PHYSICS

BOOKS - SHREE BALAJI PHYSICS (HINGLISH)

WORK AND ENERGY

Illustration

1. A plank of mass M and length L is placed at rest on a smooth horizontal surface A small block of mass m is projected wii:h a velocity v_0 as shown in the Fig. 3.31 (a), The coefficient of friction between the block and the plank is μ, plank is very long so that block eventually comes to rest on it.

(i) Find the work done by the ftjctioh force on the block during the period it slides on the plank. Is the Work positive or negative ?'

(ii) Calculate the work done on the plank during the same period. Is the work positive or negative?

(iii) Also, determine the net work done by friction. Is it positive or negative ?

Watch Video Solution

Eample

1. An object is displaced from position vector $\vec{r}_1 = \left(2\hat{i} + 3\hat{j}\right)m$ to $\vec{r}_2 = = \left(4\hat{j} + 6\hat{k}\right)m$ under a force $\vec{F} = \left(3x^2\hat{i} + 2y\hat{j}\right)N$. Find the. work done this force.

Watch Video Solution

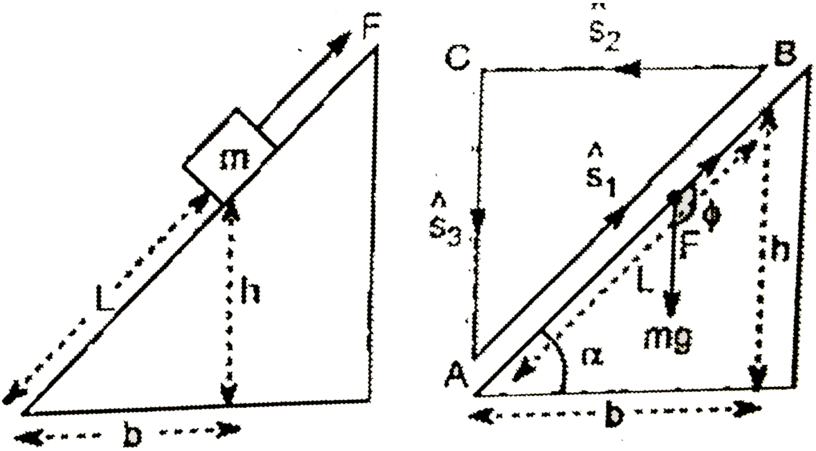
2. An object is displaced from point $A(2m, 3m, 4m)$ to a point $B(1m, 2m, 3m)$ under a constant force $F = \left(2\hat{i} + 3\hat{j} + 4\hat{k}\right)N$. Find the work done by this force in this process.

Watch Video Solution

3. A block is being pulled slowly along a frictionless incline1 , [Fig. 3E. .3(a}.

(a) Show that the gravitationalforce is conservative . .

(b) Now.consider the incline tb be rough to show that frictional force is non-conservative...

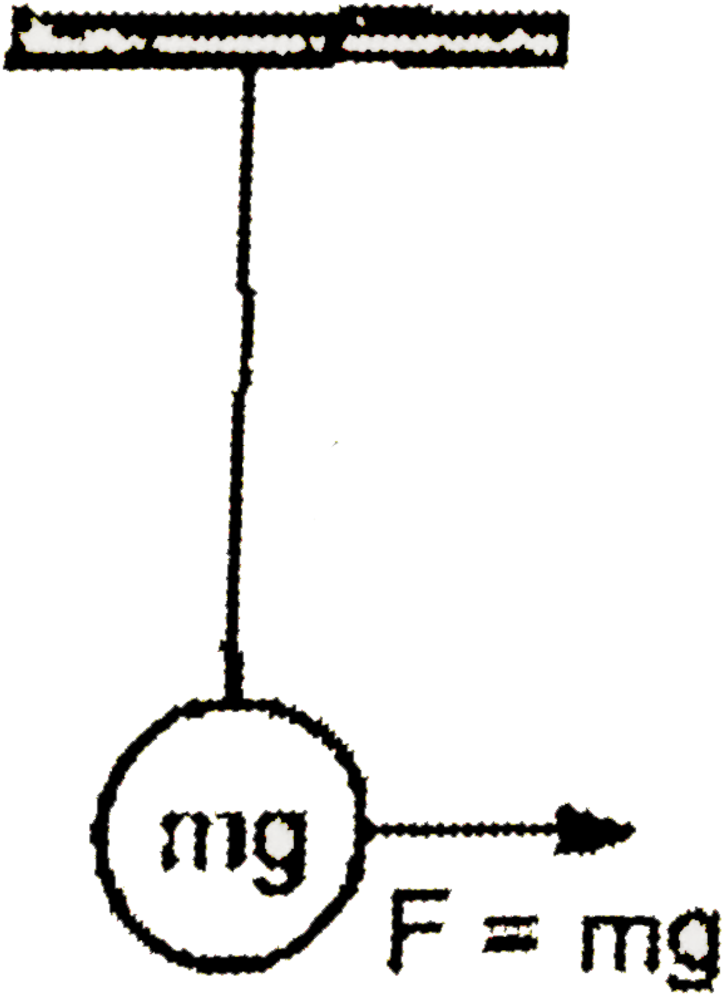


Watch Video Solution

4. A pendulum bob of mass m is suspended at rest. A constant horizontal force $F = mg$ starts acting on it. Find

(a) the maximum angular defection of the string.

(b) the maximum possible tension in the string.



Watch Video Solution

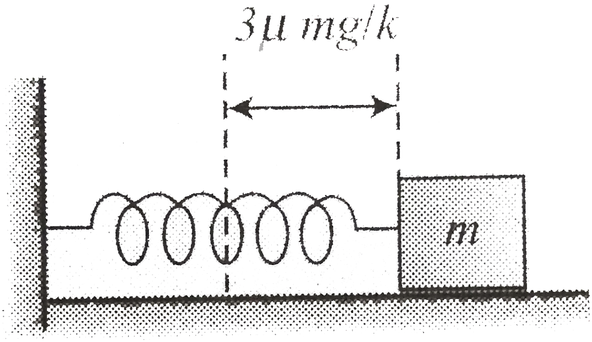
5. Under the action of a force, a $2kg$ body moves such that its position x as a function of time is given by $x = \frac{t^3}{3}$ where x is in metre and t in second. The work done by the force in the first two seconds is .

Watch Video Solution

6. A force of $\left(3\hat{i} - 1.5\hat{j}\right)N$ acts on 5 kg body. The body is at a position of $\left(2\hat{i} - 3\hat{j}\right)m$ and is travelling at ms^{-1}. The focce acts on the body until it is at the position $\left(\hat{i} + 5\hat{j}\right)m$. Assuming no other force does work on the body, the final speed of the body.

Watch Video Solution

7. A spring block system is placed on a rough horizontal surface having coefficient of friciton μ. The spring is given initial elongation $3\mu mg/k$ (where m=mass of block and k=spring constant) and the block is released from rest. For the subsequent motion, find



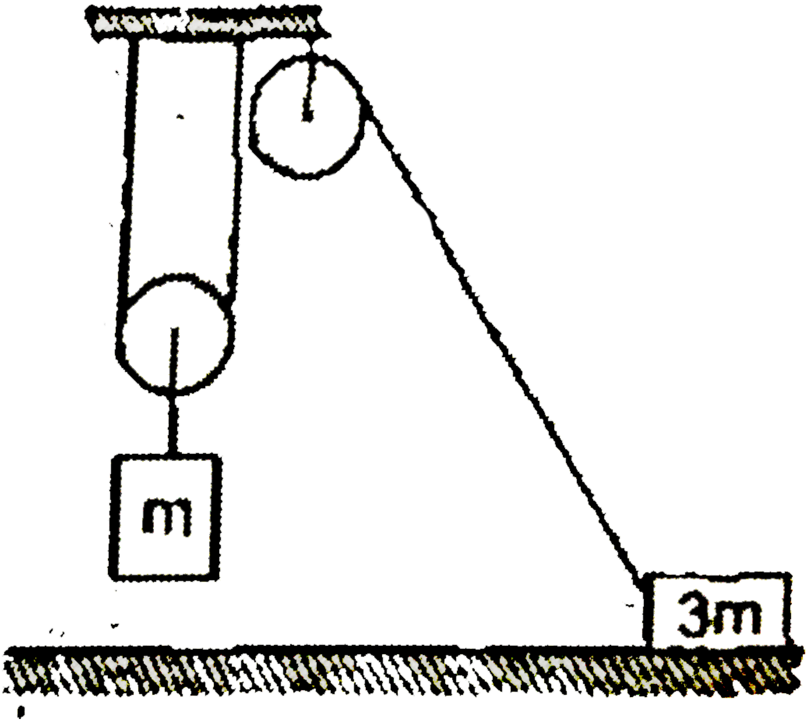
a. Initial acceleration of block

b. Maximum compression in spring

c. Maximum speed of the block

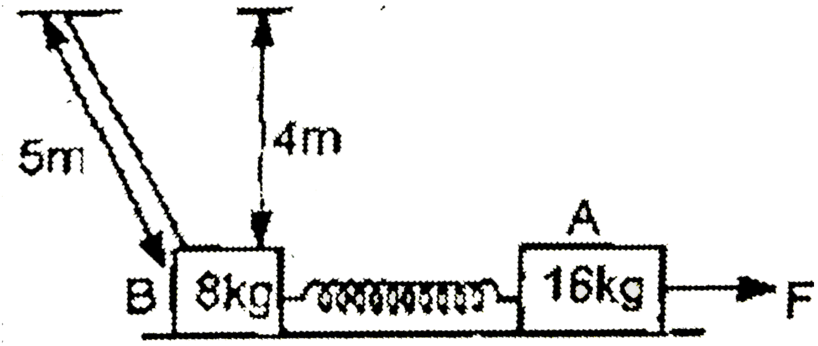
Watch Video Solution

8. In the figure shown, the mass of the hanging block is m, while that of the black resting on the floor is 3m. The floor is horizontal and frictionless and all pulleys ideal. The system is initially held stationary with the inclined thread making an angle $\theta = 30^\circ$ with the horizontal. The blocks are now released from rest and allowed to move. the hanging block falls through a height (49.5) m before hitting the floor. it is found that the value of θ becomes 60°, when the hanging block hits the floor. Find the speed with which the hanging block hits the floor.



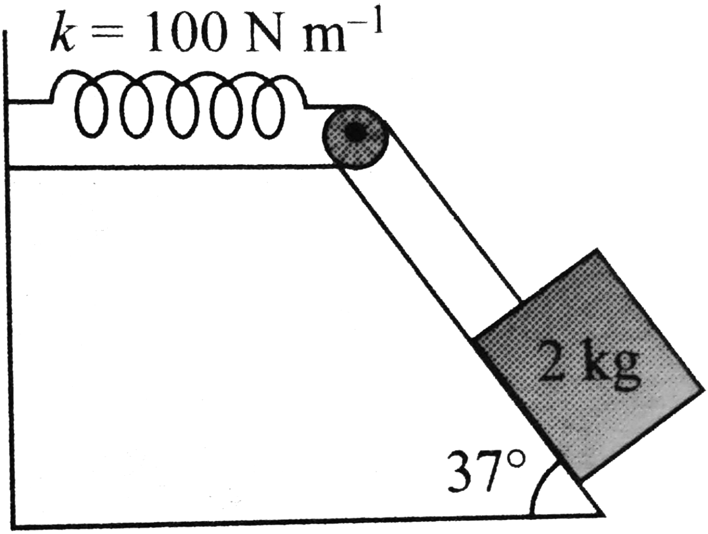
Watch Video Solution

9. Two blocks having masses $8kg$ and 16 kg are connected to the two ends of a light spring. The system is placed on a smooth horizontal floor. An inextensible starting also connects B with ceiling as shown in figure at the initial moment. Initially the spring has its natural length. A constant horizontal force F is applied to the heavier block as shown. What is the maximum possible value of F so the lighter block doesn't loose contant with ground



Watch Video Solution

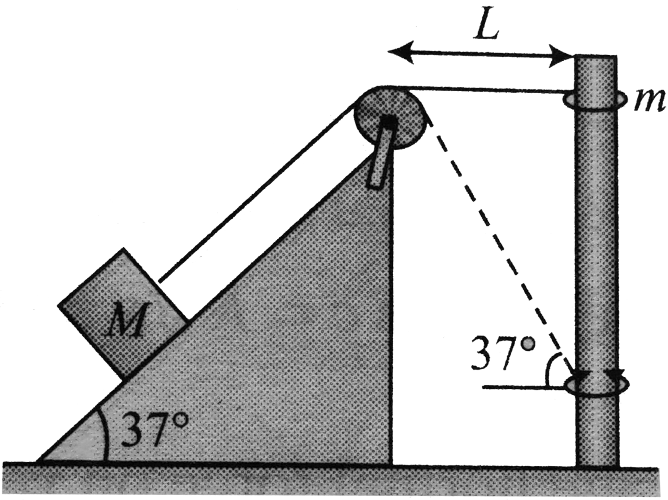
10. a. A $2-kg$ situated on a smooth fixed incline is connected to a spring of negligible mass, with spring constant $k=100Nm^{-1}$, via a frictionless pulley. The block is released from rest when the spring is unstretched. How far does the block moves down the incline before coming (momentarily) to rest? What is its acceleration at its lower point?



b. The experiment is repeated on a rough incline. If the block is observed to move $0.20m$ down along the incline before it comes to instantaneous rest, calculate the coefficient of kinetic friction.

Watch Video Solution

11. A ring of mass $m = 1kg$ can slide over a smooth vertical rod. A light string attached to the ring passing over a smooth fixed pulley at a distance of $L = 0.7m$ from the rod as shown in figure.

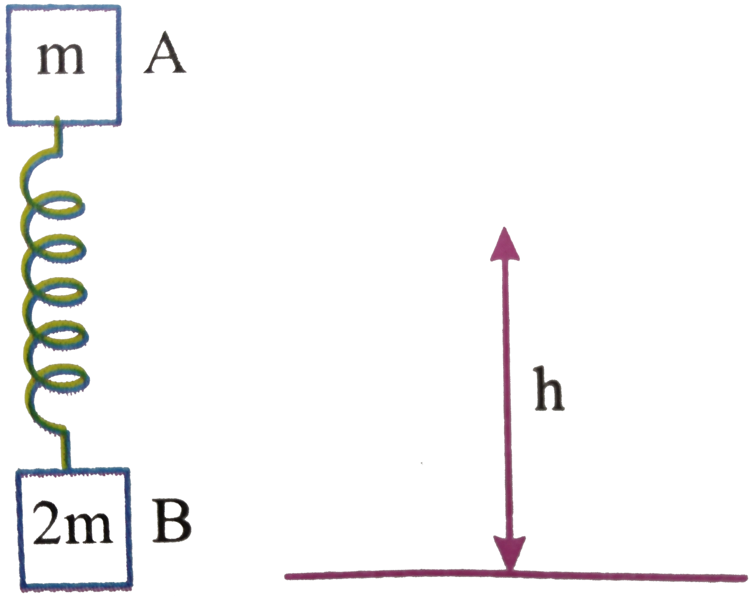


At the other end of the string mass $M = 5kg$ is attached, lying over a smooth fixed inclined plane of inclination angle 37°. The ring is held in level with the pulley and released. Determine the velocity of ring when the string makes an angle $(\alpha = 37^\circ)$ with the horizontal. $[\sin 37^\circ = 0.6]$

Watch Video Solution

12. From what minimum height $h$must the system be released when spring is unstretches so that after perfectly inelastic collision $(e = 0)$

with ground, B may be lifted off the gound: (Spring constant $= k$)



Watch Video Solution

13. A pendulum bob of mass m and length L is released from angle θ with the vertical. Find

(a) the speed of the bob at the bottom of the swing and

(b) tension in the string at that time

Watch Video Solution

14. A boy throws a ball with initial velocity u at an angle of projection θ from a tower of height H.

Neglecting air resistance, find

a. How high above the building the ball rises

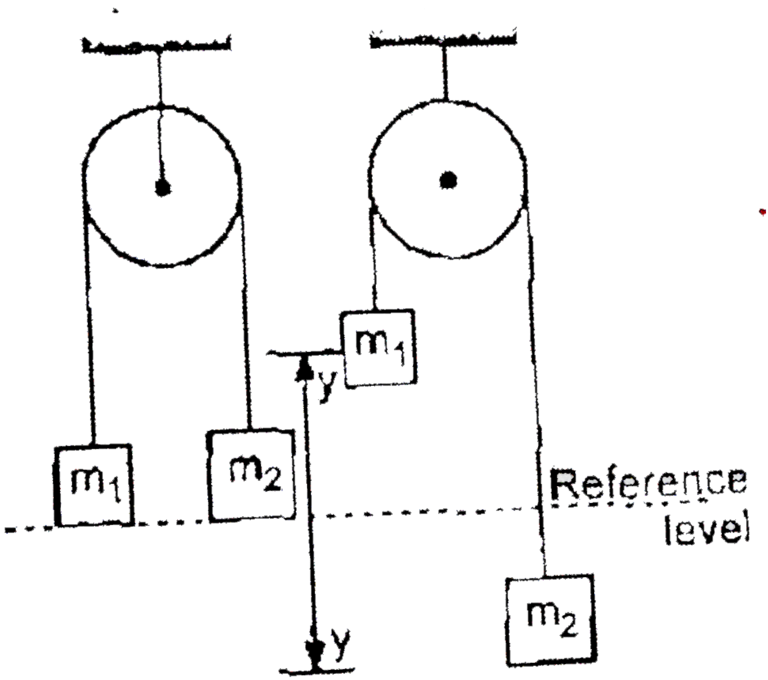
b. Its speed just before it hits the ground.

Watch Video Solution

15. Consider an Atwood machine with both the masses at the same level as shown in Fig. 3E.15. Use the principle of conservation of energy to find

(a) speed of either of the masses as a function of its position and

(b) the acceleration of either of the masses.



Watch Video Solution

16. A block of mass m hangs an a vertical spring. Initially the spring is unstretched, it is now allowed to fall from rest. Find

(a) the distance the block falls if the block is released slowly,

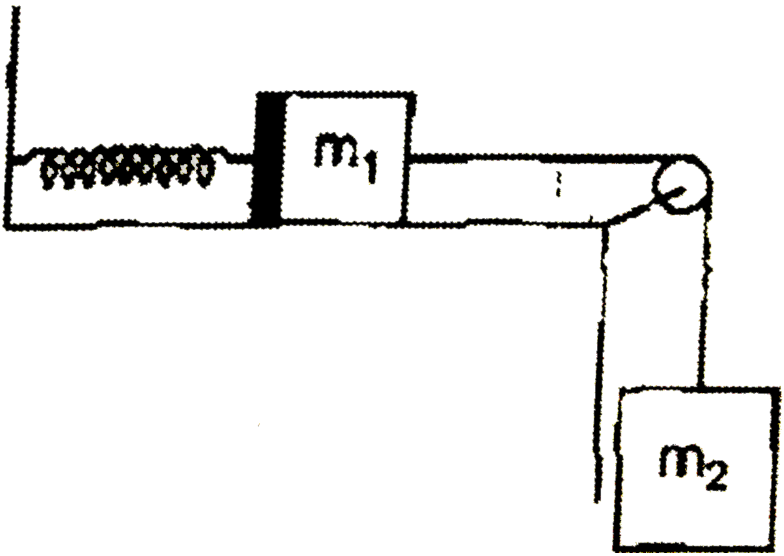
(b) the maximum distance the block falls before it begins to move up

Watch Video Solution

17. In Fig 3E.17, the mass m_2 rests on a rough table. The mass m_1 is pushed against the spring to which it is not attached Force constant of the spring is k, coefficient of friction is μ_k.

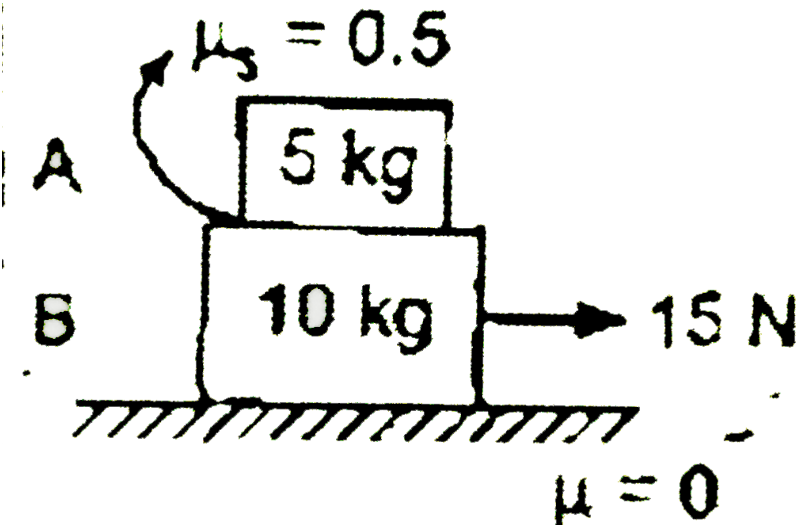
(a) Find the speed of the blocks after the spring is released and m_2 has fallen a distance of h.

(b) If the spring is attached to the block and it falls a distance h before coming to rest, calculate the coefficient of friction μ_k.



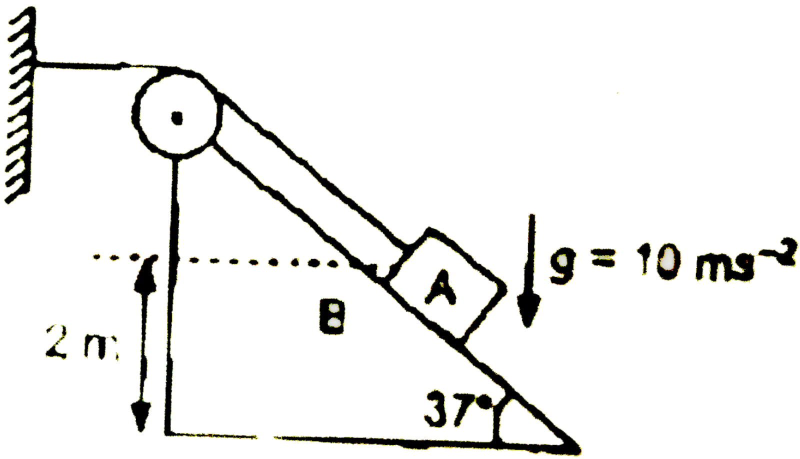
Watch Video Solution

18. The force 15 N pulls the lower block for 2m, find speed.



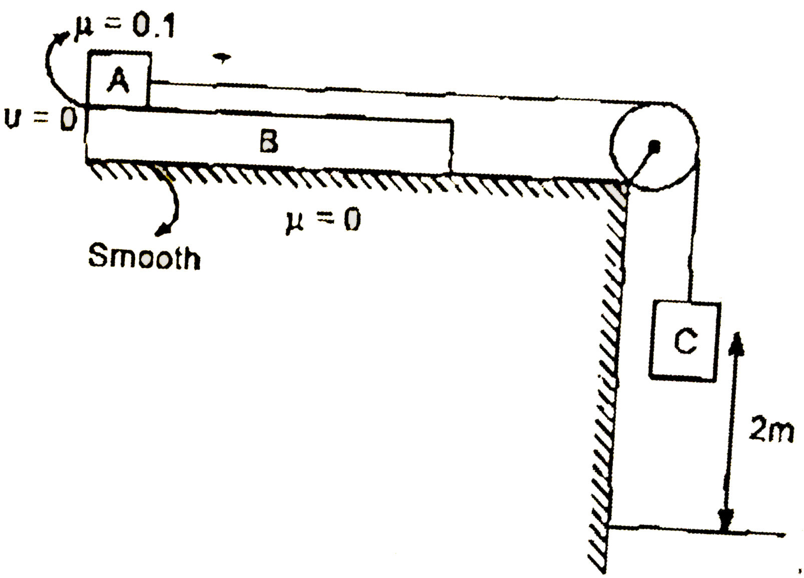
Watch Video Solution

19. Find velocity of A and B when A is about to touch the ground Also verify that work done by tension on the whole system and N between A and B is zero



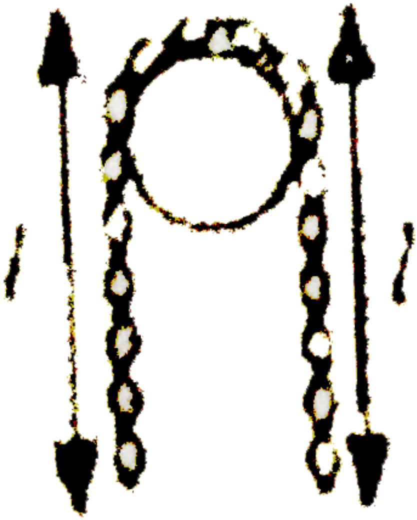
Watch Video Solution

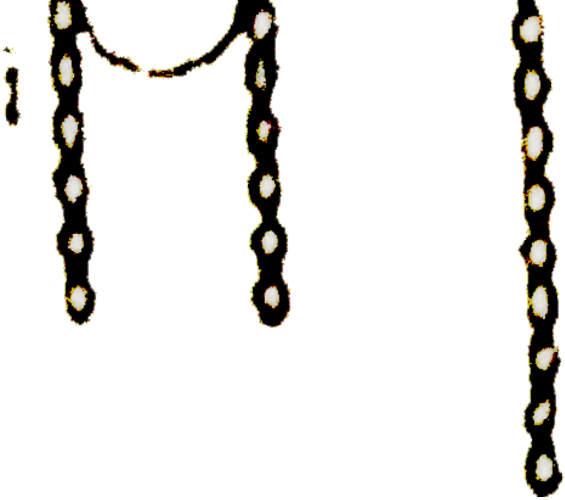
20. $m_A = 1kg, m_B = 2kg, m_C = 10kg$



Watch Video Solution

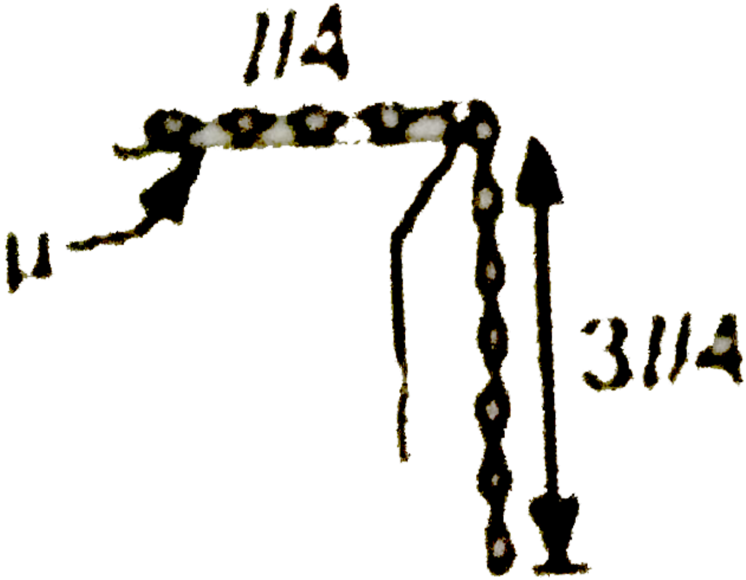
21. If chain starts slipping find its KE when chain becomes completely straingt.





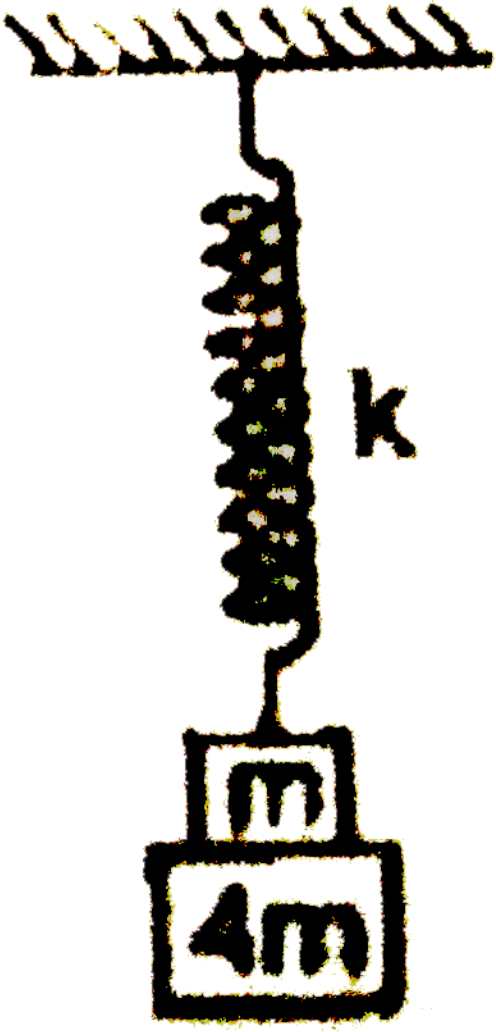
Watch Video Solution

22. Chain is on the verge of slipping, find the velocity of the chain, when it has slipped.



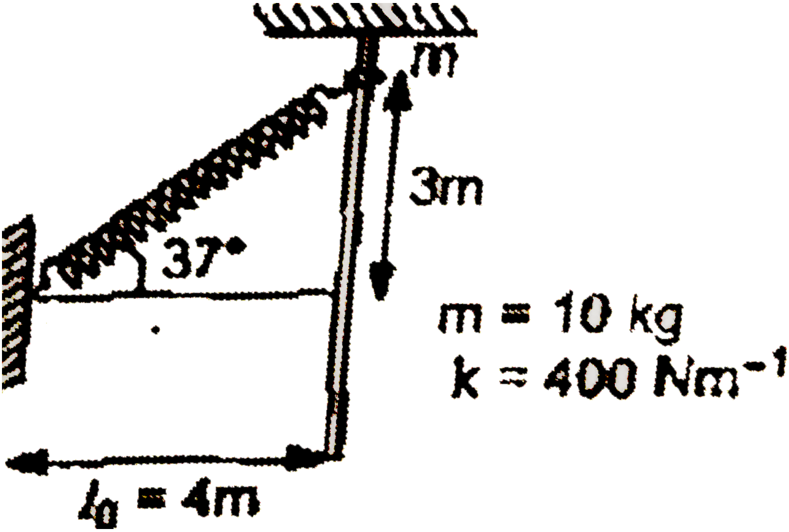
Watch Video Solution

23. Find how much m will rise if 4m falls away. Block are at rest and in equilibrium.



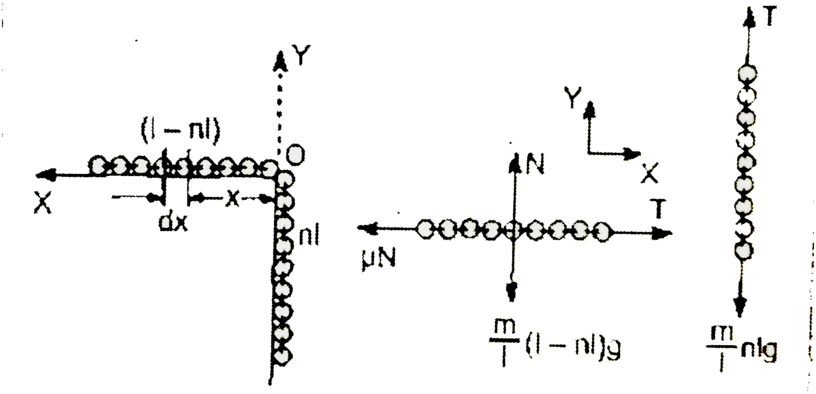
Watch Video Solution

24. Find velocity of ring when spring becomes horizontal



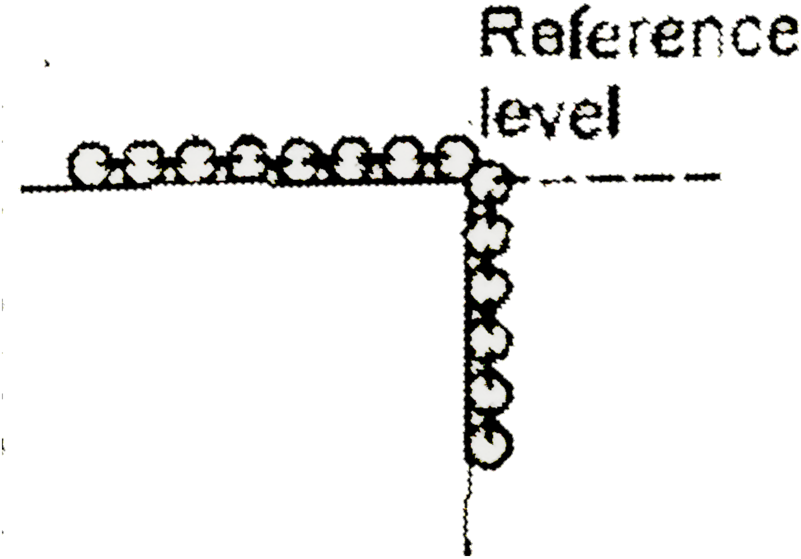
Watch Video Solution

25. A chain of mass m and length 1 lies on a rough table. The chain just starts to slip when the overhaning part equals n^{th} fraction of the chain length. If the chain is slightly distributed so that it completely slips off the table, what is the work performed by the friction forces.



Watch Video Solution

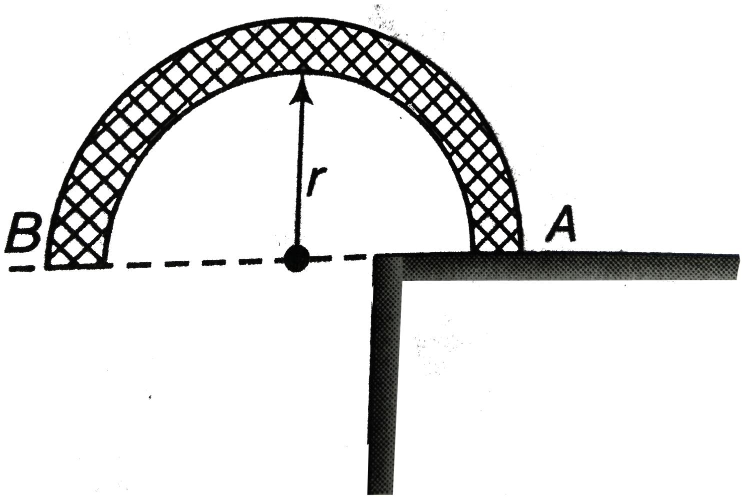
26. A uniform chain of length 1 and mass m is kept on a smooth table. It is released from rest when the overhaning part was n^{th} fraction of total length. Find the kinetic energy of the chain as it completely slips off the table



Watch Video Solution

27. A uniform chain of length of length πr lies inside a smooth semicircular tube (AB) of radius r. Assuming a slight disturbance to start the chain in motion, the velocity with which it will emerge from the end

(B) of the tube will be



Watch Video Solution

28. A uniform chain of mass m and length $l < \frac{\pi R}{2}$ is placed on a smooth hemisphere of radius R with on of its ends fixed at the top of the sphere.

(a) Find the gravitational potential energy of chain assuming base of hemisphere as reference.

(b) what will be the tangential acceleraion of the chain when it starts sliding down.

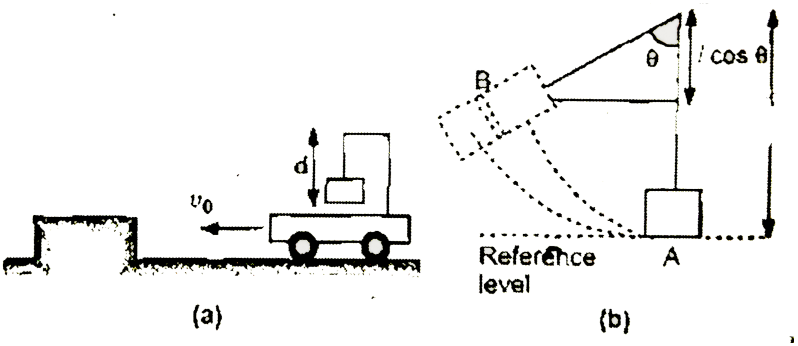
(c) If the chain slides down the sphere, find the kinetic energy of the chain when it has slipped through an angle β.

Watch Video Solution

29. A pendulum bob is suspended on a flat car that moves with velocity v_0. The flat car is stopped by a bumper:

(a) What is the angle through which the pendulum swings.

(b) If the swing angle is $\theta = 60^\circ$ and $1 = 5m$, what was the initialy speed of the flat car ?



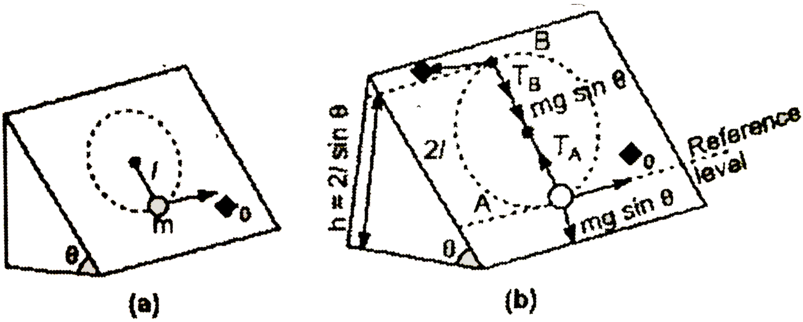
Watch Video Solution

30. A pendulum bob can swing along a ciircular path on a smooth inclined plane, as shown in Fig. 3E.31, where $m = 1.2kg, 1 = .075m, \theta = 37^\circ$. At the lowest point of the circle the tension in the sting is $T = 110N$. Determine

(a) the speed of the bob at the lowest point,

(b) the speed of the bob at the highest point on the circle and

(c) the tension in the string at the highest position



(a)

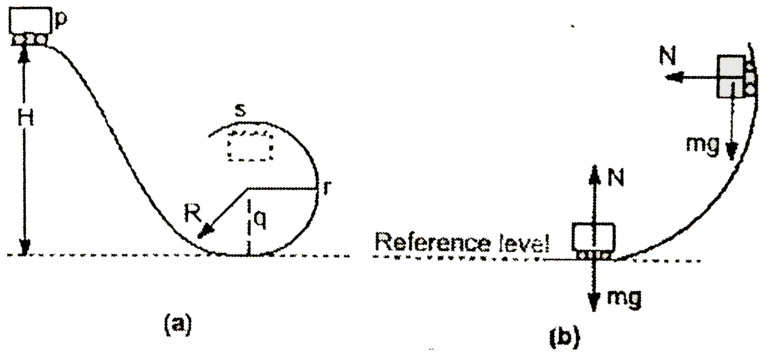
Watch Video Solution

31. A small toy car of mass m slides with negligible friction on a "loop" the loop track as shown in Fig.3E.32. The toy car starts from rest at a point H above the level of the lowest point of the track

(a) If $H = 2R$, what normal force is exerted by the track on the toy car at point q?. What are the speed and normal force at point r ?

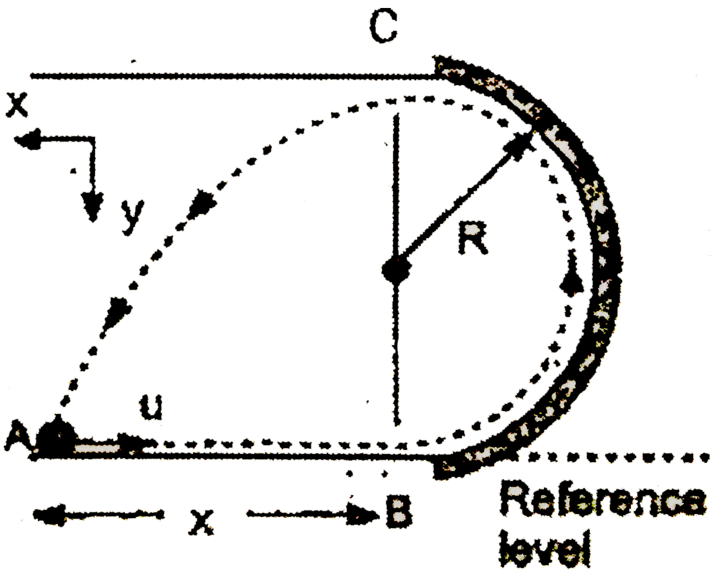
(b) At what height will the ball leave the track and to what maxiumum height will it rise afterwards ?

(c) If $H = 4R$, what is the speed and normal reaction reaction at point s ?



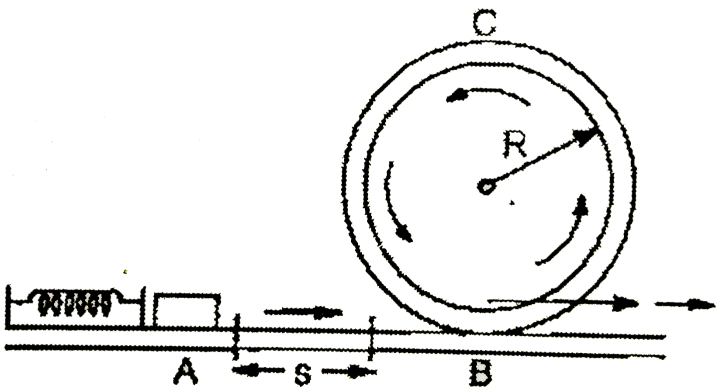
Watch Video Solution

32. A small ball is rolled with speed u from point A along a smooth circular track as shown in Fig. 3E.33. If $x = 3R$, determine the required speed u so that the ball returns to A, the point of projection. What is the minimum value of x for which the ball can reach the point of projection ?



Watch Video Solution

33. A block of mass m is pressed against a spring of force constant k. The block after leaving contact with the spring moves along a "loop" the loop track. The sliding surface is smooth except for rough portion of length s equal to R as shown in Fig. 3E.34, where the coefficient of friction is μ_k. Determine the minimum spring compression x for which the particle will not lose contant with the track ?



Watch Video Solution

34. A particle attached to a vertical string of length 1m is projected horizontally with a velocity $5\sqrt{2}m/s$

(a) What is maximum height reached by the particle from the lower most point of its trajectory.

(b) If the string breaks when it makes an angle of 60° with downward vertical, find maximum height reached by the particle from the lower most point of its trajectory

Watch Video Solution

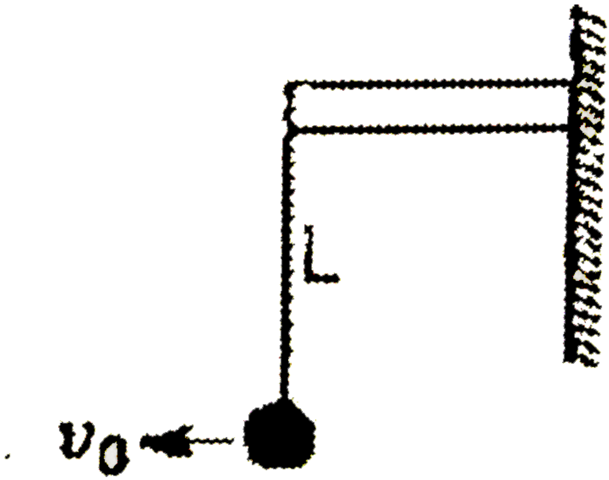
35. A particle is suspended by a light vertical inelastic string of length 1 from a fixed support. At its equilbrium position it is projected horizontally with a speed $\sqrt{6gl}$. Find the ratio of the tension in the string in its horizontal position to that in the string when the particle is vertically above the point of support.

Watch Video Solution

36. A small ball is hung as shown an a string of length L.

(a) If $v_0 > \sqrt{6gl}$, find the angle $\theta(< 90^\circ)$ [in terms of, v_0, g, L] with the upward vertical at which the string becomes slack.

(b) find the value of v_0 [in terms of g, L] if the particle passes through point of suspension



Watch Video Solution

37. A simple pendulum swings with angular amplitude θ. The tension in the string when it is vertical is twice the tension in its extreme position. Then, $\cos\theta$ is equal to

Watch Video Solution

38. A heavy particle hanging from a string of length l is projected horizontally with speed $\sqrt{gl}$. Find the speed of the particle at the point where the tension in the string equals weight of the particle.

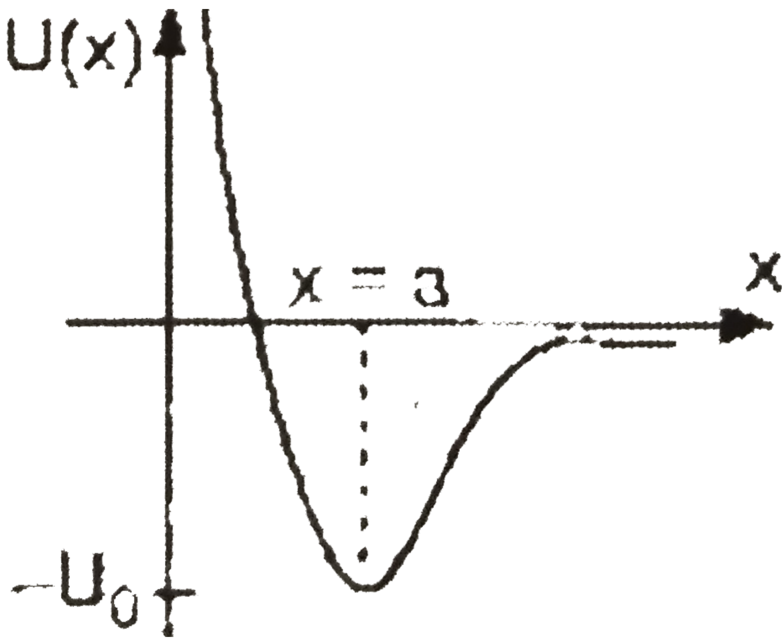
Watch Video Solution

39. The force between two atoms in a diatomic molecule can be represented approaximately by the potential energy function

$$U = U_0\left[\left(\frac{a}{x}\right)^{12} - 2\left(\frac{a}{x}\right)^{6}\right]$$

where U_0 and a are constant (a) At what value of x is the potential energy zero ?

(b) Fidn teh force F_x. (c) At what value of X is the potential energy a minmum ?



Watch Video Solution

40. A body of mass $2kg$ is moving under the influence of a central force whose potential energy is given by $U = 2r^3 J$. If the body is moving in a circular orbit of $5m$, its energy will be

Watch Video Solution

41. A single conservative force $F(x)$ acts on a $1.0 - kg$ particle that moves along the x-axis. The potential energy $U(x)$ is given by $U(x) = 20 + (x - 2)^2$ where x is in meters. At $x = 5.0m$, the particle has a kinetic energy of $20J$.

Determine the equation of $F(x)$ as a function of x.

Watch Video Solution

42. Consider a one-dimensional motion of a particle with total energy E. There are four regions A, B, C and D is which the relation between potential energy U, kinetic energy (K) and total energy E is as given below

RegionA:$U > E$ Region B:$U < E$

Region C:$K < E$ Region D:$U > E$

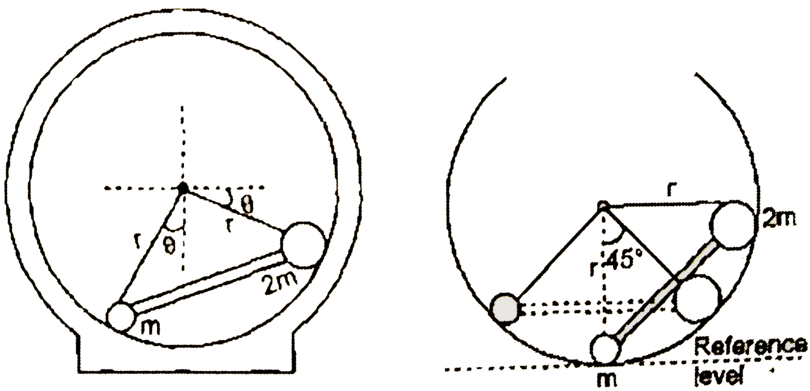
State with reason in each case whether a particle can be found in the given region or not.

Watch Video Solution

43. Two particle of mass m and 2m, connected by a massless rod, slide on the insider of a smooth circular ring of radius r, as shown in Fig. 3E.44 (a). If the assembly is released from rest when $\theta = 0$, determine

(a) the velocity of the particle when the rod passes the horizontal position,

(b) the maximum velocity $v_{\max}$ of the particles.



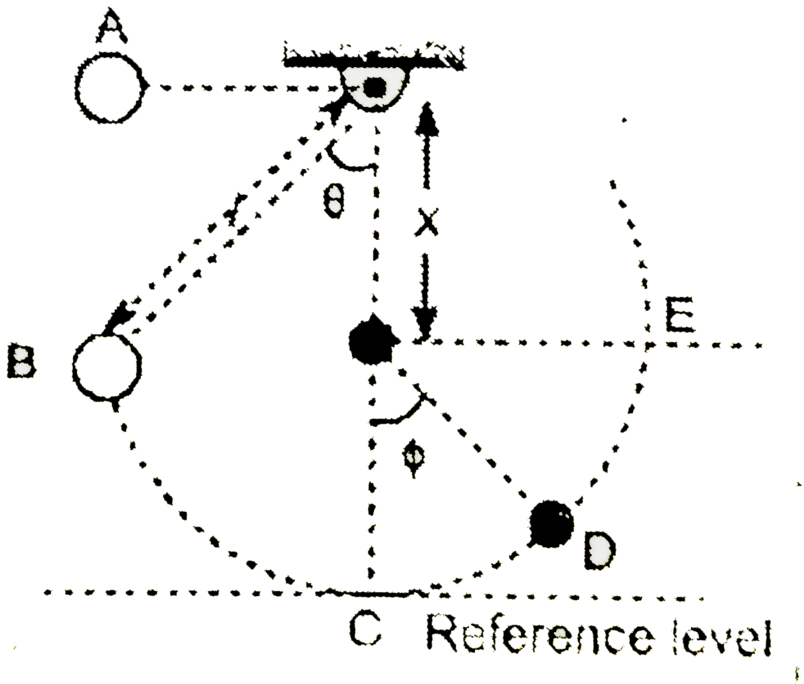
Watch Video Solution

44. The figure shows a pendulum of length l suspended at a distance x vertically above a peg.

(a) The pendulum bob is deflected through an angle θ and then released. Find the speed of the bob at the instant

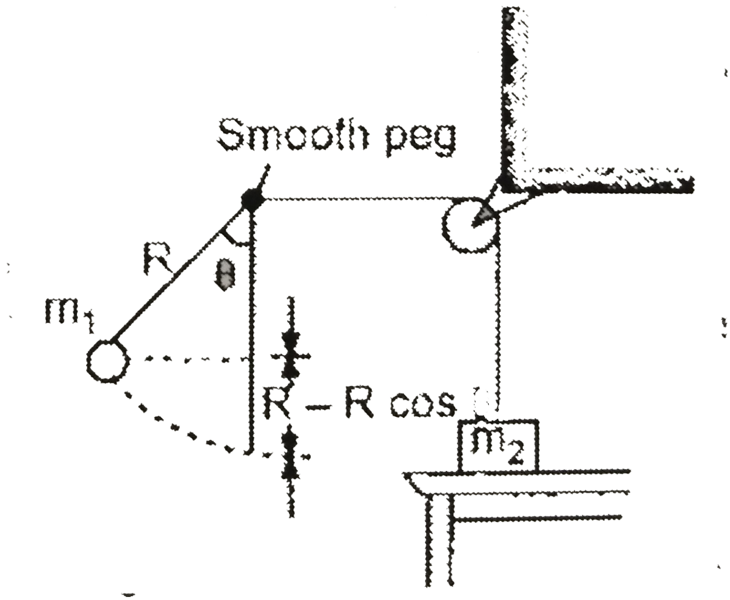
(b) The pendulum is released when $\theta = 90^\circ$. For what x (position of peg) will the pendulum complete the circle ?

(c) The pendulum is released when $\theta = 60^\circ$. what is the velocity of the bob as it passes position E.



Watch Video Solution

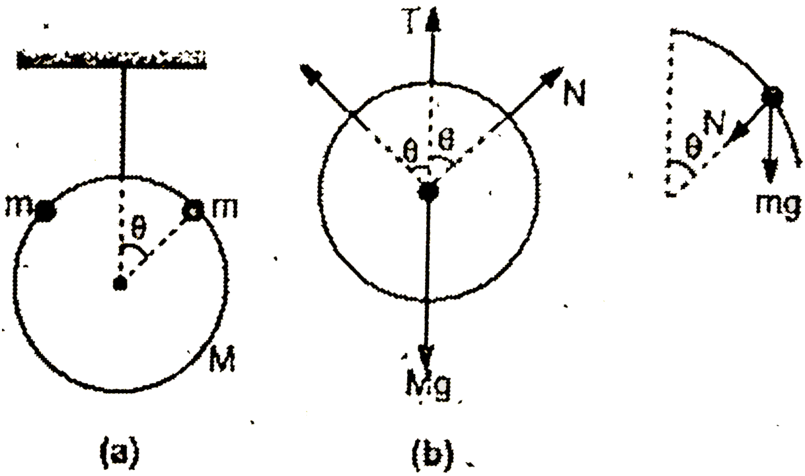
45. Two blocks are connected by a massless string that passes over a frictionless peg as shown in Fig. 3E.46. One end of the string is attached to a mass $m_1 = 3kg$ i.e. a distance $R = 1.20m$ from the peg. The other end of the string is connected to a block of mass $m_2 = 6kg$ resting on a table. From what angle θ, measured from the vertical, must the 3 kg block be released in order to just lift the 6 kg block off the table ?



Watch Video Solution

46. Fig. 3E.47 (a) shows a circular ring of mass M that hangs in a vertical plane. Two beads of mass m are released simultaneously from the top of the ring in opposite directions. There is no frictional force between the bead and the ring. Show that the ring will starts to rise if $m > \frac{3M}{2}$. If m

= 2M, at what angle θ from vertical this happends ?



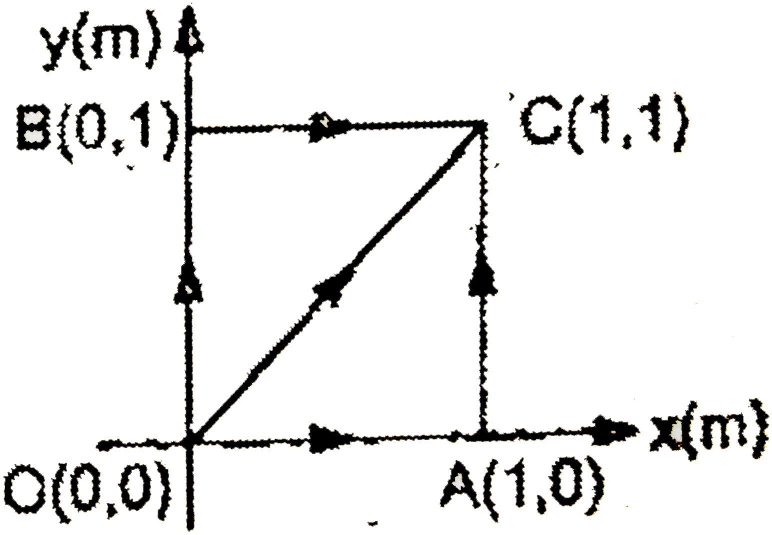
(a)

Watch Video Solution

47. A force acting on a certain particle depends of the particles position in the xy-plane. This force F is given by the expression

$\vec{F} = \left(xy\hat{i} + xy\hat{j}\right)\left(1N/m^2\right)$

where x and y are expressed in metre. If $\vec{F}$ is a conservation force ?



Watch Video Solution

Level 1

1. A small block of mass m is kept on a rough inclined surface of inclination θ fixed in an elevator. The elevator goes up with a uniform velocity v and te block does not slide n te wedge. The work done by the force of friction on the block in time t will be

A. Zero

B. $mgvt\cos^2\theta$

C. $mgvt\sin^2\theta$

D. $mgvt\sin 2\theta$

Answer: C

Watch Video Solution

2. Consider two observers moving with respect to each other at a speed v along·a straight line. They observe a block of mass m moving a distance 1 on a rough surface. The following quantities will be same as observed by the observers

A. Kinetic energy of the block at time

B. Work done by friction

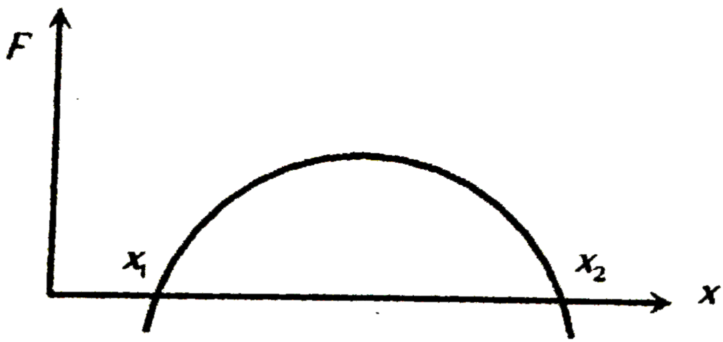
C. Total work done on the block

D. Acceleration of the block

Answer: D

Watch Video Solution

3. The force acting on a body moving along x -axis varies with the position of the particle as shown in the fig. The body is in stable equilibrium at.



A. $x = x_1$

B. $x = x_2$

C. Both $x = x_1$ and $x = x_2$

D. Neither at $x = x_1$ and $x = x_2$

Answer: B

Watch Video Solution

4. A uniform chain has mass Mand length L. It is lying on a smooth horizontal table with half of its length hanging vertically downward. The work done in pulling the chain up the table is:

A. $MgL/2$

B. $MgL/4$

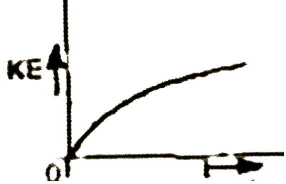
C. $MgL/8$

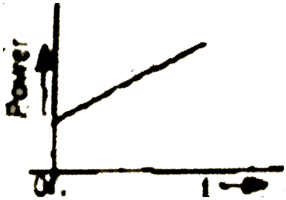
D. $MgL/16$

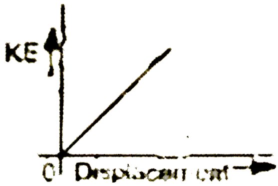
Answer: C

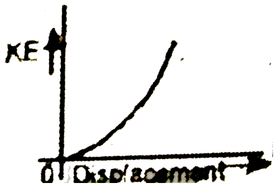
Watch Video Solution

5. A block is resting over a smooth horizontal plane. A constant horizontal force starts acting on it at $t=0$. Which of the following graph is correct:

A. 

B. 

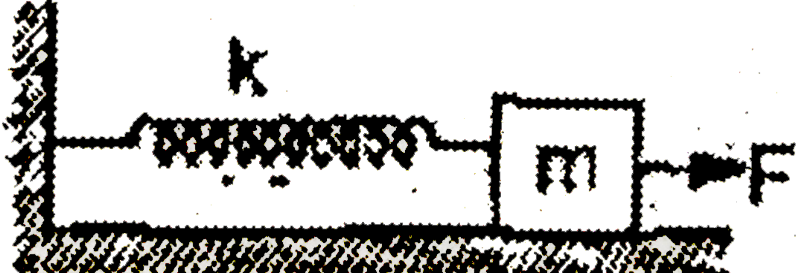
C. 

D. 

Answer: C

Watch Video Solution

6. If the block in the shown arrangement is acted upon by a· constant force F for $t \leq 0$, its maximum speed will be:



A. $F / \sqrt{mk}$

B. $2F / \sqrt{mk}$

C. $F / \sqrt{2mk}$

D. $\sqrt{2F} / \sqrt{mk}$

Answer: A

Watch Video Solution

7. A block hangs freely from the end of a spring. A boy then slowly pushes the block upwards so that the spring becomes strain free. The gain in gravitational potential energy of the block during this process is not equal to

A. The work done by · the boy , against the gravitational force acting on the block.

B. The loss of energy stored in the spring minus the work done by the tension in the spring

C. The work done on tlie block by the boy plus the loss of energy stored in the spring.

D. The work done on the block by the boy minus the work done by the tension in the spring plus the loss of energy stored in the spring.

Answer: C

Watch Video Solution

8. A particle of mass m is moving in a circular path of constant radius r such that its centripetal acceleration a_c is varying with time t as $a_c = k^2rt^2$, where k is a constant. The power delivered to the particle by the forces acting on it is :

A. $2\pi mk^2r^2t$

B. mk^2r^2t

C. $\frac{mk^4r^2t^5}{3}$

D. zero

Answer: B

Watch Video Solution

9. A self-propelled vehicle of mass m, whose engine delivers a constant power P, has an acceleration $a = (P/mv)$. (Assume that there is no friction). In order to increase its velocity from v_1 to v_2, the distan~e it has to travel will be:

A. $\frac{3P}{m}\left(v_2^2 - v_1^2\right)$

B. $\frac{m}{3P}\left(v_2^3 - v_1^3\right)$

C. $\frac{m}{3P}\left(v_2^2 - v_1^2\right)$

D. $\frac{m}{3P}(V_2 - v_1)^3$

Answer: B

Watch Video Solution

10. A stone tied to a string of length L is whirled in a vertical circle with the other end of the string at the centre. At a certain instant of time the stone is at lowest position and has a speed u . Find the magnitude of the change in its velocity as it reaches a position, where the string is horizontal.

A. $\sqrt{u^2 - 2gl}$

B. $\sqrt{2gl}$

C. $\sqrt{u^2 - gl}$

D. $\sqrt{2u^2 - gl}$

Answer: D

Watch Video Solution

11. A ball of mass 5.0 gm and relative density 0.5 strikes the surface of the water with a velocity of 20 m/sec. It comes to rest at a depth of 2m. Find the work done by the resisting force in water: (take $g = 10m/s^2$)

A. $-6J$

B. $+7.5J$

C. $-9J$

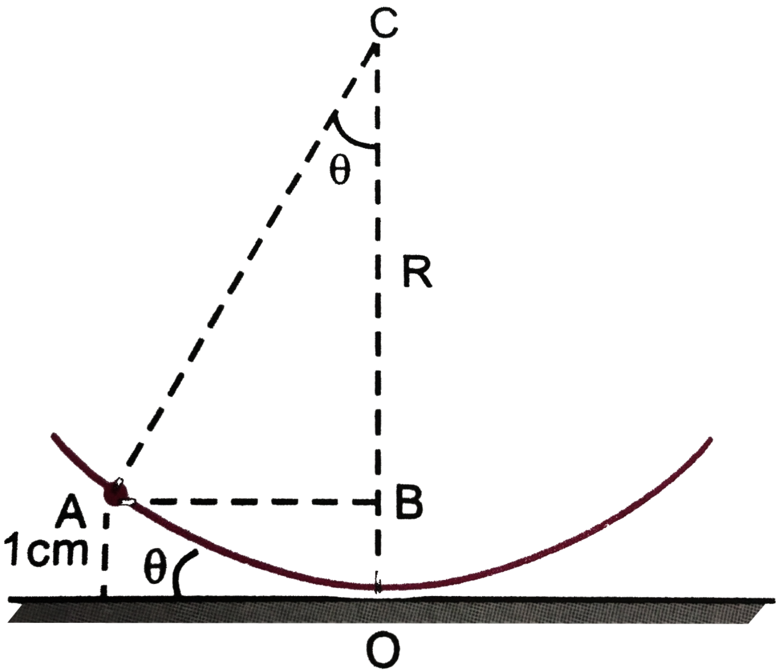
D. $-10J$

Answer: C

Watch Video Solution

12. Aparticle of mass 1 g executes an oscillatory motion on the concave surface of a spherical dish of radius 2m placed on a horizontal plane, Figure . If the motion of the particle begins from a point on the dis at a height of 1 cm. from the horizontal plane and coefficient of friction is 0.01

, fing the total distance covered by the particle before coming to rest.



A. $100m$

B. 1 m

C. 10 m

D. 0.1 m

Answer: B

Watch Video Solution

13. A spring is compressed between two toy carts to masses m_1 and m_2. When the toy carts are released, the spring exerts on each toy cart equal and opposite forces for the same small time t. If the coefficients of friction μ between the ground and the toy carts are equal, then the magnitude of displacements of the toy carts are in the ratio

A. $\frac{s_1}{s_2} = -\frac{m_2}{m_1}$

B. $\frac{s_1}{s_2} = -\frac{m_1}{m_2}$

C. $\frac{s_1}{s_2} = -\left(\frac{m_2}{m_1}\right)^2$

D. $\frac{s_1}{s_2} = -\left(\frac{m_1}{m_2}\right)^2$

Answer: C

Watch Video Solution

14. A light spring is hung vertically from a fixed support and a heavy mass is attached to its. lower end. The mass is then slowly lowered to its equilibrium position: This stretches the spring by an amount d. If the same body is permitted to fall instead, through what distance does it stretch the string?

A. d

B. 1.5 d

C. 2 d

D. 3 d

Answer: C

Watch Video Solution

15. A running man has half the KE that a body of half his mass has. The man speeds up by $1.0ms^{-1}$ and then has the same energy as the boy. What were the original speeds of the man and the boy?

A. $2m/s$

B. $9.6m/s$

C. $4.8m/s$

D. 7.2 m//s`

Answer: C

Watch Video Solution

16. An elastic spring of unstretched length L and force constant K is stretched by amoun t x .It is further stretched by another length y The work done in the second streaching is

A. $\left(\frac{1}{2}\right)ky^2$

B. $\left(\frac{1}{2}\right)k\left(x^2+y^2\right)$

C. $\left(\frac{1}{2}\right)k(x+y)^2$

D. $\left(\frac{1}{2}\right)ky(2x+y)$

Answer: D

Watch Video Solution

17. A ball P is projected vertically up. Another similar ball Q is projected at ari angle 45°. Both reach the same height during their motion. Then, at the starting point, ratio of kinetic energy of P and Q is?

A. 0.5

B. 0.25

C. 2

D. 4

Answer: A

Watch Video Solution

18. A particle of mass m is moving in a horizontal circle of radius r, under a centripetal force equal to $(-K/r^2)$, where k is a constant. The total energy of the particle is -

A. $KE = \left(\frac{k}{2r}\right), PE = -\left(\frac{k}{r}\right), ME = -\left(\frac{k}{2r}\right)$

B. $KE = \left(\frac{k}{2r}\right), PE = -\left(\frac{k}{2r}\right), ME =$ zero

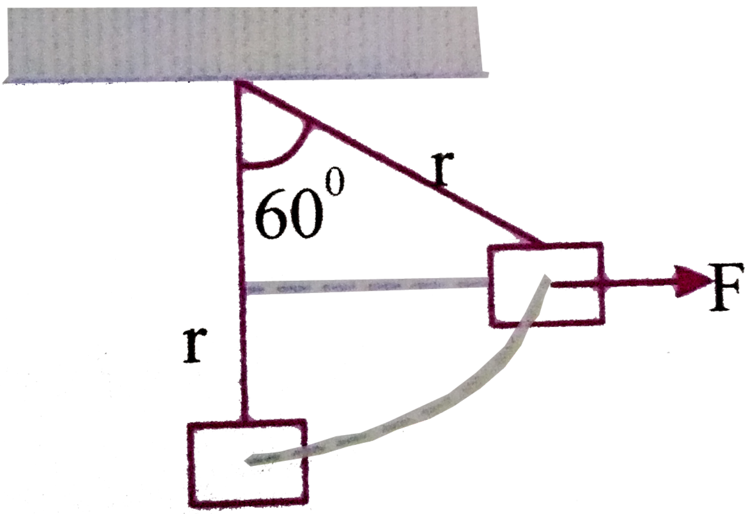
C. $KE =$ zero, PE = zero, ME = zero

D. $KE = \left(\frac{k}{r}\right), PE = -\left(\frac{k}{2r}\right), ME = \left(\frac{k}{2r}\right)$

Answer: A

Watch Video Solution

19. A $10kg$ block is pulled along a frictionless surface in the form of an arc of a circle of radius $10m$. The applied force is $200N$. Find the work done by (a) applied force and (b) gravitational force in displacing through an angle 60°.



A. $4.7m/s$

B. $15.7m/s$

C. $16.7m/s$

D. $17.3m/s$

Answer: D

Watch Video Solution

20. 1 kg block collides with a horizontal massless spring of force constant $2N/m$. The block compresses the spring by 4m. If the coefficient of kinetic friction between the block and the· surface is 0.25, what was the speed of the block at the instant of collision? (take $g = 10m/s^2$)

Watch Video Solution

21. A stone with weight W is thrown vertically upward into the air with initial velocity v_0. If a constant forcef due to air drag acts on the stone throughout the flight & if the maximum height attain by stone is h and velocity when it strikes to the ground is v. Which one is correct?

A. $h = v_0^2\left(1 + \frac{f}{W}\right)/2g, v = v_0$

B. $h = v_0^2/2g\left(1 + \frac{f}{W}\right), v = \text{ zero}$

C. $h = v_0^2/2g\left(1 + \frac{f}{W}\right), v = v_0\sqrt{\frac{W - f}{W + f}}$

D. $h = v_0^2/2g\left(1 + \frac{f}{W}\right), v = v_0\sqrt{\frac{W + f}{W - f}}$

Answer: C

Watch Video Solution

22. A stone of mass m, tied to the end of a string, is. whirled around in a horizontal circle (neglect gravity). The length of the string is reduced gradually such that mvr = constant. Then, the tension in the string is given · by $T = Ar''$, where A is a constant and r is the instantaneous radius of the circle. Then, n is equal to:

A. $+2$

B. -2

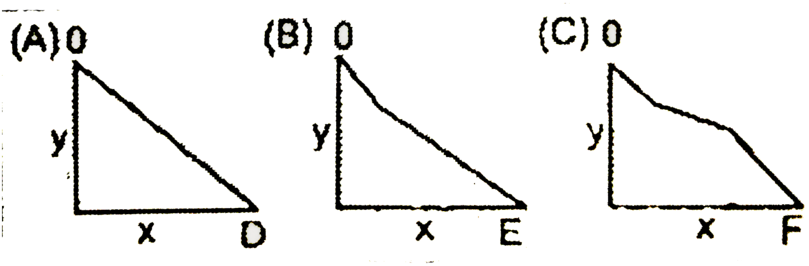
C. $+3$

D. -3

Answer: D

Watch Video Solution

23. A block of mass m released from rest from point O as shown below. The velocity of the block at the lowest points are v O , v E, v F respectively. Assume coefficient of kinetic friction between surface and the block is same in all cases. Then,

(a) 

A. $v_D > v_E > v_F$

B. $v_f > v_E > v_D$

C. $v_D = v_E = v_F$

D. $v_D = v_E v_F = 0$

Answer: C

Watch Video Solution

24. The mass m slides down the track and completes the vertical circle on the smooth curved surface. The minimum value of h will be:

A. R

B. 2 R

C. 2.5 R

D. 3 R

Answer: C

Watch Video Solution

25. A body of mass m is moving in a circle of radius 'r' with a constant speed v. The force on the body is $\frac{mv^2}{r}$ and is r directed towards the center. If work done by this force in moving the body over half the circumference and complete circumference is W and W', then:

A. $W = \frac{mv^2}{r}. \pi, W' =$ zero

B. $W = \frac{mv^2}{r}. 2r, W' =$ zero

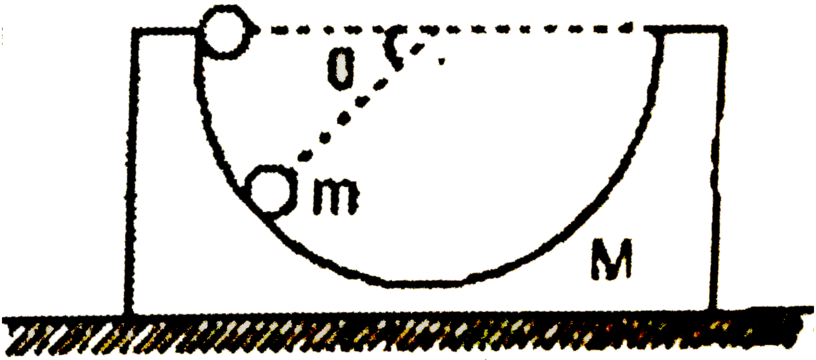
C. $W = \frac{mv^2}{r}, W' = \frac{mv^2}{r}.2\pi r$

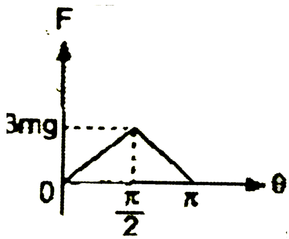
D. W = zero, W' zero

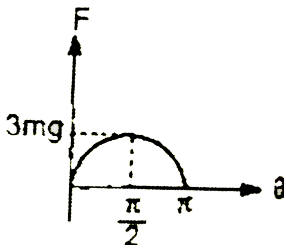
Answer: D

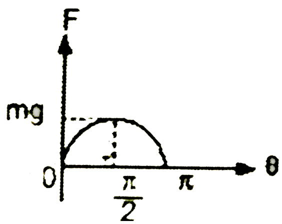
Watch Video Solution

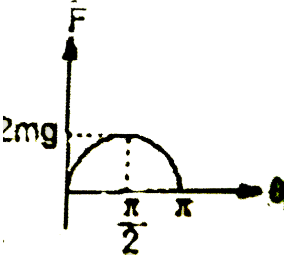
26. In the shown figure, a small mass m starts sliding down a smooth and stationary circular track. Which of the following graph best represents the variation of magnitude of the force applied by the track on the mass and the angle θ?



A. 

B. 

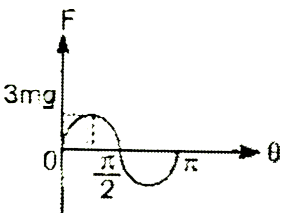
C. 

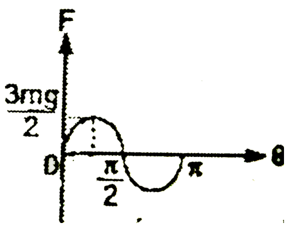
D. 

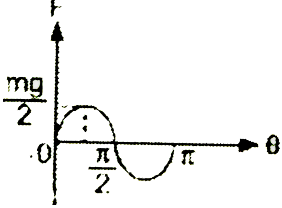
Answer: B

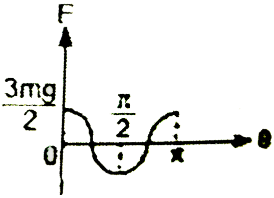
Watch Video Solution

27. In the Q. No. 26, if $M = 2m$ and friction exists between the circular track and the horizontal surface then, which of the following lot best represents the variation of frictional force versus the angle θ:

A. 

B. 

C. 

D. 

Answer: B

View Text Solution

28. A particle of mass m is whirled in a vertical circle with the help of a thread. If^{-} the maximum tension in the thread is double its minimum value then the value of minimum tension in the thread will be:

A. 6 mg

B. zero

C. 3 mg

D. can't be found

Answer: A

View Text Solution

29. A particle of mass m is located in a one dimensional potential field where potential energy of the particle has the form $U(x) = \frac{a}{x^2} - \frac{b}{x}$ where a and b are positive constants. The position of equilibrium is:

A. $\frac{b}{2a}$

B. $\frac{2b}{a}$

C. $\frac{a}{b}$

D. $\frac{2a}{b}$

Answer: D

View Text Solution

30. Two cylindrical vessels of equal cross-sectional area. A contain water upto height h_1 and h_2. The vessels are interconnected so that the levels in them becomes equal. The work done by the force of gravity during the process is:

A. zero

B. $\rho A\left(\frac{h_1+h_2}{2}\right)^2 g$

C. $\rho A\left(\frac{h_1-h_2}{2}\right)^2 g$

D. $\frac{\rho A h_1 h_2}{2} g$

Answer: C

View Text Solution

31. A block of mass 100 g moved with,a speed of 5 m/s at the highest point in a closed circular tube of radius 10 ,cm kept in a vertical plane. The cross-section of the tube is such that the block just fits in it., The block makes several oscillations inside the tube and finally steps at the lowest point. The work done by t\Ie tube on the block during the process is:

A. 1.45 J

B. $-1.45 J$

C. 0.2 J

D. zero

Answer: B

View Text Solution

32. A heavy stone is thrown from a cliff of height h with a speed .v. The stone will hit ground with maximum speed if it is thrown:

A. vertically downward

B. verticaliy.upward

C. horizontally

D. the speed does not depend on the initial direction

Answer: D

View Text Solution

33. Two springs A and B $(k_A = 2k_B)$ are stretched by applying forces of equal magnitudes at the four ends. If the energy stored in A is E, that in B is:

A. $\frac{E}{2}$

B. $2E$

C. E

D. $\frac{E}{4}$

Answer: B

View Text Solution

34. Two equal masses are attached to the two ends of a spring of spring constant k. The masses are pulled out ,YI)l~etri~ally to ~tretch the spring by a length· x over its natural length. The work done by the spring on each mass is:

A. $\frac{1}{2}kx^2$

B. $-\frac{1}{2}kx^2$

C. $\frac{1}{4}kx^2$

D. $-\frac{1}{4}kx^2$

Answer: D

View Text Solution

35. The negative of the work done 'by the conservative internal forces on a system equals the change in:

A. total energy

B. kinetic energy

C. potential energy

D. none of these

Answer: C

View Text Solution

36. The work done by the external forces on a system equals the change in

A. total energy

B. kinetic energy

C. potential energy

D. none of these

Answer: A

Watch Video Solution

37. The work done by all the forces (external and internal) on a system equals the change in

A. total energy

B. kinetic energy

C. potential energy

D. none of these

Answer: B

Watch Video Solution

38. ________ of a two particle system depends only on the separation between the two particles. The most appropriate choice for the blank space n the above sentence is

A. kinetic energy

B. total mechanical energy

C. potential energy

D. total energy

Answer: C

Watch Video Solution

39. A block of mass m slides down a smooth vertical circular track. During the motion, the block is in:

A. vertical equilibrium

B. horizontal equilibrium

C. radial equilibrium

D. none of the above

Answer: D

Watch Video Solution

40. A particle is rotated in a vertical circle by connecting it to a string of length l and keeping the other end of the string fixed. The minimum speed of the particle when the string is horizontal for which the particle will complete the circle is

A. $\sqrt{gl}$

B. $\sqrt{2gl}$

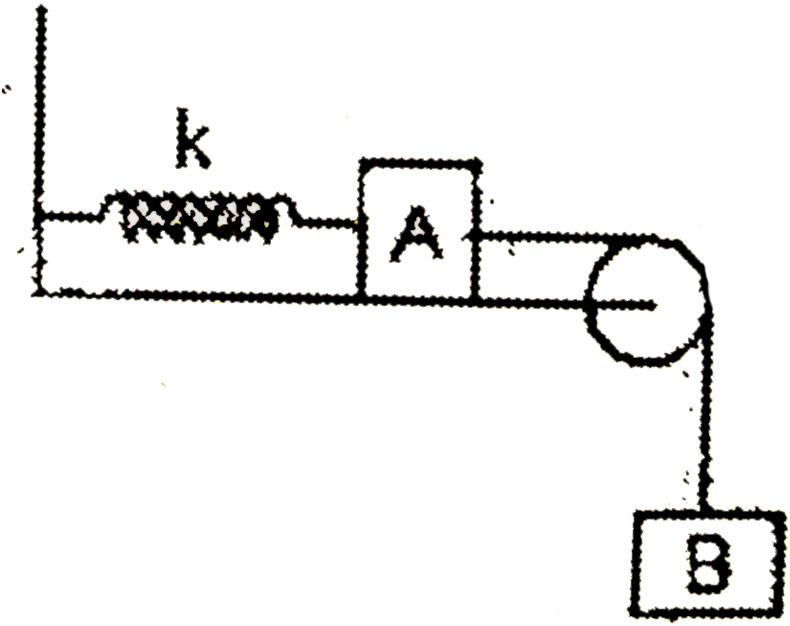
C. $\sqrt{3gl}$

D. $\sqrt{5gl}$

Answer: C

Watch Video Solution

41. In the shown diagram mass of A is m and that of B is 2 m. All the surfaces are smooth. System is released from rest with spring unstretched. Then, the maximum extension (x_m) in spring will be:



A. $\frac{mg}{k}$

B. $\frac{2mg}{k}$

C. $\frac{3mg}{k}$

D. $\frac{4mg}{k}$

Answer: D

Watch Video Solution

42. In above question, speed of block A, when the extension in spring is $\frac{x_m}{2}$, is:

A. $2g\sqrt{\frac{m}{k}}$

B. $2g\sqrt{\frac{2m}{k}}$

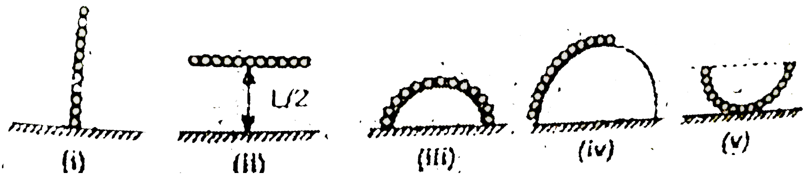
C. $2g\sqrt{\frac{2m}{3k}}$

D. $g\sqrt{\frac{4m}{3k}}$

Answer: D

View Text Solution

43. A chain of length L and mass Mis arranged as shown in following four cases. The correct decreasing order of potential energy (assumed zero at horizontal surface) is:

(i) 

A. $i > ii > iii > iv > v$

B. $i = ii > iii > iv > v$

C. $i = ii > iv > iii > v$

D. $i = ii > iv > v > iii$

Answer: C

Watch Video Solution

44. A block of mass m is pulled by a constant powert P placed on a rough horizontal plane. The friction coefficient the block and surface is μ. The maximum velocity of the block is.

A. $\frac{P}{mg}$

B. $\frac{\mu P}{mg}$

C. $\frac{P}{\mu mg}$

D. $\frac{P}{\mu^2 mg}$

Answer: C

Watch Video Solution

45. Forces acting on a particle moving in a straight line varies with the velocity of the particle as $F = \frac{\alpha}{v}$ where α is constant. The work done by this force in time interval Δt is :

A. $\alpha \Delta t$

B. $\frac{1}{2} \alpha \Delta t$

C. $2\alpha \Delta t$

D. $\alpha^2 \Delta t$

Answer: A

Watch Video Solution

46. A pendulum of mass 1 kg and length = 1m is released from rest at angle = 60 . The power delivered by all the forces acting on the bob at angle = 30 will be: (g = 10 m/s2)

A. 1.34ω

B. 13.4ω

C. 0.67ω

D. 5ω

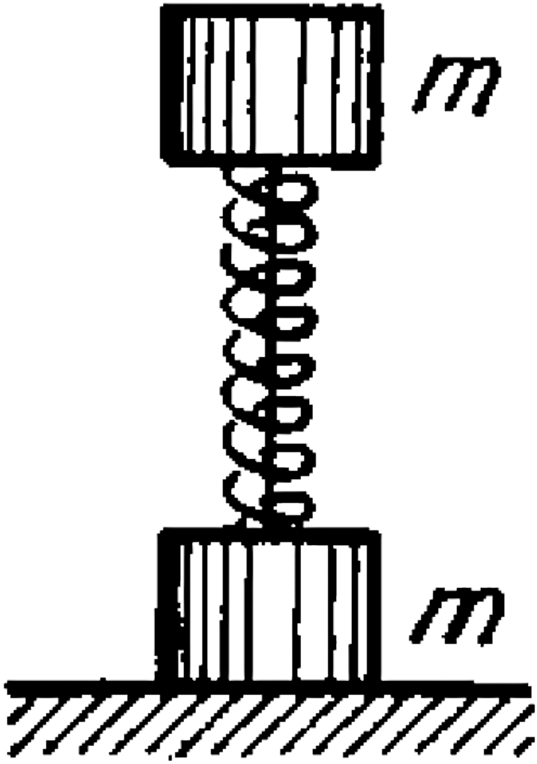
Answer: D

Watch Video Solution

47. A system consists of two identical cubes, each of mass m, linked together by the compressed weightless spring of stiffness $\varkappa$ (figure). The cubes are also connected by a thread which is burned through at a certain moment. Find:

(a) at what values of Δl, the initial compression of the spring, the lower cube will bounce up after the thread has been burned through:

(b) to what height h the centre of gravity of this system will rise if the initial compression of the spring $\Delta l = 7mg/\varkappa$.



A. $\dfrac{2mg}{k}$

B. $\dfrac{3mg}{k}$

C. $\dfrac{3mg}{2k}$

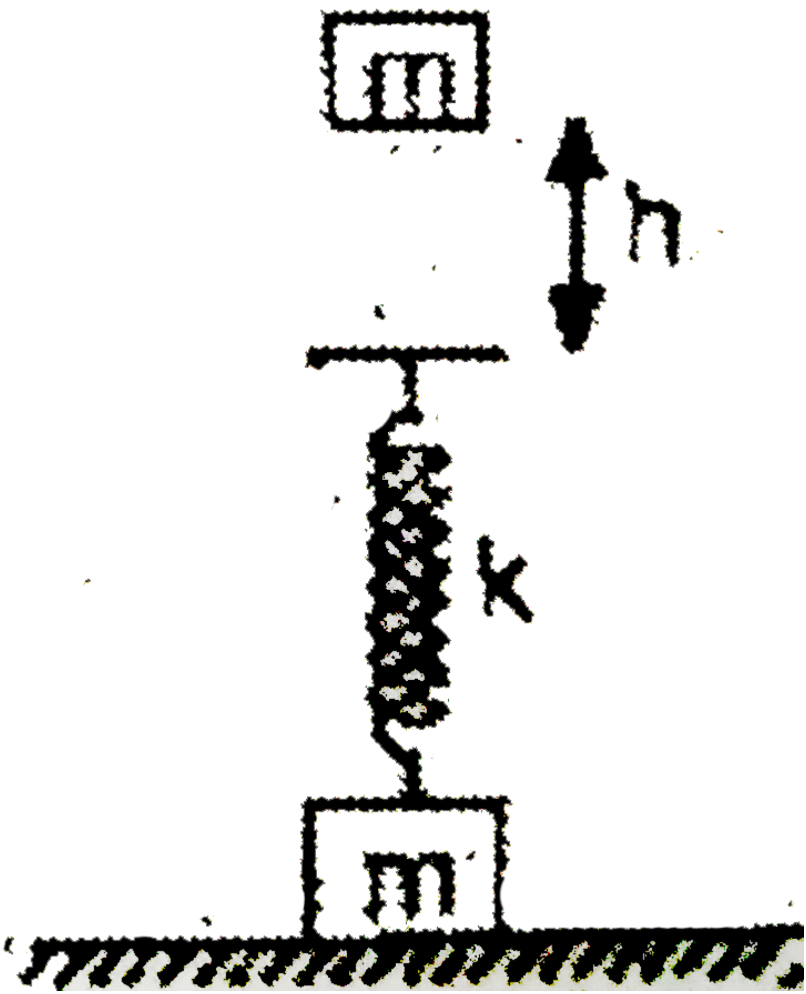
D. $\dfrac{6mg}{k}$

Answer: B

Watch Video Solution

Watch Video Solution

48. In the shown figure, the mass in sticks to the string just after it strikes it. Then the minimum value of h, so that the lower mass bounce off the ground during 'its rebound is:



A. $\dfrac{2mg}{k}$

B. $\dfrac{3mg}{k}$

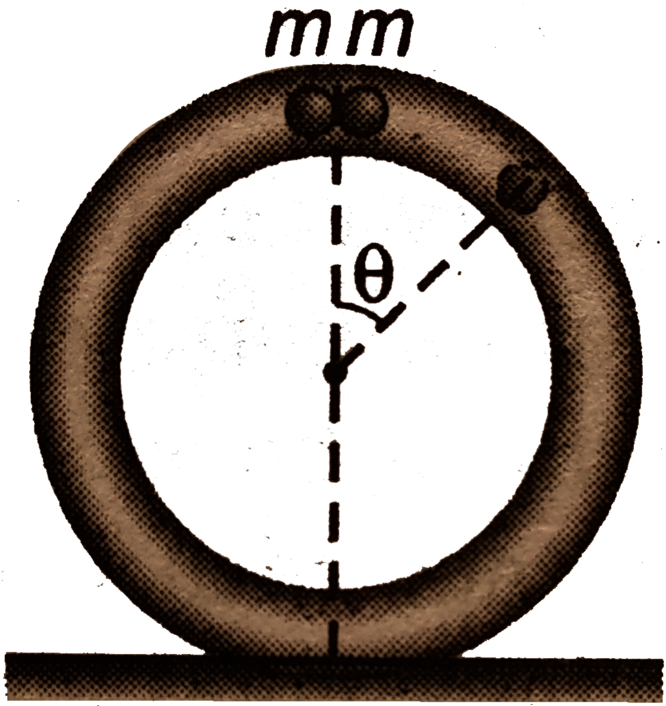
C. $\dfrac{3mg}{2k}$

D. $\dfrac{6mg}{k}$

Answer: C

Watch Video Solution

49. A circular tube of mass M placed veticlly on a horizontal surface as shown in the figure. Two small spheres, each of mass m , just fit in the tube, are released from the top. If θ gives the angle between radius vector of eirther ball with the vertical, obtain the value of the ratio M/m if the tube breacks its contact with ground when $\theta = 60^\circ$. Neglect any friction.



A. $2'$

B. $\frac{1}{2}$

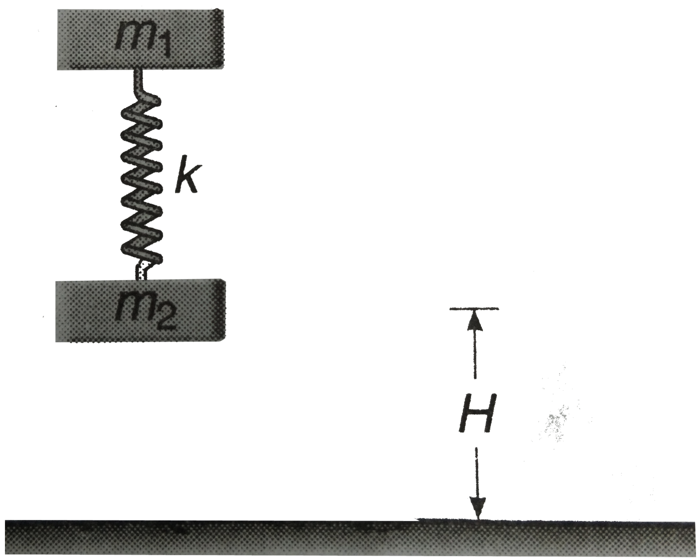
C. $3'$

D. $\frac{1}{3}$

Answer: A

Watch Video Solution

50. A spring mass system is held at rest with the spring relaxed at a height (H) above the ground. Determine the minimum value of (H) so that the system has a tendency to rebound after hitting the ground. Given that the coefficient of restitution between (m_2) and ground is zero.



A. $\frac{2mg}{k}$

B. $\frac{3mg}{k}$

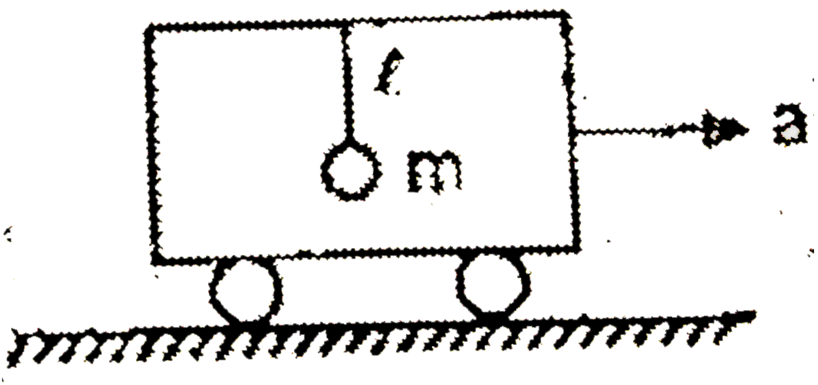
C. $\frac{3mg}{2k}$

D. $\frac{6mg}{k}$

Answer: C

Watch Video Solution

51. In shown figure, the trolley starts accelerating with acceleration a. The maximum angle deflected by thread from vertical will be:



A. $\tan^{-1}\left(\frac{a}{g}\right)$

B. $\tan^{-1}\left(\frac{2a}{g}\right)$

C. $2\tan^{-1}\left(\frac{a}{g}\right)$

D. $\tan^{-1}\left(\frac{a}{2g}\right)$

Answer: C

Watch Video Solution

52. A force $F = -K\left(y\hat{i} + x\hat{j}\right)$ (where K is a positive constant) acts on a particle moving in the x-y plane. Starting from the origin, the particle is taken along the positive x-axis to the point $(a, 0)$, and then parallel to the y-axis to the point (a, a). The total work done by the force F on the particle is

A. $-2Ka^2$

B. $2Ka^2$

C. $-Ka^2$

D. Ka^2

Answer: C

Watch Video Solution

53. A particle free to move along the (x - axis) hsd potential energy given by $U(x) = k\left[1 - \exp\left(-x^2\right)\right]f$ or $-oo \leq x \leq +oo$, where (k) is a positive constant of appropriate dimensions. Then.

A. At point away from the origin, the particle is in unstable equilibrium

B. For any finite non-zero ,value of x, there is force directed away from the origin

C. If its total mechanical energy if K/2, it. has its minimum ri at the origin

D. None of these

Answer: D

Watch Video Solution

Level 2

1. The potential energy U in joule of a particle of mass $1kg$ moving in $x-y$ plane obeys the law$U=3x+4y$, where (x,y) are the co-ordinates of the particle in metre. If the particle is at rest at $(6,4)$ at time $t=0$ then :

A. the particle has constant acceleration

B. the particle has zero acceleration

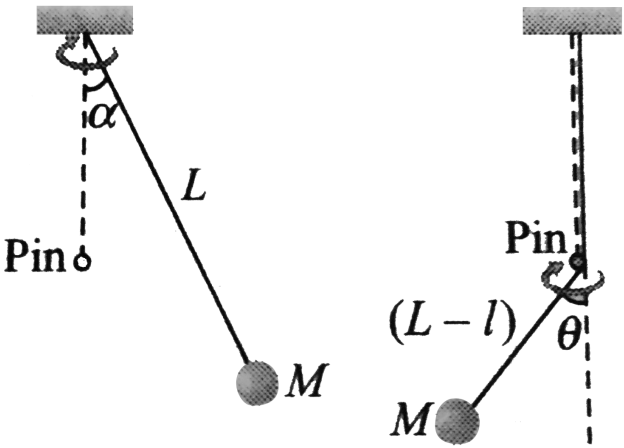
C. the speed of the particle when it crosses y-axis is $10m/s$

D. co-ordinate of particle at $t=1$ sec is (4.5, 2)

Answer: A::C::D

Watch Video Solution

2. A simple pendulum consisting of a mass M attached to a string of length L is released from rest at an angle α. A pin is located at a distance l below the pivot point. When the pendulum swings down, the string hits the pin as shown in figure. The maximum angle θ which the string makes with the vertical after hitting the pin is



A. $\cos^{-1}\left(\frac{L\cos\alpha+l}{L+l}\right)$

B. $\cos^{-1}\left(\frac{L\cos\alpha+l}{L-l}\right)$

C. $\cos^{-1}\left(\frac{L\cos\alpha-1}{L-l}\right)$

D. $\cos^{-1}\left(\frac{L\cos\alpha-l}{L+l}\right)$

Answer: C

Watch Video Solution

3. An object is displaced from a point A(0, 0, 0) to B(1m, 1m , 1m) under a force $\overrightarrow{F} = \left(y\hat{i} + x\hat{j}\right)N$. Find the work done by this force in this process.

A. 1 J, non-conservative

B. 1 J, conservation

C. zero, conservative

D. zero, non-conservative

Answer: B

Watch Video Solution

4. A particle mass is tied to an ideal string and whirled in a vertical circle of radius L, where L is off-course the length of the string. If the ratio of the maximum to minimum tension in the string throughout the motion is 2 : 1, then the maximum possible speed of the partcle will be:

A. $\sqrt{11gL}$

B. $\sqrt{5gL}$

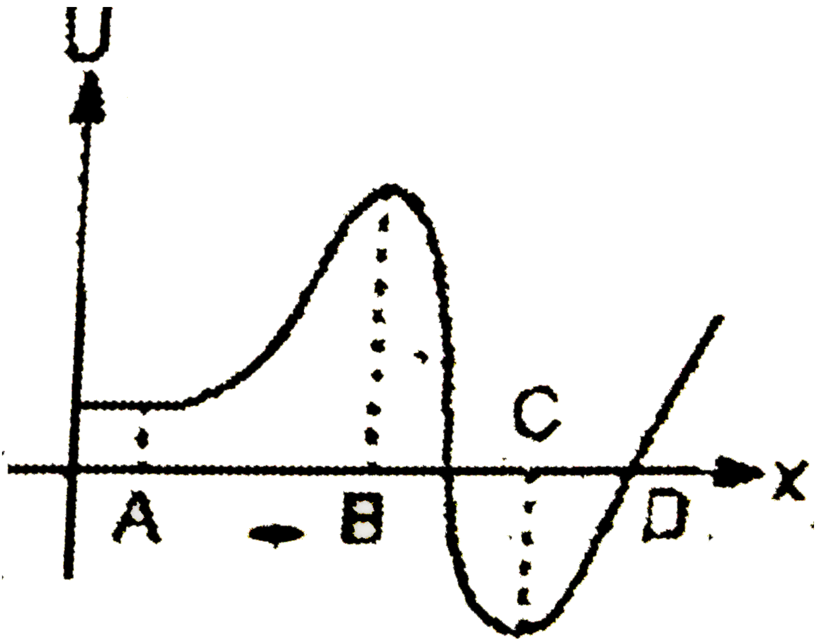
C. $\sqrt{10gL}$

D. sqrt(3 gL)`

Answer: A

View Text Solution

5. The following plot shows the variation of potential energy (U) of a system versus position (x). From the graph we can interpret that :



A. Point D is position of neutral equilibrium

B. Point B is position of unstable equilibrium

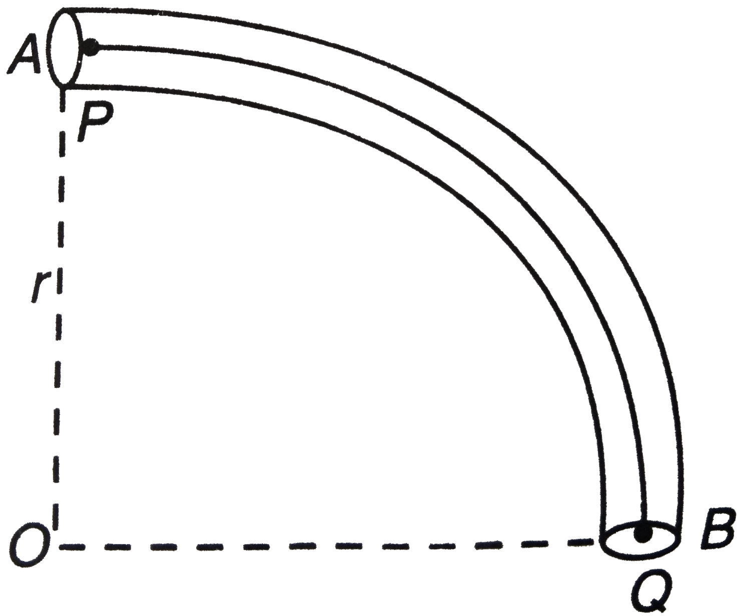
C. Point C is position of stable equilibrium

D. Point A is position of neutral equilibrium

Answer: B::C::D

View Text Solution

6. A smooth narrow tube in the form of an arc AB of a circle of centre O and radius r is fixed so that A is vertically above O and OB is horizontal. Particles P of mass m and Q of mass 2 m with a light inextensible string of length (pi r/2) connecting them are placed inside the tube with P at A and Q at B and released from rest. Assuming the string remains taut during motion, find the speed of particles when P reaches B.



A. $\sqrt{\frac{2gR}{3}}$

B. $\sqrt{\frac{2gR}{3\pi}}$

C. $\sqrt{\frac{2(1+\pi)gR}{3}}$

D. $\sqrt{\frac{2\pi gR}{3}}$

Answer: C

Watch Video Solution

7. In a children\'s park, there is a slide which has a total length of 10 m and a height of 8.0 m figure. Vertical ladder are provided to reach the top. A boy weighting 200 N climbs up the ladder to the top of the slide and slides down to the ground. The averages friction offered by the slide is three tenth of his weight. Find a. the work done by the ladder on the boy as he goes up. b. the work done by the slide on the boy as he comes down. Neglect any work done by forces inside the body of the boy.

A. The work done by ladder on the boy as he goes up is zero

B. The work done by ladder on boy as he goes up is $-1600J$

C. The work done by slide on boy as he comes down is. 600 J'

D. The work done by slide on boy as he comes down is 1600 J

Answer: A::C

Watch Video Solution

8. A particle of mass m is kept at the top of a smooth fixed sphere. It is given a horizontal velocity v then:

A. it will start moving along a circular path if $v < \sqrt{gR}$

B. it will start moving along a circular path if $v > \sqrt{gR}$

C. it will start moving along a parabolic path if $v < \sqrt{gR}$

D. it will start moving along a parabolic path if $v > \sqrt{gR}$

Answer: A::D

View Text Solution

9. The total work done on a particle is equal to the change in its kinetic energy

A. always

B. only if the forces acting on it are conservative

C. only if gravitational force along acts on it

D. only if elastic force along acts on it

Answer: A

Watch Video Solution

10. A particle is acted upon by a force of constant magnitude which is always perpendiculr to the velocity of the particle. The motion of the particle takes place in a plane. It follows that

A. its velocity is constant

B. its acceleration is constant

C. its kinetic energy is constant

D. it moves in a circular path

Answer: C::D

Watch Video Solution

11. You lift a suitcase from the floor and keep it on a table. The work done by you on the suitcae does not depend on

A. the path taken by the suitcase

B. the time taken by you in doing so

C. the weight of the suitcase

D. your weight

Answer: A::B::D

Watch Video Solution

12. A particle of maas m is attched to a light string of length l, the other end of which is fixed. Initially the string is kept horizontal and the particle is given an upwrd velocity v. The particle is just able to complete a circle

A. The -string becomes slack when the particle reached its highest point

B. The velocity of the particle becomes zero at the highest point

C. The kinetic energy of the ball in initial position was

D. The particle again passes through the initial position

Answer: A::D

Watch Video Solution

13. The string of a simple pendulum can with stand a maximum tension equal to 4 times the weight of bob suspended to it. The string is made horizontal and bob is released from rest then:

A. String will break somewhere during the motion and will then follow straight line path

B. String will break somewhere during the motion and then follow parabolic path

C. It will complete the vertical circle

D. Motion will be oscillatory and string will not break

Answer: D

View Text Solution

14. A particle of mass m is at rest in a train moving with constant velocity with respect to ground. Now the particle is accelerated by a constant force F_0 acting along the direction of motion of train for time t_0. A girl in the train and a boy on the ground measure the work done by this force. Which of the following are incorrect?

A. Both will measure the same work

B. Boy will measure higher value than the girl

C. Girl will measure higher value than the boy

D. Data are insufficient for the measurement of work ' done by the force F_0

Answer: A::C

View Text Solution

15. The potential energy in joules of a particle of mass 1 kg moving in a plane is given by $U = 3x + 4y$, the position coordinates of the point being x and y, measured in metres. If the particle is initially at rest at (6, 4), then:

A. its acceleration is of magnitude $5m/s^2$

B. its speed when it crosses they-axis is $10m/s$

C. it crosses the y-axis $(x = 0)$ at $y = -4$

D. it moves in a straight line passing through the origin (0, O)

Answer: A::B::C

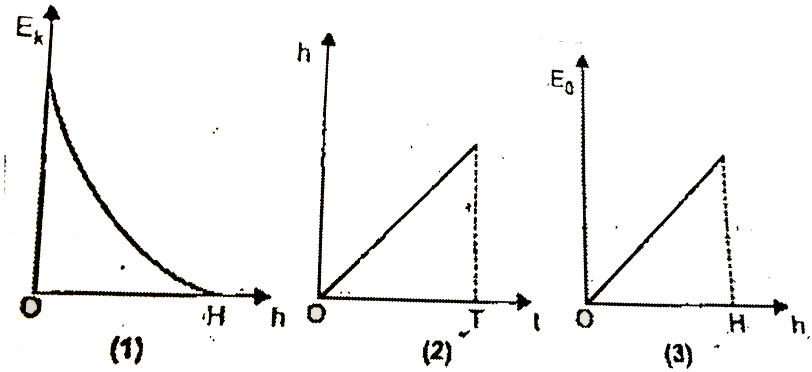
View Text Solution

16. A ball is projected vertically upwards. Air resistance and variation in g may be neglected. The ball rises to its maximum height H in a time T, the height being h after a time t :

(1) The graph of kinetic energy E_k of the ball against height h is shown in figure 1

(2) The graph of height h against time t is shown in figure 2

(3) The graph of gravitational energy E_k of the ball against height h is shown in figure 3



(1)

-Which the figure shows the correct answers ?

A. 3 only

B. 1, 2

C. 2, 3

D. 1 only

Answer: A

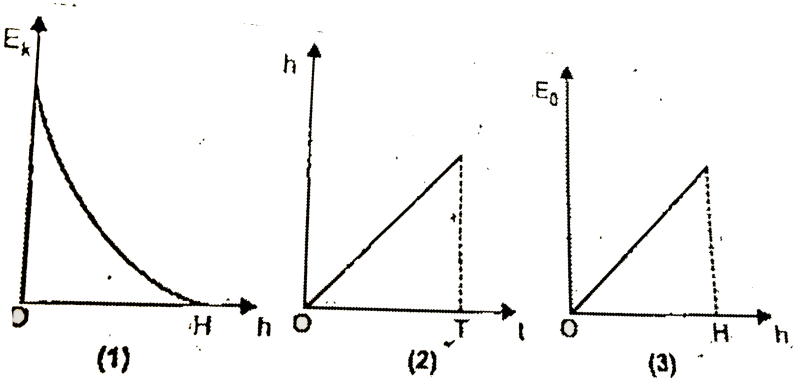
View Text Solution

17. A ball is projected vertically upwards. Air resistance and variation in g may be neglected. The ball rises to its maximum height H in a time T, the height being h after a time t :

(1) The graph of kinetic energy E_k of the ball against height h is shown in figure 1

(2) The graph of height h against time t is shown in figure 2

(3) The graph of gravitational energy E_k of the ball against height h is shown in figure 3



(1)

(2)

In the above situation the block wili have maximum velocity when:

A. the spring force becomes zero

B. the frictional force becomes zero

C. the net force becomes zero

D. the acceleration of block becomes zero

Answer: C::D

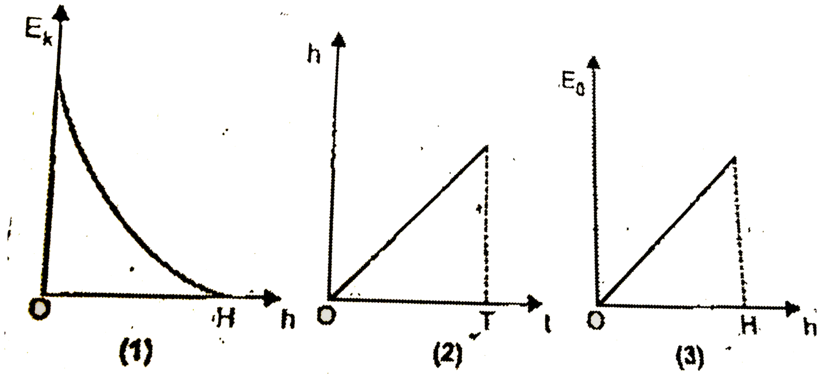
View Text Solution

18. A ball is projected vertically upwards. Air resistance and variation in g may be neglected. The ball rises to its maximum height H in a time T, the height being h after a time t :

(1) The graph of kinetic energy E_k of the ball against height h is shown in figure 1

(2) The graph of height h against time t is shown in figure 2

(3) The graph of gravitational energy E_k of the ball against height h is shown in figure 3

(1) 

Two particles move on a circular path (one just inside and the other just outside) with angular velocities ro and 5ω starting from the same point. Then :

A. they cross each other at regular intervals of time $\frac{2\pi}{4\omega}$ when their angular velocities are oppositely directed

B. they cross each other at points on the path subtending an angle of 60° at the centre if their angular velocities are oppositely directed

C. they cross at intervals of time $\frac{\pi}{3\omega}$ if their angular velocities are oppositely directed

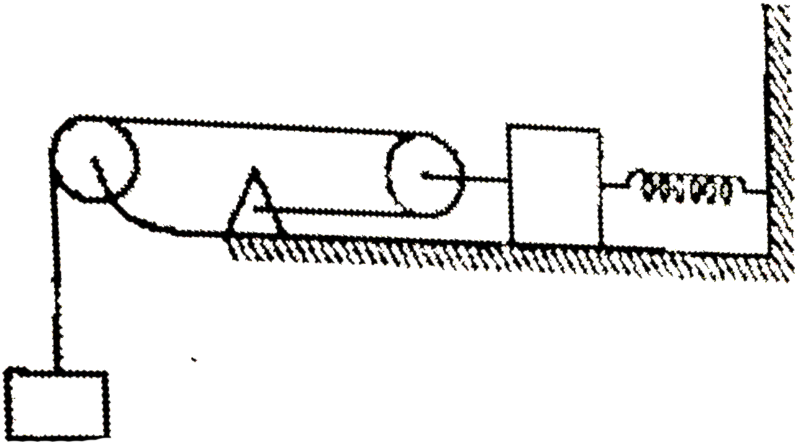
D. they cross each other .at points on the path subtending 90° at the centre if their angular velocities are in the same sense

Answer: B::C::D

Watch Video Solution

Level 3

1. In the shown figure, the spring and string is ideal. The spring the stiffness of $100N/m$ and $m = 1kg$ friction exists between mass 2m and surface with coefficient $\mu = 0.8$. The system is released with spring from its relaxed position. Based on above data, answer the following question: (take $g = 10m/s^2$)



Maximum extension in spring is :

A. 8 cm

B. 4 cm

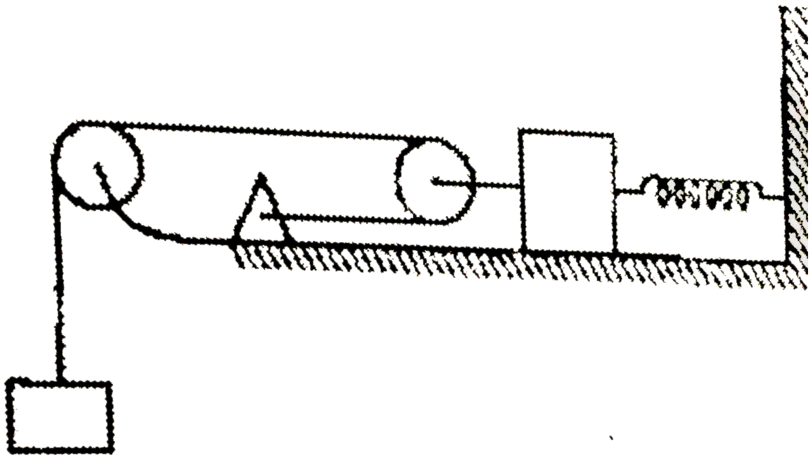
C. 36 cm

D. 20 cm

Answer: A

Watch Video Solution

2. In the shown figure, the spring and string is ideal. The spring the stiffness of $100N/m$ and $m = 1kg$ friction exists between mass 2m and surface with coefficient $\mu = 0.8$. The system is released with spring from its relaxed position. Based on above data, answer the following question: (take $g = 10m/s^2$)



Magnitude of work done by gravity during the motion of system is :

A. 0.8 J

B. 1.6 J

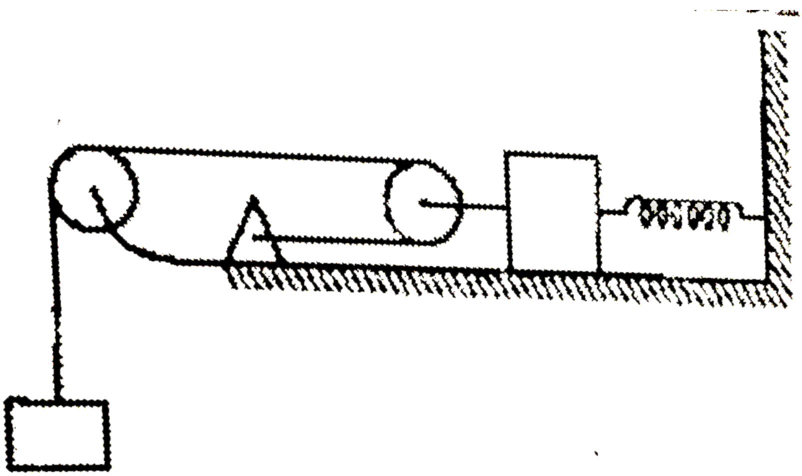
C. 0.4 J

D. 4 J

Answer: B

Watch Video Solution

3. In the shown figure, the spring and string is ideal. The spring the stiffness of $100N/m$ and $m = 1kg$ friction exists between mass 2m and surface with coefficient $\mu = 0.8$. The system is released with spring from its relaxed position. Based on above data, answer the following question: (take $g = 10m/s^2$)



Magnitude of net work done by spring after the system is released for motion is:

A. 0.8 J

B. 1.6 J

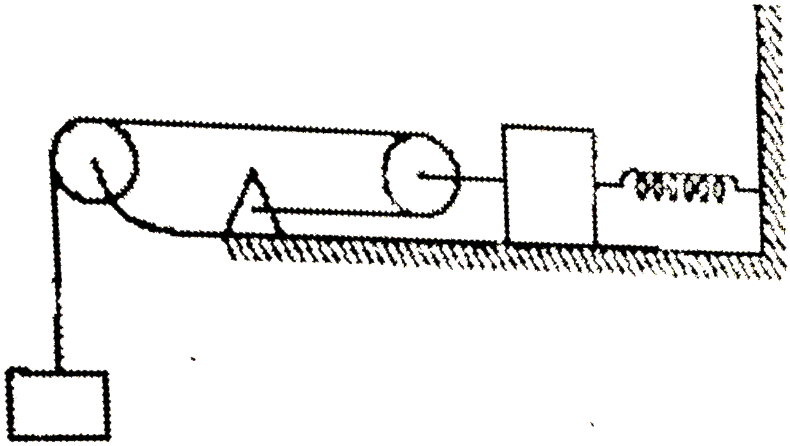
C. 0.32 J

D. 2.40 J

Answer: C

Watch Video Solution

4. In the shown figure, the spring and string is ideal. The spring the stiffness of $100N/m$ and $m = 1kg$ friction exists between mass 2m and surface with coefficient $\mu = 0.8$. The system is released with spring from its relaxed position. Based on above data, answer the following question: (take $g = 10m/s^2$)



Frictional force acting on the mass 2m when it finally comes to rest is:

A. 16 N

B. 8 N

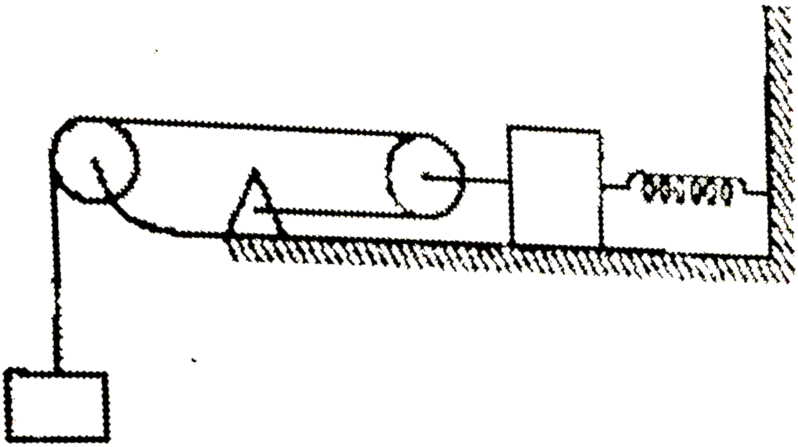
C. 12 N

D. zero

Answer: C

Watch Video Solution

5. In the shown figure, the spring and string is ideal. The spring the stiffness of $100N/m$ and $m = 1kg$ friction exists between mass 2m and surface with coefficient $\mu = 0.8$. The system is released with spring from its relaxed position. Based on above data, answer the following question: (take $g = 10m/s^2$)



After what displacement of mass 2m, its velocity becomes maximum ?

A. 4 cm

B. 8 cm

C. 2 cm

D. zero

Answer: A

Watch Video Solution

6. A single conservative force $F(x)$ acts on a $1.0 - kg$ particle that moves along the x-axis. The potential energy $U(x)$ is given by $U(x) = 20 + (x - 2)^2$ where x is in meters. At $x = 5.0m$, the particle has a kinetic energy of $20J$.

What is the mechanical energy of a system?

A. zero

B. 20 J

C. 29 J

D. 49 J

Answer: D

Watch Video Solution

7. A single conservative $f_{(x)}$ acts on a $m = 1kg$ particle moving along the x-axis. The potential energy $U_{(x)}$ is given by :

$U_{(x)} = 20 + (x - 2)^2$

where x is in metres. At $x = 5m$, a particle has kintetic energy of 20 J

The maximum value of potential energy is:

A. zero

B. 20 J

C. 29 J

D. 49 J

Answer: B

Watch Video Solution

8. A single conservative $f_{(x)}$ acts on a $m = 1kg$ particle moving along the x-axis. The potential energy $U_{(x)}$ is given by :

$U_{(x)} = 20 + (x - 2)^2$

where x is in metres. At $x = 5m$, a particle has kintetic energy of 20 J

The maximum speed of the particle is:

A. $1m/s$

B. $29m/s$

C. $\sqrt{29}m/s$

D. $\sqrt{58}m/s$

Answer: D

Watch Video Solution

9. A single conservative $f_{(x)}$ acts on a $m = 1kg$ particle moving along the x-axis. The potential energy $U_{(x)}$ is given by :

$U_{(x)} = 20 + (x-2)^2$

where x is in metres. At $x = 5m$, a particle has kintetic energy of 20 J

The minimum speed of the particle is:

A. $1m/s$

B. $\sqrt{40}m / s$

C. $\sqrt{58}m / s$

D. zero

Answer: D

Watch Video Solution

10. A single conservative $f_{(x)}$ acts on a $m = 1kg$ particle moving along the x-axis. The potential energy $U_{(x)}$ is given by :

$U_{(x)} = 20 + (x - 2)^2$

where x is in metres. At $x = 5m$, a particle has kintetic energy of 20 J

The maximum value of potential energy is:

A. zero

B. 20 J

C. 29 J

D. 49 J

Answer: D

Watch Video Solution

11. A single conservative $f_{(x)}$ acts on a $m = 1kg$ particle moving along the x-axis. The potential energy $U_{(x)}$ is given by :

$U_{(x)} = 20 + (x - 2)^2$

where x is in metres. At $x = 5m$, a particle has kintetic energy of 20 J

The least value of x (position of particle is) will be:

A. zero

B. -2

C. $-\sqrt{29} + 2$

D. $\sqrt{29} + 2$

Answer: C::D

Watch Video Solution

12. A single conservative $f_{(x)}$ acts on a $m = 1kg$ particle moving along the x-axis. The potential energy $U_{(x)}$ is given by :

$U_{(x)} = 20 + (x - 2)^2$

where x is in metres. At $x = 5m$, a particle has kintetic energy of 20 J

The largest value of x will be:

A. zero

B. -2

C. $-\sqrt{29} + 2$

D. $\sqrt{29} + 2$

Answer: D

Watch Video Solution

13. A single conservative $f_{(x)}$ acts on a $m = 1kg$ particle moving along the x-axis. The potential energy $U_{(x)}$ is given by :

$U_{(x)} = 20 + (x - 2)^2$

where x is in metres. At $x = 5m$, a particle has kintetic energy of 20 J

The position of equilibrium and its nature is:

A. $x = 2$, unstable

B. x = 2, stable

C. x = 2, neutral

D. no equilibrium position exists

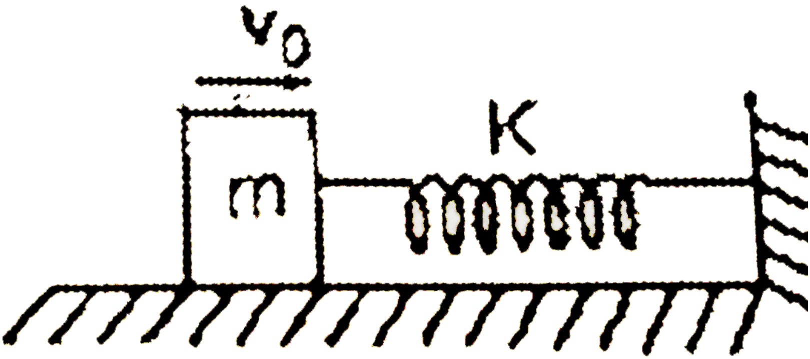
Answer: B

Watch Video Solution

14. A block of mass m moving with a velocity v_0 on a smooth horizontal surface strikes and compresses a spring ofstiffuess k till mass coines to rest as shown in the figure. This phenomenon is observed by two observers :

(a) Standing on the horizontal surface

(b) standing on the block



To an observer A the work done by spring force is:

A. negative but nothing can be said about its mangnitude

B. $-\frac{1}{2}mv_0^2$

C. positive but nothing can be said about its magnitude

D. $+\frac{1}{2}mv_0^2$

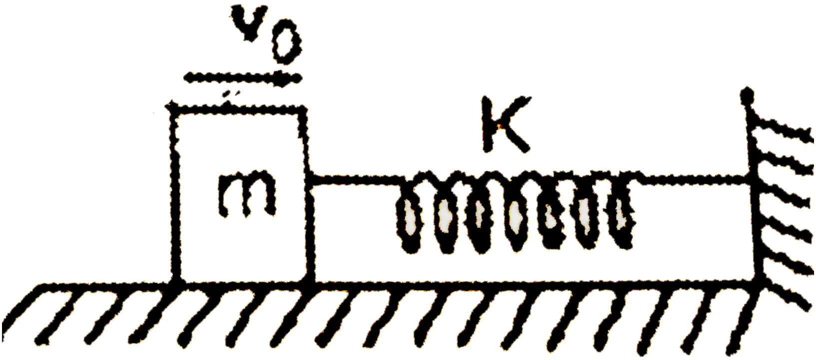
Answer: B

Watch Video Solution

15. A block of mass m moving with a velocity v_0 on a smooth horizontal surface strikes and compresses a spring ofstiffuess k till mass coines to rest as shown in the figure. This phenomenon is observed by two observers :

(a) Standing on the horizontal surface

(b) standing on the block



To an observer A, the work done by the normal reaction N between the block and the spring on the block is :

A. zero

B. $-\frac{1}{2}mv_0^2$

C. $+\frac{1}{2}mv_0^{2-}$

D. none of these

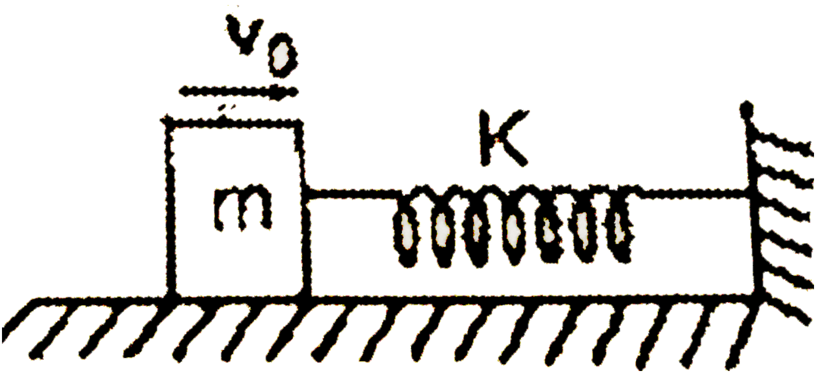
Answer: B

View Text Solution

16. A block of mass m moving with a velocity v_0 on a smooth horizontal surface strikes and compresses a spring ofstiffuess k till mass coines to rest as shown in the figure. This phenomenon is observed by two observers :

(a) Standing on the horizontal surface

(b) standing on the block



To an observer A, the net work done on the block is:

A. $-mv_0^2$

B. $+mv_0^2$

C. $-\frac{1}{2}mv_0^2$

D. zero

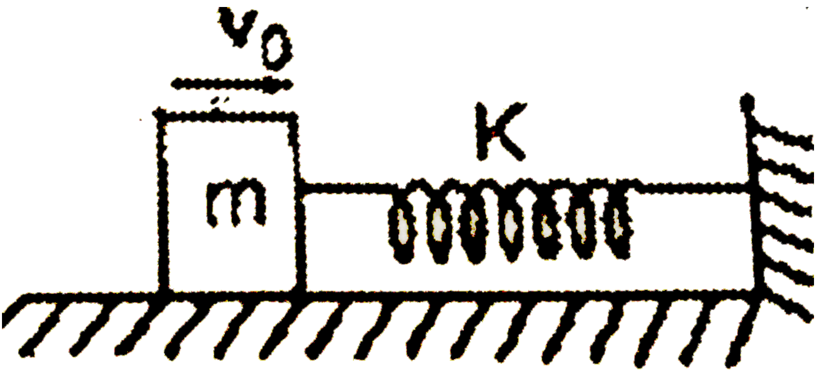
Answer: C

View Text Solution

17. A block of mass m moving with a velocity v_0 on a smooth horizontal surface strikes and compresses a spring ofstiffuess k till mass coines to rest as shown in the figure. This phenomenon is observed by two observers :

(a) Standing on the horizontal surface

(b) standing on the block



Accoording to the observer A :

A. the kinetic energy of the block is converted into the potential energy of the spring

B. the mechanical energy of the spring-mass system is conserved

C. the block loses its kinetic energy because of the negative work done by the conservative force of spring

D. all of the above

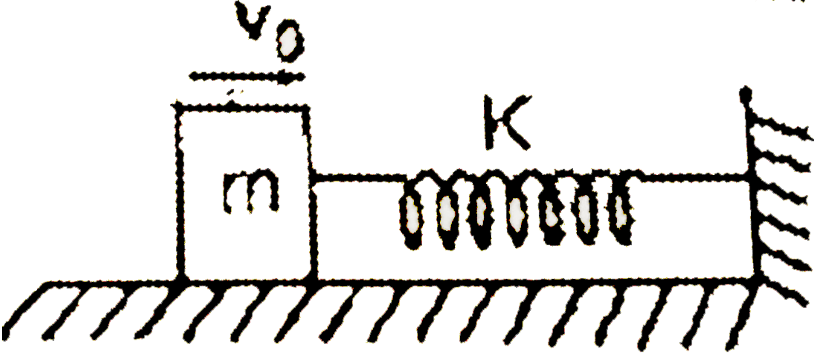
Answer: D

Watch Video Solution

18. A block of mass m moving with a velocity v_0 on a smooth horizontal surface strikes and compresses a spring ofstiffuess k till mass coines to rest as shown in the figure. This phenomenon is observed by two observers :

(a) Standing on the horizontal surface

(b) standing on the block



To an observer B, when the block is compressing the spring :

A. velocity of the block is decreasing

B. retardation of the block is increasing

C. kinetic energy of the block is zero

D. all of the above

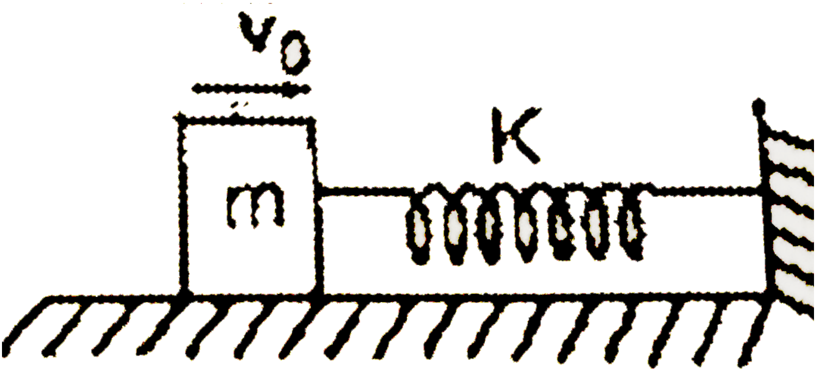
Answer: C

Watch Video Solution

19. A block of mass m moving with a velocity v_0 on a smooth horizontal surface strikes and compresses a spring ofstiffuess k till mass coines to rest as shown in the figure. This phenomenon is observed by two observers :

(a) Standing on the horizontal surface

(b) standing on the block



According to observer B, the potential energy of the spring increases :

A. due to the positive work done by pseudo-force

B. due to the positive work done by normal reaction between spring and wall

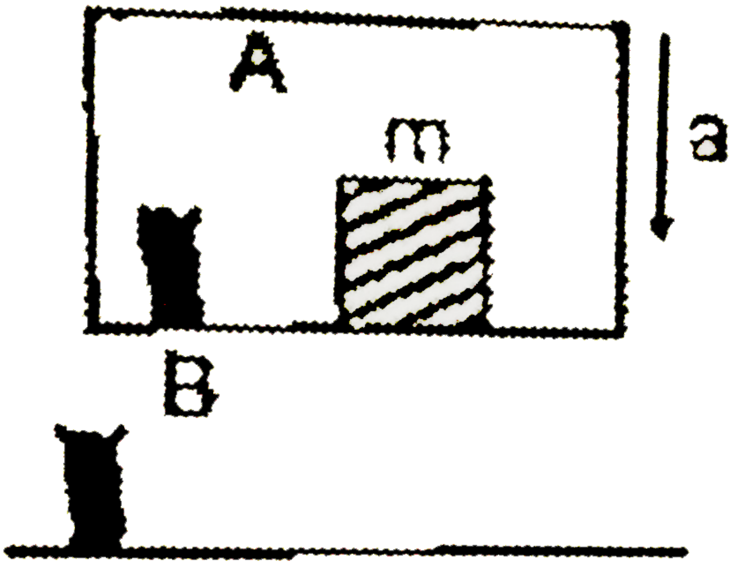
C. due to the decrease in the kinetic energy of the block

D. all of the above

Answer: B

Watch Video Solution

20. A block of mass mis kept in an elevation which starts1 moving downward with an acceleration aas shown in figure. The block is observed by two observers A and B for a time interval t_0



The observer B finds that the work done by gravity on the block is :

A. $\frac{1}{2}mg^2t_0^2$

B. $-\frac{1}{2}mg^2t_0^2$

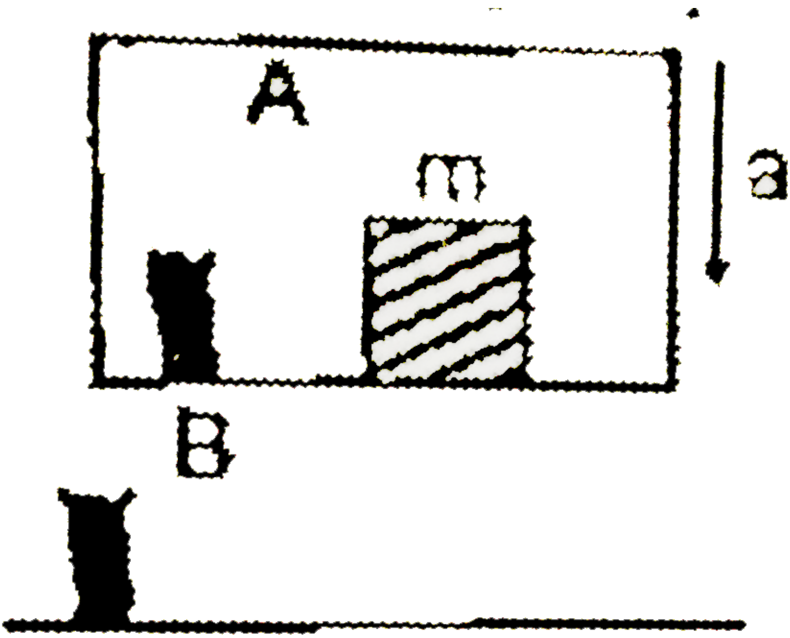
C. $\frac{1}{2}mgat_0^2$

D. $-\frac{1}{2}mgat_0^2$

Answer: C

Watch Video Solution

21. A block of mass mis kept in an elevation which starts1 moving downward with an acceleration aas shown in figure. The block is observed by two observers A and B for a time interval t_0



The observer B finds that the work done by pseudo-force on the block is :

A. zero

B. $-ma^2t_0$

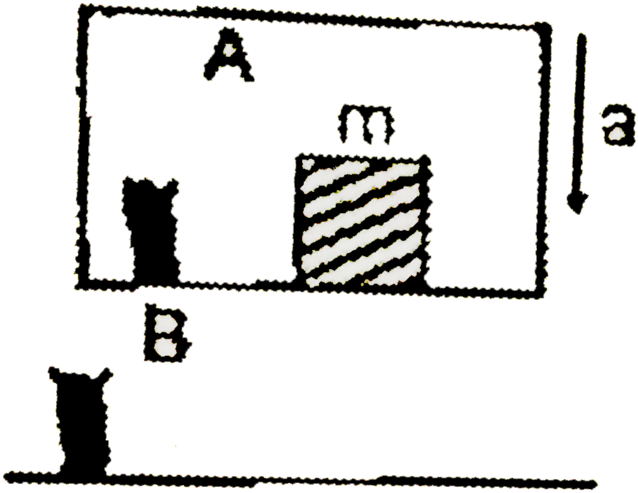
C. $+ma^2t_0$

D. $-mgat_0$

Answer: A

Watch Video Solution

22. A block of mass mis kept in an elevation which starts1 moving downward with an acceleration aas shown in figure. The block is observed by two observers A and B for a time interval t_0



According to observer B, the net work done on the block is:

A. $-\frac{1}{2}ma^2t_0^2$

B. $\frac{1}{2}ma^2t_0^2$

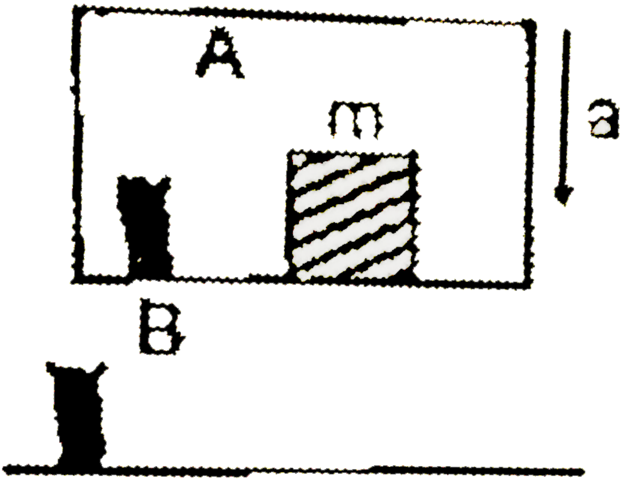
C. $\frac{1}{2}mgat_0^2$

D. $-\frac{1}{2}mgat_0^2$

Answer: B

Watch Video Solution

23. A block of mass mis kept in an elevation which starts1 moving downward with an acceleration aas shown in figure. The block is observed by two observers A and B for a time interval t_0



According to the observer A :

A. the work done by gravity is zero

B. the work done by normal reaction is zero

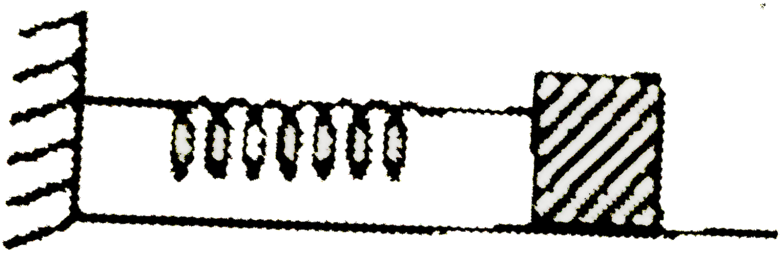
C. the work done by pseudo-force is zero

D. all of the above

Answer: D

Watch Video Solution

24. A spring block system is placed on a rough horizontal floor. The block is pulled towards right to give spring an eleongation less than $\frac{2\mu mg}{K}$ but more than $\frac{\mu mg}{K}$ and released.



Which of the following Jaws/principles of physics can be applied on the spring block system ?

A. Conservation of mechanical energy

B. Conservation of momentum

C. Work energy principle

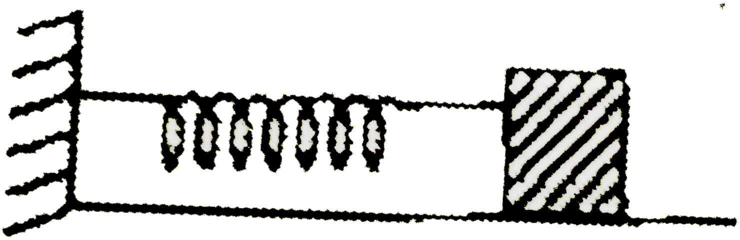
D. None

Answer: C

Watch Video Solution

Watch Video Solution

25. A spring block system is placed on a rough horizontal floor. The block is pulled towards right to give spring an eleongation less than $\frac{2\mu mg}{K}$ but more than $\frac{\mu mg}{K}$ and released.



The correct statement is :

A. The block will cross the mean position

B. The block will come to rest when the forces acting · on it are exactly balanced

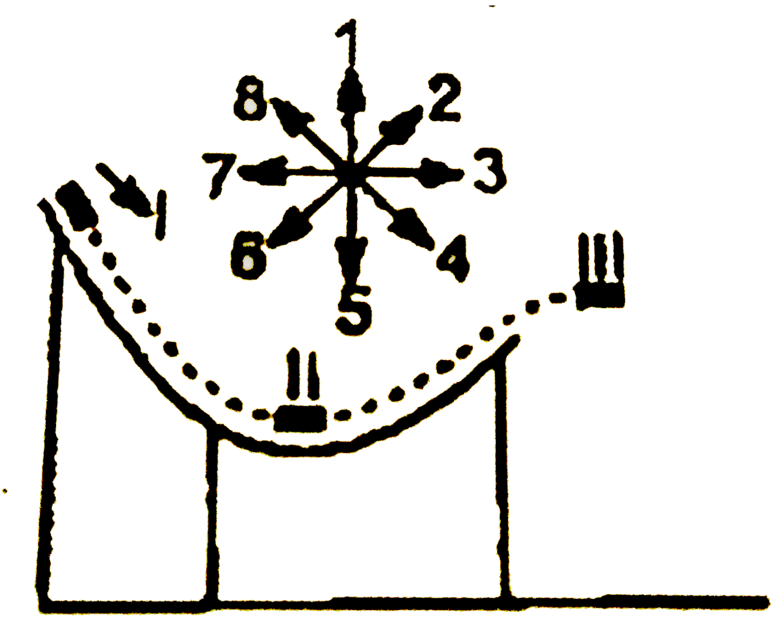
C. The block will come to rest when the work done by friction becomes equal to the change in energy stored in spring

D. None

Answer: C

Watch Video Solution

26. This diagram depicts a block sliding along a, frictionless ramp in vertical plane. The eightl numbered arrows in the diagram represent directions, to be referred to when answering the questions.



The direction of the acceleration of the block, when in position I, is best represented by which of the arrows in the diagram ?

A. 2

B. 4

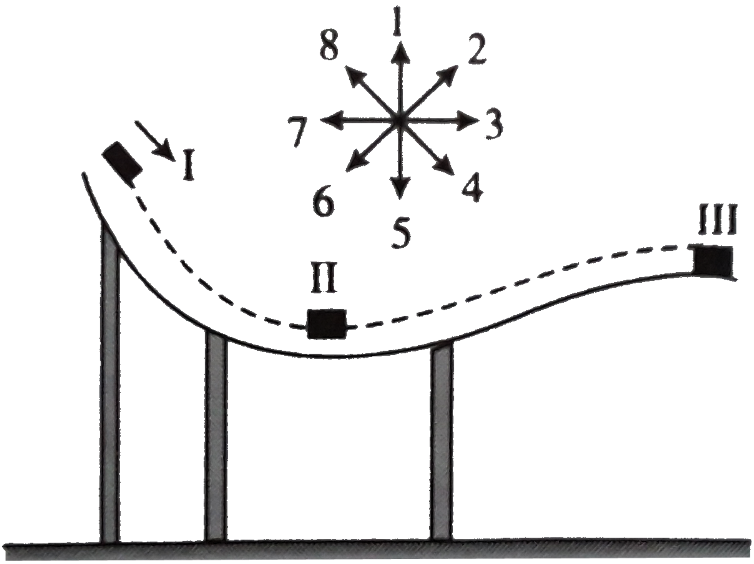
C. 5

D. None of the arrows, the acceleration is zero

Answer: B

View Text Solution

27. figure depicts a block sliding along a frictionless ramp in vertical plane Eight numbered arrows in the diagram repreesent direction to be referred to when answering the questions



Position - i : Starts sliding on curve path

Position - ii : Lowest position of the curve path

Position - iii : Just outside of the curve path

The direction of the acceleration of the blocks when in position ii is best represented by which of the arrows in the diagram?

A. 1

B. 3

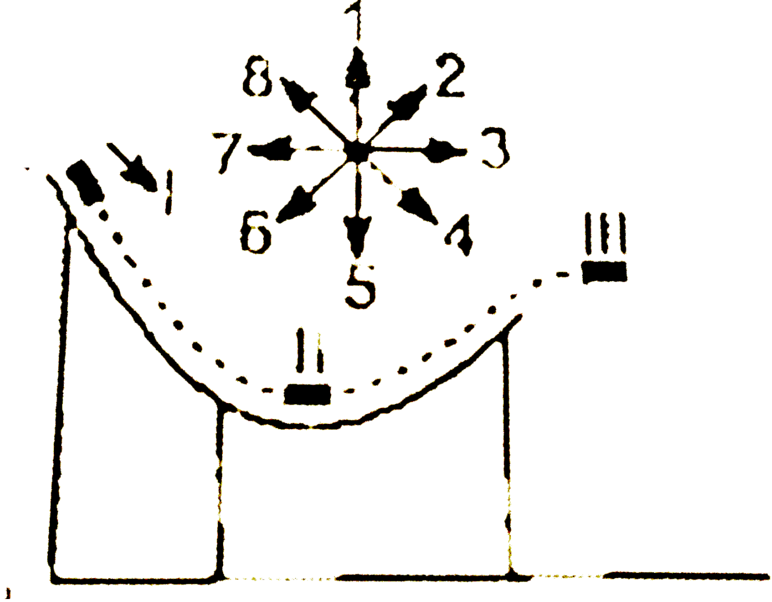
C. 5

D. 8

Answer: A

Watch Video Solution

28. This diagram depicts a block sliding along a, frictionless ramp in vertical plane. The eightl numbered arrows in the diagram represent directions, to be referred to when answering the questions.



The direction of the acceleration of the block (after leaving the ramp) at position III is best represented by which of the arrows in the diagram ?

A. 2

B. 5

C. 6

D. None of the arrows, the acceleration is zero

Answer: B

Watch Video Solution

29. The kinetic energy of any body depends on the frame of reference of the observer. The kinetic energy is given by $1/2mv_{\text{rel}}^2$. Similarly the displacement of the object from different frames of reference will be: different. But the forces acting on the body remain unchanged. So work done by the forces as seen from: different frames will be different. But work energy! theorem will still be hold in every inertial reference' frame.

For example, if a block of mass 2kg is moving with, velocity of $1m/s$ towards east on a rough surface, its $KE = \frac{1}{2} \times 2 \times 1^2 = 1J$

If it comes to rest, its $KE = 0$

work done by friction $= K_f - k_i = -1J$

If we observe it form a frame 2 moving with $1m/s$ toward east, its initial velocity will appear to be $1 - 1 = 0$

Initial $KE = \frac{1}{2} \times 2 \times 0^2 = 0$

Final velocity $= 0 - 1 = -1$

Final $KE = \frac{1}{2} \times 2 \times (-1)^2 = 1J$

$\Rightarrow$ Work done by friction $= 1 - 0 = 1J$

According to passage:

A. In 2^{nd} frame, force of friction was opposite to displacement

B. In 2^{nd} frame, force of friction was in same direction as displacement

C. In ground frame, force of friction is in same direction as the displacement

D. None of the above

Answer: B

Watch Video Solution

30. The kinetic energy of any body depends on the frame of reference of the observer. The kinetic energy is given by $1/2mv_{\text{rel}}^2$. Similarly the displacement of the object from different frames of reference will be: different. But the forces acting on the body remain unchanged. So work done by the forces as seen from: different frames will be different. But work energy! theorem will still be hold in every inertial reference' frame. For example, if a block of mass 2kg is moving with, velocity of $1m/s$ towards east on a rough surface, its $KE = \frac{1}{2} \times 2 \times 1^2 = 1J$

If it comes to rest, its $KE = 0$

work done by friction $= K_f - k_i = -1J$

If we observe it form a frame 2 moving with $1m/s$ toward east, its initial velocity will appear to be $1-1=0$

Initial $KE = \frac{1}{2} \times 2 \times 0^2 = 0$

Final velocity $= 0 - 1 = -1$

Final $KE = \frac{1}{2} \times 2 \times (-1)^2 = 1J$

$\Rightarrow$ Work done by friction $= 1 - 0 = 1J$

What should be the velocity of an observer so that he will report the work done by friction on the block to be 0:

A. $\frac{1}{2}m/sW$

B. $\frac{1}{2}m/sE$

C. $1m/sW$

D. $1m/sE$

Answer: B

Watch Video Solution

31. The kinetic energy of any body depends on the frame of reference of the observer. The kinetic energy is given by $1/2mv_{\text{rel}}^2$. Similarly the displacement of the object from different frames of reference will be: different. But the forces acting on the body remain unchanged. So work done by the forces as seen from: different frames will be different. But work energy! theorem will still be hold in every inertial reference' frame.

For example, if a block of mass 2kg is moving with, velocity of $1m/s$ towards east on a rough surface, its $KE = \frac{1}{2} \times 2 \times 1^2 = 1J$

If it comes to rest, its $KE = 0$

work done by friction $= K_f - k_i = -1J$

If we observe it form a frame 2 moving with $1m/s$ toward east, its initial velocity will appear to be $1 - 1 = 0$

Initial $KE = \frac{1}{2} \times 2 \times 0^2 = 0$

Final velocity $= 0 - 1 = -1$

Final $KE = \frac{1}{2} \times 2 \times (-1)^2 = 1J$

$\Rightarrow$ Work done by friction $= 1 - 0 = 1J$

Choose correct statement :

A. In ground frame, work done by friction on ground is positive

B. In ground frame, work done by friction on ground is negative

C. In frame 2, work done by friction on ground is negative

D. In frame 2, work done by friction on ground is positive

Answer: C

Watch Video Solution

32. The potential energy at a point, relative to the reference point is always defined as the negative of work done by the force as the object moves from the reference point to the point considered. The value of potential energy at the reference point itself can be set equal to zero because we are always concerned only with differences of potential energy between two points and the associated change of kinetic energy. A particles A is fixed at origin of a fixed coordinate system. A particle B which is free to move experiences an force $\overrightarrow{F} = \left(-\frac{2a}{r^3} + \frac{\beta}{r^2}\right)\hat{r}$ due to particle A where $\hat{r}$ is the position vector of particle B relative to A. It is given that the force is conservative in nature and _potential energy at infinity is zero. If B has to be removed from the influence of A, energy has to be supplied for such a process. The ionization energy E 0 is work that has to be done by an external agent to move the particle from a distance r_0 to infinity slowly. Here r_0 is the equilibrium position of the particle What is potential energy function of particle as function of r.

A. $\frac{\alpha}{r^2} - \frac{\beta}{r}$

B. $-\frac{\alpha}{r^2} + \frac{\beta}{r}$

C. $-\frac{\alpha}{r^2} - \frac{\beta}{r}$

D. $\frac{\alpha}{r^2} + \frac{\beta}{r}$

Answer: B

Watch Video Solution

33. The potential energy at a point, relative to the reference point is always defined as the negative of work done by the force as the object moves from the reference point to the point considered. The value of potential energy at the reference point itself can be set equal to zero because we are always concerned only with differences of potential energy between two points and the associated change of kinetic energy.

A particles A is fixed at origin of a fixed coordinate system. A particle B which is free to move experiences an force $\vec{F} = \left(-\frac{2a}{r^3} + \frac{\beta}{r^2} \right) \hat{r}$ due to particle A where $\hat{r}$ is the position vector of particle B relative to A. It is given that the force is conservative in nature and _potential energy at infinity is zero. If B has to be removed from the influence of A, energy has to be supplied for such a process. The ionization energy E 0 is work that has to be done by an external agent to move the particle from a distance r_0 to infinity slowly. Here r_0 is the equilibrium position of the particle

Find the ionization energy E_0 of the particle B

A. $\frac{\beta^2}{2\alpha}$

B. $\frac{2\beta^2}{\alpha}$

C. $\frac{\beta^2}{4\alpha}$

D. $\frac{\beta^2}{\alpha}$

Answer: C

Watch Video Solution

34. The potential energy at a point, relative to the reference point is always defined as the negative of work done by the force as the object moves from the reference point to the point considered. The value of potential energy at the reference point itself can be set equal to zero because we are always concerned only with differences of potential energy between two points and the associated change of kinetic energy. A particles A is fixed at origin of a fixed coordinate system. A particle B which is free to move experiences an force $\overrightarrow{F}=\left(-\frac{2a}{r^3}+\frac{\beta}{r^2}\right)\hat{r}$ due to particle A where $\hat{r}$ is the position vector of particle B relative to A. It is given that the force is conservative in nature and _potential energy at infinity is zero. If B has to be removed from the influence of A, energy has to be supplied for such a process. The ionization energy E 0 is work that has to be done by an external agent to move the particle from a distance r_0 to infinity slowly. Here r_0 is the equilibrium position of the particle

If particle B is transferred slowly from point $P_1\left(\sqrt{2}r_0, \sqrt{2}r_0\right)$ to point $P_2\left(\frac{r_0}{\sqrt{2}}, \frac{r_0}{\sqrt{2}}\right)$ in the xy-plane by an external agent, calculate work required to be done by it in the process:

A. $\frac{9\beta^2}{64alpga}$

B. $\frac{\beta^2}{16\alpha}$

C. $\frac{\beta^2}{64\alpha}$

D. None of these

Answer: B

Watch Video Solution

Matching Types Problems

1. Match the following :

	Column-I		Column-II
(A)	Work done by all the forces	(P)	Change in potential energy
(B)	Work done by conservative forces	(Q)	Change in kinetic energy
(C)	Work done by external forces	(R)	Change in mechanical energ
		(S)	None

Watch Video Solution

2. A particle is suspended from a string of length R. It is given a velocity $u = 3\sqrt{gR}$ at the bottom. Match the following:

	Column-1	Column-2
(A)	Velocity at B	(P) 7 mg
(B)	Velocity at C	$(Q)\sqrt{5gR}$
(C)	Tension in string at B	$(R)\sqrt{7gR}$
(D)	Tension in string at C	$(S)5mg$
		(T)None

Watch Video Solution

3. A force F=kx (where k is a positive constant) is acting on a particle Work done:

	Column-1	Column-2
(A)	in displacing the body from x=2 to x=4	(P) Negative
(B)	In displacing the body from x=-4 to x=-2	(Q) Positive
(C)	In displacing the body from x=-2 to x=+2	(R) Zero

Watch Video Solution

4. F-x and corresponding U-x graph are as shown in figure. Three points A,B and C in F-x graphs may be corresponding to P,Q and R in the U-x graph. Match the following

	Column-1	Column-2
(A)	A	(P) P
(B)	B	(Q) Q
(C)	C	(R) R
		(S) None

Watch Video Solution

5. A body is moved along a straight line by a machine delivering a power proportional to time $(P \propto t)$ Then match the following :

	Column-1	Column-2
(A)	Velocity is proportional to	(P) t
(B)	Displacement proportional to	$(Q) t^2$
(C)	Work done proportional to	$(R) t^3$

Watch Video Solution

6. A pendulum is released from point A as shown in figure. At some instant net force on the bob is making and angle θ with the string. Then match the following:

	Column-1	Column-2
(A)	F or $\theta = 30^\circ$	(P) Particle may be moving between B & A
(B)	F or $\theta = 120^\circ$	(Q) Particle may be moving between C & B parti
(C)	F or $\theta = 90^\circ$	(R) Particle is at A
(D)	F or $\theta = 0^\circ$	(S) Particle is at B
		(T) None

Watch Video Solution

7. Match the following :

	Column-1	Column-2
(A)	Electrostatic potential energy	(P) Positive
(B)	Gravitational potential energy	(Q) Negative
(C)	Elastic potential energy	(R) Zero
(D)	Magnetic potential energy	(S) Not defined

Watch Video Solution

8. A particle of mass m kg is displaced from one given point to another given point under the action of several conservative and non conservative forces (Neglect relativistic considerations) Now match the following .

	Column-1	Column-2
(A)	Displacement of particle	(P) Path dependent
(B)	Work done conservative force	(Q) Path independent
(C)	Work done by non-conservative force	(R) Frame dependent
(D)	Angular displacement	(S) Frame independent
		(T) Dependent on location c

View Text Solution

9. In the figure shown, upper block is given a velocity $6m/s$ and very long plank, velocity $3m/s$ The following quantities are to be matched when both attain same velocity.

	Column-1	C
(A)	Work done by friction on 1 kg block in joule	(P)
(B)	Work done by friction on 2 kg plank in joule	(Q)
(C)	Magnitude of change in momentum in N-s of 2 kg plank	(R)
(D)	Change in KE of system consisting of block and plank in joule	(S)
		(T)

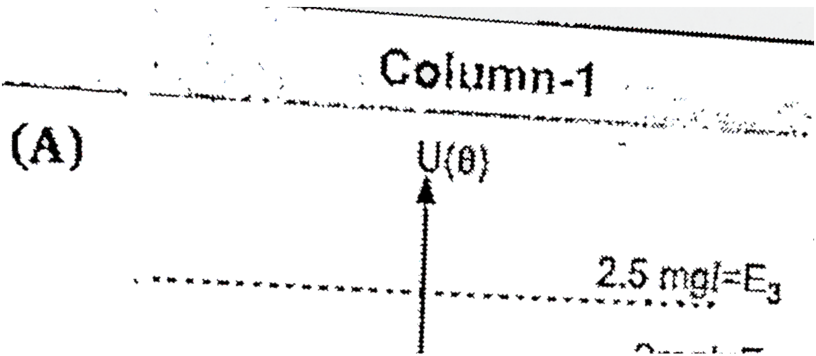
View Text Solution

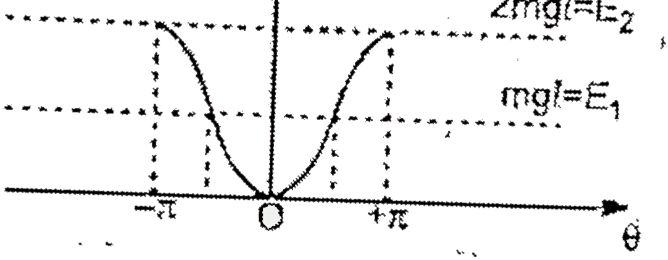
10. Initially spring are in natural length An application of external varying force F causes the block to move slowly distance x towards wall on smooth floor:

	Column - 1		Column - 2
(A)	Work done by S_2 on block	(P)	zero
(B)	Work done by S_2 and S_1	(Q)	$-\frac{1}{2}\left(\frac{k_1k_2}{k_1+k_2}\right)x^2$
(C)	Work done by F on block	(R)	$\frac{1}{2}\left(\frac{k_1k_2}{k_1+k_2}\right)x^2$
(D)	Work done by S_1 on wall	(S)	$\frac{1}{2}\frac{k_1k_2^2x^2}{(k_1+k_2)}$

View Text Solution

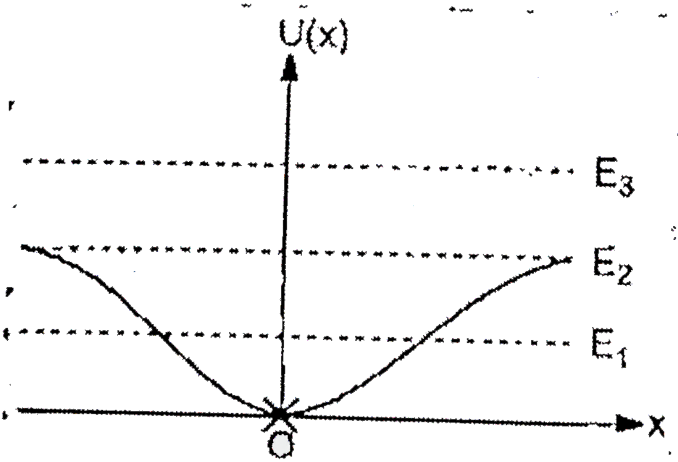
11. Column-1 represents potential energy graph for certain system. Column-2 gives statement related to graphs.





U vs θ graph for a bob hanging vertically from a string with its lowest position as reference level and θ is angle of string from vertical line

(B)



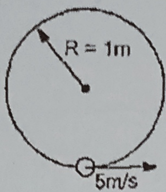
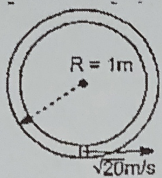
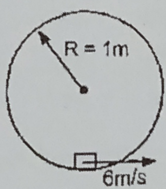
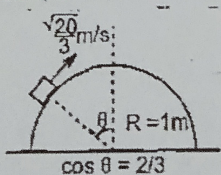
A particle moving along x-axis with potential energy function as $U(x) = [1 - e^{-x^2}]$

View Text Solution

12. A bob tied to an ideal string of length l is released from the horizonatal position shown. A peg P whose height is adjustable, can arrest the free swing of the pendulum, as shown in figure

	Column-1	Column-2
(A)	For what range of y will the string wind up on the peg remaining taut throughout the swing	$(P)\frac{2l}{5} < y$
(B)	For what range of y will the pendulum become projectile	$(Q)0 < y <$
(C)	For what value of y will mechanical energy always remain conserved	$(R)\frac{2l}{5} < y$
		$(S)\frac{l}{3} < y <$

13. In column-1 a situation is depicted each of which is in vertical plane. The surfaces are frictionless. Match with appropriate entries in column-2.

Column-1	Column-2
(A) Bead is threaded on a circular fixed wire and is projected from the lowest point 	(P) Normal force is zero at topmost point of its trajectory
(B) Block loosely fits inside the fixed small tube and is projected from lowest point 	(Q) Velocity of the body is zero at topmost point of its trajectory
(C) Block is projected horizontally from lowest point of a smooth fixed cylinder 	(R) Acceleration of the body is zero at the topmost point of its trajectory
(D) Block is projected on a fixed hemisphere from angular position θ 	(S) Normal force is radially outward at topmost point of trajectory

Watch Video Solution

14. A block of mass m is tied with an inextensible light string of length$l$. One end of the string is fixed at point O. Block is released (from rest) at A. Find acceleration of particle during its motion in vertical plane at positions specified in column-1 and match them with column-2. Given that A and O are at same horizontal level.

	Column -1		Column -2
(A)	Highest point	(P)	Acceleration is horizontal
(B)	At lowest point	(Q)	Acceleration is vertically
(C)	At $\theta = \tan^{-1}\left(\sqrt{2}\right)$ with vertical	(R)	Acceleration is vertically d
		(S)	Acceleration has both horiz

Watch Video Solution