PHYSICS

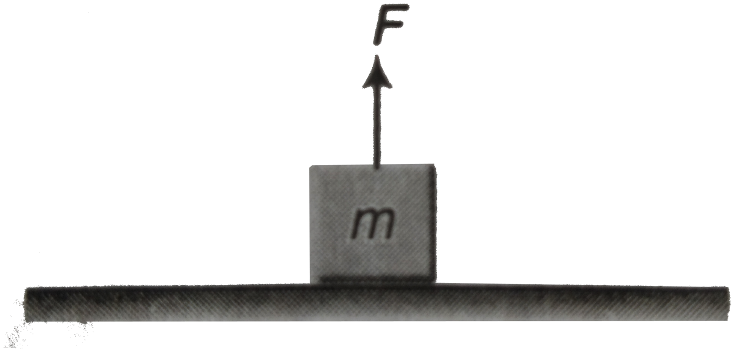
BOOKS - DC PANDEY PHYSICS (HINGLISH)

WORK, ENERGY & POWER

Example

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

2. A block of mass $m = 2kg$ is pulled by a force $F = 40N$ upwards through a height $h = 2m.$ Find the work done on the block by the applied force F and its weight mg. $(g = 10m/s^2)$.



A. -20

B. -10

C. -30

D. -40

Answer: D

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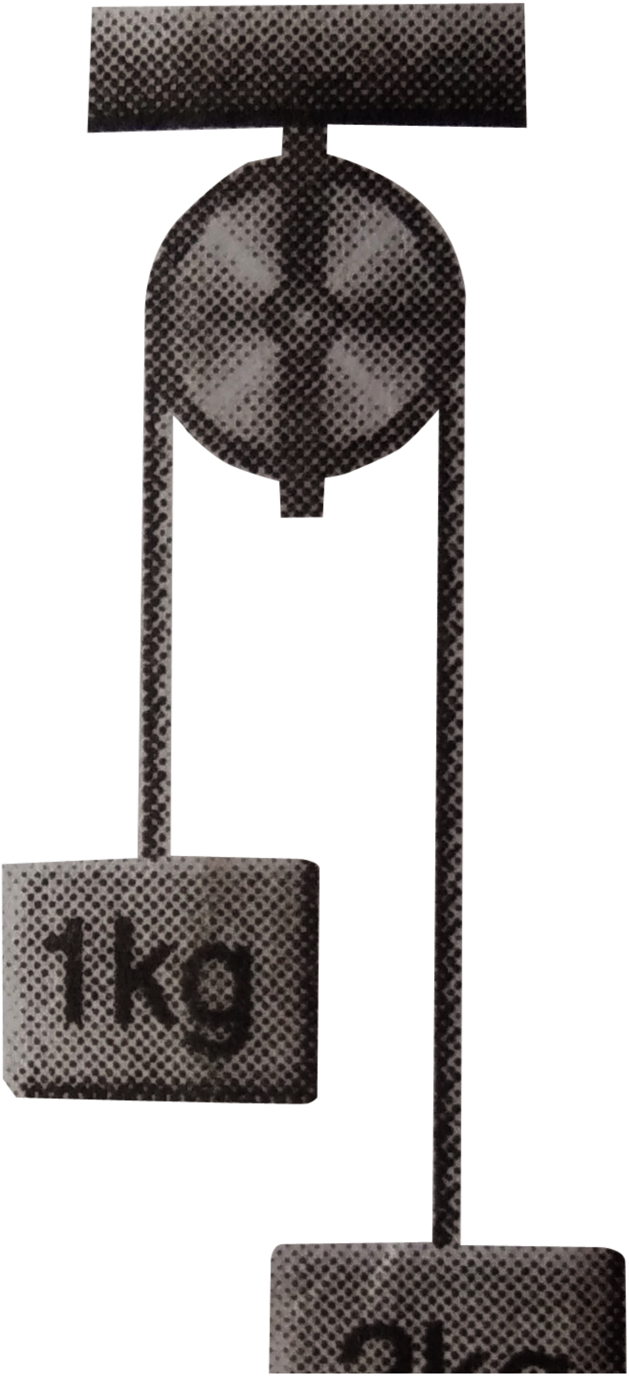
3. Two uneqal masses of 1 kg and 2 kg are attached at the two ends of a light inextensible string passing over a smooth pulley as shown . If the system is released from rest, find the work done by string on both the blocks in 1 s.

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



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4. A force $F = (2 + x)$ acts on a particle in x-direction where F is in newton and x in metre. Find the work done by this force during a displacement form 1. 0 m to x = 2.0 m.

A. $1.5J$

B. $2.5J$

C. $3.5J$

D. $4.5J$

Answer: C

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5. A force $F = -\frac{k}{x_2}(x \neq 0)$ acts on a particle in x-direction. Find the work done by this force in displacing the particle from. $x = +a$ to $x = 2a$. Here, k is a positive constant.

A. $-\frac{k}{2}a$

B. $-\frac{k}{a}$

C. $-2\frac{k}{a}$

D. $-\frac{a}{k}$

Answer: A

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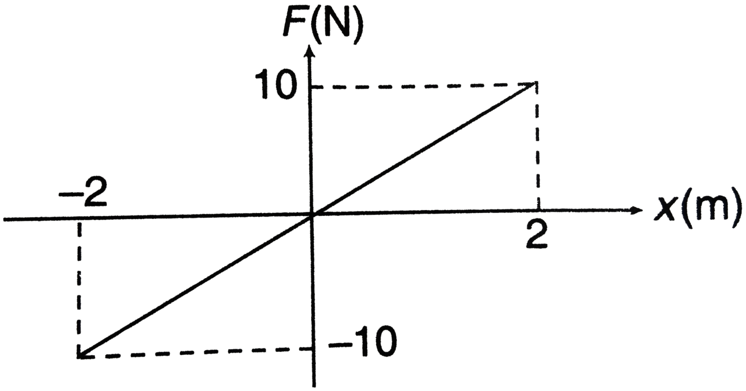
6. A force (F) acting on a particle varoes work done by a particle varies with the with the position x as shown in figure



Find the work done by by force in displacing the particle from .

(a) $x = -2m$ to $x = 0$

(b) $x = 0$ to $x = 2m$. .

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

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8. An object is displaced from positin vector $r_1 = \left(2\hat{i} + 3\hat{j}\right)$ m to $r_2 = \left(4\hat{i} + 6\hat{j}\right)$ m under a forc $F = \left(3x^2\hat{i} + 2y\hat{j}\right)N$ Find the work done by this force.

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9. An object of mass 5 kg falls from rest through a vertical distance of $20m$ and attains a velocity of 10 m/s. How much work is done by the resistance of the air on the objrct?

$\left(g = 10m/s^2\right)$.

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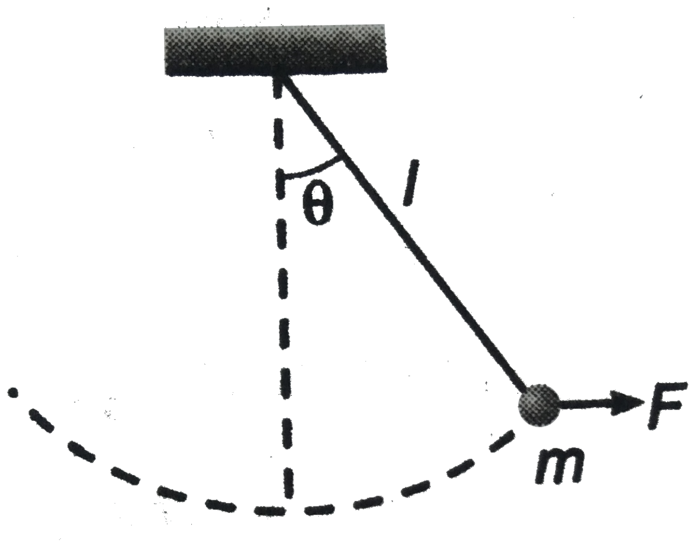
10. An object of mass m is tied to a string of length l and a variable force F is applied on it which brings the string gradually at angle θ with the vertical. Find the work done by the force F.



A. $mgl(1 + \cos\theta)$

B. $\dfrac{mg}{l(1 - \cos\theta)}$

C. $mgl(1 - \cos\theta)$

D. $\dfrac{mg}{l(1 + \cos\theta)}$

Answer: C

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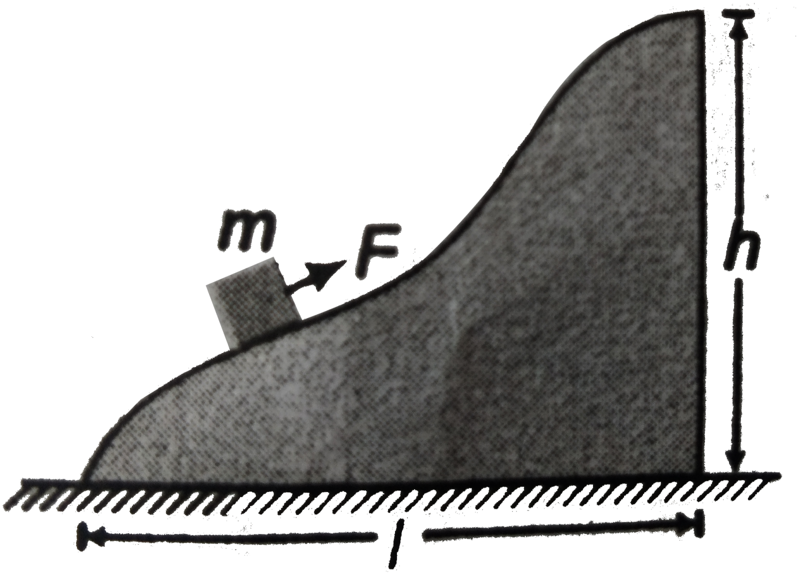
11. A body of mass m was slowly hauled up the hill as shown in the fig. by a force F which at each point was directed along a tangent to the trajectory. Find the work performed by this force, if the height of the hill is h, the length of its base is l and the coefficient ot friction is μ.



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12. The displacement x of particle moving in one dimension, under the action of a constant force is related to the time t by the equation

$t = \sqrt{x} + 3$

where $xis \in meters$ and $t \in \sec onds$. Find

(i) The displacement of the particle when its velocity is zero , and

(ii) The work done by the force in the first $6 \sec onds$.

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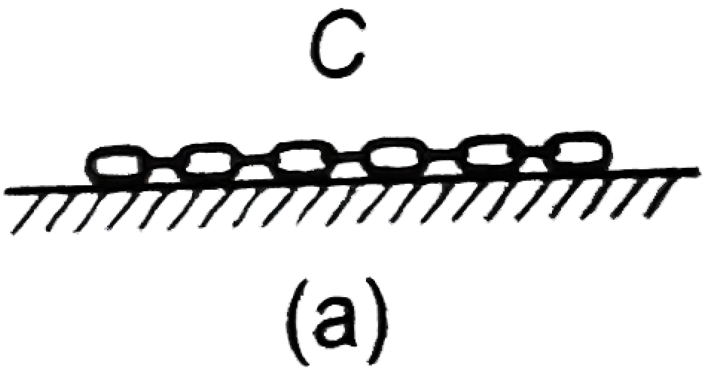
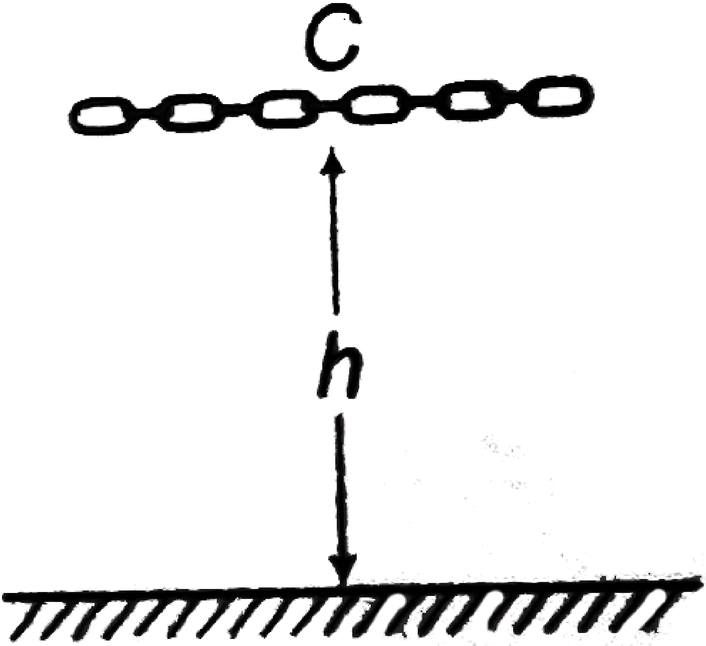
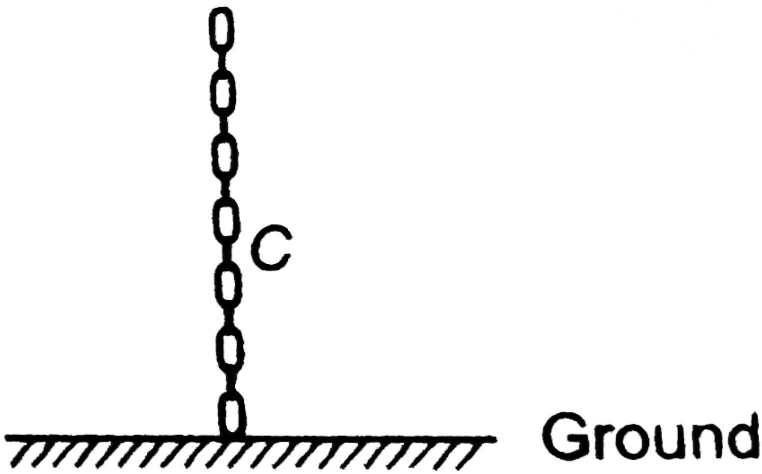
13. A chain of mass m and length I is kept in three positions as shown below. Assuming (h=0) on the ground find potential inergy of chain in all three cases.



(a)



(b)



(c)

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14. Potential energy of a body in position A is-40J. Work done by conservative force in moving the body from A to B is $-20J$. Find potential energy of the body in position B.

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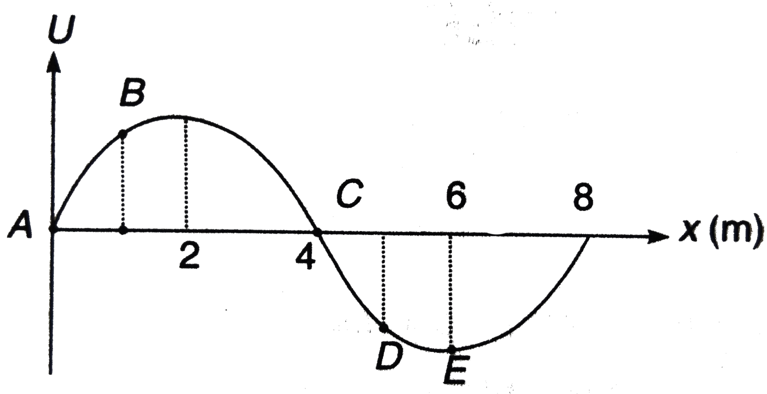
15. For the potential energy curve shown shown in figure.



(a) Find directions of force at points A, B, C, D and E.

(b) Find positions of stable, unstable and neutral equilibriums.

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16. The potential energy of a conservative force field is given by

$U = ax^2 - bx$

where, a and b are positive constants. Find the equilibrium position and discuss whether the equilibrium is stable, unstable or neutral.

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17. A ball of mass 1 kg is dropped from a tower. Find power of gravitational force at time $t = 2s$. Take `g=10m//s^(2).

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18. A particle of mass m is lying on smooth horizontal table. A constant force F tangential to the surface is applied on it. Find .

(a) average power over a time interval from $t = 0$ to $t = t$,

(b) instantaneous power as function of time t.

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19. A body is displaced from position A to position B. Kinetic and potential energies of the body at positions A and B are

$K_A = 50J, U_A = -30J, K_B = -10J$ and $U_B = 20J$.

Find work done by

(a) conservative forces (b) all forces (c)forces other than covservative forces.

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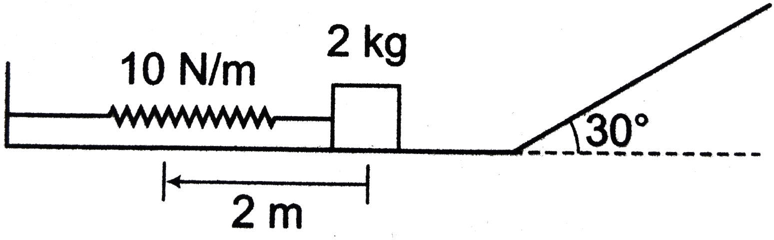
Solved Examples

1. In the figure shown, all surfaces are smooth and force constant of spring is $10N/m$. Block of mass (2 kg) is attaced with the spring. The spring is compressed by (2m) and then released. Find the maximum distance d travelled by the block over the inclined plane. Take

$g = 10m / s^2$.



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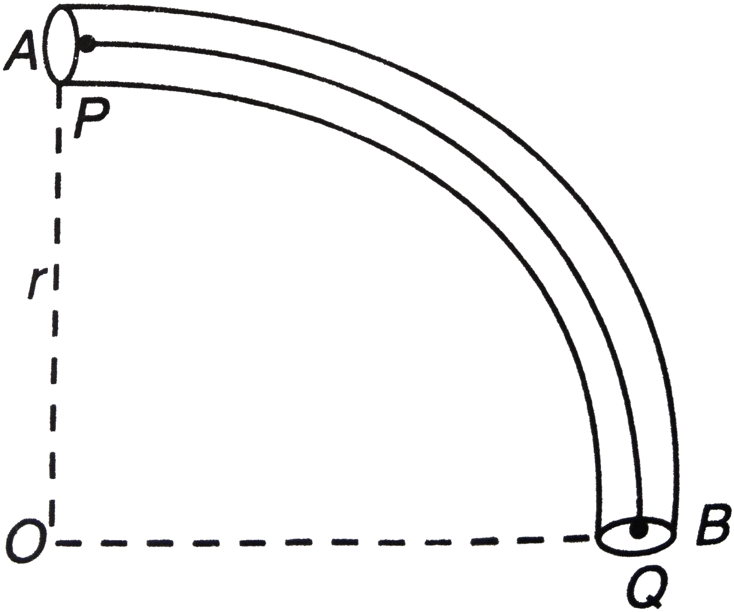
2. A smooth narrow tube in the form of an arc AB of a circle of centre O and radius r is fixed so that A is vertically above O and OB is horizontal. Particles P of mass m and Q of mass 2 m with a light inextensible string of length (pi r//2) connecting them are placed inside the rube with P at A and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



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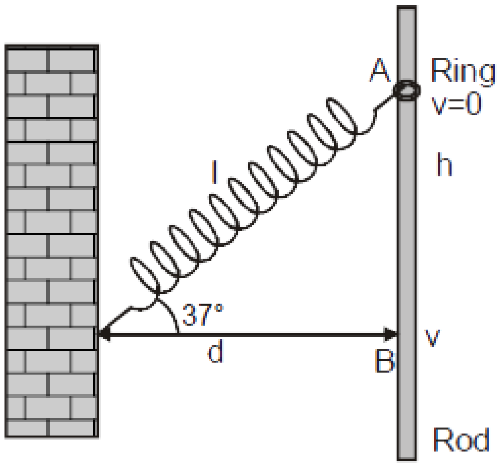
3. One end of a light spring of natural length d and spring constant k is fixed on a rigid wall and the other is attached to a smooth ring of mass m which can slide without friction on a vertical rod fixed at a distance d from the wall. Initially the spring makes an angle of 37° with the horizontal as shown in fig. When the system is released from rest, find the speed of the ring when the spring becomes horizontal.

[sin 37° = 3/5]



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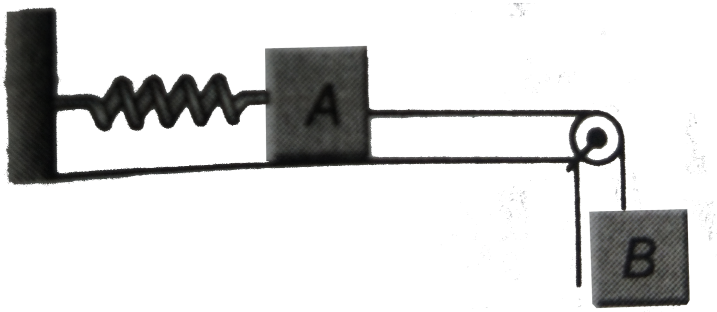
4. In the adjoining figure, block A is of mass (m) and block B is of mass 2m. The spring has force constant k. All the surfaces are smooth and the system is released form rest with spring unstreched.



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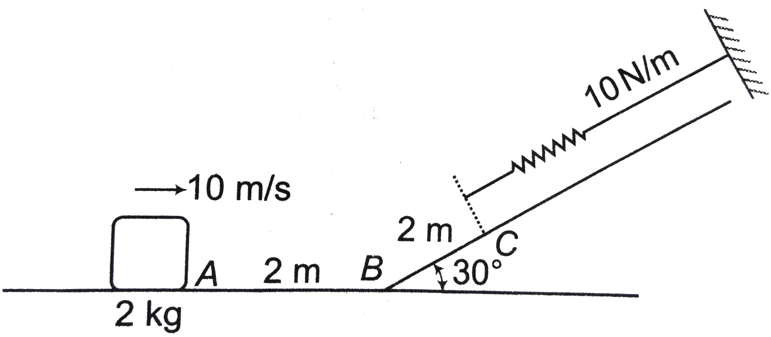
5. 

In the figure shown, $AB = BC = 2m$. Friction coefficient everywhere is $\mu = 0.2$. Find the maximum compression of the spring.

A. $1.48m$

B. $3.45m$

C. $4.75m$

D. $2.45m$

Answer: D

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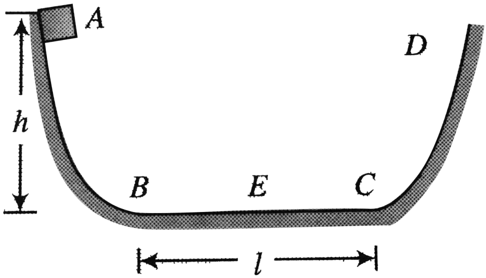
6. A particle slides along a track with elevated ends and a flat central part as shown in figure. The flat part has a length $l = 3m$. The curved portions of the track are frictionless. For the flat part, the coefficient of kinetic friction is $\mu_k = 0.2$. The particle is released at point A which is at height $h = 1.5m$ above the flat part of the track. Where does the particle finally come to rest?



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7. A $0.5kg$ block slides from the point A on a horizontal track with an initial speed $3m/s$ towards a weightless horizontal spring of length $1m$ and force constant $2N/m$. The part AB of the track is frictionless and the part BC has the conficient of static and kinetic friction as 0.20

respectively. If the distancences AB and BD are $2m$ and $2.14m$ respectively, find total distance through which the block moves before it comes to rest completely. `(g=10 m//s^(2)).

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8. A body is desplaced from origin to $(2m, 4m)$ under the following two forces:

(a) $F = \left(2^{\hat{i}} + 6^{\hat{j}}\right)N$, a constant force

(b) $F\left(2x^{\hat{i}} + 3y^2\hat{j}\right)N$

Find word done by the given forces in both cases.

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

(a) $-2ka^2$, (b) $2ka^2$, (c)-ka^(2), (d)ka^(2)`

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10. A body is displaced from prigin to (1m,1m) by force

$F=\left(2y\hat{i}+3x^2\hat{j}\right)$ along two paths

(a) $x=y$ (b) $y=x^2$

Find the work done along both paths.

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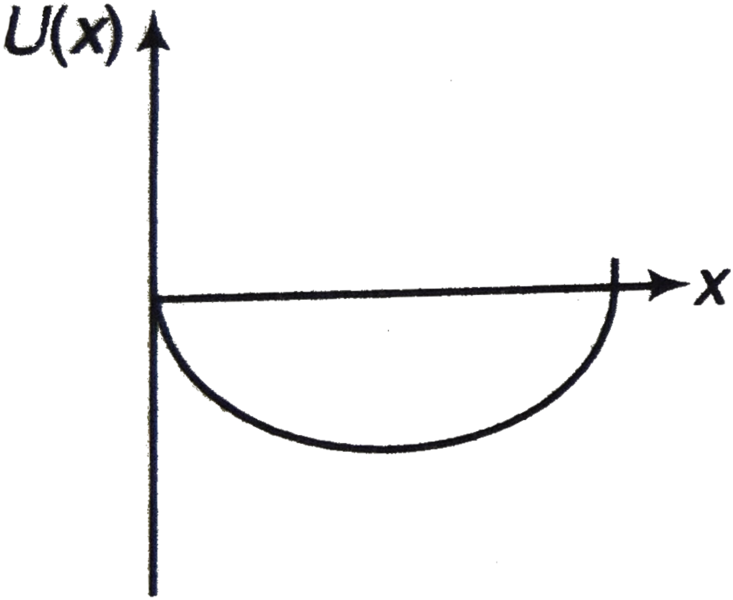
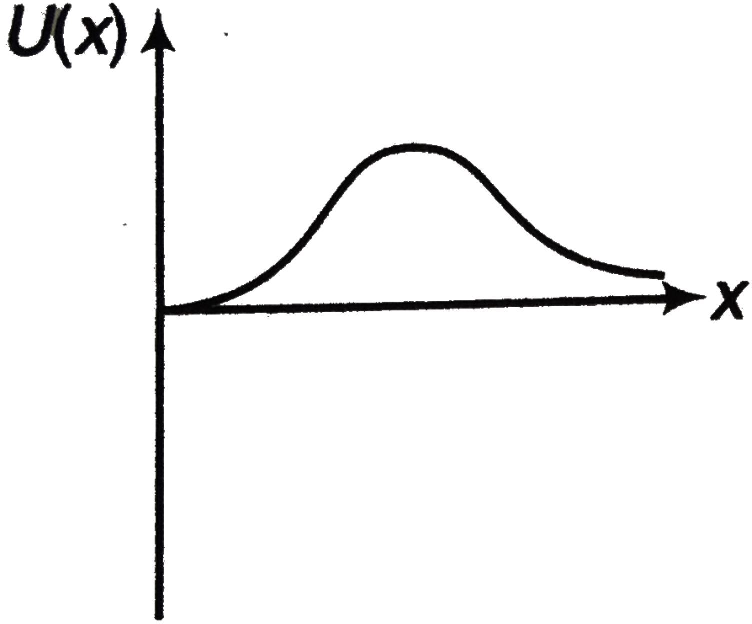
11. A particle, which is constrained to move along x-axis, is subjected to a force in the some direction which varies with thedistance x of the particle from the origin an $F(x)=-kx+ax^3$. Here, k and a are positive constants. For $x(\geq 0,$ the functional form of the potential energy (u) U of the U (x) the porticle is.



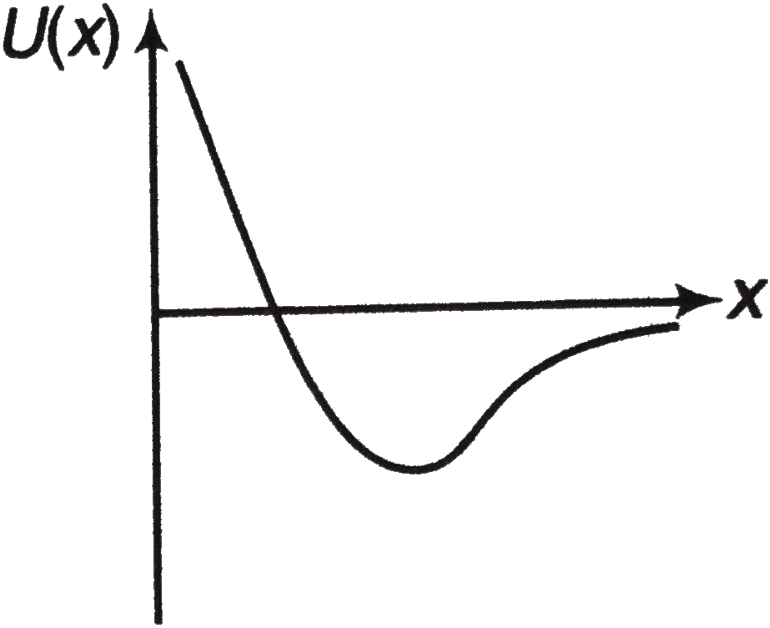
(a)

(a) , (b)



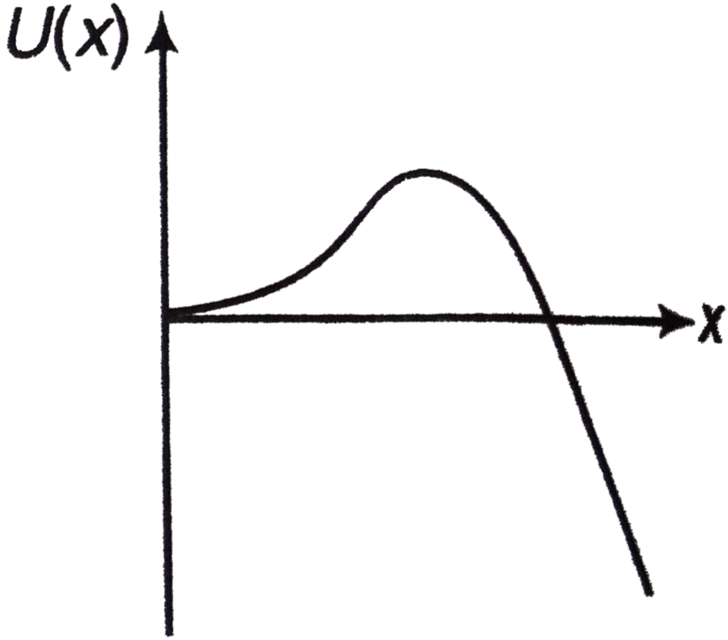
(b)

, (c)



(c)

, (d)



(d)

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12. 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 $U(x)$ verses x will be (where U is the potential energy function.)

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Type 2

1. In the figure sown in the concept, find

(a) Equilbrium extension $x_{\circ}(= AB)$

(b) Maximum extension $x_m(= AC)$

(c)Maximum speed at point B.

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Miscellaneous Example

1. A small mass m starts from rest and slides down the smooth spherical surface of F. Assume zero potential energy at the top. Find

(a) the change in potential energy,

(b) the kintic energy,

(c) the speed ot the mass as a function of the angle θ made by the radius through the mass with the vertical.

A. $-mgR(1 - \cos\theta), mgR(1 - \cos\theta), v = \sqrt{2gR(1 - \cos\theta)}$

B. $-mgR(1+\cos\theta), mgR(1-\cos\theta), v=\sqrt{2gR(1-\cos\theta)}$

C. $-mgR(1-\cos\theta), mgR(1+\cos\theta), v=\sqrt{2gR(1-\cos\theta)}$

D. $-mgR(1-\cos\theta), mgR(1-\cos\theta), v=\sqrt{2gR(1+\cos\theta)}$

Answer: A

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2. A smooth track in the form of a quarter-circle of radius 6 m lies in the vertical plane. A ring of weight 4(N) moves from P_1 and P_2 under the action of forces F_1, F_2 and F_3. is always towards P_2 under the action of forces F_1, F_2 and F_3 Force F_1 is always towards P_2 and is always (20) N in maghitude, force F_2 always acts hotizontally and is always (30 N) in magnitude, force F_3 always acts tangentially to the track and is of magnitude $(15-10s)N$, where s is in metre. If the particle has speed $4m/s$ at P_1,what will its speed be at P_2?

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3. A single conservative force F(x) acts on a on a (1.0kg) particle that moves along the x-axis. The potential energy U(x) is given by:

$U(x) = 20 + (x - 2)^2$

where, x is meters. At $x = 5.0m$ the particle has a kinetic energy of $20J$

(a) What is the mechanical energy of the system?

(b) Make a plot of U(x) as a function of x for $-10m \leq x \leq 10m$, and on the same graph draw the line that represents the mechanical energy of the system. Use part (b) to determine.

(c) The least value of x and

(d) the greatest value of x between which the particle can move.

(e) The maximum kinetic energy of the particle and

(f) the value of x at which it occurs.

(g) Datermine the equation for $F(x)$ as a function of x.

(h) For what (finite) value of x does $F(x) = 0$?.

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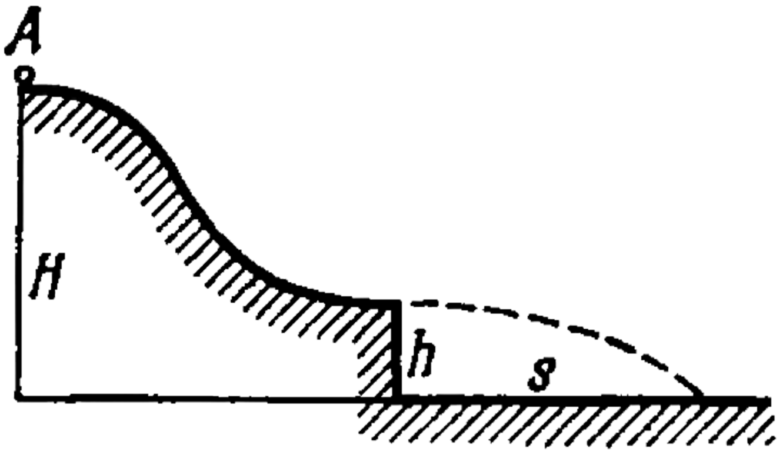
4. A small disc A slides down with initial velocity equal to zero from the top of a smooth hill of height H having a horizontal portion. What must be the height of the horizontal portion h to ensure the maximum distance s covered by the disc? What is it equal to?



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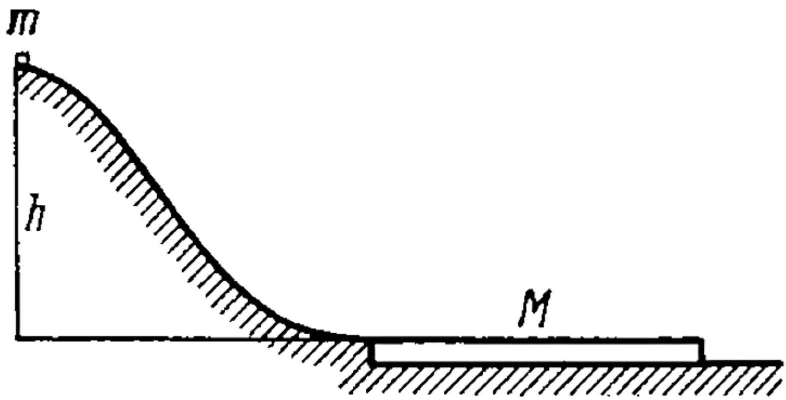
5. A small disc of mass m slides down a smooth hill of height h without initial velocity and gets onto a plank of mass M lying on the horizontal plane at the base of the hill. (figure). Due to friction between the disc and the plank the disc slows down and, beginning with a certain moment, moves in one piece with the plank.

(1) Find the total work performed by the friction forces in this process.

(2) Can it be stated that the result of obtained does not depend on the choice of the reference frame?



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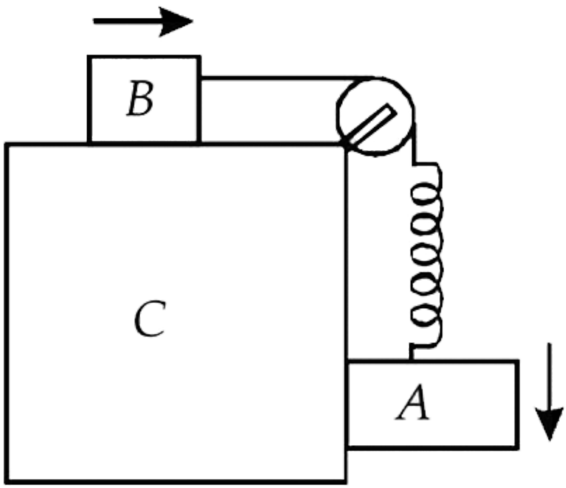
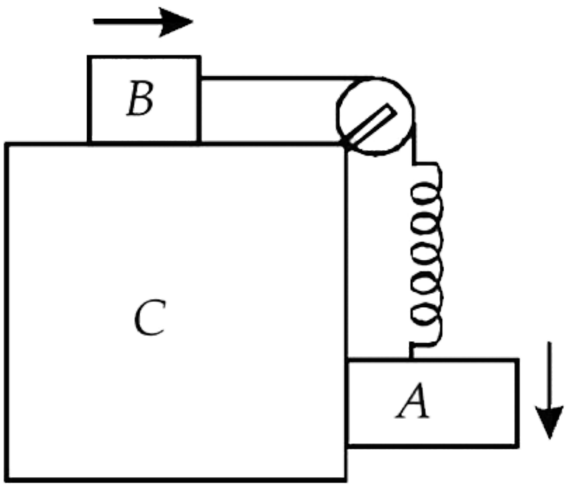
6. Two blocks A and B are connected to each other by a string and a spring , the spring pases and a frictionlesss pulley as down over in the figure . Block B sides over the horizental top surface of a strionry block C both with the verical side of C , both with the same conform speed



The coefficient of friction between the surface the of block is 0.2 force constant of the spring is 1960 newtons , if mass of block A is 2 kg , celculate the mass of block F and B and the energy stored is the spring



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Exercise 9 1

1. A block is displaced from $(1m, 4m, 6m)$ to $\left(2\hat{i} + 3\hat{j} - 4\hat{k}\right)m$ under a constant force $F = \left(6\hat{i} - 2\hat{j} + \hat{k}\right)N$. Find the work done by this force.

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2. A block of mass $2.5kg$ is pushed 2.20m along a frictionless horizontal table by a constant force 16 N directed 45° above the horizontal. Determine the work done by.

(a) the applied force,

(b) the mormal force exerted by the table,

(c) the force of gravity and

(d) determine the total work done on the block.

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3. A block is pulled a distance x along a rough horizontal table by a horizontal string. If the tension in the string is T, the weight of the block is W, the reaction is N and frictonal force is F. Write down expressions for the work done by each of these forces.

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4. A bucket tied to a string is lowered at a constant acceleration of $g/4$. If mass of the bucket is m and it is lowered by a distance /then find then work done by the string on the bucket.

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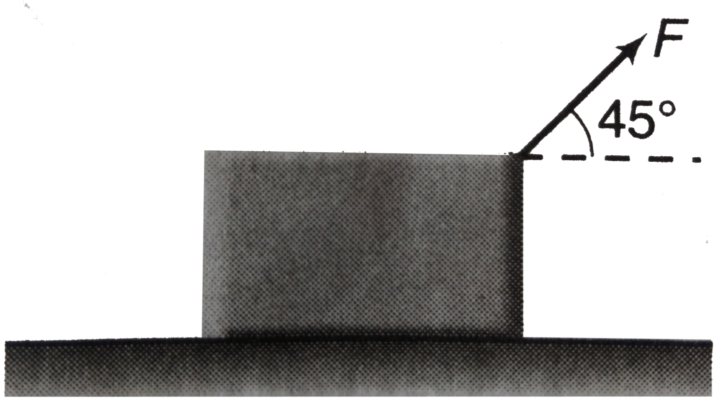
5. A $1.8kg$ block is moved at constant speed over a surface for which coefficient of friction $\mu = \frac{1}{4}$ it is pulled by a force F acting at 45° with horizontal as shown in Fig. The block is displaced by 2 m. Find the work done on the block by (a) the force F (b) friction (c) gravity.



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6. A block is constrained to move along x-axis under a force $F = -2x. Here, Fis \in \neq w \to n$ and $x \in metre. F \in dthew$ or $kdo \neq$

x=2m to $x = -4$ m.

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7. A block is constrained to move along x-axis under a forc $F = \frac{4}{x^2}(x \neq 0)$. Here, F is in newton and x in metre. Find the work done by this force when the block is displaced from $x = 4$ m to $x = 2m$.

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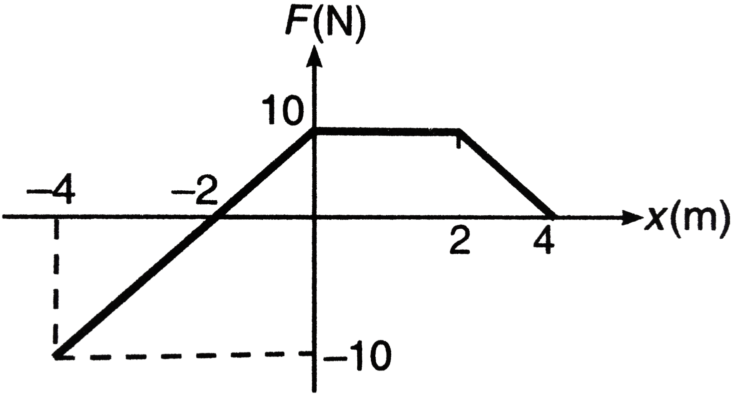
8. Force acting on a particle varies with displacement as shown is Fig. Find the work done by this force on the particle from $x = -4m$ to `x = +

4m.



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9. A particle is subjected to a force F_x that varies withes position as shown in figure. Find the work done by the force on the body as it moves

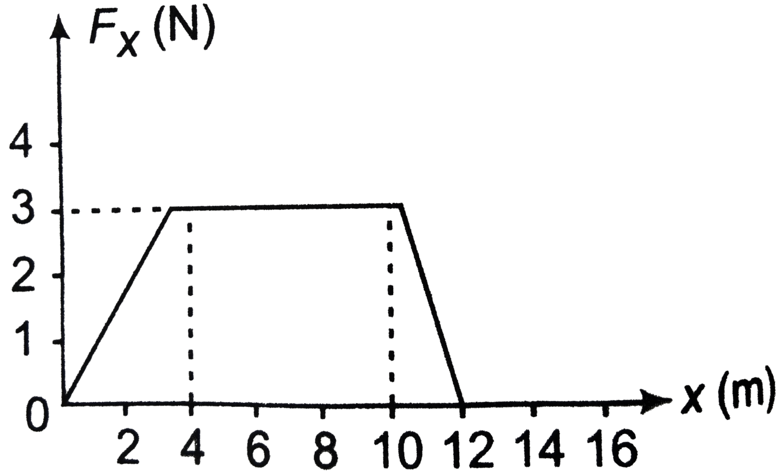
(a) from $x = 10.0m$ to $x = 5.0m$,

(b) from $x = 5.0m$ to $x = 10.0m$,

(c) from $x = 10.\ 0m$ to $x = 15.0m$,

(d) what is the total work done by the force over the distance $x = 0$ to

$x = 15.0$?



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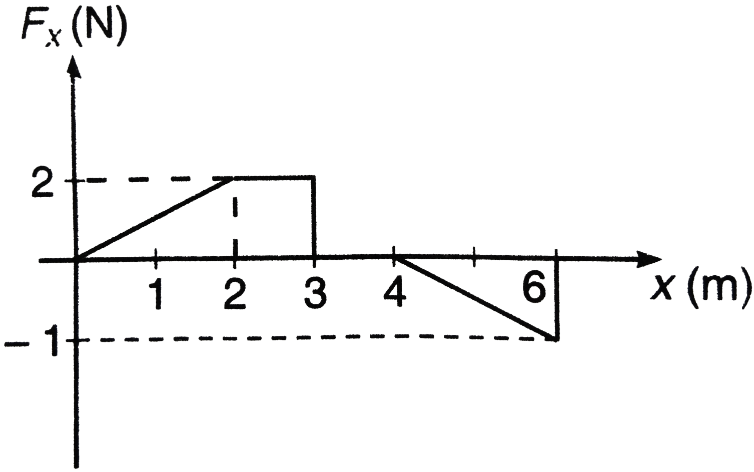
10. A child applies a force F parallel to the x-axis to block moving on a horizontal surface. As the child controls the speed of the block, the x-component of the force varies with the x-coordinate of the block as shown in figure. calculate the work by the force F whin the block moves.



(a) from $x = 0$ to $x = 3.0m$

(b) from $x = 3.0m$ to $x = 4.0m$

(c) from $x = 4.0m$ to $x = 7.0m$

(d) from $x = 0$ to $x = 7.0m$.

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Exercise 9 2

1. A ball of mass 100 gm is projected upwards with velocity $(10m/s)$. It returns back with $(6m/s)$. Find work done by air resistance .

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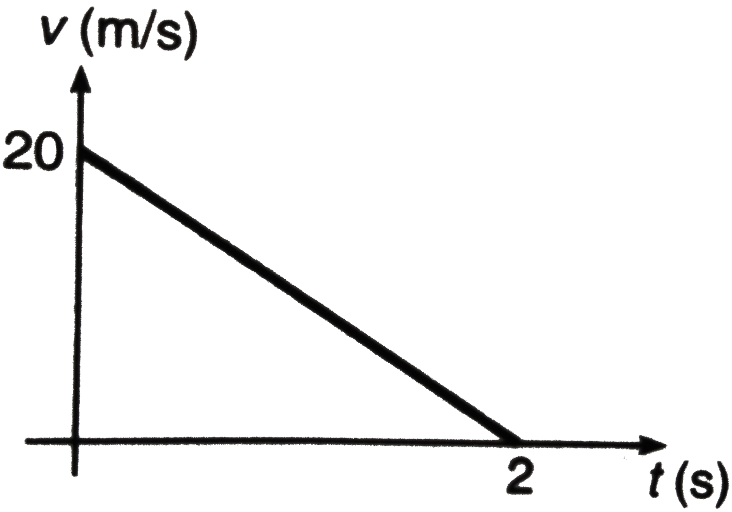
2. Velocity-time graph of a particle of mass (2 kg) moving in a straight line is as shown in Fig. 9.20. Find the word done by all the forces acting on the



particle. .

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3. Is work energy theorem valid in noninertial frames?

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4. A particle of mass m moves on a straight line with its velocity varying with the distance travelled according to the equation $v = a\sqrt{x}$, wher ea is a constant. Find the total work done by all the forces during a displacement from $x = 0 \rightarrow x = d$.

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5. A 5 kg mass is raised distance of $4m$ by a vertical force of 80 N. Find the final kinetic energy of the mass if it was originally at rest.$g = 10m/s^2$.

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6. An object of mass m has a speed v_0 as it passes throgh the origin. Origin. It subjected to a retaeding force given by $F(x) = -Ax$. Here, A is a positive constant. Find its x-coordinate when it stops.

A. $x = v_0\sqrt{\frac{m}{A}}$

B. $x = v_0\sqrt{\frac{A}{m}}$

C. $x = v_0\left(\frac{m}{A}\right)$

D. $x = v_0\left(\frac{A}{m}\right)$

Answer: A

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7. A block of mass M hanging over a smooth and light pulley through a light string. The other end of the string is pulled by a constant force F. The kinetic of the block increases by $40J$ in $1s$. State whether the following statements are true or false.

(a) The tension in the string is Mg .

(b) The work done the tension on the block is $40J$.

(c) the tension in the string is F.

(d) The work done by the force of gravity is 40J in the above 1s .

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8. Displacement of a particle of mass 2 kg varies with time as $s = (2t^2 - 2t + 10)m$. Find total work done on the particle in a time interval from $t = 0$ to $t = 2s$.

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9. A block of mass 30.0 kg is being brought down by a chain. If the block acquires as speed of 40.0cm/s` in dropping down 2.00 m ,find the work done by the chain during the process.

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Exercise 9 3

1. if work done by a conservative force is positive the select the correct option(s).

(a) potential energy will decrease.

(b) potential energy may increase or decrease.

(c)kinetic energy will increase.

(d) kinetic energy may increase or decrease.

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2. Work done by a conservative force in bringing a body from infinity to A is 60 J and to B is 20J. What is the difference in potential energy between point A and B, i.e. $U_B - U_A$.

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Exercise 9 4

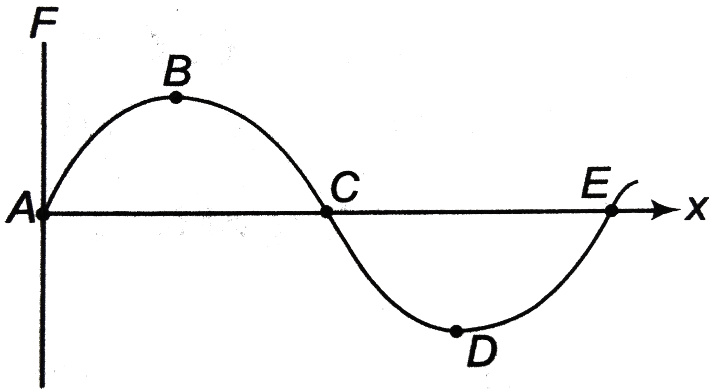
1. Potential energy of a particle moving along x-axis is by

$$U = \left(\frac{x^3}{3} - 4x + 6\right).$$

here, U is in joule and x in metre. Find position of stable and unstable equilibrium.

Watch Video Solution

2. Force acting on a particle moving along x-axis as shown in figure. Find points of stable and unstable equlibrium.



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3. Two point charges $+q$ and fixed at $(a, 0, 0)$ and $(-a, 0, 0)$. A third point charge $-q$ is at origin. State whether ite equlilbrium is stable, unstable or neutral if it is slightly displaced:

(a) along x-axis. , (b) along y-axis.

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4. potential enrgy of a particle along x-axis varies as, $U = -20 + (x-2)^2$, where U is in joule and x in meter. Find the equilibrium position and state whether it is stable or unstable equilibrium.

A. U=-20

B. x=2

C. U=+20

D. x=-2

Answer:

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5. Force acting on a particle constrained to move along x-axis is $F = (x-4)$. Here, F is in newton and x in metre. Find the equilibrium position and state whether it is stable or unstable equilibrium.

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Exercise 9 5

1. A block of mass 1kg start moving with constant acceleration $a = 4m/s_2$ Find.

(a) average power of the net force in time inteval from $t = 0$ to $t = 2s$,

(b) instantaneous power of the net force at $t = 4s$.

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2. A constant power P is applied on a particle of mass m. find kinetic energy, velocity and displacement of particle as function of time t.

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Introductory

1. A time varying power and velocity of particle as function of mass m. find.

(a) kinetic energy and velocity of particle as function of time.

(b) average power over a time intrval from $t = 0$ to $t = t$.

View Text Solution

Level 1 Assertion And Reason

1. Assertion : Power of a constant force is also constant.

Reason : Net constant force will always produce a constant acceleration.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true and the Reason is not the correct explanation of the Assertion.

C. If Assertion is true, but the Reason is false

D. If Assertion is false but the Reason is true.

Answer: D

Watch Video Solution

2. Asseration : A body is moved from $x = 2$ to $x = 1$ under a force `F =4x, the work done by this force is negative.

Reason : Force and displacement are in opposite directions .

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true and the Reason is not the correct explanation of the Assertion.

C. If Assertion is true, but the Reason is false

D. If Assertion is false but the Reason is true.

Answer: A

Watch Video Solution

3. Assertion : If work done by conservative forces is positive, kinetic energy will increase.

Reason : Because potential energy will decrease.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true and the Reason is not the correct explanation of the Assertion.

C. If Assertion is true, but the Reason is false

D. If Assertion is false but the Reason is true.

Answer: D

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4. Assertion : In circular motion work done by all the forces acting on the body is zero.

Reason : Centripetal force and velocity are mutually perpendicular.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true and the Reason is not the correct explanation of the Assertion.

C. If Assertion is true, but the Reason is false

D. If Assertion is false but the Reason is true.

Answer: D

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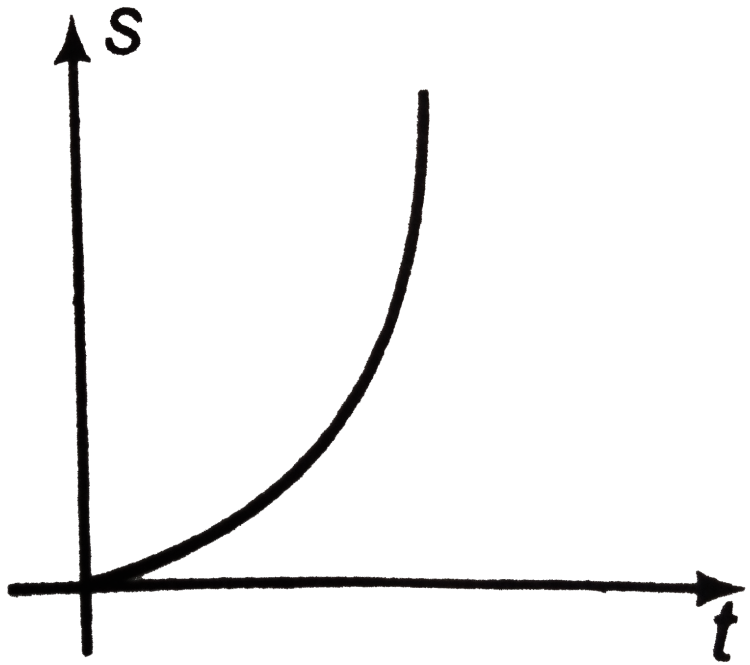
5. Asseration : Corresponding to displacement-time graph of a particle moving in a the body is positive.



Reason : Speed of particle is increasing.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true and the Reason is not the correct explanation of the Assertion.

C. If Assertion is true, but the Reason is false

D. If Assertion is false but the Reason is true.

Answer: A

View Text Solution

6. Asseration : Work done by a constant force is path independent.

Reason : All constantant forces are conservative in nature.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true and the Reason is not the correct explanation of the Assertion.

C. If Assertion is true, but the Reason is false

D. If Assertion is false but the Reason is true.

Answer: C

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7. Assertion : Work-energy theorem can be applied for non-inertial frames also.

Reason : Earth is a non-inertial frame.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true and the Reason is not the correct explanation of the Assertion.

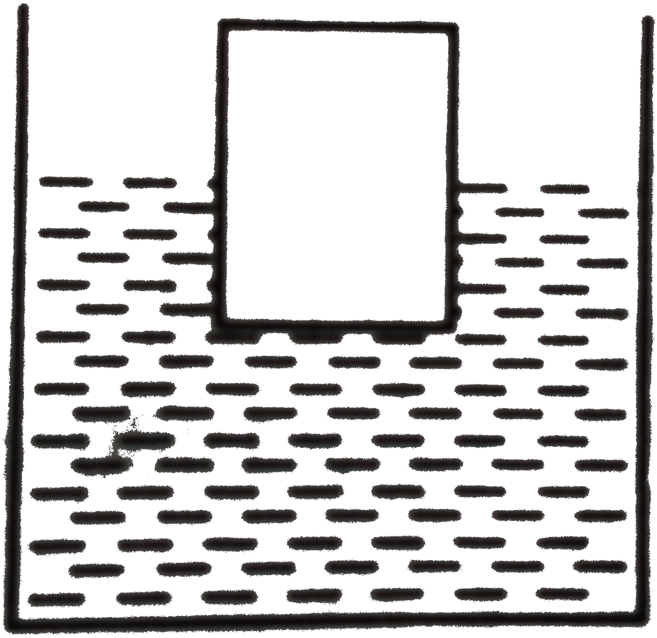
C. If Assertion is true, but the Reason is false

D. If Assertion is false but the Reason is true.

Answer: B

Watch Video Solution

8. Asseration : A wooden block is floating in a liquid as shown in figure, in vertical direction equilibrium of block stable.



Reason : When depressed in downward direction is starts oscillating.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true and the Reason is not the correct explanation of the Assertion.

C. If Assertion is true, but the Reason is false

D. If Assertion is false but the Reason is true.

Answer: A

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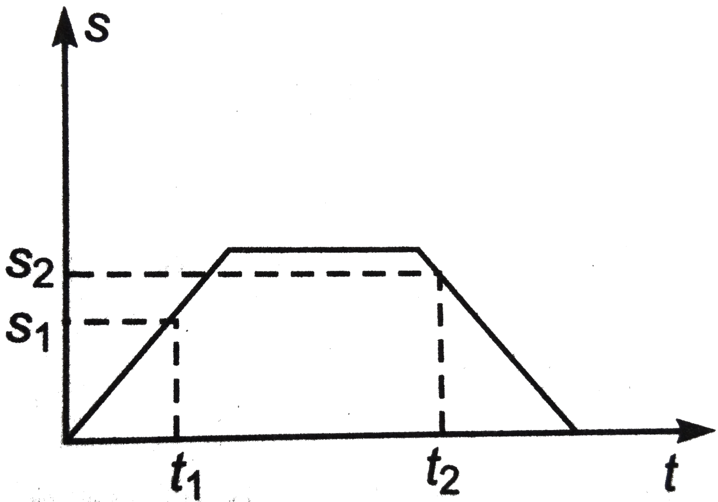
9. Asseration : Displacement time graph of a particle moving in a straight line is shown in figure. Work done by all the forces between time interval t_1 and t_2 is definitely zero.



,

Reason : Work done by all the forces is equal to change in kinetic energy.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true and the Reason is not the correct explanation of the Assertion.

C. If Assertion is true, but the Reason is false

D. If Assertion is false but the Reason is true.

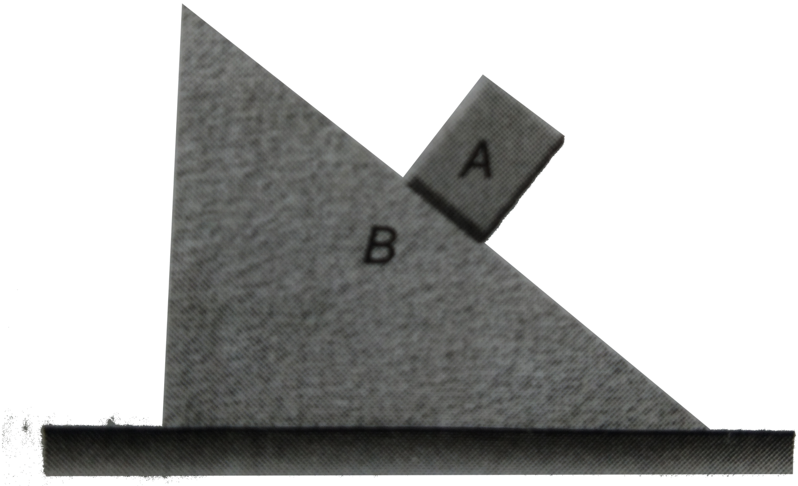
Answer: D

Watch Video Solution

10. Asseration : All surfaces shown in figure are smooth. Block A comes down along the wedge B. Work done by normal reaction (between A and B) on B is positive while on A it is negative.

Reason : Angle between normal reaction and net desplacement of A is greater than 90° while between normal reaction and net displacement of

B is less than 90°



A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true and the Reason is not the correct explanation of the Assertion.

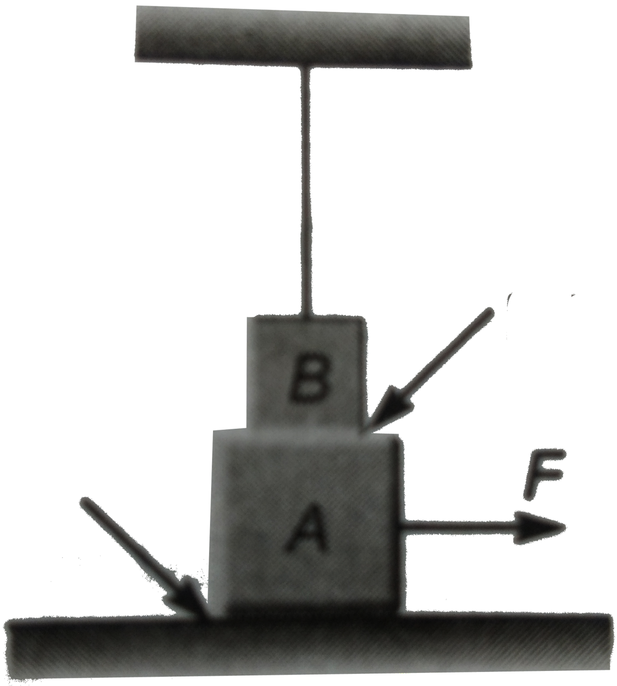
C. If Assertion is true, but the Reason is false

D. If Assertion is false but the Reason is true.

Answer: A

Watch Video Solution

11. Asseration : A plank A is placed on a rough surface over which a block B is placed. In the shown situation, elastic cord is unstretched. Now a gradually increasing force F is appled slowly on A until the relative motion between the block and plank starts.



At this moment cord is making an angleθ with the vertical. Work done by force F is equal to energy lost against fricton f_2, plus potential energy stored in the cord.

Reason : work done by static friction f_1 on the system as a whole is zero.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true and the Reason is not the correct explanation of the Assertion.

C. If Assertion is true, but the Reason is false

D. If Assertion is false but the Reason is true.

Answer: A

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12. Asseration : A block of mass m starts moving on a rough horizontal surface with a velocity v. It stops due to friction between the block and the surface after moving through a ceratin distance. The surface is now tilted to an angle of 30° with the horizontal and same block is made to go up on the surface with the same initial velocity v. The decrease in the mechanical energy in the second situation is small than the first situation.

Reason : The coefficient of friction between the block and the surface decreases with the increase in the angle of inclination.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true and the Reason is not the correct explanation of the Assertion.

C. If Assertion is true, but the Reason is false

D. If Assertion is false but the Reason is true.

Answer: C

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Level 1 Objective

1. Identify, which of th following energies can be positive (or zero) only ?

A. Kinetic energy

B. Potential energy

C. Mechanical energy

D. Both kinetic and mechanical energy

Answer: A

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

A. always

B. only if the forces acting on the body are conservative

C. only in the inertial force frame

D. only if no external force is acting

Answer: A

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3. Work done by force of static friction .

A. can be positive

B. can be negative

C. can be zero

D. All of these

Answer: D

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4. Work done when a force $F = \left(\hat{i} + 2\hat{j} + 3\hat{k}\right)N$ acting on a particle takes it from the point

$r_1 = \left(\hat{i} + \hat{k}\right)$ the point $r_2 = \left(\hat{i} - \hat{j} + 2\hat{k}\right)$ is .

A. $3J$

B. $1J$

C. $zero$

D. $2J$

Answer: B

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5. A particle moves along the x-axis from $x = 0$ to $x = 5m$ under the influence of a given by

$F = 7 - 2x + 3x^2$. The instantaneous power applied to the particle is.

A. $360J$

B. $85J$

C. $185J$

D. $135J$

Answer: D

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6. A particle moves with a velocity $v = \left(5\hat{i} - 3\hat{j} + 6\hat{k}\right)ms^{-1}$ under the influence of a constant force $F = \left(10\hat{i} + 10\hat{j} + 20\widehat{h}\right)N$, the instantaneous power applied to the particle is.

A. $200W$

B. $320W$

C. $140W$

D. $170W$

Answer: C

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7. A pump is required to lift $800kg$ of water per minute from a 10 m deep well and eject it with speed of $20kgm/s$. The required power in watts of

the pump will be

A. 6000

B. 4000

C. 5000

D. 8000

Answer: B

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8. A ball is dropped onto a floor from a height of $10m$. If 20% of its initial energy is lost,then the height of bounce is

A. $2m$

B. $4m$

C. $8m$

D. $6.4m$

Answer: C

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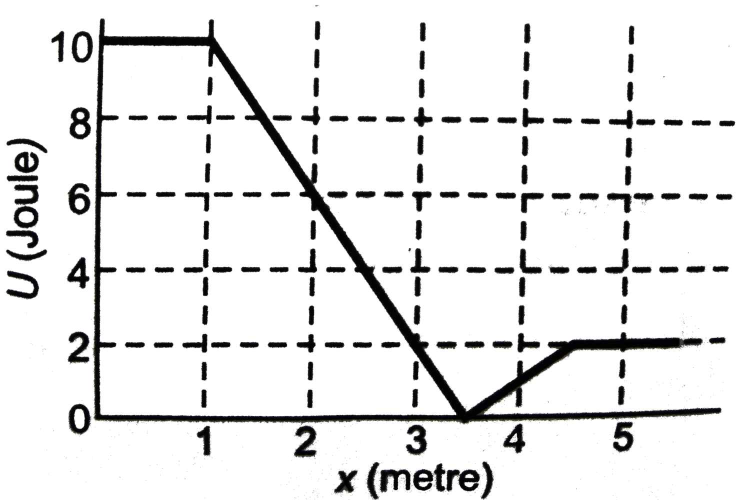
9. A body with mass $1kg$ moves in one direction in the presence of a force which is described by the potential energy graph. If the body is releasd from rest at $x = 2m$, than its speed when it crosses $x = 5m$, is (Neglect dissipative forces).



A. $2\sqrt{2}ms^{-1}$

B. $1ms^{-1}$

C. $2ms^{-1}$

D. $3ms^{-1}$

Answer: A

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10. A body has kinetic energy E when projected at angle of projection for maximum range. Its kinetic energy at the highest point of its path will be

A. E

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

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

D. $zero$

Answer: B

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

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

B. 1/2 (M + m)gh`

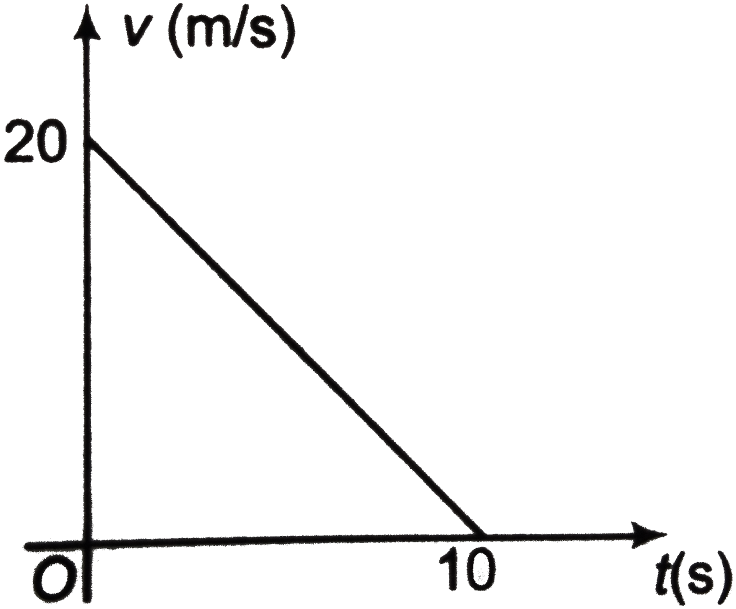
C. $(M+m)gh$

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

Answer: A

Watch Video Solution

12. The velocity of a particle decreases uniformly from $20ms^{-1}$ to zero in to $10s$ as shown in figure. If the mass of the particle is $2kg$, the identify the correct statement.



A. The net force acting on the particle is opposite to the direction of motion

B. The work done by friction force is $-400J$

C. The magnitude of friction force acting on the particle is $4N$

D. All of the above.

Answer: A

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13. The minimum stopping distance of a car moving with velocity u is x. If the car is moving with velocity 2v, then the minimum stopping distance will be.

A. $2x$

B. $4x$

C. 3x`

D. $8x$

Answer: B

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14. A projectile is fired from the origin with a velocity v_0 at an angle θ with x-axis. The speed of the projectile at an altitude h is .

A. $v_0 \cos \theta$

B. $\sqrt{v_0^2 - 2gh}$

C. $\sqrt{v_0^2 \sin^2 \theta - 2gh}$

D. None of these

Answer: B

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15. A particle of mass m moves from rest under the action of a constant force F which acts for two seconds. The maximum power attained is

A. $2Fm$

B. $\frac{F^2}{m}$

C. $\frac{2F}{m}$

D. $\frac{2F^2}{m}$

Answer: D

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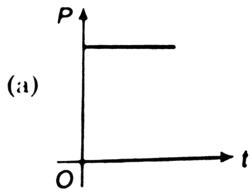
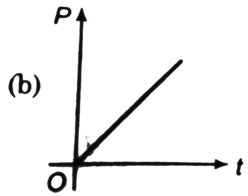
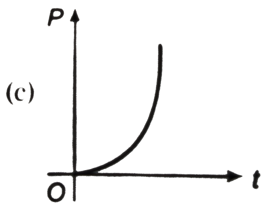
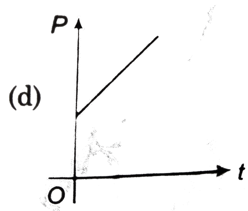
16. A body moves under the action of a constant force along a straight line. The instantaneous power developed by this force with time t is correctly represented by.

A. 

B. 

C. 

D. 

Answer: B

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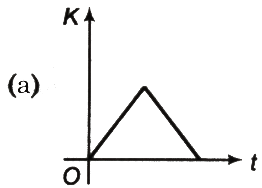
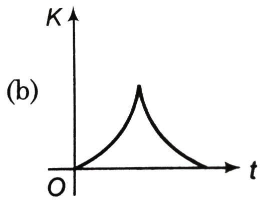
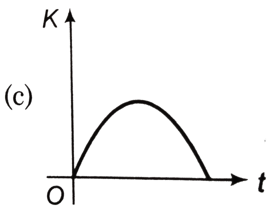
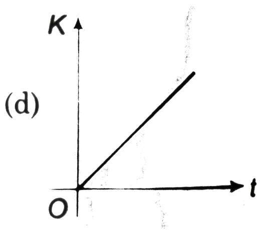
17. A ball is dropped at $t = 0$ from a height on a elastic surface. Identify the gragh which correctly represents theation of kinnetic energe K with time t.

A. 

B. 

C. 

D. 

Answer: B

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18. A block of mass 5 kg is raised from the bottom of the lake to a height of 3m without change in kinetic energy. If the density of the block is $3000 kgm^{-3}$, then the work done is equal to.

A. $100J$

B. $150J$

C. $50J$

D. $75J$

Answer: A

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19. A bode mass m is projected at an angle θ with the horizontal with an initial velocity u, the average power of gravitational force over the whole time of flight is.

A. $mgu\cos\theta$

B. $\frac{1}{2}mg\sqrt{u\cos\theta}$

C. $\frac{1}{2}mgu\sin\theta$

D. $zero$

Answer: D

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20. A spring of force constant k is cut in two parts at its one-third lingth. When both the parts are stretched by same amount. The word done in the two parts will be .

A. equal in both

B. greater for the longer part

C. greater for the shorter for the shorter part

D. data insufficient.

Answer: C

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21. A particle moves under the action of a force $F = 20\hat{i} + 15\hat{j}$ along a straight line $3y + \alpha x = 5$, where, α is a constant. If the work done by the force F is zero the value of α is .

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

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

C. 3

D. 4

Answer: D

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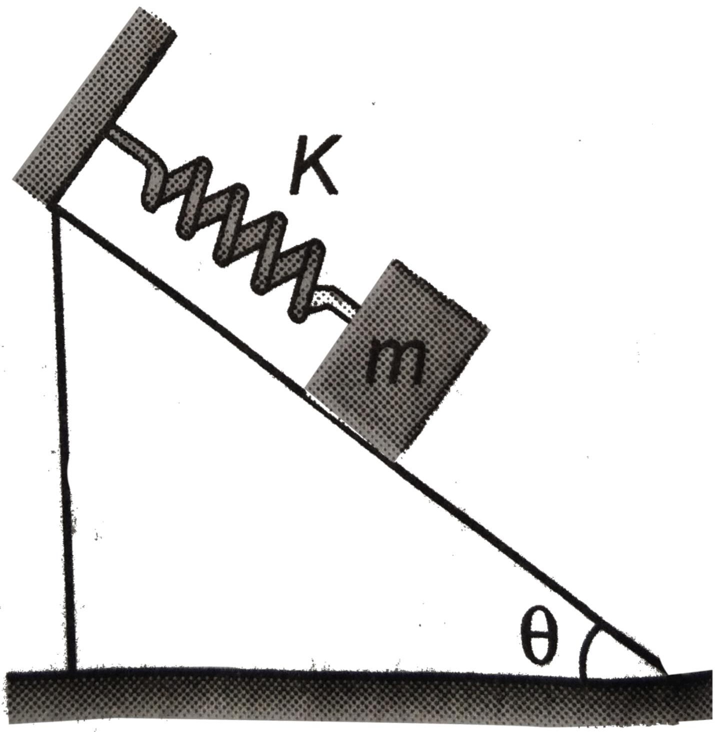
22. A system of wedge and block as shown in figure, is released with the spring in its natural length. All surfaces are frictionless. Maximum elongation in the spring will be



A. $\dfrac{2mg\sin\theta}{K}$

B. $\dfrac{mg\sin\theta}{K}$

C. $\frac{4mg\sin\theta}{K}$

D. $\frac{mg\sin\theta}{2K}$

Answer: A

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23. A force $F = \left(3t\hat{i} + 5\hat{j}\right)N$ acts on a body due to which its displacement varies as $S = \left(2t^2 \widehat{-} 5\hat{j}\right)m$. Work done by these force in $2s$ is .

A. $32J$

B. $24J$

C. $46J$

D. $20J$

Answer: B

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24. An open knife of mass m is dropped from a height h on a wooden floor. If the blade penetrates up to the depth d into the wood. The average resistance offered by the wood to the knife edge is to the depth d into the wood, the average resistance offered by the wood to the knife edge is .

A. $mg\left(1+\frac{h}{d}\right)$

B. $mg\left(1+\frac{h}{d}\right)^2$

C. $mg\left(1-\frac{h}{d}\right)$

D. $mg\left(1\frac{+}{h}\right)$

Answer: A

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25. Two springs have force constants k_A and k_B such that $k_B = 2k_A$. The four ends of the springs are stretched by the same force. If energy stored in spring A is E, then energy stored in spring B is.

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

B. $2E$

C. E

D. $4E$

Answer: A

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26. 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. $0.15m$

B. $0.12m$

C. $0.5m$

D. $0.25m$

Answer: A

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27. A bullet moving with a speed of $100ms^{-1}$ can just penetrate into two planks of equal thickness. Then the number of such planks, if speed is doubled will be .

A. 6

B. 10

C. 4

D. 8

Answer: D

Watch Video Solution

28. A body of mass 100 g is attached to a hanging spring force constant is $10N/m$. The body is lifted until the spring is in its unstretched state and then released. Calculate the speed of the body when it strikes the table $15cm$ release point .

A. $1m/s$

B. $0.866m/s$

C. $0.225m/s$

D. $1.5m/s$

Answer: B

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29. An ideal massless spring S can compressed 1.0 m in equilibrium by a force of $1000N$. This same spring is placed at the bottom of a friction less inclined plane which makes an angle $\theta = 30^\circ$ with the horizontal. A $10kg$ mass m is released from the rest at top of the inclined plane and is brought to rest momentarily after compressing the spring by $2.0m$. the distance through which the mass moved before coming to rest is.

A. $8m$

B. $6m$

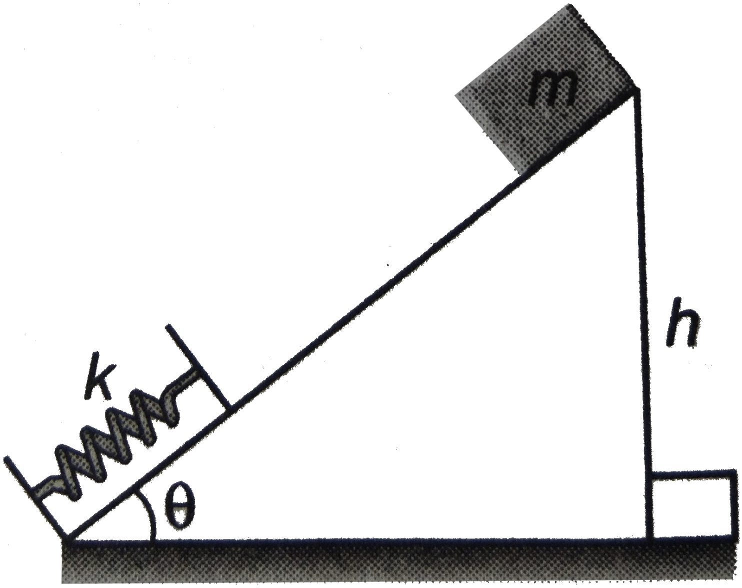
C. $4m$

D. $5m$

Answer: C

Watch Video Solution

30. A body of mass m is released from a height h on a smooth inclined plane that is shown in the figure. The following can be true about the velocity of the block knowing that the wedge is fixed.



A. v is highest when it just touches the spring

B. v is highest when it compresses the spring by some amount

C. v is highest when the spring comes back to natural position

D. v is highest at the maximum compression

Answer: B

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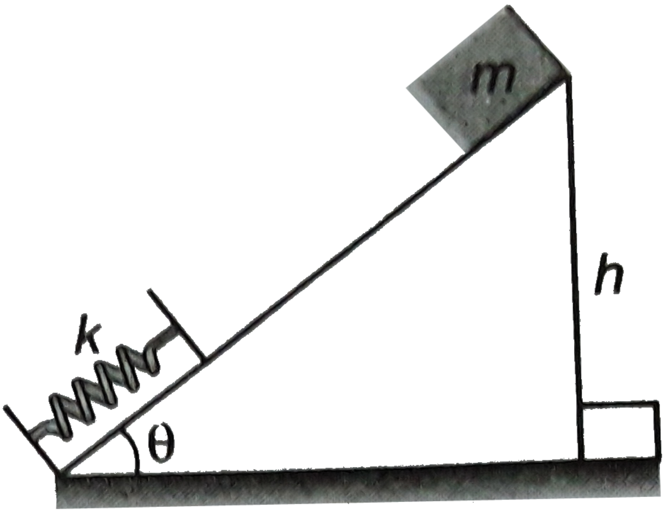
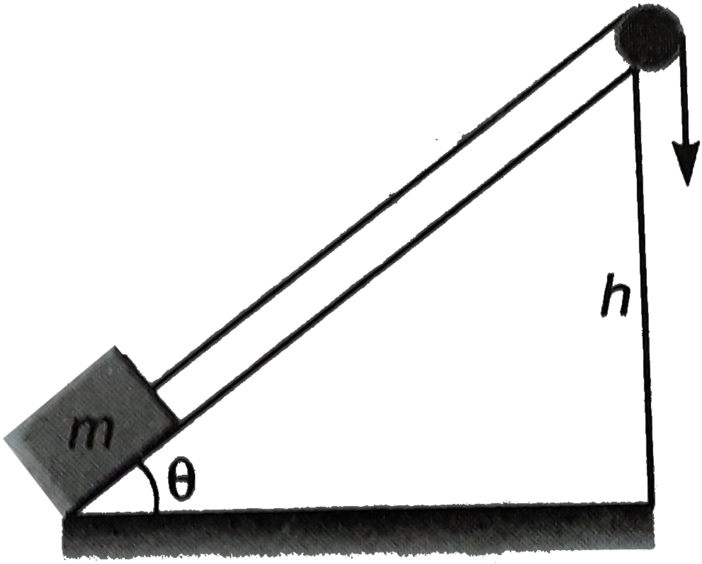
31. A block of mass m is directly pulled up slowly on a smooth inclined plane of height h and inclination θ with the help of a string parallel to the incline. Which of the following statement is incorrect for the block when it moves up from the bottom to the top the incline? .





A. Work done by the normal reaction force is zero .

B. Work done by the string is mgh

C. Work done by gravity is mgh

D. Net work done on the block is zero

Answer: C

Watch Video Solution

32. A spring of natural length l is compressed vertically downward against the floor so that its compressed lengtg becomes $\frac{1}{2}$. On releasing, the spring attins its natural length. If k is the siffness constant of spring, then the work done by the spring on the floor is

A. $zero$

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

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

D. kl^2

Answer: A

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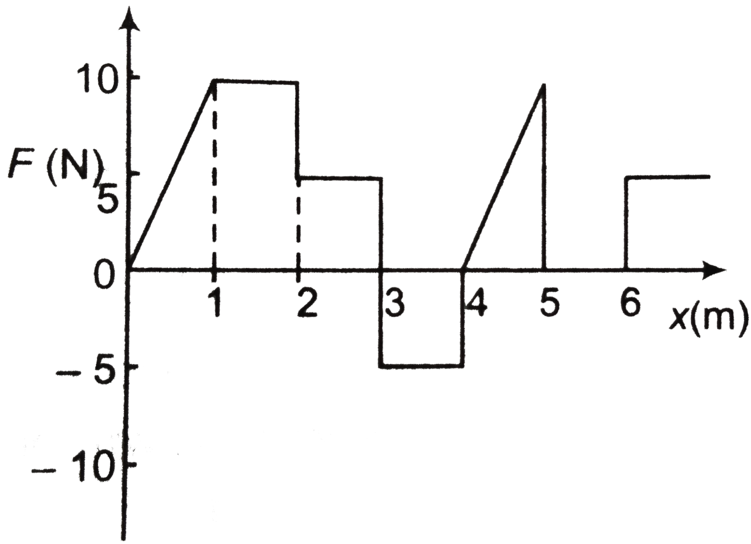
33. The relationship between the force F and position x of body is as shown in figure. The work done in displacing the body from ($x = 1m$ to $x = 5m$) will be



A. $30J$

B. $15J$

C. $25J$

D. $20J$

Answer: D

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

A. $1600J$

B. $160J$

C. $16J$

D. $1.6J$

Answer: C

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35. The kinetic energy of a projectile at its highest position is K. If the range of the projectile is four times the height of the projectile, then the initial kinetic energy of the projectile is .

A. $\sqrt{2}K$

B. $2K$

C. $4K$

D. $2\sqrt{2}K$

Answer: B

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

A. $32J$

B. $46J$

C. $61J$

D. $102J$

Answer: B

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37. A bolck of mass $10kg$ is moving in x-direction with a constant speed of $10m/s$. it is subjected to a retardeng force $F = -0.1xJ/m$. During its travel from $x = 20m$ to $x = 30m$. Its final kinetic energy will be .

A. $475J$

B. $450J$

C. $275J$

D. $250J$

Answer: A

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38. A ball of mass $12kg$ and another of mass $6kg$ are dropped from a 60 feet tall building after a fall of 30 feet each towards earth, their kinetic energies will be in the ratio of .

A. $\sqrt{2} : 1$

B. $1 : 4$

C. $2 : 1$

D. $1 : \sqrt{2}$

Answer: C

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Level 1 Subjective

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

A. $6.25N - m$

B. $\frac{12}{50}N - m$

C. $18.75N - m$

D. $25.00N - m$

Answer: C

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2. Momentum of a particle is increased by 50%. By how much percentage kintic energy of particle will increase?

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3. Kinetic energy of a particle is increased by 1%. By how much percentage momentum of the particle will increase ?

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4. Two equal masses are attached to the two end of a spring of force constant k the masses are pulled out symmetrically to stretch the spring by a length $2x_0$ over its natural length. Find the work done by the spring on each mass.

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5. A rod of length $1.0m$ and mass $0.5kg$ fixed at ond is initially hanging vertical. The other end is now raised until it makes an angle 60° with the vertical. How much work is required?

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6. A particle is pulled a distance $l$up a rough plane inclined at an angle α to the horizontal by a string inclined at an angle β to the plane $(\beta + \ < 90^\circ)$. If the tension the string is T, the normal reaction between the partical and plane is N, the frictional force is F, and the weight of the particle is w. write down expression for the work done by each of forces.

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7. A chain of mass m and length l lies on a horizontal table. The chain is allowed to slide down gently from the side of the table. Find the speed of the chain at the instant when last link of the chain slides from the table. Neglect friction everywhere.

(a) the force from thelicopter and

(b) the gravitational force on her

(c) What are speed ot the kinetic energy and.

(d) the speed of the astronaut just before she reaches the helicopter?

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8. A helicopter lifts a $72kg$ astronaut $15m$ vertically from the ocean by means of a cable. The acceleration of the astronaut is $\frac{g}{10}$. How much work is done on the astronaut by $\left(g = 9.8m/s^2\right)$

(a) what is the kinetic energy of the block as it passese through x=2.0m ? $(b) W\hat{i} s the \max i \mu m k \in e t i c e \neq r g y o f t h e b l o c k b e t w e e n$x=0 and x=2.0m`?

View Text Solution

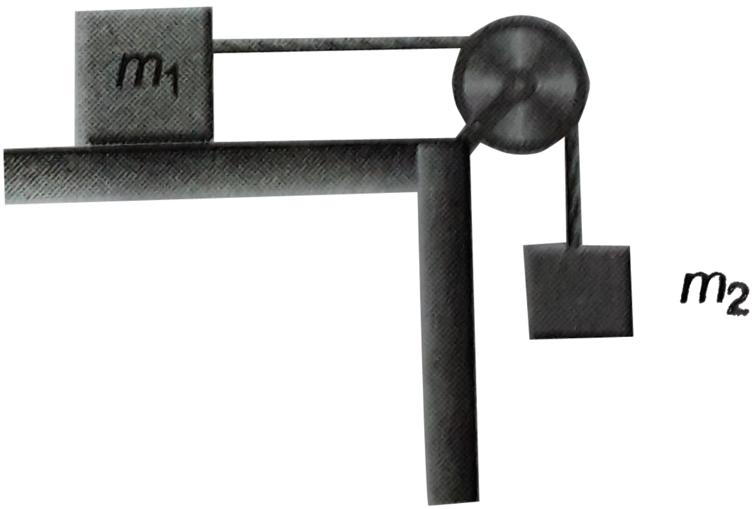
9. A$1.5kg$ block is initially at rest on a horizontal frictionless surface when a horizontal force in the positive direction of initial position of the block is $x - 0.$

View Text Solution

10. A small block of mass $1kg$ is kept on a rough inclined wedge of inclination 45° fixed in an elevator. The elevator goes up with a uniform velocity $v = 2m/s$ and the block done not slide on the wedge. Find the work done by the of friction on the block in $1s$. $(g = 10m/s^2)$

Watch Video Solution

11. Two masses $m_1 = 10Kg$ and $m_2 = 5kg$ are connected by an ideal string as shown in the figure. The coefficient of friction between m_1 and the surface is $\mu = 0.2$ Assuming that the system is released from rest calculate the velocity of blocks when $m_2 has descended by$4m. (g=10 m//s^(2))`



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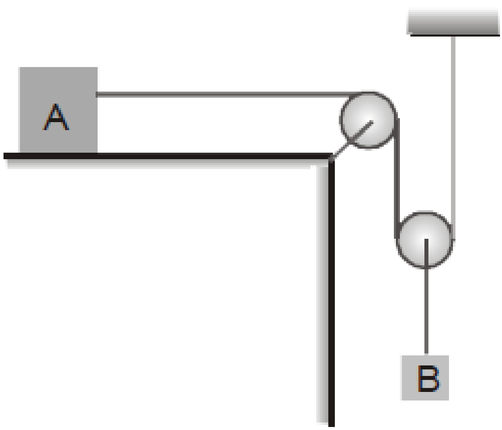
12. A smooth spehre of radius R is made to translate oin a straight line with a constant acceleration a. A particle kept on the top of the sphere is released rom there at zero velocity with respect to the sphere. Find the speed of the particle with respect to the sphere as a functon of the angle θ it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

Watch Video Solution

13. In the arrangement shown in figure m_A = 4.0 kg and m_B = 1.0 kg. The system is released from rest and block B is found to have a speed 0.3 m/s after it has descended through a distance of 1m. Find the coefficient of friction between the block and the table. Neglect friction elsewhere. (Take g = 10 m/s^2)



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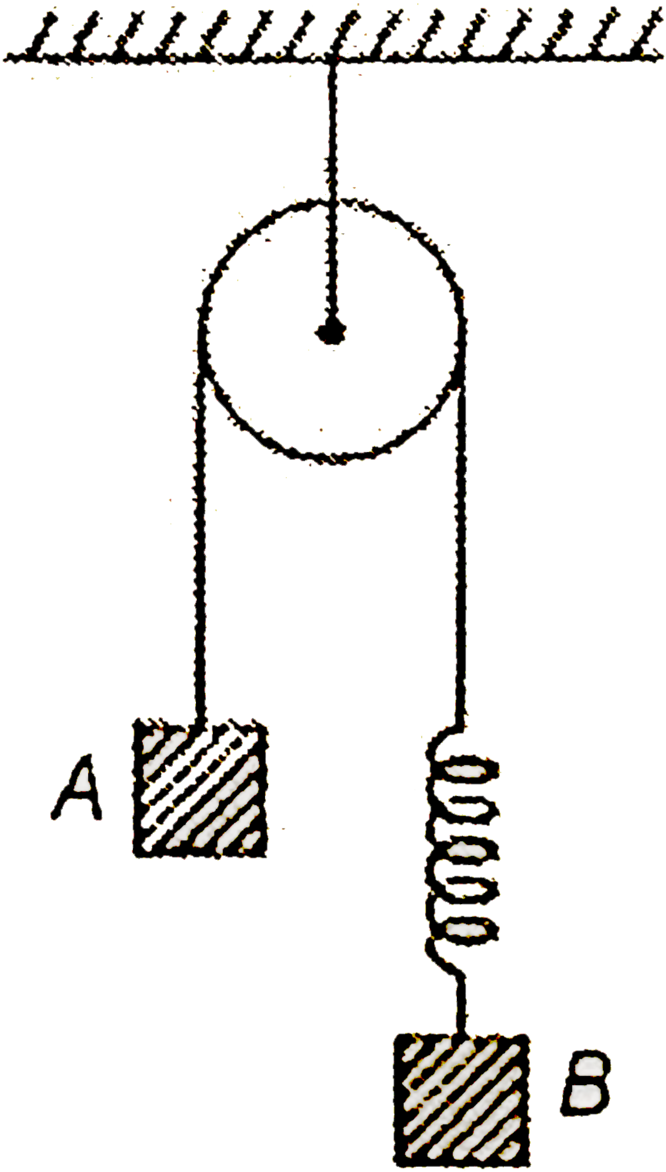
14. In figure, block A is released from rest, when spring is at its natural unstretched length. For block B of mass M to leave contact with the ground at some stage, the minimum mass of A must be



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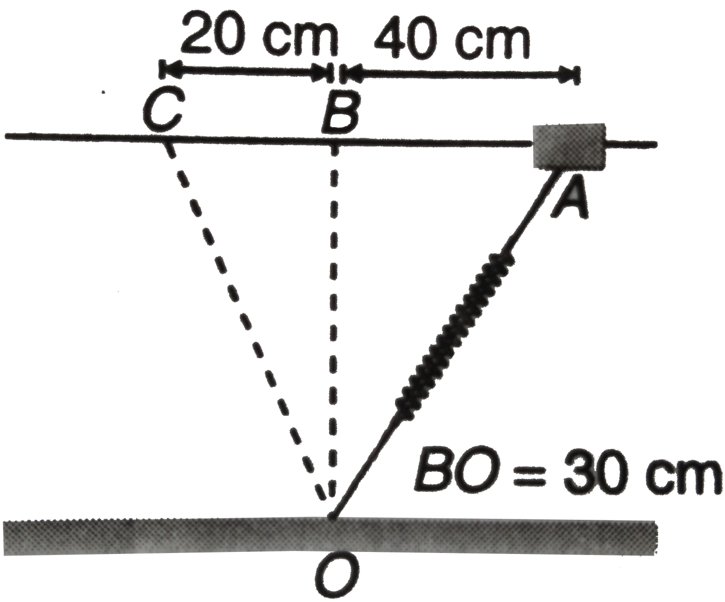
15. As shown in figure a smooth rod is mounted just above a table top $10kg$ collar, which is able to slide on the rod with negligible friction is farstened to a spring whose other end is attached to a pivot at O. The spring has negligible mass, a relaxed length of $10cm$ and a spring constant of $500N/m$ the collar is released from rest at point A. (a) What is its velocity as it passes point B?



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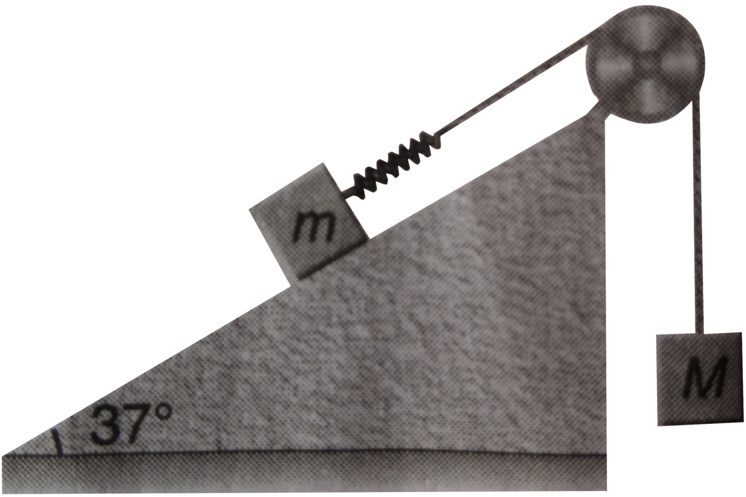
16. A block of mass m is attached with a massless spring of force constant K. the block is placed over a rough inclined surface for which the coefficient of friction is $\mu = \frac{3}{4}$ find the minimum value of M required to move the block up the place. (Neglect mass of string and pulley. Ignore friction in pulley).



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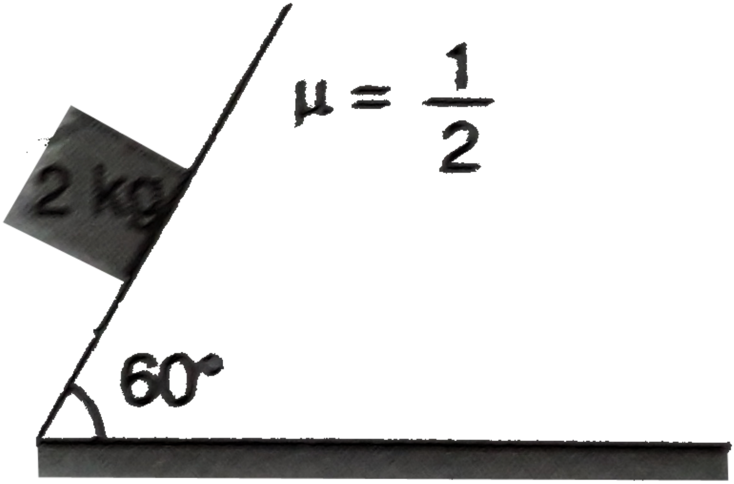
17. A block of mass $2kg$ is released from rest on a rough inclined ground as shown in figure. Find the work done on the block by.



(Take $g10m/s^2$).

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18. The potential energy of a two particle system separated by a distance r is given by $U(r) = \frac{A}{r}$ where A is a constant. Find to the radial force F_r, that each particle exerts on the other.

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19. A single conservative fore F_x acts on a $2kg$ particle that moves along the x-axis. The potential energy is given by.

$U = (x-4)^2 - 16$

Here, x is in metre and U in joule. At $x = 6.0m$ kinetic energy of particle is $8J$ find .

(a) total mechanical energy

(b) maximum kinetic energy

(c) values of x between which particle moves

(d) the equation of F_x as a funcation is zero

(e) the value of x at which F_x is zero .

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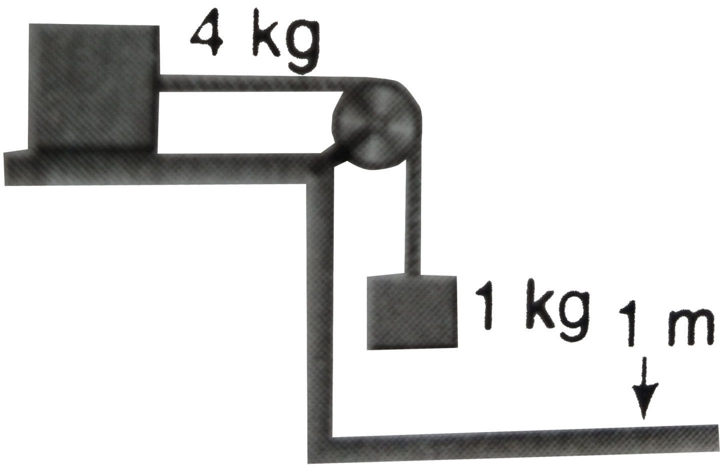
20. A $4kg$ block is on a smooth horizontal table. The block is connected to a second block of mass $1kg$ by a massless flexible taut cord that passes over a frictionless pulley. The $1kg$ block is $1m$ above the floor. The two block are released from rest. With what speed does the $1kg$ block hit the ground?



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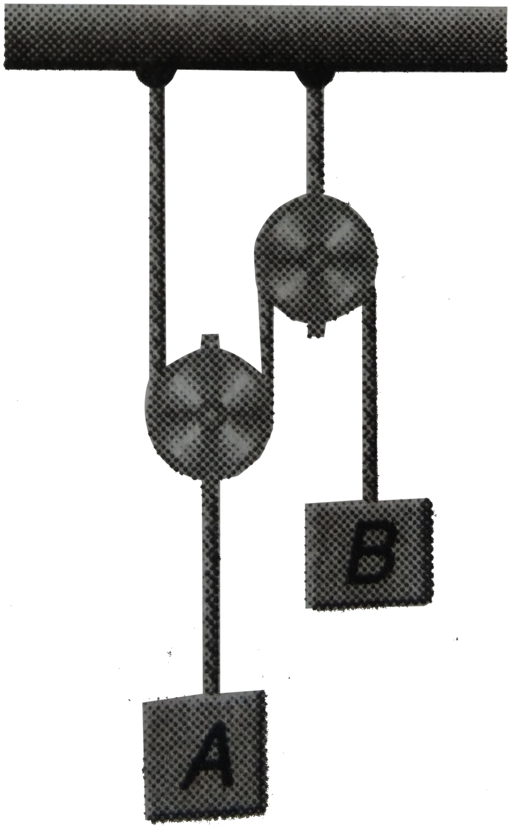
21. Block A has a weight of $3000N$ and block B has a weight of $500N$.

Determine the distance that A must descend from rest before it obtains a speed of $2.5m / s$. Neglect the mass of the cord and pulleys.



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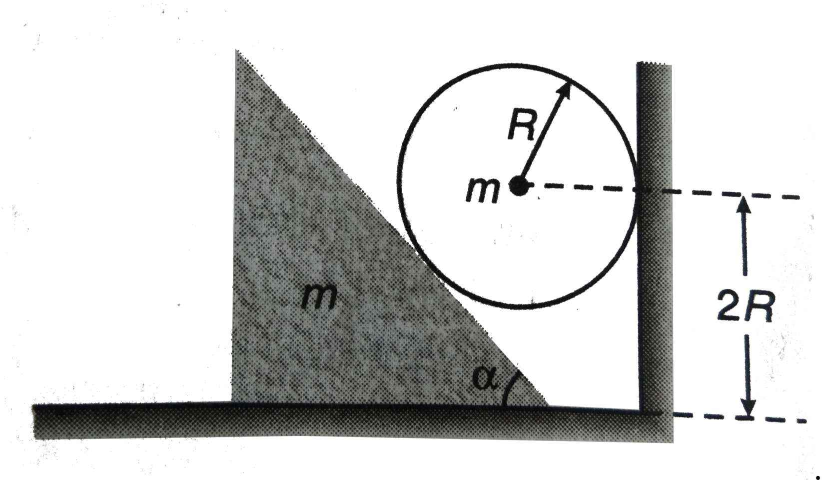
22. A sphere of mass m held at a height $2R$ between a wedge of same m and a rigid wall, is released from, Assuming that all the surfaces are frictionless. Find the speed of the bodies when the sphere hits the ground.



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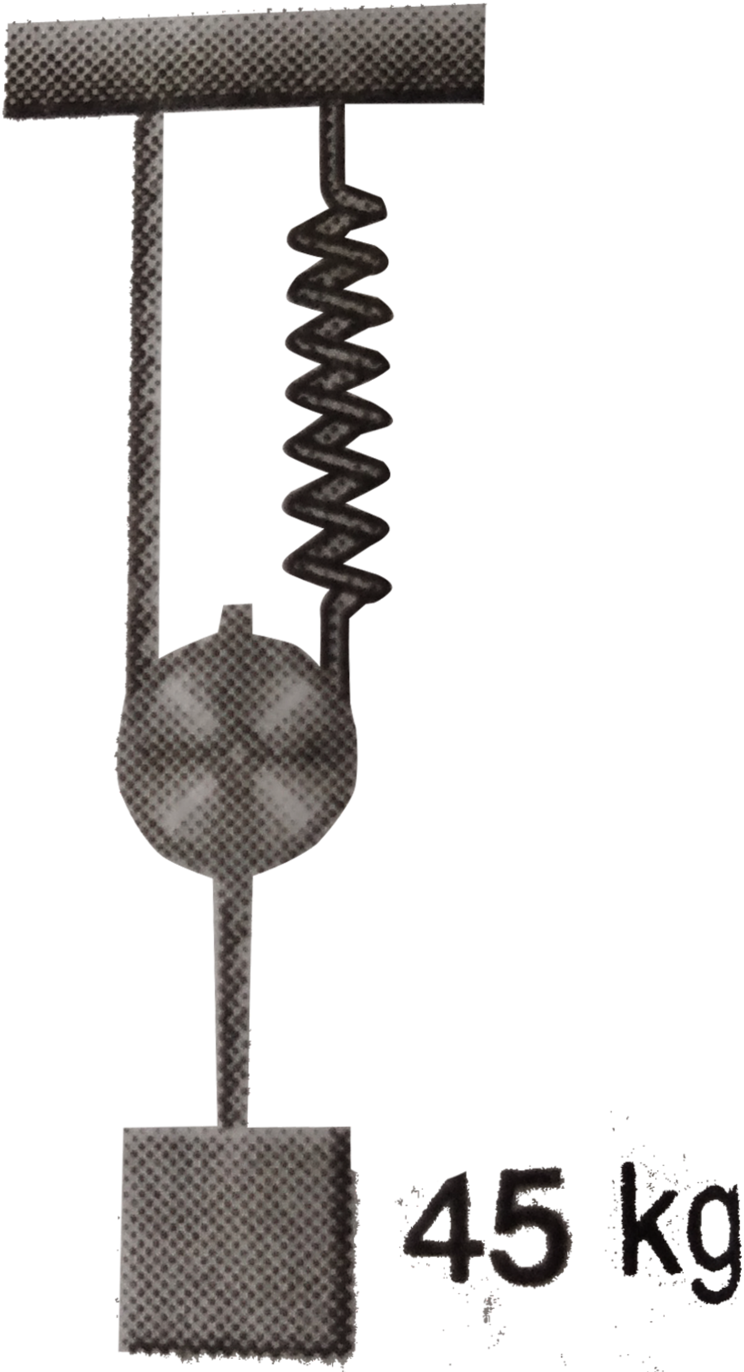
23. The system is released from rest with the spring initally stretched $75mm$. Calculate the velocity v of the block afrer it has dropped $12mm$.

The spring has a stiffness of $1050 N/m$. Neglect the mass of the small



pulley.

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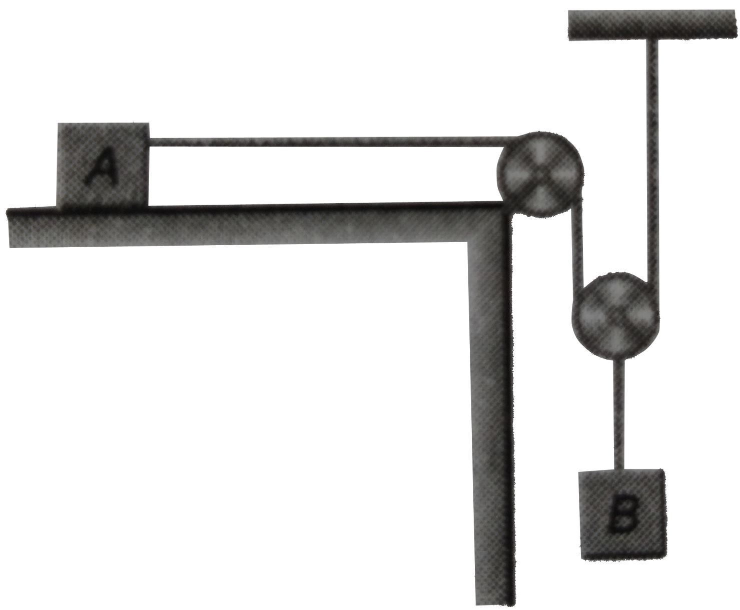
24. In the arrangement shown in figure $m_A = 4.\ kg$ and $m_B = 1.0kg$. The system is released from rest and block B is found to have a speed $0.3m/s$ after it has descended through a distance of $1.\ m$ find the coefficient of friction between the block and the table. Neglect friction elsewhere. (Take $g = 10m/s^2$).



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25. A disc of mass $m = 50g$ slides with the zero initial velocity down an inclined plane set at an angle $\alpha = 30^\circ$ to the horizontal, having traversed the distance $l = 50cm$ along the horizontal plane, the disc stops. Find the work performed by the friction forces over the whole distance, assuming the friction coefficient $k = 0.15$ for both inclined and horizontal planes.

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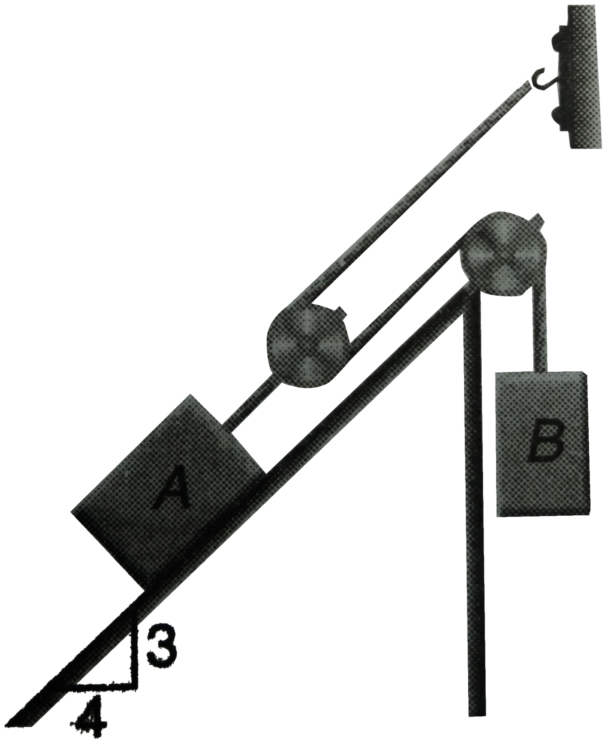
26. Block A has a weight of $3000N$ and block B has a weight of $50N$. Coefficient of friction for A is $\mu_k = 0.2$. Determine the pseed of block A after moves 1m down the plane, starting from rest. Negelect the mass of the cord and pulleys.



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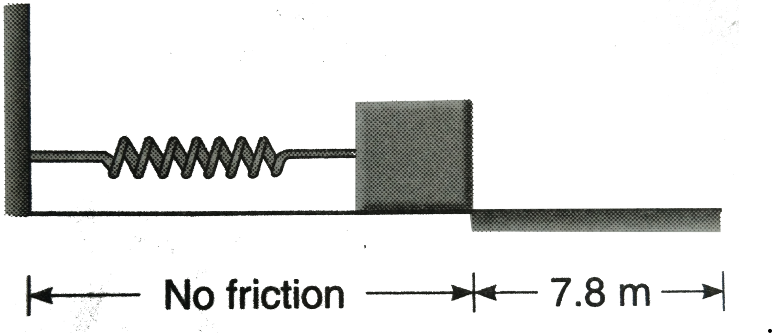
27. Figure shows, a $3.5kg$ block accelerated by a compressed spring whose spring constant is $740N/m$. After, leaving the spring at the spring' s relaxed length, the block travels over a horizontal surfce, with a coefficient of kinetic friction of 0.25, for a distance of $7.8m$ before stopping. $(g = 9.8m/s^2)$.



(a) What is the increase in the thermal energy of the block-floor system ?

(b) What is the maximum kinetic energy of the block ?

(c) Through that distance is the spring compressed before the block begins to move ?

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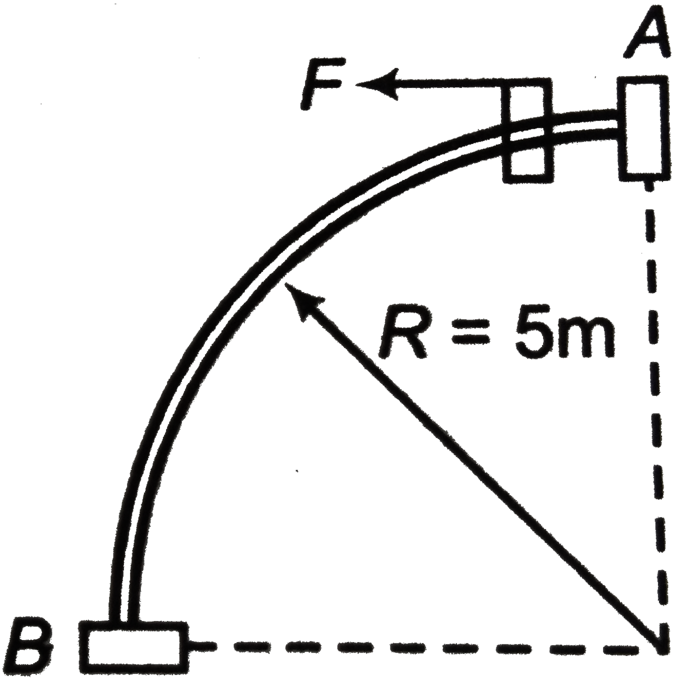
Level 2 Objective

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



A. (a) $14.14ms^{1}$

B. (b) $7.07ms^{-1}$

C. (c) $4ms^{-1}$

D. (d) $25ms^{-1}$

Answer: A

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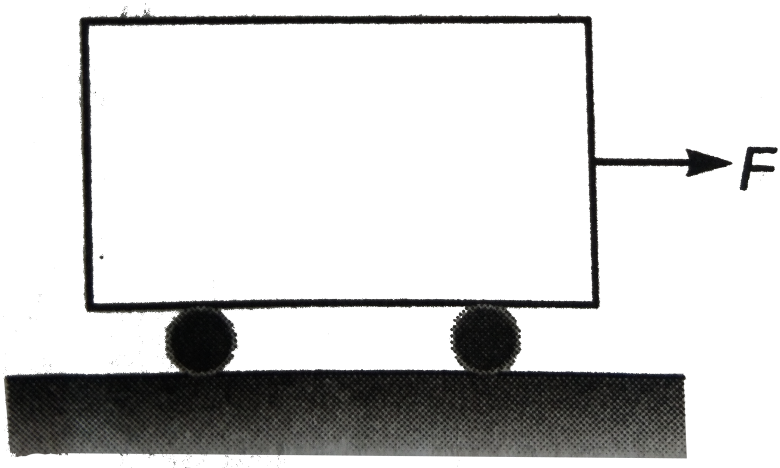
2. A car of mass m is accelerating on a level smooth road under the action of a single F. The power delivered to the car is constant and equal to P. If the velocity of the car at an instant is v, then after travelling how much distance it becomes double?



A. (a) $\frac{7mv^3}{3P}$

B. (b) $\frac{4mv^3}{3P}$

C. (c) $\frac{mv^3}{P}$

D. (d) $\frac{18mv^3}{7P}$

Answer: A

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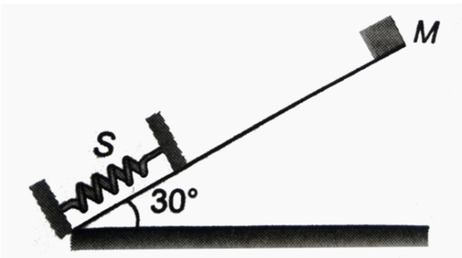
3. An ideal massless spring S can compressed 1.0 m in equilibrium by a force of $1000N$. This same spring is placed at the bottom of a friction less inclined plane which makes an angle $\theta = 30^{\circ}$ with the horizontal. A (10 kg) mass (m) is released from rest at the top of the incline and and is brought to rest momentarily after compressing the spring by $2m$. If $g = 10ms^{-1}$, what is the speed of just before it touches the spring?



.

A. $\sqrt{20}ms^{-1}$

B. $\sqrt{30}ms^{-1}$

C. $\sqrt{10}ms^{-1}$

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

Answer: A

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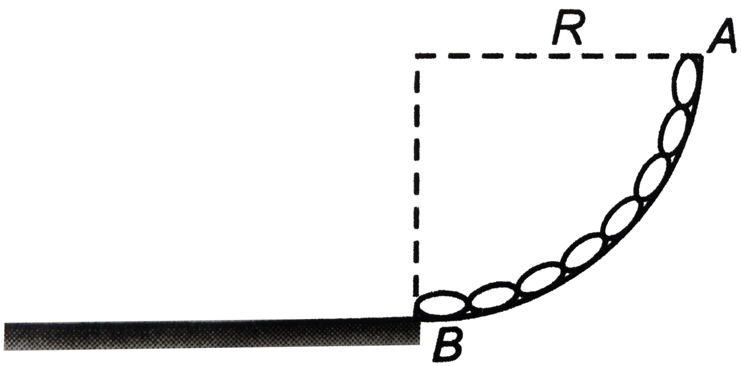
4. A smooth chain (AB) of mass (m) rests against a surface in the form of a quarter of circle of radius R. If it is released from rest, the form of a quarter of a circle of radius R. If it is releaded from, the velocity of the chain after it comes over the horizontal part of the surface is .



A. (a) $\sqrt{2}gR$

B. (b) $\sqrt{gR}$

C. (c) $\sqrt{2gR\left(1-\frac{2}{\pi}\right)}$

D. (d) $\sqrt{2gR(2-\pi)}$

Answer: C

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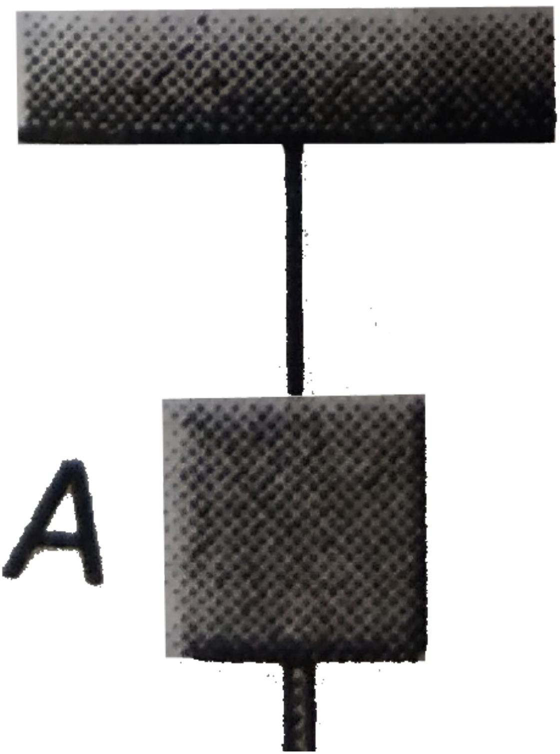
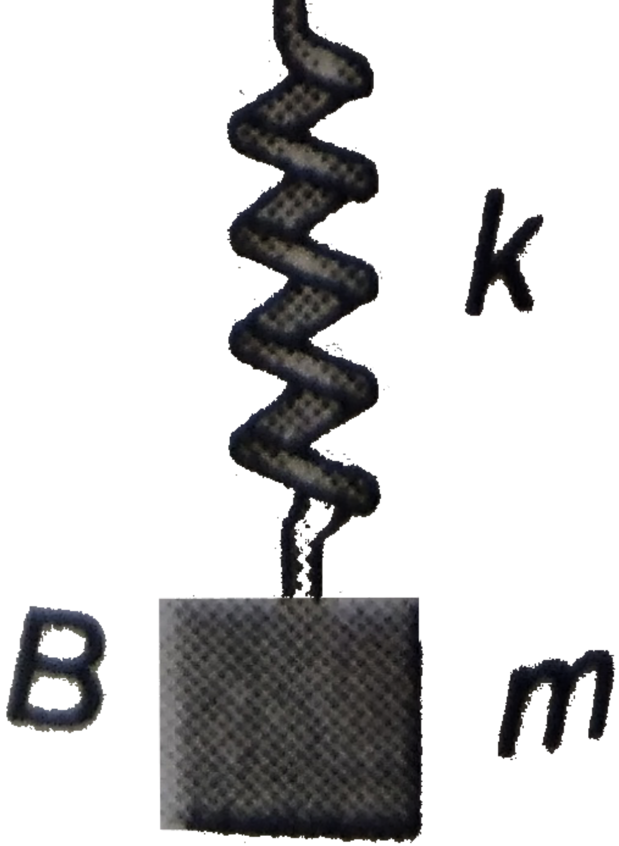
5. Initially the system shown in figure is in equilibrium. At the moment, the string is cut the downward of $a(1)$ and a_2 are.





A. (a) zero and zero

B. (b) 2g and zero

C. (c) g and zero

D. (d) None of the above

Answer: B

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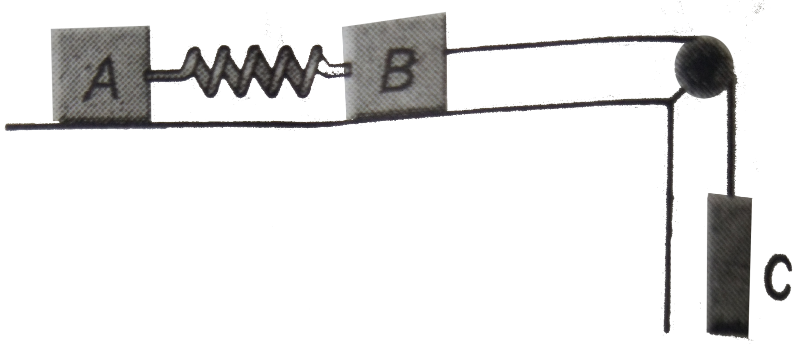
6. In the diagram shown, the block A and B are of the same mass M and the mass of the block C is (M_1). Friction is present only under the block A. the whole system is suddenly released from the state of rest. The minimum coefficient of friction on keep the block A in the state of rest is equal to .



A. (a) $\frac{M_1}{M}$

B. (b) $\frac{2M_1}{M}$

C. (c) $\frac{M_1}{2M}$

D. (d) None of these`

Answer: B

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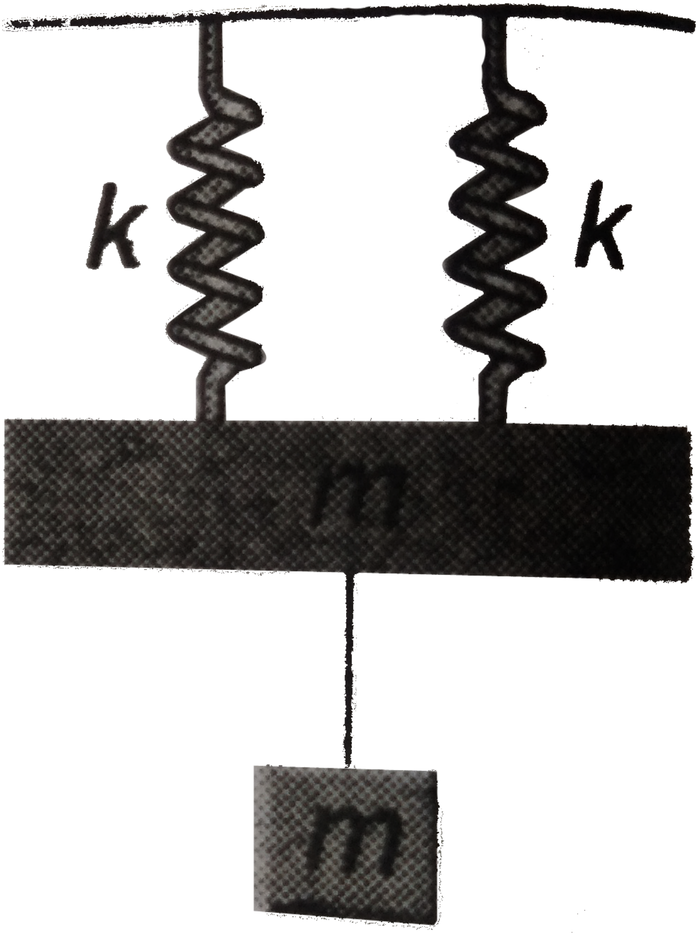
7. System shown in figure is in equilibrium, find the magnitude of net change in the string tension between two masses just after, when one of the springs in cut, Mass of both the blocks is same and equal to m spring constant of both springs is k.



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

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

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

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

Answer: A

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8. A body is moving is down an inclined plane of slope 37° the coefficient of friction between the body and the plane varies as $\mu = 0.3x$, where x is the distance traveled down the plane by the body. The body will have maximum speed. $\left(\sin 37^\circ = \frac{3}{5}\right)$.

A. at $x = 1.16m$

B. at $x = 2m$

C. at bottommost point of the plane

D. at $x = 2.5m$

Answer: D

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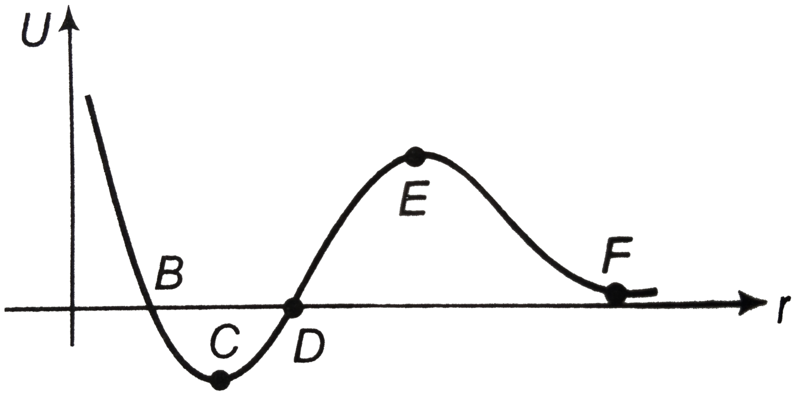
9. The given plot shows the variation of U, the potential energy of interaction between two particles with the distance separating them r,



A. B and D are equilibrium points

B. C is a point of stable equilibrium

C. The force of stable equilibrium between the two particles is attracive between points C and D and repulsive between D and E .

D. The force of interaction between particles is repulsive between points E and F.

Answer: C

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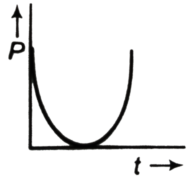
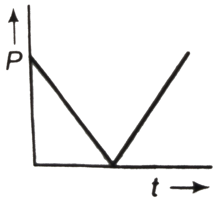
10. A particle is projected at $t = 0$ from a point on the ground with certain velocity at an angle with the horizontal. The power of gravitation force is plotted against time. Which of the following is the best representation?

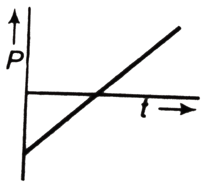
A. (a)



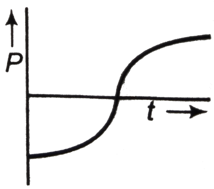
B. (b)



C. (c)



D. (d)



Answer: C

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11. A block of mass m is attached to one end of a mass less spring of spring constant k. the other end of spring is fixed to a wall the block can move on a horizontal rough surface. The coefficient of friction between the block and the surface is μ then the compession of the spring for which maximum extension of the spring becomes half of maximum compression is .

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

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

C. $\frac{4mg\mu}{k}$

D. None of these

Answer: C

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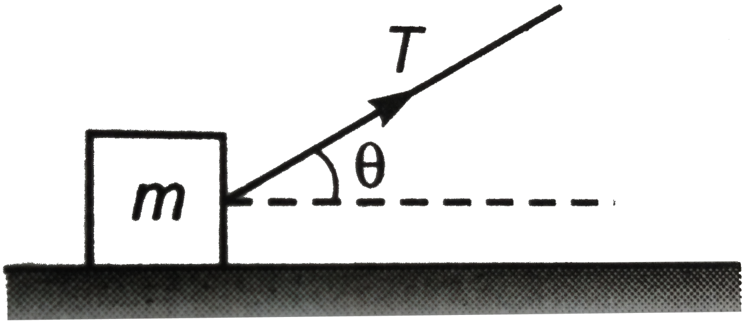
12. A block of mass (m) slides along the track with kinetic friction mu. (A) man pulls the block through a rope which makes an angle θ with the horizontal as shown in the figure. The block moves with constant speed v. Power dlivered by man is



A. Tv

B. $Tv\cos\theta$

C. $(T\cos\theta - \mu mg)v$

D. zero

Answer: B

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13. The potential energy ϕ in joule of a particle of mass $1kg$ moving in x-y plane obeys the law, $\phi = 3x + 4y$. Here, x and y are in metres. If the particle is at rest at $(6m, 8m)$ at time 0, then the work done by conservative force on the particle from the initial position to the instant when it crosses the x-axis is .

A. $25J$

B. $25J$

C. $50J$

D. $-50J$

Answer: C

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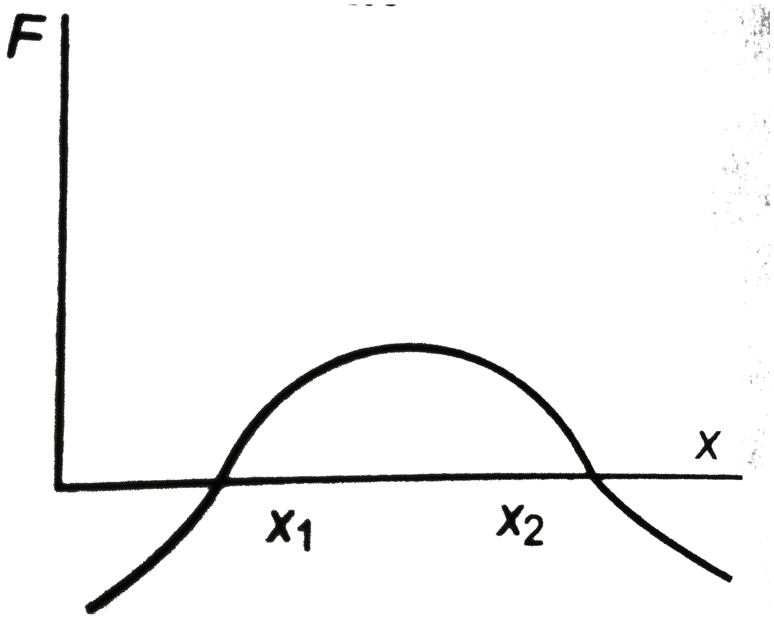
14. The force acting on a body moving along x-axis varies with the position of the particle shown in the figure. The body is in stable equilibrium at



A. $x = x_1$

B. $x = x_2$

C. both x_1 and x_2

D. neither x_1 nor x_2

Answer: B

Watch Video Solution

15. A small mass slides down an inclined plane of inclination θ the horizontal the coefficient of friction is $m = \mu_0 x$, where x is the distance by the mass before it stops is .

A. $\dfrac{1}{\mu_0 \tan\theta}$

B. $\dfrac{4}{\mu_0}\tan\theta$

C. $\dfrac{1}{2\mu_0}\tan\theta$

D. $\dfrac{1}{\mu_0}\tan\theta$

Answer: A

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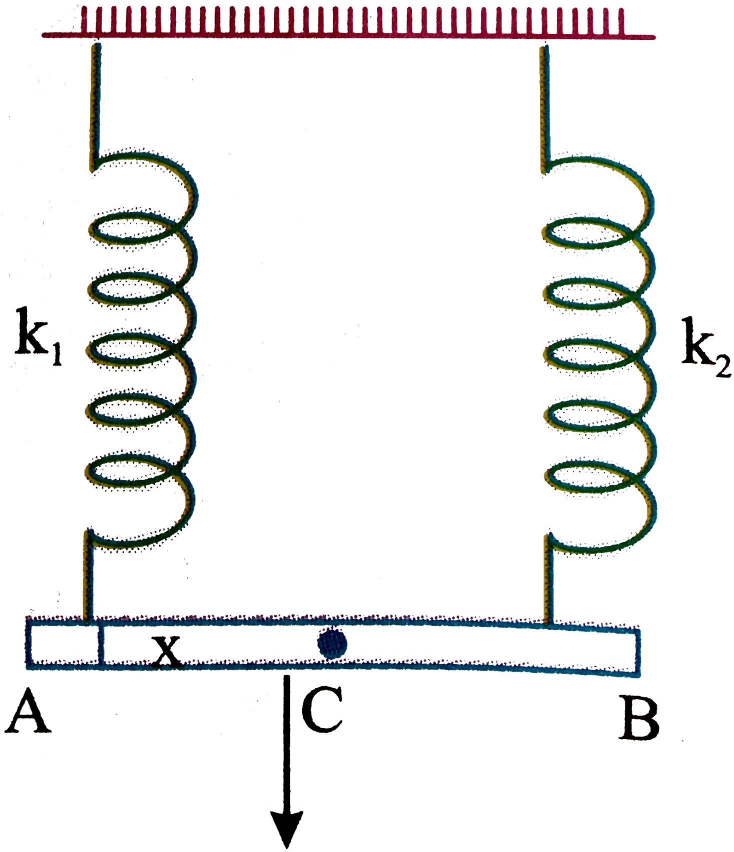
16. Two light vertical springs with equal natural length and spring constants k_1 and k_2 are separated by a distance l. Their upper end the ends A and B of a light horizontal rod AB. A vertical downwards force F is applied at point C on the rod. AB will remain horizontal in equilibrium if the distance AC is



A. $\frac{lk_1}{k_2}$

B. $\frac{lk_1}{k_2+k_1}$

C. $\frac{lk_2}{k_1}$

D. $\frac{lk_2}{k_1+k_2}$

Answer: D

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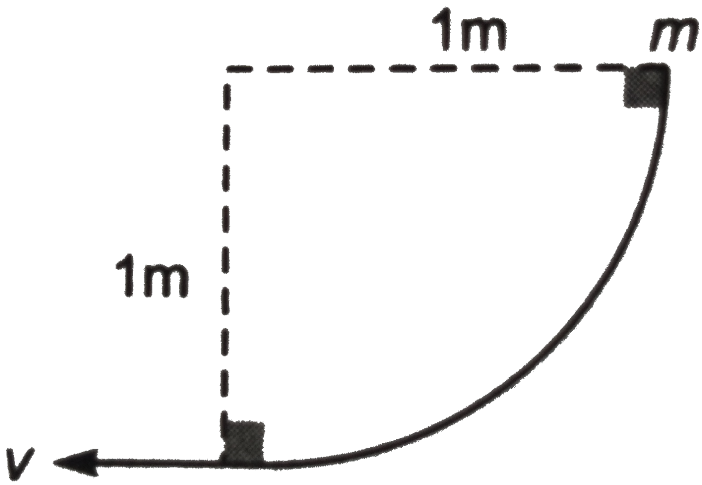
17. A block of mass $1kg$ slides down a curved track which forms one quadrant of a circle of radius $1m$ as shown in figure. The speed of block at the bottom of track is $v = 2ms^{-1}$. The work done by the of friction is



A. $+4J$

B. $-4J$

C. $-8J$

D. $+8J$

Answer: C

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18. 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 constant and x is the distance between the atoms. The atoms is an stable equilibrium, when-

A. $\left(\frac{2a}{b}\right)^{1/6}$

B. $\left(\frac{a}{b}\right)^{1/6}$

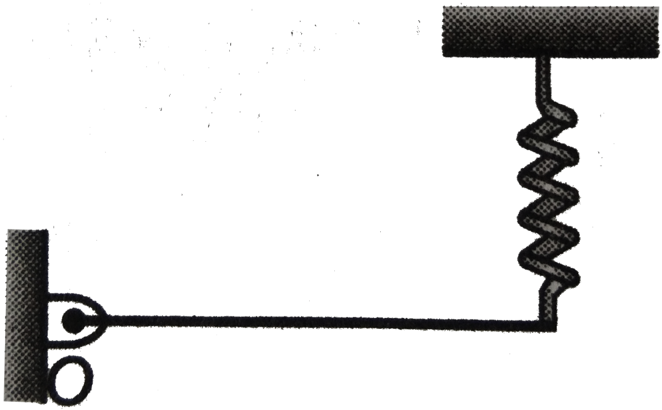
C. $\left(\frac{b}{2a}\right)^{1/6}$

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

Answer: A

Watch Video Solution

19. A rod mass (M) hinged at (O) is kept in equilibrium with a spring of stiffness (k) as shown in figure. The potential energy stored in the spring is .



A. $\frac{(mg)^2}{4k}$

B. $\frac{(mg)^2}{2k}$

C. $\frac{(mg)^2}{8k}$

D. $\frac{(mg)^2}{k}$.

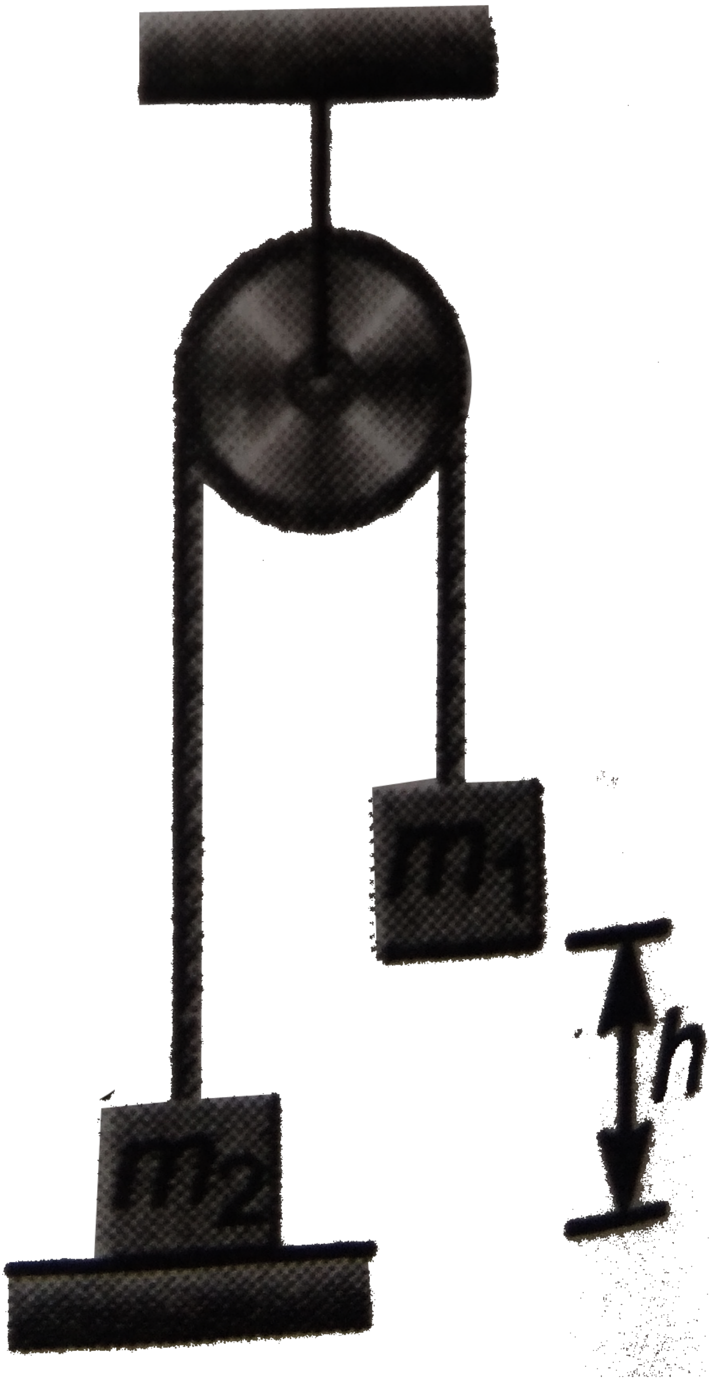
Answer: C

Watch Video Solution

20. In the figure. (m_2) (ltm_(1))

$arejo \in ed \rightarrow \geq therbyap \underline{\leq}\_ y. Whenthemass$(m_(1))

$isre \leq asedomtheheighth$h` above the floor, it strikes the floor with a speed .



A. $\sqrt{2gh\left(\frac{m_1 - m_2}{m_1 + m_2}\right)}$

B. $\sqrt{2gh}$

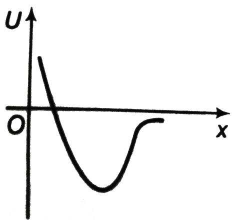
C. $\sqrt{\frac{2m_2gh}{m_1 + m_2}}$

D. $\sqrt{\frac{2m_1gh}{m_1 - m_2}}$

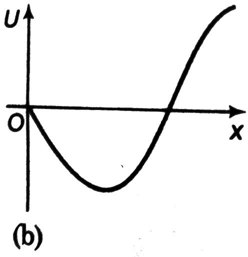
Answer: A

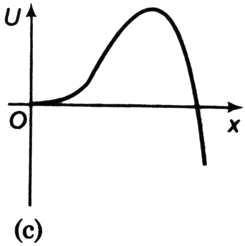
Watch Video Solution

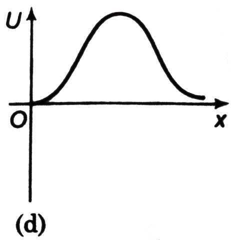
21. A particle free to move along x-axis is acted upon by a force $F = -ax + bx^2 whrtea$ and $barepositivecons\tan ts$. For ximplies0`, the correct variation of potential energy function U(x) is best represented by.

A. 

(a)

B. 

C. 

D. 

Answer: C

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22. Fqual net forces ant on two different block (A) and (B) masses (m) and 4(m) respectively For same displacement, identify the correct statement.

A. Their kinetic energies are in the ratio $\frac{K_A}{K_B} = \frac{1}{4}$

B. Their speeds are in the ration $\frac{v_A}{v_B} = \frac{1}{1}$

C. Work done on the block are in the ratio $\frac{W_A}{W_B} = \frac{1}{1}$

D. All of the above

Answer: C

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23. The potential energy function of a particle in the x-y plane is given by $U = k(x+y)$, where (k) is a constant. The work done by the conservative force in moving a particlae from (1,1) to (2,3) is .

A. $-3k$

B. $+3k$

C. k

D. None of these

Answer: A

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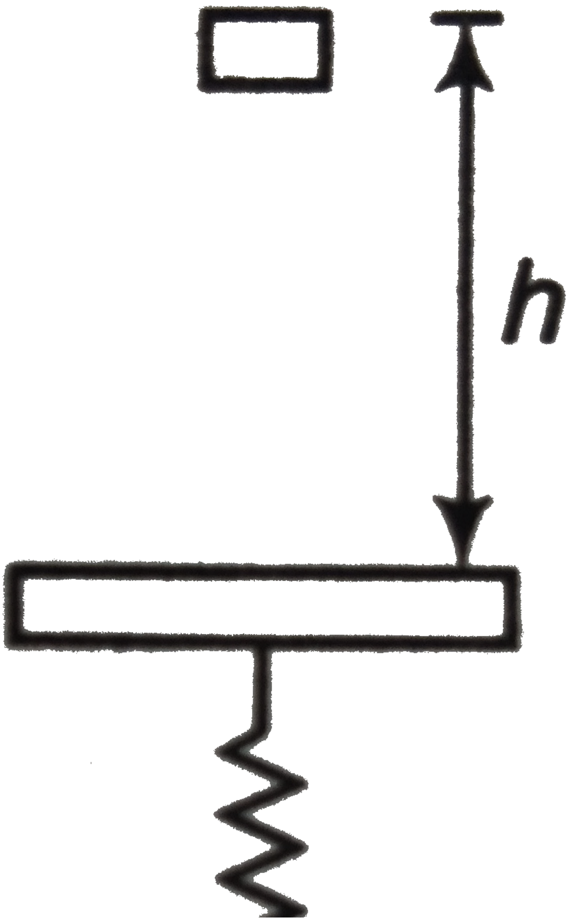
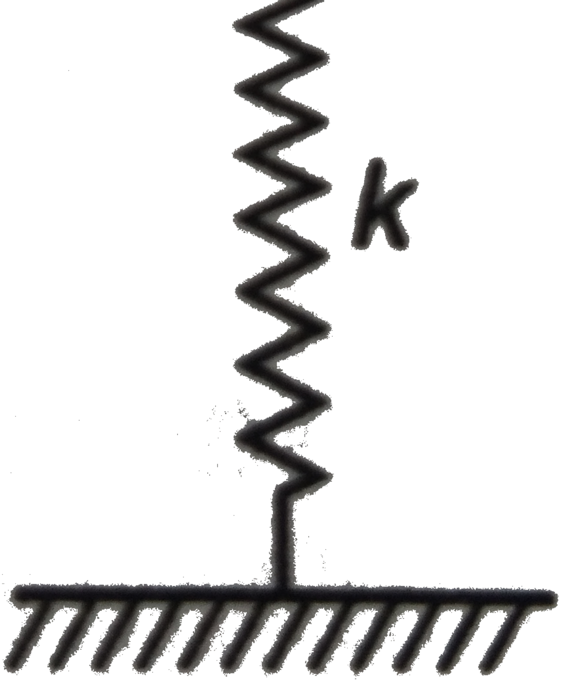
24. A vertical spring is fixed to one of its end and a massless plank pland fitted to other end, A block is released from a height (h) as shown, spring is in relaxed position then choose the correct statement.





A. The maximum compression of the spring does not depend on h.

B. The maximum kinetic energy of the block does not depend on h.

C. the compression of the spring at maximum (KE) of the block does not depend on h.

D. The maximum compression of the spring does not depend on k.

Answer: C

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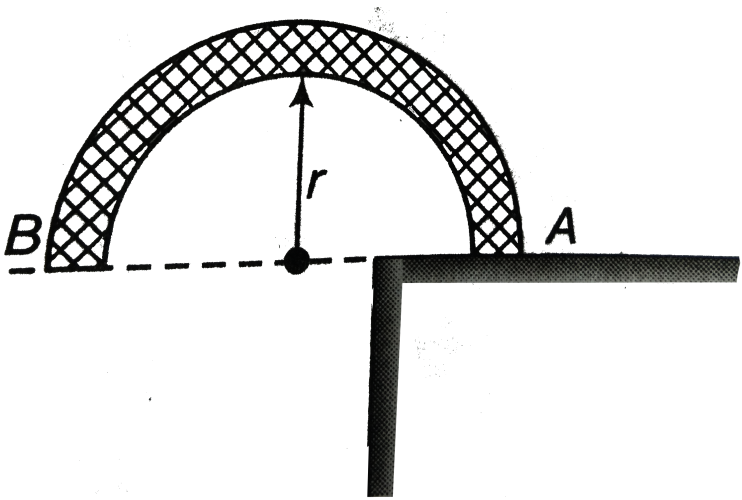
25. A uniform chain of length of length πr lies inside a smooth semicircular tube (AB) of radius f. Assuming a slight disturbance to start the chain in motion, the velocity it will emerge from the end (B) of the tube will be



A. $\sqrt{gr\left(1+\frac{2}{9}\pi\right)}$

B. $\sqrt{2gr\left(\frac{2}{\pi}+\frac{\pi}{2}\pi\right)}$

C. $\sqrt{gr(\pi+2)}$

D. $\sqrt{\pi gr}$

Answer: B

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26. A block of mass m is connected to a spring of force constant k. Initially the block is at rest and the spring has natural length. A constant force F is applied hrizontally towards right. The maximum speed of the block will be (there is no friction between block and the surface)

A. $\frac{F}{\sqrt{2mgk}}$

B. $\frac{F}{\sqrt{mk}}$

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

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

Answer: B

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27. Two blocks are connected to an ideal spring of stiffness $200N/m$. At a certain moment, the two block are moving in opposite diretion with speeds $4ms_1$ and ' 6 ms_(1) ' the instantaneous elongation of the spring $10cm$, The rate at which the spring energy $\left(k\frac{x^2}{2}\right)$ is increasing is.

A. $500J/s$

B. $400J/s$

C. $200J/s$

D. $100J/s$.

Answer: C

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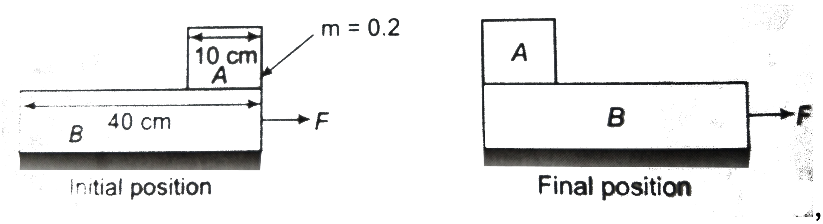
28. A block (A) of mass $45kg$ is placed on another block (B) of mass $123gk. Nowblock(B) is displaced by extenala \geq ntby 50$ cm` horizontally towards right. During the same time block (A) just reaches to the left end of block (B), Initial and final positions are shown in figures . the work done on block (A) in ground frame is



A. $-18J$

B. $18J$

C. $36J$

D. $-36J$.

Answer: B

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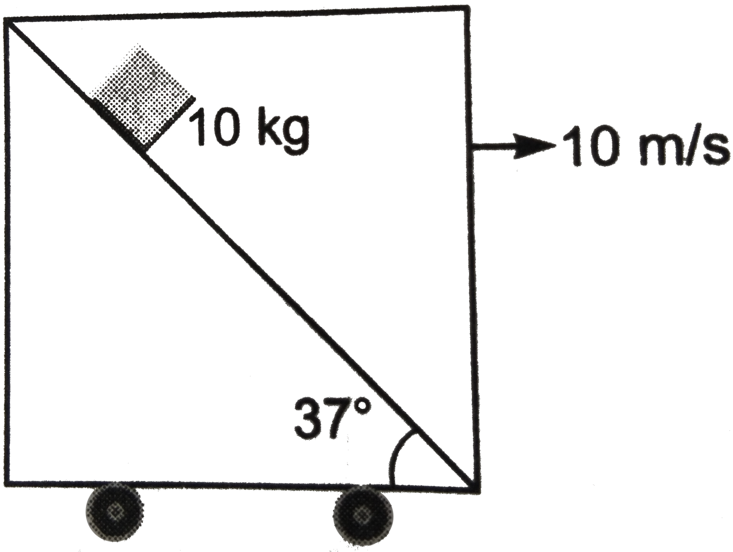
29. A block of mass $10kg$ is released on a fixed wedge inside a cart which is moving with constant velocity $10ms^{-1}$ towards right. There is no relative motion between block and cart. Then work done by normal reaction on block in two seconds from ground frame will be (

$g = 10ms^{-2}$)



A. $1320J$

B. $960J$

C. $1200J$

D. $240J$

Answer: B

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30. A block tied between identical springs is in equilirium. If upper spring is cut, then the acceleration of the nlock just after cut is $5ms^1$ Now if instead of upper string lower spring is cut, then the acceleration of the block just after the cut will be (Take $g = 10m/s^2$).

A. $1.25ms^{-2}$

B. $5ms^{-2}$

C. $10ms^{-2}$

D. $2.5ms^{-2}$

Answer: B

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Level 2 More Than One Correct

1. The potential energy of a particle of mass 5 kg moving in xy-plane is given as $U = (7x + 24y)$ joule, x and y being in metre. Initially at $t = 0$, the particle is at the origin $(0, 0)$ moving with velovity of $\left(8.6\hat{i} + 23.2\hat{j}\right)ms^{1}$, Then

A. The velocity of the particle at $t = 4s, 5ms^{-1}$

B. The acceleration of the particle is $5ms^{-2}$.

C. The direction of motion of the particle initially (at t=0) is right angles to the direction of acceleration.

D. The path of the particle is circle.

Answer: A::B

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2. The potential energy of a particle is given by formula $U = 100 - 5x + 100x^2, where$U` and are .

A. At $0.05m$ form the origin is 50 ms^(2).

B. At 0.05 m from the mean position is 100 ms^(2).

C. At 0.05 m feom the origin is 150 ms^(2).

D. At $0.05m$ from the mean position is $200ms^{-1}$

Answer: A::B::C

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3. One end of a light spring of spring constant k is fixed to a wall and the other end is tied to a block placed on a smooth horizontal surface. In a displacment, the work done by the spring is $+\left(\frac{1}{2}\right)kx^2$. The possible cases are.

A. The spring was initially compessed by a distance x and was finally in its natural length .

B. It was initially stretched by a distance x and finally was in its natural length.

C. It was initially natural length and finally in a compressed position.

D. It was initially in its natural length and finally in a stretched position.

Answer: A::B

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4. Identify the correct statement about work energy theorem.

A. Work done by all the forces is equal to the decrease in potential energy.

B. Work done by all the forces except the conservative is equal to the change in mechanical energy.

C. Work done by all the forces is equal to the change in kinetic energy .

D. Work done by all the forces is equal to the change in potential energy

Answer: B::C

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5. A disc of mass 3 m and a dise of mass m are connected by a massless sping of stiffness k. The heavier is disc placed on the ground with the spring vertical and lighter disc on top from its equilibrium position the upper disc is pushed down by a distance δ and released. Then.

A. if $\delta > \frac{3mg}{k}$ the lower desc will bounce up.

B. if $\delta = \frac{2mg}{k}$ maximum normal reaction fron on lower disc = 6mg .

C. if $\delta = \frac{2mg}{k}$ maximum normal reaction from ground on lower disc = 4 mg.

D. if $\delta > \frac{4mg}{k}$, the lower disc will bounce up

Answer: B::D

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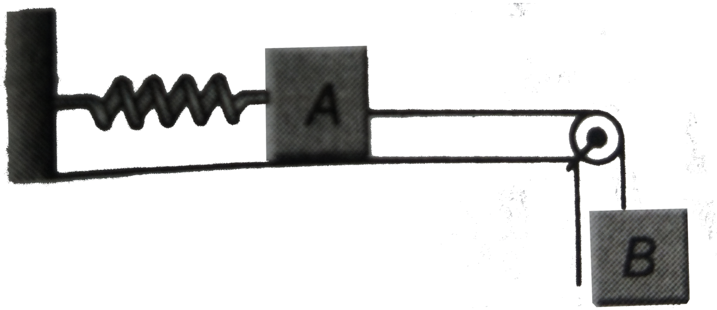
6. In the adjoining figure, block A is of mass (m) and block B is of mass2 m. The spring has force constant k. All the surfaces are smooth and the system is released form rest with spring unstretched.



A. The maximum extension of the spring is $\frac{4mg}{k}$.

B. The speed of A when extension in spring is $\frac{2mg}{k}$ is $2g\sqrt{\frac{2m}{3k}}$.

C. The acceleration of block B when the extension in the spring is maximum, is $\frac{2}{3}g$

D. Tension in the thread for extension of $\frac{2mg}{k}$ in spring is mg

Answer: A

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7. If kinetic energy of a body is increasing then.

A. work done by conservative forces must be positive.

B. work done by conservative forces may be positive.

C. work done by conservative forces may be zero

D. work done by non-conservative forces may be zero

Answer: B::C::D

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8. At two positons kinetic energy and potential energy of a particle are $K_1 = 10J : U_1 = -20J, K_2 = 20J, U_2 = -10J$. In moving from 1 to 2

.

A. work done by conservative forces is positive.

B. work done by conservative forces is negative.

C. work done by all the forces is positive .

D. work done by all the forces is negative.

Answer: B::C

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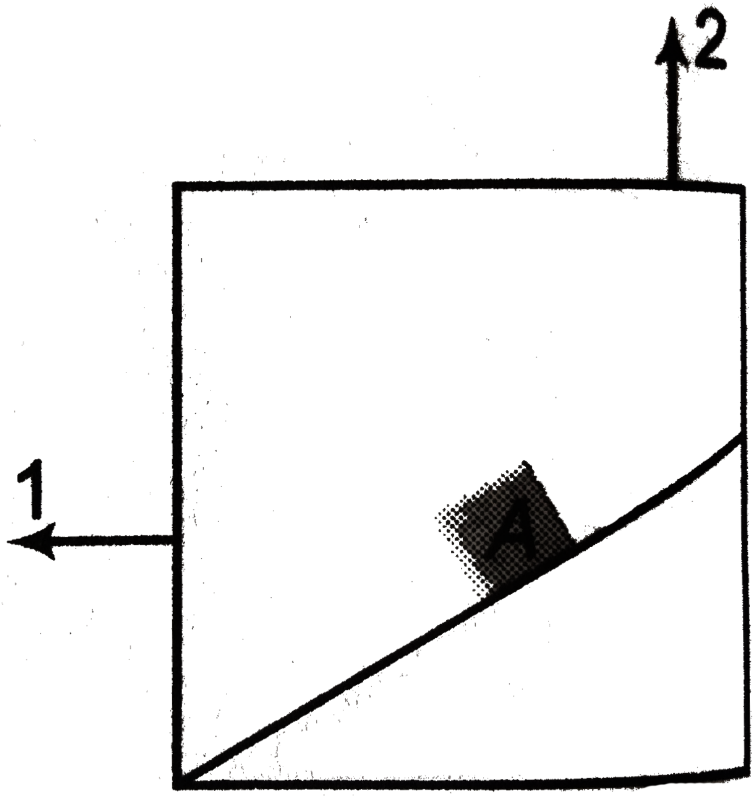
9. Block A has no relative motion with resprct to wedge fixed to the lift as shown in figure during motion-1 or motion-2 Then,



A. work done by gravity on block A in motion-2 is less then in motion-1

B. wrok done by normal reaction on block A in both be motions will be positive.

C. work done by force of friction in motion-1 may be positive.

D. work done by force of friction in motion-1 may be positive.

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

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Level 2 Subjective

1. Two block of masses m_1 and m_2 connected by a light spring rest on a horixontal plane. The cofficient 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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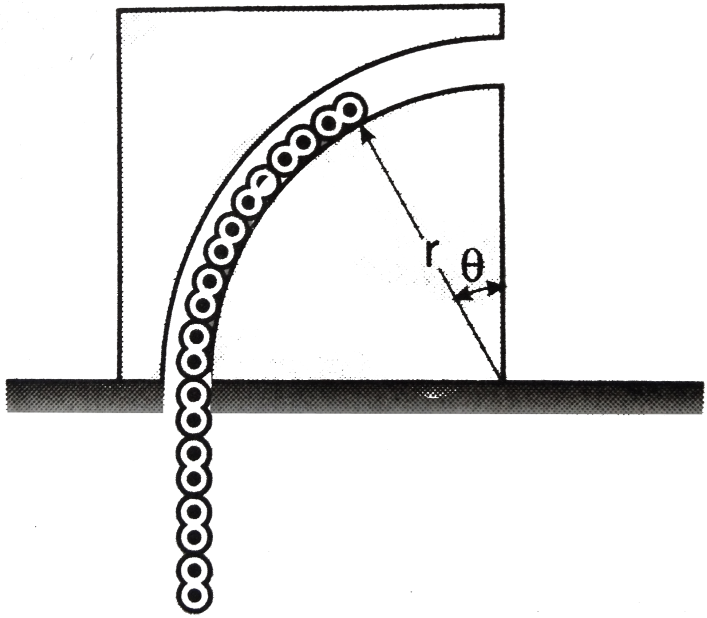
2. The flexible bicycle type chain of length $\frac{\pi r}{2}$ and mass per unit length ρ is released from rest with $\theta = 0^\circ$ In the smooth circular channel and falls through the hole in the supporting surface, Determine the velocity v of the chain as the last link leaves the slot.



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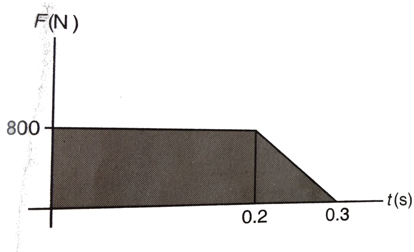
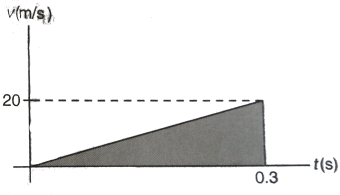
3. A baseball having a mass of $0.4kg$ is thrown such that the force acting on it varies with time as shown in the first graph. The correspondeng velocity time gragh is shown in the second graph. Detemine the power applied as a functon time and the work done till $t = 0.3s$.





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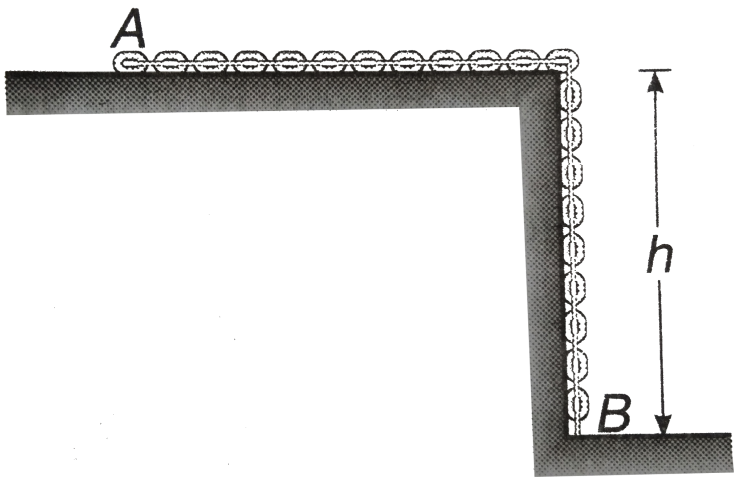
4. A chain (AB) of length l loaded in a smooth horizontal table so that its fraction of length h hangs freely and toucher the surface of the table with its end B. At a certain moment ,the end A of the chain is set free. With what velocity will this end the chain slip out of the table ?



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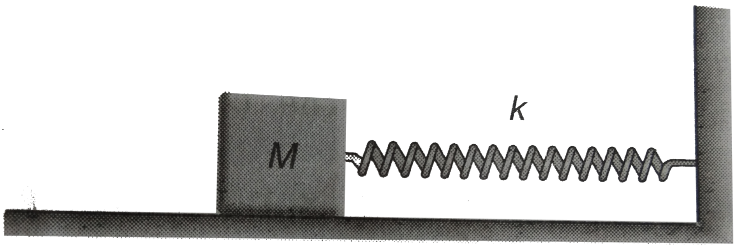
5. The block shown in the figure is acted on by a sping with spring constant (k) and (a) weak frictional force of constant of constant magitude (f.) The block is pulled a distance x_0 from equilibrium position and then then then fren released. It oscillates many times ultimately comes to rest.



(a) Show that the decrease of amplitude is the same for each cycle of lscillation.

(b) Find the number of cycles the mass oscillates before coming to rest.

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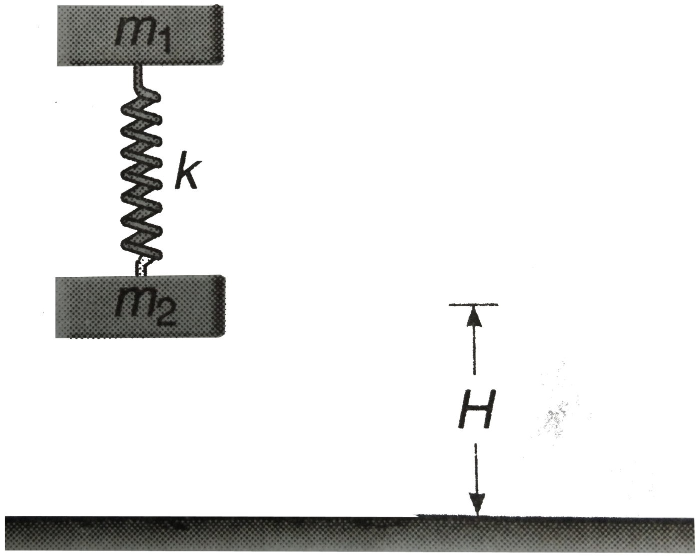
6. A spring mass system is held at rest with the spring relaxed at a height (h) above the ground. Determine the minimum value of (H) so that the systen has a tendency to rebound after hitting the ground. Given that the coefficient of restitution between (m_2) and ground is zero.



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7. A block of mass m moving at a speed v compresses a spring throgh a distance x before its speed is halved. Find the spring constant of the spring.

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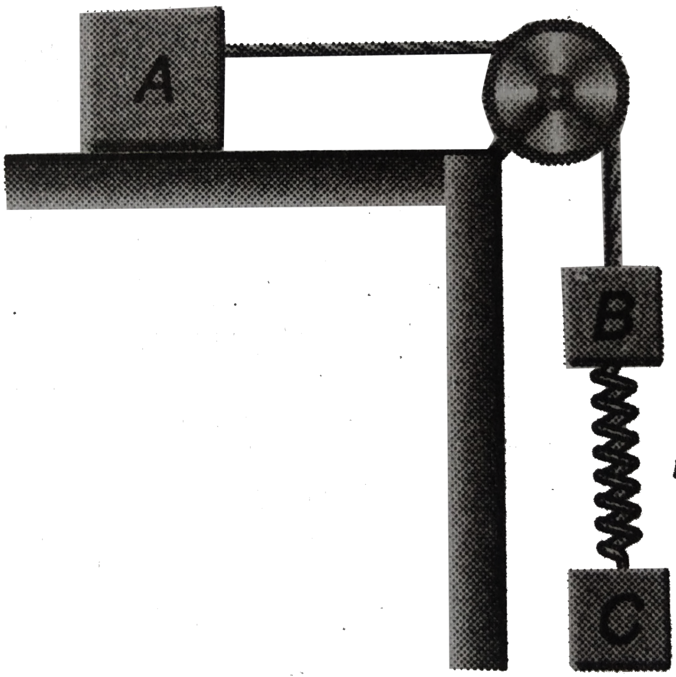
8. In the figure shown masses of the blocks A, B and C are 6kg, 2kg and 1kg respectively. Mass of the spring is negligibly small and its stiffness is 1000 N//m. The coefficient of friction between the block A snd the table is $\mu = 0.8$. Initially block C is held such that spring is in relaxed position. The block is released from rest. Find $(g = 10m / s^2)$.



(a) the maximum distance moved by the kinetic C.

the acceleration of each block, when clongation in the spring is maximum.

A. (a) the maximum destance moved by the block C.

B. (b) the acceleration of each block, when elongation in the spring is maximum.

C.

D.

Answer: A::B::C

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

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10. A particle moving in a straight line is acted upon by a force which works at a constant rate and chages ist melocity from (u and v) over a distance x. Prove that the taken in it is

$$\frac{3}{2}(u+v)\frac{x}{u^2+v^2+uv}.$$

A. $t=\frac{3x(u+v)}{2(u^2+v^2+uv)}$

B. $t=\frac{3x(u-v)}{2(u^2+v^2+uv)}$

C. $t=\frac{3x(u+v)}{2(u^2+v^2-uv)}$

D. $t=\frac{3x(u+v)}{2(u^2-v^2+uv)}$

Answer: A

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11. AS chain of length l and mass m lies o the surface of a smooth sphere of radius $R>l$ with one end tied to the top of the sphere. a.Find the gravitational potential energy of the chain with reference level at the centre of the sphere. B. suppose the chin is released and slides down the sphere. Find the kinetic eneergy of the chain, when it has slid through an angle θ c. find the tangential acceleration $\frac{dv}{dt}$ of the chain when the chain starts sliding down.

A. (a) Find the gravitonal potential energy of the chain with reference livel at the centre of the sphere.

B. (b) Suppose the chain is released and slides down the sphere. Find the kinetic energy of the chain, when it has slid through an angle thela.

C. (c) Find the tangential acceleration (dv)/(dt)of the chain when the chain starts sliding down.

D.

Answer: A::B::C

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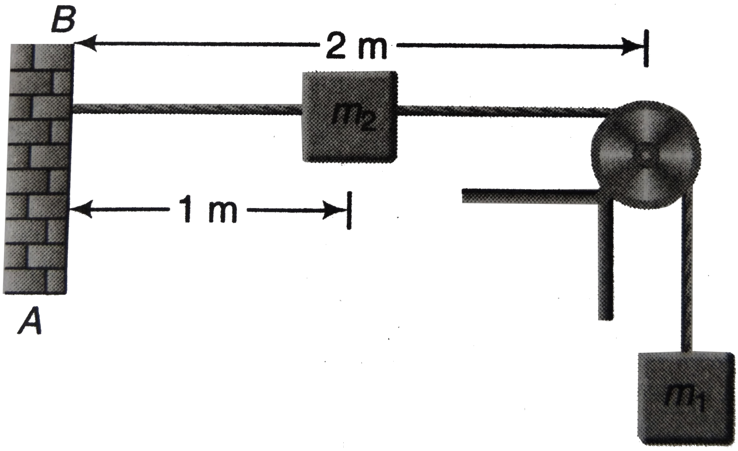
12. Find the speed of both the blocks at the moment the block m_2 hits the wall AB, after the blocks are released from rest. Given that

$m_1 = 0.5kg$ and $m_2 = 2kg, \left(g = 10m/s^2\right)$



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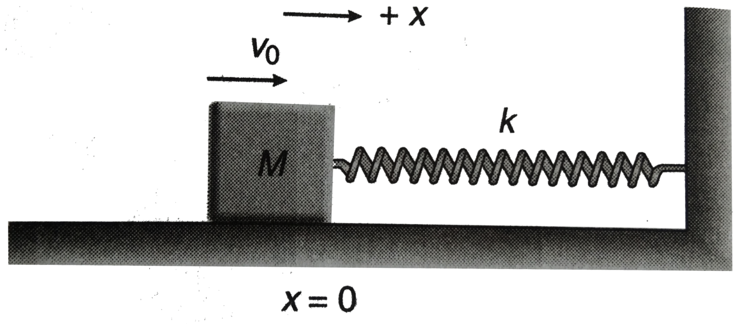
13. A block of mass M slides along a horizontal table with speed v_0. At $x = 0$, it hits a spring with spring constant k and begins to experience a friction force. The coefficient of friction is variable and is given by $\mu = bx$, where b is a positive constant. Find the loss in mechanical energy when the block has first come momentarily to rest.



A. $\dfrac{v_0^2 M^2 g}{2(k - bMg)}$.

B. $\dfrac{v_0^2 M^2 g}{2(k + bMg)}$.

C. $\dfrac{2\left(v_0^2 M^2 g\right)}{(k + bMg)}$.

D. $\dfrac{2\left(v_0^2 M^2 g\right)}{(k + bMg)}$.

Answer: B

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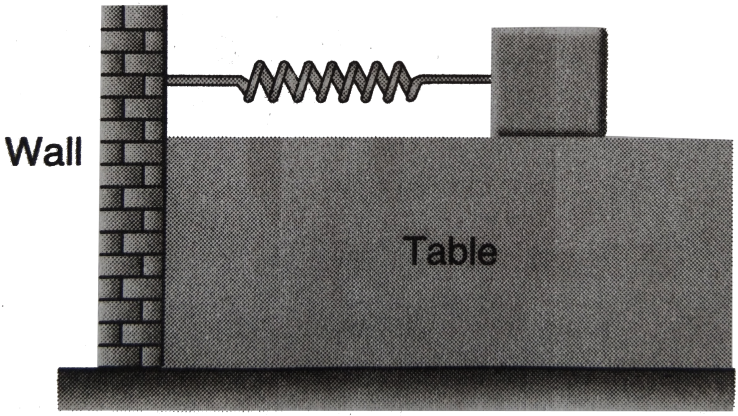
14. A small block of ice with mass $0.120kg$ is placed against a horizontal compressed spring mounted on a horizonta table top that is $1.90m$ above the floor. The spring has a force constant $k = 2300M/m$ and is initially compressed $0.045m$. The mass of the spring is negligible. The spring is releaded and the block slock slides along the table, goes off the edge and travels to the floor. If there is negligible friction between the ice and the table, what is the speed of the block of ice when it reaches the floor. $(g = 9.8m/s^2)$



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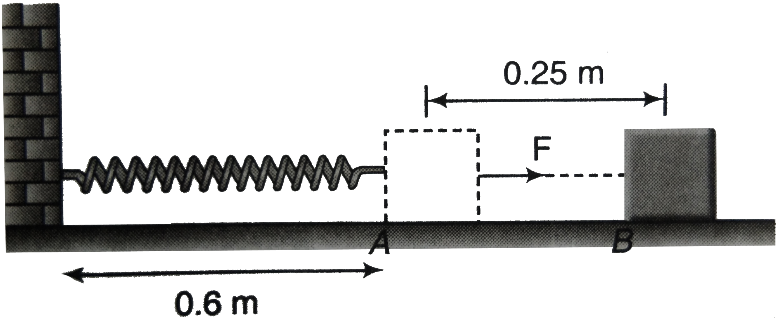
15. A $0.500kg$ block is attached to a spring with length $0.60m$ and force constant $k = 40.0N/m$. The mass of the spring is negligible. You pull the block to the right along the surgace with a constant horizontal force $F = 20.0N$. (a) What is the block's speed when the block reaches point B,which is $0.25m$ to the right of right of point A? (b) What the block reaches point B, you let go off the block. In the subsequent motion, how close dies the block get to the wall where the lift end of the spring is attached? Neglect size of block and friction.



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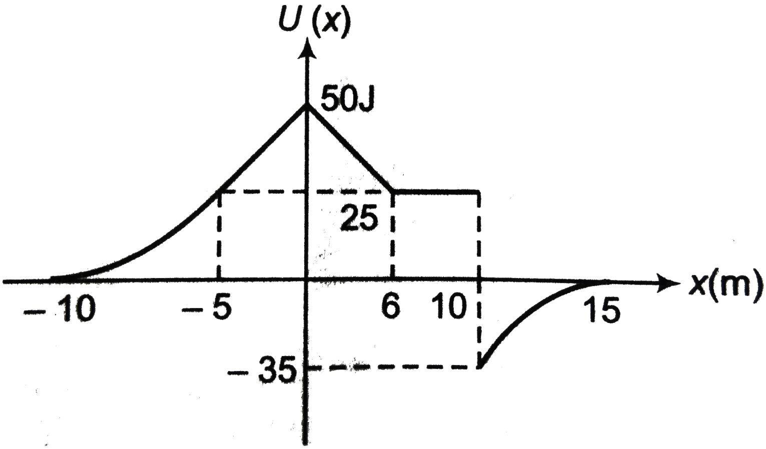
Level 2 Comprehension Based

1. The figure shows the variation of potential energy of a particle as a funcation pf x, the x-coordination of the region. It has been assumed that potential energy depends only on x. For all other values x, U is zero. i.e. for$x < -10$ and $x > 15, U = 0$.



If total mechanical energy of the particle is $25J$, then it can found in the region

A. $-10 < x < -5$ and $6 < x < 15$

B. $-10 < x < 0$ and $6 < x < 10$

C. $-5 < x < 6$

D. $-10 < x < 10$

Answer: A

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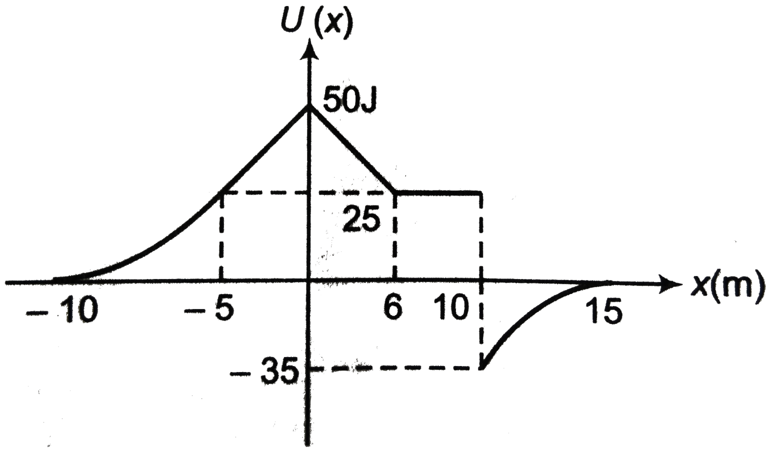
2. The figure shows the variation of potential energy of a particle as a funcation pf x, the x-coordination of the region. It has been assumed that potential energy depends only on x. For all other values x, U is zero. i.e. for$x < -10$ and $x > 15, U = 0.$



If total mechanical energy of the particle is $-40J$, then it can be found in region.

A. $x < 10$ and $x > 15$

B. $-10 < x < 5$ and $6 < x < 15$

C. $10 < x < 15$

D. It is not possible

Answer: D

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