

JEE-Main-26-07-2022-Shift-2 (Memory Based)

Physics

Question: Two projectiles are thrown with same initial velocity at angle 30° & 45° with horizontal. Find ratio of their ranges.

Options:

(a) $\frac{\sqrt{5}}{2}$

(b) $\frac{\sqrt{7}}{2}$

(c) $\frac{\sqrt{3}}{2}$

(d) $\frac{\sqrt{6}}{2}$

Answer: (c)

Solution:

$$R = \frac{u^2 \sin 2\theta}{g}$$

$$\Rightarrow \frac{R_1}{R_2} = \frac{\sin 60^\circ}{\sin 90^\circ} = \frac{\sqrt{3}}{2}$$

Question: Find radius of gyration of solid cylinder about an axis perpendicular to cylinder axis & passing through centre is

Options:

(a) $\sqrt{\frac{L^2}{2^2} + \frac{R^2}{4}}$

(b) $\sqrt{\frac{L^2}{3^2} + \frac{R^2}{4}}$

(c) $\sqrt{\frac{L^2}{1^2} + \frac{R^2}{4}}$

(d) $\sqrt{\frac{L^2}{1^2} - \frac{R^2}{2}}$

Answer: (c)

Solution:

Moment of inertia of a solid cylinder about transverse axis.

$$= \frac{1}{4}MR^2 + \frac{1}{12}ML^2$$

$$\therefore K = \sqrt{\frac{I}{M}} = \sqrt{\frac{R^2}{4} + \frac{L^2}{12}}$$

Question: Two bodies m_1 and m_2 are attracting each other with gravitational force.

Acceleration of m_1 is a_1 when $m_1 = 2 m_2$ and a_2 when $m_1 = 3 m_2$. Find ratio of a_1 and a_2 .

Options:

(a) $\frac{6}{2}$

(b) $\frac{4}{2}$

(c) $\frac{5}{2}$

(d) $\frac{3}{2}$

Answer: (d)

Solution:

$$a = \frac{F}{m_1} = \frac{Gm_2}{r^2}$$

$$\text{So } a_1 = \frac{G(m_1/2)}{r^2} \text{ and } a_2 = \frac{G(m_1/3)}{r^2}$$

$$\frac{a_1}{a_2} = \frac{3}{2}$$

Question: A mass 0.5 kg moving with 12 m/s collides with a wall elastically. Find time of collision if $F = 100$ N acts during collision.

Options:

(a) $t = 0.16$ s

(b) $t = 0.12$ s

(c) $t = 0.10$ s

(d) $t = 0.15$ s

Answer: (b)

Solution:

$$\begin{array}{c} 0.5 \text{ kg} \\ \bullet \longrightarrow 12 \text{ m/s} \end{array}$$

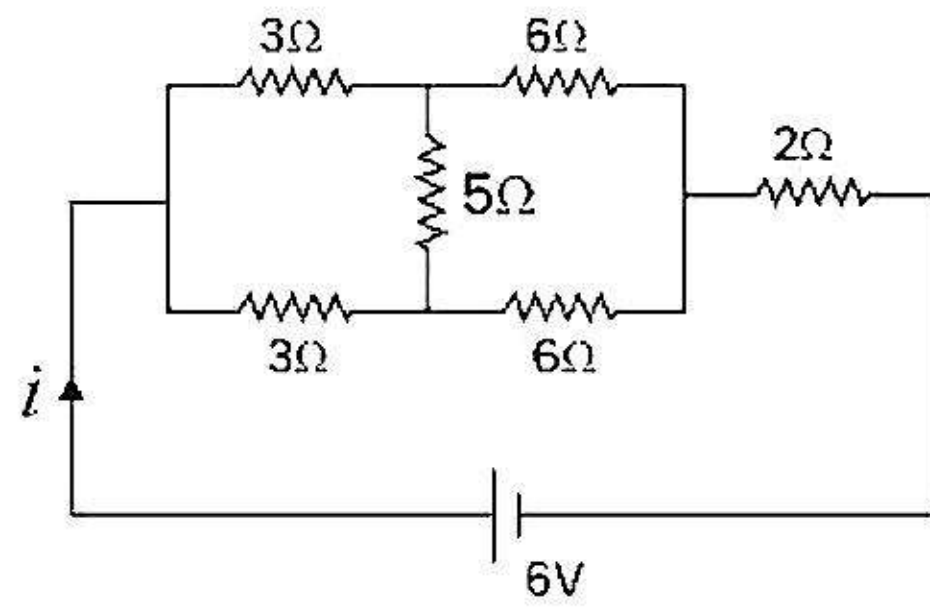
$$\begin{array}{c} 0.5 \text{ kg} \\ \longleftarrow \bullet \\ 12 \text{ m/s} \end{array}$$

$$\text{Change in momentum} = 2mu = 2 \times 0.5 \times 12 = 12 \text{ kg m/s}$$

$$F = \frac{dp}{dt} \quad 100 = \frac{12}{t}$$

$$\boxed{t = 0.12 \text{ s}}$$

Question: Find i



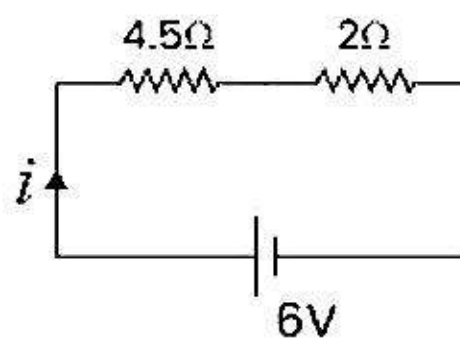
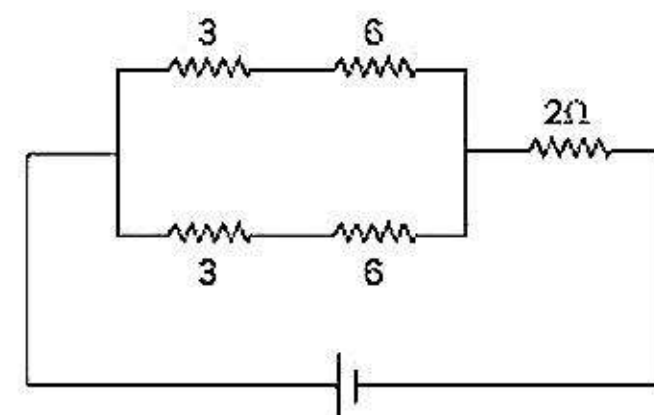
Options:

- (a) 0.723 A
- (b) 0.523 A
- (c) 0.923 A
- (d) 0.623 A

Answer: (c)

Solution:

wheat more bride



$$i = \frac{6}{4.5 + 2} = 0.923A$$

Question: Two springs connected with spring constant $3k$ and k in series have time period T_1 , and in parallel have time period T_2 . Ratio of T_1/T_2 is?

Options:

- (a) 7.31
- (b) 2.31
- (c) 5.30
- (d) 4.31

Answer: (b)

Solution:

$$\frac{1}{k_s} = \frac{1}{3k} + \frac{1}{k} = \frac{4}{3k} \Rightarrow k_s = \frac{3k}{4}$$

$$k_p = 3k + k = 4k \Rightarrow k_p = 4k$$

$$\therefore T = 2\pi\sqrt{\frac{m}{k}} \text{ so } T \propto \frac{1}{\sqrt{k}}$$

$$\text{So, } \frac{T_1}{T_2} = \sqrt{\frac{k_p}{k_s}} = \sqrt{\frac{4k}{3k/4}} = \frac{4}{\sqrt{3}}$$

$$= 2.31$$

Question: A coil having resistance 8Ω has flux varying with time as $\phi = \frac{2}{3}(9 - t^2)$. Find heat produced in coil until flux becomes zero.

Options:

- (a) $H = 2J$
- (b) $H = 5J$
- (c) $H = 1J$
- (d) $H = 3J$

Answer: (a)

Solution:

ϕ is zero at $t = 3s$

$$\varepsilon = -\frac{d\phi}{dt} = \frac{2}{3} \times 2t = \frac{4}{3}t$$

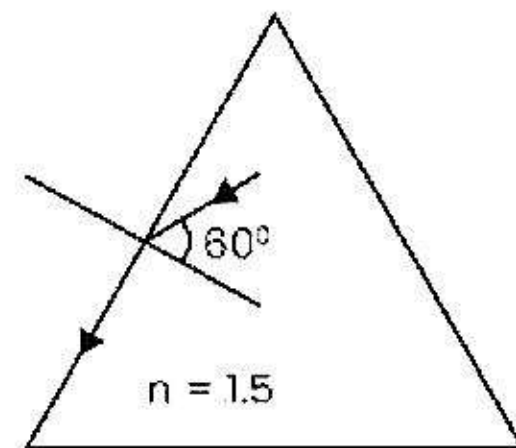
$$\text{current } i = \frac{\varepsilon}{R} = \frac{4t}{3 \times 8} = \frac{t}{6} A$$

$$H = \int_0^3 i^2 R dt = \int_0^3 \frac{t^2}{36} \times 8 dt = \frac{8}{36} \times \frac{t^3}{3} \Bigg|_0^3$$

$$= \frac{8}{36} \times \frac{3^3}{3} = \frac{8}{36} \times 9$$

$$H = 2J$$

Question: A ray is incident inside glass prism, grazes after refraction as shown. Find refractive index of liquid.



Options:

- (a) $\frac{4\sqrt{4}}{3}$
- (b) $\frac{4\sqrt{3}}{4}$
- (c) $\frac{3\sqrt{3}}{4}$

(d) $\frac{3\sqrt{5}}{4}$

Answer: (c)

Solution:

Snell's law

$$v_1 \times \sin 60^\circ = v_2 \sin 90^\circ$$

$$1.5 \times \frac{\sqrt{3}}{2} = v_2 \times 1$$

$$v_2 = \frac{3\sqrt{3}}{4}$$

Question: Two Nuclei have masses in ratio 4 : 3. Find ratio of there Nuclear Density?

Options:

(a) 4 : 1

(b) 1 : 1

(c) 6 : 1

(d) 2 : 2

Answer: (b)

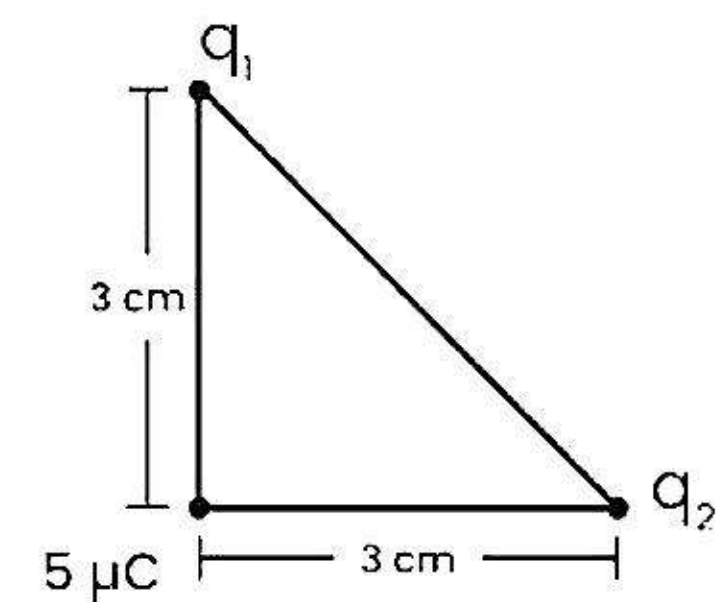
Solution:

Nuclear density is independent of nuclear mass.

Question: In the given figure, find the magnitude of force on $5\mu\text{C}$ charge is:

q_1 is $0.16\mu\text{C}$

q_2 is $0.3\mu\text{C}$



Options:

(a) 14 N

(b) 12 N

(c) 17 N

(d) 10 N

Answer: (c)

Solution:

$$\frac{9 \times 10^9 \times 5 \times 0.3 \times 10^{-12}}{9 \times 10^{-4}}$$

$$\frac{9 \times 10^9 \times 5 \times 0.16 \times 10^{-12}}{9 \times 10^{-4}}$$

$$F = \sqrt{8^2 + 15^2} = 17 N$$

Question: A body is projected from surface of earth with velocity $\frac{1}{3}$ rd of escape velocity.

Find maximum height achieved.

Options:

(a) $\frac{R}{2}$

(b) $\frac{R}{6}$

(c) $\frac{R}{8}$

(d) $\frac{R}{10}$

Answer: (c)

Solution:

$$\text{Escape velocity} = \sqrt{\frac{2GM}{R}}$$

$$\text{Velocity of projection} = \frac{1}{3} v_e = \frac{1}{3} \sqrt{\frac{2GM}{R}}$$

$$E_i = K + U$$

$$= \frac{1}{2} m \frac{1}{9} \left(\frac{2GM}{R} \right) - \frac{GmM}{R}$$

$$= \frac{GmM}{9R} - \frac{GmM}{R} = \frac{-8}{9} \frac{GmM}{R}$$

At maximum height (h)

$$E_f = 0 - \frac{GmM}{(R+h)}$$

$$E_i = E_f \Rightarrow -\frac{8}{9} \frac{GmM}{R} = -\frac{GmM}{(R+h)}$$

$$\Rightarrow (R+h) = \frac{9R}{8}$$

$$\Rightarrow 8R + 8h = 9R$$

$$h = \frac{R}{8}$$

Question: Maximum amplitude of AM modulated wave is 6 and minimum amplitude of AM modulated wave is 2, modulation index in percentage is x% find x.

Options:

(a) 10%

(b) 25%

(c) 35%

(d) 50%

Answer: (d)

Solution:

$$m = \frac{A_{\max} - A_{\min}}{A_{\max} + A_{\min}} = \frac{6-2}{6+2} = \frac{1}{2} = 50\%$$

Question: Two bodies with mass m and 8m have same kinetic energy. The ratio of their momentum is?

Options:

(a) 0.5

(b) 0.8

(c) 0.25

(d) 0.35

Answer: (d)

Solution:

$$P = \sqrt{2mKE}$$

$$\frac{P_1}{P_2} = \sqrt{\frac{m_1}{m_2}} = \sqrt{\frac{m}{9m}} = \frac{1}{3}$$

$$\frac{P_1}{P_2} = 0.33 \text{ (Approx.)}$$

Question: A nucleus of mass M splits into daughter nuclei $\frac{m'}{3}$ and $\frac{2m'}{3}$ ($m' < M$). Find the ratio of de-Broglie wavelength of two daughter nuclei.

Options:

(a) λ are same

(b) λ of smaller part is more

(c) λ of bigger part is more

(d) Data insufficient

Answer: (a)

Solution:

As initially m' at rest,

$\frac{m'}{3}, \frac{2m'}{3}$ will have some momentum.

$$\lambda = \frac{h}{p}$$

Hence, λ are same.

Question: Find γ in terms of degree of freedom f .

Options:

(a) $1 + \frac{2}{f}$

(b) $\frac{2}{f}$

(c) $1 - \frac{2}{f}$

(d) $1 - f$

Answer: (a)

Solution:

$$\gamma = 1 + \frac{2}{f}$$

Question: $y = 2 \sin(\omega t - kx)$ find λ such that wave velocity = maximum velocity of particle

Options:

(a) 2π

(b) 4π

(c) 7π

(d) 10π

Answer: (b)

Solution:

$$\text{Wave velocity} = \frac{\omega}{k}$$

$$\text{Particle velocity (maximum)} = \omega A$$

$$\frac{\omega}{k} = \omega A$$

$$\frac{1}{k} = A = 2$$

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

$$\therefore \frac{2\pi}{\lambda} = \frac{1}{2}$$

$$\boxed{\lambda = 4\pi}$$

Question: Breaking stress of a wire is increased by 2.5 times and tensile force is increased from 10 to 25 metric tonnes. If initial minimum cross section is $2.5 \times 10^{-4} m^2$ the minimum area to sustain the new load is

Options:

(a) $2.5 \times 10^{-4} m^2$

(b) $1.5 \times 10^{-4} m^2$

(c) $2.5 \times 10^4 m^2$

(d) $2.5 \times 10^2 m^2$

Answer: (a)

Solution:

$$\sigma = \frac{F}{A} \Rightarrow A = \left(\frac{F}{\sigma} \right)$$

$$\frac{A_1}{A_2} = \frac{2.5 \times 10^{-4}}{A_2} = \frac{\frac{10 \times 10^3 g}{25 \times 10^3 g}}{\frac{25 \times 10^3 g}{2.5 \times 10^3 g}} = \frac{10}{25} \times 2.5$$

$$\frac{A_1}{A_2} = 1 \text{ so } A_2 = A_1 = 2.5 \times 10^{-4} m^2$$

Question: A light ray has speed $1.5 \times 10^8 m/s$ in medium 1 and $2 \times 10^8 m/s$ in medium 2. Find critical angle for system

Options:

(a) $\sin^{-1} \left(\frac{1}{2} \right)$

(b) $\sin^{-1} \left(\frac{2}{3} \right)$

(c) $\sin^{-1} \left(\frac{3}{4} \right)$

(d) $\cos^{-1} \left(\frac{1}{2} \right)$

Answer: (c)

Solution:

$$\mu = \frac{C}{V}; \frac{\mu_1}{\mu_2} = \frac{v_2}{v_1} = \frac{2 \times 10^8}{1.5 \times 10^8} = \frac{4}{3}$$

$$\text{Also, } \sin i_c = \frac{\mu_2}{\mu_1}$$

$$\therefore i_c = \sin^{-1} \left(\frac{3}{4} \right)$$

Question: The magnitude of magnetic field associated with an EM wave is 5×10^{-6} . The electric field magnitude is going to be;

Options:

(a) $1 \frac{KN}{C}$

(b) $1.5 \frac{KN}{C}$

(c) $2.5 \frac{KN}{C}$

(d) $3.5 \frac{KN}{C}$

Answer: (b)

Solution:

$$E = BC$$

$$E = 5 \times 10^{-6} \times 3 \times 10^8$$

$$= 15 \times 10^2$$

$$= 1.5 \frac{KN}{C}$$

Question: Projection of vector $\vec{A}$ on vector $\vec{B}$ is:

Options:

(a) $(\vec{A} \cdot \hat{B}) \hat{A}$

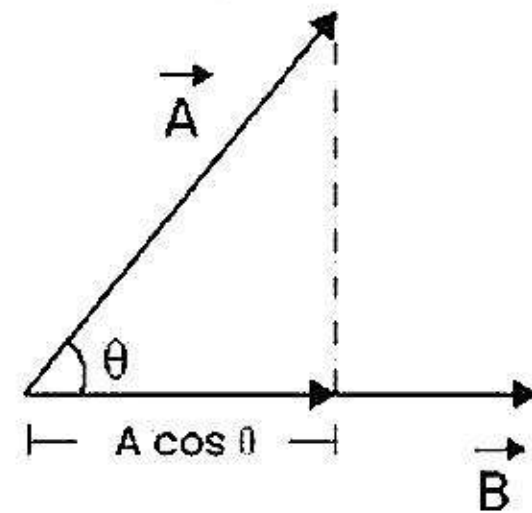
(b) $(\vec{A} \cdot \hat{B}) \hat{B}$

(c) $\hat{A}$

(d) $|\vec{A}| \hat{A}$

Answer: (b)

Solution:



$$\vec{A} \cdot \vec{B} = AB \cos \theta$$

$$A \cos \theta = \frac{\vec{A} \cdot \vec{B}}{B}$$

$$A \cos \theta = \vec{A} \cdot \hat{B}$$

In vector from $(\vec{A}.\hat{B})\hat{B}$