PHYSICS

BOOKS - MTG-WBJEE PHYSICS (HINGLISH)

WORK, POWER, ENERGY

Exercise Wb Jee Workout Category 1 Single Option Correct Type 1 Mark

1. A body of mass $3kg$ is under a constant force which causes a displacement s metre in it, given by the relation $s = \frac{1}{3}t^2$, where t is in seconds. Work done by the force in 2 seconds is

A. $\frac{8}{3}J$

B. $\frac{19}{5}J$

C. $\frac{5}{19}J$

D. $\frac{3}{8}J$

Answer: A

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2. A body of mass 4 kg is acted upon by a force. The position of body with respect to time is denoted by $x = \frac{t^4}{4}$. The work done by the force in first three seconds can be expressed in (J)

A. 1458

B. 729

C. 54

D. 27

Answer: A

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3. A heavy body and a light body have equal K.E. which one of them has greater momentum?

A. Light object

B. Heavy object

C. Both have same momentum

D. Data is not sufficient

Answer: B

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4. The potential energy $U = 3ax^3 - 2bx^2$. The force constant is represented by

A. 8b

B. 6b

C. 4b

D. 2b.

Answer: C

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5. Two particles have masses m and 4m and their kinetic energies are in the ratio 2 : 1. What is the ratio of their linear momenta?

A. $1/\sqrt{2}$

B. $1/2$

C. $1/4$

D. $1/16$

Answer: A

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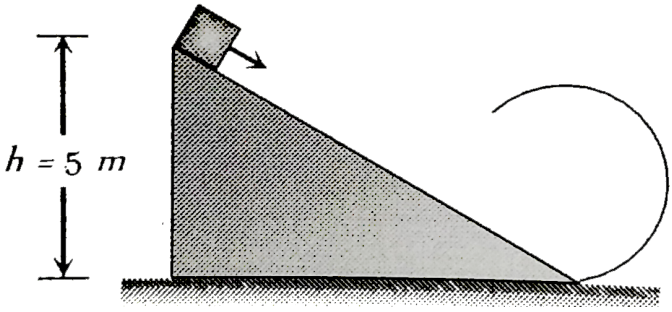
6. As per given figure to complete the circular loop what should be the radius if initial height

is 5 m



A. 4 m

B. 2 m

C. 2.5 m

D. 3m

Answer: B

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7. If kinetic energy of a body is increased by 300%, then percentage change in momentum will be

A. 1

B. 2

C. $\sqrt{300}\%$

D. 4

Answer: A

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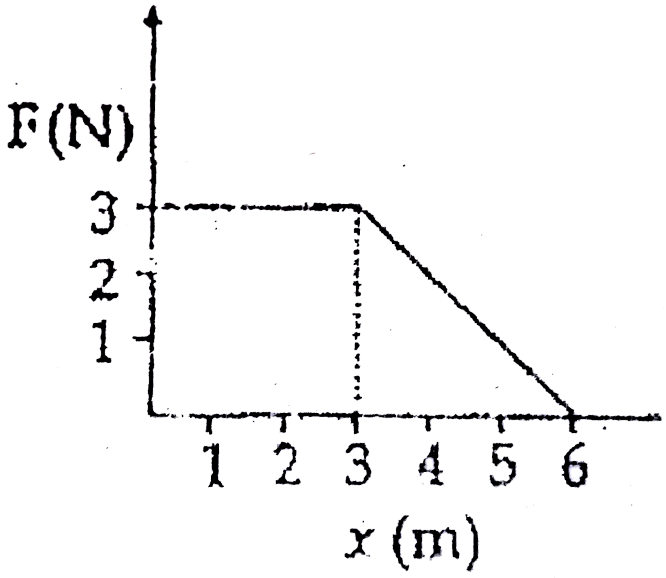
8. A force F acting on an object varies which distance x as shown in the figure. The force is in N and x in m. The work done by the force in moving the object from x = 0 to x = 6 m is



A. 18.0 J

B. 13.5 J

C. 9.0 J

D. 4.5 J

Answer: B

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9. mass of 0.5 kg moving with a speed of $1.5m/s$ on a horizontal smooth surface, collides with a nearly weightless spring of force constant k = 50 N/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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10. A force $F = Kx^2$ acts on a particle at an angle of 60° with the x–axis. the work done in displacing the particle from x_1 to x_2 will be –

A. $\frac{k}{6}(x_2^2 - x_1^2)$

B. $\frac{k}{6}(x_2^3 - x_1^3)$

C. $k(x_2 - x_1)$

D. $k(x_2^3 - x_1^3)$.

Answer: B

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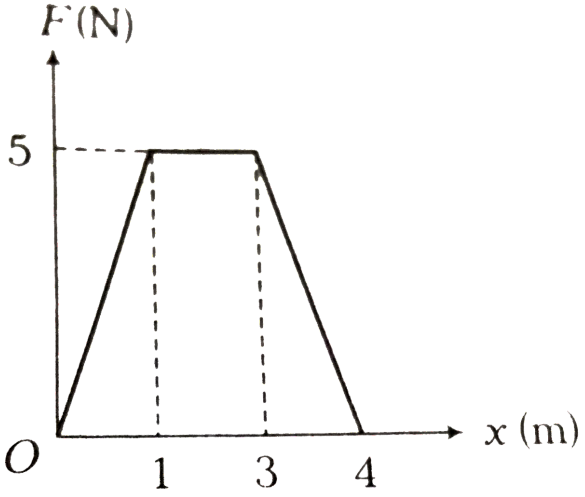
11. The force F acting on a particle is moving in a straight line as shown in figure. What is the work done by the force on the particle in the 4 m of the trajectory?



A. 5J

B. 10J

C. 15J

D. 2.5J

Answer: D

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12. The speed v reached by a car of mass m in travelling a distance x, driven with constant power P, is given by

A. $v = \frac{3xP}{m}$

B. $v = \left(\frac{3xP}{m}\right)^{1/2}$

C. $v = \left(\frac{3xP}{m}\right)^{1/3}$

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

Answer: C

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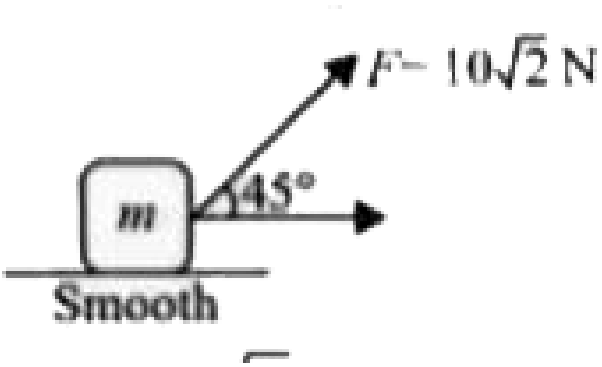
13. A block of mass 20 kg is moving on a smooth surface by pulling through a light string of tension $10\sqrt{2}$ N. Find the work done by string on the block for a displacement of 2

m along the surface.



A. 10J

B. $20\sqrt{2}$J

C. 20J

D. $10\sqrt{2}$J

Answer: C

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14. A ball of mass$2kg$ and another of mass $4kg$ are dropped together from a 60 feet tall building . After a fall of 30 feet each towards earth , their respective kinetic energies will be the ratio of

A. $\sqrt{2}:1$

B. $1:4$

C. $1:2$

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

Answer: C

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

A. $-2ka^2$

B. $2ka^2$

C. $-ka^2$

D. ka^2.

Answer: C

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16. A cubical vessel of height 1 m is full of water. What is the workdone in pumping water out of the vessel?

A. 1250 J

B. 5000 J

C. 1000 J

D. 2500 J

Answer: B

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17. 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

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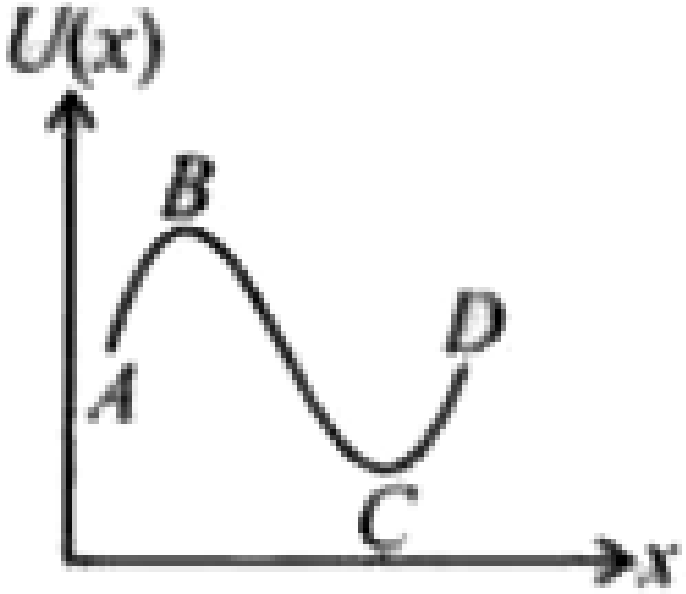
18. The potential energy of a particle varies with distance x as shown in the graph. The force acting on the particle is zero at



A. C

B. B

C. B and C

D. A and D

Answer: C

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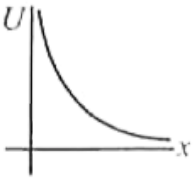
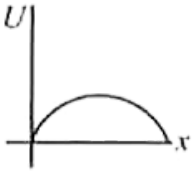
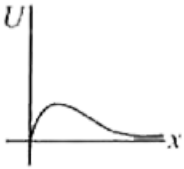
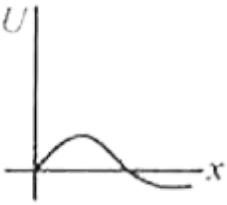
19. A particle which is constant to move along the $x - a\xi s$, is subjected to a force in the same direction which varies with the distance x of the particle from the origin as $F(x) = -Kx + ax^3$. Hero K and a are

positive constant . For $x \geq 0$, the fanctional from of the patential every `U(x) of the particle is

A. 

B. 

C. 

D. 

Answer: A

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20. When a spring is stretched by 10 cm, the potential energy stored is E. When the spring is stretched by 10 cm more, the potential energy stored in the spring becomes

A. $2E$

B. $4E$

C. $6E$

D. $10E$.

Answer: B

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21. A spring of constant 100 N/m is stretched by applying equal forces each of magnitude Fat the two ends. The energy stored in the spring is 200 J. Now spring is cut into two equal parts and one of the part is stretched by

applying equal forces each of magnitude F at the two ends. The energy stored is

A. 200 J

B. 100 J

C. 400 J

D. 50 J.

Answer: B

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22. Power supplied to a particle of mass 4 kg varies with time as $P = \frac{3t^2}{2}$ watt. Here t in second. If velocity of particle at t = 0 is v = 0, the velocity of particle at time t = 2s will be

A. $1ms^{-1}$

B. $4ms^{-1}$

C. $2ms^{-1}$

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

Answer: B

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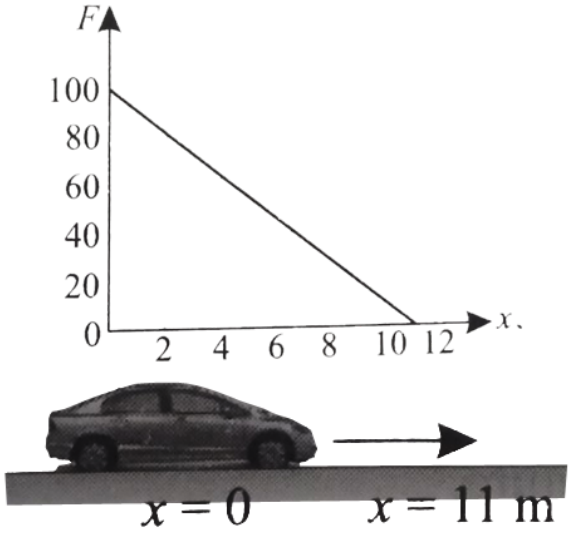

23.

A toy car of mass 5 kg moves up a ramp under the influence of force F plotted against displacement x. The maximum height attained is given by

A. 20 m

B. 15 m

C. 11 m

D. 5 m

Answer: C

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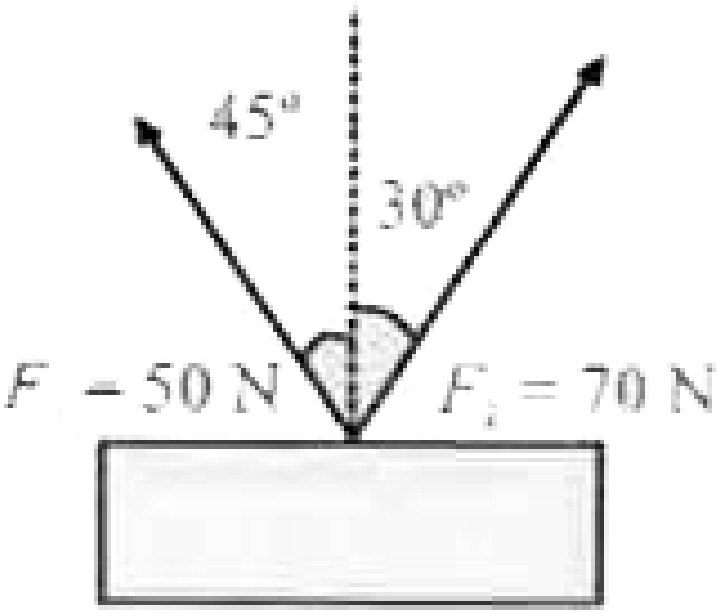
24. Figure shows the top view of two horizontal forces pulling a box along the floor. The work done by each force to displace the

box 70 cm along the broken line is :



A. 24.74 J, 42.4 J

B. 42.4 J, 20.75 J

C. 40J, 24.74 J

D. 42 J, 24 J.

Answer: A

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25. Two particles A and B of equal masses lie close together on a horizontal table and are connected by a light inextensible string of length l. A is projected vertically upwards with a velocity $\sqrt{10gl}$. Find the velocity with which it reaches the table again.

A. At lowest position, particle A has more speed than that of particle B

B. At lowest position, particle A has lesser speed than B

C. At the lowest position, both have same speed

D. None of the above

Answer: B

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26. A man throws the bricks to a height of 12 m where they reach with a speed of $12m/s$. If he throws the bricks such that they just reach that height, what percentage of energy will be saved? $(g = 9.8m/s^2)$

A. 0.29

B. 0.46

C. 0.38

D. 0.5

Answer: C

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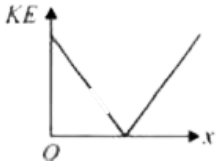
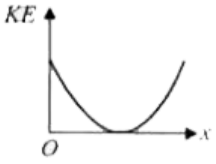
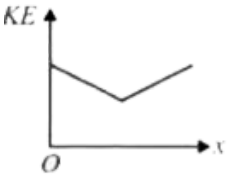
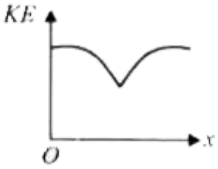
27. A ball is thrown up with a certain velocity at angle θ to the horizontal. The kinetic energy varies with height h of the particle as:

A. 

B. 

C. 

D. 

Answer: D

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28. 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.

A. $\frac{3mv^2}{4x^2}$

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

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

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

Answer: A

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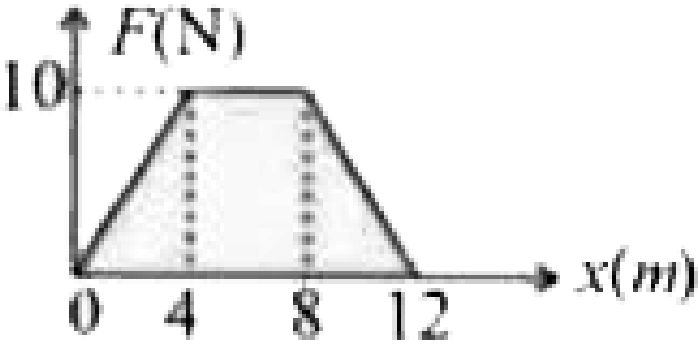
29. A particle of mass 0.1 kg is subjected to a force which varies with distance as shown in figure.



If it starts its journey from rest at x = 0, its velocity at $x = 12$ m is

A. zero

B. $20\sqrt{2}$m s^{-1}

C. $20\sqrt{3}$ m s^{-1}

D. $40ms^{-1}$

Answer: D

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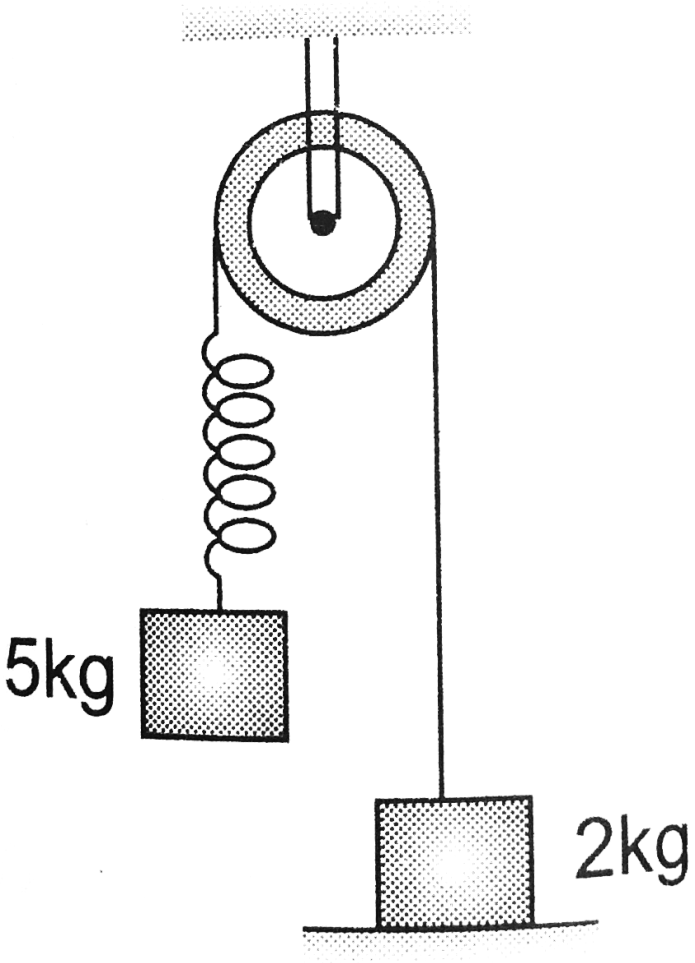
30. System shown in figure is released from rest . Pulley and spring is mass less and friction is absent everywhere. The speed of $5kg$ block when $2kg$ block leaves the constant of with ground is (force constant of spring

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



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

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

C. $2ms^{-1}$

D. $3\sqrt{2}ms^{-1}$

Answer: B

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Exercise Wb Jee Workout Category 2 Single Option Correct Type 2 Mark

1. A body of mass $6kg$ is under a force which causes displacement in it given by $S = \frac{t^2}{4}$

maters where t is time . The work done by the force in 2 sec is

A. $12J$

B. $9J$

C. $6J$

D. $3J$.

Answer: D

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2. 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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3. If the kinetic energy of a body changes by 20%, then its momentum would change by

A. 0.2

B. 0.24

C. 0.1

D. 44%.

Answer: C

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4. If r is the interatomic distance, a and b are positive constants, U denotes potential energy which is a function dependent on r as follows :

$$U = \frac{a}{r^{10}} - \frac{b}{r^5}.$$

The equilibrium distance between two atoms is

A. $\left(\frac{b}{2a}\right)^{1/5}$

B. $\left(\frac{2a}{b}\right)^{1/5}$

C. $\left(\frac{b}{2a}\right)^{\frac{1}{10}}$

D. $\left(\frac{2a}{b}\right)^{\frac{1}{10}}$.

Answer: B

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5. IF a particle of mass m is moving in a horizontal circle of radius r with a centripetal force $\left(-\frac{K}{r^2}\right)$, then its total energy is

A. $-\beta/2R$

B. $\beta \times 2R$

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

D. $\frac{2R}{\beta}$

Answer: A

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6. A particle of mass m moves along a circular path of radius r with a centripetal acceleration a_n changing with time t as $a_n = kt^2$, where k is a positive constant. The average power

developed by all the forces acting on the particle during the first t_0 seconds is

A. $\frac{mrk^4}{t_0^2}$

B. $\frac{mkrt_0^2}{2}$

C. $\frac{mrkt_0^2}{8}$

D. $mrk^4t_0^2\ )\ \frac{}{16}$

Answer: B

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7. If momentum is increased by 20%, then kinetic energy increases by

A. 0.48

B. 0.44

C. 0.4

D. 36%.

Answer: B

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8. An engine can pull four coaches at a maximum speed of $20ms^{-1}$. The mass of the engine is twice the mass of every coach. Assuming resistive forces to be proportional to the weight, approximate maximum speeds of the engine, when it pulls 12 and 6 coaches, are

A. 8.5 m s^{-1} and $15ms^{-1}$, respectively

B. 6.5 m s^{-1} and 8 m s^{-1}, respectively

C. 8.5 m s^{-1} and 13 m s^{-1}, respectively

D. 10.5 m s^{-1} and 15 m s^{-1}, respectively.

Answer: A

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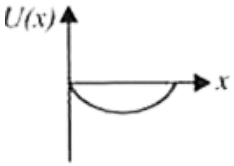
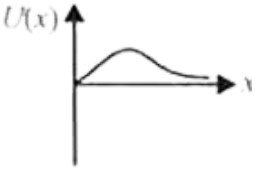
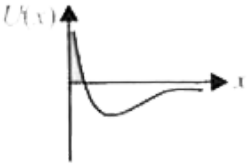
9. A particle which is constant to move along the $x - a\xi s$, is subjected to a force in the same direction which varies with the distance x of the particle from the origin as $F(x) = -Kx + ax^3$. Hero K and a are positive constant . For $x \geq 0$, the fanctional from of the patential every `U(x) of the particle is

A. 

B. 

C. 

D. 

Answer: D

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10. The displacement x of a particle at time t moving under a constant force is $t = \sqrt{x} + 3$, x in metres, t in seconds. Find the work done by the force in the interval from $t = 0$ to $t = 6$ second.

A. 8J

B. 4J

C. 0J

D. 6J

Answer: C

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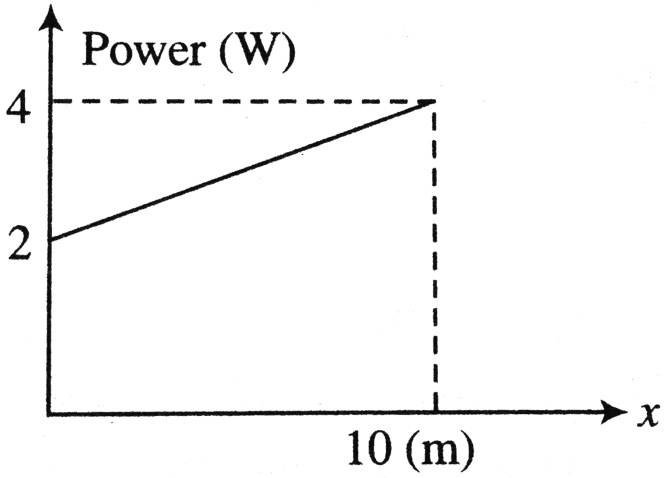
11. A particle A of mass $10/7kg$ is moving in the positive direction of $x - a\xi s$. At initial position $x = 0$, its velocity is $1ms^{-1}$, then its velocity at $x = 10m$ is (use the graph given)



A. $4ms^{-1}$

B. $2ms^{-1}$

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

D. $\frac{100}{3}ms^{-1}$.

Answer: A

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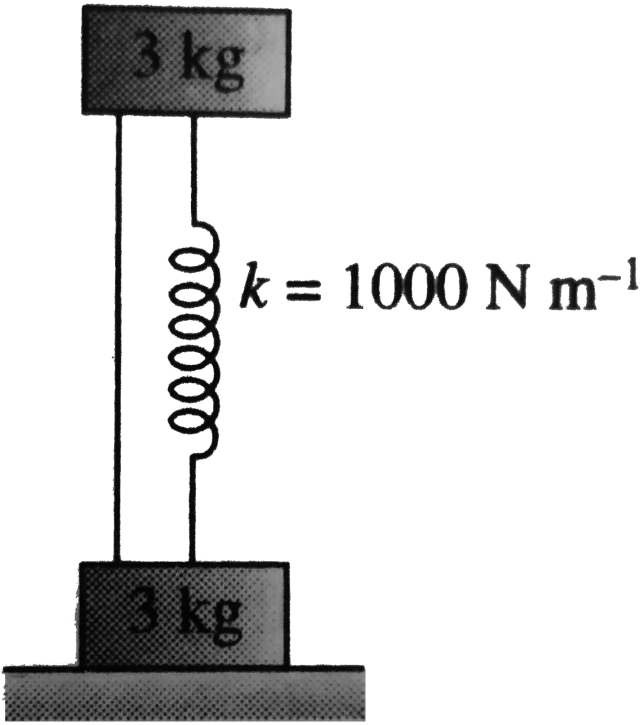
12. A system consists of two identical cubes, each of mass $3kg$, linked together by a compressed weightless spring of force

constant $1000Nm^{-1}$. The cubes are also connected by a thread which is burnt at a certain moment. At what minimum value of initial compression x_0 (in cm) of the spring will the lower cube bounce up after the thread is burnt together?



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

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

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

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

Answer: B

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13. 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: A

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14. A particle of mass m moves with a variable velocity v, which changes with distance covered x along a straight line as $v = k\sqrt{x}$, where k is a positive constant. The work done by all the forces acting on the particle, during the first t seconds is

A. $\frac{mk^4}{t^2}$

B. $\frac{mk^4t^2}{4}$

C. $\frac{mk^4t^2}{8}$

D. $\frac{mk^4t^2}{16}$

Answer: C

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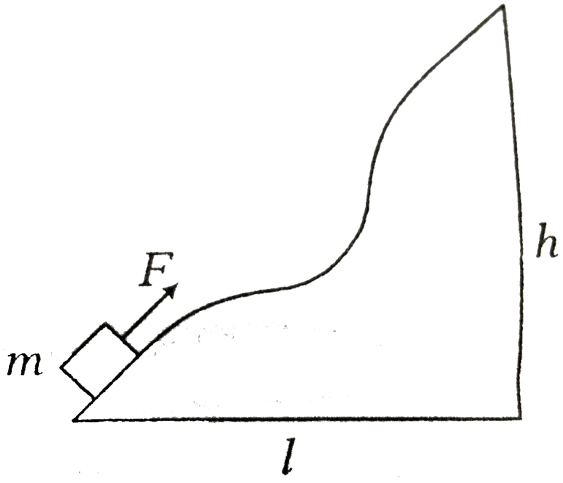
15. A body of mass m was slowly pulled up the hill by a force F which at each point was directed along the tangent of the trajectory. All surfaces aresmooth. Find the work

performed by this force.



A. mgl

B. $-mgl$

C. mgh

D. zero

Answer: C

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Exercise Wb Jee Workout Category 3 One Or More Than One Option Correct Type 2 Marks

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

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

B. $\vec{F} = \frac{3\left(x\hat{i} + y\hat{j}\right)}{\left(x^2 + y^2\right)^{3/2}}$

C. $\vec{F} = \frac{3\left(y\hat{i} + x\hat{j}\right)}{\left(x^2 + y^2\right)^{3/2}}$

D. none of these

Answer: A::B

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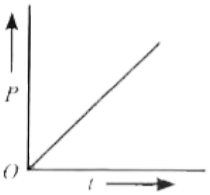
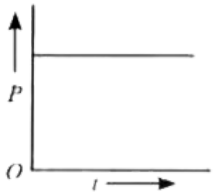
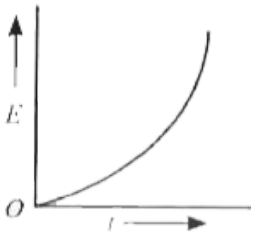
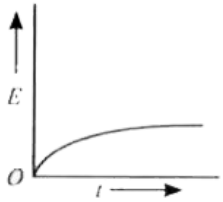
2. A vehicle is driven along a straight horizontal track by a motor which exerts a constant driving force. The vehicle starts from rest at $t = 0$ and the effects of friction and air resistance are negligible. If the kinetic eneryg of the vehicle at time t is E and power

developed by the motor is P, which of the following graphs are correct?

A. 

B. 

C. 

D. 

Answer: A::C

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3. A man of mass m is standing on a stationary flat car of mass M. The car can move without friction along horizontal rails. The man starts walking with velocity v relative to the car. Work done by him

A. is greater than $\frac{1}{2}mv^2$ if the walks along rails.

B. is less than $\frac{1}{2}mv^2$ if the walks along rails.

C. is equal to $\frac{1}{2}mv^2$ if he walks normal to rails.

D. can never be less than $\frac{1}{2}mv^2$.

Answer: B::C

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4. When a bullet is fired from a gun

A. The kinetic energy of the bullet is more than that of the gun.

B. The acceleration of the bullet is more than that of the gun.

C. The momentum of the bullet is more than that of gun.

D. The velocity of the bullet is more than that of the gun.

Answer: A::B::D

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5. A body of mass $1kg$ is taken from infinity to a point P. When the body reaches that point, it has a speed of $2ms^{-1}$. The work done by the conservative force is $-5J$. Which of the following is true (assuming non-conservative and pseudo-forces to be absent).

A. Work done by the applied force is +7 J.

B. The total energy possessed by the body at P is +5 J.

C. The potential energy possessed by the body at P is $+5$ J.

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

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

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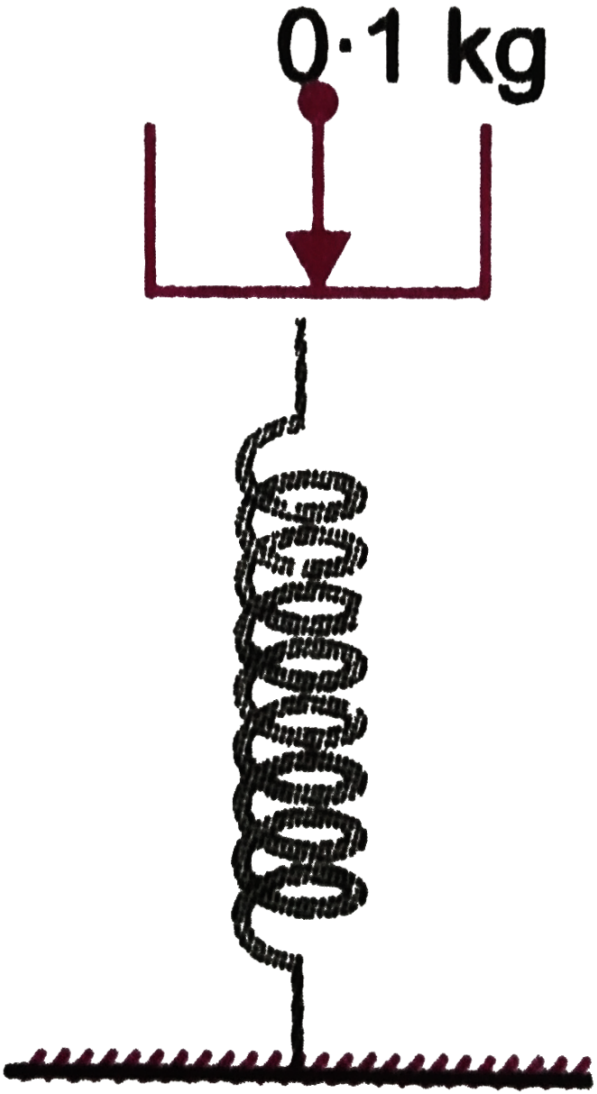
6. A massless platform is kept on a light elastic spring as shown in figure. When a small stone of mass 0.1 kg is dropped on the pan from a

height of 0.24 m, the spring compresses by 0.01m. From what height should the stone be droppped to cause a compression of 0.04m in

the spring ?



A. particle should be dropped from a height of 3.96m to cause a compression of 0.04 m.

B. Conservation of energy will be followed by the particle.

C. particle should be dropped from a height of 5.42m to cause a compression of 0.04 m.

D. None of these.

Answer: A::B

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

A. the particle has constant acceleration.

B. the particle has zero acceleration.

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

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

Answer: A::C::D

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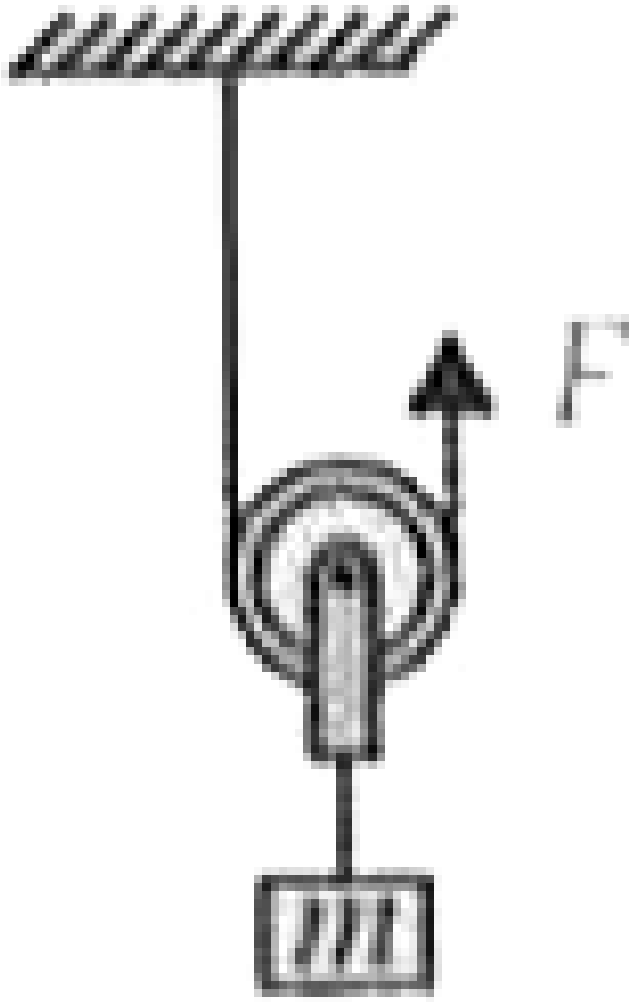
8. A block of mass 2 kg is hanging from a light, smooth pulley through a light string. The kinetic energy of block increased to 16 J in 2 s

by applying a constant force F on one end of upper string. Then



A. the force F may be 12 N

B. the force F may be 8 N

C. the potential energy of block may increase

D. the potential energy of the block may decrease.

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

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9. A particle of mass m (starting at rest) moves vertically upwards from the surface of earth under an external force $\vec{F}$ which varies with height z as $\vec{F} = (2 - \alpha z)m\vec{g}$ where α is a positive constant. If H is the maximum height to which particle rises. Then

A. $H = \dfrac{1}{\alpha}$

B. $H = \dfrac{2}{\alpha}$

C. Work done by $\vec{F}$ during motion upto $\dfrac{H}{2}$ is $\dfrac{3mg}{2\alpha}$

D. Velocity of particle at $\frac{H}{2}$ is $\sqrt{\frac{g}{\alpha}}$

Answer: B::C::D

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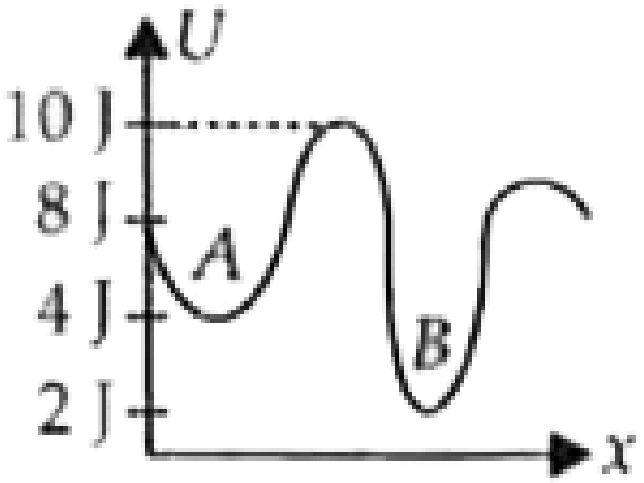
10. A particle moves along x-axis whose potential energy versus x-coordinate graph is shown in the given figure. At x = 0, the particle is released form rest. Two potential wells A

and B are shown in the figure. Then,



A. the particle will never reach the potential well B.

B. the particle will be trapped into the potential well A.

C. the maximum kinetic energy during motion of the particle is 4 J.

D. the maximum kinetic energy during motion of the particle is 6 J.

Answer: A::B::C

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Exercise Wb Jee Previous Years Questions Category 1 Single Option Correct Type 1 Mark

1. When a body is acted by a constant force, then which of the following quantities remains constant

A. Speed

B. Rate of change of acceleration

C. Kinetic energy

D. Rate of change of kinetic energy

Answer: D

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2. Work done for a certain spring when stretched through 1 mm is 10 joule. The amount of work that must be done on the spring to stretch it further by 1 mm is

A. 30J

B. 40J

C. 10J

D. 20J.

Answer: A

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3. A body is moved from rest along a staight line by a machine delivering constant power .Calcualte the velo0city and distance moved by the body as a funidion of time .

A. S = $at + bt^2$, a, b are constants

B. S = bt^2, b is a constant

C. S = $at^{3/2}$, a is constant

D. S = at, a is constant

Answer: C

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