CHAPTER 6 THERMOCHEMISTRY

ENERGY → capacity to do work
$W = F \times d = -P\Delta V$

radiant → SOLAR light em

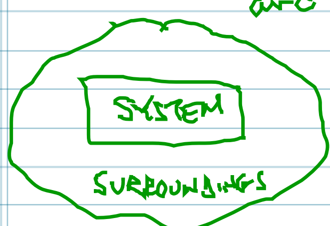
thermal → E associated w/ the random motion of molecules (total KE)

$T \propto$ average KE (not the total KE)

CHEMICAL E → a form of pot'l energy → E "stored"
↳ within the structural units of a chemical compound → associated w/ the positions/arrangements of the atoms within a substance

HEAT (q)
→ the transfer of thermal E between 2 bodies at a different T
"heat flow"

THERMOCHEMISTRY → the study of heat flow and chemical reactions



① open system → matter and heat can both flow

② closed system → heat can flow

③ isolated system → no heat or matter can flow

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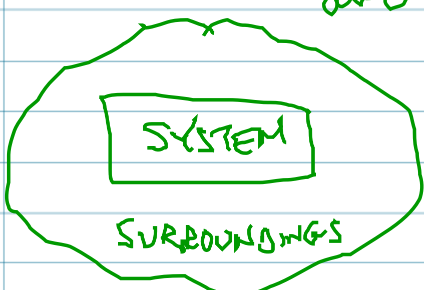

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EXOTHERMIC heat (thermal E) flows out of the system
- frequently PE → KE

ENDOTHERMIC heat flows into the system
(KE → PE)

"open air system" ⟹ constant P

ENTHALPY (H) → the heat flow into or out of a system at constant P

$H = E + PV$

↑ unknowable (PE + KE)

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

EXO: ΔH (−) ENDO: ΔH (+)

THERMOCHEMICAL EQUATIONS

→ contains an "E" term

$2H_2 + O_2 \longrightarrow 2H_2O$ $\Delta H = \ominus 571.6$ kJ/mol$_{rxn}$ EXO

$2HCl_{(g)} \longrightarrow H_2 + Cl_2$ $\Delta H = \oplus 184.6$ kJ/mol$_{rxn}$ ENDO

HINDENBERG 1.8×10^7 g H_2

how much heat is released if all the H_2 burns?

$$1.8\times10^7\text{ g}\times\frac{1\text{ mol}}{2.02\text{ g}}\times\frac{\ominus 571.6\text{ kJ}}{\textcircled{2}\text{ mol }H_2} = \ominus 2.5\times10^9\text{ kJ}$$

How many grams of Cl_2 could be produced if all this heat was used to decompose HCl gas?

$$+2.5\times10^9\text{ kJ}\times\frac{1\text{ mol }Cl_2}{184.6\text{ kJ}}\times\frac{70.90\text{ g}}{1\text{ mol}} = 9.6\times10^8\text{ g }Cl_2$$

CALORIMETRY → lab techniques to measure heat flow

heat capacity (C) → the amount of heat that must be absorbed to raise the T of an entire object by 1°C

$q = C\Delta T$

specific heat (s or c) → the amount of heat that must be absorbed to raise the T of 1 g of a substance by 1°C

$q = ms\Delta T$

$C = \text{mass}\times s$ $\quad s_{H_2O(l)} = 4.184\ \text{J/g°C}$ $\quad s = \frac{q}{m\Delta T}$

$\Delta T = T_f - T_i$ $\quad$ * ΔT sign determines sign of q