# Exercise

**6.2 Define work. What is its SI unit?**

**Ans: Work:**

Work is done when a force acting on a body displaces it in the direction of a force. Work is a scalar quantity. It depends on the force acting on a body, displacement of the body and the angle between them.

Work done = Force x displacement

Or $W = F S$ (i)

$W = F_x \times S$

$W = (F \cos \theta) S$

$W = FS \cos \theta$ (ii)

**Unit of work:**

SI unit of work is joule (J). it is defined as

The amount of work is one joule when a force of one newton displaces a body through one metre in the direction of force.

Thus $1 J = 1 N \times 1 m$

**6.3 When does a force do work? Explain.**

**Ans:** Work is said to be done when a force acts on a body and moves it in the direction of the force. Greater is the force acting on a body and longer is the distance moved by it, larger would be the work done. Mathematically, Work is product of force F and displacement S in the direction of force. Thus

Work done = Force x displacement

Or $W = F S$ (i)

If the force is unbalance, it causes acceleration. This involves doing work to move it in a certain direction.

### 6.4 Why do we need energy?

**Ans: Need of energy:**

The energy is an important and fundamental concept in science. It links almost all the natural phenomena. When we say that a body has energy, we mean that it has the ability to do work, so it possesses energy. The energy of running water can be used to run the water mills or water turbines.

Energy exists in various forms such as mechanical energy, heat energy, light energy, sound energy, electrical energy, chemical energy and nuclear energy etc. Energy can be transformed from one form into another.

### 6.5 Define energy, give two types of mechanical energy.

**Ans: Energy:**

A body possesses energy if it is capable to do work.

**Types of mechanical energy:**

Mechanical energy possessed by a body is of two types: kinetic energy and potential energy.

### 6.6 Define K.E. and derive its relation.

**Ans: Kinetic Energy:**

The energy possessed by a body due to its motion is called its kinetic energy.

**Derivation of K.E:**

Consider a body of mass *m* moving with velocity *v*. The body stops after moving through some distance *S* due to some opposing force such as force of friction acting on it. The body possesses kinetic energy and is capable to do work against opposing force *F* until all of its kinetic energy is used up.

K.E. of the body = Work done by it due to motion

$$K.E = FS \qquad (i)$$

$$V_i = v$$

$$V_f = 0$$

As $F = ma$

$$A = -\frac{F}{m}$$

Since motion is opposed, hence, *a* is negative. Using 3rd equation of motion:

$$2aS = V_f^2 - V_i^2$$

$$2\left(-\frac{F}{m}\right)S = (0)^2 - (v)^2$$

$$FS = \frac{1}{2}mv^2 \qquad (ii)$$

From Eq. (i) and (ii), we get

$$K.E. = \frac{1}{2}mv^2 \qquad (iii)$$

Equation (iii) gives the *K.E.* possessed by a body of mass m moving with velocity v.

### 6.7 Define potential energy and derive its relation.

**Ans: Potential Energy:**

The energy possessed by a body due to its position is known as its potential energy.

**Derivation of P.E:**

Let a body of mass *m* be raised up through height *h* from the ground. The body will acquire potential energy equal to the work done in lifting it to height h.

Thus, Potential energy P.E. = F x h

= w x h

(Here weight of the body = w = mg)

P.E. = w h = mgh ..... (i)

Thus, the potential energy possessed by the body with respect to the ground is mgh and is equal to the work done in lifting it to height *h*.

ClassNotes

**6.8 Why fossil fuels are called non-renewable form of energy?**

**Ans:** Fossil fuels are known as nonrenewable resources because it took millions of years for them to attain the present form.

We use fossil fuels such as coal, oil and gas to heat our houses and run industry and transport. They are usually hydrocarbons (compounds of carbon and hydrogen). When they are burnt, they combine with oxygen from the air. The carbon becomes carbon dioxide; hydrogen becomes hydrogen oxide called water; while energy is released as heat. In case of coal:

Carbon + Oxygen $\longrightarrow$ carbon dioxide + heat energy

Hydrocarbon + Oxygen $\longrightarrow$ carbon dioxide + water + heat energy

**6.9 Which form of energy is most preferred and why?**

**Ans:** Solar energy is most preferred.

**Explanation:**

Solar energy is the energy coming from the Sun and is used directly and indirectly. Sunlight does not pollute the environment in any way. The sunrays are the ultimate source of life on the Earth. We are dependent on the Sun for all our food and fuels. If we find a suitable method to use a fraction of the solar energy reaching the Earth, then it would be enough to fulfil our energy requirement.

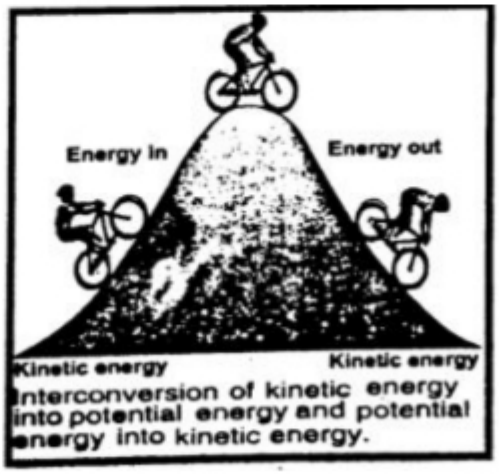
**6.10 How is the energy converted from one form to another? Explain.**

**Ans: Interconversion of energy:**

Energy cannot be destroyed however it can be converted into some other forms.

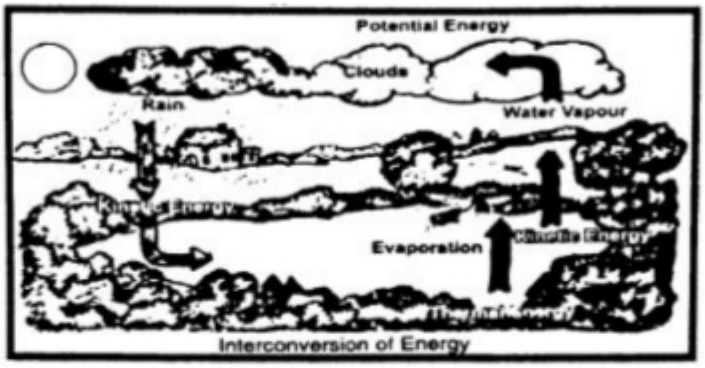
**Examples**:

**i.** Rub your hands together quickly. You will feel them warm. You have used your muscular energy in rubbing hands as a result heat is produced. In the process of rubbing hands, mechanical energy is converted into heat energy.



Interconversion of kinetic energy into potential energy and potential energy into kinetic energy.

**ii.** Processes in nature are the results of energy changes. For example, some of the heat energy from the Sun is taken up by water in the oceans. This increases the thermal energy.




Thermal energy causes water to evaporate from the surface to form water vapors. These vapors rise up and form clouds. As they cool down, they form water drops and fall down as rain. Potential energy changes to kinetic energy as the rain falls, this rain water may reach a lake or a dam. As the rain water flows down, its kinetic energy changes into thermal energy while parts of the kinetic energy of flowing water is used to wash away soil particles of rocks known as soil erosion.

Note:

During the interconversion of energy from one form to other forms, the total energy at any time remains constant.

**6.11 Name five devices that convert electrical energy into mechanical energy.**

**Ans:** **(i)** Electric motor converts electrical energy to mechanical energy.

**(ii)** Drill machine

**(iii)** Electric fan

**(iv)** Electric spinner

**(v)** Electric grinder

**6.12 Name a device that converts mechanical energy into electrical energy.**

Ans: Electric generator converts mechanical energy into electrical energy.

**6.13 What is meant by efficiency of a system?**

**Ans: Efficiency:**

The ratio of the useful work done by a device or machine to the total energy taken up by it is called its efficiency.

*OR*

Efficiency of a system is the ratio of required form of energy obtained from a system as output to the total energy given to it as input.

$$\text{Efficiency} = \frac{\textbf{required form of output}}{\textbf{total input energy}} \quad \text{(i)}$$

$$\%\ \text{Efficiency} = \frac{\textbf{required form of output}}{\textbf{total input energy}} \times \mathbf{100} \quad \text{(ii)}$$

**6.14 How can you find the efficiency of a system?**

**Ans:** $$\text{Efficiency} = \frac{\textbf{required form of output}}{\textbf{total input energy}} \quad \text{(i)}$$

$$\%\ \text{Efficiency} = \frac{\textbf{required form of output}}{\textbf{total input energy}} \times \mathbf{100} \quad \text{(ii)}$$

**6.15 What is meant by the term power?**

**Ans:** Power is defined as the ratio of doing work.

Mathematically,

$$\text{Power} \quad P = \frac{\textbf{Work done}}{\textbf{Time taken}}$$

$$\text{Or} \quad P = \frac{\mathbf{W}}{\mathbf{t}} \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(i)}$$

Since work is a scaler quantity, therefore, power is also a scalar quantity.

**Note:** Bigger units of power are kilowatt (kW), megawatt (MW) etc.

1 kW = 1000W = $10^3$

1MW = 1000 000 = $10^6$

1 horsepower = 1hp = 746 W

**6.16 Define watt.**

**Ans: Unit of power**

SI unit of power is watt (W). It is defined as

**Watt:**

The power of a body is one watt if it does work at the rate of 1 joule per second (1 J $s^{-1}$).

ClassNotes