

Class: 7

Subject: Physics (CONCISE PHYSICS SELINA)

Chapter - 3 Energy

Work

Work is said to be done if applied force on the body moves it if no motion takes place no work is said to be done.

The work done by a force on a body is equal to the product of the force and the distance moved by the body in the direction of force i.e.

Work done = force x distance moved in the direction of the force

$$W = F \times d$$

Units of work

The S.I. unit is Joule and C.G.S unit is erg.

One joule of work is said to be done when a force of one Newton (1N) moves a body by the distance of one meter (1m) in the direction force.

Factors affecting the amount of work

The amount of work done depends on two factors

1. On the magnitude of the force applied (greater the force applied greater is the work done).
2. On the distance moved in the direction of force. (Greater the distance moved greater is work done).

Energy

Energy is the capacity of doing work.

Units of energy

The S.I. unit is Joule (J). A body is said to possess an energy on one joule if a force of one Newton moves the body by a distance of one meter in direction of force.

Other units are calorie (cal) and kilo-calorie (kcal).

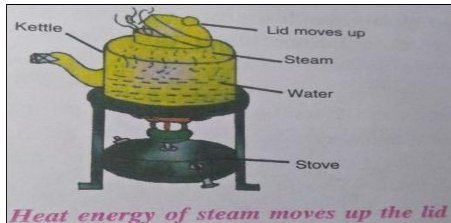
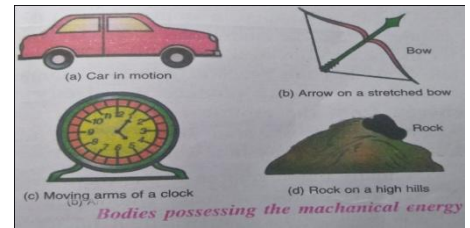
$$1 \text{ cal} = 4.2 \text{ J}$$

$$1 \text{ kcal} = 1000 \text{ cal}$$

Different forms of Energy

A. Mechanical energy

The energy possessed by a body due to its state of rest or state of motion is called the mechanical energy.



B. Heat energy

The energy released when we burn coal, oil, wood or gas is called the heat energy.

C. Light energy

Light is a form of energy in presence of which other objects are seen.



D. Chemical energy

The energy possessed by the fuels such as coal, oil, gas is etc. is called chemical energy.

E. Sound Energy

A vibrating body possesses the sound energy.



F. Magnetic Energy

The energy possessed by the magnet is called the magnetic energy.

G. Electrical Energy

When two dry bodies are rubbed together they possess the electrical energy.





H. Atomic energy

The energy stored in atoms is called the atomic Energy.

Forms of mechanical energy

1. Potential energy

The energy possessed by a body due to its state of rest or position is called potential energy. It is written as P.E or U.

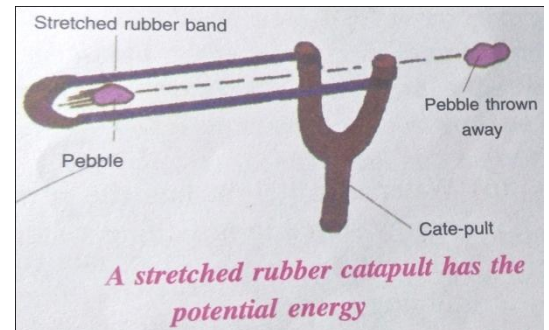
Examples:

A compressed spring has a potential energy because of its compressed state.

A stretched rubber band has the potential energy.

Factors affecting the potential energy

- The mass of the body: (Greater the mass of the body, greater is the potential energy of the body.)
- Height of the body above the ground: (Higher the height of the body, greater is its potential energy.)



2. Kinetic energy

The energy possessed by a body due to its state of motion is called its kinetic energy. It is written as K.E. or K. Example: a bullets fire from a gun. An apple falling from a tree.

Factors affecting the kinetic energy of a moving body

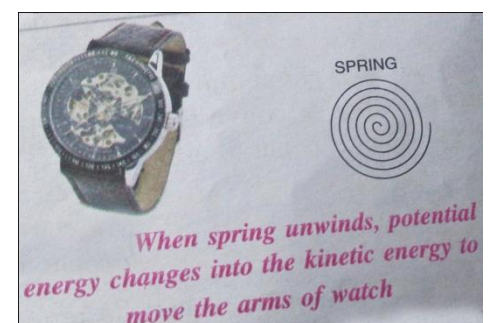
- The mass of the body (Greater the mass of the body, higher its Kinetic energy)
- The speed of the body (More the speed of the body, higher its kinetic energy).



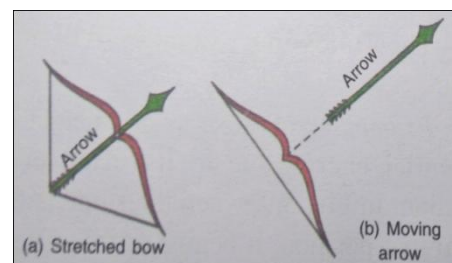
Conversation of potential energy into the kinetic energy

The potential energy changes into the kinetic energy when it is put to use.

Example: a wound up watch spring has the potential energy because of its wound up state. As the spring unwinds itself, the potential energy changes into the kinetic energy. This kinetic energy does work in moving the arms of the watch.



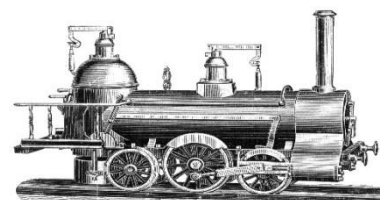
A stretched bow has the potential energy because of its stretched position. When the stretched bow is released, the potential energy of the bow changes into its kinetic energy. This kinetic energy does work on the arrow and makes the arrow to move.



Conversion of one form of energy into the other form or transformation of energy

One form of energy can be converted into the other form.

- In a steam engine, the chemical energy of the coal first changes into the heat energy of the steam. Then heat energy of steam changes into the mechanical energy which makes the train to move.
- In an electric heater, oven, geyser, toaster etc. the electrical energy changes into the heat energy.
- In an electrical cell while in use, the chemical energy changes into the electrical energy.
- In an electric bell while ringing, the electrical energy changes into the sound energy.
- In an electrical generator (or dynamo), the mechanical energy changes into the electrical energy.
- In a microphone, the sound energy changes into the electrical energy.
- The plants during photosynthesis changes the light energy received from sun into the chemical energy.



Law of conservation: the total energy is always conserved in each transformation of energy

Assignment 3.1

Write down the following question/answer in the copy and learn.

Question: Two bodies A and B of masses 10 kg and 20 kg respectively are at the same height above the ground. Which of the two has the greater potential energy?

Answer: The body B having mass 20 kg has the greater potential energy. This can be explained as follows:

$$P.E. = mgh.$$

For both the bodies gravity and height are same so the body with greater mass possesses greater potential energy.

Question: Define the term kinetic energy. Give one example of a body which possesses kinetic energy.

Answer: The energy of a body in motion is called its kinetic energy. It is defined as follows:

Kinetic energy of a body is the energy possessed by it due to its state of motion. Actually, it is the work done on the body bringing it to the state of motion. In short form it is written as K.E. or K.

Example: In a swinging pendulum moving to and fro, the bob has the kinetic energy.

Question: Can a body possess energy even when it is not in motion? Explain your answer with an example.

Answer: Yes, a body possesses energy even when it is not in motion; Consider a body raised to a certain height says h . Its velocity is zero. Kinetic energy will be zero but the body will have.

$$P.E. = mgh$$

Thus, a body may possess energy even though it is not in motion.

Question: Name the type of energy (kinetic or potential) possessed by the following:

a moving cricket ball.

A stone at rest on the top of a building.

A compressed spring.

A moving bus.

A bullet fired from a gun.

Water flowing in a river.

A stretched rubber band.

Answer:

(i) Kinetic energy.

(ii) Potential energy.

(iii) Potential energy.

(iv) Kinetic energy.

(v) Kinetic energy.

(vi) Potential energy.

(vii) Potential energy.

Question 18.

State the energy changes that occur in the following:

(i) the unwinding of a watch spring.

(ii) Burning coal while operating a steam engine.

(iii) Lighting of a torch bulb.

(iv) An electric generator (or dynamo).

Answer:

(i) Potential energy to kinetic energy.

(ii) Chemical energy of coal changes to heat energy of the steam. Heat energy changes into mechanical energy.

(iii) Chemical energy into light and heat energy.

(iv) Electrical energy change into mechanical energy.

Question:

Energy can exist in several forms and may change from one form to another. Give two examples to show the conversion of energy from one form to another.

Answer:

The examples that show the conversion of energy from one form to another Are:

- (1) in a steam engine, the chemical energy of the coal first changes into the heat energy of the steam. Then heat energy of steam changes into the mechanical energy which makes the train to move.
- (2) In an electric motor (or in fan), the electrical energy changes into the mechanical energy. This energy rotates the axle of motor (or the blades of the fan).

Question:

What do you mean by conservation of mechanical energy? State the condition when does it hold.

Answer:

This means "The total MECHANICAL ENERGY (P.E + K.E) of an isolated system at any instant is equal to the sum of kinetic ENERGY and the potential ENERGY."

Condition: Condition under which the mechanical energy is conserved is "WHEN THERE ARE NO FRICTIONAL FORCES." In other words the mechanical energy is conserved strictly in vacuum where friction due to air is absent.

Question:

Give one example to show that the sum of potential energy and kinetic energy remains constant if friction is ignored.

Answer:

During the vertical fall of ball, if friction due to air is neglected, the total sum of potential energy and kinetic energy at each point of its path remains same.

Question:

A ball is made to fall freely from a height. State the kind/ kinds of energy possessed by the ball when it is

- (a) at the highest point
- (b) just in the middle
- (c) at the ground.

Answer:

- (a) Potential energy.
- (b) Potential energy + Kinetic energy.
- (c) Kinetic energy.

Question:

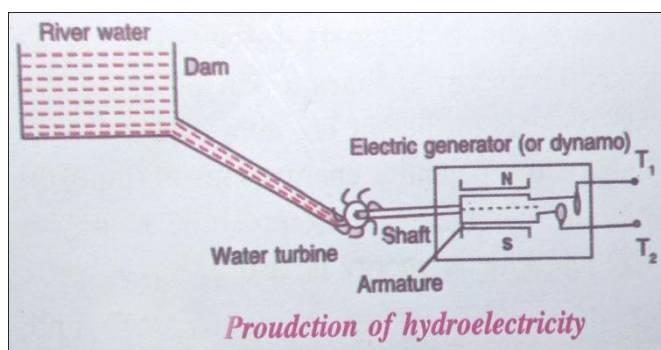
State the changes in form of energy while producing hydro electricity.

Answer:

The water in motion in a river or sea has the kinetic energy. The energy possessed by the flowing

water is called the hydro energy. The most important use of hydro energy is to produce electricity from it.

Figure shows the principle of a hydroelectric power plant. The flowing water of river is collected in a dam at a high altitude. The water stored in the dam has the potential energy. When water from dam falls on the water turbine, the potential energy of the water stored in dam changes into its kinetic energy and this kinetic energy of water is transferred to the blades of turbine as the kinetic energy which rotates the turbine. As the turbine rotates, it rotates the armature of the generator (or dynamo) to produce electricity.



Assignment 3.2

Answer the following questions:

1. Define the terms work energy. State their S.I. units and define them.
2. A bucket full of water is on the first floor of your house and another identical bucket with same quantity of water is kept on the second floor. Which of the two has greater potential energy?
3. A cyclist doubles his speed. How will his kinetic energy change: increase, decrease or remain same?
4. Give one relevant example for each of the following transformation of energy :
 - a) Electrical energy to heat energy.
 - b) Electrical energy to mechanical energy.
 - c) Electrical energy to light energy.
 - d) Chemical energy to heat energy.
 - e) Chemical energy to light energy.

Fill in the blanks:

1. An electric fan converts electrical energy into energy.
2. Cooking gas converts..... energy into heat energy.
3. Energy possessed by a compressed spring is energy.
4. The ability to do work is called
5. The energy possessed by a body due to its position is called..... energy.
6. The energy possessed by a body due to its motion is called..... energy.
7. Green plants convert..... energy into chemical energy.
8. The S.I. unit of energy is.....
9. An object falling freely from the roof of a multistory building has potential energy and energy when halfway down the building.