

## What is Work?

Work is said to be done when a body or object moves with the application of external force. We can define work as an activity involving a movement and force in the direction of the force. For example, a force of 30 newton (N) pushing an object 3 meters in the same direction of the force will do 90 joules (J) of work.

### Formula of Work-

When we kick a football, we are exerting an external force called  $F$  and due to this force (kick), the ball moves to a certain distance. This disposition of ball from position A to B is known as displacement ( $d$ ). This work is said to be done and can be calculated as  $W = F \times d$

$$\text{Work} = \text{Force} \times \text{Displacement} = \mathbf{F} \times \mathbf{d}$$

### Unit of Work

If a force of 5 newton is applied to an object and it moves 2 meters, the work will be 10 newton-meter. Newton meter is termed as Joules and it is the unit of Work.

### Example of work

An object is horizontally dragged across the surface by a 100 N force acting parallel to the surface. Find out the amount of work done by the force in moving the object through a distance of 8 m

We know that,

$$F = 100 \text{ N}$$

$$d = 8 \text{ m}$$

Since  $F$  and  $d$  are in the same direction,

$$\theta = 0, [\theta \text{ is the angle of the force to the direction of movement}]$$

$$W = F \cos \theta$$

$$= 100 \times 8 \times \cos 0$$

$$= 800 \text{ J [Since } \cos 0 = 1]$$

### What is Energy?

Energy is the ability to perform work. Energy can neither be created nor destroyed. It can only be transformed from one kind to another. The unit of Energy is same as of Work i.e. Joules. Energy is found in many things and thus there are different types of energy.

All forms of energy are either kinetic or potential. The energy in motion is known as Kinetic Energy whereas Potential Energy is the energy stored in an object and is measured by the amount of work done.

## **Types of energy**

Some other types of energy are given below:

- Mechanical energy
- Mechanical wave energy
- Chemical energy
- Electric energy
- Magnetic energy
- Radiant energy
- Nuclear energy
- Ionization energy
- Elastic energy
- Gravitational energy
- Thermal energy
- Heat Energy

## **Unit of energy**

The SI unit of energy is joules (J), which is named in honor of James Prescott Joule.

## **What is Power?**

Power is a physical concept that has several different meanings, depending on the context and the information that is available. We can define power as the rate of doing work. It is the amount of energy consumed per unit time.

## **Formula of power**

As discussed power is the rate of doing work. Therefore, it can be calculated by dividing work done by time. The formula for power is given below.

$$P=W/t$$

Where,

P = Power

W = Work done

t = Time taken

## **Unit of Power**

As power doesn't have any direction, it is a scalar quantity. The SI unit of power is Joules per Second (J/s), which is termed as Watt. Watt can be defined as the power taken to do one joule of work in one second. The unit Watt is dedicated in honor of So James Watt, the developer of the steam engine.

## Example of Power

A garage hoist lifts a truck up 2 meters above the ground in 15 seconds. Find the power delivered to the truck. [Given: 1000 kg as the mass of the truck]

First we need to calculate the work done, which requires the force necessary to lift the truck against gravity:

$$F = mg = 1000 \times 9.81 = 9810 \text{ N.}$$

$$W = F \times d = 9810\text{N} \times 2\text{m} = 19620 \text{ Nm} = 19620 \text{ J.}$$

$$\text{The power is } P = W/t = 19620\text{J} / 15\text{s} = 1308 \text{ J/s} = 1308 \text{ W.}$$

$$P = F \times v$$

Where,

P = Power

F = Force and

V = velocity

## Work, Power and Energy Questions

1. What is the relationship of work energy and power?
2. What happens to the energy as work is done?
3. What is the difference between work energy and power?
4. Is energy transferred the same as work done?
5. How does work affect an object's energy?
6. How is work energy and power related to each other?
7. How are force energy and work related?
8. What is the formula of work energy and power?
9. How do you calculate energy from power?
10. Can force be converted into energy?