PHYSICS

BOOKS - CHHAYA PHYSICS (BENGALI ENGLISH)

WORK AND ENERGY

Example

1. To displace body by 50m , 150J of work is done . What is the force applied in the direction of

the displacement ?

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2. A body of mass 10 kg is raised by 5m . What is the work done ?

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3. A cycle with the rider has a total mass of 80 kg, it rolls down 60 m on a plane of inclination

30° . What is the total work done by gravity on the cycle ?

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4. A man of mass 100 kg climbs up a ladder of length 10m. The ladder makes angle 60° with the horizontal . Find the work done by the man against gravity in climbing up the ladder . $[g = 9.8m \cdot s^{-2}]$.

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5. A body is constrained to move along the z-axis is subject to a constant force F = $\left(-\hat{i} + 2\hat{j} + 3\hat{k} \right) N$. Calculate the work done by this force in moving the body a distance of 4m along the z-axis .

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6. A force F acting on an object varies with distance x as shown here [Fig.1.10].

The force is in N and x in m. what is the amount

of work done by the force in moving the object from x=0, to x=6 m ?

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7. The relationship between the force F and the position x of a body is as shown is Fig.1.11 . What will be the amount of work done in displacing the body from x=1 m to x=5 m ?

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8. A position dependent force $f = \left(7 - 2x + 3x^2\right)$ N acts on a body of mass 2 kg and displaces it from x=0 to x=5 m. Determine the amount of work done in joule.

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9. A man of mass 50 kg clikmbs up 20 steps of a staircase in 5s . Each step is 30 cm high. Find the power applied by the man .

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10. Find the power applied by a man of mass 70 kg , carrying a load of 45 kg, moving up at 6.4 km per hour along a plane of inclination $\frac{1}{10}$.

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11. Water is lifted to a vertical height of 90 m using a 7.46 kW engine. If the efficiency of the engine is 80% , find the amount of water lifted in a minute.

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12. Calculate the kinetic energy of a bullet of mass 50 g moving with a velocity of $200m \cdot s^{-1}$.

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13. A ball is moving in air at $15m \cdot s^{-1}$. The ball is hit with a bat and it attains a velocity of $20m \cdot s^{-1}$ in the opposite direction . If its kinetic energy changes by 8.75 J , what is the change in its momentum ?

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14. A body of mass 10 kg falls from a height of 10 m. What will be its kinetic energy just before it touches the ground ?

Prove that, this kinetic energy is equal to the potential stored at the initial position of the body. $[g = 980cm \cdot s^{-2}]$

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15. A force F acts on a stationary body of mass m for a time t. Show that, the kinetic energy of the body iin that time $= \frac{F^2t^2}{2m}$.

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16. A body of mass m , starting from rest , moves with constant acceleration . After a time T it attains a velocity V. Show that the work done by the body in time $t = \frac{1}{2} m \frac{V^2}{T^2} \cdot t^2 \cdot$

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17. A body of mass 1 kg is thrown with a velocity of $250 cm \cdot s^{-1}$, from a height 8m above the

earth's surface . What will be its kinetic energy just before it touches the ground ?

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18. A body of mass 5g is moving in a straight line with a velocity of $10cm \cdot s^{-1}$. A force of $10\sqrt{2}$ dyn is applied on the body at an angle of 45° with the line of motion. What is the change in kinetic energy of the body in 1 st second ?

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19. A bullet of mass 50 g , moving a velocity of $200m \cdot s^{-1}$, strikes and penetrates a wooden block. If the resistance f the wooden block on the bullet is 4900 N, find the distance up to which the bullet penetrates the block.

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20. A bullet, of mass 50 g and of initial speed $400m \cdot s^{-1}$, penetrates a wall against an average force of 4×10^4N. it comes out with a speed of $50m \cdot s^{-1}$. What is the thickness of

the wall ?

Another bullet with a lesser mass, but with the same initial velocity , penetrates the wall but is unable to come out . what is the maximum possible mass of the second bullet ?

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21. A body of mass $0.03kg$, falling from a height of 20 m, penetrates 1.5 m into the soil. Find the average resistive force of the soil.

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22. After falling from a height of 200 m , water flows horizontally with a certain velocity . Ignoring any energy dissipation , find the velocity of flow.

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23. Mass of the bob of a simple pendulum is 10g and the effective length is 13 cm. The bob is pulled 5 cm away from the vertical and then released. What will be the kinetic energy of the bob when it passes through the lowest point?

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24. After a collision with an ideal spring , a body of mass 8g , moving with a constant velocity of $10cm \cdot s^{-1}$ comes to rest. Force constant of the spring is $200dyn \cdot cm^{-1}$. If the total kinetic energy of the body is spent in compressing the spring , find the compression.

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25. Effective length of a pendulum is 50 cm and the mass of the bob is 4g . The bob is drawn to one side until the string is horizontal , and is then released. When the string makes an angle 60° with the vertical , what is the velocity and the kinetic energy of the bob ?

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26. Mass of the bob of a pendulum is 100g and the length of the string is 1m . The bob is initially held is such a way that the string is

horizontal . The bob is then released. Find the kinetic energy of the bob when the string makes an angle of

(i) 0° with vertical

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27. Mass of the bob of a pendulum is 100g and the length of the string is 1m . The bob is initially held is such a way that the string is horizontal . The bob is then released. Find the kinetic energy of the bob when the string makes

an angle of

(ii) 30° with the vertical .

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28. A body of mass 1 kg falls to the ground from the roof of a building 20 m high. Find its

(i) initial potential energy,

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29. A body of mass 1 kg falls to the ground from the roof of a building 20 m high. Find its

(ii) velocity when it reaches the ground,

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30. A body of mass 1 kg falls to the ground from the roof of a building 20 m high. Find its

(iii) Maximum kinetic energy and

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31. A body of mass 1 kg falls to the ground from the roof of a building 20 m high. Find its

(iv) kinetic and potential energies at a position 2 m above the earth's surface.

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32. A pump lifts 200L of water per minute through a height of 5m , and ejects it through an orifice 2 cm in diameter. Find the velocity of efflux of water and the power of the pump.

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33. A body of mass 10 kg is raised to a height of 10 m with an upward force of 196 N . Find the work done by the upward force and the work done against gravitation. Show that the total energy in this case is equal ot the work done by the upward force .

$[g = 9.8m \cdot s^{-2}]$

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34. A body of mass 10 kg moving with a speed of $2.0m \cdot s^{-1}$ on a frictionless table strikes a

mounted spring and comes to rest. If the force constant of the spring be $4 \times 10^5 N \cdot m^{-1}$, then what will be the compression on the spring ?

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35. Fig.1.22 shows two blocks of masses $m_1 = 3kg$ and $m_2 = 5kg$, both moving towards right on a frictionless surface with speeds $u_1 = 10m \cdot s^{-1}$ and $u_2 = 4m \cdot s^{-1}$ respectively. To the back side of m_2 an ideal spring fo force constant $1000N \cdot m^{-1}$ is

attached. Calculate the maximum compression of the spring when the blocks collide ?

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36. A block weighing 250N is pulled over a horizontal plane at a constant velocity up to a distance of 10 m. The coefficient of kinetic friction is 0.2 and the force is applied by a string, attached with the block, inclined at 60° with the vertical . Find the work done against friction.

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37. A particle is sliding down along an inclined plane. Frictional force is 0.2 times the normal reaction , and the inclination of the plane is 60° . What is the acceleration of the particle ? If the mass of the particle is 1g , find the change in the sum of potential and kinetic energies of the particle as it slides down the plane by 1 m.

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38. A box of mass 12 kg pushed up by a distance of 10 m on application of a 100N force along a plane of inclination 30°. If the coefficient of friction is $\frac{1}{\sqrt{3}}$, find the work done against friction. $\left[g = 10m \cdot s^{s-2}\right]$

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39. A car of mass 1000 kg moves up at $40km \cdot h^{-1}$ along an inclined plane of slope $\frac{1}{50}$. Coefficient of rolling friction between the

road and the wheels of the car is 0.3. Find the power of the car engine.

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40. An engine, working at a constant rate, is pulling a train of mass 500 tonne along a plane of inclination $\sin^{-1}\left(\frac{1}{100}\right)$. If the frictional force per metric tonne is 49 N and the train is moving with a velocity of $10m \cdot s^{-1}$, what is the power of the engine in kilowatt ? [1 tonne (metric ton) =1000 kg]

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41. A loaded lorry of total mass 5000 kg can come down from the top of a slope (1:40) effortlessly at $18km \cdot h^{-1}$. What should be the horsepower of its engine so that it can go up with the same speed, from the base to the top ? Resistance due to friction may be taken to be the same in both cases.

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42. A car of mass 500 kg is moving up along an inclined surface of slope $\frac{1}{25}$ at a constant speed of $72km \cdot h^{-1}$. If the coefficient of friction between the road and the car wheel is 0.1 , find the power of the car engine $(g = 9.8m \cdot s^{-2})$.

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43. A 1.5 m long chain of mass 0.8 kg is kept on a horizontal table and a part of its length hangs from the edge of the table. When the length of

the hanging part is one- third the total length of the chain, it starts sliding off the table. What will be the work done by friction when the whole length of the chain slides off the table ?

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44. A body of mass 10 kg is pushed up 50 cm from the ground , along a plane inclined at 45° to the horizontal. If coefficient of friction is 0.2 , then calculate the work done.

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45. By application of a force F , a body of mass m is raised to the top of a hill .F is tangential along the whole path. If the height of the hill is h, the length of the base of the hill is l , and the coefficient of friction is μ , then find the work done.

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46. A body of mass 1 kg is tied with a thread and is whirled in a vertical circal of radius 50 cm with a speed of $500cm \cdot s^{-1}$. What will be the

tension in the thread at the highest and the lowest positions of the body ?

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47. A particle of mass 100 g is suspended from the end of a weightless string of length 100 cm and is rotated in a vertical plane. The speed of the particle is $200cm \cdot s^{-1}$ when the string makes an angle of $\theta = 60^{\circ}$ with the verctcal. Determine

(i) the tension in the string when $\theta = 60^{\circ}$ and

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48. A particle of mass 100 g is suspended from the end of a weightless string of length 100 cm and is rotated in a vertical plane. The speed of the particle is $200cm \cdot s^{-1}$ when the string makes an angle of $\theta = 60^{\circ}$ with the verctcal. Determine

(ii) the speed of the particle at the lowest position . Acceleration due to gravity = $980cm \cdot s^{-2}$.

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49. A body slides down an inclined plane after being released from rest from a height h and finally it describes a circle of radius r instead of travelling along a horizontal floor. For what minimum value of h , can the particle describe that motion ? Ignore friction.

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50. A body starts falling from the top of a smooth sphere of radius r. What angle does the body subtend at the centre of the sphere when

it just loses contact with the sphere and what will be its velocity then ?

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51. Two particles of equal mass moving towards each other with velocities $20m \cdot s^{-1}$ and $30m \cdot s^{-1}$ collide. If the collision is elastic, find their velocities after the collision.

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52. Three balls A,B,C of masses m_1, m_2 and m_3 respectively are kept at rest along a straight line.

Now A moving in that straight line with velocity u_1 strikes C. As a rsult velocity of C becomes u_3. If the collisions are elastic , show that $u_3 = 4u_1$ when $m_1 > > m_2$ and $m_2 > > m_3$. In case A hits C directly will the velocity of C be higher or lower ?

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53. Two bodies of masses 5 kg and 10 kg move towards each other with velocities $10m \cdot s^{-1}$ and $14m \cdot s^{-1}$ respectively. If the coefficient of restitution is 0.8, find their velocities after the collision.

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54. Two bodies of masses 1 kg and 0.5 kg move towards each other with velocities $10cm \cdot s^{-1}$ and $5cm \cdot s^{-1}$ respectively . After collision, the bodies coalesce (join together).

Find the common velocity after collision and the loss in kinetic energy.

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55. A car of mass 2000 kg collides with a truck of mass $10^4 kg$ moving at $48 km \cdot h^{-1}$. After collision, the car rides up the truck and the truck-car combination moves at $15 km \cdot h^{-1}$. What was the velocity of the car before collision ?

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56. A ball of mass 100 g was thrown vertically upwards with a velocity of $49m \cdot s^{-1}$. At the same time another identical ball was dropped, to fall along the same path from a height of 98 m. After some time, the two balls collided and got stuck together. This combined mass then fell to the ground. How long was the combined mass in motion?

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57. A bullet of mass 50 g is fired into a wooden block of mass 2 kg resting on a smooth table surface. The bullet entres at $50m \cdot s^{-1}$ and gets embedded in the block. Find the final velocity of the block. Find the initial and the final kinetic energy of the block -bullet system.

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58. A bullet of mass 250g , moving with a horizontal velocity of $400m \cdot s^{-1}$, gets embedded in a target. The target of mass 4.75

kg can move freely. Find the loss of kinetic energy due to this collision. What happens to this energy loss ?

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59. Two particles of masses m_1 and m_2 moving with velocities u_1 and u_2 , respectively and making an angle θ between them, collide with each other. After collision, the 1st particle travels in the initial direction of motion of the 2nd, and vice-verses. Find the velocities of the

two particles after collision. Under what condition, would this collision be elastic ?

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60. A bomb explodes and splits up into three fragments.

Two fragments, each of mass 200g, move away from each other making an angle 120° , at a speed of $100m \cdot s^{-1}$. Find the direction and velocity of the third fragment whose mass is 500 g. Also find out the energy released in explosion.

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61. A spaceship while flyting in space, splits up into three equal parts, due to an explosion. One fragment keeps moving in the same direction, the other two fly of at 60° to the original direction , on either side. If the energy released due to the explosion is twice the kinetic energy of the spaceship, find the kinetic energy of each of the fragment.

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62. A glass ball is dropped from a height of 15 m onto a horizontal glass plate at rest. Find the upward rise of the ball after impect. The coefficient of restitution e=0.8.

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63. A ball is dropped from a height of 90m onto a horizontal plane rest. Find the total distance travelled by it before coming to rest. The coefficient of restitution e=0.5.

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64. A ball is dropped from a height of 1m onto a horizontal plane. The ball takes 1.3 s from its time of release for the second impact with the plane. Find the coefficient of restitution.

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65. A bullet of mass m hits a wooden block of mass M, suspended by a string of length l, and gets embedded in it. If the velocity of the bullet is v, find the angular displacement of the block.

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66. A boy of mass m_1 , standing on a smooth horizontal surface, throws a sphere of mass m_2 parallel to the surface. After a time t, if the separation between them becomes x, then show that the work done by the boy in throwing the sphere

$$= \frac{1}{2}\left(\frac{x}{t}\right)^2\left(\frac{m_1 m_2}{m_1 + m_2}\right)$$

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67. Two blocks m_1 and m_2 of masses 2kg and 5kg, respectively, are moving on a smooth plane along a straight line in the same direction, with velocities $10m \cdot s^{-1}$ and $3m \cdot s^{-1}$ respectively. The block m_2 is situated ahead of the block m_1. An ideal spring $\left(k = 1120N \cdot m^{-1}\right)$ is attached to the back of the block m_2. Find the compression of the spring when m_1 collides with m_2.

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68. A ball moving at $9m \cdot s^{-1}$, collides with an identical ball at rest. After collision, both the balls scatter at 30° with the initial direction of motion. Find the velocity of each ball after collision. Does the kinetic energy remain conserved in such a collision ?

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69. Two identical blocks A and B, each of mass m, are connected to each other with a spring of length L [Fig.1.51].

Force constant of the spring is k. The system is kept on a horizontal table. An identical third block C moving with a velocity v along the line AB collides with A elastically .

(i) What is the kinetic energy of the system A-B in the most compressed state ?

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70. Two identical blocks A and B, each of mass m, are connected to each other with a spring of length L [Fig.1.51].

Force constant of the spring is k. The system is kept on a horizontal table. An identical third block C moving with a velocity v along the line AB collides with A elastically .

(ii) What is the maximum compression of the spring ?

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71. A mass 2m is at rest and another mass m is moving with a velocity. An elastic collision takes place between them. Show that the mass m

loses $\frac{8}{9}$ part of its initial kinetic energy in this collision.

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72. Two flat disca A and B are kept on a smooth horizontal table. The disc A moves with a velocity u and makes a perfectly elastic collision with B. if the mass of A is k times the mass of B, using conservation laws, find the fraction of kinetic energy of A transferred from A to B .Also prove that if the mass of B was k times the mass

of A , the fraction of kinetic energy transferred would have been the same.

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73. A small ball A travels in a vertical plane along a quarter of a circular path of radius 10 cm , as shown in Fig.1.52,

and hits another ball B of the same mass at rest. Considering the collision to be elastic, and neglecting frictional force, find the velocity of each ball after the collision.

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74. A fire brigade pump draws water from a reservoir 2m below the ground. It hurls the stream of water at 50 kg per second . This water stream strikes the top of a 8 m high wall, at a speed of $5m \cdot s^{-1}$. Determine the power of the pump.

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75. A vetical spring fixed at its upper end can be elongated by 2 cm under the action of a stretching force of (80g) g. A body of mass 600g is attached to its free end , and then the system is displaced from its equilibrium position by 8 cm . Find the energy of the system at this position. The mass is then released. if the energy is conserved , find the velocity of the body 4 cm away from its equilibrium position $[g = 1000cm \cdot S^{-2}]$

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76. A conveyor belt, run by a motor, is moving at a constant speed of $5m \cdot s^{-1}$. If 5 kg of sand is sprinkled per second on the belt, then what extra power should the motor supply to the belt?

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77. A pump can raise 100 L of water per minute to a height of 10 m . What should be the power of the pump ?

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78. A conservative force acting on a particle is $F = -Ax + Bx^2$ where A and B are constants and x is in m. Find the potential energy associated with the force ?

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Section Related Questions

1. Define work.

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2. State the conditions under which the work done by a force is positive or negative.

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3. What is understood by no-work force ?

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4. How is work done measured ?

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5. Name the units of work in CGS and in SI. Define each unit.

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6. Work out the relationship between erg end joule.

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7. Define 'power'

8. What is meant by the statement -Power of an engine is 10 hp ?

9. What are the units of power in CGS system and in SI ?

10. Define horsepower , or, what is meant by horsepower ?

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11. Establish the relationship between horsepower and watt .

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12. Define watt.

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13. What is meant by 'transformation of energy ?

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14. What is meant by the law of conservation of energy ?

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15. What is mechanical energy ?

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16. Write about the different forms fo mechanical energy .

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17. What is kinetic energy ?

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18. Find the expression for the kinetic energy of an object of mass m, moving with velocity v.

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19. Show that the work done by a varible force is equal to the change in kinetic energy of an object.

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20. Can a body have negative value of potential energy and kinetic energy ?

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21. What is elastic potential energy ?

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22. The work done by any conservation force is reversible -explain.

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23. The work done by any non-conservative force is not reversible-explain.

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24. What do you mean by the efficiency of a machine ?

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Higher Order Thinking Skill Hots Questions

1. A car is moving with a uniform velocity along a horizontal road. Does the engne of car do any work in this instance ?

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2. Earth revolves round the sun (say in a circular path under the action of the force exerted by the sun on the earth. Is the sun doing any work ? Explain .

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3. A man is swimming against current such that his position with respect to the river bank remains unaltered. Is the man doing any work ?

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4. When a weightlifter remains stationary with a weight lifted over his head, how much work does he do ?

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5. A bullet is fired from a rifle. The rifle is free to recoil. Compare the kinetic energy of the rifle with that of the bullet .

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6. If a car is driven along a straight path by an engine of constant power , find the displacement -time relation.

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7. A car and a lorry are moving with the same kinetic energy. Both are brought to rest with the same opposing force applied through brakes. Which one will stop within a less distance ?

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8. Momentum of a lighter and a heavier mass are equal . Which one of them has a greater kinetic energy ?

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9. Kinetic energy of a lighter body is equal to that of a heavier body. Which one of them has a greater momentum ?

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10. A body has mechanical energy but no momentum, or has momentum but no mechanical energy -is it possible ?

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11. A man with a bucket of water in his hand is standing inside a lift moving upwards. Write

(i) whether the man does any work on the bucket of water

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12. A man with a bucket of water in his hand is standing inside a lift moving upwards. Write

(ii) whether the energy of the bucket remains unchanged.

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13. One gets less hurt when one jumps from a height on sand than on hand floor. Why ?

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14. Does work done against gravity depend on the speed of lifting a body ? Explain .

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15. Inside a compartment of a train running with a uniform velocity , a boy throws a ball. Does the kinetic energy of the ball depend on the velocity of the train ?

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16. To reach the same height , why is it easier to follow a path of lower inclination ?

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17. Show that for a simple pendulum, the work done by the tension of the string becomes zero during its oscillation.

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18. Prove that,a freely falling body of mass m loses its potential energy by $\frac{1}{2}mg^2(2t-1)$ during its fall in the t th second.

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19. Gravitational force is a conservative force, but frictional force is non-conservative Why ?

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20. Can kinetic energy of a body be negative ?

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21. Momentum of a body is increased by 100 % . What is the percentage increase in its kinetic

energy ?

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22. An electron and a proton are detected in a cosmic ray experiment . Both of them have kinetic energy 100 keV. Which one is faster ?

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23. Is air resistance a conservative force ?

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24. A box is lifted vertically by 6m in 3 s.

(i) If the box is lifted to the same height in a zig-zag way what would be the change in the work done ?

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25. A box is lifted vertically by 6m in 3 s.

(ii) if the box is lifted in 5 s instead of in 3 s , what would be the change in the work done ?

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26. A hydrogen -gas -filled balloon of mass m can rise to a maximum height h above the earth's surface .On the earth's surface, potential energy of the balloon=

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27. What is the percentage increase in the momentum of a body when its kinetic energy inreases by 69 % ?

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28. A particle of mass m, moving with a constant acceleration , acquires a velocity v_0 in time t_0 . Initially the particle was at rest. Find the average power and the instaneous power of the applied force.

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29. Is it possible to increase the kinetic energy of a body without applying an external force ?

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30. Height of the vertex of an inclined plane is h . From the vertex , a body is released along the inclined plane . Explain whether the kinetic energy of the body at the base of the inclined plane depends on the inclination.

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31. A body tied to a thread is made to revolve in a horizontal plane with a definite velocity and

the thread does not snap. But when the body is made to revolve in a vertical plane, the thread snaps. How is it possible ?

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32. Two bodies of different masses have the same momentum. Compare their kinetic energies.

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33. Unbalanced system of forces can produce acceleration as well as deformation in a body, but balanced system of forces produces deformation only explain.

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34. What are the characteristics of an elastic collision between two bodies ?

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35. Two protons are drawn near each other . Will the potential energy of the system increases or decrease ? What will happen if a proton and an electron are drawn near each other ?

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36. What is the condition for the collision of two bodies to be one-dimensional ?

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37. A shot is fired from a gun. What will be the changes in momentum and kinetic energy ?

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38. A molecule in a gas container hits a horizontal wall with a speed of $200m \cdot s^{-1}$ at an angle of 30° with the normal and rebounds with the same speed . Is momentum conserved in the collision ? Is the collision elastic or inelastic ?

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Exercise Multiple Choice Questions

1. A constant force $\vec{A} = -\hat{i} + 2\hat{j} + 3\hat{k}N$ acts on a body, and shifts it 4 m along z-axis and then 3m along y-axis.

Work done by $\vec{F}$ will be

A. 6J

B. 12J

C. 18 J

D. 24 J

Answer: C

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2. A force acts on a particle of mass 3kg, such that the position of the particle changes with time as per the equation $x = 3t - 4t^2 + t^3$. If we express x in m and t in s , work done in 4s will be

A. 570 mJ

B. 450 mj

C. 490 J

D. 576 J

Answer: D

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3. A chain is on a smooth horizontal table with $\frac{1}{3}$ of its length hanging off the edge. If mass and length of the chain are M and l respectively

, work done to pull up the hanging part of the chain will be [g= acceleration due to gravity]

A. Mgl

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

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

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

Answer: D

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4. As an object revolves in a circular path of radius r, a force F is acting on it such that its direction is perpendicular to that of he instantaneous velocity v of the object. Work done by the force in one complete revolution is

A. $F \cdot v$

B. $F \cdot r$

C. $F \cdot 2\pi r$

D. 0

Answer: D

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5. A particle moving on xy-plane is acted upon by a force $\vec{F} = -K\left(y\hat{i} + x\hat{j}\right)$ where K is a constant . Starting from the origin , the particle si brought to the point (a,0) along the positive x-axis and then to the point (a,a) parallel to y-axis. Work done by the force on the particle will be

A. $-2Ka^2$

B. $2Ka^2$

C. $-Ka^2$

D. Ka^2

Answer: C

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6. A force is acting on a mass of 6kg. Displacement x of the mass is related with time t as $x = \frac{t^2}{4}$m. work done by the force in 2 s is

A. 12J

B. 9J

C. 6J

D. 3J

Answer: D

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7. Work done by a force $\vec{F} = \left(\hat{i} + 2\hat{j} + 3\hat{k}\right)$N acting on a particle in displacing it from the point $\vec{r}_2 = \hat{i} - \hat{j} + 2\hat{k}$ to the point $\vec{r}_1 = \hat{i} + \hat{j} + \hat{k}$ is

A. $-3J$

B. $1J$

C. zero

D. $2J$

Answer: B

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8. A mass M is lowered with the help of a string by a distance x at a constant acceleration $\frac{g}{2}$.

The magnitude of work done by the string will be

A. Mgx

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

C. $\frac{1}{2}Mgx$

D. Mgx^2

Answer: C

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9. Force acting on a particle is $\left(2\hat{i}+3\hat{j}\right)$ N. Work done by this force is zero ,when a particle is moved on the line $3y+kx=5$. Here value of k is

A. 2

B. 4

C. 6

D. 8

Answer: A

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10. A particle of mass m accelerating uniformly has velocity v at time t_1 . What is work done in time t?

A. $\frac{1}{2}\frac{mv^2}{t_1^2}t^2$

B. $\frac{1}{2}\left(\frac{m}{t_1}\right)^2 t^2$

C. $\frac{mv^2}{t_1^2}t^2$

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

Answer: A

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11. A mass of 2kg falls from a height of 40 cm on a spring with a force constant of 1960 N/m. The spring is compressed by (take $g = 9.8m / s^2$)

A. 10 cm

B. 1.0 cm

C. 20 cm

D. 5 cm

Answer: A

Watch Video Solution

12. A gardener pushes a lawn roller through a distance 20m. If he applies a force of 20 kg -wt in a direction inclined at 60° to the ground , the work done by him is

A. 1960 J

B. 196 J

C. 1.96 J

D. 196 KJ

Answer: A

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13. Power required to raise a mass of 120 kg vertically upwards at a velocity of $4.5m \cdot s^{-1}$is

A. 5 kW

B. 5.3 kW

C. 8kW

D. 11.2 kW

Answer: B

Watch Video Solution

14. A machine, applying a constant power is driving an object along a straight line. Displacement of the object in time t is

A. directly proportional to $\sqrt{t}$

B. directly proportional to $4\sqrt{t^3}$

C. directly proportional to $\sqrt{t^3}$

D. directly proportional to t^2

Answer: C

Watch Video Solution

15. A windmill generates electrical energy. Suppose, the windmill converts a fixed part of the wind energy linked with the blades, to electrical energy . If the wind velocity is v, the output electric power is directly proportional to

A. v

B. v^2

C. v^3

D. v^4

Answer: C

Watch Video Solution

16. A particle moves with a velocity $5\hat{i} - 3\hat{j} + 6\hat{k}m/s$ under the influence of a constant force, $\vec{F} = 10\hat{i} + 20\hat{k}N$. The instantaneous power applied to the particle is

A. 200 J/s

B. 40J/s

C. 140 J/s

D. 170 J/s

Answer: D

Watch Video Solution

17. A quater horse power motor runs at a speed of 600 rpm. Assuming 40% efficiency, the work done by the motor in one rotation will be

A. 7.46 J

B. 7400 J

C. 7.46 erg

D. 74.6 J

Answer: A

Watch Video Solution

18. Energy of a body thrown upward is

A. maximum at the highest point

B. minimum at the highest point

C. same at all points

D. can be maximum at any point

Answer: C

View Text Solution

19. A particle is moving in a straight line such that its retardation is directly proportional to its displacement . Decrease in the kinetic energy of the body is directly proportional to

A. x^2

B. e^x

C. x

D. $\log_e x$

Answer: A

Watch Video Solution

20. Starting from rest a car moves on a plane. The coefficient of friction (μ) between the tyres and the plane increases linearly with the distance (x) . Kinetic energy (K) of the car depends on x as

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

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

C. $K \propto x$

D. $K \propto x^2$

Answer: D

Watch Video Solution

21. A particle falls from rest under the action of gravity . Variation of kinetic energy (KE) and potential energy (PE) of the particle , with time t is represented by the graph

A. 

B. 

C. 

D. 

Answer: B

View Text Solution

22. A long spring is stretched by 2 cm. its potential energy is U . If the spring is stretched by 10 cm , its potential energy would be

A. $\frac{U}{25}$

B. $\frac{U}{5}$

C. 5U

D. 25U

Answer: D

Watch Video Solution

23. In which of the following cases the potential energy is defined

A. both conservative and non-conservative forces

B. conservative force only

C. non-conservative force only

D. neither conservative nor non-conservative forces

Answer: B

View Text Solution

24. A body of mass m thrown vertically upwards attains a maximum height h. At what height will its kinetic energy be 75% of its initial value?

A. $\frac{h}{6}$

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

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

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

Answer: C

Watch Video Solution

25. For a moving particle (mass m, velocity v) having a momentum p, which one of the followings correctly describes the kinetic energy of the particle ?

A. $\frac{p^2}{2m}$

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

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

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

Answer: A

Watch Video Solution

26. The potential energy of a system increases if work is done

A. by the system against a conservative force

B. by the system against a non-conservative force

C. upon the system by a non-conservative force

D. upon the system by a non-conservative force

Answer: A

View Text Solution

27. Two bodies of masses 4 kg and 5kg are moving with equal momentum. Then , the ratio of their respective kinetic energies is

A. $4:5$

B. $2:1$

C. $1:3$

D. $5:4$

Answer: D

 Watch Video Solution

28. A particle of mass m at rest in acted upon by a force P for a time t. its kinetic energy after an interval t is

A. $\frac{P^2t^2}{m}$

B. $\frac{P^2t^2}{2m}$

C. $\frac{P^2t^2}{3m}$

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

Answer: B

29. If the linear momentum of a body is increased by 50% , then the kinetic energy of that body increases by

A. 1

B. 1.25

C. 2.25

D. 0.25

Answer: C

Watch Video Solution

30. one end of a thead of length h has a stone tied to it . Taking the other end as the centre, it is revolved in a vertical plane. When the stone reaches the lowest point of its path, it attains the speed u. when the thread is horizontal ,the speed of the stone is

A. $\sqrt{u^2 - 2gh}$

B. $\sqrt{2gh}$

C. $\sqrt{u^2 - gh}$

D. $2\sqrt{u^2 - gh}$

Answer: A

View Text Solution

31. Along the surface of a hemispherical container, a small ball is pushed down from a height h, such that the ball rises up to the

opposite edge. If the height of the container is R , the ball must be pushed with a velocity

A. $\sqrt{2hg}$

B. $\sqrt{2gR}$

C. $\sqrt{2g(R+h)}$

D. $\sqrt{2g(R-h)}$

Answer: D

View Text Solution

32. A bucket full of water is rotated in a vertical circle of radius r. if the water does not spill out , the minimum speed of the bucket at top most point will be

A. $\sqrt{rg}$

B. $\sqrt{5rg}$

C. $\sqrt{2rg}$

D. $\sqrt{r/g}$

Answer: A

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33. A ball with a momentum p falls on a floor vertically and bounces a number of times . If the coefficient of restitution is e, momentum transferred to the floor is

A. p(1+e)

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

C. $p\left(1+\frac{1}{e}\right)$

D. $p\left(\frac{1+e}{1-e}\right)$

Answer: D

View Text Solution

Exercise Very Short Answer Type Questions

1. A force is acting on a body in motion, but is not doing any work. Give an example of such a force.

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2. Is work a vector or a scalar quantity ?

Watch Video Solution

Watch Video Solution

3. What is the amount of work done by a force when the body moves in a circular path ?

Watch Video Solution

4. In a tug -of -war game, which of the teams does effective work ?

Watch Video Solution

5. A person is carrying a bucket of water, and is in a lift moving up with uniform velocity . Is the person doing any work on the bucket of water ? Will the energy of the bucket and water remain constant ?

View Text Solution

6. A motor drives a belt at a constant velocity of $vm \cdot s^{-1}$. If m kg of sand fall on the belt per second ,what is the rate of work done by the force exerted by the belt on the sand ?

Watch Video Solution

7. A boy tried to lift a bucketful of water , but failed. What is the work done by him ?

Watch Video Solution

8. What is the work done by the tension in the string during the oscillation of a simple pendulum ?

Watch Video Solution

9. A box was lifted vertically through a height of 6m in 3s . If the box would have been lifted in a zig-zag way in 5 s ,work done would have been same. Is the statement true or false ?

Watch Video Solution

10. $1kg \cdot m = \ldots\ldots\ldots\ldots J.$ [Fill in the blank]

Watch Video Solution

11. A force $\vec{F} = \left(5\hat{i} + 3\hat{j} + 2\hat{k}\right)N$ acts on a particle , and the particle moves from the origin to a point $\vec{r} = \left(2\hat{i} - \hat{j}\right)$m.

what will be the work done on the particle ?

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12. How many jouls are in 1 MeV ?

Watch Video Solution

13. What is the unit of energy ?

Watch Video Solution

14. Does the kinetic energy of a ball, thrown inside a moving train, depend on the speed of the train ?

View Text Solution

15. Which type of energy is lost in doing work against friction ?

Watch Video Solution

16. A small car and a lorry are moving with the same kinetic energy . Brakes are applied to produce the same force against the motion. Which one will cover a greater distance before stopping ?

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17. When a body falls on the ground from a height ,it becomes slightly warm-why ?

Watch Video Solution

18. Is the resistance due to air a conservative force ?

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19. What happens to internal energy , when temperature of body increases ?

 Watch Video Solution

20. What type of energy is stored in the spring of a watch ?

 Watch Video Solution

21. Kinetic energies of a heavy and a light object are the same. Momentum of the which object will be higher ?

Watch Video Solution

22. Momenta of a light and a heavy body are the same .Which body has greater kinetic energy ?

Watch Video Solution

23. If E is the kinetic energy of a body of mass m, what will be its momentum ?

Watch Video Solution

24. An object breakes up into two masses m_1 and m_2 due to explosion. The two fragments move in opposite directions. What will be the relation between the kinetic energy and the masses ?

Watch Video Solution

25. What is the loss of KE of a freely falling body of mass m , during the t th second ?

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26. The increase in momentum of a body is 100% . What will be the increases in its kinetic energy ?

Watch Video Solution

27. The increase in kinetic energy of a body is 69% . What will be the increases in its momentum ?

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28. Which physical quantity in conserved during both the elastic and inelastic collision ?

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29. Two objects coalesce after a collision with each other. What is the coefficient of restitution ?

Watch Video Solution

30. Coefficient of restitution between a ball and a horizontal floor is $e = \frac{1}{2}$. If the ball falls from a height of 10 m , after its impact with the floor, the ball rebounces up to a height of ..... [Fill in the blank]

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Exercise Short Answer Type Questions I

1. A motor car is moving with a constant speed . Is the car engine doing any work?

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2. Kinetic energy of a moving object is K and its momentum is p . Obtain a relation between them .

Watch Video Solution

3. Show that $P = \vec{F} \cdot \vec{v}$ where P is the power , $\vec{F}$ is the force and $\vec{v}$ is the velocity.

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4. Can there be an object which has energy but no momentum , or has momentum but no energy ?

Watch Video Solution

5. What should be the angle between force and displacement vector for a force to do maximum work ?

Watch Video Solution

6. How will the momentum of a body change if its kinetic energy is doubled ?

Watch Video Solution

7. A boy has a bag of sand of mass 20 kg . First of all, he keeps the bag on his head and moves 10 metre. Second time, he drags the bag through 10 metres on a frictionless surface. In which case, he does more work?

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8. A cake of mud is thrown on a wall, where it sticks . What happens to its initial kinetic energy ?

Watch Video Solution

9. How will the kinetic energy of the body change if its momentum in doubled ?

Watch Video Solution

10. Show that the momentum of a body having mass m and the kinetic energy E is $\sqrt{2mE}$.

Watch Video Solution

Exercise Short Answer Type Questions Ii

1. Give an example of a non-conservative force. Explain whether the work done by this force contradicts the law of conservation of energy.

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2. Show that the work done by an external constant force on a body is equal to the change in kinetic energy of the body.

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3. Prove that the work done by a body sliding down a smooth inclined plane , from a height h to the ground level, is the same as the work done in a free fall from the same height h to the ground .

Watch Video Solution

4. Between a light and a heavy vehicle, moving with the same momentum , which one has a greater kinetic energy ?

Watch Video Solution

5. Show that the potential energy of a body raised vertically to a height h is the same as the potential energy of the body raised to the same height along a smooth inclined plane.

Watch Video Solution

6. A ball of mass m falls from a height h on a stationary horizontal plane and bounces up . If the coefficient of restitution is e, show that, the

loss in kinetic energy due of impact is mgh $(1 - e^2)$.

Watch Video Solution

7. A particle is moving in a circular path of radius r with constant speed. Due to change in the direction of motion of the particle continously, the velocity of the particle is changing . But the kinetic energy of the particle remains the same. Explain why ?

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Problem Set I

1. A man of mass 60 kg climbed up 15 steps, each of height 15 cm. Find the work done .

Watch Video Solution

2. An object of mass 10 kg is kept on a horizontal table. On application of a force of 20 N , the object shifts horizontally by 8m. If the applied force makes an angle of 60° with the horizontal , find the work done .

Watch Video Solution

3. Rainfall , from cloud at a height of 1.6 km above the earth's surface ,deposits water up to a depth of 1.25 cm over an area of $2.4m^2$. What was the work done in lifting that water up to the cloud -level ?

Watch Video Solution

4. A man of mass 100 kg climbs up a ladder of height 10 m. The ladder makes an angle 60°

with the horizontal . Express the work done by the man against gravity, in SI unit . $g = 980cm \cdot s^{-2}$

Watch Video Solution

5. Using a rope , a block of mass M is lowered through a height d with a uniform vertical acceleration $\frac{g}{4}$. How much work was done on the block ?

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6. A block , weighing 25.51 kg, was pulled with uniform velocity along a horizontal plane through a distance of 10 m . What is the work done by the force if the coefficient of sliding friction between the block and the plane is 0.2 and the applied force makes an angle of 60° with the vertical ?

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7. A uniform brick is of size $6cm \times 8cm \times 8cm$ and has a mass of 2.5 kg. it is resting with its

largest surface on the ground. What is the work that is to be done to bring it to rest on one of its smallest surface ?

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8. Mass of a rod of length 4m is 3 kg. Its centre of gravity is 1.5 m from one of its ends. At the other end a mass of 8 kg is tied up. The rod is at a horizontal position. It is turned to a vertical position in such a way that the 8 kg mass goes to the top. What is the work done in changing the orientation of the rod ?

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9. An object of mass 25 g is under water at a depth of 50 cm . Relative density of the meterial of the object is 5 and the value of g is $980cm \cdot s^{-2}$. Calculate the work done in lifting the object up to the surface from its present position.

Watch Video Solution

10. A constant force $\vec{F} = \left(-\hat{i} + 2\hat{j} + 3\hat{k} \right)$ N acts on a body. How much work is to be done to move the body first through a distance 4m along z-axis and then 3m along y-axis ?

Watch Video Solution

11. A force $\vec{F} = \left(2\hat{i} - 6\hat{j} \right)$ N is applied on a body which is sliding over a floor. If the body in displaced through $3\hat{i}m$, how much work is done by the force ?

Watch Video Solution

12. A particle moves from position $\vec{r}_1 = 2\hat{i} + 3\hat{j}$ to position $\vec{r}_2 = 3\hat{i} + 7\hat{j}$, under the action of a force $\left(10\hat{i} + 13\hat{j}\right)$ N Calculate the work done.

Watch Video Solution

13. The relation between the displaement x and the time t for a body of mass 2 kg moving under the action of a force is given by $x = t^3/3$, where x is in metre and t in second . Calculate

the work done by the body in the first 2 seconds

.

Watch Video Solution

14. A man pushes a roller with a force of 60N through a distance of 30 m. Calculate the work done if the handle of the roller is inclined at an angle of 60° with the ground .

Watch Video Solution

15. A rain drop of radius 2mm falls from a height of 250 m above the ground. What is the work done by the gravitational force on the drop ?

Watch Video Solution

16. A boy of mass 20 kg , moved up to the top of a building of height 18 m , carrying a box of mass 2.5 kg. if he did this in 1.5 min, what was his rate of doing work ?

Watch Video Solution

17. A man of mass 60 kg , climbed 20 steps in 10 s carrying load of 20 kg over his head. Each step was 20 cm high . Find the power of the man.

Watch Video Solution

18. Against an average pressure of 10 cm of mercury, a human heart pumps $50cm^3$ of blood in every beat. If the beat frequency is 72 per minute, what is the power of the heart?

Watch Video Solution

19. Time taken by man of weight 580 N to climb up to the top of a towar 80 m high was 4min . What was the power of the man ?

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20. A pump lifts 5000kg of water per minute through a height of 12m. Find the power of the engine if 30 % of energy is wasted.

Watch Video Solution

21. An engine can eject 6000 kg of water upwards at $15m \cdot s^{-1}$, in 1 min . Find the power of the engine.

Watch Video Solution

22. The engine of a train has to apply a force of 5000 N to overcome friction to run at a uniform rate of $90km \cdot h^{-1}$. What is the power developed by the engine ?

Watch Video Solution

23. A water pump raises water at a rate of $0.50m^3 / \min$ from a depth of 30 m . If the pump is 70% efficient . What power is developed by the engine . $g = 9.8m \cdot s^{-2}$ and density of water = $10^3 kg \cdot m^{-3}$.

Watch Video Solution

24. A electric motor creates a tension of 4500 N a hoisting cable and reels it at a rate of $2m \cdot s^{-1}$. Calculate the power of the motor.

Watch Video Solution

25. A bullet of mass 80 g strikes a target at $100cm \cdot s^{-1}$. After penetration, its velocity reduces to $50cm \cdot s^{-1}$. How much of its kinetic energy is spent ?

Watch Video Solution

26. A body of mass 1kg , at a height of 8m above the ground , is thrown vertically upwards at a velocity of $250cm \cdot s^{-1}$. What will be the kinetic energy of the body when it just reaches

the ground ?

$(g = 980cm \cdot s^{-2})$

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27. A body of mass 10 kg is thrown vertically upwards with a velocity of $2m \cdot s^{-1}$ from top of a tower of height 10 m . What will be its kinetic energy when it strikes the ground ?

Watch Video Solution

28. Linear momenta of two masses m and 2m are equal. What is the ratio of their respective kinetic energies ?

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29. Kinetic energies of two masses m and 2m are equal. What is the ratio of their respctive linear momenta ?

Watch Video Solution

30. A bullet of mass m, moving with a velocity u hits a wooden block of mass M and gets embedded. Assuming that the wooden block can move freely, show that, the loss of kinetic energy $= \frac{1}{2}\frac{mM}{m+M}u^2$.

Watch Video Solution

31. A bullet of mass 10 g travels horizontally with a speed of $100m \cdot s^{-1}$ and penetrates in a wooden block of mass 990 g suspended by a string . Find the vertical height through which the block rises. Take $g = 10m \cdot s^{-2}$.

Watch Video Solution

32. A ball is dropped from rest from a height of 10 m. if it loses 20% of its KE on striking the ground ,what is the height to which the ball bounces ?

Watch Video Solution

33. A pendulum bob of mass 10^{-2} kg is raised to a height of 5×10^{-2} m and then released. At the bottom of its swing , a mass of 10^{-3} kg is

added to it . To what height will the combined mass rise ? $\left(g = 10m \cdot s^{-2}\right)$

Watch Video Solution

34. A force of 30 N acts on a body of mass 2.0 kg starting from rest upto a distance of 3.0 m . Then the force reduces to 15N and acts in the same direction upto 2.0 m . Calculate the final kinetic energy of the body.

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35. A body is kept hanging means of a thread of length 1.25 m. if the body is given a horizontal velocity of $7\sqrt{2}m \cdot s^{-1}$. It describes a complete vertical circle. What will be the velocity of the body at the highest point of its path ?

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36. A stone of mass 500 g is tied at one end of a thread . If the stone is rotated along a circular path of radius 100 cm in a vertical plane with velocity $4m \cdot s^{-1}$, what will be the tensions in

the thread at the highest and the lowest positions of the stone ? ($g = 980cm \cdot s^{-2}$)

Watch Video Solution

37. A child revolves a stone of mass 0.5 kg tied to the end of a string of length 40 cm in a vertical circle. The speed of the stone at the lowest point of the circle is 2 m/s calculate the tension in the string at this point.

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38. A moving body A collides directly with a stationary body B and comes to rest. If there is a loss of half the initial energy during the collision find the value of the coefficient of restitution.

Watch Video Solution

39. A sphere falls on a stationary horizontal plane from some height, after bouncing off the surface it comes back to the plane again after 1

s. if the coefficient of restitution is $\frac{1}{4}$ find the initial height from which the sphere had fallen.

View Text Solution

40. A bomb explodes into two fragment of masses 2.0 kg and 1.0kg. The total kinetic energy of the fragment is $3.0 \times 10^4 J$. Calculate (i) kinetic energy of the bigger fragment ,

(ii) momentum of the smaller fragment.

Watch Video Solution

41. Kinetic energy of an object is 1J . A force of 1 Mdyn is applied to stop the object. How far does the object go before coming to rest ?

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42. A chain is kept on a smooth horizontal table. $\frac{1}{5}$th of the length of the chain is hanging off the table. If l is the length of the chain and m is its mass, how much work is to be done to full the hanging part of the chain onto the table ?

View Text Solution

43. A body of mass 2 kg is dropped from a height of 40 cm on a spring cushion of spring constant $1960N \cdot m^{-1}$.

What will be the compression of the spring ?

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44. A boat is moving at $25m \cdot s^{-1}$. Power of the engine of the boat is 600 W . What is the resistance of water against the boat's motion ?

Watch Video Solution

45. An object , starting from rest, rolled down a smooth path. The path is one fourth of the circumference of a circle of radius r . What is the velocity of the object at the lower end of the path ?

Watch Video Solution

46. A block of wood of mass 10 kg is suspended with a long rope. A bullet of mass 50 g moving at $0.3km \cdot s^{-1}$ hits and gets embedded in that

block . What will be the vertical rise of the block ? $[g = 980cm \cdot s^{-2}]$

Watch Video Solution

47. A ball is moving with a velocity $v_1 = 15m \cdot s^{-1}$. When hit by a racket , it returns in the opposite direction at a velocity $v_2 = 20m \cdot s^{-1}$. If the change in kinetic energy is $\Delta E = 8.75J$, find the change in the magnitude of the momentum of the ball.

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48. A proton and electron have kinetic energy equal to $10^5 eV$ and $10^4 eV$ respectively. Which of them moves faster ? Also calculate the ratio of their speeds. Given, mass of electron $= 9.11 \times 10^{-31} kg$, mass of proton $= 1.67 \times 10^{-27} kg$ and $1eV = 1.6 \times 10^{-19}$ Joule.

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49. In a circus , the diameter of globe of death is 30 m. From what minimum height must a cylist

start in order to roll down the inclined and go round the globe successfully ?

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Problem Set Ii

1. Applying a force of F =196 N upwards, a body of mass 10 kg is raised up to a height of 10 m. Find the work done by the force F and the work done against gravity. Note that the work done by the force F is more than the gravitational

potential energy . Show how the law of conservation of energy is still obeyed.

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2. Displacement x in metre and time t in second are related as $t = \sqrt{x} + 3$, for a particle of mass 1g moving in a straigh line.

(i) what is the displacement when velocity is zero?

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3. Displacement x in metre and time t in second are related as $t = \sqrt{x} + 3$, for a particle of mass 1g moving in a straigh line.

(ii) What is the work done in the first 6 s of motion ?

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4. A body of mass m is thrown up at a velocity u along a plane of inclination θ. If coefficient of friction between the body and the plane is μ, what would be the work done by friction when

the body rises up to the highest point of its motion ?

View Text Solution

5. A car of mass 500 kg moves with a constant velocity 72km/hr

(i) along a horizontal path,Coefficient of sliding friction between the road and the wheel is 0.1 . Find the engine power

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6. A car of mass 500 kg moves with a constant velocity 72km/hr

(ii) upwards along a mountain road of inclination $\frac{1}{25}$, Coefficient of sliding friction between the road and the wheel is 0.1 . Find the engine power

Watch Video Solution

7. A car of mass 500 kg moves with a constant velocity 72km/hr

(iii) downwards along the road of inclination

1/50. Coefficient of sliding friction between the road and the wheel is 0.1 . Find the engine power

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8. An engine is pulling up a train at $54km \cdot h^{-1}$ along a plane of slope $\frac{1}{200}$. Total mass of the engine and the train is 200 tonne (metric ton) , and the frictional force per tonne (metric ton) is 98 N . If the efficiency of the engine is 85% , what is the power of the engine ?

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9. What is the power required to raise 450 L of water per minute through a height of 10 m vertically, and to eject it through a orifice of radius 4 cm

View Text Solution

10. A fire engine raises 6 kL of water per minute to a height of 2m and ejects it at $9.2m \cdot s^{-1}$.

Find the power of the engine. Given mass of 1L of water is 1 kg.

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11. A railway engine of mass 12,000 kg is moving at constant speed of $5m \cdot s^{-1}$ up an inclined of 15°. Calculate the power of the engine. Given $g = 9.8m \cdot s^{-2}$.

Watch Video Solution

12. A motor can pump up water to fill a tank of volume $500m^3$ in 25 minutes, which is placed at a height of 20m. If efficiency of the motor is 40% , calculate the power of the motor.

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13. A motor boat is moving at a steady speed of $36.\ km \cdot h^{-1}$. If the water resistance to the motion of boat is 4000N, calculate the power of the engine.

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14. A body of mass 100g is dropped from the top of a tower 100m high. Find its kinetic energy (i) one second after the drop,

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15. A body of mass 100g is dropped from the top of a tower 100m high. Find its kinetic energy (ii) just before it touches the ground.

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16. Find the acceleration of a body falling down a rough plane, inclined at an angle 30° . The force of friction is 0.2 times the normal reaction. After descending 1m along the inclined plane, what will be the change in the sum of the potential and the kinetic energies ? Mass o the body is 1g.

Watch Video Solution

17. Two particles of masses m_1 and m_2 move on the same plane. If their relative velocity is u,

and the velocity of their centre of mass is v, show that the total kinetic energy is $\frac{1}{2}(m_1+m_2)v^2+\frac{1}{2}\left(\frac{m_1m_2}{m_1+m_2}\right)u^2$.

Watch Video Solution

18. A bullet of mass m moving with a horizontal velocity v entered a block of mass M. As a result , the block and the bullet start moving together. Show that, after the impact, $\frac{m}{M+m}$ part of the kinetic energy of the bullet is available as mechanical energy. What happens to the rest of the energy?

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19. A particle of mass 5g is moving with a velocity of $10cm \cdot s^{-1}$ along a straight line. A force of $10\sqrt{2}$dyn is applied at an angle of 45° with the direction of motion of the particle . Find the change in kinetic energy of the particle in 1 s.

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20. What is the energy required to raise water through 20m , at 90 litre per minute ?

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21. The kinetic energy of a body increases by 300 % . How much linear momentum of the body will increases?

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22. A bullet of mass 20 g moving with a speed of $500cm \cdot s^{-1}$ is just able to pierce a plank 5 cm thick. Calculate its velocity ,when the same bullet penetrates through the same plank 1 cm thick.

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23. A particle of mass 0.5 kg travels in a straigh line with a velocity $v = 5x^{5/2} m \cdot s^{-1}$. How much work is done by the net force during the displacement from x=0 to x=2 m ?

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24. A body of mass 1 kg is tied with a thread of length 20 cm and is rotated in a vertical circle. Determine the minimum velocity of the body at its highest position and its velocity at the lowest position, as well as tension in the thread under the same conditions .

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25. A pendulum bob of mass m is displaced through an angle θ from its equilibrium position and then released. What will be the tension in the string when the bob crosses the equilibrium position?

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26. A ball of mass M is hanging from the lower end of a string of length l. a bullet of mass m moving horizontally hits the ball and sticks to it. What should be the minimum velocity of the

bullet so that the ball will be able to complete a full circle ?

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27. A small body is placed at the top of a smooth sphere of radius r. what should be the horizontal velocity given to the body so that it loses contact with the sphere when its height from the centre of the sphere is $\frac{4r}{5}$?

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28. A body of mass 40 kg is tied at one end of a string of length l. The body is oscillating in a vertical plane with angular amplitude θ_0 . What is the tension in the string when it makes and angle θ with the vertical ? If the breaking load for the string is 80 kgf, what can be the maximum angular amplitude of the body ?

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29. A nail is located at a certain distance vertically below the point of suspension of a

simple pendulum . The pendulum bob is released from a position where the string makes an angle of 60° with the vertical. When the thread of the pendulum gets obstructed by the nail, if the bob can perform a complete rotation with the nail as centre ,find out the distance of the nail from the point of suspension.

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30. A body weighing 0.4 kg is whirled in a vertical circle making 2 revolutions per second.

If the radius of the circle si 1.2 m , find the tension in the string when the body is

(i) at the bottom of the circle, (ii) at the top of the circle.

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31. A particle of 1g moving with a velocity of $6cm \cdot s^{-1}$ collides elastically with a stationary particle of mass 2g , and is deflected throgh an angle of 90° . Find out

(i) the velocity of the 1g particle , and

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32. A particle of 1g moving with a velocity of $6cm \cdot s^{-1}$ collides elastically with a stationary particle of mass 2g , and is deflected throgh an angle of 90° . Find out

(ii) the magnitude and direction of the velocity of the 2g particle, after collision.

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33. What percentage of KE of a moving particle is transferred to a stationary particle when it strikes the stationary particle of 4 times its mass ?

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34. Radius of an iron is 2 cm. The ball is kept at rest on a frictionless horizontal surface. Another ball of radius 4 cm ,moving with velocity $81cm \cdot s^{-1}$, collides with it. Find the velocities of both the balls after collision.

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35. The mass of air striking the blades of a windmill every second is 400 kg . The velocity of the wind is $20m \cdot s^{-1}$. What is the rate of storage of energy in the windmill (in kW unit)? How much water can be raised per second , up to a height of 5m, using the windmill?

$g = 10m \cdot s^{-2}$.

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36. From a waterfall 60 m high, water falls at a rate of $27m^3 \cdot s^{-1}$. If 75% of energy is available at the bottom for use , how much power will be generated ? Mass of $1m^3$ of water is $10^3 kg$. If the power is used to lift water from a 180 m deep tubewell, how much water can be raised in 1 s?

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37. Bricks are passed on by one labourer to another at a height 3m from the ground, by

being thrown upwards from the ground level.Bricks reach the second labourer, at a speed of $3m \cdot s^{-1}$. If the bricks were thrown up in such a way that they would reach the second labourer, at zero speed, what fraction of the work done by the thrower would have been saved ?

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38. A ball is thrown down with an initial velocity v_0 from a height of 10m. The ball lost 50% of its energy on coming in contact with the ground ,

and then bouncing back up to the same height. Find v_0 of the ball. If the initial velocity was upward instead of downward, up to what height would the ball have bounced ?

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39. A block of mass 2kg falls along a plane of inclination 60° . Coefficient of friction between the block and the plane $= \sqrt{\frac{3}{2}}$. What force is to be applied on the block so that it

slides down

(ii) moves up , without any acceleration ? If the

velocity of the block in both cases is the same, find the ratio of the effective powers.

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40. From a rod fixed on a vertical wall, a simple pendulum is suspended. Its bob is pulled away from the wall to a horizontal position and then released. If the coefficient of restitution is $\frac{2}{\sqrt{5}}$, what would be the minimum number of impacts of the bob with the wall, after which the amplitude of the pendulum becomes less than 60°?

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41. A train of mass M is in motion. When its velocity is u_1 and acceleration is a_1 , resistive force against its speed is R_1 . Also when velocity is $u_2$and acceleration is a_2, resistive forced is R_2 . If the engine works at a fixed rate P, show that $P(u_2 - u_1) = u_1u_2(R_1 - R_2) + Mu_1u_2(a_1 - a_2)$.

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42. A bullet of mass 50 g , moving with a velocity of $50m \cdot s^{-1}$ hits and enters a wooden block of mass 2kg and comes to rest within it. The wooden block was initially at rest on a smooth table. Find the final velocity of the wooden block. What are the initial and final kinetic energies of the block-bullet system?

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43. A uniform chain in held on a frictionless table with one-third of its length hanging over

the edge. If the chain has a length l and mass m , how much work is required to pull the hanging part back on the table ?

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44. A 5kg rifle fires a 5g bullet with a speed of $500m \cdot s^{-1}$. What kinetic energy is acquired

(i) by the bullet and

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45. A 5kg rifle fires a 5g bullet with a speed of $500m \cdot s^{-1}$. What kinetic energy is acquired

(ii) by the the rifle ?

Watch Video Solution

46. A 5kg rifle fires a 5g bullet with a speed of $500m \cdot s^{-1}$.

(iii) Find the ratio of the distance, the rifle moves backward while the bullet is in the barrel to the distance the bullet moves forward.

Watch Video Solution

47. A 10g bullet is fired from a rifle horizontally into a 5kg block of wood suspended by a string and the bullet gets embedded in the block. The impact causes the block to swing to a height of 5 cm above its initial level. Calculte the velocity of the bullet.

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Problem Set Ii Hots Numerical Problems

1. A body, moving on a horizontal smooth plane with a velocity of $50cm \cdot s^{-1}$, collides elastically with another stationary body of the same mass. After collision, if velocity of the 1st body becomes $30m \cdot s^{-1}$, what is the velocity acquired by the 2nd ? Also show that the two bodies move at right angles to each other after collision.

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2. A body of mass 1 kg breaks due to an explosion into three pieces of mass ratio $1:1:3$

. Two equal masses move at right angles to each other , and attain a velocity $30m \cdot s^{-1}$. What is the velocity of the heavier piece ?

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3. A spherical body collision head-on with another identical spherical body at rest. If the coefficient of restitution is e, show that the ratio of their velocities after collision is $(1-e):(1+e)$.

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4. Two spheres of the same mass move in the same direction , and the velocity of the first is double that the second. They collide head-on and lose $\frac{1}{18}$th of their kinetic energy. Find the coefficient of restitution.

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5. A ball of density d, is dropped on a solid horizontal plane . It returns in time t_1 to the point from where it was dropped after an elastic collision . From the same height, the ball

is now dropped on a liquid surface of density d_L

(i) if $d < d_L$, the time required by the ball to return to the original height is t_2. Find the value of t_2 in terms of $t_1, d \text{ and } d_L$.

View Text Solution

6. A ball of density d, is dropped on a solid horizontal plane . It returns in time t_1 to the point from where it was dropped after an elastic collision . From the same height, the ball is now dropped on a liquid surface of density d_L

(ii) if $d = d_L$ how is the velocity of the ball in the liquid related to the depth of the liquid?

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7. A body of mass m is moving along x-axis with a velocity V, and another body of mass M is moving along y-axis with a velocity v. After collision they coalesce.

(i) Find the magnitude and direction of velocity of the combined mass.

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8. A body of mass m is moving along x-axis with a velocity V, and another body of mass M is moving along y-axis with a velocity v. After collision they coalesce.

(ii) Find the fraction of initial kinetic energy transferred to heat energy, after collision.

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9. A neutron collided elastically with the nucleus of the a carbon atom at rest . Show that the

neutron lost 0.284 part of its initial kinetic energy .

Watch Video Solution

Entrance Corner Assertion Reason Type

1. Statement I: Absolute PE of a system as measured by two different persons at the same time can be different.

Statement II: Value of absolute PE of a system depends upon the reference value chose.

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true , statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: A

Watch Video Solution

2. Statement I: Work done by normal contact force can be non -zero

Statement II: Normal contact force is always perpendicular to displacement of object. (Here displacement is measured with respect to frame of reference attached to the two surface in contact.)

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true , statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: A

Watch Video Solution

3. Statement I: In a circular motion, work done by centripetal force is not always zero.

Statement II: If speed of the particle increases or decreases in circular motion, net force, acting on the particle is not direction towards the centre.

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true , statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: D

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4. Statement I: When a body moves uniformly in a circular its momentum goes on changing but its kinetic energy remains constant.

Statement II: $\vec{p} = \overrightarrow{mv}, KE = \frac{1}{2}mv^2$. In circular motion $\vec{v}$ changes, v^2 does not change.

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true , statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: A

Watch Video Solution

5. Statement I: If a particle of mass m is connected to a light rod and whirled in a vertical circle of radius R, then to complete the circle, the minimum velocity of the particle at the lowest point is $\sqrt{5gR}$.

Statement II: Mechanical energy is conserved and for the minimum velocity at the lowest point, the velocity at the highest point will be zero.

A. Statement I is true, statement II is true, statement II is a correct explanation for

statement I.

B. Statement I is true , statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: D

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6. Statement I: Work done by constant force is equal to magnitude of force multiplied by displacement .

Statement II: Work done is scalar quantity. It may be positive, negative or zero.

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true , statement II is true, statement II is not a correct explanation

for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: D

Watch Video Solution

7. Statement I: if work done by conservative force is negative then potential energy associated with that force should increase.

Statement II: This is from the reaction Δu=- W.

Here Δu is change in potential energy and W is work done by conservative force.

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true , statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: A

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Entrance Corner Multiple Correct Answers Type

1. The potential energy of a particle is given by the formula $U = 100 - 5x + 100x^2$, U and x are in SI units. If mas of the particle is 0.1 kg then magnitude of its acceleration .

A. at 0.05m from the origin is $50m \cdot s^{-2}$

B. at 0.5m from the mean position is

$100m \cdot s^{-2}$

C. at 0.05 m from the origin is $150m \cdot s^{-2}$

D. at 0.05 m from the mean position is

$200m \cdot s^{-2}$

Answer: A::B::C

Watch Video Solution

2. When a bullet is fired from a gun

A. kinetic of bullet is more than that of gun

B. acceleration of bullet is more than that of gun

C. momentum of bullet is more than that of gun

D. velocity of bullet is more than that of gun

Answer: A::B::D

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Entrance Corner Comprehension Type

1. A body of mass 2 kg starts from rest and moves with uniform acceleration . It acquires a velocity $20m \cdot s^{-1}$ in 4 s.

(i) Power exerted on the body at 2s is

A. 50W

B. 100W

C. 150W

D. 200W

Answer: B

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2. A body of mass 2 kg starts from rest and moves with uniform acceleration . It acquires a velocity $20m \cdot s^{-1}$ in 4 s.

(ii) Averrage power transferred to the body in first 2 s is

A. 50W

B. 100W

C. 150W

D. 200W

Answer: A

3. A block of 2.5 kg is pulled 2.20m along a fricctionless horizontal table by a constant force 16N directed at 45° abve the horizontal.

(i) Work done by the applied force is

A. 25J

B. 27J

C. 24.9J

D. 22.5 J

Answer: C

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4. A block of 2.5 kg is pulled 2.20m along a fricctionless horizontal table by a constant force 16N directed at 45° abve the horizontal.

(ii) Work done by the normal force exerted by the table is

A. 24.9 J

B. zero

C. 27J

D. 27.5 J

Answer: B

 Watch Video Solution

5. A block of 2.5 kg is pulled 2.20m along a fricctionless horizontal table by a constant force 16N directed at 45° abve the horizontal.

(iii) Work done by the force of gravity is

A. 24.9J

B. 27J

C. zero

D. 27.5J

Answer: A

 Watch Video Solution

Entrance Corner Integer Answer Type

1. A body of mass 4kg is moving with a momentum of $8kg \cdot m \cdot s^{-1}$. A force of 0.4 N acts on it in the direction of motion of the body for 10 seconds. Determine the increases in kinetic energy in joules.

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Examination Archive With Solutions Wbchse

1. The velocity of a 10 kg mass is increased from $2m \cdot s^{-1}$ to $4m \cdot s^{-1}$. The amount of work

done in doing so is

A. 60J

B. 20 J

C. 120J

D. cannot be determined from the given data

Answer: A

 Watch Video Solution

2. When a spring is stretched by an amount 3 cm , the potential energy stored in the spring is U. if the spring is stretched by an amount 6 cm its stored potential energy is

A. 2U

B. 3U

C. 4U

D. 6U

Answer: C

 Watch Video Solution

3. A car of mass M moves up an inclined road making an angle θ with the horizontal with constant speed v. if μ is the coefficient of friction between the type of the car and the road, show that the power of the engine of the car is $P = vMg(\sin\theta + \mu\cos\theta)$.

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4. A particle moves from a point $\vec{r}_1 = \hat{i} + 3\hat{j}$ in metre to another point $\vec{r}_2 = 2\hat{i} + 4\hat{j}$ in

metre under the action of the force $\vec{F} = 3\hat{i} + 5\hat{j}$ in newton. Find the work done by th force on the particle during the displacement.

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5. What is a conservative force ? Show that for a conservative force, work done around a closed path is zero.

Watch Video Solution

6. A box is being displaced by a machine of fixed power along a straight line . The displacement is time t in proportional to

A. $t^{1/2}$

B. $t^{3/4}$

C. $t^{3/2}$

D. t^2

Answer: D

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7. Two spting having force constant k_1 and $k_2 (k_1 > k_2)$ respectively increases its length by same amount . On which spring work done will be more and why?

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8. The velocity of a moving body of mass m along positive.x axis is $v = a\sqrt{x}$ (a=constant). Find the work done by the force applied on the body to displace it from x=0 to x=l.

Watch Video Solution

9. Show that mechanical energy of a body sliding down freely along a smooth inclined plane is conserved.

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10. If the coefficient of restitution is zero for collision between two bodies then

A. both the bodies are at rest

B. both are attached with each other

C. both are moving with same velocity in the opposite directions

D. both are moving with same direction with different velocities

Answer: B

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11. 1 joule =1.....

A. $N \cdot m^2$

B. $kg \cdot m \cdot s^{-2}$

C. $N \cdot m$

D. $N^2 \cdot m^2$

Answer: C

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12. Give the definition of coefficient of restitution .Prove that for perfect elastic collision of two bodies moving in the same line , the kinetic energy is conserved.

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13. Mortars are thrown from a cannon. Prove that the KE at which a mortar goes in forward is much more compared to the recoiled energy of the cannon.

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14. Define gravitational unit of work done .

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15. Draw the graph representing linear momentum and change in kinetic energy .

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16. A particle of mass m is rotated in a circular path of radius r under the influence of a force $F = -\frac{k}{r^2}$, where k is a constant. Find the total energy of the particle.

Watch Video Solution

17. Which of the following is not conserved in inelastic collision ?

A. momentum

B. kinetic energy

C. both momentum and KE

D. none of these

Answer: B

 Watch Video Solution

18. A stone tied to a string of length L is whirled in a vertical circle with the other end of string at the centre.

At a certain instant of time, the stone is at its lowest position, and has a speed u. The magnitude of its velocity , as it reach a position where the string is horizontal, is

A. $\sqrt{u^2 - 2gL}$

B. $\sqrt{2gL}$

C. $\sqrt{u^2 - gL}$

D. $\sqrt{2(u^2 - gL)}$

Answer: A

Watch Video Solution

19. What is a conservative force ? Show that for a conservative force, work done around a closed path is zero.

Watch Video Solution

20. A body of mass m moving with a velocity u strikes elastically a stationary body of mass 2m .

After the elastic collision the bodies move with velocities v and V respectively . Show that the body of mass m loses $\frac{8}{9}$ part of its initial kinetic energy.

Watch Video Solution

21. If there by perfectly elastic collision between two bodies of the same mass moving along a straight line, the two bodies will

A. stay static

B. stick together

C. move in opposite directions with the same speed

D. move with interchanged speeds

Answer: D

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22. The number of joules in $1kg \cdot m$ is

A. 9.8

B. 980

C. 1000

D. 10^5

Answer: A

Watch Video Solution

23. The displacement of a body of mass 3 kg under the action of a force is $s = \frac{t^2}{3}$ metre. The work done in time 2s by the same force (in J) is

A. 2

B. 3.8

C. 5.2

D. 2.66

Answer: D

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24. Which one of the kinematic equations states the work energy principle ?

Watch Video Solution

25. A car of mass M moves upward with a constant speed v along an inclined road making an angle θ with the horizontal . If μ be the coefficient of friction between the road and the wheel of the car, show that the power of the engine of the car is $P = vMg(\sin\theta + \mu\cos\theta)$.

Watch Video Solution

26. A particle moves from a points $\vec{r}_1 = \hat{i} + 2\hat{j}$ in metre to another point $\vec{r}_2 = 2\hat{i} + 4\hat{j}$ in metre under the action of a force $\vec{F} = 2\hat{i} + 3\hat{j}$

in newton. Find the work done by the force on the particle in the displacement.

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27. Define conservative force. Show that the work done around a closed path in a conservative force field is zero.

Watch Video Solution

Examination Archive With Solutions Wbjee

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

A. 30J

B. 40J

C. 10J

D. 20J

Answer: A

Watch Video Solution

2. A bullet of mass 4.2×10^{-2}kg moving at a speed of 300 m/s, gets stuck into a block with a mass 9 times that of the bullet. If the block is free to move without any kind of friction, the heat generated in the process will be

A. 45cal

B. 405 cal

C. 450 cal

D. 1701 cal

Answer: B

Watch Video Solution

3. A small steel ball bounces on a steel plate held horizontally. On each bounce the speed of the ball arriving at the plate is reduced by a factor e (coefficient of restitution) in the rebound , so that

$V_{\text{upward}} = eV_{\text{downward}}$

If the ball is initially dropped from a height of

0.4m above the plate and if 10s later the bouncing ceases, the value of e is

A. $\sqrt{\frac{2}{7}}$

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

C. $\frac{13}{18}$

D. $\frac{17}{18}$

Answer: D

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Examination Archive With Solutions Jee Main

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

A. 44%

B. 50%

C. 56%

D. 62%

Answer: C

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2. A point paticle of maas m, moves along the uniformly rough track PQR as shown in the figure. The coefficient of friction between the particle and the rough track equals μ. The particle is released from rest from the point P and it comes to rest at a point R. The energies lost by the ball, over the parts PQ and QR of the track are equal to each other and no energy is

lost when particle changes direction from PQ to QR . the values of the coefficient of friction μ and the distance x(=QR) are respectively close to

A. 0.2 and 6.5 m

B. 0.2 and 3.5m

C. 0.29 and 3.5 m

D. 0.29 and 6.5 m

Answer: C

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3. A person trying to lose weight by burning fat lifts a mass of 10 kg up to a height of 1m 1000 times.

Assume that the potential energy lost each time he lowers the mass is dissipated.

How much fat will he use up considering the work done only when the weight is lifted up ? Fat supplies $3.8 \times 10^7 J$ of energy with a 20% effciency rate.Take $g = 9.8 m / s^2$

A. 2.45×10^{-3}kg

B. 6.45×10^{-3}kg

C. 9.89×10^{-3}kg

D. 12.89×10^{-3}kg

Answer: D

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4. A body of mass m=10^{-2} kg is moving in a medium and experiences a frictional force $F = -kv^2$. Its initial speed is $v_0 = 10m \cdot s^{-1}$. If after 10 s ,its energy is $\frac{1}{8}mv_0^2$, the value of k will be

A. $10^{-3} kg \cdot m^{-1}$

B. $10^{-3} kg \cdot s^{-1}$

C. $10^{-4} kg \cdot m^{-1}$

D. $10^{-1} kg \cdot m^{-1} \cdot s^{-1}$

Answer: C

Watch Video Solution

5. A Time dependent force F=6t acts on a particle of mass 1kg. If the particle starts from

rest, the work done by the force during the first 1 s will be

A. 4.5 J

B. 22J

C. 9J

D. 18J

Answer: A

 Watch Video Solution

6. It is found that it a neutron suffers an elastic collinear collision with deuterium at rest, fractional loss of its energy is p_d , while for its similar collision with carbon nucleus at rest, fractional loss of energy is p_c. The values of p_d and p_c are respectively

A. 0,0

B. 0,1

C. 0.89,0.28

D. 0.28,0.89

Answer: C

Watch Video Solution

7. A particle is moving in a circular path of radius a under the action of an attractive potential $U = -\frac{k}{2r^2}$. Its total energy is

A. zero

B. $-\frac{3}{2}\frac{k}{a^2}$

C. $-\frac{k}{4a^2}$

D. $\frac{k}{2a^2}$

Answer: A

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8. In a collinear collision , a particle with an initial speed v_0 strikes a stationary particle of the same mass. If the final total kinetic energy is 50% greather than the original kinetic energy, the magnitude of the relative velocity between the two particles, after collision, is

A. $\frac{v_0}{2}$

B. $\frac{v_0}{\sqrt{2}}$

C. $\frac{v_0}{4}$

D. $\sqrt{2}v_0$

Answer: D

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Examination Archive With Solutions Aipmt

1. A body of mass 4m is lying in xy-plane at rest. It suddenly explodes into three pieces. Two

pieces, each of mass m move perpendicular to each other with equal speeds v. The total kinetic energy generated due to explosion is

A. mv^2

B. $\frac{3}{2}mv^2$

C. $2mv^2$

D. $4mv^2$

Answer: B

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2. A particle of mass m is driven by a machine that delivers a constant power k watts. If the particle starts from rest the force on the particle at time t is

A. $\sqrt{\frac{mk}{2}}t^{-1/2}$

B. $\sqrt{mk}t^{-1/2}$

C. $\sqrt{2mk}t^{-1/2}$

D. $\frac{1}{2}\sqrt{mk}t^{-1/2}$

Answer: A

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3. Two particles of masses m_1, m_2 move with initial velocities u_1 and u_2 . On collision , one of the particles get excited to higher level , after , absorbing energy ε . If final veloctites of particles be v_1 and v_2 , then we must have

A. $m_1^2 u_1 + m_2^2 u_2 - \varepsilon = m_1^2 v_1 + m_2^2 v_2$

B.

$$\frac{1}{2} m_1 u_1^2 + \frac{1}{2} m_2 u_2^2 = \frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2 - \varepsilon$$

C.

$$\frac{1}{2} m_1 u_1^2 + \frac{1}{2} m_2 u_2^2 - \varepsilon = \frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2$$

D.

$$\frac{1}{2}m_1^2u_1^2 + \frac{1}{2}m_2^2u_2^2 + \varepsilon = \frac{1}{2}m_1^2v_1^2 + \frac{1}{2}m_2^2v_2^2$$

Answer: A

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Examination Archive With Solutions Neet

1. A body of mass 1kg begins to move under the action of a time dependent force $\vec{F} = \left(2t\hat{i} + 3t^2\hat{j}\right)N$ where $\hat{i}$ and $\hat{j}$ are unit

vectors along x and y-axis . What power will be developed by the force at the time t ?

A. $\left(2t^2 + 4t^4\right)W$

B. $\left(2t^3 + 3t^4\right)W$

C. $\left(2t^3 + 3t^5\right)W$

D. $\left(2t^2 + 3t^3\right)W$

Answer: C

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2. What is the minimum velcoity with which a body of mass m must enter a vertical loop of radius R so that it can complete the loop ?

A. $\sqrt{2gR}$

B. $\sqrt{3gR}$

C. $\sqrt{5gR}$

D. $\sqrt{gR}$

Answer: C

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3. A particle of mass 10 g moves along a circle of radius 6.4 cm with a constant tangential acceleration. What is the magnitude of this acceleration if the kinetic energy of the particle becomes equal to 8×10^{-4}J by the end of the second revolution after the beginning of the motion ?

A. $0.15m/s^2$

B. $0.18m/s^2$

C. $0.2m/s^2$

D. $0.1m/s^2$

Answer: D

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4. A body initially at rest, breaks up into two pices of masses 2M and 3M respectively, together , having a total kinetic energy E. The piece of mass 2M , after breaking up, has a kinetic energy

A. $\frac{2E}{5}$

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

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

D. $\frac{3E}{5}$

Answer: D

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5. A body starts moving unidirectionally under the influence of a source of constant power . Which one of the graph correctly shows the variation of displacement (s) with time (t) ?

A. 

B. 

C. 

D. 

Answer: D

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6. A body initially at rest and sliding along a frictionless track from a height h (as shown in the Fig.1.71) just completes a vertical circle of

diameter AB =D . The height h is equal to

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

B. D

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

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

Answer: D

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7. A moving block having mass m , collides with another stationary block having mass 4m. The lighter block comes to rest after collision . When the initial velocity of the ligheter block is v, then the value of coefficient of restitution e will be

A. 0.8

B. 0.25

C. 0.5

D. 0.4

Answer: B

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1. Prove that the total mechanical energy remains constant for a ball mass m dropped from a tower of height h.

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2. Answer with reason: In an elastic collision of two billiard balls, is the total kinetic energy conserved during the short time of collision of the balls (i.e., when they are in contact)?

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3. The casting of a rocket in flight burns up due to friction. At whose expense the heat energy required for burning obtained ? The rocket or the atmosphere ,or both /

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4. What are conservative forces ? Give an example.

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5. Distinguish between elastic and inelastic collisions.

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6. if the force applied on an object is 5N and the power expended by it 20W , what is the velocity of the object ?

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7. From the graph shown Fig.1.73 calculate the work done by the applied force and frictional force over a distance of 2m.

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8. State and prove law of conservation of mechanical energy in a free fall with a necessary diagram.

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9. Two objects of masses in the ratio 1:2 collide elastically with each other. What is the ratio of their kinetic energies ?

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10. State and prove work- energy theorem for a variable force.

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11. What will happen in an elastic collision in one dimension when a heavy body collides with a light body at rest?

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12. Two bodies A and B weighing 5kg and 6kg respectively have equal momentum . Which one has more kinetic energy ?

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13. What is meant by elastic collision ? Show that when two bodies of equal masses moving in one dimension suffer elastic collision, their velocities are exchanged after collision.

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14. State work-energy theorem. Prove it for a constant force.

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15. Two bodies of different masses have equal kinetic energies . Which will have more momentum ?

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16. Angad and Nalin were observing a building having two different staircases. One slanting and other vertically spiral. Angad was of the opinion that a person using slanting staircase will be doing more work against gravity but Nalin though otherwise. They started quarrelling. Arif, their friend, explained and gave entirely different view and pacified them.

What according to you was the explanation given by Arif?

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17. Angad and Nalin were observing a building having two different staircases. One slanting and other vertically spiral. Angad was of the opinion that a person using slanting staircase will be doing more work against gravity but Nalin though otherwise. They started quarrelling. Arif, their friend, explained and gave entirely different view and pacified them.

(b) What appreciable values do you see in Arif ?

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18. Angad and Nalin were observing a building having two different staircases. One slanting and other vertically spiral. Angad was of the opinion that a person using slanting staircase will be doing more work against gravity but Nalin though otherwise. They started quarrelling. Arif, their friend, explained and gave entirely different view and pacified them.

(c) Does it also follow with friction? why or why not ?

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19. Prove that the velocity get interchange in case of elastic collision of two objects of same mass.

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20. State work-energy theorem. The momentum of a body of mass 5 kg is 500 $kg \cdot m \cdot s^{-1}$. Find its kinetic energy.

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21. A light body and a heavy body have same linear momentum . Which one has greater kinetic energy ?

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22. State and prove work-energy theorem.

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23. State if the following statement is true of false. Give reason for your answer"In an inelastic collision, the final kinetic energy is always less than the initial kinetic energy of the system."

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24. A ball of 0.1 makes an elastic collision with a ball of unknown mass that is initially at rest. If the 0.1 kg ball rebounds at one third of its original speed, what is the mas of the other ball ?

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25. The sign of work done by a force on a body is important to understand . State carefully if the following quantities are positive or negative.

(a) work done by a man in lifting a bucket out of a well by mass of a rope tied to the bucket .

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26. The sign of work done by a force on a body is important to understand . State carefully if the following quantities are positive or negative.

(b) work done by friction on a body sliding down an inclined plane.

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27. The sign of work done by a force on a body is important to understand . State carefully if the following quantities are positive or negative.

(c) work done by an applied force on a body moving on a rough horizontal plane with uniform velocity.

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