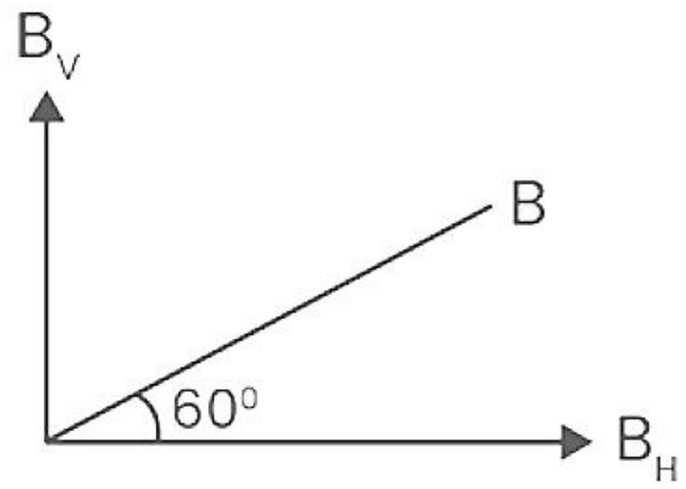
JEE-Main-27-06-2022-Shift-2 (Memory Based)

Physics

Question: Which one is not showing the dimension of time-
Options:
(a) $\sqrt{LC}$
(b) $\frac{L}{R}$
(c) CR
(d) $\frac{C}{R}$
Answer: (d)
Solution:
$[L]=\left[ML^2T^{-2}A^{-2}\right]$
$[R]=\left[ML^2T^{-3}A^{-2}\right]$
$[C]=\left[M^{-1}L^{-2}T^4A^2\right]$
(a) $\left[\sqrt{LC}\right]=\left[M^0L^0T^2A^0\right]^{1/2}=[T]$
(b) $\left[\frac{L}{R}\right]=\left[M^0L^0T^1A^0\right]=[T]$
(c) $[CR]=\left[M^0L^0T^1A^0\right]=[T]$
(d) $\left[\frac{C}{R}\right]=\left[M^{-2}L^{-4}T^6A^4\right]$
So right answer is d.

Question: Rod of length 20 cm is moving with speed 10m/s in horizontal plane. Horizontal component of earth's magnetic field is 0.3 T. Angle of dip is 60°. Find potential of rod?
Options:
(a) 1.6 V
(b) 2.62 V
(c) 1.039 V
(d) 1.25 V
Answer: (c)
Solution:
$\tan 60^\circ=\frac{B_v}{B_H}$
$B_V=0.3\times\sqrt{3}$
$\varepsilon=B_vVL$
$\varepsilon=0.3\sqrt{3}\times10\times0.2$

$\varepsilon = 1.039V$



Question: A spring of natural length L is attached with a mass M is rotated in horizontal circle with angular velocity ω. Find elongation in spring.

Options:

(a) $\frac{m\omega^2 k}{(L-m)}$

(b) $\frac{m\omega^2 L}{(k-m\omega^2)}$

(c) $\frac{m\omega^2 L}{(k-m)}$

(d) None of these

Answer: (b)

Solution:

$m\omega^2(L+x) = kx$

$m\omega^2 L = kx - m\omega^2 x$

$\Rightarrow x = \frac{m\omega^2 L}{(k-m\omega^2)}$

Question: A proton and deuteron moving in circular orbit in uniform magnetic field with same velocity. Ratio of radius of deuteron to radius to proton is x : 1. Find value of x?

Options:

(a) 2

(b) 5

(c) 4

(d) 7

Answer: (a)

Solution:

$r = \frac{mv}{Bq}$

$r_P = \frac{m_P v}{Bq}$

$r_D = \frac{2m_P v}{Bq}$

$$\frac{r_D}{r_p} = \frac{2}{1}$$
$$\Rightarrow x = 2$$

Question: If in SHM motiontime period is 6 sec, what is the time taken to travel from extreme position to a distance of half the amplitude from mean position is

Options:

(a) 4 sec

(b) 1 sec

(c) 0.024 sec

(d) 0.25 sec

Answer: (b)

Solution:

Let SHM equation

$y = A\cos\omega t$

At t = 0, y = A

For $y = \frac{A}{2}$

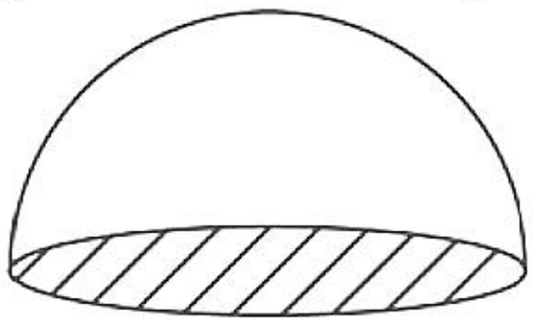
$$\frac{A}{2} = A\cos\left(\frac{2\pi}{T} \times t\right)$$

$$\cos\frac{\pi}{3} = \cos\left(\frac{2\pi}{T} \times t\right)$$

$$\frac{2\pi}{T} \times t = \frac{\pi}{3}$$

$$t = \frac{T}{6} = 1\,\text{sec}$$

Question: Find flux through shaded area



Options:

(a) $\frac{q}{2\varepsilon_0}$

(b) $\frac{q\varepsilon_0}{2}$

(c) $\frac{q^2\varepsilon_0}{2}$

(d) None of these

Answer: (a)

Solution:

If it was a complete sphere, then flux $= \frac{q}{\varepsilon_0}$

For half portion $\phi = \frac{q}{2\varepsilon_0}$

Question: Transistor work like switch in
Options:
(a) Active region
(b) Cutoff and saturation region
(c) Cutoff region only
(d) Saturated region only
Answer: (b)
Solution:
Transistor acts as a switch in the saturation region and cutoff region.

Question: An electron makes a transition from lower orbit showing energy E_1 to higher orbit having energy E_2 by absorbing a photon of frequency 'f' then
Options:
(a) $f = \frac{h}{(E_1 - E_2)}$
(b) $f = \frac{(E_2 - E_1)}{h}$
(c) $f = \frac{h^2}{(E_1 - E_2)}$
(d) None of these
Answer: (b)
Solution:
Energy of photon= hf
Energy required for transition $= E_2 - E_1$
$hf = E_2 - E_1$
$f = \frac{(E_2 - E_1)}{h}$

Question: If a ray is refracted to denser medium then
Options:
(a) Speed, wavelength and frequency remains constant
(b) Speed and wavelength decreases, frequency constant
(c) Speed, wavelength and frequency increases
(d) Speed, wavelength and frequency decreases
Answer: (b)
Solution:
When a ray goes from rarer medium to denser medium then its speed and wavelength decreases but frequency always remains constant.So correct answer is (B).

Question: If a gas with gamma 1.4 expands isobarically, and work done is 400 J, then what is the heat given to the system?
Options:
(a) 1500J
(b) 1400J

(c) 2000J
(d) 2200J
Answer: (b)
Solution:
First law of thermodynamics is:

$$Q = p\Delta V + nC_V\Delta T$$

$$= p\Delta V + n\frac{R}{\gamma - 1}\Delta T$$

$$= p\Delta V\left(1 + \frac{1}{\gamma - 1}\right)$$

$$= 400\left(1 + \frac{1}{0.4}\right)$$

$$= 400 \times 3.5$$

$$= 1400J$$

Question: Dimension of the quantity which is showing Pascal- Second
Options:
(a) $ML^{1}T^{1}$
(b) $ML^{-2}T^{-2}$
(c) $ML^{-1}T^{-2}$
(d) MLT^{-2}
Answer: (a)
Solution: Pascal-sec are unit of Pressure – Time

$$= \frac{F}{A}.t = \frac{\left[MLT^{-2}\right][T]}{\left[L^2\right]} = \left[ML^{-1}T^{-1}\right]$$

Question: A particle moving in vertical circle tied to string. Velocity at bottom is u. Magnitude of change in velocity when string becomes horizontal is $v = \sqrt{x\left(u^2 - g'\right)}$. Find value of x?

Options:
(a) 2
(b) 3
(c) 4
(d) 5
Answer: (a)
Solution: When string is horizontal, let's assume speed to be v then by conservation of energy

$$mgR + \frac{1}{2}mv^2 = \frac{1}{2}mu^2$$

$$\Rightarrow v^2 = u^2 - 2gR$$

$$\Rightarrow v = \sqrt{u^2 - 2gR}$$

Final velocity vector is $\vec{v} = \sqrt{u^2 - 2gR}\,\hat{j}$
Initial velocity vector is $\vec{u} = u\hat{i}$

$$|\Delta\vec{v}| = \sqrt{|v^2| + |u^2|}$$

$$= \sqrt{u^2 - 2gR + u^2} = \sqrt{2u^2 - 2gR}$$

$= \sqrt{2\left(u^2 - gR\right)}$

Question: A stone is dropped from 4.9 m above water level. It entered with velocity v and then continue at constant velocity v. It took 4 seconds from throw to reach ground. Find depth of water.

Options:

(a) 20.4 m

(b) 29.4 m

(c) 2.94 m

(d) 19.4 m

Answer: (b)

Solution: Velocity after falling through a height of 4.9 m

$v^2 - u^2 = 2as$

$v^2 - 0 = 2(9.8)(4.9)$

$v = 9.8 m/s$

Time taken to fall by 4.9 m

$9.8 = 0 + 9.8t$

$\Rightarrow t = 1 sec$

Rest of 3 sec it went inside water with constant speed 9.8 m/s

$\therefore$ Depth of water $9.8 \times 3 = 29.4 m$

Question: A lens of power P is cut into two parts horizontally. Then one of the parts is equally divided into two vertical parts. Let's assume that P_1 is the power of the half lens and P_2, P_3 be the powers of the quarter lenses. Then choose the wrong option

Options:

(a) $P_1 = \frac{P}{2}$

(b) $P_2 = P_1$

(c) $P_3 = P_2$

(d) $P_3 = \frac{P_1}{2}$

Answer: (d)

Solution:

 = P

 = P_1

P_2 =  ,  = P_3

$$P_1 = \frac{P}{2} \text{ and } P_3 = P_2 = P_1 = \frac{P}{2}$$

Question: SHM $x = \sin \pi\left(t + \frac{1}{3}\right)$. Find V at $t = 1$

Options:

(a) 1.5 m/s

(b) 15.10 m/s

(c) 2.8 m/s

(d) 1.57 m/s

Answer: (d)

Solution: $x = \sin \pi\left(t + \frac{1}{3}\right)$

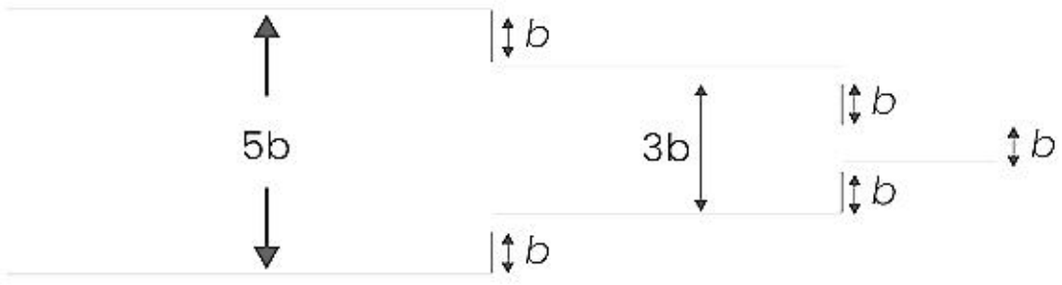
$$v = \frac{dx}{dt} = \cos \pi\left(t + \frac{1}{3}\right)$$

At $t = 1$

$$v = \pi \cos\left(\frac{4\pi}{3}\right) = -\frac{\pi}{2}$$

$$= -1.57 m/s$$

Question: 6 capacitor plates are arranged as shown. The area of each plate is A. The capacitance of the arrangement is _____.



Options:

(a) $\frac{15}{28}\left(\frac{\varepsilon_0 A}{b}\right)$

(b) $\frac{23}{15}\left(\frac{\varepsilon_0 A}{b}\right)$

(c) $\frac{15}{22}\left(\frac{\varepsilon_0 A}{b}\right)$

(d) $\frac{17}{23}\left(\frac{\varepsilon_0 A}{b}\right)$

Answer: (b)

Solution: All are parallel

$C_1 = \frac{\varepsilon_0 A}{5b}, C_2 = \frac{\varepsilon_0 A}{3b}, C_3 = \frac{\varepsilon_0 A}{b}$

Equivalent capacitance $= \frac{\varepsilon_0 A}{b}\left(\frac{1}{5}+\frac{1}{3}+1\right)$

$= \frac{23}{15}\frac{\varepsilon_0 A}{b}$

Question: 4 masses at corners of square m and a mass M at center. Find potential energy of system?

Options:

(a) $\frac{-4\sqrt{2}Gmm_1}{a} - \left(4+\sqrt{2}\right)\frac{Gm^2}{a}$

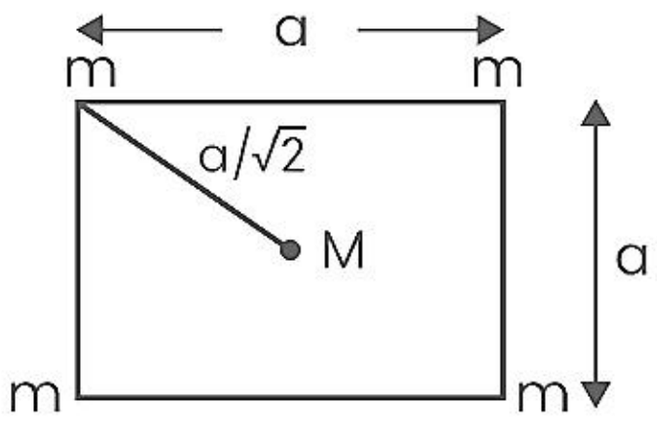
(b) $\frac{4\sqrt{2}Gmm_1}{a} + \left(4 \div \sqrt{2}\right)\frac{Gm^2}{a}$

(c) $\frac{-4\sqrt{2}Gmm_1}{a} + \left(4+\sqrt{2}\right)\frac{Gm^2}{a}$

(d) $\frac{-4\sqrt{2}Gmm_1}{a} - \left(4-\sqrt{2}\right)\frac{Gm^2}{a}$

Answer: (a)

Solution:



$U = -\left[4\frac{GMm}{\left(\frac{a}{\sqrt{2}}\right)}\right] - \frac{4Gm^2}{a} - \frac{2Gm^2}{\sqrt{2}a}$

$= -\frac{4\sqrt{2}GMm}{a} - \left(4+\sqrt{2}\right)\frac{Gm^2}{a}$

Question: A rope of mass 10 kg and length 5 m is suspended from a ceiling. If a force of 30 N is applied at the middle of the rope, then find the angle made by the rope with vertical.

Options:

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

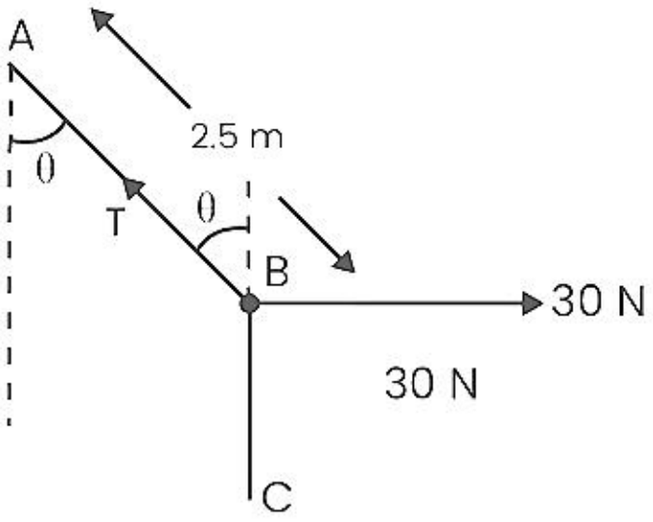
(b) $\frac{2.5}{5}$

(c) $\frac{3}{5}$

(d) $\frac{1}{5}$

Answer: (c)

Solution:



$AB = BC = 2.5m$ (each has mass 5 kg)

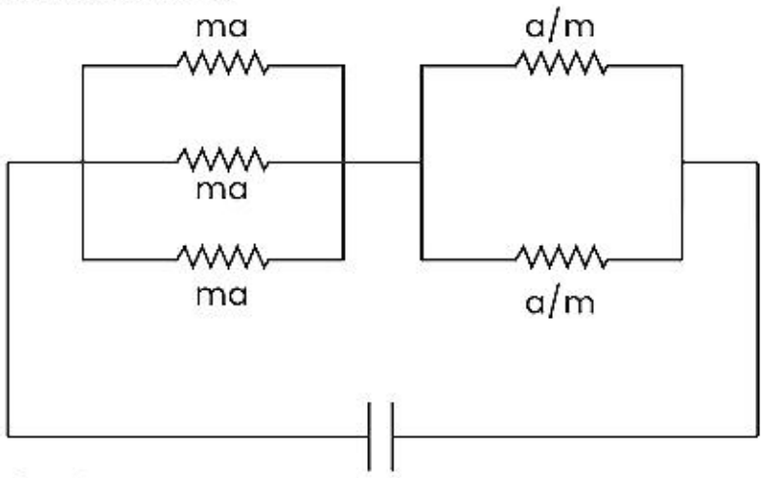
At point B

$T\cos\theta = 5g = 50$

$T\sin\theta = 30$

$\therefore \tan\theta = \frac{3}{5}$

Question: For the figure given, a is constant. Find value of m for which equivalent resistance is maximum.



Options:

(a) $\sqrt{\frac{1}{3}}$

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

(c) $\sqrt{\frac{4}{3}}$

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

Answer: (d)

Solution: Equation resistance $R = \frac{ma}{3} + \frac{a}{2m}$

$\frac{dR}{dm} = \frac{a}{3} - \frac{a}{2m^2}$

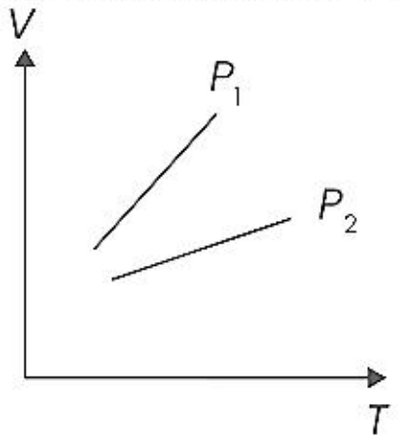
Putting equal to zero

$\frac{a}{3} - \frac{a}{2m^2} = 0$

$\frac{1}{3} = \frac{1}{2m^2} \Rightarrow m^2 = \frac{3}{2}$

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

Question: For the V-T graph we can say



Options:

(a) $P_1 < P_2$

(b) $P_1 > P_2$

(c) $P_1 = P_2$

(d) No relationship can be obtained

Answer: (a)

Solution: $PV = nRT$

$V = \frac{nRT}{P}$

$\frac{nR}{P}$ is the slope

More slope = less pressure

$\therefore P_1 < P_2$