Chapter
9

Work and Energy

Points to Study

9.1 work
9.2 Energy
9.3 Mechanical energy
9.4 conversion of energy
9.5 Sources of energy
9.6 Measures of energy conservation.

In normal conversation all laborious activities like- reading, writing, cooking, carrying weight, swimming, etc. called work by us. Shatish feels tired after 4 hour reading, whereas Reeta does not feel tired after 8 hour reading. Who has done more work? This cannot be answered logically. Thus physical or mental labour cannot be defined as work in science. Then what is called work in scientific terms. Let us know about it.

9.1 Work

Activity-1

1. Put a ball on floor and push it. i.e exert force on ball.
2. Push the walls with your hands.

In both above activities, which is the object displaced from its one position to another position? Here, the ball has travelled some distance in certain direction. The distance covered by an object in certain direction is called displacement. So we can say that ball is displaced due to force exerted on it whereas the wall is not displaced at all. Becuase of this, displacement of walls is zero.

The action for producing the displacement by exerting force on object is called work.

In first object (ball) is displaced. In this action , work is done. Whereas in second object (wall) is not displaced. So, in this action, work is not done. That means, wok done after exerting force on wall is zero.

Most of time we are curious to know how much work was done by us? How do we calculate amount (quantity) of work? Let us know about it.

Activity-2

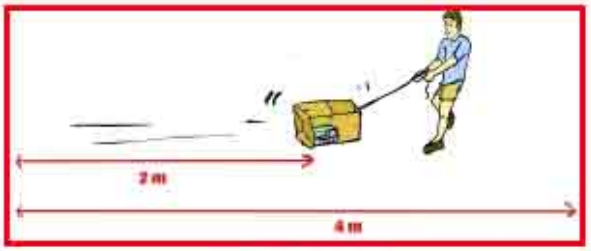


Fig. 9.1 (a)

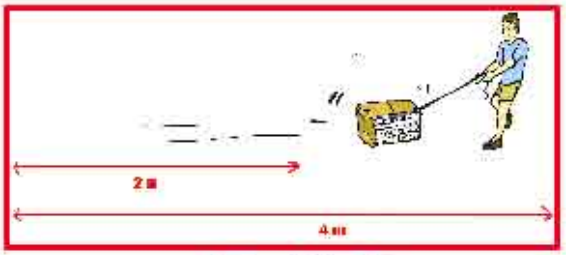


Fig. 9.1 (b)

1. Put only two books in empty card board cartoon and close it. Now, clamp a rope on it and drag upto two meter on floor. Now, drag it upto four metre. In which situation work is done more?(as fig 9.1(a)). It is clear that the more displacement more work done by an object.

"Work done on object depends on displacement."

2. In earlier cartoon, put only two books and drag it upto 4 metre. After that, fill it completely with more books and drag it upto 4 metre. { As in fig 9.1(b),} in both situations displacement is equal. In which situation more force is exerted? In which situation work is done more ?

In second situation more force is exerted. In second situation work is done more. It is clear that the more displacement more work done by an object.

"Work done on object depends also on force exerted on object."

On the basis of above discussion, we came to know that work depends upon the following two dialogue-

1. displacement covered by an object.
2. Magnitude of force exerted on object

If force is exerting on object then displacement covered in the direction of force, then work done can be calculated by the following formula-

Work = force × displacement in direction of force

The International unit (SI) of work is 'Joule'.

9.2 Energy

Activity - 3

You can do many work due to your capacity of doing work. Similarly animal also can do many work as per their capacity. Discuss and make list of work done by the animals with help of fig 9.2.

Fig 9.2 Work done by the animals

In nature we see that not only living body has capacity to do work but also non living body also do work e.g. we can run big machines by water falling from height on it, wind mill drives by fast blowing air, the generator is running by water steam using coal's heat, etc . So we can say that objects, either living body or non-living body, can have capacity to do work.

Capacity of doing work in objects is called energy.

It is clear that flowing water, air, coal, steam, diesel, petrol, power, etc., has energy. It can be used to do many works.

Activity-4

The objects, which have energy, are used to do work on other objects. Some action are given in table 9.1. write the name of object on which work is done and by which work is done.

Table 9.1

Sr. No.	Action	Object by which work is done	Object on which work is done
1	Playing football	Player	
2	Driving bull cart		
3	Moving the leaves		
4	Driving wind mill		

It is clear that an object does work on other object. To do work, first object losses energy due to that energy of first object decreases. The work done by the first object is appear in second object. As a result the energy of second object increases.

We can say that work and energy are equivelent to each other. That is why, the international unit of energy is Joule.

There are various form of energy. One of them is called mechanical energy. What is the mechanical energy? Let us know about it.

9.3 Mechanical energy

Mechanical energy is combination of kinetic energy and potential energy.

Kinetic energy :

We have seen that flowing water takes many things with it. Objects are moving with flowing air. Wind mill can run by wind energy. Ball in motion collides with another ball then another ball also came into motion. Search similar examples. Where object possrecss capacity to do work (energy) due to their motion.

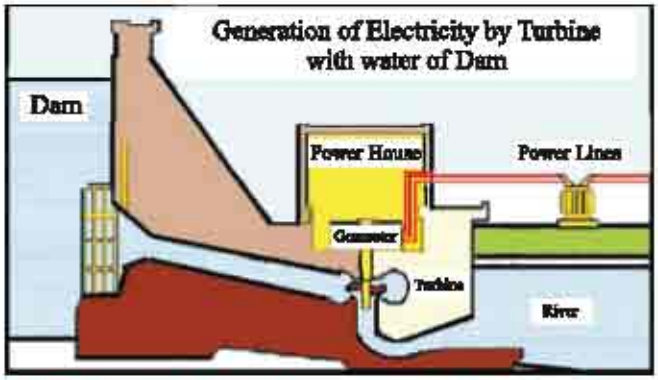
The capacity of doing work due to an object is in motion , called kinetic energy.

Potential energy:

The turbine can be rotated by water falling from height. Motion of stone by the sling-shot rubber. Similarly, in arrow-bow system , the arrow is fired by stiff string of bow and it comes into motion. So we can say that energy is stored intheri objects due to change in position or shape bow and arrow.

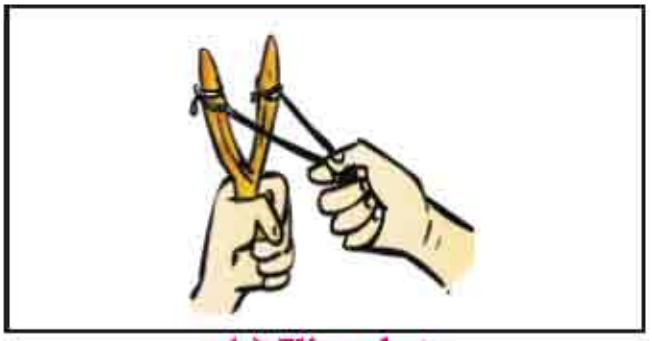
Look the machine inside the key-toys car. Similarly, look the machine inside key-watch system. Spring is inside of it. When we rotate the key then spring is pressed. i.e. change occurs in position. That is why the energy stored in it to perform work. Resultant, they starts to motion.

When we make change in position or shape of an object, then mechanical energy stored in it, call it potential energy.

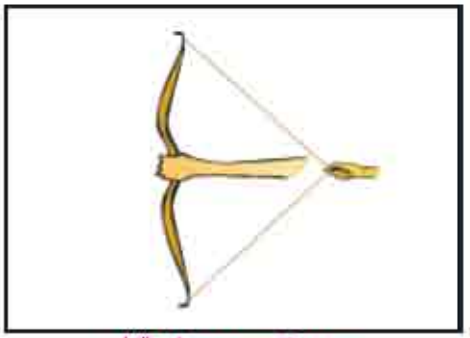


(a) To run turbine by water falls from dam.

(b) Internal view if spring loaded watch.



(c) Sling-shot.



(d) Arrow-Bow.

Fig. 9.3

So we can say that mechanical energy has two forms-

1. Kinetic energy and 2. Potential energy.

Various forms of energy

You have already read the following topic as motion, heat , light, electric, sound, magnet, atomic structure and chemical reactions etc. Discuss with help of table 9.2 about the various forms of energy related to it.

Table 9.2 Various forms of energy

SR No.	Energy	Brief description	examples
1	Mechanical energy · Kinetic energy · Potential energy	Energy stored in objects due to in motion or in position	Due to motion: Water, air, Vehicle, ball, etc. Due to position: Spring, sling-shot, arrow-bow, etc
2	Heat energy	Energy stored in burning objects of hot objects	Run the engine due to heat of coal, motion in vehicles due to petrol or diesel, etc

3	Chemical energy	Energy stored in fuel. Chemical energy converts into electric energy in cell or battery.	All types of fuel.
4	Light energy	Energy stored into light of sun or bulb, etc.	Heating the objects in sun rays, electric generation by solar cell.
5	Electric energy	Energy obtained due to charge in motion.	Lightning of bulb, electric fan, electric motor, etc.
6	Magnetic energy	Energy stored in magnetic field	Iron objects attract in magnetic field.
7	Sound energy	Energy stored in sound (vibration)	Sound obtained by various musical instruments vibrations.
8	Atomic energy	Energy obtained nuclear fusion or fission.	Electricity generation in atomic (nuclear) reactor.

9.4 Conversion of energy

Energy can be converted one form to other form. Look carefully at the fig. 9.4 and tell which form of energy is converted into other form of energy?

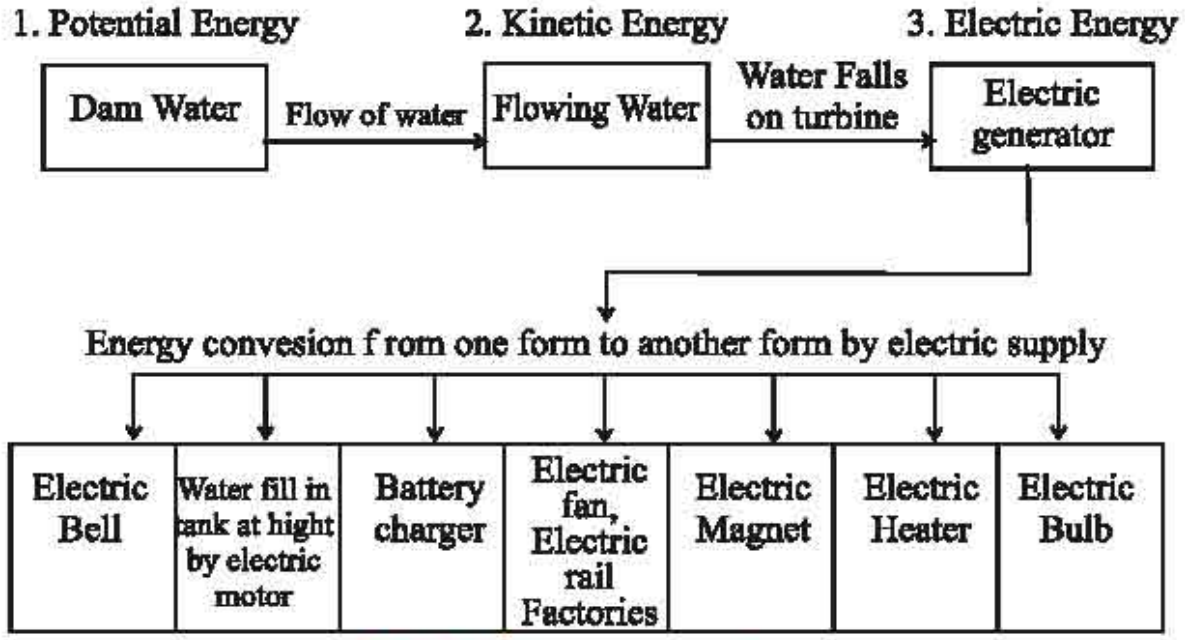


Fig. 9.4 Energy conversion.

Activity 5

In daily life we see the energy conversion from one form into another form. On the basis of your daily analysis, fill the table 9.3

Table 9.3

Sr. No.	Item name	Energy consumed by the item.	Energy conversion by item.
1	Bulb or tube light	Electric energy	Light energy
2	Electric heater	-	-
3	Solar cell	Light energy	
4	Electric cell	-	-
5	Microphone	-	-
6	Loudspeaker	-	-
7	Turbine run from Dam	-	-
8	Diesel engine	-	-
9	Nuclear reactor	-	-
10	Wind mill	-	-
11	Dynamo / electric generator	-	-

9.5 Various sources of energy:

We use many energy resources to get energy for daily routine work e.g. cooking food from coal, wood, kerosene, fuel gas, bio-gas etc. Petrol or diesel is needed to run vehicles. Various energy resources- kinetic energy of water, heat energy of coal, wind energy, etc. are used to generate electricity. These energy resources are classified as following:

Conventional energy resources:

LPG, diesel, petrol, kerosene, natural gas, mineral coal, etc, are taken out from underground of earth. It is assumed that before lacs of year , many living bodies and plants are buried in to earth due to earths movements. As time elapsed, it is converted into petroleum or mineral coal due to high pressure and temperature under the earth. It is called fossil fuel. We use these materials after conversion of the stored chemical energy into heat energy. We use wood to cooking food. It is the reason to cut the forest and reduction occurs in wood.

The fossil fuel and wood fuel petroleum, diesel, natural gas, coal, etc. are called conventional energy resources.

The use of conventional energy sources are continuously increasing to full fill the energy demand due to increase in population and development in various sectors. These fuel reservoir is slowly depleting by continuously ejecting from underground of earth. If it is used at the same rate then these will sources deplete very soon and energy crisis will appear in the world. Lets assume if supplies of petrol or LPG gas are stop then what would be it seffect ?

To avoid from globed energy crisis in future, it is necessary to do judicial use of the conventional energy resources, to search for alternative resources of energy and increase it uses. What are the alternate energy resources ?

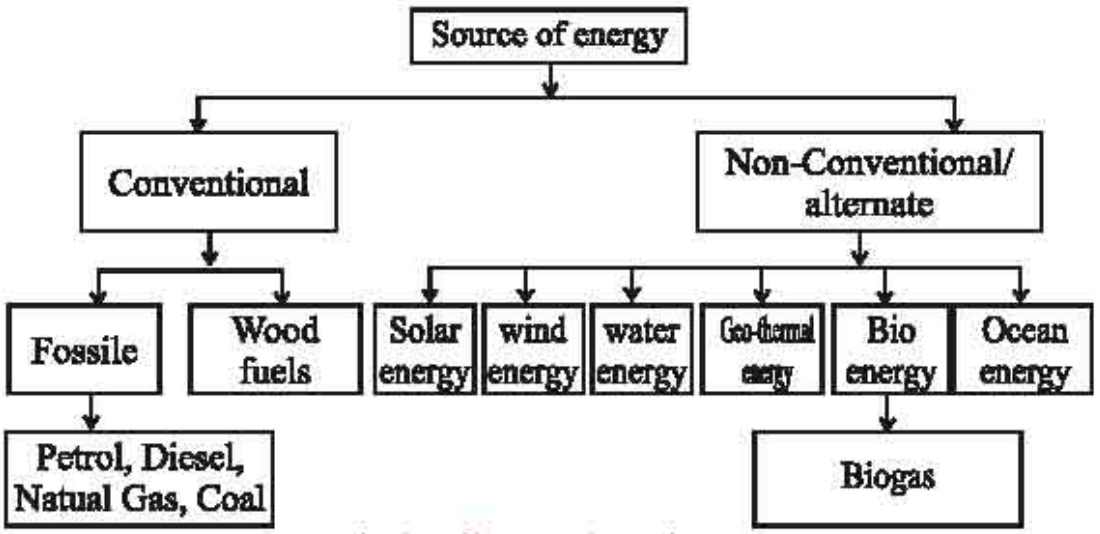


Fig 9.5 Conversion of energy

Conventional and non-conventional energy sources:-

Energy obtained from - alternate sun, wind, water, bio-waste, atomic reactor, oceans, underground earth energy, etc are called non-conventional energy resources or alternate energy resources. These sources can be used repeatedly. these is also called renewable energy resource. These resource never depletes. To extract more energy from theses sources, research is continuously going on by the scientist. Lot of apparatus are available in market to convert solar energy into electric energy, heat the water, cooking of food items, etc. wind mills are installed in many places to generate electric energy from wind energy. Our government is providing funding to install bio-gas plant and use of dung or other bio-waste. It is called bio energy. The big size dams are build on the big rivers to run turbine by water falling on it through height. Turbine is attached with electric generator which produce electric energy. This arrangement is called hydro plat. The electricity generated by all these means is supplied to big cities, small villages, etc. to use it.

The electricity is generated from atomic (nuclear) reactor. This type of reactor is called atomic reactors. In rajasthan, a atomic power plant is situated at Rawatbhata in chittorgarh district which generates electricity. Submarine also runs by use of atomic energy.

The energy of tides, prompt waves and currents in ocean can be converted into electrical energy. It is called ocean energy.

Temperature increases as proceed underground to earth. This heat energy can be converted into electrical energy. It is called geo-thermal energy.

Fig. 9.6 Wind mill of solar energy plant.

Activity -6

find out the location of various power plants- hydro , thermal and atomic power plants, in Rajasthan. And mark all these on Rajasthan map.

Save energy is the conserve energy.

To protect ourselves form world wide energy crisis, we must conserve energy. It is duty for all of us to use energy judiciously . What do you do for save energy? Let discuss the energy measures and enlist them.

9.6 Measures of energy conservation.

1. Use electric objects as on need. Switch off all the electrical instruments when there is no one present.
2. Save the fuel by using solar cookers, advanced hearth, pressure cookers, etc. do not burn the fuel un-necessary in kitchen gas (LPG), kerosene, stove etc.
3. stop the engines when you are stay at any location or waiting for an person. By this mechanism you can save petrol, diesel. vehicles check up and service must do routinely. Use optimized oil and air.
4. By increasing the use of solar energy, we can save more conventional resources.

5. We can conserve the conventional energy resources by producing biogas from the bio-waste matter and dung.
6. We must use such technology during the building construction so that building will cool in summer and hot in winter. We can reduce use of A.C. or heater by this mechanism and save electricity.
7. To make use of electric energy or other energy form to manufacture daily routine life objects. Use these objects with judiciously.
8. The electricity may be conserve by using LED lights in place of tube lights or normal bulb in houses or institutions.

What you have learnt

- Work done by an object depends on the force exerted on object and displacement in the direction of force.
- The capacity of doing work is called energy. The international unit (SI) of work and energy is Joule.
- The energy in moving objects due to it is in motion, is called kinetic energy of an object.
- When any object change its position of shape then it store mechanical energy. It is called potential energy.
- There are two forms of mechanical energy:-1. Kinetic energy and 2. Potential energy.
- There are various forms of energy like mechanical energy, heat energy, light, electric, sound, magnetic, chemical, atomic energy, etc.
- Energy can be converted from one form to another form.
- There may be energy crisis for uncontrolled use of conventional energy resources :- wood, coal, petroleum, etc.
- To overcome the energy crisis, the use of non-conventional must be increased and stop the misuse of energy.

Exercises

Choose the correct answer.

1. The unit of energy is -.

(A) Newton (B) Kilogram
(C) Joule (D) Watt ( )

2. The capacity of doing work is called -
   (A) Power (B) force
   (C) momentum (D) energy ( )
3. one of the following is not fossil fuel -
   (A) petrol (B) Wood
   (C) natural gas (D) Diesel ( )
4. Which is the apparatus used to convert electric energy into sound energy -
   (A) Electric motor (B) electric magnet
   (C) electric heater (D) electric bell ( )

Fill in the blanks (with suitable words.)

1. The energy in objects due to its motion, is called .....of an object.
2. The stressing the rubber in sling-shot, the .....energy stored in it.
3. Electric cell, used in house hold, converts.....energy into electric energy.
4. Unit of energy is.....

Match the column (A) and Column (B)

(A) Energy conversation	(B) Instrument
i. Electric energy to sound energy	(A) Solar cell
ii. Electric energy to heat energy	(B) Dynamo (generator)
iii. Mechanical energy to electric energy	(C) Electric heater
iv. Light energy to electric energy	(E) Speaker

Short answer type questions

1. Define work.
2. Which are the things on which work done on the object depend?
3. Give the two-two names of the things which store kinetic energy and potential energy in it on the basis of daily life observation.
4. How do we define the energy conversation? Explain energy transfer on the basis of three different examples.

Long answer type questions:

1. what do you mean by global energy crisis? What are the measures you adopt to resolve the globe energy crisis. Describe it in detail.
2. Explain the differences between conventional energy sources and non-conventional energy sources with providing suitable examples..

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