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India's Number 1 Education App

PHYSICS

AIMED AT STUDENTS PREPARING FOR IIT JEE EXAMS

WORK POWER AND ENERGY

Solved Example

1. A body is displaced from $\vec{r}_A = \left(2\hat{i} + 4\hat{j} - 6\hat{k}\right)$ to $\vec{r}_B = \left(6\hat{i} - 4\hat{j} + 3\hat{k}\right)$ under a constant force $\vec{F} = \left(2\hat{i} + 3\hat{j} - \hat{k}\right)$. Find the work done.

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2. A force $\vec{F} = 2x\hat{i} + 2\hat{j} + 3z^2\hat{k}N$ is acting on a particle .Find the work done by this force in displacing the body from $(1, 2, 3)m$ to $(3, 6, 1)m$

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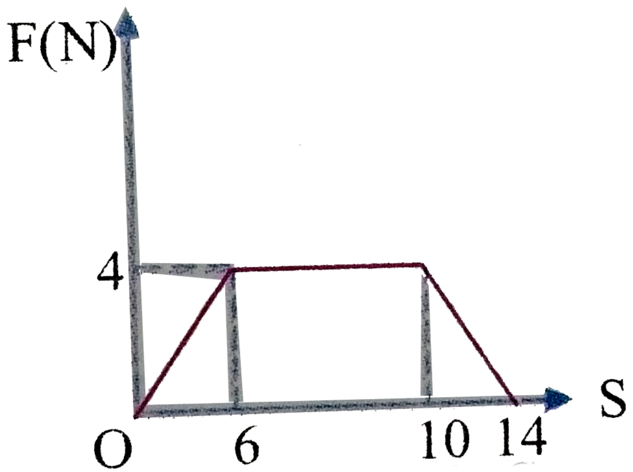
3. The force acting on an object varies with the distance travelled by the object as shown in the figure. Find the work done by the force in moving the object from $x = 0m$ to $x = 14m$.



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4. When a rubber bandis streched by a distance x , if exerts resuring foprce of magnitube $F = ax + bx^2$ where$a$ and b are constant . The work in streached the unstreched rubber - band by L is

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5. A particle of mass m is projected at an angle α to the horizontal with an initial velocity u. The work done by gravity during the time it reaches its highest point is

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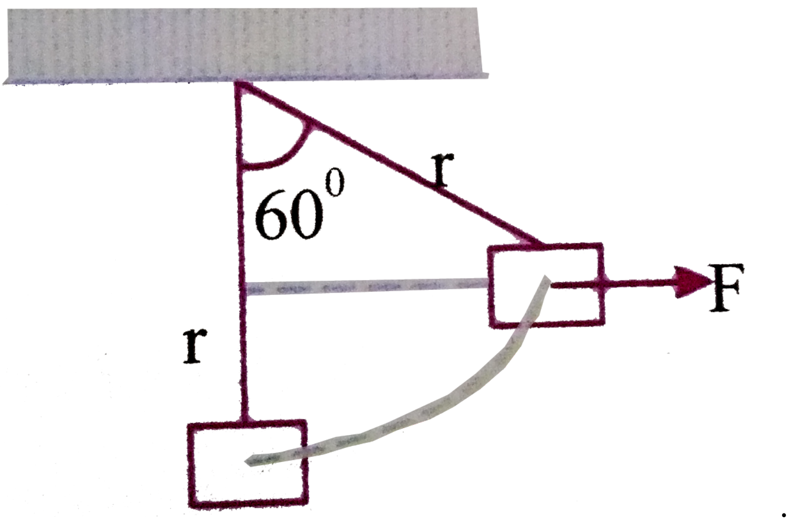
6. A $10kg$ block is pulled along a frictionless surface in the form of an arc of a circle of radius $10m$. The applied force is $200N$. Find the work done by (a) applied force and (b) gravitational force in displacing through an angle 60°.



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7. A uniform chain of length $2m$ is kept on a table such that a length of $60cm$ hangas freely from the adge of the table . The table . The total mass of the chain ia $4kg$ What is the work done in pulling the entire the chain the on the table ?

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8. Find the work done in lifting a body of mass $20kg$ and specific gravity 3.2 to a height of $8m$ in water ? $\left(g=10m/s^2\right)$.

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9. A block of 'm' is lowered with the help of a rope of negligible mass through a distance 'd' with an acceleration of $g/3$. Find the work done by the rope on the block ?

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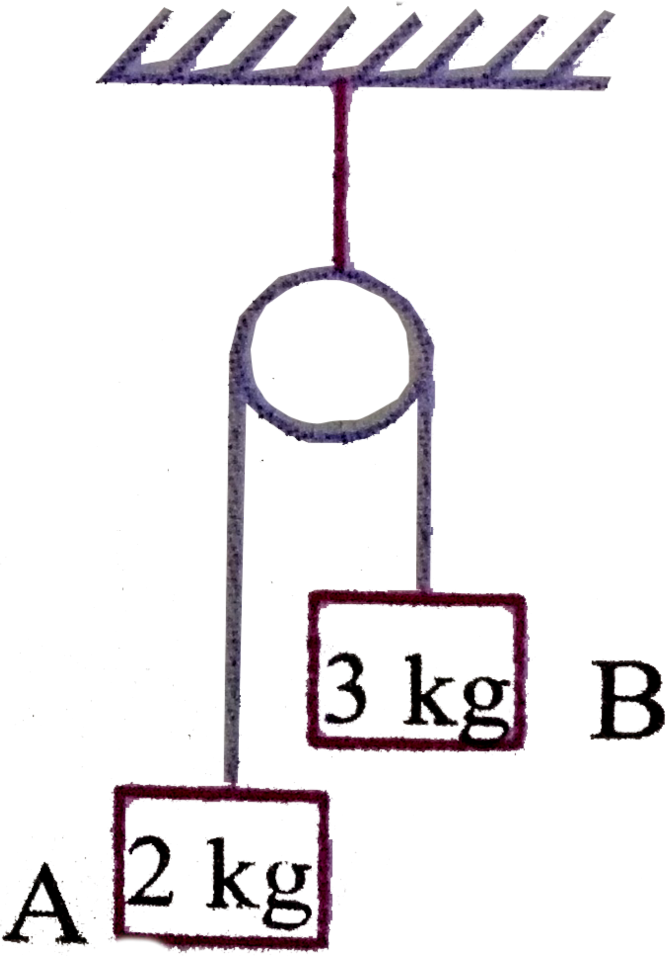
10. If the system shown in released from rest. Find the net workdone by tension in first one second $\left(g = 10m / s^2\right)$.



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11. A particle is projected at $60(\circ)$ to the horizontal with a kinetic energy K. The kinetic energy at the highest point is

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12. An athlete in the Olympic gamed covers a distance of $100m$ in $10s$. His kinetic energy can be estimated to be in range.

(1) $200J - 500J$

(2) $2 \times 10^5 J - 3 \times 10^5 J$

(3) $20,000J - 50,000J$

(4) $2,000J - 5,000J.$

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13. The kinetic energy of a particle moving along a circle of radius R depends on the distance covered s as $K = \lambda s^2$, where λ is a constant. Find the force acting on the particle as a function of s.

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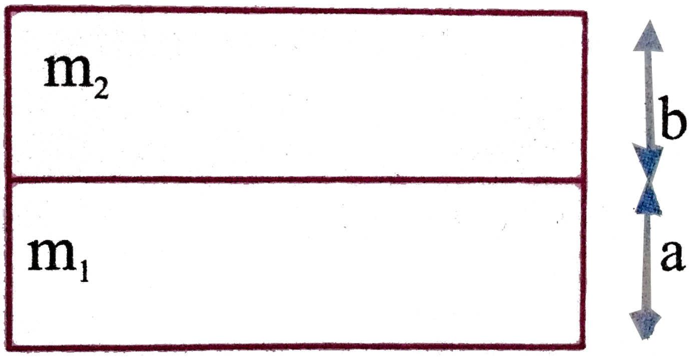
14. A rectangular plank of mass m_1 and height 'a' is on a horizontal surface. On the top of it another rectangular plank of mass m_2 and height 'b' is placed. Find the potential energy of the system ?



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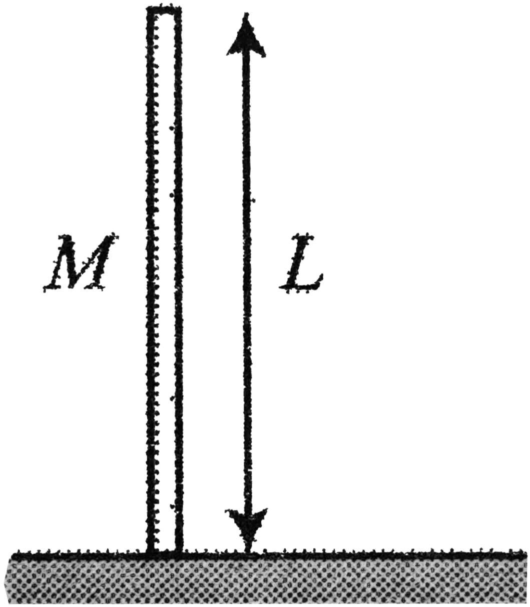
15. A uniform rod of mass M and length L is held vertically upright on a horizontal surface as shown in figure. Assuming zero potential energy at the base of the rod, determine the potential energy of the rod.



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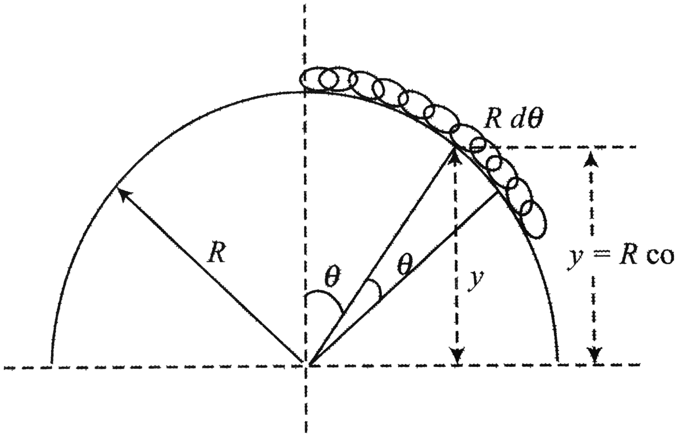
16. A chain of length l and mass m lies of the surface of a smooth hemisphere of radius $R > l$ with one end tied to the top of the hemisphere. Taking base of the hemisphere as reference line, find the

gravitational potential energy of the chain.



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17. 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

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18. 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 .

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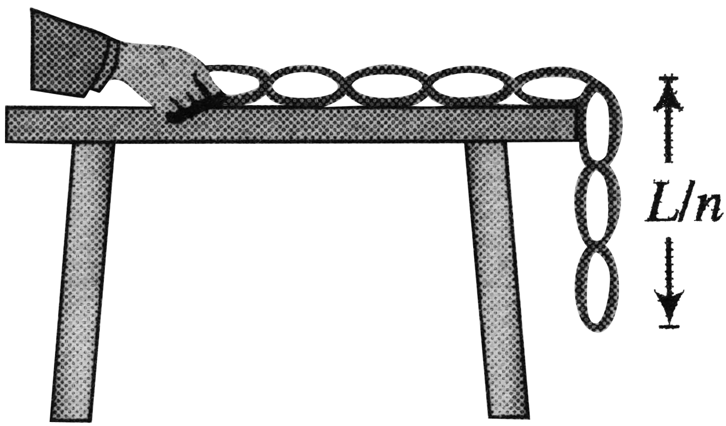
19. A chain of length L and mass M is held on a frictionless table with $(1/n)th$ of its length hanging over the edge. When the chain is released, find the velocity of chain while leaving the table.



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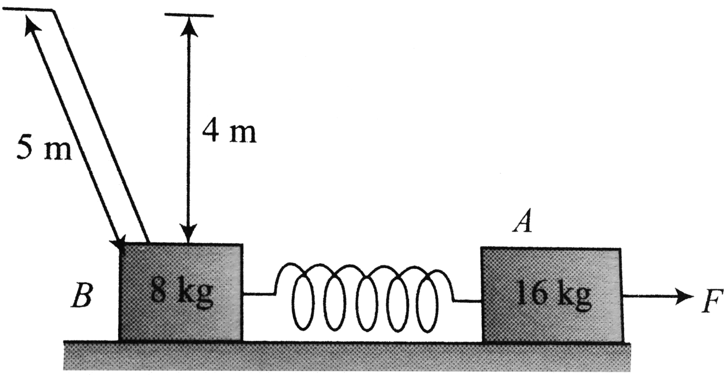
20. Two blocks having masses $8kg$ and $16kg$ are connected to the two ends of a light spring. The system is placed on a smooth horizontal floor. An inextensible string also connects B with ceiling as shown in the figure at the initial moment. Initially the spring has its natural length. A constant horizontal 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 contact with ground?



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21. A $2kg$ block slides on a horizontal floor with the a speed of $4m/s$ it strikes a uncompressed spring , and compresses it till the block is motionless . The kinetic friction force is compresses is $15N$ and spring constant is $10000N/m$. The spring by

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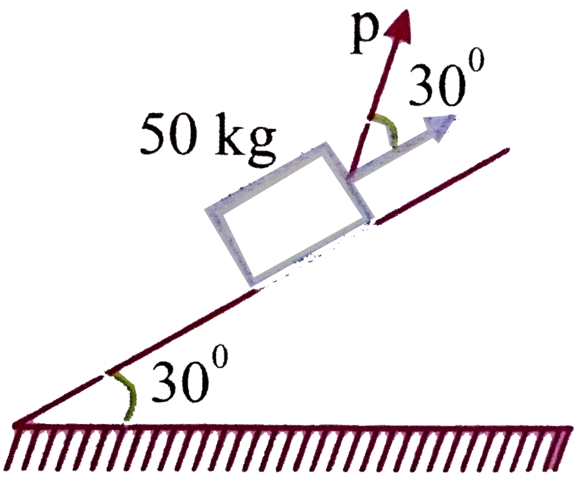
22. In the below figure, what constant force 'P' is requried to bring the $50kg$ body, which starts from rest to a velocity of $10m/s$ in moving $7m$ along the plane ? (Neglect friction).



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23. Figure shows a spring fixed at the bottom end of an incline of inclination 37^0. A small block of mass 2 kg starts slipping down the incline from a point 4.8 m away from the spring. The block compresses the spring by 20 cm, stops momentarily and then rebounds through a distance of 1 m up the incline. Find a. the frictioin coefficient between the plane and the block and b. the spring constant of the spring. Take $g = 10\frac{m}{s^2}$.

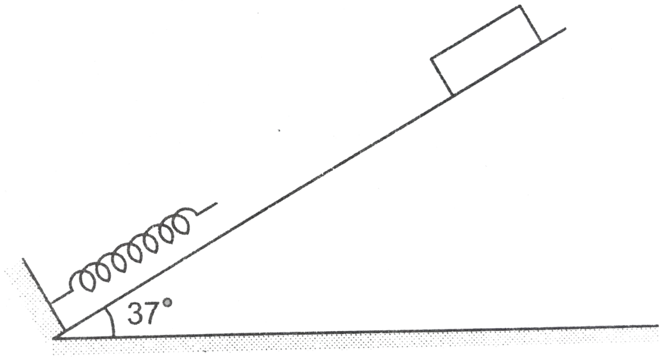

Figure 8-E7

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24. In a molecule, the potential energy between two atoms is given by $U(x) = \frac{1}{x^{12}} - \frac{b}{x^6}$. Where 'a' and 'b' are positive constants and 'x' is the distance between atoms. Find the value of 'x' at which force is zero and minimim $P.E$ at that point.

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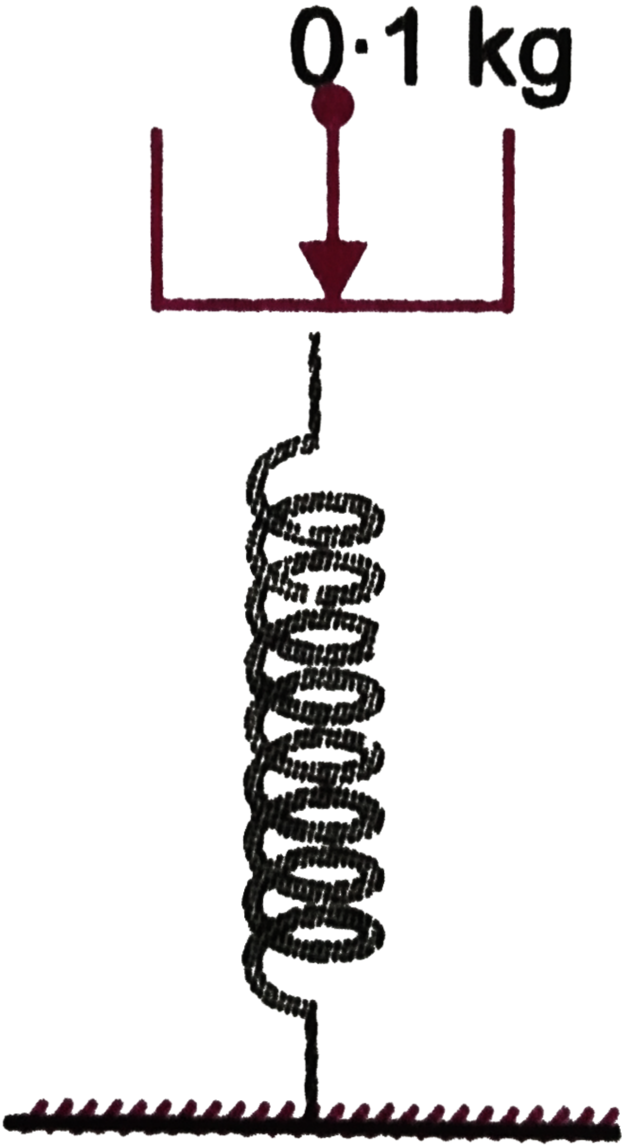
25. A massless platform is kept on a light elastic spring as shown in figure. When a small stone of mass 0.1 kg is dropped on the pan from a height of 0.24 m, the spring compresses by 0.01m. From what height should the stone be droppped to cause a compression of 0.04m in the spring ?



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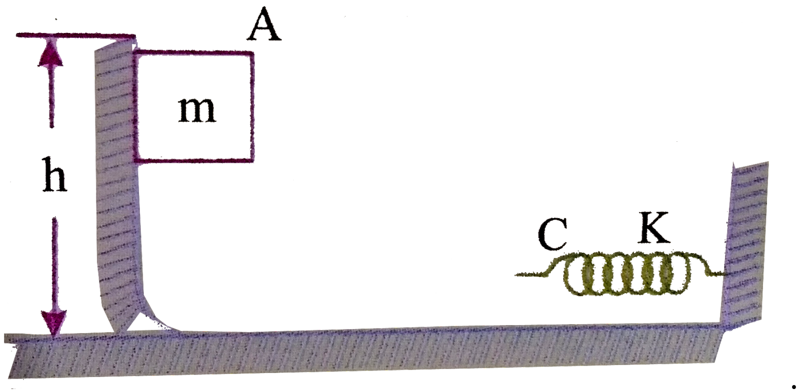
26. A small mass 'm' is sliding down on a smooth curved incline form a height 'h' and finally moves through a horizontal smooth surface. A light spring of force constant K is fixed with a vertical rigid stand on the horizontal surface, as shown in the figure. Find the value for the maximum compression in the spring if mass 'm' is released from rest from height 'h' and hits the spring in the horizontal surface.



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27. A vehicle of mass 15 quintal climbs up a hill $200m$ high. It then moves on a level road with a speed of $30ms^{-1}$. Calculate the potential energy gained by it and its total mechanical energy while running on the top of the hill.

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28. A particle is released from height H. At cartain height from the ground its kinetic energy is twice its gravitational potential energy. Find the height and speed of particle at that height.

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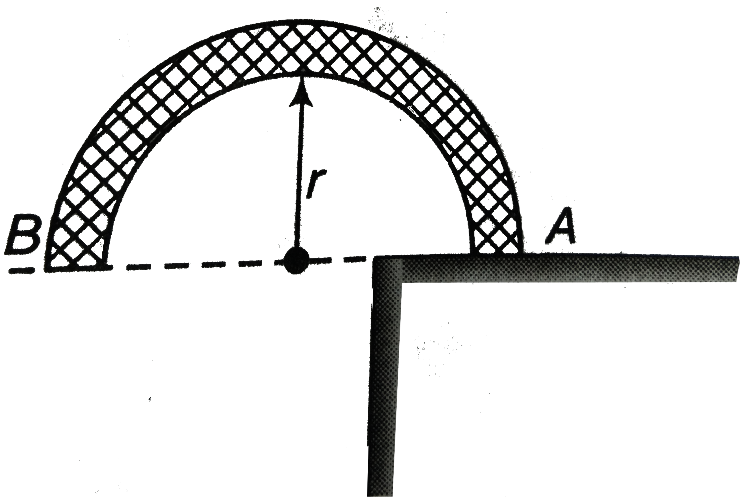
29. A uniform chain of length of length πr lies inside a smooth semicircular tube (AB) of radius r. Assuming a slight disturbance to start the chain in motion, the velocity with which it will emerge from the end (B) of the tube will be



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30. The potential energy of a $1kg$ particle free to move along the x- axis is given by $V(x)=\left(\frac{x^4}{4}-\frac{x^2}{2}\right)J$

The total mechainical energy of the particle is $2J$. Then , the maximum speed (in m//s) is

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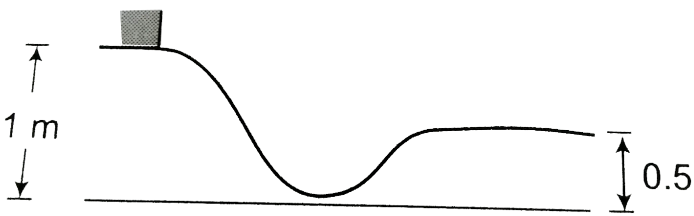

31.

The figure shown a particle sliding on a frictionless track, which teminates in a straight horizontal section. If the particle starts slipping from the point A, how far away from the track will the particle hit the ground?

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32. An automobile is moving at $100kmph$ and is exerting attractive force of $3920N$. What horse power nust the engine develop, if 20% of the power developed is wasted ?

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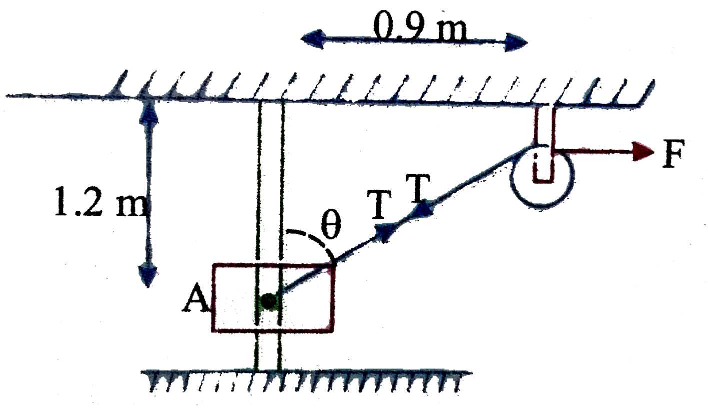
33. The $50N$ collar starts from rest at A and is lifted with a constant speed of $0.6m/s$ along the smooth rod. Determine the power developed by the force F at the instant shown.



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34. A machine delivers power to a body which is directly proportional to velocity of the body. If the body starts with a velocity which is almost negligible, find the distance covered by the body in attaining a velocity v.

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35. Find the power of an engine which can draw a train of 400 metric ton up the inclined plane of 1 in 98 at the rate $10ms^{-1}$. The resistance due to friction acting on the train is $10N$ per ton.

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36. A hose pipe has a diameter of $2.5cm$ and is required to direct a jet of water to a height of atleast $40cm$. Find the minimum power of the pump needed for this hose.

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37. A body of mass m accelerates uniformly from rest to velocity v_0 in time t_0, find the instantaneous power delivered to body when velocity is $\frac{v_0}{2}$.

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38. A nail is located at a certain distance vertically below the point of suspension of a simple pendulum. The pendulum bob is released from a position where the string makes an angle of 60° with the vertical. Calculate the distance of nail from the point of suspension such that the bob will just perform revolutions with the nail as centre. Assume the length of the pendulum to be one meter.

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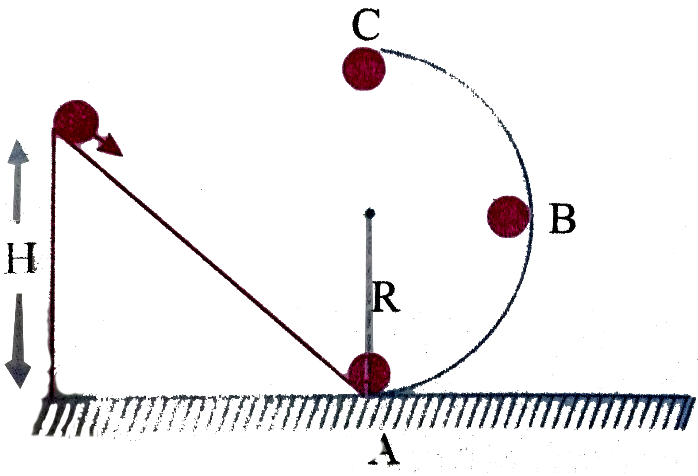
39. A body slides without friction from a height $H = 60cm$ and then loops the loop of radius $R = 20cm$ at the bottom of an incline. Find the ratio of forces exerted on the body by the track at the positions A, B and

$C\left(g = 10ms^{-2}\right)$.



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40. A heavy particle hanging from a fixed point by a light inextensible string of length l is projected horizonally with speed $\sqrt{gl}$. Find the speed of the particle and the inclination of the string to the vertical at the instant of the motion when the tension in the string is equal to the weight of the particle.

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41. A bullet of mass m moving at a speed v hits a ball of mass M kept at rest. A small part having mass m\' breaks from the ball and sticks to the bullet. The remaining ball is found to move at a speed v_1 in the direction of the bullet. Find the velocity of the bullet after the collision.

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42. Two bodies of masses m_1 and m_2 are moving with velocities $1ms^{-1}$ and $3ms^{-1}$ respectively in opposite directions. If the bodies undergo one dimensional elastic collision, the body of mass m_1 comes to rest. Find the ration of m_1 and m_2.

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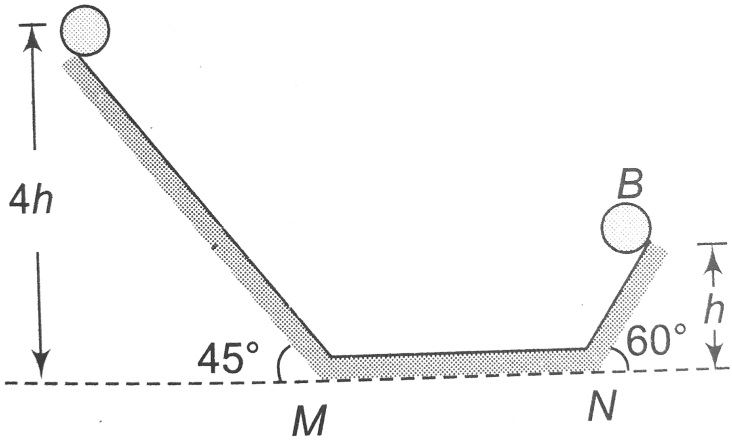
43. Two identical balls $A \text{ and } B$ arereleased from the positions shown in figure. They collide elasticallly on horizontal position MN . The ratio of the heightsattaned by A and B after collisuion will be (neglect friction):



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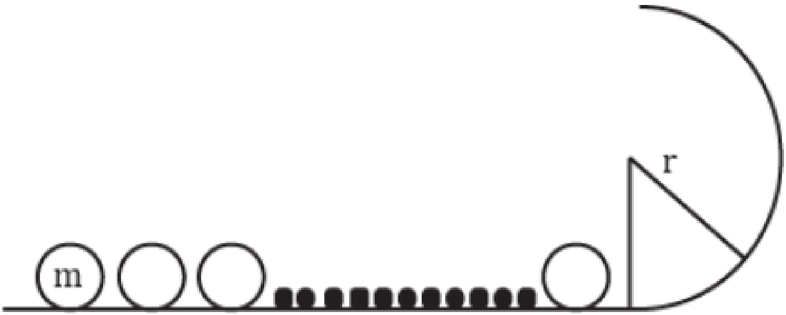
44. n elastic balls are placed at rest on a smooth horizontal plane which is circular at the ends with radius r as shown in the figure. The masses of the balls are $m, \frac{m}{2}, \frac{m}{2^2}, \text{..............} \frac{m}{2^{n-1}}$ respectively. What is the minimum velocity which should be imparted to the first ball of mass m such that

n^th ball completes the vertical circle



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45. Ball 1 collides directly with another identical ball 2 at rest. Velocity of second ball becomes two times that of 1 after collison. Find the coefficient of restitution between the two balls?

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46. A body X with a momentum p with another identical stationary body Y one dimensionally. During the collision Y gives an impulse J to body X. Then coefficient of restitution is:

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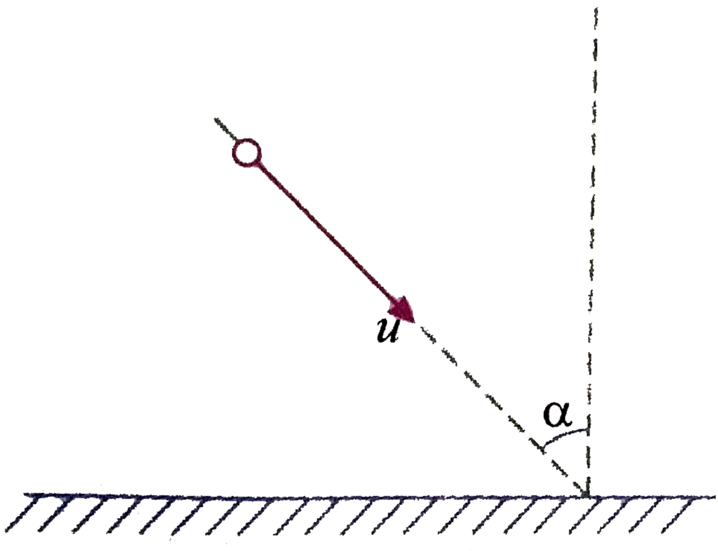
47. A ball of mass m collides with the ground at an angle. With the vertical. If the collision lasts for time t, the average force exerted by the ground on the ball is : (e = coefficient of restitution between the ball and the ground)



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48. A ball strickes a horizontal floor at an angle $\theta = 45^{\circ}$ with the normal to floor. The coefficient of restitution between the ball and the floor is

$e = 1/2$. The function of its kinetic energy lost in the collision is.

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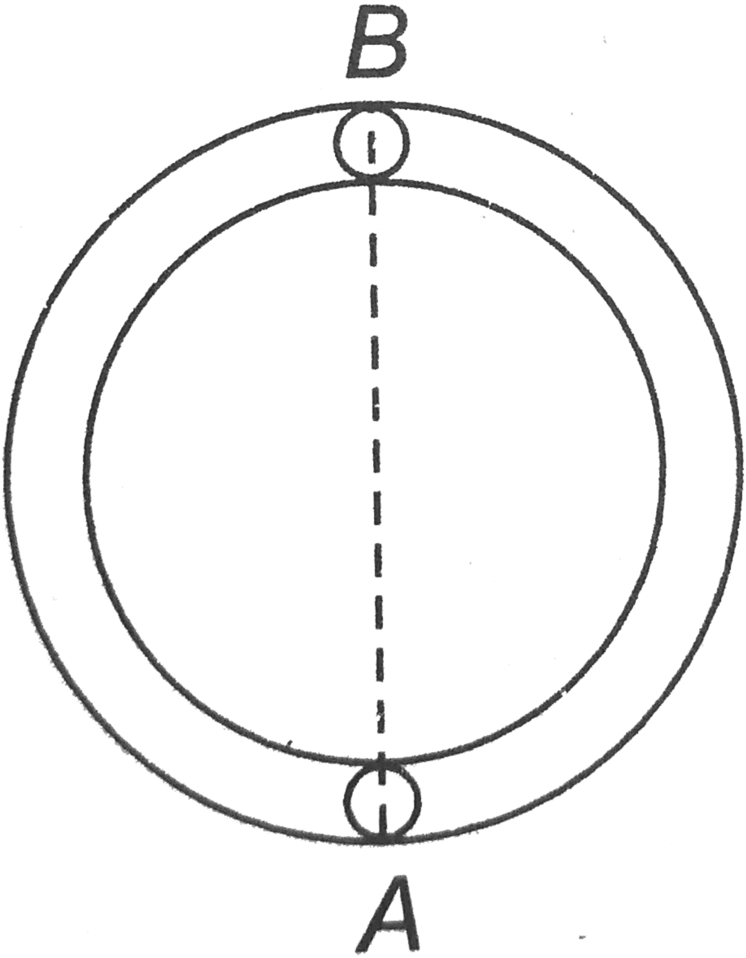
49. Two equal sphere A and b lie on a smooth horizontal circle groove at opposite ends of a diameter. At time $t = 0$, A is projected along the groove and tis first implings on$B$ at time $t = T_1$ and $aga \in attime$t =

T_(2). *Ifeisthecoefficientofrestitution, theratio*T_(2)//T_(1)` is



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50. After perfectly inelastic collision between two identical balls moving with same speed in different directions, the speed of the combined mass becomes half the initial speed. Find the angle between the two before collision.

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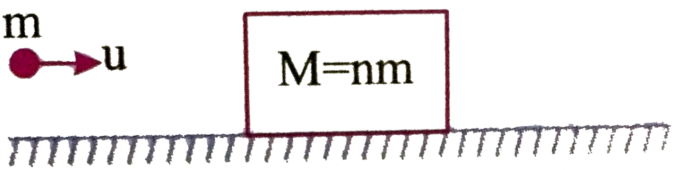
51. A bullet of mass 'm' moving with velocity 'u' passes through a wooden block of mass $M = nm$ as shown in figure. The block is resting on a smooth horizontal floor. After passing through the block, velocity relative to the block is



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52. A block of mass $0.50kg$ is moving with a speed of $2.00m/s$ on a smooth surface. It strikes another mass of $1kg$ at rest and they move as a single body. The energy loss during the collision is

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53. Consider a rubber ball freely falling from a height $h = 4.9m$ onto a horizontally elastic plate. Assume that the duration of collision is negligible and the collisions with the plate is totally elastic .

Then the velocity as a function of time and the height as a function of time will be :

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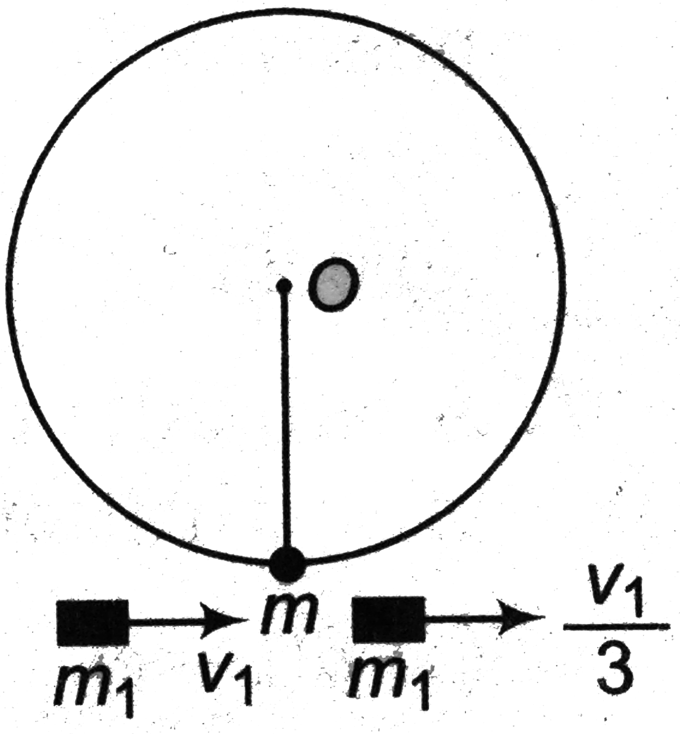
54. A pendulum consists of a wooden bob of mass m and length l. A bullet of mass m_1 is fired towards the pendulum with a speed v_1 and it emerges from the bob with speed $\frac{v_1}{3}$. The bob just completes motion along a vertical circle. Then v_1 is



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55. Two billiard balls of same size and mass are in contact on a billiard table. A third ball of same mass and size strikes them symmetrically and remains at rest after the impact. Find the coefficient of restitution between the balls?

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C.U.Q-Key

1. In which of the following, the work done by the mentioned force is negative ? The work done by

A. the tension in the cable while the lift is ascending

B. the gravitational force when a body slides down an inclined plane

C. the applied force to maintain uniform motion of a block on a rough horizontal surface

D. the gravitational force when a boby is thrown up

Answer: D

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2. A man pushes a wall and fails to displace it.He does

A. negative work

B. positive but not maximum work

C. maximum work

D. no work at all

Answer: D

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3. A bucket full of water is drawn up by a person. In this case the work done by gravitational force is

A. negative because the force and displacement are in opposite directions

B. positive because the force and displacement are in the same direction

C. negative because the force and displacement are in the same direction

D. positive because the force and displacement are in opposite direction

Answer: A

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4. A man is rowing a boat upstream and inspite of that the boat is found to be not moving with respect to the bank. The work done by the man is

A. zero

B. positive

C. negative

D. may be $+ve$ or $-ve$

Answer: A

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5. A ball is thrown vertically upwards from the ground. Work done by air resistance during its time of flight is

A. positive during ascent and negative during descent

B. positive during ascent and descent

C. negative during ascent and positive during descent

D. negative during ascent and descent

Answer: D

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6. An agent is moving a positively charged body towards another fixed positive charge. The work done by the agent is

A. positive

B. negative

C. zero

D. may be positive or negative

Answer: A

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7. Work done by force of static friction .

A. can be zero

B. can be positive

C. can be negative

D. any of the above

Answer: D

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8. Potential energy is defined for

A. non-conservative force only

B. conservative force only

C. both conservative & non-conservative forces

D. neither conservative nor non-conservative forces

Answer: B

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9. Which of the following forces is called a conservative force ?

A. Frictional force

B. Air resistance

C. Electrostatic force

D. Viscous force

Answer: C

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10. Identify the non-conservative force in the following

A. Weight of a body

B. Force between two ions

C. Magnetic force

D. Air resistance

Answer: D

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11. If x, F and U denote the dispalcement, force acting on and potential energy of a particle then

A. $U = F$

B. $F = +\frac{dU}{dx}$

C. $F = -\frac{dU}{dx}$

D. $F = \frac{1}{x}\left(\frac{dU}{dx}\right)$

Answer: C

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12. In the case of conservative force

A. work done is independent of the path

B. work done in a closed loop is zero

C. work done against conservative force is store is the form of potential energy

D. all the above

Answer: D

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13. The change in kinetic energy per unit 'space' (distance) is equal to

A. power

B. momentum

C. force

D. pressure

Answer: C

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14. When the momentum of a body a doubled, the kinetic energy is

A. doubled

B. halved

C. becomes four times

D. becomes three times

Answer: C

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15. For the same kinetic energy, the momentum shall be maximum for which of the following particle ?

A. Electron

B. Proton

C. Deuteron

D. Alpha particle

Answer: D

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16. If the momentum of a particle is plotted on $X -$ axis and its kinetic energy on the $Y -$ axis, the graph is a

A. straight line

B. parabola

C. rectangular hyperbola

D. circle

Answer: B

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17. When two identical balls are moving with equal speed in opposite direction, which of the following is true ? For the system of two bodies.

A. momentum is zero, kinetic energy is zero

B. momentum is not zero, kinetic energy is zero

C. momentum is zero, kinetic energy is not zero

D. momentum is not zero, kinetic energy is not zero

Answer: C

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18. The product of linear momentum and velocity of a blood represents.

A. half of the kinetic energy of the body

B. kinetic energy of the body

C. twice the kinetic energy of the body

D. mass of the body

Answer: C

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19. The KE of a freely falling body

A. is directly proportional to height of its fall

B. is inversely proportional to height of its fall

C. is directly proportional to square of time of its fall

D. 1 and 3 are true

Answer: D

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20. Consider the following two statements:

A. Linear momentum of a system of partcles is zero.

B. Kinetic energ of a system of particles is zero.

A. A does not imply $B \& B$ does not imply A

B. A implies $B \text{ and } B$ does not imply A

C. A does not imply B but B implies A

D. A implies B and B implies A

Answer: C

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21. Internal forces can change

A. Linear momentum as well as kinetic energy

B. Linear momentum but not the kinetic energy

C. Kinetic energy but not linear momentum

D. neither the linear momentum nor the kinetic energy

Answer: C

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22. If the force acting on a body is inversely proportional to its speed, then its kinetic energy is

A. linearly related to time

B. inversely proportional to time

C. inversely proportional to the square of time

D. a constant

Answer: A

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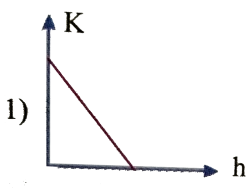
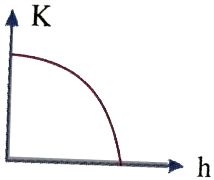
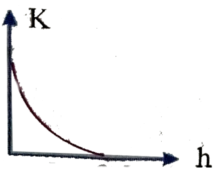
23. Which of the following graphs depicts the variation of KE of a ball bouncing on a horizontal floor with height ? (Neglect air resistances)

A. 

B. 2) 

C. 3) 

D. None of these

Answer: A

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24. Which of the following statements is correct?

A. KE of a system cannot be changed without changing its momentum

B. KE of a system can be changed without changing its momentum

C. Momentum of a system cannot be changed with changing its KE

D. A system cannot have energy without having momentum

Answer: A

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25. Two bodies of unequal masses have same linear momentum. Which one has greater K.E. ?

A. lighter body

B. heavier body

C. both

D. none

Answer: A

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26. Two bodies of masses m_1 and m_2 have equal KE. Their momenta is in the ratio

A. $\sqrt{m_2} : \sqrt{m_1}$

B. $m_1 : m_2$

C. $\sqrt{m_1} : \sqrt{m_2}$

D. $m_1^2 : m_2^2$

Answer: C

Watch Video Solution

27. A body can have

A. changing momentum and finite kinetic energy

B. zero kinetic energy and finite momentum

C. zero acceleration and increasing kinetic energy

D. finite acceleration and zero kinetic energy

Answer: A

Watch Video Solution

28. A rock of mass m is dropped to the ground from a height h. A second rock, with mass $2m$, is dropped from the same height. When the second rock strikes the ground, what is its kinetic energy? (a) Twice that of the first rock, (b) four times that of the first rock, (c) same as that of the first rock, (d) half as much as that of the first rock, (e) impossible to determine.

A. twice that of the first rock

B. four times that of the first rock

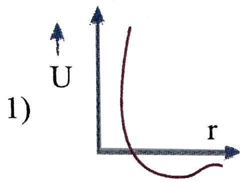
C. the same as that of the first rock

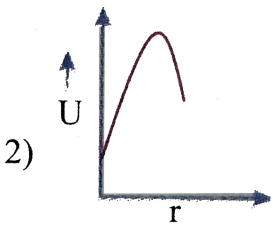
D. half that of the first rock

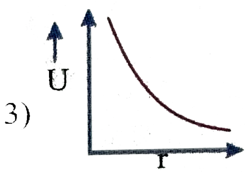
Answer: A

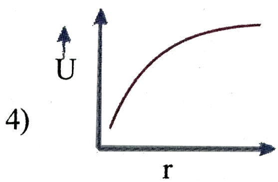
Watch Video Solution

29. These diagrams represent the potential energy U of a diatomic molecule as a function of the inter-atomic distance r. The diagram corresponds to stable molecule found in nature is.

A. 

B. 

C. 

D. 

Answer: A

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Watch Video Solution

30. Two springs have their force constants K_1 and K_2 and they are stretched to the same extension. If $K_2 > K_1$ work done is

A. same in both the springs

B. more in springs K_1

C. more in springs K_2

D. independent of spring constant K

Answer: C

Watch Video Solution

31. Two spring have their force constants K_1 and $K_2 (K_2 > K_1)$. When they are stretched by the same force, work done is

A. same in both the springs

B. more in springs K_1

C. more in springs K_2

D. independent of spring constant K

Answer: B

Watch Video Solution

32. A lorry and a car moving with the same KE are brought to rest by applying the same retarding force. Then

A. lorry will come to rest in a shorter distance

B. car will come to rest in a shorter distance

C. both come to rest in same distance

D. any of above

Answer: C

Watch Video Solution

33. A shell is fired into ait at an angle θ with the horizontal form the ground. On reaching the maximum height

A. its kinetic energy is not equal to zero

B. its kinetic energy is equal to zero

C. its potential energy is equal to zero

D. both its potential and kinetic energies are zero

Answer: A

Watch Video Solution

34. A cricket ball and a ping-pong ball are dropped. When they vacuum chamber from same height. When they have fallen half way down, they have the same

A. velocity

B. potential energy

C. kinetic energy

D. mechanical energy

Answer: A

Watch Video Solution

35. A cyclist free-wheels from the top of a hill, gathers speed going down the hill, applies the brakes and eventually comes to rest at the bottom of the hill. Which one of the following energy changes take place.

A. Potential to kinetic and to heat energy

B. Kinetic to potential and to heat energy

C. chemical to heat and to potential energy

D. Kinetic to heat and to chemical energy

Answer: A

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36. If 'E' represents total mechanical energy of a system while 'U' represents the potential energy, then $E - U$ is

A. always zero

B. negative

C. either positive or negative

D. positive

Answer: D

Watch Video Solution

37. For a body thrown vertically upwards, its direction of motion changes at the point where its total mechanical energy is

A. greater than the potential energy

B. less than the potential energy

C. equal to the potential energy

D. zero

Answer: C

Watch Video Solution

38. Internal forces can change

A. Kinetic energy

B. mechanical energy

C. Momentum

D. 1 and 2

Answer: D

Watch Video Solution

39. The negative of the work done by the conserative internal forces on a system equals the change iln

A. the change in kinetic enegry of the system

B. the change in potential energy of the system

C. the change in total mechanical energy of the system

D. the change in the momentum of the system

Answer: B

Watch Video Solution

40. Which of the following statements is wrong ?

A. KE of a body is independent of the direction of motion

B. In an elastic collision of two bodies, the momentum and energy of each body is conserved

C. If two protons are brought towards each other, the PE of the system increases

D. A body can have energy without momentum

Answer: B

Watch Video Solution

41. When a body falls from an aeroplane there is increase in its :

A. acceleration

B. potential energy

C. kinetic energy

D. mass

Answer: C

Watch Video Solution

42. A body is moved along a straight line by a machine delivering constant power . The distance moved by the body is time t is proptional to

A. $t^{1/2}$

B. $t^{3/4}$

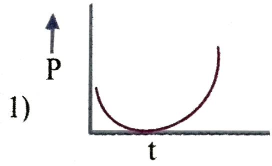
C. $t^{3/2}$

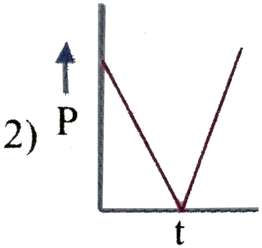
D. t^2

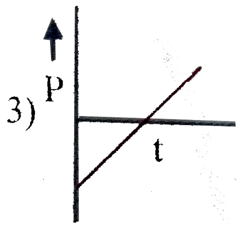
Answer: C

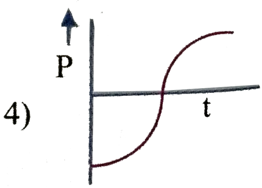
Watch Video Solution

43. A particle is projected at $t = 0$ from a point on the ground with certain velocity at an angle with the horizontal. The power gravitational force is plotted against time. Which of the following is the best representation ?

A. 

B. 

C. 

D. 

Answer: C

Watch Video Solution

44. A body starts from rest and acquires velocity V in time T. The instantaneous power delivered to the body in time 't' proportional to

A. $\frac{V}{T}t$

B. $\frac{V^2}{T}t^2$

C. $\frac{V^2}{T^2}t$

D. $\frac{V^2}{T^2}t^2$

Answer: C

Watch Video Solution

45. A car drives along a straight level frictionless road by an engine delivering constant power. Then velocity is directly proportional to

A. t

B. $\frac{1}{\sqrt{t}}$

C. $\sqrt{t}$

D. t^2

Answer: C

Watch Video Solution

46. A particle is projeced with a velocity u making an angle θ with the horizontal. The instantaneous power of the gravitational force

A. varies linearly with time

B. is constant throughout the path

C. is negative for complete path

D. varies inversly with time

Answer: A

Watch Video Solution

47. A motor car of m travels with a uniform speed v on a convex bridge of radius r. When the car is at the middle point of the bridge, then the force exterted by the car on the bridge is

A. mg

B. $mg + \frac{mv^2}{r}$

C. $mg - \frac{mv^2}{r}$

D. $mg \pm \frac{mv^2}{r}$

Answer: C

Watch Video Solution

48. A gramphone record is revolving with an angular velocity ω. A coin is placed at a distance R from the centre of the record. The static coefficient of friction is μ. The coin will revolve with the record if

A. $R > \frac{\mu g}{\omega^2}$

B. $R = \frac{\mu g}{\omega^2}$

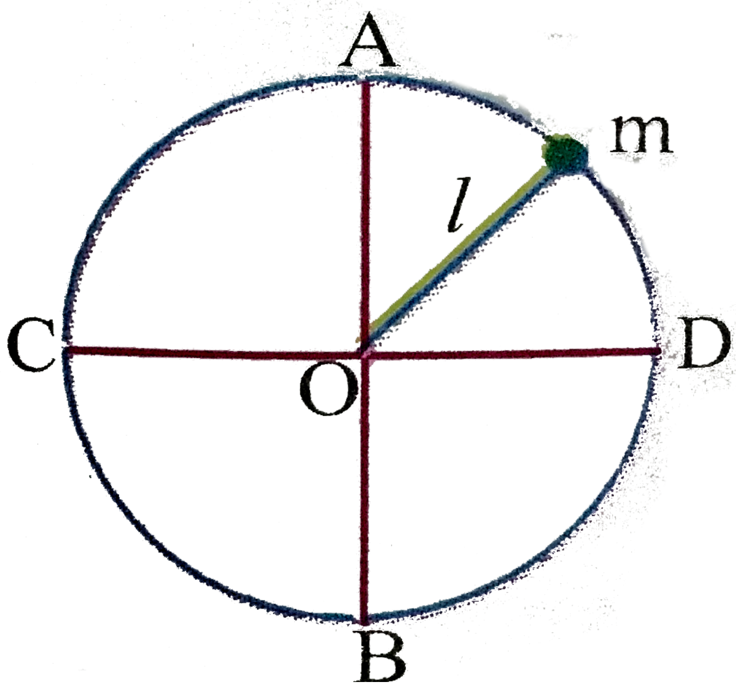
C. $R < \frac{\mu g}{\omega^2}$

D. $R \leq \frac{\mu g}{\omega^2}$

Answer: D

Watch Video Solution

49. A small sphere of mass 'm' is attached to a cord and rotates in a vertical plane about a point O. If the average speed of the sphere is increased, the cord is most likely to break at the orientation when the mass is at :



A. bottom point B

B. the point C

C. the point D

D. top point A

Answer: A

Watch Video Solution

50. A car is moving up with uniform speed along a fly over bridge which is part of a vertical circle. The true statement from the following is

A. Normal reaction on the car gradually decreases and becomes minimum at highest position of bridge

B. Normal reaction on the car gradually increases and becomes maximum at highest position

C. Normal reaction on car does not change

D. Normal reaction on the car gradually decreases and becomes zero at highest position

Answer: B

Watch Video Solution

51. A bottle of soda water is rotated in a vertical circle with the neck held in hand. The air bubbles are collected

A. near the neck

B. near the bottom

C. at the middle

D. uniformly in the bottle

Answer: A

Watch Video Solution

52. A vehicle is moving with uniform speed along horizontal, concave and convex surface roads. The surface on which, the normal reaction on the vehicle is maximum is

A. concave

B. convex

C. horizontal

D. same at all surfaces

Answer: A

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53. A ball with initial momentum $\overrightarrow{P}$ collides with rigid wall elastically. If $\overrightarrow{P^1}$ be its momentum after collision then

A. $\overrightarrow{P^1} = \overrightarrow{P}$

B. $\overrightarrow{P^1} = -\overrightarrow{P}$

C. $\overrightarrow{P^1} = 2\overrightarrow{P}$

D. $\overrightarrow{P^1} = -2\overrightarrow{P}$

Answer: B

Watch Video Solution

54. Choose tha false statement

A. In a perfect elastic collision the relative velocity of approach is equal to the relative velocity of separation

B. In an inelastic collision the relative velocity of approach us less than the relative velocity of separation

C. In an inelastic collision the relative velocity of separation is less than relative velocity of approach

D. In perfect inelastic collision relative velocity of separation is zero]

Answer: B

Watch Video Solution

55. Two particles of different masses collide head on. Then for the system

A. loss of KE is zero, if it was perfect elastic collision

B. If it was perfect inelastic collision, the loss of KE of the bodies moving in opposite directions is more than that of the bodies moving in the same direction

C. loss of momentum is zero for both elastic and inelastic collision

D. $1, 2$ and 3 are correct

Answer: D

Watch Video Solution

56. A $2kg$ mass moving on a smooth frictionless surface with a velocity of $10ms^{-1}$ hits another $2kg$ mass kept at rest, in a perfect inelastic collision. After collision, if they move together

A. they travel with a velocity of $5ms^{-1}$ in the same direction

B. they travel with a velocity of $10ms^{-1}$ in the same direction

C. they travel with a velocity of $10ms^{-1}$ in opposite direction

D. they travel with a velocity of $5ms^{-1}$ in opposite direction

Answer: A

Watch Video Solution

57. In an elastic collision

A. The initial kinetic energy is equal to the final kinetic energy

B. The final kinetic energy is less than the initial kinetic energy

C. The kinetic energy remains constant

D. the kinetic energy first increases then decreases.

Answer: A

Watch Video Solution

58. In an inelastic collision, the kinetic energy after collision

A. is same as before collision

B. is always less than before collision

C. is always greater than before collision

D. may be less or greater than before collision

Answer: B

Watch Video Solution

59. A ball hits the floor and rebounds after an inelastic collision. In this case

A. the momentum of the ball just after the collision is same as that just before the collision

B. The mechanical energy of the ball remains the same on the collision

C. The total momentum of the ball and the earth is conserved

D. the total kinetic energy of the ball and the earth is conserved.

Answer: C

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60. About a collision which is not correct

A. physical contact is must

B. colliding particles can change their direction of motion

C. the effect of the external force is not considered

D. linear momentum is conserved

Answer: A

Watch Video Solution

61. In one-dimensional elastic collision, the relative velocity of approach before collision is equal to

A. relative velocity of separation after collision

B. $'e'$ times relative velocity of separation after collision

C. $'1/e'$ times relative velocity of separation after collision

D. sum of the velocities after collision

Answer: A

Watch Video Solution

62. Two identical bodies moving in opposite direction with same speed, collide with each other. If the collision is prefectly elastic then

A. after the collision both comes to rest

B. after the collision first comes to rest and second moves in the opposite direction with same speed.

C. after collision they recoil with same speed

D. both and 1 and 2

Answer: C

Watch Video Solution

63. A body of mass 'm' moving with certain velocity collides with another identical body at rest. If the collision is perfectly elastic and after the collision both the bodies moves

A. in the same direction

B. in opposite direction

C. in perpendicular direction

D. at 45° to each other

Answer: C

Watch Video Solution

64. Six steel balls of identical size are lined up along a straight frictionless groove. Two similar balls moving with speed v along the groove collide with this row on the extreme left end. Then

A. one ball from the right end will move on with speed v

B. two balls from the extreme right end will move on with speed v and the remaining balls will be at rest

C. all the balls will start moving to the right with speed $v/8$

D. all the six ball originally at rest will move on with speed $v/6$ and the incident calls will come to rest

Answer: B

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65. A lighter body moving with a velocity v collides with a heavier body at rest. Then

A. the lighter body rebounced with twice the velocity of bigger body

B. the lighter body retraces its path with the same velocity in magnitude

C. the heavier body does not move practically

D. both (2) and (3)

Answer: D

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66. A heavier body moving with certain velocity collides head on elastically with a lighter body at rest, then

A. smaller body continues to be in the same state of rest

B. smaller body starts to move in the same direction with same velocity as that of bigger body

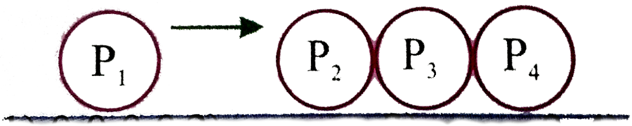
C. the smaller body start to move with twice the velocity of the bigger body in the same direction

D. the bigger body comes to rest

Answer: C

Watch Video Solution

67. A perfectly elastic ball P_1 of mass 'm' moving with velocity v collides elastically with three exactly similar balls P_2, P_3, P_4 lying smooth table. Velocity of the four balls after collision are



A. $0, 0, 0, 0,$

B. v, v, v, v

C. $v, v, v, 0$

D. $0, 0, 0, v$

Answer: D

Watch Video Solution

68. Two bodies P and Q of masses m_1 and m_2 $(m_2 > m_1)$ are moving with velocity v_1 and v_2 force exerted by P on Q during the collision is

A. greater that the force exerted by Q on P

B. less than the force exerted by Q on P

C. same as the force exerted by Q on P

D. sam as the force exerted by Q on P but opposite in direction

Answer: D

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69. The coefficient of restitution (e) for a perfectly elastic collision is

A. -1

B. 0

C. ∞

D. 1

Answer: D

Watch Video Solution

70. A ball of mass M moving with a velocity v collides perfectly inelastically with another ball of same mass but moving with a velocity v in the opposite direction. After collision

A. both the balls come to rest

B. the velocities are exchanged between the two balls

C. both of them move at right angles to the original line of motion

D. one ball comes to rest and another ball travels back with velocity $2v$

Answer: A

Watch Video Solution

71. A ball of mass 'm' moving with speed 'u' undergoes a head-on elastic collision with a ball of mass 'nm' initially at rest. Find the fraction of the incident energy transferred to the second ball.

A. $\frac{n}{n+1}$

B. $\frac{n}{(n+1)^2}$

C. $\frac{2n}{(1+n)^2}$

D. $\frac{4n}{(1+n)^2}$

Answer: D

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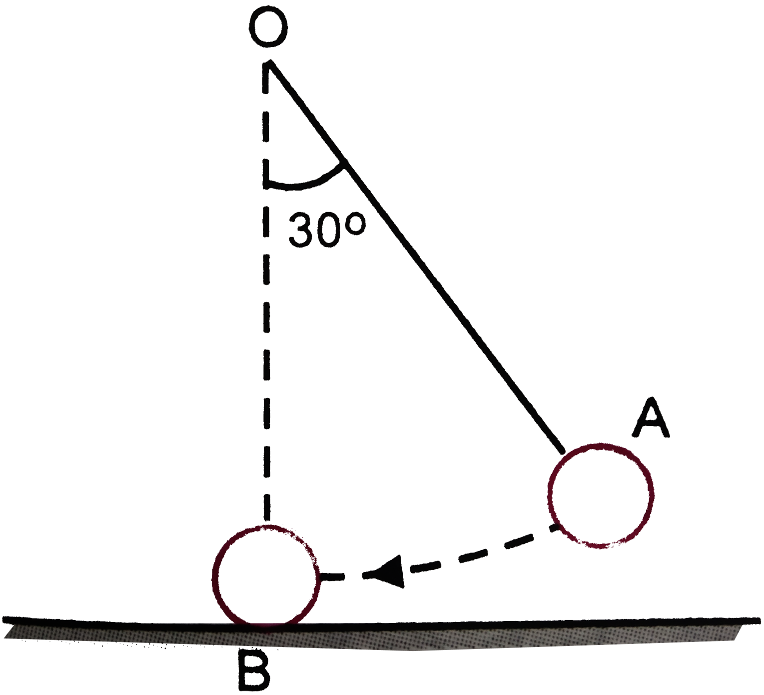
72. The bob A of a simple pendulum released from 30° to the vertical hits another bobo B of the same mass at rest on a table as shown in figure. How high does the bob A rise after the collision ? Neglect the size of the bobs and assume the collision to be elastic.



A. 30°

B. 60°

C. 15°

D. zero

Answer: D

Watch Video Solution

73. Two sphere 'X' and 'Y' collide. After collision, the momentum of X is doubled. Then

A. the initial momentum of X and Y are equal

B. the initial momentum of X is greater then that of Y

C. the initial momentum of Y is double that of X

D. the loss in momentum of Y is equal to the initial momentum of X

Answer: D

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74. A bullet is fired into a wooden block. If the bullet gets embedded in wooden block, then

A. momentum alone is conserved

B. kinetic momentum and kinetic energy are conserved

C. both momentum and kinetic energy are conserved

D. neither momentum nor kinetic energy are conserved

Answer: A

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75. During collision, which of the following statement is wrong ?

A. there is a change in momentum of individual bodies

B. the change in total momentum of the system of colliding particle is zero

C. the change in total energy is zero

D. law of conservation of momentum is not valid.

Answer: D

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Level- I (C.W)

1. If $\overrightarrow{F} = 2\hat{i} + 3\hat{j} + 4\hat{k}$ acts on a body and displaces it by $\overrightarrow{S} = 3\hat{i} + 2\hat{j} + 5\hat{k}$, then the work done by the force is

A. 12 J

B. 20 J

C. 32 J

D. 64 J

Answer: C

Watch Video Solution

2. A force of $1200N$ acting on a stone by means of a rope slides the stone through a distance of $10m$ in a direction inclined at 60° to the force. The work done by the force is

A. $6000\sqrt{3}J$

B. 6000 J

C. 12000 J

D. 8000 J

Answer: B

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3. A man weighing $80kg$ climbs a staircase carrying a $20kg$ load. The staircase has 40 steps, each of $25cm$ height. If he takes 20 seconds to climb, the work done is

A. 9800 J

B. 490 J

C. $98 \times 10^5 J$

D. 7840 J

Answer: A

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4. The work done by a force $\vec{F} = 3\hat{i} - 4\hat{j} + 5\hat{k}$ displaces the body from a point $(3, 4, 6)$ to a point $(7, 2, 5)$ is

A. 15 units

B. 25 units

C. 20 units

D. 10 units

Answer: A

Watch Video Solution

5. A force $\vec{F} = \left(6\hat{i} - 8\hat{j}\right)N$, acts on a particle and displaces it over $4m$ along the X-axis and $6m$ along the Y-axis. The work done during the total displacement is

A. 72 J

B. 24 J

C. $-24J$

D. zero

Answer: C

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6. A lawn roller is pulled along a horizontal surface through a distance of $20m$ by a rope with a force of $200N$. If the rope makes an angle of 60° with the vertical while pulling, the amount of work done by pulling force is

A. 4000 J

B. 1000 J

C. $2000\sqrt{3}J$

D. 2000 J

Answer: C

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7. An object has a displacement from position vector $\overrightarrow{r}_1 = \left(2\hat{i} + 3\hat{j}\right)m$ to $\overrightarrow{r}_2 = \left(4\hat{i} + 6\hat{j}\right)m$ under a force $\overrightarrow{F} = \left(3x^2\hat{i} + 2y\hat{j}\right)N$, then work done by the force is

A. 24 J

B. 33 J

C. 83 J

D. 45 J

Answer: C

Watch Video Solution

8. A shot is fired at 30° with the vertical from a point on the ground with kinetic energy K. If air resistance is ignored, the kinetic energy at the top of the trajectory is

A. $3K/4$

B. $K/2$

C. K

D. $K/4$

Answer: D

Watch Video Solution

9. A body starts from rest and is acted on by a constant force. The ratio of kinetic energy gained by it in the first five seconds to that gained in the next five seconds is

A. $2:1$

B. $1:1$

C. $3:1$

D. $1:3$

Answer: D

Watch Video Solution

10. A simple pendulum of length 1m has bob of mass 100 g. It is displaced through an angle of 60° from the vertcal and then released. The kinetic energy of bob when it passes through the mean position is

A. $0.49J$

B. $0.94J$

C. 1 J

D. $1.2J$

Answer: A

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11. A body starts from rest and moves with uniform acceleration. What is the ratio of kinetic energies at the end of $1st$, $2nd$ and $3rd$ seconds of its journey ?

A. $1:8:27$

B. $1:2:3$

C. $1:4:9$

D. $3:2:1$

Answer: C

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12. A liquid of specific gravity 0.8 is flowing in a pipe line with a speed of $2m/s$. The $K.E$ per cubic meter of it is

A. 160 J

B. 1600 J

C. 160.5 J

D. 1.6 J

Answer: B

Watch Video Solution

13. A $60kg$ boy lying on a surface of negligible friction throws horizontally a stone of mass $1kg$ with a speed of $12m/s$ away from him. As a result with what kinetic energy he moves back ?

A. 2.4 J

B. 72 J

C. 1.2 J

D. 36 J

Answer: C

Watch Video Solution

14. Two stones of masses m and $2m$ are projected vertically upwards so as to reach the same height. The ratio of the kinetic energies of their projection is

A. $2:1$

B. $1:2$

C. $4:1$

D. $1:4$

Answer: B

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15. A neutron, one of the constituents of a nucleus, is found to pass two points 60 metres apart in a time interval of 1.8×10^{-4} sec. The mass of the neutron is $1.67 \times 10^{-27} kg$. Assuming that the speed is constant, its kinetic energy is

A. 9.3×10^{-17} joule

B. 9.3×10^{-14} joule

C. 9.3×10^{-21} joule

D. 9.3×10^{-11} joule

Answer: A

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16. A tank of size $10m \times 10m \times 10m$ is full of water and built on the ground. If $g = 10ms^{-2}$, the potential energy of the water in the tank is

A. $5 \times 10^{7} J$

B. $1 \times 10^8 J$

C. $5 \times 10^4 J$

D. $5 \times 10^5 J$

Answer: A

Watch Video Solution

17. A bob of mass 0.3 kg falls from the ceiling of an elevator moving down with a uniform speed of $7ms^{-1}$. If hits the floor of the elevator (length of the elevator $=$ 3m) and does not rebound. What is the heat produced by the impact ? Would your answer be different if the elevator were stationary ?

A. 8.82 J

B. 7.72 J

C. 6.62 J

D. 5.52 J

Answer: A

Watch Video Solution

18. A spring when compressed by $4cm$ has $2J$ energy stored in it. The force requried to extend it by $8cm$ will be

A. 20 N

B. 2 N

C. 200 N

D. 2000 N

Answer: C

Watch Video Solution

19. The elastic potential enegry of a stretched spring is given by $E = 50x^2$. Where x is the displacement in meter and and E is in joule, then the force constant of the spring is

A. 50 Nm

B. $100Nm^{-1}$

C. $100N/m^2$

D. 100 Nm

Answer: B

Watch Video Solution

20. A body of mass $2kg$ is projected with an initial velocity of $5ms^{-1}$ along a rough horizontal table. The work done on the body by the frictional forces before it is brought to rest is

A. 250 J

B. 25 J

C. $-250J$

D. $-25J$

Answer: D

Watch Video Solution

21. An object is acted on by a retarding force of $10N$ and at a particular instant its kinetic energy is $6J$. The object will come to rest after it has travelled a distance of

A. $3/5m$

B. $5/3m$

C. $4m$

D. $16m$

Answer: A

Watch Video Solution

22. By applying the brakes without causing skid, the driver of a car is able to stop his car with in a distance of $5m$, if it is going at $36kmph$. If the car were going at $72kmph$. Using the same brakes, he can stop the car over a distance of

A. 10 m

B. 2.5 m

C. 20 m

D. 40 m

Answer: C

Watch Video Solution

23. A bullet fired into a trunk of a tree loses $1/4$ of its kinetic energy in travelling a distance of 5 cm`. Before stopping it travels s further distance of

A. 150 cm

B. 1.5 cm

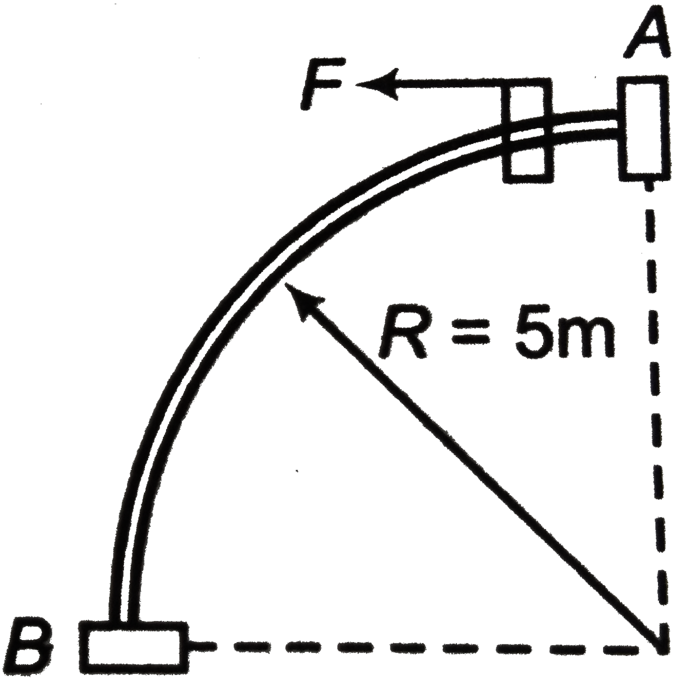
C. 1.25 cm

D. 15 cm

Answer: D

Watch Video Solution

24. A bead of mass $\frac{1}{2}kg$ starts from rest from A to move in a vertical place along a smooth fixed quarter ring of radius $5m$, under the action of a constant horizontal force $f = 5N$ as shown. The speed of bead as it reaches the point (B) is [Take $g = 10ms^{-2}$]



A. $14.14m/s$

B. $7.07m/s$

C. $5m/s$

D. $25m/s$

Answer: A

Watch Video Solution

25. A cradle is 'h' meters above the ground at the lowest position and 'H' meters when it is at the highest point. If 'v' is the maximum speed of the swing of total mass 'm' the relation between 'h' and 'H' is

A. $.^{1}/_{2}mv^{2}+h=H$

B. $(v^{2}/2g)+h=H$

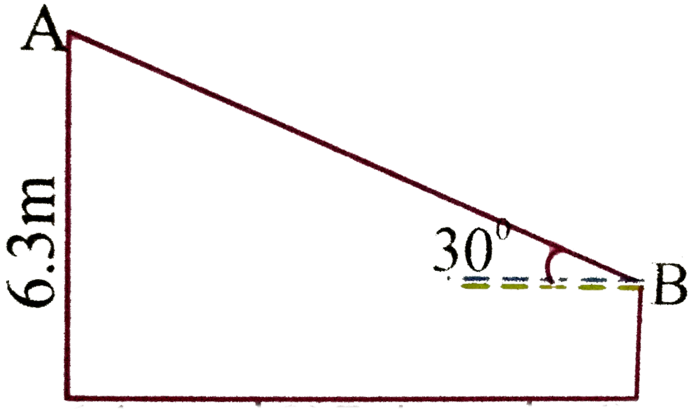
C. $(v^{2}/g)+2h=H$

D. $(v^{2}/2g)+H=h$

Answer: B

Watch Video Solution

26. AB is a frictionless inclined surface making an angle of 30° with horizontal. A is $6.3m$ above the ground while B is $3.8m$ above the ground. A block slides down form A, initially starting from rest. Its velocity on reaching B is



A. $7ms^{-1}$

B. $14ms^{-1}$

C. $7.4ms^{-1}$

D. $4.9ms^{-1}$

Answer: A

Watch Video Solution

27. A stone of mass "m" initially at rest and dropped from a height "h" strikes the surface of the earth with a velocity "v". If the gravitational force acting on the stone is W, then which of the following identities is correct ?

A. $mv - mh = 0$

B. $.^{1}/_{2}mv^{2} - Wh^{2} = 0$

C. $.^{1}/_{2}mv^{2} - Wh = 0$

D. $.^{1}/_{2}mv^{2} - mh = 0$

Answer: C

Watch Video Solution

28. A motor boat is going in a river with a velocity $\vec{V} = \left(4\hat{i} - 2\hat{j} + \hat{k}\right)ms^{-1}$. If the resisting force due to stream is $\vec{F} = \left(5\hat{i} - 10\hat{j} + 6\hat{k}\right)N$, then the power of the motor boat is

A. 100 W

B. 50 W

C. 46 W

D. 23 W

Answer: C

Watch Video Solution

29. Two riffles fire the same number of bullets in a givem interval of time. The second fires bullets of mass twice that fired by the first and with a velocity that is half that of the first. The ratio of their powers is

A. $1 : 4$

B. $4 : 1$

C. $1 : 2$

D. $2 : 1$

Answer: D

Watch Video Solution

30. A car weighing $1000kg$ is going up an incline with a slope of 2 in 25 at a steady speed of $18kmph$. If $g = 10ms^{-2}$, the power of its engine is

A. 4 kW

B. 50 kW

C. 625 kW

D. 25 kW

Answer: A

Watch Video Solution

31. A crane can lift up $10,000kg$ of coal in 1 hour form a mine of $180m$ depth. If the efficiency of the crane is 80%, its input power must be $(g = 10ms^{-2})$.

A. 5 kW

B. 6.25 kW

C. 50 kW

D. 62.5 kW

Answer: B

Watch Video Solution

32. A man carries a load of $50kg$ through a height of $40m$ in 25 seconds. If the power of the man is $1568W$, his mass is

A. 5 kg

B. 1000 kg

C. 200 kg

D. 50 kg

Answer: D

Watch Video Solution

33. An electric motor creates a tension of 4500 newton in a hoisting cable and reels it at the rate of $2m/s$. What is the power of the motor ?

A. 15 kW

B. 9 kW

C. 225 W

D. 9000 kW

Answer: B

Watch Video Solution

34. A juggler throws continuously balls at the rate of three in each second, each with a velocity of $10ms^{-1}$. If the mass of each ball is $0.05kg$ his power is

A. 2 W

B. 50 W

C. 0.5 W

D. 7.5 W

Answer: D

Watch Video Solution

35. A body of mass $2kg$ attached at one end of light string rotated along a vertical circle of radius $2m$. If the string can withstand a maximum tension of $140.6N$, the maximum speed with which the stone can be rotated is

A. $22m/s$

B. $44m/s$

C. $33m/s$

D. $11m/s$

Answer: D

Watch Video Solution

Watch Video Solution

36. A pilot of mass m can bear a maximum apparent weight 7 times of mg. The aeroplane is moving in a vertical circle. If the velocity of aeroplane is $210m/s$ while diving up from the lowest point of vertical circle, then the minimum radius of vertical circle should be

A. 375 m

B. 420 m

C. 750 m

D. 840 m

Answer: C

Watch Video Solution

37. The length of ballistic pendulum is $1m$ and mass of its block is $0.98kg$. A bullet of mass 20 gram strikes the block along horizontal direction and gets embedded in the block. If block + bullet completes vertical circle of radius $1m$, then the striking velocity of bullet is

A. $280m / s$

B. $350m / s$

C. $420m / s$

D. $490m / s$

Answer: B

Watch Video Solution

38. A simple pendulum is oscillating with an angular amplitude 60°. If mass of bob is 50 gram, then the tension in the string at mean position is $(g = 10ms^{-2})$

A. 0.5 N

B. 1 N

C. 1.5 N

D. 2 N

Answer: B

Watch Video Solution

39. A body is moving in a vertical circle such that the velocities of body at different points are critical. The ration of velocities of body at angular displacements 60° and 120° from lowest point is

A. $\sqrt{5} : \sqrt{2}$

B. $\sqrt{3} : \sqrt{2}$

C. $\sqrt{3} : 1$

D. $\sqrt{2} : 1$

Answer: D

Watch Video Solution

40. A ball of mass $0.6kg$ attached to a light inextensible string rotates in a vertical circle of radius $0.75m$ such that it has speed of $5ms^{-1}$ when the string is horizontal. Tension in the string when it is horizontal on other side is $(g = 10ms^{-2})$.

A. 30 N

B. 26 N

C. 20 N

D. 6 N

Answer: C

Watch Video Solution

41. A $6kg$ mass travelling at $2.5ms^{-1}$ collides head on with a stationary $4kg$ mass. After the collision the $6kg$ mass travels in its original direction with a speed of $1ms^{-1}$. The final velocity of $4kg$ mass is

A. $1ms^{-1}$

B. $2.25ms^{-1}$

C. $2ms^{-1}$

D. $0ms^{-1}$

Answer: B

Watch Video Solution

42. A body of mass $10kg$ moving with a velocity of $5ms^{-1}$ hits a body of $1gm$ at rest. The velocity of the second body after collision. Assuming it to be perfectly elastic is

A. $10ms^{-1}$

B. $5ms^{-1}$

C. $15ms^{-1}$

D. $0.10ms^{-1}$

Answer: A

Watch Video Solution

43. A block of mass $1kg$ moving with a speed of $4ms^{-1}$, collides with another block of mass $2kg$ which is at rest. The lighter block comes to rest after collision. The loss in KE of the system is

A. 8 J

B. $4 \times 10^{-7} J$

C. 4 J

D. 0 J

Answer: C

Watch Video Solution

44. A marble going at a speed of $2ms^{-1}$ hits another marble of equal mass at rest. If the collision is perfectly elastic, then the velocity of the first marble after collision is

A. $4ms^{-1}$

B. $0ms^{-1}$

C. $2ms^{-1}$

D. $3ms^{-1}$

Answer: B

Watch Video Solution

45. A heavy ball moving with speed v collides with a tiny ball. The collision is elastic, then immediately after the impact, the second ball will move with a speed approximately equal to

A. v

B. $2v$

C. $v/3$

D. infinite

Answer: B

Watch Video Solution

46. A $1kg$ ball moving at $12m/s$ collides head on with a $2g$ ball moving in the opposite direction at $24m/s$. The velocity of each ball after the impact, if the coefficient of restitution is $2/3$ is

A. $12m/s, 36m/s$

B. $-28m/s, -4m/s$

C. $20m/s, 24m/s$

D. $-20m/s, -4m/s$

Answer: B

Watch Video Solution

47. A $6kg$ mass collides with a body at rest. After the collision, they travel together with a velocity one third the velocity of $6kg$ mass. The mass of the second body is

A. 6 kg

B. 3 kg

C. 12 kg

D. 18 kg

Answer: C

Watch Video Solution

48. A body of mass m moving at a constant velocity v hits another body of the same mass moving with a velocity $v/2$ but in the opposite direction and sticks to it. The common velocity after collision is

A. v

B. $v/4$

C. $2v$

D. $v/2$

Answer: B

Watch Video Solution

49. An $8gm$ bullet is fired horizontally into a $9kg$ block of wood and sticks in it. The block which is free to move, has a velocity of $40cm/s$ after impact. The initial velocity of the bullet is

A. $450m/s$

B. $450cm/s$

C. $220m/s$

D. $220cm/s$

Answer: A

Watch Video Solution

50. A block of wood of mass $9.8kg$ is suspended by a string. A bullet of mass $200gm$ strikes horizontally with a velocity of $100ms^{-1}$ and gets embedded in it. The maximum height attained by the block is $(g = 10ms^{-2})$.

A. 0.1 m

B. 0.2 m

C. 0.3 m

D. 0 m

Answer: B

Watch Video Solution

51. A $15gm$ bullet is fired horizontally into a $3kg$ block of wood suspended by a string. The bullet sticks in the block, and the impact causes the block to swing $10cm$ above the initial level. The velocity of the bullet nearly is (in ms^{-1})

A. 281

B. 326

C. 184

D. 58

Answer: A

Watch Video Solution

52. A body of mass $20gm$ is moving with a certain velocity. It collides with another body of mass $80gm$ at rest. The collision is perfectly inelastic. The ratio of the kinetic energies before and after collision of the system is

A. $2:1$

B. $4:1$

C. $5:1$

D. $3:2$

Answer: C

Watch Video Solution

53. A rubber ball drops from a height 'h'. After rebounding twice from the ground, it rises to $h/2$. The co-efficient of restitution is

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

B. $\left(\frac{1}{2}\right)^{1/2}$

C. $\left(\frac{1}{2}\right)^{1/4}$

D. $\left(\frac{1}{2}\right)^{1/6}$

Answer: C

Watch Video Solution

54. A body dropped freely from a height h onto a horizontal plane, bounces up and down and a horizontal plane, bounces up and down and finally comes to rest. The coefficient of restitution is e. The ratio of velocities at the beginning and after two rebounds is

A. $1 : e$

B. $e : 1$

C. $1 : e^2$

D. $e^2 : 1$

Answer: C

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55. In the above problem, the ratio of times of two consecutive rebounds is

A. $1 : e$

B. $e:1$

C. $1:e^2$

D. $e^2:1$

Answer: A

Watch Video Solution

56. In the above problem the ratio of distances travelled in two consecutive rebounds is

A. $1:e$

B. $e:1$

C. $1:e^2$

D. $e^2:1$

Answer: C

Watch Video Solution

57. A ball is dropped onto a horizontal floor. Reaches a height of $144cm$ on the first bounce and $81cm$ on the second bounce. Coefficient of restitution is

A. 0

B. 0.75

C. $81/144$

D. 1

Answer: B

Watch Video Solution

58. A ball is dropped onto a horizontal floor. Reaches a height of $144cm$ on the first bounce and $81cm$ on the second bounce. The height it attains on the third bounce is

A. $45.6cm$

B. $81cm$

C. $144cm$

D. $0cm$

Answer: A

Watch Video Solution

59. A ball is dropped from height 'H' onto a horizontal surface. If the coefficient of restitution is 'e' then the total time after which it comes to rest is

A. $\sqrt{\frac{2H}{g}}\left(\frac{1-e}{1+e}\right)$

B. $\sqrt{\frac{2H}{g}}\left(\frac{1+e}{1-e}\right)$

C. $\sqrt{\frac{2H}{g}}\left(\frac{1+e^2}{1-e^2}\right)$

D. $\sqrt{\frac{2H}{g}}\left(\frac{1-e^2}{1+e^2}\right)$

Answer: B

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60. A stationary body explodes into two fragments of masses m_1 and m_2. If momentum of one fragment is p, the energy of explosion is

A. $\dfrac{p^2}{2(m_1+m_2)}$

B. $\dfrac{p^2}{2\sqrt{m_1 m_2}}$

C. $\dfrac{p^2(m_1+m_2)}{2m_1 m_2}$

D. $\dfrac{p^2}{2(m_1-m_2)}$

Answer: C

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Level- II (C.W)

1. A body of mass $5kg$ is moved up over $10m$ along the line of greatest slope of a smooth inclined plane of inclination 30° with the horizontal. If $g = 10m/s^2$, the work done will be

A. 500 J

B. 2500 J

C. 250 J

D. 25 J

Answer: C

Watch Video Solution

2. A particle of mass $0.5kg$ is displaced from position $\vec{r}_1(2, 3, 1)$ to $\vec{r}_2(4, 3, 2)$ by applying a force of magnitude $30N$ which is acting along $\left(\hat{i} + \hat{j} + \hat{k}\right)$. The work done by the force is

A. $10\sqrt{3}J$

B. $30\sqrt{3}$

C. 30 J

D. 40 J

Answer: B

Watch Video Solution

3. Kinetic energy of a particle moving in a straight line varies with time t as $K = 4t^2$. The force acting on the particle

A. is constant

B. is increasing

C. is decreasing

D. first increase and then decreases

Answer: A

Watch Video Solution

4. A block of mass $5kg$ initially at rest at the origin is acted upon by a force along the positive $X - direction$ represented by $F = (20 + 5x)N$. Calculate the work done by the force during the displacement of the block from $x = 0$ to $x = 4m$.

A. 100 J

B. 150 J

C. 120 J

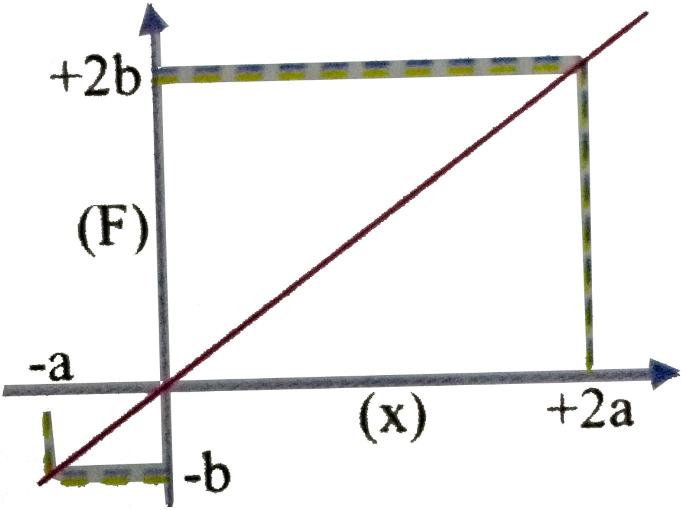
D. 75 J

Answer: C

Watch Video Solution

5. A force F acting on a particle varies with the position x as shown in the graph. Find the work done by the force in displacing the particle from

$x = -a$ to $x = +2a$.



A. $\frac{3ab}{2}$

B. $\frac{4ab}{2}$

C. $\frac{2}{3ab}$

D. $\frac{2}{4ab}$

Answer: A

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6. A force $\overrightarrow{F} = \left(2\hat{i} + 3\hat{j} - 4\hat{k}\right)N$ acts on a particle moves $5\sqrt{2}m$, the work done by force in joule is

A. $25\sqrt{2}$

B. $5\sqrt{58}$

C. 25

D. 10

Answer: C

Watch Video Solution

7. Two forces each of magnitude $10N$ act simultaneously on a body with their directions inclined to each other at an angle of 120° and displaces the body over $10m$ along the bisector of the angle between the two forces. Then the work done by force is

A. 5 J

B. 1 J

C. 50 J

D. 100 J

Answer: C

Watch Video Solution

8. n' identical cubes each of mass 'm' and edge 'L' are on a floor. If the cubes are to be arranged one over the other in a vertical stack, the work to be done is

A. $Lmng(n-1)/2$

B. $Lg(n-1)/mn$

C. $(n-1)/Lmng$

D. $Lmng/2(n-1)$

Answer: A

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9. A uniform chain of mass m & length L is kept on a smooth horizontal table such that $\frac{L}{n}$portion of the chaing hangs from the table. The work dione required to slowly bringsthe chain completely on the table is

A. $mgL/16$

B. $mgL/32$

C. $3mgL/32$

D. $mgL/8$

Answer: B

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10. A body is displaced from $(0, 0)$ to $(1m, 1m)$ along the path $x = y$ by a force $F = \left(x^2\hat{j} + y\hat{i}\right)N$. The work done by this force will be

A. $\frac{4}{3}J$

B. $\frac{5}{6}J$

C. $\frac{3}{2}J$

D. $\frac{7}{5}J$

Answer: B

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11. A particale moves under the effect of a force $F = Cs$ from $x = 0$ to $x = x_1$. The work down in the process is

A. C^2 / x_1^2

B. Cx_1^2

C. $.^1 /_2 Cx_1^2$

D. $.^1 /_2 C^2 / x_{1^2}$

Answer: C

Watch Video Solution

12. Under the action of force $2kg$ body moves such that its position 'x' varies as a function of time t given by : $x = t^2/2$. The work done by the force in the first 5 seconds is

A. 2.5 J

B. $0.25J$

C. 25 J

D. 250 J

Answer: C

Watch Video Solution

13. A body of mass $5kg$ at rest under the action of a force which gives its velocity given by $v = 3 \times tm/s$, here 't' is time in seconds. The work done by the force in two seconds will be

A. 90 J

B. 45 J

C. 180 J

D. 30 J

Answer: A

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14. A body freely falls from a certain height onto the ground in a time 't'. During the first one third of the interval it gains a kinetic energy ΔK_1 and during the last one third of the interval, it gains a kinetic energy ΔK_2. The ratio $\Delta K_1 : \Delta K_2$ is

A. $1:1$

B. $1:3$

C. $1:4$

D. $1:5$

Answer: D

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15. A man has twice the mass of a boy and has half the kinetic energy of the boy. The ratio of the speeds of the man and the boy must be

A. $2:1$

B. $4:1$

C. $1:4$

D. $1:2$

Answer: D

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16. The speed of a car changes from 0 to $5ms^{-1}$ in the first phase and from $5ms^{-1}$ to $10ms^{-1}$ in the second phase and from $10ms^{-1}$ to

$15ms^{-1}$ during the third phase. In which phase the increase in kinetic energy is more ?

A. first phase

B. second phase

C. third phase

D. same in all the three phases

Answer: C

Watch Video Solution

17. A rubber ball falling from a height of $5m$ rebounds from hard floor to a height of $3.5m$. The $\%$ loss of energy during the impact is

A. 20%

B. 30%

C. 43%

D. 50%

Answer: B

Watch Video Solution

18. A long spring when stretched by $x cm$, has a potential energy U. On increasing the stretching to $nx cm$, the potential energy stored in spring will be

A. $\frac{U}{N}$

B. NU

C. N^2U

D. $\frac{U}{N^3}$

Answer: C

Watch Video Solution

19. An elastic spring is compressed between two blocks of masses $1kg$ and $2kg$ resting on a smooth horizontal table as shown. If the spring has $12J$ of energy and suddenly released, the velocity with which the larger block of $2kg$ moves will be

A. $2m/s$

B. $4m/s$

C. $1m/s$

D. $8m/s$

Answer: A

Watch Video Solution

20. A block of mass $2kg$ is on a smooth horizontal surface. A light of force constant $800N/m$ has one end rigidly attached to a vertical wall and lying on that horizontal surface. Now the block is moved towards the wall compressing the spring over a distance f $5cm$ and then suddenly released. By the time the spring regains its natural length and looses contact with the block, the velocity acquired by the block will be

A. $200m/s$

B. $100m/s$

C. $2m/s$

D. $1m/s$

Answer: D

Watch Video Solution

21. A bullet of mass $10gm$ is fired horizontally with a velocity $1000ms^{-1}$ from a riffle situated at a height $50m$ above the ground. If the bullet reached the ground with a velocity $500ms^{-1}$, the work done against air resistance in the trajectory of the bullet is (in joule) $(g = 10ms^{-2})$.

A. 5005

B. 3755

C. 3750

D. 17.5

Answer: B

Watch Video Solution

22. A drop of mass $1.00g$ falling from a height $1.00km$. It hits the ground with a speed of $50.0ms^{-1}$. What is the work by the unknown resistive force ?

A. $-8.75J$

B. $8.75J$

C. $-4.75J$

D. $4.75J$

Answer: A

Watch Video Solution

23. A block of mass $5kg$ is initially at rest on a rough horizontal surface. A force of $45N$ acts over a distance of $2m$. The force of friction acting on the block is $25N$. The final kinetic energy of the block is

A. 40 J

B. 90 J

C. 50 J

D. 140 J

Answer: A

Watch Video Solution

24. A block of mass $2kg$ is initially at rest on a horizontal frictionless surface. A horizontal froce $\overline{F} = (9 - x^2)\overline{i}$ newton acts on it, when the block is at $x = 0$. The maximum kinetic energy of the block between $x = 0m$ and $x = 3m$ in joule is

Conservation of mechanical energ

A. 24

B. 20

C. 18

D. 15

Answer: C

Watch Video Solution

25. A freely falling body takes $4s$ to reach the ground. One second after release, the percentage of its potential energy, that is still retained is

A. $6.25\ \%$

B. $25\ \%$

C. $37.5\ \%$

D. $93.75\ \%$

Answer: D

Watch Video Solution

26. A vertically projected body attains the maximum height in $6s$. The ratio of kinetic energy at the end of 3^{rd} second to decrease in kinetic energy in the next three seconds is

A. $1:1$

B. $1:3$

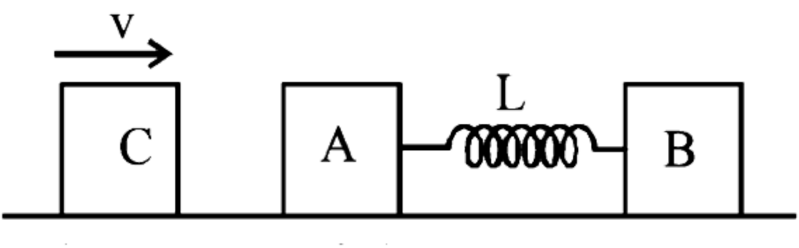
C. $3:1$

D. $9:1$

Answer: A

Watch Video Solution

27. Two blocks A and B, each of mass m, are connected by a masslesss spring of natural length L and spring constant K. The blocks are initially resting on a smooth horizontal floor with the spring at its natural length, as shown in fig. A third identical block C, also of mass m, moves on the floor with a speed v along the line joining A and B, and collides elastically with A. Then



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

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

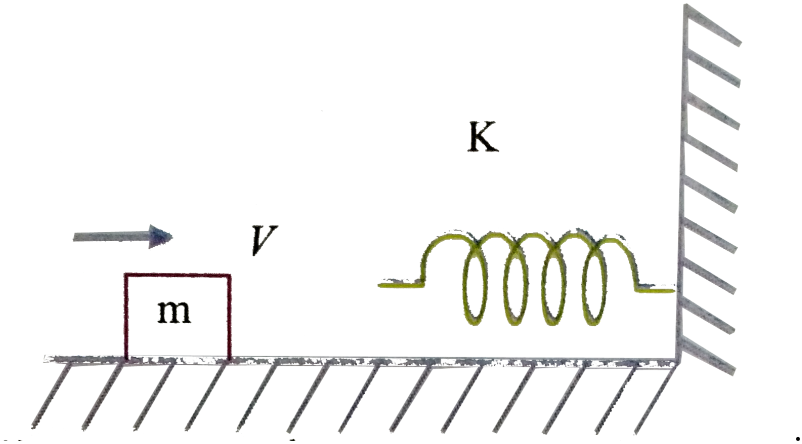
C. $\sqrt{\frac{mv}{2k}}$

D. $\frac{mv}{2k}$

Answer: A

Watch Video Solution

28. A block of mass $m = 25kg$ on a smooth horizontal surface with a velocity $\vec{v} = 3ms^{-1}$ meets the spring of spring constant $k = 100N/m$ fixed at one end as shown in figure. The maximum compression of the spring and velocity of block as it returns to the original position respectively are.



A. $1.5m, \ -3ms^{-1}$

B. $1.5m, 0ms^{-1}$

C. $1.0m, 3ms^{-1}$

D. $0.5m, 2ms^{-1}$

Answer: A

Watch Video Solution

29. A body is thrown vertically up with certain initial velocity, the potential and kinetic energies of the body are equal is thrown with double the velocity upwards, the ratio of potential and kinetic energies upwards, the ratio of potential and kinetic energies of the body when it crosses the same point, is

A. $1:1$

B. $1:4$

C. $1:7$

D. $1:8$

Answer: C

Watch Video Solution

30. A machine rated as $150W$, changes the velocity of a $10kg$ mass from $4ms^{-1}$ to $10ms^{-1}$ in $4s$. The efficiency of the machine is nearly.

A. 70%

B. 30%

C. 50%

D. $40\ \%$

Answer: A

Watch Video Solution

31. A pump is required to lift $600kg$ of water per minute from a well $25m$ deep and to eject it with a speed of $50ms^{-1}$. The power required to perform the above task is

A. 10 kW

B. 15 kW

C. 20 kW

D. 25 kW

Answer: B

Watch Video Solution

32. A tank on the roof of a $20m$ high building can hold $10m^3$ of water. The tank is to be filled form a pond on the ground in 20 minutes. If the pump has an efficiency of 60%, then the input power in kW is

A. 1.1

B. 2.74

C. 5.48

D. 7.0

Answer: B

Watch Video Solution

33. An electric fan, with effective area of cross-section 'A', accelerates air of density 'rho' to a speed 'v'. What is the power needed for this process ?

A. $\rho A v$

B. $.^1/_2 \rho A v$

C. $\rho A v^2$

D. $.^1 / _2 \rho A v^3$

Answer: D

Watch Video Solution

34. A point size mass $100gm$ is rotated in a vertical circle using a cord of length $20cm$. When the string makes an angle 60° with the vertical, the speed of the mass is $1.5m/s$. The tangential acceleration of the mass in that position is (in ms^{-2}).

A. 4.9

B. $4.9\sqrt{2}$

C. $4.9\sqrt{3}$

D. 9.8

Answer: C

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Watch Video Solution

35. A vehicle is travelling along concave road then along convex road of same radius of curvatures at uniform speed. If the normal reactions on the vehicle as it crosses the lowest point of concave surface, highest point of concave surface, highest point of convex surface are $1.5 \times 10^4 N, 3 \times 10^3 N$ respectively, then the mass of vehicle is $\left(g = 10m/s^{-2}\right)$.

A. 400 kg

B. 450 kg

C. 800 kg

D. 900 kg

Answer: D

Watch Video Solution

36. The length of a simple pendulum is $1m$. The bob is given a velocity $7ms^{-1}$ in horizontal direction from mean position. During upward motion of bob, if the string breaks when the bob is horizontal, then the maximum vertical height of ascent of bob from rest position is

A. $2.5m$

B. 2 m

C. 3 m

D. $3.5m$

Answer: A

Watch Video Solution

37. A body is allowed to slide down a frictionless track from rest position at its top under gravity. The track ends in a circular loop of diameter D. Then, the minimum height of the inclined track (in terms of D) so that it may complete successfully the loop is

A. $7D/4$

B. $9D/4$

C. $5D/4$

D. $3D/4$

Answer: C

Watch Video Solution

38. A body is mass m is rotating in a vertical circle of radius 'r' with critical speed. The difference in its $K.E$ at the top and at the bottom is

A. 2 mgr

B. 4 mgr

C. 6 mgr

D. 3 mgr

Answer: A

Watch Video Solution

39. A simple pendulum of length 'l' carries a bob of mass 'm'. If the breaking strength of the string is $3mg$, the maximum angular amplitude from the vertical can be

A. 0°

B. 30°

C. 60°

D. 90°

Answer: D

Watch Video Solution

40. A body of mass $4kg$ moving with a speed of $3ms^{-1}$ collides head on with a body of mass $3kg$ moving in the opposite direction at a speed of

$2ms^{-1}$. The first body stops after the collision. The final velocity of the second body is

A. $3ms^{-1}$

B. $5ms^{-1}$

C. $-9ms^{-1}$

D. $30ms^{-1}$

Answer: A

Watch Video Solution

41. Three identical particles with velocities $v_0\hat{i}$, $-3v_0\hat{j}$ and $5v_0\hat{k}$ collide successively with each other in such a way that they form a single particle. The velocity vector of resultant particle is

A. $v_0\left(\hat{i}-3\hat{j}+5\hat{k}\right)$

B. $\frac{v_0}{3}\left(\hat{i}-3\hat{j}+5\hat{k}\right)$

C. $\frac{v_o}{2}\left(\hat{i}-3\hat{j}+5\hat{k}\right)$

D. $\frac{v_0}{3}\left(\hat{i} - 3\hat{j} + 5\hat{k}\right)$

Answer: B

Watch Video Solution

42. From the top of a tower of height $100m$ a $10gm$ block is dropped freely and a $6gm$ bullet is fired vertically upwards from the foot of the tower with velocity $100ms^{-1}$ simultaneously. They collide and stick together. The common velocity after collision is $\left(g = 10ms^{-2}\right)$.

A. $27.5ms^{-1}$

B. $150ms^{-1}$

C. $40ms^{-1}$

D. $100ms^{-1}$

Answer: A

Watch Video Solution

43. A steel ball of radius $2cm$ is initially at rest. It is struck head on by another stell ball of radius $4cm$ travelling with a velocity of $81cm/s$. If the collision is elastic their respective final velocities are

A. $63cm/s$, $144cm/s$

B. $144cm/s$, $63cm/s$

C. $19cm/s$, $100cm/s$

D. $100cm/s$, $19cm/s$

Answer: B

Watch Video Solution

44. A steel ball of radius $2cm$ is initially at rest. It is struck head on by another stell ball of radius $4cm$ travelling with a velocity of $81cm/s$. The common velocity if it is perfectly inelastic collision.

A. $144cm/s$

B. $61cm/s$

C. $81cm/s$

D. $72cm/s$

Answer: D

Watch Video Solution

45. A tennis ball bounces down a flight of stairs, striking each step in turn and rebounding to half to height of the step. The coefficient of restitution is

A. $1/2$

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

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

D. $\left(\frac{1}{\sqrt{2}}\right)^{1/4}$

Answer: B

Watch Video Solution

46. A ball hits the ground and loses 20% of its momentum. Coefficient of restitution is

A. 0.2

B. 0.4

C. 0.6

D. 0.8

Answer: D

Watch Video Solution

47. A plastic ball falling from a height $4.9m$ rebounds number of times. If total time for second collision is $2.4\sec$, then coefficient of restitution is

A. 0.3

B. 0.4

C. 0.7

D. 0.6

Answer: C

Watch Video Solution

48. A ball is dropped from a height 'h' on to a floor of coefficient of restitution 'e'. The total distance covered by the ball just before second hit is

A. $h(1-2e^2)$

B. $h(1+2e^2)$

C. $h(1+e^2)$

D. he^2

Answer: B

Watch Video Solution

49. In two separate collisions, the coefficient of restitutions e_1 and e_2 are in the ratio $3:1$. In the first collision the relative velocity of approach is twice the relative velocity of separation. Then, the ratio between relativevelocity of approach and relative velocity of separation in the second collision is

A. $1:6$

B. $2:3$

C. $3:2$

D. $6:1$

Answer: D

Watch Video Solution

50. A sphere of mass m moving with constant velocity u, collides with another stationary sphere of same mass. If e is the coefficient of restitution, the ratio of the final velocities of the first and second sphere is

A. $\frac{1+e}{1-e}$

B. $\frac{1-e}{1+e}$

C. $\frac{e}{1-e}$

D. $\frac{1+e}{e}$

Answer: B

Watch Video Solution

51. A canon shell fired breaks into two equal parts at its highest point. One part retraches the path to the canon with kinetic enegry E_1 and the kinetic energy of the second part is E_2. Relation between E_1 and E_2 is

A. $E_2 = E_1$

B. $E_2 = 4E_1$

C. $E_2 = 9E_1$

D. $E_2 = 15E_1$

Answer: C

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52. A body of $200g$ begins to fall from a height where its potential energy is $80J$. Its velocity at a point where its kinetic and potential energies are equal $(\in m/s)$.

A. $10\sqrt{8}$

B. 4

C. 400

D. 20

Answer: D

Watch Video Solution

53. The work done by a force $\overline{F} = 2\overline{i} - \overline{j} - \overline{k}$ in moving an object from origin to a point whose position vector is $\bar{r} = 3\overline{i} + 2\overline{j} - 5\overline{k}$.

A. 1 unit

B. 9 units

C. 13 units

D. 60 units

Answer: B

Watch Video Solution

54. A ball at rest is dropped from a height of $12m$. If it looses 25% of its kinetic energy on striking the ground and bounces back to a height 'h'.

The value of 'h' is equal to

A. 3 m

B. 6 m

C. 9 m

D. 12 m

Answer: C

Watch Video Solution

55. A mass of $2.9kg$ is suspended from a string of length $50cm$ and is at rest . Another body of mass $100gm$ which is moving horizontal with a velocity of $150m/s$ strikes it . After striking the two bodies combine together . Tension in the string , when it is at an angle of 60° with the velocity is : $g = 10m/s^2$

A. 140 N

B. 135 N

C. 125 N

D. 90 N

Answer: B

Watch Video Solution

56. A body is thrown vertically upward from a point A 125 m above the ground. It goes up to a maximum height of 250 m above the ground and passes through A on its downward journey. The velocity of the body when it is at a height of 70 m above the ground is $\left(g = 10m / s^2\right)$

A. $50ms^{-1}$

B. $60ms^{-1}$

C. $80ms^{-1}$

D. $20ms^{-1}$

Answer: B

Watch Video Solution

57. A body is mass $300 kg$ is moved through $10 m$ along a smooth inclined plane of inclination angle 30°. The work done in moving (in joules) is $(g = 9.8 ms^{-2})$.

A. 4900

B. 9800

C. 14700

D. 2450

Answer: C

Watch Video Solution

58. A ball of mass 'm' moving with a horizontal velocity 'v' strikes the bob of mass 'm' of a pendulum at rest. During this collision, the ball sticks with the bob of the pendulum. The height to which the combined mass raises is (g = acceleration due to gravity).

A. $\frac{v^2}{4g}$

B. $\frac{v^2}{8g}$

C. $\frac{v^2}{g}$

D. $\frac{v^2}{2g}$

Answer: B

Watch Video Solution

59. The velocity 'v' reached by a car of mass 'm' on moving a certain distance from the starting point when driven by a motor with constant power 'P' is such that

A. $v \propto \frac{3P}{m}$

B. $v^2 \propto \frac{3P}{m}$

C. $v^3 \propto \frac{3P}{m}$

D. $v \propto \left(\frac{3P}{m}\right)^2$

Answer: C

Watch Video Solution

60. A ball 'A' of mass 'm' moving along positive x-direction with kinetic energy K and linear momentum "p" undergoes elastic head on collision with a stationary ball 'B' of mass M. After the collision, the ball A moves along negative x-direction with kinetic energy $K/9$, the final linear momentum of the ball B is

A. P

B. $P/3$

C. $4P/3$

D. 4P

Answer: C

Watch Video Solution

61. Displacement of a body is $5i + 3j - 4km$ due to the action of a force $6i + 6j + 4kN$ on it for $5a$. The power in watt is

A. 16

B. 9.6

C. 6.4

D. 3.2

Answer: C

Watch Video Solution

62. A ball at rest is dropped freely from a height of $20m$. It loses 30% of its energy on striking the ground and bounces back. The height to which it bounces back is

A. 14 m

B. 12 m

C. 9 m

D. 6 m

Answer: A

Watch Video Solution

63. A $3kg$ sphere makes an inelastic collision with another sphere at rest and they stick after the collision. If the composite mass moves with a speed of $\frac{1^{th}}{4}$ of the initial speed of $3kg$ sphere, the mass of second sphere is

A. 12 kg

B. 9 kg

C. 6 kg

D. 3 kg

Answer: B

Watch Video Solution

64. A ball is let to fall frm a height h_0. It makes 'n' collisions with the horizontal ground. If after 'n' collisions it rebounds with a velocity v_n and the ball rises to a height h_n, then the coefficient of restitution for the collision is

A. $e = \left(\frac{h_n}{h_o}\right)^{\frac{1}{2n}}$

B. $e = \left(\frac{h_n}{h_o}\right)^{\frac{n}{2}}$

C. $e = \left(\frac{h_0}{h_n}\right)^{\frac{n}{2}}$

D. $e = \left(\frac{h_0}{h_n}\right)^{\frac{1}{2n}}$

Answer: A

Watch Video Solution

65. A bullet is fired normally towards an immovable wooden block. If it loses $25\,\%$ of its kinetic energy in penetrating through the block at thickness x, the further distance penetrated by the bullet into the block is

A. 2x

B. 4x

C. 6x

D. 8x

Answer: B

Watch Video Solution

66. A ball is falling freely from a certain height. When it reached $10m$ height from the ground its velocity is v_0. It collides with the horizontal ground and loses $50\,\%$ of its energy and rises back to height of $10m$. The value of velocity v_0 is

A. $7ms^{-1}$

B. $10ms^{-1}$

C. $14ms^{-1}$

D. $16ms^{-1}$

Answer: C

Watch Video Solution

67. A motor of power P_0 is used to deliver water at a certain rate through a given horizontal pipe. To increase the rate of flow of water through the same pipe 'n' times, the power of the motor is increased to P_1. The ratio of P_1 to P_0 is

A. $n:1$

B. $n^2:1$

C. $n^3:1$

D. $1:n^3$

Answer: C

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68. A body of mass $5kg$ makes an elastic collision with another body at rest and continues to move in the original direction after the collision with a velocity equal to $1/10^{th}$ of its original velocity. The mass of the second body is

A. $4.09kg$

B. $0.5kg$

C. $5kg$

D. $5.09kg$

Answer: A

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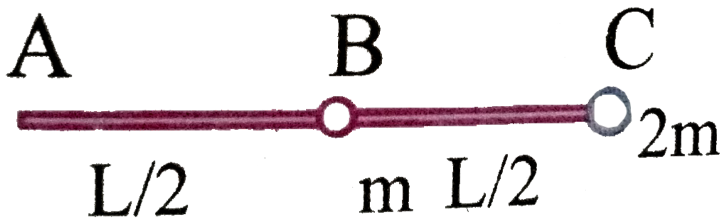
Level- III (C.W)

1. A long rod ABC of mass "m" and length "L" has two particles of masses "m" and "2m" attached to it as shown in the figure. The system is initially in the horizontal position. The work to be done to keep it vertical with A hinged at the bottom is



A. $2mgL$

B. $3mgL/2$

C. $5mgL/2$

D. $3mgL$

Answer: D

Watch Video Solution

2. A particle of mass $100g$ is thrown vertically upwards with a speed of $5m/s$. The work done by the force of gravity during the time the particle goes up is

A. $-0.5J$

B. $-1.25J$

C. $1.25J$

D. $0.5J$

Answer: B

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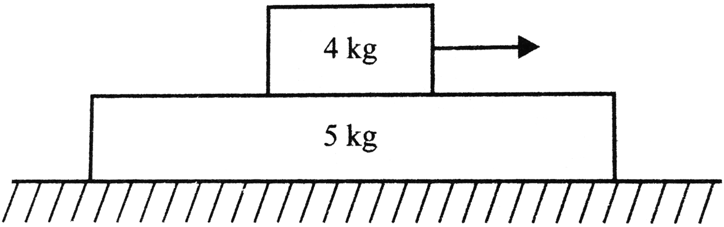
3. A large slab of mass $5kg$ lies on a smooth horizontal surface, with a block of mass $4kg$ lying on the top of it. The coefficient of friction between the block and the slab is 0.25. If the block is pulled horizontally by a force of F $= 6N$, the work done by the force of friction on the slab, between the instants $t = 2s$ and $t = 3s$, is $\left(g = 10ms^{-2}\right)$



A. $2.4J$

B. $5.55J$

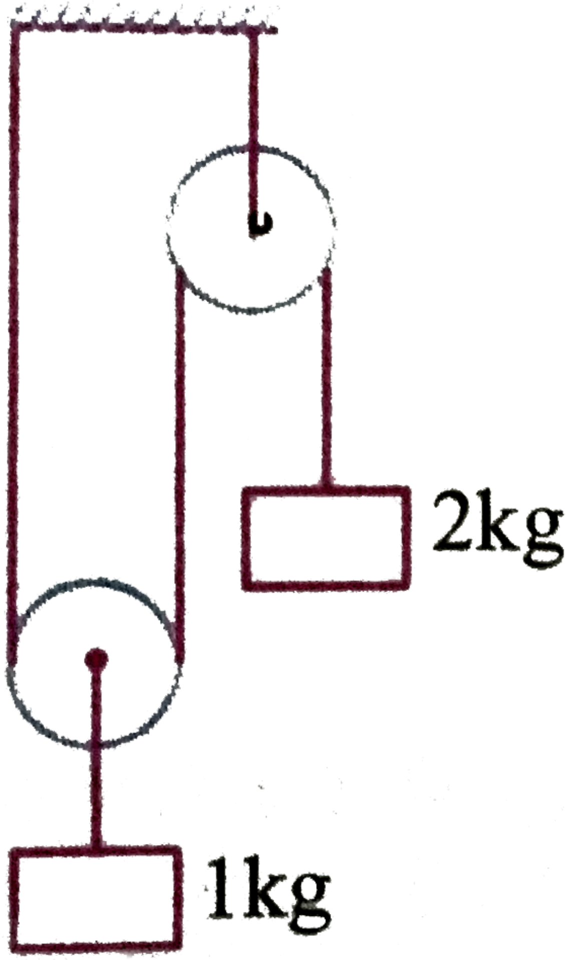
C. $4.44J$

D. $10J$

Answer: B

Watch Video Solution

4. In the pulley-block system shown in figure, strings are light. Pulleys are massless and smooth. System is released from rest. In 0.3 seconds.



(a) work done on $2kg$ block by gravity is $6J$

(b) work done one $2kg$ block by string is $-2J$

(c) work done on $1kg$ block by gravity is $-1.5J$

(d) work done on $1kg$ block string is $2J$.

A. only a, d are correct

B. only b, d are correct

C. only a, b, c are correct

D. All are correct

Answer: D

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5. A particle of mass $0.5kg$ travels in a straight line with velocity $v = ax^{3/2}$ where $a = 5m^{-1/2}s^{-1}$. What is the work done by the net force during its displacement from $x = 0$ to $x = 2m$?

A. 50 J

B. 20 J

C. 80 J

D. $45.5J$

Answer: A

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6. A particle of mass $2kg$ starts moving in a straight line with an initial velocity of $2m/s$ at a constant acceleration of $2m/s^2$. Then rate of change of kinetic energy.

A. is four times the velocity at any moment

B. is two times the displacement at any moment

C. is four times the rate of charge of velocity at any moment

D. is constant throughout

Answer: A

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7. 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. $\sqrt{2}+1$

B. $\sqrt{2} - 1$

C. $\sqrt{2} + 2$

D. $\sqrt{2} - 2$

Answer: A

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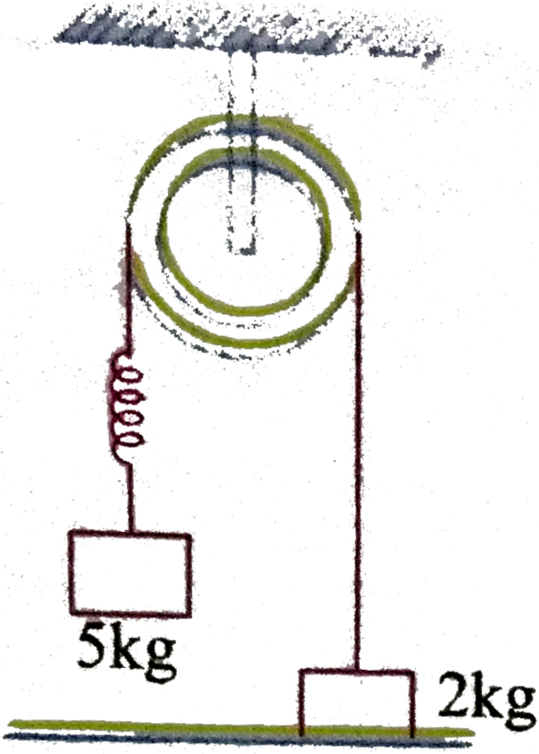
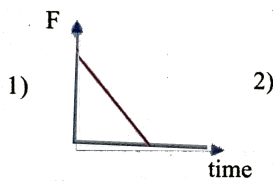
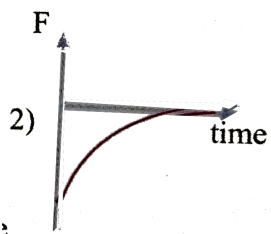
8. The kinetic energy (KE) versus time graph for a graph for a particle moving along a straight line is shown in the figure. The force vs time graph for the particle may be

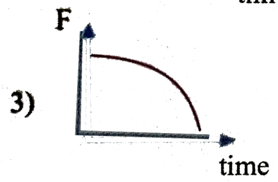


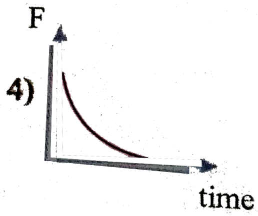
A.



B.



C. 

D. 

Answer: D

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9. A lifting machine, having an efficiency of 80% uses $2500J$ of energy in lifting a $10kg$ load over a certain height. If the load is now allowed to fall through that height freely, its velocity at the end of the fall will be $(g = 10m/s^2)$

A. $10ms^{-1}$

B. $15ms^{-1}$

C. $20ms^{-1}$

D. $25ms^{-1}$

Answer: C

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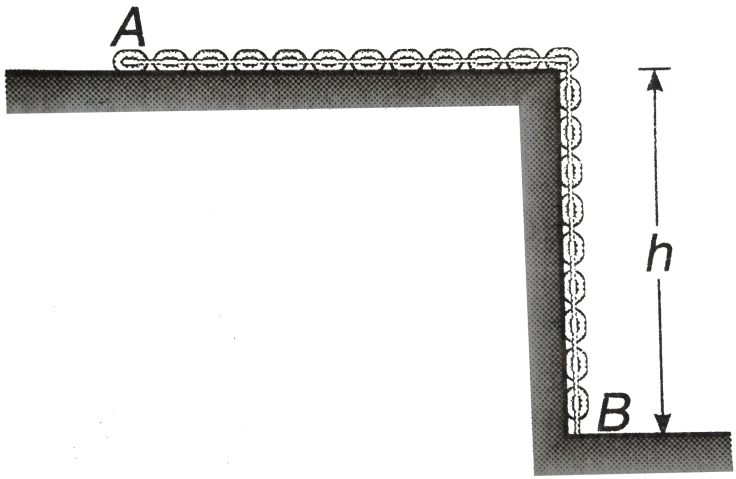
10. A chain (AB) of length l loaded in a smooth horizontal table so that its fraction of length h hangs freely and touches the surface of the table with its end B. At a certain moment ,the end A of the chain is set free. With what velocity will this end the chain slip out of the table ?



A. $h\sqrt{\frac{2g}{Lh}}$

B. $\sqrt{2gh \log_e\left(\frac{L}{h}\right)}$

C. $\sqrt{2gl \log_e\left(\frac{L}{h}\right)}$

D. $\frac{1}{hL}\sqrt{2g}$

Answer: B

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11. A block of mass $m = 1kg$ moving on a horizontal surface with speed $v_i = 2ms^{-1}$ enters a rough patch ranging from $x0.10m \rightarrow x = 2.01m$. The retarding force F_r on the block in this range ins inversely proportional to x over this range

$F_r = -\frac{k}{x} for 0.1 < x < 2.01m$

$= 0$ for $< 0.1m$ and $x > 2.01m$ where $k = 0.5J$. What is the final K.E. and speed v_f of the block as it crosses the patch?

A. $2ms^{-1}$

B. $1ms^{-1}$

C. $3ms^{-1}$

D. $0.5ms^{-1}$

Answer: B

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12. A $1.5kg$ block is initially at rest on a horizontal frictionless surface. A horizontal force $\vec{F} = (4 - x^2)\hat{i}$ is applied on the block. Initial position of the block is at $x = 0$. The maximum kinetic enery of the block between $x = 0$ and $x = 2m$ is

A. $2.33J$

B. $8.67J$

C. $5.33J$

D. $6.67J$

Answer: C

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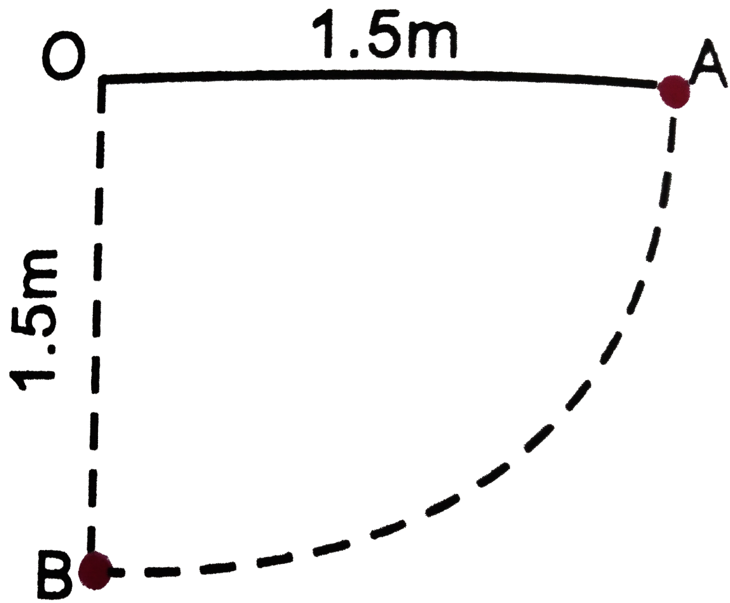
13. The bob A of a simple pendulum is released from a horizontal position A as shownin in figure. If the length of the pendulum is 1.5m , what is the speed with which the bob arrives at the lowermost point B, given that it dissipates 5% of its initial energy against air resistance ?



A. 3.14

B. 5.28

C. 1.54

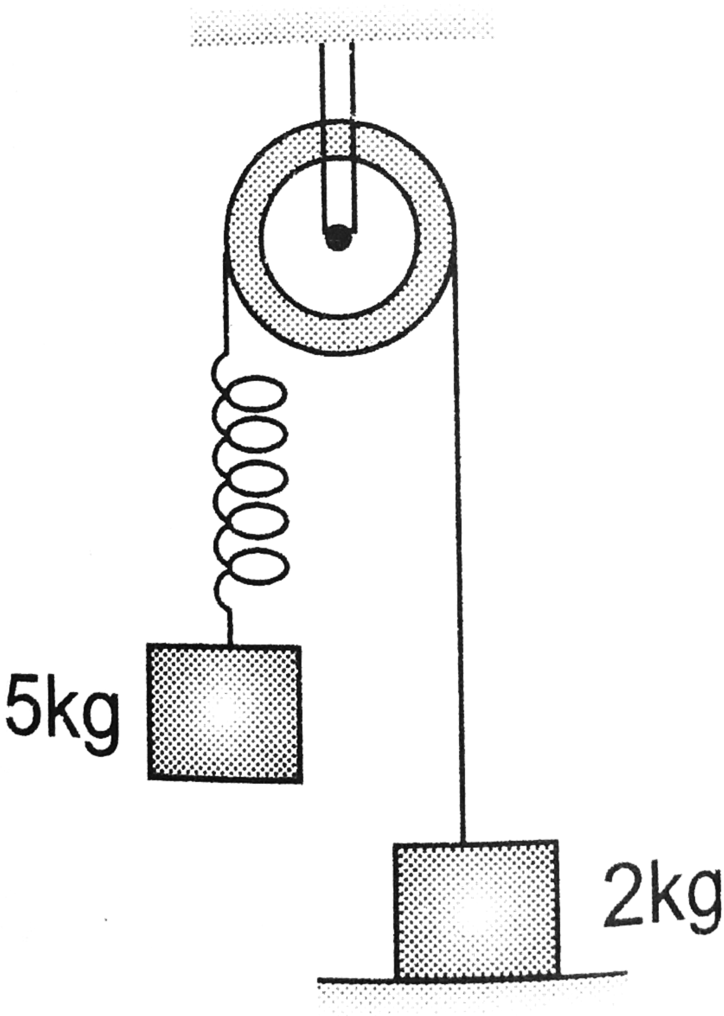
D. 8.26

Answer: B

Watch Video Solution

14. System shown in figure is released from rest . Pulley and spring is mass less and friction is absent everywhere. The speed of $5kg$ block when $2kg$ block leaves the constant of with ground is (force constant of spring

$k = 40N/m$ and $g = 10m/s^2$)



A. $\sqrt{2}m/s$

B. $2\sqrt{2}m/s$

C. $2m/s$

D. $\sqrt{2}m/s$

Answer: B

Watch Video Solution

15. The potential energy of a particle of mass m is given by $U = \frac{1}{2}kx^2$ for $x < 0$ and $U = 0$ for $x \geq 0$. If total mechanical energy of the particle is E. Then its speed at $x = \sqrt{\frac{2E}{k}}$ is

A. zero

B. $\sqrt{\frac{2E}{m}}$

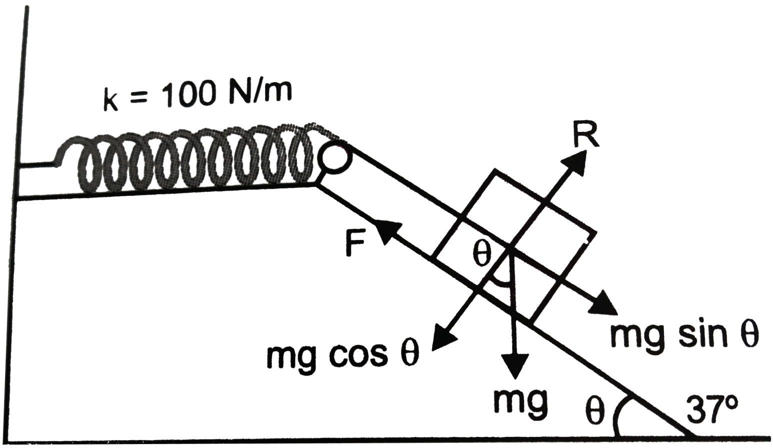
C. $\sqrt{\frac{E}{m}}$

D. $\sqrt{\frac{E}{2m}}$

Answer: B

Watch Video Solution

16. A 1kg block situated on a rough incline is connected to a spring of spring constant $100Nm^{-1}$ as shown in figure,. The block is released from rest with the spring in the unstretched position. The block moves 10cm down the incline before coming to rest. Find the coefficient of friction between the block and the incline. Assume that the spring has negligible mass and the pulley is frictionless.



A. 0.125

B. 1.25

C. 5.2

D. 4.5

Answer: A

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17. A light spring of force constant 'K' is held between two blocks of masses 'm' and '2m'. The two blocks and the spring system rests on a smooth horizontal floor. Now th blocks are moved towards each other compressing the springs by 'x' and suddenly released. The relative velocity between the blocks when the spring attains its natural length will be

A. $\left(\sqrt{\frac{3K}{2m}}\right)x$

B. $\left(\sqrt{\frac{2K}{3m}}\right)x$

C. $\left(\sqrt{\frac{K}{3m}}\right)x$

D. $\left(\sqrt{\frac{K}{2m}}\right)x$

Answer: A

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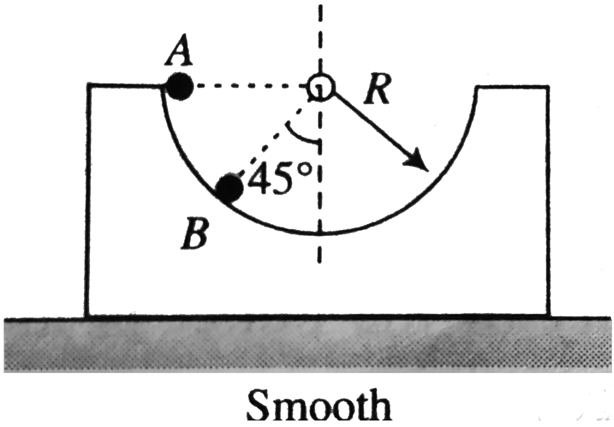
18. A ball of mass m is released from A inside a smooth wedge of mass m as shown in figure. What is the speed of the wedge when the ball reaches point B?



A. $\left(\frac{gR}{3\sqrt{2}}\right)^{\frac{1}{2}}$

B. $\sqrt{2gR}$

C. $\left(\frac{5gR}{2\sqrt{3}}\right)^{\frac{1}{2}}$

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

Answer: A

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19. Power supplied to a mass $2kg$ varies with time as $P = \frac{3t^2}{2}$ watt. Here t is in second . If velocity of particle at $t = 0 is v = 0$, the velocity of particle at time $t = 2s$ will be:

A. $1m/s$

B. $4m/s$

C. $2m/s$

D. $2\sqrt{2}m/s$

Answer: C

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20. A particle of mass in is moving in a circular with of constant radius r such that its contripetal accelenation a_c is varying with time t as $a_c = K^2 r t^2$ where K\` is a constant . The power delivered to the particles by the force action on it is

A. zero

B. $mk^2r^2t^2$

C. mk^2r^2t

D. mk^2rt

Answer: C

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21. A constant power P is applied to a particle of mass m. The distance traveled by the particle when its velocity increases from v_1 to v_2 is (neglect friction):

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

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

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

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

Answer: C

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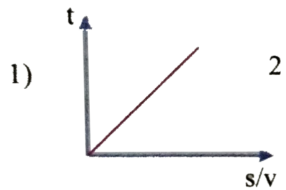
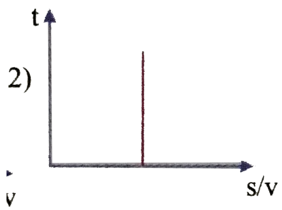
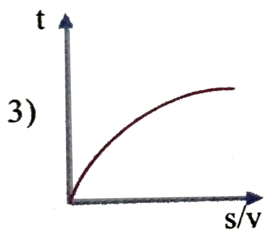
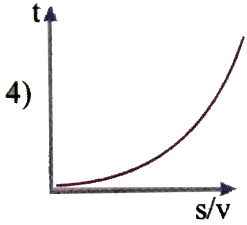
22. A body is moved from rest along a straight line by a machine delivering constant power. The ratio of displacement and velocity (s/v) varies with time t as

A. 

B. 

C. 

D. 

Answer: A

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23. Power applied to a particle varices with time as $P = (3t^2 - 2t + 1)$ watt, where t is in second. Find the change in its kinetic energy between time $t = 2s$ and $t = 4s$.

A. 32 J

B. 46 J

C. 61 J

D. 100 J

Answer: B

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24. A car of mass M accelerates starting from rest. Velocity of the car is given by $v = \left(\frac{2Pt}{M}\right)^{\frac{1}{2}}$ where P is the constant power supplied by the engine. The position of car as a function of time is given as

A. $\left(\frac{8P}{9M}\right)^{\frac{1}{2}}t^{\frac{3}{2}}$

B. $\left(\frac{9P}{8M}\right)^{\frac{1}{2}}t^{\frac{3}{2}}$

C. $\left(\frac{8P}{9M}\right)^{\frac{1}{2}}t^{\frac{2}{3}}$

D. $\left(\frac{9P}{8M}\right)t^{3}$

Answer: A

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25. During gas of negligible mass is sealed in a test tube of mass $50gm$ with the helo of a stopper of mass $3.5gm$. The test tube is suspended from a fixed point with help of massless string such that the test tube is horizontal and distance between point of suspension and centre of mass of test tube is $25cm$. The test tube is heated to a temperature due to which stopper is ejected out horizontally while test tube completes a vertical circle of radius $25cm$. The minimum velocity with which stopper should be ejected out is

A. 72 kmph

B. 90 kmph

C. 180 kmph

D. 360 kmph

Answer: C

Watch Video Solution

26. A nail is fixed at a point P vertically below the point of suspension 'O' of simple pendulum of length $1m$. The bob is released when the string of pendulum makes an angle 30° with horiozontal. The bob reaches lowest point and then describes vertical circle whose centre coincides with P . The least distance of P from O is

A. $0.4m$

B. $0.5m$

C. $0.6m$

D. $0.8m$

Answer: D

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27. A simple pendulum with a bob of mass 'm' swings with angular amplitude of 60°. When its angular displacement is 30°, the tension in the strings would be

A. $3\sqrt{3}mg$

B. $\frac{mg}{2}(3\sqrt{3}-2)$

C. $\frac{1}{2}mg\left(\frac{3}{\sqrt{3}+2}\right)$

D. $\frac{1}{2}mg(3-\sqrt{2})$

Answer: B

Watch Video Solution

28. A block is freely sliding down from a vertical height $4m$ on smooth inclined plane. The block reaches bottom of inclined plane and then it decribes vertical circle of radius $1m$ along smooth track. The ratio of normal reactions on the block while it crossing lowest point and highest point of vertical circle is

A. $6:1$

B. $5:1$

C. $3:1$

D. $5:2$

Answer: C

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29. The length of a ballistic pendulum is $1m$ and mass of its block is $1.9kg$. A bullet of mass $0.1kg$ strikes the block in horizontal direction with a velocity $100ms^{-1}$ and got embedded in the block. After collision the combined mass swings away from lowest point. The tension in the strings when it makes an angle 60° with vertical is $\left(g = 10ms^{-2}\right)$.

A. 20 N

B. 30 N

C. 40 N

D. 50 N

Answer: C

Watch Video Solution

30. A stone attached to a string is rotated in a vertical circle such that when it is at the top of the circle its speed is V and there is neither tension nor slacking in the string. The speed of stone when its angular displacement is 120° from the lowest point is

A. $\frac{3}{2}V$

B. $\sqrt{2}V$

C. $\sqrt{3}V$

D. $\sqrt{\frac{3}{2}}V$

Answer: B

Watch Video Solution

31. Mass of the bob of a simple pendulum of length L is m. If the bob is projected horizontally from its mean position with velocity $\sqrt{4gL}$, then the tension in the string becomes zero after a vertical displacement of

A. $L/3$

B. $3L/4$

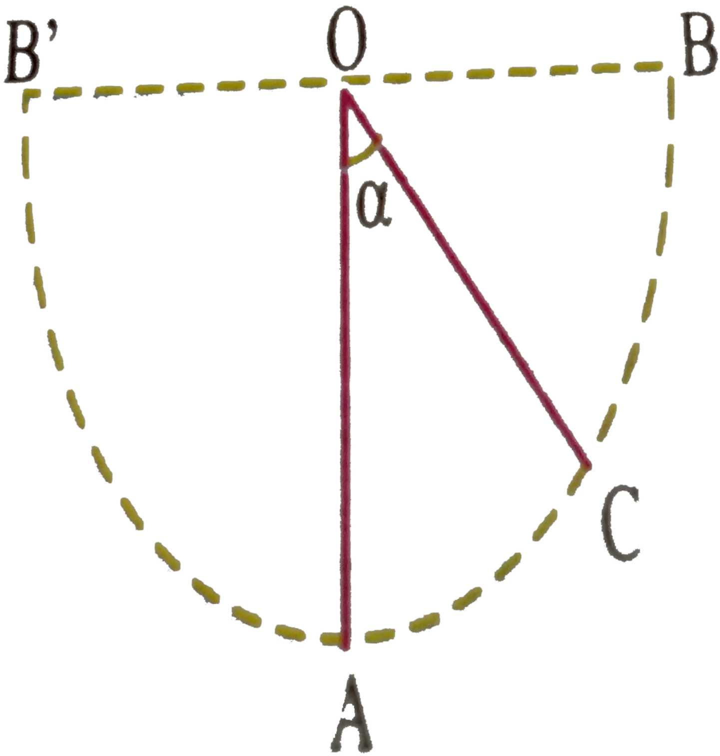
C. $4L/3$

D. $5L/3$

Answer: D

Watch Video Solution

32. A bob of mas M is suspended by a massless string of length L. The horizontal velocity v at position A is just sufficient to make it reach the point B. The angle θ at which the speed of the bob is half of that at A, satisfies.



A. $\theta = \frac{\pi}{4}$

B. $\frac{\pi}{4} < \theta < \frac{\pi}{2}$

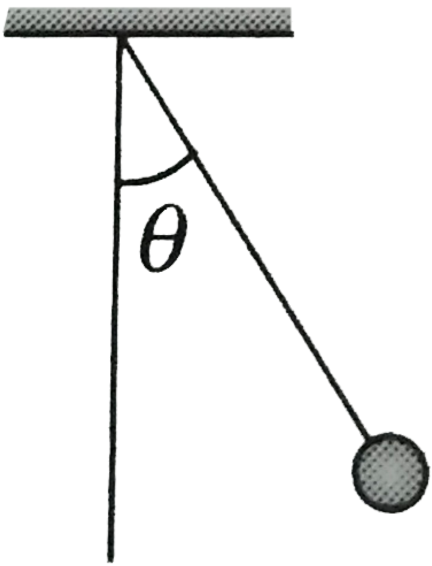
C. $\frac{\pi}{2} < \theta < \frac{3\pi}{4}$

D. $\frac{3\pi}{4} < \theta < \pi$

Answer: B

Watch Video Solution

33. A simple pendulum is oscillating with an angular amplitude of 90° as shown in the figure. The value of θ for which the resulting acceleration of the bob is directed (i) vertically downward, (ii) vertically upward and (iii) horizontally is`



A. 0^{0}, $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$, 90^{0}

B. 90^{0}, $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$, 0^{0}

C. $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$, 0^{0}, 90^{0}

D. $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right), 90^0, 0^0.$

Answer: A

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34. A block of wood of mass $3M$ is suspended by a string of length $\frac{10}{3}m.$ A bullet of mass M hits it with a certain velocity and gets embedded in it. The block and the bullet swing to one side till the string makes 120° with the initial position. the velocity of the bullet is $\left(g = 10ms^{-2}\right)$.

A. $\frac{40}{\sqrt{3}}ms^{-1}$

B. $20ms^{-1}$

C. $30ms^{-1}$

D. $40ms^{-1}$.

Answer: D

Watch Video Solution

35. A wooden block of mass $10gm$ is dropped from the top of a cliff $100m$ high. Simultaneously a bullet of same mass is fired from the foot of the cliff vertically upwards with a velocity of $100ms^{-1}$. If the bullet after collision gets embedded in the block, the common velocity of the bullet and the block immediately after collision is $(g = 10ms^{-2})$.

A. $40ms^{-1}$ downward

B. $40ms^{-1}$ upward

C. $80ms^{-1}$ upward

D. zero

Answer: B

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36. A particle of mass m has a velocity $-v_0 i$, while a second particle of same mass has a velocity $v_0 j$. After the particles collide, first particle is found to have a velocity $\frac{-1}{2} v_0 \bar{i}$ then the velocity of othe particle is

A. $\frac{-1}{2}v_0 \overrightarrow{i} + v_0 \overrightarrow{j}$

B. $\frac{1}{2}v_0 \overrightarrow{i} + v_0 \overrightarrow{j}$

C. $v_0 \overrightarrow{i} + v_0 \overrightarrow{j}$

D. $-v_0 \overrightarrow{i} + v_0 \overrightarrow{j}$

Answer: A

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37. At high altitude , a body explodes at rest into two equal fragments with one fragment receiving horizontal velocity of $10m/s$. Time taken by the two radius vectors connecting of explosion to fragments to make 90° is

A. 10 s

B. 4 s

C. 2 s

D. 1 s

Answer: D

Watch Video Solution

38. A test tube of mass $20gm$ is filled with a gas and fitted with a stopper of $2gm$. It is suspended horizontally by means of a thread of $1m$ length and heated. When the stopper kicks out, the tube just completes a circle in vertical plane. The velocity with which the stopper kicked out is

A. $7ms^{-1}$

B. $10ms^{-1}$

C. $70ms^{-1}$

D. $0.1ms^{-1}$

Answer: C

Watch Video Solution

39. Two bodies move towards each other and collide inelastically. The velocity of the first body is $2m/s$ and that of the seconf is $4m/\text{sec}$ before impact. The common velocity after collision is $1m/s$ in the direction of the first body. The number of times did the KE of the first body exceed that of the second body before collision.

A. 4.25

B. 3.25

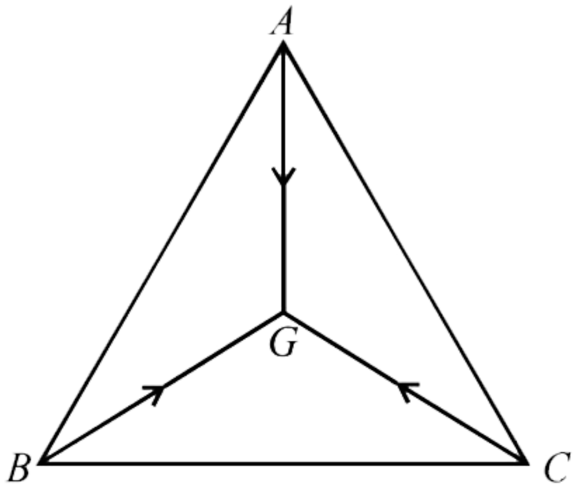
C. 2.25

D. 1.25

Answer: D

Watch Video Solution

40. Three particles A, B and C of equal mass move with equal speed V along the medians of an equilateral triangle as shown in hgure. They collide at the centroid G of the triangle. After the collision, A comes to test, B retraces its path with the speed V. What is the velocity of C ?



A. v along BG

B. $\frac{v}{2}$ along GB

C. Zero

D. v along CG

Answer: A

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41. A moving sphere P collides another sphere Q at rest. If the collision takes place along the line joining their centers of mass such that their total kinetic enegry is conserved and the fraction of $K.E$ transferred by the colliding particle is $\frac{8}{9}$, then the mass of P and mass of Q bears a ratio

A. $\sqrt{8} : 3$

B. $9 : 8$

C. $2 : 3$

D. $2 : 1$

Answer: D

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42. A particle strikes a horizontal frictionless floor with a speed 'u' at an angle 'theta' with the vertical and rebounds with a speed 'v' at an angle 'alpha' with the vertical. Find the value of 'v' if 'e' is the coefficient of restitution.

A. $v = u\sqrt{e^2 \sin^2 \theta + \cos^2 \theta}$

B. $v = u\sqrt{e^2 \cos^2 \theta + \sin^2 \theta}$

C. $v = u\sqrt{e^2 \cos^2 \theta + \tan^2 \theta}$

D. $v = u\sqrt{\cot^2 \theta + e^2 \cos^2 \theta}$

Answer: B

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43. Two sphere A and B of equal masses lie on the smooth horizontal circular groove at opposite ends of diameter and at the end of time 't','A' impings on 'B' . If 'e' is the coefficient of restitution, the second impinge will occur after a time

A. $\frac{2t}{e}$

B. $\frac{t}{e}$

C. $\frac{\pi t}{e}$

D. $\frac{2\pi t}{e}$

Answer: A

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44. A ball is thrown at an angle of incidence $'\theta'$ on a horizontal plane such that the incident direction and the reflected direction are at right angle to each other. If the coefficient of restuitution is $'e'$ then $'\theta'$ is equal to

A. $\tan^{-1}(e)$

B. $\tan^{-1}(2e)$

C. $\tan^{-1}\left(\sqrt{2}e\right)$

D. $\tan^{-1}\left(\sqrt{e}\right)$

Answer: D

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45. Consider the collision depicted in Figure, to be between two billiard balls with equal masses $m_1 = m_2$. The first ball is called the cue and the second ball is called the target. The billiard player wants to sink the target ball in a corner pocket, which is at an angle $\theta_2 = \phi = 37^\circ$. Assume that the collision is elastic and that friction and rotational motion are not important. Obtain $\theta_1 = \theta$.

A. 37°

B. 90°

C. 45°

D. 53°

Answer: D

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46. A projectile is fixed on a horizontal ground. Coefficient of restitution between the projectile and the ground is 'e'. If a, b and c be the ration of time of flight $\left[\frac{T_1}{T_2}\right]$, maximum height $\left[\frac{H_1}{H_2}\right]$ and horizontal range $\left[\frac{R_1}{R_2}\right]$ in first two collisions with the ground, then

A. $a = \frac{1}{e}$

B. $b = \frac{1}{e^2}$

C. $c = \frac{1}{e}$

D. $1, 2, \&3$

Answer: D

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47. A wall moving with velocity $2cms^{-1}$ towards the ball and ball is moving towards the wall with a velocity $10cms^{-1}$. It hits the wall normally and makes elastic collision with wall. The velocity of ball after collision with wall in cms^{-1}.

A. 12

B. 8

C. 14

D. 16

Answer: C

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48. A body A moves towards a wall with velocity V. The wall also moves towards the body A with velocity V_0. After collision the body moves in opposite direction with velocity $V^{|}$ which is $\left(1+\frac{2V_0}{V}\right)$ times the velocity V. The coefficient of restitution is

A. $\frac{1}{4}$

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

C. 1

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

Answer: C

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49. A sphere A of mass m moving with a velocity hits another stationary sphere B of same mass. If the ratio of the velocity of the sphere after collision is $\frac{v_A}{v_B} = \frac{1-e}{1+e}$ where e is the coefficient of restitution, what is the initial

velocity of sphere A with which it strikes?

A. $V_A + V_B$

B. $V_A - V_B$

C. $V_B - V_A$

D. $\frac{(V_B + V_A)}{2}$

Answer: A

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50. A ball A of mass $3m$ is placed at a distance d from the wall on a smooth horizontal surface Another ball B of mass m moving with velocity u collides with ball A. The coefficient of restitution between the balls and the wall and between the balls is e

(a) the velocity of ball B after collision is $\frac{u(3e-1)}{4}$.

(b) the velocity of ball B after collision is $\frac{u(2e-1)}{4}$.

(c) after collision, ball A will have away by distance $\frac{d(2e-1)}{(2e-1)}$ during the time ball B returns back to wall.

(d) after collision, ball A will move away by distance $\frac{d(e-1)}{(3e-1)}$ during the time ball B returns back to wall.

A. a,d

B. a,c

C. b,d

D. c,d

Answer: A

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NCERT (Based Questions)

1. An electron and a proton are moving under the influence of mutual forces. In calculating the change in the kinetic energy of the system during motion, one ignores the magnetic force of one on another. This is because,

A. the two magnetic force are equal and opposite, so they produce no net effect.

B. the magnetic forces do no work on each particle.

C. the magnetic force do equal and opposite (but non-zero) work on each particle.

D. the magnetic forces are necessarily negligible.

Answer: B

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2. A proton is kept at rest. A positively charged particle is released from rest at a distance d in its field. Consider two experiments, one ini which the charged particle is also a proton and in another, a position. In the same time t, the work done on the two moving charged particles is

A. same as the same force law is involved in the two experiments.

B. less for the case of a positron, as the positron moves away more rapidly and the force on it weakens.

C. more for the case of a positron, as the positron moves away a larger distance.

D. same as the work done by charged particle on the stationary proton.

Answer: C

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3. A man squatting on the ground gets straight up and stand. The force of reaction of ground on the man during the process is.

A. constant and equal to mg in magnitude

B. constant and greater than mg in magnitude

C. variable but always greater than mg.

D. at first greater than mg, and later becomes equal to mg.

Answer: D

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4. A cyclist comes to a skidding stop in $10m$. During this process, the force on the cycle due to the road is $200N$ and is directly opposite to the motion.

a. How much work does the road do on the cycle?

b. How much work does the cycle do on the road?

A. $+200J$

B. $-200J$

C. zero

D. $-20,000J$

Answer: C

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5. A body is falling freely under the action of gravity alone in vacuum. Which of the following quantities remain constant during the fall ?

A. Kinetic energy.

B. Potential energy.

C. Total mechanical energy

D. Total linear momentum

Answer: C

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6. During inelastic collision between two bodies, which of the following quantities always remain conserved ?

A. Total kinetic energy.

B. Total mechanical energy.

C. Total linear momentum.

D. Speed of each body.

Answer: C

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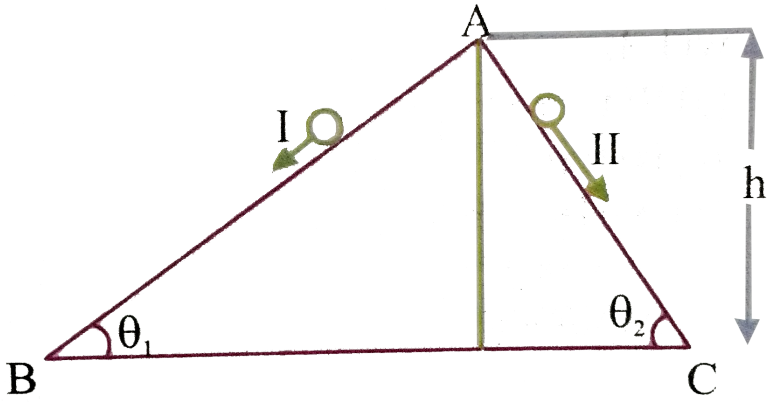
7. Two inclined frictionless tracks, one gradual and the other steep meet at a from where two stones are allowed to slide down from rest, one on each track as shown in Figure. Which of the following statement is correct ?



A. Both the stone reach the botton at the same time but not with the same speed.

B. Both the stone reach the bottom with the same speed and stone I reaches the bottom earlier than stone II Figure.

C. Both the stones reach the bottom with the same speed and stone II reaches the bottom earlier than stone I.

D. Both the stones reach the bottom at different times and with different speeds.

Answer: C

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8. A body of mass $0.5kg$ travels in a straight line with velocity $v = ax^{3/2}$ where $a = 5m/s^2$. The work done by the net force during its displacement from $x = 0$ to $x = 2m$ is

A. $1.5J$

B. 50 J

C. 10 J

D. 100 J

Answer: B

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9. A mass of $5kg$ is moving along a circular path or radius $1m$. If the mass moves with 300 revolutions per minute, its kinetic energy would be

A. $250p^2$

B. $100p^2$

C. $5p^2$

D. 0

Answer: A

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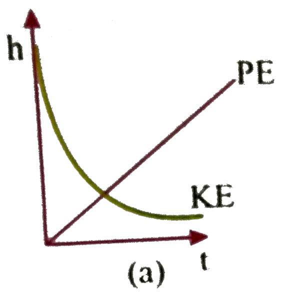
10. A raindrop falling from a height h above ground, attains a near terminal velocity when it has fallen through a height $(3/4)h$. Which of the diagrams shown in figure correctly shows the change in kinetic and potential energy of the drop during its fall up to the ground ?

A. 

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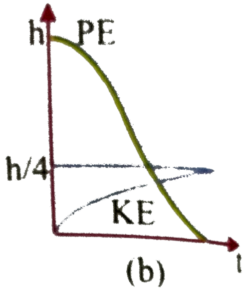
B. 
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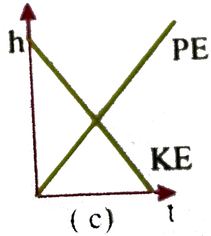
C. 
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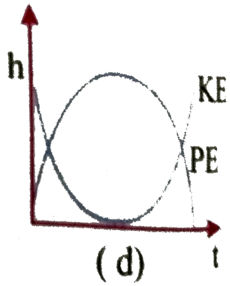
D. 
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Answer: B

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11. In a shotput event an athlete throws the shotput of mass $10kg$with an initial speed of $1ms^{-1}$ at 45° from a height $1.5m$ above ground. Assuming air resistance to be negligible and acceleration due to gravity to be $10ms^{-2}$, the kinetic energy of the shotput when it just reaches the ground will be

A. $2.5J$

B. $5.0J$

C. $52.5J$

D. $155.0J$

Answer: D

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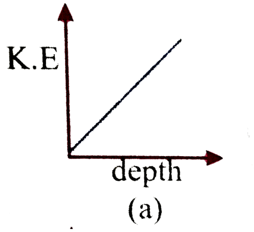
12. Which of the diagrams corectly shows the change in kinetic energy of an iron sphere falling freely in a lake having sufficient depth to impart it a terminal velocity ?

A. 

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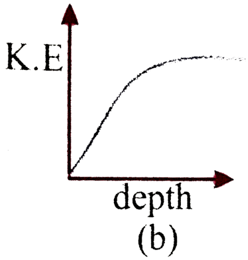
B. 

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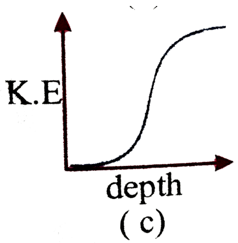
C. 

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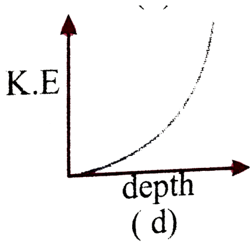
D. 

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Answer: B

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13. A bullet of mass m fired at 30° to the horizontal leaves the barrel of the gun with a velocity v. The bullet hits a soft target at a height h above the ground while it is moving downward and emerges out with half the kinetic energy it had before hitting the target.

Which of the following statements are correct in respect of bullet after it emerges out of the target ?

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14. Calculate the power of a crane in watts, which lifts a mass of $100kg$ to a height of $10m$ in $20s$.

A. 590 w

B. 480 w

C. 490 w

D. 600 w

Answer: C

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15. The average work done by a human heat while it beats once is $0.5J$. Calculate the power used by heat if it beats 72 times in a minute.

A. 0.6 w

B. 0.8 w

C. 6 w

D. 8 w

Answer: A

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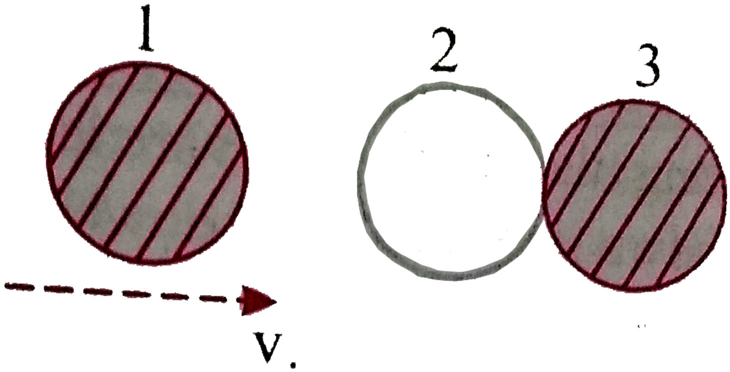
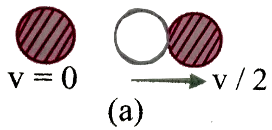
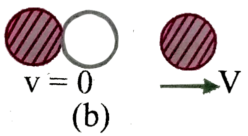
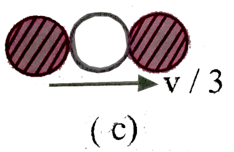
16. Two identical ball bearings in contact with each other and resting on a frictionless table are hit heat-on by another ball bearing of the same mass moving initially with a speed V as shown in figure.

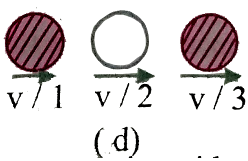


If the collision is elastic, which of the following (figure) is a possible result after collision ?

A. 

B. 

C. 

D. 

Answer: B

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17. A cricket ball of mass $150g$ moving with a speed of $126km/h$ hits at the middle of the bat, held firmly at its position by the batman. The ball moves straight back to the bowler after hitting the bat. Assuming that collision between ball and bat is completely elastic and the two remain in contact for $0.001s$, the force that the batsman had to apply to hold the bat firmly at its place would be

A. $10.5N$

B. $21N$

C. $1.05 \times 10^4 N$

D. $2.1 \times 10^4 N$

Answer: C

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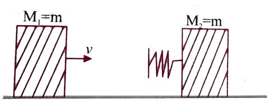
18. Two blocks M_1 and M_2 having equal mass are free to move on a horizontal frictionless surface. M_2 is attached to a massless spring as shown in figure. Initially M_2 is at rest and M_1 is moving toward M_2 with speed v and collides head-on with M_2.

A. While spring is fully compressed all the KE of M_1 is stored as PE of spring.

B. While spring is fully compressed the system momentum us not conserved, though final momentum is equal to initial momentum

C. If spring is massless, the final state of the M_1 is state of rest.

D. If the surface on which blocks are moving has friction, then collision cannot be elastic.



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Answer: C

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19. From a building two balls A and B are thrown such that A is thrown upwards and B downwards (both vertically with the same speed). If v_A and v_B are their respective velocities on reaching the ground , then

A. $v_B > v_A$

B. $v_A = V_B$

C. $v_A > v_B$

D. their velocities depend on their masses

Answer: B

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20. Speeds of two identical cars are u and 4u at at specific instant. The ratio of the respective distances in which the two cars are stopped from that instant is

A. $1:1$

B. $1:4$

C. $1:8$

D. $1:16$

Answer: D

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21. A spring of force constant $800N/m$ has an extension of 5cm. The work done in extending it from 5cm to 15cm is

A. 16 J

B. 8 J

C. 32 J

D. 24 J

Answer: B

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22. Two masses of $1kg$ and $16kg$ are moving with equal kinetic energy. The ratio of magnitude of the linear momentum is

A. $1:2$

B. $1:4$

C. $1:\sqrt{2}$

D. $\sqrt{2}:1$

Answer: B

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23. A car, moving with a speed of $50km/hr$, can be stopped by brakes after at least $6m$. If the same car is moving at a speed of $100km/hr$, the minimum stopping distance is

A. 6 m

B. 2 m

C. 18 m

D. 24 m

Answer: D

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24. A body is moved along a straight line by a machine delivering constant power . The distance moved by the body is time t is proptional to

A. $t^{1/2}$

B. $t^{3/4}$

C. $t^{3/2}$

D. $t^{1/4}$

Answer: C

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25. A spring of spring constant $5 \times 10^3 N/m$ is stretched initially by 5 cm from the unstretched position. The work required to further stretch the spring by another 5 cm is .

A. $6.25N - m$

B. $12.50N - m$

C. $18.75N - m$

D. $25.00N - m$

Answer: C

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26. Consider the following two statements:

A. Linear momentum of a system of partcles is zero.

B. Kinetic energ of a system of particles is zero.

A. A does not imply $B \& B$ does not imply A

B. A implies B but B does not imply A

C. A does not imply B but B implies A

D. A implies B and B implies A

Answer: B

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27. A particle move in a straight line with retardation proportional to its displacement its loss of kinectic energy for any displacement x is proportional to

A. x

B. e^x

C. x^2

D. $\log_e x$

Answer: C

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28. A force $\vec{F} = \left(5\vec{i} + 3\vec{j} + 2\vec{k}\right)N$ is applied over a particle which displaces it from its origin to the point $\vec{r} = \left(2\vec{i} - \vec{j}\right)m$. The work done on the particle in joules is.

A. $+10$

B. $+7$

C. -7

D. $+13$

Answer: B

Watch Video Solution

29. A body of mass m, accelerates uniformly from rest to V_1 in time t_1. The instantaneous power delivered to the body as a function of time t is.

A. $\frac{mv_1t^2}{t_1}$

B. $\frac{mv_1^2t}{t_1^2}$

C. $\frac{mv_1t}{t_1}$

D. $\frac{mv_1^2t}{t_1}$

Answer: B

Watch Video Solution

30. A particle is acted upon by a force of constant magnitude which is always is perpendicular to the velocity of the particle , the motion of the particles takes place is a plane it follow that

A. its kinetic energy is constant

B. its acceleration is constant

C. its velocity is constant

D. it moves in a straight line.

Answer: A

Watch Video Solution

31. A uniform chain of length $2m$ is kept on a table such that a length of $60cm$ hangas freely from the adge of the table . The table . The total mass of the chain ia $4kg$ What is the work done in pulling the entire the chain the on the table ?

A. $7.2J$

B. $3.6J$

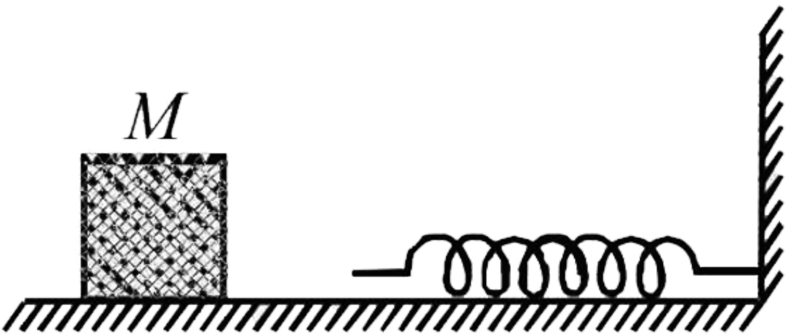
C. $120J$

D. $1200J$

Answer: B

Watch Video Solution

32. The block of mass M moving on the frictionless horizontal surface collides with the spring constant k and compresses it by length L . The maximum momention of the block after collision is



A. $\frac{ML^2}{K}$

B. zero

C. $\frac{KL^2}{2M}$

D. $\sqrt{MKL}$

Answer: D

Watch Video Solution

33. A particle of mass 0.3 kg subject to a force $F = -kx$ with $k = 15N/m$. What will be its initial acceleration if it is released from a point 20cm away from the origin?

A. $10m/s^2$

B. $5m/s^2$

C. $15m/s^2$

D. $3m/s^2$

Answer: A

Watch Video Solution

34. A spherical ball of mass $20kg$ is stationary at the top of a hill of height $100m$, it rolls down a smooth surface to the ground , then climbs up another bill of height of $30m$ and final rolls down to a horizontal base at a height of $20m$ about the ground . The velocity attained by the ball is

A. $10\sqrt{30}m / s$

B. $10m / s$

C. $20m / s$

D. $40m / s$

Answer: D

Watch Video Solution

35. A body of mass m is acceleratad uniformaly from rest to a speed v in a time T . The instanseous power delivered to the body as a function of time is given by

A. $\frac{1}{2}\frac{mv^2}{T^2}t^2$

B. $\frac{1}{1}\frac{mv^2}{T^2}t$

C. $\frac{mv^2}{T^2}t^2$

D. $\frac{mv^2}{T^2}t$

Answer: D

Watch Video Solution

36. A particle of mass $100g$ is thrown verically upward with a speed of $5m/s$. The work done by the of gravity during the time the particle goes up is

A. $1.25J$

B. $0.5J$

C. $-0.5J$

D. $-1.25J$

Answer: D

Watch Video Solution

37. The potential energy of a $1kg$ particle free to move along the x- axis is given by $V(x)=\left(\frac{x^4}{4}-\frac{x^2}{2}\right)J$

The total mechainical energy of the particle is $2J$. Then , the maximum speed (in m//s) is

A. $\frac{1}{\sqrt{2}}$

B. 2

C. $\frac{3}{\sqrt{2}}$

D. $\sqrt{2}$

Answer: C

Watch Video Solution

38. A mass of M kg is suspended by a weightless string. The horizontal force that is required to displace it until the string makes an angle of 45°

with the initial vertical direction is

A. $\frac{Mg}{\sqrt{2}}$

B. $Mg(\sqrt{2}-1)$

C. $Mg(\sqrt{2}+1)$

D. $Mg\sqrt{2}$

Answer: B

Watch Video Solution

39. A ball of mass 0.2 kg is thrown vertically upwards by applying a force by hand. If the hand moves 0.2 m while applying the force and the ball goes upto 2 m height further, find the magnitude of the force. (Consider $g = 10m/s^2$).

A. 20 N

B. 22 N

C. 4 N

D. 16 N

Answer: A

Watch Video Solution

40. A $2kg$ block slides on a horizontal floor with the a speed of $4m/s$ it strikes a uncompressed spring , and compresses it till the block is motionless . The kinetic friction force is compresses is $15N$ and spring constant is $10000N/m$. The spring by

A. 2.5

B. 11.0

C. 8.5

D. 5.5

Answer: D

Watch Video Solution

41. A particle is projected at $60(\circ)$ to the horizontal with a kinetic energy K. The kinetic energy at the highest point is

A. zero

B. $\frac{K}{4}$

C. $\frac{K}{2}$

D. K

Answer: B

Watch Video Solution

42. An athlete in the Olympic gamed covers a distance of $100m$ in $10s$. His kinetic energy can be estimated to be in range.

(1) $200J - 500J$

(2) $2 \times 10^5 J - 3 \times 10^5 J$

(3) $20, 000J - 50, 000J$

(4) $2, 000J - 5, 000J$.

A. $200J - 500J$

B. $2 \times 10^5 J - 3 \times 10^5 J$

C. $20, 000J - 50, 000J$

D. $2, 000J - 5, 000J.$

Answer: D

Watch Video Solution

43. The potential energy function for the force between two atoms in a diatomic molecule is approximate given by $U(r) = \frac{a}{r^{12}} - \frac{b}{r^6}$, where a and b are constants and r is the distance between the atoms. If the dissociation energy of the molecule is $D = [U(r = \infty) - U_{\text{at equilibrium}}]$, D is

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

B. $\frac{b^2}{12a}$

C. $\frac{b^2}{4a}$

D. $\frac{b^2}{6a}$

Answer: C

Watch Video Solution

44. Statement-1: Davisson-Germer experiment established the wave nature of electron

Statement-2: If electrons have wave nature, they can interfere show differaction.

A. Statement 1 is false, Statement 2 is true

B. Statement 1 is true, Statement 2 is false

C. Statement 1 is true, Statement is the correct explanation for statement 1

D. Statement 1 us true, Statement 2 is true, Statement 2 is not the correct explanation for statement 1.

Answer: A

Watch Video Solution

45. When a rubber bandis streched by a distance x , if exerts resuring foprce of magnitube $F = ax + bx^2$ where$a$ and b are constant . The work in streached the unstreched rubber - band by L is

A. $\frac{aL^2}{2} + \frac{bL^3}{3}$

B. $\frac{1}{2}\left(\frac{aL^2}{2} + \frac{bL^3}{3}\right)$

C. $\frac{bL^2}{2} - \frac{aL^3}{3}$

D. $\frac{1}{2}\left(\frac{bL^2}{2} - \frac{aL^3}{3}\right)$

Answer: A

Watch Video Solution

Level-V (Single Answer)

1. A simple pendulum having bob of maas m is suspended from the ceiling of a car used in a stunt film shooting. The car moves up along an inclined cliff at a speed v and makes a jump to leavwe the cliff and lands at some the top of the cliff. The tension in the string when the car is in air is

A. mg

B. $mg - \frac{mv^2}{R}$

C. $mg + \frac{mv^2}{R}$

D. zero

Answer: D

Watch Video Solution

2. A particle of mass m is projected at an angle α to the horizontal with an initial velocity u. The work done by gravity during the time it reaches its highest point is

A. $u^2 \sin^2 \alpha$

B. $\frac{mu^2 \cos^2 \alpha}{2}$

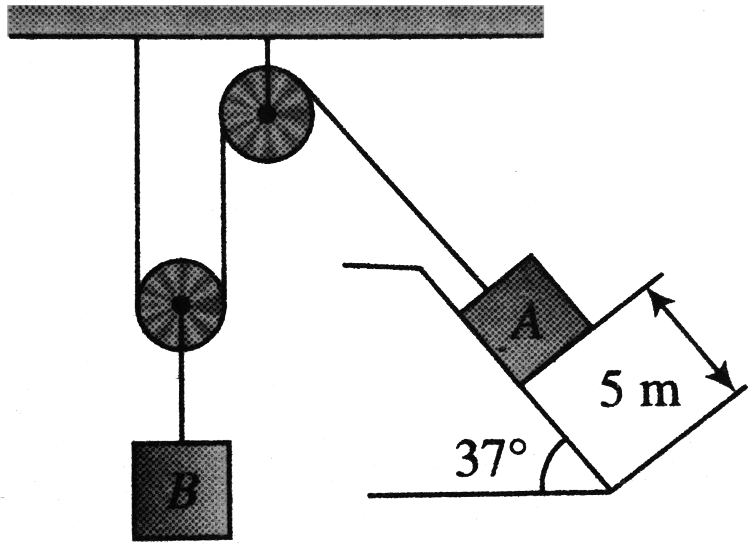
C. $\frac{mu^2 \sin^2 \alpha}{2}$

D. $-\frac{mu^2 \sin^2 \alpha}{2}$

Answer: D

Watch Video Solution

3. The blocks A and B shown in figure have masses $M_A = 5kg$ and $M_B = 4kg$. The system is released from rest. The speed of B after A has travelled a distance $1m$ along the incline is



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

B. $\frac{\sqrt{3}}{4}\sqrt{g}$

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

D. $\frac{\sqrt{g}}{2}$

Answer: C

Watch Video Solution

4. A particle is projected along a horizontal field whose coefficient of friction varies as $\mu = A/r^2$, where r is the distance from the origin in meters and A is a positive constant. The initial distance of the particle is $1m$ from the origin and its velocity is radially outwards. The minimum initial velocity at this point so the particle never stops is

A. ∞

B. $2\sqrt{gA}$

C. $\sqrt{2gA}$

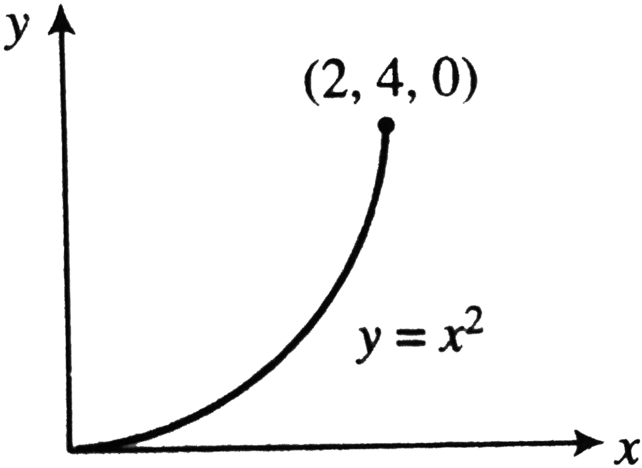
D. $4\sqrt{gA}$

Answer: C

Watch Video Solution

5. A force $\overrightarrow{F} = (3xy - 5z)\hat{j} + 4z\hat{k}$ is applied on a particle. The work done by the force when the particle moves from point $(0, 0, 0)$ to point

$(2, 4, 0)$ as shown in figure.



A. $\frac{280}{5}$ units

B. $\frac{140}{5}$ units

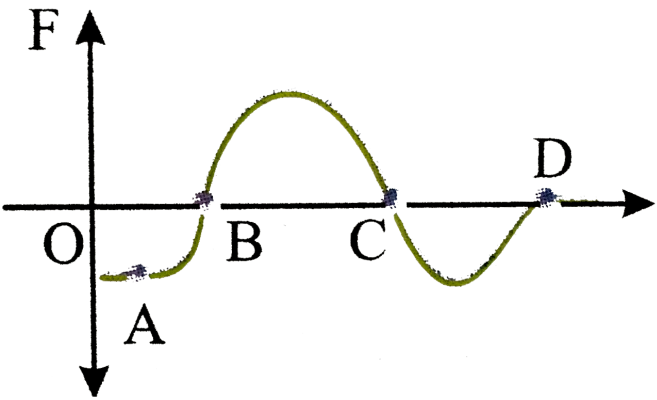
C. $\frac{232}{5}$ units

D. $\frac{192}{5}$ units

Answer: D

Watch Video Solution

6. A particle is being acted upon by one dimensional conservative force. In the $F - x$ curve shown, four points A, B, C, D are marked on the curve. State which type of equilibrium is the particle have at position c.



A. stable equilibrium

B. unstable

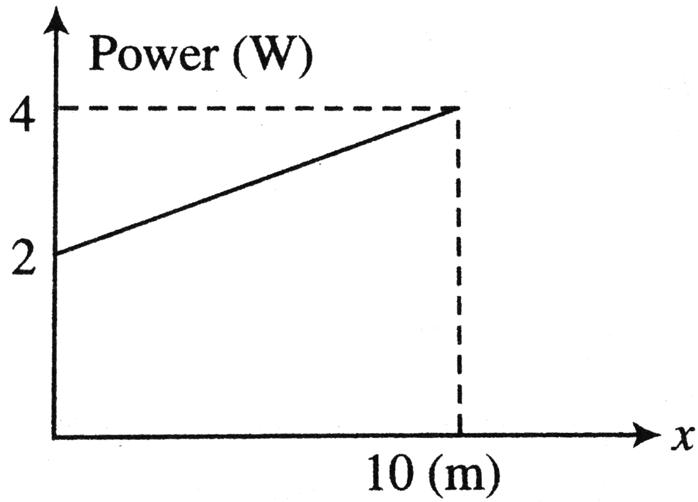
C. Neutral

D. No equilibrium

Answer: A

Watch Video Solution

7. A particle A of mass $10/7kg$ is moving in the positive direction of $x - a\xi s$. At initial position $x = 0$, its velocity is $1ms^{-1}$, then its velocity at $x = 10m$ is (use the graph given)



A. $4m/s$

B. $2m/s$

C. $3\sqrt{2}m/s$

D. $100/3m/s$

Answer: C

Watch Video Solution

8. The potential energy of a particle is determined by the expression $U = \alpha(x^2 + y^2)$, where α is a positive constant. The particle begins to move from a point with coordinates $(3, 3)$, only under the action of potential field force. Then its kinetic energy T at the instant when the particle is at a point with the coordinates $(1, 1)$ is

A. 8α

B. 24α

C. 16α

D. zero

Answer: C

Watch Video Solution

9. An engine is hauling a train of mass m on a level track at a constant speed v. The resistance due to friction is f. What power is the engine producing? What extra power must the engine develop to maintain the speed up a gradient 1 in l. What is the new total power developed by the engine develop to maintain the speed up a gradient 1 in l. What is the new total power developed by the engine ?

A. Power expended by the engine is "mfu".

B. The extra power developed by the engine to maintain a speed u up a gradient on of h in s is $\frac{mghu}{s}$.

C. The frictional force exerting on the train is mf on the level track

D. None of above is correct

Answer: B

Watch Video Solution

10. A body of mass m slides down a plane inclined at an angle α. The coefficient of friction is μ. Find the rate at which kinetic plus gravitational potential is dissipated at any time t.

A. $\mu m t g^2 \cos \alpha$

B. $\mu m t g^2 \cos \alpha(\sin \alpha - m \cos \alpha)$

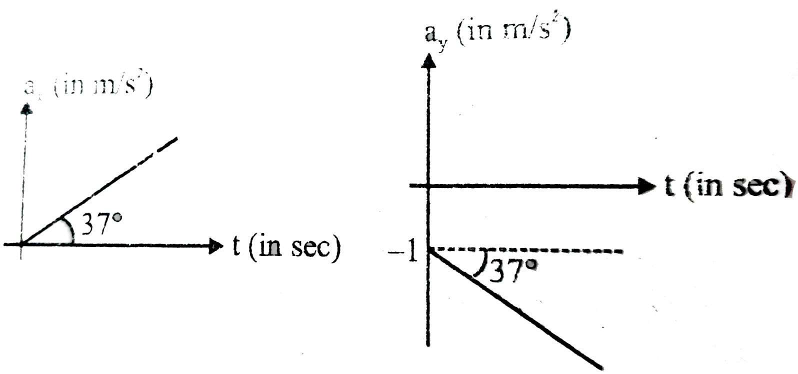
C. $\mu m t g^2 - \sin \alpha$

D. $\mu m t g^2 \sin \alpha(\sin \alpha - m \cos \alpha)$

Answer: B

Watch Video Solution

11. In the figure the variations of componets of acceleration of particles of mass 1kg is shown w.r.t. time. The initial velocity of the particle is $\overrightarrow{u} = \left(-3\hat{i} + 4\hat{j}\right)$m/s. the total work done by the resultant force on the particles in time intervals from t=0 to t=4 seconds is :



A. $22.5J$

B. 10 J

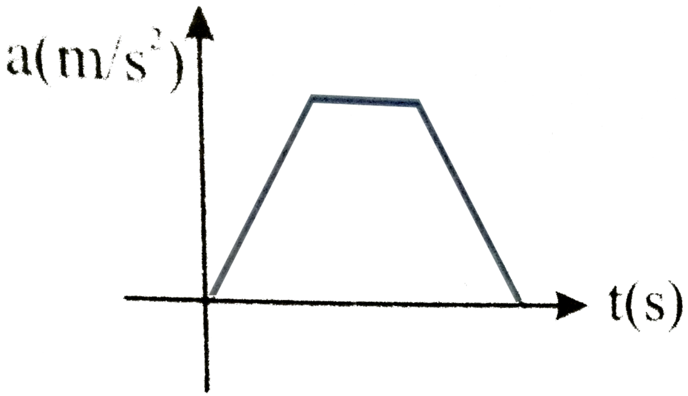
C. 0

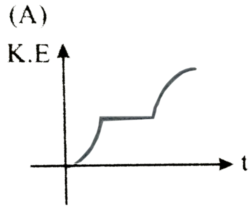
D. None of these

Answer: B

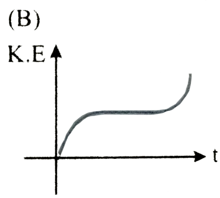
Watch Video Solution

12. For a particle moving on a straight lint the variation of acceleration with time is given by the graph as shown. Initially the particle was at rest. Then the corresponding kinetic energy of the particle versus time graph will be

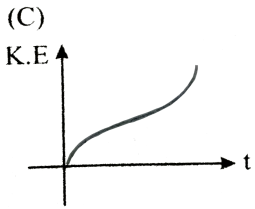




A.

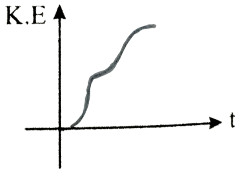


B.



C.

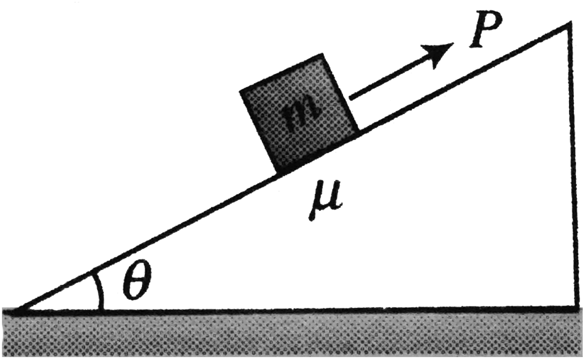
(D)

D. 

Answer: D

Watch Video Solution

13. A block of mass m is being pulled up a rough incline by an agent delivering constant power P. The coefficient of friction between the block and the incline is μ. The maximum speed of the block during the course of ascent is



A. $v = \dfrac{P}{mg\sin\theta + \mu mg\cos\theta}$

B. $v = \dfrac{P}{mg\sin\theta - \mu mg\cos\theta}$

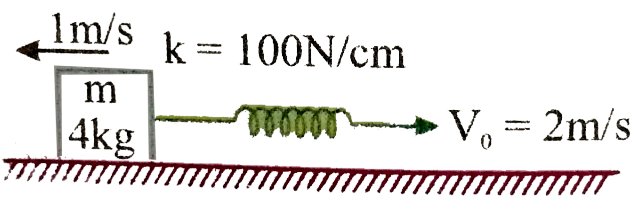
C. $v = \dfrac{2P}{mg\sin\theta - \mu mg\cos\theta}$

D. $v = \dfrac{3P}{mg\sin\theta - \mu mg\cos\theta}$

Answer: A

Watch Video Solution

14. The spring block system lies on a smooth horizontal surface. The free end of the spring is being pulled towards right with constant speed $v_0 = 2m/s$. At $t = 0\,\text{sec}$, the spring of constant $k = 100N/cm$ is unstretched and the block has a speed $1m/s$ to left. The maximum extension of the spring is.



(A) 2 cm (B) 4 cm (C) 6 cm

A. 2 cm

B. 4 cm

C. 6 cm

D. 8 cm

Answer: C

Watch Video Solution

15. Two equal masses are attached to the two ends of a spring of spring constant k. The masses are pulled a part symmetrically to stretch 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

Watch Video Solution

16. A block of mass m is allowed to slide down a fixed smooth inclined plane of angle q and length l. The magnitude of power developed by the gravitational force when the block reaches the bottom is.

A. $\sqrt{2m^2l(g\sin\theta)^3}$

B. $(2/3)m^3lg^2\sin\theta$

C. $\sqrt{(2/3)m^2l^2g\cos\theta}$

D. $(1/3)m^3lg^2\sin\theta$

Answer: A

Watch Video Solution

17. An object or mass (m) is located at the origin of a vertical plane. The body is projected at an angle θ with velocity u. The mean power developed by the gravitational force during the interval of time till it reaches maxmum height

A. $mgu\sin\theta$

B. $\frac{mgu\sin\theta}{2}$

C. $\frac{mgu\sin\theta}{3}$

D. $\frac{mgu\sin\theta}{4}$

Answer: B

Watch Video Solution

18. The potential enery of a particle varies with posiion x according to the relation $U(x) = 2x^4 - 27x$ the point $x = \frac{3}{2}$ is point of

A. unstable equilibrium

B. stable equilibrium

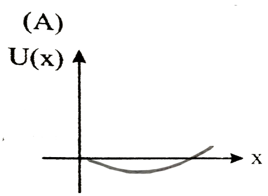
C. neutral equilibrium

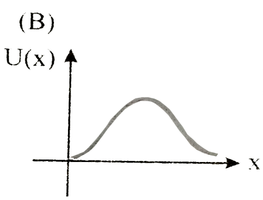
D. None of these

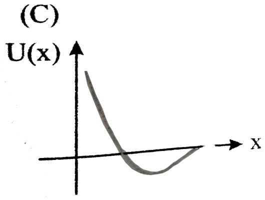
Answer: B

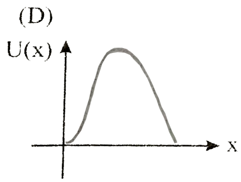
Watch Video Solution

19. A particle, which is constrained to move along the x-axis, is subjected to a force from the origin as $F(x) = -kx + ax^3$. Here k and a are origin as $F(x) = -kx + ax^3$. Here k and a are positive constants. For $x = 0$, the functional form of the potential energy $U(x)$ of particle is.

A. 

B. 

C. 

D. 

Answer: D

Watch Video Solution

20. A force $F = -K\left(y\hat{I} + x\hat{j}\right)(where$K $isaposivecons\tan t)actsonapartic \le mov \in g \in the$xy $pla \ne . Start \in gf$ or $mthe$ or $ig \in al, theparticalistakenalong \in thepo$ xa$\xi s \to thep\oint$(x,0) and $thenpartical \to theya\xi sthep\oint$(x,0) . $The \to talw$ or $kdo \ne bythef$ or ceF` on the particls is

A. $-2Ka^2$

B. $2Ka^2$

C. $-Ka^2$

D. Ka^2

Answer: C

Watch Video Solution

21. A smooth spehre of radius R is made to translate oin a straight line with a constant acceleration a. A particle kept on the top of the sphere is released rom there at zero velocity with respect to the sphere. Find the speed of the particle with respect to the sphere as a functon of the angle θ it slides.

A. $\sqrt{Rg(\sin\theta + \cos\theta)}$

B. $\sqrt{Rg(1 + \cos\theta - \sin\theta)}$

C. $\sqrt{4Rg\sin\theta}$

D. $\sqrt{2Rg(1 + \sin\theta - \cos\theta)}$

Answer: D

Watch Video Solution

22. The potential energy of a $1kg$ particle free to move along the x- axis is given by $V(x) = \left(\frac{x^4}{4} - \frac{x^2}{2}\right)J$

The total mechainical energy of the particle is $2J$. Then , the maximum speed (in m//s) is

A. $1/\sqrt{2}$

B. 2

C. $3/\sqrt{2}$

D. $\sqrt{2}$

Answer: C

Watch Video Solution

23. A smooth spehre of radius R is made to translate oin a straight line with a constant acceleration a. A particle kept on the top of the sphere is released rom there at zero velocity with respect to the sphere. Find the speed of the particle with respect to the sphere as a functon of the angle θ it slides.

A. $\sqrt{Rg(\sin\theta + \cos\theta)}$

B. $\sqrt{Rg(1 + \cos\theta - \sin\theta)}$

C. $\sqrt{4Rg\sin\theta}$

D. $\sqrt{2Rg(1 + \sin\theta - \cos\theta)}$

Answer: D

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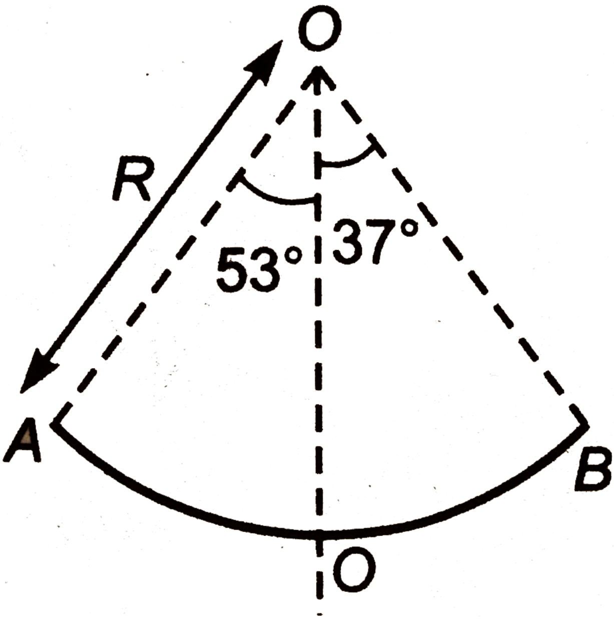
24. A section of fixed smooth circular track of radius R in vertical plane is shown in the figure. A block is released from position A and leaves the track at B The radius of curvature of its trajectory just after it leaves the



track B is ?

A. R

B. $\frac{R}{4}$

C. $\frac{R}{2}$

D. none of these

Answer: C

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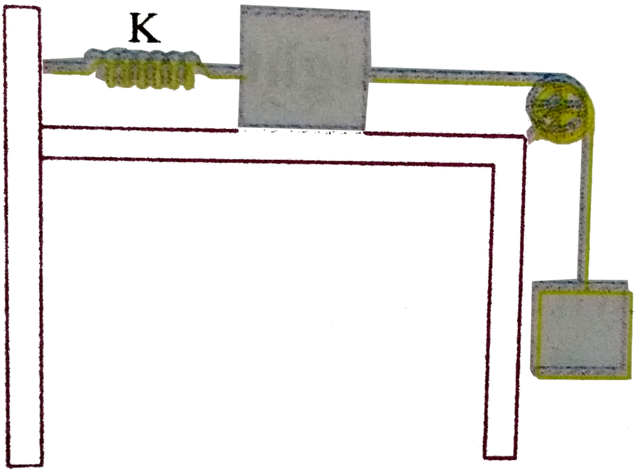
Level-V (Multiple Answer)

1. Two blocks, of masses M and $2M$, are connected to a light spring of spring constant K that has one end fixed, as shown in figure. The horizontal surface and the pulley are frictionless. The blocks are released from when the spring is non deformed. The string is light.



A. Maximum extension in the spring is $\frac{4Mg}{K}$.

B. Maximum kinetic energy of the system is $\frac{2M^2g^2}{K}$.

C. Maximum energy stored in the spring is four times that of maximum kinetic energy of the system.

D. When kinetic energy of the system is maximum energy stored in the spring is $\frac{4M^2g^2}{K}$.

Answer: A::B::C

Watch Video Solution

2. Select the correct alternatives :

A. Work done by static friction is always zero

B. Work done by kinetic friction can be positive also

C. Kinetic enery of a system can not be increased without applying any external force on the system

D. Work energy theoram is valid in non-inerial frames also.

Answer: B::D

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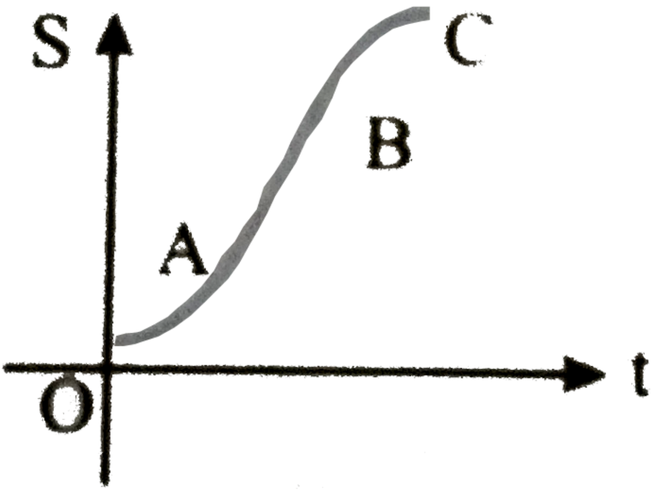
3. Displacement time graph of a particle moving in a straight line is as shown in figure. Select the correct alternative (s) :



A. Work done by all the forces in region OA and BC is positive

B. Work done by all the forces in region AB is zero

C. Work done by the forces in region BC is negative

D. Work done by all the forces in region OA is negative.

Answer: B

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4. Which of the following is//are conservative force (s) ?

A. $\overrightarrow{F} = 2r^3\hat{r}$

B. $\overrightarrow{F} = \frac{5}{r}\hat{r}$

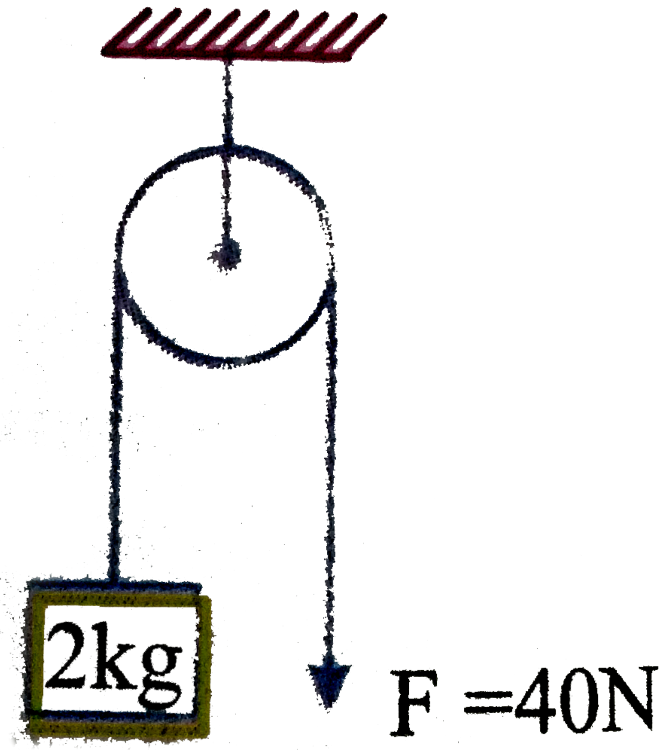
C. $\overrightarrow{F} = \frac{3(xi + yj)}{(x^2 + y^2)^{3/2}}$

D. $\overrightarrow{F} = \frac{3\left(x^2 i + yj\right)}{(x^2 + y^2)^{3/2}}$

Answer: A::B::C

Watch Video Solution

5. A block of mass $2kg$ is hanging over a smooth and light pulley through a light string. The order end of the string is pulled by a constant force $F = 40N$. The kinetic energy of the particle increase $40J$ in a given interval of time. Then : $(g = 10m / s^2)$.



A. tension in the strings is $40N$

B. displacement of the block in the given interval of time is $2m$.

C. work done by gravity is $-20J$

D. work done by tension is $80J$

Answer: A::B::D

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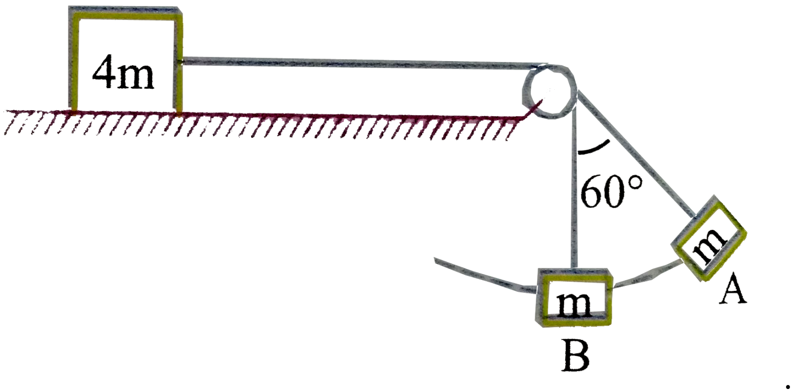
6. In the system shown in the figure the mass m moves in a circular arc of angular amplitude 60°. Mass $4m$ is stationary. Then :



A. the minimum value of coefficient of friction between the same of mass $4m$ and the surface of the table is 0.50

B. the work done by gravitational force in the block m is positive when it moves from A to B

C. the power delovered by the tension when m moves from A to B is zero

D. The kinetic energy of m in position B equals the work done by gravitational force on the block when its from position A to B.

Answer: A::B::C::D

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7. A strip of wood mass M and length l is placed on a smooth horizontal surface. An insect of mass m starts from rest at one end of the strip and walks to the other end in time t, moving with a constant speed.

A. The speed of the insect as seen from the ground is $< \frac{l}{t}$.

B. The speed of the spring as seen from the ground is $\frac{l}{t}\left(\frac{M}{M+m}\right)$

C. The speed of the strip as seen from the ground is $\frac{l}{t}\left(\frac{m}{M+m}\right)$

D. The total kinetic energy of the system is $\frac{1}{2}(m+M)\left(\frac{l}{t}\right)^2$.

Answer: A::C

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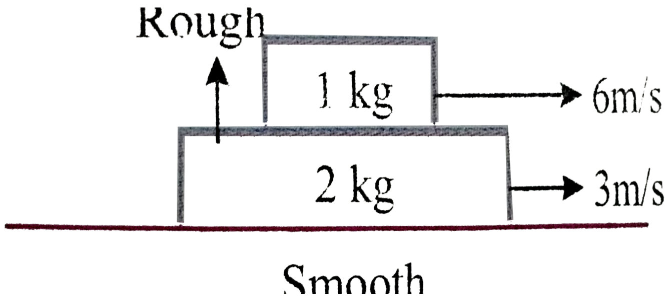
8. In the figure shown upper block is given a velocity of $6m/s$ and lower block $3m/s$. When relative motion between them is stopped.



A. Work done by friction on upper block is negative

B. Work done by friction on both blocks is positive

C. The magnitude of work done by friction on upper block is $10J$

D. Net work done by friction is zero.

Answer: A::C

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9. 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 particle when it crosses the y-axis is $10m/s$.

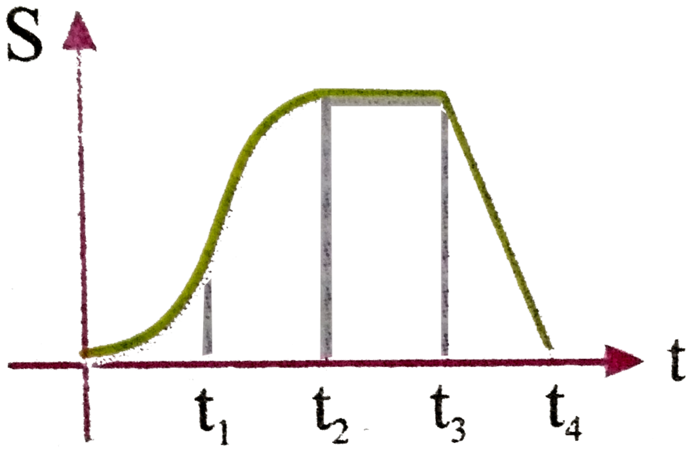
D. co-ordinates of particle at $t=1s$ are $(4.5, 2)$.

Answer: A::C::D

Watch Video Solution

10. Displacement time graph of a particle moving in a straight line is as shown in figure.

From the graph we can conclude that work done on the block is :



A. positive from 0 to t_1

B. negative from t_1 to t_2

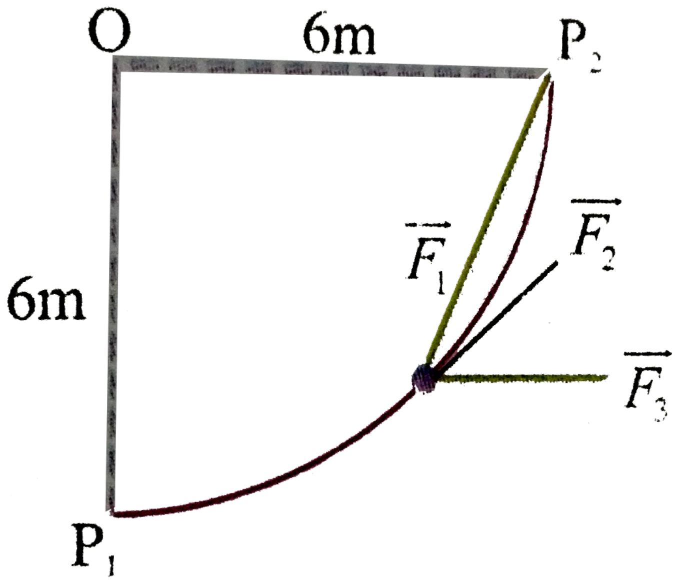
C. zero from t_2 to t_3

D. negative from t_3 to t_4.

Answer: A::B::C

Watch Video Solution

11. A smooth track in the form of a quarter circle of radius $6m$ lies in the vertical plane. A particle moves from P_1 to P_2 under the action of forces $\overrightarrow{F}_1, \overrightarrow{F}_2$ and $\overrightarrow{F}_3$ Force $\overrightarrow{F}_1$ is 20N, Force $\overrightarrow{F}_2$ is always $30N$ in magnitude. Force $\overrightarrow{F}_3$ always acts tangentiallly to the track and is of magnitude $15N$. Select the correct alternative (s) :



A. Work done by $\overrightarrow{F}_1$ is $120J$

B. Work done by $\overrightarrow{F}_2$ is $180J$

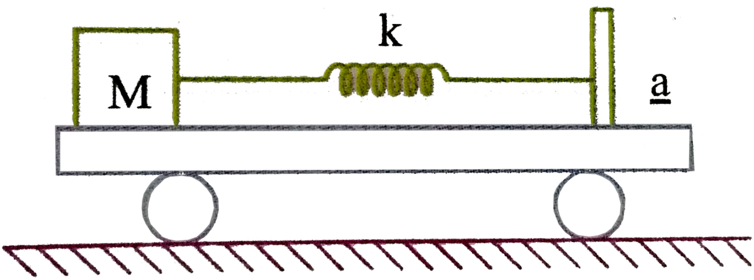
C. Work done by $\overrightarrow{F}_3$ is $45\pi J$

D. $\overrightarrow{F}_1$ is conservative in nature.

Answer: B::C::D

Watch Video Solution

12. A block of mass M_1 is attached with a spring constant k. The whole arrangement is placed on a vechile as shown in the figure. If the vehicle starts moving towards right with an acceleration a (there is no friction anywhere), then :



A. maximum elongation in the spring is $\frac{Ma}{k}$

B. maximum elongation in the spring is $\frac{2Ma}{k}$

C. maximum compression in the spring $\frac{2ma}{k}$

D. maximum compression in the spring is zero.

Answer: B::D

Watch Video Solution

13. A small ball of mass m is released from rest at a height h_1 above ground at time $t = 0$. At time $t = t_0$, the ball again comes to rest at a height h_2 above ground. Consider the ground to be perfectly rigid and neglect air friction. In the time interval from $t = 0$ to $t = t_0$, pick up the correct statements.

A. Work done by gravity on ball is $mg(h_1 - h_2)$

B. Work done by ground on ball for duration of contact is $mg(h_1 - h_2)$.

C. Average acceleration of the ball is zero.

D. Net work done on the ball by all forces except gravity is $mg(h_1 - h_2)$.

Answer: A::C::D

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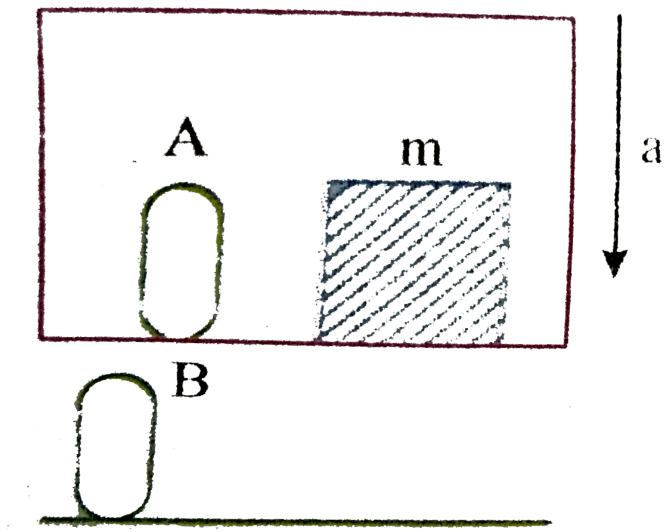
Level-V (Comprehension)

1. A block of mass m is kept in an elevation which starts moving downward with an acceleration 'a' as 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. $-\frac{1}{2}mg^2t_1^0$

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

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

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

Answer: C

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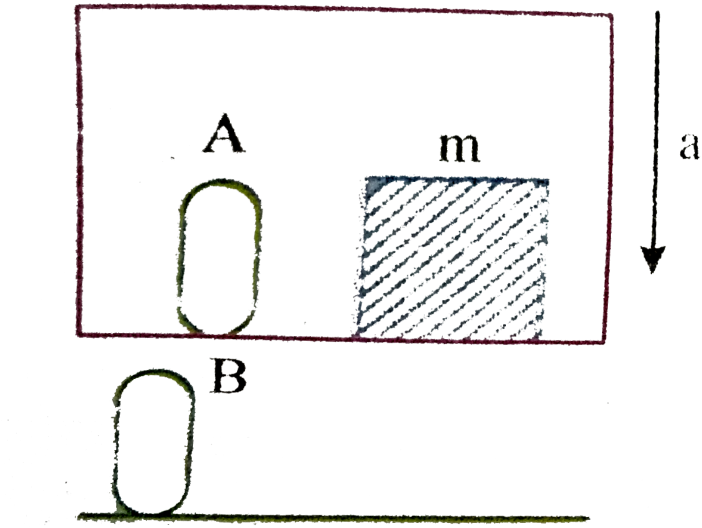
2. A block of mass m is kept in an elevation which starts moving downward with an acceleration 'a' as shown in figure. The block is observed by two observers A and B for a time interval t_0.



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

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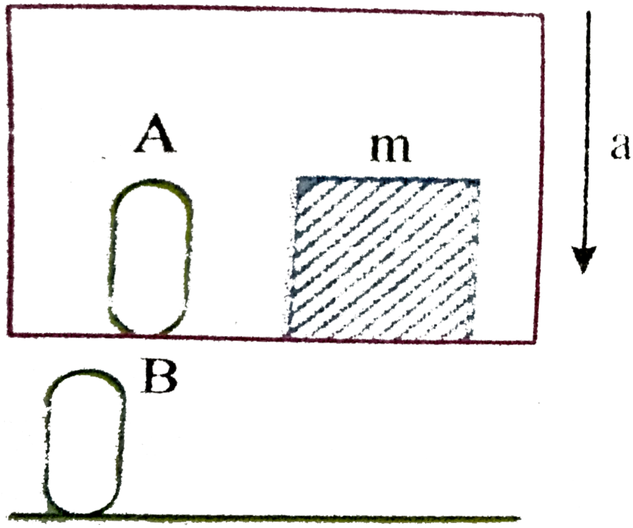
3. A block of mass m is kept in an elevation which starts moving downward with an acceleration 'a' as shown in figure. The block is observed by two observers A and B for a time interval t_0.



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

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

B. $\frac{1}{2} m a^2 t_0^2$

C. $\frac{1}{2} m g a t_0^2$

D. $-\frac{1}{2} m g a t_0^2$

Answer: B

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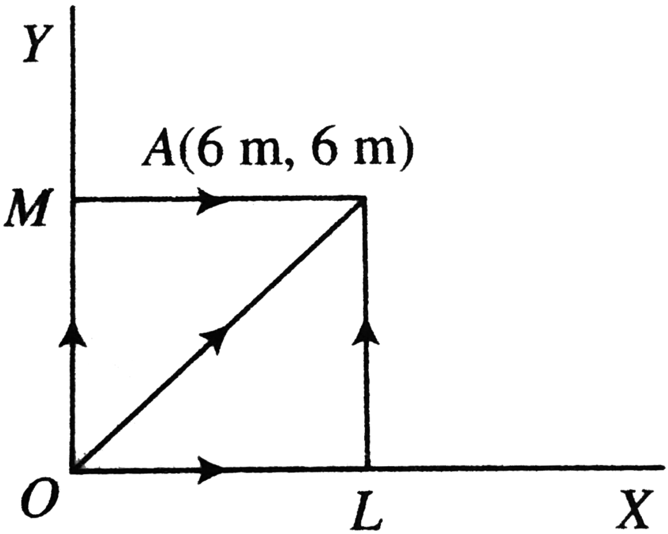
4. Force acting on a particle moving in the x-y plane is $\overrightarrow{F}=\left(y^2\hat{i}+x\hat{j}\right)N$, x and y are in metre. As shown in figure, the particle moves from the origin O to point A $(6m, 6m)$. The figure shows three paths, OLA, OMA, and OA for the motion of the particle from O to A.



(A)

Which of the following is correct?

A. There is equal probability for the force being conservative or non-conservative.

B. Conservative or non-conservative nature of force cannot be prediced on the basis of given information

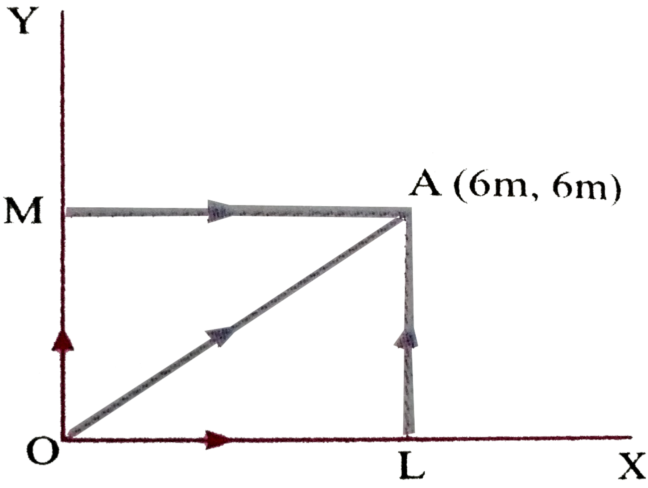
C. The given force is non-conservative

D. The force is conservative

Answer: C

Watch Video Solution

5. Force acting on a particle moving in the $x - y$ plane is $\overrightarrow{F} = \left(y^2\hat{i} + x\hat{j}\right)N$, x and y are in metre. As shown in fig. the particle moves from the origin O to point $A(6m, 6m)$. The figure shows three paths, OLA, OMA and OA for the motion of the particle from O to A.



(A)

Along which of the three paths is the work done maximum.

A. OA

B. OMA

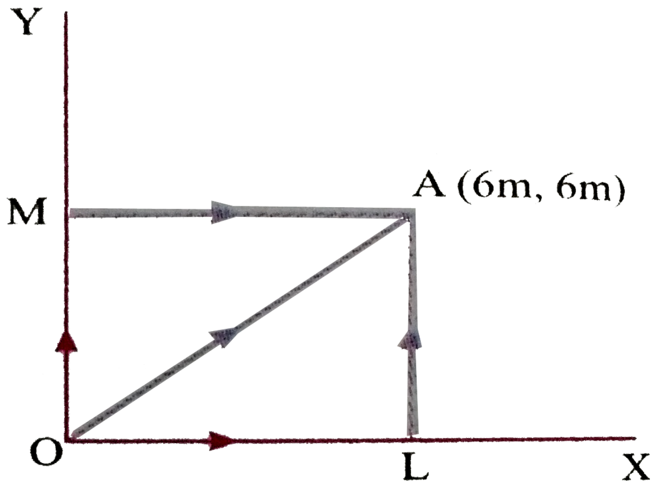
C. OLA

D. work done has the same value for all the three paths

Answer: A

Watch Video Solution

6. Force acting on a particle moving in the $x-y$ plane is $\vec{F}=\left(y^2\hat{i}+x\hat{j}\right)N$, x and y are in metre. As shown in fig. the particle moves from the origin O to point $A(6m, 6m)$. The figure shows three paths, OLA, OMA and OA for the motion of the particle from O to A.



(A)

Work done for motion along path OA is nearly

A. $383J$

B. $90J$

C. $180J$

D. $1811J$

Answer: B

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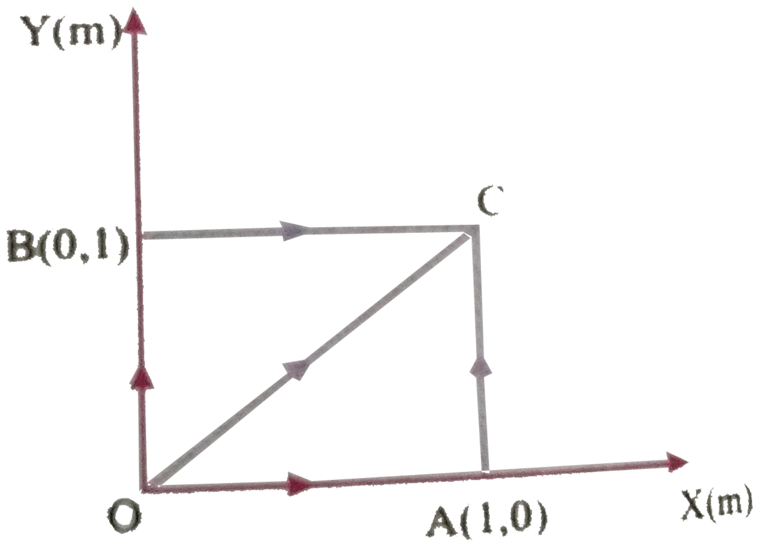
7. One of the forces acting on a certain particle depends on the particle's position in the xy-plane. This force $\overrightarrow{F}$ expressed in newtons, is given by the expression $\overrightarrow{F} = \left(xy\hat{i} + xy\hat{j}\right)$ where x and y are in metres. The particle is moved from O to C through three different paths :-



The work done by this force on path OC is

A. $\frac{1}{2}J$

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

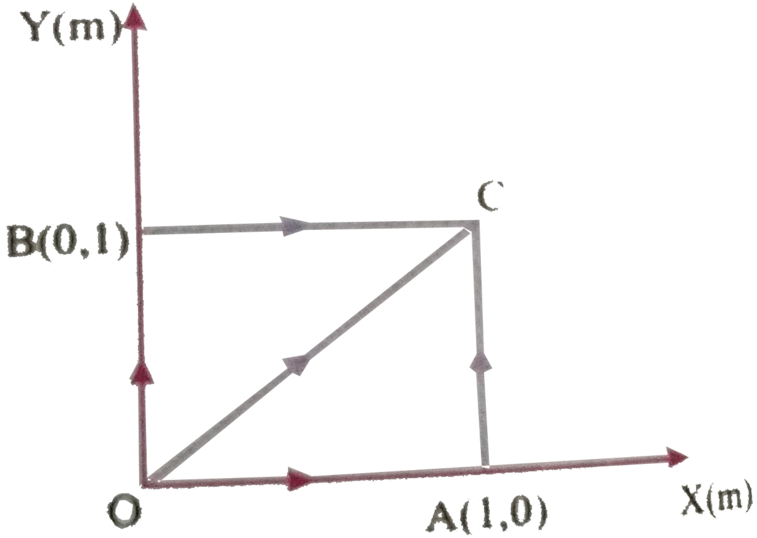
C. $\frac{2}{3}J$

D. $-\frac{2}{3}J$

Answer: C

Watch Video Solution

8. One of the forces acting on a certain particle depends on the particle's position in the xy-plane. This force $\overrightarrow{F}$ expressed in newtons, is given by the expression $\overrightarrow{F} = \left(xy\hat{i} + xy\hat{j}\right)$ where x and y are in metres. The particle is moved from O to C through three different paths :-



The work done by this force on path OAC is.

A. $\frac{1}{2}J$

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

C. $\frac{2}{3}J$

D. $-\frac{2}{3}J$

Answer: A

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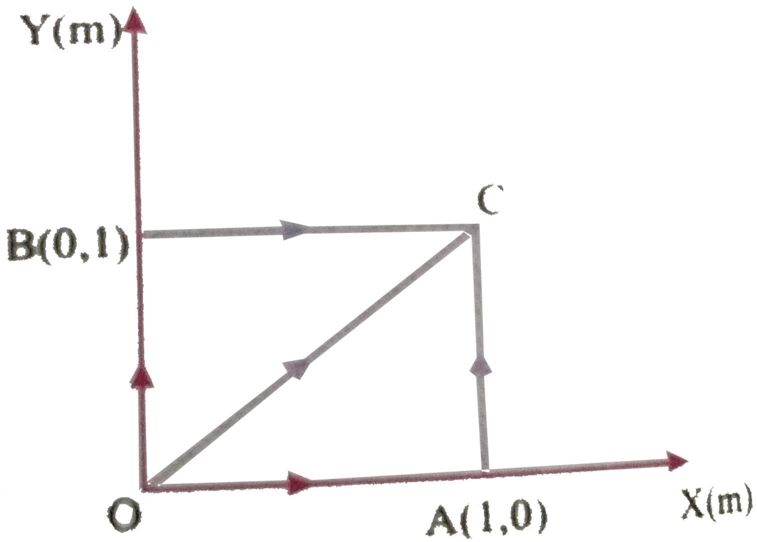
9. One of the forces acting on a certain particle depends on the particle's position in the xy-plane. This force $\vec{F}$ expressed in newtons, is given by the expression $\vec{F} = \left(xy\hat{i} + xy\hat{j}\right)$ where x and y are in metres. The particle is moved from O to C through three different paths :-



The work done by this force on path OBC is

A. $\frac{1}{2}J$

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

C. $\frac{2}{3}J$

D. $-\frac{2}{3}J$

Answer: A

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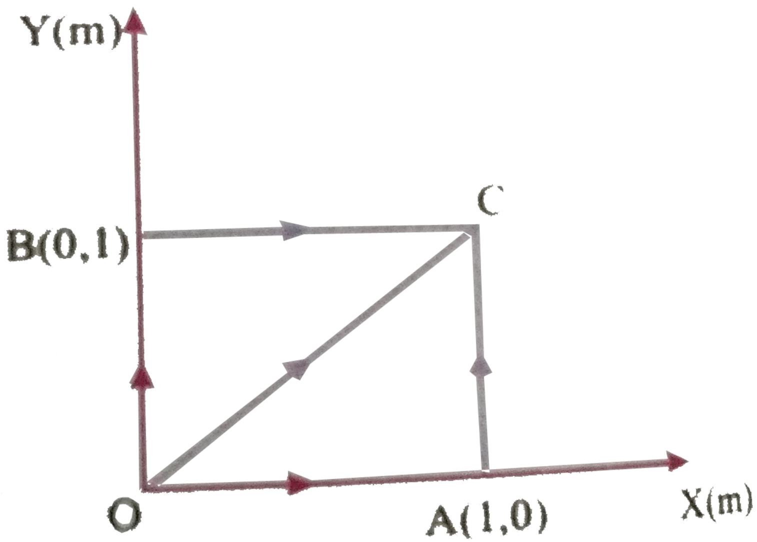
10. One of the forces acting on a certain particle depends on the particle's position in the xy-plane. This force $\overrightarrow{F}$ expressed in newtons, is given by the expression $\overrightarrow{F} = \left(xy\hat{i} + xy\hat{j}\right)$ where x and y are in metres. The particle is moved from O to C through three different paths :-



Which of the following can be negative ?

A. Kinetic energy

B. Potential energy

C. Chemical Energy

D. All of these

Answer: B

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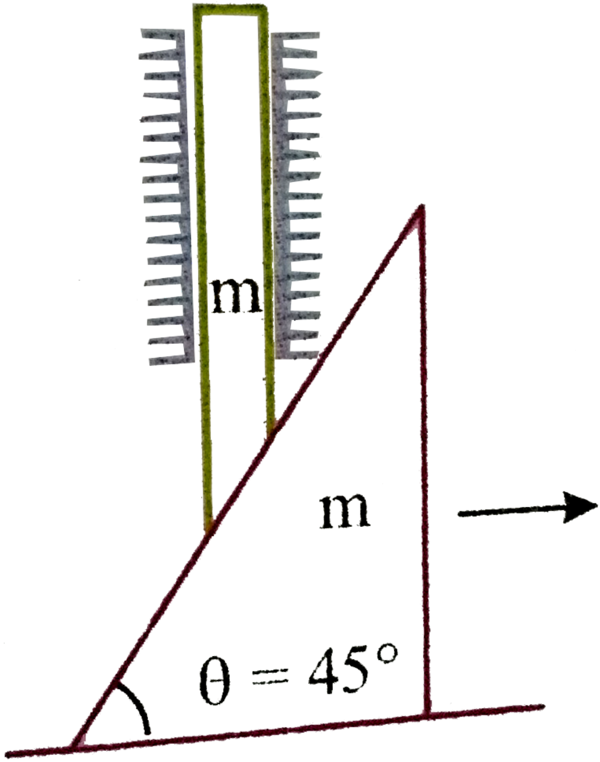
11. A smooth vertical rod is released from rest such that it is constrained to move vertically on a smooth wedge $(\theta = 45^\circ)$. When the wedge moves through a distance x, the speed of the rod is :



A. $\sqrt{2gx}$

B. $\sqrt{\frac{gx}{2}}$

C. $\sqrt{gx}$

D. none of these

Answer: C

Watch Video Solution

12. The work done by the normal reaction on the rod is :

A. mgx

B. $-\frac{mgx}{2}$

C. $\frac{3}{2}mgx$

D. $-mgx$

Answer: B

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13. The work done by the normal reaction on the wedge is :

A. mgx

B. $-\frac{mgx}{2}$

C. $\frac{3}{2}mgx$

D. $\frac{mgx}{2}$

Answer: D

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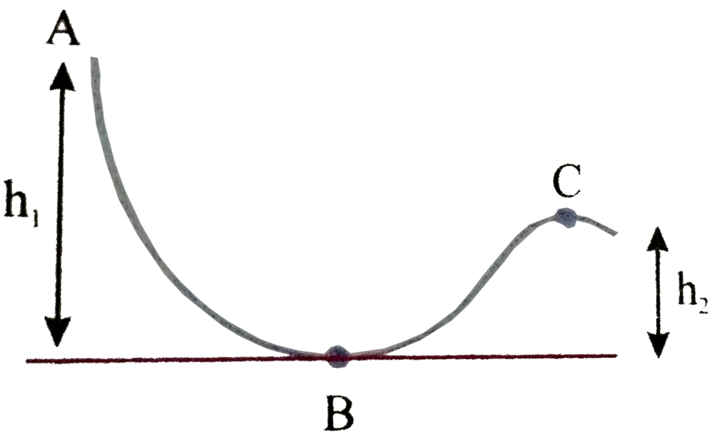
14. A block of mass $m = 1kg$ is released from point A along a smooth track as shown. Part AB is circular with radius $r_1 = 4m$ and circular at C with radius r_2. Height of point A is $h_1 = 2m$ and of c is $h_2 = 1m(g = 10m/s^2)$.



The force exerted by block on the track at B is

A. 10 N

B. 20 N

C. 30 N

D. 40 N

Answer: B

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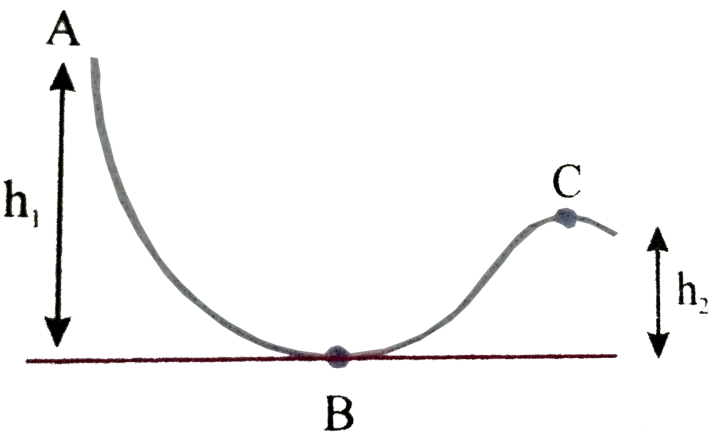
15. A block of mass $m = 1kg$ is released from point A along a smooth track as shown. Part AB is circular with radius $r_1 = 4m$ and circular at C with radius r_2. Height of point A is $h_1 = 2m$ and of c is $h_2 = 1m(g = 10m/s^2)$.



The minimum safe value of r_2 so that the block does not fly off the track at C is

A. 1 m

B. 2 m

C. $1.5m$

D. 3 m

Answer: B

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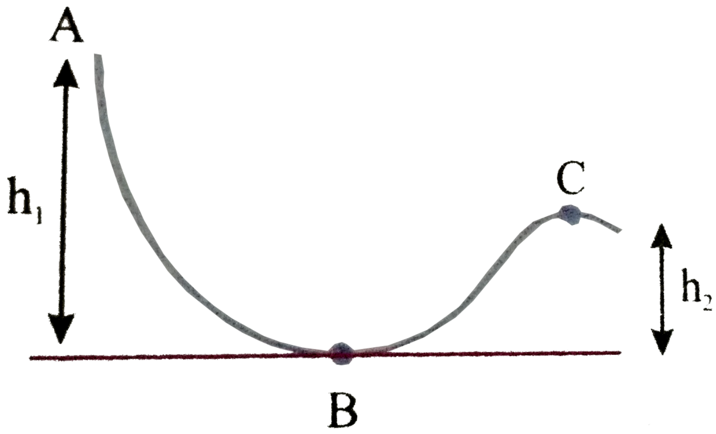
16. A block of mass $m = 1kg$ is released from point A along a smooth track as shown. Part AB is circular with radius $r_1 = 4m$ and circular at C with radius r_2. Height of point A is $h_1 = 2m$ and of c is $h_2 = 1m\left(g = 10m/s^2\right)$.



The work done by gravitational force from A to C is

A. 10 J

B. 20 J

C. 30 J

D. 40 J

Answer: A

Watch Video Solution

17. A chain of length $l = \pi R / 4$ is placed. On a smooth hemispherical surface of radius R with one of its ends fixed at the top of the sphere.

Mass of chain is $\sqrt{\pi kg}$ and $R = 1m$. $\left(g = 10m/s^2\right)$.

The gravitational potential energy of the chain considering reference level at the base of hemisphere is

A. 20 J

B. $20\sqrt{2}J$

C. 40 J

D. $40\sqrt{2}J$

Answer: C

Watch Video Solution

18. A chain of length $l = \pi R/4$ is placed. On a smooth hemispherical surface of radius R with one of its ends fixed at the top of the sphere. Mass of chain is $\sqrt{\pi kg}$ and $R = 1m$. $\left(g = 10m/s^2\right)$.

If the chain sliped down the sphere, kinetic energy of the chain when it has sliped through an angle $\theta = \frac{\pi}{4}$.

A. $23.4J$

B. $63.44J$

C. 80 J

D. $97.4J$

Answer: A

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19. A chain of length $l = \pi R/4$ is placed. On a smooth hemispherical surface of radius R with one of its ends fixed at the top of the sphere. Mass of chain is $\sqrt{\pi kg}$ and $R = 1m$. $\left(g = 10m/s^2\right)$.

The tangential acceleration of the chain when its starts sliding down.

A. $\frac{40}{\pi}\left(1 - \frac{1}{\sqrt{2}}\right)$

B. $\frac{20}{\pi}\left(1 - \frac{1}{\sqrt{2}}\right)$

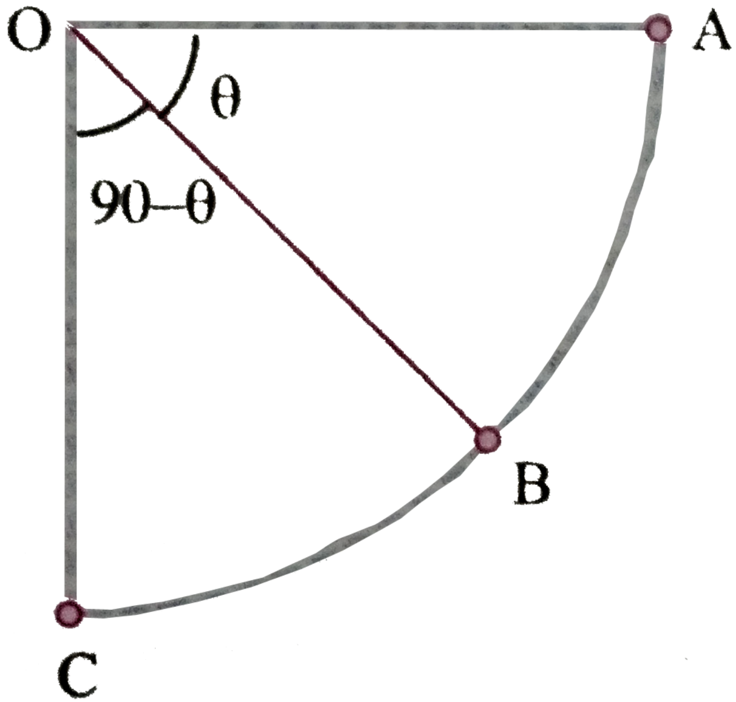
C. $10\left(1 - \frac{1}{\sqrt{2}}\right)$

D. zero

Answer: A

Watch Video Solution

20. One end of a light string of length L is connected to a ball and the other end is connected to a fixed point O. The ball is released from rest at $t = 0$ with string horizontal and just taut. The ball then moves in vertical circular path as shown. The time taken by ball to go from position A to B is t_1 and from B to lowest position C is t_2. Let the velocity of ball at B is $\vec{v}_B$ and at C is $\vec{v}_C$ respectively.



If $\left|\vec{v}_C = 2\left|\vec{v}_B\right|\right.$ then the value of θ as shown is

A. $\dfrac{\cos^{-1}(1)}{2}$

B. $\sin^{-1}\left(\dfrac{1}{4}\right)$

C. $\dfrac{\cos^{-1}(1)}{2}$

D. $\dfrac{\sin^{-1}(1)}{2}$

Answer: B

Watch Video Solution

21. One end of a light of length L is connected to a ball and other end is connected to a fixed point O. The ball is released from rest at $t=0$ with string horizontal and just taut. The ball then moves it vertival circular pathh as shown. The time taken by ball to go from position A to B ist_1 and from B to lowest position C is t_2. Let the velocity of ball at B is $\vec{v}_B$ and at C is $\vec{v}_C$ respectively. 

If $\left|\vec{v}_c\right| = 2\left|\vec{v}_B\right|$ then

A. $t_1 > t_2$

B. $t_1 < t_2$

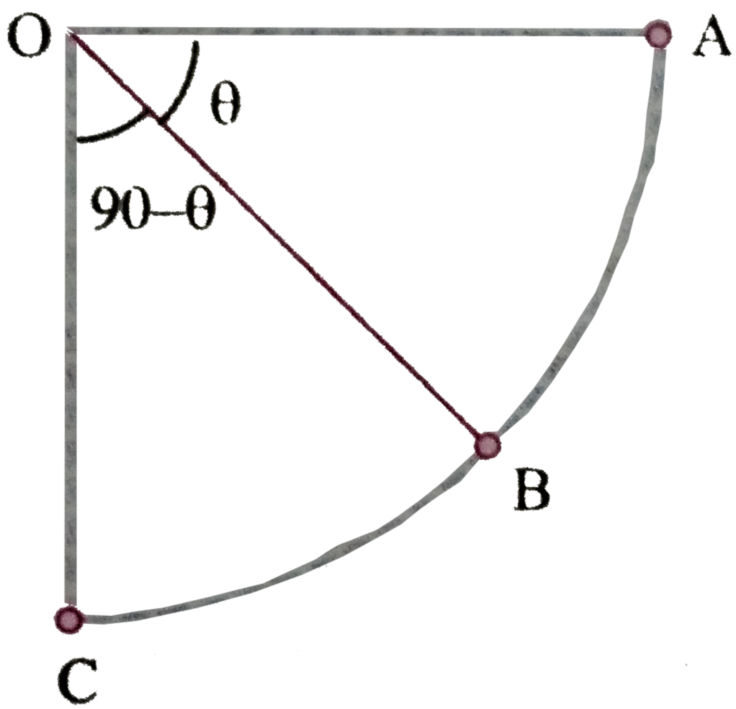
C. $t_1 = t_2$

D. Information is insufficient.

Answer: B

Watch Video Solution

22. One end of a light string of length L is connected to a ball and the other end is connected to a fixed point O. The ball is released from rest at $t = 0$ with string horizontal and just taut. The ball then moves in vertical circular path as shown. The time taken by ball to go from position A to B is t_1 and from B to lowest position C is t_2. Let the velocity of ball at B is $\vec{v}_B$ and at C is $\vec{v}_C$ respectively.



If $\left|\vec{v}_C\right| = 2\left|\vec{v}_B\right|$ then the value of θ as shown is

A. $\cos^{-1}\left(\frac{1}{4}\right)^{1/3}$

B. $\sin^{-1}\left(\frac{1}{4}\right)^{1/3}$

C. $\cos^{-1}\left(\frac{1}{2}\right)^{1/3}$

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

Answer: B

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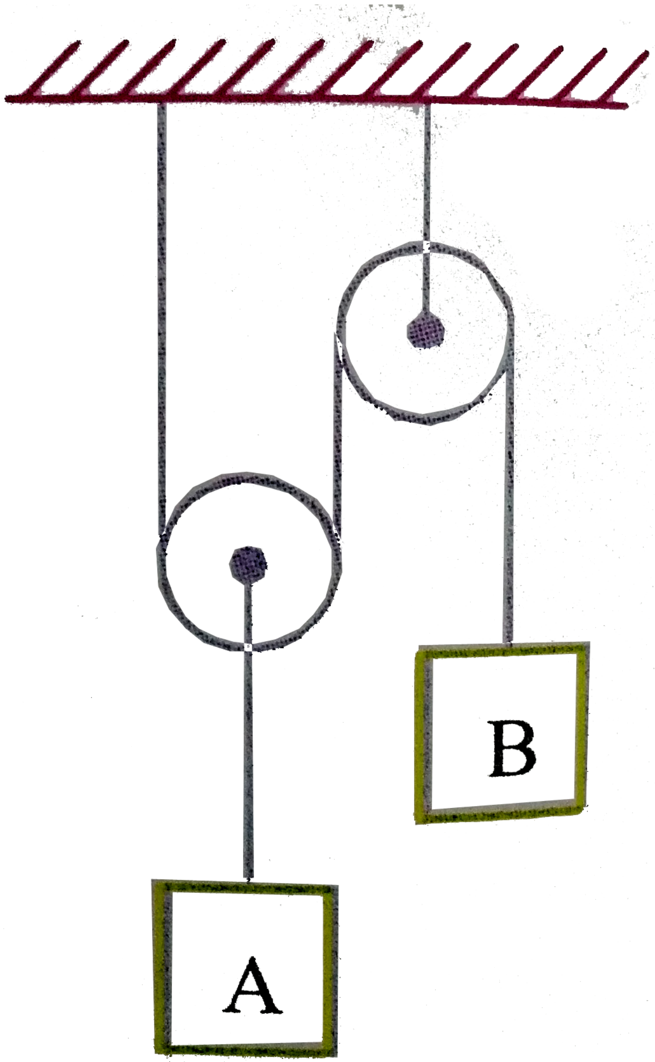
Level-V (Integer)

1. Block A has a weight of $300N$ and block B has weight $50N$. Calculate the distance A must descent form rest before it obtains a speed of $4m/s$

(Neglect the mass of cord and pulleys). $(Take g = 10 m/s^2)$.



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2. A particle of mass m moves along a circle of radius R with a normal acceleration varying with time as $a_n = bt^2$, where b is a constant. Find the time dependence of the power developed by all the forces acting on the particle, and the mean value of this power averaged over the first 2 seconds after the beginning of motion, $(m = 1, v = 2, r = 1)$.

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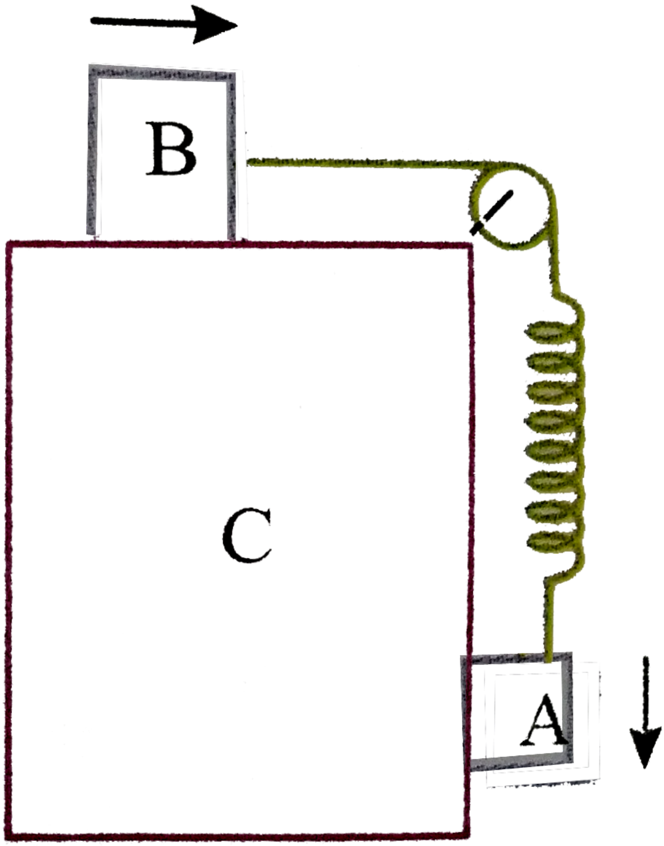
3. Two blocks A and B are connected to each other by a string and a spring , the string passes over a frictionless pulley as shown in the figure. Block B slides over the horizontal top surface of a stationary block C and the block A slides along the vertical side of C, both with the same uniform speed. The coefficient of friction between the surface and blocks is $0.5K = 2000N/m$. If mass of A is $2kg$ calculate mass of B.



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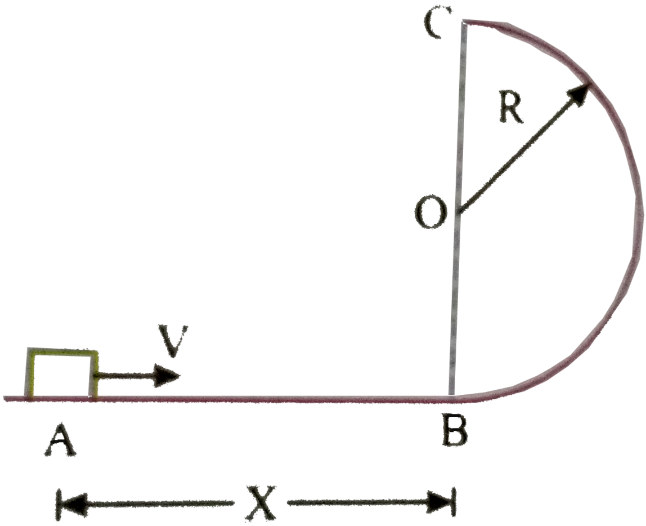
4. A small block is given a velocity v from point A. Given $x = 3R$, $R = 20m$ and $g = 9.8m/s^2$. If the block strikes the point A after it leaves the smooth circular track in vertical plane, the value of v is

$7x$, find v ?



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5. A particle is projected along the inner surface of a smooth vertical circle of radius R, its velocity at the lowest point being $(1/5)(\sqrt{95gR})$. If the particle leaves the circle at an angular distance $\cos^{-1}(x/5)$ from the highest point, the value of x is.

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Level-VI (Single Answer)

1. An engine pumps water continously through a hose. Water leave the hose with a velocity v and m is the mass per unit length of the Water jet. What is the rate at Which kinetic energy is imparted to water?

A. $\frac{1}{2}m_0v^3$

B. $\frac{1}{2}m_0v^2$

C. $\frac{1}{2}m_0v^{3/2}$

D. $\frac{1}{2}m_0v^{1/2}$

Answer: A

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2. A hemispherical vessel of radius R moving with a constant velocity v_0 and containing a ball, is suddenly haulted. Find the height by which ball will rise in the vessel, provided the surface is smooth :

A. $\frac{v_0^2}{2g}$

B. $\frac{2v_0^2}{g}$

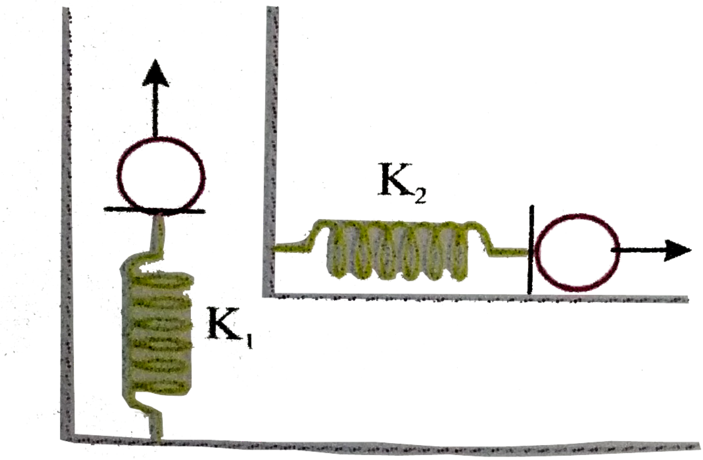
C. $\frac{v_0^2}{g}$

D. None of these

Answer: A

Watch Video Solution

3. Two ball of same mass are projected as shown. By compressing equally (say x) the springs of different force constants K_1 and K_2 by equal magnitude. The first ball is projected upwards along smooth wall and the other on the rough horizontal floor with coefficient of friction μ. If the first ball goes up by height h, then the distance covered by the second ball will be :



A. $\frac{2hK_2}{\mu K_1}$

B. $\frac{hK_1}{2\mu K_2}$

C. $\frac{3hK_2}{2\mu K_1}$

D. $\frac{hK_2}{\mu K_1}$

Answer: D

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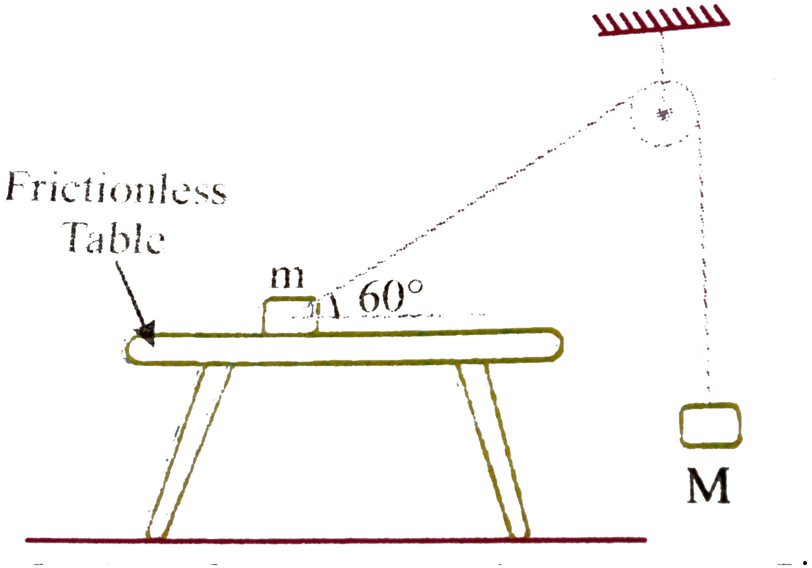
4. What is the minimum value of the mass M so that the block is lifted off the table at the instant shown in the diagram ? Assume that the blocks are initially at rest.



A. $\frac{m}{\sin 60^\circ}$

B. $\frac{m}{\tan 60^\circ}$

C. $m \sin 60^\circ$

D. none of these

Answer: D

Watch Video Solution

5. A bob of mass m is suspended from a fixed support with a light string and the system with bob and support is moving with a uniform horizontal acceleration. The breaking strength of the string is $mg\sqrt{2}$. Find the workdone by the tension in the string in the first one second :

A. $2mg^2$

B. $\frac{mg^2}{\sqrt{2}}$

C. $\frac{mg^2}{2}$

D. $mg^2\sqrt{2}$

Answer: C

Watch Video Solution

6. A particle moves move on the rough horizontal ground with some initial velocity V_0. If $\frac{3}{4}$ of its kinetic enegry lost due to friction in time t_0. The coefficient of friction between the particle and the ground is.

A. $\dfrac{V_0}{2gt_0}$

B. $\dfrac{V_0}{4gt_0}$

C. $\dfrac{3V_0}{4gt_0}$

D. $\dfrac{V_0}{gt_0}$

Answer: A

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7. The total mechanical enegry of a particle is E. The speed of the particle at $x = \left(\frac{2E}{K}\right)^{1/2}$ is $\left(\frac{2E}{m}\right)^{1/2}$. Find the potential energy of the particle at x :

A. zero

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

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

D. $\frac{2}{5}Kx^2$

Answer: A

Watch Video Solution

8. The coefficient of friction between a particle moving with some velocity V_0 and the rough horizontal surface is $\left(\frac{V_0}{2gt_0}\right)$. Find how much kinetic energy is lost in time t_0 due to friction :

A. $1/4$

B. $1/2$

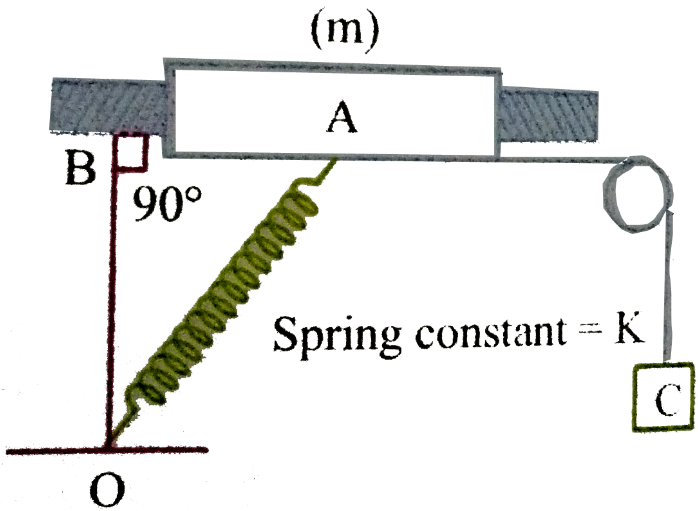
C. $3/4$

D. $2/3$

Answer: C

Watch Video Solution

9. A block A os mass m slides on a smooth slider in the system as shown. A block c of mass hanging from a pulley pulls block A. When the block A was at position B, the spring was unstretched. Find the speed of the block A when $AB = OB = L$.



A. $\left[\frac{gL}{\sqrt{2}} - \frac{KL^2\sqrt{2}}{m}\right]^{\frac{1}{2}}$

B. $\left[gL - \frac{KL^2}{2m}\left(\sqrt{2}-1\right)^2\right]^{\frac{1}{2}}$

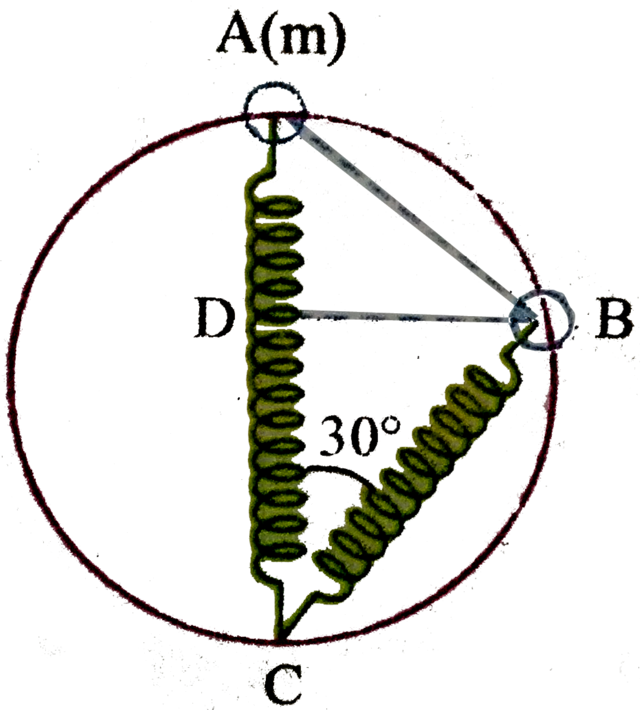
C. $\left[gL - \frac{2KL^2}{m}\left(\sqrt{2}-1\right)^2\right]^{\frac{1}{2}}$

D. $\left[\frac{gL}{2} - \frac{KL^2\sqrt{2}}{m}\right]^{\frac{1}{2}}$

Answer: B

Watch Video Solution

10. A ring 'A' of mass 'm' is attached to a stretched spring of force constant K, which is fixed at C on a smooth vertical circular track of radius R. Points A and C are diametrically opposite. When the ring slips form rest in the track to point B, making an angle of 30° with AC. $(\angle ACB = 30^\circ)$ spring becomes unstretched. Find the velocity of the ring at B.



A. $\left[\frac{KR^2}{2m}(2-\sqrt{3})^2 + gR\sqrt{3}\right]^{\frac{1}{2}}$

B. $\left[\frac{KR^2}{m}(2-\sqrt{3})^2 + gR\right]^{\frac{1}{2}}$

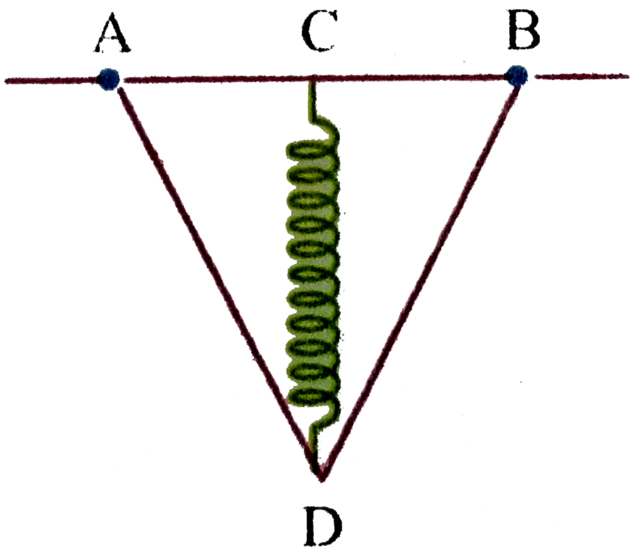
C. $\left[\frac{2KR^2}{m}(2-\sqrt{3})^2 + gR\sqrt{3}\right]^{\frac{1}{2}}$

D. $\left[\frac{KR^2}{2m}(\sqrt{2}-1)^2 + gR\right]^{\frac{1}{2}}$.

Answer: B

Watch Video Solution

11. A and B are smooth light hinges equidistant from C, which can slides on ABC. The spring of force constant K is fixed at its one end C and conncented to light rods AD and BD at point D. A block of mass m is suspended at D. Find the velocity of the block, when $\angle CAD$ changes from 30° to 45°. $AD = BD = L$.



A. $\left[gL - \frac{KL^2}{2m}\left(\sqrt{2}-1\right)^2\right]^{\frac{1}{2}}$

B. $\left[gL\sqrt{2} - \frac{KL^2}{2m}\left(\sqrt{2}-1\right)^2\right]^{\frac{1}{2}}$

C. $\left[gL\left(\sqrt{2}-1\right) - \frac{KL^2}{4m}\left(\sqrt{2}-1\right)^2\right]^{\frac{1}{2}}$

D. $\left[gL - \frac{KL^2}{2m}\right]^{\frac{1}{2}}$

Answer: C

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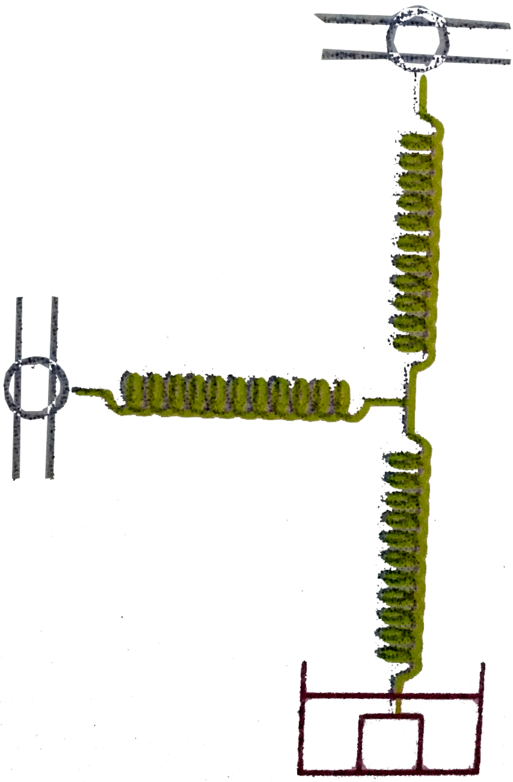
12. Three springs A, B and C each of force constant K, are connected at O. The other ends of B and C can slide on smooth sliders. A pan is hanging from other end of the spring A. When a block of mass m is placed into he pan, find the amount of workdone by the gravity on block system after it stops vibrating. The spring C does not sag :



A. $\dfrac{3m^2g^2}{2K}$

B. $\dfrac{m^2g^2}{K}$

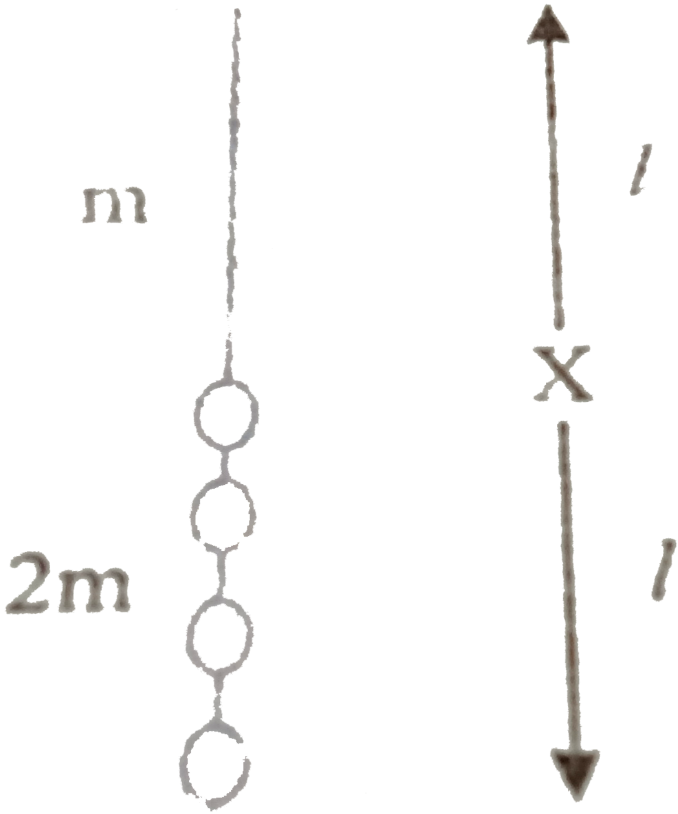
C. $\frac{2m^2g^2}{K}$

D. $\frac{m^2g^2}{2K}$

Answer: C

Watch Video Solution

13. A rope of length l and mass 'm' is connected to a chain of length l and mass $2m$ and hung vertically as shown. What is the change in graviational potential energy if the system is inverted and hung from same point.



A. mgl

B. $4mgl$

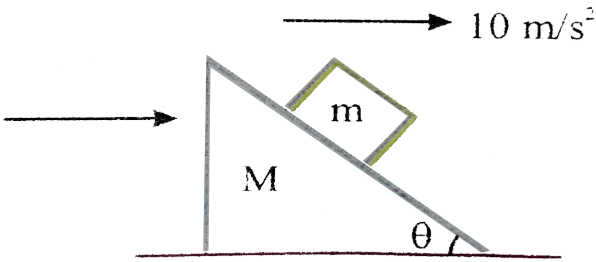
C. $3mgl$

D. $2mgl$

Answer: A

Watch Video Solution

14. In the figure shown all the surfaces are frictionless and mass of block $m = 1kg$, block and wedge are held initially at rest, now wedge is given a horizontal acceleration of $10m/s^2$ by applying a force on the wedge so that the block does not slip on the wedge, the work done by normal force in ground frame on the block in $\sqrt{3}\sec$ is



A. 30 J

B. 60 J

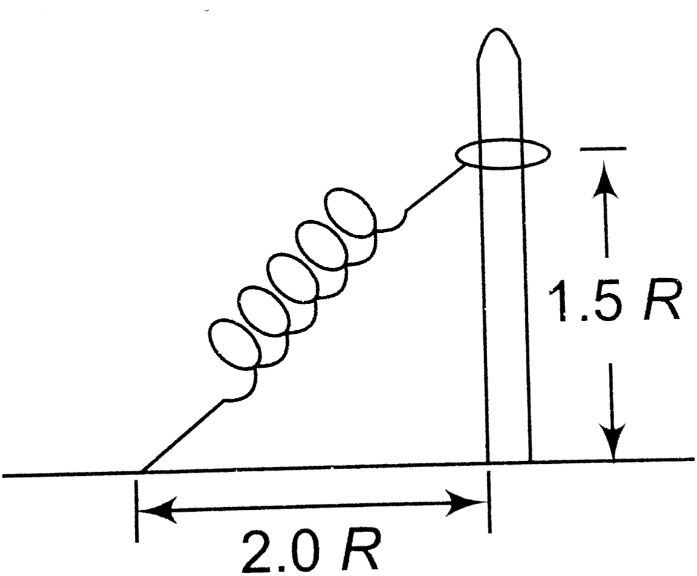
C. 150 J

D. $100\sqrt{3}J$

Answer: C

Watch Video Solution

15. A ring of mass m can slide over a smooth vertical rod as shown in figure. The ring is connected to a spring of force constant $k = 4mg/R$, where $2R$ is the natural length of the spring . The other end of spring is fixed to the ground at a horizontal distance $2R$ from base of the rod . If the mass is released at a height $1.5J$ then the velocity of the ring as it reaches the ground is



A. $\frac{mgR}{2}, 2\sqrt{gR}$

B. $mgR, 2\sqrt{gR}$

C. $\frac{mgR}{2}, \sqrt{2gR}$

D. $\frac{mgR}{2}, \sqrt{gR}$

Answer: A

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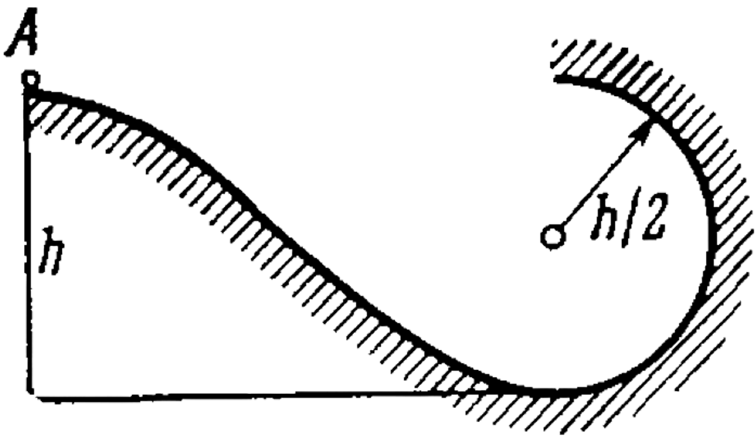
16. A small body A starts sliding from the height h down an inclined groove passing into a half-circle of radius $h/2$ (figure).



Assuming the friction to be negligible, find the velocity of the body at the highest point of its trajectory (after breaking off the groove).

A. $\sqrt{\frac{9}{27}gh}$

B. $\sqrt{\frac{8}{27}gh}$

C. $\sqrt{\frac{27}{8}gh}$

D. $\sqrt{\frac{10}{27}gh}$

Answer: B

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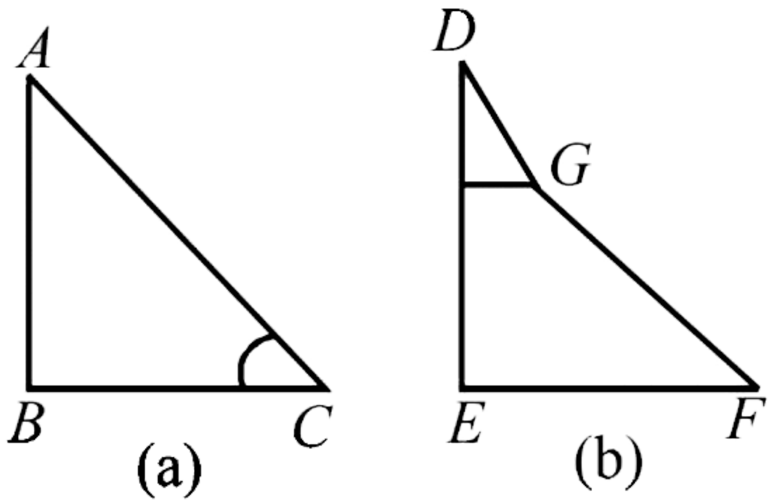
17. 

In the figure (a) and (b) AC and GF are fixed inclined planes $BC = EF = x$ and $AB = DE = y$ A small block of mass M is rdeased from the point A it sides down AC and maches C with a speed V_C The same block is relessed from rest from the point D it sides down DGF and reached the point the F with $V_p THecoefficientsofki \leq ticictionbetweentheblock$ and $thesarface$ AC and DGF$aremu$col$c\underline{a}te$V_(C) and V(p)`

A. $1.7m/s$

B. $2.7m/s$

C. $3.7m/s$

D. $0.7m/s$

Answer: A

Watch Video Solution

18. A $0.5kg$ block slides from the point A on a horizontal track with an initial speed $3m/s$ towards a weightless horizontal spring of length $1m$ and force constant $2N/m$. The part AB of the track is frictionless and the part BC has the coefficient of static and kinetic friction as '0.22' and 0.20 respectively. If the distances AB and BD are $2m$ and $2.14m$ respectively, find total distance through which the block moves before it comes to rest completely. `(g=10 m//s^(2)).

A. $4.20m$

B. $4.14m$

C. $4.24m$

D. $4.26m$

Answer: C

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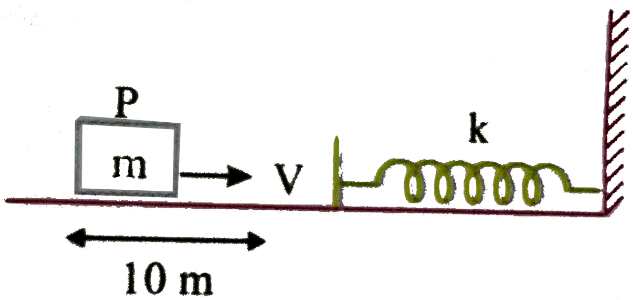
19. A block of mass $1kg$ kept over a smooth surface is given velocity $2m/s$ towards a spring of spring constant $1N/m$ at a distance of $10m$. Find after what time block will be passing through P again



A. $(20 + 2\pi)\sec$

B. $10\sec$

C. $(10 + 2\pi)\sec$

D. $(10 + \pi)\sec$

Answer: D

Watch Video Solution

20. A body is displaced from $(0, 0)$ to $(1m, 1m)$ along the path $x = y$ by a force $F = \left(x^2\hat{j} + y\hat{i}\right)N$. The work done by this force will be

A. $\frac{4}{3}J$

B. $\frac{5}{6}J$

C. $\frac{3}{2}J$

D. $\frac{7}{5}J$

Answer: B

Watch Video Solution

21. 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

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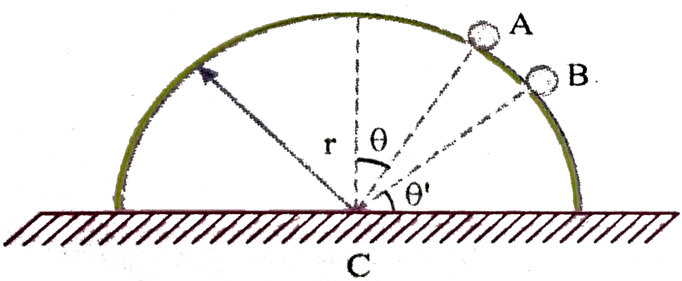
22. A particle of mass m initially at rest starts moving from point A on the surface of a fixed smooth hemisphere of radius r as shown. The particle looses its contact with hemisphere at point B. C is centre of the hemisphere. The equation relating θ and θ' is



A. $3\sin\theta = 2\cos\theta'$

B. $2\sin\theta = 3\cos\theta'$

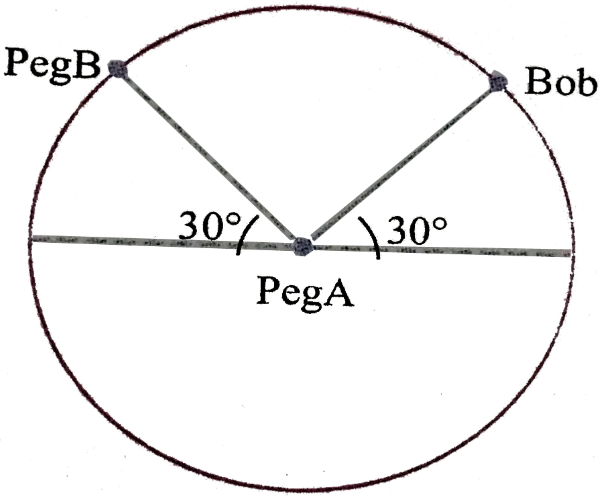
C. $3\sin\theta' = 2\cos\theta$

D. $2\sin\theta = 3\cos\theta'$

Answer: C

Watch Video Solution

23. A bob attached to one end of a string, other end of which is fixed at peg A. The bob is taken to a position where string makes an angle of to a position where string makes an angle of 30° with the horizontal. On the circular path of the bob in vertical plane there is a ped 'B' at a symmetrical position with respect to the position of release as shown in the figure. If V_c and V_a be the minimum speeds is clockwise and anticlock wise directions respectively, given to the bob in order to hit the ped 'B' then ratio $V_c : V_a$ is equal to



A. $1:1$

B. $1:\sqrt{2}$

C. $1:2$

D. $1:4$

Answer: C

View Text Solution

24. A wind - powered generator convets and energy into electrical energy . Assume that the generator convents a fixed fraction of the wind energy intercepited by to blades into electrical energy for wind speed V , the electrical power output will be propertional to

A. v

B. v^2

C. v^3

D. v^4

Answer: C

Watch Video Solution

25. An ideal spring with spring - constant K is bung from the colling and a block of mass M is attached to its lower end the mass is released with the spring initally unstetched . Then the maximum exlemsion in the spring is

A. $\frac{4Mg}{k}$

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

C. $\frac{Mg}{k}$

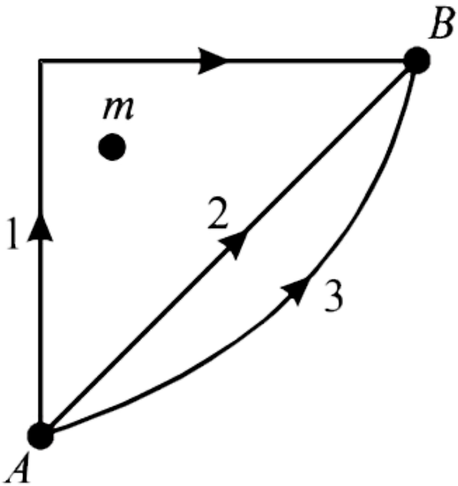
D. $\frac{Mg}{2k}$

Answer: B

Watch Video Solution

26. If $W_1 W_2$ and W_3 represent the work done in moving a particle from A to B along three different paths 1.2 and3 respectively (asshown) in the gravitational fieled of a point mass m, find the correct relation between

W_(1) W_(2) and W_(3)`



A. $W_1 > W_2 > W_3$

B. $W_1 = W_2 = W_3$

C. $W_1 < W_2 < W_3$

D. $W_2 > W_1 > W_3$

Answer: B

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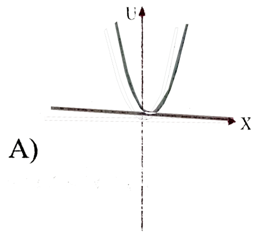
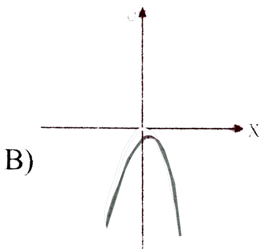
27. A particle is acted by x force $F = Kx$ where K is $a(+ Ve)$ constant its potential mwrgy at $x = 0$ is zero . Which curve correctly represent the variation of putential energy of the block with repect to x

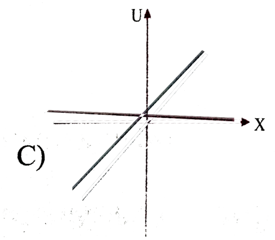
A.



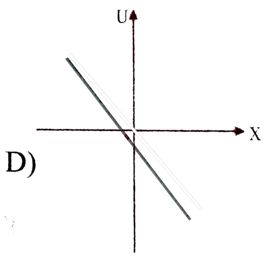
B.



C.



D.



Answer: A

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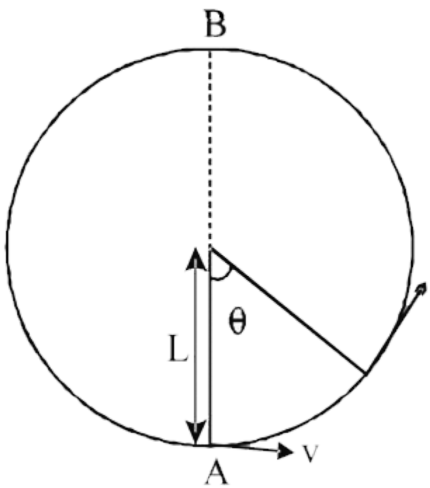
28. A bob of mass M is suspended by a massless string of length L. The horizonta velocity v at position A is just sufficient to make it reach the point B. The angle θ at which the speed of the bob is half of that at A, satisfies



A. $\theta = \frac{\pi}{4}$

B. $\frac{\pi}{4} < \theta < \frac{\pi}{2}$

C. $\frac{\pi}{2} < \theta < \frac{3\pi}{4}$

D. $\frac{3\pi}{4} < \theta < \pi$

Answer: D

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29. The work done an a particle of mass m by a force

$$K\left[\frac{x}{(x^2+y^2)^{3/2}}\hat{i}+\frac{y}{\left(x^2+y^{2^{3/2}}\right)\hat{j}}\right]$$ $(Kbe \in gacons\tan tofap \propto riate$ dir

(a,0) $\rightarrow thep \oint$(0,a)` along a circular path of radius a about the origin in x - y plane is

A. $\frac{2k\pi}{a}$

B. $\frac{k\pi}{a}$

C. $\frac{k\pi}{2a}$

D. zero

Answer: D

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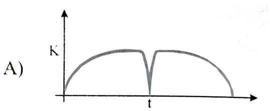
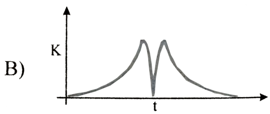
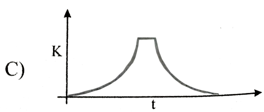
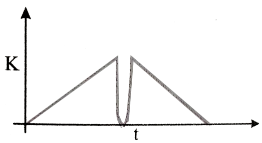
30. A tennis ball dropped on a barizoontal smooth surface , it because back to its original postion after hiting the surface the force on the bell during the collision is propertional to the length of compression of the bell . Which one of the following skethes desches discribe the variation of its kinetic energy K with time 1 mass apporiandly ? The figure as only illistrative and not to the scale .

A. 

B. 

C. 

D. 

Answer: B

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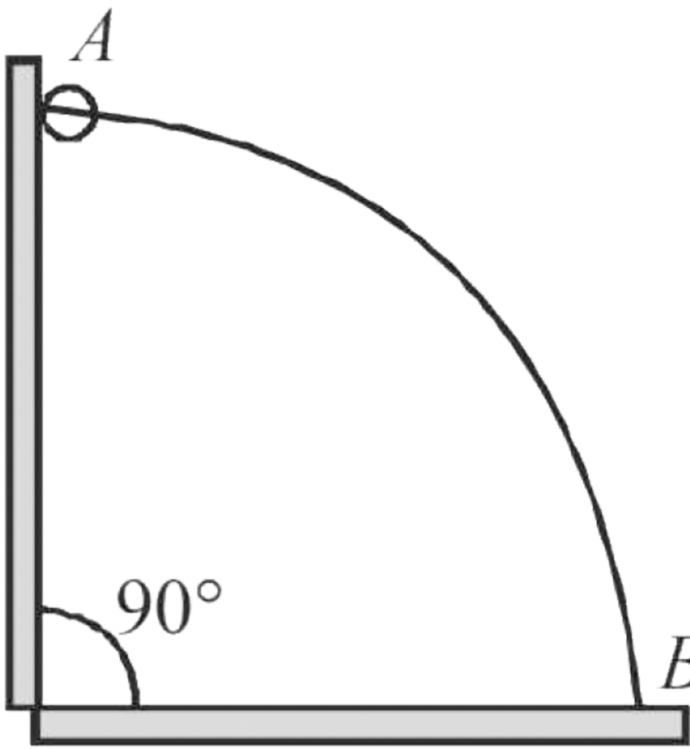
31. A wire, which passes through the hole in a small bead, is bent in the form of quarter of a circle. The wire is fixed vertically on ground as shown in the figure. The bead is released from near the top of the wire and it slides along the wire without friction. As the bead moves from A to B, the force it applies on the wire is



A. always radially outwards

B. always radially inwards

C. radially outwards initially and radially inwards later.

D. radially inwards initially and radially outwards later.

Answer: D

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Level-VI (Multiple Answer)

1. The potential energy of a particle moving along x-axis is given by $U = 20 + 5\sin(4\pi x)$, where U is in J and x is in metre under the action of conservative force :

A. if total mechanical energy is $20J$,

then at $x = 7/8m$, particle is at equilibrium

B. if total mechanical energy is $20J$,

then at $x = 7/8m$ particle is not at equilibrium

C. if total mechanical energy is $20J$,

then at $x = 3/8m$, particle is at equilibrium

D. if total mechanical energy is $20J$,

then at $x = 3/8m$, particle is not at equilibrium.

Answer: A::C

Watch Video Solution

2. A block of mass $1kg$ moves towards a spring of force constant $10N/m$. The spring is massless and unstretched. The coeffcient of friction between block and surface is 0.30. After compressing the spring, block does not return back : $(g = 10m/s)$.

A. the maximum value of speed of block for which it is possible is

$3.8m/s$

B. the maximum value of speed of block of which it is possible is

$4.2m/s$

C. if E_i and E_f are initial and final mechanical energy, which is sum of kinetic energy and potential energy, than work done by friction on a system is $(E_i - E_f)$.

D. statement in option (C) is wrong.

Answer: A::C

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3. The spring constant of spring A is twice the spring constant of spring B. Each of the spring is cut into two pieces. First piece of spring A is $(4/5)$ of the total length. Second piece of spring B is $(5/6)$ of its total length. Both springs are of equal lengh initially :

A. the ratio of force constant of first piece of spring B to the first piece of spring A is $(12/5)$

B. the ratio of force constant of first piece of spring B to the first piece of spring A is 2

C. the ratio of force constant of second piece of spring A to the first piece of spring B is $5/3$

D. the ratio of force constant of second piece of spring A to the first piece of spring B is $7/5$.

Answer: A::C

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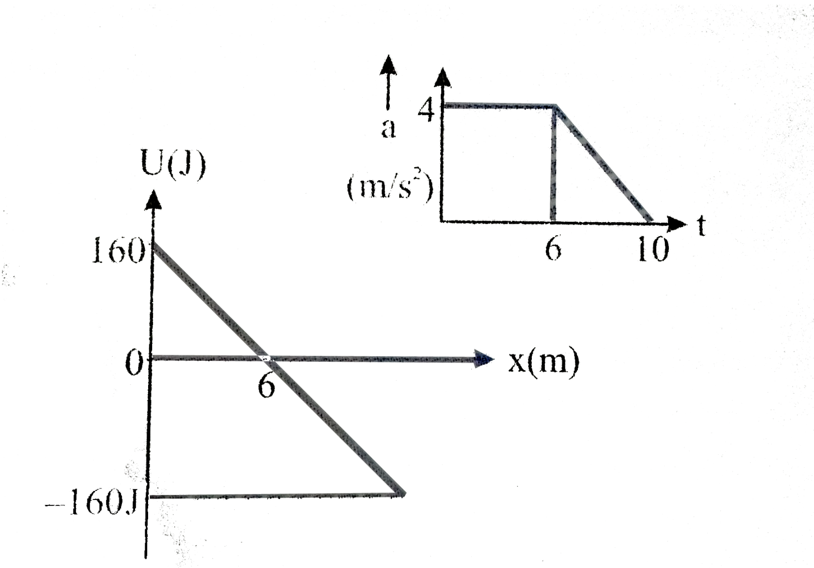
4. A particle of mass $1kg$ is moving X-axis. Its velocity is $6m/s$ at $x=0$. Acceleration-displacement curve and potential energy-dispalcement curve of the particle are shown :



A. the work done by all the forces is $704J$

B. the work done by external forces is $350J$

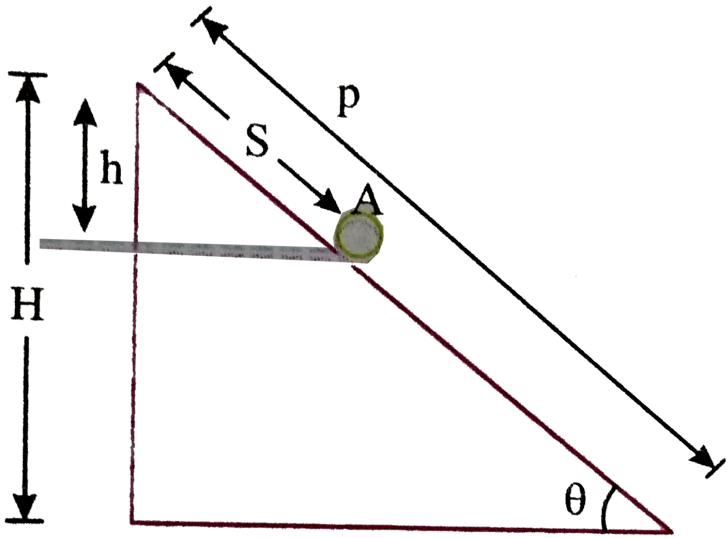
C. the work done by external forces is $384J$

D. the work done by conservation forces is $300J$.

Answer: A::C

Watch Video Solution

5. A particle sides down from rest on an inclined plane of angle θ with horizontal. The distances are as shown. The particle slides down to the position A, where it velocity is v.



A. $\left(v^2 - 2gh\right)$ will remain zero

B. $\left(v^2 - 2gs\sin\theta\right)$ will remain zero

C. $\left[\dfrac{v^2 - 2gs(H-h)}{(p-s)}\right]$ will remain zero

D. $\left[v^2 - \dfrac{2gsH}{p}\right]$ will remain zero.

Answer: A::B::C::D

Watch Video Solution

6. A particle is taken from point A to point B under the influence of a force field. Now it is taken back from B to A and it is observed that the work done in taking the particle from A to B is not equal to the work done in taking it from B to A. If W_{nc} and W_c are the work done by non-conservative and conservative forces present in the system, respectively, ΔU is the change in potential energy and Δk is the change in kinetic energy, then

A. $W_{nc} - \Delta U = \Delta D$

B. $W_c = -\Delta U$

C. $W_{nc} + W_c = \Delta k$

D. $W_{nc} - \Delta U = -\Delta k$

Answer: A::B::C

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7. An engine is pulling a train of mass m on a level track at a uniform speed u. The resistive froce offered per unit mass is f.

A. Power produced by the engine is mfu

B. The extra power developed by the engine to maintain a speed u up a gradient on of h in s is $\frac{mghu}{s}$.

C. The frictional force exerting on the train is mf on the level track

D. None of above is correct

Answer: A::B::C

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8. The alternative that gives the conservative force of the following is.

A. $\overrightarrow{F}_1 = 2xy\hat{i} + x^2\hat{j}$

B. $\overrightarrow{F}_2 = y^3\hat{i} + xy^2\hat{j}$

C. $\overrightarrow{F_3} = y\hat{i} + x\hat{j}$

D. $\overrightarrow{F_4} = xy^2\hat{i} + x^2\hat{j}$

Answer: A::C

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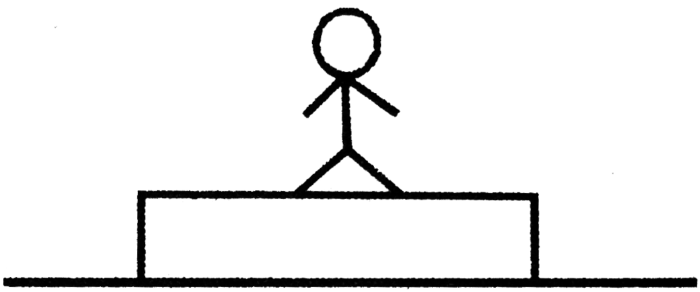
9. A man is standing on a plank which is placed on smooth horizontal surface. There is sufficient friction between the feet of man and plank. Now man starts running over plank, correct statement is /are



A. Work done by friction on man with respect to ground is negative

B. Work done by friction on man with respect to ground is positive

C. Work done by friction on plank with respect to ground is positive

D. Work done by friction on man with respect to plank is zero.

Answer: B::C::D

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10. A small sphere of mass m suspended by a thread is first taken a side so that the thread forms the right angle with the vertical and then released, then

A. Total acceleration of sphere as a function of θ measured from the vertical is $g\sqrt{1+3\cos^3\theta}$

B. Thread tension as a function of θ measured from the vertical is $T = 3mg\cos\theta$

C. The angle θ between the thread and the vertical at the moment when the total acceleration vector of the sphere is directed horizontally is $\cos^{-1}1/\sqrt{3}$.

D. The thread tension at the moment when the vertical component of the sphere's velocity is maximum will be mg.

Answer: A::B::C

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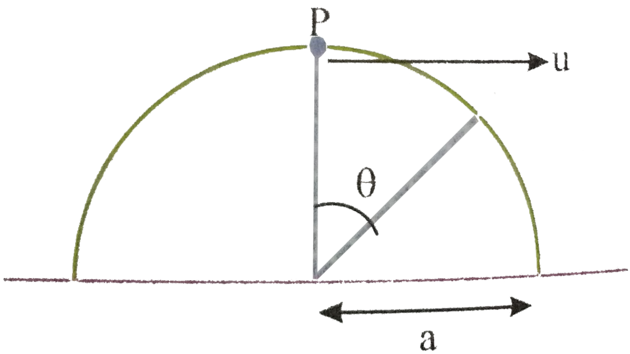
11. A particle P is initially at rest on the top pfa smooth hemispherical surface which is fixed on a horizontal plane. The particle is given a velocity u horizontally. Radius of spherical surface is a.



.

A. If the particle leaves the sphere, when it has fallen vertically by a distance of $\frac{a}{4}mu = \frac{\sqrt{ga}}{2}$.

B. If the particle leaves the sphere at angle θ (fig) where $\cos\theta = \frac{\sqrt{3}}{2}$,

then $u = \frac{\sqrt{ag}}{3}$

C. If $u = 0$ and the particle just slides down the hemispherical surface,

it will leave the surface when $\cos\theta = \frac{2}{3}$.

D. The minimum value of u, for the object to leave the sphere without

sliding over the surface is $\sqrt{ag}$.

Answer: A::C::D

Watch Video Solution

Level-VI (Comprehension)

1. The potential energy U(in J) of a particle is given by $(ax + by)$, where a and b are constants. The mass of the particle is $1kg$ and x and y are the coordinates of the particle in metre. The particle is at rest at $(4a, 2b)$ at time $t = 0$.

Find the speed of the particle when it crosses x-axis

A. $2\sqrt{a^2 + b^2}$

B. $\sqrt{a^2 + b^2}$

C. $\frac{1}{2}\sqrt{a^2 + b^2}$

D. $\sqrt{\frac{(a^2 + b^2)}{2}}$

Answer: A

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2. The potential energy U(in J) of a particle is given by $(ax + by)$, where a and b are constants. The mass of the particle is $1kg$ and x and y are the coordinates of the particle in metre. The particle is at rest at $(4a, 2b)$ at time $t = 0$.

Find the speed of the particle when it crosses y-axis.

A. $4\sqrt{a^2 + b^2}$

B. $2\sqrt{2(a^2+b^2)}$

C. $\sqrt{2(a^2+b^2)}$

D. $\sqrt{(a^2+b^2)}$

Answer: B

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3. The potential energy $U(\text{in } J)$ of a particle is given by $(ax+by)$, where a and b are constants. The mass of the particle is $1kg$ and x and y are the coordinates of the particle in metre. The particle is at rest at $(4a, 2b)$ at time $t=0$.

Find the acceleration of the particle.

A. $4\sqrt{a^2+b^2}$

B. $2\sqrt{2(a^2+b^2)}$

C. $\sqrt{2(a^2+b^2)}$

D. $\sqrt{(a^2+b^2)}$

Answer: D

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4. The potential energy U(in J) of a particle is given by $(ax + by)$, where a and b are constants. The mass of the particle is $1kg$ and x and y are the coordinates of the particle in metre. The particle is at rest at $(4a, 2b)$ at time $t = 0$.

Find the coordinates of the particle at $t = 1$ second.

A. $(3.5a, 1.5b)$

B. $(3a, 2b)$

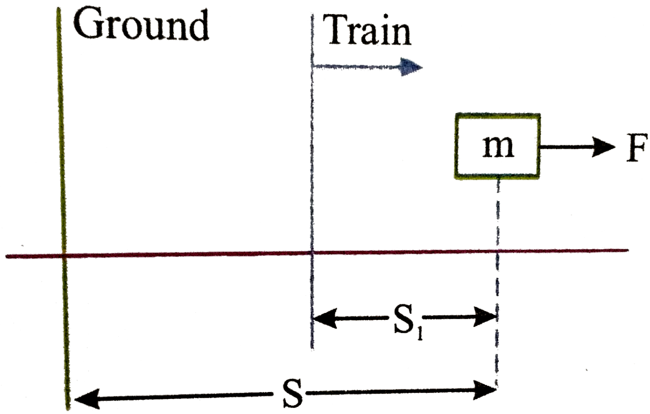
C. $(3a, 3b)$

D. $(3a, 4b)$

Answer: A

Watch Video Solution

5. A block of mass m sits at rest on a frictionless table in a rail car that is moving with speed v_c along a straight horizontal track (fig.) A person riding in the car pushes on the block with a net horizontal force F for a time t in the direction of the car's motion.



What is the final speed of the block according to a person in the car ?

A. $\frac{Ft}{m}$

B. $\frac{2Ft}{m}$

C. $-\frac{Ft}{m}$

D. zero

Answer: A

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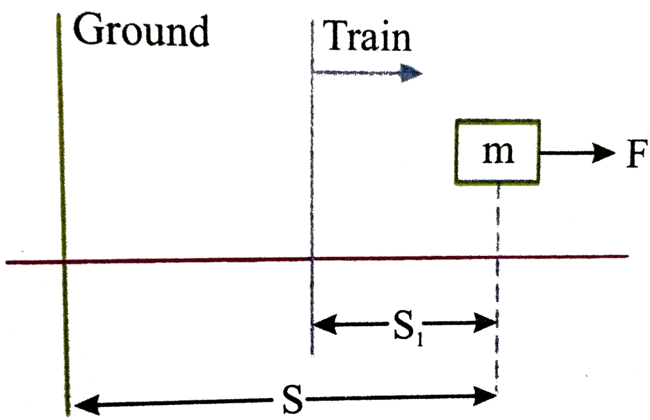
6. A block of mass m sits at rest on a frictionless table in a rail car that is moving with speed v_c along a straight horizontal track (fig.) A person riding in the car pushes on the block with a net horizontal force F for a time t in the direction of the car's motion.



According to a person standing on the ground outside the train ?

A. $V_c + \frac{Ft}{m}$

B. $V_c - \frac{2Ft}{m}$

C. $\frac{Ft}{m} - V_c$

D. zero

Answer: A

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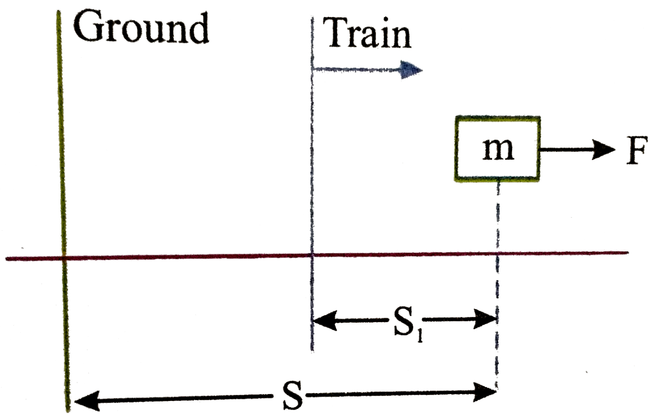
7. A block of mass m sits at rest on a frictionless table in a rail car that is moving with speed v_c along a straight horizontal track (fig.) A person riding in the car pushes on the block with a net horizontal force F for a time t in the direction of the car's motion.



How much did $K.E$ of the block change according to the person in the car ?

A. $\frac{F^2t^2}{2m}$

B. $\frac{F^2t^2}{m}$

C. $\frac{2F^2t^2}{m}$

D. None of these

Answer: A

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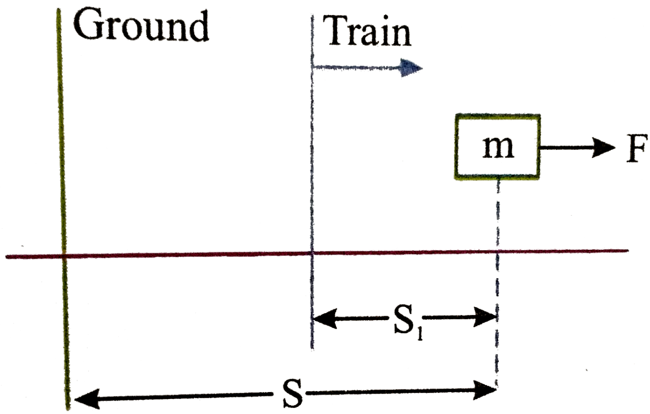
8. A block of mass m sits at rest on a frictionless table in a rail car that is moving with speed v_c along a straight horizontal track (fig.) A person riding in the car pushes on the block with a net horizontal force F for a time t in the direction of the car's motion.



According to the person on the ground. The change in KE of block is

A. $\dfrac{m\left(V_c + \frac{Ft}{m}\right)^2}{2} - \dfrac{mv_c^2}{2}$

B. $\dfrac{m\left(V_c + \frac{Ft}{m}\right)^2}{2} + \dfrac{mv_c^2}{2}$

C. $\dfrac{mv_c^2}{2} - \dfrac{m\left(V_c + \frac{Ft}{m}\right)^2}{2}$

D. None of these

Answer: A

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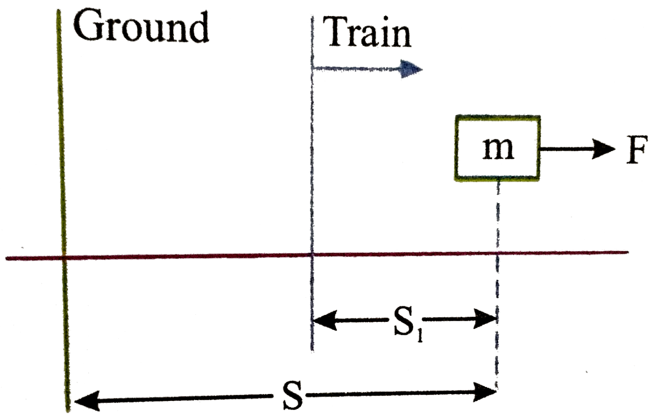
9. A block of mass m sits at rest on a frictionless table in a rail car that is moving with speed v_c along a straight horizontal track (fig.) A person riding in the car pushes on the block with a net horizontal force F for a time t in the direction of the car's motion.



In terms of F, m & t, how far did the the force displace the object according to the person in car ?

A. $\frac{Ft^2}{m}$

B. $\frac{Ft^2}{2m}$

C. $\frac{2Ft^2}{m}$

D. $\frac{4Ft^2}{m}$

Answer: B

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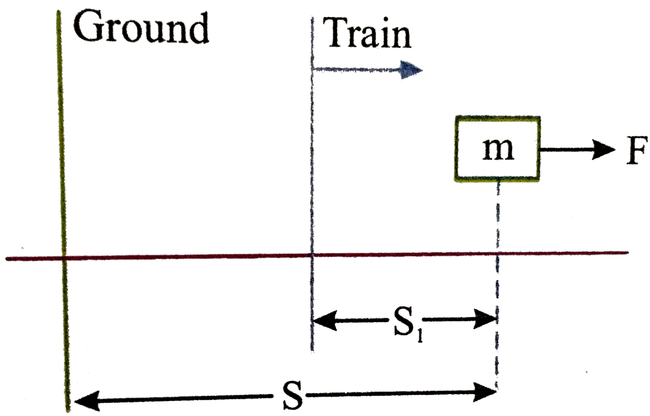
10. A block of mass m sits at rest on a frictionless table in a rail car that is moving with speed v_c along a straight horizontal track (fig.) A person riding in the car pushes on the block with a net horizontal force F for a time t in the direction of the car's motion.



According to the person on the ground. The displacement of block is

A. $\frac{Ft^2}{2m} + 2v_c t$

B. $\frac{Ft^2}{2m} + v_c t$

C. $\frac{Ft^2}{m} + v_c t$

D. $\frac{Ft^2}{2m} - v_c t$

Answer: B

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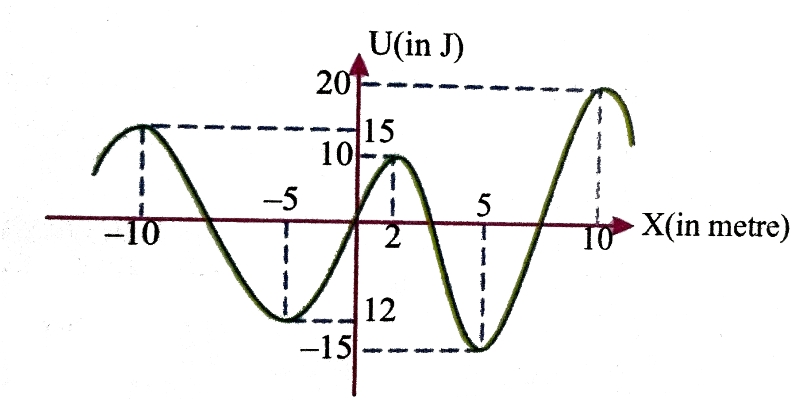
11. In the figure the variation of potential energy of a particle of mass $m = 2kg$ is represented w.r.t. its x-coordinate. The particle moves under the effect of this conservative force along the x-axis.



If the particle is released at the origin then

A. it will move towards positive x-axis.

B. it will move towards negative x-axis.

C. it will remain stationary at the origin.

D. its subsequent motion cannot be decided due to lack of information.

Answer: B

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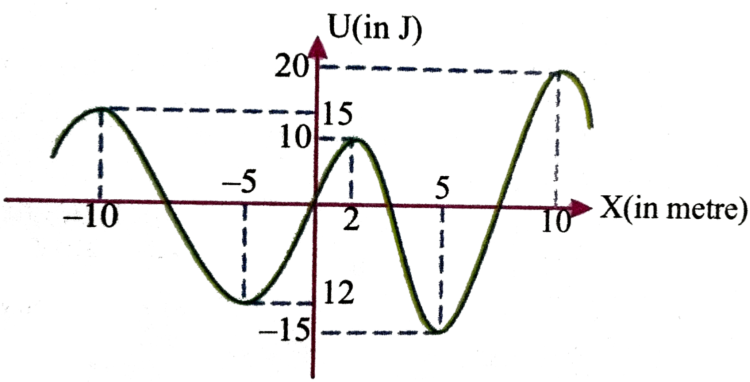
12. In the figure the variation of potential energy of a particle of mass $m = 2kg$ is represented w.r.t. its x-coordinate. The particle moves under the effect of this conservative force along the x-axis.



$x = -5m$ and $x = 10m$ position of the particle are respectively of

A. neutral and stable equilibrium.

B. neutral and unstable equilibrium.

C. unstable and stable equilibrium.

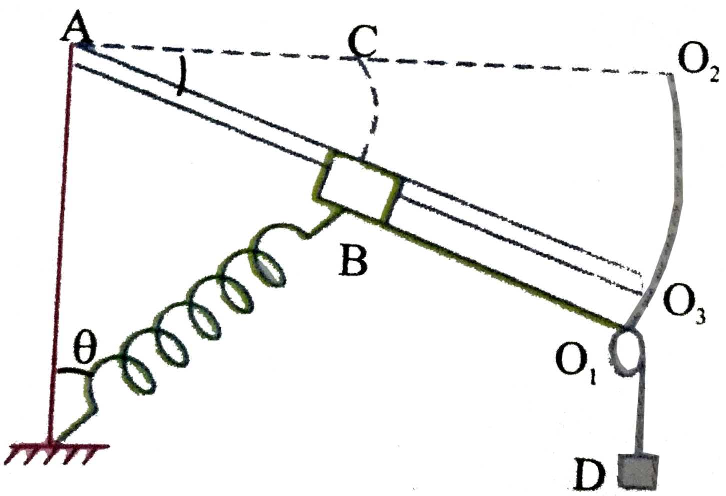
D. stable and unstable equilibrium.

Answer: D

Watch Video Solution

13. Rod AO_3 of length L can rotate abput A. Initially rod was at position AO_2, when spring OB of force constant K, attached to block B of mass m was at position OA with unstretched length L. The smooth block B can slide on rod when pulled by the block D of mass m through a massless spring and smooth pulley at O_1.

Find the velocity of the block B, when the rod and spring at B make an angle of 30° with their respective initial positions : (B is the middle point of the block)



A. $\left[\dfrac{10mgL - KL^2\left(2-\sqrt{3}\right)^2}{8m}\right]^{\frac{1}{2}}$

B. $\left[\dfrac{2mgL - KL^2\left(\sqrt{2}-1\right)}{4m}\right]^{\frac{1}{2}}$

C. $\left[\dfrac{5mgL - KL^2\left(\sqrt{2}-1\right)}{4m}\right]^{\frac{1}{2}}$

D. $\left[\dfrac{6mgL - KL^2\left(\sqrt{2}-1\right)}{4m}\right]^{\frac{1}{2}}$

Answer: A

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14. Rod AO_3 of length L can rotate abput A. Initially rod was at position AO_2, when spring OB of force constant K, attached to block B of mass m was at position OA with unstretched length L. The smooth block B can slide on rod when pulled by the block D of mass m through a massless spring and smooth pulley at O_1.

Find the work done by the frictional force (if slider is rough) at the instant when rod and the spring attached at block B make an angle of 30° with their respective initial positions.

A. $\frac{1}{2}KL^2(2-\sqrt{3})^2 - mgL$

B. $KL^2(2-\sqrt{3})^2 - \frac{mgL}{4}$

C. $\frac{1}{8}KL^2(2-\sqrt{3})^2 - \frac{5}{4}mgL$

D. $\frac{1}{2}KL^2(\sqrt{2}-1)^2$

Answer: C

Watch Video Solution

15. A particle of mass M attached to an inextensible strintg is moving in a vertical circle of radius R.about fixed point O. It is imparted a velocity u in horizontal directional at lowest position as shown in figure.

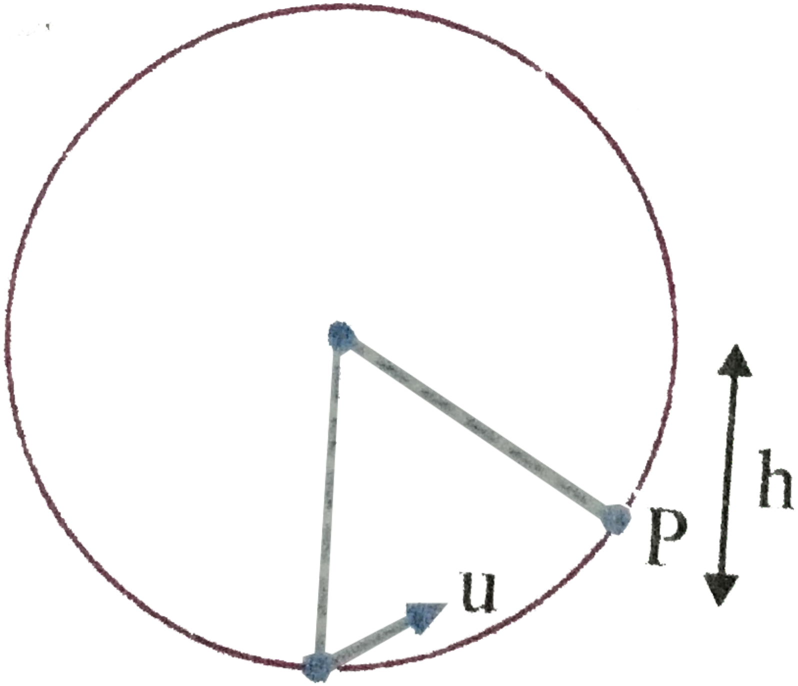
Following information is being given

(i) Velocity at a height h can be calculated by using formula $v^2 = u^2 - 2gh$

(ii) Particle will complete the circle if $u \geq \sqrt{5gR}$

(iii) Particle will oscillates in lower half $(0^\circ < \theta \leq 90^\circ)$ if $0 < u \leq \sqrt{2gR}$

(iv) The magnitude of tension at a height $'h'$ is calculated by using formula $T = \frac{M}{R}\left[u^2 + [gR - 3gh]\right]$



If $R = 2m$, $M = 2kg$ and $u = 12m/s$. Then value of tension at lowest position is

A. 120 N

B. 164 N

C. 264 N

D. zero

Answer: B

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16. A particle of mass M attached to an inextensible strintg is moving in a vertical circle of radius R.about fixed point O. It is imparted a velocity u in horizontal directional at lowest position as shown in figure.

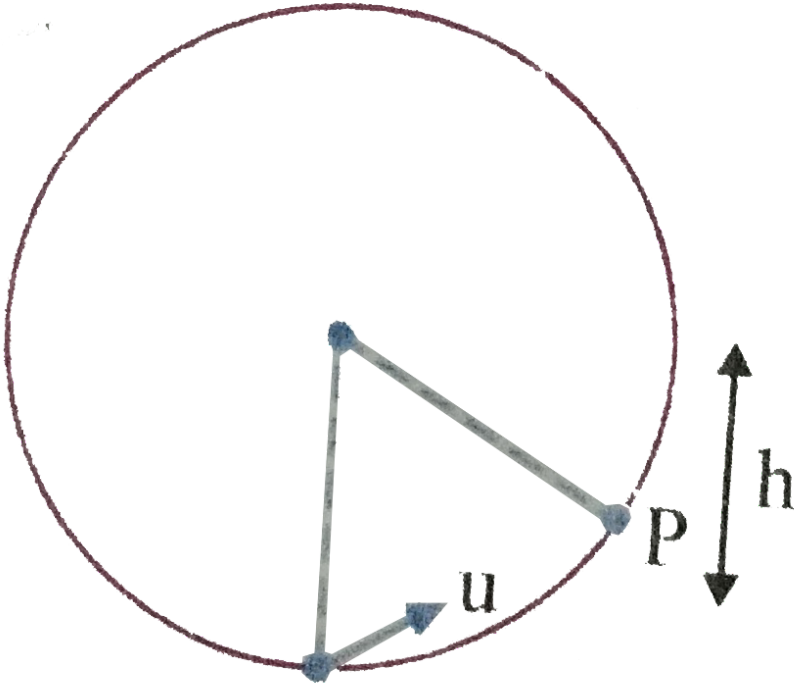
Following information is being given

(i) Velocity at a height h can be calculated by using formula $v^2 = u^2 - 2gh$

(ii) Particle will complete the circle if $u \geq \sqrt{5gR}$

(iii) Particle will oscillates in lower half $(0^\circ < \theta \leq 90^\circ)$ if $0 < u \leq \sqrt{2gR}$

(iv) The magnitude of tension at a height $'h'$ is calculated by using formula $T = \frac{M}{R}\left[u^2 + [gR - 3gh]\right]$



Tension at highest point of its trajectory in above question will be

A. 100 N

B. 44 N

C. 144 N

D. 264 N

Answer: B

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17. A particle of mass M attached to an inextensible strintg is moving in a vertical circle of radius R.about fixed point O. It is imparted a velocity u in horizontal directional at lowest position as shown in figure.

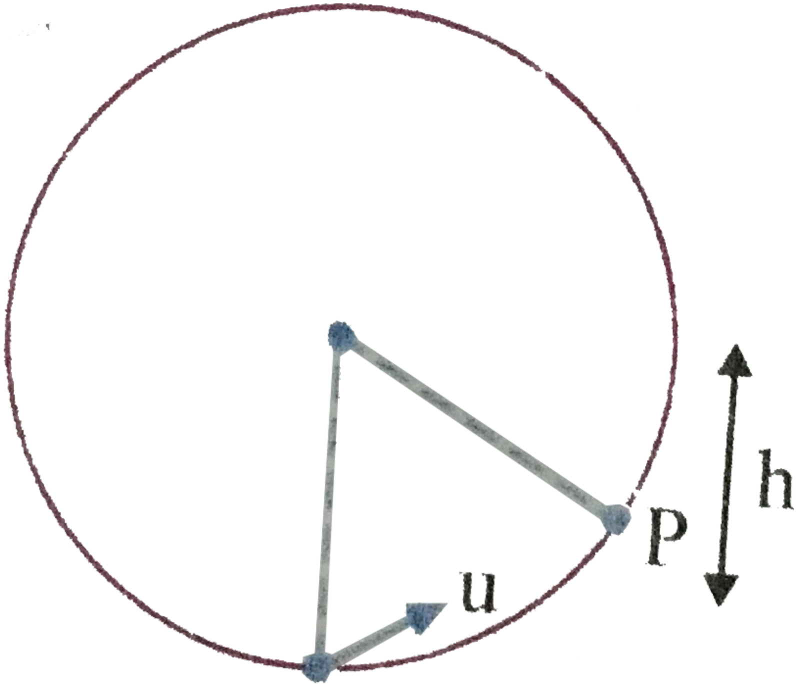
Following information is being given

(i) Velocity at a height h can be calculated by using formula $v^2 = u^2 - 2gh$

(ii) Particle will complete the circle if $u \geq \sqrt{5gR}$

(iii) Particle will oscillates in lower half $(0^\circ < \theta \leq 90^\circ)$ if $0 < u \leq \sqrt{2gR}$

(iv) The magnitude of tension at a height $'h'$ is calculated by using formula $T = \frac{M}{R}\left[u^2 + [gR - 3gh]\right]$



If $M = 2kg, R = 2m$ and $u = 10m/s$. Then velocity of particle when $\theta = 60^\circ$ is

A. $2\sqrt{5}m/s$

B. $4\sqrt{5}m/s$

C. $5\sqrt{2}m/s$

D. $5m/s$

Answer: B

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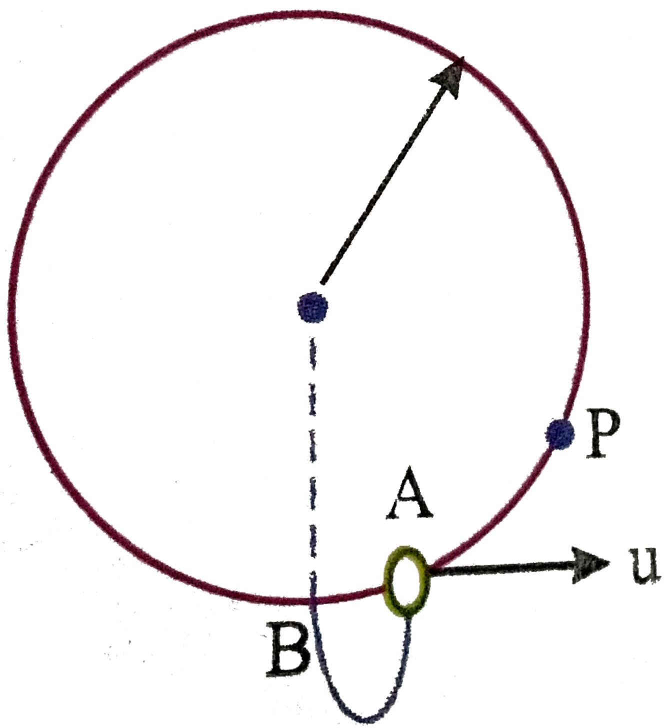
18. A bead of mass m is threaded on a smooth circular wire centre O, radius a, which is fixed in vertical plane. A light string of natural olength 'a', elastic constant $=\frac{3mg}{a}$ and breaking strength $3mg$ connects the bead to the lowest point A of the wire. The other end of the string is fixed to ring at point B near point A. The string is slaked initially. The bead is projected from A with speed u.



The smallest value u_0 of u for which the bead will make complete revolutions of the wire will be

A. $u_0 = \sqrt{5ga}$

B. $u_0 = \sqrt{6ga}$

C. $u_0 = \sqrt{7ga}$

D. $u_0 = 2\sqrt{ga}$

Answer: C

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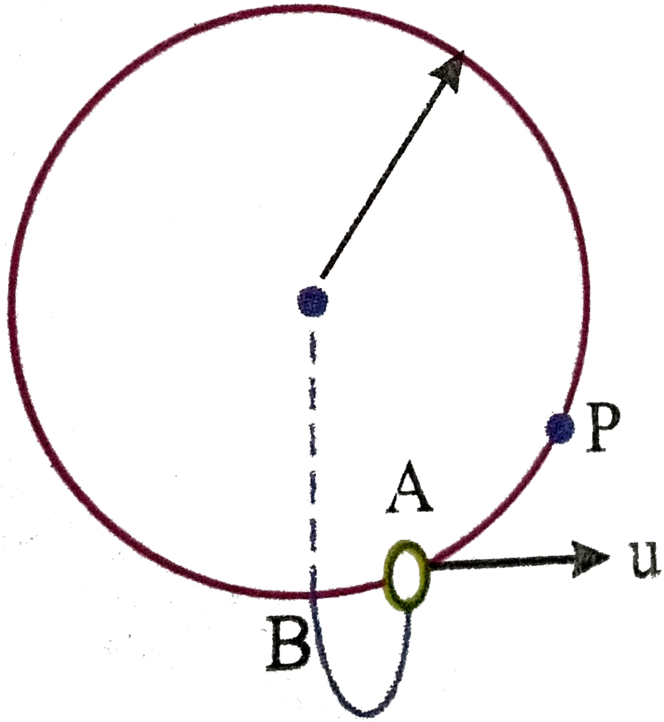
19. A bead of mass m is threaded on a smooth circular wire centre O, radius a, which is fixed in vertical plane. A light string of natural olength 'a', elastic constant $= \frac{3mg}{a}$ and breaking strength $3mg$ connects the bead to the lowest point A of the wire. The other end of the string is fixed to ring at point B near point A. The string is slaked initially. The bead is projected from A with speed u.



If $v = 2u_0$, the tension T in th elastic string when the bead is at the highest point B of the wire is

A. $\frac{3\mu_0^2}{a}$

B. $4mg$

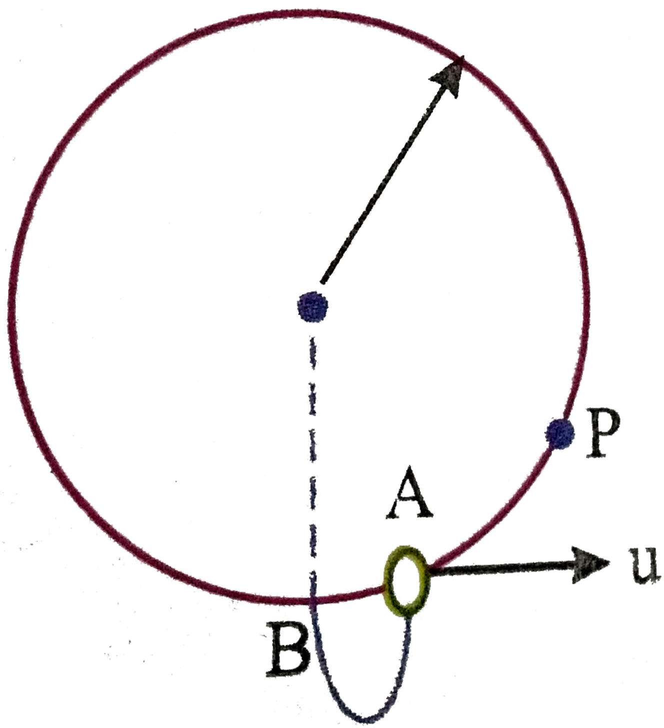
C. $2mg$

D. $\left(\frac{4u_0^2}{a} - g\right)m$

Answer: D

Watch Video Solution

20. A bead of mass m is threaded on a smooth circular wire centre O, radius a, which is fixed in vertical plane. A light string of natural olength 'a', elastic constant $= \frac{3mg}{a}$ and breaking strength $3mg$ connects the bead to the lowest point A of the wire. The other end of the string is fixed to ring at point B near point A. The string is slaked initially. The bead is projected from A with speed u.



The elastic energy stored in the string when the bead is at the highest point B will be

A. $\frac{3mga}{2}$

B. $2mga$

C. $4mga$

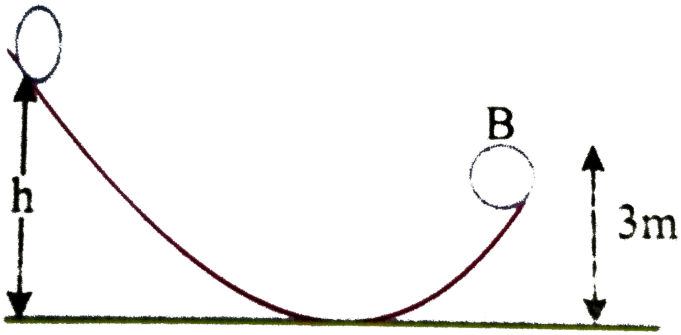
D. $\frac{2mga}{2}$

Answer: A

Watch Video Solution

Level-VI (Integer)

1. A ball leaves the track at B which is at $3m$ height from bottom most point of the track. The ball further rises upto $4m$ height from the bottom most point before falling down. Find h (in m), if the track at B makes an angle 30° with horizontal.



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2. The displacement x (in m), of a patticle of mass m (in kg) is related to the time t (in second) by $t = \sqrt{x} + 3$. Find the work done in first six second. (in mJ).

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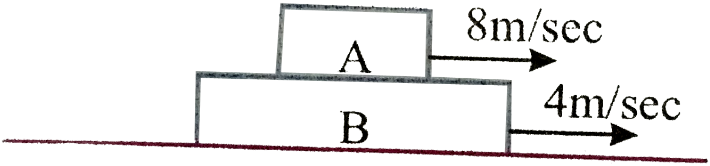
3. Block A of mass $1kg$ is placed on the rough surface of block B of mass $3kg$. Block B is placed on smooth horizontal surface. Blocks are given the velocities as shown. Find net work done by the frictional force. [in

$(-)veJ]$.



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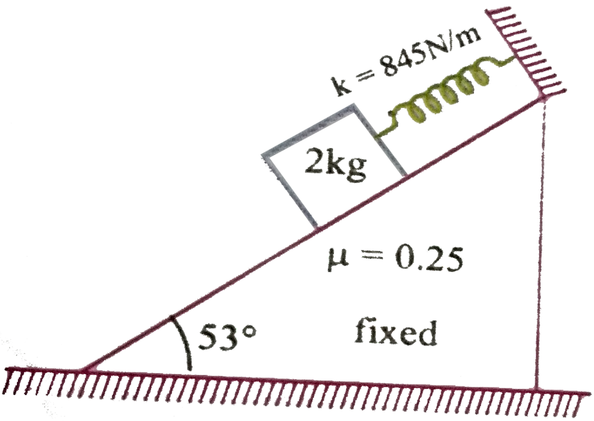
4. A block of mass $2kg$ is placed on an inclined plane of angle 53°, attached with a spring as shown. Friction coefficient between block and the incline is 0.25. The block is released from the rest and when spring is in natural length. Find maximum speed of the block it acquires after the release in cm//s is found to be nearly $5n$. Find $'n'\left(take g = 10m/s^2\right)$.



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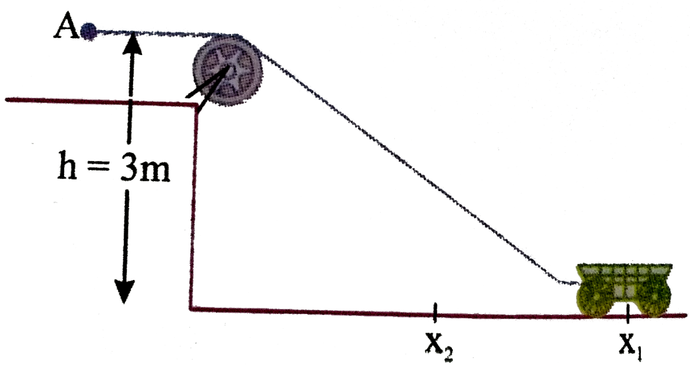
5. Figure shows a light, inextensible string attached to a cart that can slide along a frictionless horizontal rail aligned along an x axis. The left end of the string is pulled over a pulley, of negligible mass and friction and fixed at height $h = 3m$ from the ground level. The cart slides from $x_1 = 3\sqrt{3}m$ to $x_2 = 4m$ and during to move, tension in the string is kept constant $50N$. Find change in kinetic energy of the cart in joules. $\left(Use\sqrt{3} = 1.7\right)$ in form of $10xn$, where $n =$



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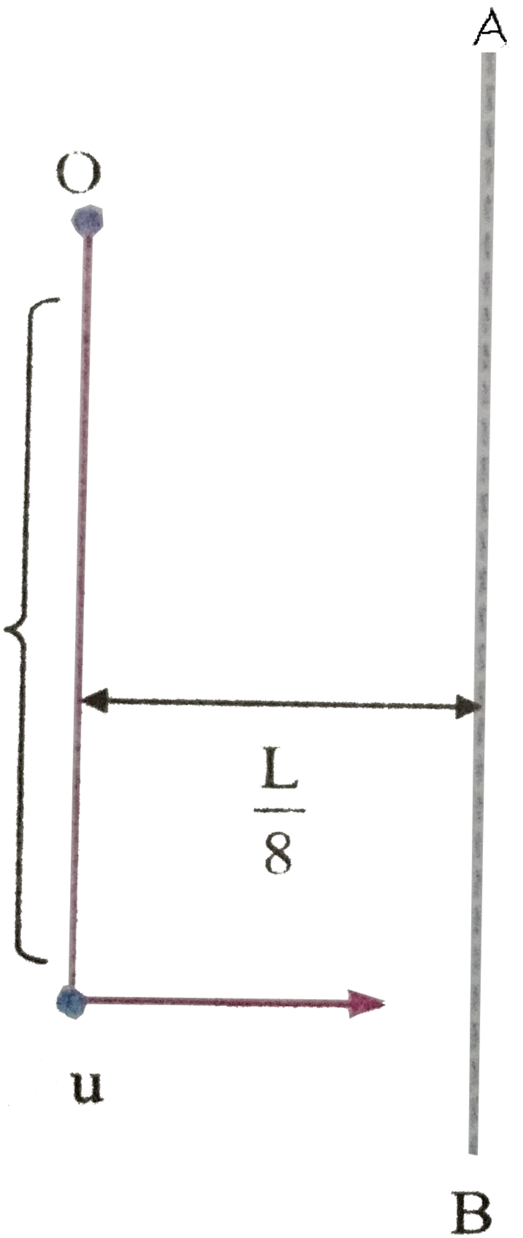
6. A particle is suspended vertically from a point O by an inextensible massless string of length L. A vertical line AB is at a distance of $L/8$ from O as shown. The object is given a horizontal velocity u. At some point, its motion ceases to be circular and eventually the object passes through the line AB. At the instant of crossing AB, its velocity is horizontal. Find u.



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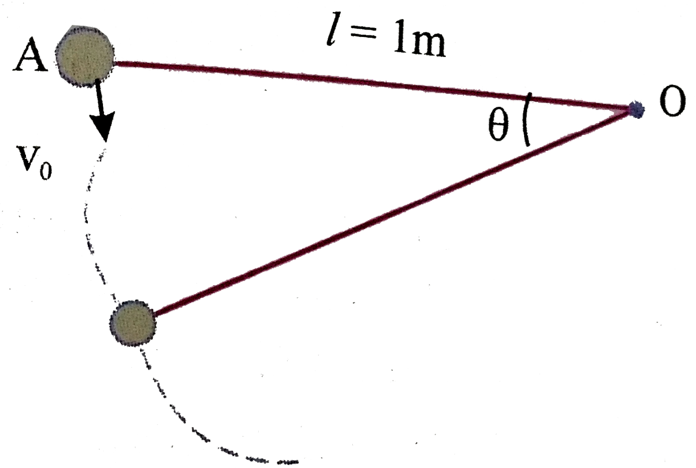
7. The sphere at P is given a down ward velocity v_0 and swings in a vertical plane at the end of a rope of $l = 1m$ attached to a support at O. The rope breaks at angle 30° from horizontal, knowing that it can withstand a maximum tension equal to four times the weight of the sphere. then the value of v_0 will be $\left(g = 10m/s^2\right)$.



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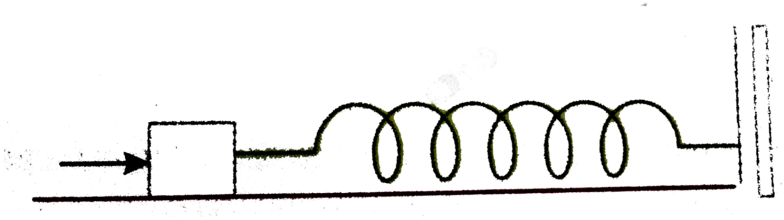
8. A block of mass $0.18kg$ is attached to a spring of force-constant $2N/m$. The coefficient of friction between the block and the floor is 0.1 Initially the block is at rest and the spring is un-stretched. An impulse is given to the block as shown in the figure. The block slides a distance of $0.06m$ and comes to rest for the first time. The initial velocity of the block in m//s is $V = N/10$. Then N is :



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9. A particle of mass $0.2kg$ is moving in one dimension under a force that delivers constant power $0.5W$ to the particle. If the initial speed (in ms^{-1}) after $5s$ is.

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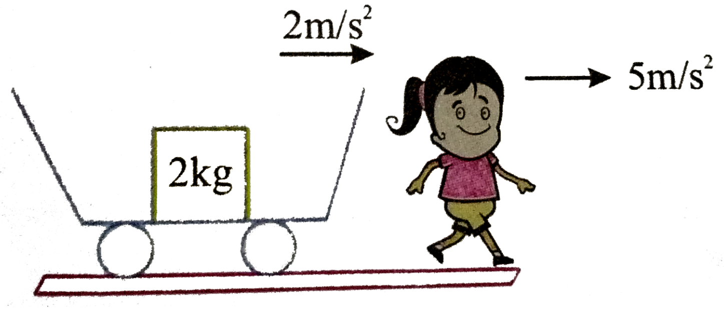
10. An observed and a vehicle, both starts moving together from rest with accelerations $5m/s^2$ and $2m/s^2$, respectively. There is a $2kg$ block on the floor of the vehicle, and $\mu = 0.3$ between their surfaces. Find the work done by the running observer, during first 2 seconds of the motion.



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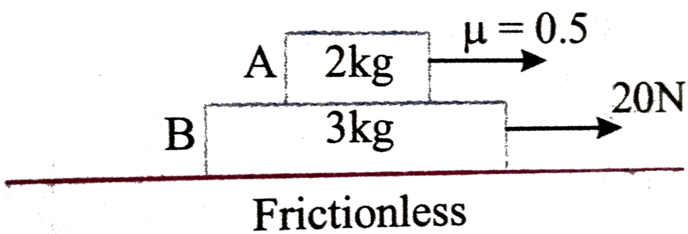
11. Two block A and B are placed one over other. Blocks B is acted upon by a force of $20N$ which displaces it through $5m$. Find work done by frictional force on block A.



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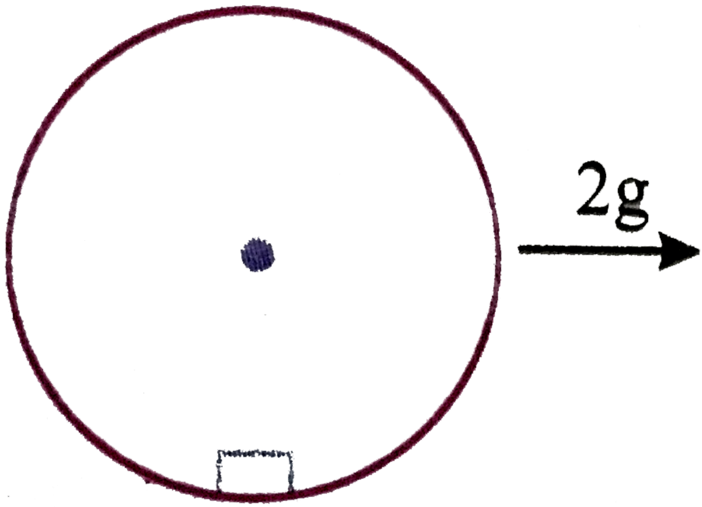
12. A block of mass m is placed inside a smooth hollow cylinder of radius R kept horizontally. Initially system was at rest. Now cylinder is given constant acceleration $2g$ in the horizontal direction by external agent. Find the maximum angular displacement of the block with the vertical.



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