PHYSICS

BOOKS - PRADEEP PHYSICS (HINGLISH)

WORK, ENERGY AND POWER

SAMPLE PROBLEM

1. A box is pushed through 4.0m across a floor offereing 100N resistance. How much work is done by the (i) applied force (ii) resisting force?

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2. A force $\widehat{F} = \left(\hat{i} + 2\hat{j} - \hat{k}\right)N$ moves a particle along a vector $\hat{s} = \left(4\hat{i} + \hat{j} + 7\hat{k}\right)$ metre. What is the work done?

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3. A force $F = (10 + 0.50x)$ acts on a particle in the x direction, where F is in newton and x in meter. Find the work done by this force during a displacement form x=0 to x=2.0m

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4. An elevatore weighinig 500kg is to be lifted up at a constant velocity of $0 \cdot 4m / s$. What should be the minimum horse power of the motor to be used ?

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5. A person weighing 70kg runs up a flight of 30steps in 35seconds. What is the power of the person if each step is 20cm high?

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6. The linear momentum of a body is increased by 10%. What is the percentage change in its KE?

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7. A body of mass 5 kg initally at rest, is subjected to a force of 20N. What is the kinetic energy acquired by the body at the end of half minute?

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8. Find the average frictional force needed to stop a car weighing 500 kg in a distance of 25 m if the initial speed is 72 km/h.

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9. A bullet of mass 20gram strikes a target with a velocity of $100m/s$ and is brougth to rest after piercing 20cm into it. What is the average force of resistance offered by the target?

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10. How high must a body be lifted so that it gain P.E. equal to its KE while moving with a velocity of $30m/s$?Take $g = 10m/s^2$

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11. The length of a steel wire increases by $0 \cdot 5cm$, when it is loaded with a weight of $5 \cdot 0kg$. Calculate force constant of the wire and

workdown in stretching the wire. Take $g = 10ms^{-1}$.

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12. The potential energy of a spring, when stretched through a distance x is 50J. What would be the work done in stretching it further through the same distance?

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13. In a nuclear reation, the mass defect is 1atomic mass unit. What is the energy released ?

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14. If 2000kg of water is heated from 0°C to $100^\circ C$, what will be the corresponding increase in mass of water? Take specific heat of water $= 1cal. g^{-1}.^\circ C^{-1}$.

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15. A rubber ball falls on a floor from a height of $19 \cdot 6m$. Calculate the velocity with which it strikes the ground. To what height will the ball rebounce if it loses 25% of its energy on striking the ground?

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16. A body of mass 2 kg makes an elastic collision with another body at rest and continues to move in the original direction with a speed equal to one third of its original speed. Find the mass of the second body.

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17. A ball of mass 1kg moving with a velocity of 15m / s undergoes a head on elastic collision with another ball of unknown mass at rest, and rebound with a velocity of $10m/s$. What is the mass of the other ball?

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18. A ball moving with a speed of $9m/s$ strikes an identical ball at rest, such that after the collision, the direction of each ball makes an angle of 30° with the original line of motion. Find the speeds of the two balls after collision.

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Curiosity questions

1. Can you visualize how a car reaches high speeds and how a person scales high cliffs?

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2. What is tidal energy ? How is it harnessed ?

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solved examples

1. A perosn is holding a bucket by applying a force of 20N. He moves a horizontal distance of 15m first and then climbs up a distance of 12m. What is the total work done by him?

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2. Calculate work done in raising a stone of mass 5kg and specific gravity 3 lying at the bed of a lake through a height of 4 metre.

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3. A uniform chain of length $2m$ is kept on a table such that a length of $60cm$ hangs freely from the edge of the table. The total mass of the chain is $4kg$. What is the work done in pulling the entire the chain the on the table?

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4. A cluster of clouds at a height of 1000m above the earth burst and enough rain fell to cover an area of $10^6 m^2$ with a depth of 2cm. How much work would have been done in raising water to the height of clouds ? Take $g = 10m / s^2$ and density of water $10^3 kg / m^3$.

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5. A particle is acted upon by constant forces $\overrightarrow{F}_1 = \left(2\hat{i} - 3\hat{j} + 4\hat{k}\right)$ and $\overrightarrow{F}_2 = \left(-\hat{i} + 2\hat{j} - 3\hat{k}\right)$ is displaced from the point $A(2, 1, 0)$ to the point $B(-3, -4, 2)$. Find the total work done by the forces.

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

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7. Calculate work done in moving the object from $x=2$ to $x=3m$ from the graph shown here.

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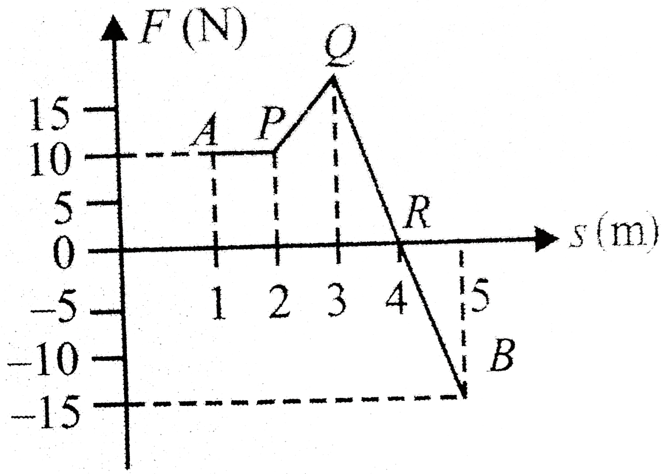
8. A body moves from point A to B under the action of a force, varying in magnitude as shown in figure. Obtain the work done. Force is expressed in newton and displacement in meter.



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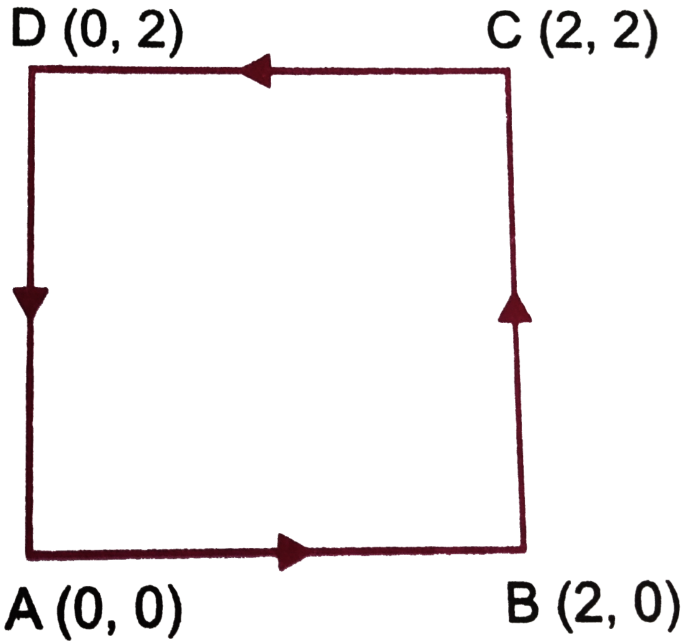
9. A force $\vec{F} = 2x\hat{j}$ newton acts in a region where a particle moves annticlockwise in a

square loop of 2m in $x - y$ plane as shown in figure . Calculate the total amount of work done. Is this force a conservative force or a non-conservative force?



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

$t = \sqrt{x} + 3$

where $x is \in meters$ and $t \in \sec onds$. Find

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

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

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11. A cyclist comes to a skidding stop in $10m$. During this process, the force on the cycle due to the road is $200N$ and is directly opposite to the motion.

a. How much work does the road do on the cycle?

b. How much work does the cycle do on the road?

12. A woman pushes a trunk on a railway platform which has a rough surface. She applies a force of 100N over a distance of 10m. Thereafter, she gets progressively tired and her applied force reduces linearly with distance to 50N. The total distance through which trunk has been moved is 20m. Plot the force applied by the woman and the frictional force, which is 50N against the distance. Calculat the work done by the two forces over 20m.

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13. A particle moves from position $3\hat{i}+2\hat{j}-6\hat{k}$ to $14\hat{i}+13\hat{j}+9\hat{k}$ due to a uniform force of $4\hat{i}+\hat{j}+3\hat{k}N$. If the displacement is in meters, then find the work done by the force.

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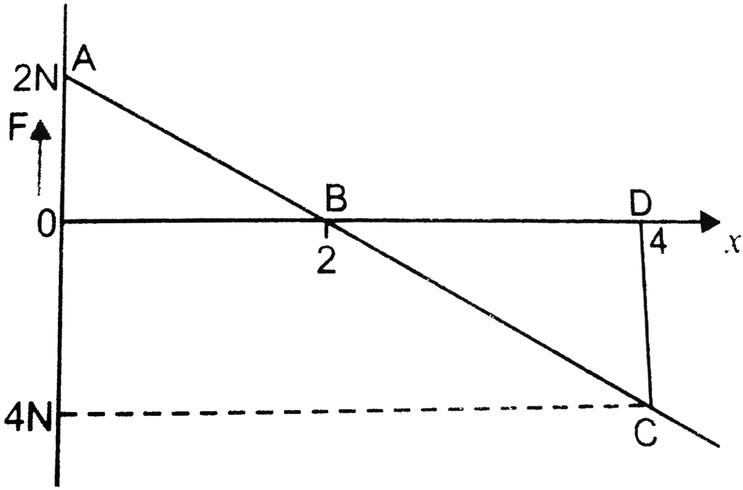
14. The variation of force acting on a body with the displacement of body is shown in figure. Calculate work done by the force in the interval

(i) $0 \leq x \leq m$ (ii) $2m \leq x \leq 4m$



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15. A shot travelling at the rate of $100 m/s$ is just able to pierce a plant 4 cm thick. What velocity is required to just pierce a plank 9cm thick ?

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16. If KE of a body increases by 300%, by what $\%$ will the linear momentum of the body increase?

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17. The kinetic energy of a body decreases by 19%. What is the percentage decrease in its momentum?

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18. Two identical $5kg$ blocks are moving with same speed of $2m/s$ towards each other along a friction less horizontal surface . The two blocks collide , stick together and come to rest. Consider the two blocks as a system . The work done by the external and ijnternal force are respectively:

19. A running man has half the KE that a body of half his mass has. The man speeds up by $1.0ms^{-1}$ and then has the same energy as the boy. What were the original speeds of the man and the boy?

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20. A particle of mass $0.5kg$ travels in a straight line with a velocity $v = \left(5x^{5/2}\right)m/s$. How much work is done by the net force during the displacement from $x = 0$ to $x = 2m$?

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21. It is well known that a rain drop falls under the influence of the downward gravitational force and the opposing resistive force. The latter is known to be proportional to the speed of the drop, but is otherwise undetermined. Consider a drop of mass 1.0g falling from a height of 1.00km. It hits the ground with a speed of $50.0ms^{-1}$ (a) What is the work done by the gravitational force ? (b) What is the work done by the unknown resistive force ?

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22. When an automobile moving with a speed of $36km/h$ reaches an upward inclined road of angle 30°, its engine is switched off. If the coefficient of friction is 0.1, how much distance will the automobile move before coming to rest ? Take $g = 10ms^{-2}$.

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23. The mass of a pendulum bob is 0.2kg, and it is suspended by a string 1m long. It is pulled aside until the thread is at 30° to the vertical. How much work is done ? The ball is now released. Find its K.E. at the lowest point ? Take $g=10ms^{-2}$.

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24. A block of mass $m=1kg$ moving on a horizontal surface with speed $v_i=2ms^{-1}$ enters a rough patch ranging from

$x0.10m \rightarrow x = 2.01m$. The retarding force F_r on the block in this range ins inversely proportional to x over this range

$$F_r = -\frac{k}{x} for 0.1 < x < 2.01m$$

$= 0$ for $< 0.1m$ and $x > 2.01m$ where $k = 0.5J$. What is the final K.E. and speed v_f of the block as it crosses the patch?

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25. To stimulat car accidents, the auto manufacturers study the collisions of moving cars with mounted springs of different spring constants. Consider a typical simulation with a car of mass 1000kg moving with a speed of $18.0km/h$ on a smooth road and colliding with a horizontally mounted spring of spring constant $6.25 \times 10^3 Nm^{-1}$. What is the maximum compression of the spring?

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26. Consider Example 22. Takin the coefficient of friction, μ to be 0.5, calculate the maximum compression of the spring.

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27. Express (a) the energy required to break one bond in DNA $\left(10^{-10}J\right)$ in eV.

(b) the kinetic energy of an air molecule $\left(10^{-21}J\right)$ in eV.

(c) the daily intake of a human adult $\left(10^{7}J\right)$ in kilocalories.

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28. A body of mass 50kg has a momentum of $1000 kgm / s$. Calculate its K.E.

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29. If the linear momentum of a body increases by 20%, what will be the percentage increase in KE of body ?

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30. A vehicles of mass 10 quintals climba up a hill 200m high and thenmoves on a level road with a velocity of $36km/h$ .Calculate its total mechanical energy while running on the top of the hill.

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31. A ball falls undal gravity from a height of 10m with an initial downward velocity u. It collides with ground, loses halft its energy and then rises back to the same height. Find the initial velocity u.

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32. A bullet of mass 10g travels horizontally with speed $100m/s$ and is absorbed by a wooden block of mass 900 g suspended by a string. Find the vertical height through which the block rises. Given $g=10m/s^2$

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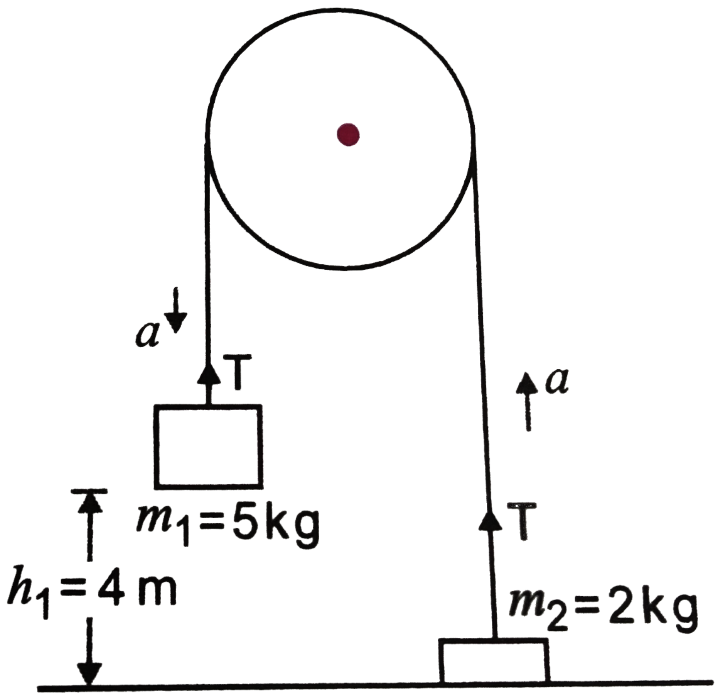
33. Two masses as shown in figure. Are released from their positions. Calculate the velocity with which the mass of 5kg touches the surface if its initial heigth from the surface is 4m. Also, show that the gain in KE of the system is equal to loss in its P.E. Take $g = 10ms^{-2}$.



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34. In a ballistics demonstration, a police officer fires a bullet mass $50.0g$ with speed $200ms^{-1}$ on soft plywood of thickness 2.00cm. The bullet emerges only with 10% of its initial kinetic energy. What is the emergent speed of the bullet ?

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35. A force is acting on a body moving alonog x-axis in the direction of motion of the body. If this force produces a potential energy $u = Ax^4$, where $A = 1.2 Jm^{-4}$, then the what is the force acting on the body when the body is at $x = -0.8m$?

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36. A 3.0kg block has a speed of $2m/s$ A and $6m/s$ at B. If the distance from A and B along the curve is 12m, how large a frictional force acts on it ? Assuming the same friction, how far from B will it stop ?

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37. Two springs have force constants K_1 and K_2, where $K_1 > K_2$. On which spring, more work is downe if

(i) they are stretched by the same force?

(ii) they are stretched by the same amount?

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38. A block of massm, initally at rest is dropped from a height h onto a spring whose force constant is K. Find the maximum distance x through which the spring will be compressed.

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39. A spring of force constant $24N/m$ is resting on a frictionless horizontal surface. A force of 10N is applied on the block of mss 4kg at one end of the spring. What is the speed of the block when it has been moved through a distance of 0.5 m ?

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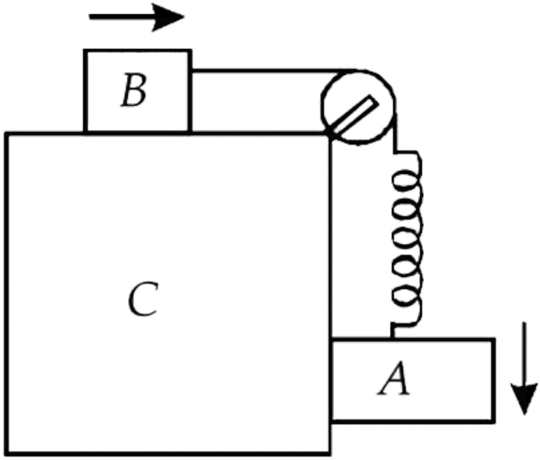
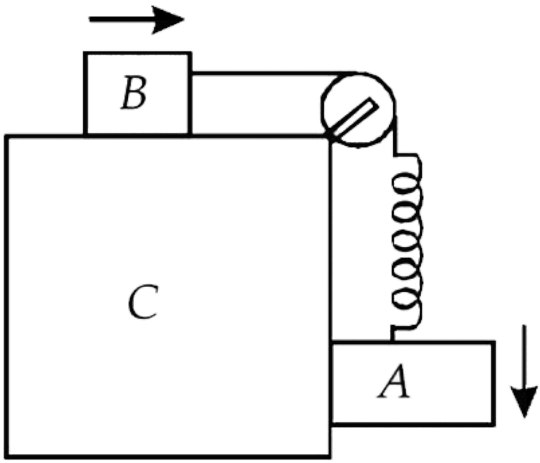
40. Two blocks A and B are connected to each other by a string and a spring , the spring pases and a frictionlesss pulley as down over in the figure . Block B sides over the horizontal top surface of a strionry block C both with the verical side of C , both with the same conform speed



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



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41. If a body of mass m suspended by a spring comed to rest after a downward displecemtn y_0, claculate (a) force constant of the spring, (b) loss in gravitational potential energy, (c) gain in elastic potential energy of spring.

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42. A block of mass $5.7kg$ slides on a horizontal frictionless table with a constant speed of $1.2ms^{-1}$. It is brougth momentarily to rest by compressing a spring in its path. By what maximum distance is the spring compressed ? The spring constant $k = 1500Nm^{-1}$.

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43. Estimate the amount of energy released in the nuclear fusion reaction:

$_(1)H^2 + ._1 H^2 \rightarrow ._2 He^2 + ._0 n^1$ Given that

$M(._1 H^2) = 2.0141u, M(._2 He^3) = 3.0160u$

$m_n = 1.0087u$,

where $1u = 1.661 \times 10^{-27} kg$.

Express your answer in units of MeV.

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44. A particle of rest mass m_0 moves with a spess $c/2$. Calculate its

(i) mass (ii) momentum (iii) total energy (iv)K.E.

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45. How much mass is converted into tenergy per day in a nuclear power plant operated at 10^7 kW?

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46. 200 kg of water is heated from $20^\circ C$ to $100^\circ C$. If specifice heat of water is

$4.2 \times 10^3 Jkg^{-1} 0C^{-1}$, calculate the increase in the mass of water.

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47. A car of mass 1000kg accelerates uniformly from rest to a velocity of $54km/h$ in 5 seconds. Calculate (i) its acceleration (ii) its gain in KE (iii) average power of the engine during this period.

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48. An electric motor is used to lift an elevator and its load (total mass 1500kg) to a height of 20m. The time taken for the job is 20s. What work is done ? What is the rate at which work is done. If efficiency of the motor is 75%, at which rate is the energy supplied to the motor?

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49. A machine gun fires 60 bullets per minute with a velocity of $700ms^{-1}$. If each bullet has a mass of 50g, find the power of the gun.

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50. A man cycles up a hill whose slope is 1 in 20 with a velocity of $6.4kmh^{-1}$ along the hill. The weight of the man and the cycle is 98kg. What work per minute is the man doing ? What is his horse power ?

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51. The human heart discharges 75ml of blood at each beat against a pressure of 0.1m of Hg.

Calculate the power of the heart assuming that the pulse frequency is 80 beats per minute. Given, density of mercury $= 13.6 \times 10^3 kg/m^3$

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52. An elevator can carry a maximum load of $1800kg$ (elevator + passengers) is moving up with a constant speed of $2ms^{-1}$. The friction force opposite the motion is $4000N$.What is minimum power delivered by the motor to the elevator?

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53. A standard car developes 40 H.P. Find the maximum speed the car can attain agains a resistance of 20kg wt. due to air and friction. Gvien efficiency of the engin is $25\%.1H.P. = 746W$ and $g = 10ms^{-2}$.

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54. The turbine pits at Niagra Falls are 50m deep. The average horse power develop is 5000.

If the efficiency of the generator 85% , how much water passes through the turbine per minute ? Take $g = 10m/s^2$.

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55. A railway carriage of mass 9000kg moving with a speed of $36kmh^{-1}$ collides with a stationary carriage of the same mass. After the collision, the two get coupled and move together. What is this common speed ? What type of collision is this?

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56. A ball is dropped from a heigth H. It rebounds from the ground a number of times. If coefficient is e, to what height does it go after nth rebounding ?

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57. A plastice ball is dropped from a height of 1m and rebounds several times from the floor. IF1.3 s elaspes from from the moment it is dropped to the second impact with the floor, what is the coefficient of restitution?

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

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59. A body of mass M at rest is struck by a moving body of mass. Prove that the fraction of the initial kinetic energy of mass transferred to the struck body is $\frac{4Mm}{(m+M)^2}$

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60. In a nuclear reactor, a neutron of high speed $(\approx 10^7 ms^{-1})$ must be slowed down to $10^3 ms^{-1}$ so that it can have a high probality of interacting with isotipe $\_92U^{235}$ and causing it to fission. Show that a neutron can lose most of its K.E. in an elastic collision with a light nuclei like deuterium or carbon which has a mass of only a fewe times the neutron mass. The material making up the light nuclei usually heavy water (D_2O) or graphite is called modertaor.

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61. Consider the collision depicted in Figure, to be between two billiard balls with equal masses $m_1 = m_2$. The first ball is called the cue and the second ball is called the target. The billiard player wants to sink the target ball in a corner pocket, which is at an angle $\theta_2 = \phi = 37^\circ$. Assume that the collision is elastic and that friction and rotational motion are not important. Obtain $\theta_1 = \theta$.

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62. A and B are two particles having the same mass m. A is moving along X-axis with a speed of $10ms^{-1}$ and B is at rest. After undergoing a perfectly elastic collision with B, particle A gets scattered through an angle of 30°. What is th edirection of motion of B, and the speeds of A and B, after the collision?

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63. Two particles A and B of masses m and 2m are moving along the X-axis and Y-axis respectively with the same speed v. They collide at the origin and coalesce into one body, after the collision. What is the velocity of this coalesced mass? What is the loss of energy during this collision?

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64. Two particles of masses 0.5 kg and 0.25kg moving with velocity 4.0 m/s and -3.0m/ collide head on in a perfectly inelastic collision. Find the velocity of the composite particle after collision and KE lost in the collision.

65. A toy rocket of mass 0.1 kg hass a small fuel of mass 0.02 kg, which it burns out in 3s.

Starting from rest on a horizontal smooth track, it gets a speed of $20ms^{-1}$ after the fuel is burnt out. What is the approcimate thrust of the rocket ? What is the energy content per unit mass of the fuel ? (Ignore the small mass variation of teh rocket during fuel burning).

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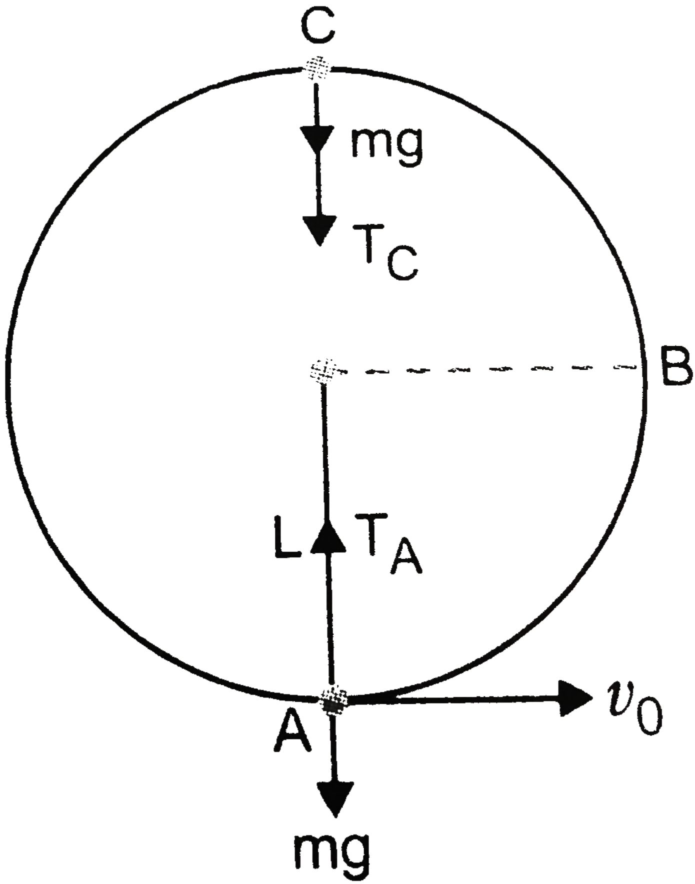
66. A bob of mass m is suspended by a light string of length L. It is imparted a horizontal velocity v_0 at the lowest point A such that it completes a semi-circular trajectory in the vertical plane with the string becoming slack on reaching the topmost point C, figure, Obtain an expression for (i) v_0 (ii) the speeds at points B and C, (ii) the ration of kinetic energies (K_B / K_C) at B and C.

Comment on the nature of the trajectory of the bob after it reahes the poing C.



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67. A ball moves along a curved path of radius 5m as shown in figure. It starts from point A and reaches the point B. Calculate the normal force that acts on the ball at B, assuming that there is no friction between the ball and the surface of contact.

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68. A bullet of mass m hits a target of mass M hanging by a string and gets embeded in it. If the block rises to a height h as a result of this collision, the velocity of the bullet before collision is

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69. A uniform chain of mass m & length L is kept on a smooth horizontal table such that $\frac{L}{n}$ portion of the chaing hangs from the table. The work dione required to slowly bringsthe chain completely on the table is

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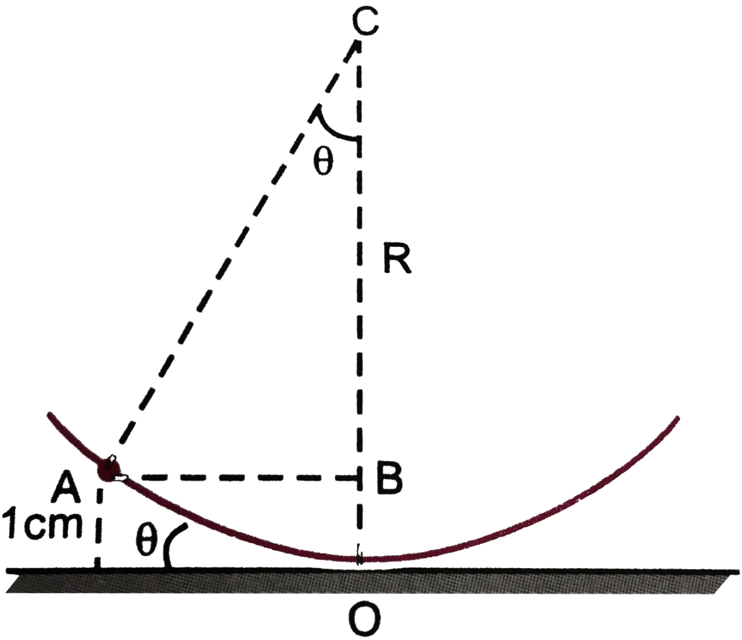
70. Aparticle of mass 1 g executes an oscillatory motion on the concave surface of a spherical dish of radius 2m placed on a horizontal plane, Figure . If the motion of the particle begins from a point on the dis at a height of 1 cm. from the horizontal plane and coefficient of friction is 0.01 , fing the total distance covered by the particle before coming to rest.



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71. A particle of mass 0.1kg has an iniital speed of $4ms^{-1}$ at a point A on a roudh horizontal road. The coefficient of friction between the object and road is 0.15. The particle moves to a point B at a distance of 2m from A. What is the speed of particle at B ?

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

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72. A 100 metric ton engine is moving up a slope of gradient 5° at a speed of 100 metre / hour. The coefficient of friction between the engine and the rails is 0.1. If engine has an efficiency of 4% for converting heat into work, find the amount of coal the engine has to burn in one hour. Burning of 1 kg coal yields 50000J.

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73. A ball moving with a speed of $9m/s$ strikes an identical ball at rest, such that after the collision, the direction of each ball makes an angle of 30° with the original line of motion. Find the speeds of the two balls after collision.

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Conceptual Problems

1. A body is in accelerated motion. Is it possible that no work is done ? Give some example.

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2. A coolie with load on his head is walking on a horizontal platform. What is work done against gravity.

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3. A porter carrying load on his head moves up a staircase. Is he doing any work?

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4. When an arrow is shot from a bow, it has kinetic energy. From where does it get the kinetic energy ?

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5. One end of a spring is rigidly fixed. A block attached to the free end of the spring is pulled through a distance x_0. On releasing the block, its amplitude of motion cannot exceed $\pm x_0$. Why?

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6. A uniform rectangular parallelopiped of mass m having sides, l, 2l and 4l is placed in turn on each of its three sides on a horizontal surface. What is the potential energy of the parallelopiped in the three positions ? Which position is most stable?

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7. Two protons are brought towards each other. Will the potential energy of the system decrease or increase? If a proton and an electron be brought nearer, then?

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8. Mountain roads rarely go straight up the slope, but wind up gradually. Why?

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9. A light body A and a heavy B have equal linear momentum. Then the KE of the body A is

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

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11. A lorry and a car, moving with the same kinetic energy are brought to rest by application of brakes which provied equal retarding forces. Which one of them will come to rest in a shorter distance ?

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12. A truck and a car are moving with the same K.E. on a straight road. Their engines are simultaneously switched off. Which one will stop at a lesser distance ?

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13. The velocity of an aeroplane is made twice (a) What will happen to the momentum? Will the momentum remain conserved? (b) What will happen to the K.E.? Will the energy remain conserved ?

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14. In a thermal station, coal is used for the generation of electricity. Mention how energyh changes from one form to the other before it is trnsformed into electrical energy?

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15. What is the minimum energy released in the annhilation of an electron positron pair?

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16. The heart rate (number of heart beats / minute) scales as $1/L$, where L is the characteristic lnegth of the mammal. (a) Can you explain this ? (b). The scale factor of a human relative to a monkey is about 2.5. What is the monkey's heart rate ?

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17. The absolute value of potential energy (and therefore total energy) has no physical significance. It is the difference of potential energies that matters. One can, therefore, add or subtract a constant to the potential energy (provided we do it to potential energy at every position for a given force) without any change in the physical situation. By convention, for forces which fall off to zero at large distances, the potential energy at infinity is taken to be zero. With this choice, is the potential energy positive or negaive for (a) electron bound state, (b) planet-satellite system, (c) electron-electron system?

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18. A spring of force constant k is cut into two pieces of lengths l_1 and l_2. Calculate force constant of each part.

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19. If stretch in a spring of force constant k is doubled, calculate

(a) ration of final to initial force in the spring.

(b) ratio of elastic energies stored in the two cases.

(c) work done in changing to the state of double stretch.

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20. The potential energy of two atoms separated by a distance x is give by

$U = -A/x^0$, where A is a positive constant. What is the force exerted by one atom on another atom ?

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21. Two collies lift some load from the road to the roof of a bus. One of them takes 1 min. and the other takes two min. to do the same job. Who has done more work and whose power is more ?

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22. A force is acting on a body moving along x-axis in the direction of motion of the body. If this force produces a potential energy $u = Ax^4$, where $A = 1.2 J m^{-4}$, then the what is the force acting on the body when the body is at $x = -0.8 m$?

Watch Video Solution

23. Chemical, gravitational and nuclear energies are nothing but potential energies for different types of forces in nature. Explain this statement clearly with examples.

Watch Video Solution

24. When is the exchange of energy maximum during an elastic collision?

Watch Video Solution

25. A body of a mass m moving with speed v collides elastically head on with another body of mass m, initially at rest. Show that the moving body will come to a stop after collision.

Watch Video Solution

26. Two ball bearings of mass m each moving in opposite directions with same speed v collide head on with each other. If the collision is perfectly elastic, what will be the outcome of the collision ?

Watch Video Solution

27. In a nuclear reactor, a neutron of high speed $(\approx 10^7 ms^{-1})$ must be slowed down to $10^3 ms^{-1}$ so that it can have a high probality of interacting with isotipe $\_92U^{235}$ and causing it to fission. Show that a neutron can lose most of its K.E. in an elastic collision with a light nuclei like deuterium or carbon which has a mass of only a fewe times the neutron mass. The material making up the light nuclei usually heavy water (D_2O) or graphite is called modertaor.

Watch Video Solution

Very Short Anwer Question.

1. A force acts perpendicular to the direction of motion of a body. What is work done?

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2. What is work done when a body is moving at constant speed over a frictionless horizontal surface ?

Watch Video Solution

3. State the factors on which work done by a force depends.

Watch Video Solution

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

Watch Video Solution

5. What is work done by the force of tension in the string of a simple pendulum?

Watch Video Solution

6. What is represented by area under the force displacement curve?

Watch Video Solution

7. Give an example in which a force does work on a body but fails to change its Kinetic energy.

Watch Video Solution

8. Does a man standing at rest on a moving truck possess KE?

Watch Video Solution

9. Out of joule, calorie, kilowatt and electron volt, which one is not the unit of energy?

Watch Video Solution

10. Is power a scalar or vector ?

Watch Video Solution

11. Name the physical quantity, which is expressed as force times velocity.

Watch Video Solution

12. When is KE of a planet revolving around the sunn maximum?

Watch Video Solution

13. What is work done by centripetal force in moving on body half-cycle on a circular path of radius 30m?

Watch Video Solution

14. Show graphically the variation of potential energy of an object thrown vertically upwards w.r.t. its height.

Watch Video Solution

15. What is spring constant ? What are its SI units?

Watch Video Solution

16. Name the process in which momentum changes but KE does not.

Watch Video Solution

17. What is the source of KE of falling rain drops ?

Watch Video Solution

18. What is work done in holding a 15kg suitcase while waiting for a bus for 15 minutes ?

Watch Video Solution

19. Is it practically possible to have situtations where $(E - V) < 0$?

Watch Video Solution

20. Can K.E. of a system be increased or decreased without applying any external force on the system?

Watch Video Solution

21. Does the sun do any work on earth, when earth revoves around the sun in a perfectly circular orbit?

Watch Video Solution

22. Does K.E. depend upon the direction of motion involved ? Can it be negative ? Does its value depend on frame of refrence?

Watch Video Solution

23. Name the largest and smallest practical unit of energy.

Watch Video Solution

24. Is work done by a non conservative force always negative ? Comment.

Watch Video Solution

25. Does potential energy of a spring decrease / increase when it is compressed or stretched ?

Watch Video Solution

26. When an air bubble rises in water, what happens to its potential energy /

Watch Video Solution

27. Name the process in which momentum changes but KE does not.

Watch Video Solution

28. A shot fired from a cannon explodes in air. What will be the changes in the momentum and the kinetic energy?

Watch Video Solution

29. The momentum of an object is doubled. How does its K.E. change?

Watch Video Solution

30. Can P.E. of an object be negative?

Watch Video Solution

31. Does the work done in moving a body depend on how fast or how slow the body is moved?

Watch Video Solution

32. A spring is cut into two equal halves. How is the spring constant of each half affected?

Watch Video Solution

33. Is it possible exert a force which does work on a body without changing its kinetic energy? If so, give example.

Watch Video Solution

34. In case of a moving body as force of friction is μmg, can we regard μmgx as potential energy similar to mgh?

Watch Video Solution

35. A ball of mass m moving with vel. V strikes head on elastically with a number of balls of same mass at rest in a line. Only one ball from other side moves with same velocity. Explain wy not two balls move simultaneously, each with ve. $v/2$?

Watch Video Solution

36. Is it possible to have a collision in which the whole of KE is lost?

Watch Video Solution

37. If two objects collide and one is initially at rest (a) is it possible for both to be at rest after collision ? (b) is it possible for any one to be at rest after collision.?

Watch Video Solution

Watch Video Solution

38. In which, elastic or inelastic collision, the momentum is conserved ? What about K.E.?

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39. Which physical quantities are conserved in an elastic collision?

Watch Video Solution

40. Which physical quantity is conserved in both, elastic and inelastic collision?

Watch Video Solution

41. If two bodies stick together after collision. Will the collision be elastic or inelastic?

Watch Video Solution

42. A bullet gets embedded in a wooden block. Where does its KE go?

Watch Video Solution

43. A rough inclined plane is placed on a cart moving with a constant velocity u on horizontal ground. A block of mass M rest on the incline. Is any work done by force of friction between the block and incline ? Is there then a dissipation of energy ?

Watch Video Solution

44. Why is electrical power required at all when the elevatore is descending ? Why should there be a limit on the number of passengers in this case ?

Watch Video Solution

45. A body is being raised to a height h from the surface of earth. What is the sign of work done by

(a) applied force (b) gravitational force ?

Watch Video Solution

46. Calculate the work done by a car against gravity in moving along a straight horizontal road. The mass of the car is 400 kg and the distance moved is 2m.

Watch Video Solution

47. A body falls towards earth in air. Will its total mechanical energy be conserved during the fall ? Justify.

Watch Video Solution

48. A body is moved along a closed loop. Is the work done in moving the body necessarily zero ? If not, state the condition under which work done over a closed path is always zero.

Watch Video Solution

49. In an elastic collision of two billiard balls, which of the following quantities remain conserved during the short time of collision of the balls (i.e., when they are in contact).

(a) Kinetic energy . (b) Total linear momentum ?

Give reason for your answer in each case.

Watch Video Solution

50. A crane lifts a mass of $100kg$ to a height of $10m$ in $20s$. The power of the crane is $(Take g = 10ms^{-2})$

Watch Video Solution

51. The average work done by a human heart while it beats once is $0.5J$. Calculate the power used by heart if it beats 72 times in a minute.

Watch Video Solution

52. Give example of a situation in which an applied force does not result in a change in kinetic energy.

Watch Video Solution

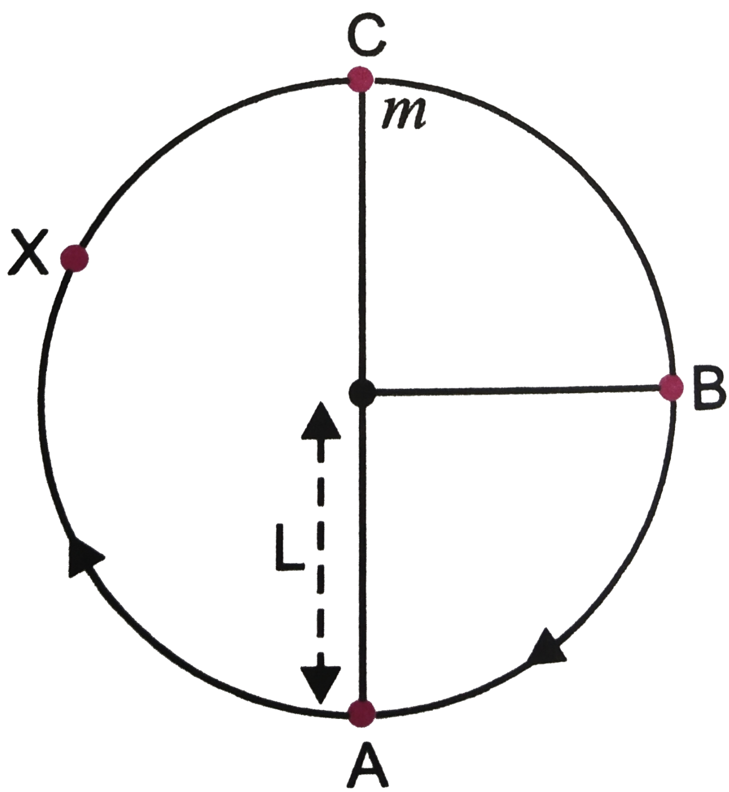
Watch Video Solution

53. Two bodies of unequal mass are moving in the same direction with equal kinetic energy. The two bodies are brought to rest by applying retarding force of same magnitude. How would the distance moved by them before coming to rest compare ?

Watch Video Solution

54. A bob of mass m suspended by a light string of length L is whirled into a vertical circle as shown in figure . What will be the trajectory of the particle if the string is cut at

(a) Point B ? (b) Point C? (c) Point X?



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Short Answer Question

1. Does the work done in raising a body through a certain height depend upon how fast it is raised ?

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2. In a tug of war, one team is giving way to other. What work is being done and by whom?

Watch Video Solution

3. What sort of energy is associated with a bird flying in air ?

Watch Video Solution

4. Momentum of a body is doubled. By what percent does its KE change?

Watch Video Solution

5. When a spring is compressed or stretched, what happens to its potential energy?

Watch Video Solution

6. Out of kilowatt hour and electron volt, which is bigger unit of energy and by what factor?

Watch Video Solution

7. Work done in moving a body over a closed loop in zer'. Is this statement true for all forces?

Watch Video Solution

8. A rocket explodes in mid air. What happens to its total momentum and total KE?

Watch Video Solution

9. A particle is moving in a circular path of given radius with number of rotations per second (i) constant (ii) decreasing (iii) increasing.

What happens to work done in the three cases?

Watch Video Solution

10. Can you associate potential energy with a non conservative force ?

Watch Video Solution

11. A spark is produced when two stones strike against each other. Why?

Watch Video Solution

12. In an exothermic chemical reaction, is mass being converted into energy?

Watch Video Solution

13. A hydrogen bomb is more powerful than an atom bomb. Why?

Watch Video Solution

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

Watch Video Solution

15. A shot fired from a cannon explodes in air. What will be the changes in the momentum and the kinetic energy?

Watch Video Solution

16. Explain with reason whether the potential energy in the following cases increases or decreases:

(a) a spring is compressed,

(b) a spring is stretched,

(c) two dissimilar charges brought near each other,

(d) a body is taken away agains the gravitational force.

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17. Two springs have force constants K_1 and K_2, where $K_1 > K_2$. On which spring, more work is downe if

(i) they are stretched by the same force?

(ii) they are stretched by the same amount?

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18. A amn rowing a boat upstream is at rest with respect to shore. (a) Is he doing any work ? (b) If he stope rowing and moves down with the stream, is any work being done on him ?

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19. A pump motor is used to deliver water at a certain rate from a given pipe. To obtain 'n' times water from the same pipe in the same time by what amount (a) the force and (b) power of the motor should be increased ?

Watch Video Solution

20. A spring is compressed by tieing its ends together tightly. It is then placed in acid and dissolves. What happens to its stored potential energy.

Watch Video Solution

21. (a) Two masses one n times heavier than the other are dropped from same height. How do their momentum compare just before they hit the ground ?

(b) Two masses one n times heavy as the other heave equal knetic energy. How do their momentum compare ?

Watch Video Solution

22. (a) Can kinetic energy of a system be changed without changing its momentum ?

(b) Can momentum of a system be changed without changing its kinetic energy?

Watch Video Solution

23. A meteorite burns in the atmosphere before it reaches the earth ' s surface . What happens to its momentum ?

Watch Video Solution

24. Can a body have momentum without energy?

Watch Video Solution

25. Can a body have energy without having momentum ?

Watch Video Solution

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

Watch Video Solution

27. Can a body have momentum when its energy is negative?

Watch Video Solution

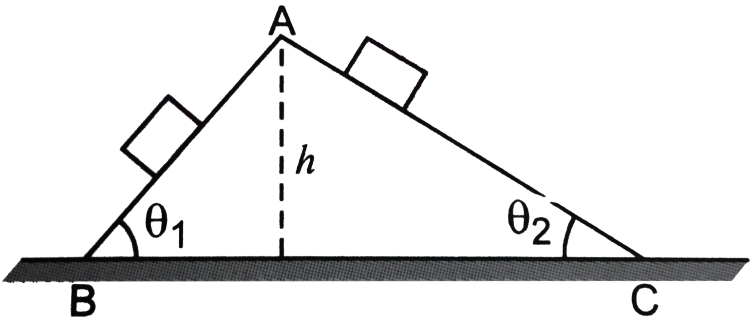
28. The potential energy function for a particle executing simple harmonic motion is given by $V(x) = \frac{1}{2}kx^2$, where k is the force constant of the oscillatore. For $k = \frac{1}{2}Nm^{-1}$, show that a particle of total energy 1 joule moving under this potential must turn back when it reaches $x = \pm 2m$.

Watch Video Solution

29. A stone is dropped from the top of a high tower. Will the mechanical energy of the stone be conserbed or not if the force of friction due to air is not neglected ?

Watch Video Solution

30. Figure shows two smooth inclined planes with different inclinations. Two blocks of same mass are allowed to slide down the two planes from the top A. Which block will arrive on the ground with greater velocity?



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31. A man can jump higher on moon than on earth. With same effort, can a runner improve his timing for 100m race on moon as compared to that on earth?

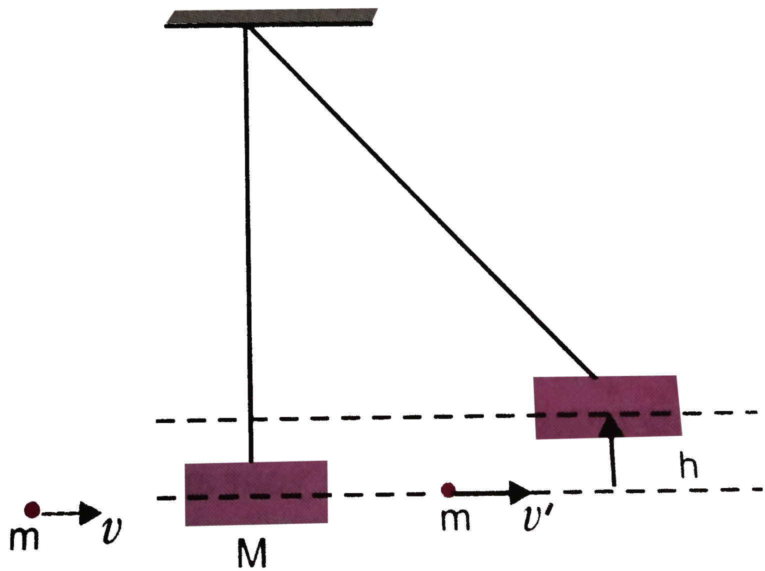
Watch Video Solution

32. A force F is related to the position of a particle by the relation $F = (10x^2)N$. Find the work done by the force when the particle moves from $x = 2m \rightarrow x = 4m$.

Watch Video Solution

33. A bullet of mass 0.01J kg and travelling at a speed of $500m/s$ strikes a block of mass 2 kg which is suspended by a string of length 5m.

The cnetre of gravity of the block is found to rise a vertical distance of 0.1m, figure. What is the speed of the bullet after it emerges from the block ? $(g = 9.8m/s^2)$.



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34. In any perfectly inelastic collision, is whole of KE lost ?

Watch Video Solution

35. Throwinig mud on a wall is an example of perfectly inelastic collision. Comment.

Watch Video Solution

36. What is meant by zero work ? State the conditions under which a force does no work. Give any one example.

Watch Video Solution

37. Two bodies of unequal masses have same linear momentum. Which one has greater K.E. ?

Watch Video Solution

38. Tow bodies of unequal masses have same K.E. Which one has greater linear momentum?

Watch Video Solution

39. How do potential energy and K.E. of a spring vary with displacement ? Is this variation different from variation in potential energy and K.E. of a body in free fall ?

Watch Video Solution

40. What is meant by mass energy equivalence ?

Discuss its significance in Physics.

Watch Video Solution

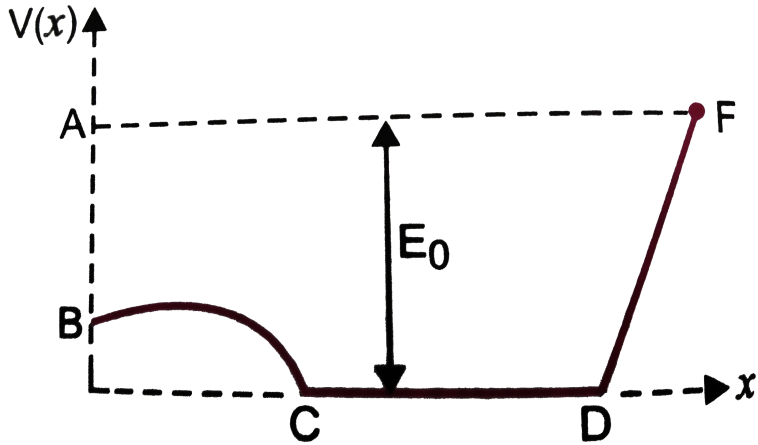
41. Hydrogenic materials are used as moderators in nuclear reactors to slow doen the neutrons. Why ?

Watch Video Solution

42. How do you justify energy conservation from the vibrations of a simple pendulum ?

Watch Video Solution

43. A graph of potential energy $V(x)$ verses x is shown in figure. A particle of energy E_0 is executing motion in it. Draw graph of velocity and kinetic energy versus x for one complete cycle AFA.



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44. A ball of mass mm, moving with a speed $2v_0$, collides inelasticaly $(e > 0)$ with an identical ball at rest. Show that (a) For head - on collision, both the balls move forward.

(b) For a genergcollision, the angle between the two velocities of scattered balls is less that 90°.

Watch Video Solution

45. Consider a one-dimensional motion of a particle with total energy E. There are four regions A, B, C and D is which the relation between potential energy U, kinetic energy (K) and total energy E is as given below

RegionA: $U > E$ Region B: $U < E$

Region C: $K < E$ Region D: $U > E$

State with reason in each case whether a particle can be found in the given region or not.

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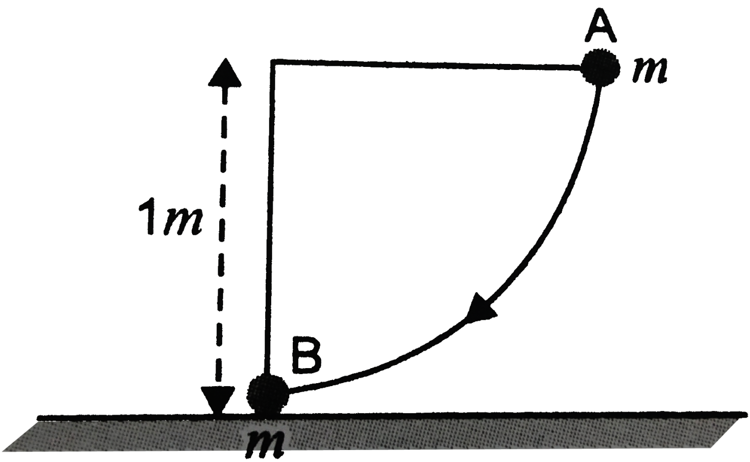
46. The bob A of a pendulum released from horizontal to the vertical hits another bob B of the same mass at rest on a table as shown in figure.

If the length of the pendulum is 1m, calculate

(a) the height to which bob A will rise after collision.

(b) the speed with which bob B starts moving.

Neglect the size of the bobs and assume the collision to be elastic.



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47. A raindrop of mass $1g$ falling from a height of $1km$ hits is the ground with a speed of

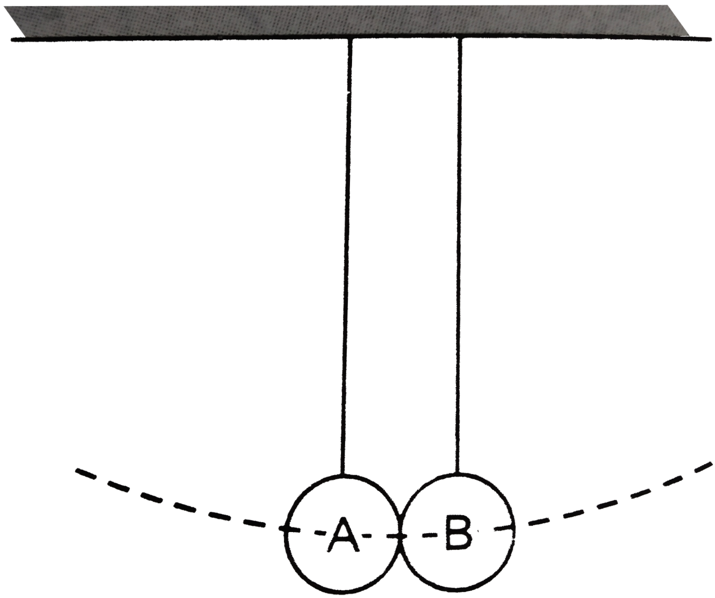
$50ms^{-1}$. Which of the following statements is correct? $(\text{Taking} g = 10ms^{-2})$.

Watch Video Solution

48. Two pendulums with identical bobs and lengths are suspended from a common support such that in rest position, the two bobs are in constact, . One of the bobs is released after being displaced by 10° so that it collides elastically head - on with the other bob.

(a) Describe the motion of two bobs.

(b) Draw a graph showing variation in energy of either pendulum with time,for $0 \leq t \leq 2T$, where T is the period of each pendulum.



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49. Suppose the average mass of raindrops is $3.0 \times 10^{-5} kg$ and their average terminal velocity $9ms^{-1}$. Calculate the energy transferred by rain to each square metre of the surface at the place which receives 100 cm of rain in a year.

Watch Video Solution

50. An engine is attahed to a wagon through a shock absorber of length 1.5m. The system with a total mass of 50,000kg is moving with a speed of $36kmh^{-1}$ when the brakes are applied to bring it to rest. In the process of the system being brought to rest, the spring of the shock absorber gets compressed by $1.0m$. If 90% of energy of the wagon is lost due to friction, calculate the spring constant.

Watch Video Solution

51. An adult weighing 600N raises the centre of gravity of his body by 0.25m while taking each step of 1m lenth in jogging. If he jogs for 6km, calculate the energy utilised by him in jogging assuming that there is no energy loss dur to friction of ground and air. Assuming that the body of the adult is capable of converting 10%

of energy intake in the form of food, calculate the energy equivalent fo food that would be required to compensate energy utilised for jogging.

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52. On complete combustion , a litre of petrol gives off heat equivalent to $3 \times 10^7 J$. In a test drive, a car weighing 1200kg, including the mass of driver, runs 15kg per litre while moving with a uniform speed on a straight track. Assuming that friction offered by the road surface and air to be uniform, calculate the force of friction acting on the car during the test drive. If the efficiency of the car engine were `0.5.

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Long Answer Question

1. Explain what is meant by work. Obtain an expression for work done by a constant force.

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2. What is meant by positive work, negative work and zero work ? Illustrate your answer with examples of each type.

Watch Video Solution

3. Obtain graphically and mathematically work done by a variable force.

Watch Video Solution

4. What are conservative and non-conservative forces, explain with examples. Mention some of their properties.

Watch Video Solution

5. What is meant by power and energy ? Give their units.

Watch Video Solution

6. Explain the meaning of K.E. with examples. Obtain an expression for K.E. of a body moving uniformly ?

Watch Video Solution

7. State and explain work energy principle.

Watch Video Solution

8. What do you mean by potential energy ? Give any two examples of potential energy other than that of the gravitational potential energy.

Watch Video Solution

9. Derive the expression for gravitational potential energy?

Watch Video Solution

10. Explain what is meant by potential energy of a spring ? Obtaining an expression for it and discuss the nature of its variation.

Watch Video Solution

11. Mention some of the different forms of energy and discuss them briefly.

Watch Video Solution

12. What is meant by mass energy equivalence ? Discuss its significance in Physics.

Watch Video Solution

13. State and establish principle of conservation of energy.

Watch Video Solution

14. How do vibrations of a simple pendulum and motion of a ball over a watch glass illustrate the principle of energy conservation ?

Watch Video Solution

15. What is meant by a collision ? Discuss two types of collision with their essential characteristics.

Watch Video Solution

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

Watch Video Solution

17. Discuss briefly inelastic collisions in one dimension.

Watch Video Solution

18. Give a brief account of elastic collisions in two dimensions.

Watch Video Solution

19. Briefly analyse inelastic collision in two dimensions.

Watch Video Solution

20. A block of mass 1kg is pushed up a surface inclined to horizontal at an angle of 30° by a force of 10N parallel to the inclined surface $[figure]$. The coefficient of friction between block and the incline is 0.1. If the block is pushed up by 10 m along the incline, calculate

(a) work done against gravity

(b) work done against force of friction

(c) increase in potential energy

(d) increase in kinetic energy

(e) work done by applied force.

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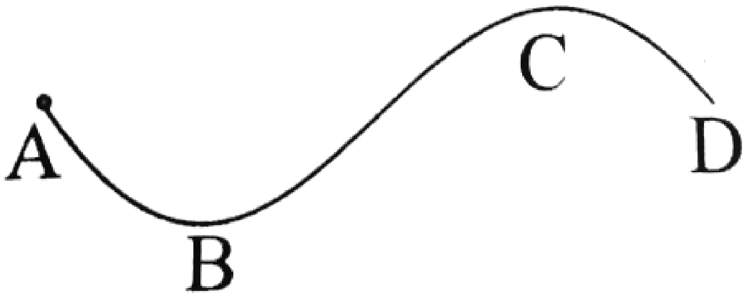
21.



A curved suface is shown in figure. The portion BCD is free of friction. There are three spherical balls of identical radii and masses. Balls are released from rest one by one from A which is at a slightly greater height than C.

Wioth the surface AB, ball 1 has large enough friction to cause rolling down without slipping, ball 2 has a small friction and ball 3 has a negligible friction.

(a) For which ball is total mechanical energy conserved?

(b) Which ball(s) can reach D?

(c)For ball which do not reach D, which of the balls can reach back A?

Watch Video Solution

22. A rocket accelerates straight up by ejecting gas downwards. In a small time interval Δt, it ejects a gas of mass Δm at a relative speed u .

Calculate KE of the entire system at $t + \Delta t$ and t and show that the device that ejects gas does work $= \left(\frac{1}{2}\right)\Delta m. u^2$ in this time interval (neglect gavity).

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23. Two identical steel cubes (masses 50g, side 1cm) collide head on face to face with a speed of 10 cm/ s each . Find the maximum compression of each. Young's modulus for steel $= Y = 2 \times 10^{11} N / m^2$.

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Watch Video Solution

24. A baloon filled with helium rises against gravity increasing its potential energy. The speed of the baloon also increases as it rises. How do you reconcile this with the law of conservation of mechanical energy ? You can neglect viscous drag of air and assume that density of air is constant.

Watch Video Solution

Advanced Problems For Competitions

1. Two identical 5 kg blocks are moving with same speed of $2m/s$ towards eachother along a frictionless horizontal surface. The two blocks collide, stick together and come to rest. Consider the two blocks as a system. Caluculate work done by (i) external forces (ii) internal forces.

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2. A uniform chain of mass m & length L is kept on a smooth horizontal table such that $\frac{L}{n}$ portion of the chaing hangs from the table. The work dione required to slowly bringsthe chain completely on the table is

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3. A 50 g lead bullet (specific heat 0.02) is initially at $30^{\circ}C$. It is fired vertically upward with a speed of $840ms^{-1}$. On returning to the starting level it strikes a cake of ice at $0^{\circ}C$. How

much ice is melted ? Assume that all energy is spent in melting only. Latent heat of ice $= 336 jg^{-1}$.

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4. A particle of rest mass m_0 moves with a spess $c/2$. Calculate its

(i) mass (ii) momentum (iii) total energy (iv)K.E.

Watch Video Solution

5. A certain spring that obeys Hook's law is stretched by an external agent. The work done in stretching the spring by $10cm$ is $4J$. How much additional work is required to stretch the spring an additional $10cm$?

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6. A perosn decides to use his bath tub water to generate electric power to run a 40W bulb. The bath tub is located at a height of 10m from the ground and it holds 200 litres of water. He instals a water driven wheel generator on the ground. At what rate should the water drain from the bath tub to light the bulb? How long can he keep the bulb on , if bath tub was full initially ? Efficiency of generator is 90% . Take $g = 9.8m/s^2$

Watch Video Solution

7. What is the power output of a $._{92}U^{235}$ reactor if it is takes 30 days to use up $2kg$ of fuel, and if each fission gives $185MeV$ of usable energy ?.

Watch Video Solution

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

$t = \sqrt{x} + 3$

where $x is \in meters$ and $t \in \sec onds$. Find

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

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

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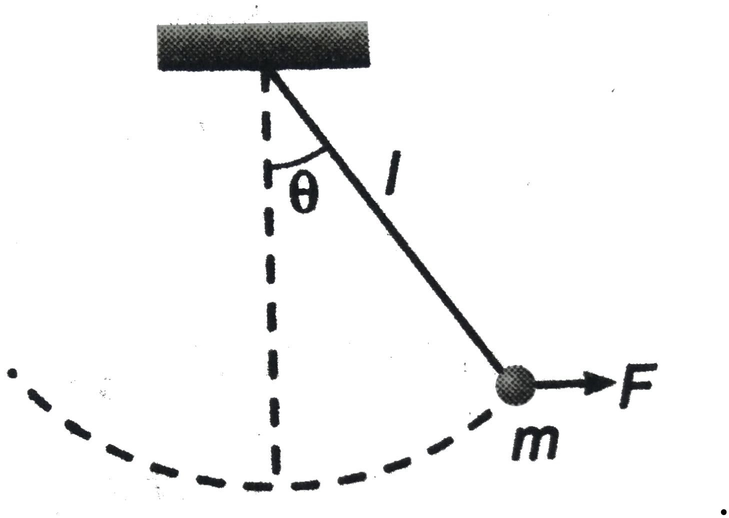
9. An object of mass m is tied to a string of length l and a variable force F is applied on it which brings the string gradually at angle thit θ with the vertical. Find the work done by the force F



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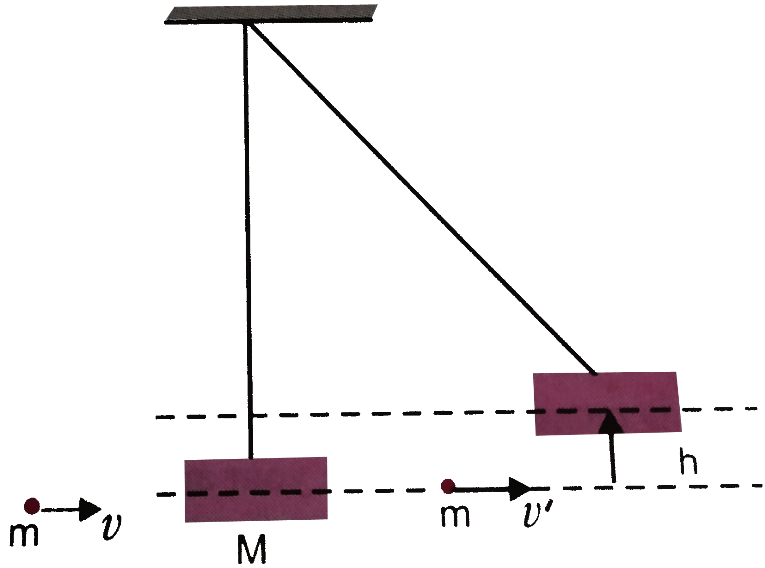
10. A bullet of mass 0.01J kg and travelling at a speed of $500 m / s$ strikes a block of mass 2 kg which is suspended by a string of length 5m. The cnetre of gravity of the block is found to rise a vertical distance of 0.1m, figure. What is the speed of the bullet after it emerges from the block ? $\left(g = 9.8m/s^2\right)$.



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

Watch Video Solution

12. A soild ball of density half that of water falls freely under gravity from a height of 19.6 m and then enters water. Upto what depth will the ball go. How much time will it take to come again to the water surface? Neglect air resistandce and viscosity effects in water. (Take $g = 9.8m/S^2$).

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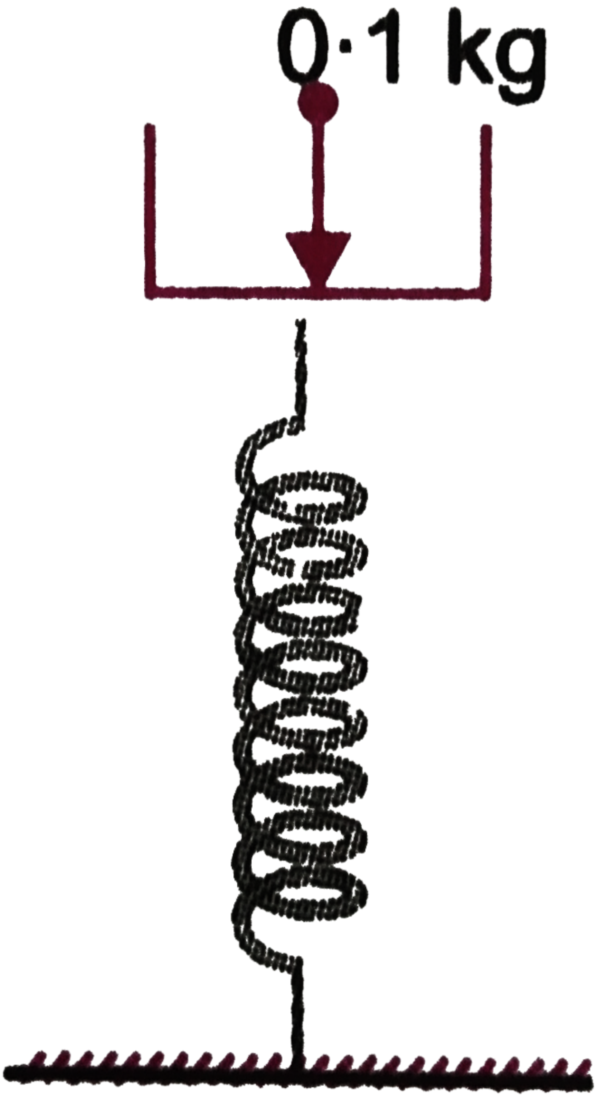
13. A massless platform is kept on a light elastic spring as shown in figure. When a small stone of mass 0.1 kg is dropped on the pan from a height of 0.24 m, the spring compresses by 0.01m. From what height should the stone be droppped to cause a compression of 0.04m in the spring ?



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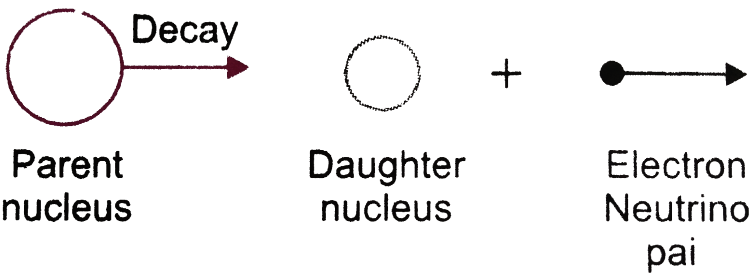
14. In the bets decay of Na^{24}, the combined electron neutrino momentum has a magnitude equal to $4MeV/c$. What is the recoil energy of daughter nucleus , given that its mass $23.99u$? Take $c = 3 \times 10^8 m/s$ and $1u = 1.66 \times 10^{-27} kg$.



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15. The iron Fe^{27} nucleus emits a y-axis of energy 14.4KeV. If mass of nucleus is 56.935u, calculate the recoil energy of the nucleus. Take $1u = 1.66 \times 10^{-27} kg.$

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16. A block of mass m is pushed against a spring of spring constant k fixed at ne end to a wall. The block ocan side on a frictionless tableas shown in figure. The natural length of thespring is L_0 and it is compressed ti half its natural length when the block is relesed. Find teh velocity of the block aa s function of its distance x from the wall .

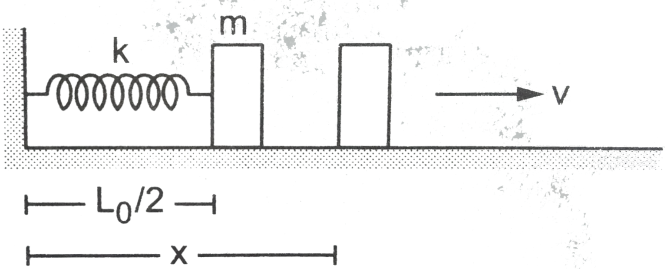

Figure 8-W6

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17. A trolly of mass 200kg moves with a uniform speed of 36 km / h on a frictionless track. A child of mass 20kg runs on the trolly from one end to the other (10m away) with a speed of $4m/s$ relative to the trolly in a direction opposite to the trolly's motion and jumps out of the trolly. How much has teh trolly moved from the time the child begins to run ?

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

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19. A car of mass one metric ton travels along a horizontal straight road with its engine working at a constant rate of 20kW. The resistance to motion of the card is 600N. Find the acceleration of the car at an instant, when its speed is 25 m/s

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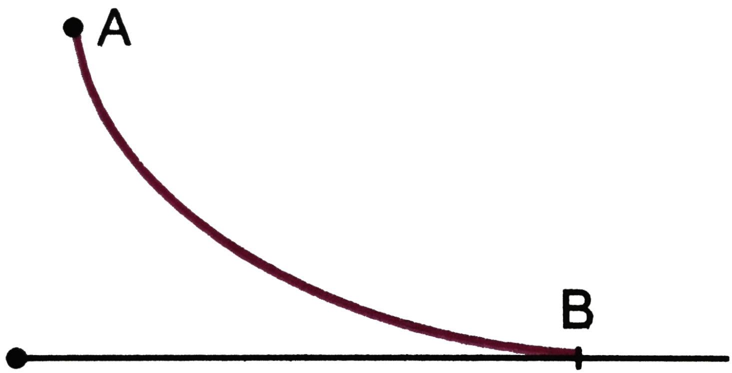
20. Figure, shows a vertical cross section of a surface. A and B are two points on the cross sections. A particle of mass 0.15kg is released from rest at A. (i) Assuming that particle reaches B with a speed of $8m/s$ and there is no resistance to motion, find the height of A above B.

(ii) Assuming instead that the particle reaches B with a speed of $6m/s$ and that the height of A above B is 4m, find work done against resistance to motion.



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NCERT EXERCISES WITH SOLUTIONS

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

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

(b) Work done by gravitational force in the above case. (c) Work done by friction on a body sliding down an iniclined plane.

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

(e) Work done by the resistive force of air on a vibrating pendulum in bringing it to rest.

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2. A body of mass 2 kg initially at rest moves under the action of an applied horizontal force of 7N on a table with coefficient of kinetic friction $= 0.1$. Calculate the

(a) work done by applied force in 10s. (b) work done by friction in 10s.

(c) work done by the net force on the body in 10s.

(d) change in K.E. of body in 10s, and interpret your result.

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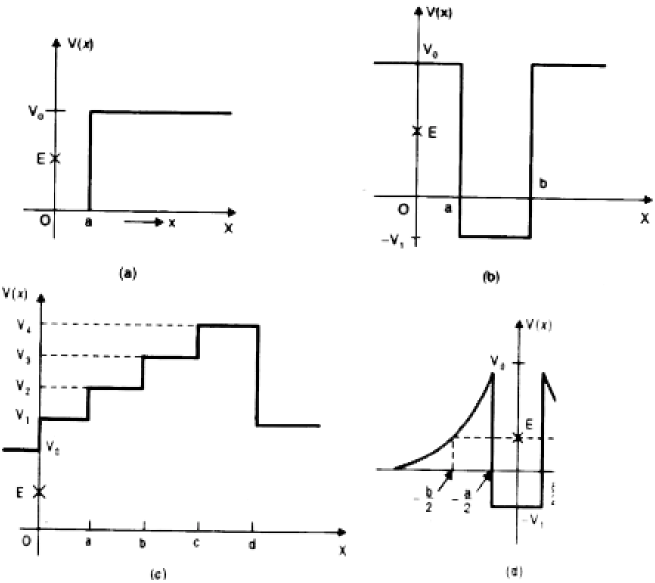
3. Given in fig are examples of some potential energy functions in one dimension. The total enrgy of the particle is indicated by a cross on the ordinate axis. In each case, specify the regions, if any, in which the particle cannot be found for the given energy. Also, indicate the minimum total energy the particle must have in each case. Think of simple physical contexts for which these potential energy shapes are relevant.



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4. The potential energy function for a particle executing simple harmonic motion is given by $V(x) = \frac{1}{2}kx^2$, where k is the force constant of the oscillatore. For $k = \frac{1}{2} Nm^{-1}$, show that a particle of total energy 1 joule moving under this potential must turn back when it reaches $x = \pm 2m$.

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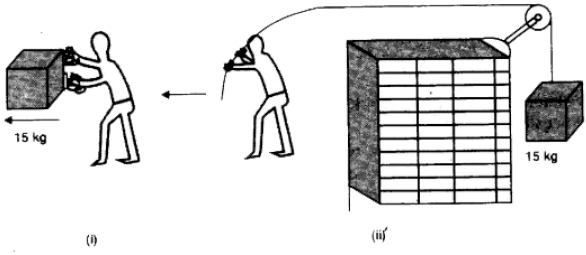
5. Answer the following:

a) The casing of a rocket in flight burns up due to friction. At whose expense is the heat required for burning obtained? The rocket or the atmosphere?

b) Comets move around the sun in highly

elliptical orbits. The gravitational force on the comet due to the sun is not normal to the comet's velocity in general. Yet the work done by the gravitatonal force over every complete orbit of the comet is zero. Why?

c) An artificial satellite orbiting the earth in very atmosphere loses its energy grdually due to dissipation against atmospheric resistance, howerver small. Why then does its speed increase progressively as it comes closer and closer tothe earth? d)In fig i) the man walks 2m carrying a mass of 15 kg on his hands. In Fig ii) he walks the same distance pulling the rope behind him. The rope goes over pulley, and a mass of 15 kg hangs at its other end. In which case is the work done greater?



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6. Underline the correct alterntaive:

a) when a conservative force does positivie work on a body, the potential energy of the body increase/decreases/remains unaltered.

work done by a body against friction always results in a loss of its kinetic /potential energy.

c) The rate of change of total momentum of a many-particle system is proportional to the external force/ sum of the internal forces on the system.

d) In an inelastic collision of two bodies, the quantities which do not change after the collision are the total kinetic energy/total linear momentum/total enregy of the system of two bodies.

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7. State if each of the following statements is true or false. Give reasons for your answer.

a) In an elastic collision of two bodies, the momentum and energy of each body is conserved.

b)Total energy of a systm is always conserved,no matter what internal and external forces on the body are present.

Work done in the motion of a body over a closed loop is zero for every force in nature.

d) In an inelastic collision, the final kinetic energy is always less than the initial kinetic energy of the sytem.

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8. Anwer carefully, with reasons:

a) 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)?

Is the total linear momentum conserved during the short time of an elastic collision of two balls?

c) What are the answers to a) and b) for an inelastic collision?

d) If the potenital energy of two billiard balls depends only on the separation distance between their centers, is the collision elastic or inelastic? (note we are talking here of potential energy corresponding to the force during collision, not gravitational potential energy).

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9. A body is initially at rest. It undergoes one-dimensional motion with constant acceleration.

The power delivered to it at time t is proportional to (i) $t^{1/2}$ (ii) t (iii) $t^{3/2}$ (iv) t^2

Watch Video Solution

10. A body is moving undirectionally under the influence of a source of constatn power. It displacement in time t is proportional to (i) $t^{1/2}$ (ii) t (iii) $t^{3/2}$ (iv) t^2

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11. A body constrained to move along the z-axis of a co-ordinate system, is subjected to a constant force $\overrightarrow{F}$ given by $\overrightarrow{F} = -\hat{i} + 2\hat{j} + 3\hat{k}$ Newton where $\hat{i}$, $\hat{j}$and $\hat{k}$ represent unit vectors along x-,y-,and z-axes of the system, respectively. Calculate the work done by this force in displacing the body through a distance of $4m$ along the z-axis.

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12. An electron and a proton are detected in a cosmic ray experiment, the first with kinetic energy 10 keV and second with 100keV. Which is faster, the electron or proton ? Obtain the ratio of their speeds. Take mass of electron $9.11 \times 10^{-31} kg.$ Mass of proton $= 1.67 \times 10^{-27} kg$ and $1eV = 1.6 \times 10^{-19} J.$

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13. A rain drop of radius 2mm, falls from a height of 500 m above the ground. It falls with decreasing acceleration due to viscous resistance of air until half its original height. It attains its maximum (terminal) speed, and moves with uniform speed there after. What is the work done by the gravitational force on the drop in the first half and second half of its journey ? Take density of water $= 10^3 kg/m^3$. What is the work done by the resistive force in the entire journey if its speed on reaching the ground is $10ms^{-1}$?

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14. A molecules in a gas container hits the wall with speed 200m/s at an angle 30° with the normal, and reboudns with the same speed. Is momentum conserved in the collision ? Is the collision elastic or inelastic ?

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15. A pump on the ground floor of a building can pump of water to fill a tank of volume $30ms^3$ in $15 \min$. If the tank is $40m$ above the ground and the efficiency of the pump is 30% , how much electric power is consumed by the pump? $\left(\text{Take} g = 10 m s^2\right)$

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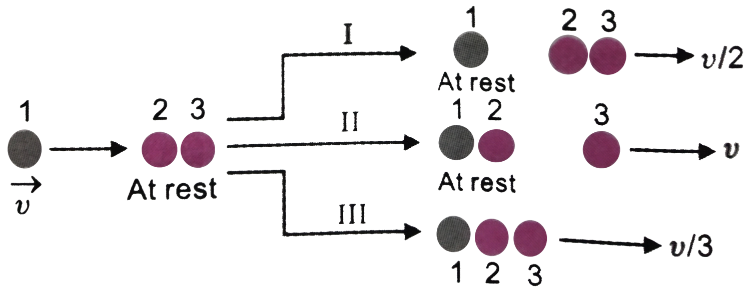
16. Two identical ball bearings in contact with each other and resting on a frictionless table are hit head on by another ball bearing of the same mass moving initially with a speed v, figure,. If the collision is elastic, which of the following is a possible result after collisioin?



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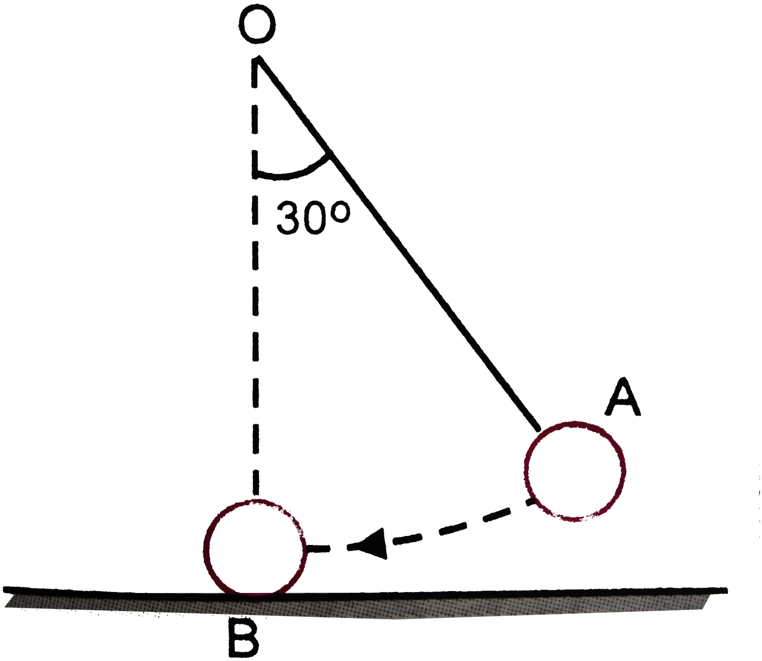
17. The bob A of a simple pendulum released from 30° to the vertical hits another bobo B of the same mass at rest on a table as shown in figure. How high does the bob A rise after the collision ? Neglect the size of the bobs and assume the collision to be elastic.



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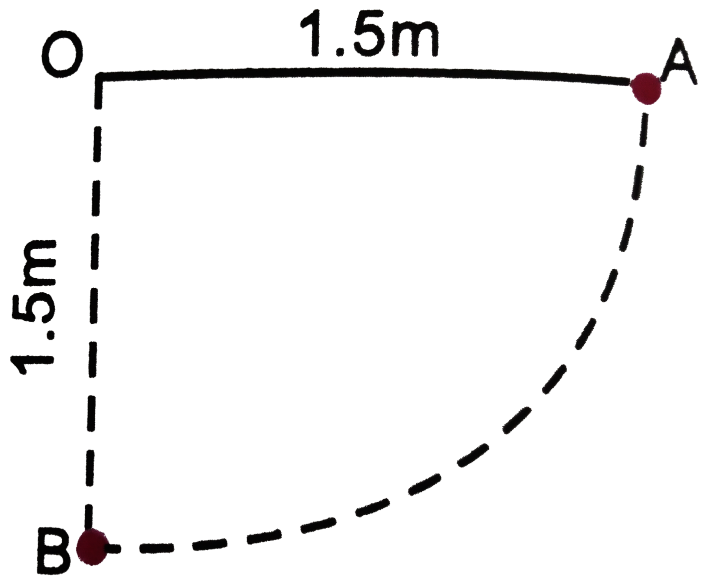
18. The bob A of a simple pendulum is released

from a horizontal position A as shownin in figure. If the length of the pendulum is 1.5m , what is the speed with which the bob arrives at the lowermost point B, given that it dissipates 5% of its initial energy against air resistance ?



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19. A trolley of mass 300 ks carrying a sand bag of 25 kg is moving uniformly with a speed of $27km/h$ on a frictionless track. After a while, sand starts leaking out of a hole on the trolley's floor at the rate of $0.05kgs^{-1}$. What is the speed of the trolley after the entire sand bag is empty ?

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20. A particle of mass $0.5kg$ travels in a straight line with velocity $v = ax^{3/2}$ where

$a = 5m^{-1/2}s^{-1}$. What is the work done by the net force during its displacement from $x = 0$ to $x = 2m$?

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21. The blades of a windmill sweep out a circle of area A. (a) If the wind flows at a velocity v perpendicular to the circle, what is the mass of air passing through it in time t? (b) What is K.E. of the air ? (c) Assume that the wind mill converts 25% of the wind's energy into electrical energy , and that

$A = 30m^2, v = 36km/h$ and the density of air is $1.2kg/m^3$. What is electrical power produced ?

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22. A person trying to lose weight (dieter) lifts a 10 kg mass through 0.5m, 1000 times, A ssume that the potential energy lost each time she lowers the mass is dissipated (a) How much work does she does against the gravitational force ? (b) Fat supplies $3.8 \times 10^7 J$ of energy per kilogram which is converted to mechanical energy with a 20% efficiency rate. How much fat will the dieter use up ?

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23. A family uses 8kW of power. (a) Direct solar energy is incident on the horizontal surface at an average rate of 200 W per square metre. If 20% of this energy can be converted to useful electrical energy, how large an area is needed to supply 8kW? (a) Compare this area to that of the roof of a typical house.

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24. A bullet of mass 0.012 kg and horizontal speed $70ms^{-1}$ strikes a block of wood of mass 0.4 kg and instantly comes to rest with respect to the block. The block is suspended from the ceiling by thin wire. Calculate the height to which the block rises. Also, estimate the amount of heat produced in the block.

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25. Two inclined frictionless tracks, one gradual and the other steep meet at O, from where two stones are allowed to slide down from rest, one on each track. Will the stones reach the bottom at the same time ? Will they reach there with the same speed ? Explain.

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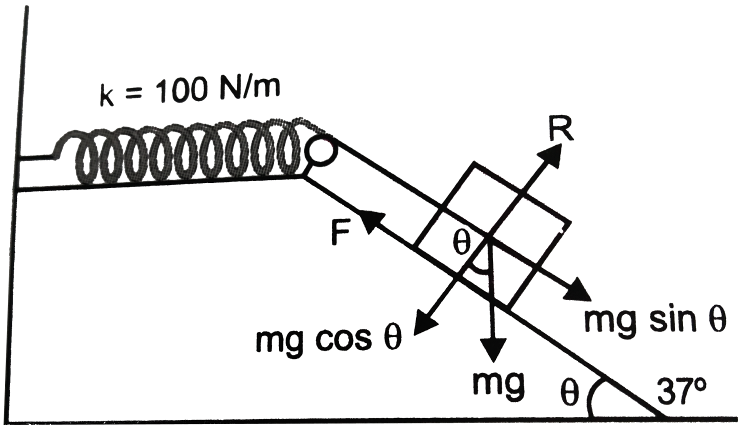
26. A 1kg block situated on a rough incline is connected to a spring of spring constant $100 Nm^{-1}$ as shown in figure,. The block is released from rest with the spring in the unstretched position. The block moves 10cm down the incline before coming to rest. Find the coefficient of friction between the block and the incline. Assume that the spring has negligible mass and the pulley is frictionless.



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27. A bob of mass 0.3 kg falls from the ceiling of an elevator moving down with a uniform speed of $7ms^{-1}$. If hits the floor of the elevator (length of the elevator $=$ 3m) and does not rebound. What is the heat produced by the impact ? Would your answer be different if the elevator were stationary ?

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28. A trolly of mass 200kg moves with a uniform speed of 36 km/h on a frictionless track. A child of mass 20kg runs on the trolly from one end to the other (10m away) with a speed of $4m/s$ relative to the trolly in a direction opposite to the trolly's motion and jumps out of the trolly. How much has teh trolly moved from the time the child begins to run ?

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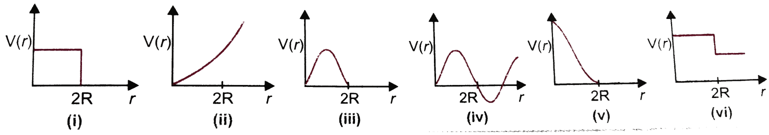
29. Which of the following potential energy curves in figure., cannot possibley describly describe the elastic collision of two billiard balls ? Here r is distance between centres of the balls.



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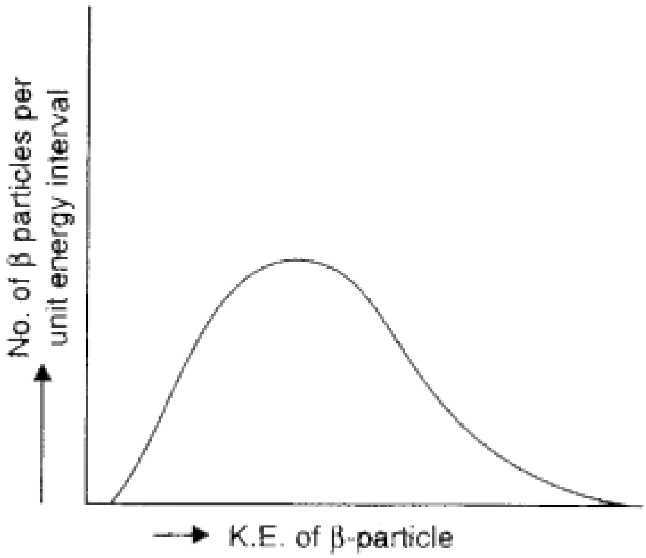
30. Consider the decay of a free neutron at rest:

n $\top$ $+e^-$ Show that the tow-body dacay of this type must necessarily give an electron of fixed energy and, therefore, cannot for the observed continous energy distribution in the

β-decay of a neutron or a nucleus.



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Additional Exercises

1. A and B are two particles having the same mass m. A is moving along X-axis with a speed of $10ms^{-1}$ and B is at rest. After undergoing a perfectly elastic collision with B, particle A gets scattered through an angle of 30°. What is th edirection of motion of B, and the speeds of A and B, after the collision?

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2. A and B are two particles having the same mass m. A is moving along X-axis with a speed

of $10ms^{-1}$ and B is at rest. After undergoing a perfectly elastic collision with B, particle A gets scattered through an angle of 30°. What is th edirection of motion of B, and the speeds of A and B, after the collision?

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3. A and B are two identical balls. A moving with a speed of $6m/s$, along the positive X-axis, undergoes a collision with B initially at rest. After collision, each ball moves along directions making angles of $\pm 30^{\circ}$ with the X-axis. What are the speeds of A and B after the collision ? I s this collision perfectly eleastic ?

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higher order thinking skills

1. Two balls A and B of masses 0.3 kg and 0.2 kg respectively are moving along positive X-axis and negaive X-axis with velocities 2.0 m/s. They collide and thereafter move in the directions opposite to their original directions.

Find the velocities of A and B after collision. Also, calculate total K.E. of the ball before and after collision.

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2. A bob of mass m attached to one end of a light rod hangs vertically. The rod is tuned throudh 90° so that it becomed horizontal and then relseased . Calculate the angle between the rod and vertical positior at which the tension in the rod is equal to weight of the bob.

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3. An object of mass 5 kg is projecte with a velocity of $20ms^{-1}$ at an angle of 60° to the horizontal. At the highest point of its path , the projectile explodes and breaks up into two fragments of masses 1kg and 4 kg. The fragments separate horizontally after the explosion, which releases internal energy such that $K.E.$ of the system at the highest point is doubled. Calculate the separation betweent the two fragments when they reach the ground.

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4. Figure, shows the transverse section of a hill. A ball of mass 0.5 kg is given a K.E. of 300J at A and rolls down to C. Assuming that there is no friction, calculate

(i) K.E. of ball at B

(ii) P.E. of ball at C, taking P.E. at A equal to zero

(iii) speed of the ball at C, and

(iv) change is P.E. in going from B to C . Take $g = 10m/s^2$

5. A 100 metric ton engine is moving up a slope of gradient 5° at a speed of 100 metre $/$ hour. The coefficient of friction between the engine and the rails is 0.1. If engine has an efficiency of 4% for converting heat into work, find the amount of coal the engine has to burn in one hour. Burning of 1 kg coal yields 50000J.

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6. A block of mass 1.2 kg moving at a speed of 20 cm /s collides head on with a similar block kept at rest. The coefficient of restitution is 3/5. find the loss of kinetic energy during the collision.

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

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8. Figure shows a loopthe loop track of raidus R. A car (without engine) starts from a platform at a distance h above the top of the loop and goes around the loop without falling off the track. Find the minimum value of h for a successful looping. Neglect friction.

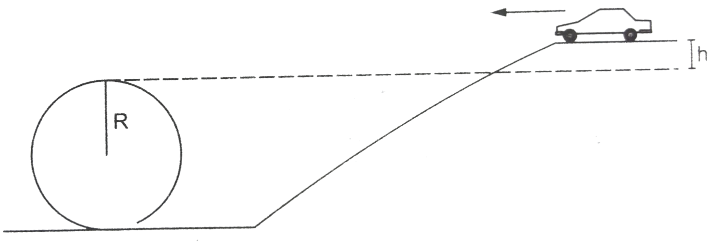

Figure 8-W9

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9. A particle of mass m moving eastward with a velocity V collides with another particle of same mass moving northwards with the same speed V. The two particles coalesce and the new particle moves in NE direction. Calculate magnitude and direction of velocity of new particle.

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10. A soild ball of density half that of water falls freely under gravity from a height of 19.6 m and then enters water. Upto what depth will the ball go. How much time will it take to come again to the water surface? Neglect air resistandce and viscosity effects in water. (Take $g = 9.8m/S^2$).

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value Based Question

1. According to work energy theorem or work energy principle, work done by net force in displacing a body is always equal to change in K.E. of the body. Similarly , if some work is drawn from the body, K.E. of the body decreases by the same amount. In either process, we assume that potential energy of the body does not change.

Read the above passage and answer the following question:

(i) A car weighing 500 kg is running at a speed of $72km / h$. In how much distance will it stope by applying a braking force of 4000N?

(ii) What are the implication of this theorem in day to day life ?

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2. In every day language, we often use the terms work, energy and power. The exact definition of these terms are related loosely to the physiological pictures these terms generate in our mind. Work done on a body is stored in the body in the form of energy. Thus, energy is capacity of the body to do the work. Power determines the rate of doing work. Tiem taken to complete the work is significant in power and not in energy.

Read the above passage and answer the following questions :

(i) Rakesh can put in long hours of work without getting tired. Does he have large energy or large power ?

What is needed in boxing or karate ?

(iii) Who is said to be a powerful leader ?

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3. Rahul and Ankur are two friends planning to go on Bharat Darshan. Rahul is a Science graduate and Ankur is an Arts graduate. They go to hire a taxi. For Maruti van as taxi, the rate is Rs. 6 per km and For an SUV as taxi, the rate is Rs. 9 per km. Rahul suggestes to Ankur to hire an SUV as taxi instead of Maruti Van , inspite of the cost factore.

Read the above passage and answer the following question.

(i) Do you agree with Rahul ? Justify.

(ii) What values are displayed by Rahul?

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4. A collision in which there is absolutely no loss of $K.E.$ is called an elastic collision. In such a collision, the linear momentum , total energy and kinetic energy, all are conserved.The coefficient of restitution / resilience of perfectly elastic collisions is unity.

Read the above passage and answer the following questions :

(i) When two bodies of equal masses undergo perfectly elastic collision in one dimension, what happens to their velocities ?

(ii) How is this fact applied in a nuclear reactor ?

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5. A force is said to be conservative if work done by or agains the force depends only on initial and final positions of the body and not on the nature of path followed.

A force is said to be non-conservative, if work done by or against the force in moving a body from one position to another, depeds on the path followed between these two positions.

Potential energy is defined only for conservative forces. It does not exist for non-conservative forces.

Read the above passage and answer the following question :

(i) Give two examples, each for conservative and non-conservative forces.

(ii) Potential energy does not exist for non-conservative forces. What does it imply ini day to day life ?

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Multiple choice question

1. The correct relattion between joule and erg is

A. $1J = 10^{-7} erg$

B. $1J = 10^{7} erg$

C. $1J = 10^{-5} erg$

D. $1J = 10^{5} erg$

Answer: B

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2. When a body is thrown up, work done by gravity on the body is

A. positive

B. zero

C. negative

D. cannot say

Answer: C

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3. A person holds on a weight of $10kg$ at a height of $5m$ above the ground for 5 minutes. Work done by him is

A. zero

B. $50J$

C. $250J$

D. $300J$

Answer: A

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4. A body is undergoing non-uniform circular motion. Work done by radial force on the body is

A. zero

B. positive

C. negative

D. none of these

Answer: A

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5. In Q.4. work done by tangential force on the body is

A. zero

B. non-zero

C. sometimes zero and other times not

D. cannot say

Answer: B

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6. Which one of the following is a non-conservative force ?

A. gravitational force

B. electrostatic force

C. magnetic force

D. force of friction

Answer: D

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7. The linear momentum of a body is increased by 10%. What is the percentage change in its KE?

A. 10%

B. 20%

C. 21%

D. none of these

Answer: C

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8. Electric potential energy V between two charges varies with distance (r) between them as

A. $V \propto r$

B. $V \propto \frac{1}{r}$

C. $V \propto r^2$

D. $V \propto \frac{1}{r^2}$

Answer: B

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9. In any kind of collision

A. linear momentum is always conserved

B. kinetic energy is always conserved

C. both (a) and (b)

D. neither (a) nor (b)

Answer: A

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10. For a perfectly elastic collision and a perfectly inelastic collision, values of coefficient of restitution are respectively

A. $0, 0$

B. $0, 1$

C. $1, 1$

D. $1, 0$

Answer: D

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11. The balls, having linear momenta $\overrightarrow{p}_1 = \overrightarrow{\pi}$ and $\overrightarrow{p}_{2\_2} = -\overrightarrow{\pi}$, undergo a collision in free space. There is no external force acting on the balls. Let $\overrightarrow{p}'_1$ and $\overrightarrow{p}'_2$ be their final momenta.The following option (s) is (are) NOT ALLOWED for any non-zero value of $p, a_1, a_2, b_1, b_2, c_1$ and c_2.

A. $\overrightarrow{p'_1} = a_1\hat{i} + b_1\hat{j} + c_1\hat{k}, \overrightarrow{p'_2} = a_2\hat{i} + b_2\hat{j}$

B. $\overrightarrow{p'_1} = c_1\hat{k}, \overrightarrow{p'_2} = c_2\hat{k}$

C.

$$\overrightarrow{p'_1} = a_1\hat{i} + b_1\hat{j} + c_1\hat{k}, \overrightarrow{p'_2} = a_2\hat{i} + b_2\hat{j} - c_1\hat{k}$$

D. $\overrightarrow{p_1'} = a_1\hat{i} + b_1\hat{j}, \overrightarrow{p_2'} = a_2\hat{k} + b_1\hat{j}$

Answer: A::D

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12. When work done on a particle is positive, then its

A. KE increases

B. KE decreases

C. KE remains constant

D. momentum increases

Answer: A::D

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13. A particle is acted upon by a force of constant magnitude which is always is perpendicular to the velocity of the particle, the motion of the particles takes place is a plane it follow that

A. its velocity is constant

B. its acceleration is constant

C. its KE is constant

D. it moves in a circular path

Answer: C::D

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14. You lift a suitcase from the floor and keep it on a table. The work done by you on the suitcase does not depend on

A. the path taken by suitcase

B. the time taken by you in doing so

C. weight of suitcase

D. frame of reference

Answer: A::B

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15. If the force is always perpendicular to motion, then KE remains constant

A. KE remains constant

B. Work done is zero

C. velocity is constant

D. speed is constant

Answer: A::B::D

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16. A point mass of 1kg collides elastically with a stationary point mass of 5 kg. After their collision, the 1kg mass reverses its direction and moves with a speed of $2ms^{-1}$. Which of the following statements (s) is (are) correct for the system of these two masses?

A. Total momentum of the system is $3kgms^{-1}$

B. Momentum of $5kg$ mass after collision is $4kgms^{-1}$

C. Kinetic energy of the centre of mass is $0.75J$

D. Total kinetic energy of the system is $4J$

Answer: A::C

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

A. the spring was initially compressed by a distance x and was finally in its natural length

B. it was initially in its natural length and finally in a compressed position

C. it was initially stretched by a distance x and finally was in its natural length

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

Answer: A::C

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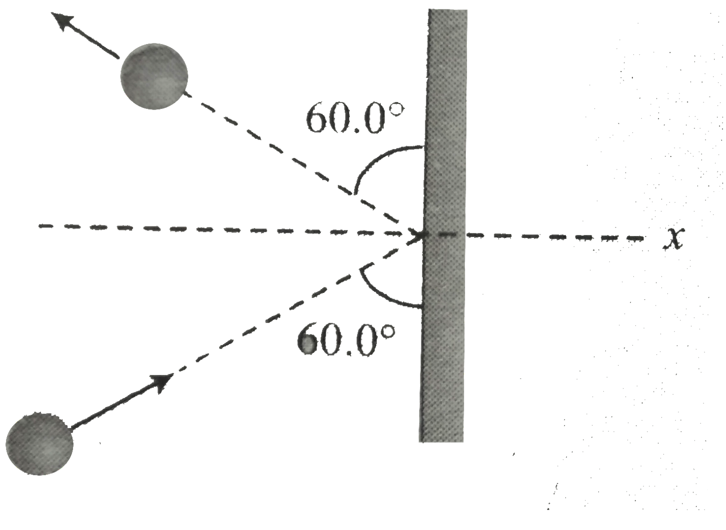
18. A 3-kg steel ball strikes a wall with a speed of $10.0ms^{-1}$ at an angle of 60.0° with the surfaces of the wall. The ball bounces off with the same speed and same angle. If the ball was in contact with the wall for 0.2s, find the average force exerted by the wall on the ball.



A. $300N$

B. zero

C. $150\sqrt{3}N$

D. $150N$

Answer: D

Watch Video Solution

19. A force F acting on a body depends on its displacement S as $F \propto S^{-1/3}$. The power delivered by F will depend on displacement as

A. $S^{2/3}$

B. $S^{1/2}$

C. S

D. S^{0}

Answer: D

Watch Video Solution

20. A heavy stone is thrown from a cliff of height h in a given direction. The speed with which it hits the ground

A. must be larger than the speed of projection

B. must be independent of the speed of projection

C. must depend on the speed of projection

D. may be smaller than the speed of projection.

Answer: A::C

Watch Video Solution

21. A ball falls vertically onto a floor with momentum p and then bounces repeatedly. If coefficient of restitution is e, then the total momentum imparted by the ball to the floor is

A. $p(1+e)$

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

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

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

Answer: C

Watch Video Solution

22. No work is done by a force on an object if

A. the object is stationary but the point of aplication or the force moves on the object

B. the object moves in such a way that the point of application of the force remains fixed

C. the force is always perpendicular to its velocity

D. the force is always perpendicular to its acceleration.

Answer: A::B::D

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23. A particle is acted upon by a force of constant magnitude which is always perpendiculr to the velocity of the particle. The motion of the particle takes place in a plane. It follows that

A. it moves in a circular path

B. its velcoity is constant

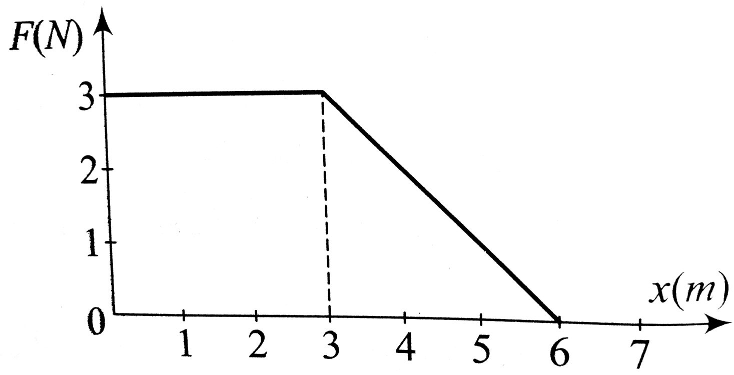
C. its acceleration is constant

D. its kinetic energy is constant

Answer: A::D

Watch Video Solution

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



A. $18.0J$

B. $13.5J$

C. $4.5J$

D. $9.0J$

Answer: B

Watch Video Solution

25. The upper half of an inclined plane with inclination ϕ is perfectly smooth while the lower half is rough. A body starting from rest at the top will again come to rest at the bottom if the coefficient of friction for the lower half is given by

A. $\tan\phi$

B. $2\tan\phi$

C. $2\cos\phi$

D. $2\sin\phi$

Answer: B

Watch Video Solution

26. A ball hits a floor and rebounds after an inelastic collision. In this case

A. the total energy of the ball and the earth remains the same

B. the total momentum of the ball and the earth is conserved

C. the momentum of the ball just after collision is same as that just before the collision

D. the mechanical energy of the ball remains the same during the collision.

Answer: A::B

Watch Video Solution

27. A smooth block is released at rest on a 45° incline and then slides a distance 'd'. The time taken to slide is 'n' times as much to slide on rough incline than on a smooth incline. The coefficient of friction is

A. $\mu_s = \sqrt{1 - \frac{1}{n^2}}$

B. $\mu_s = 1 - \frac{1}{n^2}$

C. $\mu_k = \sqrt{1 - \frac{1}{n^2}}$

D. $\mu_k = 1 - \frac{1}{n^2}$

Answer: D

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28. A body moving towards a finite body at rest collides with it. It is possible that

A. both the bodies move after collision

B. both the bodies come to rest

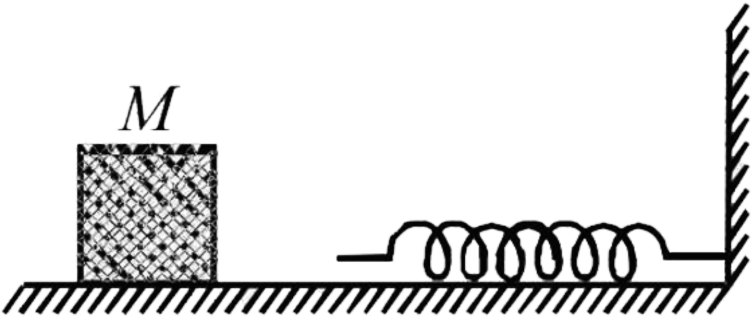
C. the stationary body remains stationary, the moving body changes its velocity

D. the moving body comes to rest and the stationary body stationary body starts moving.

Answer: A::D

Watch Video Solution

29. The block of mass M moving on the frictionless horizontal surface collides with the spring constant k and compresses it by length L . The maximum momentum of the block after collision is



A. $\frac{ML^2}{K}$

B. zero

C. $\frac{KL^2}{2M}$

D. $L\sqrt{MK}$

Answer: D

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Fill in the blanks

1. In a perfectly elastic collision in two dimensions between two particles of ....mass,the two particles move at ....to each other.

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2. Work is said to be done by a force when ....in the ....of the force

Watch Video Solution

3. Absolute unit energy on SI is ....and on CGS system,it is ....where............ = ...

Watch Video Solution

4. A weight lifter does...............in lifting the weight...................the ground but .... in...................the weight up.

Watch Video Solution

5. Work Done By A Variable Force

Watch Video Solution

6. Gravitational force is ....and frictional force is a................ .

Watch Video Solution

7. Power of a person / machine is defined as the ....at which ....

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8. The linear momentum of a body is increased by 10%. What is the percentage change in its KE?

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9. According to work energy principle, work done by ....in displacing body .... to...................... in.................. .

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10. A collision is an isolated event in which..................exert...................on one another for.................. .

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Problems For Practice

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

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2. A man moves on a straight horizontal road with a block of mass 2 kg in his hand. If he covers a distance of $40m$ with an acceleration of $1ms^{-2}$, find the work done by the man.

Watch Video Solution

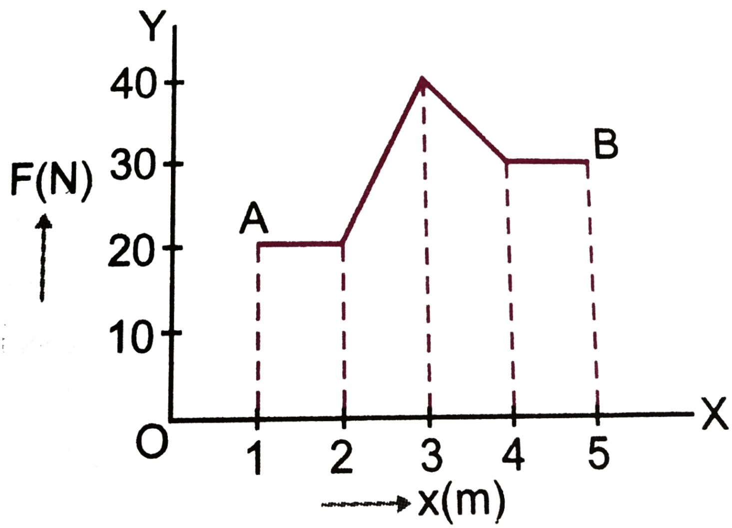
3. Calculate work done in raising a stone of mass 5kg and specific gravity 3 lying at the bed of a lake through a height of 4 metre.

Watch Video Solution

4. A man weighing $60kg\ f$ suports a body of $20kgf$ on his head. Calculate work done by him in moving a distance of $15m$ up an incline of 1 in 10 . Take $g = 9.8m/s^2$

Watch Video Solution

5. A body moves from a point A to B under the action of a force shown in figure. What is the amount of work done ?



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

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7. A man weighing $55kg$ supports a body of $20kg$ on his head. Calculate work done by him if he moves a distance of $20m(i)$ on a horizontal road, (ii) upon a smooth incline of 1 in 5. Take

$g = 10ms^{-2}$

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8. A body of mass $0.3kg$ is taken up an inclined plane of length $10m$ and height $5m$, and then allowed to slide down to the bottom again. The coefficient of friction between the body and the plane is 0.15.

What is the

(a) work done by the gravitational force over the round trip ?

(b) work done by the applied force on the upward journey ?

(c) work done by the frictional force over the round trip ,

(d)kinetic energy of the body at the end of the trip ?

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9. A force exerts an impulse J on a body changing its speed from u to v. The force and object's motion are along the same line. Show that the work done by the force is $J(u+v)/2$

Watch Video Solution

10. A particle moves from a point $\overrightarrow{r}_2 = \left(2\hat{i} + 3\hat{j}\right)$ to another point $\overrightarrow{r}_2 = \left(3\hat{i} + 2\hat{j}\right)$ during which a certain force $\overrightarrow{F} = \left(5\hat{i} + 5\hat{j}\right)$ acts on it. Calculate work done by the force on the particle during this displacement.

Watch Video Solution

11. In a ballistic demonstration, a police officer fires a bullet of mass $50g$ with a speed of $220m/s$ on a wooden target. The bullet emerges with 20% of its initial $K.E.$ What is the emergent speed of the bullet ?

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

Watch Video Solution

13. A toy rocket of mass 0.1 kg hass a small fuel of mass 0.02 kg, which it burns out in 3s. Starting from rest on a horizontal smooth track, it gets a speed of $20ms^{-1}$ after the fuel is burnt out. What is the approcimate thrust of the rocket ? What is the energy content per unit mass of the fuel ? (Ignore the small mass variation of teh rocket during fuel burning).

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14. While catching a cricket ball of mass $200g$ moving with a velocity of $20ms^{-1}$, the player draws his hands backwards through $20cm$. Find the work done in catching the ball and the average force exerted by the ball on the hand.

Watch Video Solution

15. A body of mass $2kg$ is resting on rough horizontal surface. A force $20N$ is applied to it for $10s$ parallel to the surface. If coefficient of kinetic friction between the surfaces in contact in 0.2. Caluculate (i) work done by applied force in $10s$. (ii) change in KE of object in $10s$.

Take $g = 10m / s^2$

Watch Video Solution

16. Themasses of $1g$ and $4g$ are moving with equal kineticc energies. Calculate the ration of the magnitudes of their linear momenta.

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17. Linear momentum of particle is increased by

(a) 100% (b) 1%

without changing its mass. Find percentage increase in its kinetic energy in both cases.

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18. An automobile moving at a speed of $72kmh^{-1}$ reaches the foot of a smooth incline, when the engine is switched off. How much distance does the automobile go up the incline before coming to rest. The angle of inclination with horizontal is 30° and $g = 9.8 m s^{-2}$?

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19. A bullet weighing $10 g$ is fired with a velocity of $800 m s^{-1}$. After passing through a mud wall $1 m$ thick, its velocity decreases to $100 m s^{-1}$. Find the average resistance offered by the mud wall.

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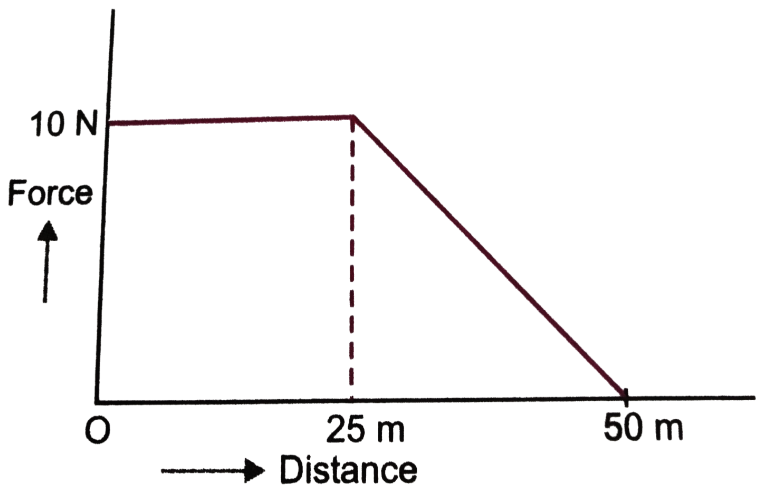
20. A body of mass $5kg$ is acted upon by a variable force. The force varies with the distance covered by the body as shown in figure. What is the speed of the body when it has covered $25m$? Assume that the body starts from rest.



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21. A horizontal force of $5N$ acts on a body of mass $2kg$ initally at rest. It starts moving on a table having coefficient of friction $= 0.2$ Calculate

(i) work doen by the applied force in $5s$

(ii) work done by force of friction in $5s$

(iii) work done by net force is $5s$

(iv) change in $K.E.$ of the body in $5s$.

What do you conclude from this ?

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22. A girl of mass $40kg$ sits on a swing formed by a rope $6m$ long. A person pulls the swing to a side so that the rope makes an angle of 60° with vertical . What is the gain in $P.E.$ of the girl.

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23. A ball bounce of 80% of its original height . What fraction of its mechanical energy is lost in each bounce ?

Watch Video Solution

24. A simple pendulum of length $1m$ has a wooden bob of mass $1kg$. It is struck by a bullet of mass $10g$ moving with a speed of $200m/s$. The bullet gets embedded into the bob. Obtain the height to which the bob rises before swinging back.

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

Watch Video Solution

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

Watch Video Solution

26. A pendulum bob has a speed 3m/s while passing thorugh its lowest position. What is its speed when it makes an angle of 60^0 with the vertical? The length of the pendulum is 0.5m Take $g = 10\frac{m}{s^2}$.

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27. A $16kg$ block moving on a frictionless horizontal surface with a velocity of $4m/s$ compresses an ideal spring and comes to rest. If the force constant of the spring be $100N/m$, then how much is the spring commpressed ?

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28. The bob of a pendulum has its rest point 1 metre below the support. The bob is pulled aside until the string makes an angle of 15° with the vertical. Upon release, with what speed does the bob swing past its rest point ?

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29. The string of a pendulum is $2.0m$ long. The bob is pulled sideways so that the string becomes horizontal and then the bob is released. What is the speed with which the bob arrives at the lowest point ? Assume theat 10% of initial energy is dissipated against air resistance. Take $g = 10m/s^2$

Watch Video Solution

30. A spring gun has a spring constant of $80Ncm^{-1}$. The spring is compressed $12cm$ by a ball of mass $15g$. How much is the potential energy of the spring ? If the trigger is pulled, what will be the velocity of ball ?

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31. A ball of mass m is droppped from a height h on a platform fixed at the top of a vertical spring. The platform is depressed by a distance x. What is the spring constant K?

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

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33. A certain spring that obeys Hook's law is stretched by an external agent. The work done in stretching the spring by $10 cm is 4J$. How much additional work is required to stretch the spring an additional $10cm$?

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34. A spring of force constant 24N / m is resting on a frictionless horizontal surface. A force of 10N is applied on the block of mss 4kg at one end of the spring. What is the speed of the block when it has been moved through a distance of 0.5 m ?

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35. An object is attached to a vertical springs and lowered slowly to its equilibrium position. This stretches the spring by a distance d. If the same object is attached to the same vertical spring, but permitted to fall freely, through what distance does it stretch the spring ?

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36. About $4 \times 10^9 kg$ of matter is converted into energy in the sun each second. What is the power output of the sun ?

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37. Show that energy equivalent of one atomic mass unit is nearly $933 MeV$.

Take $1 amu = 1.66 \times 10^{-27} kg$

Watch Video Solution

38. What is the minimum energy released in the annhilation of an electron positron pair?

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39. When slow neutrons are incident on a target containing ${ }_{\cdot 92} U^{235}$, a possitle fission reactionis

$${ }_{\cdot 92} U^{235}+n \rightarrow { }_{\cdot 56} Ba^{141}+_{36} Kr^{92}+3n+Q$$

Estimate the amount of energy released using the following data :

$$M\left[{ }_{\cdot 92} U^{235}\right]=235.04u,$$

$M\left[{}_{\cdot 56}Ba^{141}\right] = 140.91u,$

$M\left[{}_{\cdot 36}Kr^{92}\right] = 91.926u,$

$M_n = 1.0087u.$

Take $1u = 1.661 \times 10^{-27} kg.$

$1MeV = 1.602 \times 10^{-13} J$

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40. A nucleus of radium $\left({}_{\cdot 88}Ra^{226}\right)$ decays to ${}_{\cdot 86}Rn^{222}$ by emisson of $\alpha -$ particle $\left({}_{\cdot 2}He^{4}\right)$ of energy $4.8MeV$. If meass of ${}_{\cdot 86}Rn^{222} = 222.0a.m.u$ mass of ${}_{\cdot 2}He^{4}$ is 4.003 a.m.u. and mass of

$\cdot_{88} Ra^{226}$ is 226.00826 a.m.u., then calculate the recoil energy of the daughter nucleus. Take $1 a. m. u. = 931 MeV$

Watch Video Solution

41. If $1000 kg$ of water is heated from $0^{\circ} C$ to $100^{\circ} C$, calculate the increase in mass of water.

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42. A well $20m$ deep and $3m$ is diameter contains water to a dept of $14m$. How long will a $5hp$ engine take to empty it ?

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43. An elevator which can carry a maximum load of $1800kg$ is moving with a constant speed of $2ms^{-1}$. The frictional force opposing the motino is $5000N$. Calculate the minimum power delivered by the motor to the elevator in watt and hp ?

Take $g = 10m / s^2$

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44. A lift is designed to carry a load of 4000 kg through 10 floors of a building, avarage 6m per floor, in 10s. Calculate the power of the lift.

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45. An engine pumps up $100kg$ water through a height of $10m$ in $5s$. If efficiency of the engine is 60%. What is the power of the engine? $Takeg = 10ms^2$.

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46. A pump can throw up 10 quntals of coal per hour from a coal mine $120m$ deep. Calculate the power of the engine in watt assuming that efficiency is 80%.

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47. Find the power of a person who can chew $30g$ of ice in one minute. Latent heat of ice $= 80cal/gm, J = 4.2$joule/cal.

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48. A car of mass $2000kg$ is lifted up a distance of $30m$ by a crane in 1 minute . A second crane does the same job in 2 minues. Do the cranes consume the same or different amounts of fuel

? What is the power supplied by each crane ? Neglect power disspation against friction.

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

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50. A car of mass 1000kg accelerates uniformly from rest to a velocity of $54km/h$ in 5 seconds. Calculate (i) its acceleration (ii) its gain in KE (iii) average power of the engine during this period.

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51. A car weighing $1120kg$ is going up an incline of 1 in 56 at the rate of $20m$ in $2s$. Find the power of the engine if frictional force is $64N$.

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52. A train weighing 100 metric ton is running on a level track with a uniform speed of $72kmh^{-1}$. If the frictional resistance amounts to $0.5kg$ per metric ton, find the power of the engine

Watch Video Solution

53. An engine of weight 6.5 metric ton is going up an inclined plane of 5 in 13 at the rate of $9km/h$. If the coefficient of friction is $\frac{1}{120}$.

Calculate the power of the engine. Take $g = 9.8 m / s^2$

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54. The human heart forces $4000 cm^3$ of blood per minute through the arteries under pressure of $130 mm$. The density of blood is $1.03 g / cc$. What is the horse power of the heart ?

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55. A ball moving with a speed of $9m/s$ strikes an identical ball at rest, such that after the collision, the direction of each ball makes an angle of 30° with the original line of motion. Find the speeds of the two balls after collision.

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56. A nucleus of radium $\left(._{88}Ra^{226}\right)$

decays to $._{86}Rn^{222}$

by emisson of $\alpha -$ particle $\left(._{2}He^{4}\right)$ of energy $4.8MeV$. If meass of $._{86}Rn^{222} = 222.0a.m.u$

mass of $._{2}He^{4}$ is 4.003 a.m.u. and mass of $._{88}Ra^{226}$ is 226.00826 a.m.u., then calculate the recoil energy of the daughter nucleus. Take $1a.m.u. = 931MeV$

Watch Video Solution

57. A body of mass 2 kg makes an elastic collision with another body at rest and contiues to move in the original direction with a speed equal to one thrid of its original speed. Find the mass of the second body.

Watch Video Solution

58. What percentage of $K.E.$ of a moving particle is transferred to a stationary particle when it stikes the stationary particle of 4 times its mass?

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59. A bomb at rest explodes into two fragments of masses $3.0kg$ and $1.0kg$. The total kinetic energy of the fragments is $6 \times 10^4 J$. Calculate

(i) , kinetic energy of the bigger fragment (ii) momentum of the smaller fragment.

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60. A uranium 238 nucleus, initially at rest emits an alpha particle with a speed of $1.4 \times 10^7 \frac{m}{s}$. Calculate the recoil speed of the residual nucleus thorium 234. Assume that the mas of a nucleus is proportional to the mass number.

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61. The first ball of mass m moving with the velocity v collides head on with the second ball of mass m at rest. If the coefficient of restitution is e, then the ratio of the velocities of the first and the second ball after the collision is

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62. What percentage of $K.E.$ of a moving particle is transferred to stationary sphere particle , when it strikes the stationary particle of (a) 100 times its mass (b) equal mass ?

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63. What percentage of $K.E.$ of a moving particle is transferred to a stationary particle, when moving particle strikes with a stationary particle of mass (a) 19 times in mass (b) equal in mass (c) $\frac{1}{19}$ th of its mass ?

A. k

B.

C.

D.

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64. A simple pendulum of length $1m$ has a wooden bob of mass $1kg$. It is struck by a bullet of mass $10g$ moving with a speed of $200m/s$. The bullet gets embedded into the bob. Obtain the height to which the bob rises before swinging back.

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

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65. A moving body of mass m makes a head on elastic collision with another body of mass $2m$ which is initially at rest. Find the fraction of kinetic energy lost by the colliding particles after collision.

Watch Video Solution

66. A particle of mass m strikes on ground with angle of incidence 45°. If coefficient of restitution, $e = \frac{1}{\sqrt{2}}$, find the velociy after impact and angle of reflection.

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67. A body of mass m falls from a height h and collides with another body of same mass at rest. After collision, the two bodies combine and move through distance (d) till they come to rest. Find the work done against the resistive force.

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68. A $10kg$ ball and a $20kg$ ball approach each other with velocities $20m/s$ and $10m/s$ respectively. What are their velocities after collision, if the collision is perfectly elastic ?

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69. A sphere of mass m collides against a pendulum of mass m with horizontal velocity v_{90}). (i) Calculate the maximum height reached by the pendulum if the masses scatter elastically along the line of initial motion, (ii) What is the maximum height reached by the pendulum if the two masses stick together ?

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70. A ball moving on a horizontal frictionless plane hits an identical ball at rest with a velocity of $0.5m/s$. If the collision is elastic, calculate the speed imparted to the target ball, if the speed of projectile after the collision is $30cm/s$. Show that the two balls will move at right angles to eachother, after the collision.

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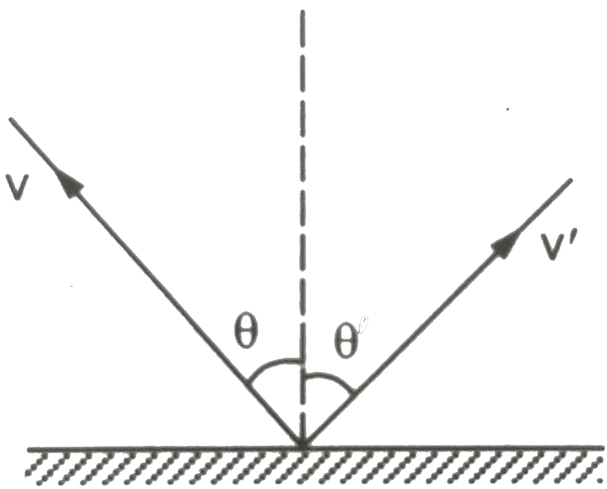
71. A ball moving with velocity $2ms^{-1}$ collides head on with another stationary ball of double the mass. If the coefficient of restitution is 0.5, then their velocities (in ms^{-1}) after collision will be

Watch Video Solution

72. A ball of a mass m hits the floor with as speed v making an angle of incidence θ with the normal. The coefficient of restitution is e. Find the speed of the reflected ball and the angle of reflection of the ball.



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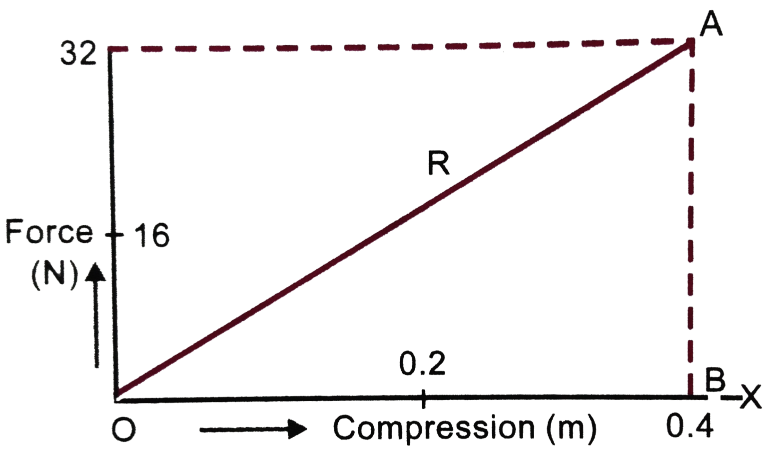
73. Figure shows a force compression curve of a spring. A body of mass $5kg$ moving with the velocity of $8m/s$ hits the spring. Calculate the force constant of the spring and also the compression produced in the spring when the body hits it.



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74. A body falling on the ground from a height of $10m$ rebounds to a height of $2.5m$. Calculate (i) the percentage loss of kinetic energy of the body during its collision with the ground. (ii) ratio of the velocities of the body just before and just after collision.

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75. The iron Fe^{27} nucleus emits a y-axis of energy 14.4KeV. If mass of nucleus is 56.935u, calculate the recoil energy of the nucleus. Take $1u = 1.66 \times 10^{-27} kg.$

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76. A particle moves in a straight line with retardatino proportional it its displacement. Calculate the loss of $K.E.$ for any displacement x.

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NCERT(Multiple choide questions-1)

1. An electron and a proton are moving under the influence of mutual forces. In calculating the change in the kinetic energy of the system during motion, one ignores the magnetic force of one on another. This is because,

A. the two magnetic forces are equal and opposite, so they produce no net effect.

B. the megnetic forces do not work on eaxh particle.

C. the magnetic forces do equal and oppite (but non-zero) work on each particle

D. the magnetic forces are necessarily negligible.

Answer: B

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2. A proton is kept at rest. A positively charged particle is released from rest at a distance d in its field. Consider two experiments, one ini which the charged particle is also a proton and in another, a position. In the same time t, the work done on the two moving charged particles is

A. same as the same force law is involved in the two experiments.

B. less for the case of a positron, as the positron moves away more rapidly and the force on it weakens.

C. more for the case of a positron, as the positron moves away a larger distance.

D. same as the work done by charged particle on the stationary proton.

Answer: C

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3. A man squatting on the ground gets straight up and stand. The force of reaction of ground on the man during the process is.

A. constant and equal to mg in magnitude.

B. constant and greater than mg in magnitude.

C. variable but always greater than mg.

D. at first greater than mg, and later becomes equal to mg

Answer: D

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4. A bicyclist comes to a skidding stop in $10m$. During this process, the force on the bicycle due to the road is $200N$ and is directly opposed to the motion. The work done by the cycle on the road is

A. $+2000J$

B. $-2000J$

C. zero

D. $-20000J$

Answer: C

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5. A body is falling freely under the action of gravity alone in vacuum. Which of the following quantities remain constant during the fall ?

A. Kinetic energy

B. Potential energy

C. Total mechanical energy

D. Total linear momentum.

Answer: C

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6. During inelastic collision between two bodies, which of the following quantities always remain conserved ?

A. Total kinetic energy.

B. Total mechanical energy

C. Total linear momentum

D. Speed of each body.

Answer: C

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7. Two inclined frictionless tracks, one gradual and the other steep meet at O, from where two stones are allowed to slide down from rest, one on each track. Will the stones reach the bottom at the same time ? Will they reach there with the same speed ? Explain.

A. $V = O, K = E$

B. $V = E, K = O$

C. $V < E, K = O$

D. $V = O, K < E.$

Answer: C

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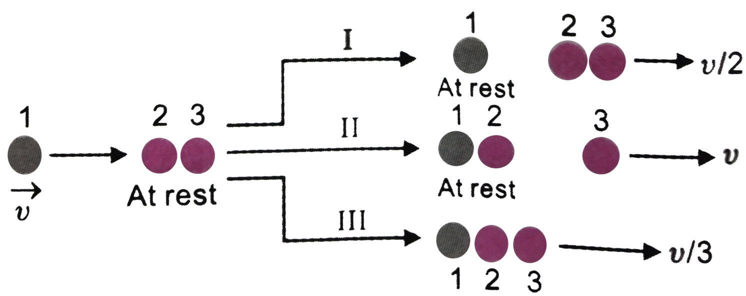
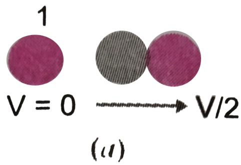
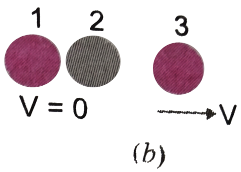
8. The potential energy function for a particle executing simple harmonic motion is given by $V(x) = \frac{1}{2}kx^2$, where k is the force constant of the oscillatore. For $k = \frac{1}{2}Nm^{-1}$, show that a particle of total energy 1 joule moving under this potential must turn back when it reaches $x = \pm 2m$.

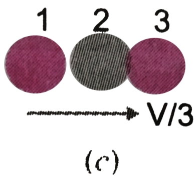
Watch Video Solution

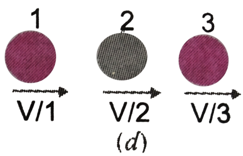
9. Two identical ball bearings in contact with each other and resting on a frictionless table are hit head on by another ball bearing of the same mass moving initially with a speed v, figure,. If the collision is elastic, which of the following is a possible result after collisioin?



A. 

B. 

C. 

D. 

Answer: B

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10. A particle of mass $0.5 kg$ travels in a straight line with velocity $v = a x^{3/2}$ where $a = 5 m^{-1/2} s^{-1}$. What is the work done by the net force during its displacement from $x = 0$ to $x = 2 m$?

A. $1.5 J$

B. $50 J$

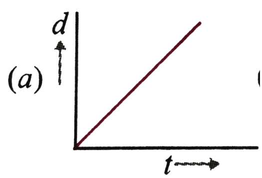
C. $10 J$

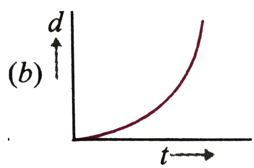
D. $100 J$

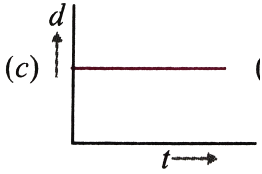
Answer: B

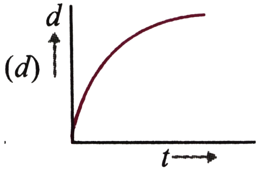
Watch Video Solution

11. A body is moving unidirectionally under the influence of a source of constant power supplying energy. Which of the diagrams shown in figure. Correctly shows the displacement-time curve for its motion ?

A. 

B. 

C. 

D. 

Answer: B

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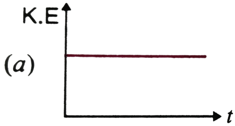
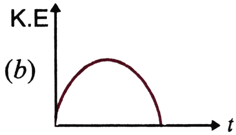
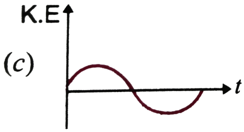
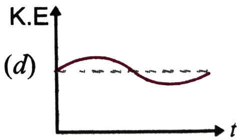
12. Which of the diagrams shown in figure. Most closely shows the variation in kinetic energy of the earth as it moves once around the sun in its elliptical orbit ?

A. 

B. 

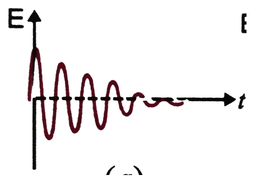
C. 

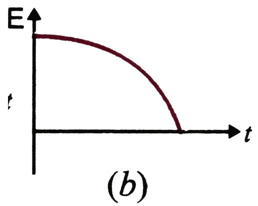
D. 

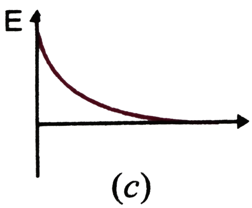
Answer: D

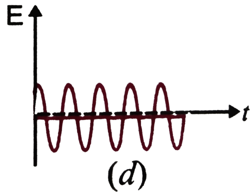
Watch Video Solution

13. Which of the diagram shown in figures respresents variation of total mechanical energy of a pendulam oscillation in air as function of time?

A. 

B. 

C. 

D. 

Answer: C

Watch Video Solution

14. A mass of $5kg$ is moving along a circular path or radius $1m$. If the mass moves with 300 revolutions per minute, its kinetic energy would be

A. $250\pi^2$

B. $100\pi^2$

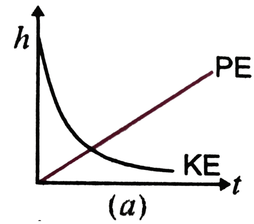
C. $5\pi^2$

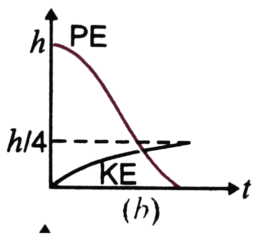
D. 0

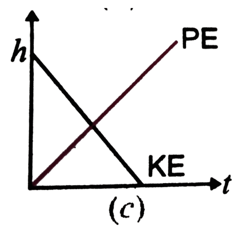
Answer: A

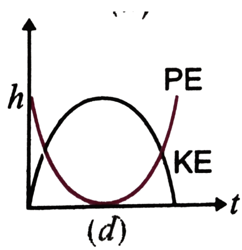
Watch Video Solution

15. A raindrop falling from a height h above ground, attains a near terminal velocity when it has fallen through a height $(3/4)h$. Which of the diagrams shown in figure correctly shows the change in kinetic and potential energy of the drop during its fall up to the ground ?

A. 

B. 

C. 

D. 

Answer: B

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16. In a shotput event, an athlete throws the shotput of mass $10kg$ with an initial speed of $1ms^{-1}$ at 45° from a heigth $1.5m$ above ground. Assuming air resistance to be negligible and acceleration due to gravity to be $10ms^{-2}$, the kinetic energy of the shotput when it just reaches the ground will be

A. $2.5J$

B. $5.0J$

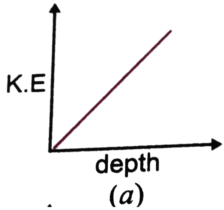
C. $52.5J$

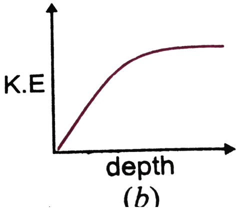
D. $155.0J$

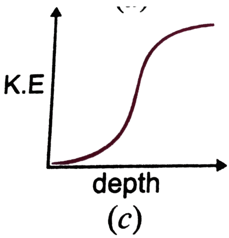
Answer: D

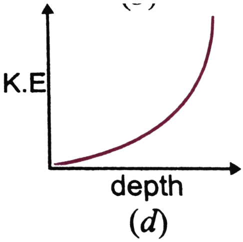
Watch Video Solution

17. Which of the diagrams in figure, correctly shows the change in kinetic energy of an iron sphere falling freely in a lake having sufficient depth to impart if a terminal velocity ?

A. 

B. 

C. 

D. 

Answer: B

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18. A cricket ball of mass $150g$ moving with a speed of $126km/h$ hits at the middle of the bat, held firmly at its position by the batman. The ball moves straight back to the bowler after hitting the bat. Assuming that collision between ball and bat is completely elastic and the two remain in contact for $0.001s$, the force that the batsman had to apply to hold the bat firmly at its place would be

A. $10.5N$

B. $21N$

C. $1.05 \times 10^4 N$

D. $2.1 \times 10^4 n$

Answer: C

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19. A man of mass m, standing at the bottom of the staircase of height L climbs it and stands at its top.

A. Work done by all forces on man is equal to the rise in potential energy mgL.

B. Work done by all forces on man is zero

C. Work done by the gravitational force on man is mgL

D. The reaction force from a step does not do work because the point of application of the force does not move while the force exists.

Answer: B::D

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20. A bullet of mass m fired at 30° to the horizontal leaves the barrel of the gun with a velocity v. The bullet hits a soft target at a height h above the ground while it is moving downward and emerges out with half the kinetic energy it had before hitting the target.

Which of the following statments are correct in respect of bullet after it emerges out of the target ?

A. The internal energy of the particles of the target will increase.

B. The velocity of the bullet will be more than half of its earlier velocity.

C. The bullet with continue to move along the same parablic path.

D. The bullet will move in a diffeent parabolic path.

Answer: A::B::D

Watch Video Solution

21. Two blocks M_1 and M_2 having equal mass are free to move on a horizontal frictionless surface. M_2 is attached to a massless spring as shown in figure. Initially M_2 is at rest and M_1 is moving toward M_2 with speed v and collides head-on with M_2.

A. While spring is fully compressed, all the KE of M_1 is stored as PE of spring.

B. While spring is fully compressed, the system momentum is not conserved, though final momentum is equal to intital momentum.

C. If spring is massless, the final state of M_1 is state of rest.

D. If the surface on which blocks are moving has friction, then collision cannot be elastic.

Answer: C::D

Watch Video Solution

JEE (Main and Advanced)

1. A particle moves along a curve of unknown shape but magnitude of force F is constant and always acts along tangent to the curve.Then

A. F may be conservative

B. F must be conservative

C. F may be non-conservative

D. F must be non-conservative

Answer: D

Watch Video Solution

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

A. $450J$

B. $275J$

C. $250J$

D. $475J$

Answer: D

Watch Video Solution

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

A. $\sqrt{mKt}^{-1/2}$

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

C. $\frac{1}{2}\sqrt{mKt}^{-1/2}$

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

Answer: D

Watch Video Solution

4. A force $F = (10 + 0.50x)$ acts on a particle in the x direction, where F is in newton and x in meter. Find the work done by this force during a displacement from x=0, ox=2.0m

A. $25J$

B. $29J$

C. $21J$

D. $18J$

Answer: C

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5. A body of mass $1kg$ begins to move under the action of a time dependent force $\overrightarrow{F} = \left(2t\hat{i} + 3t^2\hat{j}\right)N$, where $\hat{i}$ and $\hat{j}$ are unit vectors along X and Y axis. What does will be developed by the source at time t ?

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

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

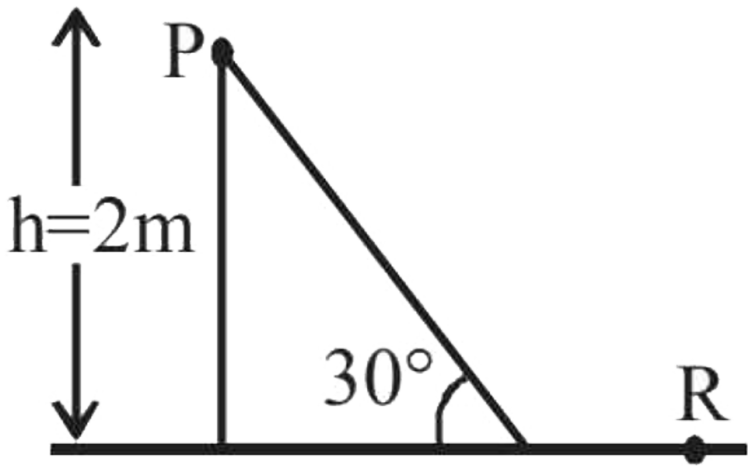
C. $\left(2t^3 + 3r^5\right)W$

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

Answer: C

Watch Video Solution

6. A point particle of mass m, moves long the uniformly rough track PQR as shown in 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 value of the coefficient of friction μ and the distance x $(=QR)$, are, respectively close to:



A. 0.2 and $6.5m$

B. 0.2 and $3.5m$

C. 0.29 and $3.5m$

D. 0.29 and $6.5m$

Answer: C

Watch Video Solution

7. A person trying to lose weight by burning fat filts a mass of $10kg$ upto a being of $1m1000$ time . Assume that the potential energy lost each time be lower the mass is dissipated . How much far will be use up considering the work done only when the weight is lifted up ? Far supplies $3.8 \times 10^7 J$ of energy per kg wich is canverted to mechanical energy with $x20\%$

efficiency rate Take $= 9.8ms^{-2}$

A. $2.45 \times 10^{-3} kg$

B. $6.45 \times 10^{-3} kg$

C. $9.89 \times 10^{-3} kg$

D. $12.89 \times 10^{-3} kg$

Answer: D

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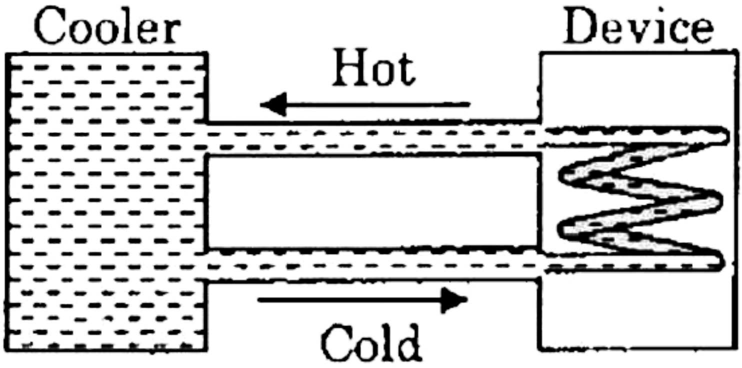
8. A water cooler of storages capacity 120 liters can cool water at a constant rate of P watts. In a closed circulation system (as shown schematically in the figure), the water from the cooler is used to cool an external device that generates constantly 3kW of heat (thermal load). The temperature of water fed into the device cannot exceed $30^\circ C$ and the entire stored 120 liters of water is initially cooled to $10^\circ C$. The entire system is thermally insulated. The minimum value of P (in watts) for which the device can be operated for 3hours is



(Specific heat of water is $4.2 kJkg^{-1}K^{-1}$ and the density of water is $1000 kgm^{-3}$)

A. 1600

B. 2067

C. 2533

D. 3933

Answer: B

Watch Video Solution

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

A. $450J$

B. $275J$

C. $250J$

D. $475J$

Answer: D

Watch Video Solution

10. Two similar springs P and Q have spring constants K_P and K_Q. They are stretched first by the same amount (case a),then by the same force (case b). The work done by the spring

W_P and W_Q are relased as, in case (a) and case (b), respectively.

A. $W_P = W_P, W_P = W_Q$

B. $W_P < W_P, W_Q = W_P$

C. $W_P > W_Q, W_Q > W_P$

D. $W_P = W_Q, W_P > W_Q$

Answer: C

Watch Video Solution

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

A. $\sqrt{mKt}^{-1/2}$

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

C. $\frac{1}{2}\sqrt{mKt}^{-1/2}$

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

Answer: D

Watch Video Solution

12. A ball is projected vertically down with an initial velocity from a height of $20m$ onto a horizontal floor. During the impact it loses $50\,\%$ of its energy and rebounds to the same height. The initial velocity of its projection is

A. $10m\,/\,s$

B. $14m\,/\,s$

C. $20m\,/\,s$

D. $28m\,/\,s$

Watch Video Solution

13. A rod of mass m and length l is lying on a horizontal table. Work done in making it stand on one end will be

A. mgl

B. $mgl/2$

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

D. $2mgl$

Watch Video Solution

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

A. $10^{-4} kgm^{-1}$

B. $10^{-1} kgm^{-1}$

C. $10^{-3} kgm^{-1}$

D. $10^{-3} kgm^{-1}$

Watch Video Solution

15. 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 $1\,\text{sec.}$ will be

A. $9J$

B. $18J$

C. $4.5J$

D. $22J$

Watch Video Solution

16. A long spring when stretched by $x cm$, has a potential energy U. On increasing the stretching to $nx cm$, the potential energy stored in spring will be

A. U/n

B. Nu

C. n^2U

D. U/n^2

Watch Video Solution

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

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

B. $\frac{1}{2}\frac{mv^2t}{T^2}$

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

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

Answer: C

Watch Video Solution

18. A lorry and a car moving with the same kinetic energy are brought to rest by the application of brakes which provides equal retarding forces. Which of them will come to rest in a shorter distance?

A. $x_1 = x_2$

B. $x_1 = 2x_2$

C. $2x_1 = x_2$

D. $x_1 = 4x_2$

Answer: A

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19. It is well known that a rain drop falls under the influence of the downward gravitational force and the opposing resistive force. The latter is known to be proportional to the speed of the drop, but is otherwise undetermined.

Consider a drop of mass 1.0g falling from a height of 1.00km. It hits the ground with a speed of $50.0 ms^{-1}$ (a) What is the work done by the gravitational force ? (b) What is the work done by the unknown resistive force ?

A. $(i) - 10J \ (ii) - 8.25J$

B. $(i) 1.25J \ (ii) - 8.25J$

C. $(i) 100J \ (ii) 8.75J$

D. $(i) 10J \ (ii) - 8.75J$

Answer: D

Watch Video Solution

20. At sea level, a N_2, molecule in air has an average translational $KE = 6.2 \times x10^{-21} J$. Its mass is $4.7 \times 10^{-26} kg$. If the molecule shoots up straight without any resistance, it will risw to a height of

A. $135 km$

B. $13.5 km$

C. $1.35 km$

D. $1350 km$

Answer: B

Watch Video Solution

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

A. 50%

B. 100%

C. 125%

D. 25%

Answer: C

Watch Video Solution

22. An explosion blows a rock into three parts. Two parts go off at right angles to each other . These two are $1kg$ first part moving with a velocity of $12ms^{-1}$ and $2kg$ second part moving with a velocity of $8ms^{-1}$. If the third part flies off with a velocity of $4ms^{-1}$. Its mass would be

A. $3kg$

B. $5kg$

C. $7kg$

D. $17kg$

Answer: B

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23. A uniform force of $\left(3\hat{i} + \hat{j}\right)$ newton acts on a particle of mass $2kg$. Hence the particle is displaced from position $\left(2\hat{i} + \hat{j}\right)$ meter to position $\left(4\hat{i}+3\hat{j}-\hat{k}\right)$ meter. The work done by the force on the particle is :

A. $15J$

B. $9J$

C. $6J$

D. $13J$

Answer: B

Watch Video Solution

24. A ball of mass 0.2 kg is thrown vertically upwards by applying a force by hand. If the hand moves 0.2 m while applying the force and the ball goes upto 2 m height further, find the magnitude of the force. (Consider $g = 10m/s^2$).

A. $22N$

B. $4N$

C. $16N$

D. $20N$

Answer: D

Watch Video Solution

25. The velocity of a particle at which the kinetic energy is eqyal to its rest mass energy is

A. $\left(\frac{3c}{2}\right)$

B. $3\frac{c}{\sqrt{2}}$

C. $\frac{(3c)^{1/2}}{2}$

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

Answer: D

Watch Video Solution

26. A running man has the same kinetic energy as that of a boy of half his mass. The man speed up by $2ms^{-1}$ and the body changes his speed by xms^{-1} so that the kinetic energies of the boy and the man are again equal. Then x in ms^{-1} is

A. $-2\sqrt{2}$

B. $+2\sqrt{2}$

C. $\sqrt{2}$

D. 2

Answer: B

Watch Video Solution

27. If the potential energy of a gas molecule is $U = \frac{M}{r^6} - \frac{N}{r^{12}}$, M and N being positive constants, then the potential energy at equlibrium must be

A. zero

B. $M^2/4N$

C. $N^2/4M$

D. $MN^2/4$

Answer: B

Watch Video Solution

28. In which case does the potential energy decrease ?

A. on compressing the spring

B. on stretching a spring

C. on moving a body against gravitational pull

D. on rising of an air bubble in water

Answer: D

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

A. m

B. $\sqrt{m}$

C. $\frac{1}{\sqrt{m}}$

D. none of the above

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30. A body of mass$5kg$ is moving with a momentum of $10kgm/s$. A force of $0.2N$ acts on it in the direction of motion of the body for $10\sec$. The increase in its kinetic energy.

A. $2.8J$

B. $3.2J$

C. $3.8J$

D. $4.4J$

Answer: D

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31. A body is moving undirectionally under the influence of a source of constant power. It displacement in time t is proportional to (i) $t^{1/2}$ (ii) t (iii) $t^{3/2}$ (iv) t^2

A. $t^{1/2}$

B. t

C. $t^{3/2}$

D. t^2

Answer: C

Watch Video Solution

32. A bullet fired into a fixed target loses half of its velocity after penetrating 3cm. How much further it will penetrate before coming to rest assuming that it faces constant resistance to motion?

A. $1.0cm$

B. $1.5cm$

C. $2.0cm$

D. $3.0cm$

Answer: A

Watch Video Solution

33. It requires 20 turns of the stem of a watch to wind the main spring and this stores sufficient energy to keep the watch running for $30 hrts.$ If 10 turns are given to thestem, the watch will run for

A. $20h$

B. $24h$

C. $7.5h$

D. $10h$

Answer: C

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34. The potential energy of a $1kg$ particle free to move along the x- axis is given by

$$V(x) = \left(\frac{x^4}{4} - \frac{x^2}{2}\right)J$$

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

A. $\sqrt{2}$

B. $1/\sqrt{2}$

C. 2

D. $3/\sqrt{2}$

Answer: C

Watch Video Solution

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

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

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

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

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

Answer: D

Watch Video Solution

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

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

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

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

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

Answer: A

Watch Video Solution

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

A. $8.5cm$

B. $5.5cm$

C. $2.5cm$

D. 11.0 cm`

Answer: B

Watch Video Solution

38. Water falls from a height of $60m$ at the rate $15kg/s$ to operate a turbine. The losses due to frictional forces are 10% of energy . How much power is generated to by the turbine? ($g = 10m/s^2$).

A. $8.1kW$

B. $10.2kW$

C. $12.3kW$

D. $7.0kW$

Answer: A

Watch Video Solution

39. An engine pumps water continously through a hose. Water leave the hose with a velocity v and m is the mass per unit length of the Water jet. What is the rate at Which kinetic energy is imparted to water?

A. $\frac{1}{2}m^2v^2$

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

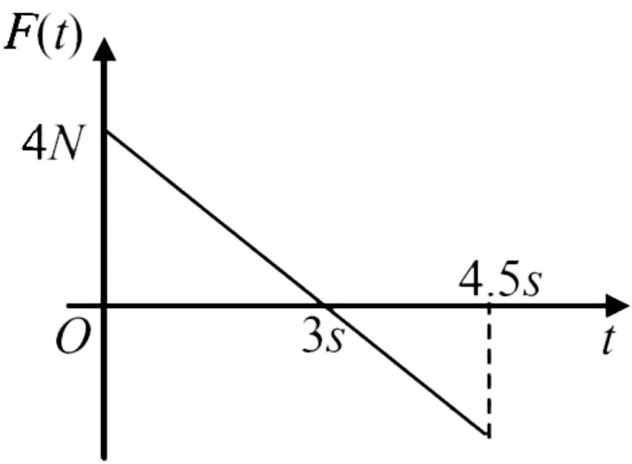
C. mv^3

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

Answer: B

Watch Video Solution

40. A block of mass 2 kg is from to move along the x - axis it is at rest and from $1 = 0$ onwards it is subjeted to a time - depended force $F(i)$ in the x diretion . The force $F(1)$ varies with 1 as shown in the figure . The kinetic of the block after 4.5 second is



A. $4.50J$

B. $7.50J$

C. $5.06J$

D. $14.06J$

Answer: C

Watch Video Solution

41. The potential energy funtions for the force between two along in a distance molecule is approximately given by

$U(x) = \frac{a}{x^{12}} - \frac{b}{x^6}$ where a and b are constant and x is the distance between the aloms , if the discision energy of the molecale is $D = [U(x = \infty) - U$ atequlibrium] , D is

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

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

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

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

Answer: B

Watch Video Solution

42. An engine pumps water through a hose pipe. Water passes through the pipe and leaves it with a velocity of $2ms^{1}$. The mass per unit length of water in the pipe is $100kgm^{-1}$. What is the power of the engine?

A. $400W$

B. $200W$

C. $100W$

D. $800W$

Answer: A

Watch Video Solution

43. A man of $50kg$ mass is standing in a gravity free space at a height of $10m$ above the floor. He throws a stone of $0.5kg$ mass downwards with a speed $2m/s$. When the stone reaches the floor, the distance of the man above the floor will be

A. $9.9m$

B. $10.1m$

C. $1.0m$

D. $20m$

Answer: B

Watch Video Solution

44. Express (a) the energy required to break one bond in DNA $(10^{-10}J)$ in eV.

(b) the kinetic energy of an air molecule $(10^{-21}J)$ in eV.

(c) the daily intake of a human adult $(10^{7}J)$ in kilo-calories.

A. $10^{-1}J$

B. $10^{18}J$

C. $10^{-7}J$

D. $10^{-20}J$

Answer: D

Watch Video Solution

45. If a spring of stiffness $'k'$ is cut into two parts $'A'$ and $'B'$ of length $l_A : l_B = 2:3$, then the stiffness of spring $'A'$ is given by

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

B. $\frac{3k}{5}$

C. $\frac{2k}{5}$

D. k

Answer: A

Watch Video Solution

46. At time $t = 0s$ particle starts moving along the $x-$ axis. If its kinetic energy increases uniformly with time $'t'$, the net force acting on it must be proportional to

A. $\sqrt{t0}$

B. constant

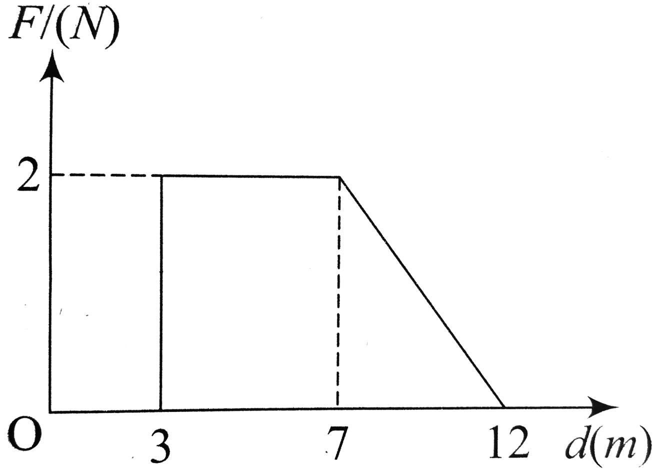
C. t

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

Answer: D

Watch Video Solution

47. force F on a particle moving in a straight line veries with distance d as shown in the figure. The work done on the particle during its displacement of $12m$ is



A. $18J$

B. $21J$

C. $26J$

D. $13J$

Answer: D

Watch Video Solution

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

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

A. $B/2A$

B. $2A/B$

C. A/B

D. B/A

Answer: B

Watch Video Solution

49. A car of mass m starta from rest and accelerates so that the instyantaneous power delivered to the car has a constant magnitude P_0. The instaneous velocity of this car is proportional to

A. $t^2 P_0$

B. $t^{1/2}$

C. $t^{-1/2}$

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

Answer: B

Watch Video Solution

50. Two point masses 1 and 2 move with uniform velocities $\overrightarrow{v}_1$ and $\overrightarrow{v}_2$, respectively. Their initial position vectors are $\overrightarrow{r}_1$ and $\overrightarrow{r}_2$, respectively. Which of the following should be satisfied for the collision of the point masses?

A. $\overrightarrow{r_1} \times \overrightarrow{v_1} = \overrightarrow{r_2} \times \overrightarrow{v_2}$

B. $\dfrac{\overrightarrow{r_1} - \overrightarrow{r_2}}{\left|\overrightarrow{r_1} - \overrightarrow{r_2}\right|} = \dfrac{\overrightarrow{v_2} - \overrightarrow{v_1}}{\left|\overrightarrow{v_2} - \overrightarrow{v_1}\right|}$

C. $\overrightarrow{r_1} . \overrightarrow{v_1} = \overrightarrow{r_2} . \overrightarrow{v_2}$

D. $\overrightarrow{r_1} \times \overrightarrow{v_2} = \overrightarrow{r_2} \times \overrightarrow{v_1}$

Answer: B

Watch Video Solution

51. On a friction surface a block a mass M moving at speed v collides elastic with another block of same mass M which is initially at rest . After collision the first block moves at an angle θ to its initial direction and has a speed $\frac{v}{3}$. The second block's speed after the collision is

A. $\sqrt{3}v/2$

B. $2\sqrt{2}v/3$

C. $3v/4$

D. $3v/\sqrt{2}$

Answer: B

Watch Video Solution

52. Figure shows a smooth curved track terminating in a smooth horizontal part. A spring of spring constant 400 N/m is attached at one end of a wedge fixed rigidly with the horizontal part. A 40 g mas is released from rest at a height of 4.9 m n the curved track. Find the maximum compression of the spring.

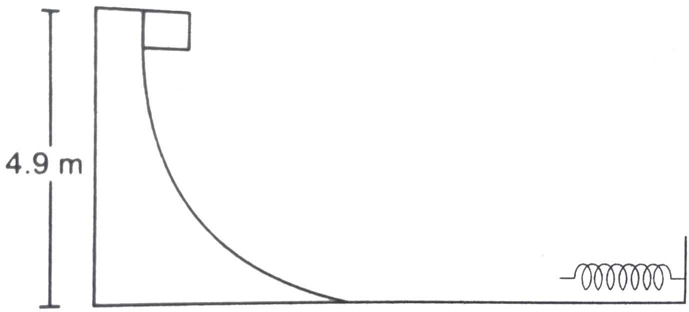


Figure 8-W8

A. $9.8m$

B. $9.8cm$

C. $.98m$

D. $.009km$

Answer: B

Watch Video Solution

53. A block of mass m moving at speed v collides wilth another block of mass 2 m at rest. The lighter block comes to rest after the collision. Find the coefficient of restitution.

A. 0.5

B. 0.4

C. 0.6

D. 0.8

Answer: A

Watch Video Solution

54. A particle of mass m moving in the x direction with speed 2v is hit by another particle of mass 2m moving in they 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

Watch Video Solution

55. A block of mass $0.50kg$ is moving with a speed of $2.00m/s$ on a smooth surface. It strikes another mass of $1kg$ at rest and they move as a single body. The energy loss during the collision is

A. $0.16J$

B. $1.00J$

C. $0.67J$

D. $0.34J$

Answer: C

Watch Video Solution

56. 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 enegry. If final velocities of particles be v_1 and v_2 then we must have

A.

$$\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 - \varepsilon$$

B.

$$\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 - \varepsilon = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2$$

C.

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

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

Answer: B

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57. A body of mass m_1 collides elastically with another body of mass m_2 at rest. If the velocity of m_1 after collision is $\frac{2}{3}$ times its initial velocity, the ratio of their masses is :

A. $1:5$

B. $5:1$

C. $5:2$

D. $2:5$

Answer: B

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58. A heavy truck moving with a velocity of $60km/h$ collides with a light drum at rest. If the collision is elastic, then the velocity of the drum immediately after collision will be

A. zero

B. $60 km / h$

C. $120 km / h$

D. $30 km / h$

Answer: C

Watch Video Solution

59. A bullet hits and gets embedded in a solid block resting on a frictionless surface. In this process, which of the following is correct ?

A. Only momentum is conserved

B. Only kinetic energy is conserved

C. Neither momentum nor kinetic energy is conserved

D. Both, momentum and kinetic energy are conserved

Answer: A

Watch Video Solution

60. A bullte weighing $5g$ and moving with a velocity $600m/s$ strikes a $5kg$ block of ice resting on a frictionless surface. The speed of the block after the collision is

A. $6cm/s$

B. $60cm/s$

C. $6m/s$

D. $0.6cm/s$

Answer: B

Watch Video Solution

61. Two perfectly elastic particles A and B of equal masses travelling along a line joining them with velocities $15m/s$ and $10m/s$ respectively collide. Their velocities after the elastic collision will be (in m/s) respectively

A. $0 \text{ and } 25$

B. $5 \text{ and } 20$

C. 10 and 15

D. 20 and 5

Answer: C

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62. A ball moving with velocity $2ms^{-1}$ collides head on with another stationary ball of double the mass. If the coefficient of restitution is 0.5, then their velocities (in ms^{-1}) after collision will be

A. $0, 2$

B. $0, 1$

C. $1, 1$

D. $1, 0.5$

Answer: B

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63. A ball of mass $1kg$ moving with velocity $3m/s$, collides with spring of natural length

$2m$ and force constant $144N/m$. What will be length of compressed spring ?

A. $2m$

B. $1.5m$

C. $1m$

D. $0.5m$

Answer: B

Watch Video Solution

64. A ball is dropped on the ground from a height of $1m$. The coefficient of restitution is 0.6. The height to which the ball will rebound is

A. $0.6m$

B. $0.4m$

C. $0.36m$

D. $0.16m$

Answer: C

Watch Video Solution

65. A shell is fired from a cannon with a velocity $v(m/\sec.)$ at an angle θ with the horizontal direction. At the highest point in its path it explodes into two pieces of equal mass. One of the pieces retraces its path to the cannon and the speed (in $m/\sec.$) of the other piece immediately after the explosion is

A. $3v\cos\theta$

B. $2v\cos\theta$

C. $(3/2)v\theta$

D. $\left(\sqrt{3}/2\right)v\cos\theta$

Watch Video Solution

66. An object of mass $40kg$ and having velocity $4m/s$ collides with another object of mass $60kg$ having velocity $2m/s$. The loss of energy when the collision is perfectly inelastic is

A. $392J$

B. $440J$

C. $48J$

D. $110J$

Answer: C

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67. A body of mass $5m$ initially at rest explodes into 3 fragments with mass ratio $3:1:1$. Two of fragments each of mass $'m'$ are found to move with a speed $60m/s$ in mutually perpendicular direction. The velocity of third fragment is

A. $60\sqrt{2}$

B. $20\sqrt{3}$

C. $10\sqrt{2}$

D. $20\sqrt{2}$

Answer: D

Watch Video Solution

68. Particle A makes a head on elastic collision with another stationary particle B. They fly apart in opposite directions with equal speeds. The mass ratio will be

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

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

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

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

Answer: B

Watch Video Solution

69. The first ball of mass m moving with the velocity v collides head on with the second ball of mass m at rest. If the coefficient of restitution is e, then the ratio of the velocities of the first and the second ball after the collision is

A. $\frac{1-e}{1+e}$

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

C. $\frac{1+e}{2}$

D. $\frac{1-e}{2}$

Answer: A

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70. A body of mass $2kg$ moving with a velocity of $6m/s$ strikes inelastically another body of same mass at rest. The amount of heat evolved during collision is

A. $36J$

B. $18J$

C. $9J$

D. $3J$

Answer: B

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71. A ball moving with a speed of $9m/s$ strikes an identical ball at rest, such that after the collision, the direction of each ball makes an angle of 30° with the original line of motion. Find the speeds of the two balls after collision.

Watch Video Solution

72. If two masses m_1 and m_2 collide, the ratio of change in their respective velocities is proportional to

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

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

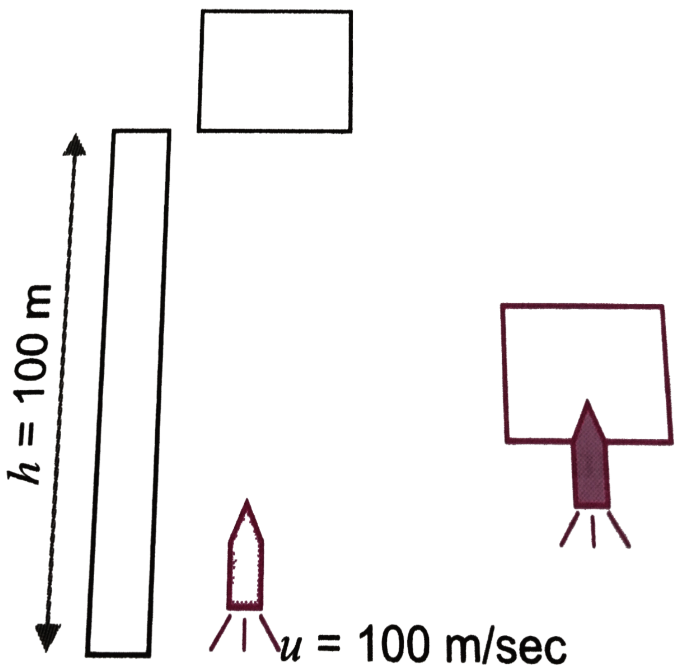
C. $\frac{m_2}{m_1}$

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

Answer: C

Watch Video Solution

73. A wooden block of mass $10gm$ is dropped from the top of a tower $100m$ high. Simultaneously, a bullet of mass $10gm$ is fired from the foot of the tower vertically upwards with a velocity of $100 m / \sec$, figure. If the bullet is embedded in it, how high will it rise above the tower before it starts falling ? (Consider $g = 10 m / \sec^2$)



A. $80 m$

B. $85m$

C. $75m$

D. $10m$

Answer: C

Watch Video Solution

74. A car weighing $2 \times 10^3 kg$ and moving at $20m/s$ along a main road collides with a lorry of mass $8 \times 10^3 kg$ which emerges at $5m/s$ from a cross road at right angles to the main road. If the two vehicles lock, what will be their velocity after the collision ?

A. $4/\sqrt{2}m/s, 45^{\circ}$ with cross road

B. $4/\sqrt{2}m/s, 60^{\circ}$ with cross road

C. $4/\sqrt{2}m/s, 60^{\circ}$ with main road

D. $4/\sqrt{2}m/s, 45^{\circ}$ with main road

Answer: D

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75. A bom of mass $1kg$ is thrown vertically upwards with a speed of $100m/s$. After 5 seconds, it explodes into two fragments. One fragment of mass $400gm$ is found to go down with a speed of $25m/s$. What will happen to the second fragment just after the explosion ? $(g = 10ms^{-1})$

A. It will go upwards with speed $40m/s$

B. It will go upwards with speed $100m/s$

C. It will go upwards with speed $60m/s$

D. It will go downwards with speed $40m/s$

Answer: B

Watch Video Solution

76. A stationary partical explodes into two partical of a masses m_1 and m_2 which move in opposite direction with velocities v_1 and v_2. The ratio of their kinetic energies E_1 / E_2 is

A. m_2 / m_1

B. m_1 / m_2

C. 1

D. m_1v_2/m_2v_1

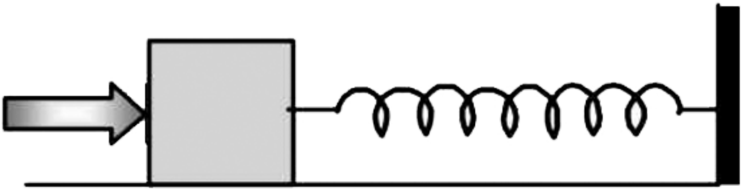
Answer: A

Watch Video Solution

77. A block of mass $0.18kg$ is attached to a spring of force constant $2N/m$ The coefficient of friction between the block and the force is 0.1 insitially its block is at rest and the block as spring is an streched , As impalse is given to the block as shown in the figure . The block sides a distance of 0.06 in and comes to the first time .

The initial velocity of the for blocks is mis

$V = N10$ then N is .



A. 3

B. 4

C. 5

D. 2

Answer: B

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78. A solid cylinder of mass $3kg$ is rolling on a horizontal surface with velocity $4ms^{-1}$. It collides with a horizontal spring of force constant $200Nm^{-1}$. The maximum compression producec in the spring will be :

A. $0.5m$

B. $0.6m$

C. $0.7m$

D. $0.2m$

Answer: B

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79. Two sphere A and B of masses m_1 and m_2 respectivelly colides. A is at rest initally and B is moving with velocity v along x-axis. After collision B has a velocity $\frac{v}{2}$ in a direction perpendicular to the original direction. The mass A moves after collision in the direction.

A. same as that of B

B. opposite to that of B

C. $\theta = \tan^{-1}(1/2)$to the $x-$ axis

D. $\theta = \tan^{-1}(-1/2)$to the $x-$ axis

Answer: D

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80. A particle of mass 4 m which is at rest explodes into three fragments. Two of the fragments each of mass m are found to move with a speed v each in mutually perpendicular directions. The total energy released in the process of explosion is ....

A. mv^{20}

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

C. $2mv^2$

D. $4mv^2$

Answer: B

Watch Video Solution

81. When a rubber bandis streched by a distance x , if exerts resuring foprce of magnitube $F = ax + bx^2$ where$a$ and b are constant . The work in streached the unstreched rubber - band by L is

A. $\frac{aL^2}{2} + \frac{bL^3}{3}$

B. $\frac{1}{2}\left(\frac{aL^2}{2} + \frac{bL^3}{3}\right)$

C. $aL^2 + bL^3$

D. $\frac{1}{2}(aL^2 + bL^3)$

Answer: A

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82. Hailstorms are observed to stike the surface of a frozen lake at an angle of 30° with the vertical and rebound at an angle of 60° with vertical. Assuming the contact to be smooth, the coefficient of restitution is

A. $1/4$

B. $1/3$

C. $1/5$

D. $3/4$

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Comprehension

1. Work is said to be done by a force acting on a body, provided the body is displaced actually in any direction except in a direction perpendicular to the direction of the force. Mathematically, $W = \overrightarrow{F} . \overrightarrow{c} = Fs\cos\theta$,

Whereas energy is capacity of a body to do the work, power is the rate at which the body can do the work.

$$P = \frac{W}{t} = \overrightarrow{F} . \frac{\overrightarrow{s}}{t} = \overrightarrow{F} . \overrightarrow{v}$$

Both, work and energy are measured in joule and power is measured in watt.

With the help of the comprehension given

above, choose the most appropriate alternative for each of the following question :

A box is pushed through $4.0m$ across a floor offering $100N$ resistance. Work done by the applied force is

A. $400J$

B. $-400J$

C. $25J$

D. $0.04J$

Answer: A

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2. Work is said to be done by a force acting on a body, provided the body is displaced actually in ay direction except in a direction perpendicular to the direction of the force. Mathmatically, $W = \overrightarrow{F} . \overrightarrow{c} = Fs\cos\theta$, Whereas eenrgy is capacity of a body to do the work, power is the rate at which the body can do the work.

$$P = \frac{W}{t} = \overrightarrow{F} . \frac{\overrightarrow{s}}{t} = \overrightarrow{F} . \overrightarrow{v}$$

Both, work and energy are measured in joule and power is measured in watt.

With the help of the comprehension given

above, choose the most appropriate alternative for each of the following question :

`In the above question, work done by the resisting force is

A. $400J$

B. $-400J$

C. zero

D. $-25J$

Answer: B

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3. Work is said to be done by a force acting on a body, provided the body is displaced actually in ay direction except in a direction perpendicular to the direction of the force. Mathmatically, $W = \overrightarrow{F} \,.\, \overrightarrow{c} = Fs\cos\theta$, Whereas eenrgy is capacity of a body to do the work, power is the rate at which the body can do the work.

$$P = \frac{W}{t} = \overrightarrow{F} \,.\, \frac{\overrightarrow{s}}{t} = \overrightarrow{F} \,.\, \overrightarrow{v}$$

Both, work and energy are measured in joule and power is measured in watt.

With the help of the comprehension given above, choose the most appropriate alternative for each of the following question :

In the above question, work done by gravity is

A. $400J$

B. $-400J$

C. zero

D. $-25J$

Answer: C

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4. Work is said to be done by a force acting on a body, provided the body is displaced actually in any direction except in a direction perpendicular to the direction of the force.

Mathematically, $W = \overrightarrow{F} . \overrightarrow{c} = Fs \cos \theta,$

Whereas energy is capacity of a body to do the work, power is the rate at which the body can do the work.

$$P = \frac{W}{t} = \overrightarrow{F} . \frac{\overrightarrow{s}}{t} = \overrightarrow{F} . \overrightarrow{v}$$

Both, work and energy are measured in joule and power is measured in watt.

With the help of the comprehension given

above, choose the most appropriate alternative for each of the following question :

A truck draw a tractor of mass $1000kg$ at a steady rate of $20ms^{-1}$ on a level road. The tension in the coupling is $2000N$. Power spent on the tractor is

A. $40W$

B. $20W$

C. $20kW$

D. $40kW$

Answer: D

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5. Potential energy of a body is the energy possessed by the body by virtue of its position. P.E. $= mgh$ where the symbols have their usual meaning. Kinetic energy of a body is the energy possessed by the body by virtual of its velocity.

$$K.E. = \frac{1}{2}mv^2$$

Energy can neither be created nor be destroyed. However energy can be changed from one form to other, such that energy appearing in one form is equal to the energy disappearing in the other form.

With the help of the passage given above, choose the most appropriate alternative for each of the following question :

A body of mass $1kg$ is allowed to fall freely under gravity. The momentum of the body 5 second after it starts falling is

A. $100kgms^{-1}$

B. $50kgms^{-1}$

C. $150kgms^{-1}$

D. $200kgms^{-1}$

Answer: B

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6. Potential energy of a body is the energy possessed by the body by virtue of its position. P.E. $= mgh$ where the symbols have their usual meaning. Kinetic energy of a body is the energy possessed by the body by virtual of its velocity. $K.E. = \frac{1}{2}mv^2$

Energy can neither be created nor be destroyed. However energy can be changed from one form

to other, such that energy appearing in one form is equal to the energy disappearing in the other form.

With the help of the passage given above, choose the most appropriate alternative for each of the following question :

Kinetic energy of the body at the same time is

A. $1250J$

B. $2500J$

C. $625J$

D. $25000J$

Answer: A

Watch Video Solution

7. Potential energy of a body is the energy possessed by the body by virtue of its position. P.E. $= mgh$ where the symbols have their usual meaning. Kinetic energy of a body is the energy possessed by the body by virtual of its velocity.

$$K.E. = \frac{1}{2}mv^2$$

Energy can neither be created nor be destroyed. However energy can be changed from one form

to other, such that energy appearing in one form is equal to the energy disappearing in the other form.

With the help of the passage given above, choose the most appropriate alternative for each of the following question :

The body will attain this K.E. when it falls freely from a height of

A. $125m$

B. $250m$

C. $1250m$

D. $2500m$

Answer: A

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8. Potential energy of a body is the energy possessed by the body by virtue of its position. P.E. $= mgh$ where the symbols have their usual meaning. Kinetic energy of a body is the energy possessed by the body by virtual of its velocity.

$$K.E. = \frac{1}{2}mv^2$$

Energy can neither be created nor be destroyed. However energy can be changed from one form

to other, such that energy appearing in one form is equal to the energy disappearing in the other form.

With the help of the passage given above, choose the most appropriate alternative for each of the following question :

Velocity of the body on striking the ground will be

A. $25m / s$

B. $12.5m / s$

C. $50m / s$

D. $100m / s$

Answer: C

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9. Potential energy of a body is the energy possessed by the body by virtue of its position. P.E. $= mgh$ where the symbols have their usual meaning. Kinetic energy of a body is the energy possessed by the body by virtual of its velocity.

$$K.E. = \frac{1}{2}mv^2$$

Energy can neither be created nor be destroyed. However energy can be changed from one form

to other, such that energy appearing in one form is equal to the energy disappearing in the other form.

With the help of the passage given above, choose the most appropriate alternative for each of the following question :

The ratio of potential energy to kinetic energy at a height of $62.5m$ above the ground is

A. 2

B. 1

C. 3

D. 4

Answer: B

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Integer Type Questions

1. A bullet fired into a fixed target loses half of its velocity after penetrating 3cm. How much further it will penetrate before coming to rest assuming that it faces constant resistance to motion?

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2. The potential energy of a $2kg$ particle free to move along the $x-$ axis is given by

$$V(x)\left[\frac{x^4}{4}-\frac{x^2}{2}\right]joule$$

The total mechanical energy of the particle is $0.75J$. The maximum speed of the particle (in m/s) is :

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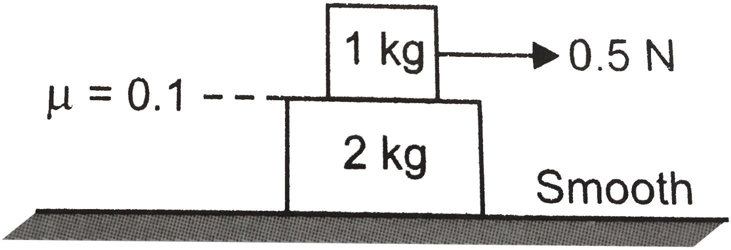
3. A force of $0.5N$ is applied on upper block as shown in figure. The work done (in joule) by upper block on lower block for a displacement of $3m$ is :



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4. The potential energy of a partical of mass $2kg$ moving in $y-z$ plane is given by $U=(-3y+4z)J$ where y and z are in metre. The magnitude of force (in newton) on the particle is :

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5. A bucket of mass $4/3$ is tied to a string and is lowered at a constant acceleration of $g/4$. The magnitude of work done (in joule) by the string in lowering the bucket by $10cm$ would be :

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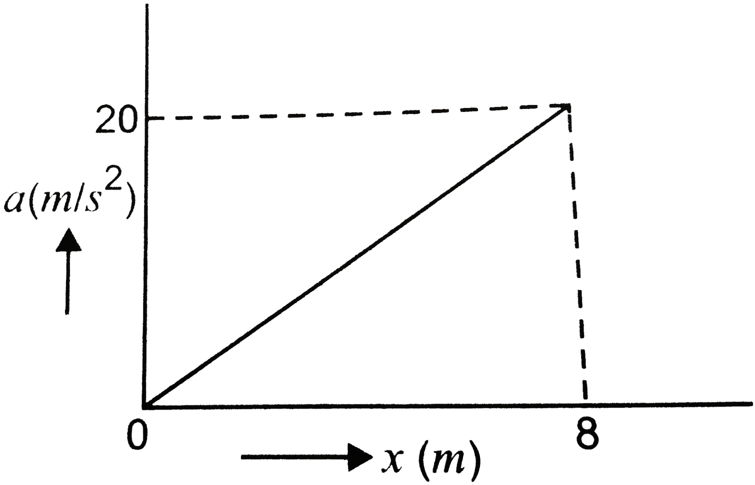
6. A $100g$ block moves along $X-$ axis. Its acceleration as a function of displacemetn is shown in figure. Calculate work done (in joule) on the block by the force applied as the block moves from $x = 0$ to $x = 8m$.



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7. Two bodies of masses m and $4m$ are moving with equal linear momenta. The ratio of their kinetic energies is :

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8. A bomb of mass $16kg$ at rest explodes into two pieces of masses $4kg$ and $12kg$. If KE of $4kg$ mass is $288J$, what is the velocity (in ms^{-1} of the other piece of $12kg$?

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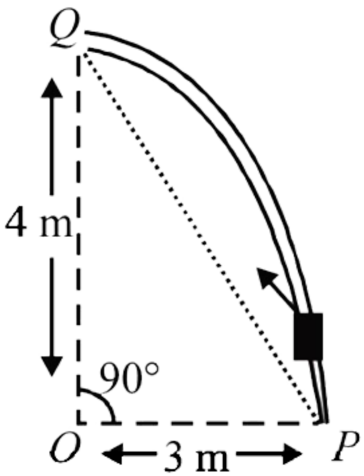
9. Constant as eliptical rail PQ in the varticle plain with $OP = \; = 3m$ and $OQ = 4m$. A block of mass 1 kg is pailed along the rail from

P to Q with a force of $18N$, which is always parallel to less PQ Assuming are frictionless losess , the kinetic energy the block when 0 reches Q is $(n \times 10)$ pales . THe velie of a (Take acceleration due to gravity) $= 10 ms^{-2}$)



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Assertion-Reason Type Questions

1. Assertion : When two equal masses undergo a glancing elastic collision with one of them at rest then after the collisioin, they will move at $90^{\circ 0}$ to eachtoerh.

Reason : It follows from the principle of conservation of linear momentum .

A. If both, Assertion and Reason are true and Reason is correct explantion of Assertion.

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

Assertion.

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

D. If both, Assertion and Reason are false.

Answer: A

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2. Assertion: According to law of conservation of machainical energy change in potential energy is equal and opposite to the change in kinetic energy

Reason: Mechanical energy is not a conserved quantity.

A. If both, Assertion and Reason are true and Reason is correct explantion of Assertion.

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

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

D. If both, Assertion and Reason are false.

Answer: C

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3. Assertion : Work is done only by conservative force.

Reason : Non conservative forces are no good to do any work.

A. If both, Assertion and Reason are true and Reason is correct explantion of Assertion.

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

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

D. If both, Assertion and Reason are false.

Answer: D

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4. Assertion : A body cannot have energy without possessing momentum but it can have momentum without having energy.

Reason : Momentum and energy have same dimensions.

A. If both, Assertion and Reason are true and Reason is correct explantion of Assertion.

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

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

D. If both, Assertion and Reason are false.

Answer: D

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5. Assertion: A quick collision between two bodies is more violent that show collision , even when initial and final velocity are identical.

Reason: The rate of change of momentum determine that force is small or large.

A. If both, Assertion and Reason are true and Reason is correct explantion of Assertion.

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

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

D. If both, Assertion and Reason are false.

Answer: A

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6. Assertion : Work done by the frictional force is negaive

Reason : This is because frictional force acts along the dirction of motion

A. If both, Assertion and Reason are true and Reason is correct explantion of Assertion.

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

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

D. If both, Assertion and Reason are false.

Answer: C

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7. Assertion : Work done by the centripetal force in moving a body along a circle is always zero.

Reason : Because displacement of the body is along the force.

A. If both, Assertion and Reason are true and Reason is correct explantion of Assertion.

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

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

D. If both, Assertion and Reason are false.

Answer: C

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8. Assertion : Work done by or against gravitational force in moving a body from one point to another is independent of the actual path followed between the two points.

Reason : This is because gravitational forces are conservative forces.

A. If both, Assertion and Reason are true and Reason is correct explantion of Assertion.

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

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

D. If both, Assertion and Reason are false.

Answer: A

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9. Assertion : Work done by orforce of friction in moving a body through any round trip is zero.

Reason : Because friction is a conservative force.

A. If both, Assertion and Reason are true and Reason is correct explantion of Assertion.

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

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

D. If both, Assertion and Reason are false.

Answer: D

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10. Assertion : Time taken by a body to complete a given work has nothing to do with energy of the body.

Reason : Because power of a body is the rate of doing work.

A. If both, Assertion and Reason are true and Reason is correct explantion of Assertion.

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

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

D. If both, Assertion and Reason are false.

Answer: B

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11. Assertion: A spring has potential energy , both when it is compressed or stretched.

Reason: In compressing or stretching, work is done on the spring against the restoring force.

A. If both, Assertion and Reason are true and Reason is correct explantion of Assertion.

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

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

D. If both, Assertion and Reason are false.

Answer: A

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12. Assertion : Graph between potential energy of a spring versus the extension / compression (x) of the string is a straight ling.

Reason : This is because potential energy is directly proportional to x.

A. If both, Assertion and Reason are true and Reason is correct explantion of Assertion.

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

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

D. If both, Assertion and Reason are false.

Answer: D

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13. Assertion : When current is drawn from a cell, chemical energy is converted into heat energy.

Reason : This is because wire through which current flows gets heated.

A. If both, Assertion and Reason are true and Reason is correct explantion of Assertion.

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

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

D. If both, Assertion and Reason are false.

Answer: D

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14. STATEMENT-l : In an elastic collision between two bodies, the relative speed of the bodies after collision is equal to the relative speed before the collision.

STATEMENT-2 : In an elastic collision, the linear momentum of the system is conserved.

A. If both, Assertion and Reason are true and Reason is correct explantion of Assertion.

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

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

D. If both, Assertion and Reason are false.

Answer: D

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15. Assertion: Mass and energy are not conserved separately, but are conserved as a single entity called mass-energy.

Reason: Mass and energy conservation can be obtained by Einstein equation for energy.

A. Statement - 1 is ture , statement -2 is true, and statement-2 is correct explanation of statement -1.

B. Statement-1 if ture, statement-2 is true, but statement -2 is not a correct explanation of statement-1.

C. Statement-1 is true, but statement -2 is false.

D. Statement-1 is false, but statement-2 is true.

Answer: A

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16. Statement-1 : Kinetic energy is conserved in both, perfectly elastic and perfectly inelastic collisions.

Statement-2 : Because linear momentum is conserved in both.

A. Statement - 1 is ture , statement -2 is true, and statement-2 is correct explanation of statement -1.

B. Statement-1 if ture, statement-2 is true, but statement -2 is not a correct explanation of statement-1.

C. Statement-1 is true, but statement -2 is false.

D. Statement-1 is false, but statement-2 is true.

Answer: D

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17. Statement-1 : For any collision, coefficient of restitution $(e0$ lies between 0 and 1.

Statement-2 : This is because no collision may be $100\ \%$ elastic or $100\ \%$ inelastic.

A. Statement -1 is ture , statement -2 is true, and statement-2 is correct explanation of statement -1.

B. Statement-1 if ture, statement-2 is true, but statement -2 is not a correct explanation of statement-1.

C. Statement-1 is true, but statement -2 is false.

D. Statement-1 is false, but statement-2 is true.

Answer: A

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18. Statement -1 : When momentum (p) of a body is increased by 50%, its KE (E) increases by 125% .

Statement-2 : This is because $p \propto v$ and $E \propto v^2$

A. Statement - 1 is ture , statement -2 is true, and statement-2 is correct explanation of statement -1.

B. Statement-1 if ture, statement-2 is true, but statement -2 is not a correct explanation of statement-1.

C. Statement-1 is true, but statement -2 is false.

D. Statement-1 is false, but statement-2 is true.

Answer: A

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19. Statement-1 : Friction is non-conservation force.

Statement-2 : This is because work done against friction, in moving a body over a closed path, is never zero.

A. Statement - 1 is ture , statement -2 is true, and statement-2 is correct explanation of statement -1.

B. Statement-1 if ture, statement-2 is true, but statement -2 is not a correct explanation of statement-1.

C. Statement-1 is true, but statement -2 is false.

D. Statement-1 is false, but statement-2 is true.

Answer: A

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20. Statement-1 : A body with negative energy cannot have momentum.

Statement-2 : This is because momentum can be positive only.

A. Statement - 1 is ture , statement -2 is true, and statement-2 is correct explanation of statement -1.

B. Statement-1 if ture, statement-2 is true, but statement -2 is not a correct explanation of statement-1.

C. Statement-1 is false, but statement-2 is false.

D. Statement-1 is false, but statement-2 is true.

Answer: C

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21. Statement-1 : Energy released when a mass of one microgram disappears in a process is $9 \times 10^7 J$.

Statement-2 : It follows from $E = \frac{1}{2}mv^2$

A. Statement - 1 is ture , statement -2 is true, and statement-2 is correct explanation of statement -1.

B. Statement-1 if ture, statement-2 is true, but statement -2 is not a correct explanation of statement-1.

C. Statement-1 is true, but statement -2 is false.

D. Statement-1 is false, but statement-2 is true.

Answer: C

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22. This question has statement 1 and statement 2 . Of the four choice given after the Statement , choose the one that best describe the two Statement .

If the spring $S_1$and S_2 of force constant k_1 and k_2 respectively , are streached by the same force , it is found that more work is done on spring S_1 then on spring S_2

Statement -1: If statement by the same answer work done on S_1 work on S_1 is more then S_2

Statement - 2 : $k_1 < k_2$

A. Statement - 1 is ture , statement -2 is true, and statement-2 is correct explanation of statement -1.

B. Statement-1 if ture, statement-2 is true, but statement -2 is not a correct explanation of statement-1.

C. Statement-1 is true, but statement -2 is false.

D. Statement-1 is false, but statement-2 is true.

Answer: D

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23. Statement -1: Two particles moving in the same direction do not lose all their energy in a completely inelastic collision.

Statement -2 : Principle of conservation of momentum holds true for all kinds of collisions.

A. Statement -1 is ture , statement -2 is true, and statement-2 is correct explanation of statement -1.

B. Statement-1 if ture, statement-2 is true, but statement -2 is not a correct explanation of statement-1.

C. Statement-1 is true, but statement -2 is false.

D. Statement-1 is false, but statement-2 is true.

Answer: B

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24. This question has statement I and statement II. Of the four choices given after the statements, choose the one that best describes the two statements.

Statement I: A point particle of mass m moving with speed v collides with stationary point particle of mass M. If the maximum energy loss possible glven as $f\left(\frac{1}{2}mv^2\right)$ then $f=\left(\frac{m}{M+m}\right)$

Statement II: Maximum energy loss occurs when the particles get stuck together as a result of the collision.

A. Statement - 1 is ture , statement -2 is true, and statement-2 is correct explanation of statement -1.

B. Statement-1 if ture, statement-2 is true, but statement -2 is not a correct explanation of statement-1.

C. Statement-1 is true, but statement -2 is false.

D. Statement-1 is false, but statement-2 is true.

Answer: D

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