CHAPTER NO. 4 (WORK AND ENERGY)

Question 4.1:- A person holds a bag of groceries while standing still, talking to a friend. A car is stationary with its engine running. From the stand point of work, how are these two situations similar?

Answer:- Both the situations are similar because work done is zero in both cases. The displacement is zero in both cases because objects are stationary in both cases so work done = (Force) (Displacement) = Zero.

Question 4.2:- Calculate the work done in kilo joules in lifting a mass of 10 kg (at a steady velocity) through a vertical height of 10 m.

Answer:- We can calculate work done as under:-

Mass = m = 10 kg

Force = Weight = mg = 10 x 9.8 = 98 N

Height = 10 m

Work Done = W = Force x Displacement = (mg)(h) = mgh = 10 x 9.8 x 10 = 980 J

W = 980/1000 kJ = 0.98 kJ

Question 4.3:- A force F acts through a distance L. The force is then increased to 3F, and then acts through a further distance of 2L. Draw the work diagram to scale.

Answer:- A force F acts through a distance L, so work done is $W_1 = FL$.

Now, the force is increases to 3F and acts through a further distance of 2L, so work done is $W_2 = (3F)(2L) = 6FL$.

Total work done = $W = W_1 + W_2 = FL + 6FL = 7FL$

Question 4.4:- In which case is more work done? When a 50 kg bag of books is lifted through 50 cm, or when a 50 kg crate is pushed through 2 m across the floor with a force of 50 N?

Answer:- Case 1:- m = 50 kg, h = 50 cm = 0.5 m, F = mg = 50 x 9.8 = 490 N

$W_1 = mgh = (490)(0.5) = 245$ N

Case 2:- m = 50 kg, d = 2 m, F = 50 N

$W_2 = Fd = (50)(2) = 100$ N

So more work is done in first case.

Question 4.5:- An object has 1 J of potential energy. Explain what does it mean?

Answer:- An object has 1 J potential energy, it means that it has the ability to do a work of 1 J due to its constrained position/state in a force field such as gravitational field, elastic field, electric field etc.

It means 1 J of work is done on the object by some external energy against gravitational field, elasticity of an object or electric field etc.

Question 4.6:- A ball of mass m is held at a height h_1 above a table. The table top is at a height h_2 above the floor. One students says that the ball has potential energy mgh_1 but another says that it is $mg(h_1+h_2)$. Who is correct?

Answer:- Both students are correct.

If we consider table top as reference point, the potential energy of the object will be $\mathbf{mgh_1}$.

If we consider floor level as reference point, the potential energy will of the object will be $\mathbf{mg(h_1+h_2)}$.

Question 4.7:- When a rocket re-enters the atmosphere, its nose cone becomes very hot. Where does this heat energy come from?

Answer:- When a rocket re-enters the atmosphere at a high velocity, some part of its kinetic energy is utilized in doing work against the air friction. The work done against the air resistance appears as heat energy and its nose cone becomes very hot.

Question 4.8:- What sort of energy is in the following: (a) Compressed spring (b) Water in a high dam (c) A moving car.

Answer:- Following types of energies are present:-

(a) A compressed spring has elastic potential energy due to work done against its elasticity.

(b) Water in a high dam has gravitational potential energy due to its high position with reference to basin of the dam.

(c) A moving car has kinetic energy due to its motion.

Question 4.9:- A girl drops a cup from a certain height, which breaks into pieces. What energy changes are involved?

Answer:- A cup has gravitational P.E. at a certain height. When the cup is dropped, the gravitational P.E. decreases and K.E. increases. Just before striking the floor, the whole P.E. is converted into K.E. On striking the ground, K.E. is changed into sound, heat and work done to break the cup into its pieces.

Question 4.10:- A boy uses a catapult to throw a stone which accidently smashes a green-house window. List the possible energy changes.

Answer:- The elastic potential energy of the catapult is converted into kinetic energy of the stone. When the stone strikes the green house window, the kinetic energy of the stone is utilized into sound, heat and work done in breaking the window glass into pieces.