PHYSICS

AAKASH INSTITUTE ENGLISH

WORK, ENERGY AND POWER

EXAMPLE

1. If the magnitude of two vectors are 4 and 6 and the magnitude of their scalar product is $12\sqrt{2}$ what is the angle between the vectors?

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2. Find the angle between force $\overrightarrow{F} = \left(5\hat{i} + 5\hat{j} + 5\hat{k}\right)$ unit and displacement $\overrightarrow{d} = \left(3\hat{i} + 4\hat{j} - 3\hat{k}\right)$ unit Also find the projection of $\overrightarrow{F} on \overrightarrow{d}$.

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3. A raindrop of mass 2g falling from a height of 1.00 km, hits the ground with a speed of $40.0ms^{-1}$.

(a) Find the work done by the grativational force.

(b) Find the work done by the opposing resistive force $(g = 10ms^{-2})$

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4. A gas filled in a cylinder fitted with movable piston is allowed to expand. What is the nature of the work done by the gas?

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5. A body is pushed through 5 m across a surface offering 75 N resistance How much work is done by the (1) applied force (ii) resisting force ?

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6. In CID serial (on TV), Abhijeet fires a bullet of mass 100 g with a speed of $100ms^{-1}$ on a soft plywood of thickness 4 cm the bullet emerges with 10% of its initial KE. Find the emergent speed of the bullet.

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7. A gardener pushes a lawn roller on a rough surface. He applies a force of 150 N over a distance of 5 m. After he gets tired and his applied force reduces linerly with distance to 75 N. The total distance moved is 10 m. Plot the force applied by the gardencer and the frictional force, which is 75 N versus displacement. Calculate the work done by the two forces over 10 m.

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8. The position (x) of a particle of mass 1 kg moving along x-axis at time t is given by $\left(x = \frac{1}{2}t^2\right)$ meter. Find the work done by force acting on it in time interval from t=0 to t=3 s.

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9. A particle of mass m is released in a smooth hemispherical bowl from shown position A. Find work done by gravity as it reaches the lowest point B.

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10. A body is subjected to a constant force given by

$\overrightarrow{F}(N) = -\hat{i} + 2\hat{j} + 3\hat{k}$

What is the work done by this force in moving the body through a distance of 4 m along the z=axis and then 3 m along the y-axis?

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11. The distance x moved by a body of mass 0.5 kg under the action of a force varies with time t as

$$x(m) = 3t^2 + 4t + 5$$

Here, t is expressed in second. What is the work done by the force in first 2 seconds?

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12. If force $\overrightarrow{f} = \left(3x\overrightarrow{i} + y^2\overrightarrow{j}\right)$ N is acting on a body and body moves from (1m, 2m, 1m) to (2m, 3, 8m), then find the work done due to the force

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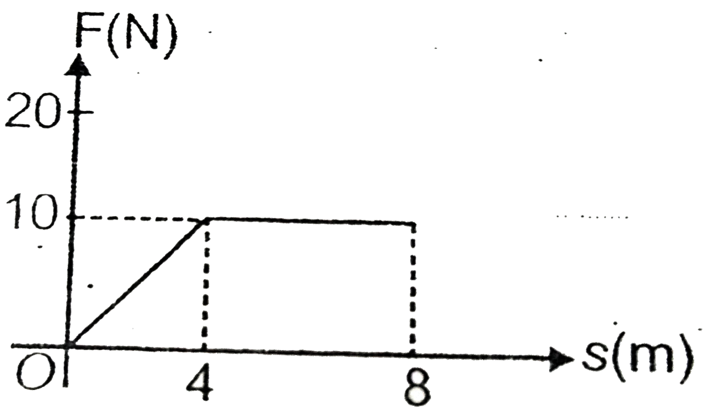
13. Force acting on a particle varies with displacement as shown in figure. Find the total work done by the force.



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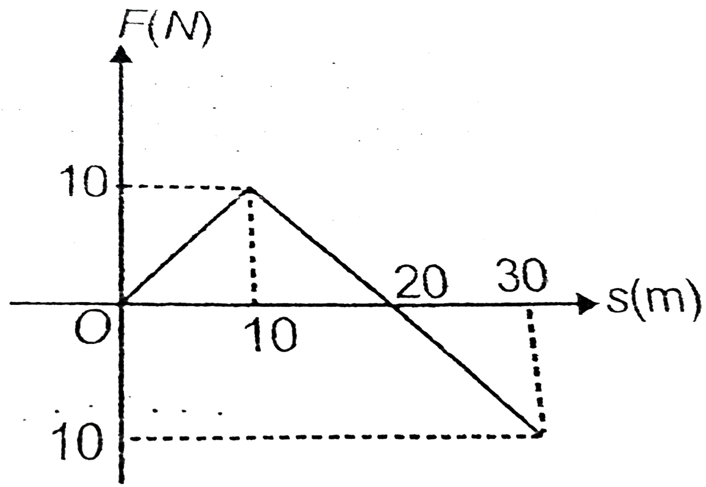
14. Force versus displacemetn curve is shown in the diagram. Find the wor done by the forfe at the end of the displacements

(i) 10m (ii) 20 m (iii) 30m



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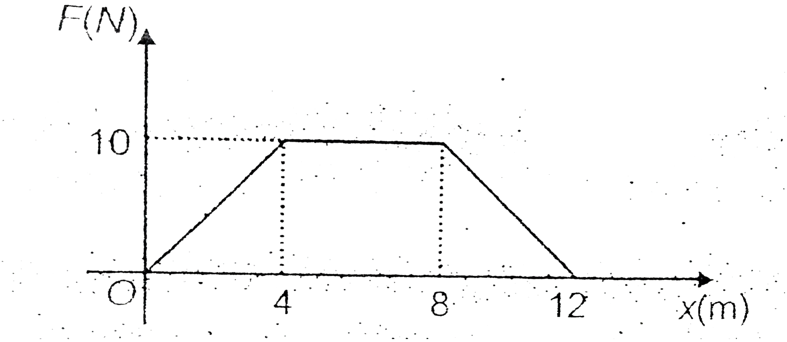
15. A particle of mass 0.5 kg is subjected to a force which varies with distance as shown in figure



1. The work done by the force during the displacement from $x = 0$ to $x = 4$ and $x = 4$ to $x = 12$are respectively

$(1) 20J, 40J \quad (2) 40J, 40J \quad (3) 20J, 60J \quad (4) 40J, 80J$

2. The increaase in kinetic energy of the particle during its displac ement from $x = 0$ to $x = 12$ m is

$(1) 20J \quad (2) 40J \quad (3) 80J \quad (4) 120J$

3. If the speed of the particle at $x = 0$ is 4 m/s, its

speed st $x = 8$ m is

$(1) 8m/s$ $(2) 16m/s$ $(3) 32m/s$ $(4) 4m/s$

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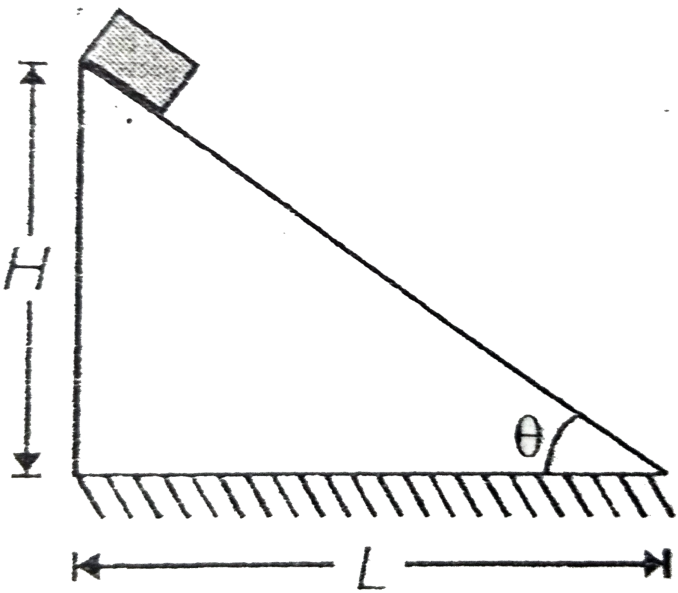
16. A small blockofmass 'm' is released from rest at the top of a rough inclined plane as shown The coefficient of friction between the block and inclined plane is $'\mu'$ Using work-energy theorem, find the speed of block as it passes the lowest point.



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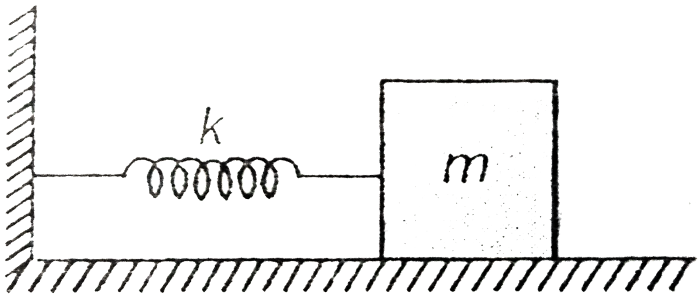
17. Figure shows a block of mass 'm' resting on a smooth horizontal surface. It is connected to a rigid wall by a massless spring of stiffness 'k'. The spring

is in its natural length. A constant horizontal force F starts acting on the block towards right. Find (i) speed of the block as it moves throught a distance x, (ii) speed when the block is in equlibrium and (iii) maximum extension produced in the speing.



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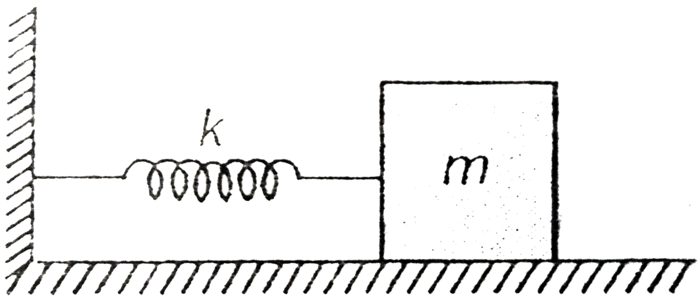

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19. A body of mass 'm is drhopped from a height 'h'. The speed with which body hits the ground is $\sqrt{0.9gh}$ Find the work done by air-resistance furing its fall.

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20. A body of mas 5 kg is placed at origin. A force starts acting on the body given by $\overrightarrow{F} = (2 + 3x)\hat{i}$ where x is the distance of body from origin in meters. Find the speed acquired by the body as it passes through $x = 5m$.

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

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22. Shown that work done by a conservative force on a particle moving between two points is path independent.

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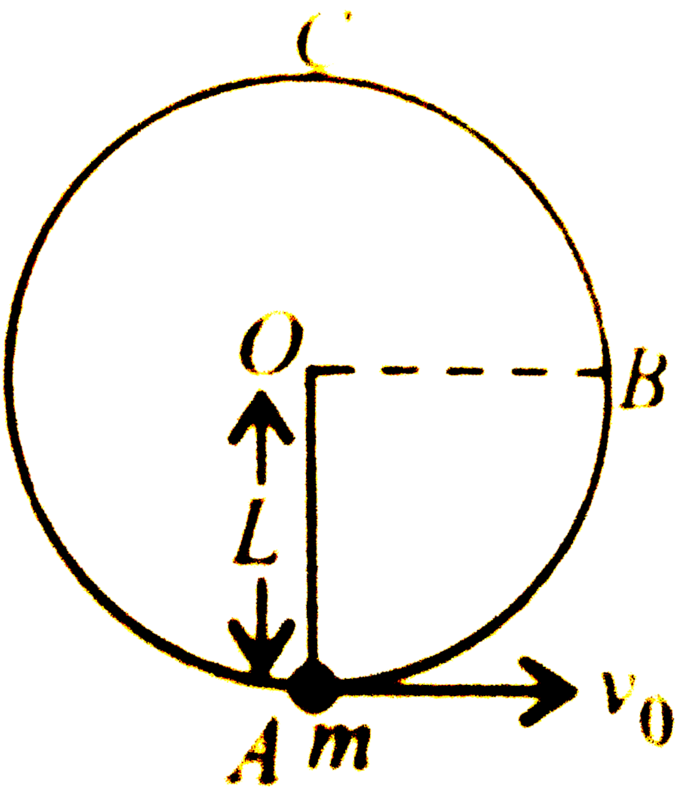
23. A bob of mass m is suspended by a light string of length L. It is imparted a horizontal velocity v_0 at the lowest point A such that it completes a circle in the vertical plane.



Match the Column I with Column II.

	Column I		Column II
(A)	Velocity v_0 is	(p)	3
(B)	Velocity at point B is	(q)	$\sqrt{gL}$
(C)	Velocity at point C is	(r)	$\sqrt{5gL}$
(D)	Ratio of kinetic energy at B and C is	(s)	$\sqrt{3gL}$

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24. A small stone of mass 0.4 kg tied to a massless inextensible string is made to loop the loop Radius of the path is 4 m. Find its speed at the highest point. How would this speed change if mass of the stone is decoreased by 10% ? $\left(g = 10ms^{-2}\right)$.

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25. Auto manufactures study the collision of cars with mounted spring of different spring constant. Consider a car of mass 1500 kg moving with a speed of $36 kmh^{-1}$ on a smooth road and colliding with a horizontally mounted spring of spring constant $7.5 \times 10^3 Nm^{-1}$. Find the maximum compression of the spring .

26. Consider example 25, taking the coefficient of friction μ to be 0.4 and calculate the maximum compression of the spring $(g = 10 ms^{-2})$

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27. Examine table 3 and express (a) energy required to break one bond in DNA in eV, (b) typical energy of a proton in a nucleus in eV, (c) energy released in burining 1000 kg of coal in kilicalories

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28. An engine pumps 400 kg of water through height of 10 m in 40 s. Find the power of the engine if its efficiency is 80% (Take ,g =10 ms^{-2}).

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29. A particle is moving along x-axis under the action of force, F which varies with its position as $F \propto \frac{1}{4\sqrt{x}}$. Find the variation of power due to this fore with x.

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30. An elevator that can carry a maximum load of 1500 kg (elvator+ passengers) is moving up with a constant speed of 2 ms^{-1}. The frictional force opposing the motion is 3000 N. Find the minmum power delvered by the motor to the elevator in watts as well as in horse power $(g = 10ms^{-2})$

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31. In a nuclear reactor, a neutron of high speed $(\approx 10^7 ms^{-1})$ must be slowed down to $10^3 ms^{-1}$ so that it can have a high probality of interacting with isotipe $\_92U^{235}$ and causing it to fission.

Show that a neutron can lose most of its K.E. in an elastic collision with a light nuclei like deuterium or carbon which has a mass of only a fewe times the neutron mass. The material making up the light nuclei usually heavy water (D_2O) or graphite is called modertaor.

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32. Consider objects of masses m_1 and m_2 moving initially along the same straight line with velocities u_1 and u_2 respectively. Considering a perfectly elastic collision (with $u_1 > u_2$) derive expressions for their velocities after collision.

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33. Two particles A and B have the same mass m. A is moving along X-axis with a speed of $5ms^{-1}$ and B is at rest. After undergoing a perfectly elastic collision with B, particle A gets scattered through an angle of 60°. What is the direction of B, and the speeds of A and B, after the collision ?

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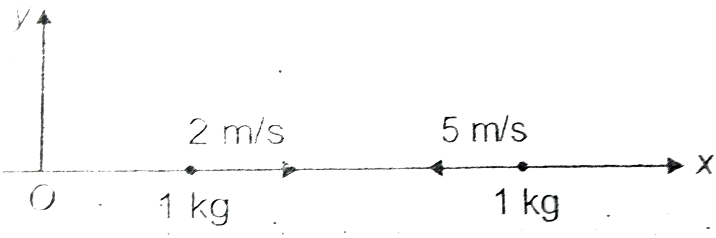
34. Two particles of mass 1 kg and 2 kg are moving with speed 2 m/s and 5 m/s as shown in the figure, they collides perfectly inelastically. And second particle come to rest after collision. Find

(a) Their final velocity

(b) Loss in kinetic energy



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35. A moving particle of mass m makes a head-on perfectly inelastic collision with a particle of mas 2m which is initially at rest. Find the fractional loss in energy of the colliding partic le after collision.

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36. A small ball is dropped from rest from height 10 m on a horizontal floor. If coefficient of restitution between ground and body is 0.5 then find the maximum height it can rise after collision.

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37. A body of mass 500 g is suspended from the ceilling by a massless, inextensible and flexible string. A bullet of mass 10 g moving with velocity 300 m/s strikes the body herizontally and comes out horizontally with 200 m/s. Find the height to which the body will rise.

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38. A particle of mass m is projected towards a wall such that the angle of incidence is θ and the speed just before collision is u. Assuming that the wall is smooth and the collision is elastic, show that the ball rebounds at same angle.

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39. Two objects slide over a frictionless horizontal surface The first object, mass $m_1 = 5$ kg, is propelled with a speed $u = 4.5 m/s$ towards the second object, mass $m_2 = 2.5$ kg while is intially at rest. After the collision, both objects have velocities which are directed at $\theta = 30^\circ$ on either side of the original line of motion of the first object. What are the final speed of the two object? Is the collision elastic or inelastic?

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40. If a sphere of mass m moving with velocity u collides with another identical sphere at rest on a frictionless surface, then which of the following is correct ?

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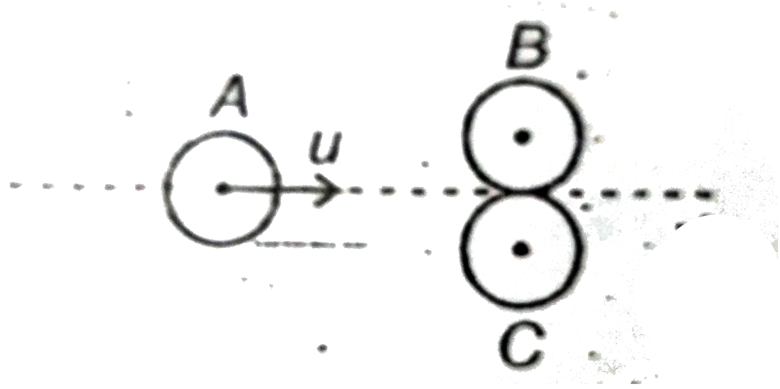
41. B and C are two identicalsphereskeptincontact with eachother on a horizontalfrictionaless floor.Another identicalspherea A moving with velocity u along the common tangent to B and C strikes B and C simultaneously.



Find their velocties after collision if

(a) Collision is elastic

(b) Collision is inelastic with coefficient of restitution e.

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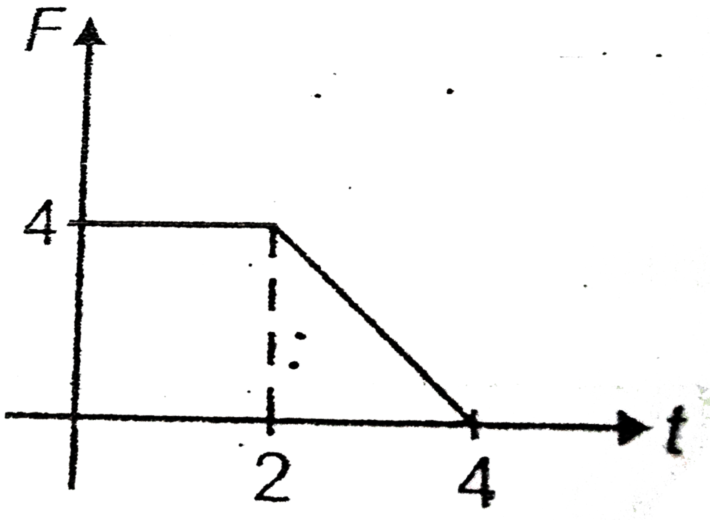
42. A force F is acted on a body as shown in the figure. Find the impulse of the force in first four

seconds.



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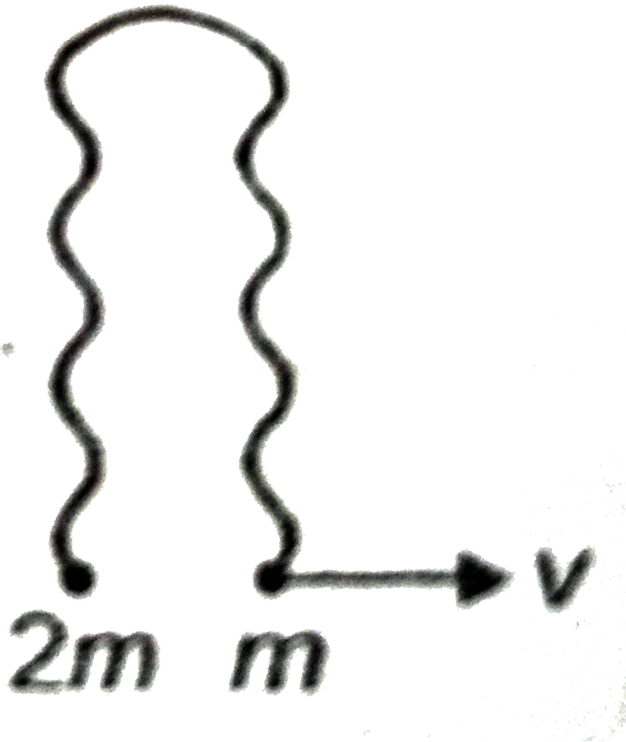
43. Two particles of a mass 2m and m are tied with an inextensible string the particle of mass m is given a speed V as shown in the figure. Find the speed with which the particle of mass 2m starts

moving.



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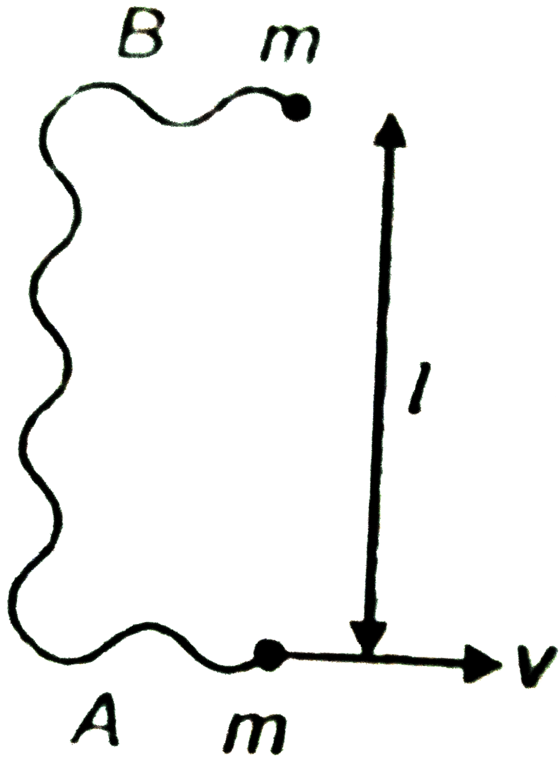
44. Two paricles A and B of equal masses m are t ied with an inextensible string of length 2l. The initial distance between A and B is l. Particle A is given speed v as shown. Find the speed of particie A and B just after the string becomes taut.



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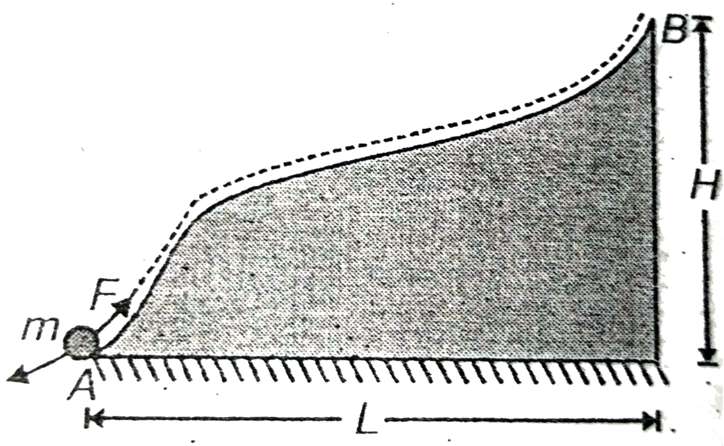
45. A small object of mass 'm' is moved over a rough, curved surface as shown. The force which moves it along the dotted path shown is always tangential to the curved path. If the object moves with negligible speed, find the work done by the force F in moving it from A to B. The coefficient of friction between the object and the curved surface is μ.



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46. A particle moves in x-y plane under action of a path dependent force $F = y\hat{i} + x\hat{j}$. The work done by the force as it moves in x-y plane can be evaluated by solving the integral $\int \overrightarrow{F} . \overrightarrow{d} \overrightarrow{r}$, where $\overrightarrow{dr} = dx\hat{i} + dy\hat{j}$. The position coordinates x and y will vary according to some constraint determined by teh path followed by the particle. For example, if particle moves along a straight line from one position to other, then an possible rarticle. For example, if particle moves along a straight line from one position to other, then a possible relation is $y = mx + c$. NOw. try to solve the following questions.

1. The particel moves along a straight line from origin to (a ,a) . The work done by the force on the particle is

$(1) a^2$ $(2) 2s$ $(3) \frac{a^2}{2}$ (4)Zero

2. The particle moves from $(0, 0)$ to (a,0) and then from, $(a, 0)$ to (a, a), in straight line paths. The work done by the force on the particle is

$(1) a^2$ $(2) 2a$ $(3) \frac{a^2}{2}$ (4) Zero

3. The differential work by the given force over an elementary displacement is given as $dW = \vec{F} . \vec{dr} = ydx + xdy$

This can be expressed as $dW = d(xy)$. From this, it can be inferred that the work done by the force

(1) Depends only on initial and final values of x and y

(2) Depends on initial and final values and on the path followed

(3) Is zero for any values of x and y

(4) Is zero when object returns to original position after following any path

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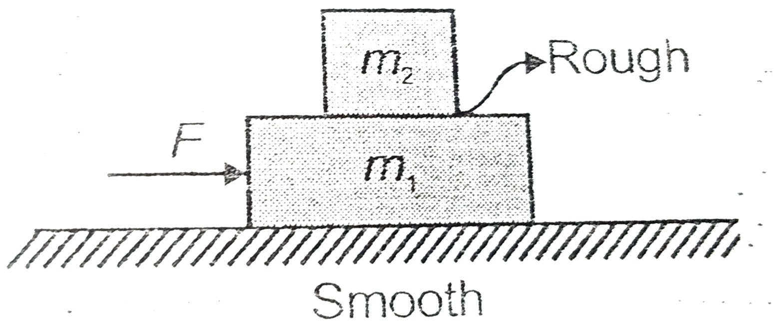
47. The figure shows two blocks of mass m_1 and m_2 placed one above the other. These is no friction between the lower block and ground. The lower block is being pushed by a constant horizontal force F. There is sufficient friction between the blocks so that they do not slip over each other. Draw the free body diagram of the upper block in the frame of groung and in the frame of lower block. Find the work done by various forces on the upper block in the two frames as the arrangement moves through 'S'



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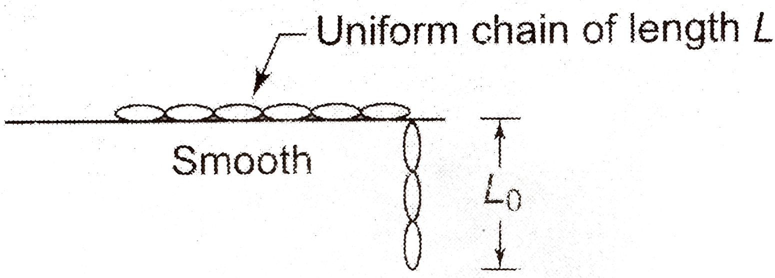
48. 

Consider a uniform chain of mass m and length L, the chain is released when hanging length is L_0. Find the speed with which the chain leaves the table.

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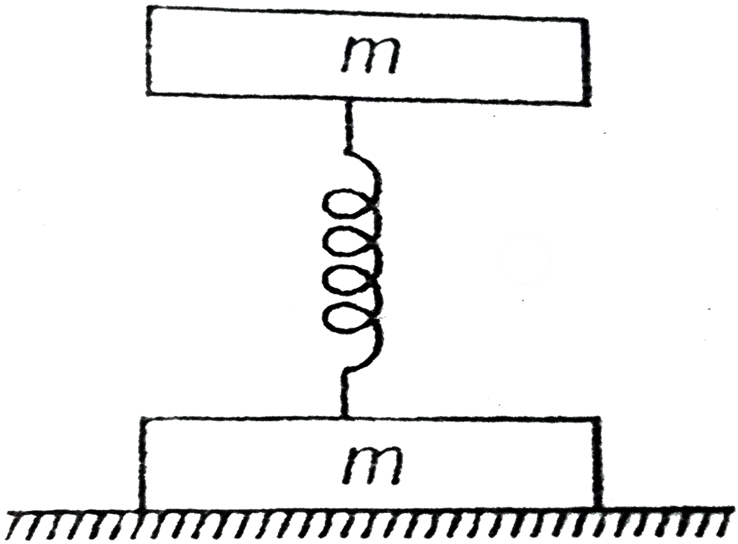
49. Figure shows two discs of same mass m. They are rigidy attached to a spring of stiffness k. The system is in equlibrium. From this equilibrium

position, the upper disc is pressed down slowly by a distance x and released. Find the minimum value of x, if the lower disc is just lifted off the ground.



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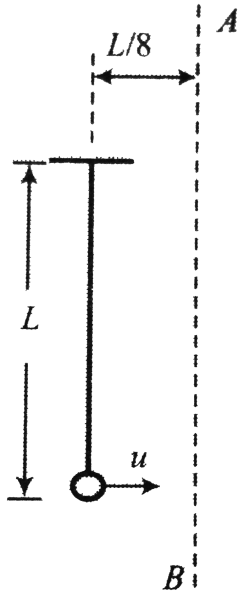
50. A particle is suspended vertically from a point O by an inextensible massless string of length L. A vertical line AB is at a distance $L/8$ from O as shown in figure. A horizontal velocity u is imparted to tha particle. At horizontal velocity u is imparted to the particle. At some point, its motion ceases to be circular and eventually the object passes through line AB. At the instant of crossing AN, its velocity is horizontal. Find out the value of u.



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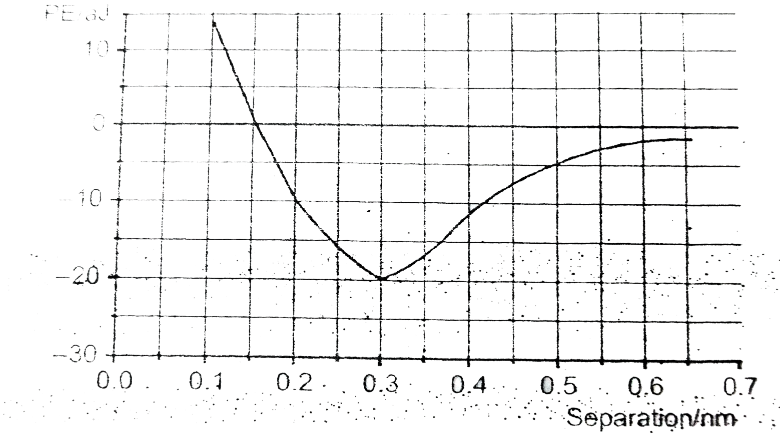
51. The graph shows the potential energy of a system of two ions as a function of their interionic

separtion.



The system of the two icns has a total mechanical energy of $-0.5 \times 10^{-17} j$. What is the range of possible values for the distance between the two ions? At what separation do the ions have minimum kinetic energy? What is the maximum possible kinetic energy of the ions? what energy is required to breake apart this ionic molecule?

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(a) Find the work done by the gravitational force.

(b) Find the work done by t he opposing resistive force $(g = 10 ms^{-2})$

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60. Show that work done by a conservative force on a particle moving between two points is path independent.

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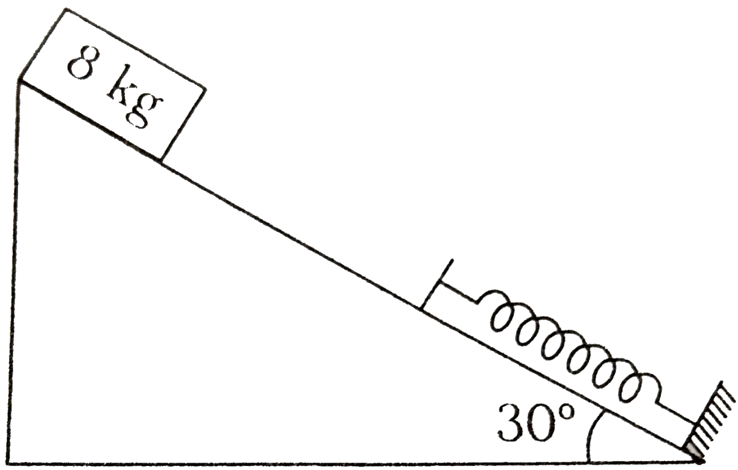
61. A block of mass 8 kg is released from the top of an inclined smooth surface as shown in figure. If spring constant of spring is 200 Nm^(-1) and block comes to rest after compressing spring by 1 m then find the distance travelled by block before it comes



to rest

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62. A simple pendilum with bob of mass m and length l is held in position at an angle θ with t he verticle. Find its speed when it passes the lowest position.

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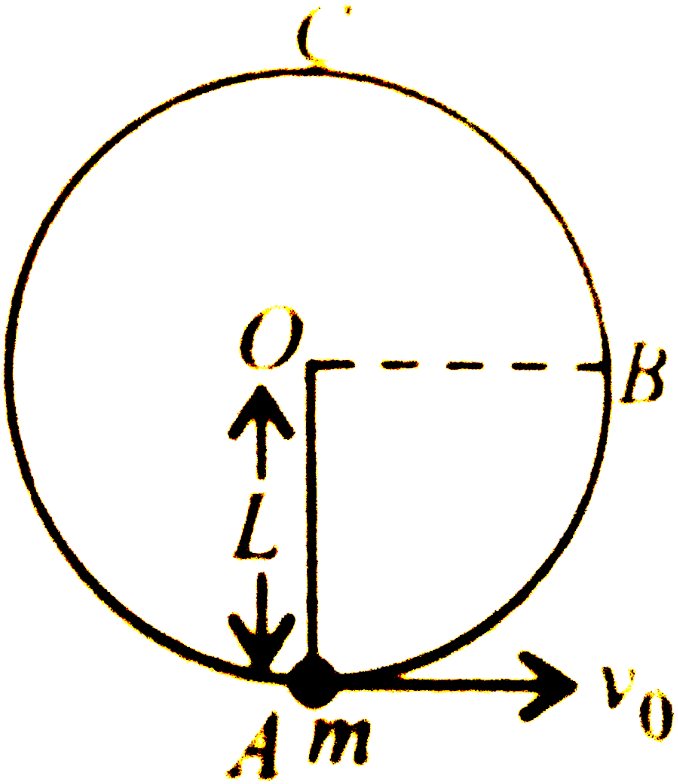

Match the Column I with Column II.

Column I		Column II	
(A)	Velocity v_0 is	(p)	3
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(C)	Velocity at point C is	(r)	$\sqrt{5gL}$
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66. Consider Example 8, taking the coefficient of friction, μ, to be 0.5 and calculate the maximm compression of the spring.

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67. The amount of energy released in burning 1 kg of coal is

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68. A particle slides on frictionless x - y plane. It is acted on by a conservative force described by the potential - energy function $U(x, y) = \frac{1}{2}k(x^2 + y^2)$. Derive an expression for the force acting on the particle.

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69. An engine pumps 400 kg of water through height of 10 m in 40 s. Find the power of the engine if its efficiency is 80% (Take ,g =10 ms^{-2}).

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75. An object of mass m moving with speed u collides one dimentionally with another identical

object at rest. Find their velocities after collision, if coefficient of restitution of collision is e.

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76. A body of mass 'm' falls from height 'h' on the ground. If 'e' be the coefficient of restitution between the body and the ground, find (i) the velocity with which it rises after the n^{th} collision with the ground (ii) The height upto which it rises after the n^{th} collision.

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77. A particle of mass m moving with speed v in position x - direction collides perfectly inelastically with another identical particle moving with same speed in positive y - direction . Find final velocity of the combination.

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78. A particle of mass m moving with speed u collides perfectly inelastically with another particle of mass 2m at rest. Find loss of kinetic energy of system in the collision.

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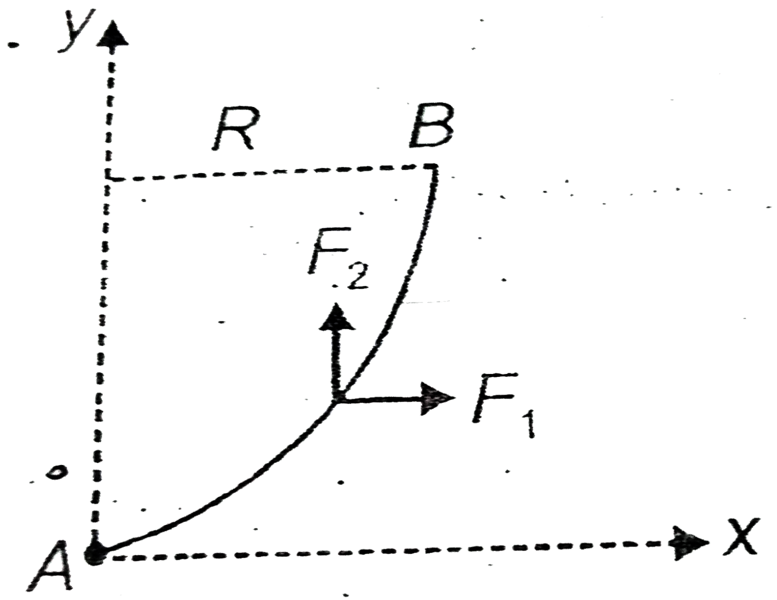
IILUSTRATION

1. A particle moves on a circular path of radius R under the action of two constant forces F_1 and F_2. F_1 act along positive x axis and F_2 acts along positive y-axis. Find the work done by F_1 and F_2 in moving the particle from position A to position B as shown in figure.



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2. A golf player hits a golf ball of mass 100 g and imparts it a speed of 50 m/s. If golf stick remains in contact with the ball for 0.01 s, then the average force exerted by the golf stick on the ball.

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TRY YOURSELF

1. If the magnitudes of two vectors are 3 and 4 and magnitude of their scalar product is 6 what is the angle between the vectors ?

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2. If the magnitudes of two vectors are 2 and 3 and magnitude of their scalar product is $2\sqrt{3}$ what is the angle between the vectors ?

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3. Find the angle between the force $\overrightarrow{F}\left(5\hat{i}+4\hat{j}-3\hat{k}\right)$units and displacement $\overrightarrow{d}=\left(3\hat{i}+4\hat{j}+5\hat{k}\right)$ unit. Also find the projection of $\overrightarrow{F}$ on $\overrightarrow{d}$

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4. Find the angle between the $\overrightarrow{F}=\left(4\hat{i}+3\hat{j}\right)$ units and displacement $\overrightarrow{d}=\left(4\hat{j}-3\hat{k}\right)$ unit. Also find the projection of $\overrightarrow{F}$ on $\overrightarrow{d}$

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5. A bullet of mass 10 g moving with a velocity $300ms^{-1}$ strikes a wooden block and comes out from ot her side with a velocity of $200ms^{-1}$. Find the work done by t he resistive force on the bullet.

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6. A ball of mass 1 kg is projected with $10ms^{-1}$ froom the top of a toer of height 20 m. What is its speed when it is at vertical distance of 10 m below point of projection? $(g = 10ms^{-2})$

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9. A car comes to a sliding stop in 5 m. During this process, the force on the car due to road is 100 N and is directed opposite to the motion.

(a) How much work done the road do on the car?

(b) How much work done the car do on the road?

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10. A 100 kg block is kept in the back of a truck moving with an acceleration of $2ms^{-2}$ There is no relative motion. What is the work done by frictional force on the block as truck is displaced by 2 m w.r.t. Ground

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12. A body of mass 100 g moving on a test track has final KE of 50 J after traveling a distance of 10 cm. Assuming 90% loss of energy due to friction, find the intial speed of the body

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13. A force $F = (5 + 2x)$ acts on a particle in x direction where F is in newtown and x is meter. Find the work done by this force during displacement from $x = 0$ to $x = 1m$.

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14. A particle moves along x-axis from $x = 0$ to $x = 2$ m under the influence of a force F (in N) given by $F = 3x^2 + 2x - 5$. Calculate the work done

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15. A body of mass 2 kg moving on a horiontal surface with speed $v_i = 1 ms^{-1}$ enters a rough patch ranging from $x = 0.5m$ to $x = 1.5m$. If the body comes to rest after passing the patch, then find the retarding force on the body.

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constant. Find work done by the force acting on the particle during its motion from $x = 0$ to $x = 4m$.

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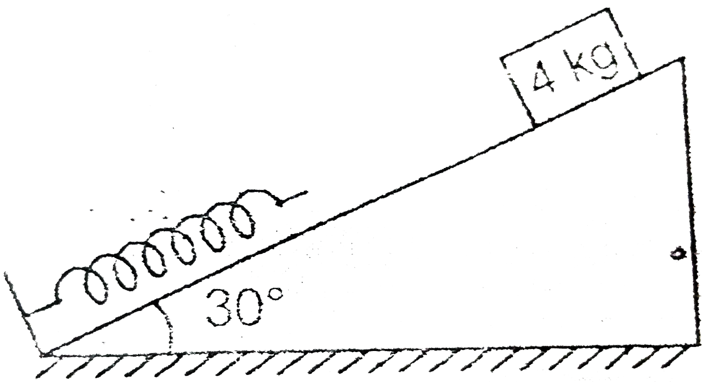

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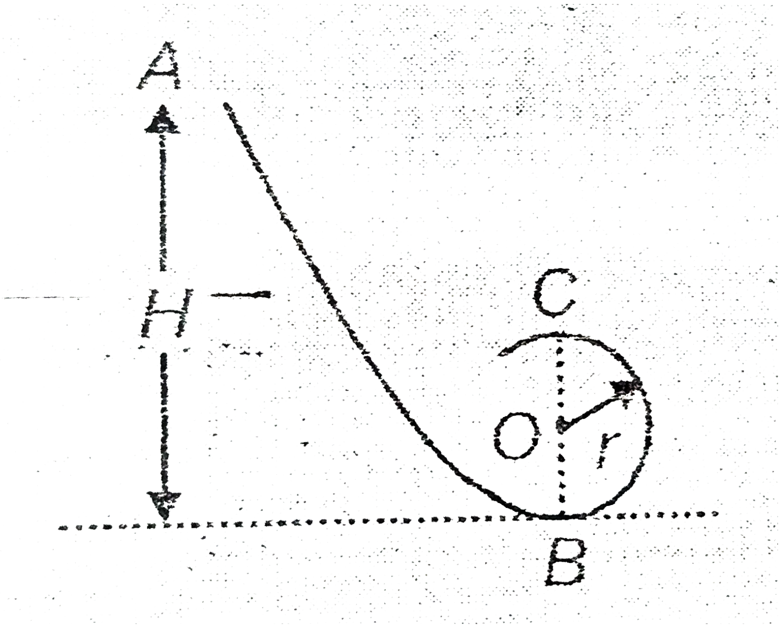
What is the force on the circular track when it is at point (a) B, (b) C?



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23. A block of mass 0.1 kg attached to a spring of spring constant 400 N/m is putted rightward from

$x_0 = 0$ to $x_1 = 15$ mm. Find the work done by spring force.

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24. In the above question, find the work done by the spring force as the block is moved leftward from $x_1 = 15mm$ to $x_z = -10mm$.Take spring constant as 400 N/m.

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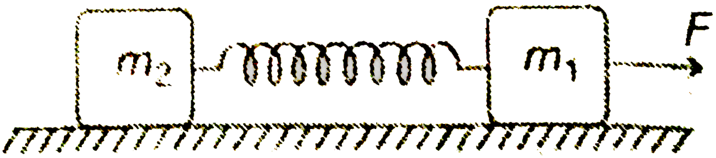
25. Two blocks of masses $m_1 = 1kg$ and $m_2 = 2kg$ are connected by a non-deformend light spring. They are lying on a rough horizontal surface. The coefficient of friction between the blocks and the surface is 0.4. What minimum constant force F has to be applied in horizontal direction to the block of mass m_1 in order to shift the other block? $(g = 10m/s^2)$



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26. Two block of masses m_1 and m_2 connected by a light spring rest on a horizontal plane. The coefficient of friction between the block and the surface is equal to μ. What minimum constant force has to be applied in the horizontal direction to the block of mass m_1 in order to shift the other block?

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34. For Q. 33, calculate how fast will the same truck move down the hill with same power.

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37. Consider an elastic head on collision between a neutron and a light nuclei like Beryllium and calculate neutron's energy transferred to Beryllium?

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38. Considering equal mases, get the expressions for the velocities of bodies after the collision.

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39. For example 32 consider target body B initially at rest, get the expressin for velocities of bodies after the collision

$(a)m_1 = m_2(b)m_2 > \ > m_1(c)m_2 < \ < m_1$

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40. Two particles, A and B of masses m and 3m, are moving along X and Y axes respectively, with the same speed v. They collide at the origin, and coalesce into one body, after the c ollision. What is the velocity of this coalesced mass ?

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41. Q.39, find the loss of energy during the inelatic collision.

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42. When a person jumps from a tree to the ground what happens to the momentum of the person upon striking the ground ?

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43. It is possible for a body to receive a larger impulse from a small force than from a large force.

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44. At a hydroelectric power plant, water is directed at high speed against turbine blades on an axle that turns an electric generatior. For maximum power generation, should the turbine blades be desigened so that the water is brought to a dead stop, or so that the water rebounds?

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48. Find the angle between force $\overrightarrow{F} = \left(5\hat{i} + 5\hat{j} + 5\hat{k}\right)$ unit and displacement $\overrightarrow{d} = \left(3\hat{i} + 4\hat{j} - 3\hat{k}\right)$ unit Also find the projection of $\overrightarrow{F}$ ond $\overrightarrow{d}$.

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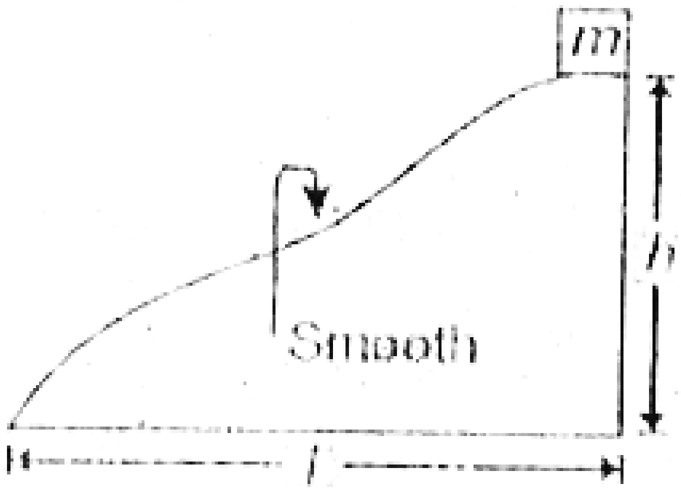
57. A block of mass m is released along a smooth track shown in figure from its top point. Find the word done by gravity during its downward motion to the bottom of track.



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58. If force $F = \left(2x + 3x^2\right)N$ is applied on a particle along x = axis, then find the work done by it during motion of particle from x = 0 to x = 2 m.

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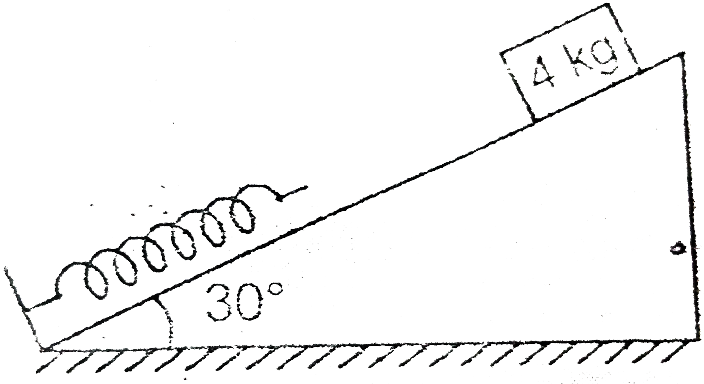

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65. The potential energy of a particle of mass 1 kg moving along x-axis given by $U(x) = \left[\frac{x^2}{2} - x\right] J$. If total mechanical speed (in m/s):-

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66. A simple pendulum of length l has maximum angular displacement θ . Then maximum kinetic energy of a bob of mass m is

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67. A small stone of mass 100 g in rotated I a verticlal circle of radius 40 cm. What is the minimum speed needed at the lowest point for looping the loop? Also find the tension in the string at this point $\left(g = 10 ms^{-2}\right)$.

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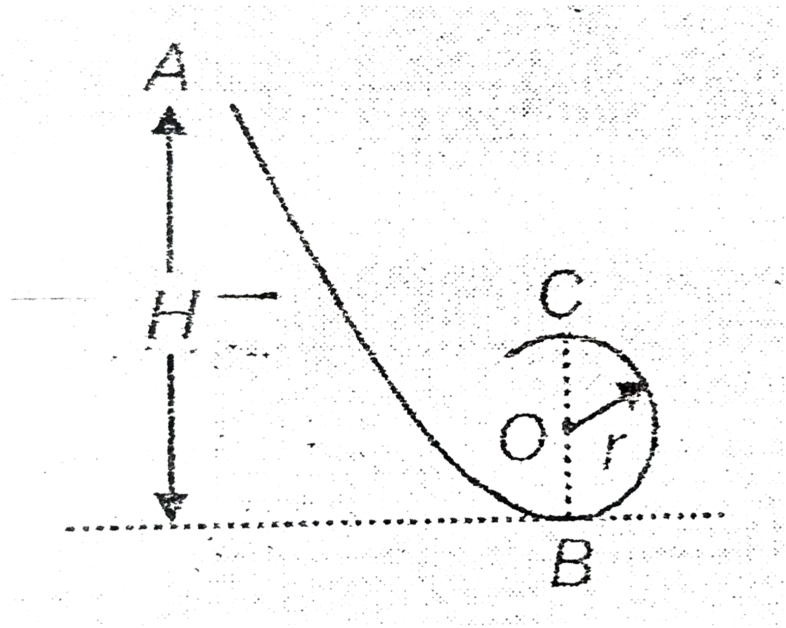

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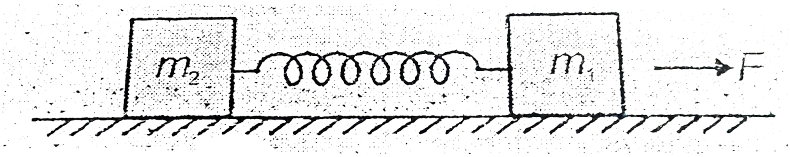
73. Two bodies of masses m_1 and m_2 are connected by a non-deformed light speing and lie on a horizontal plane. Coefficient of friction between the surface and the blocks is μ. Find an expression for the work done by the various foeces.

Force F is applied horzontally to body of mass m_1 in order to shift body of mass m_2.



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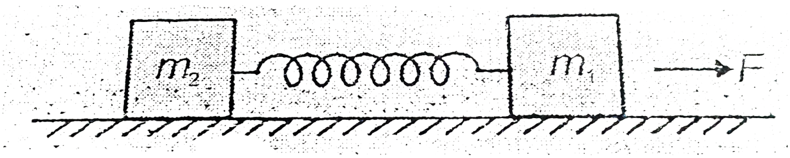

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77. The potential energy U(x) of a particle moving along x - axis is given by $U(x) = ax - bx^2$. Find the equilibrium position of particle.

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78. The potential energy of an object of mass m moving in xy plane in a conservative field is given by U = ax + by , where x and y are position coordinates of the object. Find magnitude of its acceleration :-

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79. An engine pumps 800 kg of water through height of 10 m in 80 s. Find the power of the engine if its efficiency is $75\ \%$

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84. A truck can move up a road having a grade of 1.0 m rise for every 50 m with a speed of $18(km)/(h)$. The resisting force is equal to $(1)/(25)$ of the weight of the truck. With what speed the same truck moves down the hill with the same power?

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85. Provided a racing car does not lose traction, the time taken by it to race from rest through a distance depends mainly on engine's power P. Derive the time t in terms of S and P, assuming that power is constant.

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86. Consider an elastic collision between a neutron and a light nuclei like Beryllium and colculate neuton's energy transferred to Beryllium,

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87. In example 21, consider an elastic collision between a neutron and a light nuclei like carbon and calculate fractional KE lost.

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88. Discuss elastic collision in one dimension. Obtain expressions for velocities of the two bodies after such a collision.

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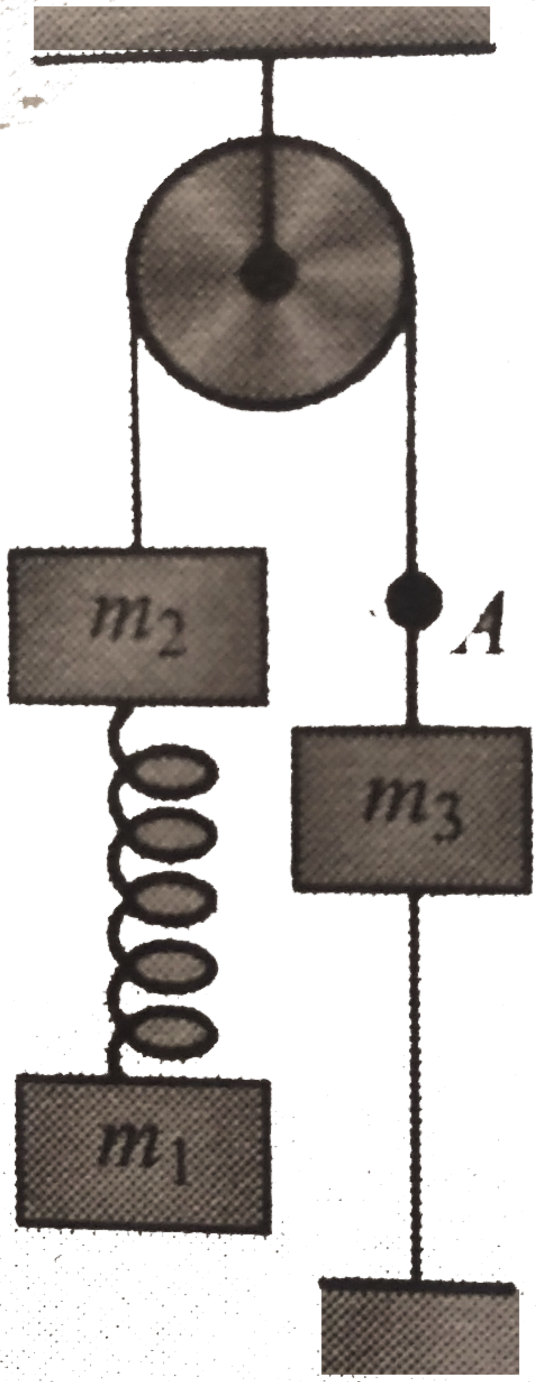
89. Three blocks arranged with pullwy and spring as shown in fig. If the string connecting blocks m_2 and m_3 is cut at point A, find the acceleration of masses m_1, m_2 and m_3. Just after the string is cut at point

A.


m_2
A
m_3
m_1

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91. A particle of mass m moving in the x direction with speed 2v is hit by another particle of mass 2m moving in the y direction with speed v. If the collision is perfectly inelastic, the percentage loss in the energy during the collision is close to

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92. A ball is dropped on the ground from a height 10 m. If coefficient of restitution f 0.4, then find the height of which ball will rebound.

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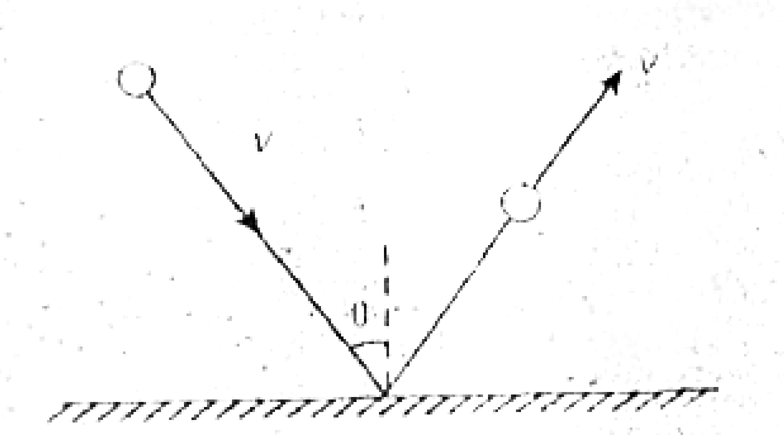
93. A ball moving with speed v collides with a horizontal smooth surface at an angle θ with

normal to surface as shown in figure. If coefficient of restitution of collision is e, then find v'



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94. Two bodies having masses m_1 and m_2 and velocities v_1 and v_2 colide and form a composite system. If $m_1v_1 + m_2v_2 = 0(m_1 \neq m_2$. The velocity of composite system will be

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95. An object of mass m_1 moving with speed v collides with another object of mass m_2 at rest and stick to it. Find the impulse imparted to the second object.

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SECTION-A (OBJECTIVE TYPE QUESTIONS (ONE OPTIONISCORRECT)

1. A man carries a load of 5 kg on his head through a distance of 10 m. the minimum amount of work is done when he

A. Move it up an inclined plane

B. Moves it down an inclined plane

C. Moves it over a horizontal surface

D. Lifts it vertically upwards.

Answer: C

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2. A body moves a distance of 5 m along a straight line under the action of a force 10 N. If the work done is $25\sqrt{3}$ joule, the angle which the force makes with the direction of motion of the body is

A. 0°

B. 30°

C. 45°

D. 60°

Answer: B

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3. A particle is desplaced from a position $\left(2\hat{I}+4\widehat{-}3\hat{k}\right)$ metre to another position $\left(12\hat{i}+14\hat{j}+7\hat{k}\right)$ metre under the action of force $\left(\hat{i}+2\hat{j}-\hat{k}\right)$ metre under rthe action of force $\left(\hat{i}+2\hat{j}-\hat{k}\right)$ N. Work done by the force is

A. $5J$

B. $10J$

C. $15J$

D. $20J$

Answer: D

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4. A block of mass m tied to a string is lowered by a distance d, at a constant acceleration of $g/3$. The work done by the string is

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

B. $\frac{-mgh}{3}$

C. mgh

D. $\frac{4}{3}mgh$

Answer: D

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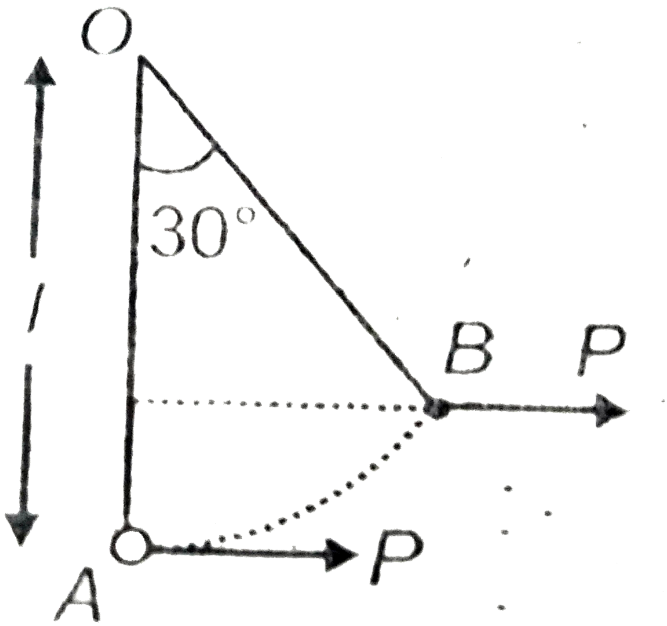
5. A bob of mass m is pulled along a circular arc by means of a constant horizontal force P as shown. Work done in lifting the bob from A to B is



A. mgl

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

C. Pl

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

Answer: B

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6. Work done by a frictional force is

A. Is always zero

B. is always negative

C. Is always positive

D. May be positive, negative or zero

Answer: D

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7. Under the action of a force, a 1 kg body moves, such that its position x as function of time t is given by $x = \frac{t^3}{2}$. where x is in meter and t is in second. The work done by the force in fiest 3 second is

A. $143J$

B. $2430J$

C. $\frac{729}{8}J$

D. $24.3J$

Answer: C

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

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9. Two bodies of different masses m_1 and m_2 have equal momenta. Their kinetic energies E_1 and E_2 are in the ratio

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

B. $\sqrt{\frac{m_1}{m_2}}$

C. $\frac{m_1}{m_2}$

D. $\frac{m_2}{m_1}$

Answer: D

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10. A drop of mass 2.0 g falls from a cliff of height 1.0 km It hits the ground with a speed of $50.0ms^{-1}$. The work done by the resistive force is

A. $-10J$

B. $-12.50J$

C. $-15.5J$

D. $-17.50J$

Answer: D

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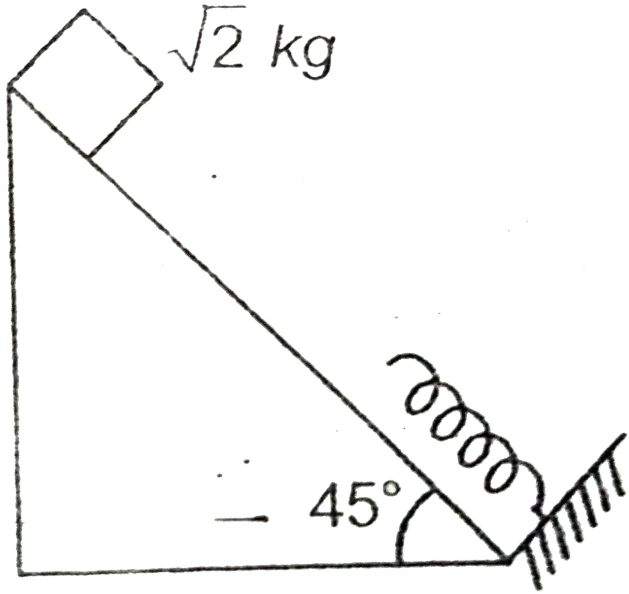
11. A block of mass $\sqrt{2}$ kg is released from the top of an inclined smooth surface as shown in fighre. If spring constant of spring is 100 N/m and block comes to rest after compressing the spring by 1 m, then the distance travelled by block befor it comes to rest is



A. $1m$

B. $1.25m$

C. $2.5m$

D. $5m$

Answer: D

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12. A simple pendulum with bob of mass m and length x is held in position at an angle θ_1 and then angle θ_2 with the vertical. When released from these positions, speeds with which it passes the lowest postions are $v_1 \& v_2$ respectively. Then , $\frac{v_1}{v_2}$ is.

A. $\frac{1-\cos\theta_1}{1-\cos\theta_2}$

B. $\sqrt{\frac{1-\cos\theta_1}{1-\cos\theta_2}}$

C. $\sqrt{\frac{2gx(1-\cos\theta_1)}{1-\cos\theta_2}}$

D. $\sqrt{\dfrac{1-\cos\theta_1}{2gx(1-\cos\theta_2)}}$

Answer: B

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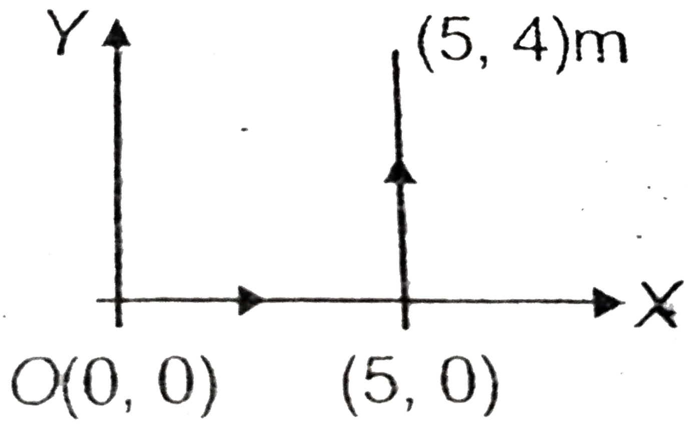
13. A force $\overrightarrow{F}=\left(4\hat{i}+5\hat{j}\right)N$ acts on a particle moving in XY plane. Starting from origin, the particle first goes along x-axis to the point (5.0) m and then parallel to the Y-axis to the point $(5, 4$ m.

The total work done by the force on the particle is



A. $-20J$

B. $+20J$

C. $-40J$

D. $+40J$

Answer: D

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14. Work energy theorem is applicable

A. Only for conservation forces

B. Only for inertial frames

C. Only when pseudo forces are absent

D. Always

Answer: D

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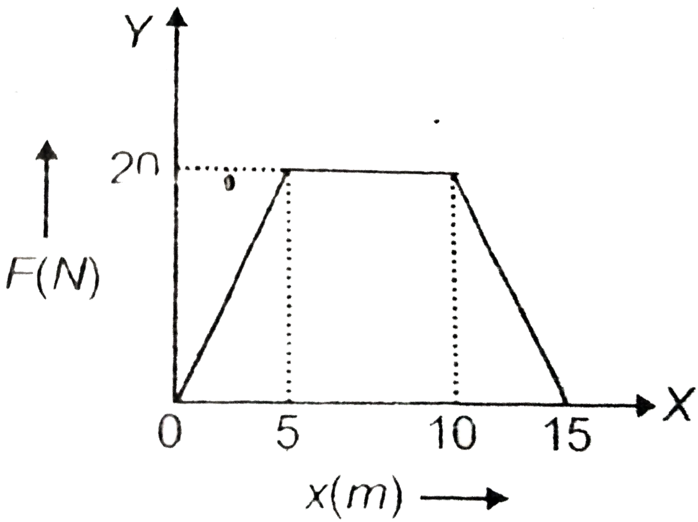
15. A particle of mass 1 kg is subjected to a force which varies with distance as shown. If it starts it s journey from rest at $x = 0$. then its velocity at $x = 15$ m is



A. 0

B. $20\sqrt{3}ms^{-1}$

C. $20\sqrt{2}ms^{-1}$

D. $20ms^{-1}$

Answer: D

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16. Potential energy is defined

A. Only in conservative fields

B. As the negative work done by conservative forces

C. As the negative of work done by external forces when $\Delta K = 0$

D. All of these

Answer: A

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17. An unloaded bus can be stopped by applying brakes on straight road after covering distance x. Suppose. The passengers add 40% of its weight as the load the braking force remains same. How far will the bus go after the application of the breakes? (Velocity of bus is same in both the cases)

A. x

B. $1.4x$

C. $2x$

D. $2.4x$

Answer: B

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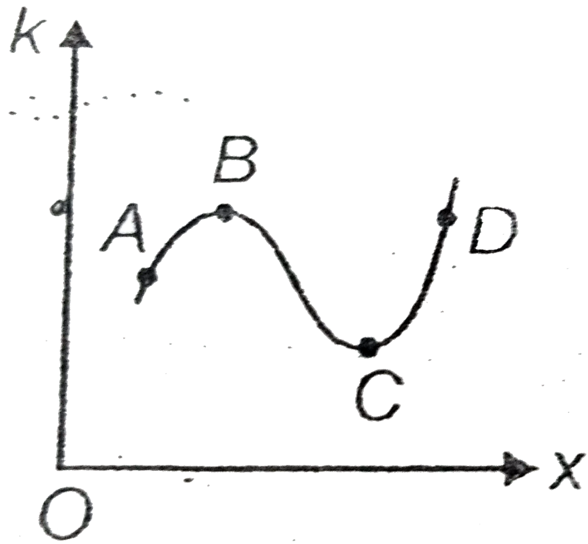
18. For a particle moving under the action of a variable force, kinetic energy (k) varsus position (x) graph is given, then



A. At A, particle is decelerating

B. At B, particle is decelerating

C. At C, particle has maxijmum velocity

D. At D, particle has maximum acceleration

Answer: D

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19. A spring with spring constaant k when compressed by 1 cm the PE stored is U. If it is further compressed by 3 cm, then change in its PE is

A. 3 U

B. 9 U

C. 8 U

D. 15 U

Answer: D

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20. Two springs have spring constants k_1 and $k_2 (k_1 \neq k_2)$. Both are extended by same force. If their elastic potential energical are U_1 and U_2, then U_2 is

A. $\frac{k_2}{k_1} U_1$

B. $\frac{k_1}{k_2} U_1$

C. $\sqrt{\frac{k_1}{k_2} U_1}$

D. $\sqrt{\frac{k_2}{k_1} U_1}$

Answer: B

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21. KE of a body is increased by 44%. What is the percent increse in the momentum ?

A. 10%

B. 20%

C. 30%

D. 44%

Answer: B

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22. When momentum of a body increases by 200% its KE increases by

A. 200%

B. 300%

C. 400%

D. 800%

Answer: D

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23. A buttle weighting 10 g and moving with a velocity $800 ms^{-1}$ strikes a 10 kg block resting on a frictionless surface. The speed of the block after the perfectly inelastic collision is approximately

A. $8 cms^{-1}$

B. $80 cms^{-1}$

C. $8 ms^{-1}$

D. $0.8 cms^{-1}$

Answer: B

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24. which a U^{238} nucleus original at rest , decay by emitting an alpha particle having a speed u , the recoil speed of the residual nucleus is

A. $\frac{4v}{238}$

B. $-\frac{4v}{238}$

C. $\frac{v}{4}$

D. $-\frac{4v}{234}$

Answer: D

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25. An engine develops 20 kW of power. How much time will it take to lift a mass of 400 kg to a height of 40 m? $(g = 10ms^{-2})$

A. $4s$

B. $5s$

C. $8s$

D. $10s$

Answer: C

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26. The power of water pump is 4 kW. If $g = 10ms^{-2}$, the amount of water it can raise in 1 minute to a height of 20 m is

A. 100 litre

B. 1000 litre

C. 1200 litre

D. 200 litre

Answer: C

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27. A particle moves with the velocity $\vec{v} = \left(5\hat{i} + 2\hat{j} - \hat{k}\right)ms^{-1}$ under the influence of a constant force, $\vec{F} = \left(2\hat{i} + 5\hat{j} - 10\hat{k}\right)N$. The instantaneous power applied is

A. 5 W

B. 10 W

C. 20 W

D. 30 W

Answer: D

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28. A particle moves along X-axis from $x = 0$ to $x = 1$ m under the influence of a force given by $F = 3x^2 + 2x - 10$. Work done in the process is

A. $+4J$

B. $-4J$

C. $+8J$

D. $-8J$

Answer: D

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29. A body constrained to move in z direction is subjected to a force given by $\overrightarrow{F} = \left(3\hat{\jmath} - 10\hat{\jmath} + 5\hat{k}\right)N$. What is the work done by this force in moving the body through a distance of 5 m along z-axis?

A. 15 J

B. $-15J$

C. $-50J$

D. $25J$

Answer: D

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30. The KE acquired by a mass m in travelling a certain distance d, starting from rest, under the action of a constant force is directly proportional to

A. Directly proportional to $\sqrt{m}$

B. Directly proportiional to m

C. Directly proportional to $\frac{1}{m}$

D. None of these

Answer: D

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31. Momentum of a body increae by 0.02% percent increase in KE is

A. 0.02%

B. 0.04%

C. 0.01%

D. 0.08%

Answer: B

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32. A body loses half of its velocity on penetrating 6 cm in wooden block. How much will it penetrate more before coming to rest ?

A. $1cm$

B. $2cm$

C. $3cm$

D. $4cm$

Answer: B

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33. The PE of a 2 kg particle, free to move along x-axis is given by $V(x) = \left(\frac{x^3}{3} - \frac{x^2}{2}\right)J$. The total mechanical energy of the particle is 4 J. Maximum speed (in ms^{-1}) is

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

B. $\sqrt{2}$

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

D. $\frac{5}{\sqrt{6}}$

Answer: D

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34. If 250 J of work is done in sliding a 5 kg block up an inclined plane of height 4 m. Work done against friction is $(g = 10ms^{-2})$

A. $50J$

B. $100J$

C. $200J$

D. Zero

Answer: A

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35. An object of mass 80 kg moving with velocity $2ms^{-1}$ hit by collides with another object of mass 20 kg moving with velocity $4ms^{-1}$ Find the loss of energy assuming a perfectly, inelastic collision

A. $12J$

B. $24J$

C. $30J$

D. $32J$

Answer: D

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36. Which of the following is not conserved in an inelestic collision ?

A. Kinetic energy

B. Momentum

C. Neither momentum nor kinetic energy

D. Both momentum and kinetic energy

Answer: A

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37. A ball of mass m moving with velocity u collides head-on which the second ball of mass m at rest. If the coefficient of restitution is e and velocity of first ball after collision is v_1 and velocity of second ball after collision is v_2 then

A. $v_1 = \frac{(1-e)u}{2}, v_2 = \frac{(1+e)u}{2}$

B. $v_1 = \frac{(1+e)u}{2}, v_2 = \frac{(1-e)u}{2}$

C. $v_1 = \frac{u}{2}, v_2 = -\frac{u}{2}$

D. $v_1 = (1+e)u, v_2 = (1-e)u$

Answer: A

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38. Particle A makes a perfectly elastic collision with anther particle B at rest. They fly apart in opposite direction with equal speeds. If the masses are $m_A \& m_B$ respectively, then

A. $2m_A = m_B$

B. $3m_A = m_B$

C. $4m_A = m_B$

D. $\sqrt{3}m_A = m_B$

Answer: B

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39. A shell of mass m moving with a velocity breakes up suddenly into two pieces. The pa having mass $\frac{m}{3}$ remains stationary. The velocity the other part will be

A. v

B. 2v

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

D. $\frac{3}{2}v$

Answer: D

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40. A particle of mass m moving towards west with speed v collides with another particle of mass m movies towards south. If two particles st ich t o each other the speed of the new particle of mass 2 m will be

A. $v\sqrt{2}$

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

C. v/2

D. v

Answer: B

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41. A body of mass 10 kg moving with speed of $3ms^{-1}$ collides with another stationary body of mass 5 kg As a result, the two bodies stick togethre. The KE of composite mass will be

A. 30 J

B. 60 J

C. 90 J

D. 120 J

Answer: A

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42. A bullet of mass m hits a block of mass M. The transfer of energy is maximum when

A. $m > \; > M$

B. $M > \; > m$

C. $M = 2m$

D. $M = m$

Answer: D

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43. A car moving with a velocity of 40 km/h can be stopped by brekes after travelling at least 5 m. If same car moves at a speed of 80 km/h the minimum stopping distance is

A. 10 m

B. 5 m

C. 15 m

D. 20 m

Answer: D

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44. A stationary particle explodes into two particles of masses x and y, which move in opposite directions wit h velocity v_1 and v_2. The ratio of their kinetic energies $(E_1 : E_2)$ is

A. 1

B. $\frac{xv_2}{yv_1}$

C. $\frac{x}{y}$

D. $\frac{y}{x}$

Answer: D

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45. A stone of mass 0.2 kg is tied to one end of a string of length 80 cm. Holding the other and, the stone is whiled into a vertical circle. The minimum speed of the stone and tension at the lowest point of circular path so that it just comletes the circle are

A. $5ms^{-1}, 10N$

B. $6.32ms^{-1}, 12N$

C. $6.32ms^{-1}, 10N$

D. $2ms^{-1}, 10N$

Answer: B

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46. A particle of mass 200 g is moving in a circle of radius 2 m. The particle is just looping the loop. The speed of the particle and the tension in the string at highest point of the circule path are $(g = 10ms^{-2})$

A. $4ms^{-1}, 5N$

B. $4.47ms^{-1}$, zero

C. $2.47ms^{-1}$, zero

D. $1ms^{-1}$, zero

Answer: B

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47. A particle of mass 200 g , is whirled into a vertical circle of radius 80 cm uisig a massless string The speed of the particle when the string makes an angle of 60° with the vertical line is $1.5ms^{-1}$. The tension in the string at this position is

A. 1 N

B. $1.56N$

C. 2 N

D. 3 N

Answer: B

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48. A small ball of mass m moving with speed v collides elastically with a simple pendulum with bob of mass m at rest. The maximum height attained by the bob after collision is

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

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

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

D. 0

Answer: B

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49. A particle of mass m moving with speed u collides perfectly inelastically with another particle of mass 3 m at rest. Loss of KE of system in the collision is

A. $\frac{3}{4}\mu^2$

B. $\frac{3}{8}\mu^2$

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

D. $\frac{1}{8}\mu^2$

Answer: B

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50. Select the false statement

A. In elastic collision, KE is not conserved during the collision

B. The coefficient of restitutio for a collision between two steel balls lies between 0 and 1

C. The momentum of a ball colliding elastically with the floor is conserved

D. In an oblique elastic collision between two indentical bodies with one of them at rest initially, the final velocities are perpendicular

Answer: C

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51. In a vertical spring mass system, a block of mass m is initially at rest when there is no extension. Now if the mass is released suddenly, then the maximum elongation in the spring is

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

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

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

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

Answer: B

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52. A body is projected from ground obliquely. During downward motion, power delivered by gravity of it

A. Increases

B. decreases

C. Remains constant

D. First decreases and then becomes constant

Answer: A

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53. The blades of a windmill sweep out a circle of area A. (a) If the wind flows at a velocity v perpendicular to the circle, what is the mass of the air passing through in time t? (b) What is the kinetic energy of the air? (c) Assume that the windmill converts 25% of the wind's energy into electrical energy, and that $A = 30m^2, v = 36kmh^{-1}$ and the density of air is $1.2kgm^{-3}$, what is the electrical power produced?

A. $\dfrac{\rho A v^3}{2}$

B. $\dfrac{\rho A v^2}{2}$

C. $\rho A v^2$

D. $2\rho A v^2$

Answer: A

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54. 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. $\dfrac{mv_1^2}{T_1^2}t$

B. $\dfrac{mv_1}{T_1^2}t$

C. $\left(\dfrac{mv_1}{T_1}\right)^2 t$

D. $\dfrac{mv_1^2}{T_1}t^2$

Answer: A

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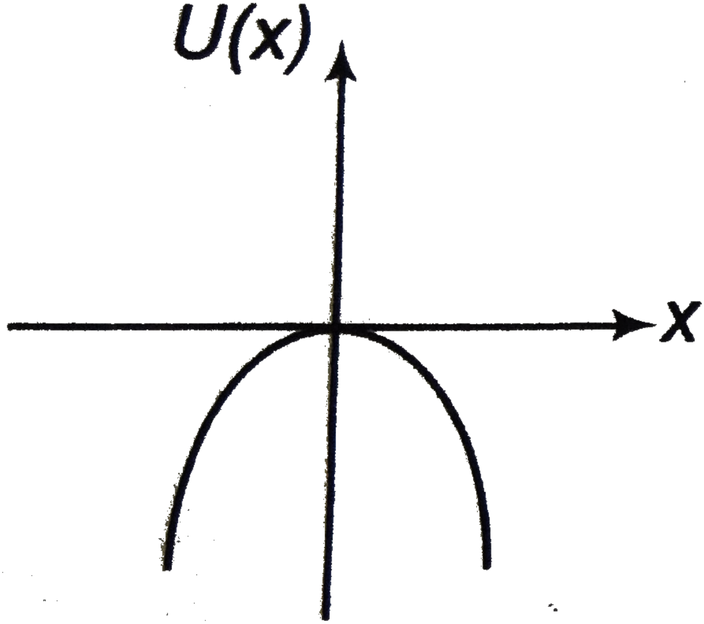
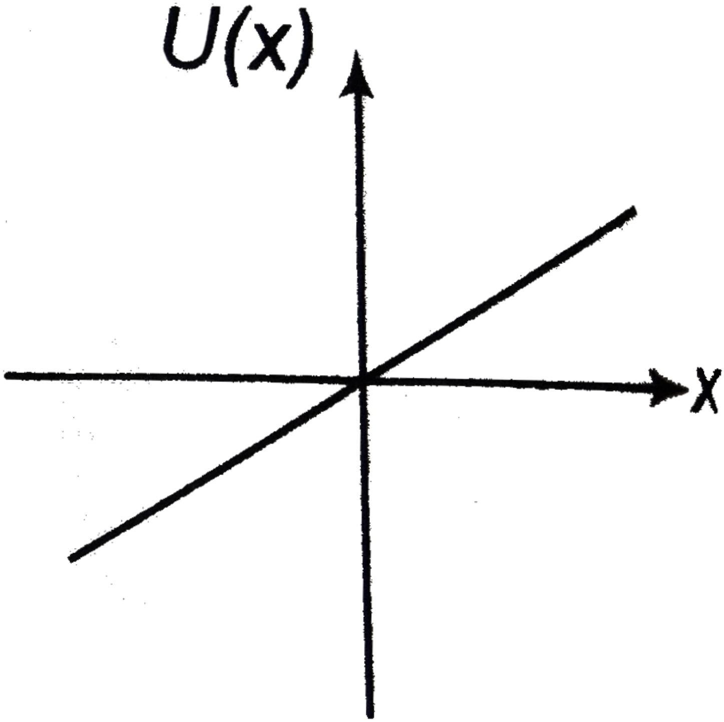
55. A particle is placed at the origin and a force $F = kx$ is acting on it (where k is a positive constant). If $U(0) = 0$, the graph of $U(x)$ versus x will be (where, (U) is the potintial enetgy function).



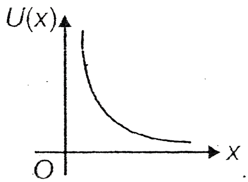
(a)

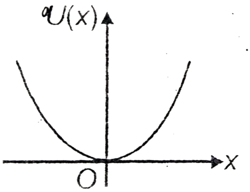
(a) , (b)

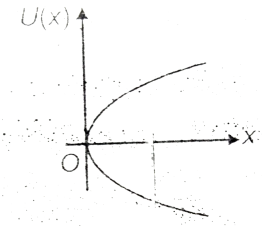


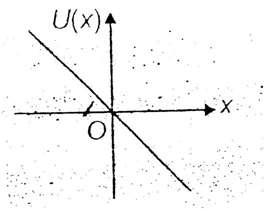
(d)

, (d) .

A. 

B. 

C. 

D. 

Answer: B

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56. A pump is used to pump a liquid of density ρ continuously through a pipe of cross, sectional area A. If liquid is flowing with speed v, then average power of pump is

A. $\frac{1}{3}\rho AV^2$

B. $\frac{1}{2}\rho AV^2$

C. $2\rho AV^2$

D. $\frac{1}{2}\rho AV^3$

Answer: D

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57. A car of mass m has an engine which can deliver power P. The minimum time in which car can be accelerated from rest to a speed v is :-

A. $\frac{mv^2}{2P}$

B. Pmv^2

C. $2Pmv^2$

D. $\frac{mv^2}{2}P$

Answer: A

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58. A neutron travelling with a velocity v and kinetic energy E collides perfectly elastically head on with the nucleus of an atom of mass number A at rest. The fraction of the total kinetic energy retained by the neutron is

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

B. $\left(\frac{A+1}{A-1}\right)^2$

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

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

Answer: A

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59. A bullet of mass m moving with velocity v strikes a suspended wooden block of mass M . If the block rises to a height h , the initial velocity of the block will be ?

A. $\sqrt{2gh}$

B. $\frac{M+m}{m}\sqrt{2gh}$

C. $\frac{m}{M+m}\sqrt{2gh}$

D. $\frac{M+m}{M}\sqrt{2gh}$

Answer: B

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60. A ball of mass M moving with speed v collides perfectly inelastically with another ball of mass m at rest. The magnitude of impulse imparted to the first ball is

A. Mv

B. mv

C. $\frac{Mm}{M+m}v$

D. $\frac{M^2}{M+m}v$

Answer: C

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SECTION-B (SUBJECTIVE TYPE QUESTIONS) (ONE OPTIONS IS CORRECT)

1. A particle of mass m has half the kinetic energy of another particle of mass $\frac{m}{2}$. If the speed of the heavier particle is increased by $2ms^{-1}$ its new kinetic energy becomes equal to t he original kinetic energy of the lighter particle. The ratio of the orighinal speeds of the lighter and heavier particle is

A. $1:1$

B. $1:2$

C. $1:3$

D. $1:4$

Answer: B

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2. A graph is plotted by taking transnational kinetic energy of body as ordinate and velocity as abscissa. Slope of the graph at an instant represents its

A. Velocity

B. Mass

C. Momentum

D. Kinetic energy pre unit mass

A. Velocity

B. Mass

C. Momentum

D. Kinetic energy per unit mass

Answer: C

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3. A body of mass 2 kg is acted upon by two forces

$\overrightarrow{D}_1 = \left(2\hat{i} + 3\hat{j}\right)N$ and $\overrightarrow{F}_2\left(-2\hat{k} + 3\hat{j}\right)N$. If the body is displaced from $A(3m, -2m, 1m)$ to B $(-1m, +2m, -3m)$, then work done on the body is

A. 40 J

B. $-40J$

C. 24 J

D. $-24J$

Answer: C

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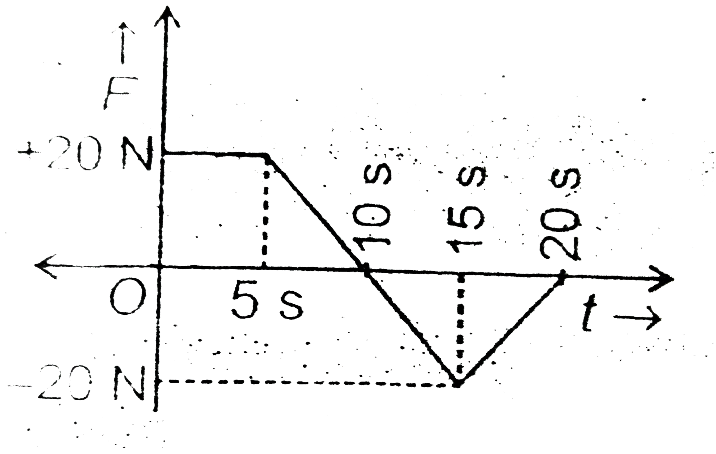
4. A body of mass 2 kg starts with an intitial-velocity 5 m/s. It the body is acted upon by a time dependent force (F) as shown in figure, then work done on the body in 20 s is

A. – 875 J

B. 875J

C. 600J

D. – 600 N J



A. $-875J$

B. $875J$

C. 600 J

D. $-600NJ$

Answer: B

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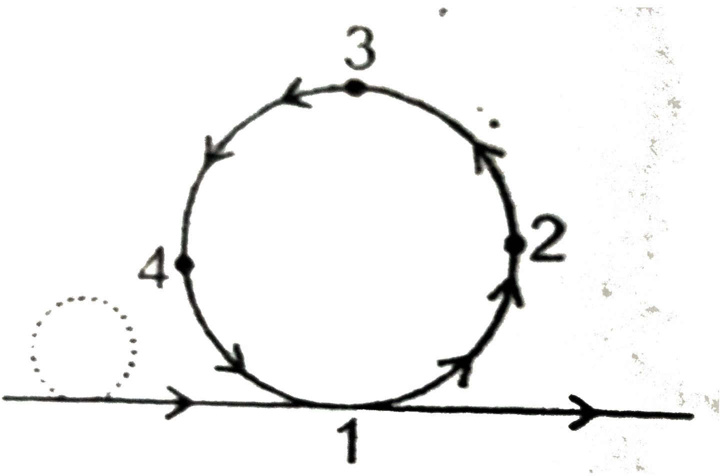
5. A rectangular block is mobing along a frictionless path, when it encounters the circular loop as shown. The block passes points 1, 2, 3, 4, before ret runing to the horizontal tracks. At point 3



A. Its mechanical energy is minimum

B. The foeces on it area balanced

C. It experiences a net upward force

D. Its speed is minimum

Answer: D

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6. The position of a particle moving on a stringht line under rthe action of a force is given as $x = 50t - 5t^2$ Here, x is in metre and t is in second. If mass of the particle is 2 kg, the work done by the force acting on the particle in first 5 s is.

A. 2500 J

B. $-2500J$

C. 5000 J

D. $-5000J$

Answer: B

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7. Which of the following statements is correct

A. Work done by static friction is always zero

B. Work done by kinetic friction is always negative

C. The negative of the work done by the conservative internal forces on a system equals the change in kinetic energy

D. The work dony by all the forces on a system equals the change in kinetic energy

Answer: D

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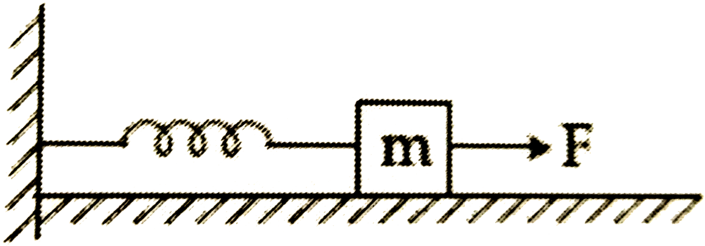
8. A block of mass m, lying on a smooth horizontal surface, is attached to a spring (of negligible mass) of spring constant k. The other end of the spring is fixed, as shown in the figure. The block is initally at rest in its equilibrium position. If now the block is pulled withe a constant force F, the maximum speed of the block is :



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

B. $\frac{1}{4}mv^2$

C. $\frac{1}{6}mv^2$

D. $\frac{1}{8}mv^2$

Answer: C

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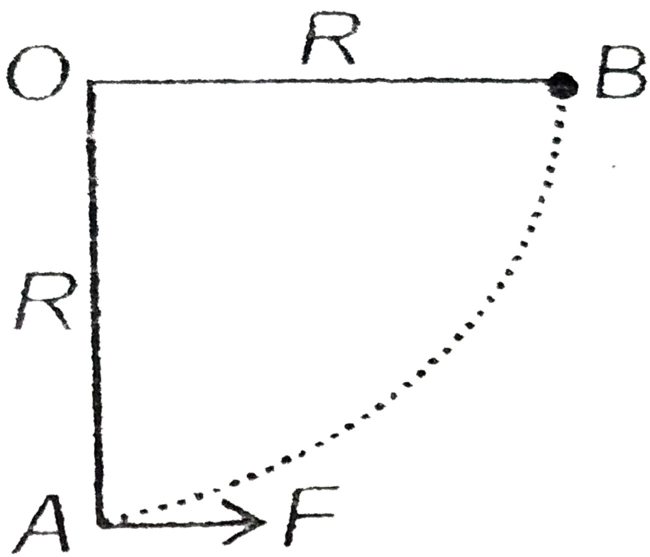
9. A block of mass m is taken from A to B under the action of a constant force F. Work done by this force is



A. $\frac{\pi FR}{2}$

B. $\pi F R$

C. FR

D. Zero

Answer: C

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10. A body of mas m starts from rest with a constant power. If velocity of the body at displacement s is v, then the correct alternative is

A. $s \propto v$

B. $s \propto v^2$

C. $s \propto v^3$

D. $s \propto v^4$

Answer: C

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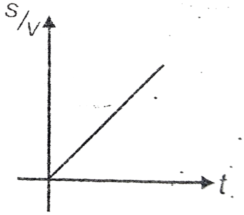
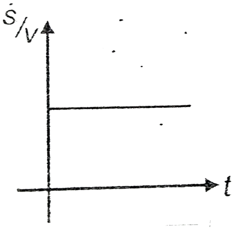
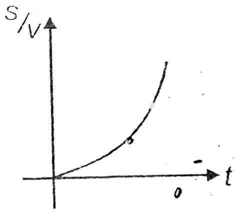
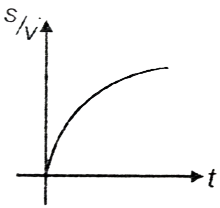
11. A body is moved from rest along a straight line by a machine delivering constant power. The ratio of displacement and velocity (s/v) varies with time t as

A. 

B. 

C. 

D. 

Answer: A

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12. 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

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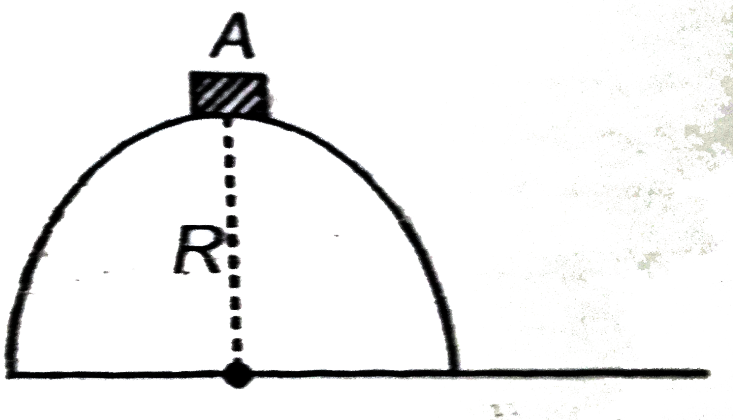
13. Figure shows a body A at the top of a frictionless hemispherical inverted bowl of radius R. If the body starts slipping from the highest point, then the horizontal distance between the point where it leaves contact with sphere and the point at which the body was placed is



A. $\frac{\sqrt{5}R}{3}$

B. $\sqrt{3}R$

C. $\frac{\sqrt{5}R}{2}$

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

Answer: A

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14. A ball suspended by a thread swings in a vertical plane so that its acceleration in the extreme position and lowest position are equal. The angle θ of thread deflection in the extreme position will be

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

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

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

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

Answer: D

Watch Video Solution

15. A car of mass m has an engine which can deliver constant power P.the maximum speed that the car can attain in t seconds in

A. $\sqrt{\frac{3}{4}\frac{Pt}{m}}$

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

C. $\sqrt{\frac{2Pt}{m}}$

D. $\sqrt{\frac{Pt}{m}}$

Answer: C

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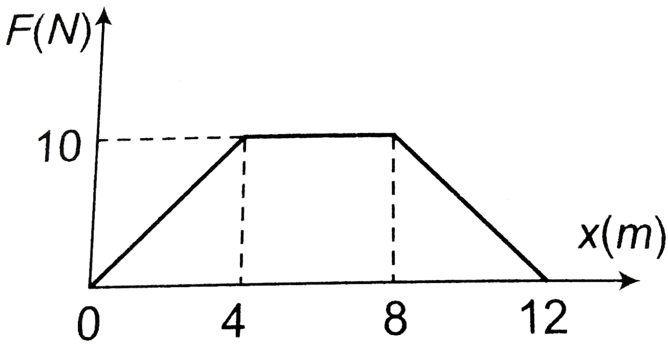
16. 

A particle of mass 0.1 kg is subjected to a force which varies with distance as shown in figure. If it starts its journey from rest at $x=0$, its velocity at $x=12m$ is

A. $4\sqrt{5}m/s$

B. $20\sqrt{2}m/s$

C. $20\sqrt{3}m/s$

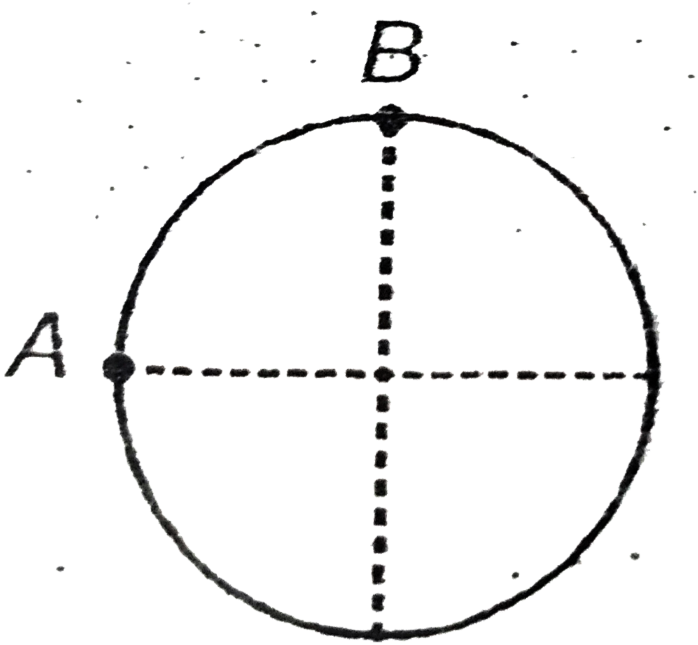
D. $40m/s$

Answer: D

Watch Video Solution

17. A particle is moving in a verticalcircle such that the tensionin the string at the topmost point B is zero.Theaccelerationof theparticle at point A is

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



A. $10\sqrt{5}m/s^2$

B. $10\sqrt{10}\frac{m}{s^2}$

C. $10m/s^2$

D. $5\sqrt{10}m/s^2$.

Answer: B

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18. A block of mass M is attached to the lower end of a verticle spring. The spring is hung from a ceiling and has force constant value k. The mass is released form rest with the spring intially unstretched. The maximum extension produced in the length of the spring will be

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

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

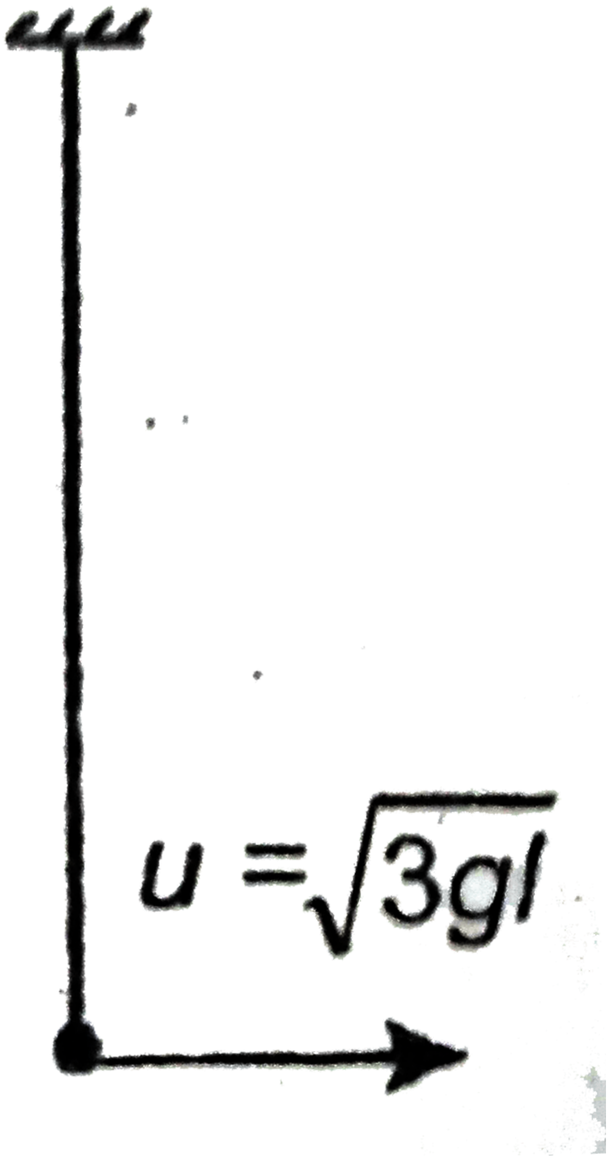
C. $\dfrac{3mg}{2k}$

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

Answer: A

Watch Video Solution

19. The bob of pendulum is project with horizontal velocity of $\sqrt{3gf}$ I is the length of string. Find the angular displacement of string before it becomes slack.



A. $\pi - \cos^{-1} 1/3$

B. $\cos^{-1} 2/3$

C. $\pi - \cos^{-1} 2/3$

D. $\cos^{-1} 1/3$

Answer: A

Watch Video Solution

20. A uniform chain of mass 4 kg and length 2 m overhangs a smooth table with its one third part lying on the table Find the speed of chain as it completely slips of the table. (Take $g = 10\frac{m}{s^2}$)

A. $\frac{10}{3}m/s$

B. $2m/s$

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

D. $\frac{4}{2}m/s$

Answer: A

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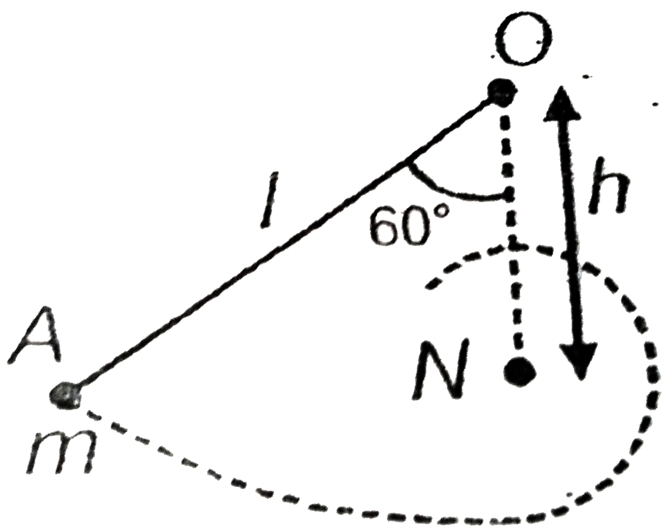
21. A particle of mass m, attached to the end of string of length l is released from the initial position A as shown in the figures. The particle moves in a vertical circular path about O. When it is vetically below O, the string makes contact with nail N placed directly below O at distance h and rotat es around

it. If the particle just complete the vertical circle

about N,then



A. $h=\frac{3l}{5}$

B. $h=\frac{2l}{5}$

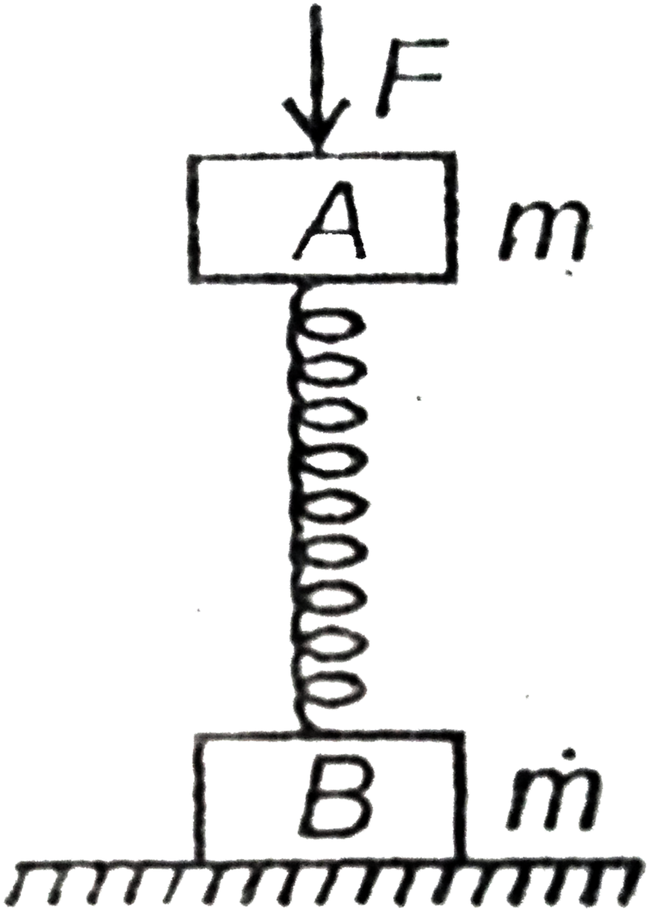
C. $h=\frac{l}{5}$

D. $h=\frac{4l}{5}$

Answer: D

Watch Video Solution

22. A system consists of t wo identical masses A and B of mass m each connected to ends of a massless spring of force constant k as shown in figure.



The minimum force F applied vertically downward on A, such that on its release, B will leave the floor.

A. mg

B. 2mg

C. 3mg

D. 4mg

Answer: B

Watch Video Solution

23. A car starts from rest and moves on a surface in which the coefficient of friction between the road and the tyres increases linearly with distance (x). The car moves with the maximum possible acceleration. The kinetic energy (E) of the car will depend on x as

A. $E \propto \frac{1}{x^2}$

B. $R \propto \frac{1}{x}$

C. $E \propto x$

D. $E \propto x^2$

Answer: D

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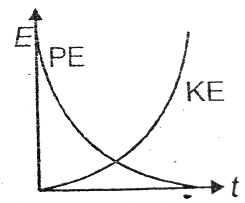
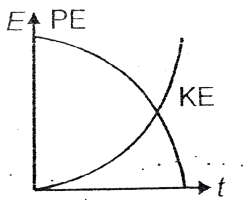
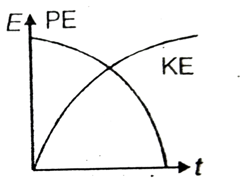
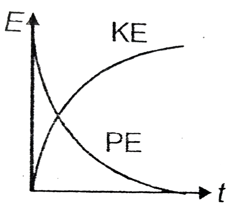
24. A particle falls from rest under gravity. Its potential energy with respect to the ground (PE) and its kinetic energy (KE) are plotted against time (t). Choose the correct graph.

A. 

B. 

C. 

D. 

Answer: B

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

A. $-\frac{K}{r}$

B. $\frac{1.5k}{r}$

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

D. $-\frac{3k}{2r}$

Answer: C

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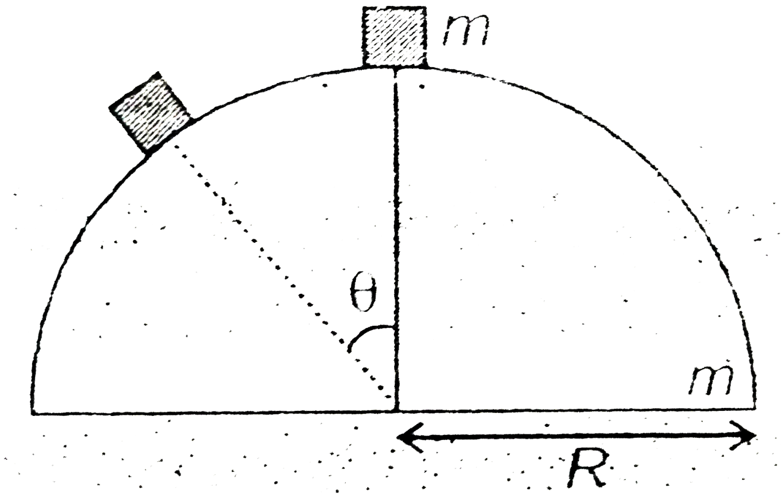
26. A particle is placed on the top of a hemispherical shell of same mass. Shellis free to move on the smooth ground. If particle is given a given a gentle push and reaches to anglular position q as shown in figure then for an observer fixed on a shell, ratio of reaction force exerted by shell to peudo force (as observed from shell) acting on particale, is



A. a. $\sin\theta$

B. b. $\cos ec\theta$

C. c. $\cos\theta$

D. d. $\sec\theta$

Answer: B

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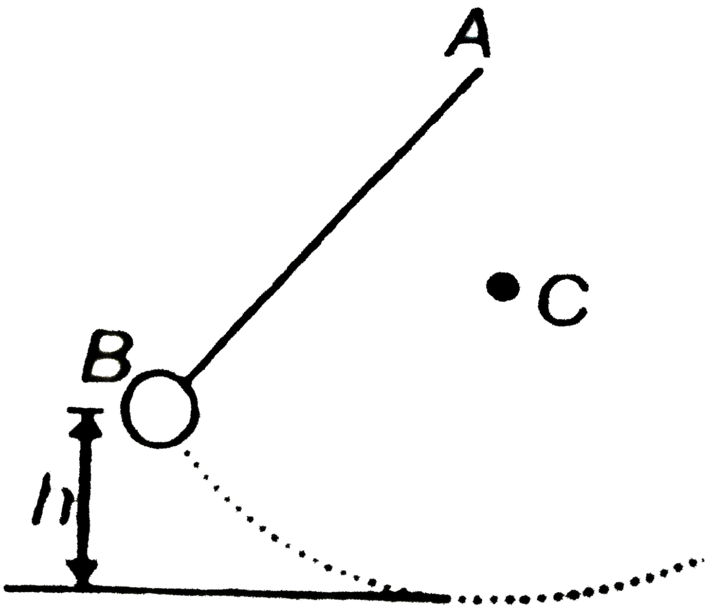
27. A bob is tied up with a string AB of length l. End A of the string is fixed. There is a obstacle C vertically below A so that length $AC = \frac{2l}{3}$. Bob is released from a height 'h' from its lowermost possible position so that it is just able to comlete verticle circular motion about C. Find 'h'.



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

B. $\frac{4l}{3}$

C. $\frac{5l}{3}$

D. $\frac{5l}{6}$

Answer: D

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28. If the linear momentum is increased by 50%, then kinetic energy will be increased by

A. $50\,\%$

B. $100\,\%$

C. $125\,\%$

D. $25\,\%$

Answer: C

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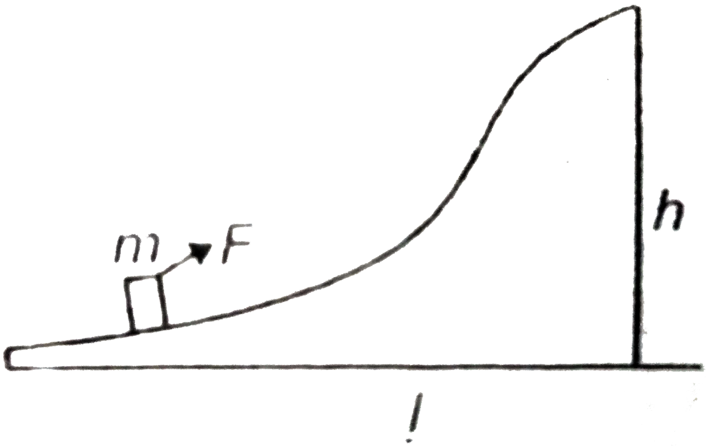
29. A body of mass m was slowly pulled up the hill by a force F which at each point was directed along the tangent of the trajectory. All surfaces are smooth. Find the work done by this force



A. mgh

B. mgl

C. Zero

D. Data insufficient

Answer: A

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30. Work done by a spning force is

A. Always negative

B. Always positive

C. Always zero

D. may be positive and negative

Answer: D

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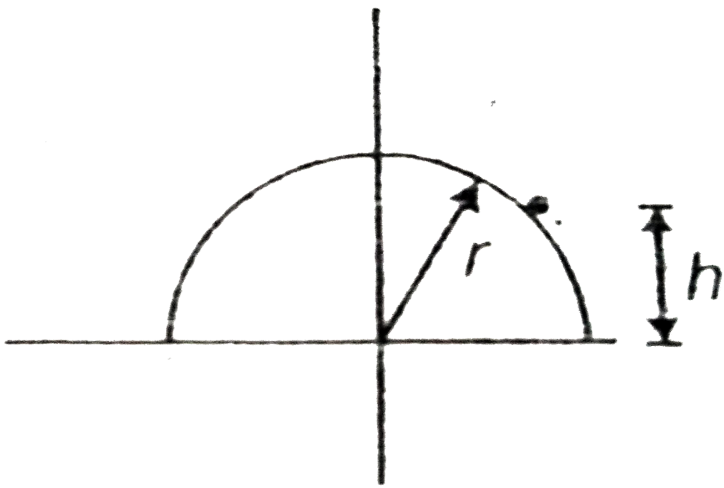
31. A small body of mass m slides without friction from the top of a hemisphere of radius r. At what hight will the body be detached from the surface of hemisphere?



A. $h = \frac{r}{2}$

B. $h = \frac{r}{3}$

C. $h = \frac{2r}{3}$

D. $h = \frac{r}{4}$

Answer: C

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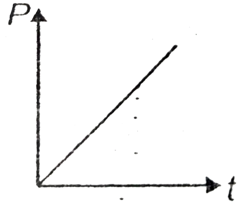
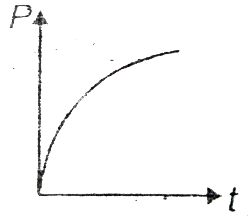
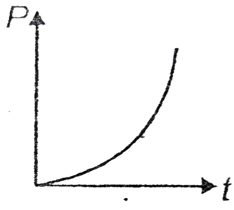
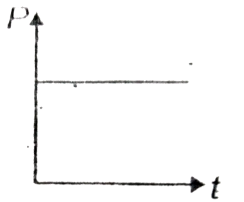
32. A motor drives a body along a straight line with a constant force. The power P developed by the motor must vary with time t as

A. 

B. 

C. 

D. 

Answer: B

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33. An engine pumps water continuously through a hole. Speed with which water passes through the hole nozzle is v, and k is the mass per unit length of the water jet as it leaves the nozzle. Find the rate at which kinetic energy is being imparted to the water.

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

B. $\frac{1}{2}kv^3$

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

D. $\frac{v^3}{2k}$

Answer: B

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34. A machine which is 75% efficient, use 12 J of energy in lifting 1 kg mass through a certain height. The mass is then allowed to fall through the same height.Find the velocity at the end of its fall.

A. $\sqrt{24}$

B. $\sqrt{18}$

C. 6

D. $\sqrt{9}$

Answer: D

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35. A bullet when fixed at a target with a velocity of $100 ms^{-1}$, penetrates one metre into it. If the bullet is fired with the same velocity as a similar target with a thickness 0.5 metre, then it will emerge from it with a velocity of

A. $50\sqrt{2} m / s$

B. $\frac{50}{\sqrt{2}} m / s$

C. $50 m / s$

D. $10 m / s$

Answer: A

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

A. $\sqrt{gl}$

B. $\sqrt{2gl}$

C. $\sqrt{3gl}$

D. $\sqrt{5gl}$

Answer: C

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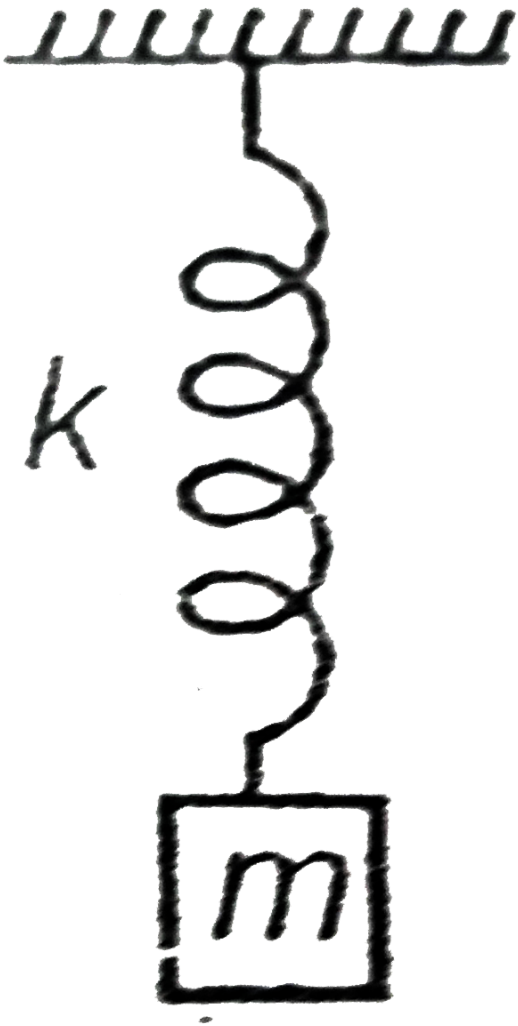
37. The block of mass m is released when the spring was in its natrual length. Spring constant is k. Find the maximum elongation of the spring.



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

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

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

D. Cannot be calculated

Answer: B

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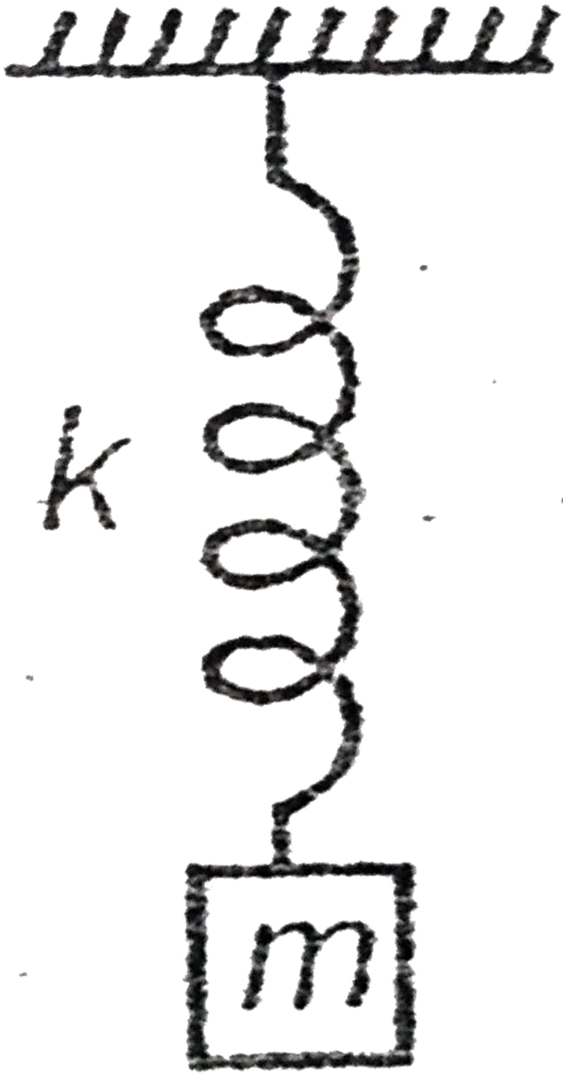
38. Consider the spring blcok system shoen in the figure initially block m is in equlibrium. An impulse gives the block a velocity v upwards. Find the maximum speed of the block during the motion.



A. v

B. 2v

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

D. $\frac{5v}{2}$

Answer: A

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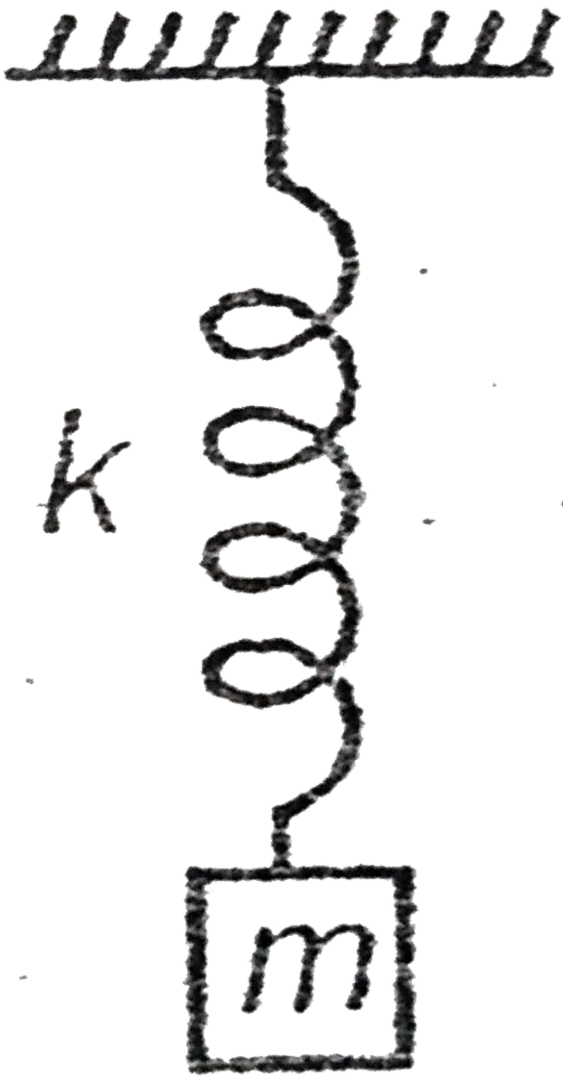
39. Consider the spring block system shown in the figure initially block m is in equilibrium. An impulse gives the block a velocity v upwards. Find the maximum speed of the block during the motion.



A. $h\sqrt{\frac{k}{m}}$

B. $2h\sqrt{\frac{k}{h}}$

C. $h\sqrt{\frac{m}{k}}$

D. $2h\sqrt{\frac{m}{k}}$

Answer: A

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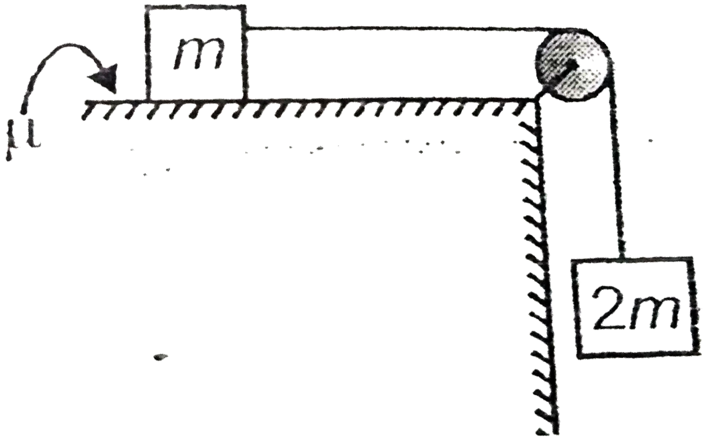
40. Consider the system shown in the figure. Coefficient of friction between the block and table is $\mu = 0.5$. The system is released from rest. Find the work done by friction, when the speed of block is 10 m/s $(m = 1kg)$



A. $-10J$

B. $-20J$

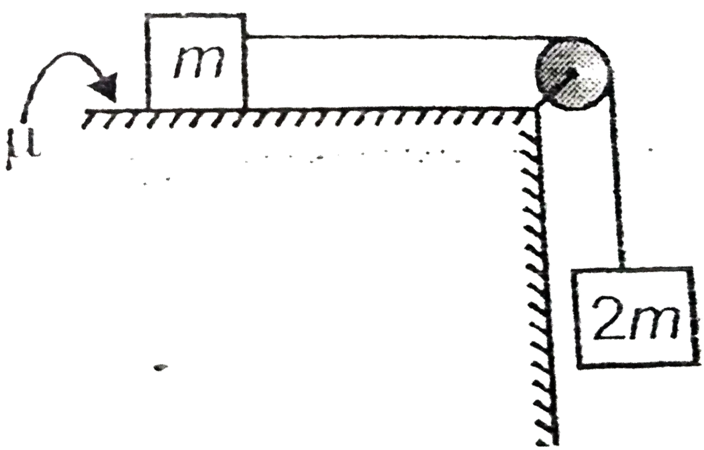
C. $-30J$

D. $-50J$

Answer: D

Watch Video Solution

41. Consider the system shown in the figure. Coefficient of friction between the block and table is $\mu = 0.5$. The system is released from rest. Find the work done by friction, when the speed of block is 10 m/s $(m = 1kg)$



A. 100 J

B. $-100J$

C. 200 J

D. $-200J$

Answer: C

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42. A particle of mass m initially moving with speed v.A force acts on the particle f=kx where x is the distance travelled by the particle and k is constant. Find the speed of the particle when the work done by the force equals W.

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

B. $\sqrt{\frac{2W}{m}+v^2}$

C. $\sqrt{\frac{2W}{k}+v^2}$

D. $\sqrt{\frac{W}{2m}+v^2}$

Answer: B

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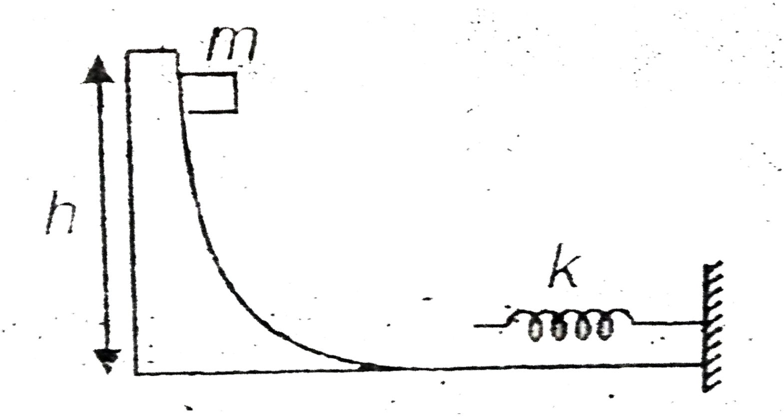
43. A block of mass m is released from a height h from the top of a smooth surface. There is an ideal spring of spring constant k at the bottom of the track. Find the maximum compression in the spring

(Wedge is fixed)



A. $\sqrt{\frac{2mgh}{k}}$

B. $\sqrt{\frac{mgh}{k}}$

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

D. Cannot be determined

Answer: A

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44. A particle of mass m initially at rest. A variabl force acts on the particle $f = kx^2$ where k is a constant and x is the displacment. Find the work done by the force f when the speed of particles is v.

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

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

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

D. $2mv^2$

Answer: C

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45. A massive spring of mass m and length l is fixed at one end and the other end is given a velocity v such that speed of spring particles increases increases linearly. Find the kinetic energy of spring.

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

B. $\frac{1}{6}mv^2$

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

D. $\frac{1}{3}mv^2$

Answer: B

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SECTION-C (OBJECTIVE TYPE QUESTIONS) (MORE THAN ONE OPTIONS ARE CORRECT)

1. A body of mass 2 kg is dropped from rest from a height 20 m from the surface of Earth. The body hits the ground with velocity 10 m/s, then work done: $(g = 10m/s^2)$

A. On the body is 100 j

B. By the gravity is 400 J

C. By the dissipative force is 300 J

D. By the disspipative force is $-300J$

Answer: A::B::D

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2. Consider the body of mass 0.2 kg and a smooth incline of hight 3.2 m and length 10 m. Select the correct alternative

A. a. Minimum work required to lift the block from the ground and put it at the top is 6.4 J

B. b. Work required to slide the body up the incline (slowly) is 6.4 J

C. c. Maximum speed of the body slipping down from rest on the plane, on reaching the ground is 8 m/s

D. d. Work required to slide the body down the plane is more than 6.4 J

Answer: A::B::C

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3. A body is acted upon by a force. If work done by the force is zero, then which of the following is (are) possible?

A. The body moves in such a way that point of application of the force remains fixed

B. The body remains stationary but the point of application of the force moves on the object

C. The force is always. Perpendicular to its acceleration

D. The velocity is always perpendicular to the force

Answer: A::B::D

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4. A,B and C are three persons who can row their boats with speeds 10 m/s 7 m/s and 3 m/s respectively in still water Velociy of flow of water in a river is 7 m/s All start rowing their boats upstream then

A. Work done on A by water w.r.t. B is positive

B. Work done on B by water w.r.t. bank of river is zero

C. Work done on C by water w.r.t. B is negative

D. Work done on B by water w.r.t. C is positive

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

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5. A body is moving on a circlar path of radius r with constant speed under the action of force $\frac{K}{r^3}$ Assuming infinity as zero potential energy reference, tick the correct alternative

A. Kinetic energy of body is $\frac{K}{2r^2}$

B. Potential energy of the body is $\frac{K}{2r^2}$

C. Mechanical energy of the body is $-\frac{K}{2r^2}$

D. The body is in a bound state

Answer: A::B

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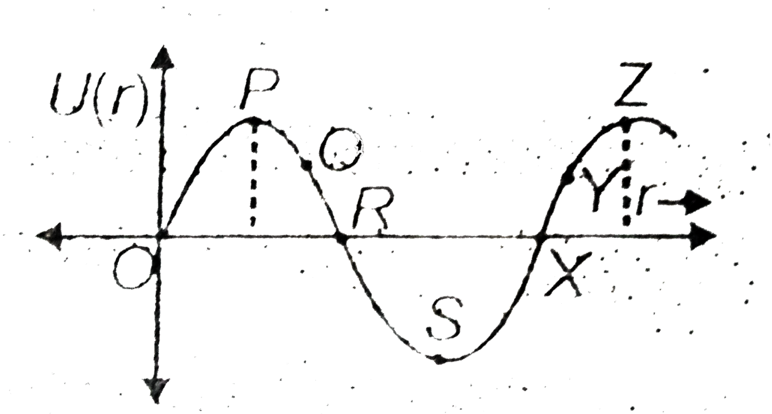
6. Potential energy U(r) varies with position r as shown in figure



Which of the following conclusions are correct?

A. Force is positive at Q and R

B. Force is negative at O and X

C. Forces is maximum (magnitude) at O, R and X

D. Equlibrium is indicated at P, S and Z

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

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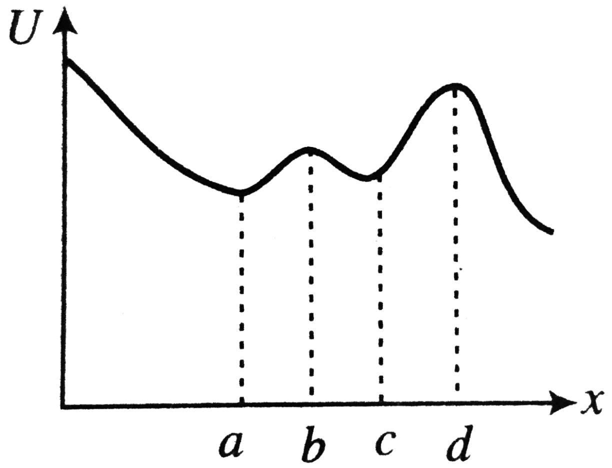
7. Figure shows a plot of the potential energy as a function of x for a particle moving along the x-axis.

Which of the following statement(s) is/are true?



A. The particle is in equlibrium at 3 out of 4

B. The particle is in equlibrium at 2 out of 4

points shown

C. The particle is in stable equlibrium at $x = b$

D. The particle is in unstable equlibrium at

$x = d$

Answer: A::C::D

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8. A 5 kg body is fired vertically up with a speed of 200 m/s. Just before it hits the ground, its speed is 150 m/s. Over the entire trip,

A. Change in internal energy of the projectile and air is $-43750J$.

B. The work done by gravity is 44000 J

C. The work done by gravity is zero

D. The time of upward motion is less than that for downward motion

Answer: A::C::D

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9. Which of the following statements are incorrect?

A. If there were no friction, work needed to be done to move a body up an inclined plane will be zero.

B. If there were no friction, the moving vechicles could not be stopped even by locking the breakes

C. As the angle of inclination is increased, the normal reaction on the body placed on it increases

D. A duster weighing 0.5 N is pressed against a vertical board with a force of 11 N If the coefficient of friction is 0.5 the work done in rubbing it upwards through a distance of 10 cm is 0.55 J

Answer: A::C::D

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10. The kinetic energy of a particle continuously increases with time. Then

A. the magnitude of its linear momentum also increases continously with time

B. the height above th ground level must continously decreases

C. the resultant force on the particle must be parallel to the velocity at all instants

D. the resultant force on the particle must be at an angle less than $90^{\circ 0}$ all the time

Answer: A::D

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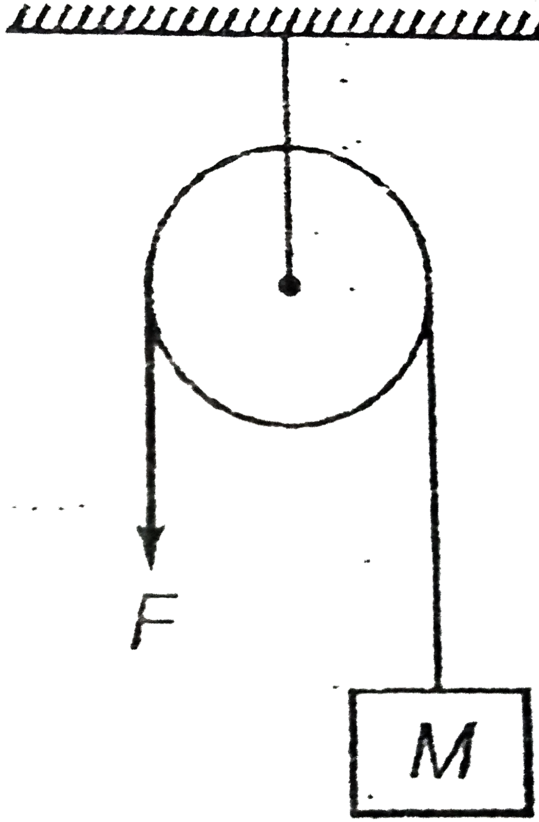
11. A block of mass 10 kg is hanging over a smooth and light pulley through a light string and the other end of the string is pulled down by a constant force F. The kinetic energy of the block increases by 20 J in

1 s



A. Tension in string is 120 N

B. Tension is string is 100 N

C. The work done by tension on the block is 120 J

in 1 s

D. The work done by the force of gravity is 100 J

Answer: A::C

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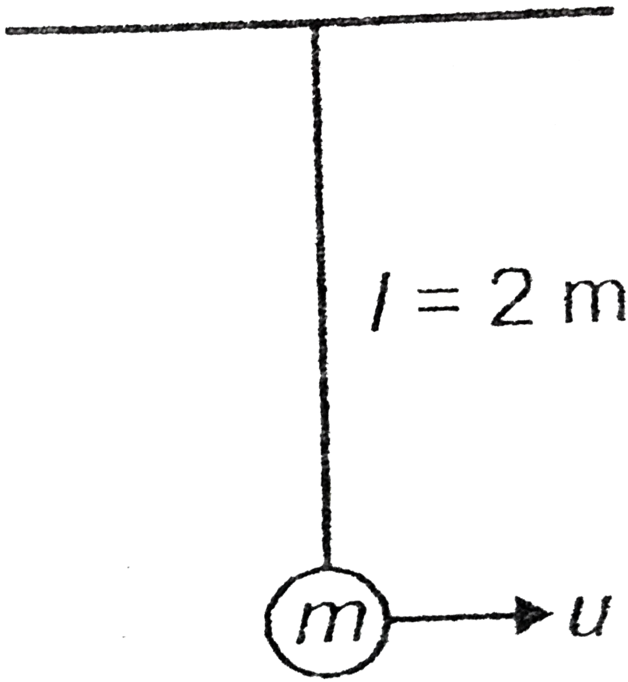
12. The work done by the force of gravity is 100 J



A. If bob is given an initial velocity $u = 12$ m/s it complete the loop

B. If $u = 8m/s$ maximum height attained by bob is 4 m

C. If $u = 10m/s$, maximum height attained by bob is 4 m

D. If $u = 2m/s$, it excautes oscillation

Answer: A::B::D

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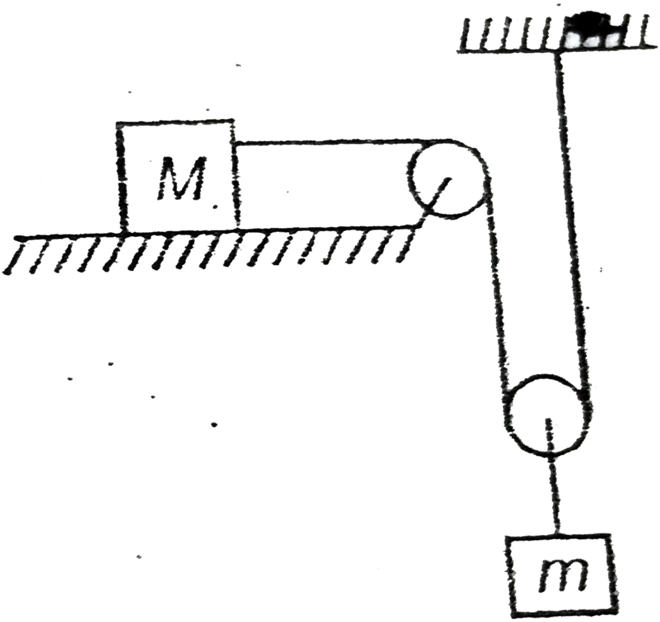
13. In the figure show $m = 1kg$, M = 2 kg. When smaller block (m) descends through 1m, it acquires a speed of 1 m/s. Take $g = m/s^2$ and choose the correct statements out of the following



A. When the speed of smaller block (m) is 1 m/s.

B. When the speed of smaller block (m) is 1 m/s,

the speed of bigger block is 2 m/s

C. Coefficient of kinetic friction between the bigger block (M) and horizontal surface is $\frac{13}{40}$

D. Coefficient of kinetic friction between the bigger block (M) and horizontal surface is $\frac{12}{80}$

Answer: B::D

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14. A light rigid rod of length l is hinged at one end and it is free to rotate in a vertical plane. A particle of mass m is attached to another end of the rod. The particle is released from rest at its highest point. Select the correct statement out of the following

A. Tension in the rod is zero when it makes an angle of $\cos^{-1}\left(\frac{1}{3}\right)$ with the vertical

B. Tension in the rod is zero when it makes an angle of $\cos^{-1}\left(\frac{2}{3}\right)$ with the vertical

C. Speed of partical of mass m is $\sqrt{\frac{2}{3}gl}$ when the tension in the rod is zero

D. Speed of particle of mass m is $\sqrt{\frac{4}{3}gl}$ when the tension in the rod is zero

Answer: B::C

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15. Potential energy of a system of particles is $U = \frac{\alpha}{3r^3} - \frac{\beta}{2r^2}$, where r is distance between the particles. Here α and β are positive constants. Which of the following are correct for the system?

A. Equlibrium separation between the particles is $\frac{\alpha}{\beta}$

B. For $r = \frac{\alpha}{\beta}$, the equlibrium is stable

C. For $r = \frac{\alpha}{\beta}$, the equlibrium is unstable

D. Work required to slowly move the particles to infinite separation from initial equlibrium position is $\frac{\beta}{\alpha}$

Answer: A::C

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

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

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

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

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

Answer: A::B::D

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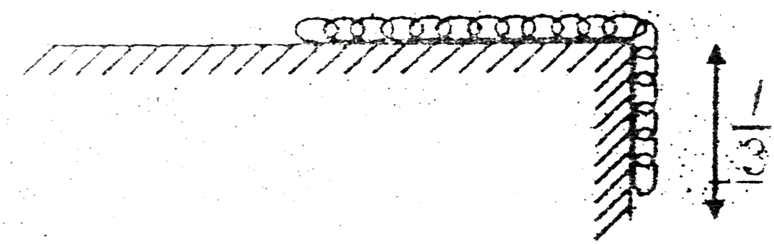
SECTION-D (LINKED COMPREHENSION TYPE QUESTIONS) (COMPREHENSION-I)

1. A uniform chain of mass m and length l is lying on a horizontal table with one-third of its length hanging over the edge of the table.



If the chain is limiting equlibrium, what is the coefficient of friction for the contact between table and chain?

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

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

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

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

Answer: A

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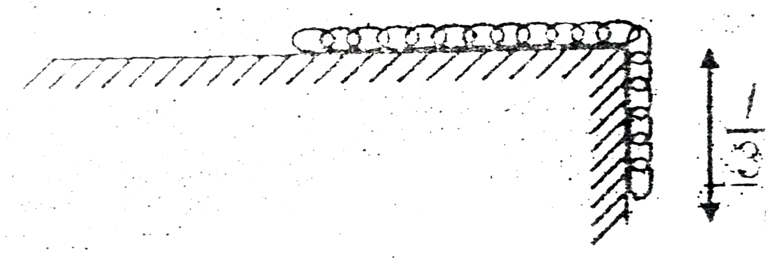
2. A uniform chain of mass m and length l is lying on a horizontal table with one-third of its length hanging over the edge of the table.



If a gentle push is given to hanging end, it will start moving down. What is the change in gravitational potential energy of the chain, as it just leaves the table?

A. $\frac{4mgl}{9}$

B. $-\frac{4mgl}{9}$

C. $\frac{17mgl}{18}$

D. $-\frac{mgl}{18}$

Answer: B

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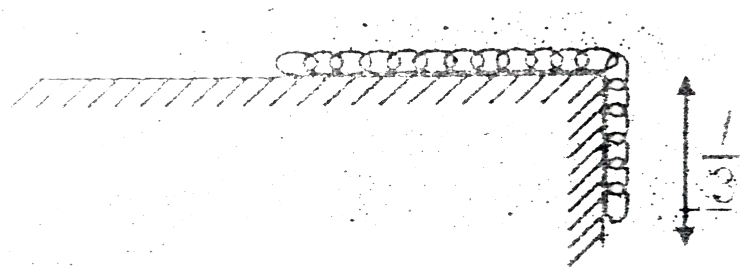
3. A uniform chain of mass m and length l is lying on a horizontal table with one-third of its length hanging over the edge of the table.



What is the speed of the chain, when it just loses contact with the table?

A. $\sqrt{2gl}$

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

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

D. $\sqrt{gl}$

Answer: C

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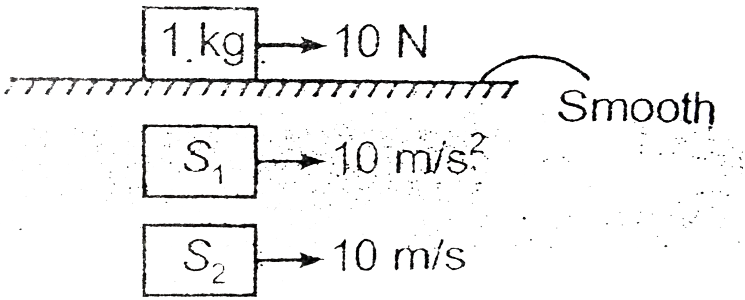
SECTION-D (LINKED COMPREHENSION TYPE QUESTIONS) (COMPREHENSION-II)

1. A constant force of 10 N act on a block as shown in figure initial velocity of the block is zero. It is observed from three frames of reference S_1, S_2 and ground. The frame S_1 start from rest and move with constnat acceleration $10m/s2$. The frames S_1 and S_2 and particle start moving simultaneously at $t = 0$.



Work done on block in 1 s as observed from frame S_1 is

A. 50 J

B. $-50J$

C. 100 J

D. Zero

Answer: D

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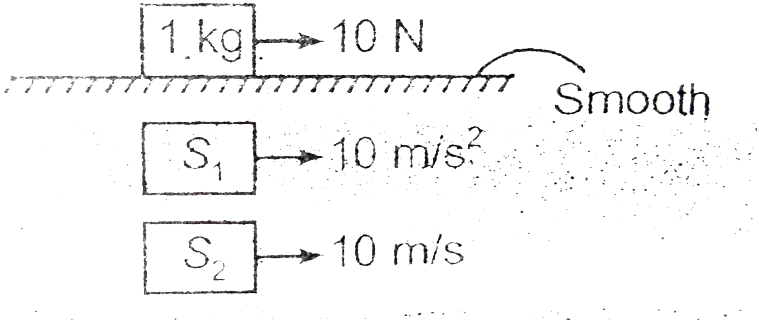
2. A constant force of 10 N act on a block as shown in figure initial velocity of the block is zero. It is observed from three frames of reference S_1, S_2 and ground. The frame S_1 start from rest and move with constnat acceleration $10m/s2.$ The frames S_1 and S_2 and block start moving simultaneously at $t=0.$



Net work done on block in 1 s as observed from frame S_2 is

A. 50 J

B. $-50J$

C. 100 J

D. Zero

Answer: B

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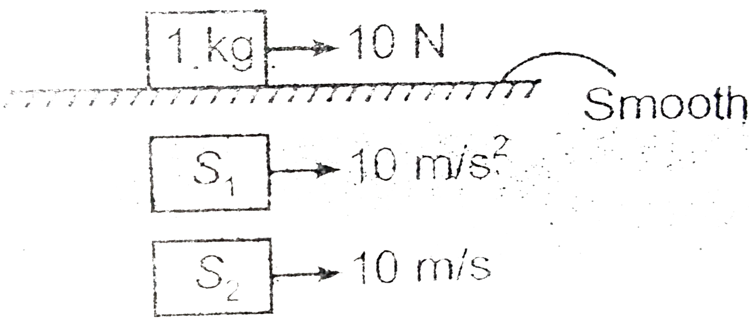
3. A constatnt force of 10 N act on a block as shown in figure intal velocity of the particle is zero. It is observed from three frames of reference S_1, S_2 and ground. The frame S_1 start from rest and move with constnat acceleration $10m / s$. The frames S_1 and S_2 and particle start moving simultaneously at $t = 0$.



The rate at which work is done by constant force on the particle is always non-negative when observed fom

A. S_1 only

B. S_1 and ground

C. S_2 only

D. S_1, S_2 and ground

Answer: B

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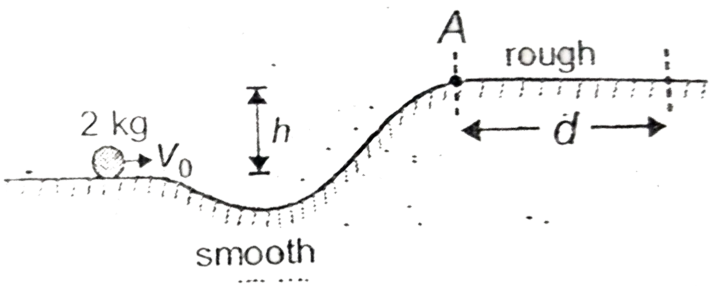
SECTION-D (LINKED COMPREHENSION TYPE QUESTIONS) (COMPREHENSION-III)

1. In the arrangement show in figure, the track is frictionless until the body reaches the higher level. A frictional force stops the body in a distance d from A. The initial speed of the body v_0 is 6 m/s the height h is 1 m and the coefficient of kinetic friction is 0.2.



The speed of body at the higher level A is

A. 3 m/s

B. 4 m/s

C. 5 m/s

D. 4.25 m/s

Answer: B

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2. In the arrangement shown in figure, the track is frictionless until the body reaches the higher level. A frictional force stops the body in a distance d from A. The initial speed of the body v_0 is 6 m/s the height h is 1 m and the coefficient of kinetic friction is 0.2. What is the maximum distance d travelled by body on rough surface?

A. 3 m

B. 4 m

C. 5 m

D. 4.25 m

Answer: B

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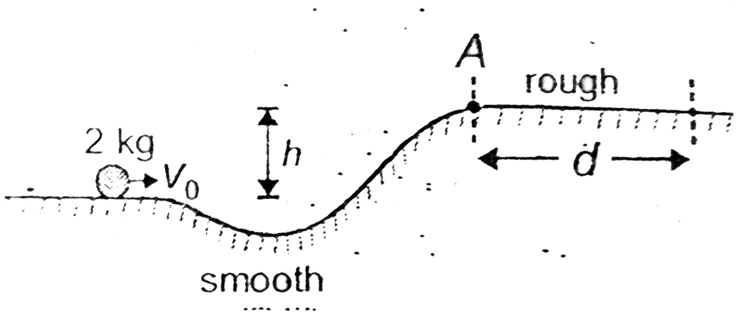
3. In the arrangement show in figure, the track is frictionless until the body reaches the higher level. A frictional force stops the body in a distance d from A. The initial speed of the body v_0 is 6 m/s the height h is 1 m and the coefficient of kinetic friction is 0.2.



What is the work done by friction force on the body during the motion.

A. $-30J$

B. $-15J$

C. $-16J$

D. $-20J$

Answer: C

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SECTION-D (LINKED COMPREHENSION TYPE QUESTIONS) (COMPREHENSION-IV)

1. A particle of mass m moves along a horizontal circle of radius R such that normal acceleration of particle varies with time as $a_n = kt^2$. where k is a constant.

Tangential force on particle at t s is

A. $2m\sqrt{k}R$

B. $m\sqrt{k}R$

C. $\frac{m}{2}\sqrt{kR}$

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

Answer: B

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2. A particle of mass m moves along a horizontal circle of radius R such that normal acceleration of particle varies with time as $a_n = kt^2$. where k is a constant.

Total force on particle at time t s is

A. $m\sqrt{k(R^2 + kt^4)}$

B. $m\sqrt{k(R + kt^4)}$

C. $2m\sqrt{k(R + kt^4)}$

D. $\frac{m}{2}\sqrt{k(R + kt^4)}$

Answer: B

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3. A particle of mass m moves along a horizontal circle of radius R such that normal acceleration of particle varies with time as $a_n = kt^2$. where k is a constant.

Power developed by total at time T is

A. $\frac{mkRT}{3}$

B. $2mkRT$

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

D. mkRT

Answer: D

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SECTION-E (ASSERTION-REASON TYPE QUESTIONS)

1. A partical moves in a conservation filed with no other forces acting on it. At a given instant, the kinetic energy of the particle is 0.5 J and potential energy is $-0.3H$.

STATEMENT 1 The particle must escape the field at same instant of time

STATEMENT 2. The total machanical energy of the particle is positive.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: A

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2. STATEMENT-1 The kinetic energy gradient is proportional to acceleration of a particle moving along a straight line.

STATEMENT-2: Work done by net force is equal to increase in kinetic energy of a particle.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: A

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3. STATEMENT-1 The work done on a body by spring force is always negative.

STATEMENT-2 The force acting on a body due to the spring always tries to decreases the extension or compression of friction.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-2

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-2

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: D

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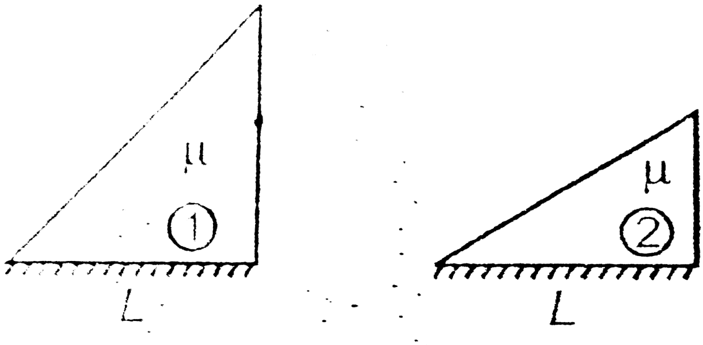
4. Consider a block of mass m that slides down the different inclined planes having same base legth L and same coefficient of friction.



STATEMENT-1 Work done by force of friction will be same for the motion of the two inclined planes.

STATEMENT-2 Frictional force is a conservation force.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-4

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for

Statement-4

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: C

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5. STATEMENT-1 When a conservative force performs positive work on a body, potential energy of the system decreases.

STATEMENT-2 Work done by a conservative force does not produce any change in kinetic energy.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-5

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-5

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: C

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6. STATEMENT-1 Work done by a force depends on the frame of reference.

STATEMENT-2 Displacement of a body is different in different frames of reference.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: A

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7. STATEMENT-1 Positive potential energy means that a positive work will be done on the body by the conservative force while returning to its reference position.

STATEMENT-2 The absolute value of potential energy depends on reference.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: B

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8. STATEMENT-1 Work done by gravity in raising a box onto a platform does not depend on how fast it is raised

STATEMENT-2 Work done depends only on force and displacement

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: C

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9. STATEMENT-1 Work done by static friction in any reference frame is zero

STATEMENT-2 If work done on the body is positive its kinetic energy increases.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for

Statement-9

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-9

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: D

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SECTION-F (MATRIX-MATCH TYPE QUESTIONS)

1. A girl is swinging in a swing with a constant angular amplitude 60°. Force constnat of the cushion on which she sits is K. Strings of swing are massless and extensible. Assuming highest point as Datum, match the entries in column I and II

Column I	Column II
(A) At the lowest point of swing	(p) Kinetic energy is maximum
(B) The instant at which potential energy in string is maximum	(q) Elastic potential energy is ma
(C) The instant at which potential energy in the cushion is minimum	(r) Kinetic energy is minimum
(D) The instant at which tangential acceleration is minimum	(s) Gravitational potential energy

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2. Match the following

Column I	Column II
(A) Force of friction	(p) Change in kinetic energy
(B) Normal reaction on a block kept on horizontal ground	(q) Change in mechanical energy
(C) Work done by all forces	(r) Can be less than mg
(D) Work done by all forces other than conservative forces	(s) May be equal to mg

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3. Match the following

Column I	Column II
(A) Momentum of particle is increases by 100%. Corresponding change in kinetic energy of particle is	(p) 10%
(B) Kinetic energy of particle is decreased by 100%. Corresponding change in momentum of particle is	(q) 2%
(C) Momentum of particle is increases by 1%. Corresponding change in kinetic energy of particle is	(r) 100%
(D) Kinetic energy of particle is increase by 21%. Corresponding change in momentum of particle is	(s) 300%

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4. The potential energy for a conservative system is given by $U = \frac{x^3}{3} - \frac{5x^2}{2} + 6x + 3$. Match all the entries in Column I to all the entries in Column II.

Column I	Column II
(A) The magnitude of net force on particle at $x = 0$	(p) $\frac{23}{3}$
(B) The equilibrium positions are	(q) 2
(C) The stable equilibrium position is	(r) 3
(D) Potential energy at unstable equilibrium	(s) 6

5. Column II lists some expression of force and potential energy. Match the entries in column I with the expression in column II.

Column I	Column II
(A) Force acting on the particle is constant	(p) $\vec{F} = y\hat{i}$
(B) Force on the particle is non-conservative	(q) $\vec{F} = x\hat{i}$
(C) At origin the particle will be in equilibrium	(r) $\vec{F} = (10 - 2x)\hat{i}$
(D) Particle can be in stable equilibrium at some points	(s) $U = (x^2 - 25)$
	(t) $U = 10x$

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SECTION-G (INTEGER ANSWER TYPE QUESTIONS)

1. A particle experience a force of 10 N which is constant in magnitude and is always acting towards origin. Calculate the work done by the force on the particle during its displacement from $(1, 2, 3)$ to $(-1, -2, 3)$:

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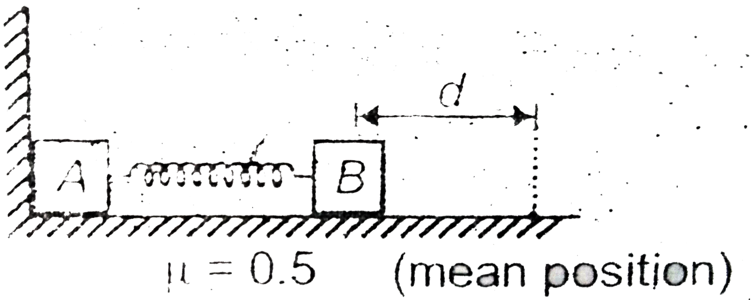
2. A block A has a mass $m_1 = 2kg$ and is attached to a spring of spring constant 50 N/m. Another block of mass 4 kg is pressed against A, so that the spring is compressed by a distance d. Then find the maximum value of d (in metre) for which on release of B. the block A does no lose contact from wall. (Friction coefficient $\mu = 0.5$).



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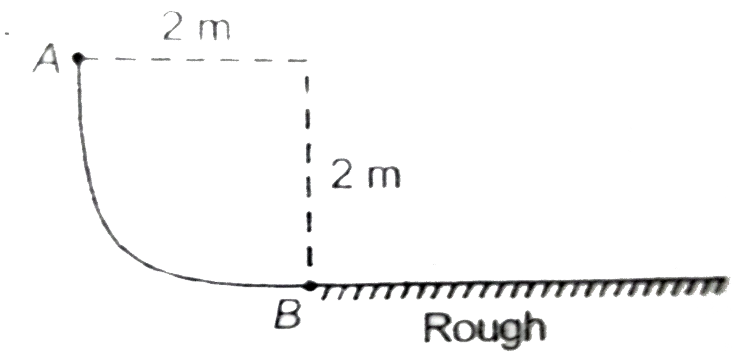
3. A block is released at A and slides on smooth surface in shape of quarter circel. The horizontal part is rough if the block comes to rest 1.0 m away from B, then what is the coefficient of kinetic friction?



4. A particle is acted upon by a force $\vec{F} = y\hat{i} + x\hat{j}$ newton. When the particle is moved from (1 m, 1 m) to (9m, 3 m) via straight path, work done by $\vec{F}$ is y. What is the value of $\frac{x}{y}$?

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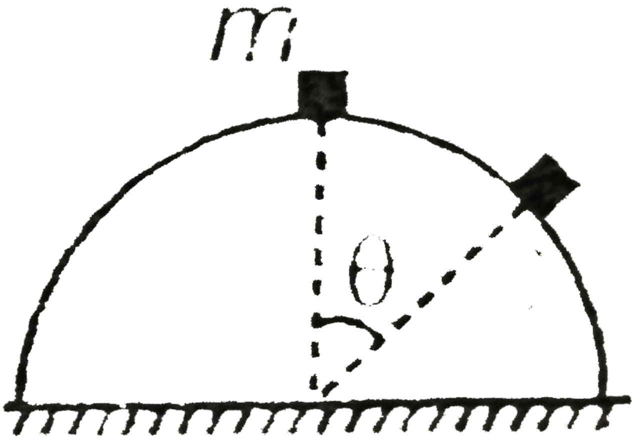
5. A particle of mass m is placed in equilibrium at the top of a fixed rough hemisphere of radius R. Now the particle leaves the contact with the surface of the hemisphere at angular position θ with the vertical where $\cos\theta = \frac{3}{5}$. if the work done against friction is $\frac{2mgR}{10x}$, find x.



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6. Under the action of foece, 1 kg body moves such that its position x as a function of time t is given by $x = \frac{t^3}{3}$, x is meter. Calculate the work done (in joules) by the force in first 2 seconds.

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SECTION-H (MULTIPLE TRUE FALSE TYPE QUESTIONS)

1. STATEMENT-1: Work done by the net force acting on a particle is equal to the change in its kinetic energy.

STATEMENT-2: Change in potential energy is always equal to the work done by external forces.

STATEMENT-3: Work energy theorem is not applicable, if the work is done by the non-conservative forces

A. T T F

B. T F T

C. T F F

D. F T T

Answer: C

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2. STATEMENT-1: Work-energy theorem is consequence of Newton's laws of motion.

STATEMENT-2: The work done by a conservative force along a closed path is zero.

STATEMENT3: Work done by a constant force is independent of the path.

A. T T T

B. T F T

C. F F T

D. F F F

Answer: A

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3. STATEMENT-1: Potential energy has a minimum at the position of stable equilibrium.

STATEMENT-2: Mechanical energy of a system is always positive

STATEMENT 3-: Work done by the friction may be positive

identify the correct combination of true (T) and false (F) of the given three statements

A. T F T

B. T T T

C. F F T

D. F F F

Answer: A

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4. Choose the correct combination of true (T) or fale (F) for the statements.

STATEMENT-1: A particle may be accelerating in a reference frame even if net extermal force on the particle is zero.

STATEMENT-2: Newton's laws are valid only in frames at rest.

STATEMENT-3: Work done by a force depends on reference frame.

A. T T T

B. T F T

C. F F T

D. F F F

Answer: B

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5. STATEMENT-1: When a machine gun fires n bullets per second each with kinetic energy k, power of the gun is P = nk

STATEMENT-2: Power P = work done/time.

STATEMENT-3: For uniform circular motion the instantaneous power delivered by centripetal force is always zero.

A. T T T

B. F F F

C. T T F

D. F T T

Answer: A

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6. A man rowing a boat upstream is at rest with respect the bank.

STATEMENT-1: The man is doing no work with respect to ground.

STATEMENT-2: The man is doing a positive work with respect to stream.

STATEMENT-3: Work done does not depend in frame of reference.

A. T T T

B. T T F

C. T F F

D. F F T

Answer: B

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7. STATEMENT -1: Work done on a body A by B must be equal and opposite and the work done by A on B

STATEMENT-2: if body undergoes a displacement under the action of a force, then the force must have done some work.

STATEMENT-3: When we climb the stairs, it is the work done by the stairs which increases our potential energy.

A. F F F

B. T T T

C. T T F

D. F T F

Answer: A

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8. STATEMENT-1: Kilowatt hour is a unit of power

STATEMENT-2: Work done energy have same SI units.

STATEMENT-3: Dimensions of work is ML^2T^2.

A. F F F

B. F T T

C. T T F

D. F T F

Answer: B

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9. STATEMENT-1: If a car and truck hacve same momentum then the tr5uck has more kinetic energy

STATEMENT-2: If a car and truck have same kinetic energy then the truck has more momentum.

STATEMENT-3: If a car and truck have same kinetic energy then both have same momentum

A. T T F

B. F F T

C. F T F

D. T F T

Answer: C

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10. STATEMENT-1: If a spring is elongated it does positive work

STATEMENT-2: If a spring is compressed it foes negative work

STATEMENT-3: Spring does not work whether it is elongated or compressed as it is non-living

A. T T F

B. T F F

C. F T T

D. F T F

Answer: D

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SECTION-I (SUBJECTIVE TYPE QUESTIONS)

1. A box of mass 200 kg is kept on a rough horizontal floor having coefficient of static friction $\mu_s = 0.25$ and coefficient kinetic friction $\mu_k = 0.2.$ Find the work done by a man to slide the body slowly through 20 m with a minimum force. Also find the magnitude of the minimum force.

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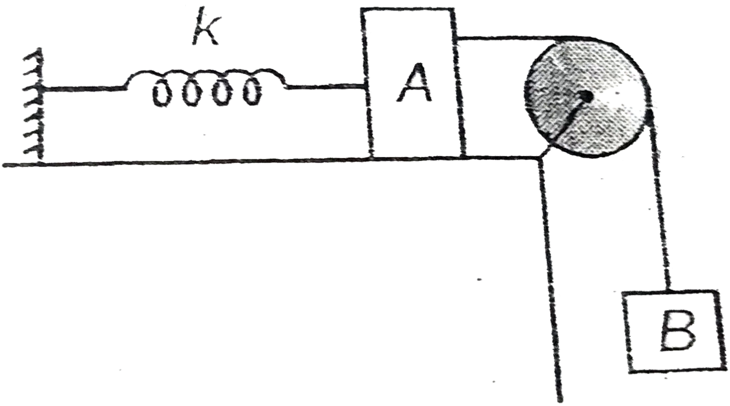
2. Consider the situation shown in figure.



Mass of block A is m and that of blcok B is 2m. The force constant of string is k. Friction is absent everywhere. System is released from rest with the spring unstretched. Find

(a) The maximum extension of the spring x_m

(b) The speed of block A when the extension in the springt is $x = \frac{x_m}{2}$

(c) The net acceleration of block B when extension in the spring is $x = \frac{x_m}{4}$.

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3. A block of mass m is pulled by a constant power P placed on a rough horizontal plane. The friction coefficient between the block and the surface is μ. Maximum velocity of the block will be

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4. Starting form rest, a body slides down a 45° inclined plane in twice the time it takes to slide down the same distance in the absence of friction. The coefficient of friction between the body and the inclined plane is

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5. A bullet of mass 20 g travelling horizontally at $100ms^{-1}$ gets embedded at the centre of a block of wood of mass 1kg, suspended by a light vertical string of 1m in length. Calculate the maximum inclination of the string to the vertical.

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6. A cord is used to lower vertically a block of mass M by a distance d with constant downward acceleration $\frac{g}{4}$. Work done by the cord on the block is

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SECTION-J (AAKASH CHALLENGERS QUESTIONS)

1. Rain drops each of mass m falling from rest in air experience an upward force given by f= - bv where b

is a constant and v is velocity of the drop. Using work energy theorem, derive an expression for

(A) $v = f(t)$ i.e. velocity function of time.

(B) $\frac{dE}{dt} = f(t)$ where E = Total mechanical energy of the rain drop

(C) Draw the graphs $\frac{dE}{dt}, \frac{dU}{dt}$ and P_{viscous} as a function of time U is potential energy and P represent power ?

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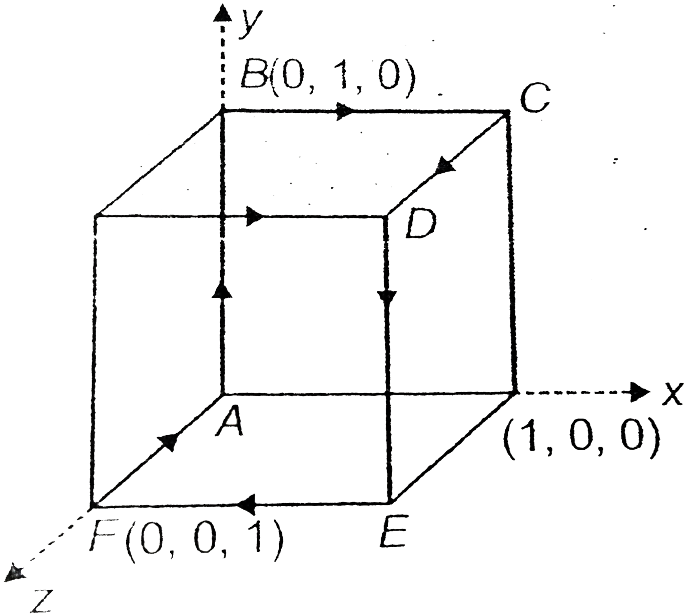
2. A particle is moved foom the orgin A, back to the origin, along the path ABCDEFA as shown in figure



(A) Find the work done by the force $\overrightarrow{F} = y\hat{i} + z\hat{j} + x\hat{k}$ acting on the particle, in the round trip?

(B) Is the force given in part (A) conservative?

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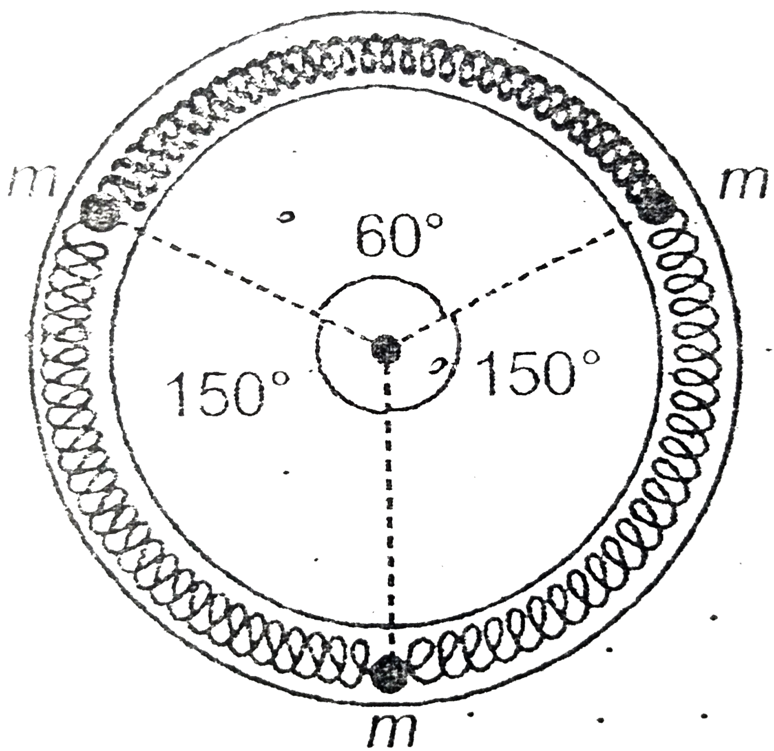
3. Three particeles each of mass m are converted by three identical speings each of stiffness k. The rings and springs can slide along a smooth vertical rigid circular wire of radius R. Find the potential energy of the system relative to the centre O.



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4. In a simple pendulum, the breaking strength of the string is double the weight of the bob. The bob is released from rest when the string is horizontal. The string breaks when it makes an angle θ with the vertical.

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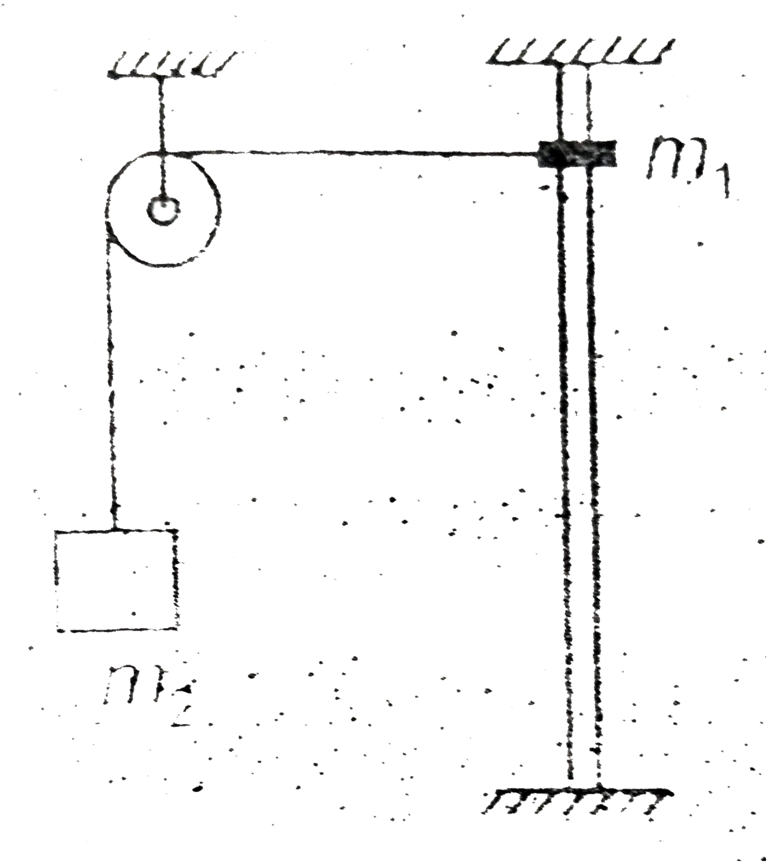
5. A smooth ring of mass $m1$ connected with a hanging block of mass $m2$, by a long inextensible string, is released from rest. The ring moves vertically along a fixed rigid rod as shown in figure.

Describe the motion of the ring if

(A) $m1 = 2m2$

(B) $m1 = m2$

(C) $m1 = \frac{m2}{2}$



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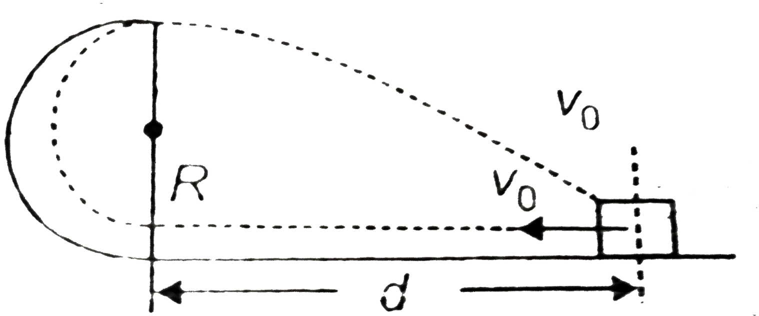
6. A block is projected with a speed v_0 strikes the point pf projection after describing the path as shown in figure by dotted line. If friction exists for the path of length d and the vertical circular path is smooth, assuming coefficient of frictioin to be μ



(A) Find v_0?

(B) What is the minimum value of v_0 ?

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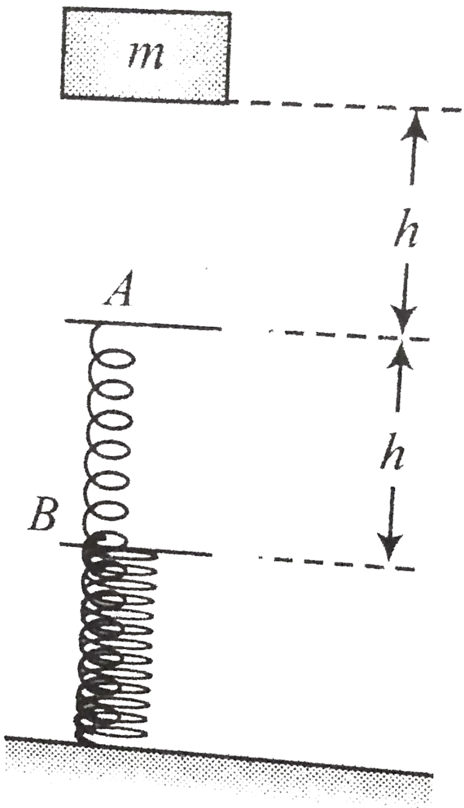
7. A block of mass m is released from rest onto a spring. A having stiffness $k_A = mg/2h$ as shown in figure. If the block compresses spring B through a distance h, find the:



a. stiffness of the spring B

b. equilibrium position of the block

c. maximum velocity of the block

d. maximum acceleration of the block

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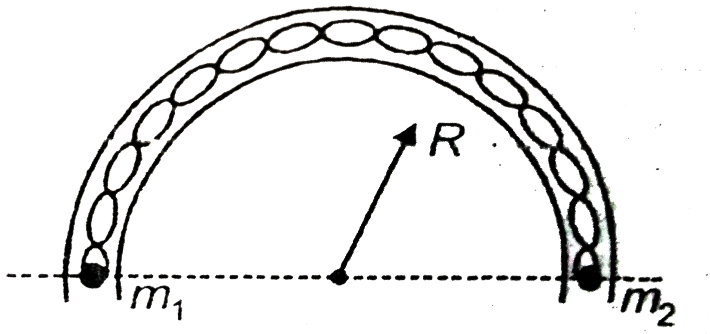
8. Two beads of masses m_1 and m_2 connected by an inextensible string are kept at rest at the horizontal diametrical points of a fixed smooth vertical semicircular tube. If the beads are released from the given position, find their speeds as the function of vertical distance y converted by mass

m_2.



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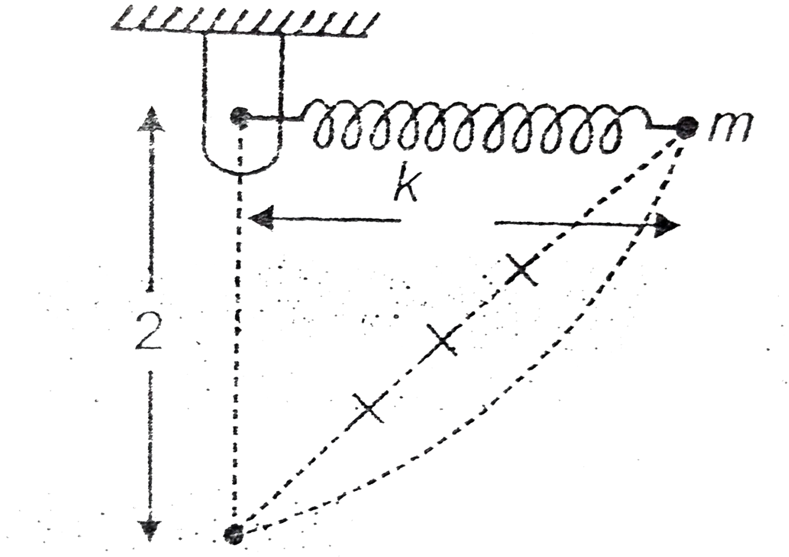
9. A partical of mass m attached with a massless spring of natural length l and stiffness constant k is releaased from rest from the horizontal positon of the relaxed spring.



When the particle passes through its lowest point, the maximum length of the spring bocomes 2l find the

(A) Speed of the particle at its lowest point

(B) Acceleration of the particle at its lowest position.

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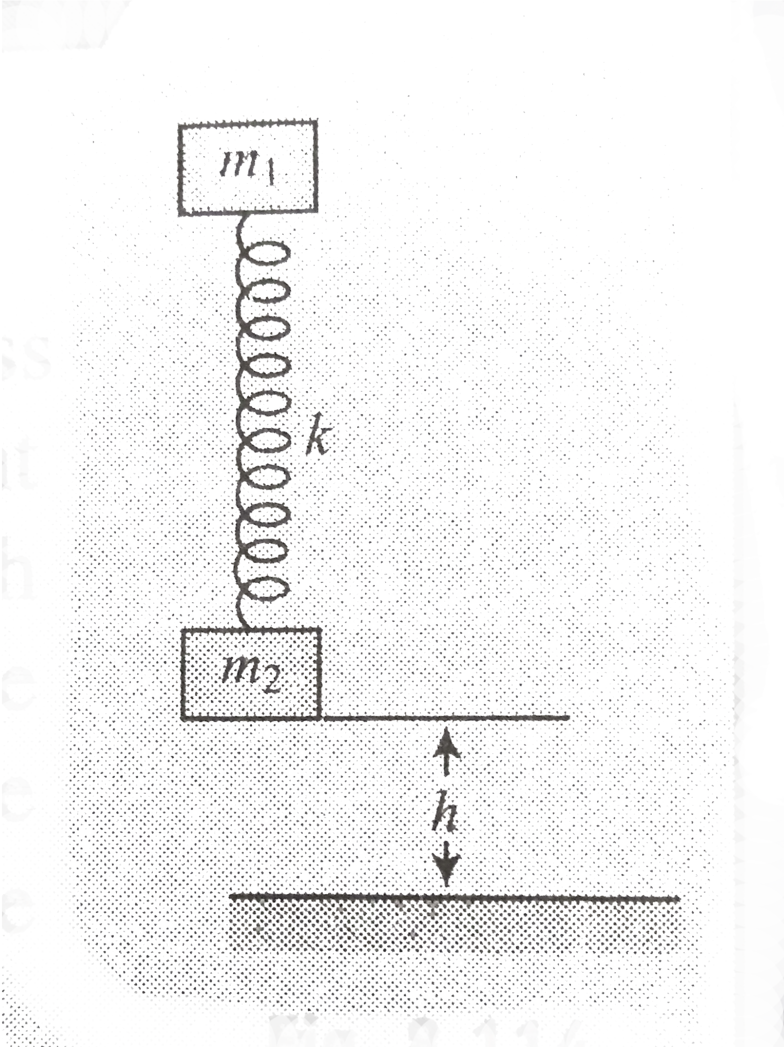
10. A spring-mass system (m_1 + massless spring + m_2) fall freely from a height h before m_2 colliding inelastically with the ground. Find the minimum value of h so that block m_2 will break off the surface. Assume k=stiffness of the spring.



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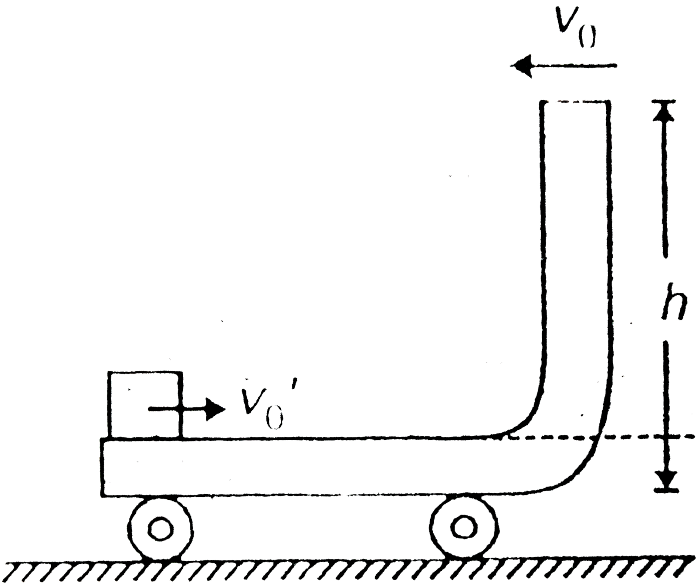
11. A smooth sledge is moving with constant velocity v_0 toward left. A block is pushed toward right with a velocity v_0’ (relative to ground).



(A) Find the velocity with which the block escapes from the sledge and necessary critical v_0 for escaping from the sledge

(B) Will the block launch onto the sledge again?

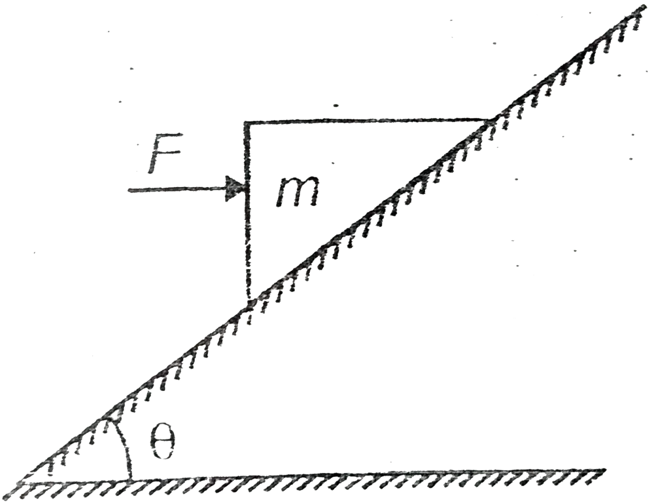
Watch Video Solution

12. A prismatic block of mass m is lifted through a distanced along the slant. If the coefficient of friction between the block and slant surface is 1μ. find the

(A) Work done by force F, friction and gravity.

(B) Speed of the block after moving through a distance d.

Assuming, $\mu = 1/6, \theta = 45\%^{\circ}$ and $F = 2mg$



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13. Discuss the stability of an atom in a molecule possessing Lennard-joners potential energy function

$$U(x) = 4\varepsilon\left[\left(\frac{\alpha}{x}\right)^{12} - \left(\frac{\alpha}{x}\right)^{6}\right]$$

where x=separation between the atoms, $\alpha = 0.263$ nm and $\varepsilon = 1.5 \times 10^{-22} J$

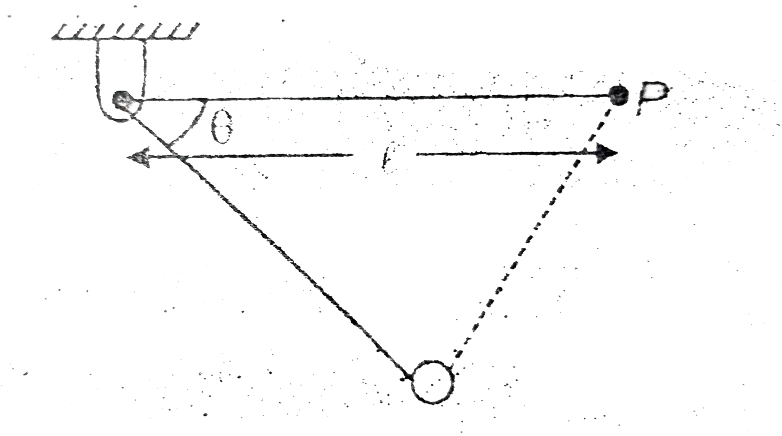
Watch Video Solution

14. A pendulum bob swing from the point P when the ideal string of length l is horizontal. Find the

(A) Speed

(B) Acceleration of the bob

(C) Power delivered by gravity at an angular position θ



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EXERCISE

1. A particle moves from point P(1,2,3) to (2,1,4) under the action of a constant force $F = \left(2\hat{i} + \hat{j} + \hat{k}\right)N$. Work done by the force is

A. 2 J

B. 4 J

C. 16 J

D. 8 J

Answer: A

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2. Which of the following vector is perpendiuclar to the vector $\overrightarrow{A} = 2\hat{i} + 3\hat{j} + 4\hat{k}$?

A. $\hat{i} + \hat{j} + \hat{k}$

B. $4\hat{i} + 3\hat{j} - 2\hat{k}$

C. $\hat{i} + 3\hat{j} + \hat{k}$

D. $\hat{i} + 2\hat{j} - 2\hat{k}$

Answer: D

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3. A block of mass 2 kg is plased on a smooth horizontal surface. Two forces $F_1 = 20$ N and $F_2 = 5$ N start acting on the block in opposite directions as shown. If block gets displaced by 5 m in the direction of net force then work done by F_2 is

:-

A. $-75J$

B. $75J$

C. $-25J$

D. $25J$

Answer: C

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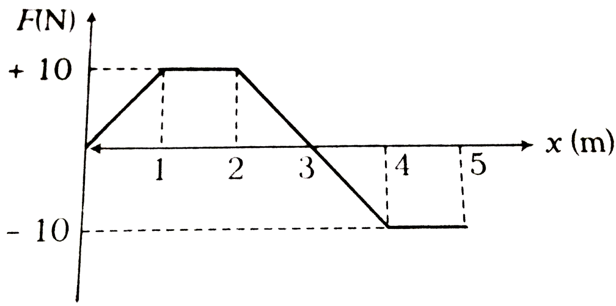
4. A position dependent force F ia acting on a particle and its force-position curve is shown in the figure. Work done on the particle, when its displacement is from 0 to 5 m is



A. 35 J

B. 25 J

C. 15 J

D. 5 J

Answer: D

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5. A man of mass 50 kg is standing in an elevator. If elevator is moving up with an acceleration $\frac{g}{3}$ then work done by normal reaction of elevator floor on man when elevator moves by a distance 12 m is $(g = 10m/s^2)$:-

A. 2000 J

B. 4000 J

C. 6000 J

D. 8000 J

Answer: D

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6. A particle moves along x - axis under the action of a position dependent force $F = (5x^2 - 2x)N$. Work done by force on the particle when it moves from origin to x = 3 m is

A. 45 J

B. 36 J

C. 32 J

D. 42 J

Answer: B

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7. What should be the angel between the direction of force and displacement for maximum and minimum work?

A. 90° and 0°

B. 0° and 90°

C. 0° and 180°

D. 180° and 0°

Answer: C

8. A body constrained to move along y-axis is subjected to a constant force $\overrightarrow{F} = -\hat{i} + 2\hat{j} + 3\hat{k}N$. The work done by this force in moving the body a distance of 4 m along y-axis is

A. 8 J

B. 4 J

C. 2 J

D. 6 J

Answer: A

Watch Video Solution

9. A cubical vessal of height 1 m is full of water. What is the amount of work done in pumping water out of the vessel ? (Take , $g = 10ms^2$)

A. 5000 J

B. 10000 J

C. 5 J

D. 10 J

Answer: A

Watch Video Solution

10. A person pulls a bucket of water from a well of depth h. if the mass of uniform rope is m and that of the bucket full of water is M, then work done by the person is.

A. $\left(\frac{M}{2+m}\right)gh$

B. $\left(\frac{M+m}{2}\right)gh$

C. $\left(M+\frac{m}{2}\right)gh$

D. $(M+m)gh$

Answer: C

Watch Video Solution

11. Force constants K_1 and K_2 of two springs are in the ratio $5:4$. They are stretched by same length. If potential energy stored in one spring is 25 J then potential energy stored in second spring is

A. 25 J

B. 16 J

C. 100 J

D. 20 J

Answer: D

Watch Video Solution

12. Two springs have their force constants in the ratio of $3:4$. Both the springs are stretched by applying equal force F. If elongation in first spring is x then elogation is second spring is

A. $3x$

B. $4x$

C. $\frac{4}{3}x$

D. $\frac{3}{4}x$

Answer: D

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13. A particle of mass 3 kg is moving along x - axis and its position at time t is given by equation $x = (2t^2 + 5)m$. Work done by all the force acting on it in time interval $t = 0$ to $t = 3s$ is

A. 144 J

B. 72 J

C. 108 J

D. 216 J

Answer: D

Watch Video Solution

14. A force $\overrightarrow{F} = \left(2\hat{i} + \hat{j} + \hat{k}\right)N$ is acting on a particle moving with constant velocity $\overrightarrow{v} = \left(\hat{i} + 2\hat{j} + \hat{k}\right)m/s$. Power delivered by force is

A. 4 watt

B. 5 watt

C. 6 watt

D. 8 watt

Answer: B

Watch Video Solution

15. Potential energy of a particle at position x is given by $U = x^2 - 5x$. Which of the following is equilibrium position of the particle?

A. $x = 0$

B. $x = 5$

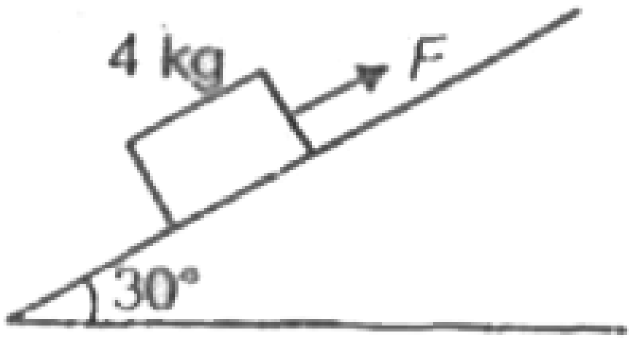
C. $x = 2.5$

D. $x = 7.5$

Answer: C

Watch Video Solution

16. A block of mass 4 kg is pulled along a smooth inclined plane of inclination 30° with constant velocity 3 m/s as shown, power delivered by the force is



A. 40 watt

B. 20 wall

C. 60 watt

D. 30 watt

Answer: C

Watch Video Solution

17. A stone is tied to one end of a light inexensible string of length l and made to roate on a vertical circle keeping other end of the spring at the centre. If speed of stone at the highest point is $v(v > \sqrt{gl})$ then its speed at the lowest point is

A. $\sqrt{4gl}$

B. $\sqrt{v^2 + 2gl}$

C. $\sqrt{v^2 + gl}$

D. $\sqrt{v^2 + 4gl}$

Answer: D

Watch Video Solution

18. From a waterfall, water is falling down at the rate of 100kg / s on the blades of turbine. If the height of the fall is 100 m , then the power delivered to the turbine is approximately equal to

A. 100 kW

B. 0.1 kW

C. 10 kW

D. 1 kW

Answer: A

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

A. $\sqrt{t}$

B. $t^{3/2}$

C. $t^{3/4}$

D. t^2

Answer: B

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20. In perfectly elastic collision between two masses m_1 and m_2 in one dimension energy transfer is a maximum, when

A. $m_1 = 2m_2$

B. $m_1 < < m_2$

C. $m_1 > > m_2$

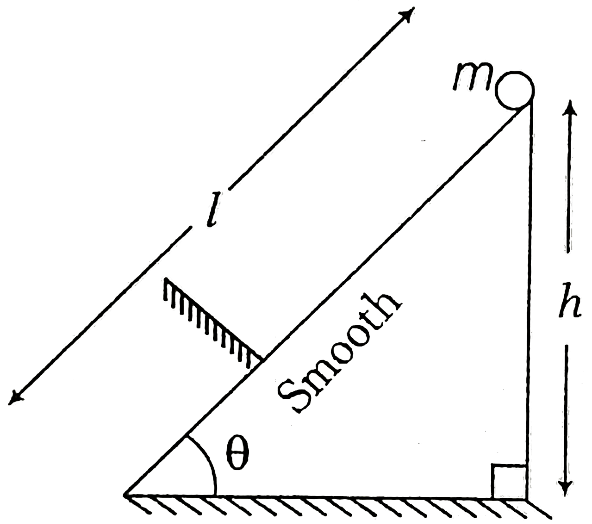
D. $m_1 = m_2$

Answer: D

Watch Video Solution

21. A ball of mass mis released from the top of an inclined plane of inclination θ as shown. It strikes a rigid surface at at a distance $\frac{3l}{4}$ from top elastically.

Impulse imparted to ball by the rigid surface is



A. $m\sqrt{\frac{3}{2}gh}$

B. $m\sqrt{3gh}$

C. $2m\sqrt{3gh}$

D. $m\sqrt{6gh}$

Answer: D

Watch Video Solution

22. Two identical balls each of mass 4 kg are moving towards each other with speeds 2 m/s and 3 m/s respectively. They undergo head on perfectly elastic collision. Then impulse imparted by one ball on other is

A. 12 Ns

B. 8 Ns

C. 20 Ns

D. 40 Ns

Answer: C

Watch Video Solution

23. A ball of mass 4 kg moving on a smooth horizontal surface makes an elastic collision with another ball of mass m at rest in the line of motion of first ball. If after collision first ball moves in the same direction with one fourth of its velocity before collision, then mass of second ball is

A. 4 kg

B. 4.4 kg

C. 2.4 kg

D. 2 kg

Answer: C

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24. A heavy vehicle moving with velocity 15 m/s strikes an object of very small mass at rest head on elastically. Velocity of object ater collision is

A. 15 m/s

B. 25 m/s

C. 20 m/s

D. 30 m/s

Answer: D

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25. Two balls of equal masses m each undergo oblique collision. If colision is perfectly elastic, then angle between their velocities after collision is

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

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

C. $\frac{\pi}{6}$

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

Answer: D

Watch Video Solution

26. A ball falls from a height such that it strikes the floor of lift at 10 m/s. If lift is moving in the upward direction with a velocity 1 m/s, then velocity with which the ball rebounds after elastic collision will be

A. 11 m/s

B. 12 m/s

C. 13 m/s

D. 9 m/s

Answer: B

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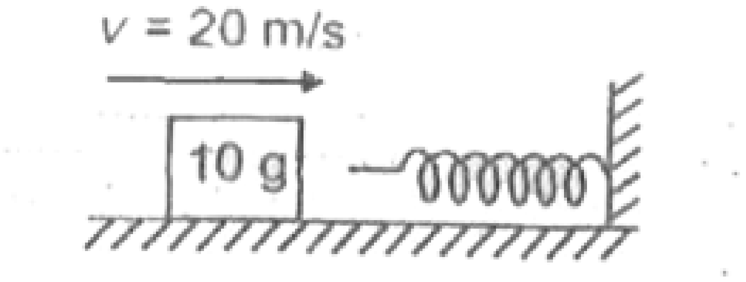
27. A block of 10 g slides on smooth horizontal surface with 20 m/s towards a spring of spring constant 100 N/m placed horizontally (as shown in figure). The maximum compression in spring is



A. 2 m

B. 0.2 m

C. 20 m

D. $\frac{4}{3}m$

Answer: B

Watch Video Solution

28. Two steel balls A and B of mass 10 kg and 10 g rolls towards each other with 5m/s and 1 m/s respectively on a smooth floor. After collision, with what speed B moves [perfectly elastic collision]?

A. 8 m/s

B. 10 m/s

C. 11 m/s

D. Zero

Answer: C

Watch Video Solution

29. Two ivory balls are placed together at rest. A third identical ball moving with velocity u in the line of first two balls, as shown in figure collide head on elastically then

A. Thrid ball comes to rest with second ball while first ball moves with speed u

B. Third ball comes to rest and other two move together with speed $\frac{u}{2}$

C. All three ball move together with speed $\frac{u}{3}$

D. All three ball move in such a manner each makes angle 120° to each other

Answer: A

Watch Video Solution

30. A ball is dropped from height h on horizontal floor. If it loses 60% of its energy on hitting the floor then height upto which it will rise after first rebounce is

A. $\frac{h}{5}$

B. $\frac{2h}{5}$

C. $\frac{3h}{5}$

D. $\frac{4h}{5}$

Answer: B

Watch Video Solution

31. Two cars of same mass are moving with velocities v_1 and v_2 respectively. If they are stopped by supplying same breaking power in time t_1 and t_2 respectively then $\frac{v_1}{v_2}$ is

A. $\frac{t_1}{t_2}$

B. $\frac{t_1^2}{t_2^2}$

C. $m\frac{t_1}{t_2}$

D. $\sqrt{\frac{t_1}{t_2}}$

Answer: D

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32. Two identical balls moving in opposite directions with speed 20 m/s and 25 m/s undergo head on perfectly inelastic collision. The speed of combined mass after collision is

A. 20 m/s

B. 22.5 m/s

C. 25 m/s

D. 2.5 m/s

Answer: D

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33. A ball of mass 5 kg moving with speed 8 m/s collides head on with another stationary ball of mass 15 kg. If collision is perfectly inelastic, then loss in kinetic energ is

A. 160 J

B. 80 J

C. 40 J

D. 120 J

Answer: D

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34. A ball dropped from height h on a horizontal floor goes up to the height $\frac{3h}{4}$ after hitting the floor. Fraction of energy of ball lost in the impact is

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

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

C. $\frac{3}{5}$

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

Answer: D

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35. Two identical balls each moving with speed v at right angle to each other collide perfectly inelastically. Their speed after collision is

A. v

B. sqrt2v`

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

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

Answer: D

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36. A ball is dropped on a horizontal surface from height h. If it rebounds upto height $\frac{h}{2}$ after first collision then coefficient of restitution between ball and surface is

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

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

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

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

Answer: A

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37. A body of mass m moving with a constant velocity collides head on with another stationary body of same mass if the coefficient of restitution between the bodies is $\frac{1}{2}$ then ratio of velocities of two bodies after collision with be

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

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

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

D. 1

Answer: A

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Assignment (SECTION - A)

1. A string is used to pull a block of mass m vertically up by a distance h at a constant acceleration $\frac{g}{3}$. The work done by the tension in the string is

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

B. $\frac{-mgh}{3}$

C. mgh

D. $\frac{4}{3}mgh$

Answer: D

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2. A particle moves along X-axis from $x = 0$ to $x = 1$ m under the influence of a force given by $F = 3x^2 + 2x - 10$. Work done in the process is

A. $+4J$

B. $-4J$

C. $+8J$

D. $-8J$

Answer: D

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3. A body constrained to move in z direction is subjected to a force given by $\overrightarrow{F} = \left(3\hat{i} - 10\hat{j} + 5\hat{k}\right)N$. What is the work done by this force in moving the body through a distance of 5 m along z-axis?

A. 15 J

B. $-15J$

C. $-50J$

D. $25J$

Answer: D

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4. If 250 J of work is done in sliding a 5 kg block up an inclined plane of height 4 m. Work done against friction is $\left(g = 10ms^{-2}\right)$

A. 50 J

B. 100 J

C. 200 J

D. Zero

Answer: A

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5. A man carries a load on his head through a distance of 5 m. The maximum amount of work is done when he

A. Moves it over an inclined plane

B. Moves it over a horizontal surface

C. Lifts it vertically upwards

D. None of these

Answer: C

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6. A rigid body moves a distance of 10m along a straight line under the action of a force 5N. If the work done by this force on the body is 25 joules, the angle which the force makes with the force makes with the direction of motion of the body is:

A. 0°

B. 30°

C. 60°

D. 90°

Answer: C

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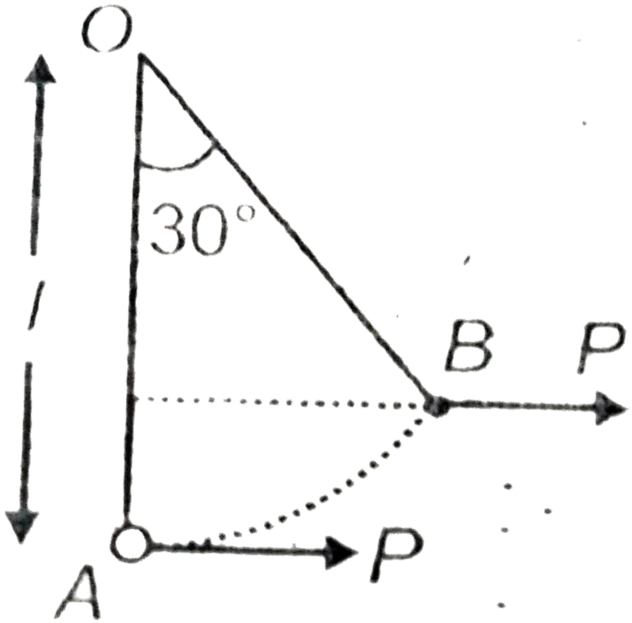
7. A bob of mass m is pulled along a circular arc by means of a constant horizontal force P as shown.

Work done in lifting the bob from A to B is



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

B. FR

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

D. mgR

Answer: C

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8. A particle is displaced from a position $2\hat{i} - \hat{j} + \hat{k}(m)$ to another position $3\hat{i} + 2\hat{j} - 2\hat{k}(m)$ under the action of a force $2\hat{i} + \hat{j} - \hat{k}(N)$. The work done by the force is

A. 8 J

B. 10 J

C. 12 J

D. 36 J

Answer: A

Watch Video Solution

9. A block of mass m tied to a string is lowered by a distance d, at a constant acceleration of $g/3$. The work done by the string is

A. $+\frac{3mgd}{4}$

B. $-\frac{mgd}{4}$

C. $-\frac{2}{3}mgd$

D. $+mgd$

Answer: C

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10. Work done by frictional force

A. Is always negative

B. Is always positive

C. Is zero

D. May be positive, negative or zero

Answer: D

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11. Under the action of a force, a 2 kg body moves such that its position x as a function of time t 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

A. 1600 J

B. 160 J

C. 16 J

D. $\frac{16}{9} J$

Answer: D

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12. A bullet loses $1/20$ of its velocity in passing through a plank. What is the least number of plank required to stop the bullet .

A. 11

B. 20

C. 21

D. infinite

Answer: A

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13. A particle moves along the X-axis from x=0 to x=5 m under the influence of a force given by $F = 7 - 2x + 3x^2$. Find the work done in the process.

A. 70

B. 135

C. 270

D. 35

Answer: B

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14. A particle of mass 2kg travels along a straight line with velocity $v = a\sqrt{x}$, where a is a constant. The work done by net force during the displacement of particle from $x = 0$ to $x = 4m$ is

A. a^2

B. $2a^2$

C. $4a^2$

D. $\sqrt{2}a^2$

Answer: C

Watch Video Solution

15. The position x of a particle moving along x - axis at time (t) is given by the equation $t = \sqrt{x} + 2$, where x is in metres and t in seconds. Find the work done by the force in first four seconds

A. Zero

B. 2 J

C. 4 J

D. 8 J

Answer: A

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16. A uniform chain of length L and mass M is lying on a smooth table and one third of its length is hanging vertically down over the edge of the table. If g is acceleration due to gravity, work required to pull the hanging part on to the table is

A. MgL

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

C. $\frac{MgL}{9}$

D. $\frac{MgL}{18}$

Answer: D

17. Two bodies of masses m_1 and m_2 have same kinetic energy. The ratio of their momentum is

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

B. $\sqrt{\dfrac{m_1}{m_2}}$

C. $\dfrac{m_1^2}{m_2^2}$

D. $\dfrac{m_2^2}{m_1^2}$

Answer: B

18. Two bodies of different masses m_1 and m_2 have equal momenta. Their kinetic energies E_1 and E_2 are in the ratio

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

B. $\sqrt{\frac{m_1}{m_2}}$

C. $\frac{m_1}{m_2}$

D. $\frac{m_2}{m_1}$

Answer: D

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19. KE of a body is increased by 44%. What is the percent increse in the momentum ?

A. 10%

B. 20%

C. 30%

D. 44%

Answer: B

Watch Video Solution

20. When momentum of a body increases by $200\ \%$ its KE increases by

A. $200\ \%$

B. $300\ \%$

C. $400\ \%$

D. $800\ \%$

Answer: D

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21. Two bodies with masses $m1kg$ and $m2kg$ have equal kinetic energies. If p_1 and P_2 are their respective momenta, then p_1 / P_2 is equal to :

A. $\frac{m_1}{m_2}$

B. $\sqrt{\frac{m_2}{m_1}}$

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

D. $\frac{m_1^2}{m_2^2}$

Answer: C

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22. The $K.E.$ acquired by a mass m in travelling a certain distance d, starting from rest, under the action of a constant force is directly propotional to

A. Directly proportional to $\sqrt{m}$

B. Directly proportional to m

C. Directly proportional to $\frac{1}{m}$

D. None of these

Answer: D

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23. $A^{238}U$nucleus decays by emitting an alpha particle of speed ums^{-1} The recoil speed of the residual nucleus is: (in ms^{-1})

A. $\frac{4v}{238}$

B. $-\frac{4v}{238}$

C. $\frac{v}{4}$

D. $-\frac{4v}{234}$

Answer: D

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

A. Always

B. Only if the conservative force are acting on it

C. Only in inertial frames

D. Only when pseudo forces are absent

Answer: A

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25. Potential energy is defined

A. Only in conservative fields

B. As the negative of work done by conservative forces

C. As the negative of workdone by eternal force when $\Delta K = 0$

D. All of these

Answer: A

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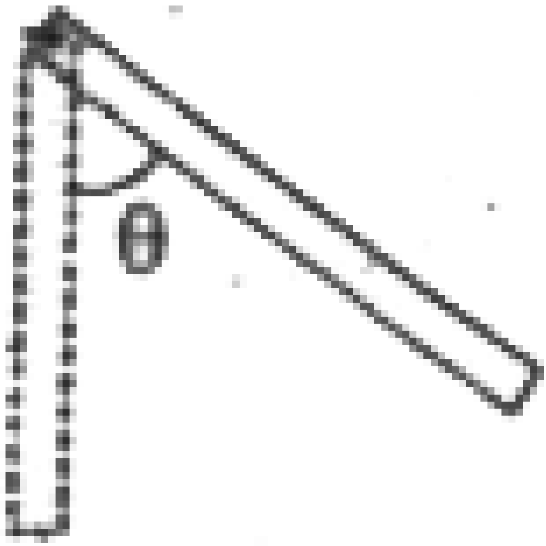
26. A stick of mass m and length l is pivoted at one end and is displaced through an angle θ. The increase in potential energy is



A. $m\frac{g(l)}{2}(1-\cos\theta)$

B. $m\frac{g(l)}{2}(1+\cos\theta)$

C. $m\frac{g(l)}{2}(1-\sin\theta)$

D. $m\frac{g(l)}{2}(1+\sin\theta)$

Answer: A

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27. A spring with spring constaant k when compressed by 1 cm the PE stored is U. If it is further compressed by 3 cm, then change in its PE is

A. 3U

B. 9U

C. 8U

D. 15U

Answer: D

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28. Two springs have spring constants k_1 and $k_2(k_1 \neq k_2)$. Both are extended by same force. If their elastic potential energical are U_1 and U_2, then U_1:U_2 is

A. $\frac{K_1}{K_2}$

B. $\frac{K_2}{K_1}$

C. $\sqrt{\dfrac{K_1}{K_2}}$

D. $\sqrt{\dfrac{K_2}{K_2}}$

Answer: B

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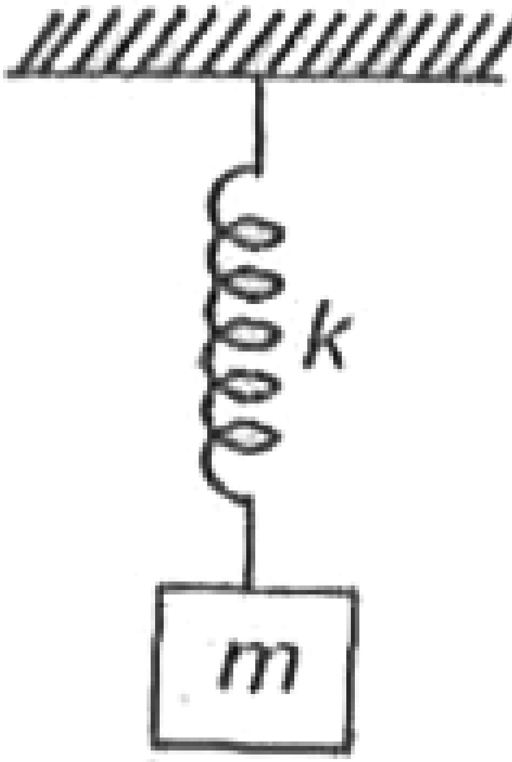
29. Initially mass m is held such that spring is in relaxed condition. If mass m is suddenly released, maximum elongation in spring will be



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

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

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

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

Answer: B

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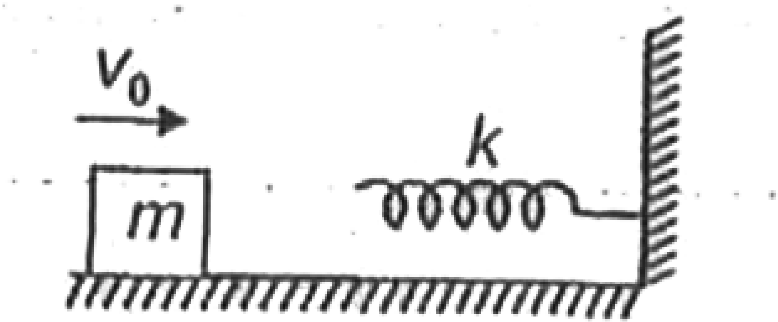
30. A block of mass m moving with velocity v_0 on a smooth horizontal surface hits the spring of constant k as shown. The maximum compression in spring is



A. $\sqrt{\frac{2m}{k}}v_0$

B. $\sqrt{\frac{m}{k}} \cdot v_0$

C. $\sqrt{\frac{m}{k}} \cdot v_0$

D. $\frac{m}{2k} \cdot v_0$

Answer: B

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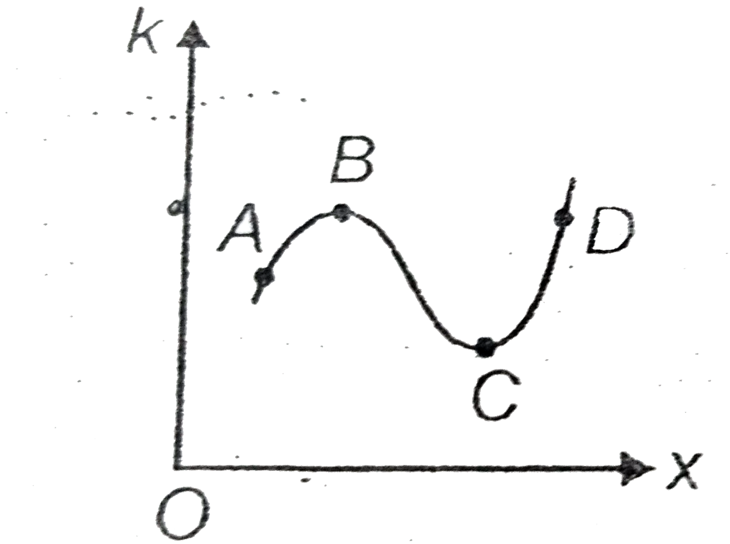
31. For a particle moving under the action of a variable force, kinetic energy (k) versus position (x) graph is given, then



A. At A particle is decelerating

B. At B particle is accelerating

C. At C particle has maximum velocity

D. At D particle has maximum acceleration

Answer: D

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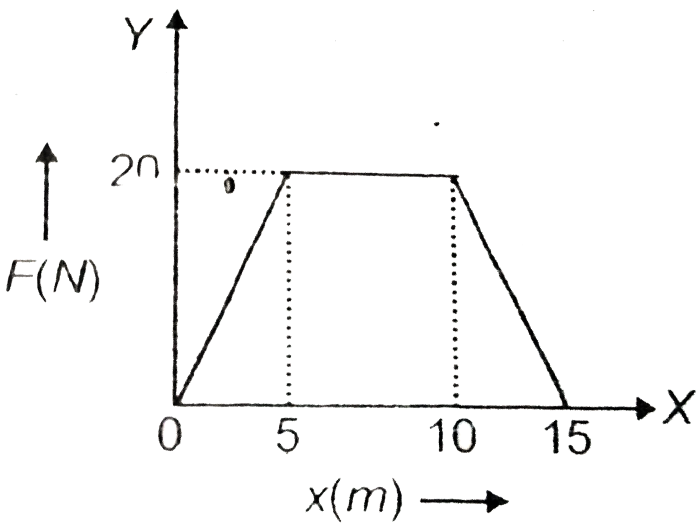
32. A particle of mass 1 kg is subjected to a force which varies with distance as shown. If it starts it s journey from rest at $x = 0$. then its velocity at $x = 15$ m is



A. 0 m/s

B. $20\sqrt{2}m / s$

C. $20\sqrt{3}m / s$

D. $40m / s$

Answer: D

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33. An unloaded bus can be stopped by applying brakies on straight road after covering a distance x. Suppose, the passenger add 50% of its weight as the load and the braking force remains unchanged, how far will the bus go after the application of the brakes ?(Velocity of bus in both case is same) (Consider negligible friction):-

A. Zero

B. 1.5x

C. 2x

D. 2.5x

Answer: B

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34. The power of water pump is 4 kW. If $g = 10ms^{-2}$, the amount of water it can raise in 1 minute to a height of 20 m is

A. 100 litre

B. 1000 litre

C. 1200 litre

D. 2000 litre

Answer: C

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35. A particle moves with the velocity $\overrightarrow{v} = \left(5\hat{i} + 2\hat{j} - \hat{k}\right)ms^{-1}$ under the influence of a constant force, $\overrightarrow{F} = \left(2\hat{i} + 5\hat{j} - 10\hat{k}\right)N$. The instantaneous power applied is

A. 5 W

B. 10 W

C. 20 W

D. 30 W

Answer: D

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36. A body is projected from ground obliquely. During downward motion, power delivered by gravity of it

A. Increases

B. Decreases

C. Remains constant

D. First decreases and then becomes constant

Answer: A

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37. The blades of a windmill sweep out a circle of area A. If the wind flows at a velocity v perpendicular to the circle, then the mass of the air of density ρ passing through it in time t is

A. $\frac{\rho A v^3}{2}$

B. $\frac{\rho A v^2}{2}$

C. $\rho A v^2$

D. $2\rho A v^2$

Answer: A

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38. 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. $\frac{mv_1^2}{T_1^2}t$

B. $\frac{mv_1}{T_1^2}t$

C. $\left(\frac{mv_1}{T_1}\right)^2 t$

D. $\frac{mv_1^2}{T_1}t^2$

Answer: A

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39. The power of a pump, which can pump 500 kg of water to height 100 m in 10 s is

A. 75 kW

B. 25 kW

C. 50 kW

D. 500 kW

Answer: C

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40. A pump is used to pump a liquid of density ρ continuously through a pipe of cross, sectional area A. If liquid is flowing with speed v, then average power of pump is

A. $\frac{1}{3}\rho AV^2$

B. $\frac{1}{2}\rho AV^2$

C. $2\rho AV^2$

D. $\frac{1}{2}\rho AV^3$

Answer: D

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41. A car of mass m has an engine which can deliver power P. The minimum time in which car can be accelerated from rest to a speed v is :-

A. $\frac{mv^2}{2P}$

B. Pmv^2

C. $2Pmv^2$

D. $\frac{mv^2}{2}P$

Answer: A

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42. Water from a stream is falling on the blades of a turbine at the rate of $100kg/s$. If the height of the stram is 100 m, then power delivered to turbine is

A. 100 kW

B. 10 kW

C. 1 kW

D. 100 kW

Answer: A

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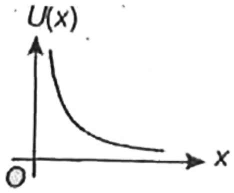
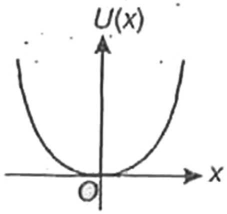
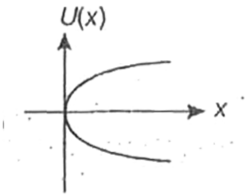
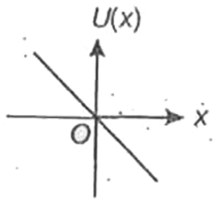
43. On a particle placed at origin a variable force $F = -ax$(where a is a positive constant) is applied. If U(0)=0, the graph between potential energy of particle U(x) and x is best represented by:-

A. 

B. 

C. 

D. 

Answer: B

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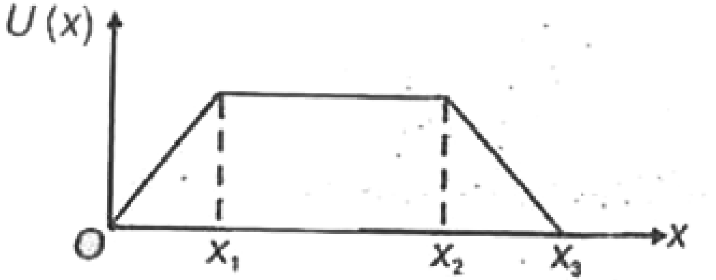
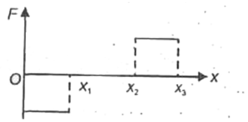
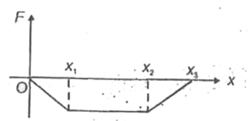
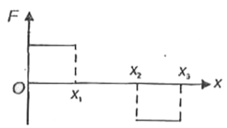
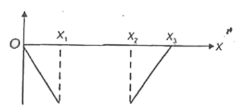
44. The variation of potential energy U of a system is shown in figure. The force acting on the system is best represented by



A. 

B. 

C. 

D. 

Answer: A

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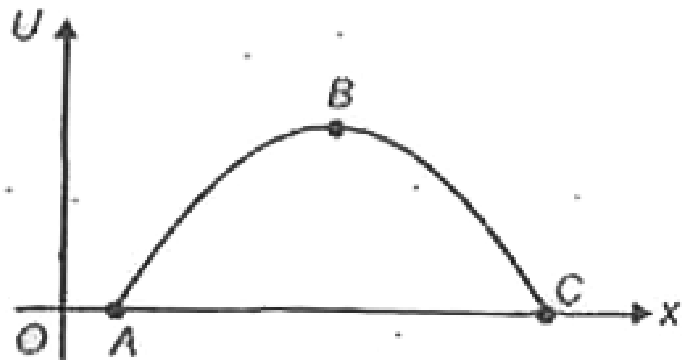
45. The variation of potential energy U of a body moving along x - axis varies with its position (x) as shown in figure



The body is in equilibrium state at

A. A

B. B

C. C

D. Both A & C

Answer: B

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46. A particle of mass 200 g is moving in a circle of radius 2 m. The particle is just looping the loop. The speed of the particle and the tension in the string at highest point of the circule path are $\left(g = 10ms^{-2}\right)$

A. $4ms^{-1}, 5N$

B. $4.47ms^{-1}$, zero

C. $2.47ms^{-1}$, zero

D. $1ms^{-1}$, zero

Answer: B

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47. A particle of mass 200 g , is whirled into a vertical circle of radius 80 cm uisig a massless string The speed of the particle when the string makes an angle of 60° with the vertical line is $1.5 ms^{-1}$. The tension in the string at this position is

A. 1 N

B. 1.56 N

C. 2 N

D. 3 N

Answer: B

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48. A stone of mass 1kg is tied with a string and it is whirled in a vertical circle of radius 1 m. If tension at the highest point is 14 N, then velocity at lowest point will be

A. $3m/s$

B. $4m/s$

C. $6m/s$

D. $8m/s$

Answer: D

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49. An object of mass 80 kg moving with velocity $2ms^{-1}$ hit by collides with another object of mass

20 kg moving with velocity $4ms^{-1}$ Find the loss of energy assuming a perfectly, inelastic collision

A. 12 J

B. 24 J

C. 30 J

D. 32 J

Answer: D

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50. A ball of mass m moving with velocity v collides head-on which the second ball of mass m at rest. I the coefficient of restitution is e and velocity of first ball after collision is v_1 and velocity of second ball after collision is v_2 then

A. $v_1 = \frac{(1-e)u}{2}, v_2 = \frac{(1+e)u}{2}$

B. $v_1 = \frac{(1+e)u}{2}, v_2 = \frac{(1-e)u}{2}$

C. $v_1 = \frac{u}{2}, v_2 = -\frac{u}{2}$

D. $v_1 = (1+e)u, v_2 = (1-e)u$

Answer: A

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51. Particle A makes a perfectly elastic collision with anther particle B at rest. They fly apart in opposite direction with equal speeds. If the masses are $m_A \& m_B$ respectively, then

A. $2m_A = m_B$

B. $3m_A = m_B$

C. $4m_A = m_B$

D. $\sqrt{3}m_A = m_B$

Answer: B

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52. A shell of mass m moving with a velocity breakes up suddenly into two pieces. The pa having mass $\frac{m}{3}$ remains stationary. The velocity the other part will be

A. v

B. 2 v

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

D. $\frac{3}{2}v$

Answer: D

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53. A particle of mass m moving towards west with speed v collides with another particle of mass m movies towards south. If two particles st ich t o each other the speed of the new particle of mass 2 m will be

A. $v\sqrt{2}$

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

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

D. v

Answer: B

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54. A body of mass 10 kg moving with speed of $3ms^{-1}$ collides with another stationary body of mass 5 kg As a result, the two bodies stick togethre. The KE of composite mass will be

A. 30 J

B. 60 J

C. 90 J

D. 120 J

Answer: A

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55. A stationary particle explodes into two particles of masses x and y, which move in opposite directions wit h velocity v_1 and v_2. The ratio of their kinetic energies $(E_1 : E_2)$ is

A. 1

B. $\frac{xv_2}{yv_1}$

C. $\frac{x}{y}$

D. $\frac{y}{x}$

Answer: D

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56. Select the false statement

A. In elastic collision, KE is not conserved during the collision

B. The coefficient of restitution for a collision between two steel balls lies between 0 and 1

C. The momentum of a ball colliding elastically with the floor is conserved

D. In an oblique elastic collision between two identical bodies with one of them at rest initially, the final velocities are perpendicular

Answer: C

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57. A bullet of mass m moving with velocity v strikes a block of mass M at rest and gets embedded into it. The kinetic energy of the composite block will be

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

B. $\frac{1}{2}(m+M)u^2$

C. $\frac{m^2v^2}{2(m+M)}$

D. $\left(\frac{m+M}{2mM}\right)u^2$

Answer: C

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58. A bullet of mass m moving with velocity v strikes a suspended wooden block of mass M . If the block rises to a height h , the initial velocity of the block will be ?

A. $\sqrt{2gh}$

B. $\dfrac{M+m}{m}\sqrt{2gh}$

C. $\dfrac{m}{M+m}\sqrt{2gh}$

D. $\dfrac{M+m}{M}\sqrt{2gh}$

Answer: B

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59. A ball is allowed to fall from a height of 10m . If there is 40% loss of energy due to impact, then after one impact ball will go up to

A. 10 m

B. 8 m

C. 4 m

D. 6 m

Answer: D

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60. A bullet weighing 10 g and moving with a velocity 300 m/s strikes a 5 kg block of ice and drop dead. The ice block is kept on smooth surface. The speed of the block after the the collision is

A. 6 cm/s

B. 60 cm/s

C. 6 m/s

D. 0.6 cm/s

Answer: B

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61. A particle of mass m moving eastward with a velocity V collides with another particle of same mass moving northwards with the same speed V. The two particles coalesce and the new particle moves in NE direction. Calculate magnitude and direction of velocity of new particle.

A. $\frac{v}{2}$ North - East

B. $\frac{v}{\sqrt{2}}$ South - West

C. $\frac{v}{2}$ North - West

D. $\frac{v}{\sqrt{2}}$ North - East

Answer: D

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62. Two perfectly elastic particles A and B of equal masses travelling along a line joining them with velocities $15m/s$ and $10m/s$ respectively collide. Their velocities after the elastic collision will be (in m/s) respectively

A. 0, 25

B. 3, 20

C. 10, 15

D. 20, 5

Answer: C

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63. Two balls of equal mass have a head-on collision with speed $6m/s$. If the coefficient of restitution is $\frac{1}{3}$, find the speed of each ball after impact in m/s

A. 18 m/s

B. 2 m/s

C. 6 m/s

D. 4 m/s

Answer: B

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64. A ball of mass M moving with speed v collides perfectly inelastically with another ball of mass m at rest. The magnitude of impulse imparted to the first ball is

A. Mv

B. mv

C. $\dfrac{Mm}{M+m}v$

D. $\dfrac{M^2}{M+m}v$

Answer: C

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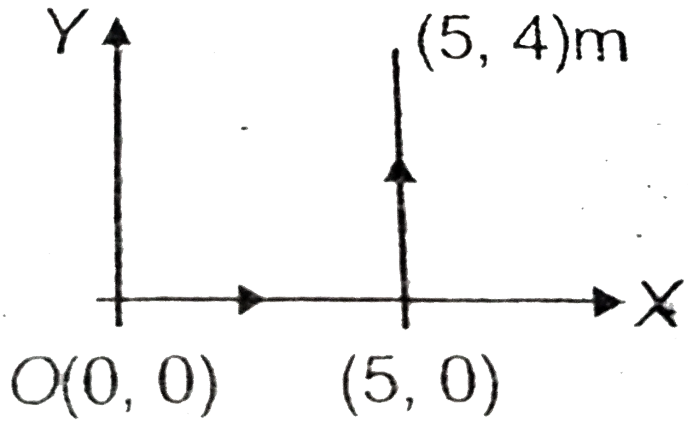
Assignment (SECTION - B)

1. A force $\overrightarrow{F}=\left(4\hat{i}+5\hat{j}\right)N$ acts on a particle moving in XY plane. Starting from origin, the particle first goes along x-axis to the point (5.0) m and then parallel to the Y-axis to the point $(5, 4$ m.

The total work done by the force on the particle is



A. $+12J$

B. $-6J$

C. $+24J$

D. $-12J$

Answer: C

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2. A body of mass m is allowed to fall with the help of string with downward acceleration $\frac{g}{6}$ to a distance x. The work done by the string is

A. $\frac{mgx}{6}$

B. $-\frac{mgx}{6}$

C. $\frac{5mgx}{6}$

D. $-\frac{5mgx}{6}$

Answer: D

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3. A chain is held on a frictionless table with $1/n$ th of its length hanging over the edge. If the chain has a length L and a mass M, how much work is required to pull the hanging part back on the table?

A. $\frac{MgL}{5}$

B. $\frac{MgL}{50}$

C. $\frac{MgL}{18}$

D. $\frac{MgL}{10}$

Answer: B

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4. A bullet of mass 20 g leaves a riffle at an initial speed 100 m/s and strikes a target at the same level with speed 50 m/s. The amount of work done by the resistance of air will be

A. 100 J

B. 25 J

C. 75 J

D. 50 J

Answer: C

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

A. $h - \dfrac{v_0^2}{2g\left(1+\frac{f}{w}\right)}$

B. $h = \dfrac{v_0^2}{2g\left(1-\frac{f}{w}\right)}$

C. $h = \dfrac{v_0^2}{2g\left(1+\frac{w}{f}\right)}$

D. $h = \dfrac{v_0^2}{2g\left(1-\frac{w}{f}\right)}$

Answer: A

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6. A spring of force constant K is first stretched by distance a from its natural length and then further by distance b. The work done in stretching the part b is

A. $\frac{1}{2}Ka(a-b)$

B. $\frac{1}{2}Ka(a+b)$

C. $\frac{1}{2}Kb(a-b)$

D. $\frac{1}{2}Kb(2a+b)$

Answer: D

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7. A man who is running has half the kinetic energy of a boy of half his mass. The man speeds up by 1 ms^{-1} and then has the same kinetic energy as the boy. The original speeds of the man and the boy was:

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

B. $(\sqrt{2}-1)m/s$

C. $2m/s$

D. $\left(\sqrt{2}+1\right)m/s$

Answer: D

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8. A particle of mass m moves with a variable velocity v, which changes with distance covered x along a straight line as $v=k\sqrt{x}$, where k is a positive constant. The work done by all the forces acting on the particle, during the first t seconds is

A. $\dfrac{mk^4t^2}{4}$

B. $\dfrac{mk^2t}{2}$

C. $\frac{ml^4t^2}{8}$

D. $\frac{mk^2t^2}{4}$

Answer: C

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9. A particle is moving in a circular path of radius r under the action of a force F. If at an instant velocity of particle is v, and speed of particle is increasing, then

A. $\overrightarrow{F}.\overrightarrow{v}=0$

B. $\overrightarrow{F}.\overrightarrow{v}>0$

C. $\vec{F} \cdot \vec{v} < 0$

D. $\vec{F} \cdot \vec{v} \geq 0$

Answer: B

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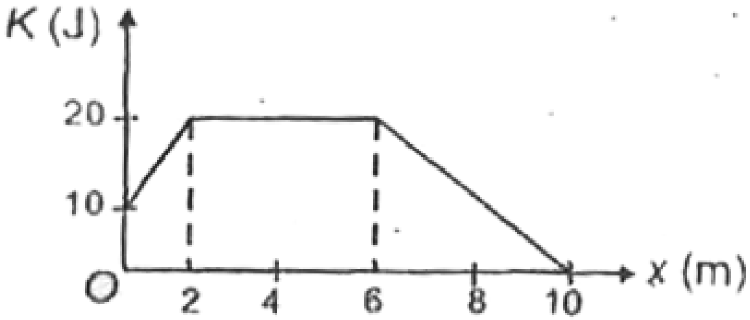
10. The kinetic energy K of a particle moving along x - axis varies with its position (x) as shown in figure



The magnitude of force acting on particle at x = 9 mis

A. Zero

B. 5 N

C. 20 Ns

D. 7.5 N

Answer: B

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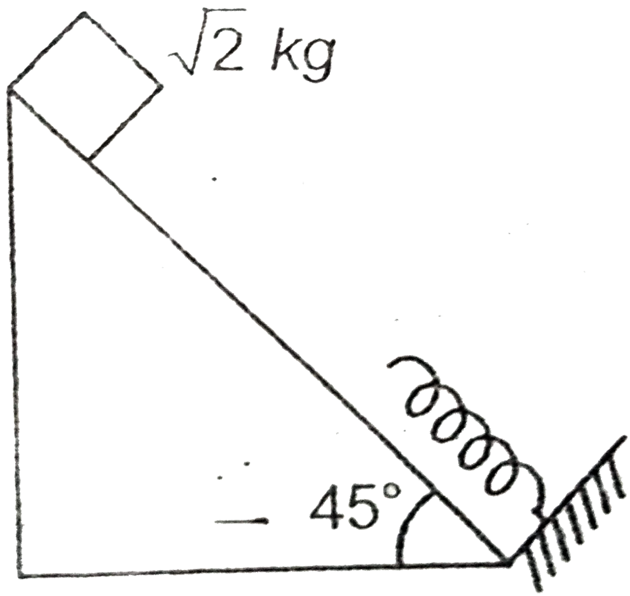
11. A block of mass $\sqrt{2}$ kg is released from the top of an inclined smooth surface as shown in fighre. If spring constant of spring is 100 N/m and block comes to rest after compressing the spring by 1 m, then the distance travelled by block befor it comes to rest is



A. 1 m

B. 1.25 m

C. 2.5 m

D. 5 m

Answer: D

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12. In net force on a system is zero then

A. its momentum is conserved

B. Its kinetic energy may increase

C. The acceleration of it's a constitutent particle may be non - zero

D. All of these

Answer: D

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13. Internal forces acting within a system of particles can alter

A. The linear momentum as well as the kinetic energy of the system

B. The linear momentum of the system, but not the kinetic energy of the system

C. The kinetic energy of the system, but not the linear momentum of the system

D. Neither linear momentum nor kinetic energy of the system

Answer: C

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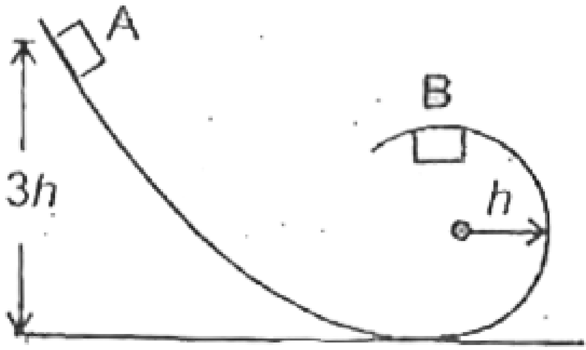
14. In the figure shown, a particle is released from the position A on a smooth track. When the particle reaches at B, then normal reaction on it by the track. When the particle reaches at B, then normal reaction on it by the track is



A. mg

B. 2mg

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

D. $\frac{m^2g}{h}$

Answer: A

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15. A particle of mass m is projected with speed u at angle θ with horizontal from ground. The work done by gravity on it during its upward motion is

A. $\frac{-mu^2\sin^2\theta}{2}$

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

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

D. Zero

Answer: A

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16. A shell at rest on a smootyh horizontal surface explodes into two fragments of masses m_1 and m_2. If just after explosion, m_1 move with speed u, then work done by internal forces during explosion is :-

A. $\frac{1}{2}(m_1 + m_2)\frac{m_2}{m_1}u^2$

B. $\frac{1}{2}(m_1 + m_2)u^2$

C. $\frac{1}{2}m_1u^2\left(1 + \frac{m_1}{m_2}\right)$

D. $\frac{1}{2}(m_2 - m_1)u^2$

Answer: C

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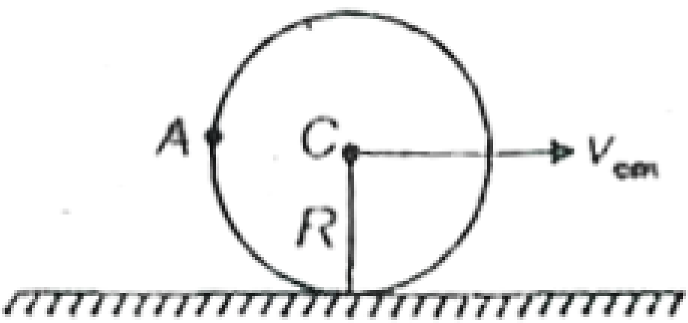
17. In case of pure rolling what will be velocity of point A of the ring of radius R ?



A. $\sqrt{gR}$

B. $\sqrt{2gR}$

C. $\sqrt{3gR}$

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

Answer: B

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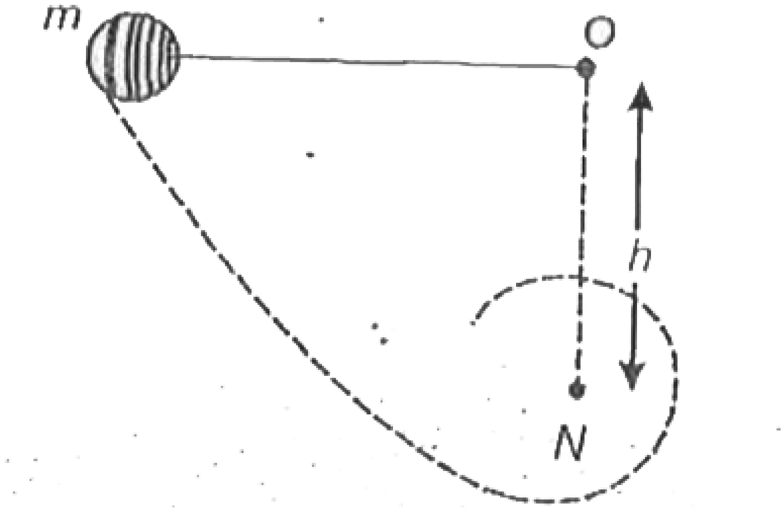
18. A particle of mass m attached to the end of string of length l is released from the horizontal position. The particle rotates in a circle about O as shown When it is vertically below O, the string makes contact with a nail N placed directly below O at a distance h and rotates around it. For the particle to swing completely around the nail in a

circle.



A. $h < \frac{3}{5}l$

B. $h \geq \frac{3}{5}l$

C. $h < \frac{2}{5}l$

D. $h \geq \frac{2}{5}l$

Answer: B

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19. If $F = 2x^2 - 3x - 2$, then select the correct statement

A. $x = -\frac{1}{2}$ is the position of stable equilibrium

B. $x = 2$ is the position of stable equilibrium

C. $x = -\frac{1}{2}$ is the position of ubstable equilibrium

D. $x = 2$ is the position of neutral equilibrium

Answer: A

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20. When a conservation force does positive work on a body, then the

A. Potential energy of body increases

B. Potential energy of body decreases

C. Total mechanical energy of body increases

D. Total mechanical energy of body decreases

Answer: B

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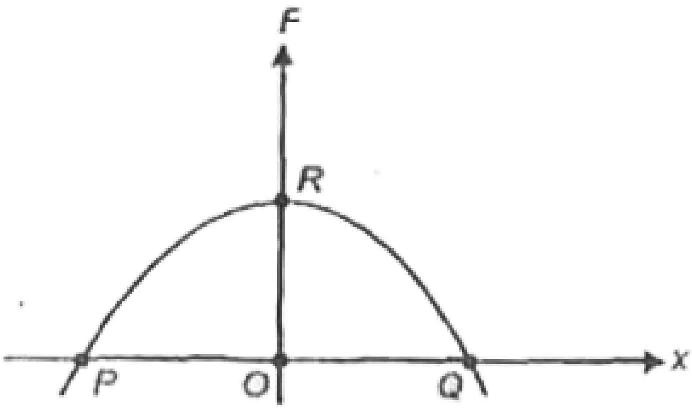
21. The variation of force F acting on a body moving along x - axis varies with its position (x) as shown in figure



The body is in stable equilibrium stable at

A. P

B. Q

C. R

D. Both P & Q

Answer: B

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22. A particle located in one dimensional potential field has potential energy function $U(x) = \frac{a}{x^2} - \frac{b}{x^3}$, where a and b are positive constants. The position of equilibrium corresponds to x equal to

A. $\frac{3a}{2b}$

B. $\frac{2b}{3a}$

C. $\frac{2a}{3b}$

D. $\frac{3b}{2a}$

Answer: D

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23. The force required to row a boat at constant velocity is proportional to square of its speed. If a speed of v km/h requires 4 kW, how much power does a speed of 2v km/h require?

A. 8 kW

B. 16 kW

C. 24 kW

D. 32 kW

Answer: D

Watch Video Solution

24. A body of mass m is projected from ground with speed u at an angle θ with horizontal. The power delivered by gravity to it at half of maximum height from ground is

A. $\frac{mgu\cos\theta}{\sqrt{2}}$

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

C. $\frac{mgu\cos(90+\theta)}{\sqrt{2}}$

D. Both (2) & (3)

Answer: D

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25. The rate of doing work by force acting on a particle moving along x-axis depends on position x of particle and is equal to 2x. The velocity of particle is given by expression :-

A. $\left[\frac{3x^2}{m}\right]^{1/3}$

B. $\left[\frac{3x^2}{2m}\right]^{1/3}$

C. $\left(\frac{2mx}{9}\right)^{1/2}$

D. $\left[\frac{mx^2}{3}\right]^{1/2}$

Answer: A

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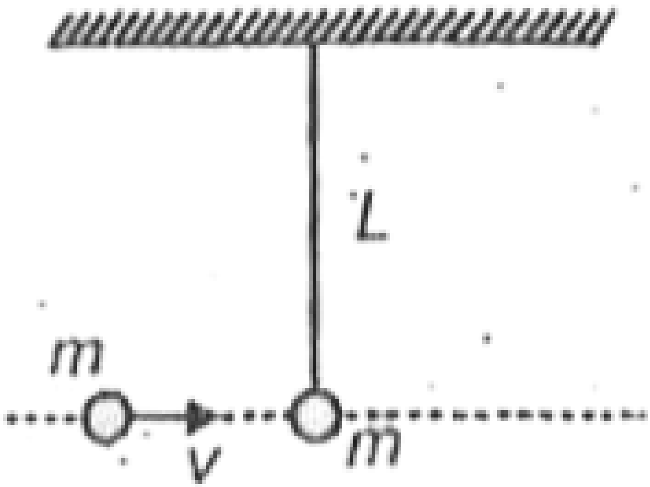
26. A small ball of mass m moving with speed v $\left(>\sqrt{2gL}\right)$ undergoes an elastic head on collision with a stationary bon of identical mass of a simple pendulum of length L. The maximum height h, from the equilibrium position, to which the bob rises after collision is



A. $\dfrac{v^2}{2g}$

B. $\dfrac{v^2}{4g}$

C. $\dfrac{v^2}{8g}$

D. $\dfrac{3v^2}{8g}$

Answer: C

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27. Two balls of masses m each are moving at right angle to each other with velocities 6 m/s and 8 m/s respectively. If collision between them is perfectly inelastic, the velocity of combined mass is

A. 15 m/s

B. 10m/s

C. 5 m/s

D. 2.5 m/s

Answer: C

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28. Sphere A of mass m moving with a constant velocity u hits another stationary sphere B of the same mass. If e is the co-efficient of restitution, then ratio of velocities of the two spheres $v_A : v_B$ after collision will be :

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

B. $\frac{2+e}{2-e}$

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

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

Answer: A

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29. A neutron collides elastically with the stationary nucleus of an atom of mass number A. If the collision is perfectly elastic, then after the collision the fraction of the initial kinetic energy retained by the neutron, is

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

B. $\left(\frac{A+1}{A-1}\right)^2$

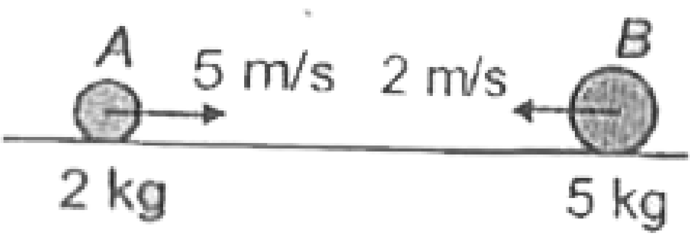
C. $\left(\frac{A-1}{A}\right)^2$

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

Answer: A

Watch Video Solution

30. Velocity of the ball A after collision with the ball B as shown in the figure is (Assume perfectly inelastic and head - on collision)



A. $\frac{3}{7}m/s$

B. $\frac{5}{7}m/s$

C. $\frac{1}{7}m/s$

D. Zero

Answer: D

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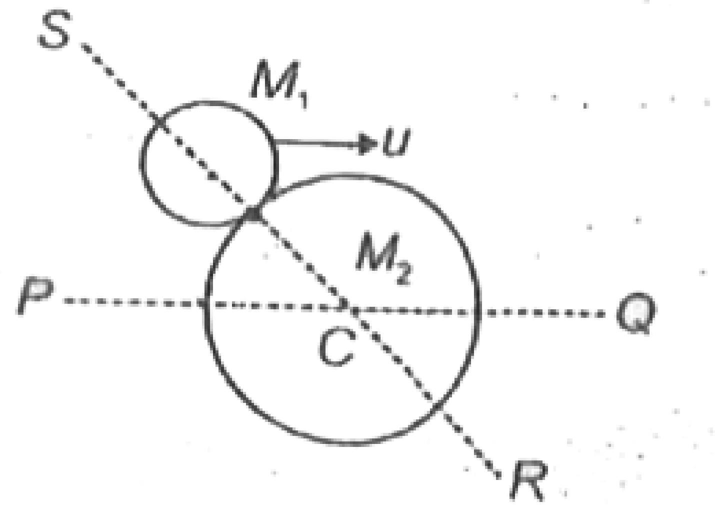
31. An object of mass M_1 moving horizontally with speed u colides elstically with another object of mass M_2 at rest. Select correct statement.



A. The momentum of system is consered only in direction PQ

B. Momentum of M_1 is conserved in direction perpendicular to SR

C. Momentum of M_2 will change in direction normal to CR

D. All of these

Answer: B

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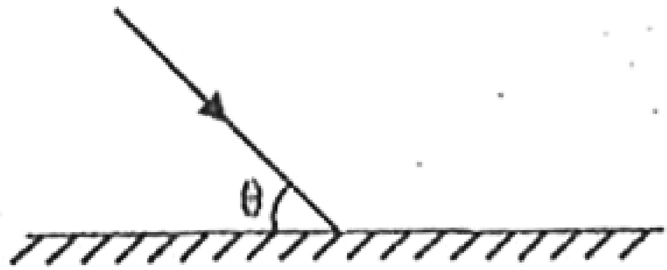
32. A ball of mass m moving with speed u collides with a smooth horizontal surface at angle θ with it as shown in figure. The magnitude of impulse imparted to surface by ball is [Coefficient of restitution of collision is e]



A. $mu(1+e)\cos\theta$

B. $mu(1-e)\sin\theta$

C. $mu(1-e)\cos\theta$

D. $mu(1+e)\sin\theta$

Answer: D

Watch Video Solution

33. A ball is dropped from a height h on a floor. The coefficient of restitution for the collision between the ball and the floor is e. The total distance covered by the ball before it comes to the rest.

A. $h\left\{\frac{1+e^2}{1-e^2}\right\}$

B. $h\left\{\frac{1-e^2}{1+e^2}\right\}$

C. $\frac{2eh}{1+e^2}$

D. $\frac{2eh}{1-e^2}$

Answer: A

Watch Video Solution

34. The PE of a 2 kg particle, free to move along x-axis is given by $V(x) = \left(\frac{x^3}{3} - \frac{x^2}{2}\right)J$. The total mechanical energy of the particle is 4 J. Maximum speed (in ms^{-1}) is

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

B. $\sqrt{2}$

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

D. $\frac{5}{\sqrt{6}}$

Answer: D

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35. A bullet of mass m moving with velocity v strikes a suspended wooden block of mass M . If the block rises to a height h , the initial velocity of the block will be ?

A. $\sqrt{2gh}$

B. $\frac{M+m}{m}\sqrt{2gh}$

C. $\frac{m}{M+m}\sqrt{2gh}$

D. $\frac{M+m}{M}\sqrt{2gh}$

Answer: B

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Assignment (SECTION - C)

1. consider a drop of rain water having mass 1 g falling from a height of 1 km. It hits the ground with a speed of 5 m/s.Take g constat with a vlaue of 10 m/s^2. The work donw by the (i) gravitational froce and the (ii) resistive force of air is

A. $(i) - 10J$ $(ii) - 8.25J$

B. $(i)1.25J$ $(ii) - 8.25J$

C. $(i)100J$ $(ii)8.75J$

D. $(i)10J$ $(ii) - 8.75J$

Answer: D

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2. A spring of force constant k is cut into lengths of ratio $1:2:3$. They are connected in series and the new force constant is k'. Then they are connected in parallel and force constant is k'. Then k' : k" is :

A. $1:6$

B. $1:9$

C. $1:11$

D. $1:14$

Answer: C

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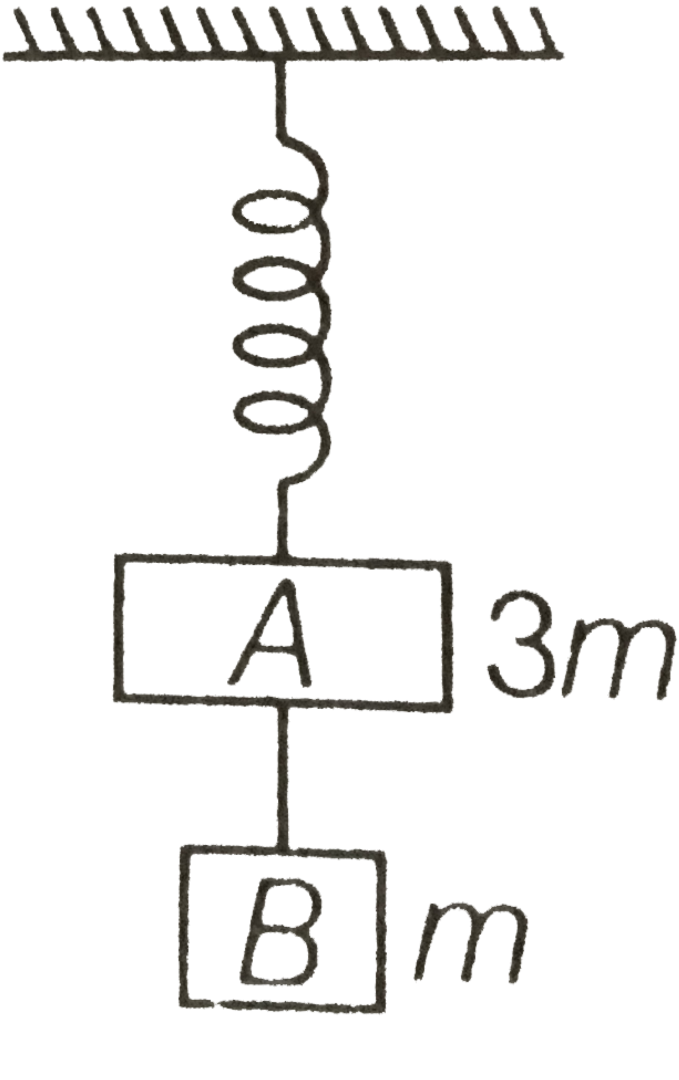
3. Two blocks A and B os masses 3m and m respectively are connected by a massless and inextensible string. The whole system is suspended by a massless spring as shown in figure. The magnitudes of acceleration of A and B immdediately after the string is cut are respectively.



A. $g, \frac{g}{3}$

B. $\frac{g}{3}, g$

C. g, g

D. $\frac{g}{3}, \frac{g}{3}$

Answer: B

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4. A particle moves from a point $\left(-2\hat{i} + 5\hat{j}\right)$ to $\left(4\hat{j} + 3\hat{k}\right)$ when a force of $\left(4\hat{i} + 3\hat{j}\right)N$ is applied. How much work has been done by the force ?

A. 8 J

B. 11 J

C. 5 J

D. 2 J

Answer: C

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5. A bullet of mass 10 g moving horizontal with a velocity of 400 m/s strikes a wood block os mass 2 kg which is suspended by light inextensible string of length 5 m. As result, the centre of gravity of the block found to rise a vertical distance of 10 cm. The speed of the bulled after it emerges of horizontally from the block will be

A. $100ms^{-1}$

B. $80ms^{-1}$

C. $120ms^{-1}$

D. $160ms^{-1}$

Answer: C

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6. Two identiacal balls A and B having velocities of 0.5 m/s and 0.3 m/s respectively collide elastically in one dimension. The velocities of B and A after the collision respectively will be

A. $-0.5m/s$ and $0.3m/s$

B. $0.5m/s$ and $-0.3m/s$

C. $-0.3m/s$ and $-0.5m/g$

D. $0.3m/s$ and $0.5m/s$

Answer: B

Watch Video Solution

7. What is the minimum velocity with which a body of mass m must enter a vertical loop of radius R so that it can complete the loop?

A. $\sqrt{5gR}$

B. $\sqrt{gR}$

C. $\sqrt{2gR}$

D. $\sqrt{3gR}$

Answer: A

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8. A body of mass 1 kg begins to move under the action of a time dependent force $F=\left(2t\hat{i}+3t^{2}\hat{j}\right)N$, where $\hat{i}$ and $\hat{j}$ are unit vector along x and y axis. What power will be developed by the force at the time?

A. $(2t^3 + 3t^5)W$

B. $(2t^2 + 3t^2)W$

C. $(2t^2 + 4t^4)W$

D. $(2t^3 + 3t^4)W$

Answer: A

Watch Video Solution

9. If Vectors $\vec{A} = \cos\omega t(i) + \sin\omega t(j)$ and $\vec{B} = \cos\omega\frac{t}{2}\hat{i} + \sin\omega\frac{t}{2}\hat{j}$are functions of time.

Then the value of t at which they are orthogonal to each other is

A. $t = 0$

B. $t = \frac{\pi}{4\omega}$

C. $t = \frac{\pi}{2\omega}$

D. $t = \frac{\pi}{\omega}$

Answer: D

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10. A ball is thrown vertically downwards from a height of 20m with an intial velocity v_0. It collides with the ground, loses 50% of its energy in collision

and rebounds to the same height. The intial velocity

v_0 is (Take, g =10 ms^{-2})

A. $10ms^{-1}$

B. $14ms^{-1}$

C. $20ms^{-1}$

D. $28ms^{-1}$

Answer: C

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11. On a frictionless surface, a block of mass M moving at speed v collides elastically with another block of same mass M which is intially at rest. After collision the first block moves at an angle θ to its initial direction and has a speed $\frac{v}{3}$. The second block's speed after the collision is

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

B. $\frac{2\sqrt{2}}{3}v$

C. $\frac{3}{4}v$

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

Answer: B

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12. The heart of a man pumps 5L of blood through the artries per minute at a pressure of 150mm of mercury. If the density of mercury be $13.6 \times 10^3 \text{Kg} / m^3$ and $g = 10m / s^2$, then the power of heart in watt is

A. 1.5

B. 1.7

C. 2.35

D. 3.0

Answer: B

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13. Two particles of masses m_1, m_2 move with initial velocities u_1 and u_2. On collision, one of the particles get excited to higher level, after absorbing energy ε. If final velocities of particles be v_1 and v_2, then we must have

A. $\frac{1}{2}m_1^2 + \frac{1}{2}m_2^2u_2^2 + \varepsilon = \frac{1}{2}m_1^2v_1^2 + \frac{1}{2}m_2^2v_2^2$

B. $m_1^2u_1 + m_2^2u_2 - \varepsilon = m_1^2v_1 + m_2^2v_2$

C. $\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 - \varepsilon$

D. $\frac{1}{2}m_1u_1^2+\frac{1}{2}m_2u_2^2-\varepsilon=\frac{1}{2}m_1v_2+\frac{1}{2}m_2v_2^2$

Answer: D

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14. Two similar springs P and Q have spring constant $K_P \text{and} \quad K_Q$, such that $K_P > K_Q$. They are stretched, first by the same amount (case a), then by the same force (case b). The work done by the springs W_P and W_Q are related as , in case (a) and case (b), respectively

A. $W_p < W_Q, W_Q < W_P$

B. $W_P = W_Q, W_P > W_Q$

C. $W_P = W_Q, W_P = W_Q$

D. $W_P > W_Q, W_Q > W_P$

Answer: D

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15. A particle of mass m is driven by a machine that delivers a constant power k watts. If the particless starts from rest, the force on the particle at time t is

A. $\dfrac{1}{\sqrt{mkt}^{\frac{-1}{2}}}$

B. $\sqrt{\frac{mk}{2}t^{\frac{-1}{2}}}$

C. $\sqrt{mkt^{\frac{-1}{2}}}$

D. $\sqrt{2mkt^{\frac{-1}{2}}}$

Answer: B

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16. A block of mass 10 kg, moving in x-direction with a constant speed of $10ms^{-1}$, is subjected to a retarding force $F = 0.1 \times J/m$ during its travel from x=20 m to 30 m. Its final KE will be

A. 250 J

B. 475 J

C. 450 J

D. 275 J

Answer: B

Watch Video Solution

17. A body of mass (4m) is lying in xy-plane at rest. It suddenly explodes into three pieces. Two pieces each of mass(m) move perpendicular to each other with equal speeds (v). The total kinetic energy generated due to explosion is

A. mv^2

B. $\frac{3}{2}mv^2$

C. $2mv^2$

D. $4mv^2$

Answer: B

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18. A uniform force of $\left(3\hat{i} + \hat{j}\right)$ N acts on a particle of mass 2kg. Hence, the particle is displaced from position $\left(2\hat{i} + \hat{k}\right)$m to position $\left(4\hat{i} + 3\hat{j} - \hat{k}\right)$m. The work done by the force on the particle is

A. 6 J

B. 13 J

C. 15 J

D. 9 J

Answer: D

Watch Video Solution

19. The potential energy of a particle in a force field is $U = \frac{A}{r^2} - \frac{B}{r}$,where A and B are positive constants and r is the distance of particle from the centre of the field. For stable equilibrium, the distance of the particle is

A. $\frac{A}{B}$

B. $\frac{B}{A}$

C. $\frac{B}{2A}$

D. $\frac{2A}{B}$

Answer: D

Watch Video Solution

20. Two spheres A and B of masses m_1 and m_2 respectively collide. A is at rest initially and B is moving with velocity v along x-axis. After collision, B has a velocity $\frac{v}{2}$ in a direction perpendicular to the original direction. The mass A moves after collision in the direction

A. $\theta = \tan^{-1}\left(\frac{1}{2}\right)$ to the x- axis

B. $\theta = \tan^{-1}\left(-\frac{1}{2}\right)$ to the y - axis

C. Same as that of B

D. Opposite to that of B

Answer: A

Watch Video Solution

21. A stone is dropped from a height h. It hits the ground with a certain momentum P. If the same stone is dropped from a height 100% more than the previous height, the momentum when it hits the ground will change by -

A. 68%

B. 41%

C. 200%

D. 100%

Answer: B

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22. A car of mass m starts from rest and accelerates so that the instantaneous power delivered to the car has a constant magnitude P_0. The instantaneous velocity of this car is proportional to -

A. $t^2 P_0$

B. $t^{1/2}$

C. $t^{-1/2}$

D. $\frac{1}{\sqrt{m}}$

Answer: B

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23. The potential energy of a system increase,if work is done

A. Upon the system by a conservative force

B. Upon the system by a nonconservative force

C. By the system against a conservative force

D. By the system against a non conservative force

Answer: C

Watch Video Solution

24. Force F on a particle moving in a straight line varies with distance d as shown in the figure. The work done on the particle during its displacement fo 12 m is

A. 13 J

B. 18 J

C. 21 J

D. 26 J

Answer: A

Watch Video Solution

25. A body projected vertically from the earth reaches a height equal to earth's radius before returning to the earth. The power exerted by the gravitational force is greatest

A. At the instant just after the body is projected

B. At the highest position of the body

C. At the instant just before the body hits the earth

D. It remains constant all through

Answer: C

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26. An engine pumps water through a hose pipe. Water passes through the pipe and leaves it with a velocity of $2ms^{1}$. The mass per unit length of water in the pipe is $100kgm^{-1}$. What is the power of the engine?

(a) 400 W (b) 200W (c) 100W (d) 800W

A. 300 W

B. 400 W

C. 200 W

D. 100 W

Answer: A

Watch Video Solution

27. A particle of mass M starting from rest undergoes uniform acceleration. If the speed acquired in time T is V, the power delivered to the particle is -

A. $\frac{MV^2}{T}$

B. $\frac{1}{2}\frac{MV^2}{T^2}$

C. $\frac{MV^2}{T^2}$

D. $\frac{1}{2}\frac{MV^2}{T}$

Answer: D

Watch Video Solution

28. An engine pumps water continuously through a hose. Water leaves 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 impartd to water?

A. mv^2

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

C. $\frac{1}{2}m^2v^2$

D. $\frac{1}{2}mv^3$

Answer: D

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29. A body of mass 1 kg is thrown upwards with a velocity 20 ms^{-1}. It momentarily comes to rest after attaining ah height of 18m. How much energy is lost due to air friction? (Take g=ms^{-2})

A. 30 J

B. 40 J

C. 10 J

D. 20 J

Answer: D

Watch Video Solution

30. A block of mass m attached in the lower and vertical spring The spring is hung from a calling and force constant value k The mass is released from rest with the spring initially unstreched The maximum value of extension produced in the length of the spring will be

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

B. $\frac{4Mg}{k}$

C. $\frac{Mg}{2k}$

D. $\frac{Mg}{k}$

Answer: A

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31. Water falls from a height of 60 m at the rate of 15 kg/s to operate a turbine. The losses due to frictional forces are 10% of energy. How much power is generated by the turbine (g=10 ms^2).

A. 7.0 W

B. 8.1 kW

C. 10.2 kW

D. 12.3 kW

Answer: B

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32. A sheel of mass 200g is ejected from a gun of mass 4 kg by an explosion that generates 1.05kJ of energy. The initial velocity of the shell is

A. $120ms^{-1}$

B. $100ms^{-1}$

C. $80ms^{-1}$

D. $40ms^{-1}$

Answer: B

Watch Video Solution

33. A vertical spring with force constant K is fixed on a table. A ball of mass m at a height h above the free upper end of the spring falls vertically on the spring so that the spring is compressed by a distance d. The net work done in the process is:-

A. $mg(h-d)+\frac{1}{2}Kd^2$

B. $mg(h+d)+\frac{1}{2}Kd^2$

C. $mg(h+d)-\frac{1}{2}Kd^2$

D. $mg(h-d)-\frac{1}{2}Kd^2$

Answer: C

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34. The potential energy of a long spring when stretched by 2 cm is U. If the spring is stretched by 8 cm the potential energy stored in it is:-

A. $4U$

B. $8U$

C. $16U$

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

Answer: C

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35. A body of mass 3kg is under a constant force, which causes a displacement s in metre in it, given by the relation $s = \frac{1}{3}t^2$, where t is in second. Work done by the force in 2 s is

A. $\frac{5}{19}J$

B. $\frac{3}{8}J$

C. $\frac{8}{3}J$

D. $\frac{19}{5}J$

Answer: C

Watch Video Solution

36. 300J of work is done in slinding a 2 kg block up an inclined plane of height 10m. Taking g $=10m/s^2$, work done against friction is

A. 200 J

B. 100 J

C. Zero

D. 1000 J

Answer: B

Watch Video Solution

37. A bomb of mass 30kg at rest explodes into two pieces of masses 18 kg and 12 kg . The velocity of 18 kg mass is $6ms^{-1}$. The kinetic energy of the other mass is

A. 256 J

B. 486 J

C. 524 J

D. 342 J

Answer: B

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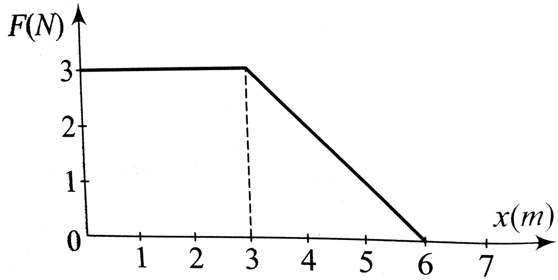
38. A Force F acting on an object varies with distance x as shown in the figure . The force is in newton and x in metre. The work done by the force in moving the object from $x = 0$ to $x = 6m$ is



(a) 4.5 J (b) 13.5 J (c) 9.0 J (d) 18.0 J

A. 4.5 J

B. 13.5 J

C. 9.0 J

D. 18.0 J

Answer: B

Watch Video Solution

39. The angle between the two vectors $A = 3\hat{i} + 4\hat{j} + 5\hat{k}$ and $B = 3\hat{i} + 4\hat{j} - 5\hat{k}$ is

A. 90°

B. 180°

C. Zero

D. 45°

Answer: A

Watch Video Solution

40. Three vectors $\vec{A}$, $\vec{B}$ and $\vec{C}$ satisfy the relation $\vec{A} \cdot \vec{B} = 0$ and $\vec{A} \cdot \vec{C} = 0$. The vector $\vec{A}$ is parallel to

A. $\vec{B}$ and $\vec{C}$

B. $\vec{A} \times \vec{B}$

C. $\vec{B} + \vec{C}$

D. $\vec{B} \times \vec{C}$

Answer: D

Watch Video Solution

41. If a unit vector is represented by $0.4\hat{i} + 0.7\hat{j} + c\hat{k}$ then the value of c is

A. $\sqrt{0.01}$

B. $\sqrt{0.11}$

C. 1

D. $\sqrt{0.35}$

Answer: D

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42. If a vector $2\hat{i} + 3\hat{j} + 8\hat{k}$ is perpendicular to the vector $4\hat{i} - 4\hat{j} + \alpha\hat{k},$ then the value of α is

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

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

C. 1

D. -1

Answer: B

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43. The work done by an applied variable force $F = x + x^3$ from x = 0 m to x = 2m, where x is displacement, is

A. 6 J

B. 8 J

C. 10 J

D. 12 J

Answer: A

Watch Video Solution

44. When a body moves with a constant speed along a circle

A. No work is done on it

B. No acceleration is produced in it

C. Its velocity remains constant

D. No force acts on it

Answer: A

Watch Video Solution

45. A position dependent force $F = 7 - 2x + 3x^2$ acts on a small body of mass 2 kg and displaced it from $x = 0$ to $x = 5m$. Calculate the work done in joule.

A. 135

B. 270

C. 35

D. 70

Answer: A

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46. A body constrained to move in y direction is subjected to a force given by $\overrightarrow{F} = \left(-2\hat{i} + 15\hat{j} + 6\hat{k}\right)$ N . What is the work done by this force in moving the body through a distance of $10m$ along y-axis ?

A. 150 J

B. 20 J

C. 190 J

D. 160 J

Answer: A

Watch Video Solution

47. A body moves a distance of 10 m along a straight line under an action of 5 N force. If work done is 25 J, then angle between the force and firection of motion of the body will be :

A. 60°

B. 75°

C. 30°

D. 45°

Answer: A

Watch Video Solution

48. A foce acts on a 30g particle in such a way that the position of the particle as a function of time is given by

$x = 3t - 4t^2 + t^3$, where x is in metre and t in second. The work done during the first 4s is

A. 490 mJ

B. 450 mJ

C. 576 mJ

D. 528 J

Answer: D

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49. Two bodies of masses m and 4 m are moving with equal K.E. The ratio of their linear momentum is

A. $1:2$

B. $1:4$

C. $4:1$

D. $1:1$

Answer: A

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50. One kilowatt hour is equal to

A. $36 \times 10^{-5} J$

B. $36 \times 10^{5} J$

C. $36 \times 10^{7} J$

D. $36 \times 10^{3} J$

Answer: B

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51. Two bodies with kinetic energies in the ratio 4:1 are moving with equal linear momentum. The ratio of their masses is

A. $4:1$

B. $1:1$

C. $1:2$

D. $1:4$

Answer: D

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52. A 1 kg stationary bomb is exploded in three parts having mass 1 : 1 : 3 respectively. Parts having same mass move in perpendicular direction with velocity $30ms^{-1}$, then the velocity of bigger part will be : -

A. $10\sqrt{2}m/s$

B. $\frac{10}{\sqrt{2}}m/s$

C. $15\sqrt{2}m/s$

D. $\frac{15}{\sqrt{2}}m/s$

Answer: A

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53. If the kinetic energy of a body is increased by 300°, its momentum will increase by

A. 100%

B. 150%

C. 265%

D. 73.2%

Answer: A

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54. A stationary particle explodes into two particle of a masses m_1 and m_2 which move in opposite direction with velocities v_1 and v_2. The ratio of their kinetic energies E_1 / E_2 is

A. $\frac{m_2}{m_1}$

B. $\frac{m_1}{m_2}$

C. 1

D. $\frac{m_1 v_1}{m_2 v_1}$

Answer: A

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55. A particle of massm_1 is moving with a velocity v_1 and another particle of mass m_2 is moving with a velocity v_2. Both of them have the same momentum, but their different kinetic energies are $E_1 \text{ and } E_2$ respectively. If $m_1 > m_2$, then

A. $E_1 < E_2$

B. $\frac{E_1}{E_2} = \frac{m_1}{m_2}$

C. $E_1 > E_2$

D. $E_1 = E_2$

Answer: A

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56. A bomb of mass 30kg at rest explodes into two pieces of masses 18 kg and 12 kg . The velocity of 18 kg mass is $6ms^{-1}$. The kinetic energy of the other mass is

A. 342 J

B. 486 J

C. 256 J

D. 524 J

Answer: B

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57. A particle is projected making angle 45° with horizontal having kinetic energy K. The kinetic energy at highest point will be : -

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

B. Zero

C. E

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

Answer: D

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58. A body dropped from a height h with initial velocity zero, strikes the ground with a velocity 3 m/s. Another body of same mass dropped from the same height h with an initial velocity of 4m/s. Find the final velocity of second mass with which it strikes the ground.

A. 5 m/s

B. 12 m/s

C. 3 m/s

D. 4 m/s

Answer: A

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59. A particle with total energy E is moving in a potential energy region U(x). Motion of the particle is restricted to the region when

A. $U(x) > E$

B. $E(x) < E$

C. $U(x) = 0$

D. $U(x) \leq E$

Answer: D

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60. The KE acquired by a mass m in travelling a certain distance d, starting from rest, under the action of a constant force is directly proportional to

A. m

B. m^0

C. $\sqrt{m}$

D. $\frac{1}{\sqrt{m}}$

Answer: B

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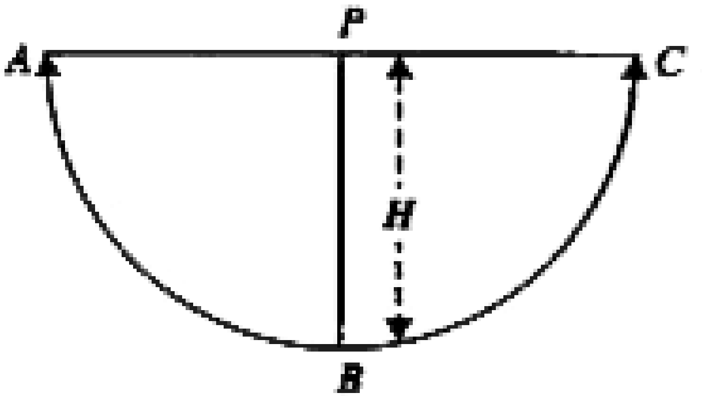
61. A simple pendulum with a bob of mass m oscillates from A to C and back to A such that PB is H. IF the acceleration due to gravity is g, the velocity of bob as it passes through B is



A. mgH

B. $\sqrt{2gH}$

C. $Zero$

D. $2gH$

Answer: B

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62. A car moving with a speed of $40km/h$ can be stopped after $2m$ by applying brakes. If the same car is moving with a speed of $80km/h$, what is the minimum stopping distance ?

A. 4m

B. 6 m

C. 8 m/s

D. 2m

Answer: C

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63. A child is swinging a swing. Minimum and maximum heights fo swing from the earth's surface are 0.75 m and 2 m respectively. The maximum velocity of this swing is

A. 10 m/s

B. 5 m/s

C. 8 m/s

D. 15 m/s

Answer: B

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64. A long spring is stretched by 2 cm, its potential energy is U. IF the spring is stretched by 10 cm, the potential energy stored in it will be

A. $\frac{U}{5}$

B. $5U$

C. $10U$

D. $25U$

Answer: D

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65. A ball of mass 2 kg and another of mass 4 kg are dropped together from a 60 feet tall building. After a fall of 30 feet each towards earth, their respective kinetic energies will be in the ratio of-

A. $\sqrt{2} : 1$

B. $1 : 4$

C. $1 : 2$

D. $1 : \sqrt{2}$

Answer: C

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66. A mass of $0.5kg$ moving with a speed of $1.5m/s$ on a horizontal smooth surface, collides with a nearly weightless spring of force constant $k = 50N/m$ The maximum compression of the spring would be.

A. 0.15 m

B. 0.12 m

C. 1.5 m

D. 0.5 m

Answer: A

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67. One coolie takes 1min to raise a box through a height of $2m$. Another one takes $30s$ for the same job and does the same amount of work. Which one of the two has greater power and which one uses greater enegy?

A. $1:2$

B. $1:3$

C. $2:1$

D. $3:1$

Answer: A

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68. In a force of 9 N is acting on a body, then find instataneous power supplied to the body when its velocity is 5m/s in the direction of force

A. 195 watt

B. 45 watt

C. 75 watt

D. 100 watt

Answer: B

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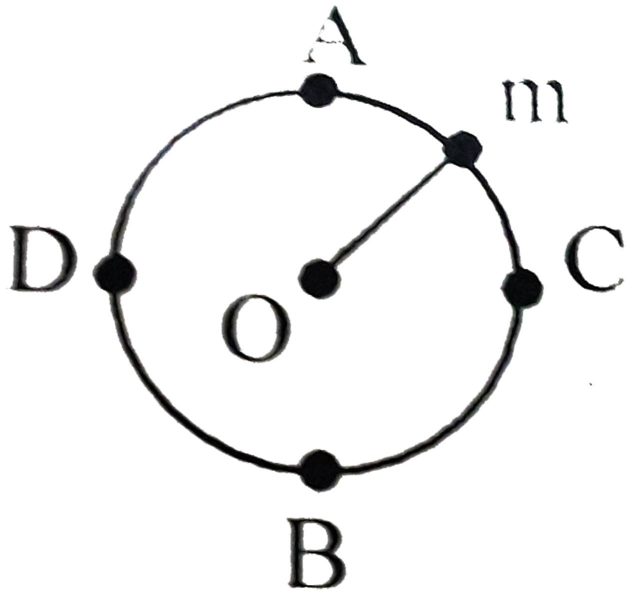
69. A mass is performing vertical ciruclar motion . If the average velocity of the particle is increased, then at which point the string will break:



A. A

B. B

C. C

D. D

Answer: B

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70. A simple pendilum with bob of mass m and length l is held in position at an angle θ with t he verticle. Find its speed when it passes the lowest position.

A. $\sqrt{2gl(1-\cos\theta)}$

B. $\sqrt{2gl}(1+\cos\theta)$

C. $\sqrt{2gl\cos\theta}$

D. $\sqrt{2gl}$

Answer: A

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

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

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

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

D. $\sqrt{2gl}$

Answer: A

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72. The potential energy between two atoms in a molecule is given by $U(x) = \frac{a}{x^{12}} - \frac{b}{x^6}$, where a and b are positive constants and x is the distance between the atoms. The atom is in stable equilibrium when

A. $x = \left(\frac{2a}{b}\right)^{1/6}$

B. $X = \left(\frac{11a}{5b}\right)^{1/6}$

C. $x = 0$

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

Answer: A

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73. The cofficient of restitution e for a perfectly elastic collision is

(a) 1 (b) zero (c) infinite (d) -1

A. 0

B. -1

C. 1

D. ∞

Answer: C

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74. A moving particle of mass m makes a head-on perfectly inelastic collision with a particle of mas 2m which is initially at rest. Find the fractional loss in energy of the colliding partic le after collision.

A. $2v_1$

B. v_1

C. $-v_1$

D. 0

Answer: B

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75. Two identical ball A and B having velocities of 0.5m/s and -0.3m/s respectively collide elastically in one dimension. The velocities of B and A after the collision respectively will be

A. $-0.5m/s$ and $+0.3m/s$

B. $+0.5m/s$ and $+0.3m/s$

C. $+0.3m/s$ and $-0.5m/s$

D. $-0.3m/s$ and $+0.5m/s$

Answer: D

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76. A body of mass m moving with velocity $3km/h$ collides with a body of mass 2m at rest. Now, the combined mass starts to move with a velocity

A. 3 km/h

B. 4 km/h

C. 1 km/h

D. 2 km/h

Answer: C

Watch Video Solution

77. A rubber ball is dropped from a height of 5 m on a planet where the acceleration due to gravity is not known. On bouncing it rises to 1.8 m. The ball loses its velocity on bouncing by a factor of

A. $\frac{3}{5}$

B. $\frac{2}{5}$

C. $\frac{16}{25}$

D. $\frac{9}{25}$

Answer: B

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78. A ball moving with velocity 2 ms^{-1} collides head on with another stationary ball of double the mass. If the coefficient of restitution is 0.5, then their velocities (in ms^{-1}) after collision will be

A. 0, 2

B. 0, 1

C. 1, 1

D. 1, 0.5

Answer: B

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79. A metal ball of mass 2 kg moving with a velocity of $36km/h$ has a head on collision with a stationery ball of mass 3 kg. If after the collision, the two balls move together, the loss in kinetic energy dur to collision is

A. 100 J

B. 140 J

C. 40 J

D. 60 J

Answer: D

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

A. $2E_A$

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

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

D. $4E_A$

Answer: A

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Assignment (SECTION - D)

1. A : The work done by a force during round trip is always zero.

R : The average value of force in round trip is zero.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1).
B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2).
C. If Assertion is true statement but Reason is false, then mark (3).
D. If both Assertion and Reason are false statements, then mark (4).

Answer: D

Watch Video Solution

2. A : The change in kinetic energy of a particle is equal to the work done on it by the net force.

R : The work-energy theorem can be used only in conservative field.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1).

B. If both Assertion & Reason are true but the reason is not the correct explanation of the

assertion, then mark (2).

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4).

Answer: D

Watch Video Solution

3. A : Internal forces can change the kinetic energy but not the momentum of the system.

R : The net internal force on a system is always zero.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1).
B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2).
C. If Assertion is true statement but Reason is false, then mark (3).
D. If both Assertion and Reason are false statements, then mark (4).

Answer: A

Watch Video Solution

4. A : The potential energy can be defined only in conservative field.

R : The value of potential energy depends on the reference level (level of zero potential energy).

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1).

B. If both Assertion & Reason are true but the reason is not the correct explanation of the

assertion, then mark (2).

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are falsė statements, then mark (4).

Answer: B

Watch Video Solution

5. A : When a body moves in a circle the work done by the centripetal force is always zero.

R : Centripetal force is perpendicular to displacement at every instant.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1).

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2).

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4).

Answer: A

Watch Video Solution

6. A : If net force acting-on a system is zero, then work done on the system may be nonzero.

R : Internal forces acting on a system can increase its kinetic energy.

A. If both Assertion & Reason are true and the reason is the correct explanation of the

assertion, then mark (1).

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2).

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4).

Answer: A

Watch Video Solution

7. A : During collision between two objects, the momentum of colliding objects is conserved only in direction perpendicular to line of impact.

R : The force on colliding objects in direction perpendicular to line of impact is zero.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1).

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2).

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are falsė statements, then mark (4).

Answer: A

Watch Video Solution

8. A : The potential energy of a system increases when work is done by conservative force.

R : Kinetic energy can change into potential energy and vice-versa.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1).
B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2).
C. If Assertion is true statement but Reason is false, then mark (3).
D. If both Assertion and Reason are false statements, then mark (4).

Answer: B

Watch Video Solution

9. A : Energy dissipated against friction depends on the path followed.

R : Friction force is non-conservative force.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1).

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2).

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4).

Answer: A

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10. A : Work done by the frictional force can't be positive.

R : Frictional force is a conservative force.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1).

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2).

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4).

Answer: D

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11. A : Power of the gravitational force on the body in a projectile motion is zero, once during its motion.

R : Power delivered by the tension in the wire to a body in vertical circle is always zero.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1).

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2).

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4).

Answer: A

Watch Video Solution

12. A : Power delivered by the tension in the wire to a body in vertical circle is always zero.

R : Tension in the wire is equal to the centripetail force acting on the body doing vertical circular motion.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1).

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2).

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are falsė statements, then mark (4).

Answer: C

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13. A : When a man is walking on a rough road, that work done by frictiona force is zero.

R : Frictional force acts in the direction of the motion of the man in this case.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1).
B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2).
C. If Assertion is true statement but Reason is false, then mark (3).
D. If both Assertion and Reason are false statements, then mark (4).

Answer: B

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