WORK AND ENERGY

LAW OF CONSERVATION OF ENERGY

Law of conservation of energy

According to law of conservation of energy, energy can neither be created nor destroyed, it can be converted from one form to another. Let us consider two cases where mechanical energy is conserved.

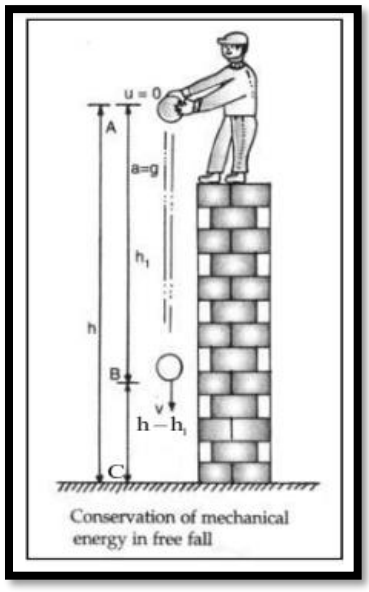
Case:

A ball is dropped from some height. At point A: Let a ball of mass m is dropped from a height h. Here the total energy (T.E.) of the ball is the sum of kinetic energy (K.E.) and potential energy (P.E.).

Potential energy = mgh

Kinetic energy $= \frac{1}{2} m(0)^2 = 0 \qquad (u = 0)$

$[T.E]_A = mgh + 0 = mgh$ ... (A)



Conservation of mechanical energy in free fall

At point B:

Let the ball travel a distance of h_1 in time t during its fall.

Then the velocity of the ball after time t can be found by using equation of motion.

$u = 0$, a

$= g$, $S = h_1$, $v = v$

Using $v^2 - u^2 = 2as$

$v^2 - u^2 = 2gh_1$

$\Rightarrow v^2 = 2gh_1$

Now K.E. at $B = \frac{1}{2}mv^2 = \frac{1}{2}m \times 2gh_1 = mgh_1$

P.E. at B $= mg\ (h - h_1)$

Total energy at B = K.E. + P.E. $= mgh_1 + mg(h - h_1) = mgh$ ... (B)

At point C:

Suppose the ball cover a distance h when it moves from A to C. Let V be the velocity of the ball at point C just before it touches the ground, then

$v^2 - u^2 = 2gh$

$v^2 - 0 = 2gh$ or $v^2 = 2gh$ therefore

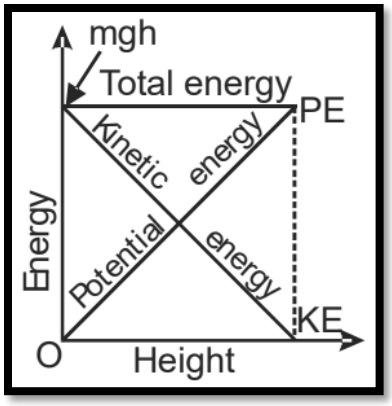
Kinetic energy (K.E.) $= 1/2\ mv^2 = 1/2\ m\ (2gh) = mgh$

and potential energy at C $\therefore$ P.E. $= 0$

Hence total energy at point C.

E = K.E. + P.E. $= mgh + 0 = mgh$ ... (C)

Thus, it is clear from equations A, B and C, that the total mechanical energy of a freely falling ball remain constant. There is, simply, a transformation of mechanical energy. This transformation is depicted in the graph of figure.



Newton's Thought

How does an object with energy do work?

Explanation

An object that possesses energy can exert a force on another object. When this happens, energy is transferred from first object to the second object. The second object may move as it receives energy and therefore do some work. thus, the first object had a capacity to do work. this implies that any object that possesses energy can do work.

Transformation of energy

We have discussed various forms of energy available to us. We convert energy from one form to another. Given by following examples.

1. Conversion of mechanical energy into electrical energy.

The potential energy of water stored in a dam is changed to kinetic energy when it falls from a height. This kinetic energy rotates a turbine to produce electric energy.

2.Conversion of electrical energy into mechanical energy.

An electric motor uses electrical energy to run various electrical appliances, e.g., a train, a fan, washing machine, mixer, grinder etc.

3. Conversion of electrical energy into heat energy.

In an electric heater, a geyser, a toaster, an oven etc., electric energy is changed to heat energy.

4. Conversion of heat energy into mechanical energy.

In heat engines (e.g., a steam engine), heat energy changes to mechanical energy.

5. Conversion of electrical energy into light energy.

In an electric bulb, a fluorescent tube, a flood light etc., electrical energy is changed to light energy.

6. Conversion of electric energy into sound energy.

An electric bell, a stereo, a loudspeaker etc., change electric energy into sound energy.

7. Conversion of chemical energy into heat energy.

When fuels are burnt, chemical energy gets converted into heat energy.

8. Conversion of electrical energy into chemical energy.

When a battery is charged, electrical energy changes into chemical energy. An inverter in our home does the same thing.

9. Conversion of sound energy to electrical energy.

A microphone converts sound energy into electrical energy.

10. Conversion of chemical energy to electrical energy.

An electric cell converts chemical energy into electrical energy.

11. Conversion of light energy into electric energy.

A solar cell converts light energy into electrical energy.

12. Conversion of chemical energy into mechanical energy.

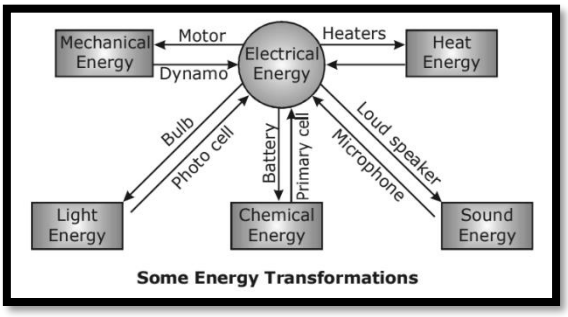
In automobiles, chemical energy of petrol, diesel or CNG (compressed natural gas) is converted into mechanical energy.

13. Conversion of light energy into chemical energy.

In photosynthesis, light energy. from the Sun is absorbed by green plants and is converted to chemical energy.

14. Conversion of nuclear energy into electrical energy.

Nuclear power. plants are used to generate electrical energy from nuclear energy



Some Energy Transformations

Some man-made devices which convert one form of energy into another are is given as follows.

S.NO	DEVICE	INPUT ENERGY	OUTPUT ENERGY
1.	Fan	Electrical energy	Kinetic energy
2.	Electric lamp	Electrical energy	Light energy
3.	Electrical heaters	Electrical energy	Heat energy
4.	Radio	Electrical energy	Sound energy
5.	Water pump	Electrical energy	to kinetic energy of impeller to potential energy of water
6.	Cell Chemical energy	Electrical energy	
7.	Microphone	Sound energy	Electrical energy
8.	Rechargeable cell	(a) During discharging Chemical energy (b) During charging	(a) Electrical energy (b) Chemical energy Electrical energy
9.	Loudspeaker	Electrical energy	Sound energy
10.	. Elevator moving up	Electrical energy	Potential energy
11.	Television	Electrical energy	Sound energy, light energy
12.	Thermal power plant	Chemical energy of coal	Electrical energy
13.	Car	Chemical energy of petrol/diesel	Mechanical energy
14.	Nuclear power plant	Nuclear energy	Electrical energy
15.	Solar cell	Solar energy	Electrical energy
16	Watch	Potential energy of wound spring	K.E. of hands of watch
17.	Generator	Kinetic energy	Electrical energy