

## Chapter Summary: Thermochemistry

**Energy:** the ability to do work.

**Units:** Joules, calories

**Thermochemistry:** study of energy changes in a system during chemical or physical changes.

**Internal Energy (U):** total energy of a system.

**Heat (q):** quantity of energy transferred between a system and its surroundings. (Remember a system does not have heat, it has energy).

**Work (w):** energy transferred between a system and surrounding.

$$\text{Work } w = -P \Delta V \text{ (pressure and change in volume)}$$

**First Law of Thermodynamics:** energy cannot be created not destroyed only exchanged between a system and surrounding.

$$\Delta U = q + w$$

### Heats of Reaction

**Exothermic:** heat released into the system (q = negative)

**Endothermic:** heat absorbed from the system (q = positive)

**Heat of reaction:** heat exchanged in a reaction system and the surroundings at a fixed temperature.

$$q_p = \Delta U + P\Delta V$$

$q_p$  = heat of reaction when P is constant

$\Delta U$  = change in energy of the system

P = pressure

$\Delta V$  = change in volume

### Enthalpy (H)

Sum of internal energy and the pressure and volume of a system.

$H = U + PV$ , however H is equivalent to heat of reaction, so

$$\Delta H = \Delta U + P\Delta V$$

Enthalpy:

- 1) Is an extensive property i.e. dependant on quantity of matter (intensive is independent of quantity e.g. density),
- 2) Depends on the present state,
- 3) Has a unique value.

### Calorimetry

**Heat Capacity:** the amount of heat required to change the temperature of a system by 1°C or 1K.

**Specific Heat:** the amount of heat required to change the temperature of 1g of substance by 1°C or 1K.

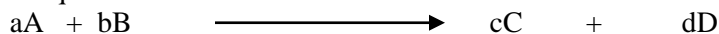
$$\text{Specific heat} = q / m\Delta T$$

$$\text{OR } q \text{ (energy)} = m \times \text{specific heat} \times \Delta T$$

**Hess's Law:** heat of reaction is constant, no matter how many steps it takes for the reaction to happen.

**Standard Enthalpy of Formation:** the heat change that results one 1 mole of compound is formed from its constituent elements in their standard states.

For a hypothetical equation:



$$\Delta H_{\text{rxn}}^{\circ} = [c\Delta H_f^{\circ}(C) + d\Delta H_f^{\circ}(D)] - [a\Delta H_f^{\circ}(A) + b\Delta H_f^{\circ}(B)]$$

In general:  $\Delta H_{\text{rxn}}^{\circ} = \Sigma n\Delta H_f^{\circ}(\text{products}) + \Sigma n\Delta H_f^{\circ}(\text{reactants})$  ( $n$  = number of moles,  $\Sigma$  = sum of)

**Note:** there are some more facts here than I taught in class but now you have a summary of the chapter. On the exam, I will ask only what I have taught in the class.