Percent yield calculation

- A student completely reacts 5.00g of magnesium with an excess of oxygen to produce magnesium oxide. Analysis reveals 8.10 g of magnesium oxide. What is the student's percentage yield?

ENERGY
Chapter 11

Any time there is a chemical reaction energy must be involved

Types of energy

- Kinetic - the energy of motion
- Potential - stored energy
- Check out this bowling ball!!

Energy in chemical reactions

- Exothermic reactions (energy is a product)

Energy is released by the chemical system

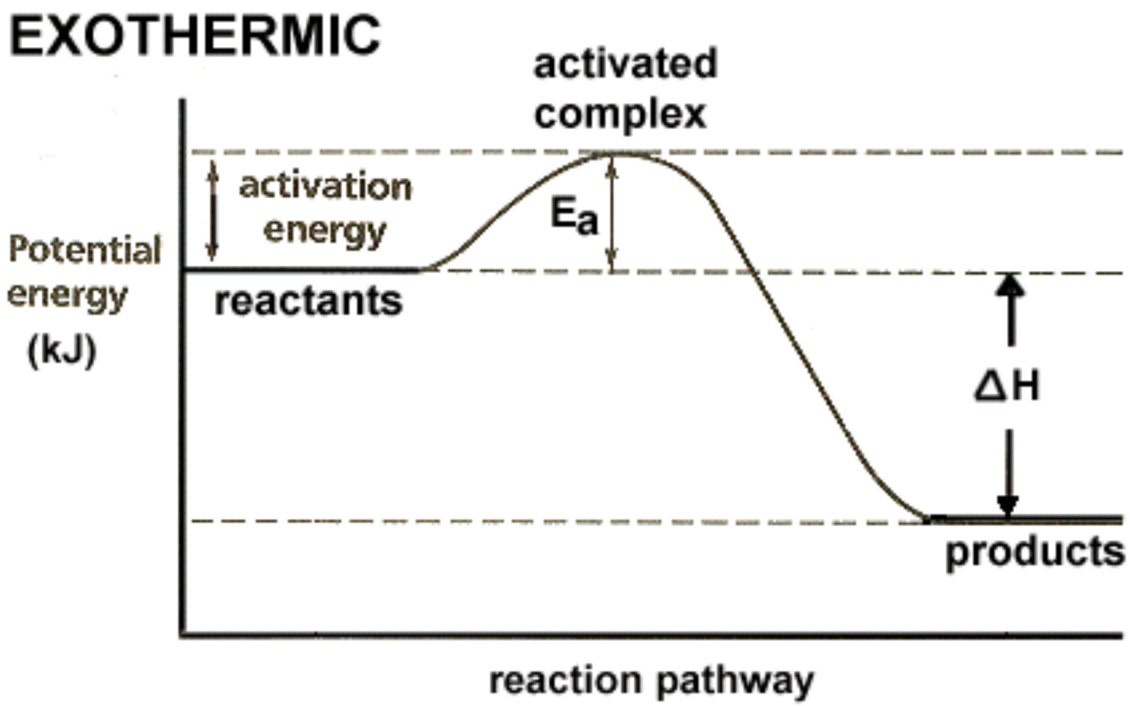
CH_4 + 2 O_2 ----> CO_2 + 2 H_2O + **energy**

- Endothermic reactions (nrg is a reactant)

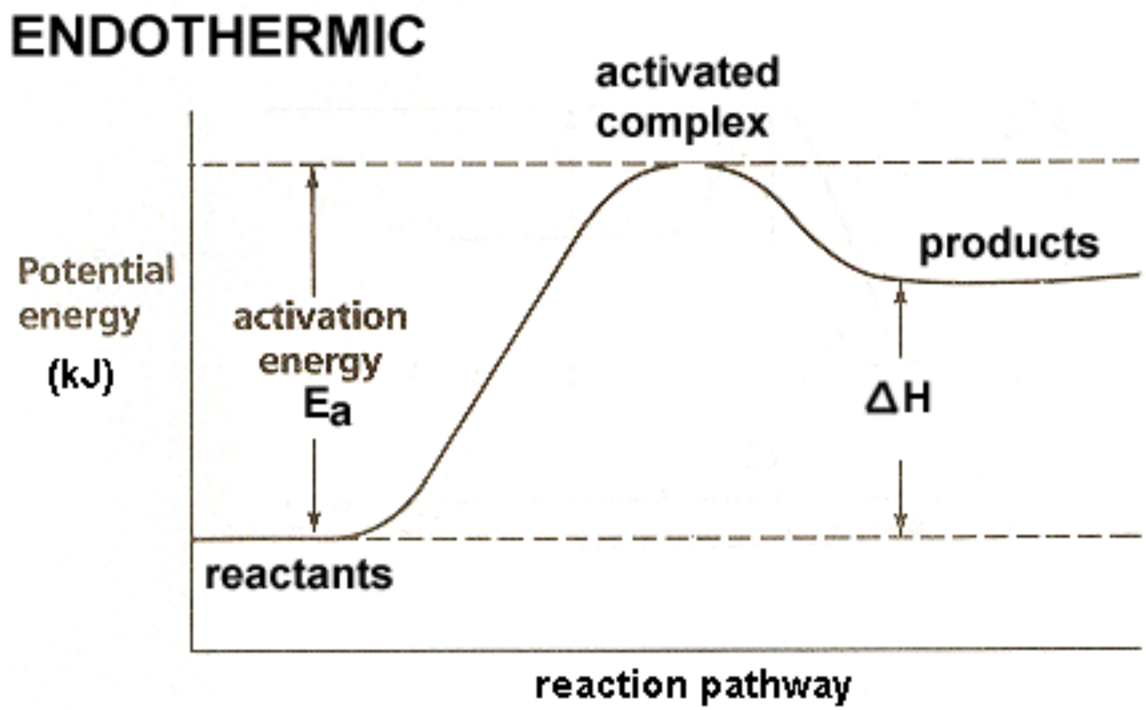
Energy is absorbed by the chemical system

2 $KClO_3$ + **energy** ----> 2 KCl + 3 O_2

Energy graphs



Energy graphs



ΔH (enthalpy)

- In exothermic reactions ΔH is negative
  - Heat flows out of the system
  - Reaction feels warm/hot

- In endothermic reactions ΔH is positive
  - Heat flows into the system
  - Reaction feels cold

Energy units

- The amount of energy needed to raise 1.00 gram of water 1.00 ^oC = calorie (cal)

- 1.0 cal = 4.18 Joules (J) Physics types like the joule

- Also the British Thermal Unit (BTU)

  The amount of energy needed to raise 1.00 pound of water 1.00 ^oF

How is energy measured?

- There is no direct energy meter. Energy is measured (calculated) indirectly
- Temperature is the average kinetic energy of a system
- To find energy, a difference of temperature is needed.

$$(\Delta T = T_{final} - T_{initial})$$

How is energy measured?

- The difference in temperature coupled with the mass and something called specific heat lets you calculate energy
- The energy of a substance depends on three things:
  - Change in temperature
  - Mass of material
  - Specific heat

Specific Heat

The specific heat (energy) of a substance is defined at the amount of heat that must be absorbed or lost for 1 g of that substance to change its temperature by 1º C.

Specific Heat

MATERIAL	SPECIFIC HEAT (Joules/gram • °C)
Liquid water	4.18
Solid water (ice)	2.11
Water vapor	2.00
Dry air	1.01
Basalt	0.84
Granite	0.79
Iron	0.45
Copper	0.38
Lead	0.13

Kinetic energy formula

- Energy = change in temperature x specific heat x mass

$$q = \Delta H = \Delta T \times C \times m$$

q= heat ΔH = enthalpy

Enthalpy is the "heat content of a system at constant pressure"

if the reaction is at a constant pressure these two values are equal

- Check out the units

$$^{o}C \times \frac{cal}{^{o}C \cdot grams} \times grams = Calories$$

Sample

- Find the energy needed to increase the temperature of water from 25^{o}C to 75^{o}C. Assume that you have 1.0 liter of water.
- The specific heat of water is 1.0 cal/g ^{o}C

Answer

$\Delta H = (75\ ^oC - 25^oC)\ \times\ 1.0\ cal/g\ ^oC\ \times 1000\ g$

$\Delta H = 50{,}000\ cal$