

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

$$m_g^{2+}Cl^{-}$$
 + N_0^{4} $C_2N_3v_2^{-}$ N_0 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

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 <u>WATER!</u>
- Double replacement reactions that form water are also called "neutralizations"

HA + BOH
$$\rightarrow$$
 H₂O + BA acid base salt "HOH" ionic compound

* To make water (H_2O), you need a source of hydrogen ion (H^4) and hydroxide ion (OH^5)

$$H^{t}(aq) + OH^{t}(aq) \rightarrow H_{2}O(\ell)$$
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^{\flat}) , 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.

$$H^{+}(aq) + OH^{-}(aq) \longrightarrow H_{2}O(Q)$$
 Net ionic equation
From the acid From the base

H2SOy(aq) + 2NaOH(aq)
$$\longrightarrow$$
2H2O(l)+ Na2SOy(aq) ions: H+ SOy2- Nat OH- "HOH"

- 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.

$$H_2(o_3 Lag) \longrightarrow H_2(l) + Co_2(g)$$
 Gas bubbles can leave solution!

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

$$H_2SO_4(a_4)+2NaH(O_3(a_4)) \rightarrow Na_2SO_4(a_4)+2H_2CO_3(a_4)$$
 $H^+SO_4^2-Na^+H(O_3^-)$

... 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.

$$H_2(O_3(aq)) \longrightarrow H_2O(l) + (O_2(q))$$

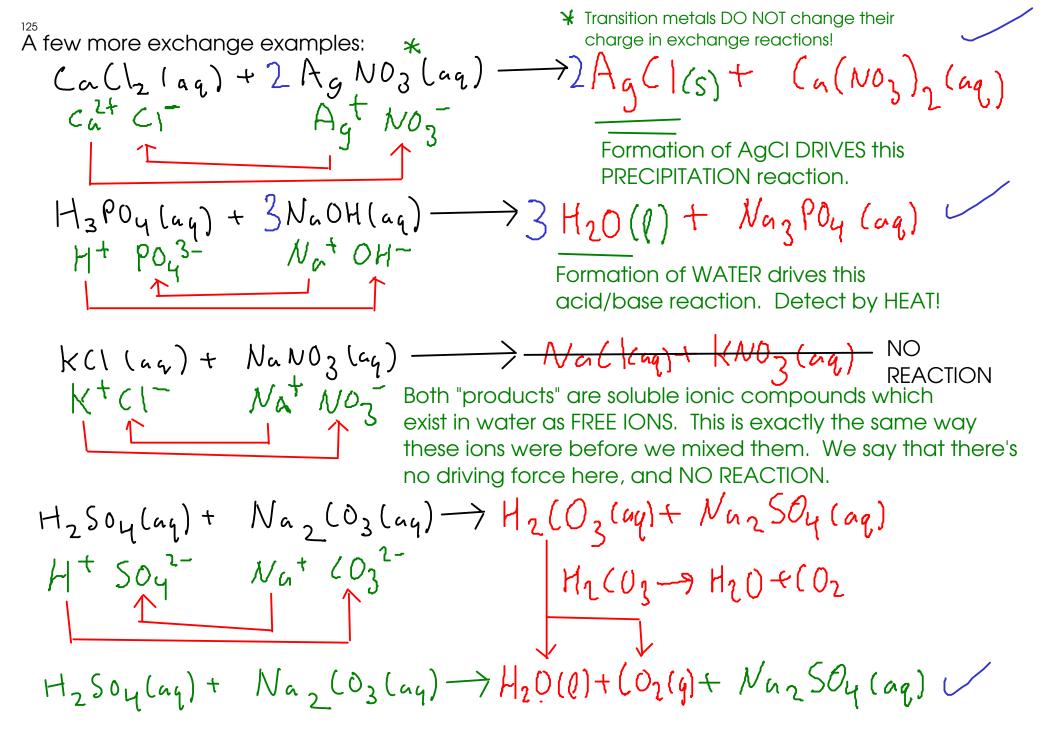
 $H_2SO_4(aq) + 2NaH(O_3(aq)) \rightarrow Na_2SO_4(aq) + 2H_2O(l) + 2(O_2(q))$

Other molecules of interest:

$$H_2$$
 SO $_3$: sulfurous acid - React an ACID with a SULFITE

$$H_2So_3(ag) \rightarrow H_2O(\ell) + So_2(g)$$

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



Formation of the weak acid CARBONIC ACID and its decomposition to WATER and CARBON DIOXIDE drive this reaction.