambda} - \phi$ where $\phi$ is the work function of the metal

$\therefore$ For wavelength $\lambda_1$ $K_1 = \frac{hc}{\lambda_1} - \phi ...(1)$

For wavelength $\lambda_2$, $K_2 = \frac{hc}{\lambda_2} - \phi ...(2)$

Given: $\lambda_1 = 3\lambda_2$

$\therefore$ Equation (1) becomes $K_1 = \frac{hc}{3\lambda_2} - \phi ...(3)$

From (2) - (3), we get $K_2 - K_1 = \frac{hc}{\lambda_2} - \frac{hc}{3\lambda_2}$

$K_2 - K_1 = \frac{2}{3}\frac{hc}{\lambda_2} \quad \Rightarrow \frac{hc}{\lambda_2} = \frac{3}{2}(K_2 - K_1)$

Put this in (2), $K_2 = \frac{3}{2}(K_2 - K_1) - \phi$

$\Rightarrow K_2 - 3K_1 = 2\phi$

As $\phi > 0 \Rightarrow K_2 - 3K_1 > 0$

Thus $K_1 < \frac{K_2}{3}$

**Question:** EM wave is moving in +x direction. If amplitude of electric field is $E_0 = 60 N/C$ which is oscillating in y direction, then find the equations of E and B

**Options:**

(a) $E = 60\sin(kx - \omega t)\hat{i}$
$B = 2\times10^{-7}\sin(k_x - \omega t)\hat{j}$

(b) $E = 60\sin(kx - \omega t)\hat{k}$
$B = 2\times10^{-7}\sin(k_x - \omega t)\hat{j}$

(c) $E = 60\sin(kx - \omega t)\hat{j}$
$B = 2\times10^{-7}\sin(k_x - \omega t)\hat{k}$

(d) $E = 60\sin(kx - \omega t)\hat{k}$
$B = 2\times10^{-7}\sin(k_x - \omega t)\hat{i}$

**Answer: (c)**

**Solution:**

$E_0 = 60$

$\therefore B_0 = \frac{E_0}{C} = \frac{60}{3\times10^8} = 2\times10^{-7}$

Since wave is moving in +x-dir

$E = 60\sin(kx - \omega t)\hat{j}$

$B = 2\times10^{-7}\sin(k_x - \omega t)\hat{k}$

**Question:** A solenoid is filled with material of susceptibility $2\times10^{-7}$ Fractional change in field intensity compared to the case when air was present inside instead of material

**Options:**

**(a)** $=2\times10^{-5}\%$
**(b)** $=4\times10^{-5}\%$
**(c)** $=3\times10^{-5}\%$
**(d)** $=5\times10^{-5}\%$
**Answer: (a)**
**Solution:**

$X_m = \frac{M}{H}$

It is already fractional change in the magnetic induction due to the medium.

$\therefore$ % age change

$= X_m \times 100$
$= 2\times10^{-7}\times100$
$= 2\times10^{-5}\%$

**Question:** Half life of radioactive material is 200 days. Find percent of substance remaining in 83 days
**Options:**

**(a) 65%**
**(b) 55%**
**(c) 44%**
**(d) 75%**
**Answer: (d)**
**Solution:**

$N = N_0\left(\frac{1}{2}\right)^{t/T}$

$T =$ half life
$t =$ time elapsed

$\therefore N = N_0\left(\frac{1}{2}\right)^{\frac{83}{200}}$

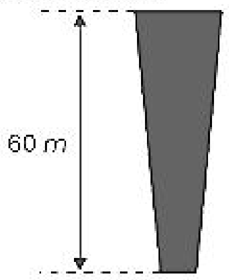
$\frac{N}{N_0}\times100 = \left(\frac{1}{2}\right)^{\frac{83}{200}}\times100$

$\approx 75\%$

**Question:** Water falls at a rate pf 600 kg/s from a height of 60 m as shown. How many bulbs of capacity 100 W each will glow from the energy produced at the bottom of the fall. Assume full conversion of energy of falling water and all bulbs glowing at 100 W each.

**Options:**

**(a) 25**
**(b) 50**
**(c) 3600**
**(d) 1000**
**Answer: (c)**
**Solution:**



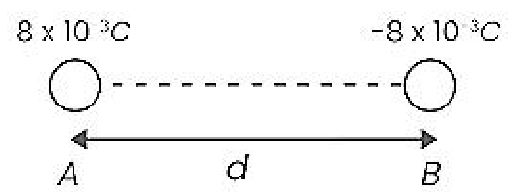

Potential energy loss per second

$= 600(10)(60) \text{J/s}$
$= 36 \times 10^4 \text{ J/s} = 36 \times 10^4 \text{ W}$

Each bulb consumes 100 W,

$\therefore$ Total no of bulbs which can glow is 3600.

**Question:** Two opposite charges are placed at a distance d as shown. Electric filed strength at mid point is $6.4 \times 10^4 \text{ N/C}$. Then the value of d is




**Options:**

**(a)** $20\sqrt{10}$
**(b)** $50\sqrt{10}$
**(c)** $30\sqrt{10}$
**(d)** $60\sqrt{10}$
**Answer: (c)**
**Solution:**

$$E = \frac{2kQ}{(d/2)^2}$$

$$6.4\times10^{4} = \frac{2\times9\times10^{9}\times8\times10^{-3}}{d^2/4}$$

$$\therefore d^2 = 9000$$

$$d = 30\sqrt{10}$$

**Question:** In series RLC circuit voltage across capacitance and inductance is twice that of resistance. If $R = 50\text{hm}, V = 220\,\text{V}, \text{f} = 50\,\text{Hz}$. If $L = 1/k\pi$ then value of k is (in m H)

**Options:**

**(a)** $11^{-2}$
**(b)** $10^{-2}$
**(c)** $12^{-2}$
**(d)** $15^{-2}$
**Answer: (b)**
**Solution:**

$$V_L = 2V_R$$

$$\omega L = 2R$$

$$L = \frac{2R}{\omega} = \frac{2R}{2\pi f} = \frac{2(s)}{2\pi(50)}$$

$$= \frac{1}{10\pi} = \frac{1}{10\pi}\times\frac{10^{-3}}{10^{-3}}$$

$$\therefore K = 10^{-2}$$