PHYSICS

BOOKS - MBD

WORK, ENERGY AND POWER

Example

1. What is the work done in holding a 15 kg suitcase whiel waiting for a bus for 15 mimnutes?

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2. What do you mean by work done by a force? What is the work done by a force?

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3. What is thw work done by tension nin the string of a simple pendulum?

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4. What is SI unit of work?

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5. What is the work done by centripetal force?/

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6. Can KE of a system be increased or decreased without the application of external force?

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7. What is the amount of work done by sun's gravitational force if earth is rotating in almost

circular orbit?

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8. A body is moving at constant speed over a frictionless surface. What is the work done by the weight?

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9. What sort of energy is associate with a bird flying in air?

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10. Can a body have energy without momentum?

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11. Can overall energy of a body be negative?

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12. A body is moving such that its linear momentum remains constant. Is the body in equilibrium?

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

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14. A body is moving at constant speed over a frictionless surface. What is the work done by the weight?

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15. Name two situations whre variable force acts.

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16. Where from the kinetic energy of falling rain drops come?

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17. Name the physical quantity which is expressed as product of force and velocity. is it a scalar or vector quantity?

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

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19. What is spring constant ? What are the SI units?

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20. When an air bubble rises in water, what happens to its potential energy?

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

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

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23. Can a body have momentum without energy?

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24. The sign of work done by a force on a body is important to understand. State carefully if the following quantities are positive or negative:- work done by a man in lifting a bucket out of a well by means of a rope tied to the bucket.

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25. The sign of work done by a force on a body is important to understand. State carefully if the following quantities are positive or negative:- work done by an applied force on a body moving on a rough horizontal plane with uniform velocity.

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

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

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27. The sign of work done by a force on a body is important to understand. State carefully if the following quantities are positive or negative:- work done by an applied force on a body moving on a rough horizontal plane with uniform velocity.

Watch Video Solution

28. The sign of work done by a force on a body is important to understand. State carefully if the following quantities are positive or negative:- work done by the resistive force of air on a vibrating pendulum in bringing it to rest.

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

0.1. Compute the:- work done by the applied force in 10 s.

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30. A body of mass 2 kg initially at rest moves under the action of an applied horizontal force of 7 N on a table with coefficient of kinetic friction = 0.1. Compute the:- work done by friction in 10 s.

Watch Video Solution

31. A body of mass 2 kg initially at rest moves under the action of an applied horizontal force of 7 N on a table with coefficient of kinetic friction = 0.1. Compute the:- work done by the net force on the body in 10 s.

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

0.1. Compute the:- change in kinetic energy of the body in 10 s, and interpret your results.

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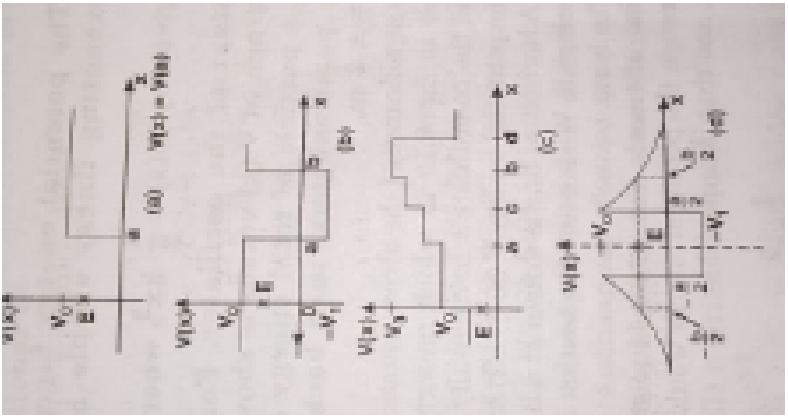
33. Given below are examples of some potential energy functions in one dimension. The total energy of the particle is indicated by a cross on the ordinate axis. In each case, specify the regions, if any, in which the particle cannot be found for

the given energy.



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34. The potential energy function for a particle executing linear simple harmonic motion is given by V{x) = $kx^2/2$, wherek is the force constant of the oscillator. For $k = 0.5Nm^{-1}$, the graph of V[x) versus x is shown in Fig. 6.12. Show that a

particle of total energy 1 J moving under this potential must 'turn back' when it reaches `x =overset+- 2 m.

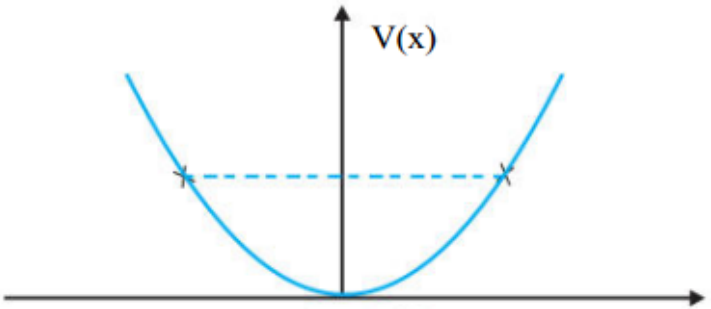

Fig. 6.12

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35. Answer the following :- The casing of a rocket in flight burns up due to friction. At whose

expense is the heat energy required for burning obtained? The rocket or the atmosphere?

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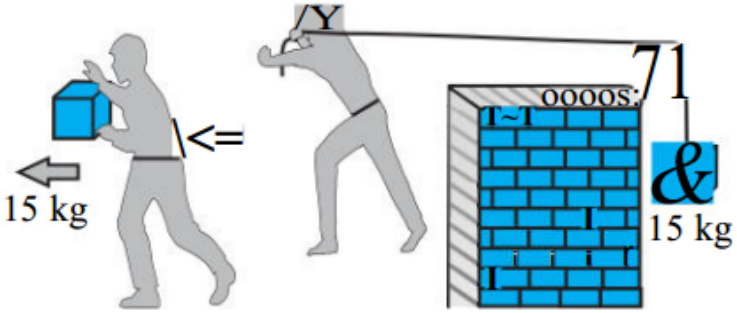
36. Answer the following :- Comets move around the sun in highly elliptical orbits. The gravitational force on the comet due to the sun is not normal to the comet's velocity in general. Yet the work done by the gravitational force over every

complete orbit of the comet is zero. Why ?



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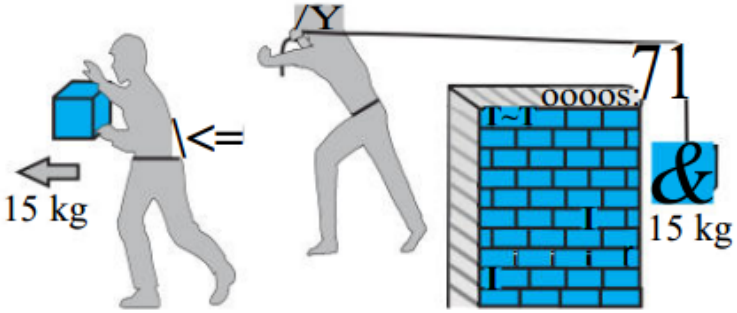
37. Answer the following :- An artificial satellite orbiting the earth in very thin atmosphere loses its energy gradually due to dissipation against atmospheric resistance, however small. Why then does its speed increase progressively as it comes

closer and closer to the earth ?



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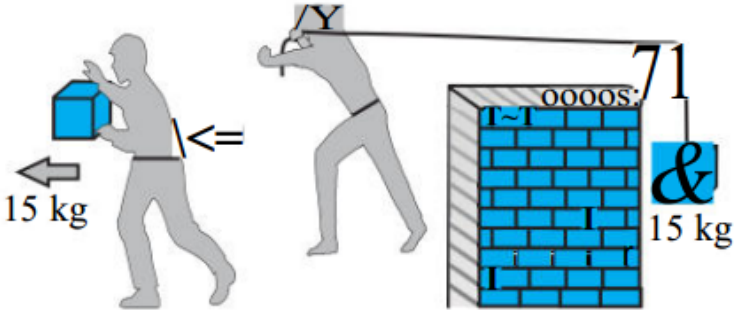
38. Answer the following :- In Fig. 6.13(i) the man walks 2 m carrying a mass of 15 kg on his hands. In Fig. 6.13(ii), he walks the same distance pulling the rope behind him. The rope goes over a pulley, and a mass of 15 kg hangs at its other end. In which

case is the work done greater ?



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39. Underline the correct alternative :- When a conservative force does positive work on a body, the potential energy of the body $\in creases/decreases/rema \in suna < ered.$

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40. Underline the correct alternative :- Work done by a body against friction always results in a loss of its kinetic / potential energy.

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41. Underline the correct alternative :- 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.

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42. Underline the correct alternative :- In an inelastic collision of two bodies, the quantities which do not change after the collision are the total kinetic $e \neq rgy/ \rightarrow tall \in earmomentum/ \rightarrow tale \neq rgy$ of the system of two bodies.

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43. State if each of the following statements is true or false. Give reasons for your answer:- In an

elastic collision of two bodies, the momentum and energy of each body is conserved.

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44. State if each of the following statements is true or false. Give reasons for your answer:- Total energy of a system is always conserved, no matter what internal and external forces on the body are present.

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45. State if each of the following statements is true or false. Give reasons for your answer:- Work done in the motion of a body over a closed loop is zero for every force in nature.

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46. State if each of the following statements is true or false. Give reasons for your answer:- In an inelastic collision, the final kinetic energy is always less than the initial kinetic energy of the system.

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47. Answer carefully, with reasons :-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) ?

Watch Video Solution

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Watch Video Solution

50. Answer carefully, with reasons:

If the potential energy of two billiard balls depends only on the separation distance between their centres, is the collision elastic or inelastic?

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51. 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

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54. 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

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55. A body is moving unidirectionally under the influence of a source of constant power. Its displacement in time tis proportional to

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59. A body constrained to move along the z-axis of a coordinate system is subject to a constant force F given by $F = -\hat{i} + 2\hat{j} + 3\hat{k}N$ where $\hat{i}, \hat{j}, \hat{k}$ are unit vectors along the x-, y- and z-axis of the system respectively. What is the work done by this

force in moving the body a distance of 4 m along the z-axis ?

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60. An electron and a proton are detected in a cosmic ray experiment, the first with kinetic energy 10 keV, and the second with 100 keV. Which is faster, the electron or the proton ? Obtain the ratio of their speeds, (electron mass = $9.11 \times 10^{-31} kg$, proton mass = $1.67 \times l0^{-27} kg$, $1eV = 1.60 \times 10^{-19} J$)

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61. A rain drop of radius 2 mm falls from a height of 500 nr above the ground. It falls with decreasing acceleration (due to viscous resistance of the air) until at half its original height, it attains its maximum (terminal) speed, and moves with uniform speed thereafter. What is the work done by the gravitational force on the drop in the first and second half of its journey ? 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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62. A molecule in a gas container hits a horizontal wall with speed 200 m s_1 and angle 30° with the normal, and rebounds with the same speed. Is momentum conserved in the collision ? Is the collision elastic or inelastic ?

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63. A pump on the ground floor of a building can pump up water to fill a tank of volume $30m^3$ in 15 min. If the tank is 40 m above the ground, and the

efficiency of the pump is 30%, how much electric power is consumed by the pump ?

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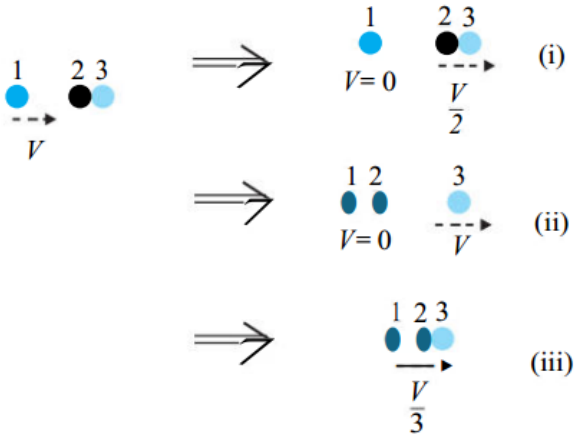
64. Two identical ball bearings in contact with each other and resting on a frictionless table are hit head-on by another ball bearing of the same mass moving initially with a speed V. If the collision is elastic, which of the following (Fig. 6.14)

is a possible result after collision ?



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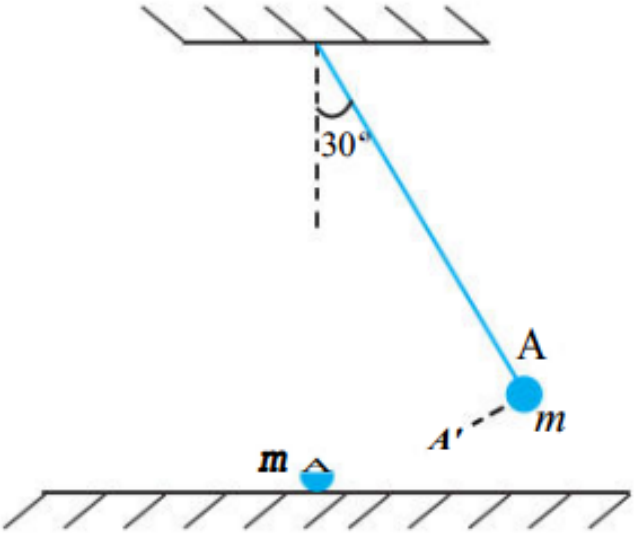
65. The bob A of a pendulum released from 30° to the vertical hits another bob B of the same mass at rest on a table as shown in Fig. 6.15. How high does the bob A rise after the collision ? Neglect the size of the bobs and assume the collision to

be elastic.



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66. The bob of a pendulum is released from a horizontal position. If the length of the pendulum is 1.5 m, what is the speed with which the bob arrives at the lowermost point, given that it

dissipated 5% of its initial energy against air resistance ?

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67. A trolley of mass 300 kg carrying a sandbag 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 floor of the trolley 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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68. A body of mass 0.5 kg travels in a straight line with velocity $v = ax\left(\frac{3}{2}\right)$ where $a = 5m\left(\frac{1}{2}\right)s^{-1}$. What is the work done by the net force during its displacement from x = 0 to x = 2 m?

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69. The blades of a windmill sweep out a circle of area:- If the wind flows at a velocity v

perpendicular to the circle, what is the mass of the air passing through it in time t ?

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70. The blades of a windmill sweep out a circle of area :-What is the kinetic energy of the air ?

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71. The blades of a windmill sweep out a circle of area :- Assume that the windmill 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 the electrical power produced ?

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72. A person trying to lose weight (dieter) lifts a 10 kg mass, one thousand times, to a height of 0.5 m each time. Assume that the potential energy lost each time she lowers the massis dissipated:- How much work does she do against thegravitational force ?

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73. A person trying to lose weight (dieter) lifts a 10 kg mass, one thousand times, to a height of 0.5 m each time. Assume that the potential energy lost each time she lowers the massis dissipated:- 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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74. A family uses 8 kW of power:- Direct solar energy is incident on the horizontal surface at an average rate of 200 W per square meter. If 20% of this energy can be converted to useful electrical energy, how large an area is needed to supply 8 kW?

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76. 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 means of thin wires. Calculate the height to which the block rises. Also, estimate the amount of heat produced in the block.

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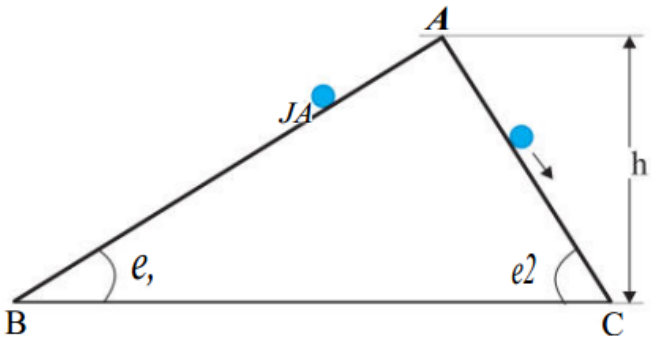
77. Two inclined frictionless tracks, one gradual and the other steep meet at A from where two stones are allowed to slide down from rest, one on each track (Fig. 6.16). Will the stones reach the bottom at the same time? Will they reach there with the same speed? Explain. Given $61 = 30^\circ$, $\theta_2 = 60^\circ$, and h= 10 m, what are the speeds and

times taken by the two stones ?



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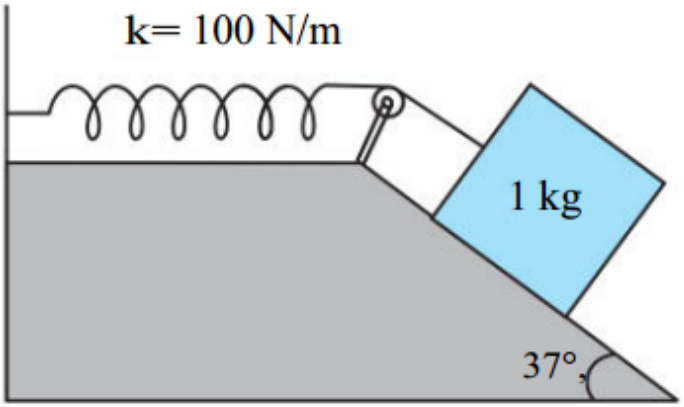
78. A 1 kg block situated on a rough incline is connected to a spring of spring constant $100Nm^{-1}$ as shown in Fig. 6.17. The block is released from rest with the spring in the unstretched position. The block moves 10 cm down the incline before coming to rest. Find the

coefficient of friction between the block and the incline. Assume that the spring has a negligible mass and the pulley is frictionless.



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79. A bolt of mass 0.3 kg falls from the ceiling of an elevator moving down with an uniform speed of $7ms^{-1}$. It hits the floor of the elevator (length

of the elevator = 3 m) 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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80. A trolley of mass 200 kg moves with a uniform speed of $36km/h$ on a frictionless track. A child of mass 20 kg runs on the trolley from one end to the other (10 m away) with a speed of $4ms^{-1}$ relative to the trolley in a direction opposite to the its motion, and jumps out of the trolley. What

is the final speed of the trolley ? How much has the trolley moved from the time the child begins to run ?

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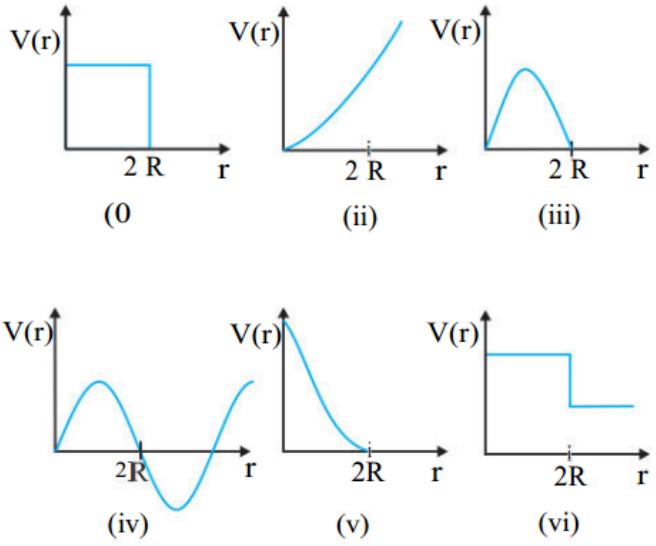
81. Which of the following potential energy curves in Fig. 6.18 cannot possibly describe the elastic collision of two billiard balls ? Here r is the

distance between centres of the balls.



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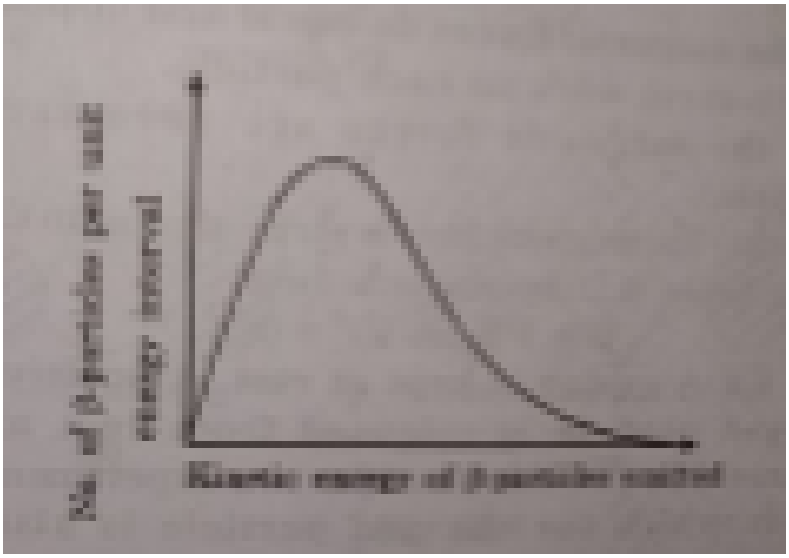
82. Consider the decay of the free neutron at rest:

$n = p + e^{-}$.

Show that the two-body decay of this type must

necessarily give an electron of fixed energy and, therefore, cannot account for the observed continuous energy distribution in the β decay of a neutron or a nucleus.



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83. 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 magnetic forces do not wokr on each particle.

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

D. the magnetic forces are necessarily negligible.

Answer:

84. 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 in which the charged particdle is also a proton and in another, a positron. 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:

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85. 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:

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

A. $+2000J$

B. $-200J$

C. Zero

D. $-20,000J$

Answer:

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87. 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 mechanicdal energy

D. Total linear moemtnum

Answer:

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88. 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:

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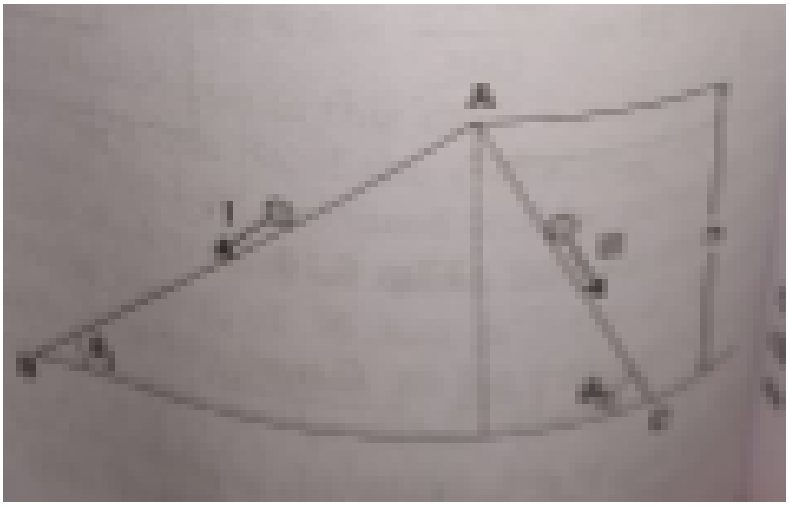
89. Two inclined frictionless tracks, one gradual and the other steep meet at A from where two stones are allowed to slide donw from rest, one of each track as shown in the figure.



A. Both the stones reach the bottom at the same time but not with the same speed.

B. Both the stones reach the bottom with the same speed and stone I reaches the bottom earlier than stone II.

C. Both the stones reach the bottom with the same speed and stone II reaches the bottom earlier than stone I.

D. Both the stones reach the bottom at different tiems and with different speeds.

Answer:

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90. The potential energy function for a particle executing linear simple harmonic motion is given by V{x) = $kx^2/2$, wherek is the force constant of the oscillator. For $k = 0.5Nm^{-1}$, the graph of V[x) versus x is shown in Fig. 6.12. Show that a particle of total energy 1 J moving under this potential must 'turn back' when it reaches `x

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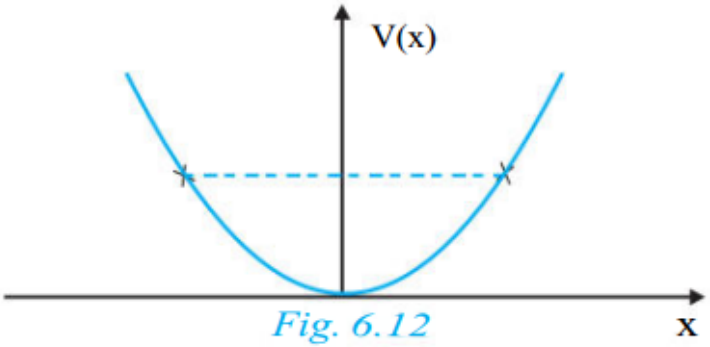

Fig. 6.12

A. V = 0, K = E

B. V = E, K = 0

C. V lt E, K = 0

D. V = 0, K lt E.

Answer:

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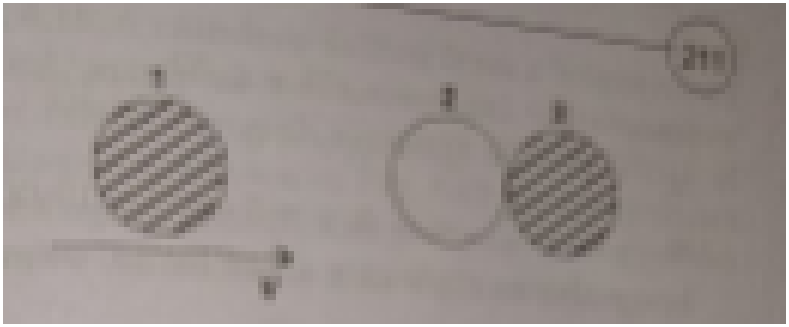
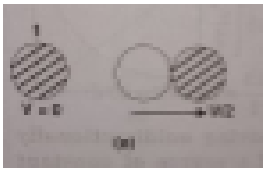
91. Two identical ball bearing in contact with each other and resting on a frictionless table are hit head on by another ball bearing of the same mass moving initially with a speed V shown in the figure.

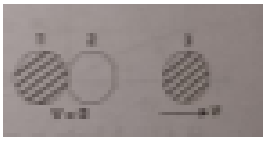


If the collision is elastic, which of the folloiwng shown in the figure is a possible result after collision ?

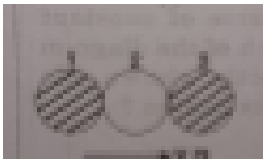
A.



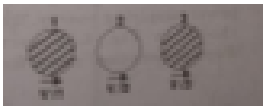
B.



C.



D.



Answer:

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92. A body of mass 0.5 kg travels in a straight line with velocity $v = ax\left(\frac{3}{2}\right)$ where $a = 5m\left(\frac{1}{2}\right)s^{-1}$. 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:

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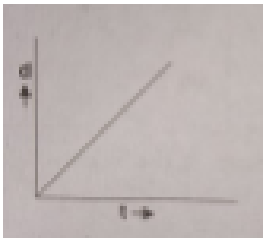
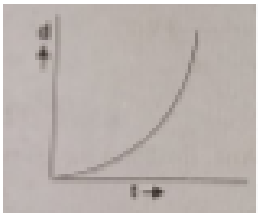
93. A body is moving unidirectionally under the influence of a source of constant power. Its displacement in time tis proportional to

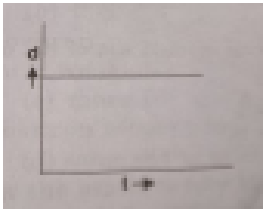
A.



B.



C.



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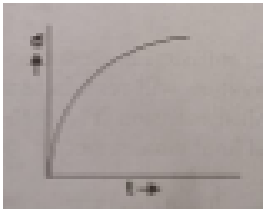
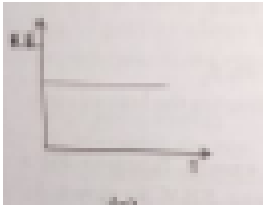


Answer:

Watch Video Solution

94. Which of the diagrams show in figure most closely shows the variation is kinetic energy of the earth as it moves once around the sun in its elliptical orbit?

A.



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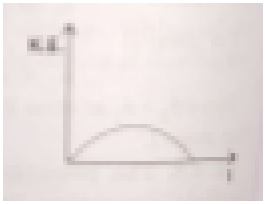
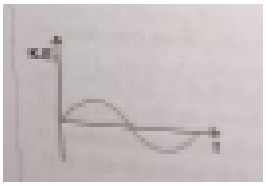
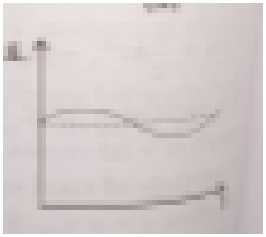


C.



D.

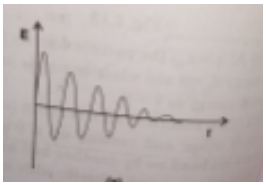


Answer:

Watch Video Solution

95. Which of the following represents electronic configuration of alkali metals.

A.



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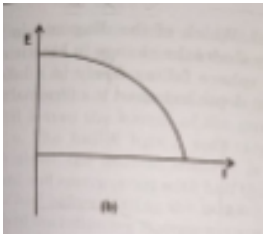
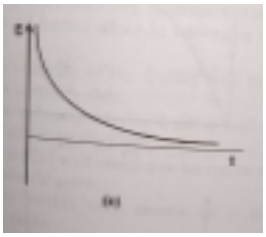


C.



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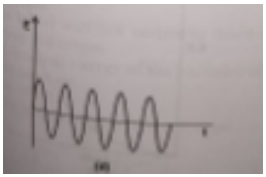

Answer:

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

A. $250\pi^2$

B. $100\pi^2$

C. $5\pi^2$

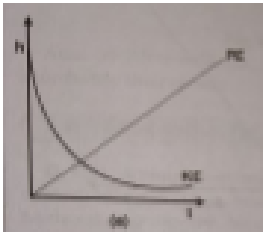
D. 0

Answer:

Watch Video Solution

97. A raindrop of mass 1.00 g falling form a height of 1 km hits the ground with a speed of $50ms^{-1}$. Calculate. the loss of P.E. of the drop.

A.



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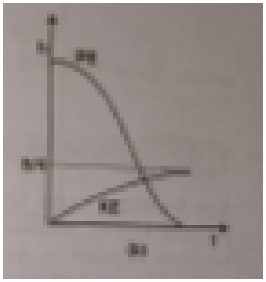

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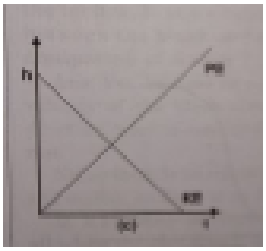
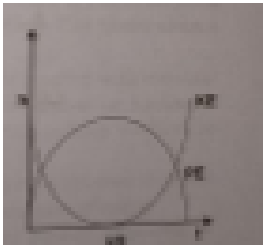


D.



Answer:

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98. In a shotput event an athlete throws the shotput of mass 10 kg with an initial speed fo $1ms^{-1}$ at 45° from a height 1.5 m 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 jst reaches the ground wil be

A. 2.5 J

B. 5.0 J

C. 52.5 J

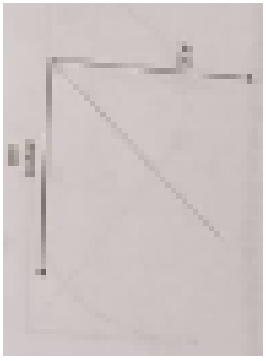
D. 155.0 J

Answer:

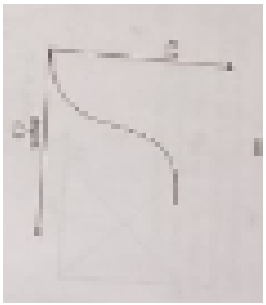
Watch Video Solution

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

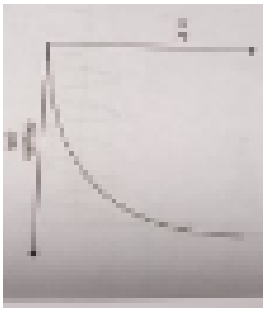
A.



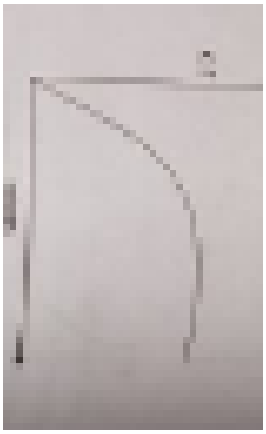
B.



C.



D.



Answer:

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100. A cricket ball of mass 150 g moving with a speed of 126 km/h hits at the iddle of the bat, held firmly at its position by the batsman. The ball

moves straight back to the bowler after hitting the bat. Assurming that collision between ball and bat is completely elastic and the two remain in contact for 0.001 s, the force that the batsman had to apply to hold the bat firmly at its place would be

A. 10.5 N

B. 21 N

C. $1.05 \times 10^4 N$

D. $2.1 \times 10^4 N$

Answer:

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101. 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 dow

work because the point of application of the

force does nt move while the force exists.

Answer:

Watch Video Solution

102. 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 targtet. which of the following statements are correct in respect of bullet after it emerges out of the target?

A. The velocity of the bullet will be reduced to half its initial value.

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

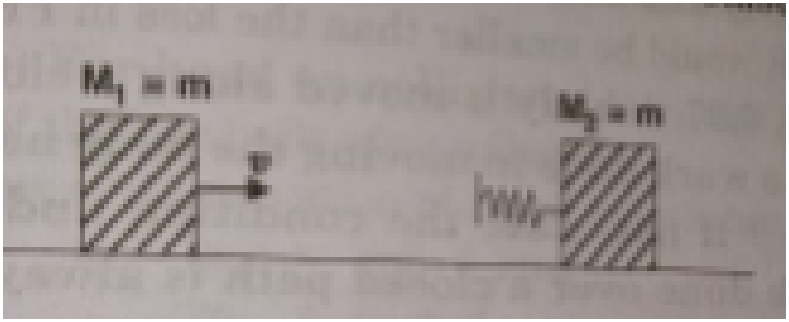
C. The bullet will move in a different parabolic path.

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

Answer:

Watch Video Solution

103. 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 the figure. Initially M_2 is at rest and M_1 is moving towards 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 initial momentum.

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

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

Answer:

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104. A rough incline plane is placed on a cart moving with a constnat velocity u on horizontal ground. A block of mass M rests on the incline. Is any work done by fore of friction between the block and incline? Is there then a dissipation of energy?

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105. Why is electrical power required at all when the elevator is descending? Why should there be a

limit on the number of passengers in this case?

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106. A body is being raised to height h from the surface of earth. What is the sign of work done by applied force

Watch Video Solution

107. A body is being raised to height h from the surface of earth. What is the sign of work done by gravitational force?

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108. 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 2 m.

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

Watch Video Solution

110. 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.

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111. Answer carefully, with reasons :-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) ?

Watch Video Solution

112. Answer carefully, with reasons :-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) ?

Watch Video Solution

113. Calculate the power of a crane in watts, which lifts a mass of 100 kg to a a height of 10 m in 20s.

Watch Video Solution

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

Watch Video Solution

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

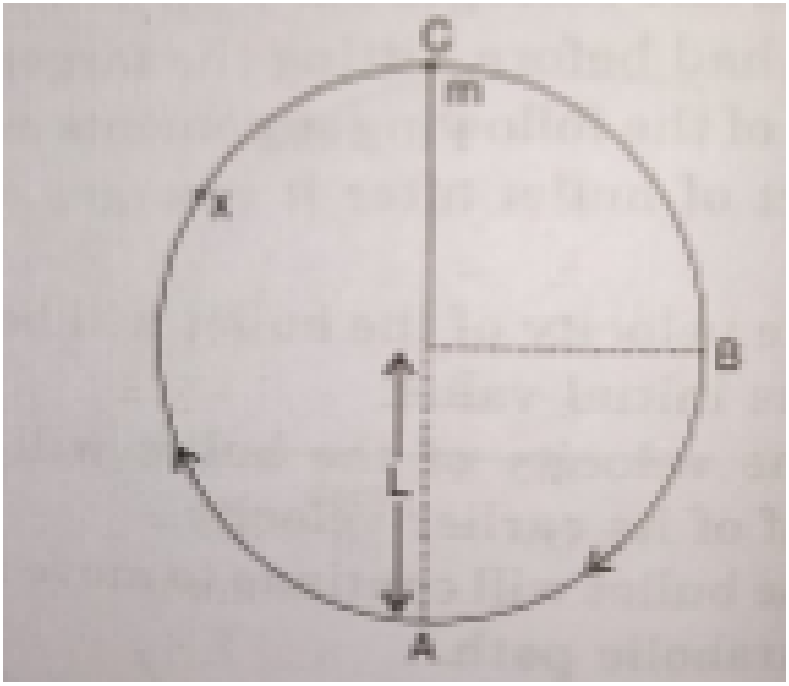
Watch Video Solution

116. 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 magntiude. How would the distance moved by them before coming to rest compare?

Watch Video Solution

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

Point B?

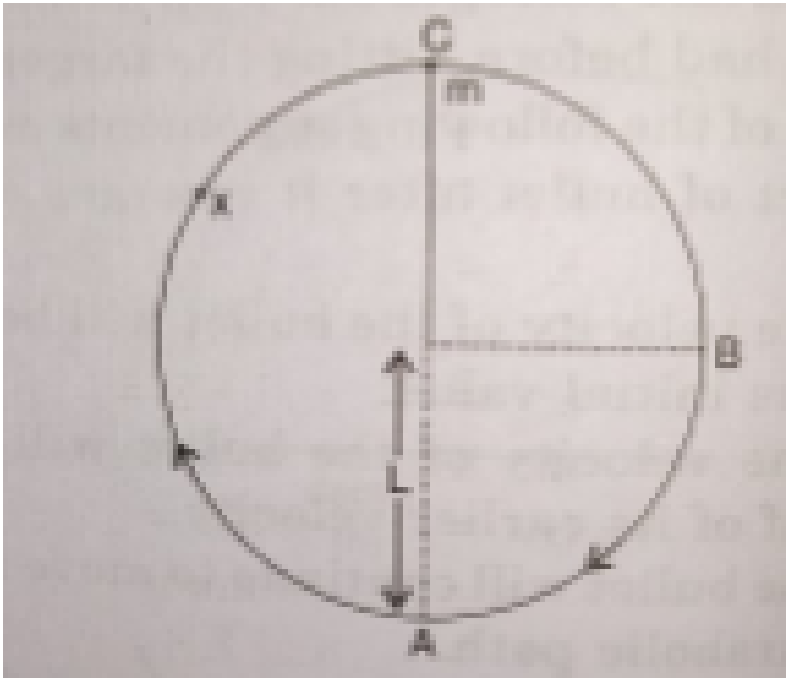


Watch Video Solution

Watch Video Solution

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

Point B?



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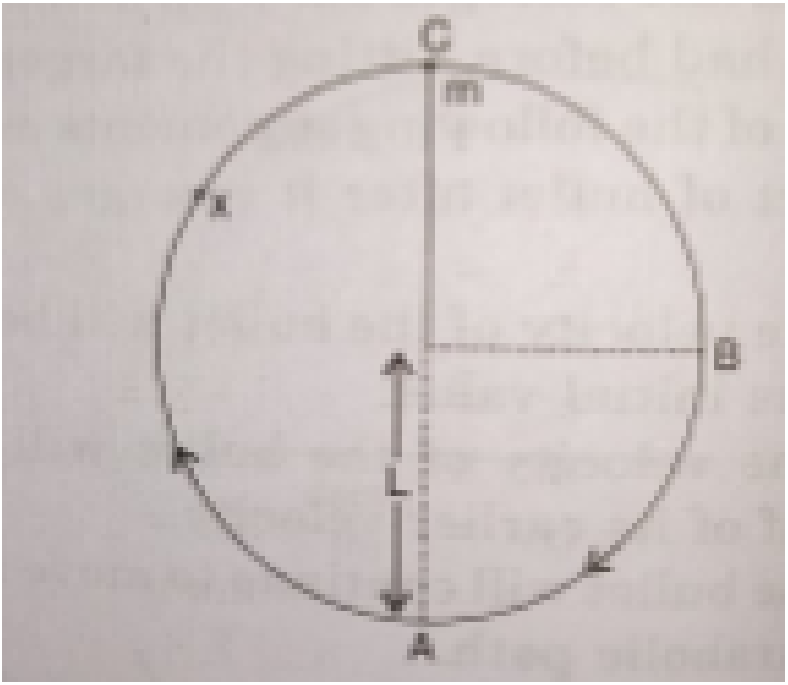
119. A bob of mass m suspended by a light string of length L is whirled into a vertical circle as shown in the figure. What will be the trajectory of the particle if the string is cut at

Point X?



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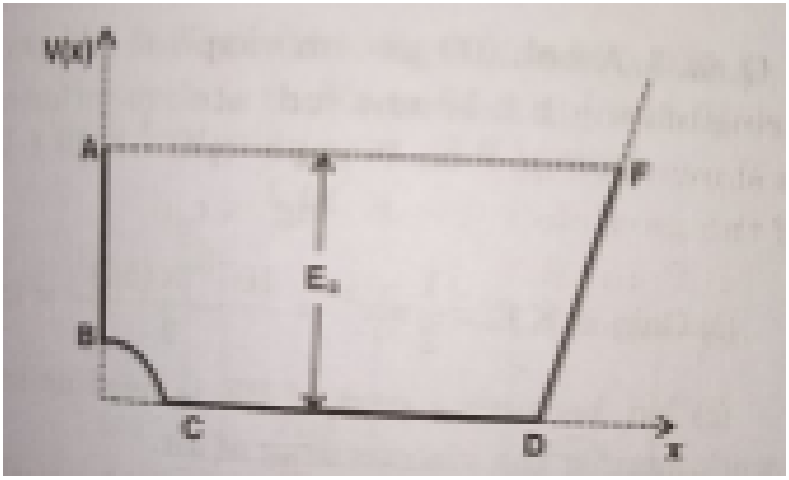
120. A graph of potential energy V (x) versus x is shwon in figure. A particle of energy E_0 is executing motion in it. Draw graph of velocity and

kinetic energy versus x for one complete cycle AFA.



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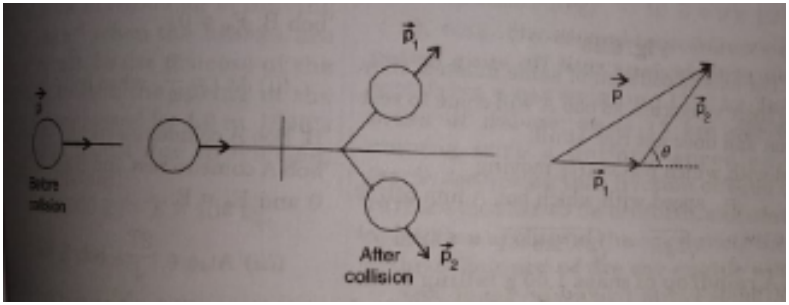
121. A ball of mass m, moving with a speed $2v_0$ collides inelastically (e>0) with an identical ball at rest. Show that for head-on collision, both the

balls move forward.



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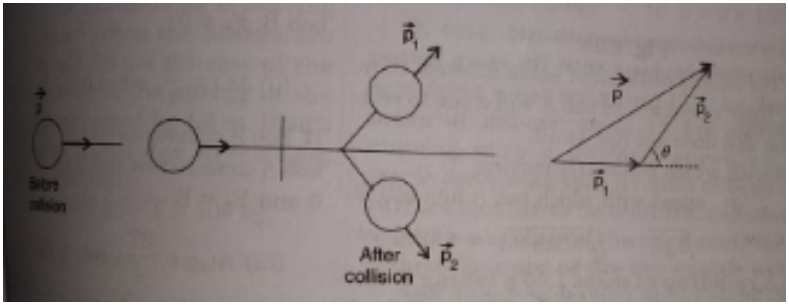
122. A ball of mass m, moving with a speed $2v_0$ collides inelastically (e>0) with an identical ball at rest. Show that For a general collision, the angle between the two velocities of scattered balls is

less than 90°.



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123. Consider a one-dimensional motion of a particle with total energy E. There are four regions A, B, C and D in which the realtion beetween potential energy V, kinetic energy (K) and total energy E is as given ahead. Region A: V>E, Region B : V < E, Region C : K > E, Region D : V > K

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

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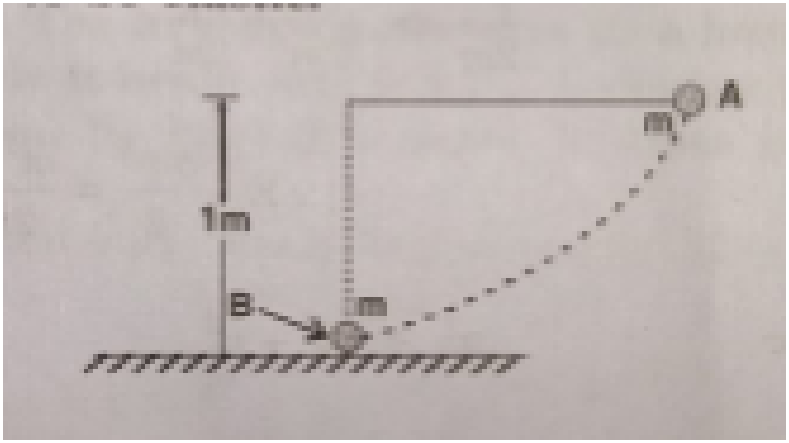
124. The bob A of a pendulum released from horizontal to the vertical hits another bob B of the same mass at rest on a table as shown in the figure. If the length of the pendulum is 1m, calculate the height to which bob A will rise after

collision.



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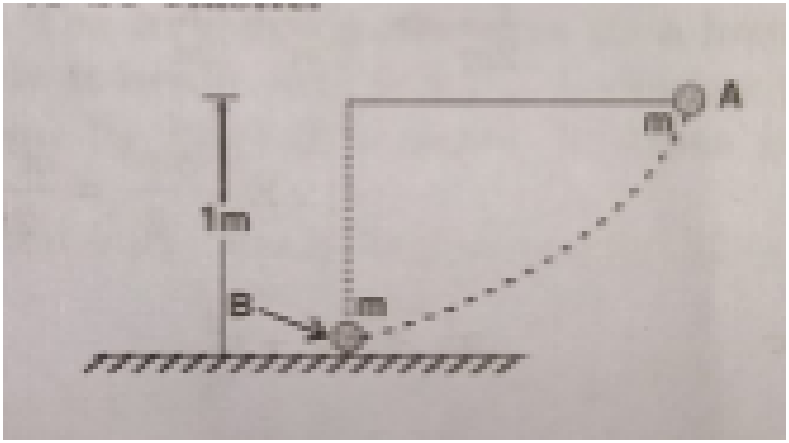
125. The bob A of a pendulum released from horizontal to the vertical hits another bob B of the same mass at rest on a table as shown in the figure. If the length of the pendulum is 1m, calculate the height to which bob A will rise after

collision.



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126. A raindrop of mass 1.00 g falling form a height of 1 km hits the ground with a speed of $50ms^{-1}$. Calculate. the loss of P.E. of the drop.

Watch Video Solution

127. A rain drop of mass 1.00 g falling from a height of 1 km hits the ground with a speed of $50ms^{-1}$. Calculate. the gain in K.E. of the drop.

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128. A rain drop of mass 1.00 g falling from a height of 1 km hits the ground with a speed of $50ms^{-1}$. Calculate. Is the gain in K.E. equal to loss of P.E.? If not, why?

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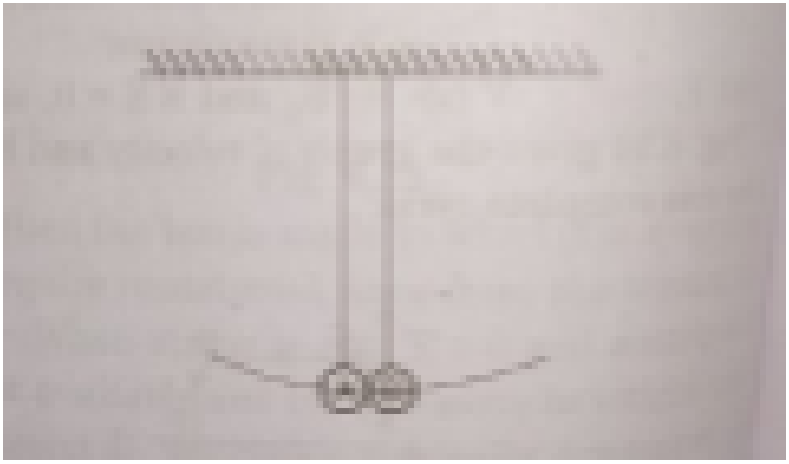
129. Two pendulums with identical bobs and lengths are suspended from a common support such that in rest position the two bobs are in contact. One of the bobs is eleased after being displaced by 10° so that it collides elastically head-on with the other bob.



Describe the motion of two bobs.

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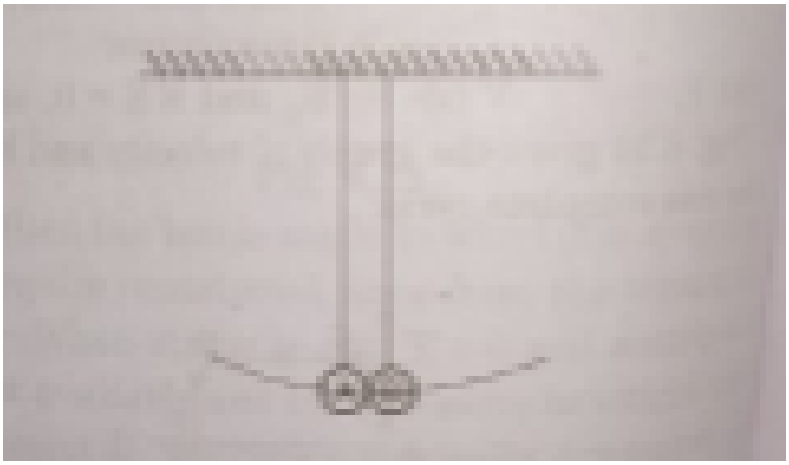
130. Two pendulums with identical bobs and lengths are suspended from a common support such that in rest position the two bobs are in contact. One of the bobs is eleased after being displaced by 10° so that it collides elastically head-on with the other bob.



Draw a graph showing variation in energy of

either pendulum with time, for $0 \leq t \leq 2T$, where T is theh period fo each pendulum.

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

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

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133. an adult weighing 600 N raises the centre of gravity of his body by 0.25 m while taking each step of 1 m length in jogging. If he jogs for 6 km, calculate the energy utilised by him in jogging assuming that there is no energy loss due to friction of ground and air.

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134. On complete combustion a litre of petrol gives off heat equivalent to $3 \times 10^7 J$. In a test drive a car weighing 1200 kg, including the mass

of driver, runs 15 km per litre while moving with a uniform speed on a straight track. Assuming tha friction offered by the road surface and air to be uniform, calcuate the force of friciton acting on the car during the test drive, if the efficiency of the car engine were 0.5.

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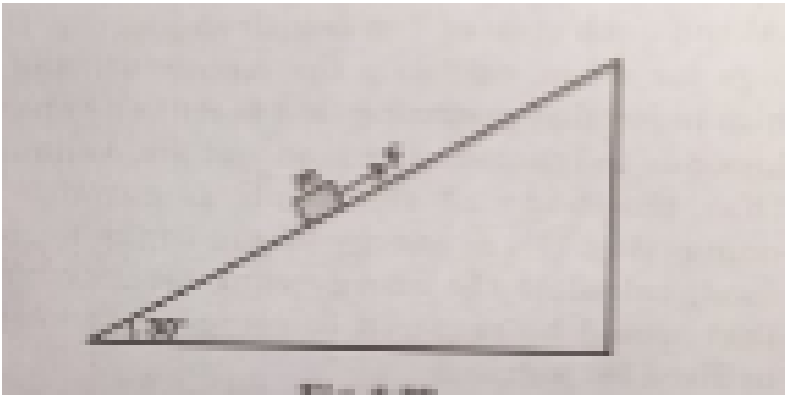
135. A block of mass 1 kg is pushed up a surface inclined to horizontal at ang angle of 30° by a force of 10 N parallel to the inclined surface in the figure. shows . The coefficient of friction between

bock and the incline is 0.1. If the block is pushed up by 10 m along the incline, calculate work done against gravity



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136. A block of mass 1 kg is pushed up a surface inclined to horizontal at ang angle of 30° by a force of 10 N parallel to the inclined surface in the

figure. shows . The coefficient of friction between bock and the incline is 0.1. If the block is pushed up by 10 m along the incline, calculate work done against force of friction

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137. A block of mass 1 kg is pushed up a surface inclined to horizontal at ang angle of 30° by a force of 10 N parallel to the inclined surface in the figure. shows . The coefficient of friction between bock and the incline is 0.1. If the block is pushed

up by 10 m along the incline, calculate increase in potential energy

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138. A block of mass 1 kg is pushed up a surface inclined to horizontal at ang angle of 30° by a force of 10 N parallel to the inclined surface in the figure. shows . The coefficient of friction between bock and the incline is 0.1. If the block is pushed up by 10 m along the incline, calculate work done by applied force.

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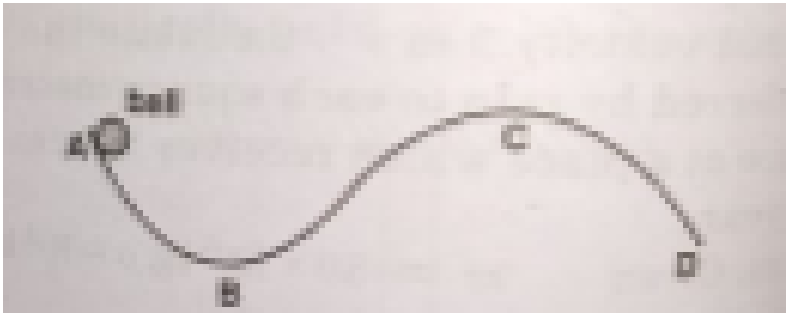
139. A curved surface is shown in the figure. The portion BCD is free of friciton. There are three spherical balls of identical radii and masses. Balls are released from rest one by one from A which is at a slightly greater height than C.



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

For which balls is total mechanical energy conserved?

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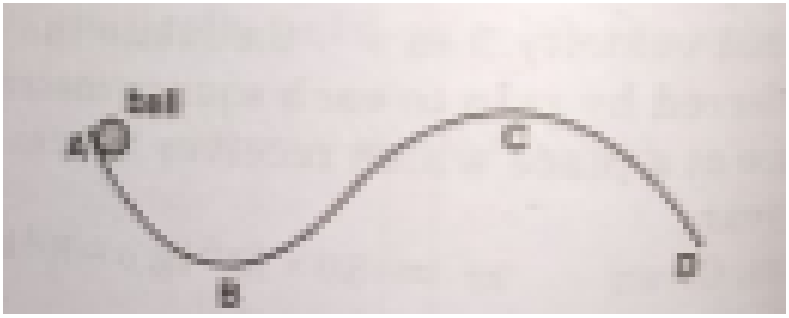
140. A curved surface is shown in the figure. The portion BCD is free of friciton. There are three spherical balls of identical radii and masses. Balls are released from rest one by one from A which is at a slightly greater height than C.



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

Which balls (s) can reach D?

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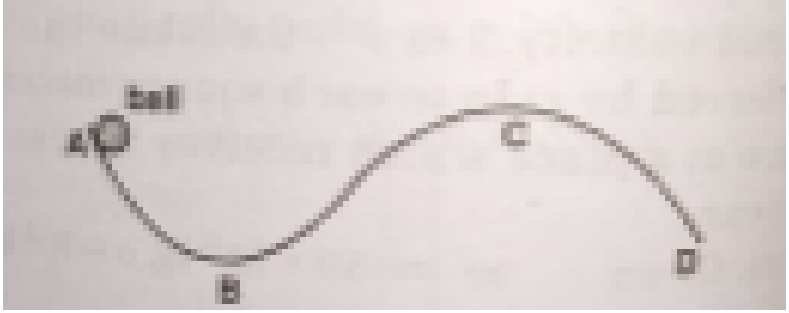
141. A curved surface is shown in the figure. The portion BCD is free of friciton. There are three spherical balls of identical radii and masses. Balls are released from rest one by one from A which is at a slightly greater height than C.



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

For balls which do nt each D, which of the balls an reach back A?

Watch Video Solution

142. A rocket accelerates sraight up by ejecting gas downwards. In a small time interval Δt, it ejects a gas of mass Δm at a relative speed μ. Calculate KE of the entire system at $t + \Delta t$ and t and show that the device that ejects gas does work = $\left(\frac{1}{2}\right)\Delta m\mu^2$ in this time interval (neglect gravity).

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143. Two identical steel cubes (masses 50 g, side 1 cm) 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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144. A ballon filled with helium rises against gravity increasing its potential energy. the speed of the ballon 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 constant.

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145. The work done by a force is given by the dot product of force $\overrightarrow{F}$ and displacement $\overrightarrow{s}$. If the work done is zero, then:

A. $\overrightarrow{F}$ and $\overrightarrow{S}$ act in the same direction

B. $\overrightarrow{F}$ and $\overrightarrow{S}$ act in the opposite direction

C. $\overrightarrow{F}$ and $\overrightarrow{S}$ are parallel to each other

D. $\overrightarrow{F}$ and $\overrightarrow{S}$ are at right angles.

Answer:

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146. A particle moves in the xy plane under the influence of a force. the rectangular components of the momentum of the particle at time t are as under. $p_x = 2\cos t$ and $p_y = 2\sin t$ The angle between the applied force and the momentum at time t is

A. 0°

B. 30°

C. 60°

D. 90°

Answer:

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147. The kinetic energy of a body becomes 4 times its initial value. The new lines momentum will be

A. same as initial value

B. four times the initial value

C. twice the initial value

D. eight times the initial value

Answer:

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148. A bullet of mass M hits a block of mass M'. The transfer of energy is maximum, when

A. M' = M

B. M' = 2M

C. M' << M

D. M' >> M

Answer:

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149. One coolie takes two minutes to raise a box from platform to train. Another coolie takes one minjte, work done

A. by the first is more

B. by the first is less

C. is same by both

D. becomes $\frac{1}{4}$ in the first.

Answer:

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150. The kinetic energy acquired by a mass m after travelling a fixed distance form rest under the action of constant force is

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

B. `directly proportional to m

C. independent of m

D. diectly proportional to $1\sqrt{m}$

Answer:

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151. In a gravitational field, the work done in transporting mass from one point to another depends on

A. end positions

B. distance between them

C. actual path of motion

D. velocity of transport

Answer:

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152. The work done by the varying force in changing the angular displacement from 0 to θ

A. (a) While spring is fully compressed all the KE of M_1 is stored as PE of spring.

B. (b) FL sin θ

C. (c) FH

D. (d) $\left(\frac{1}{2}\right) FL \sin\theta$

Answer:

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153. The work done by the tension T in t above process is

A. (a) zero

B. (b) T(L - L cos θ)

C. (c) $-TL$

D. (d) $-TL\sin\theta$

Answer:

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154. 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 magntiude. How would the distance moved by them before coming to rest compare?

A. Lorry

B. Car

C. Both will come to rest after coverting equal distances

D. It depends on their velocities.

Answer:

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155. When K.E. of a body is increased by 300 %, the momentum of the body is increased by

A. 0.2

B. 0.5

C. 1

D. 2

Answer:

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156. Two solid subber balls A and B having masses 0.2 and 0.4 are moving in opposite directions with velocity of A equal to 0.3 ms^{-1} After collission, the two balls come to rest when the velocity of B is

A. $0.15ms^{-1}$

B. $1.5ms^{-1}$

C. $-0.15ms^{-1}$

D. zero

Answer:

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157. If a stone is thrown up vertically and return to ground, its potential energy is maximum

A. during the upward journey

B. at the maximum height

C. during the return journey

D. at the bottom

Answer:

Watch Video Solution

158. A ball is dropped from a height of 20 m and rebounds to a height of 10 m. The loss of energy is

A. 0.05

B. 0.25

C. 0.5

D. 0.75

Answer:

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159. Two masses of 1g and 9 g are moving with equal kinetic energies. The ratio of the magnitudes of their respective linear momentum is

A. $1:9$

B. $9:1$

C. $3:1$

D. $1:3$

Answer:

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160. Fill in the blanks:

Moon going round the earth__ work is done.

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161. Fill in the blanks:

Wrk done is _____ if a body gets displaced in a direction opposite to the direction in which force is applied.

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162. Fill in the blanks:

Unit of work in -_____ is joule.

Watch Video Solution

163. Fill in the blanks:

_____ is the capacity of doing work.

Watch Video Solution

164. Fill in the blanks:

Gravitational force is a _____ force.

Watch Video Solution

165. Fill in the blanks:

One horse power = _____W.

Watch Video Solution

166. Fill in the blanks:

In nuclear power plants, the nuclear energy is converted into _____ energy.

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167. Define work

Watch Video Solution

168. Since work is a scalar quantity, can it have negative value?

Watch Video Solution

169. How much work is done on a body of mass 1 kg whirling on a circular path of radius 5m?

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170. Can acceleration be produced without doing any work?

Watch Video Solution

171. Two protons are brought together. How will potential energy of the system alter?

Watch Video Solution

172. An electron is moving towards a proton. Is the work done positive or negative?

Watch Video Solution

173. What is kinetic energy ? Derive a mathematical expression for kinetic energy .

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174. What is the work done by gravitational force in taking a mass m to a height h with uniform

motion?

Watch Video Solution

175. What is potential energy?

Watch Video Solution

176. A man is rowing upstream and is at rest w.r.t. shore. Is he doing work w.r.t shore?

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177. What is a collision?

Watch Video Solution

178. What is conservative force?

Watch Video Solution

179. What is non-conservative force?

Watch Video Solution

180. Can a body have momentum without energy?

Watch Video Solution

181. With what type of forces, potential energy is associated?

Watch Video Solution

182. What is coefficient of restitution? What is its value for perfectly elastic and inelastic collisions?

Watch Video Solution

183. Give some examples of P.E. other than gravitatinoal P.E.

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184. A person is trying to push a box, the whole day he makes use of his stored energy but cannot move it. In physics we say he has not done any work. Explain why?

Watch Video Solution

185. An electron is moving towards a proton. Is the work done positive or negative?

Watch Video Solution

186. An arrow is shot from a bow, from where does it get kinetic energy?

Watch Video Solution

187. Can a body have energy without momentum?

Watch Video Solution

188. State the conditions under which a force does no work.

Watch Video Solution

189. The kinetic energy of a body becomes 4 times its initial value. The new lines momentum will be

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190. What are the conditions so that transfer of kinetic energy is maximum during collision?

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

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192. A body is being raised to height h from the surface of earth. What is the sign of work done by applied force

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193. A body is being raised to height h from the surface of earth. What is the sign of work done by gravitational force?

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194. 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 2 m.

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195. Give an example of scalar product.

Watch Video Solution

196. Name the physical quantity which is expressed as product of force and velocity. is it a scalar or vector quantity?

Watch Video Solution

197. What is te relation between joule and kg m?

Watch Video Solution

198. Name the physical quantity which is expressed as product of force and velocity. is it a

scalar or vector quantity?

Watch Video Solution

199. Does the work done in raising a box on a platform depend upon how fast it is raised up? If not, why?

Watch Video Solution

200. With what type of forces, potential energy is associated?

Watch Video Solution

201. Dot product of two vectors obey _____ law.

Watch Video Solution

202. Since work is a scalar quantity, can it have negative value?

Watch Video Solution

203. Fill in the blanks:

_____ is the capacity of doing work.

Watch Video Solution

204. Work can be ___ negative or Zero.

Watch Video Solution

205. The kinetic energy of a body is always _____.

Watch Video Solution

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

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207. The collision in one dimension is also known as _____ collisions.

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208. What is work? What is it equal to?

Watch Video Solution

209. A light and a heavy body have same linear momentum. Which one has greater K.E.?

Watch Video Solution

210. What is non-conservative force?

Watch Video Solution

211. Show that gravitational force is a conservative force.

Watch Video Solution

212. Show that sum of P.E. and k.E. of a freely falling body is conserved.

Watch Video Solution

213. A lighter body and a heavier body have same K.E. Which one has greater momentum?

Watch Video Solution

214. For a force to do maximum work, what should be the angle between force and displacement vectors?

Watch Video Solution

215. What is the relation between kinetic energy and momentum?

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216. Define electric potential energy. Give its units. Calculate electric potential energy of system of n point charges.

Watch Video Solution

217. An electron and a proton have equal momentum. Which has more kinetic energy and what is the ratio between the kinetic energy of electron and proton?

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218. Two springs of spring constants k_1 and k_2 are stretched by the same force. First spring undergoes more extension than the second one. In which of the two springs, energy stored will be maximum?

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219. In what part of its orbit is the earth's potential energy greatest with respect to the sun? In what part of its orbit is its kinetic energy greatest ? Explain.

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220. Explain the term work. Obtain an expression for work done by a constant force.

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221. What do you understand by positive work, negative work and zero work? Give at least two examples of each type.

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222. Explain work done by a variable force.

Watch Video Solution

223. give relation between joule and erg. Also derive dimensional formula of work.

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224. State and prove work-energy theorem.

Watch Video Solution

225. State law of conservation of energy with examples. Explain the transformation of energy in a simple pendulum.

Watch Video Solution

226. Discuss potential energy of a coiled spring.

Watch Video Solution

227. Define the term collision. Discuss its types with examples.

Watch Video Solution

228. Discuss the elastic collision in one dimension and calculate the velocities of bodies after the collision.

Watch Video Solution

229. Define elastic and inelastic collisions. A lighter body collides with a much more massive body at rest. Prove that the directin of the lighter body is reversed and massive body remains at rest.

Watch Video Solution

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

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231. The potential energy of a certain particle is given by $U = 30x^2 - 20y^2$. Find the force acting on the particle.

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232. A bomb of mass 9 kg explodes into pieces of masses 3 kg and 6 kg. The velocity of 3 kg mass is 16 m/s. Find the kinetic energy associated with the 6 kg mass.

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233. 1 g of water cools down from its boiling point to its freezing point, it gives off about 420 J of heat energy. By how much does its mass change because of this loss in energy?

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234. A railway carriage of mass 9,000 kg moving with a speed of 36 kmh^{-1} strikes a stationary carriage of same mass. After the collision, the carriages get coupled and move together. what is their common speed after collision? Is the collision elastic?

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235. A shot travelling at the rate of $100ms^{-1}$ is just able to pierce a plank 4 cm thick. What

velcoity is required to just pierce a plank 9 mm thick?

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236. A trolley of mass 200 kg moves with a uniform speed of $36km/h$ on a frictionless track. A child of mass 20 kg runs on the trolley from one end to the other (10 m away) with a speed of $4ms^{-1}$ relative to the trolley in a direction opposite to the its motion, and jumps out of the trolley. What is the final speed of the trolley ? How

much has the trolley moved from the time the child begins to run ?

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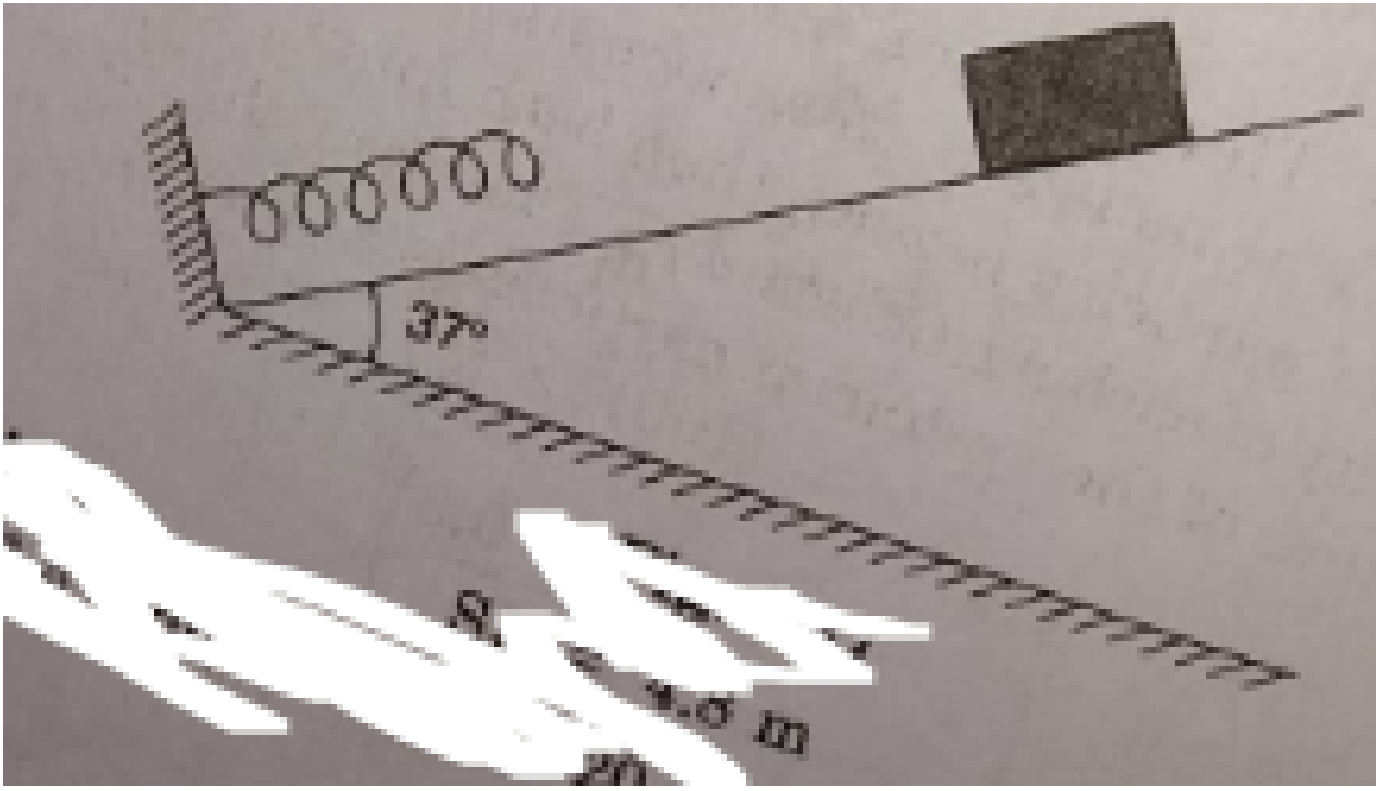
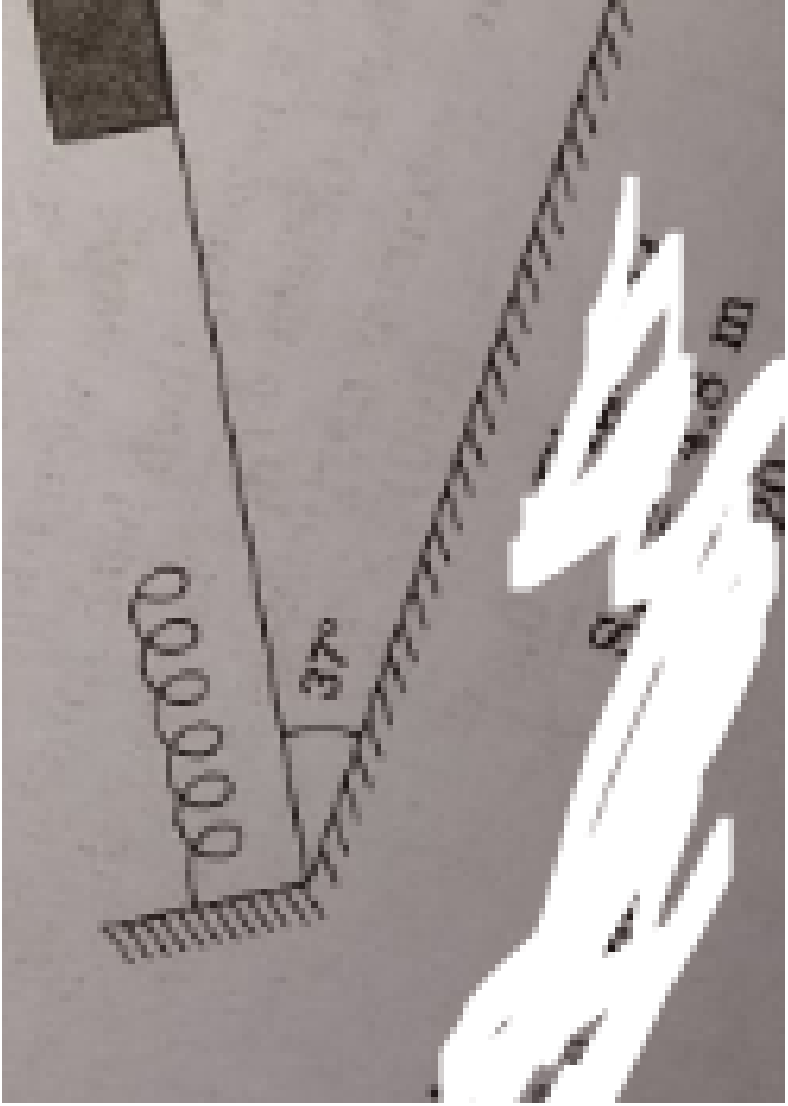
237. Shown in the figure a spring fixed at the bottomm end of all incline of inclination 37°. A small block of mass 2 kg starts slipping down the incline form a point 4.8 m aaway from the spring. The block compresses the spring by 20 cm, stops momentarily and then rebounds through a distance of 1 m up the incline. Find the friction coefficient between the palne


37°

Watch Video Solution

238. Shown in the figure a spring fixed at the bottomm end of all incline of inclination 37°. A small block of mass 2 kg starts slipping down the incline form a point 4.8 m aaway from the spring. The block compresses the spring by 20 cm, stops momentarily and then rebounds through a distance of 1 m up the incline. Find the spring constant of the spring Take $g = 10ms^{-2}$



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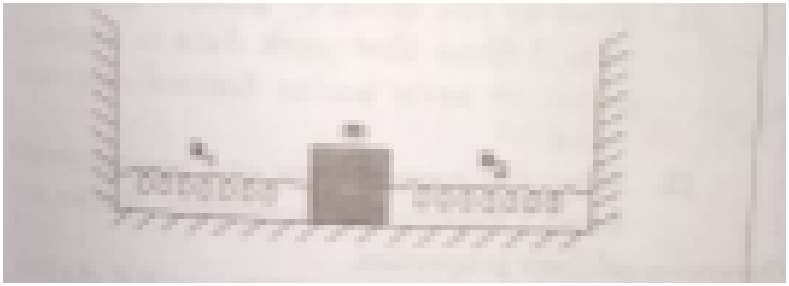
239. A block of mass m is attached to two unstrecthed of spring constant k_1 and k_2 as shown in the figure The block is displaced towards right through a distance x and is released. Find the speed of the block as it passes through the mean position shown.



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240. A 20 g bullet pierces through a plate of mass M_1 = 1 kg and then comes to rest inside a second plate of mass M_2 = 2.98 kg as shown in figure. It is found that the two plates, initially at rest, now move with equal velocities. Find the percentage loss in the initial velocity of the bullet when it is between M_1 and M_2 Neglect any loss of material of the plates, due to action of bullet.

Watch Video Solution

241. Given that linear momentum of a system of particles is zero.

Watch Video Solution

242. Given that linear momentum of a system of particles is zero.

Watch Video Solution

243. A truck moves on a level road. Doe it do any work against gravity?

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244. What happens to the P.E. when an elevator loses in coming down from the top of a building to a stop at the ground floor?/

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245. Name two situations whre variable force acts.

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246. Does the work done in raising a box on a platform depend upon how fast it is raised up? If not, why?

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247. Are kinetic and potential energies inter-convertible?

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248. Where from the kinetic energy of falling rain drops come?

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249. What are the factors on which the work done depends?

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250. Under what conditions, the work done by a fore is maximum and minimum

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251. A man is rowing a boat up a stream w.r.t the shore. Is he doing a work? Explain.

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252. A man continues to push a rock for some time but fails to moe it. What is the work done? Explain?

Watch Video Solution

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

Watch Video Solution

254. What are conservattion and non-conservation forces? Explain with examples. Mention some of their properties.

Watch Video Solution

255. Show that sum of P.E. and k.E. of a freely falling body is conserved.

Watch Video Solution

256. Define elastic collision. Show thaat in an elastic collision, relative velocity of approach before collision is equal to relative velocity of separation after collisions.

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