Reactions and Stoichiometry

Chemical reactions – reactants → products

↳ result of a chemical change due to something new being formed

- # of atoms are same for reactants/products

not molecules/phases/compounds etc.

* Exothermic and Endothermic Reactions

↳ heat exits

$A + B \longrightarrow C + D + \text{Energy}$

↳ heat enters

$A + B + \text{energy} \rightarrow C + D$

Ref. Table I to determine exo vs endo

Balancing Reactions

- hints:

1) If an atom is present in odd quantity, try to multiply by a number to make it even

2) Start with any atoms that only occur in one compound

example $1Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ [9] (2)

$2Fe + 1O_2 + 2H_2O \rightarrow 2Fe(OH)_2$ [7]

Reaction Types

1. Synthesis → $A + B \rightarrow C$ [1 product only]
2. Decomposition → $C \rightarrow A + B$ [1 reactant → 2+ products]
3. Single Replacement
   - ✱ Table J - make sure that metal being replaced is less active than one taking its place

$AB^- + C^+ \rightarrow A + CB$ cmpd = + before −

ex) $Ca + Fe(NO_3)_2 \rightarrow Fe + Ca(NO_3)_2$ Ca^{+2} NO_3^{-1}

$1Al + 3AgCl \rightarrow 3Ag + 1AlCl_3$ Al^{+3} Cl^{-1}

$Cu + NaF \rightarrow$ won't proceed b/c Cu is less reactive than Na according to table J.

4. Double Replacement

★ Table F (Solubility Tables)

$A^+B^- + C^+D^- \rightarrow AD + CB$

(use Table F to determine (aq) or (s))

ex) $FeCl_2 + MgSO_4 \rightarrow FeSO_4(aq) + MgCl_2(aq)$

ex) $Ba(NO_3)_2 + H_2CrO_4 \rightarrow BaCrO_4(s) + 2HNO_3(aq)$

5. Combustion

↳ $C_xH_x + O_2 \rightarrow CO_2 + H_2O$ (ID)

Reactions and Mass

conservation of mass = mass @ beginning of reaction should be the same @ end of the reaction

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ (ignore coefficients)

$2.3g + 0.50g = ? + 1.2g$

$2.8 = 1.6g$

Stoichiometry

- relationship between moles of reactants vs. moles of products

★ use dimensional analysis

$$6CO_2 + 6H_2O \rightarrow 1C_6H_{12}O_6 + 6O_2$$

? → How much O_2 would be produced if 2.3 moles of CO_2 were used?

start: $2.3\,mol\ CO_2 \times \frac{6\ mol\ O_2}{6\ mol\ CO_2} = 2.3\,mol\ O_2$

? mol of $C_6H_{12}O_6$ if 3.9 mol H_2O?

$3.9\,mol\ H_2O \times \frac{1\ mol\ C_6H_{12}O_6}{6\ mol\ H_2O} = .65\,mol\ C_6H_{12}O_6$

$$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$$

? NH_3. if use 7.5 mol O_2

start / end

$\frac{4\,mol\,NH_3}{5\,mol\,O_2} = \frac{x\,mol\,NH_3}{7.5\,mol\,O_2}$

$\frac{5x}{5} = \frac{4(7.5)}{5}$

$x =$

$4\,NH_3 + 5O_2 \rightarrow 4NO + 6\,H_2O$

? g of NO are produced from 2 mole NH_3

1st- find moles of NO

2nd- use Gram formula mass to convert to grams

$$\rightarrow 2\,\cancel{mol\ NH_3} \times \frac{4\ mol\ NO}{4\ \cancel{mol\ NH_3}} = 2\,mol\ NO$$

$$2\,mol\ NO \times \frac{30.0\,g}{1\,mol\ NO} = 60.0\,g\ NO$$