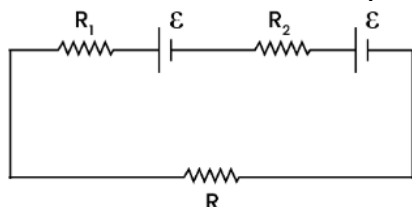


JEE-Main-27-07-2022-Shift-1 (Memory Based)

Physics

Question: Find R such that potential diff across 1st cell (on the left of the diagram) is zero.



Options:

- (a) $R = R_1 + R_2$
- (b) $R = R_1 - R_2$
- (c) $R = R_2 - R_1$
- (d) $R = R_2 + R_1$

Answer: (b)

Solution:

Current in the circuit

$$i = \frac{2\varepsilon}{R + R_1 + R_2}$$

P.D. across cell 1,

$$\varepsilon - iR_1 = 0$$

$$\varepsilon - \frac{2\varepsilon R_1}{R + R_1 + R_2} = 0$$

$$\varepsilon R + \varepsilon R_1 + \varepsilon R_2 = 2\varepsilon R_1$$

$$R = R_1 - R_2$$

Question: Two satellites of mass ratio 4:3 and radii ratio 3:4. Find the ratio of total mechanical energy.

Options:

- (a) 1
- (b) 3
- (c) 5
- (d) 2

Answer: (a)

Solution:

$$U + K = E$$

$$E = -\frac{GM_e m}{2r}$$

$$E \propto \frac{m}{r} \Rightarrow \frac{E_1}{E_2} = \frac{m_1}{m_2} \frac{r_2}{r_1}$$

$$= \frac{4}{3} \times \frac{3}{4} = 1$$

Question: Two charges Q each are placed at a distance of $2a$. At midpoint, q is placed and is displaced slightly. Find time period.

Options:

(a) $T = 4\pi \sqrt{\frac{a^3 m}{4KQq}}$

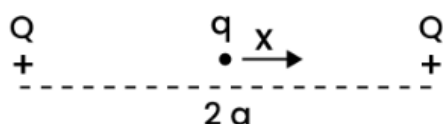
(b) $T = 3\pi \sqrt{\frac{a^3 m}{3KQq}}$

(c) $T = 2\pi \sqrt{\frac{a^3 m}{4KQq}}$

(d) $T = 2\pi \sqrt{\frac{a^3 m}{2KQq}}$

Answer: (c)

Solution:



$$a = \left(\frac{4KQq}{a^3 m} \right) x$$

$$F_{Net} = \frac{KQq}{(a-x)^2} - \frac{KQq}{(a+x)^2}$$

$$= KQq \left[\frac{(a+x)^2 - (a-x)^2}{(a-x)^2 (a+x)^2} \right]$$

$$= KQq \frac{[(2a)(2x)]}{a^4}$$

$$\Rightarrow F = \frac{4KQq}{a^3} x$$

Question: A DC current of 4 A and AC current of peak value 4A passes through 3Ω and 2Ω resistors respectively. Find the ratio of heat generated.

Options:

(a) 3 : 1

(b) 3 : 2

(c) 3 : 4

(d) 1 : 1

Answer: (a)

Solution:

For DC current

$$H_{DC} = i^2 R_1 t$$

& for AC

$$H_{AC} = i_{rms}^2 R_2 t$$

$$\frac{H_{DC}}{H_{AC}} = \frac{i^2 R_1}{i_{rms}^2 R_2}$$

$$= \frac{(4)^2}{\left(\frac{4}{\sqrt{2}}\right)^2} \frac{3}{2} = 3:1$$

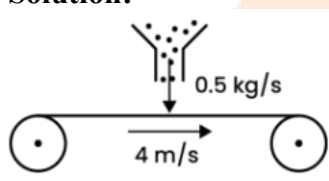
Question: Sand is falling on conveyer belt at rate of 0.5 kg/s if conveyer is moving with 4 m/s. How much power is required maintain constant speed?

Options:

- (a) 5 w
- (b) 7 w
- (c) 4 w
- (d) 8 w

Answer: (d)

Solution:



$$\text{Force} = \frac{d}{dt}(p)$$

$$= \frac{d}{dt}(mv)$$

$$= v \frac{d}{dt}(m)$$

$$= v(0.5)$$

$$F = 4 \times 0.5 = 2$$

$$\text{Power} = \text{Force} \times \text{vel.}$$

$$= 2 \times 4$$

$$= 8 \text{ W}$$

Question: If activity of radioactive sample becomes $1/16^{\text{th}}$ of its initial value in 30 hrs. Find the half-life period.

Options:

- (a) 5.5 hrs
- (b) 3.5 hrs
- (c) 7.5 hrs
- (d) 4.5 hrs

Answer: (c)

Solution:

$$\text{Activity } N = N_0 e^{-\lambda t}$$

$$\frac{N}{N_0} = \frac{1}{16} \text{ after 30 hrs}$$

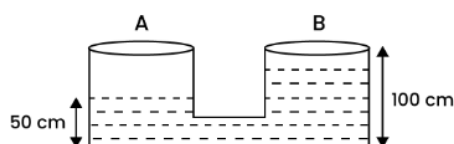
$$\frac{1}{16} = e^{-30\lambda}$$

$$e^{30\lambda} = 16 \Rightarrow \lambda = \frac{\ln 16}{30}$$

$$\text{Also, } t \frac{1}{2} = \frac{\ln 2}{\lambda}$$

$$= \left(\frac{\ln 2}{\ln 16} \right) \times 30 = 7.5 \text{ hrs.}$$

Question: Two cylinders are joined as shown.



Water flows from B to A until water level becomes same. Find work done by gravity.

Options:

- (a) $w = 625 A \rho g \times 10^{-4} J$
- (b) $w = 225 A \rho g \times 10^{-4} J$
- (c) $w = 425 A \rho g \times 10^{-4} J$
- (d) $w = 125 A \rho g \times 10^{-4} J$

Answer: (a)

Solution:

$$W = 625 \times 10^{-4} A \rho g$$

$$\text{Work done by gravity} = U_i - U_f$$

$$U_i = (A(50)\rho)(25) + A(100)\rho g(50) = A\rho g[6250]$$

$$\text{Common Height of cylinders} \Rightarrow h = 75 \text{ cm}$$

$$U_f = (A(75)\rho g) \left(\frac{75}{2} \right) \times 2 = A\rho g[5625]$$

$$w = 625 A \rho g \times 10^{-4} J$$

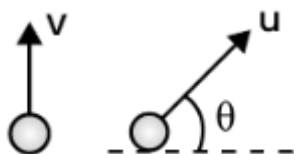
Question: A ball thrown vertically upwards. At same time another ball thrown at angle θ . If both remain in air for same time. Then ratio of maximum height.

Options:

- (a) 2 : 3
- (b) 1 : 2
- (c) 1 : 1
- (d) 2 : 1

Answer: (c)

Solution:



$$T = \frac{2v}{g} \quad T = \frac{2u \sin \theta}{g} \quad \frac{(H_{ux})_1 = \frac{v^2}{2g}}{(H_{mx})_2 = \frac{u^2 \sin 2\theta}{2g}}$$

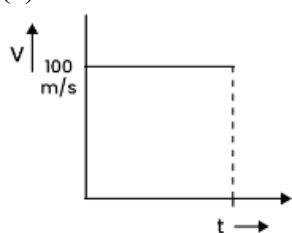
$$\frac{2v}{g} = \frac{2u \sin \theta}{g} \quad \frac{H_1}{H_2} = \frac{v^2}{u^2 \sin 2\theta}$$

$$v = u \sin \theta = \frac{1}{1}$$

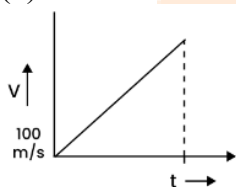
Question: A bullet is fired with velocity 100 m/s in vertically downward direction & on striking the ground it comes to rest. Draw v – t graph?

Options:

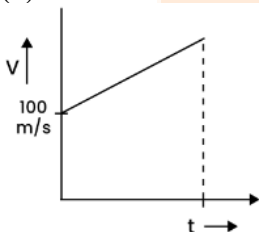
(a)



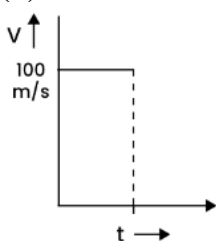
(b)



(c)

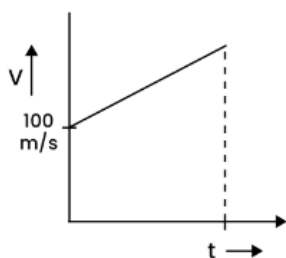


(d)



Answer: (c)

Solution:



$$v = u + at$$

$$v = 100 + gt$$

Question: The apparent angle of dip in a plane at an angle of 45° with magnetic meridian is 60° find true angle of dip

Options:

(a) $\tan^{-1} \sqrt{\frac{2}{1}}$

(b) $\tan^{-1} \sqrt{\frac{5}{2}}$

(c) $\tan^{-1} \sqrt{\frac{4}{2}}$

(d) $\tan^{-1} \sqrt{\frac{3}{2}}$

Answer: (d)

Solution:

Inclination of plane (α) = 45°

Apparent dip (δ) = 60°

Let true dip = ϕ

then we know

$$\tan \delta = \frac{\tan \phi}{\cos \phi} \Rightarrow \tan \phi = \tan 60^\circ \times \cos 45^\circ$$

$$= \sqrt{\frac{3}{2}}$$

Question: Intensity given I and 4I phase difference at A and B are 90° and 60° . Then find the difference of resultant intensity at A and B

Options:

(a) 2I

(b) 5I

(c) 7I

(d) 9I

Answer: (a)

Solution:

Intensity at A

$$I_A = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos \phi$$

$$\phi = 90^\circ$$

$$I_A = I_1 + I_2$$

$$I_A = I + 4I = 5I \dots(1)$$

Intensity at B

$$I_B = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos \phi$$

$$\phi = 60^\circ$$

$$I_B = I + 4I + 2\sqrt{I \times 4I} \times \frac{1}{2}$$

$$I_B = 7I$$

Difference in Intensity

$$\Delta I = I_B - I_A$$

$$= 7I - 5I = 2I$$

Question: A tower of height 100m is used to transmit the signal. What is the increase in height of tower required to triple the range of transmitting signals.

Options:

- (a) 200 m
- (b) 300 m
- (c) 500 m
- (d) 800 m

Answer: (d)

Solution:

$$\text{Range} = \sqrt{2Rh_T}$$

For large to be 3 times

$$3 \times \text{times} = \sqrt{2Rh_{T'}}$$

$$3 \times \sqrt{2 \times R \times 100} = \sqrt{2Rh_{T'}}$$

$$\sqrt{h_{T'}} = 30$$

$$h_{T'} = 900m$$

$$\text{So increase in length of the tower} = 900 - 100 = 800m$$

Question: Two bar magnets oscillate in earth magnetic field with time period 3 : 4 and its moment of inertia is 3 : 2 then magnetic moment ratio.

Options:

- (a) $\frac{8}{3}$
- (b) $\frac{3}{8}$
- (c) $\frac{5}{3}$
- (d) $\frac{3}{5}$

Answer: (a)

Solution:

We know, Time period is given at

$$T = 2H \sqrt{\frac{I}{\mu B}}$$

Hence, $\frac{T_1}{T_2} = \sqrt{\left(\frac{I_1}{I_2}\right)\left(\frac{\mu_2}{\mu_1}\right)}$

$$\frac{3}{4} = \sqrt{\frac{3}{2} \times \left(\frac{\mu_2}{\mu_1}\right)}$$

$$\frac{9}{16} = \frac{3}{2} \left(\frac{\mu_2}{\mu_1}\right)$$

$$\frac{\mu_2}{\mu_1} = \frac{3}{8}$$

$$\frac{\mu_1}{\mu_2} = \frac{8}{3}$$

Question: If a compound microscope is taken from air to liquid with RI = 2, % change in resolving power is

Options:

- (a) 50%
- (b) 100%
- (c) 150%
- (d) 250%

Answer: (b)

Solution:

$$R.P = \frac{1.22d}{\lambda}$$

$$(R.P)_1 = \frac{1.22d}{\lambda}$$

$$(R.P)_2 = \frac{2 \times 1.22d}{\lambda}$$

$$\% \text{ change} = \frac{(R.P)_2 - (R.P)_1}{(R.P)_1} \times 100 = \frac{2-1}{1} \times 100 = 100\%$$

Question: A block is placed on conveyor belt gently, which is moving with constant velocity 2 m/s. Coefficient of friction between belt and block is 0.4. Calculate the distance travelled by block till it comes at rest w.r.t. belt.

Options:

- (a) 0.1 m
- (b) 0.3 m
- (c) 0.5 m
- (d) 0.7 m

Answer: (c)

Solution:

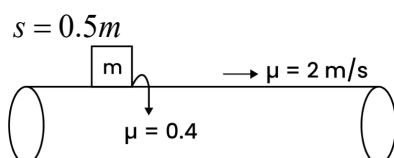
$$\text{Deceleration due to friction} = \mu g$$

$$= 0.4(10) = 4 \text{ m/s}^2$$

$$\text{Final speed w.r.t. belt} = 0$$

$$\text{Initial speed w.r.t. belt} = -2 \text{ m/s}$$

$$v^2 - u^2 = 2as \Rightarrow 0 - 4 = 2(-4)s$$



For block to be in rest w.r.t belt, both should give together so
 $a = \mu g$ (maximum possible acceleration for them to move together)

$$\text{Hence, } v^2 = u^2 + 2as$$

$$0 = u^2 - 2as$$

$$s = \frac{u^2}{2a}$$

$$s = \frac{4}{2 \times 0.4 \times 10}$$

$$s = \frac{1}{2} = 0.5m$$

Question: In a meter bridge, balancing is achieved when jockey is at mark of 30 cm, where a known resistance of $5.6k\Omega$ is used in the right gap. Value of unknown resistance in $k\Omega$ is,

Options:

- (a) 1.2
- (b) 3.2
- (c) 2.4
- (d) 5.4

Answer: (c)

Solution:

$$\frac{R_1}{l_1} = \frac{R_2}{(100 - l_1)}$$

$$\frac{R_1}{30} = \frac{5.6}{(100 - 30)}$$

$$R_1 = \frac{5.6 \times 30}{70 \times 10}$$

$$R_1 = 2.4\Omega$$

Question: If mass, length and time each has 5% error then what is the error in reading of torque?

Options:

- (a) 10%
- (b) 5%
- (c) 20%
- (d) 25%

Answer: (d)

Solution:

$$\text{Torque} = ML^2T^{-2}$$

\therefore Percentage error in torque

= % error in mass

2 (% error in length)

$$2(\% \text{ error in time}) \\ = 5 + 2(5) + 2(5) = 25\%$$

Question: Two containers contains identical at same temperature and volume. Number of moles of gas in each container are 1 and 3 respectively. Ratios of v_{rms} and pressure of gas in two containers respectively are

Options:

- (a) 1 : 1, 3 : 1
- (b) 3 : 1, 1 : 1
- (c) 1 : 3, 1 : 1
- (d) 1 : 1, 1 : 3

Answer: (d)

Solution:

$$v_{rms} = \sqrt{\frac{3k_B T}{m}}$$

As T and m are same $\frac{v_{rms,1}}{v_{rms,2}} = 1$

$$P = \frac{1}{3} \rho v_{rms}^2 = \frac{1}{3} \frac{nM}{V} v_{rms}^2$$

$$\therefore \frac{P_1}{P_2} = \frac{n_1}{n_2} = \frac{1}{3}$$

Question: A charge is moving with the velocity $3 \times 10^7 \text{ m/s}$ along y axis in an Em wave moving along x axis. Find the ratio of electric force and magnetic force exerted by the EM wave

Options:

- (a) 10 : 1
- (b) 1 : 10
- (c) 1 : 5
- (d) 1 : 6

Answer: (a)

Solution:

Magnetic force on a charge particle $F_B = qvB$

Electric force on a charge particle $F_E = qE = qcB$

$$\text{So, } \frac{F_E}{F_B} = \frac{c}{v} \Rightarrow \boxed{\frac{F_E}{F_B} = \frac{10}{1}}$$

Question: A cylinder having volume charge density ρ is uniformly charged. Find electric field at inside point $r = \frac{2\epsilon_0}{\rho}$

Options:

- (a) $0NC^{-1}$
- (b) $1NC^{-1}$
- (c) $3NC^{-1}$
- (d) $2NC^{-1}$

Answer: (b)

Solution:

Electric field at any point inside the cylinder

$$E = \frac{\rho r}{2\epsilon_0}$$

Given: $r = \frac{2\epsilon_0}{\rho}$

So, $E = \frac{\rho}{2\epsilon_0} \times \frac{2\epsilon_0}{\rho} = 1N/C$

