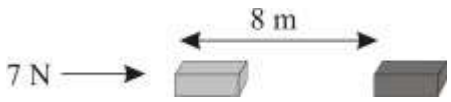
Work and Energy: Exercise Questions

[Page 148]

Q.1 A force of 7 N acts on an object. The displacement is, say 8 m, in the direction of the force. Let us take it that the force acts on the object through the displacement. What is the work done in this case?



Sol. Given: Force F =7N
Displacement = 8 m
then the work done W on the body by the force is given by:
Work done = Force × Displacement
W = F × S W = 7 × 8
= 56 Nm
= 56 J

[Page 149]

Q.1 When do we say that work is done?

Sol. Work is done whenever the given two conditions are satisfied:
(i) A force must act on the body.
(ii) There is a displacement of the body caused by the force along the direction of the applied force.

Q.2 Write an expression for the work done when a force is acting on an object in the direction of its displacement.

Sol. When a force F is applied on an object and it displaces the object through a distance S in the direction of the applied force, then the work done W on the object is given by the expression:
Work done = Force × Displacement
W = F × s

Q.3 Define 1 J of work.

Sol. 1 J of work is defined as the amount of work done by 1 N force on an object that displaces it through a distance of 1 m in the direction of the applied force.
Work = force x displacement
1 J = 1N X 1m

Q.4 A pair of bullocks exerts a force of 140 N on a plough. The field being ploughed is 15 m long. How much work is done in ploughing the length of the field?

Sol. Given: Force = 140 N
The field being ploughed or displacement = 15 m
Work done by the bullocks is given by the expression:
Work done = Force × Displacement
W = F × s
W = 140 × 15 = 2100 J
Thus, 2100 J of work is done in ploughing the length of 15 m long field.

[Page 152]

Q.1 What is the kinetic energy of an object?

Sol. It is the energy possessed by an object by the virtue of its motion. Every moving object possesses kinetic energy. Example: Kinetic energy of car of mass m is moving with velocity v, then it kinetic energy is represented by –

Kinetic Energy = ½ mv^2

Q.2 Write an expression for the kinetic energy of an object.

Sol. If an object of mass m is moving with a velocity of v m/s, then its kinetic energy E_k is given by -

$E_k=½mv^2$

SI unit of kinetic energy is Joule (J).

Q.3 The kinetic energy of an object of mass, m moving with a velocity of 5 m s–1 is 25 J.What will be its kinetic energy when its velocity is doubled? What will be its kinetic energy when its velocity is increased three times?

Sol. Given: Velocity v = 5 m/s

Kinetic energy K.E. = 25 J

Expression for kinetic energy $Ek=½mv^2$

$25 = ½ m (5)^2$

$50/25 = m$

$m = 2Kg$

(i) When the velocity of an object is doubled,

Then, v = 5 × 2 = 10 ms^{-1}.

K.E.' = ½ (2) $(10)^2$

K.E.' = 100 J

From the above result, its kinetic energy becomes 4 times its original value.

(ii) When the velocity is increased three times,

Then, its kinetic energy-

K.E.' = ½ (2) $(15)^2$

K.E.' = 225 J

From the above result, its kinetic energy becomes 9 times its original value, because it is proportional to the square of the velocity. Hence, kinetic energy = 25 × 9 = 225 J.80

[Page 156]

Q.1 What is power?

Sol. Power is defined as work done in per unit time or the transfer of energy in per unit time. If W is the amount of work done in time t, then power is given by the expression,

Power = Work done/ time = W/t

S.I unit is watt (W).

Q.2 Define 1 watt of power:

Sol. A body is said to have 1 watt power when it does work 1 joule in 1 s.

Power = Work done/time

1W = 1J/1s

Q.3 A lamp consumes 1000 J of electrical energy in 10 s. What is its power?

Sol. As we know that power is given by the expression,

Power = Work done /time

Energy consumed by the lamp = 1000 J

Power = $1000/10 = 100 Js^{-1}$

= 100 W

Q.4 Define average power.

Sol. A body does different amount of work in different time intervals. Then Average power is obtained by dividing the total amount of work done in the total time taken to do the work.

Average Power = Total work done / Total time taken