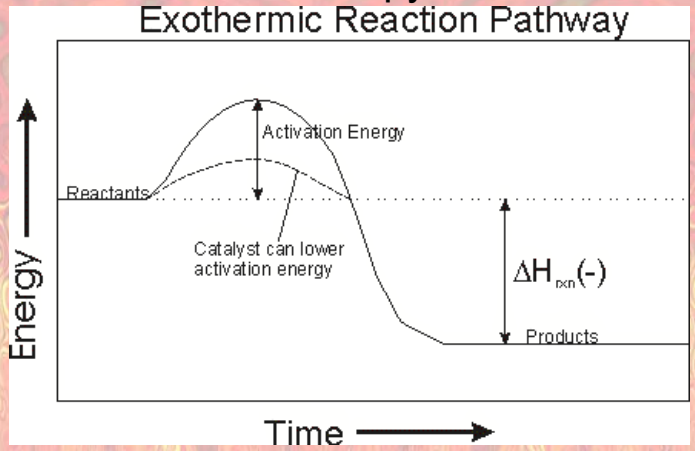
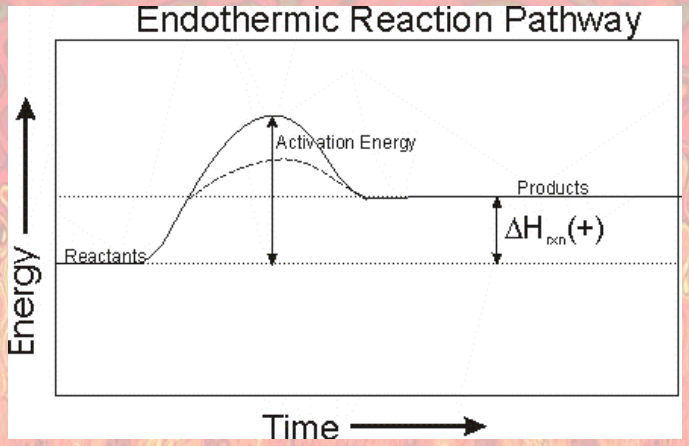
Daily Q

- How much energy would need to be added to a 10.0g sample of copper in order to increase its temperature by 3.0°C?

Enthalpy

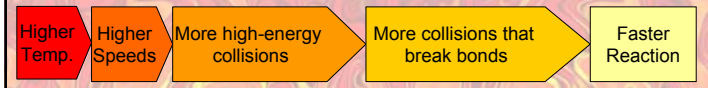


Enthalpy Cont.



Reaction Rates

- Notice that in both reaction diagrams (endo and exo) that higher energy speeds up the reaction (needed for the activation energy).



•Above diagram from World of Chemistry p. 538

•Reactions happen when bonds are broken and atoms re-combine to form new molecules

•More collisions and higher-energy collisions increase the chance that a bond can be broken – leading to a faster reaction

•Catalysts work differently – by creating a lower energy reaction pathway

Enthalpy Cont.

- **Enthalpy** is the energy content of a system (H or ΔH if talking about change)

$$\Delta H = \Sigma H_{products} - \Sigma H_{reactants}$$

Note: the H for pure elements is zero.

Enthalpy Example

Calculate ΔH for the following reaction:

$CH_4(g) + 2\ O_2(g) \rightarrow CO_2(g) + 2\ H_2O(l)$

Substance	H (kJ/mol)
CH_4	-74.8
CO_2	-393.5
H_2O	-285.83

Daily Q

- When potassium chloride reacts with oxygen under the right conditions, potassium chlorate is formed:
- $2\ KCl + 3\ O_2 \rightarrow 2KClO_3$
- Given that the heat of formation of potassium chloride is –436 kJ/mol and the heat of formation of potassium chlorate is –391 kJ/mol, determine the heat of reaction.

- Hess's Law: Overall enthalpy changes are the sum of all steps of the reaction process (add heats from all steps to get overall heat of reaction)
  - If a reaction is reversed, the sign of ΔH is also reversed
  - The magnitude of ΔH depends on the quantities of reactants and products → this means you need to multiply ΔH by the coefficient for that substance
- Hess's Law Practice Website:
- http://chemistry.csudh.edu/lechelpcs/Hesslawcsn7.html

Hess's Law Example

Calculate the heat of reaction, ΔH, for the overall reaction:

N_2 *(g)* + 2O_2 *(g)* → 2NO_2 *(g)*

Given:

2NO *(g)* → N_2 *(g)* + O_2 *(g)* ΔH=-180 kJ

2NO *(g)* + O_2 *(g)* → 2NO_2 *(g)* ΔH=-112 kJ

Hess's Law Practice

Calculate the heat of reaction, ΔH, for the overall reaction:

2 S *(s)* + 3 O_2 *(g)* → 2 SO_3 *(g)*

Given:

S *(s)* + O_2 *(g)* → SO_2 *(g)* ΔH = -297 kJ

2 SO_3 *(g)* →2 SO_2 *(g)* + O_2 *(g)* ΔH = 198 kJ

Hess's Law Exit Slip

Calculate ΔH for this reaction:

$PbCl_2$ *(s)* + Cl_2 *(g)* → $PbCl_4$ *(l)*

Given:

Pb *(s)* + Cl_2 *(g)* → $PbCl_2$ *(s)* Δ H = - 359.4 kJ

Pb *(s)* + 2 Cl_2 *(g)* → $PbCl_4$ *(l)* Δ H = - 329.3 kJ