$$q = -q$$

$$mC\Delta T = -mC\Delta T$$

$$mC(T_f - T_i) = -mC(T_f - T_i)$$

aq

17

Formation Reactions:

This reactions starts with elements only as reactants.
The reactants will form compounds as products.

elements $\Rightarrow$ compound
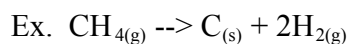
Ex. $C_{(s)} + 2H_{2(g)} \longrightarrow CH_{4(g)}$

The molar enthalpy symbol for a formation reaction is H_f.

Simple Decomposition Reactions:

This reaction starts as a compound, which decomposes into its elements.
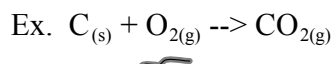(opposite of a formation reaction)

compound $\Rightarrow$ elements

Ex. $CH_{4(g)} \longrightarrow C_{(s)} + 2H_{2(g)}$

The molar enthalpy symbol is H_{SD}.

Combustion Reactions:

The reaction of a substance with excess oxygen to produce an oxide.

Ex. $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$

The molar enthalpy symbol is H_c.

(b) Molar Enthalpies
H_f - molar enthalpies of formation is the quantity of heat released or absorbed when one mole of a substance forms from its elements.

H_c - molar enthalpies of combustion is the quantity of heat released or absorbed when one mole of a substance reacts with oxygen.

H^o - standard molar enthalpy is the quantity of heat released or absorbed when one mole of a substance reacts at SATP

(c) ΔH_r - Enthalpy change is the quantity of heat released or absorbed when a reaction occurs. This may also be called "Heat of Reaction" or "Change in Heat".
$\Rightarrow$ must know the number of moles of a substance reacting to determine the enthalpy change
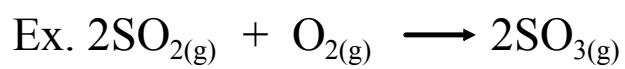
(d) Molar enthalpy may be determined from the enthalpy change as long as the number of moles (n) are known.

H_{fus} H_{solid}

$\Delta H_r = nH_r$

Ex. $2SO_{2(g)} + O_{2(g)} \longrightarrow 2SO_{3(g)}$

$H^o = -98.79kJ/mol$

How do we find the change in enthalpy of $SO_{2(g)}$??

$H_r = \Delta H_r / n$

COMMUNICATING ENTHALPY CHANGES

ΔH_r notation:
- for chemical reactions not well known, the chemical equation must accompany the enthalpy change. The molar enthalpy of reaction (or change in enthalpy) follows the equation. **For exothermic reactions the $\Delta H_r < 0$.**
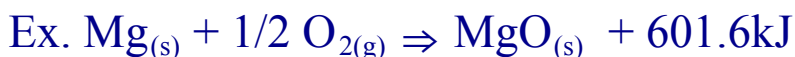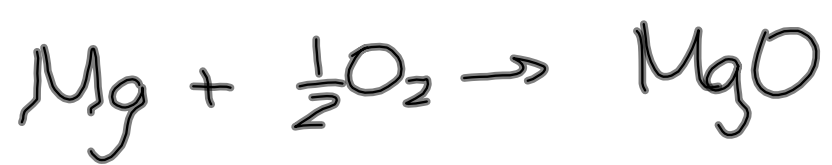
Ex. $Mg_{(s)} + 1/2\ O_{2(g)} ==> MgO_{(s)}$ $\Delta H_r = -601.6kJ$

The Enthalpy Change (ΔH_r) may be included as a term in the balanced equation:

(i) In endothermic reactions - energy is reported as a reactant and is transformed in the reaction.

Ex. $H_2O_{(l)} + 285.8kJ \Rightarrow H_{2(g)} + 1/2O_{2(g)}$

(ii) In exothermic reactions - energy is reported as a product since it is being produced.

Ex. $Mg_{(s)} + 1/2\ O_{2(g)} \Rightarrow MgO_{(s)} + 601.6kJ$

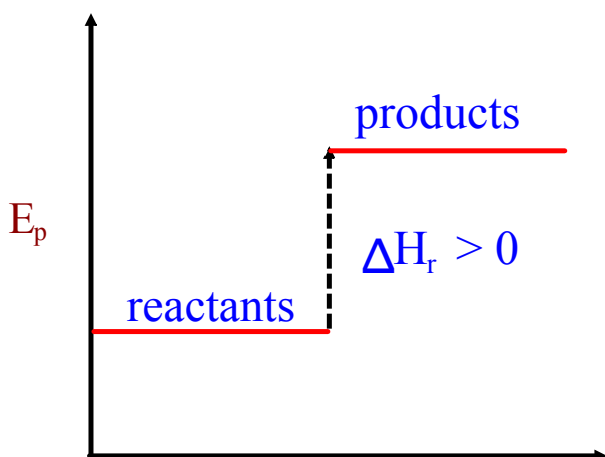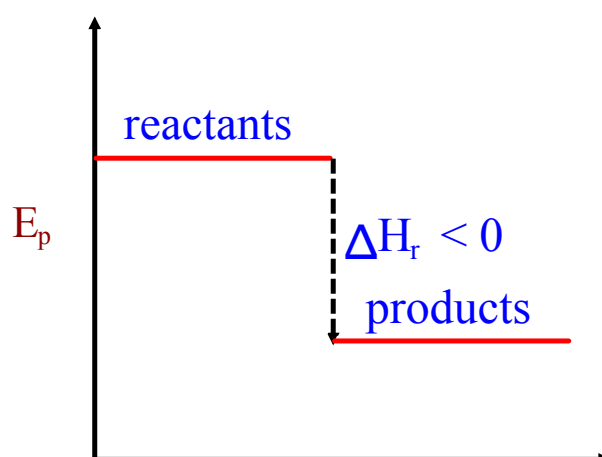$$Mg + \frac{1}{2}O_2 \rightarrow MgO$$

POTENTIAL ENERGY DIAGRAMS

- may be used to express enthalpy change (ΔH_r)
- shows the potential energy of the reactants and products
of a chemical reaction.
- shows the difference between the initial and final energies as the
enthalpy change. (ΔH_r)

Endothermic Rxn **Exothermic Rxn**

products

E_p $\Delta H_r > 0$

reactants

reactants

E_p $\Delta H_r < 0$

products

see Fig 11-8 p 373 (also 11-15,16,17)

For each of the following reactions:
(a) rewrite the equation including the enthalpy change as a term
(b) draw a potential energy diagram

(i) $C_6H_{12}O_{6(s)} + 6O_{2(g)} \longrightarrow 6CO_{2(g)} + 6H_2O_{(l)}$ $\Delta H^\circ = -2802.7 kJ$

$C_6H_{12}O_{6(s)} + 6O_{2(g)} \rightarrow 6CO_{2(g)} + 6H_2O_{(l)} + 2802.7 kJ$

E_P | $\underline{C_6H_{12}O_{6(s)} + 6O_{2(g)}}$

$\Delta H_r = -2802.7 kJ$

$\underline{6CO_{2(g)} + 6H_2O_{(l)}}$

(ii) $H_2O_{(g)} \longrightarrow H_{2(g)} + \frac{1}{2}O_{2(g)}$ $\Delta H^\circ = 241.8 \text{ kJ}$