# 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

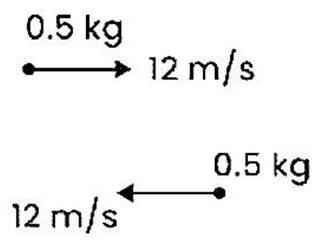
(b) t = 0.12 s

(c) t = 0.10 s

(d) t = 0.15 s

**Answer:** (b)

**Solution:**

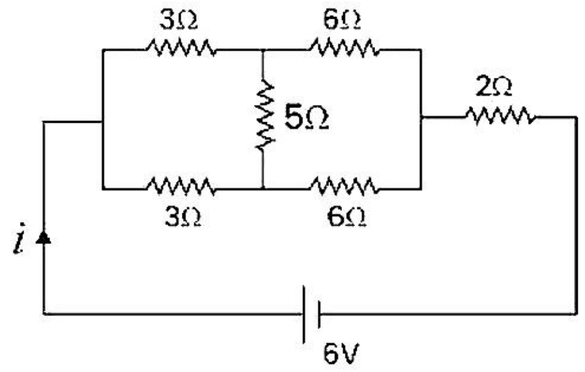



Change in momentum = 2mu = 2 x 0.5 x 12 = 12 kg m/s

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

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

**Question:** Find i




**Options:**

(a) 0.723 A

(b) 0.523 A

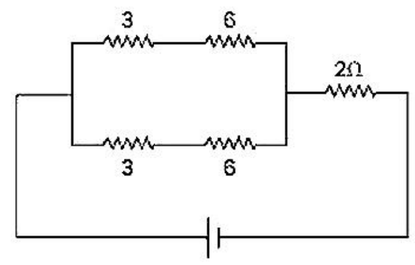
(c) 0.923 A

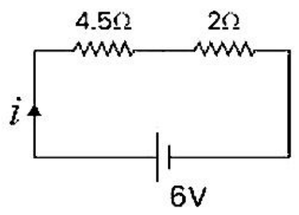
(d) 0.623 A

**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:**

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

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

$$\because T = 2\pi\sqrt{\frac{m}{k}} \text{ so } T\alpha\frac{1}{\sqrt{k}}$$

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 $\phi=\frac{2}{3}\left(9-t^2\right)$. Find heat produced in coil until flux becomes zero.

**Options:**

(a) H = 2J

(b) H = 5J

(c) H = 1J

(d) H = 3 J

**Answer:** (a)

**Solution:**

$\phi$ is zero at t = 3s

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

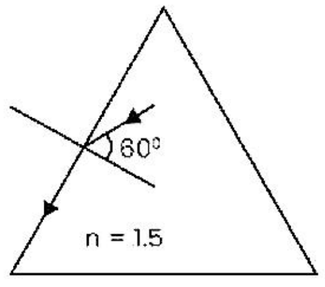
current $i=\frac{\varepsilon}{R}=\frac{4t}{3\times 8}=\frac{t}{6}A$

$H=\int_0^3 i^2R\,dt=\int_0^3\frac{t^2}{36}\times 8\,dt=\frac{8}{36}\times\frac{t^3}{3}\Big]_0^3$

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

$H=2J$

**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)

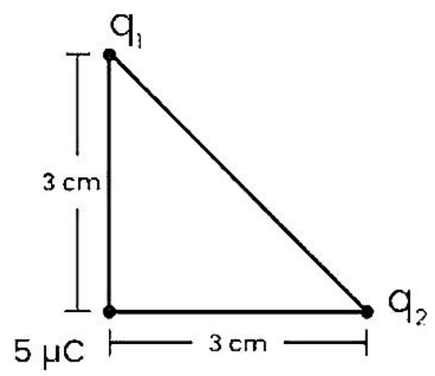
**Solution:**

Nuclear density is independent of nuclear mass.

**Question:** In the given figure, find the magnitude of force on 5μC charge is:

$q_1$ is 0.16μC

$q_2$ is 0.3 μC




**Options:**

(a) 14 N

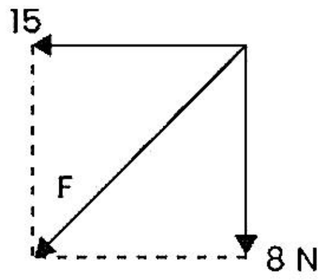
(b) 12 N

(c) 17 N

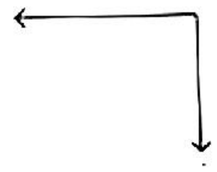
(d) 10 N

**Answer:** (c)

**Solution:**




$$\frac{9\times10^{9}\times5\times0.3\times10^{-12}}{9\times10^{-4}}$$



$$\frac{9\times10^{9}\times5\times0.16\times10^{-12}}{9\times10^{-4}}$$

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

**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:**

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

$$\frac{P_1}{P_2} = \sqrt{\frac{m_1}{m_2}} = \sqrt{\frac{m}{9m}} = \frac{1}{2\sqrt{2}}$$

$$\frac{P_1}{P_2} = 0.35 \text{ (Approx.)}$$

**Question:** 0.5A 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) $\lambda$ are same

(b) $\lambda$ of smaller part is more

(c) $\lambda$ 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, $\lambda$ are same.

**Question:** Find $\gamma$ 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 $\lambda$ such that wave velocity = maximum velocity of particle

**Options:**

(a) $2\pi$

(b) $4\pi$

(c) $7\pi$

(d) $10\pi$

**Answer:** (b)

**Solution:**

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

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 $2.5\times10^{-4}m^2$ the minimum area to sustain the new load is

**Options:**

(a) $2.5\times10^{-4}m^2$

(b) $1.5\times10^{-4}m^2$

(c) $2.5\times10^{4}m^2$

(d) $2.5\times10^{2}m^2$

**Answer:** (a)

**Solution:**

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

$$\frac{A_1}{A_2} = \frac{2.5\times10^{-4}}{A_2} = \frac{\frac{10\times10^3 g}{\sigma}}{\frac{25\times10^3 g}{2.5\sigma}} = \frac{10}{25}\times2.5$$

$$\frac{A_1}{A_2} = 1 \text{ so } A_2 = A_1 = 2.5\times10^{-4}m^2$$

**Question:** A light ray has speed $1.5\times10^8 m/s$ in medium 1 and $2\times10^8 m/s$ 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:**

$$\mu = \frac{C}{V}; \frac{\mu_1}{\mu_2} = \frac{v_2}{v_1} = \frac{2\times10^8}{1.5\times10^8} = \frac{4}{3}$$

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 $5\times10^{-6}$. 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:**

$$E = BC$$

$$E = 5\times10^{-6}\times3\times10^{8}$$

$$=15\times10^{2}$$

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

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

**Options:**

(a) $\left(\vec{A}.\hat{B}\right)\hat{A}$

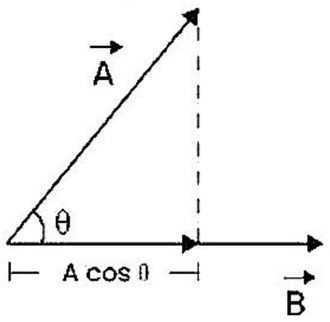
(b) $\left(\vec{A}.\hat{B}\right)\hat{B}$

(c) $\hat{A}$

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

**Answer:** (b)

**Solution:**




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

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

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

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