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More About Energy

MORE ABOUT ENERGY

You have already learnt in your earlier classes that a body capable of doing work is said to possess energy. Energy is required to do any type of work. Your body needs energy for movement and physiological functions like respiration, circulation of blood, digestion, *etc.* Your body gets this energy from the food you eat. Thus, it can be concluded that energy of a body is its capacity to do work. It is measured in terms of the amount of work that the body can do. Energy has the same unit as that of work. The S.I. unit of energy is joule (denoted by J). 1 J is the energy required to do 1 Joule of work. Sometimes a large unit of energy called kilo joule (kJ) is used.

$$1 \text{ kJ} = 1000 \text{ J}$$

Energy is used in various forms to do work, to provide warmth and to move people and goods from one place to another place. Electrical energy operates vacuum cleaners, washing machines and other appliances. Heat energy cooks food and heats your room. Chemical energy of fuel is used to move vehicles.

DIFFERENT FORMS OF ENERGY

Energy exists in various forms in nature. These forms are, mechanical energy, heat energy, light energy, chemical energy, sound energy, magnetic energy, electrical energy and atomic energy.

Mechanical energy :

The energy possessed by a body when the body is in a state of rest or motion is called the mechanical energy.

A body can move horizontally or vertically. It can also move in both the directions *e.g.*

1. A ball rolling on the ground (horizontal).
2. A ball thrown vertically upwards (vertical).
3. A javelin thrown in air (horizontal and vertical both).

The energy possessed by a body by virtue of its state of rest or the state of motion (mechanical state) is called its mechanical energy.

Mechanical energy is of *two* types :

(a) Kinetic Energy (KE)

(b) Potential Energy (PE)

(a) Kinetic Energy : The energy possessed by a body by virtue of its motion is

known as its **kinetic energy**. Energy possessed by strong blowing winds, flowing water, a bullet fired, a fast moving ball are some of the examples of energy due to motion.

Consider a body of mass '*m*' moving with velocity *v*. Its kinetic energy will be given by the formula K.E. = $\frac{1}{2}$ mv^2.

It is clear from the formula, given above, that kinetic energy is directly proportional to the mass of the body and the square of the velocity with which it moves.

Example 1 :

A body of mass '*m*' is moving with a velocity '*v*'. What would be its change in kinetic energy if the velocity is doubled?

Solution :

Mass of the body = m

Initial velocity = v

Initial kinetic energy, $KE_i = \frac{1}{2} mv^2$

And, final kinetic energy, $KE_f = \frac{1}{2} m(2v)^2$

$= \frac{1}{2} m\ (4v^2)$

$$\therefore \quad \frac{KE_f}{KE_i} = \frac{\frac{1}{2} m\ (4v^2)}{\frac{1}{2} mv^2} = \frac{KE_f}{KE_i} = 4$$

or $$KE_f = 4 \times KE_i$$

Therefore, final kinetic energy is four times the initial kinetic energy.

POTENTIAL ENERGY

The energy possessed by a body due to its position or change in shape is known as **potential energy**.

A stretched rubber band, a stretched bow, water in a dam, *etc.*, are some of the examples where the body possess potential energy.

Consider a body of mass '*m*' placed at a vertical height of *h* above the earth's surface. The potential energy of the body is given by the formula,

$$PE = m \times g \times h$$

Do You Know ?

The potential energy of an object at a height depends on the ground level or the zero level you choose. An object in a given position can have a certain potential energy with respect to one level and a different value of potential energy with respect to some other level.

Example 2 :

Calculate the potential energy gained by a body of mass 15 kg lifted to a height of 10 metres (Take $g = 10\ m/s^2$)

Solution : Given : $m = 15$ kg, $h = 10\ m$, $g = 10\ m/s^2$

$PE = ?$.

$$PE = mgh$$

$$= 15kg \times 10m/s^2 \times 10m$$

$$= 1500 \text{ Joules}$$

Example 3 :

Calculate the height through which a body of mass 30 kg can be lifted when 500 J of work is done on it (Take $g = 10\ m/s^2$).

Solution : Given : $m = 30$ kg, $g = 10\ m/s^2$ and potential energy of the body = work done on it = 500 J. Then $h = ?$.

$$PE = mgh$$

$$\Rightarrow \quad h = \frac{PE}{mg}$$

$$= \frac{500\,J}{30\,kg \times 10\,m/s^2}$$

$$= \frac{5}{3}m \; = 1{\cdot}67\;m$$

From the formula $PE = mgh$, it is clear that :

1. Potential energy is directly proportional to mass of the body.
2. Potential energy is directly proportional to the acceleration due to gravity.
3. Potential energy is directly proportional to the vertical height upto which the body is lifted.

Heat Energy :

The energy released during the burning of coal, oil, wood, gas, *etc.*, is called the **heat energy**. Steam possesses heat energy and is capable to do work. We see in our day-to-day life that when we boil water in a container with a lid on it, the lid starts moving (vibrating) as soon as the water starts boiling. This is the heat energy obtained from the steam which makes the lid move. The steam engine, invented by James Watt in the year 1765, works on the theory of heat energy.

Light Energy :

Light is a form of energy in the presence of which, different objects become visible. We cannot see the energy given out by light but we can feel its effects. The energy of light can be used to emit electrons from a metal surface (photoelectric effect). We can see an object only when light energy coming from the object enters into our eyes.

Chemical Energy :

The energy possessed by fuels such as coal, oil, gas, etc., often gets released as heat in a chemical reaction (oxidation or burning) and is called **chemical energy**. The chemical energy given out by petrol or diesel can move a car or a truck. The food that we eat possesses the chemical energy which helps us to do work.

Sound Energy :

Sound energy is possessed by a vibrating body. When sound is produced by a vibrating body, it reaches our ear membrane and makes it vibrate. Thus, we hear the sound of the vibrating body.

Magnetic Energy :

Magnetic energy is the energy given out by a magnet. A magnet attracts iron nails from a distance and make them move. An electric motor used to run a fan or other appliances gets energy from the magnet.

Electrical Energy :

Two charged bodies either attract or repel each other. And, if they are free to move, the charged bodies either move towards each other or move away from each other. This happens because of energy possessed by a charged body called electrical energy. Electrical energy is also required to move the electric charge (current) through a conductor, to run a T.V., machine, electric bell, etc.

Atomic Energy :

The energy stored in the nucleus of atoms is called the atomic or nuclear energy. This energy is used in atomic reactors to produce electrical energy. This energy is also used in making atom bombs, used for destruction in wars. Thus, atomic energy has bad as well as good effects.

TRANSFORMATION OF ENERGY FROM ONE FORM INTO ANOTHER

Energy can be converted from one form to another. This is known as the transformation of energy *e.g.*:-

(a) When a pendulum bob swings from one extreme position to another, it has maximum kinetic energy at the mean position and maximum potential energy at the extreme position. When a pendulum moves from one extreme position to mean position, its potential energy converts into kinetic energy and from mean position to extreme position, its kinetic energy converts into potential energy.

(b) In an electric bulb, electrical energy is converted into light and heat energy.

(c) In an electromagnet, the electrical energy is converted into magnetic energy.

(d) In a table fan, electrical motor, *etc.*, electrical energy is converted into kinetic energy.

(e) In a generator, the kinetic (mechanical) energy is converted into electrical energy.

(f) In a door bell or loudspeaker, the electrical energy is converted into sound energy.

(g) In a microphone, the sound energy is converted into electrical energy.

(h) In hydroelectric power station, the PE of water is converted into its KE and then this KE is used to obtain electrical energy.

(i) In a cell or battery, chemical energy is converted into electrical energy.

(j) In a steam engine, the chemical energy of the coal is first converted into heat energy of the steam and then the heat energy converts into kinetic energy of the engine.

ACTIVITY 1

Sit in small groups.
Discuss the various ways of energy conversions in nature.
Discuss following questions in your group.

(a) How do green plants produce food ?
(b) Where do they get their energy from ?
(c) Why does the air move from place to place ?
(d) How are fuels, such as coal and petroleum formed ?
(e) What kinds of energy conversions sustain the water cycle ?

ACTIVITY 2

- Many of the human activities and the gadgets we use involve conversion of energy from one form to another.
- Make a list of such activities and gadgets.
- Identify in each activity and gadget the kind of energy conversion that takes place.

SUN AS THE ULTIMATE SOURCE OF ENERGY – AN ENERGY CYCLE

The sun is the main source of all forms of energy. The sun gives us heat and light energy. A small portion of the sun's energy reaching the earth is absorbed by green plants through the process of photosynthesis. This energy is converted into chemical energy and stored in plants. In this process, carbon dioxide and water are converted into carbohydrates. These carbohydrates are used as food by the living organisms. The human beings and animals eat this food to carry out their life activities thus converting the chemical energy into mechanical energy.

Sound energy is caused by the vibrations of the vocal cord in the bodies of human beings and animals. This is a form of mechanical energy. Different forms of fuels such as coal, wood, oil are generated from the wastes and dead parts of plants, trees and animals. Heat energy is produced by the burning of these fuels. The coal and petroleum are called **fossil fuels** because they are formed by the decomposition of wastes of plants and animals which were buried underneath the earth millions of years ago.

Water in oceans, rivers, lakes, *etc*. absorb sun's energy and evaporates to form clouds. These clouds move with the wind and reach back on the earth in the form of rain and snow. The rain water is collected in dams to produce electricity in the hydroelectric power stations. This electrical energy can be further used to produce magnetic energy by making electromagnets and to run different electrical appliances and machines.

Methods to produce electricity :

Electricity is the most widely used form of energy. It is produced by the following methods :

1. By burning fuel (*i.e.* coal, petroleum, wood, *etc.*) in thermal power stations.
2. By using wind energy in wind farms through wind mills.
3. By using the nuclear or atomic energy in atomic power plants.
4. By using water energy in hydroelectric power stations through big dams.

In an electrical power generating plant, mechanical energy is converted into the electrical energy. The wire is connected to power lines that allow the current to travel between the power plant and the electrical wires in factories, homes, schools and other places.

SOURCES OF ENERGY

The energy source should be such that we should continuously get sufficient amount of energy for a longer time. The energy sources can be divided into two categories :

Renewable source of energy :

When a natural source goes on providing us energy continuously without getting exhausted, it is called renewable source of energy. It is also known as the non-conventional source of energy. A few examples are (i) solar energy (ii) wind energy (iii) hydro (or water) energy (iv) tidal energy (v) ocean thermal energy (vi) bio-energy (or biogas) (vii) geothermal energy and (viii) nuclear (or atomic energy).

Non-renewable source of energy

Fossil fuels were formed from the fossilised remains of small plants and animals underneath the earth millions of years ago. The three forms of fossil fuels are coal, petroleum and natural gas. These fuels are called the non-renewable sources of energy. If they are not carefully used, their reserves would soon get exhausted and they will not be regenerated over a short period of time. In that case, there will be an energy crisis. Thus, non-renewable sources of energy are (i) coal (ii) petroleum and (iii) natural gas.

Solar energy

The sun is the main source of energy. The sun's energy is called the solar energy. Practically, all the energy we use comes

Important thermal power plants in our country	Important hydroelectric power plants in India
1. Obra and Panki in UP. 2. Bandel, Kolaghat and Santaldihi in Bengal. 3. Korba in Chattisgarh. 4. Satpura in Madhya Pradesh. 5. Badarpur in Delhi. 6. Kothagudem in Andhra Pradesh. 7. Mumbai and Nasik in Maharashtra. 8. Barauni in Bihar. 9. Patratu in Jharkhand. 10. Bhatinda in Punjab. 11. Talcher in Orrisa. 12. Ennore and Neyveli in Tamilnadu.	1. Kakrapura project in Gujrat. 2. Upper Ganga Canal Electric grid system in UP. 3. Hirakud project in Orrisa (also known as Mahanadi river project). 4. Damodar valley project in West Bengal. 5. Baramula hydroelectric power centre in Jammu and Kashmir. 6. Bhakra nangal project in Punjab. 7. Sivasamudram in Karnataka. 8. Surya Canal Drop Hydroelectric project in Maharashtra 9. Tungabhadra project (a joint venture project of Andhra Pradesh and Karnataka).

directly or indirectly from the sun. We receive the solar energy in the form of heat and light. We use solar energy for the following purposes : (i) for drying purposes (ii) for preservation of various eatables (iii) to get rid of the moisture content from the crops for harvesting (iv) for obtaining salt from sea water (v) for producing electricity using solar cells, etc.

To avoid energy crisis, we should use more and more of solar energy at commercial level. This never ending natural source can be utilised in the following ways :

(i) Collection of solar energy for heating purposes.

(ii) Conversion of solar energy into electricity.

COLLECTION OF SOLAR ENERGY IN THE FORM OF HEAT

The devices used to collect the solar energy in the form of heat are **solar cooker** and **solar water heater**.

A solar cooker consists of a rectangular metallic, double-walled box. A thermally-insulating material such as glass wool is filled between the two walls of the box. The inner surface of the box is painted black and it has a glass cover at the top. Sunlight is reflected by a plane mirror to the enclosure, where the food to be cooked is kept in shallow vessels. The outer surface of the vessels is also painted black. The black surfaces absorb 98% of the incident heat radiation. The use of solar cookers is increasing day by day.

Fig. 9.1 : Solar Cooker

In a solar heater, water is heated by the circulation of water through pipes placed before the sun's rays. Such water heaters are installed on the roofs of hotels, hospitals, *etc*.

to supply hot water. Figure 9.2 describes the functioning of a solar water heater.

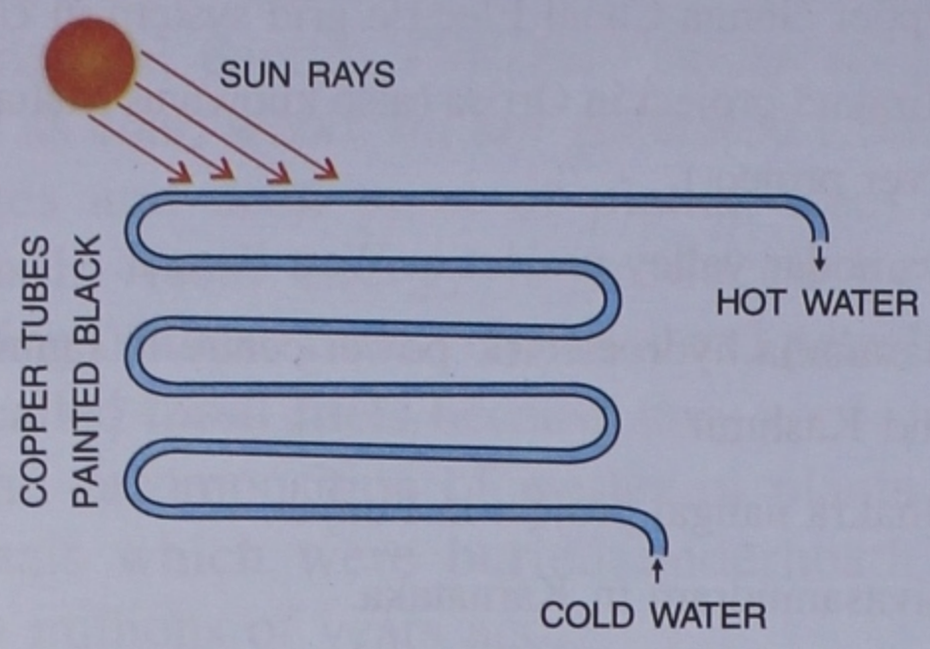

Fig. 9.2 : Solar water heater

CONVERSION OF SOLAR ENERGY INTO ELECTRICITY

The solar energy can be converted into electricity by (i) the use of solar heating devices and (ii) use of solar photovoltaic cell (solar cell).

In a solar heating device, the heat energy from sun's rays is concentrated by a number of concave mirrors on the pipes through which water circulates. The water inside the pipes starts boiling and produces steam. This steam is used to rotate a turbine which drives a generator to produce electricity. This process is called a **solar power plant**. A solar power plant of 50 kW has been installed at Gurgaon in Haryana.

A solar cell converts the solar energy into electricity. The sun's rays are made incident on thin layers of a substance like silicon or gallium which produces electricity. To obtain more electricity, a number of solar cells are joined together to form a solar cell panel. These panels are used in artificial satellites, water pumps, street lighting, *etc*.

WIND ENERGY

Wind is used as a source of energy from ancient times. The moving large masses of air produce kinetic energy. Wind has been used to power sailing ships. Today, as fossil fuels are getting scarce, wind is receiving more attention as a source of energy. Since wind possesses a large amount of kinetic energy, this energy is used in windmills. The kinetic energy of wind is converted into electrical energy by the windmills. Windfarms have been established at places where wind blows continously and with good velocity.

A windmill is used :

(i) to run a water lifting pump to draw water from a well.

(ii) to run a flour mill and

(iii) to produce electricity.

A wind generator is shown in Fig. 9.3, in which the crank of the windmill is connected to the armature of an electric generator to produce electricity. A large number of wind generators when arranged together are called wind energy farms. The largest wind energy farm is located at Lamba in Gujarat.

Fig. 9.3 : Wind generator

HYDRO (OR WATER) ENERGY

The fast flowing water possesses kinetic energy which is called the hydroenergy. Now-a-days, the energy given out by a falling or naturally flowing water is used to generate

electrical energy. The flowing water of a river is stored in a dam. It is then allowed to flow under gravity through pipes. As water flows down, its potential energy is converted into kinetic energy. The water falls on large turbine wheels connected to the electric generators which produces electricity. This is called the **hydroelectricity**.

Bhakra Dam on the Satluj (Sutlej) river near the border between Punjab and Himachal Pradesh is one of the highest dams in the world. The Govindsagar Reservoir is created by this dam. The dam provides irrigation to 10 million acres of fields in Punjab, Himachal, Haryana, Delhi and Rajasthan. Two power plants with a total capacity of 1000 mega-watt are built on either side of the dam. The other famous dams are Gandhi Sagar dam built on Chambal river in M.P., Rana Pratap Sagar dam in Kota district in Rajasthan, Krishna Raja Sagar on Kaveri River in Karnataka and Nagarjuna Sagar Dam built across Krishna river in Andhra Pradesh.

TIDAL ENERGY

The energy obtained from the rising and falling ocean's waves and tides can also be used to generate electricity with dams. The ocean water is forced through turbines to produce electricity. This is called the tidal energy or wave power. The world's first wave power station is on the scottish island of Italy. It generates enough electricity for about 400 homes. Scientists are working on the use of ocean's energy on a large scale.

OCEAN THERMAL ENERGY

We know that water at the surface of an ocean absorbs the heat from the sun and gets heated whereas water in the deep ocean remains colder. This difference in temperature of the upper and lower surface of the ocean produces energy known as the **ocean thermal energy**. This energy is used to produce electricity in ocean thermal energy conversion power plant.

BIOENERGY

The dead parts of plants, trees and animals and their wastes are called the bio masses. They contain carbon compounds. The chemical energy stored in them is called **bio- energy**. This energy also indirectly comes from the sun because plants absorb the energy from the sun and this energy is converted into chemical energy by photosynthesis. This energy is stored by the biomass. A few examples of biomass are cattle dung, wood, crop residues and agricultural wastes which were traditionally used as domestic fuel as well as for commercial purposes in older times. Nowadays, these fuels are used to produce biogas and biogas is used to produce electricity. Biogas is obtained by the decomposition of biomass in the absence of oxygen. Biogas mainly contains methane gas (45-70%) which is used as a fuel and the waste products such as nitrogen and phosphorus left from the biogas plant are used as fertilisers.

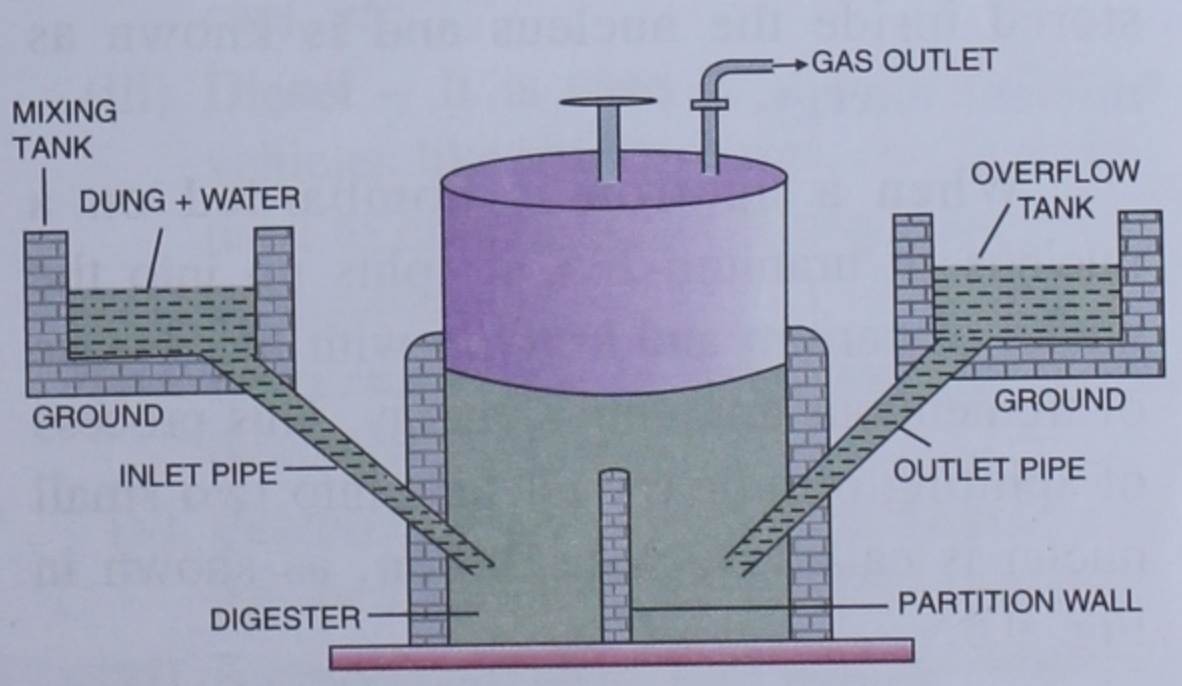

Fig. 9.4 : Biogas plant

GEOTHERMAL ENERGY

The word geothermal comes from the Greek words : **geo** means **earth** and **thermo** means **heat**. Thus, it is the heat of the earth. There are some places below the earth's surface where magma (hot molten lava) pushes up through cracks into the crust near the earth's surface. Magma can heat nearby rocks and water as hot as 700°F. Some of this hot water reaches the earth's surface as hot springs. This hot water can be used directly or converted into steam to run turbines that generate electricity.

NUCLEAR ENERGY

We are well familiar with the fact that an atom contains a nucleus at its centre which contains protons and neutrons. When protons and neutrons are combined together to form a nucleus, the mass of the nucleus obtained is less than the total mass of protons and neutrons. Thus, there is a loss in the mass during the formation of a nucleus. This loss is converted into energy according to Einsten's mass-energy equivalence, *i.e.* if mass m is converted into energy, the energy produced is $E = mc^2$ where c is the speed of light ($c = 3 \times 10^8$ ms^{-1}). This energy gets stored inside the nucleus and is known as **nuclear energy**.

When a neutron is bombarded on a nucleus of uranium-235, it splits up into the nuclei of barium and krypton with the release of tremendous amount of energy. This process of splitting of a heavy nucleus into two small nuclei is called **nuclear fission**, as shown in Fig. 9.5.

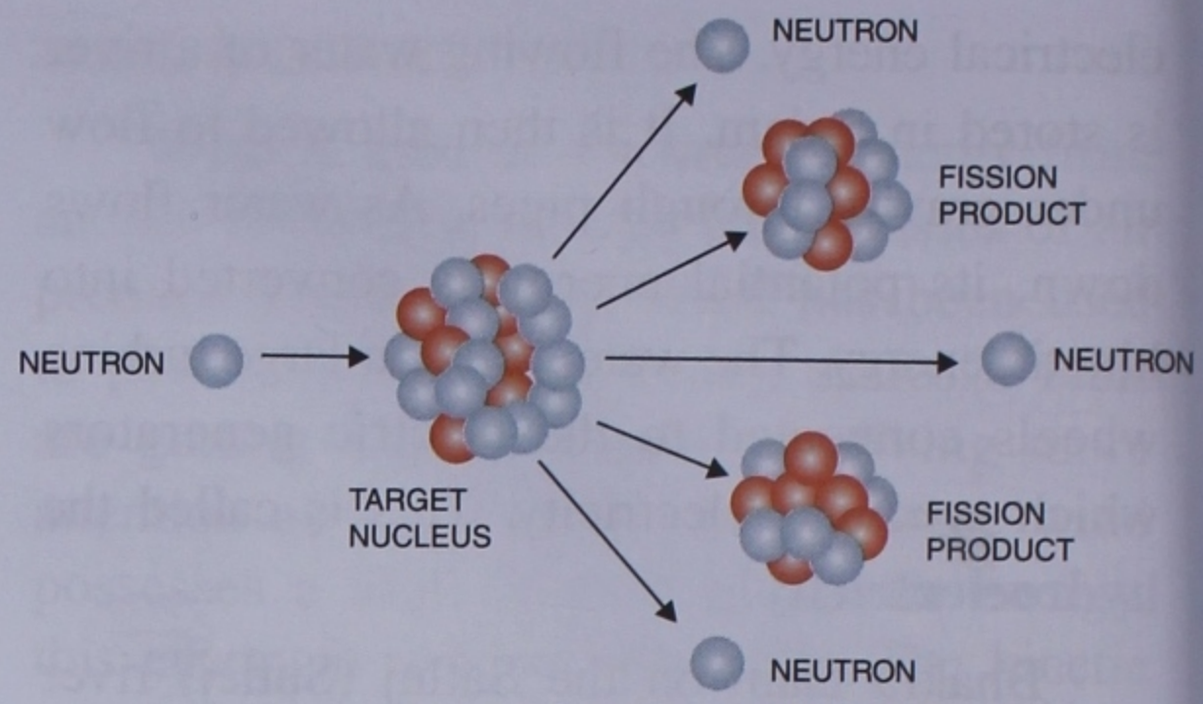

Fig. 9.5 Nuclear fission

When a decrease in mass takes place, there is release of energy. The neutrons formed in this process split the new uranium nuclei and this process continues forming a chain reaction. This chain reaction releases high amount of energy which may cause explosion. So, this reaction is controlled in a nuclear reactor. A nuclear reactor contains graphite and heavy water which act as moderators to slow down the neutrons emitted in the reaction. Further, cadmium and boron rods are also used in the nuclear reactor which act as controller by absorbing some of the neutrons formed during fission process. This controlled nuclear energy is converted into electricity in nuclear power plants.

Some of the nuclear power plants in India are located at Tarapur in Maharashtra,

Fig. 9.6 Nuclear power plant

Kakrapar in Gujarat, Kalpakkam in Tamilnadu, Narora in Uttar Pradesh and Ranapratap Sagar in Rajasthan.

HEALTH HAZARDS OF NUCLEAR POWER PLANTS

Uranium-235 used in the nuclear reactor is a radioactive substance. The fission products barium and krypton are also radioactive in nature. They emit gamma radiations which are very harmful to human body. These radiations affect the body cells which may lead to the dreadful disease of cancer. They can also damage the genes of a person and this can be transferred to the next generation. The radiations can cause any deformity in the human body.

PRECAUTIONS :

1. The radioactive elements like uranium, barium, krypton used in the reactor should be kept in containers made of thick lead walls so that their radiations do not leak out.
2. The persons working in these plants should wear special jackets and gloves made of lead linings, so that radiations do not penetrate into their body.
3. The handling of the plant should be carried out from a distance.
4. The nuclear power plant should be located at far off distance from the city population.
5. There should be proper arrangement for the disposal of the nuclear wastes.

COAL, PETROLEUM AND NATURAL GAS AS A SOURCE OF ENERGY

Coal : It is a fossil fuel. Coal is a hard, black, rock-like substance made up of carbon, hydrogen, oxygen, nitrogen and sulphur. The three main types of coal are, anthracite, bituminous and lignite. Coal is found deep in the mines under the earth's surface. It is an important source of energy and is found in abundance in India. When it burns in the presence of oxygen, it produces heat. It is used as a domestic fuel and in thermal power plants to produce electricity. The smoke produced by coal is a major cause of air pollution. We have coal mines in Bihar, West Bengal, Orissa and Madhya Pradesh. We have thermal power plants at Indraprastha and Badarpur in Delhi, at Kolaghat and Bandel in West Bengal, etc.

Petroleum : It is a liquid fossil fuel found underneath the earth. It is a dark coloured thick oil called the crude oil. To obtain oil, drilling is carried out into deposits deep below the earth's surface using oil rigs. The petroleum extract obtained from the earth's crust is not used as such and it is purified by fractional distillation (a process in which different forms of oil are obtained at different stages of refining). The products obtained after refining are :

(i) **Fuel oil** – It is used as a fuel in industries.

(ii) **Petrol** – It is a fuel used in scooters, cars, *etc*.

(iii) **Diesel** – It is used as a fuel in heavy vehicles like trucks, buses, *etc*. It is also used to operate water lifting pumps and in generators.

(iv) **Kerosene** – It is used as a fuel for domestic purposes.

(v) **Petroleum gas** – It is used as a fuel in the form of LPG for domestic purposes.

(vi) **Asphalt, paraffin wax and lubricating oil** – They are used in different types

of toiletries and in machines for lubrication.

In India, the oil wells are located in Assam and Mumbai.

NATURAL GAS

It is also a fossil fuel formed deep under the earth's surface either as such or in a combined state above the petroleum reservoirs. It is obtained by digging wells into the earth. It easily burns in the form of methane gas and is used as a domestic and industrial fuel. It is also used in thermal power plants for generating electricity. Nowadays, compressed natural gas (CNG) is widely used in industries and in vehicles as a fuel. It is an alternate to petrol and diesel and there is no pollution caused by CNG. The natural gas fields are found in Tripura, Rajasthan, offshore area of Mumbai and Krishna-Godawari delta.

JUDICIOUS USE OF ENERGY

We should be very careful in using the various forms of energy. The following precautions should be observed :

(i) Any type of leakage of oil, petrol, gas, *etc*. should be checked and prevented.

(ii) The unnecessary use of electricity should be avoided.

(iii) The machines in use should be properly lubricated from time to time so that their efficiency is not decreased. The old devices should be updated.

(iv) The fossil fuels like coal, petroleum and natural gas should be used in limits and only be used when there is no other alternative energy.

(v) More and more renewable sources of energy such as solar energy, wind energy, water energy, *etc*. should be used so that the non-renewable sources are kept in reserve.

(vi) Instead of using individual vehicles, we should try to use public transport or we should share the vehicles to save the fuel. We should try to enjoy various devices on a community bases, *e.g*. you can enjoy the T.V. shows by sitting together in one room, rather than using a number of T.V.s in different rooms.

(vii) More and more trees should be planted rather than cutting them down. In this way, the balance of the non-renewable sources of energy will be maintained.

Air Pollution : Air pollution means mixing up the air with materials injurious to health, inconvenience to animals and plants. These substances are known as **pollutants**.

Industries produce pollutants as their waste product. We burn fuels and in doing so contribute to pollution. In cities, heavy traffic gives out lot of exhaust gases which pollutes the air. Petrol engines produce carbon mono oxide, oxides of nitrogen and unburnt hydrocarbons. Similarly burning coal produces carbon dioxide smoke and sulphur dioxide. Some amount of lead oxide is also produced by combustion of petrol.

These substances pollute the air and lead to various kinds of diseases such as respiratory problems, problem leading to lungs, skin and eyes. Polluted air leads to asthma even.

Global warming : Ideally, our earth's atmosphere allows infra red radiations coming from sun to pass through and reach earth's surface, but poisonous gases like carbon

dioxide, methane, chlorofluorocarbons, nitrous oxide block these radiations. When infra red radiations are blocked, they produce heat which increases the atmospheric temperature and hence lead to **global warming**.

The gases which are responsible for global warming are called **green house gases**. Global warming has serious effects as it increases the temperature of air which will melt the glaciers and increase the level of water in sea. It will also be a threat to bio diversity.

RECAPITULATION

- In nature, the energy exists in various forms such as mechanical energy, heat energy, light energy, chemical energy, sound energy, magnetic energy, electrical energy, atomic energy, *etc*.
- Energy possessed by a body by the virtue of its state of rest or motion is called its mechanical energy.
- There are two forms of mechanical energy : *Kinetic energy* and *potential energy.*

  (a) Kinetic energy is the energy possessed by a body due to its state of motion.

  If 'm' is the mass of a body and '*v*' is its velocity, then $KE = \frac{1}{2} mv^2$.

  (b) Potential energy is the energy possessed by a body due its position.

  If 'm' is the mass of a body, '*g*' is the value of acceleration due to gravity and '*h*' is the vertical height of the body above the earth's surface, then PE = mgh.

- • When coal, kerosene oil, wood, gas, *etc*. are burnt, the energy released by them is called the heat energy.
  - Light energy makes objects visible.
  - Chemical energy of fuels moves vehicles and chemical energy of food makes us to do work.
  - Sound energy is produced when objects vibrate.
  - Magnetic energy makes a magnet attract pieces of iron and moves an electric motor to run a fan, a motor, *etc*. when electric current is passed.
  - Energy possessed by a charged body is called electrical energy.
  - Atomic energy is stored within the nucleus of an atom.
- Energy can neither be created nor it can be destroyed. But one form of energy can be converted into another form.
  - A steam engine converts chemical energy of the coal first into heat energy and then into mechanical energy.
  - An electric motor converts electrical energy into mechanical energy.
  - An electric heater, geyser, toaster, a glowing bulb, *etc*., converts electrical energy into heat energy.
  - A cell and a battery convert chemical energy into electrical energy.
  - An electric bell converts electrical energy into sound energy.
  - A generator converts mechanical energy into electrical energy.
  - A microphone converts sound energy into electrical energy.
  - A loudspeaker converts electrical energy into sound energy.
  - A photocell converts light energy into electrical energy.
- As a direct source of energy, sun gives us heat energy and light energy. And as an indirect source of energy, sun gives us almost all other types of energy.
- Electricity can be generated :
  - by burning fuels.
  - by using the wind velocity (windmill).
  - by energy possessed by the water stored in dams.
  - by atomic energy.

- The renewable source of energy provides us energy continuously without getting exhausted. Some of the examples are: solar energy, wind energy, hydroenergy, tidal energy, bio-energy, geothermal energy, nuclear energy, *etc*.
- The heat contents of solar energy are used in a solar cooker, solar water heater, *etc*., whereas its light content is used in a solar cell.
- In some places, the rocks inside the earth are very hot. The energy possessed by these rocks is called the geothermal energy and is used to generate electricity.
- Fission reaction of uranium-235 with neutron is conducted in nuclear power plants to generate electricity.

TEST YOURSELF

A. Short Answer Questions

1. Write ***true*** or ***false*** for each statement. Rewrite the false statement correctly.
   (a) A car and a truck travel with same velocity. The car has more kinetic energy.
   (b) A person climbing the stairs of a building is doing work.
   (c) A man pushing a wall is doing work.
   (d) A strong wind can turn the blades of a windmill.
   (e) A stone thrown with a high speed has potential energy.
   (f) A kerosene stove converts the chemical energy into light energy.
   (g) The mechanical energy of a body is the difference of its KE and PE.
   (h) A generator converts mechanical energy into electrical energy.
   (i) The amount of energy possessed by a body is equal to the amount of work it can do when that energy is released.
2. Fill in the blanks :
   (a) The work done by the moon in revolving around the earth is .....
   (b) A bent bow possesses ..... energy.
   (c) The total amount of energy possessed by a body always remains .....
   (d) A microphone converts ..... energy into ..... energy
   (e) If the mass of a moving object is doubled, its kinetic energy .....
   (f) The work done by the earth in moving round the sun is .....
   (g) ..... is consumed whenever work is done.
3. Tick the appropriate answer :
   (a) The S.I. unit of work is
   (i) newton (ii) erg (iii) Joule (iv) meter
   (b) If you push a wall with a force of 50N, the work you do is
   (i) 500 J (ii) 5000 J (iii) 50 J (iv) zero
   (c) The capacity to do work by a body is called its
   (i) power (ii) muscular energy
   (iii) energy (iv) None of these
   (d) If the velocity of a body is decreased,
   (i) kinetic energy remains same
   (ii) kinetic energy increases
   (iii) kinetic energy decreases
   (iv) none of these.
   (e) In a compressed spring, energy is in the form of
   (i) potential energy (ii) kinetic energy
   (iii) chemical energy (iv) sound energy
   (f) The energy possessed by a body due to its motion is called
   (i) potential energy (ii) kinetic energy
   (iii) muscular energy (iv) none of these
4. Match the following :

(a) A cell	(i) Electrical to sound
(b) An electric bulb	(ii) Electrical to mechanical
(c) A mixer grinder	(iii) Electrical to heat and light
(d) A loudspeaker	(iv) Chemical to heat, light and sound
(e) A fire cracker	(v) Chemical to Electrical

5. Answer the following questions :

(a) Define potential energy. What are the factors on which the amount of potential energy depends ?

(b) Define kinetic energy. What are the factors on which the amount of kinetic energy depends ?

(c) What will happen to kinetic energy if the
(i) mass is doubled
(ii) mass is made half
(iii) velocity is doubled
(iv) velocity is made half.

(d) What will happen to potential energy if the
(i) mass is doubled
(ii) mass is made half
(iii) height is doubled
(iv) height is reduced to half.

(e) Draw a neat labelled diagram to show the energy transformation taking place in case of a swinging pendulum.

(f) Name the energy changes taking place in electric heater and electric bulb.

(g) A body is released from a certain height above the surface of the earth. What happens to its potential energy during its motion and just at the instant it is about to touch the ground.

B. Long Answer Questions

1. Name four different forms of energy. For each, give one example.
2. Explain the energy changes that take place in :
(a) electric heater (b) electric bulb
(c) electric fan (d) generator
3. For each of the following changes of energy, give one example :
(a) mechanical to electrical
(b) electrical to mechanical
(c) chemical to electrical
(d) electrical to chemical
(e) electrical to heat
(f) heat to mechanical
4. The source of all forms of energy is sun. Explain.
5. What do you understand by :
(a) renewable source of energy
(b) non-renewable source of energy.
In each case, give *two* examples.
6. What do you understand by :
(a) solar energy for cooking ?
(b) solar energy for heating ?
(c) a solar cell ?
(d) wind energy ?
(e) hydroelectricity ?
(f) biomass ?
(g) biogas ?
(h) geothermal energy ?
(i) nuclear fission ?
7. (a) What is a fossil fuel ? Name two fossil fuels.
(b) Write the full form of :
(i) L.P.G. (ii) C.N.G.
8. What is natural gas ? Name two places where natural gas is found in India.
9. In your day-to-day life, state five ways of reducing the consumption of energy.

C. Numerical Problems

1. (a) What is the gain in potential energy in a body of mass 5 kg lifting through a vertical height of 25 metres (Take $g = 10\ m/s^2$).
(b) What is the vertical height through which a body is lifted to gain 80 J of potential energy ? The mass of the body is 5 kg. (Take $g = 10\ m/s^2$).
(c) Calculate the kinetic energy of a body of mass 30 kg if it is moving with a velocity of 6 m/s.
(d) Calculate the potential energy of a body of mass 5 kg placed at a height of 9 metres. (Take $g = 10\ m/s^2$).
(e) A TV tower is 40 m high. A mass of 5 kg is dropped from its top. Calculate the potential energy at the top and kinetic energy just before it hits the ground (Take $g = 10\ m/s^2$).

Ans. (a) 1250 J (b) 1·6 m (c) 540 J
(d) 450 J (e) each is 2000 J