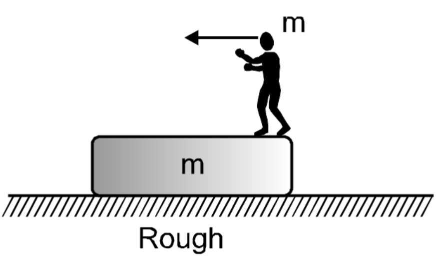
Q-1 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

A block of mass m and length l is kept at rest on a rough horizontal ground of friction coefficient μ_k. A man of mass m is standing at the right end. Now the man starts walking towards left and reaches the left end within time t. During this time, the displacement of the block is : (Assume the pressing force between the block and the ground remains constant and its value is same as it was initially. Also as sume that the block slides during the entire time (t))



(A) $\dfrac{l - \mu_k g t^2}{2}$

(B) $\dfrac{l+\mu_k g t^2}{2}$

(C) $\dfrac{\mu_k g t^2 - l}{2}$

(D) $\dfrac{l}{2}$

Correct Option : A

SOLUTION

$$(F_{\text{net}})_{\text{ext}} = \mu_k(2m)g = m_{\text{total}} a_{cm}$$

$$a_{cm} = \mu_k g$$

$$S_{cm} = 0 + \frac{1}{2}(\mu_k g)t^2$$

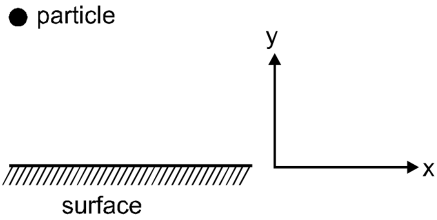
$$S_{cm} = \frac{m_1 S_1 + m_2 S_2}{m_1 + m_2}$$

$$-\frac{1}{2}(\mu_k g)t^2 = \frac{(m)(x) + (m)(x-l)}{m+m}$$

$$x = \frac{l - (\mu_k g)t^2}{2}$$

Q-2 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

A particle moving with velocity $\left(2\hat{i} - 3\hat{j}\right)$ m/s collides with a surface at rest in xzplane as shown in figure and moves with velocity $\left(2\hat{i} + 2\hat{j}\right)$ m/s after collision. Then coefficient of restitution is :



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

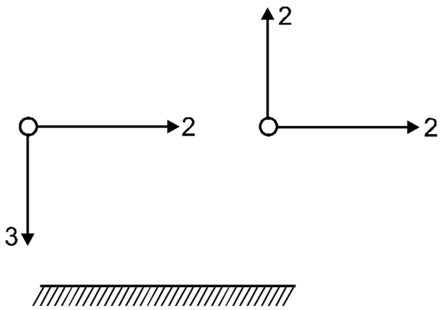
(B) 1

(C) $\sqrt{\frac{8}{13}}$

(D) $\frac{4}{5}$

Correct Option : A

SOLUTION

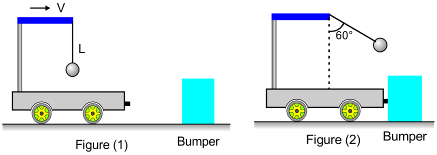


$$e = \frac{v_{sep}}{v_{opp}} = \frac{2}{3}$$

Q-3 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

A ball is suspended from the top of a cart by a light string of length 1.0 m. The cart and the ball are initially moving to the right at constant speed V, as shown in figure I. The cart comes to rest after colliding and sticking to a fixed bumper, as in figure II. The suspended ball swings through a maximum angle 60. The initial speed V is (take

$g = 10m/s^2$) (neglect friction)



(A) $\sqrt{10}m/s$

(B) $2\sqrt{5}m/s$

(C) $5\sqrt{2}m/s$

(D) 4 m/s

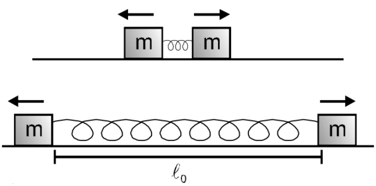
Correct Option : A

SOLUTION

As string does no work on the ball, energy conservation can be applied.

$$\frac{1}{2}mV^2 = mg(L - L\cos\theta) \Rightarrow V = \sqrt{2gL(1 - \cos\theta)}$$

on putting values $V = \sqrt{10}m/s$



Q-4 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

Two blocks each of mass m are joined together using an ideal spring of force constant K and natural length l_0 . The blocks are touching each other when the system is released from rest on a rough horizontal surface. Both the blocks come to rest simultaneously when the extension in the spring is $\frac{l_0}{4}$. The coefficient of friction between each block and the surface (assuming it to be same between any of the blocks and the surface) is :

(A) $\frac{Kl_0}{40mg}$

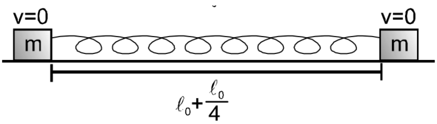
(B) $\frac{Kl_0}{8mg}$

(C) $\frac{3Kl_0}{8mg}$

(D) $\frac{17}{20}\frac{Kl_0}{mg}$

Correct Option : C

SOLUTION



Work energy theoram,

$$-\mu g\left(l_0+\frac{l_0}{4}\right)=\frac{1}{2}K\left(\frac{l_0}{4}\right)^2-\frac{1}{2}Kl_0^2\mu=\frac{3Kl_0}{8mg}$$

Q-5 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

Two spherical bodies of masses m and 5m and radii R and 2R respectively, are released in free space with initial separation between their centres equal to 12 R. If they attract each other due to gravitational force only, the distance covered by smaller sphere just before collision is

(A) $\frac{15R}{2}$

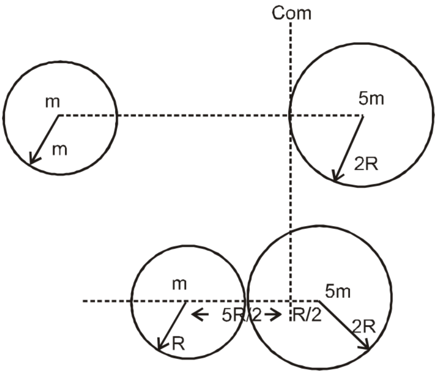
(B) $\frac{13R}{2}$

(C) 10R

(D) $\frac{17R}{2}$

Correct Option : A

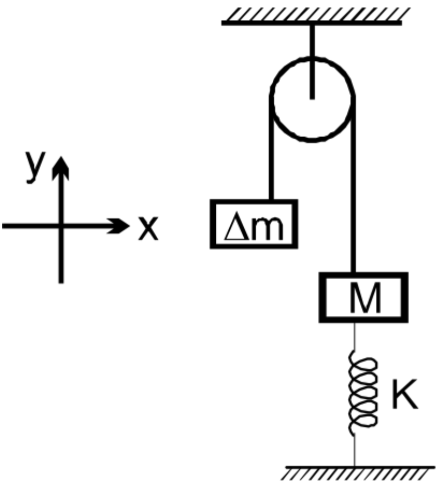
SOLUTION



Distance covered by the smaller sphere $= 10R - \frac{5R}{2} = \frac{15R}{2}$

Q-6 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

Consider the system shown in figure. Pulley, string and spring are ideal and $\Delta m < < M$. Initially spring is in its natural length and both the blocks are at rest. (Assume that initially Δm was situated at origin). Maximum y coordinate of Δm in subsequent motion is xmg/k then value of x is .



(A) 1

(B) 2

(C) 3

(D) 4

Correct Option : B

SOLUTION

As $\Delta m < \; < m$

So, we can assume that motion of mass M will not be influenced by Δm. Now, when total force on mass M by energy conservation

$$\Rightarrow kx = mg \Rightarrow x = \frac{mg}{k}$$

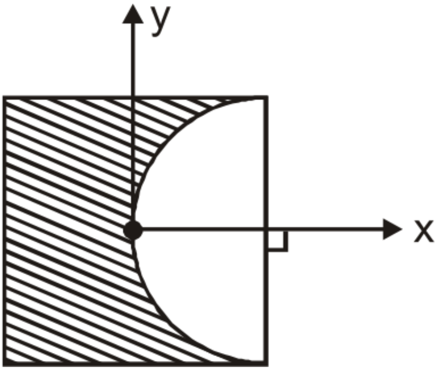
Now, maximum downwards displacement of M

$$2x = 2\frac{Mg}{k}$$

As block Δm is connected to mass M so its maximum upwards displacement $= \frac{2Mg}{k}$

Q-7 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

In the figure shown a semicircular area is removed from a uniform square plate of side l and mass m (before removing). The x-coordinate of centre of mass of remaining portion is (The origin is at the centre of square)



(A) $-\dfrac{\pi(\pi-2)l}{2(8-\pi)}$

(B) $\dfrac{\pi(\pi-2)l}{2(8-\pi)}$

(C) $-\dfrac{\pi(\pi-2)l}{8-\pi}$

(D) $-\dfrac{l\left(\pi-\frac{4}{3}\right)}{2(8-\pi)}$

Correct Option : D

SOLUTION

$$x_{cm}=\frac{m_1x_1+m_2x_2}{m_1+m_2}$$

m_1=mass of square plate

$$=m$$

x_1=c.m. of square plate =0

m_2 =mass of removed part

$$= -\frac{m}{l^2}\left(\frac{\pi\frac{l^2}{4}}{2}\right) = -\frac{\pi}{8}m$$

x_2=c.m. of removed part

$$= \frac{l}{2} - \frac{4}{3\pi}\left(\frac{l}{2}\right) = \frac{l}{2}\left(1 - \frac{4}{3\pi}\right)$$

$$\therefore x_{cm} = \frac{-\frac{\pi m}{8}.\frac{l}{2}\left(1-\frac{4}{3\pi}\right)}{m-\frac{\pi}{8}m}, x_{cm} = -\frac{l\left(\pi-\frac{4}{3}\right)}{2(8-\pi)}$$

Q-8 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

Power of the only force acting on a particle of mass m=1 kg moving in straight line depends on its velocity as $P = v^2$ where v is in m/s and P is in watt. If initial velocity of the particle is 1m/s, then the displacement of the particle in ln 2 second will be :

(A) $(\ln 2 - 1)m$

(B) $(\ln 2)^2 m$

(C) 1m

(D) 2m

Correct Option : C

SOLUTION

P=Fv

$v^2 = Fv$

Ma=v

$$1 \times v\frac{dv}{dx} = v$$

$$\int_1^v dv = \int_0^x dx$$

v-1=x

v=x+1

$$\frac{dx}{dt} = x + 1$$

$$\int_0^x \frac{dx}{x+1} = \int_0^t dt$$

$\ln(x+1) - \ln(0+1) = t$

$x + 1 = e^t$

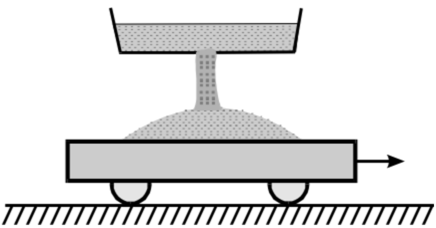
$x = e^t - 1$

at $t = \ln 2$

$x = 2 - 1 = 1m$

Q-9 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

Sand is falling on a flat car being pulled with constant speed. The rate of mass falling on the cart is constant. Then the horizontal component of force exerted by the falling sand on the cart (sand particles sticks to the cart)



(A) Increases

(B) decreases

(C) remains constant

(D) increases and then decreases

Correct Option : C

SOLUTION

The horizontal component of velocity sand just before falling on the cart is $v_s = 0$

The horizontal speed of cart $= v_c$(constant).

The rate of mass falling on cart $= \mu$(constant).

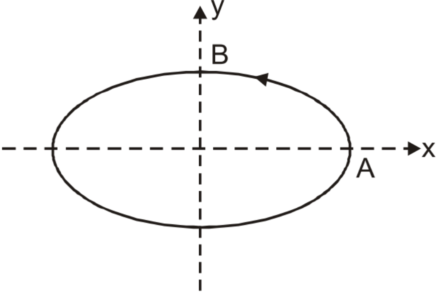
Horizontal force exerted by falling sand on cart

$$= \mu v_{rel} = \mu(v_c - v_s) = \mu v_c$$

: 'μ and v_c are constant, the horizontal force is constant.

Q-10 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

A particle is moving along an elliptical path with constant speed. As it moves from A to B, magnitude of its acceleration :



(A) Continuously increases

(B) continuously decreases

(C) Remains constant

(D) first increases and then decreases

Correct Option : B

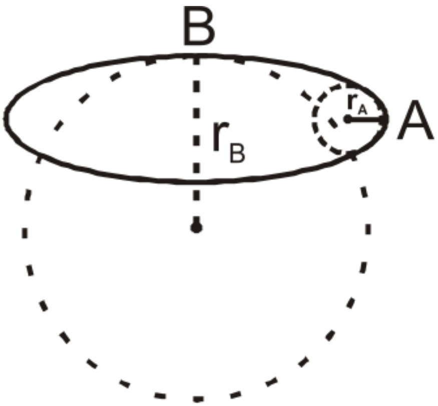
SOLUTION

$$a_t = \frac{dv}{dt} = 0$$

$$a_c = \frac{v^2}{R}$$

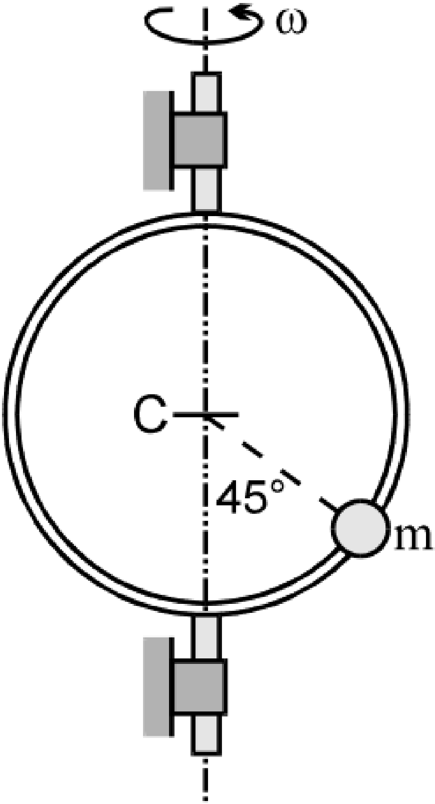
From A to B radius of curvature increases

So, acceleration decreases



Q-11 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

A small bead of mass m = 1 kg is free to move on a circular hoop. The circular hoop has centre at C and radius r = 1 m and it rotates about a fixed vertical axis. The coefficient of friction between bead and hoop is $\mu = 0.5$. The maximum angular speed of the hoop for which the bead does not have relative motion with respect to hoop, at the position shown in figure is : (Take $g = 10m/s^2$)



(A) $\left(5\sqrt{2}\right)^{1/2}$

(B) $\left(10\sqrt{2}\right)^{1/2}$

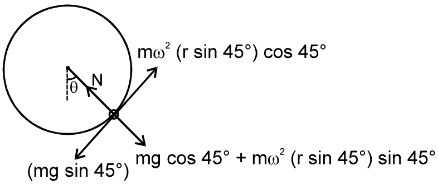
(C) $\left(15\sqrt{2}\right)^{1/2}$

(D) $\left(30\sqrt{2}\right)^{1/2}$

Correct Option : D

SOLUTION

The maximum angular speed of the hoop corresponds to the situation when the bead is just about to slide upwards. The free body diagram of the bead is



For the bead not to slide upwards.

$m\omega^2(r\sin 454)\cos 45 - mg\sin 45 < \mu N.....(1)$

where $N = mg\cos 45 + m\omega^2(r\sin 45)\sin 45......(2)$

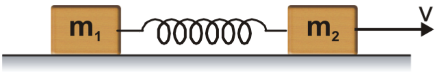
From 1 and 2 we get.

$\omega = \sqrt{30\sqrt{2}} rad / s$

Q-12 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

Two blocks of mass m_1 and m_2 $(m_1 < m_2)$ are connected with an ideal spring on a smooth horizontal surface as shown in figure. At t =

0 m_1 is at rest and m_2 is given a velocity v towards right. At this moment, spring is in its natural length. Then choose the correct alternative :



(A) Block of mass m_2 will be finally at rest after some time.

(B) Block of mass m_2 will never come to rest.

(C) Both the blocks will be finally at rest.

(D) None of these

Correct Option : B

SOLUTION

If velocity of m_2 is zero then by momentum conservation

$$m_1 v' = m_2 v$$

$$v' = \frac{m_2 v}{m_1}$$

Now, kinetic energy of m_1

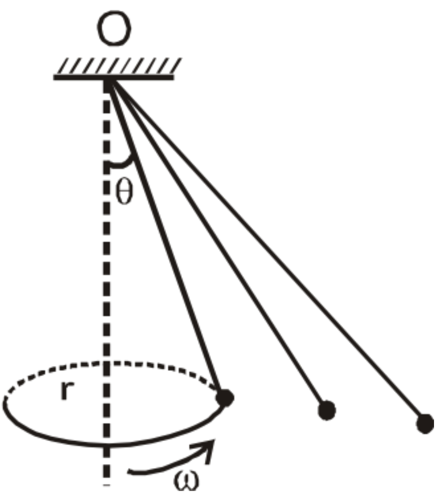
$$= \frac{1}{2} m^{1} v^{\prime 2} = \frac{1}{2} m_1 \left(\frac{m_2}{m_1}\right)^2 v^2 = \frac{1}{2}\left(\frac{m_2}{m_1}\right) m_2 v^2 = \left(\frac{m_2}{m_1}\right) \frac{1}{2} m_2 v$$

intial kinetic energy

Kinetic energy of $m_1 >$ initial mechanical of system Henced proved

Q-13 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

Three point masses are attached by light inextensible strings of various lengths to a point O on the ceiling. All of the masses swing round in horizontal circles of various radii with the same angular frequency ω (one such circle is drawn in the shown figure.) Then pick up the correct statement.



(A) The vertical depth of each mass below point of suspension from ceilling is different.

(B) The raduis of horizontal circular path of each mass is same.

(C) All masses revolve in the same horizontal plane.

(D) All the particles must have same mass.

Correct Option : C

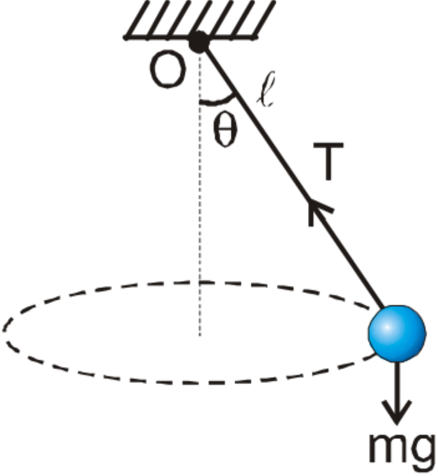
SOLUTION

For conical pendulum of length l , mass m moving along horizontal circle as shown

$T \cos \theta = mg \ldots .(1)$

$T \sin \theta = m\omega^2 l \sin \theta \ldots \ldots (2)$

From equation (1) and equation (2) , $l \cos \theta = \dfrac{g}{\omega^2}$



$l \cos \theta$ is the vertical distance of bob below O point of suspension.

hence if ω of all three pendulums are same, they shall revolve in same horizontal plane.

Alternate:

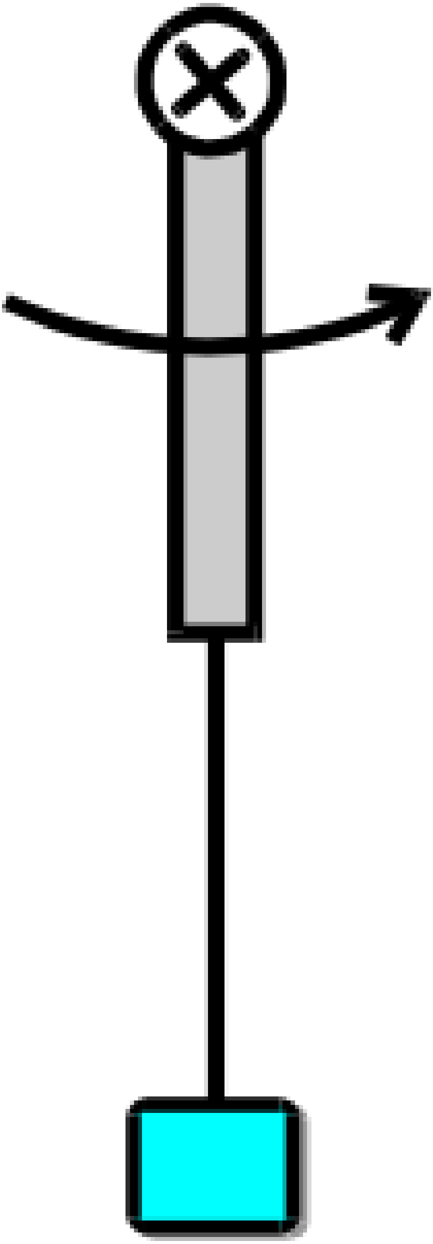
If we remember that time period T of conical pendulum is

$T = 2\pi\sqrt{\frac{L}{g}}$ where L is the vertical depth of bob below point of suspension. if T is same for three pendulums even L shall be also same. hence all three particles shall revolve in same horizontal plane.

Q-14 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

One end of a light rod of length 1 m is attached with a string of length 1m. Other end of the rod is attached at point O such that rod can move in a vertical circle. Other end of the string is attached with a block of mass 2kg. The minimum velocity that must be given to the block in horizontal direction so that it can complete the vertical circle is (

$g = 10m/s^2$).



(A) $4\sqrt{5}$

(B) $5\sqrt{5}$

(C) 10

(D) $3\sqrt{5}$

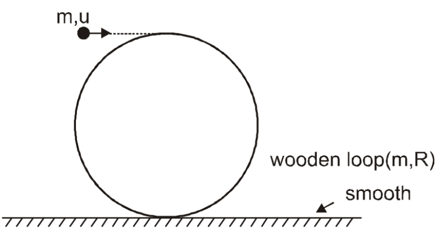
Correct Option : C

SOLUTION

NA

Q-15 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

Particle sticks to wooden loop, If particle reach at the lowest position for first time after time T. Then displacement of centre of mass of system in this time interval will be :



(A) $\sqrt{\left(\frac{uT}{2}\right)^2 + R^2}$

(B) $\sqrt{(uT)^2 + R^2}$

(C) $\frac{1}{2}\sqrt{(uT)^2 + R^2}$

(D) None of these

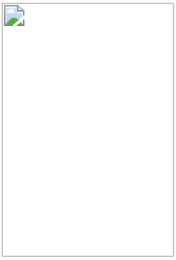
Correct Option : A

SOLUTION

NA

Q-16 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

The figure shows a block of mass M=2m having a spherical smooth cavity of radius R placed on a smooth horizontal surface .There is a small ball of mass m moving at an instant vertically downward with a velocity v with respect to the block .At this instant :



(A) The normal reaction on the ball by the block is $\frac{mv^2}{R}$

(B) The normal reaction on the ball by the block is $\frac{2}{3}\frac{mv^2}{R}$

(C) The acceleration of the block with respect to the ground is $\frac{v^2}{3R}$

(D) The acceleration of the block with respect to the ground is $\frac{v^2}{2R}$

Correct Option : B

SOLUTION

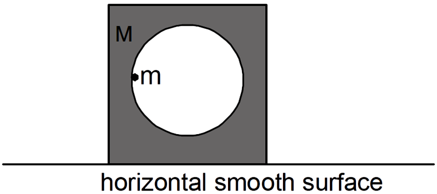
Let the normal force between the block and the ball be N

For the block, from Newton\'s II^{nd} law, we have N=Ma=2ma

For ball (with respect to the block), from Newton\'s II^{nd} law, we have

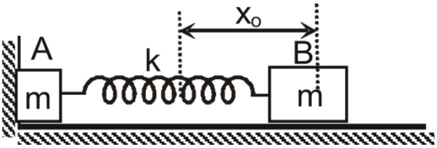
$$N + ma = \frac{mv^2}{R}$$

Solve the two equations.



Q-17 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

Two identical blocks A and B of mass m each are connected to each other by spring of spring constant k. Block B is initially shifted to a small distance x_0 to the left and then released. Choose the correct statements for this problem, after the spring attains it\'s natural length.



(A) Velocity of centre of mass of the system is $\frac{1}{2}\sqrt{\frac{k}{m}}x_0$

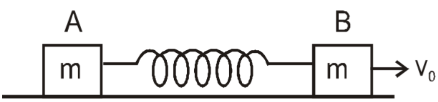
(B) Maximum elongation in spring during the subsequent motion is $\frac{x_0}{\sqrt{2}}$

(C) Maximum elongation in spring during the subsequent motion is x_0

(D) Maximum speed of block A during subsequent motion be $\sqrt{\frac{K}{m}}x_0$

Correct Option : A

SOLUTION



$$1/2mv_0^2 = 1/2lx_0^2$$

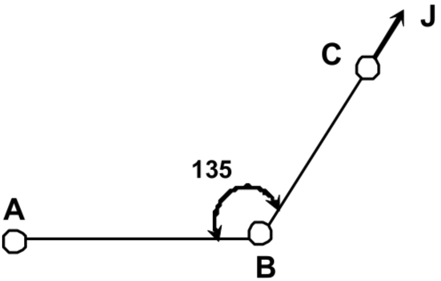
$$v_{cm} = v_0/2 = \frac{1}{2}\sqrt{\frac{k}{m}}x_0, 1/2kx^2_{\max} = \frac{1}{2}\left(\frac{m}{2}\right)v_0^2$$

$$1/2kx^2_{\max} = \frac{1}{2}\left(\frac{1}{2}kx_0^2\right) \Rightarrow x_{\max} = \frac{x_0}{\sqrt{2}}$$

$$(V_A)_{\max} = (V_B)_{\max} = v_0 = \sqrt{\frac{k}{m}}x_0$$

Q-18 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

Three identical particles A, B and C lie on a smooth horizontal table. Light inextensible strings which are just taut connect AB and BC and $\angle ABC$ is 135 . An impulse J is imparted to the particle C in the direction BC. Mass of each particle is m. Choose the correct options.



(A) Speed of A just after the impulse imparted is $\frac{\sqrt{2}J}{7m}$

(B) Speed of B just after the impulse imparted is $\frac{\sqrt{10}J}{7m}$

(C) Speed of C just after the impulse imparted is $\frac{3J}{7m}$

(D) Speed of A just after the impulse imparted is $\frac{2J}{7m}$

Correct Option : A

SOLUTION

$$\frac{J_2}{\sqrt{2}} = 2mv_1 \frac{J_2}{\sqrt{2}} = mv_2 \Rightarrow v_2 = 2v_1$$

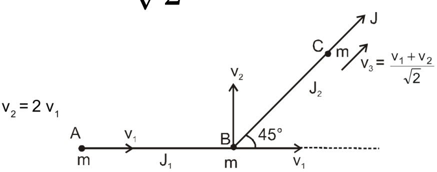
$$J - J_2 = \frac{m}{\sqrt{2}}(v_1 + v_2)$$

$$J - 2\sqrt{2}mv_1 = \frac{3mv_1}{\sqrt{2}} \Rightarrow J = \frac{7mv_1}{\sqrt{2}} \Rightarrow v_1 = \frac{\sqrt{2}J}{7m}$$

$$v_2 = \frac{2\sqrt{2}J}{7m}$$

$$v_A = v_1 = \frac{\sqrt{2}J}{7m}, v_B = \frac{\sqrt{10}J}{7m}$$

$$v_c = \frac{v_1 + v_2}{\sqrt{2}} = \frac{3J}{7m}$$



Q-19 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

A particle is attached to an end of a rigid rod. The rod is hinged at the other end and rotates in a horizontal plane about the hinge. Its angular speed is increasing at constant rate. The mass of the particle is \'m\'. The force exerted by the rod on the particle is $\overrightarrow{F}$, then choose the correct alternative(s):

(A) $F \geq mg$

(B) F is constant

(C) The angle between $\overrightarrow{F}$ and horizontal plane decreases

(D) The angle between $\overrightarrow{F}$ and the rod decreases

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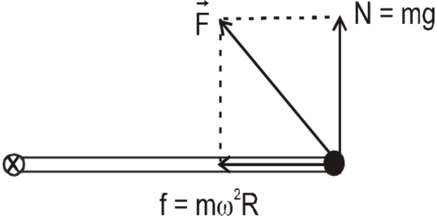
Correct Option : A

SOLUTION

$F = \sqrt{f^2 + (mg)^2}$

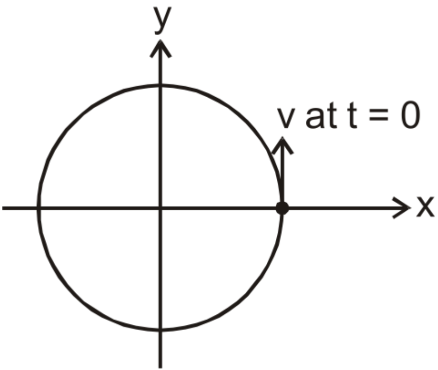
Now when the angular speed of the rod is increasing at const. rate the resultant force will be more inclined towards $\overrightarrow{f}$.



Hence the angle between $\vec{F}$ and horizontal plane decreases so as with the rod.

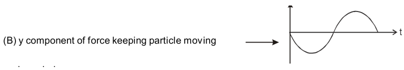
Q-20 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

A particle is moving in a uniform circular motion on a horizontal surface. Particle\'s position and velocity at time t = 0 are shown in the figure in the coordinate system. Which of the indicated variable on the vertical axis is/are correctly matched by the graph(s) shown alongside for particle\'s motion ?



(A) x component of velocity

(B) y component of force keeping particle moving in a circle

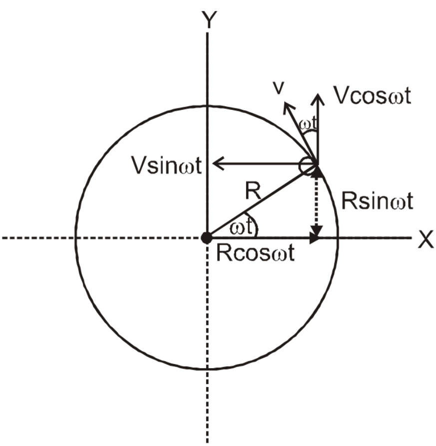


(C) Angular velocity of the particle

(D) x coordinate of the particle

Correct Option : B

SOLUTION



so X component of velocity $V_x = -V \sin \omega t$

y component of force $F_y = -mv^2 / R \sin \omega t = -m\omega^2 R \sin \omega t$

Angular velocity of particle ω=const.

X-coordinate of the particle $x = R \cos \omega t$. So B,C,D are correctly matched

Q-21 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

The linear momentum of a particle is given by $\overrightarrow{P} = \left(a \sin t \hat{i} - a \cos t \hat{j}\right) kg - m / s$. A force $\overrightarrow{F}$ is acting on the particle. Select correct alternative/s:

(A) Linear momentum $\overrightarrow{P}$ of particle is always parallel to $\overrightarrow{F}$

(B) Linear momentum $\overrightarrow{P}$ of particle is always perpendicular to $\overrightarrow{F}$

(C) Linear momentum $\overrightarrow{P}$ is always constant

(D) Magnitude of linear momentum is constant with respect to time.

Correct Option : B

SOLUTION

$$\overrightarrow{F} = \frac{\overrightarrow{dp}}{dt} = a\cos t\hat{i} + a\sin\hat{j}$$

$$\overrightarrow{F}.\overrightarrow{P} = 0$$

Magnitude of momentum.

$$= \sqrt{a^2\cos^2 t + a^2\sin^2 t} = a$$

Q-22 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

A circular road of radius r is banked for a speed v = 40 km/hr. A car of mass m attempts to go on the circular road. The friction coefficient between the tyre and the road is negligible. Choose the correct alternatives :

(A) The car can make a turn without skidding.

(B) If the car turns at a speed less than 40 km/hr, it will slip down

(C) If the car turns at the constant speed of 40 km/hr, the force by the road on the car is equal to

$$\sqrt{(mg)^2 + \left(\frac{mv^2}{r}\right)^2}$$

(D) If the car turns at the correct speed of 40 km/hr, the force by the road on the car is greater than mg as well as graeter than $\frac{mv^2}{r}$

Correct Option : A

SOLUTION

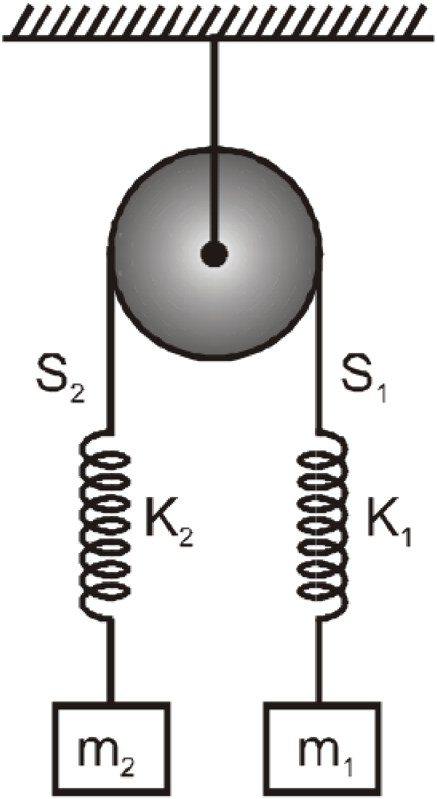
When speed of car is 40 km/hr, car can make a turn without skidding.

If speed is less than 40 km/hr than tendency of slipping is downward so it will slip down. If speed is greater than 40 km/hr than tendency of slipping upward so it will slip up. If the cars turn at correct speed 40 km/hr

$$N \sin\theta = \frac{mv^2}{r}. N = \sqrt{(mg)^2 + \left(\frac{mv^2}{r}\right)}$$

Q-23 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

Consider the condition shown in the figure. Pulley is massless and frictionless, springs are massless. Both the blocks are released with the springs in their natural lengths. Choose the correct options.



(A) Maximum elongation in the spring S_1 is

$$\frac{4m_1m_2g}{K_1(m_1+m_2)}$$

(B) Maximum elongation in the spring S_1 is

$$\frac{4m_1m_2g}{K_2(m_1+m_2)}$$

(C) If $m_1 = m_2$ both the blocks will come to

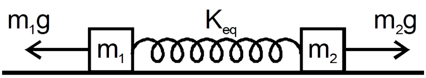
instantaneous rest simultaneously.

(D) If $K_1 = K_2$ both the blocks will come to instantaneous rest simultaneously.

Correct Option : A

SOLUTION

Above situation can be represented as



Now at maximum elongation of spring is x

$$a_{2/1} = 2g - k_{eq} \times \left(\frac{1}{m_1} + \frac{1}{m_2}\right)$$

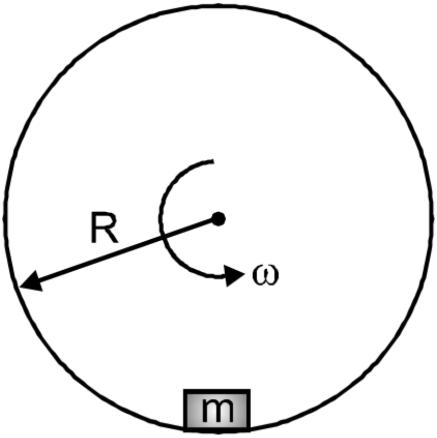
$$vdv = \left[2g - k_{eq} \times \left(\frac{m_1 + m_2}{m_1 m_2}\right)\right] dx$$

$$\Rightarrow x_{\max} = \frac{4 m_1 m_2 g}{K_{eq}(m_1 + m_2)}$$

$$k_1 x_1 = k_2 x_2 = k_{eq} x$$

Q-24 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

A cylinder of radius R is rotating about its horizontal axis with constant $\omega = \sqrt{\frac{5g}{R}}$. A block of mass m is kept on the inner surface of the cylinder. Block is moving in vertical circular motion without slipping. coefficient of friction between block and surface of cylinder is μ. If minimum value of μ for complete vertical circular motion of block is $\frac{2\sqrt{6}}{3x}$ then find \'x\'.



(A) 2

(B) 4

(C) 6

(D) 8

Correct Option : D

SOLUTION

$$N = mg\cos\theta + m\omega^2 R = mg\cos\theta + m\left(\frac{5g}{R}\right)R \Rightarrow N = 5mg + r$$

so block does not leave circular motion

$f_r = ma_T$ for limiting case

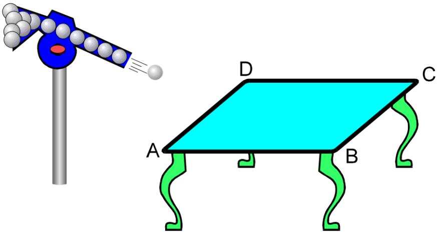
$$\mu N = ma_T \Rightarrow \mu(mg(5+\cos\theta)) = mg\sin\theta \Rightarrow \mu = \frac{\sin\theta}{5+\cos\theta}$$

$$\frac{d\mu}{d\theta} = \frac{(5+\cos\theta)(\cos\theta) - \sin\theta(-\sin\theta)}{(5+\cos\theta)^2} = 0 \Rightarrow \cos\theta = -\frac{1}{5}$$

$$\mu_{\max} = \frac{\sqrt{1-\frac{1}{25}}}{5-\frac{1}{5}} = \frac{2\sqrt{6}}{24} \Rightarrow x = 8$$

Q-25 - JEE ADVANCED-PART TEST-10 (PHYSICS)-PHYSICS

A gun which fires small balls each of mass 20 gm is firing 20 balls per second on the smooth horizontal table surface ABCD. If the collision is perfectly elastic and balls are striking at the centre of table with a speed 5 m/sec at an angle of 60 with the vertical just before collision, then force exerted by one of the leg on ground is (in N) (assume total weight of the table is 0.2 kg and $g = 10m/s^2$) :



(A) 0

(B) 4

(C) 2

(D) 1

Correct Option : D

SOLUTION

Force on table due to collision of balls :

$$F_{\text{dynamic}} = \frac{dp}{dt} = 2 \times 20 \times 10^{-3} \times 5 \times 0.5 = 2N$$

Net force on one leg $= \frac{1}{4}(2 + 0.2 \times 10) = 1N$