BALANCING

$$3MgCl_2 + 2Na_3PO_4 \longrightarrow Mg_3(PO_4)_2 + 6NaCl$$ ✓

$$C_2H_2 + 2\tfrac{1}{2}O_2 \longrightarrow 2CO_2 + H_2O$$

$$4\ 5 \ \vdots \quad 4 + 1 = 5$$

We had to use a coefficent of 2 1/2 for oxygen gas in order to have the same number of oxygen atoms on each side. But we need WHOLE NUMBERS for coefficients. To get them, multiply ALL the coefficents by a number that will get rid of the fraction in 2 1/2 ... here, that's 2.

$$2C_2H_2 + 5O_2 \longrightarrow 4CO_2 + 2H_2O$$ ✓

$$H_2SO_4 + 2NaOH \longrightarrow Na_2SO_4 + 2H_2O$$ ✓

1) Avoid H, balance S instead. (H shows up twice on the left side)
2) Avoid O, balance Na instead. (O shows up in all four compounds)
3) Balance H (shows up less than O)
4) Balance O. (already fixed!)

MOLECULAR AND IONIC EQUATIONS

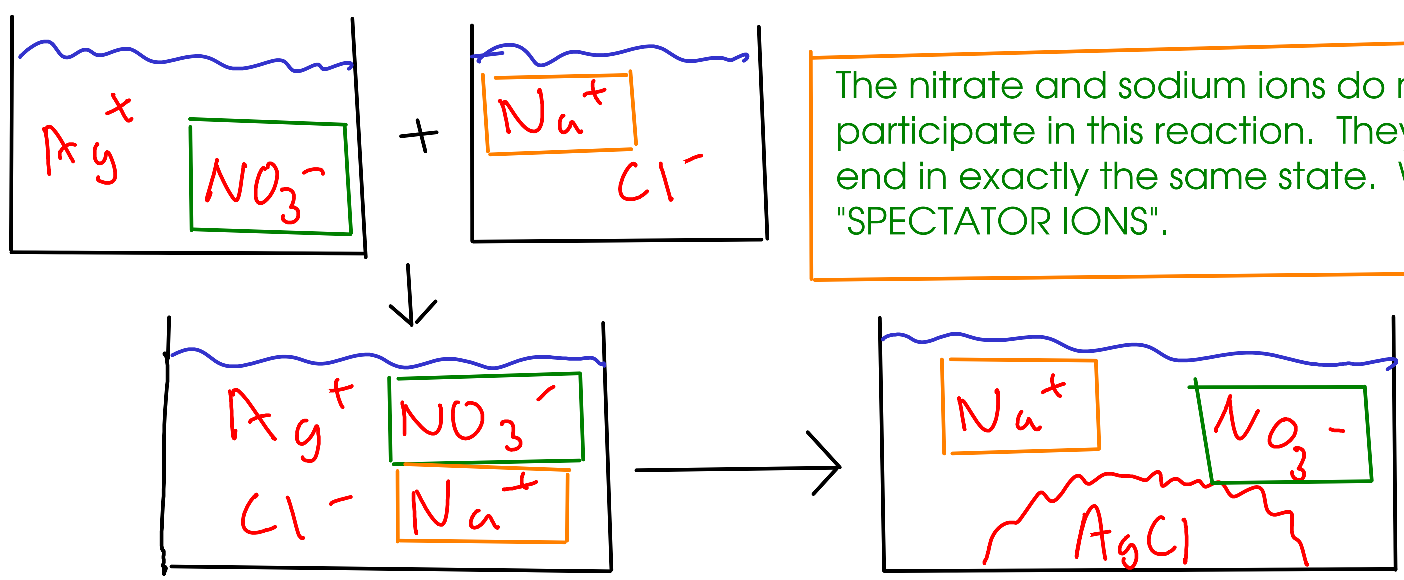
- A MOLECULAR EQUATION shows all compounds, whether or not they contain ions, as complete compounds.

$$AgNO_3(aq) + NaCl(aq) \rightarrow AgCl(s) + NaNO_3(aq)$$

- Since an ionic compound breaks apart when dissolved in water, it's sometimes useful to show these ions separately. An IONIC EQUATION shows ionic compounds as separate ions when they are dissolved in water, better representing the actual species that are reacting.

$$Ag^+(aq) + NO_3^-(aq) + Na^+(aq) + Cl^-(aq) \rightarrow AgCl(s) + Na^+(aq) + NO_3^-(aq)$$

- The above equation is a COMPLETE IONIC EQUATION. It shows every dissolved ion. But ...



The nitrate and sodium ions do not really participate in this reaction. They start and end in exactly the same state. We call them "SPECTATOR IONS".

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.

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

- 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.

Find out whether a compound is soluble by consulting a solubility chart, like the ones on p 181 in OpenStax or the one on the scienceattech.com web site!

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!*

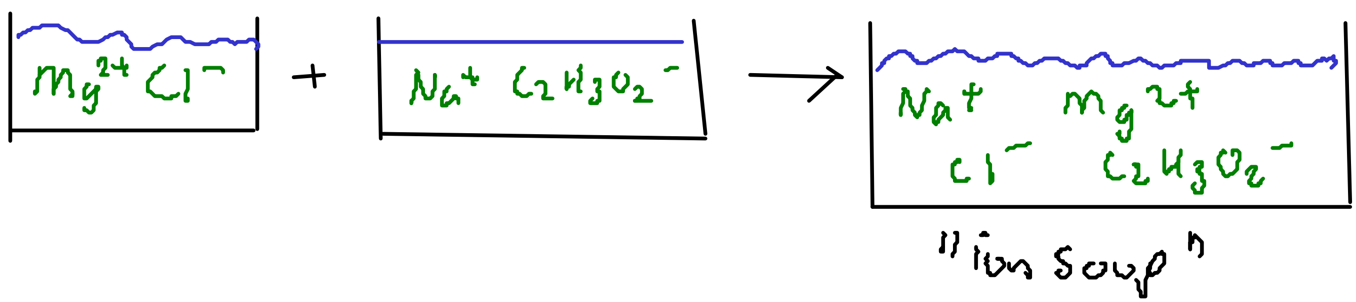
ions: Mg^{2+} Cl^- Na^+ $C_2H_3O_2^-$

"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.



NO CHANGE, therefore
NO DRIVING FORCE,
and NO REACTION

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