Types of Chemical Reactions

1. Synthesis (combination)
   2 reactants form 1 product

$$A + B \rightarrow AB$$

Ex) $Na(s) + Cl_2(g) \rightarrow NaCl(s)$

$Fe(s) + S_8(s) \rightarrow FeS(s)$

$SO_3(s) + H_2O(l) \rightarrow H_2SO_4(aq)$

2. Decomposition
   1 reactant breaks down into 2 or more products

$$CD \rightarrow C + D$$

$KClO_3(s) \rightarrow KCl(s) + O_2(g)$

$H_2O_2(aq) \rightarrow H_2O(l) + O_2(g)$

$PbSO_4(aq) \rightarrow PbSO_3(aq) + O_2(g)$

3. Combustion
   a hydrocarbon reacts w/oxygen to form carbon dioxide & water

Ex) $CH_4 + O_2 \rightarrow CO_2 + H_2O$

$C_2H_5OH + O_2 \rightarrow CO_2 + H_2O$

$C_{12}H_{22}O_{11} + O_2 \rightarrow CO_2 + H_2O$

4. Double-Replacement (do-si-do)

2 ionic compounds switch ions

$$AB + CD \rightarrow AD + CB$$

Ex.)

$$AlN(s) + MgF_2(g) \rightarrow \overset{+3\ 1-}{AlF_3(s)} + Mg_3N_2(s)$$

$$FeCl_3(s) + AgNO_3(aq) \rightarrow \overset{3+\ 1-}{Fe(NO_3)_3(aq)} + \overset{1+\ 1-}{AgCl(s)}$$

$$NaOH(s) + BeCl_2(aq) \rightarrow \overset{1+\ 1-}{NaCl(aq)} + \overset{2+\ 1-}{Be(OH)_2(aq)}$$

5. Single-Replacement

an element replaces another inside a compound

ONLY if the element doing the replacing is more reactive than the 1 in the compound.

Activity Series

metals

Li Rb K Ba Ca Na Mg Al Zn Cr Fe Co Ni Sn Pb H Cu Ag Hg Pt Au

← more reactive

F Cl O Br I S P nonmetals

$$A + BC \rightarrow B + AC \quad \text{or} \quad D + EF \rightarrow F + DE$$

A: metal; D: nonmetals

Ex.)

$$Ca(s) + Cr_2(CO_3)_2(aq) \rightarrow Cr(s) + \overset{2+\ 2-}{CaCO_3}$$

$$Na(s) + K_3PO_4(aq) \rightarrow \text{no reaction}$$

$$Cl_2(g) + MgS(s) \rightarrow S + \overset{2+\ 1-}{MgCl_2}$$

$$O_2(g) + KF(s) \rightarrow \text{no rxn}$$

Predicting Products

Synthesis (1 product)

$$Ca + N_2 \rightarrow \overset{2+\ \ 3-}{Ca_3N_2}$$

$$Al + Cl_2 \rightarrow \overset{3+\ \ 1-}{AlCl_3}$$

Decomposition (1 reactant)

$$H_2O \rightarrow H_2 + O_2$$

$$MgS \rightarrow Mg + S$$

Combustion (products are $CO_2 + H_2O$)

$$C_3H_8 + O_2 \rightarrow CO_2 + H_2O$$

$$CH_2O + O_2 \rightarrow CO_2 + H_2O$$

Double-Replacement (switch ions)

$$NaCl + AlP \rightarrow \overset{1+\ \ 3-}{Na_3P} + \overset{3+\ \ 1-}{AlCl_3}$$

$$Cu(NO_3)_2 + Li_2O \rightarrow \overset{2+\ \ 2-}{CuO} + \overset{1+\ \ 1-}{LiNO_3}$$

Single-Replacement (switch 1 ion - maybe)

✓ the activity series

$$Fe + NiCl_2 \rightarrow Ni + \overset{2+\ \ 1-}{FeCl_2}$$

$$Co + Rb_2S \rightarrow \text{No Rxn}$$