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

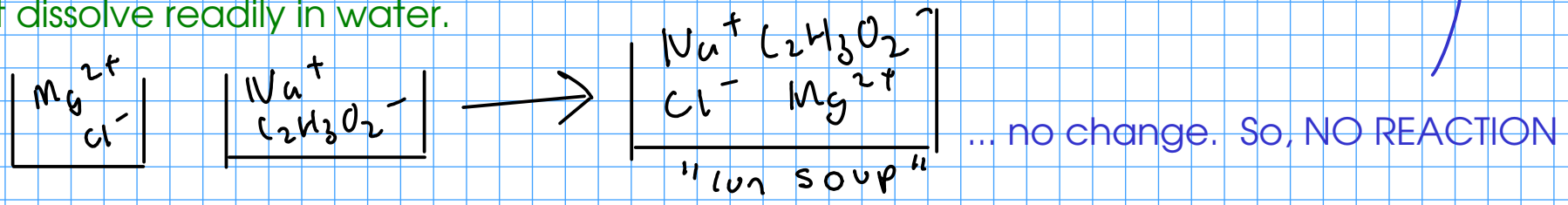
ions: Mg^{2+} Cl^- Na^+ $C_2H_3O_2^-$

"exchange"

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

$NaCl$ ... dissolves in water

So, no solid forms here. All the possible combination of ions result in compounds that dissolve readily in water.

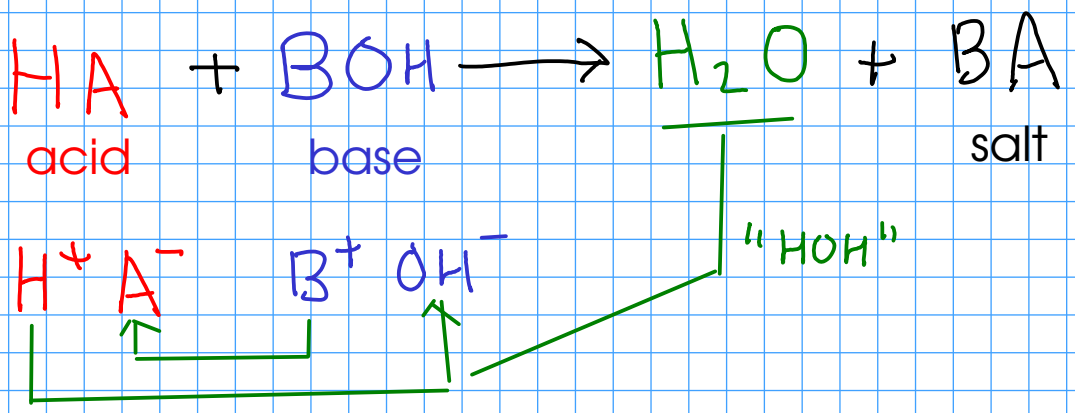


... no change. So, NO REACTION

ACID/BASE or NEUTRALIZATION

- There are several stable molecules that may be formed in double replacement reaction 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^-)

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

Net ionic equation

... 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

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

$$H^+(aq) + OH^-(aq) \longrightarrow H_2O(\ell)$$ Net ionic equation

From the acid From the base

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

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

H_2O ... stable molecule. Drives reaction!

Na_2SO_4 ... soluble ionic compound

- 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

GAS FORMATION / OTHER MOLECULES

- There are a few other molecules that can be made with exchange-type chemistry.
- Most of these molecules are unstable and can break apart to form gases.

- Formation of a weak acid:
  - The formation of ANY weak acid in an exchange-type reaction can be a driving force.
  - Some weak acids are unstable and can break apart into gas molecules.

$$H_2CO_3(aq) \longrightarrow H_2O(l) + \boxed{CO_2(g)}$$

Gas bubbles can leave solution!

... but how would you form carbonic acid in an exchange-type reaction?

acid + carbonate CO_3^{2-}

OR

acid + bicarbonate HCO_3^-

$$H_2SO_4(aq) + 2NaHCO_3(aq) \rightarrow Na_2SO_4(aq) + 2\boxed{H_2CO_3(aq)}$$

H^+ SO_4^{2-} Na^+ HCO_3^-

$$H_2SO_{4(aq)} + 2NaHCO_{3(aq)} \rightarrow Na_2SO_{4(aq)} + 2H_2CO_{3(aq)}$$

H^+ SO_4^{2-} Na^+ HCO_3^-

... but when we mix sulfuric acid and sodium bicarbonate, we observe BUBBLES. We need to write an equation that agrees with our observations. We know that carbonic acid decomposes, so we go ahead and put that into our equation.

$$H_2CO_{3(aq)} \longrightarrow H_2O_{(l)} + CO_{2(g)}$$

$$H_2SO_{4(aq)} + 2NaHCO_{3(aq)} \rightarrow Na_2SO_{4(aq)} + 2H_2O_{(l)} + 2CO_{2(g)}$$

Other molecules of interest:

H_2SO_3 : sulfurous acid - React an ACID with a SULFITE

$$H_2SO_{3(aq)} \rightarrow H_2O_{(l)} + SO_{2(g)}$$

H_2S : hydrogen sulfide (gas) - React an ACID with a SULFIDE

$$H_2SO_{4(aq)} + Na_2S_{(aq)} \rightarrow Na_2SO_{4(aq)} + H_2S_{(g)}$$

A few more exchange examples:

*In EXCHANGE reactions, transition metals do not change their charge!

$CaCl_2(aq) + 2AgNO_3^{*}(aq) \longrightarrow Ca(NO_3)_2(aq) + 2AgCl(s)$ ✓

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

PRECIPITATION!

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

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

ACID/BASE or NEUTRALIZATION. Driven by formation of water!

$KCl(aq) + NaNO_3(aq) \longrightarrow$ ~~$NaCl(aq) + KNO_3(aq)$~~ NO REACTION

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

No Reaction. Both "products" are soluble ionic compounds. That means they are present in soultion as free ions, just like they were before being mixed.

$H_2SO_4(aq) + Na_2CO_3(aq) \longrightarrow Na_2SO_4(aq) + H_2CO_3$ ↓

H^+ SO_4^{2-} Na^+ CO_3^{2-}

$\longrightarrow Na_2SO_4(aq) + H_2O(l) + CO_2(g)$

Driving force is the formation and release of carbon dioxide gas.