

10 Work, Energy and Power

10.1 Work and Energy

Energy is needed to

- Make stationary objects **move**.
- Change their **velocity**.
- To **warm them up**.

Objects can possess energy in

- Gravitational potential stores.
- Kinetic stores.
- Thermal stores.
- Elastic stores.

Energy can be transferred

- By radiation.
- Electrically.
- Mechanically.

Energy is measured in **joules**, one joule is equal to the energy needed to raise a 1N weight through a height of 1m.

The **principle of conservation of energy** - energy cannot be created or destroyed.

Work Done

Work is done on an object when a force acting on it makes it moves - energy is transferred to the object.

$$\text{Work done} = \text{force} \times \text{distance moved in the direction of the force}$$

Force-distance Graphs

The area under the line of a force-distance graph represents the total work done.

10.2 Kinetic Energy and Potential Energy

Kinetic energy is the energy of an object **due to its motion**.

$$E_K = \frac{1}{2}mv^2$$

Potential energy is the energy of an object **due to its position**.

$$\Delta E_p = F \times d = mg\Delta h$$

10.3 Power

Energy can be transferred by

- **Work done** by a force due to one object making the other object move.
- **Heat transfer** from a hot object to a cold object.
- Electricity, sound waves and electromagnetic radiation.

Power is defined as the rate of transfer of energy. The unit of power is the **watt**, equal to an energy transfer rate of 1 joule per second.

$$P = \frac{\Delta E}{\Delta t}$$

Engine Power

For a powered object moves at constant velocity at constant height.

$$P = Fv$$

And

Motive power = energy per second wasted due to resistive forces
+ gain of kinetic energy per second

10.4 Energy and Efficiency

Useful energy is the energy transferred for a purpose.

$$\text{Efficiency of a machine} = \frac{\text{useful energy transferred}}{\text{energy supplied}}$$