CHAPTER – 3 ENERGY [SOLUTIONS]

Test Your Understanding [Page no. 50]

Answer the following questions :

1. How much work is done when a body of mass *m* is raised to a height *h* above the ground?

Answer : A body of mass 'm' has to be raised at 'h' height.

So, work done = Force x displacement

= Weight of object x displacement

= m g x h

2. State the S.I. unit of work.

Answer : Joule.

3. Is work a scalar or a vector quantity?

Answer : Scalar quantity.

4. What is the condition of a force to do work on a body?

Answer : The condition is : If force is applied to the body, then the body should be displaced from its initial position.

5. Is energy a vector quantity?

Answer : No.

EXERCISE

OBJECTIVE TYPE QUESTIONS

A. Choose the correct option :

1. The amount of work done depends upon

(a) force (b) displacement

(c) velocity (d) both (a) and (b)

Answer : (d) both (a) and (b)

2. The capacity to do work is called

(a) power (b) energy

(c) force (d) displacement

Answer : (b) Energy

3. A moving car possesses

(a) sound energy (b) mechanical energy

(c) heat energy (d) chemical energy

Answer : (b) mechanical energy

4. Which form of energy does flowing water possess?

(a) Gravitational energy (b) Potential energy

(c) Electrical energy (d) Kinetic energy

Answer : (d) Kinetic energy

5. The energy possessed by a body due to its position is called its

(a) Heat energy (b) Kinetic energy

(c) Potential energy (d) Chemical energy

Answer : (c) Potenetial energy

6. Which of the following correct represents the steps involved in energy conversion in hydropower plants?

(a) Heat energy → Kinetic energy → Electric energy

(b) Kinetic energy → Heat energy → Electric energy

(c) Kinetic energy → Potential energy → Electric energy

(d) Potential energy → Kinetic energy → Electric energy

Answer : (d) Potential energy → Kinetic energy → Electric energy

7. Which one does not work on solar energy?

(a) Cookers (b) Heaters

(c) Traffic light (d) Microwave

Answer : (d) Microwave

8. Which one is not true?

(a) Energy changes its form

(b) Energy cannot be created

(c) Energy can be stored

(d) Energy can be destroyed

Answer : (d) Energy can be destroyed.

9. Which is another form of 1 Joule?

(a) 1 Nm (b) 1 Nm^{-1}

(c) 1 Nms^{-1} (d) Nm^2s^{-1}

Answer : (a) 1 Nm

10. Thermal power plant :

(a) Converts chemical energy of coal into electrical energy

(b) Converts solar energy into electrical energy

(c) Converts mechanical energy into electrical energy

(d) Converts heat energy into electrical energy.

Answer : (d) Converts heat energy into electrical energy.

B. Fill in the blanks :

1. The S.I. unit of work is……
Answer : Joule.

2. ……work is done if there is no displacement.
Answer : Zero/No.

3. Energy is a……quantity.
Answer : Scalar.

4. The energy of a body due to its motion is called……energy.
Answer : Kinetic energy.

5. The energy is due to a change in the shape of the body is called……potential energy.
Answer : Elastic.

6. We get……energy from the burning of fuel like coal, kerosene and petrol.
Answer : Heat.

7. Green plants, while preparing food convert solar energy into……energy.
Answer : Chemical.

8. A generator converts……energy into electrical energy.
Answer : Mechanical energy.

C. Write T for True and F for False statements.
1. Work done is independent of the magnitude of the force.
Answer : False.

2. A body possessing energy is capable of doing work.
Answer : True.

3. The water of flowing river has potential energy.
Answer : False.

4. If the mass of the object is doubled, its kinetic energy increases by four times.
Answer : False.

5. Energy does not occur in various forms.
Answer : False.

6. Kinetic energy is inversely proportional to the square of velocity of that object.
Answer : False.

7. We require energy to cook food.
Answer : True.

8. Work is only done when the object moves.
Answer : True.

9. An object can work more than the energy it possesses.
Answer : False.

10. Energy transformation occurs in many activities that we do in our day-to-day life.
Answer : True.

11. Kinetic energy has magnitude and direction.
Answer : False.

D. Name the devices or machines which convert:
1. Electrical energy into mechanical energy.
Answer : Electric motor.
2. Electrical energy into heat energy.
Answer : Electric Iron.
3. Chemical energy into kinetic energy (or mechanical energy).
Answer : Automobile engine.
4. Chemical energy into heat energy.
Answer : Gas stove/Furnace.
5. Light energy into heat energy.
Answer : Solar water heater.

E. Differentiate between the following :

1. Kinetic energy and potential energy.
Answer :

Kinetic Energy	**Potential Energy**
Energy possessed by a body virtue of the the state of motion.	Energy possessed by a body by virtue of its state of possition.
Example : Running train.	**Example :** The brick lying on the roof of a house.
Kinetic energy = ½ m v^2	Potential energy = m x g x h

2. Light energy and heat energy.
Answer :

Light Energy	Heat Energy
Heat is also a form of energy which we get from the Sun and also from burning of fuels like coal, kerosene and petrol.	Light is also a form of energy which we get from the Sun but, in the form of particles.
We use heat energy to warm our houses, cook food and for other purposes.	We can see all the things around us with the help of light energy.
The heat of Sun can dry our clothes.	Plants use light energy to make their food.

3. Gravitational potential energy and elastic potential energy.
Answer :

Gravitational potential energy	Elastic potential energy
The energy of the brick lying on the roof-top is known as gravitational potential energy because it has been acquired by doing work against gravity.	The stretched strings of a catapult possess potential energy due to a change in their shape (because they become long and thin).
The energy of a body due to its position above the ground is called gravitational potential energy.	The energy of a body due to a change in its shape and size is called elastic potential energy.

Subjective Type Questions

F. Answer the following questions in short.

1. Define work.
Answer : Work is the product of the component of the force in the direction of the displacement and the magnitude of this displacement.
OR
Work is the product of force exerted on the body and the distance moved by the body in the direction of force.

2. What are the quantities on which the amount of work done depends? How are they related to work?
Answer : The work done by a force on a body depends on two factors :
(i) Magnitude of the force.
(ii) Distance through which the body moves (in the direction of force).
Work = force x distance moved in the direction of force.
Work done = Force x distance

3. Is it possible that a force is acting on a body but still the work done is zero? Explain giving one example.
Answer : Yes, it is possible. Let us consider an example to explain this.
(i) When you push a wall by applying force, the wall does not move, the work done by you on the wall is zero. Therefore, no work is done if there is no displacement.
(ii) A passenger standing stationary at a railway platform with heavy bag may get tired soon but he does no work because the bag held by him does not move at all.

4. What is energy?
Answer : Energy is defined as the capacity to do work.

5. Name any four types of energy.
Answer : Four types of energy are :
(i) Kinetic energy
(ii) Potential energy
(iii) Heat energy
(iv) Light energy
(v) Sound energy
(vi) Chemical energy

6. What is mechanical energy? Give two examples.
Answer : Mechanical energy or kinetic energy is the energy that an object has due to its state of motion.
For example : (i) A moving car possesses mechanical energy due to its motion (kinetic energy).
(ii) A barbell lifted high above a weightlifter's heat possesses mechanical energy due to its vertical position above the ground.

7. Write the uses of heat energy.
Answer : We use heat energy to warm our homes, cook food and for other purposes. The heat of the Sun can dry our clothes. It can make the land dry and the air warm.

8. How does the kinetic energy of a moving body depend on its (i) speed, and (ii) mass?
Answer : (i) Kinetic energy is directly proportional to mass of the body and
(ii) Directly proportional to the square of the speed of the body.

9. Describe the energy changes which take place in a radio.
Answer : A radio transforms electrical energy to the energy of sound. In a radio set, electrical energy vibrates and creates sound through the speaker's diaphragm. Thus, the radio transforms electrical energy into kinetic energy and ultimately into sound.
10. Write the energy transformation which take place in an electric bulb (or electric lamp).
Answer : Electrical energy is converted into light energy and heat energy in an electric bulb.
It could be described as :
Electrical Energy → Heat Energy → Light Energy

11. Name five appliances or machines which use an electric motor.
Answer : Electric motors are used in electric fans, coolers, refrigerators, mixer, grinders, washing machine, water pump, electric cars etc.

G. Answer the following questions in detail.

1. (a) Define the term 'work'. Write the formula for the work done on a body when a force acts on the body in the direction of its displacement. Give the meaning of each symbol which occurs in the formula.
(b) A person of mass 50 Kg climbs a tower of height 72 metres. Calculate the work done. ($g = 9.8\ m\ s^{-2}$).
Answer : (a) Work : Work is the product of the component of the force in the direction of the displacement and the magnitude of this displacement.

OR

Work is the product of force exerted on the body and the distance moved by the body in the direction of force.
If a Force F acts on a body and moves it a distance s in its own direction, then :

$$W = F \times s$$

where, F = Force
s = distance moved in the direction of force
(b) Given, mass = 50 Kg
Height of tower = 72 metres
Gravity, $g = 9.8\ ms^{-2}$
Work done = Potential energy

$$W = m\ g\ h$$
$$W = 50 \times 9.8 \times 72$$
$$W = 35280\ J$$

2. (a) Define the term 'energy' of a body. What is the S.I. unit of energy.
(b) What are the various forms of energy?
(c) Two bodies having equal masses are moving with uniform speeds of v and 2v respectively. Find the ratio of their kinetic energies.
Answer : (a) Energy is simply defined as the ability to do work. The S.I. unit of energy is Joule (J).
(b) There are various forms of energy such as:

- Kinetic energy
- Potential energy
- Heat energy
- Light energy
- Sound energy
- Electrical energy
- Chemical energy
- Magnetic energy
- Atomic or Nuclear energy

(c) For first body

$$K.E. = \tfrac{1}{2}\ mv^2$$
$$= \tfrac{1}{2} \times m \times v^2 \quad \text{[Equation 1]}$$

For second body

$$K.E. = \tfrac{1}{2}\ mv^2$$
$$= \tfrac{1}{2} \times m \times (2v)^2$$
$$= \tfrac{1}{2} \times m\ 4v^2 \quad \text{[Equation 2]}$$

Ratio of K.E.

$$= \frac{\frac{1}{2}mv^2}{\frac{1}{2}m\ 4\ v^2}$$
$$= v^2 : 4\ v^2$$

= 1 : 4

3. What do you understand by the term "transformation of energy"? Explain with an example.

Answer : Energy exists in many different forms. One form of energy can be changed into another form. The change of one form of energy into another form of energy is known as transformation of energy.

For example : Energy Transformations at a Hydroelectric Power House

At a hydroelectric power house, the potential energy of water is transformed into kinetic energy and then into electrical energy. The transformations of energy taking place at a hydroelectric power house can be written as :

Potential energy → Kinetic energy → Electrical energy

4. State and explain the law of conservation of energy with an example.

Answer : Law of Conservation of Energy is defined as "Energy can neither be created nor destroyed. It can only be converted from one form to another form".

For example : Energy Transformations at a Thermal Power House

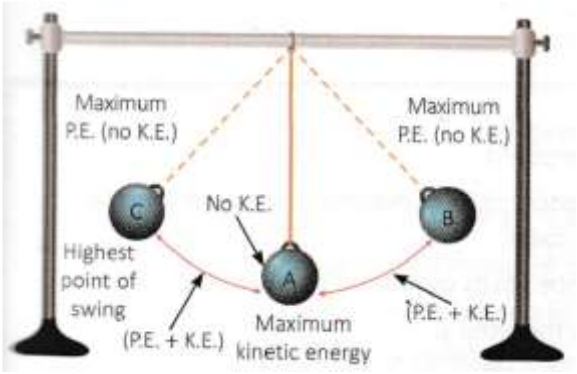
At thermal power house, chemical energy of coal is changed into heat energy, which is further converted into kinetic energy and electrical energy.

This can be written as :

Chemical energy →Heat energy →Kinetic energy →Electrical energy

5. Explain how, the total energy a swinging pendulum at any instant of time remains conserved. Illustrate your answer with the help of a labelled diagram.

Answer : A swinging simple pendulum is an example of conservation of energy. This is because a swinging simple pendulum is a body whose energy can either be potential or kinetic, or a mixture of potential and kinetic, but its total energy at any instant of time remains the same. Thus, a very simple illustration of the transformation of potential energy into kinetic energy, and of kinetic energy back into potential energy is given by a swinging simple pendulum (or an oscillating simple pendulum).



(i) When the pendulum bob is at position B, it has only potential energy(but no kinetic energy).

(ii) As the bob starts moving down from position B to position A, its potential energy goes on decreasing but its kinetic energy goes on increasing.

(iii) When the bob reaches the centre position A, it has only kinetic energy (but no potential energy).

(iv) As the bob goes from position A towards position C, its kinetic energy goes on decreasing but its potential energy goes on increasing.

(v) On reaching the extreme position C, the bob stops for a very small instant of time. So at position C, the bob has only potential energy (but no kinetic energy).