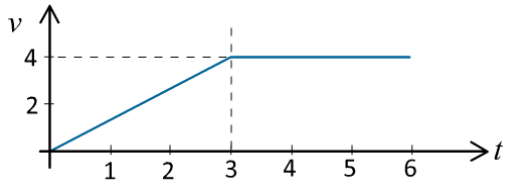
Work, Energy and Power

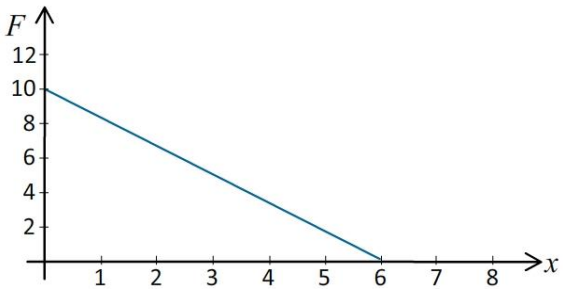
Objective : Revisiting the phenomena analyzed earlier from energy considerations

Note : Value of acceleration due to gravity may approximated as 10 ms^{-2}.

1. A body is projected vertically up with an initial velocity of 30 ms^{-1}. Find the maximum height reached by it (using the energy considerations).
2. A body is dropped from a height of 5m. Find the velocity with which it reaches the ground (using the energy considerations).
3. A body is dropped from a height of 30m. Find the height from the ground at which its potential energy is half its kinetic energy.
4. A projectile is projected with certain initial velocity. What should be the angle of projection so that its kinetic energy at the highest point of its trajectory is half the initial kinetic energy? Is the remaining half of the initial kinetic energy lost?
5. A body of mass 10 kg is released from rest on a rough inclined plane of length 2m, making an angle of 60° w.r.t. the ground. Coefficient of static friction is 0.6 and coefficient of kinetic friction is 0.4. Does the body move? If yes then, as the body reaches the ground, find
   (a) Work done by gravitational force
   (b) Work done by normal reaction
   (c) Work done by frictional force.
   (d) Is the final kinetic energy of the body equal to its initial potential energy? Give reason.
6. Two blocks of masses 4kg and 6kg are connected using a light inextensible string. The string passes over a pulley of negligible mass and friction. When the blocks are released, then in t = 2 seconds find
   (a) Work done by tension on the 4 kg block
   (b) Work done by gravitational force on the 4 kg block
   (c) Work done by tension in the string on the 6 kg block
   (d) Work done by gravitational force on the 6 kg block
   (e) Work done by total work done on the two blocks by all forces acting on them
7. A box of mass 20 kg in placed in an elevator. Find the work done by (i) gravitational force (ii) normal reaction in the following cases
   (a) Elevator moving up with uniform velocity of 1ms^{-1} for 5 seconds
   (b) Elevator moving down with uniform velocity of 1ms^{-1} for 5 seconds
   (c) Starting from rest, elevator moving up with uniform acceleration of 1ms^{-2} for 2 seconds
   (d) Starting from rest, elevator moving down with uniform acceleration of 1ms^{-2} for 2 seconds
   (e) With an initial velocity of 10m^{-1} downwards, elevator descends with uniform deceleration of 1ms^{-2} and comes to rest
   (f) In each of the above cases verify if work done by all forces is equal to change in kinetic energy of the box.
8. Velocity of a body of mass 10kg changes with time as given by the graph below. Find the work done on the body by the applied force in (a) the first 3 seconds (b) next two seconds



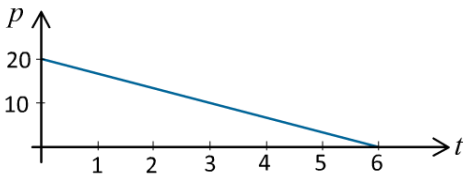
9. Force acting on a body varies with displacement as shown in the figure given below.



(a) Find the change in kinetic energy of the body.

(b) If initial KE of the body is 200 J then find the final KE of the body.

10. Calculation of work done on a body of mass 4 kg based on its p-t plot. Values of both momentum and time mentioned in the graph, are in SI units.



Answers

1. 45 m
2. 10 ms^{-1}
3. 10 m
4. 45°, No, kinetic energy lost during ascent is converted to potential energy at the highest point
5. (a) $100\sqrt{3}$ J

   (b) zero

   (c) -40 J

   (d) No, final kinetic energy is less than initial potential energy as some energy is lost in doing work against friction as the body slides down
6. (a) 192 J

   (b) -160 J

   (c) -192 J

   (d) 240 J

   (e) +80 J
7. Work done by normal reaction and gravitational forces are

   (a) +1000 J , -1000 J

   (b) -1000 J , +1000 J

   (c) +440 J , -400 J

   (d) -360 J , +400 J

   (e) -11000 J , +1000 J

   (f) In ALL the above cases it may be verified that $W_N + W_G = \Delta KE$
8. +80 J , zero
9. (a) 30 J

   (b) 230 J
10. -50 J

For detailed solutions mail your request to sigmaprc@gmail.com (mention the class / chapter / assignment number in the mail)