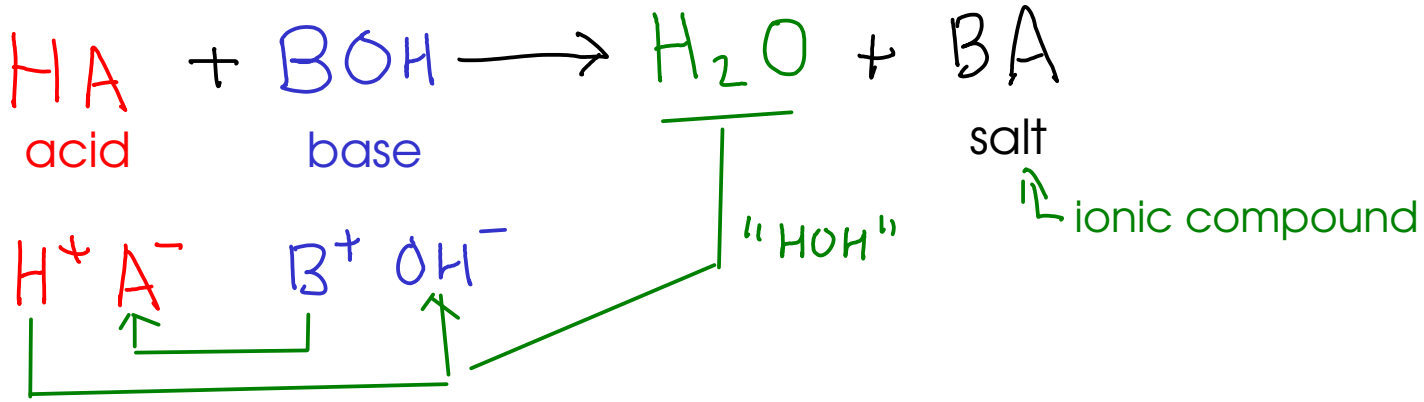
ACID/BASE REACTIONS (also called NEUTRALIZATION REACTIONS)

- 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^-)

$$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$$

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.

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

Net ionic equation

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

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

- 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

A few examples of precipitation and acid/base:

* Transition metals DO NOT change their charge in exchange reactions!

$CaCl_2(aq) + 2AgNO_3(aq) \longrightarrow 2AgCl(s) + Ca(NO_3)_2(aq)$

Ca^{2+} Cl^- Ag^+ NO_3^-

This reaction is driven by the formation of SOLID AgCl (precipitation)

$H_3PO_4(aq) + 3NaOH(aq) \longrightarrow 3H_2O(l) + Na_3PO_4(aq)$

H^+ PO_4^{3-} Na^+ OH^-

Formation of liquid water molecules drives this ACID-BASE reaction!

$KCl(aq) + NaNO_3(aq) \longrightarrow \cancel{NaCl(aq) + KNO_3(aq)}$ NO REACTION

K^+ Cl^- Na^+ NO_3^-

Neither an insoluble solid nor a molecule like water form, so we conclude that there is no driving force and NO REACTION.

$Ca(NO_3)_2(aq) + Na_2CO_3(aq) \longrightarrow 2NaNO_3(aq) + CaCO_3(s)$

Ca^{2+} NO_3^- Na^+ CO_3^{2-}

This is another precipitation, driven by the formation of the insoluble solid calcium carbonate.

OXIDATION / REDUCTION CHEMISTRY

- Precipitation reactions involve ions pairing up, but the ions themseves are not formed in precipitation reactions. Precipitation reactions (and quite a few others) start with pre-existing ions.

... but ions have to be produced somehow - through a chemistry that involves the transfer of electrons.

- OXIDATION/REDUCTION chemistry ("REDOX" chemistry) involves transfer of electrons and can make ions.