PHYSICS

BOOKS - CP SINGH PHYSICS (HINGLISH)

WORK, ENERGY AND POWER

Examples

1. A force $\overrightarrow{F} = 10\hat{i} + 2\hat{j} + 3\hat{k}$ N displaces a particle from $\overrightarrow{r}_1 = 2\hat{i} + \hat{j} + \hat{k}$ m to

$\overrightarrow{r}_2 = 4\hat{i} + 2\hat{j} + 3\hat{k}$ m Find the work done by the force.

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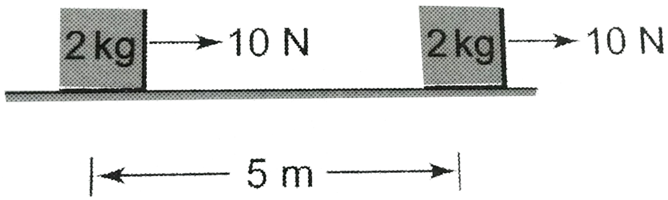
2. 

For the surface $\mu = 0.4$ find the work done by the applied force, friction and net force.

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3. A block of mass 5 kg is pulled along a horizontal. The friction coefficient between the block and the surface is 0.5. If the block travels at constant velocity, find the work done by this applied force during a displacement 4 m of the block.

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4. A block of mass 2 kg is being brought down by a string. If the block acquires a speed

$1(m)/(s)$ in dropping down 25 cm, find the work done by the string in the process.

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5. The two blocks in an Atwood machine have masses 2.0 kg and 3.0 kg. Find the work done by gravity during the fourth second after the system is released from rest.

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6. A force $F = 2x + 3x^2$N acts on a particle in the x-direction. Find the work done by this force during a displacement $x = 1.0m$ to $x = 2.0m$

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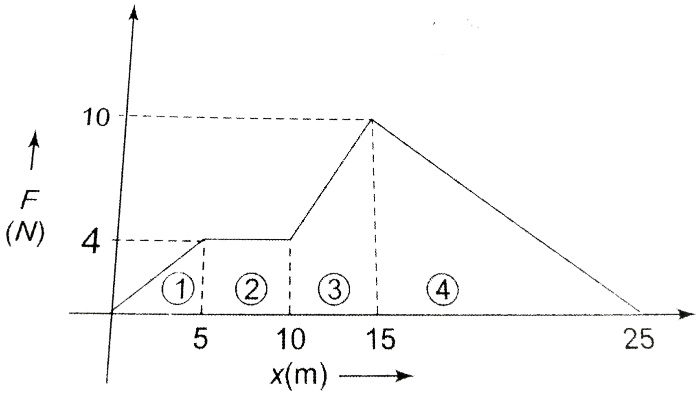

7. .

The variation of force acting on a particle along the x-axis is shown in the figure Find the work done by force during displacement $x = 0$ to $x = 25cm$

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8. Find the work done if a particle is displaced from $J(1m, 2m, 3m)$ to $K(2m, 3m, 4m)$ under a force (a) $\overrightarrow{F} = \left(2\hat{i} + 5\hat{j} + 6\hat{k}\right)N$ and (b) $\overrightarrow{F} = \left(2x\hat{i} + 3y^2\hat{j} + 4z^3\hat{k}\right)N$

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9. The work done in extending a spring by x_0 is W_0. Find the work done in further extension x_0.

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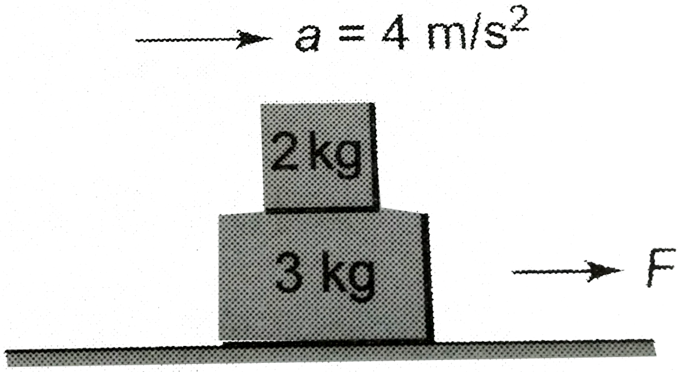

10.

Consider the situation as shown in the figure. A constant horizontal force 45 N acting on the lower blocks produces an acceleration $4(m) / (s^2)$, the two blocks always move together. Find (a) coefficient of friction between the bigger block and the horizontal surface (b) friction acting on the upper block and (c) work done by the friction on the upper block during a displacement 2m of the system.

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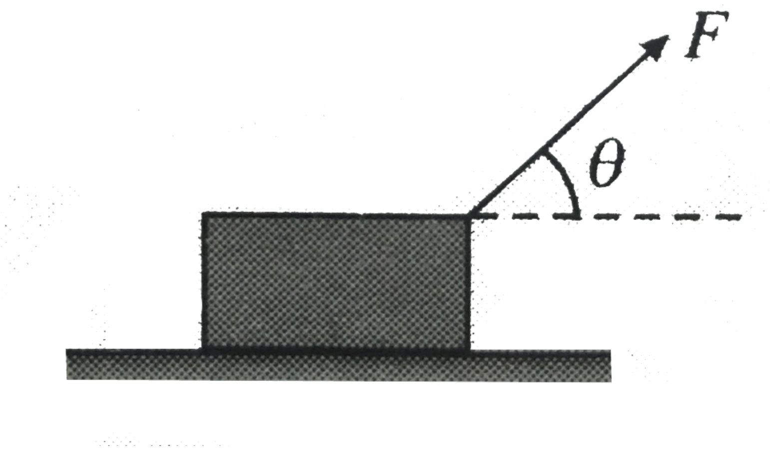
11. A block of mass m lying on a horizontal surface (coefficient of static friction $= \mu_s$) is to be brought into motion by a pulling force F At what angle θ with the horizontal should the force F be applied so that its magnitude is minimum ? Also find the minimum magnitude



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12. A uniform chain of length L and mass M overhangs a horizontal table with its two third part n the table. The friction coefficient between the table and the chain is μ. Find the

work done by the friction during the period the chain slips off the table.

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13. A particle of mass m moves on a straight line with its velocity varying with the distance traveled. Find the total work done by all the forces during a displacement $x=0$ to $x=d$ if the velocity is equal to (a) $v=\lambda\sqrt{x}$ and (b) $v=\lambda x$ is constant.

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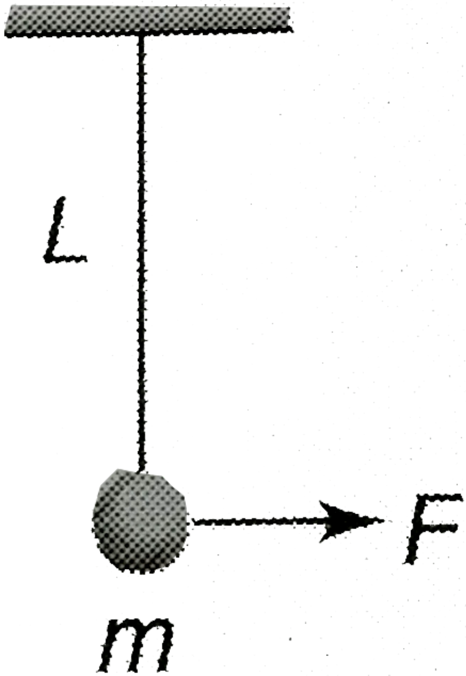
14.



A ball of mass $200g$ is attached to a string of length $50cm$ and a force F is applied on it as shown. Find the work done by this force if string makes an angle 60° with vertical. In the initial and final position, speed of the ball is zero.

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15. A particle of mass 2 kg is moving in a straight line such that its velocity is given by $v = 3t^2 (m) / (s)$, where t is in second. Find the work done by all forces in the first 2 s of its motion.

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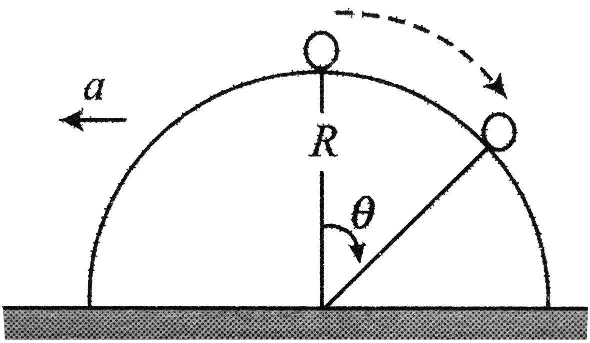
16. A small ball is placed at the top of a smooth hemispherical wedge of radius R. If the wedge is accelerated with an acceleration a, find the velocity of the ball relative to wedge as a function of θ.



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17. A uniform chain of length L and mass M is tying on a smoth table and one third of its length is banging vertically down table the edge of the table if g is acceleration the to gravity , the work required to pull the hanging part on the table is

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18. Two cyllindrical vessels of equal cross sectional ara A contain water upto heights h_1

and h_2. The vessels are interconnected so that the levels in them become equal. Calculate the work done by the force of gravity during the process. The density of water is ρ

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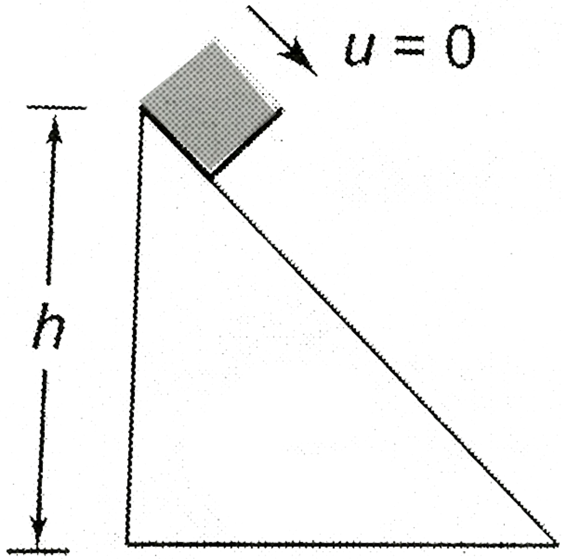

19.

A block is released from the top of the smooth inclined plane of height h. Find the speed of the block as it reaches the bottom of the plane.

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20. A particle is thrown from the top of a tower of height h with speed v_0 at an unknown angle. Find the speed with which it strikes the ground.

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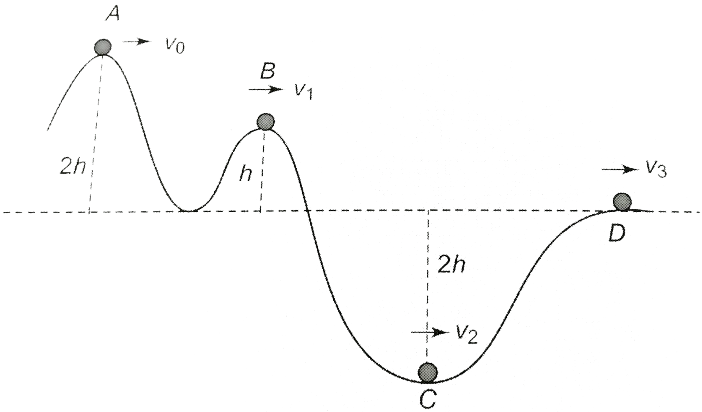
21.



A particle is given velocity v_0 at point A as shown in the figure. Find the speed of particle at point B, C and D

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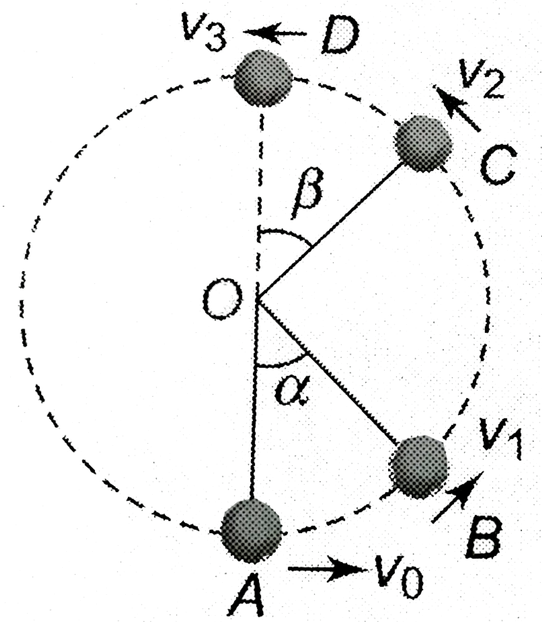

22.

A ball is attached to a string of length L and the ball is given velocity v_0 at its lowest point. Find the speed of the ball at point B,C and D. Assume that the ball is moving in vertical circle.

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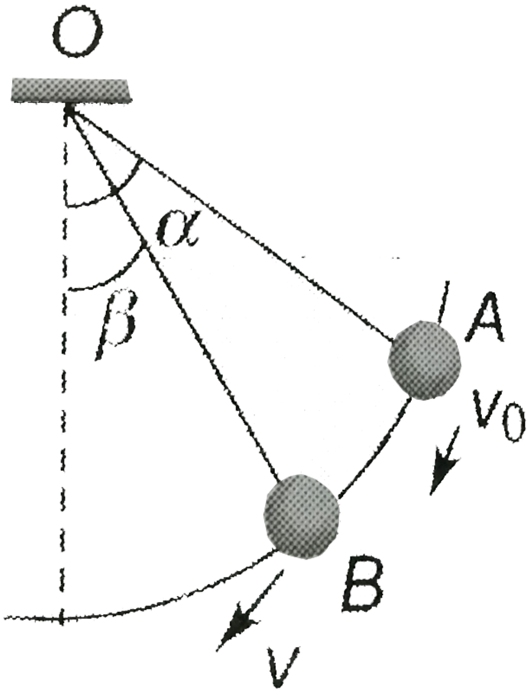

23.

A ball attached to a string length L is oscillating line a simple pendulum. Find v in terms of v_0 L α and β.

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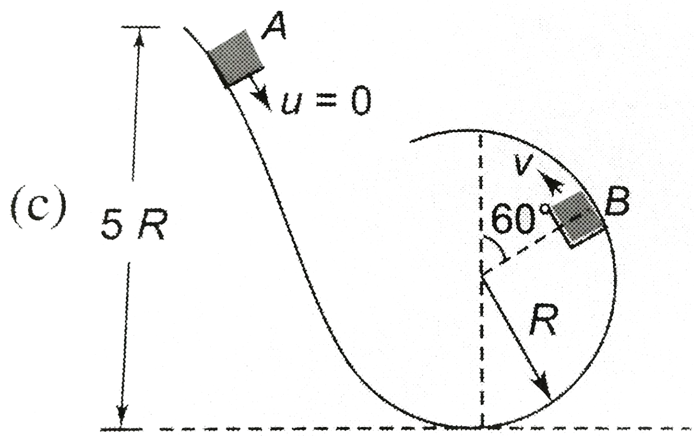
24.



A block is released from position A in the following figure. Find the speed of the block in position B. Assume the surface as frictionless.

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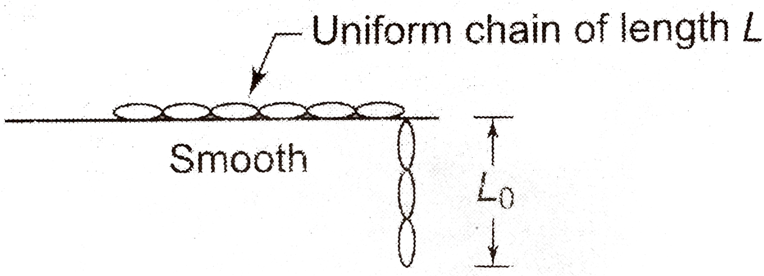
25. 

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

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26. A block of mass m moving at a speed v_0 compresses a spring of spring constant k as

shown in the figure. Find (a) the maximum compression of spring and (b) speed of the block when the spring is compressed to half of maximum compression.

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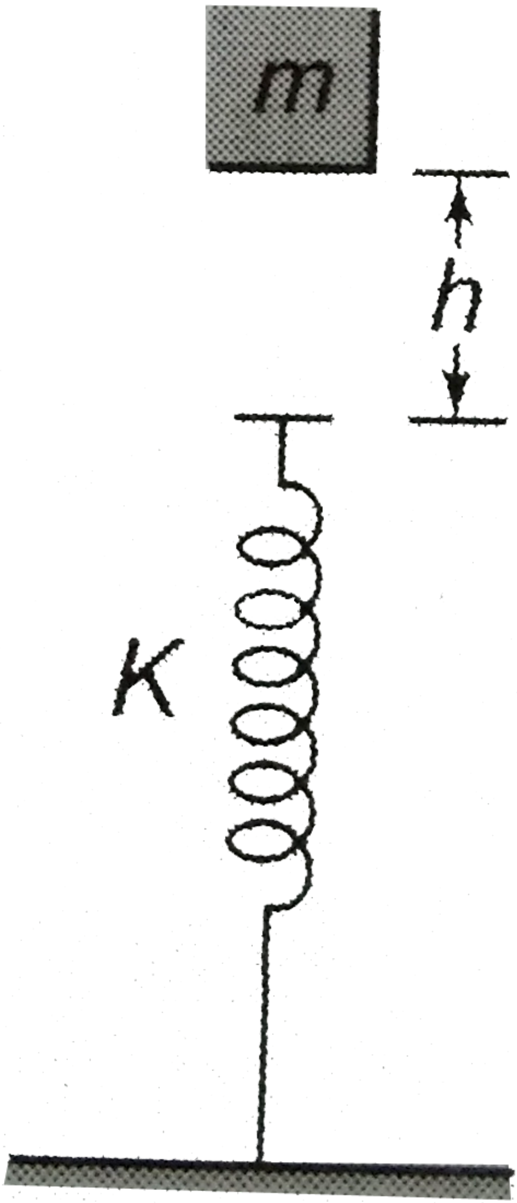

27.

A block is released from height h, find the maximum compression of spring of spring constant k.

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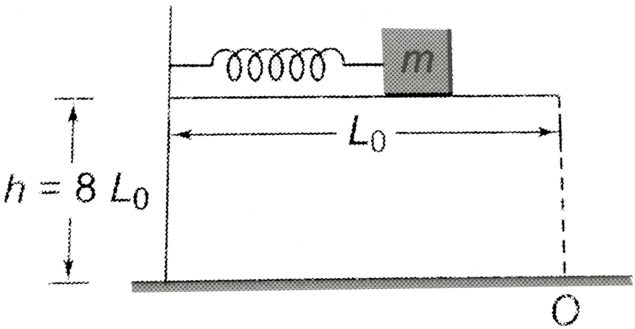

28.

A block of mass m is pressed against a horizontal spring fixed at one end to compress the spring through $(L_0)/(2)$. The natural length of the spring is L_0 and spring constant $k = (mg)/(L_0)$. When released, the block moves horizontally on smooth surface till it leaves the spring. At what horizontal distance from O it strikes the ground.

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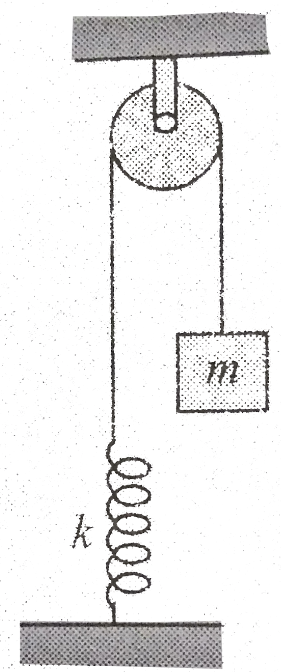
29. In figure, the stiffness of the spring is k and mass of the block is m. The pulley is fixed. Initially, the block m is held such that the elongation in the spring is zero and then released from rest. Find:

a. the maximum elongation in the spring.

b. the maximum speed of the block m. Neglect the mass of the spring and that of the string. Also neglect the friction.



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30. A block of mass m is suspened through a spring of spring constant k and is in equlibrium. A sharp blow gives the block an initial downward velocity v. How far below the equilibrium psitin, the block comes to an instantaneous rest?

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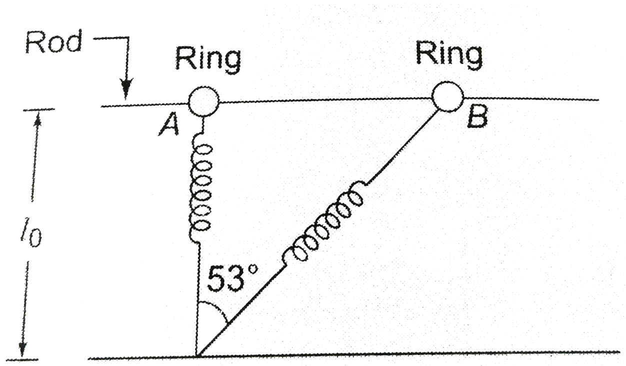
31. 

A ring of mass m is attached to a horizontal spring of spring constant k and natural length l_0. The other end of the spring is fixed and the ring can slide on a horizontal rod as shown. Now the ring is shifted to position B and released Find the speed of the ring when the spring attains its natural length.

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32. In the previous problem, the rod on which the ring slide is vertical Repeat the problem.

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33. A block of mass m is given velocity v_0 on a rough horizontal surface. After traveling a distance d. Its speed becomes $(v_0)/(2)$. Find the work done against friction. The work donw by friction and the coefficient of friction.

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34. An object of mass 4 kg falls from rest through a vertical distance of 20 m and reaches with velocity of 10 $(m)/(s)$ on ground. How much work is done by air friction?

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35. A ball is thrown vertically upward with speed $10m/s$ and it returns to the ground with speed $8m/s$. A constant air resistance acts. The minimum height attained by the ball is

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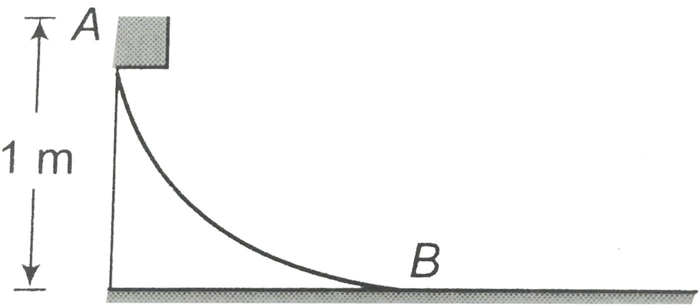
36. 

A block weighing 10 kg travels down a smooth curved track AB joined to a rough horizontal surface (see the figure.) The rough surface has a friction coefficient of 0.20 with the block. If the block starts slipping on the track from a point 1 m above the horizontal surface, how far will it move on the rough surface?

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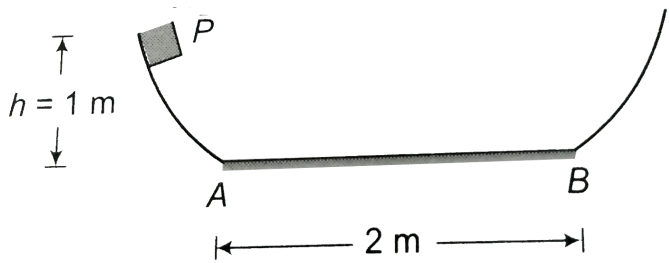
37.



The curved portions are smooth and horizontal surface is rough. The block is released from P. At what distance from A it will stop?the friction coefficient for rough flat surface is 0.2.

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38. A body of mass m is pushed with the initial velocity v_0 up an inclined plane set at an angle α to the horizontal. The friction coefficient is equal to k. What distance will the body cover before it stops and what work do the friction forces perform over this distance?

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39. A disc of mass m slides with the zero initial velocity down an inclined plane of inclination θ to the harizontal, having traveled the distance d along the horizontal plane, the disc stops. Find the work performed by the friction over the whole distance, assuming the friction coefficient μ for both the inclined and horizontal planes.

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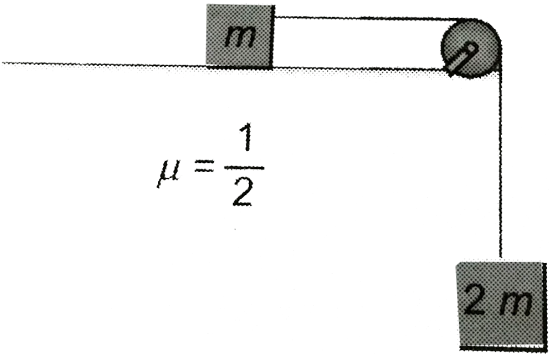
40. 

Consider the situation as shown in the figure. The system is released from rest. Find the speed of m when it has traveled a distance d on a rough surface.

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41. A ball of mass m is moved with speed v_0 at the highest point in a closed circular tube of radius R kept in the vertical plane. The cross-section of the tube is such that the block just fits in it. The block makes several oscillations inside the tube and finally stops at the lowest point. Find the work done by the tube on the block during the process.

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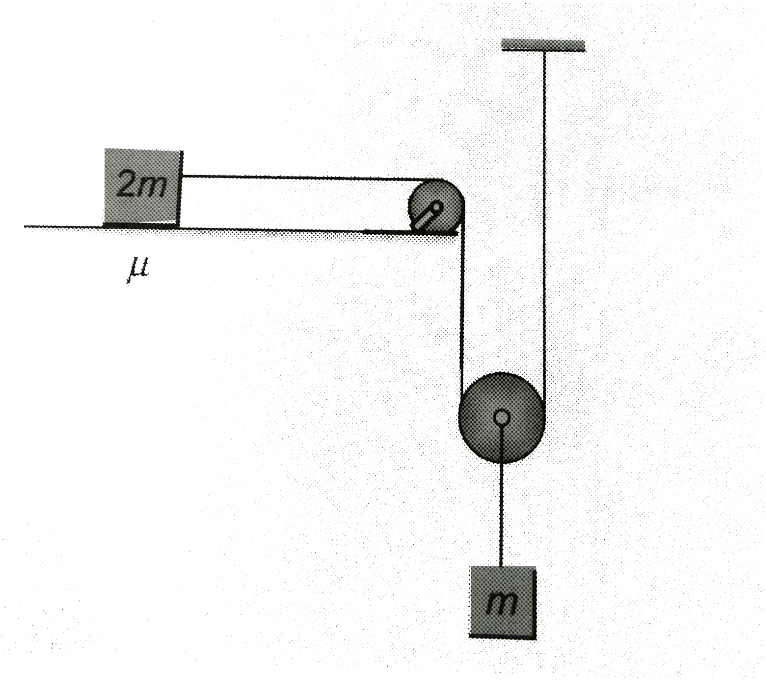
42. 

Consider a situation as shown in the figure. The system is released from rest. When the block of mass m has falled a distance L, its speed becomes $\frac{\sqrt{gL}}{3}$. Find the friction coefficient μ.

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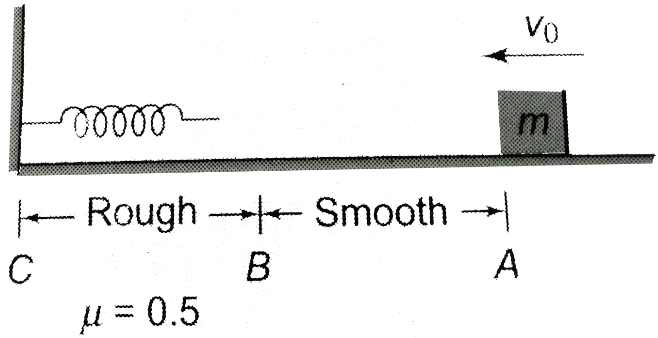

43.

A block of mass 200 g is given velocity $2(m)/(s)$ on a horizontal surface as shown in the figure. Find the maximum compression of spring of spring constant $k = 100(N)/(m)$

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44. A $0.5kg$ block slides from the point A on a horizontal track with an initial speed $3m/s$ towards a weightless horizontal spring of length $1m$ and force constant $2N/m$. The part AB of the track is frictionless and the part BC has the coefficient of static and kinetic friction as '0.22' and 0.20 respectively. If the distances AB and BD are $2m$ and $2.14m$ respectively, find total distance through which the block moves before it comes to rest completely. `(g=10 m//s^(2)).

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45. A 20 kg body is released from rest so as to slide in between vertical rails and compresses a vertical spring $\left(k = 1920\frac{N}{m}\right)$ placed at a distance $h = 1.0$m from the strating position of the body. The rails offer a frictional force of 40 N opposing the motion of body. Find (a) the velocity v of the body just before striking with the spring, (b) the maximum compression of the spring and (c) the distance h' through which the body is rebounded up.

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

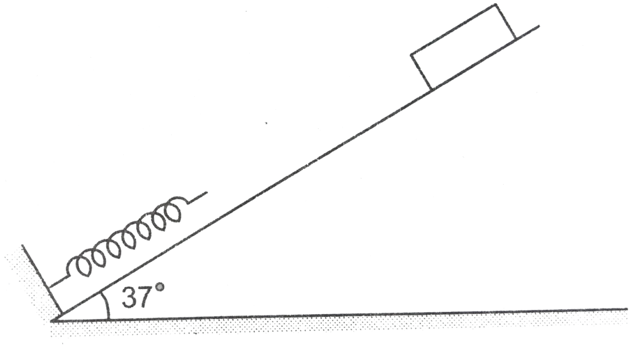

Figure 8-E7

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47. (a) What is the power of an engine which can lift 600 kg of coal per minut from a mine 20 m deep ?

(b) A 2kW motor pumps out water from a well

$10m$ deep. Calculated the quantity of water pumped out per second.

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

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

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50. In generation of hydroelectric power, water falls from some height and gravitational potential energy of water is converted into electric power with the help of turbine. In one such event, $7.2 \times 10^4 kg$ of water falls per hour from height 100m and half of the gravitational potential energy is converted into electric energy. How much power is generated?

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51. A person decides to use bath tub water to generate electric power to run a 40 W bulb. The bath tub is located at a height of 10 m from the ground and it holds 200 liters of water. He installs a water driven wheel generator on the ground. At what rate should the water drain from the bath tub to light the bulb? The density of water is $1000(kg)/(m^3)$ and efficiency of generator is 80%. How long can he keep the bulb on if the bath tub was full initially.

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52. A block of mass 3 kg is pulled up on a smooth incline of angle 37° with the horizontal. If the block moves with an acceleration $2(m)/(s^2)$, find the power delivered by the pulling force at time 5 s after the motion starts. What is the average power delivered during the 5.0 s after the motion starts?

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53. A body of mass m is thrown at an angle α to the horizontal with the initial velocity v_0 Find (a) instantaneous power of gravity as a function of time and

(b) mean power developed by gravity in time

(i) $t = 0$ to T,

(ii) $t = 0$ to $\frac{T}{2}$, (iii) $t = \frac{T}{2}$ to $t = T$, where T is the time of flight.

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54. An automobile of mass m accelerates, starting from rest, while the engine supplies constant power P. Find its position and instantaneous velocity at time t assuming the automobile starts from rest.

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55. A small body of mass m is given velocity v_0 at point O on rough horizontal surface. (a) Find the mean power developed by the friction force during the whole time of motion if the friction coefficient is constant and equal to μ_0

(b) Find the maximum instantaneous power developed by the friction force, if the friction coefficient varies as $\mu = \mu_0 x$, where μ_0 is a constant and x is the distance from the point O.

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56. A particle located in a one-dimensional potential field has its potential energy function as $U(x)\frac{a}{x^4}-\frac{b}{x^2}$, where a and b are positive constants. The position of equilibrium x corresponds to

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57. 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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58. If the potential energy function of a particle is given by $U = -\left(x^2 + y^2 + z^2\right)$J, whre x,y and z are in meters. Find the force acting on the particle at point $A(1m, 3m, 5m)$.

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Exercises

1. A particle moves from position $3\hat{i} + 2\hat{j} - 6\hat{k}$ to $14\hat{i} + 13\hat{j} + 9\hat{k}$ due to a force $\overrightarrow{F} = \left(4\hat{i} + \hat{j} + 3\hat{k}\right)$N. If the displacement is in centimeter then work done will be

A. $1J$

B. $2J$

C. $3J$

D. $2.5J$

Answer: A

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2. A body, constrained to move in the Y-direction is subjected to a force given by $\overrightarrow{F} = \left(-2\hat{i} + 15\hat{j} + 6\hat{k}\right)N$. What is the work done by this force in moving the body a distance 10 m along the Y-axis

A. 20J

B. 150J

C. 160J

D. 190J

Answer: B

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3. A force $\overrightarrow{F} = 3\hat{i} + c\hat{j} + 2\hat{k}$ acting on a particle causes a displacement $\overrightarrow{d} = -4\hat{i} + 2\hat{j} - 3\hat{k}$. If the work done is 6 J. then the value of c will be

A. 12

B. 6

C. 1

D. 0

Answer: A

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

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

A. $-2ka^2$

B. $2ka^2$

C. $-ka^2$

D. ka^2

Answer: C

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5. A man displaces a block by 5 m on a rough surface $(\mu = (1)/(2))$ by applying a force 50 N acting at 37° to the horizontal the work done by the applied force is

A. $200J$

B. $100J$

C. $150J$

D. $50J$

Answer: A

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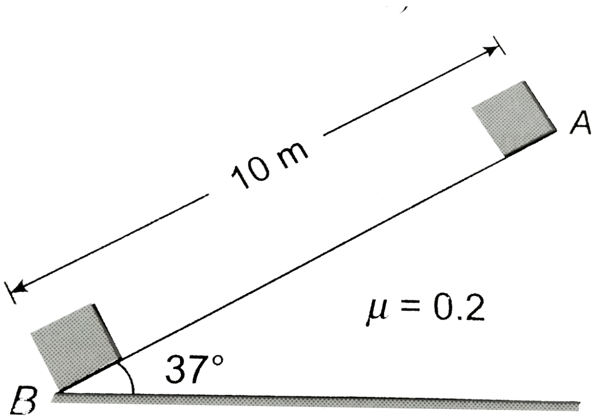
6. 

A block of mass $10kg$ is placed on a rough surface inclined plane of inclination 37° with horizontal. Now the block is released . The work done by the gravitational force and friction force, when the block moves from A to $B(\sin 37^\circ = 0.6, \cos 37^\circ = 0.8)$

A. 600J, 160J

B. $-600J,160J$

C. 600J, $-600J$

D. $-600J,-600J$

Answer: C

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7. A block of mass M is pulled along a horizontal surface by applying a force at angle θ with the horizontal. The friction coefficient between the block and the surfasce is μ. If the block travels at a uniform velocity, find the work donen by this applied force during a displacement d of the blcok.

A. $\frac{mgd\sin\theta}{\cos\theta+\mu\sin\theta}$

B. $\frac{mgd\sin\theta}{\sin\theta+\mu\cos\theta}$

C. $\frac{\mu mgd\cos\theta}{\cos\theta+\mu\sin\theta}$

D. $\frac{\mu gd\cos\theta}{\cos\theta+\mu\cos\theta}$

Answer: C

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8. A cord is used to lower vertically a block of mass M, a distance d at a constant downward acceleration of $\frac{g}{4}$, then the work done by the cord on the block is

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

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

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

D. $-\frac{3Mgd}{4}$

Answer: D

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9. The two blocks in an Atwood machine have masses 2.0 kg and 3.0 kg. Find the work done by gravity during the fourth second after the system is released from rest.

A. 70 J

B. 210 J

C. 140 J

D. 350 J

Answer: A

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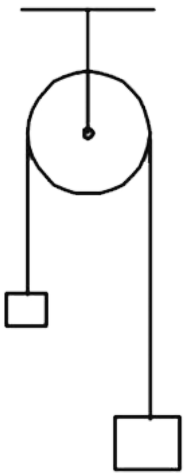
10. A light inextensible string that gas over a smoth fixed polley as shown in the figure connect two blocks of mases it 0.36 kg and 0.72 kg Taking $g = 10ms^{-2}$, find the work done by the string on the block of mass 0.36 kg doring the first second after the system is refosed from rest ,



A. 6 Joule

B. 5 Joule

C. 8 Joule

D. 2 joule

Answer: A

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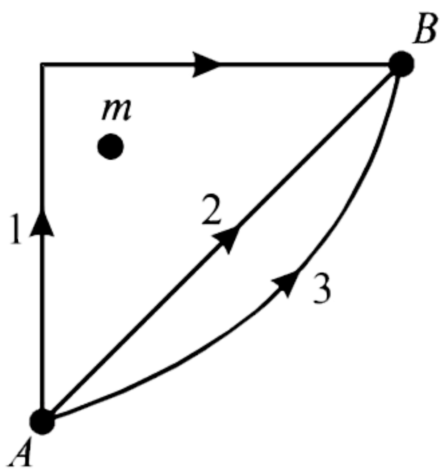
11. If W_1 ,W_2 and W_3 represent the work done in moving a particle from A to B along three different paths 1, 2 and3 respectively (as shown) in the gravitational field of a point mass m, find the correct relation between W_(1) W_(2) and W_(3)`



A. $W_1 > W_2 > W_3$

B. $W_1 = W_2 = W_3$

C. $W_1 < W_2 < W_3$

D. $W_2 > W_1 > W_3$

Answer: B

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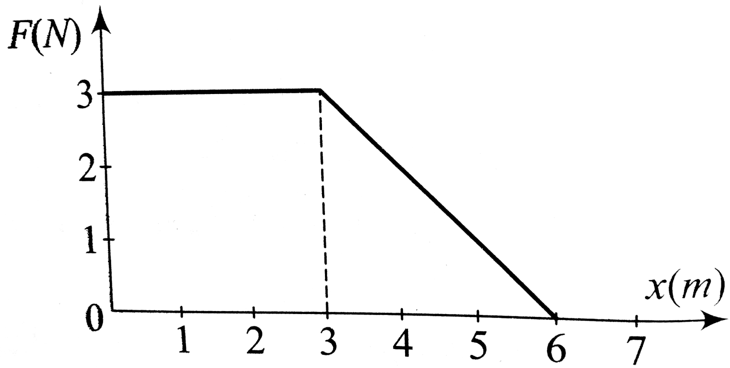
12. A Force F acting on an object varies with distance x as shown in the here . The force is in newton and x in metre. The work done by the force in moving the object from $x = 0$ to $x = 6m$ is



A. 4.5 J

B. 13.5 J

C. 9.0 J

D. 18.0 J

Answer: B

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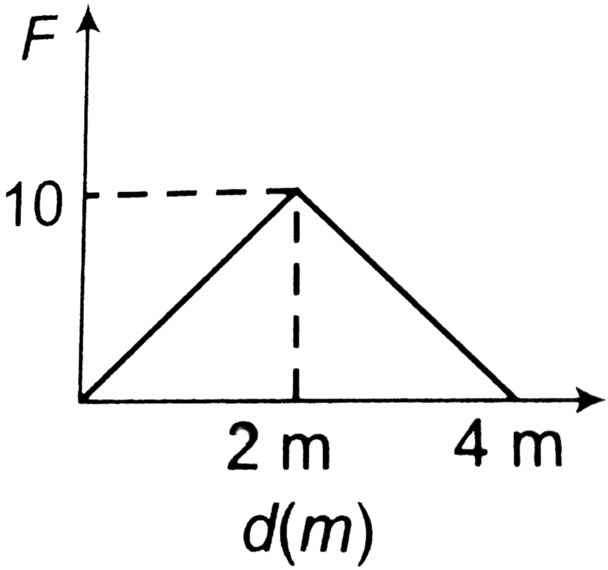
13. 

Work done from $d = 0m$ to $d = 3m$

A. 12.5 J

B. 15 J

C. 17.5 J

D. 20 J

Answer: C

Watch Video Solution

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

A. 70

B. 270

C. 35

D. 135

Answer: D

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15. A force act on a 30 gm particle in such a way that the position of the particles as a function of time is given by $x = 3t - 4t^2 + t^3$, where x is in meters and t is in seconds. The work done during the first 4 second is

A. 5.28 J

B. 450 mJ

C. 490 mJ

D. 530 mJ

Answer: A

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16. The displacement x of a particle of mass m kg moving in one dimension, under the action of a force, is related to the time t by the equation $t = 4x + 3$ where x is in meters and t is in seconds. The work done by the force in the first six seconds in joules is

A. 0

B. 3 m

C. 6 m

D. 9 m

Answer: A

Watch Video Solution

17. 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 $x = 0 \rightarrow x = d$.

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

B. $\frac{mad^2}{d}$

C. $\frac{ma^2d}{2}$

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

Answer: C

Watch Video Solution

18. A particle is moving along the x-axis and force acting on it is given by $F = F_0 \sin \omega_x N$, where ω is a constant. The work done by the force from $x = 0$ to $x = 2$ will be

A. $\dfrac{F_0}{\omega(1 - \cos\omega)}$

B. $\dfrac{F_0}{2\omega(1 - \cos 2\omega)}$

C. $\dfrac{2F_0 \sin^2 \omega}{\omega}$

D. $\dfrac{F_0}{\omega(1 + \cos 2\omega)}$

Answer: C

Watch Video Solution

19. A block of mass m at rest is acted upon by a force F for a time t. The kinetic energy of block after time t is

A. $\dfrac{Ft^2}{m}$

B. $\dfrac{F^2t^2}{2m}$

C. $\dfrac{Ft^2}{2m}$

D. $\dfrac{F^2t^2}{3m}$

Answer: B

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20. According to the work energy theorem, the work done by the net force on a particle is equal to the change in its

A. kinetic energy

B. potential energy

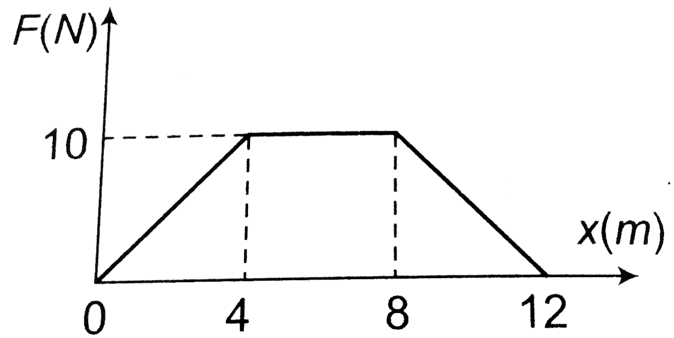
C. linear momentum

D. angular momentum

Answer: A

Watch Video Solution

21.



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

A. $0(m) / (s)$

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

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

D. $40(m) / (s)$

Answer: D

Watch Video Solution

22. A block of mass 2 kg is resting on a smooth surface. At what angle a force of 10 N be acting on the block so that it will acquire a kinetic energy of 10 J after moving 2 m

A. 30°

B. 45°

C. 60°

D. 90°

Answer: C

Watch Video Solution

23. Two blocks A and B have masses m and $4m$, respectively. Each one is acted upon by a force F. If they acquire the same kinetic energy in time t_A and t_B, then $(t_A)/(t_B)$ is

A. 2

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

C. 3

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

Answer: B

Watch Video Solution

24. A force acting on particle is given by $\overrightarrow{F} = \left(3x^2\hat{i} + 4y\hat{j}\right)N$. The change in kinetic energy of particle as it moves from $(0, 2m)$ to $(1m, 3m)$ is

A. $6J$

B. $10J$

C. $11J$

D. $13J$

Answer: C

Watch Video Solution

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

A. directly proportional to m

B. directly proportional to $\sqrt{m}$

C. inversely proportional to $\sqrt{m}$

D. independent of m

Answer: D

Watch Video Solution

Watch Video Solution

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

A. constant

B. directly proportional to time

C. inversely proportional to time

D. directely proportional to square of time.

Answer: B

Watch Video Solution

27. If the kinetic energy of body is directly proportional to time t, the magnitude of force acting on the body is (i) directly proportional to $\sqrt{t}$

(ii) inversely proportional to $\sqrt{t}$

(iii) directly proportional to the speed of the body.

(iv) inversely proportional to the speed of the body.

A. (i),(ii)

B. (i),(iii)

C. (ii),(iv)

D. (i),(iv)

Answer: C

Watch Video Solution

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

A. x^2

B. e^x

C. x

D. $\log_e x$

Answer: A

Watch Video Solution

29. Which are the following is not a conservative force?

A. Gravitational force

B. Electrostatic force between two charges

C. Magnetic force between two magnetic dipoles

D. Frictional force

Answer: A

Watch Video Solution

30. A uniform chain of length L and mass M is tying on a smoth table and one third of its length is banging vertically down table the edge of the table if g is acceleration the to gravity , the work required to pull the hanging part on the table is

A. MgL

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

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

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

Answer: D

Watch Video Solution

31. Two cyllindrical vessels of equal cross sectional ara A contain water upto heights h_1 and h_2. The vessels are interconnected so that the levels in them become equal. Calculate the work done by the force of gravity during the process. The density of water is ρ

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

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

C. $A\rho\left[\frac{(h_1 - h_2)}{4}\right]$

D. $A\rho g\left[\frac{(h_1 - h_2)}{4}\right]^2$

Answer: B

Watch Video Solution

32. When a spring is stretched by 2 cm, it stores 100 J of energy. If it is further stretched by 2 cm, the stored energy will be increased by

A. 100 J

B. 200 J

C. 300 J

D. 400 J

Answer: C

Watch Video Solution

33. The potential energy of a certain spring when stretched through a distance 'S' is 10 joule. The amount of work (in joule) that must be done on this spring to stretch it through an additional distance 'S' will be

A. 30

B. 40

C. 10

D. 20

Answer: A

Watch Video Solution

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

A. $\frac{1}{2}k\beta^2$

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

C. $\frac{1}{2}k(\alpha+\beta)^2$

D. $\frac{1}{2}k\beta(2\alpha+\beta)$

Answer: D

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35. Two spreings A and B$(k_A = 2k_B)$ ar stretched by applying forces of equa magnitudes at the foru ends. If the energy stored in A is E, that in B is

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

B. $2U$

C. U

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

Answer: B

Watch Video Solution

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

A. 16 J

B. 8 J

C. 32 J

D. 24 J

Answer: B

Watch Video Solution

37. A spring 40 mm long is stretched by the application of a force. If 10 N force required to stretch the spring through 1mm, then the work done in stretching the spring through 40 mm is

A. 84 J

B. 68 J

C. 23 J

D. 8 J

Answer: D

Watch Video Solution

38. Two equal masses are attached to the two ends of a spring of spring constant k. The masses are pulled out symmetricaly tostretch the spring by a length x over its natural length. The work doen by the spring oneach mass is

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

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

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

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

Answer: D

Watch Video Solution

39. A stone projected vertically upwards from the ground reaches a maximum height h. When it is at a height $(3h)/(4)$, the ratio of its kinetic and potential energies is

A. $3:4$

B. $1:3$

C. $4:3$

D. $3:1$

Answer: B

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Watch Video Solution

40. Two identical balls are projected, one vertically up and the other at an angle of 30° to the horizontal, with same initial speed. The potential energy at the highest point is in the ratio:

A. $1:1$

B. $2:1$

C. $3:2$

D. $4:1$

Answer: D

Watch Video Solution

41. A heavy stone is thrown from a cliff of height h with a speed v. The stone will hit the ground with maximum speed if t is thrown

A. vertcally downward

B. vertically upward

C. horizontally

D. the speed does not depend on the initial direction.

Answer: D

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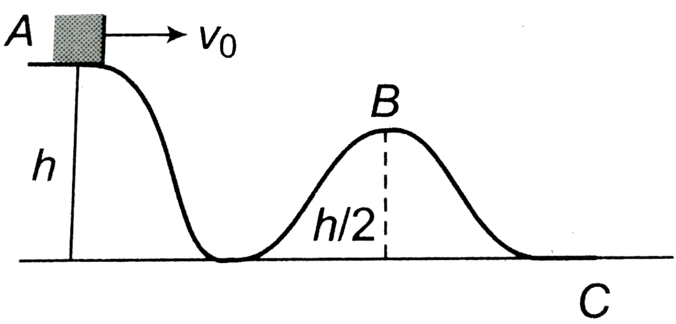
42.



The block is given an initial velcoty v_0 on smooth curved surface, Its speed when it reaches to B will be

A. v_0

B. $(v_0 + gh)^{(1)/(2)}$

C. $(v_0 + 2gh)^{(1)/(2)}$

D. none

Answer: B

Watch Video Solution

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

A. $10(m) / (s)$

B. $10\sqrt{30}(m) / (s)$

C. $40(m) / (s)$

D. $20(m) / (s)$

Answer: C

Watch Video Solution

44. A projectile is fired from the top of an 80 m high cliff with an initial speed of $30(m) / (s)$ at an unknown angle. The speed when its hits the ground.

A. $50(m) / (s)$

B. $100(m)/(s)$

C. $45(m)/(s)$

D. $20(m)/(s)$

Answer: A

Watch Video Solution

45. Three different objects of masses m_1, m_2 and m_2 are allowed to fall from rest and from the same point O along three different frictionless paths. The speeds of three objects on reaching the ground will be:

A. $m_1 : m_2 : m_3$

B. $m_1 : 2m_2 : 2m_3$

C. $1 : 1 : 1$

D. $\frac{1}{m_1} : \frac{1}{m_2} : \frac{1}{m_3}$

Answer: C

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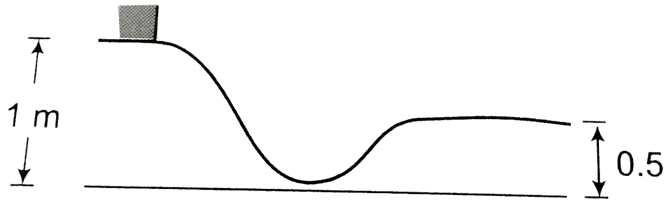
46. 

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

A. 1m

B. 2m

C. 3m

D. 4m

Answer: A

Watch Video Solution

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

A. $0.25J$

B. $0.5J$

C. $1.0J$

D. $1.4J$

Answer: B

Watch Video Solution

48. 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. $1.5m$

D. $0.5m$

Answer: A

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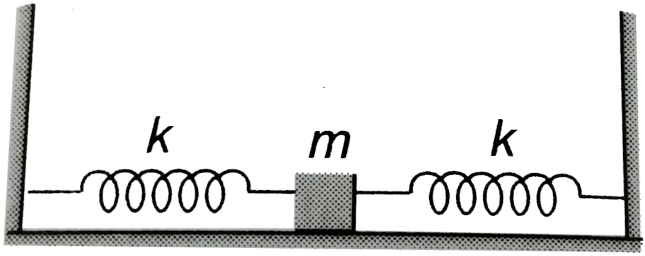
49.



A block of mass m is attached to two unstretched springs of spring constant k, each as shown. The block is displaced towards right through a distance x and is released The speed of the block as it passes through the mean position will be

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

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

C. $x\frac{m}{k}$

D. $x\frac{2k}{m}$

Answer: B

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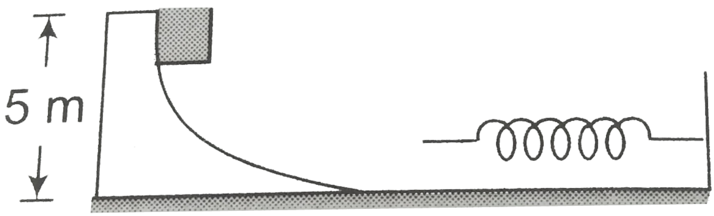


50.

The figure shows a smooth curved track terminating in a smooth horizontal part. A spring of spring constant $400(N)/(m)$ is attached at one end to a wedge fixed rigidly with the horizontal part . A 40 g mass is released from rest at a height of 5 m on the curved track. The maximum compression of the spring will be

A. $10cm$

B. $2cm$

C. $3cm$

D. $4cm$

Answer: A

Watch Video Solution

51. one end of a spring of natural length ha and spring constant k is fixed at the ground and the other is fitted with a smooth ring of mass m which is allowed to slide on a horizontal rod fixed at a height h figure. Initially, the spring makes an angle of 37^0 with the vertical when the system is released from rest. find the speed of the ring when the spring becomes vertical.

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

B. $\frac{h}{4}\sqrt{\frac{k}{m}}$

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

D. $\frac{h}{4}\sqrt{\frac{k}{2m}}$

Answer: B

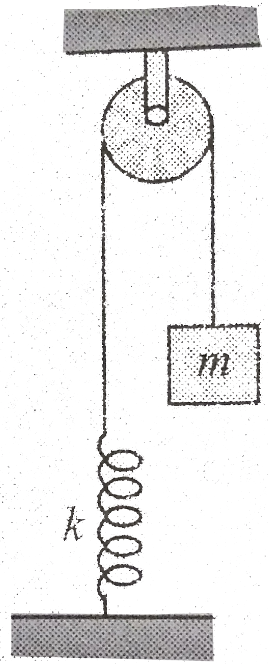
Watch Video Solution

52. In figure, the stiffness of the spring is k and mass of the block is m. The pulley is fixed. Initially, the block m is held such that the elongation in the spring is zero and then released from rest. Find:

a. the maximum elongation in the spring.

b. the maximum speed of the block m. Neglect the mass of the spring and that of the string.

Also neglect the friction.



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

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

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

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

Answer: D

Watch Video Solution

53. A vertical spring with force constant k is fixed on a table. A ball of mass m at a height h above the free upper end of the spring falls vertically on the spring , so that the spring is compressed by a distance d. The net work done in the process is

A. $mg(h+d)+\frac{1}{2}kd^2$

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

C. $mg(h-d)-\frac{1}{2}kd^2$

D. $mg(h-d)+\frac{1}{2}kd^2$

Answer: B

Watch Video Solution

54. A block of mass M is hanging over a smooth and light pulley by a constant force F.

The kinetic energy of the block increases by 20 J in 1 s.

A. The tension in the string is Mg.

B. The tenstion in the spring is F.

C. The work done by the tenstion on the block is 20 J in the above 1 s.

D. The work done by the force of gravity is 20 J in the above 1 s.

Answer: B

Watch Video Solution

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

A. zero

B. $mgvt\cos^2\theta$

C. $mgvt\sin^2\theta$

D. $mgvt \sin 2\theta$

Answer: C

Watch Video Solution

56. A body of mass $1kg$ is thrown upwards with a velocity $20ms^{-1}$. It momentarily comes to rest after attaining a height of $18m$. How much energy is lost due to air friction? $(g = 10ms^{-2})$

A. 20 J

B. 30 J

C. 40 J

D. 10 J

Answer: A

Watch Video Solution

57. A body dropped from a height H reaches the ground with a speed of 1.2 $\sqrt{gH}$. Calculate the work done by air friction.

A. $0.14mgH$

B. $0.28mgH$

C. $-0.14mgH$

D. $-0.28mgH$

Answer: D

Watch Video Solution

58. A ball is thrown vertically upward with speed $10m/s$ and it returns to the ground with speed $8m/s$. A constant air resistance acts. The minimum height attained by the ball is

A. 4.1 m

B. 5.1 m

C. 6.1 m

D. 7.1 m

Answer: A

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59. A bullet, moving with a speed of $150(m)/(s)$, strikes a wooden plank. After passing through the plank, its speed becomes $125(m)/(s)$. Another bullet of the same mass and size strikes the plank with a speed of $90(m)/(s)$. Its speed after passing through the plank would be

A. $25(m)/(s)$

B. $35(m)/(s)$

C. $50(m)/(s)$

D. $70(m)/(s)$

Answer: B

Watch Video Solution

60. A ball dropped from a height of 2 m rebounds to a height of 1.5 m after hitting the ground. Then the percentage of energy lost is

A. 25

B. 30

C. 50

D. 100

Answer: A

Watch Video Solution

61. 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. 4

B. 8

C. 6

D. 10

Answer: B

Watch Video Solution

62. A car is moving along a stight horizontal road with a speed v_0 . If the coefficient of friction between the tyres and the road is mu, the shortest distance in which the car can be stopped is.

A. $\frac{v_0^2}{\mu g}$

B. $\frac{v_0^2}{4\mu g}$

C. $\frac{v_0^2}{2\mu g}$

D. $\frac{2v_0^2}{\mu g}$

Answer: C

Watch Video Solution

63. A body of mass 0.5 kg is taken up an inclined plane of length 10 m and height 5 m and then allowed to slide down to the bottom again. The coefficient of friction between the body and the plane is 0.1. The work done by the frictional force over the round trip is

A. 5 J

B. $5\sqrt{3}J$

C. $-5J$

D. $-5\sqrt{3}J$

Answer: D

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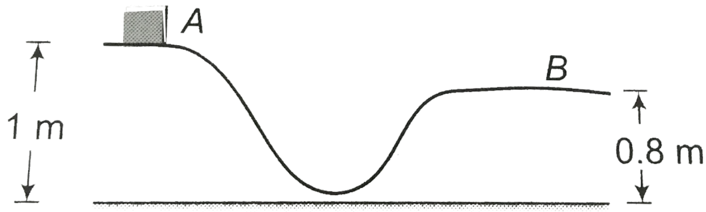
64. 

A block of mass 1 kg is placed at the point A of a rough track shown in the figure. If slightly pushed towards right, it stops at the point B of the track. The work done by the frictional force on the block during its transit from A to B is

A. $-2J$

B. $-4J$

C. $2J$

D. $4J$

Answer: A

Watch Video Solution

65. A car weighing 1400 kg is moving at speed of 54 km/h up a hill when the motor stops. If it is just able to read the destination which is at a height of 10 m above the point calculte the work done against friction (negative of the work done by the friction).

A. $17500 J$

B. $12500 J$

C. $25000 J$

D. $50000 J$

Answer: A

Watch Video Solution

66. A block of mass 100 g is moved with a speed of $5(m)/(s)$ at the highest point in a closed circular tube of radius 10 cm kept in a vertical plane. The cross-section of the tube is such that the block jst fits in it. The block makes several oscillations inside the tube and finally stops at the lowest point. The work done by the tube on the block during the process will be

A. $0.825J$

B. $-0.725J$

C. $-1.45J$

D. $2.05J$

Answer: C

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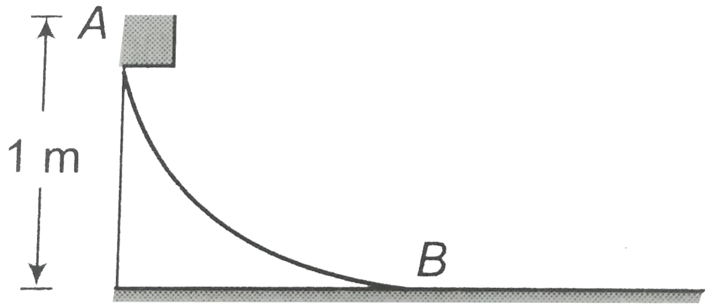
67.



A block weighing 10 kg travels down a smooth curved track AB joined to a rough horizontal surface (see the figure.) The rough surface has a friction coefficient of 0.20 with the block. If the block starts slipping on the track from a point 1 m above the horizontal surface, how far will it move on the rough surface?

A. 3 m

B. 4 m

C. 5 m

D. 6 m

Answer: C

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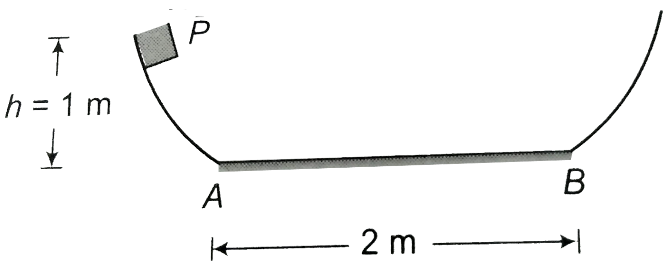
68. 

The curved portions are smooth and

horizontal surface is rough. The block is released from P. At what distance from A it will stop?

A. 1 m

B. 2 m

C. 3 m

D. 4 m

Answer: A

Watch Video Solution

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

A. 5.5 cm

B. 2.5 cm

C. 11.0 cm

D. 8.5 cm

Answer: C

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70. A particle moves with a velocity $6\hat{i} - 4\hat{j} + 3\hat{k}m/s$ under the influence of a constant force $\vec{F} = 20\hat{i} + 15\hat{j} - 5\hat{k}N.$

The instantaneous power applied to the particle is

A. $35(J)/(s)$

B. $45(J)/(s)$

C. $25(J)/(s)$

D. $195(J)/(s)$

Answer: B

Watch Video Solution

71. The power of pump, which can pump 200 kg of water to height of 200 m in 10 s $(g = 10(m)/(s^2))$

A. 40 kW

B. 80 kW

C. 400 kW

D. 960 kW

Answer: A

Watch Video Solution

72. A pump can take out 7200 kg of water per hour from a well 100 m. deep. The power of pump, assuming its efficiency as 50% will be

A. 1 kW

B. 2 kW

C. 3 kW

D. 4 kW

Answer: D

Watch Video Solution

73. In a factory it is desired to lift 746 kg of metal through a distance of 60 m is 1 min. The minimum horsepower of the engine to be used will be

A. 5

B. 10

C. 15

D. 20

Answer: B

Watch Video Solution

74. The power of a water pump is 2 kW. If $g = 10m/s^2$, the amount of water it can raise in 1 min to a height of 10 m is :

A. 2000 L

B. 1000 L

C. 100 L

D. 1200 L

Answer: D

Watch Video Solution

75. A body of mass m , accelerates uniform from rest to v_1 in time t_1 . The instanencoes power delivered to the body as a finction of t is

A. $\frac{mv_0 t}{t_0}$

B. $\left(\frac{mv_0^2}{t_0}\right)t$

C. $\left(\frac{mv_0^2}{t_0}\right)$

D. $\left(\frac{mv_0^2}{t_0^2}\right)t$

Answer: D

Watch Video Solution

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

A. $\frac{MV^2}{T}$

B. $\frac{1}{2}\frac{MV^2}{T^2}$

C. $\frac{MV^2}{T^2}$

D. $\frac{1}{2}\frac{MV^2}{T}$

Answer: D

Watch Video Solution

77. A body is initially at rest. It undergoes one-dimensional motion with constant acceleration. The power delivered to it at time t is proportional to (i) $t^{1/2}$ (ii) t (iii) $t^{3/2}$ (iv) t^2

A. $t^{(1)/(2)}$

B. t

C. $t^{(3)/(2)}$

D. t^2

Answer: B

Watch Video Solution

78. A car of mass 1250 kg is moving at $30(m)/(s)$. Its engine delivers 30 kW while resistive force due to surface is 750 N. What maximum accelration can be given to the car

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

B. $\frac{1}{4}(m)/(s^2)$

C. $\frac{1}{5}(m)/(s^2)$

D. $\frac{1}{6}(m)/(s^2)$

Answer: C

Watch Video Solution

79. A car of mass m is driven with acceleration a along a straight level road against a constant external resistive force R. When the velocity of the car V, the rate at which the engine of the car is doing work will be

A. RV

B. maV

C. $(R + ma)V$

D. $(ma - R)V$

Answer: C

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80. Water falling from a $50m$ high fall is to be used for generating electric power. If $1.8 \times 10^5 kg$ of water falls per hour and half the gravitational potential energy can be converted inito electric energy, how many 100 watt lamps can be lit ?

A. 75

B. 100

C. 125

D. 150

Answer: C

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81. An unruly demonstrator lift a stone of mass m kg from the ground and throws it at this opponent. At the time of projection, the stone is at height h meter above the ground and has a speed of $v(m)/(s)$ what horse power does he use?

A. $\frac{1}{2}\frac{mv^2}{746}$

B. $\frac{mgh}{746}$

C. $\frac{\frac{1}{2}mv^2 + mgh}{746}$

D. $\frac{\frac{1}{2}mv^2 - mgh}{746}$

Answer: C

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82. A particle of mass m is thrown with speed u at an angle of projection θ with horizontal. The average power imparted by the gravitational force until it strikes the ground is

A. zero

B. $\frac{mgH_{\max}}{T}$

C. $\frac{mgH_{\max}}{2T}$

D. $\frac{2mgH_{\max}}{T}$

Answer: A

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83. A particle of mass m is given a velocity u on a rough horizontal surface of friction coefficient μ. The average power imparted by friction until it stops is

A. zero

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

C. μmgu

D. $2\mu mgu$

Answer: B

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84. A block of mas 2.0 kg is pulled up on a smooth incline of angle 30^0 with the horizontal. If the block moves wth an acceleration of $1.0\frac{m}{s^2}$, find the power delivered by the pulling force at a time 4.0 s after the motion starts. What is the average power delivered during the 4.0 s after the motion starts?

A. 12 W

B. 24 W

C. 36 W

D. 48 W

Answer: D

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85. A block of mas 2.0 kg is pulled up on a smooth incline of angle 30^0 with the horizontal. If the block moves wth an acceleration of $1.0\frac{m}{s^2}$, find the power delivered by the pulling force at a time 4.0 s after the motion starts. What is the average power delivered during the 4.0 s after the motion starts?

A. 12 W

B. 24 W

C. 36 W

D. 48 W

Answer: B

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

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

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

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

D. $\frac{Pt}{2m}$

Answer: A

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

A. $t^{(1)/(2)}$

B. $t^{(3)/(4)}$

C. $t^{(3)/(2)}$

D. t^2

Answer: C

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88. The potential energy of a particle in a force field is:

$U = \frac{A}{r^2} - \frac{B}{r}$,. Where A and B are positive constants and r is the distance of particle from the centre of the field. For stable equilibrium the distance of the particle is

A. $(B)/(2A)$

B. $(2A)/(B)$

C. $(A)/(B)$

D. $(B)/(A)$

Answer: B

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

$D = [U(r = \infty) - U_{\text{at equilibrium}}]$, D is

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

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

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

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

Answer: D

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

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

A. $\sqrt{2}$

B. $(1) / (\sqrt{2})$

C. 2

D. $(3) / (\sqrt{2})$

Answer: D

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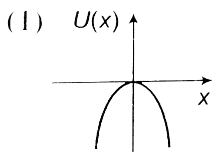
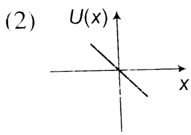
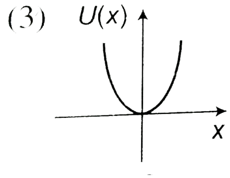
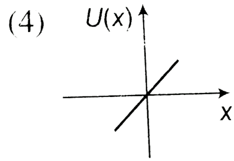
91. A particle is placed at the origin and a force F=Kx is acting on it (where k is a positive constant). If $U_{(0)}=0$, the graph of $U(x)$ verses x will be (where U is the potential energy function.)

A. 

B. 

C. 

D. 

Answer: A

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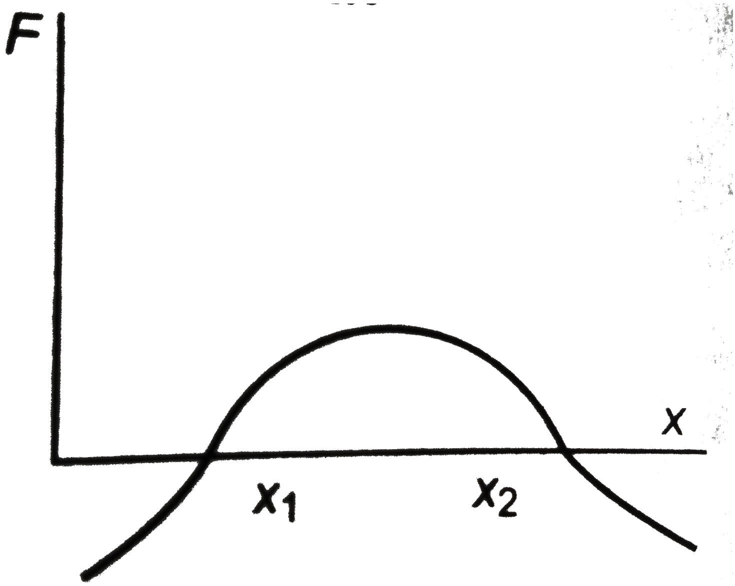
92. The force acting on a body moving along x-axis varitian of the particle particle shown in the figure. The body is in stable equlilbrium at



A. $x = x_1$

B. $x = x_2$

C. Both x_1 and x_2

D. Neither x_1 nor x_2

Answer: B

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