MOLECULAR AND IONIC EQUATIONS

- Ions that show up IN THE SAME FORM on the left and right sides of a chemical equation are called SPECTATOR IONS. If we rewrite an ionic equation to leave out the spectator ions, we get a NET IONIC EQUATION.

$$Ag^{+}(aq) + Cl^{-}(aq) \longrightarrow AgCl(s)$$

- The net ionic equation is more general than the complete ionic equation. It tells us that ANY source of aqueous silver ions will react with ANY source of aqueous chloride ions to make solid silver chloride.

(In experiment 1A, you're told to dissolve your unlnown sample in distilled water instead of tap water. That's because tap water contains choride ions and will react with silver nitrate in the same way as sodium chloride would!)

TYPES OF REACTIONS

- There are many kinds of chemical reaction. We'll begin with three types:

① PRECIPITATION REACTIONS

② ACID-BASE REACTIONS

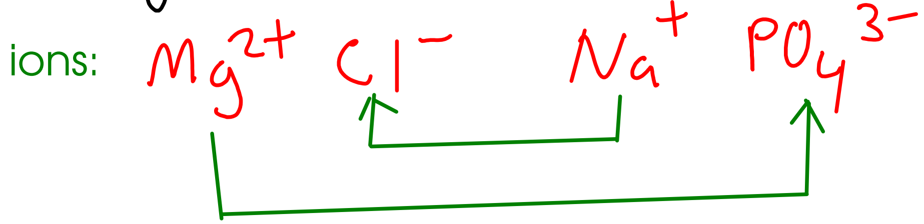
③ OXIDATION-REDUCTION REACTIONS

- Not every possible mixture of chemicals will react. Most reactions require a DRIVING FORCE, which is usually some stable substance that forms to push a reaction forward.

PRECIPITATION REACTIONS

- Driven by the formation of an insoluble ionic compound.

$$3MgCl_2(aq) + 2Na_3PO_4(aq) \rightarrow 6NaCl(aq) + Mg_3(PO_4)_2(s)$$ ✓



ions: Mg^{2+} Cl^- Na^+ PO_4^{3-}

This reaction is driven by the formation of INSOLUBLE magnesium phosphate.

Check p181 in OpeStax or the scienceattech.com site for solubility charts to determine which compounds dissolve in water!

When you're trying to complete a precipitation reaction:

① Write the IONS that form when the reactants are dissolved.

② Make NEW compounds by pairing up cations with anions. Don't forget that the positive and negative charges must balance each other out!

③ Use the solubility rules to determine the PHASE of each new compound - solid or aqueous.

④ Balance the overall equation.

$MgCl_2(aq) + NaC_2H_3O_2(aq) \rightarrow$ NO REACTION!*

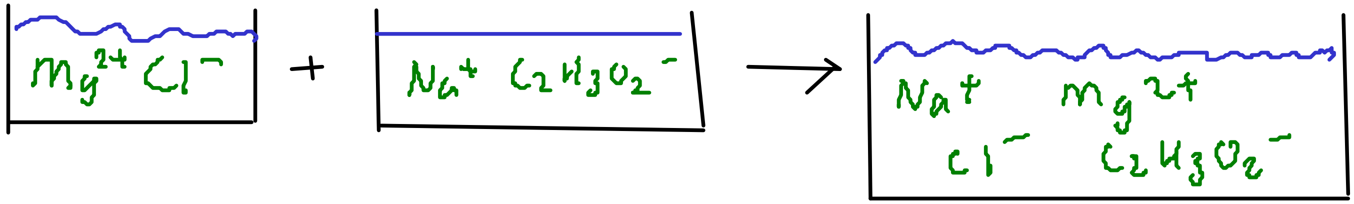
ions: Mg^{2+} Cl^- Na^+ $C_2H_3O_2^-$

"exchange"

$Mg(C_2H_3O_2)_2$ ... dissolves in water

$NaCl$ ... dissolves in water

So, no solid forms here. All possible combinations of these four ions result in compounds that dissolve readily in water.



"ion soup"

NO CHANGE, therefore
NO DRIVING FORCE,
and NO REACTION

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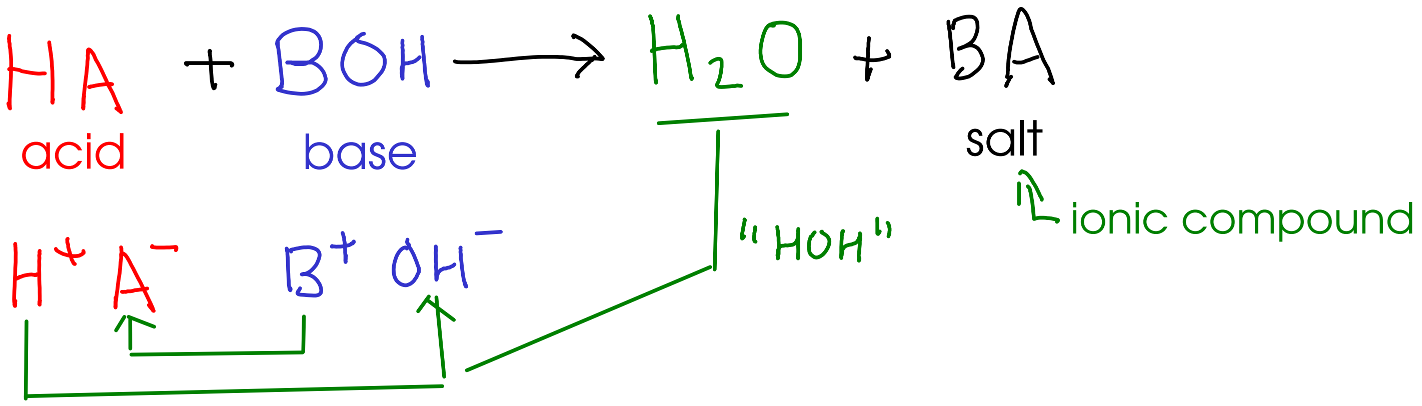
* We will learn about other driving forces than the formation of solid, but these driving forces do not apply to this reaction

ACID/BASE REACTIONS (also called NEUTRALIZATION REACTIONS)

- There are several stable molecules that may be formed in double replacement reactions, but the most common is WATER!

- Double replacement reactions that form water are also called "neutralizations"



* To make water (H_2O), you need a source of hydrogen ion (H^+) and hydroxide ion (OH^-)

$$\underbrace{H^+(aq) + OH^-(aq)}_{} \longrightarrow H_2O(l)$$

This is the
NET IONIC
EQUATION
for many
neutralizations

... assumes you're reacting STRONG acid with STRONG base!

ACIDS

- compounds that release hydrogen ion (H^+), when dissolved in water.

Properties of acids:

- Corrosive: React with most metals to give off hydrogen gas
- Cause chemical burns on contact
- Taste sour (like citrus - citric acid!)
- Changes litmus indicator to RED

BASES

- Substances that release hydroxide ion (OH^-) when dissolved in water

Properties of bases:

- Caustic: Attack and dissolve organic matter (think lye, which is NaOH)
- Cause skin/eye damage on contact
- Taste bitter
- changes litmus indicator to BLUE

Due to the dissolving action of base on your skin, bases will feel "slippery". The base ITSELF is not particularly slippery, but what's left of your skin IS!

ACID/BASE or NEUTRALIZATION reactions continued

- the driving force of these reactions is the formation of water molecules.

$$\underbrace{H^+(aq)}_{\text{From the acid}} + \underbrace{OH^-(aq)}_{\text{From the base}} \longrightarrow H_2O(l)$$

Net ionic equation

$$H_2SO_4(aq) + 2NaOH(aq) \longrightarrow 2H_2O(l) + Na_2SO_4(aq)$$

ions: H^+ SO_4^{2-} Na^+ OH^-

This reaction is driven by the formation of stable WATER MOLECULES! (No solid forms here!)

- How can this reaction be detected?
  - pH detector (indicator paper, etc.)
  - do the products have similar chemical properties to the reactants?
  - release of heat!

... formation of water is usually accompanied by a release of heat