



What is thermodynamics?

- The quantitative relationship between heat and other forms of energy
- Internal energy (ΔU)
 - the available amount of potential and kinetic energy in a substance

Mechanical Energy and Heat

- When work is done to a substance in such a way that it increases its temperature, the amount of work done is equal to the heat gained by the substance, or $W = \Delta Q$.
- Remember $W = \Delta KE$

First Law of Thermodynamics

- The amount of energy supplied to a system in the form of heat is equal to the work done by the system plus the change in internal energy of the system
- $Q = \Delta U + W$
 - W is negative when work is done on the system
 - W is positive when work is done by the system
- When other forms of energy are converted into heat, there is no energy loss.

Thermodynamic Processes

- Isothermal – Constant temperature
 - $Q = W$
- Isobaric – Constant pressure
 - $W = p \Delta V$
 - $Q = \Delta U + p \Delta V$
- Isometric – Constant Volume
 - $Q = \Delta U$

Adiabatic Processes

- A process in which heat is not added or removed from the system.
- Work done by the system decreases the internal energy of the substance
- $Q = 0 = \Delta U + W$
 $\Rightarrow W = -\Delta U$

Isothermal Expansion

- At a constant temperature, the work done by an expanding gas is the product of the pressure and the change in volume.

$$Q = W = p(V_f - V_i)$$

- Any heat that is gained by the gas must be absorbed from its surroundings. This heat causes a change in the volume, it does not increase the temperature.

Energy Transfer

- How much heat is given off when a 100kg crate pushed 5 m horizontally across the floor? ($\mu = 0.30$)

- $Q = W = F_f(d)$

- $Q = \mu F_N(d) = 0.30(100\text{kg})(9.8 \text{ m/s}^2)(5 \text{ m})$

- $Q = 1470 \text{ J}$

Return to Honors Physics Notes
