Board – CBSE	Class – 9th	Topic – Work and Energy

1. Work:

   In physics, work is defined as when the force applied to an object displaces the object in the direction of the force. Here all three terms force, displacement and direction of force are important W = Force x displacement (force in the direction of displacement)

2. Unit of work

   1 Joule = 1 Newton. 1 metre

$1\,J = 1Nm$

When a force of 1 Newton moves a body through a distance of 1 metre in its direction, the work done is 1 Joule.

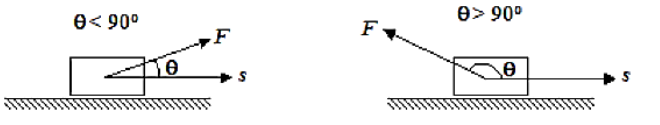
Other units of work

1 joule = $1\,N \times 1\,m = 10^5$ dyne $\times\ 10^2\,cm = 10^7 erg$

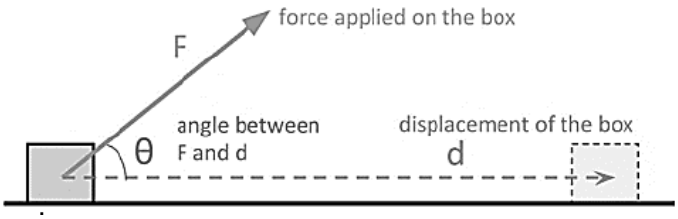
Work done by a force applied at an angle :

W = component of force in the direction of displacement,

The magnitude of displacement $W = 0\,S$



Positive Work done by a force F | Negative Work done by a force F



Work done by a force can be positive or negative, as the value of $cos0$ is positive or negative. (Therefore, F and s, being magnitudes, are always positive)

W =+ ve for 0 = acute angle

W =-ve for 0 = obtuse angle work done by the force does not depend on the displacement of the point of action.

3. Energy:

   Energy may be defined as the capacity of a body to do work.

   The SI unit of energy is the joule (J). or 1 $kJ = 1000\ J$

   Forms of energy: The various forms include potential energy, kinetic energy, heat energy, chemical energy, and light energy.

4. Kinetic Energy:

   The energy possessed by a body by virtue of its state of motion is called Kinetic energy. Kinetic energy is always positive and is a scalar. The fact that moving bodies carry energy with them is proved by some of the several happenings in daily life. Kinetic Energy, $K = \frac{1}{2}mv^2$ When m is the mass and v is the velocity of the body.

5. Potential energy :

   Potential energy is energy due to position. If a body is in a position such that if it were released, it would begin to move, it has potential energy. There are two common forms of potential energy, gravitational and elastic.

   (i) Gravitational Potential Energy: When an object is allowed to fall from one level to a lower level, it gains speed due to gravitational pull, i.e., kinetic energy. Therefore, in possessing height, a body can convert its height into kinetic energy, i.e. it possesses potential energy. If a mass m is at a height h above a lower level, the P.E. possessed by the mass is (mg) (h).

   (ii) Elastic Potential energy: The same work has to be done to change the shape of a body. This work gets stored in the deformed body in the form of elastic potential energy. Elastic potential energy is never negative, whether due to extension or compression.

6. Law of Conservation of Energy :

   According to this law, energy can only be converted from one form to another: it can neither be created nor destroyed. The total energy before and after the

transformation remains the same. The law of conservation of energy is valid in all situations and for all kinds of transformations.

7. Power:

   The time rate of doing work is defined as power (P). More quickly, work is done; power will be more.

$$Power = \frac{Work}{Time}$$

8. Unit of power :

   The unit of power is the joule per second, and this is called the Watt (W). When large amounts of power are involved, a more convenient unit is the kilowatt (kW)

   Where $1\ kW = 1000\ W$

   1 Megawatt $= 10^6$ watt

   1 horsepower $=$ 746 watt

   The unit kilowatt-hour means one kilowatt of power supplied for one hour. It is, therefore, the unit of energy. $1KWh = (1000\ J/s) \times 60 \times 60\ s = 3.6 \times 10^6\ J$