**anodiam**
Education that enlightens!

Work and Energy

Work

- **Work** is done when a **force** produces **motion** in a body.
- Work done in moving a body is equal to the product of force exerted on the body and the distance moved by the body in the direction of force.

  $\text{Work} = \text{Force} \times \text{Distance}$

  $W = F \times s$

- Work is a **scalar** quantity. It has only magnitude and no direction.
- Its SI unit is **joule** (J).
- **One joule of work** is said to be done on an object when a force of 1 N displaces the object by 1 m along the line of action of force.
- Work done by a force can be positive, negative or zero.
- It is **positive** when a force acts in the direction of motion of the body.
- It is **negative** when a force acts opposite to the direction of motion of the body.
- It is **zero** when a force acts at right angles to the direction of motion of the body.

Energy

- We define energy as the **ability to do work**.
- The amount of energy possessed by a body is the amount of work it can do when that energy is released.
- Energy is a **scalar** quantity.
- Its SI unit is **joule** (J). 1 kJ = 1000 J
- The main forms of energy are kinetic energy, potential energy, chemical energy, heat energy, light energy, sound energy, electrical energy and nuclear energy.
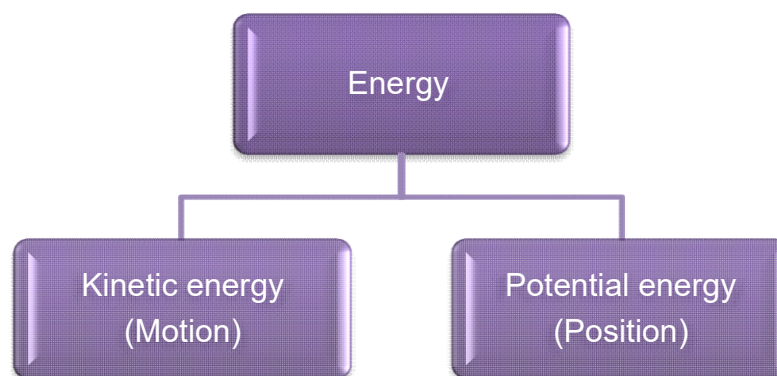
Kinetic Energy

- The energy possessed by a body on account of its **motion** is known as **kinetic energy**.
- Kinetic energy of a body is directly proportional to
    - the **mass** of the body
    - the **square of the velocity** of the body
- Kinetic energy possessed by a body of mass 'm' moving with a velocity 'v' is given by the formula:

    Kinetic Energy $= \dfrac{1}{2}\, mv^2$

Potential Energy

- The energy possessed by a body because of its **position** or **configuration** is known as **potential energy**.
- The work done in raising an object from the ground to a point against gravity is called gravitational potential energy.
- Potential energy of a body of mass 'm' raised to a height 'h' above the surface of the Earth is given by the formula:
  Potential Energy = m g h
  where 'g' is the acceleration due to gravity.
- **Law of conservation of energy**:

Energy can neither be created nor destroyed; it can only be converted from one form to the other.

- Sum of kinetic energy and potential energy of an object is its total mechanical energy.

Power

- Power is defined as the rate of doing work or the rate of transfer of energy.

$$\text{Power} = \frac{\text{Work done}}{\text{Time taken}}$$

$$\text{or Power} = \frac{\text{Energy consumed}}{\text{Time taken}}$$

- Power is a **scalar** quantity. Its SI unit is **watt** (W).
- It is said to be one watt when the rate of consumption of energy is $1\ Js^{-1}$.
- Larger units of power are **kilowatt** (kW), **megawatt** (MW) and **horsepower** (hp).
  1 kW = 1000 W
  $1\ MW = 10^6\ W$
  1 hp = 746 W

Commercial Unit of Energy

- The commercial unit of energy is **kilowatt hour** (kWh).
- One kilowatt hour is the amount of electrical energy consumed when an electrical appliance with a power rating of 1 kilowatt is used for 1 hour.
- 1 kWh is equal to 3.6×10^6 J of energy.
- 1 kilowatt hour of electrical energy is commonly known as **1 unit**.