Q-1 - JEE ADVANCED-PART TEST-4 (PHYSICS)-PHYSICS

A cannon fires successively two shells from the same point with velocity $V_0 = 250m/s$, the first at the angle $\theta_1 = 60$ and the second at the angle $\theta_2 = 45$ to the horizontal, the azimuth being the same. Neglecting the air drag, find the approximate time interval between firings leading to the collision of the shells $\left(g = 9.8m/s^2\right)$

(A) 11 sec

(B) 6 sec

(C) 15 sec

(D) 5 sec

Correct Option : B

SOLUTION

For particle-1 $y = \sqrt{3}x - \dfrac{gx^2}{2u^2(1/4)} \Rightarrow y = \sqrt{3}x - \dfrac{2gx^2}{u^2}$

For particle-2 $y = x - \dfrac{gx^2}{2u^2(1/2)} \Rightarrow y = x - \dfrac{gx^2}{u^2}$

$$x - \frac{gx^2}{u^2} = \sqrt{3}x - \frac{2gx^2}{u^2}$$

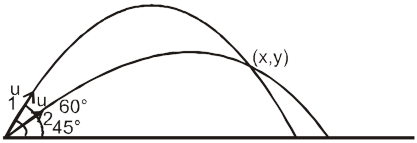
$$x(\sqrt{3}-1) = \frac{gx^2}{u^2} \Rightarrow x = \frac{u^2}{g}(\sqrt{3}-1)$$

for particle-1

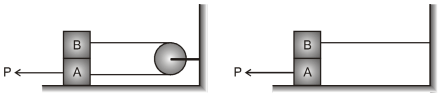
$$u(1/2)t_1 = \frac{gx^2}{g}(\sqrt{3}-1) \Rightarrow t_1 = \frac{2u}{g}(\sqrt{3}-1)$$

$$u(1\sqrt{2})t_2 = \frac{u^2}{g}(\sqrt{3}-1) \Rightarrow t_2 = \frac{\sqrt{2}u}{g}(\sqrt{3}-1)$$

$$\Delta t = u/g(2-\sqrt{2})(\sqrt{3}-1) = 10.9\,\text{sec} \approx 11\,\text{sec.}$$



Each of the two block shown in the figure has mass m. The pulley is smooth and the coefficient of friction for all surfaces in contact is μ. A constant horizontal force P applied in two cases shown in such a way that block A start just sliding then the value of minimum force P in case-I and case-II is :



(A) $2\mu mg, 3\mu mg$

(B) $3\mu mg, 2\mu mg$

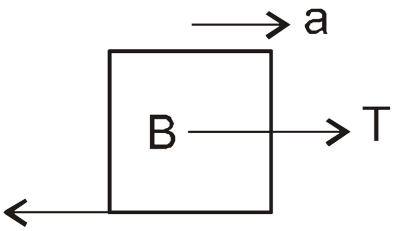
(C) $4\mu mg, 3\mu mg$

(D) $3\mu mg, 3\mu mg$

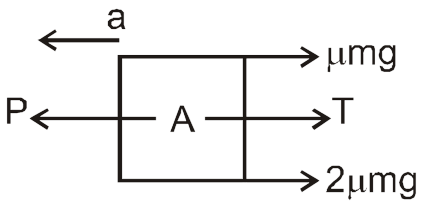
Correct Option : B

SOLUTION

Case-I



$T - \mu mg = ma$.....(1)



$P - T - 3\mu mg = ma$

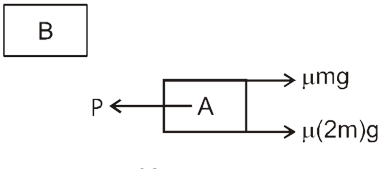
putting value of T from (1)

$p - ma - \mu mg - 3\mu mg = ma$

$P - 4\mu mg$

$a = \ -2\mu g$.....(2)

Case-II



$$a = \frac{P - 3\mu mg}{m} .....(3)$$

According to Q

acceleration is same in both cases Hence equating the equation (2) &

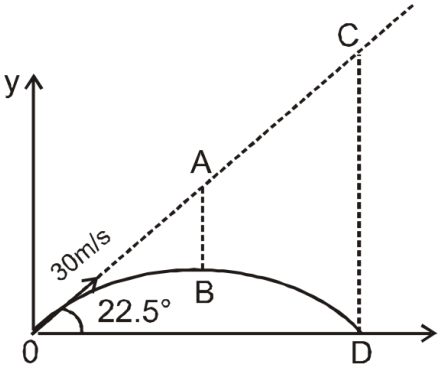
(3) $P = 2\mu g$

Q-3 - JEE ADVANCED-PART TEST-4 (PHYSICS)-PHYSICS

A particle is projected with speed $30m/s$ at angle 22.5 with

horizontal from ground as shown. AB and CD are parallel to y-axis

and B is highest point of trajectory of particle. CD / AB is



(A) 3

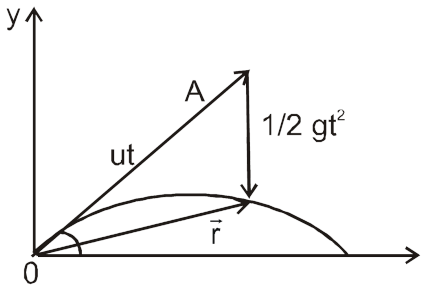
(B) $3 / 2$

(C) 2

(D) 4

Correct Option : C

SOLUTION



$$AB = 1/2g(T/2)^2 = 1/8T^2$$

$$CD = 1/2gT^2$$

$$CD/AB = 4$$

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

A block of mass m is pulled on an incline surface having coefficient of friction $\mu = 1$& angle of inclination $\theta = 30$, with the horizontal, such that required external force is minimum. The angle made by this force with the incline is :

(A) 45°

(B) 30°

(C) 75°

(D) 53°

Correct Option : D

SOLUTION

$F\cos a - \mu N - mg\sin\theta = 0$ .....(i)

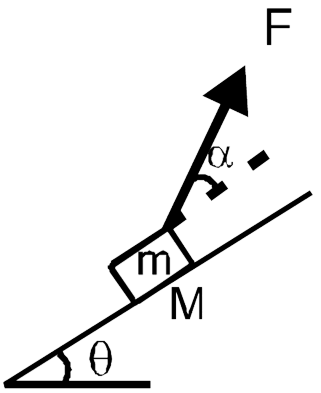
$\&N + F\sin\alpha - mg\cos\theta = 0$ ....(ii)

Solving (i) & (ii)

$$F = \frac{mg\sin\theta + \mu mg\cos\theta}{\cos\alpha + \sin\alpha}$$

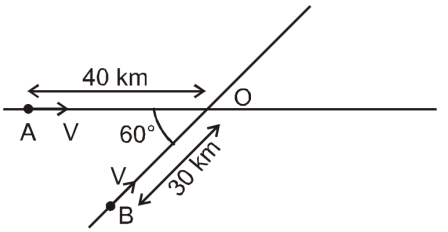
$$F_{\min} = \frac{mg\sin\theta + \mu mg\cos\theta}{\sqrt{1+\mu^2}}$$

$\&\tan\alpha = \mu \Rightarrow \alpha = \tan^{-1}\mu$



Q-5 - JEE ADVANCED-PART TEST-4 (PHYSICS)-PHYSICS

Two cars A and B moving on two straight tracks inclined at an angle 60 heading towards the crossing initially their positions are as shown in the figure. Both cars have same speed. Minimum seperation between them during their motion will be.



(A) $10km$

(B) $5\sqrt{3}km$

(C) $5km$

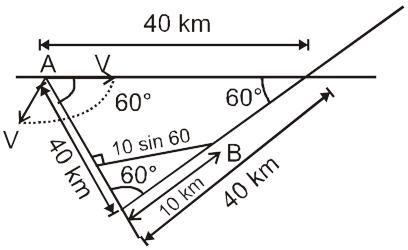
(D) $\frac{20}{\sqrt{3}}km$

Correct Option : B

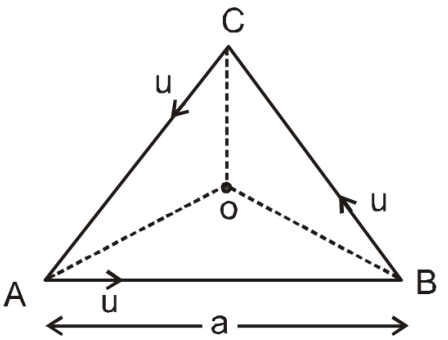
SOLUTION

Let consider B as oberver

$d_{\min} = 10\sin 60km = 5\sqrt{3}$



Three particles A, B and C situated at vertices of an equilateral triangle, all moving with same constant speed such that A always move towards B, B always towards C and C always towards A. Initial seperation between each of the particle is a. O is the centroid of the triangle. Distance covered by particle A when it completes one revolution around O is



(A) $2a\left(1-e^{-2\sqrt{3\pi}}\right)$

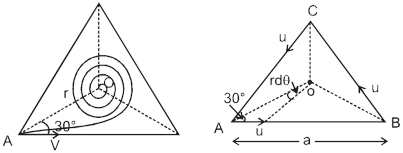
(B) $\frac{2a}{3}\left(1-e^{-2\sqrt{3\pi}}\right)$

(C) $a\left(1+e^{-2\sqrt{3\pi}}\right)$

(D) $\frac{2a}{3}\left(1-e^{-\sqrt{3\pi}}\right)$

Correct Option : C

SOLUTION



$$\frac{dr}{dt} = -v\cos 30 = -\frac{\sqrt{3}}{2}V$$

$$r\frac{dth\eta}{dt} = v\sin 30 = \sqrt{2}$$

$$\frac{1}{r}\frac{dr}{dth\eta} = -\sqrt{3}$$

$$\int_{r_0}^{r}\frac{dr}{r} = -\sqrt{3}\int_{0}^{\theta} \Rightarrow r = r_0 e^{-\sqrt{30}}$$

When A completes are revolution $\theta = 2\pi$

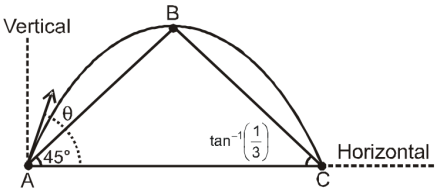
$$\text{Time taken } t = \frac{r_0\left(1-e^{-2\sqrt{3\pi}}\right)}{\sqrt{3}v/2}$$

$$\text{Distance travelled } D = vt = \frac{2r_0}{\sqrt{3}}\left(1-e^{-2\sqrt{3\pi}}\right)$$

$$D = \frac{2a}{3}\left(1-e^{-2\sqrt{3\pi}}\right)$$

Q-7 - JEE ADVANCED-PART TEST-4 (PHYSICS)-PHYSICS

ABC is a triangle in vertical plane. Its two base angles $\angle BAC$ and $\angle BCA$ are 45 and $\tan^{-1}(1/3)$ respectively. A particle is projected from point A such that it passes through vertices B and C. Find angle of projection in degrees:



(A) 60°

(B) 53°

(C) $\tan^{-1}(5/4)$

(D) $\tan^{-1}(5/3)$

Correct Option : A

SOLUTION

equation $y = x\tan\theta\left(1 - \frac{x}{R}\right)$

at $Bx = y$

$\tan\theta = \frac{R}{R - Y}$ .....(i)

$\tan 45 = \frac{Y}{X}$

$x = y$ .....(ii)

$\left(\frac{1}{3}\right) = \frac{Y}{R - x}$ ....(iii)

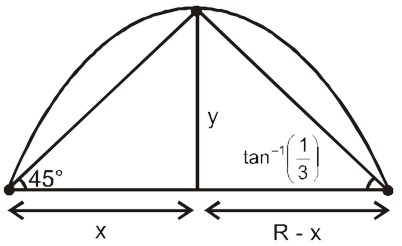
Solving equation 2 and 3

$R = 4y = 4x$ {it om (i)

$\tan\theta = \frac{R}{R - \frac{R}{4}}$

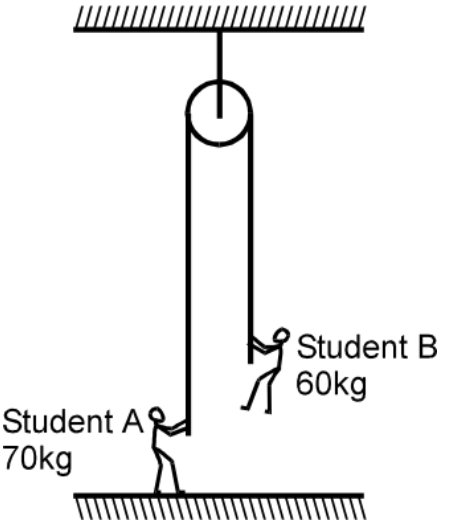
$\tan\theta = \frac{4}{3}$

$\theta = 53$



Q-8 - JEE ADVANCED-PART TEST-4 (PHYSICS)-PHYSICS

A rope of negligible mass passes over a pulley of negligible mass attached to the ceiling, as shown in figure. One end of the rope is held by Student A of mass $70kg$, who is at rest on the floor. The opposite end of the rope is held by Student B of mass $60kg$, who is suspended at rest above the floor. The minimum acceleration a_0 with which the Student B should climb up the rope to lift the Student A upward off the floor. $\left(g = 10m/s^2\right)$



(A) $\frac{1}{3} m / s^2$

(B) $\frac{2}{3} m / s^2$

(C) $\frac{4}{3} m / s^2$

(D) $\frac{5}{3} m / s^2$

Correct Option : B

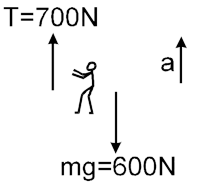
SOLUTION

For student A to just lift off the floor, tension T in string must be greater than or equal to $700N$. The $F.\ B.\ D.$ of student B is

Applying Newton\'s second law

$T - mg = ma \Rightarrow 700 - 600 = 60a$

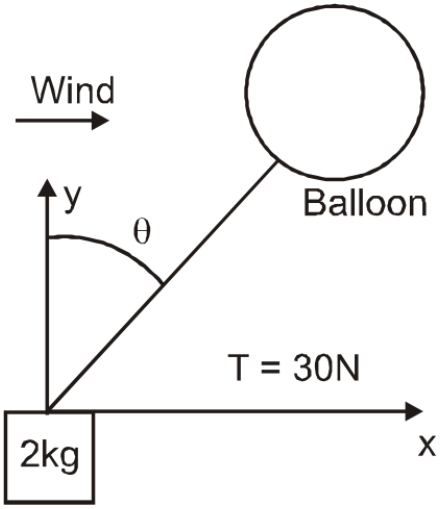
or $a = \frac{5}{3} m/s^2$



Q-9 - JEE ADVANCED-PART TEST-4 (PHYSICS)-PHYSICS

A balloon is tied to a block. The mass of the block is $2kg$. The tension of the string between the balloon and the block is $30N$. Due to the wind, the string has an angle 0 relative to the vertical direction. $\cos\theta = 4/5$and $\sin\theta = 3/5$. Assume the acceleration due to gravity is $g = 10m/s^2$. Also assume the block is small so the force on the block from the wind can be ignored. Then the x-component and the y-

component of the acceleration a of the block.



(A) $9m/s^2, 2m/s^2$

(B) $9m/s^2, 12m/s^2$

(C) $18m/s^2, 2m/s^2$

(D) $18m/s^2, 12m/s^2$

Correct Option : C

SOLUTION

The magnitude of the force (from the string) is $T = 30N$.

The x-component $= T\cos\theta = 30 \times 4/5 = 18N$.

The y-component $= T\cos\theta = 30 \times 4/5 = 24N.$

The total force on the block is:

the x-component $= 18N.$

the y-component $= 24 - mg = 24 - 20 = 4N.$

The x-component of the accelertion $= 18N/2kg = 9m/s^2$

The y-component of the acceleration $= 4N/2kg = 2m/s^2$

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

The maximum angle to the horizontal at which a stone can be thrown so that it always moves away from the thrower will be :

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

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

(C) $\sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$

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

Correct Option : C

SOLUTION

If stone always moves away from thrower then

$$\Rightarrow \frac{d\left|\overrightarrow{r}\right|}{dt} > 0$$

$$\Rightarrow \frac{d\left|\overrightarrow{r}\right|}{dt} > 0$$

$$\Rightarrow \overrightarrow{r}.\overrightarrow{v} > 0 \overrightarrow{r} = u\cos\theta t\,\overrightarrow{i} + \left(u\sin\theta t - \frac{1}{2}gt^2\right)\hat{j}$$

$$\overrightarrow{v} = u\cos\theta\hat{i} + (u\sin\theta - gt)\hat{j}$$

$$\overrightarrow{r}.\overrightarrow{v} = u^2t - \frac{3}{2}ug\sin\theta t^2 + \frac{g^2}{2}t^3 > 0$$

$$\Rightarrow \frac{g^2}{2}t^2 - \frac{3}{2}ug\sin\theta t + u^2 > 0$$

$$\sin^2\theta < \frac{8}{9} \Rightarrow \theta < \sin^{-1}\left(\frac{2\sqrt{2}}{3}\right)$$

A man starts walking on a circular track of radius R. First half of the distance he walks with speed V_1 , half of the remaining distance with speed V_2, then half of the remaining time with V_1 and rest with V_2 and completes the circle. Average speed of the man during entire motion in which he completes the circle is.

(A) $\dfrac{2V_1V_2(V_1+V_2)}{V_2^2+2V_1^2+2V_1V_2}$

(B) $\dfrac{4V_1V_2(V_1+V_2)}{V_1^2+2V_2^2+5V_1V_2}$

(C) $\dfrac{V_1V_2(V_1+2V_2)}{V_1^2+2V_2^2+5V_1V_2}$

(D) $\dfrac{(V_1+2V_2)^2}{V_1+V_2+2V_1^2V_2^2}$

Correct Option : B

SOLUTION

Let total distance travelled is $4s$

$2s \rightarrow V_1 \rightarrow t_1 = \dfrac{2s}{v_1}$

$$s \to V_2 \to t_2 = \frac{s}{V_2}$$

$$s\begin{bmatrix} V_1 & \longrightarrow & t_0 \\ V_2 & \longrightarrow & t_0 \end{bmatrix} (V_3 + V_2)t_0 = s \Rightarrow t_0 = \frac{s}{V_1 + V_2}$$

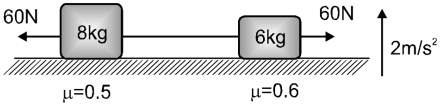
$$< V > = \frac{4s}{t_1 + t_2 + 2t_0} = \frac{4s}{\frac{2s}{V_1} + \frac{s}{V_2} + \frac{2s}{V_1 + V_2}}$$

$$= \frac{4V_1V_2(V_1 + V_2)}{2V_2(V_1 + V_2) + V_1(V_1 + V_2) + 2V_1V_2}$$

$$\frac{4V_1V_2(V_1 + V_2)}{2V_1V_2 + 2V_2^2 + V_1^2 + V_1V_2 + 2V_1V_2} = \frac{4V_1V_2(V_1 + V_2)}{V_1^2 + 2V_2^2 + 5V_1V_2}$$

Q-12 - JEE ADVANCED-PART TEST-4 (PHYSICS)-PHYSICS

Two blocks of masses $8kg$ and $6kg$ are connected with a string & placed on a rough horizontal surface. Surface itself is accelerating up with constant acceleration $2m/s^2$. Two forces $60N$ each are acting on the two blocks as shown. Friction coefficient for $8kg$ is 0.5& that for $6kg$ is 0.6. Tension in the string is : $(g = 10m/s^2)$



(A) $60N$

(B) $12N$

(C) $42.2N$

(D) $16.8N$

Correct Option : A

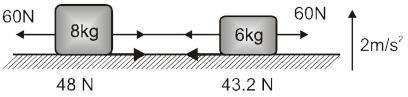
SOLUTION

f_R for $8kg = 0.5 \times 8(10 + 2) = 48N$

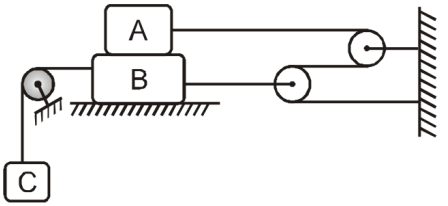
f_N for $6kg = 0.6 \times 6(10 + 2) = 43.2N$

It can be verified that limiting friction will act on $6kg$

From FBO, tension $= 16.8N$



Block A of weight $500N$ and block B of weight $700N$ are connected by rope pulley system as shown. The largest weight C that can be suspended without moving block A and B is W. The coefficient of friction for all plane surfaces of contact is 0.3. The pulleys are ideal. Find $\frac{W}{90}$.



(A) 12

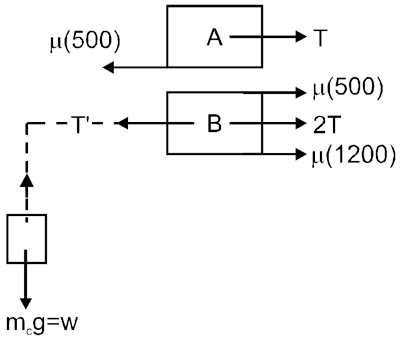
(B) 22

(C) 9

(D) 18

Correct Option : B

SOLUTION



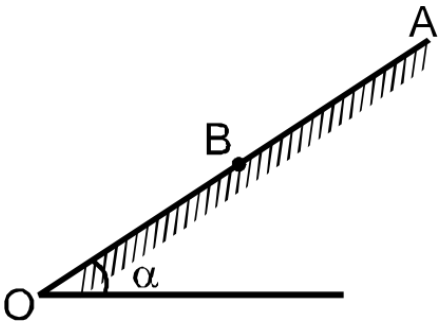
$3T + 0.3 \times 1200 = m_c g = W$ and $T = \mu(500) = 0.3 \times 500$

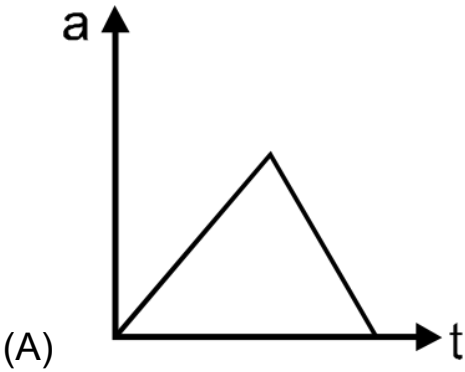
$W = m_0 g = 810N.$

Q-14 - JEE ADVANCED-PART TEST-4 (PHYSICS)-PHYSICS

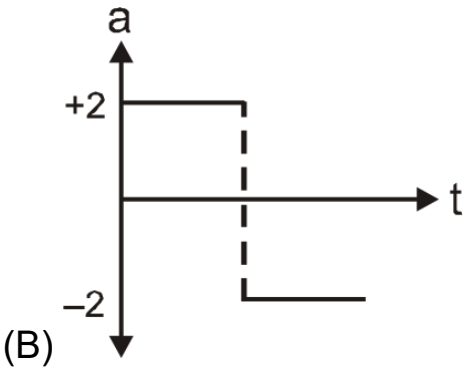
O is a point at the bottom of a rough plane inclined at an angle α to the horizontal. Coefficient of friction between AB is $\frac{\tan\alpha}{2}$ and between BO is $\frac{3\tan\alpha}{2}$. B is the midpoint of AO. A block is released from rest at A. Then identify which graphs are correct during motion of block from point A to O taking direction down the incline

plane as positive $(\sin\alpha = 1/5)$:

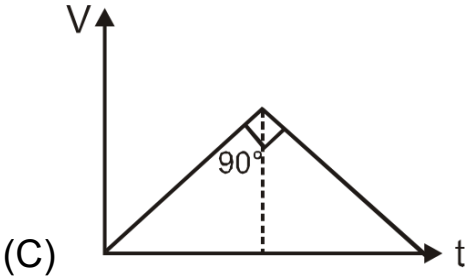




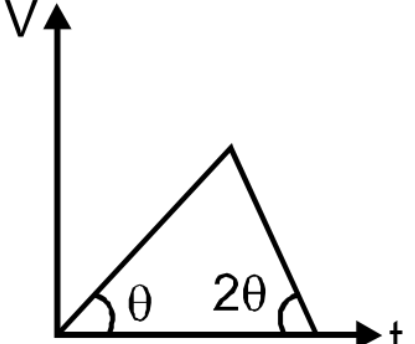
(A)



(B)



(C)



(D)

Correct Option : C

SOLUTION

For motion between AB

$$ma = mg\sin\alpha - \frac{\tan\alpha}{2}mg\cos\alpha$$

$$a = \frac{g\sin\alpha}{2} \text{ (downward)}$$

For motion between BO

$$ma = \frac{3\tan\alpha}{2}mg\cos\alpha - mg\sin\alpha$$

$$a = \frac{g\sin\alpha}{2} \text{ (upward)}$$

The velocity increases from zero to maximum value of B and then starts decreasing with same rate and finally becomes zero at O.

A block B of mass $10kg$ is placed on smooth horizontal surface over it another block A of same mass is placed. A horizontal force F is applied on block B. S_1 : No block will move unless $F > 10N$.

S_2 : Block A will move towards left.

S_3 : Acceleration of block B will never be less than that of A.

S_4 : The relative motion between A and B will start when F exceeds $10N$.

(A) FFFF

(B) TTTT

(C) FFTF

(D) TTFF

Correct Option : B

SOLUTION

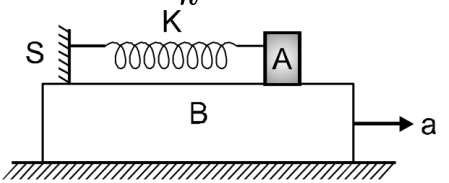
$$mv\frac{dv}{dx} = ma - kx$$

$$\int_0^0 mvdv = \int_0^x (ma - kx)dx$$

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

Q-16 - JEE ADVANCED-PART TEST-4 (PHYSICS)-PHYSICS

Block A of mass m is placed on a plank B. A light support S is fixed on plank B and is attached with the block A with a spring of spring constant K. Consider that initially spring is in its natural length. If the plank B is given an acceleration a, then maximum compression in the spring is $\frac{xma}{k}$. Find the value of x (All the surface are smooth)



(A) $\frac{ma}{2k}$

(B) $\frac{2ma}{k}$

(C) $\frac{ma}{k}$

(D) $\frac{4ma}{k}$

Correct Option : B

SOLUTION

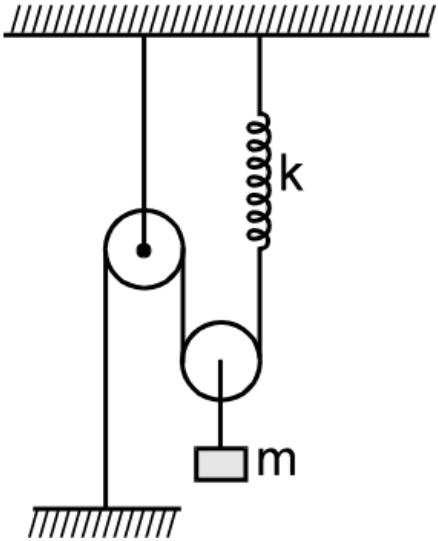
N/A

ATTEMPT FREE TEST ON DOUBTNUT

Q-17 - JEE ADVANCED-PART TEST-4 (PHYSICS)-PHYSICS

Mass m shown in figure is in equilibrium. If it is displaced further by x and released find its acceleration just after it is released. Take

pulleys to the light & smooth and strings light.



(A) $\frac{4kx}{5m}$

(B) $\frac{2kx}{5m}$

(C) $\frac{4kx}{m}$

(D) none of these

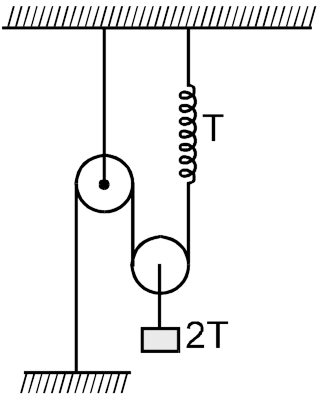
Correct Option : B

SOLUTION

Initially the block is at rest under action of force $2T$ upward and mg downwards. When the block is pulled downwards by x. The spring

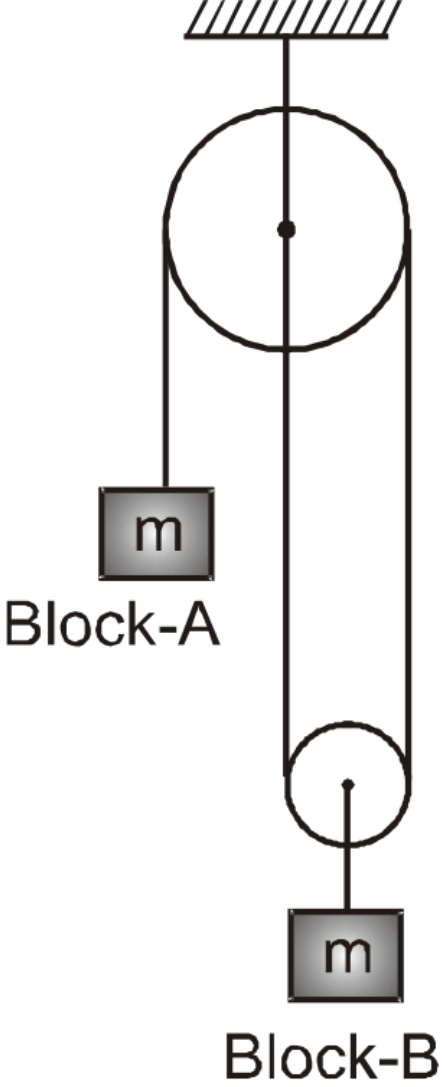
extends by $2x$. Hence tension T increases by $2kx$. Thus the net

$\therefore$ acceleration of the block is $= \dfrac{4kx}{m}$



Q-18 - JEE ADVANCED-PART TEST-4 (PHYSICS)-PHYSICS

Both the blocks shown in figure have same mass $'m'$. All the pulley and strings are massiess.



(A) Acceleration of block A is $\frac{2g}{5}$

(B) Acceleration of block A is $\frac{g}{5}$

(C) Acceleration of block B is $\frac{g}{5}$

(D) Tension in the attached with A is $\frac{3mg}{5}$

Correct Option : A

SOLUTION

$mg - T = 2ma$ .....(i)

$2T - mg = ma$ .....(ii)

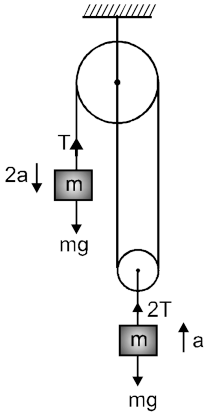
Solving.

$mg = 5ma$

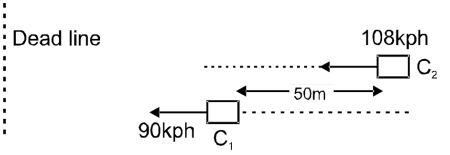
$a = \frac{g}{5}$

$T = mg - 2ma$

$= mg - 2m\frac{g}{5} = \frac{3mg}{5}$



Two cars $C_1 \& C_2$ are moving in parallel lanes in the same direction at speeds $90 kph \& 108 kph$ respectively (see figure). As the traffic signal turns red, both applies brake (assume constant retardation) simultaneously. If they both stop together at the dead line



(A) distance of dead line from C_2 is $300m$

(B) destance of dead line from C_1 is $250m$

(C) time taken by the cars to ends up after the signal turn red is $15\,\text{sec}$.

(D) time taken by the cars to ends up after the signal turn red is $20\,\text{sec}$.

Correct Option : A

SOLUTION

(i) Relative initial velocity $= 5m/s$, relative final velocity $= 0$

Relative displacement $= 50m$

Relative acceleration $=$ constant

$\Rightarrow 50 = \left(\frac{5+0}{2}\right)t \Rightarrow t \times 20\,\text{sec.}$

(ii) Distance of dead line from car $C_1 = \left(\frac{25+0}{2}\right) \times 20 = 250m.$

Q-20 - JEE ADVANCED-PART TEST-4 (PHYSICS)-PHYSICS

A man is standing on a road and observes that rain is failing at angle 45 with the vertical. The man starts running on the road with constant acceleration $0.5m/s^2$. After a certain time from the start of the motion, it appears to him that rain is still falling at angle 45 with the vertical, with speed $2\sqrt{2}m/s$. Motion of the man is in the same vertical plane in which the rain is falling. Then which of the following staement(s) are true.

(A) it is not possible

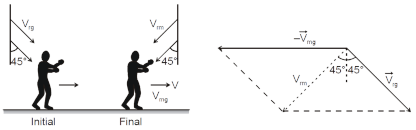
(B) Speed of the rain relative to the ground is $2m/s$

(C) Speed of the man when he finds rain to be falling at angle 45° with the vertical, is $4m/s$.

(D) The man has travelled a distance $16cm$ on the road by the time he again finds rain to be falling at angle 45°

Correct Option : B

SOLUTION



$$\overrightarrow{V}_{rg} = \overrightarrow{V}_{rm} + \overrightarrow{V}_{mg}$$

$$\overrightarrow{V}_{m} = \overrightarrow{V}_{rg} - \overrightarrow{V}_{mg}$$

$V_m \cos 45 = V_{rg} \cos 45$

$V_m = 2\sqrt{2} m/s = V_{rg}$

$V_m \cos 45 = V_{mg} - V_{rg} \cos 45$

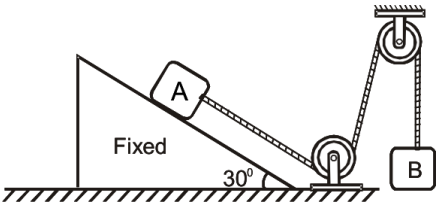
$V_{mg} = 2\sqrt{2}\frac{1}{\sqrt{2}} + 2\sqrt{2}\frac{1}{\sqrt{2}} = 4m/s$

using $v^2 = u^2 + 2$ as for the motion of man.

$s = 16m.$

Q-21 - JEE ADVANCED-PART TEST-4 (PHYSICS)-PHYSICS

Two blocks A and B of equal mass m are connected through a massless string and arranged as shown in figure. The wedge is fixed on horizontal surface. Friction is absent everwhere. When the system is released from rest.



(A) tension in string is $\frac{mg}{2}$

(B) tension in string is $\frac{mg}{4}$

(C) acceleration of A is g/2

(D) acceleration of A is 3/2 g

Correct Option : A

SOLUTION

Let a be acceleration of system and T be tension in, the string $F.B.D$ of block A

$mg\sin 30 + T = ma$

$\frac{mg}{2} + T = ma$ ....(i)

$F.B.D$ of block B

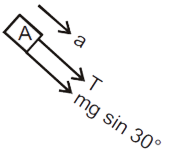
$mg - T = ma$....(ii)

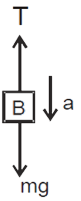
Adding equaion (i) & (ii), we get

$2ma = \frac{3mg}{2} \Rightarrow a = \frac{3}{4}g$

from equation (i),

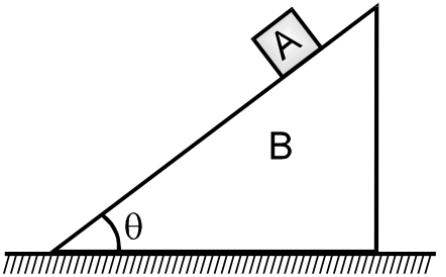
$$T = \frac{mg}{4}$$





Q-22 - JEE ADVANCED-PART TEST-4 (PHYSICS)-PHYSICS

In the figure shown , A and B are free of to move. All the surfaces are smooth. $(0 < \theta < 90)$



(A) the acceleration of A will be more than $g \sin \theta$

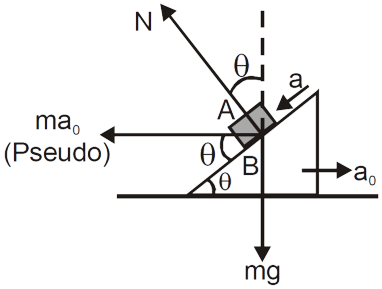
(B) the acceleration of A will be less than $g \sin \theta$

(C) normal force on A due to B will be more than $mg\cos\theta$

(D) normal force on A due to B will be less than $mg\cos\theta$

Correct Option : A

SOLUTION



$ma_0\sin\theta + N = mg\cos\theta \Rightarrow N = mg\cos\theta = ma_0\sin\theta$

$\Rightarrow N < mg\cos\theta$

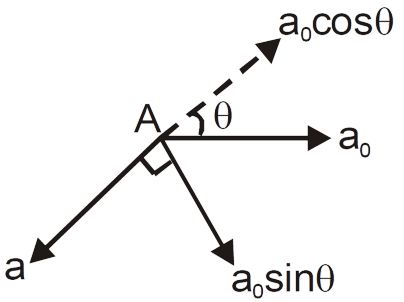
Hence, (D) is ture.

$ma_0\cos\theta + mg\sin\theta = ma$

$\Rightarrow a = g\sin\theta + a_0\cos\theta$

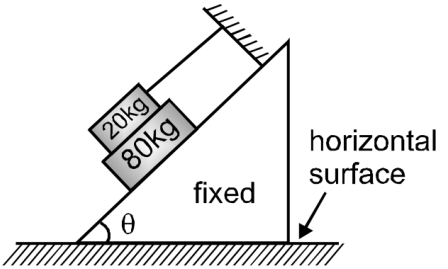
Hence acceleration of A

$$= \sqrt{(a - a_0 \cos\theta)^2 + (a_0 \sin\theta)^2} > g \sin\theta$$



Q-23 - JEE ADVANCED-PART TEST-4 (PHYSICS)-PHYSICS

The system shown is in limiting equilibrium. The coefficient of friction for all contanct surfaces is 1/4.



(A) 4

(B) 6

(C) 8

(D) 9

Correct Option : B

SOLUTION

$20g\sin\theta + f_2 = T$

$20g\sin\theta + \mu(20g\cos\theta) = T$

$80g\sin\theta = \mu(100g\cos\theta) + \mu(20g\cos\theta)$

$\tan\theta = \frac{3}{8}$

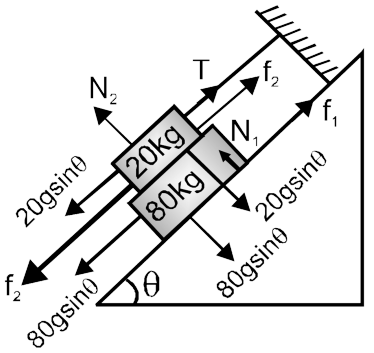
$T = 20g\sin\theta + \mu 20g\cos\theta$

$= 20g\sin\theta + \frac{1}{4} \times 20 \times g \times \frac{8}{3}\sin\theta$

$\left(\frac{100}{3}g\sin\theta\right)N$

Net friction on $80kg = f_1 + f_2 = 80g\sin\theta$

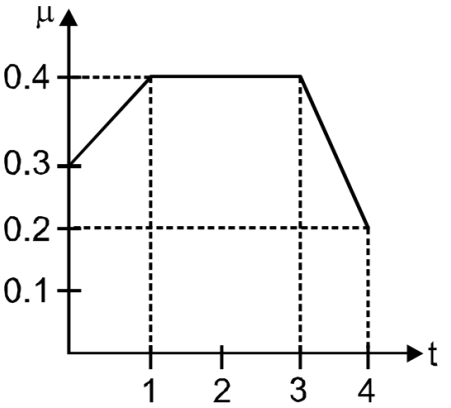
force on$80kg$ due to $20kg$ is $\sqrt{(20g\cos\theta)^2(\mu 20g\sin\theta)^2}$



Q-24 - JEE ADVANCED-PART TEST-4 (PHYSICS)-PHYSICS

A small body is projected with a velocity of $20.5ms^{-1}$ along rough horizontal surface. The coefficient of friction (μ) between the body and surface changes with time t (in s) as the the body moves along the

surface. Find the velocity at the end of 4s in m/s



(A) 24

(B) 36

(C) 40

(D) 45

Correct Option : C

SOLUTION

Impulse $= \int \overrightarrow{f}\, dt = m\left(\overrightarrow{v}_1 - \overrightarrow{v}_1\right)$

$-mg \times Areaunder\mu - t$ graph $= m(V_1 - 20.5)$

$-mg \times \left[\frac{1}{2}(0.4+0.3) \times 1 + 0.4 \times 2 + \frac{1}{2}(0.4+0.2) + 1\right] = m($

$v_1 = 6m/s$

Q-25 - JEE ADVANCED-PART TEST-4 (PHYSICS)-PHYSICS

Position (in m) of a particle moving on a straight line varies with time (in sec) as $x = t^3/3 - 3t^2 + 8t + 4(m)$. Consider the motion of the particle from t=0 to t=5 sec. S_1 is the total distance travelled and S_2 is the distance travelled during retardation. if $s_1/s_2 = \frac{(3\alpha + 2)}{11}$ the find α.

(A) 55

(B) 60

(C) 65

(D) 70

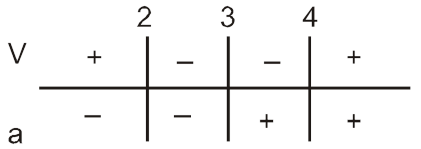
Correct Option : C

SOLUTION

$x = t^3/3 - 3t^2 + 8t + 4$

$v = t^2 - 6t + 8 = (t-2)(t-4)$

$a = 2(t-3)$



$$S_1 = \left(\frac{32}{3} \times 4\right) + \left(\frac{32}{3} - \frac{28}{3}\right) + \left(\frac{32}{3} - \frac{28}{3}\right) = \frac{20}{3} + \frac{8}{3} = \frac{2}{}$$

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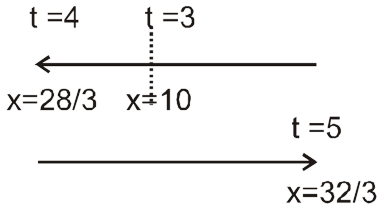

$$S_2 = \left(\frac{32}{3} - 4\right) + \left(10 - \frac{28}{3}\right) = \frac{20}{3} + \frac{2}{3} = \frac{22}{3} m$$

$$\frac{S_1}{S_2} = \frac{28}{22} = \frac{14}{11} = \frac{3\alpha + 2}{11} \Rightarrow \alpha = 4$$