CAIE Physics A-level

Topic 16: Thermodynamics

Notes

16 - Thermal Properties of Materials

16.1 - Internal Energy

The **internal energy** of a body is equal to the sum of all of the kinetic energies and potential energies of **all** its particles. The kinetic and potential energies of a body are **randomly distributed**. The **internal energy of a body is dependent on its state**, since the state of a body is determined by the value of the kinetic energies of particles.

The **internal energy** of a system can be **increased** in two ways:

1. **Do work** on the system to transfer energy to it (e.g moving its particles/changing its shape)
2. **Increase the temperature** of the system

The kinetic energy of particles is directly proportional to their temperature, therefore an increase in temperature means an increase in the average kinetic energy and so an increase in internal energy.

16.2 - The First Law of Thermodynamics

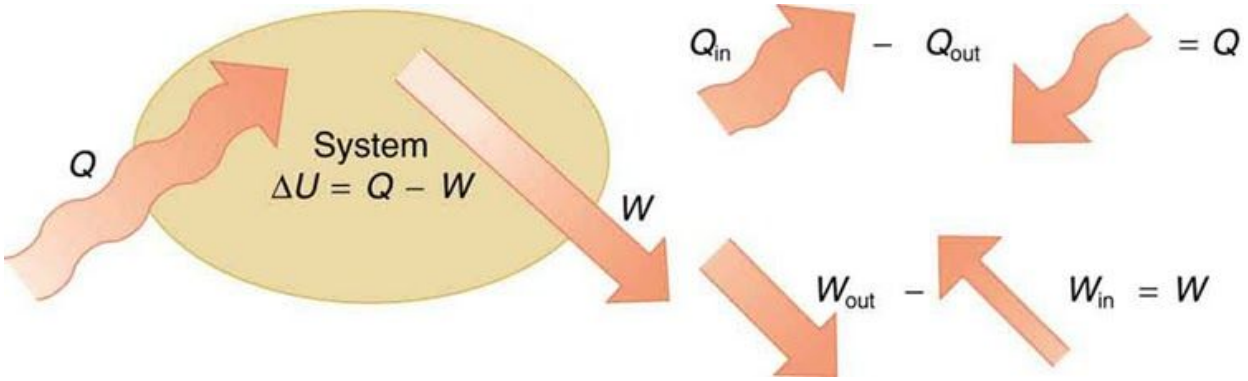
The **first law of thermodynamics** describes the conservation of energy in a system where energy can be transferred through doing work or heating. It states that the **increase in internal energy** of a system is equal to the **sum** of the **energy transferred** to it **through heating** and **work done on** the system. It is given by the following equation:

$$\Delta U = Q + W$$

In the above equation:

- ➔ **ΔU** represents the **increase** in internal energy, if **ΔU is negative**, the internal energy will **decrease**.
- ➔ **Q** is the energy transferred **to** the system through heating, therefore if **Q is negative**, energy is transferred **away** from the system through cooling.
- ➔ **W** is the work done **on** the system (occurs when a gas is compressed), therefore if **W is negative**, work is done **by** the system (occurs when a gas expands).

The diagram below shows a system which **does work**. This is shown by the fact that W is negative.



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