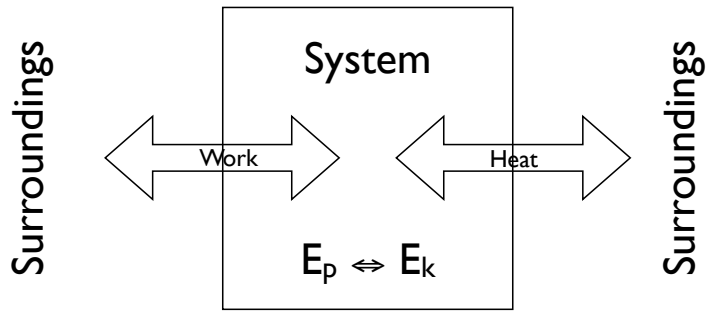
1st Law of Thermochemistry & Enthalpy

1st Law and Enthalpy

In Review



- Energy within a system can convert from potential to kinetic and vice versa without changing internal energy
- Energy can transfer between a system and its surroundings in the form of work or heat

1st Law and Enthalpy

The Rules

- The First Law of Thermodynamics
  - Energy is neither created nor destroyed when changing forms or transferring between a system and its surroundings.
  - Energy is conserved

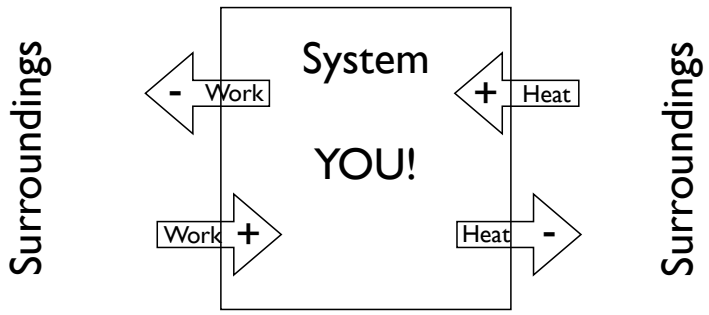
1st Law and Enthalpy

Internal Energy

- To study the energy content of a system we must consider all the sources of energy within the system
- Internal Energy
  - Abbreviated E
  - The sum of all the kinetic and potential energy in a system
  - $E = E_k + E_p$
- However, when we study internal energy, we can't speak empirically about its value.
  - Instead, we discuss energy changes.
    - $\Delta E = E_{final} - E_{initial}$
- If $E_{final} > E_{initial}$, then ΔE is positive
- If $E_{final} < E_{initial}$, then ΔE is negative

1st Law and Enthalpy

Transferring Energy



1st Law and Enthalpy

Enthalpy

- Assumes that chemical reactions take place at constant pressure in <u>open containers</u>. (Constant Pressure Container)
  - A hypothetical container which offers no resistance to expansion or contraction
    - ∴ no work is exchanged between the system and the surroundings
  - All energy loss/gain happens through heat exchange

$$\Delta E = q + w$$

1st Law and Enthalpy

Enthalpy

- Enthalpy
  - Heat exchanged in the absence of work
  - Heat exchanged under constant pressure
  - Abbreviated H
- $\Delta H = H_{final} - H_{inital}$
- Positive ΔH is endothermic
  - Takes in heat
- Negative ΔH is exothermic
  - Gives off heat

1st Law and Enthalpy

Enthalpy applied to chemical reactions

- $\Delta H = H_{(products)} - H_{(reactants)}$
- Thermochemical Equations
  - $2\ H_{2(g)} + O_{2(g)} \Rightarrow 2\ H_2O_{(l)} \quad \Delta H = -483.6\ kJ$
- Guidelines for using thermochemical equations:
  - Enthalpy is an extensive property
    - The more matter, the more energy
    - Heats of reaction given for moles represented
  - Enthalpy changes are reversible
    - $2\ H_{2(g)} + O_{2(g)} \Leftarrow 2\ H_2O_{(l)} \quad \Delta H = 483.6\ kJ$
  - Enthalpy changes are phase dependent

1st Law and Enthalpy

Heat of Reaction Sample Problem

- How much heat is released when 4.50 grams of methane gas is burned in an open container?
- $CH_{4(g)} + 2\ O_{2(g)} \Rightarrow 2\ H_2O_{(l)} + CO_{2(g)} \quad \Delta H = -890\ kJ$

1st Law and Enthalpy

Homework

- 5.19, 21, 22, 25, 34, 39, 41, 45