Unit 4—Chemical reactions
Ch 1, 3, 4, 16, 20

Introduction to reactions, *ch 1.2, 1.3, 4.1*

Compare and contrast physical changes and chemical changes

Define:

Solution

Solute

Solvent

Electrolyte

Strong electrolyte

Weak electrolyte

Non electrolyte

Summarize the solubility rules

1.
2.
3.
4.
5.
6.

List the seven strong acids:

Practice 1

Identify the following as strong, weak, or non electrolytes:

1. Lead (II) iodide
2. Hydrochloric acid
3. Sodium hydroxide
4. Nitrous acid
5. Ammonium phosphate
6. Silver chloride
7. Magnesium hydroxide
8. Copper (II) sulfate
9. Calcium carbonate
10. Acetic acid

Explain how acetic acid can be aqueous and a weak electrolyte at the same time.

Equations, *3.1, 3.2, 4.2*

Write an equation for the vaporization of water (boiling).

Write an equation for the combustion of propane, C_3H_8.

Write the following equations for $Pb(NO_3)_2(aq)$ + $KI(aq)$

Molecular equation

Complete ionic equation

Net ionic equation

Practice 2

Write molecular, complete ionic, and net ionic equations for the following. Be sure to indicate if each is aqueous, solid, liquid, or gas.

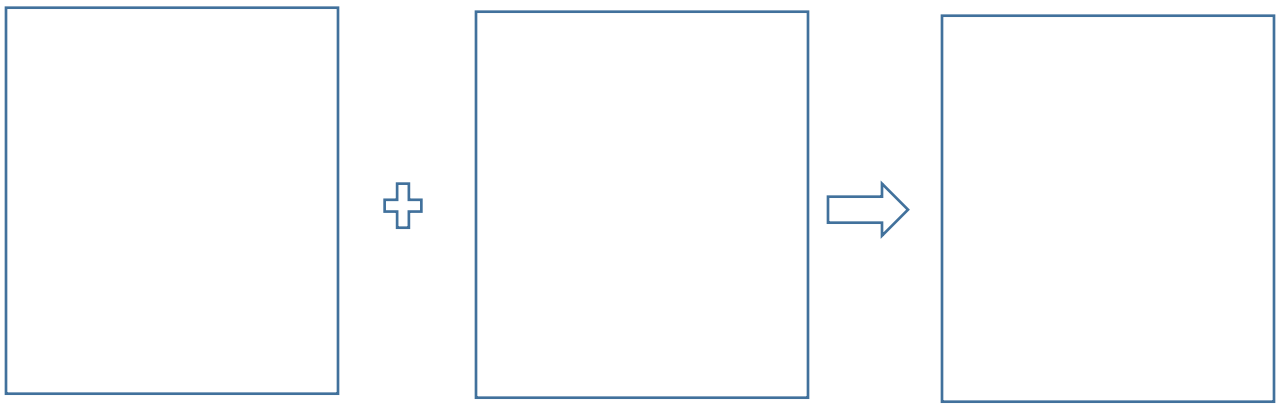
1. Iron (III) sulfate and lithium hydroxide

2. Silver nitrate and potassium phosphate

3. Hydrochloric acid and barium hydroxide

4. Sodium chloride and silver nitrate

For #4, draw the reactants before the reaction. (You need at least 3 molecules/ions of each substance present in each beaker and be mindful of the placement of your drawings.) Then draw the products after the reaction. (Be aware of how many of each ion you started with.)



What bonds are broken in the reaction $CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$? What bonds are made? Physical or chemical?

What intermolecular interactions are changed in H_2O (l) $\rightarrow$ H_2O (g)? Physical or chemical?

Is NaCl(*aq*) $\rightarrow$ Na^+(*aq*) + Cl^-(*aq*) a physical or chemical change? What happens to the chemical bonds? What happens to the intermolecular interactions?

Stoichiometry, *3.6, 3.7, 10.4, 10.5*

Practice 3

1. A piece of aluminum foil 5.11 inches x 3.23 inches x 0.0381 inches is dissolved in excess HCl(*aq*). How many grams of H_2(*g*) are produced? (BTW, the density of aluminum is 2.70 g/cm^3) *3.12 g*

2. Years of experience have proven that the percent yield for the following reaction is 74.3%

$$Hg + Br_2 \rightarrow HgBr_2$$

   a. If 10.0 g of Hg and 9.00 g of Br_2 are reacted, what mass of $HgBr_2$ will be produced? *13.3g*

b. If the reaction did go to completion, what mass of excess reagent would be left? *1.03 g*

Practice 4

1. A 1.75 g sample of solid CaO is placed in a 1.00 L vessel containing CO_2 gas at a pressure of 730. torr and a temperature of 25˚C. The CO_2 reacts with the CaO, forming solid $CaCO_3$. When the reaction is complete, the pressure of the remaining CO_2 is 150. torr.

    a. Write the balanced equation.

    b. How many moles of CO_2 reacted? *0.0312 mol*

    c. What mass of $CaCO_3$ should have formed? *3.12 g*

2. Gaseous ammonia and gaseous hydrochloric acid react to form solid ammonium chloride.

    a. Write the equation.

    b. What volume of ammonia at 1.50 atm and 25˚C is required to produce 50.0 g of ammonium chloride? *15.2 L*

Titration, *ch 4.6*

What is titration used for?

Define equivalence point and end point.

What is the difference between the equivalence point and end point?

45.7 mL of 0.500 M NaOH is used to titrate a 25.0 mL sample of aqueous HCl solution with unknown concentration. What is the concentration of HCl? $HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + HOH(l)$ {aka H_2O}
0.914 M

Practice 5

1. 45.00 mL of 2.5 M NaOH is used to titrate 15.0 mL of an unknown concentration of HCl to its endpoint. What is the molarity of the HCl? *7.5 M*

2. A 50.00 mL sample of aqueous $Ca(OH)_2$ is titrated to its endpoint with 34.66 mL of 0.0980 M nitric acid for neutralization. What is $[Ca(OH)_2]$? *0.0340 M*

3. 75 mL of 0.25M HCl is mixed with 225 mL of 0.055 M $Ba(OH)_2$. What is the concentration of the excess H^+ or OH^-? *0.020 M*

Types of reactions, *ch 3.2, 4.2, 4.3, 4.4, 16.1, 16.2, 20.1, 20.2*

Give a brief description of the following reaction types:

Synthesis or combination

Decomposition

Combustion

Single replacement

Double replacement

What type of reaction (that you already learned about) does precipitation reaction resemble? What's different?

Practice 6

1. K_3PO_4*(aq)* + $Ca(NO_3)_2$ *(aq)* →
2. $CaCl_2$*(aq)* + Na_2CO_3*(aq)* →
3. A solution of sodium phosphate is added to a solution of aluminum nitrate

4. Solutions of silver nitrate and magnesium chloride are combined

5. A solution of copper (II) sulfate is added to a solution of lithium hydroxide

What type of reaction (that you already learned about) does precipitation reaction resemble? What's different?

How can you tell a reaction is an acid-base reaction?

Water is amphiprotic. What does this mean?

Practice 7

Write the reaction. Include (s), (l), (g), (aq).

1. Calcium hydroxide in solution reacts with dilute hydrochloric acid

2. Dilute Acetic acid reacts with aqueous sodium hydroxide

3. Dilute nitric acid reacts with sodium sulfide solution (one product is a gas)

4. Dilute sulfuric acid reacts with aqueous sodium hydrogen carbonate (H_2CO_3 is unstable and decomposes to H_2O and CO_2)

Oxidation-reduction reactions are indicated by a transfer of _____ between reactants.

Summarize the rules for oxidation numbers:

Practice 8

Assign oxidation numbers to each atom in the following compounds:

1. O_2
2. HCl
3. Al_2O_3
4. $SnBr_4$
5. $Pb(NO_3)_2$
6. CH_4
7. CO_2
8. Li_2O
9. HNO_3
10. $Cr_2O_7^{2-}$
11. $NaBH_4$
12. WO_4^{2-}
13. SnF_2
14. CO_3^{2-}

What is a Brønsted-Lowry acid? Give an example.

What is a Brønsted-Lowry base? Give an example.

Identify the acid, base, conjugate acid, conjugate base: $HNO_2 + H_2O \rightarrow NO_2^- + H_3O^+$

$NH_3 + H_2O \rightarrow NH_4^+ + OH^-$

Practice 9

Identify the acid, base, conjugate acid, conjugate base:

1. $HBrO + H_2O \rightarrow H_3O^+ + BrO^-$
2. $HSO_4^- + HCO_3^- \rightarrow SO_4^{2-} + H_2CO_3$
3. $HSO_3^- + H_3O^+ \rightarrow H_2SO_3 + H_2O$

How can you tell which element is oxidized? Reduced?

$N_2(g) + 3\ H_2(g) \rightarrow 2\ NH_3(g)$

$P_4 + 10\ HClO + 6\ H_2O \rightarrow 4\ H_3PO_4 + 10\ HCl$

Practice 10

Complete and balance the reaction. Then indicate which element is oxidized and which is reduced.

1. $Br_2(l) + K(s) \rightarrow$

2. $CH_3OH(l) + O_2(g) \rightarrow$

3. $Zn(s) + HCl(aq) \rightarrow$

4. $ZnCl_2(aq) + NaOH(aq) \rightarrow$

Complete equation, then write the net ionic equation. Identify which element is oxidized and which is reduced?

$Ca(s) + HCl(aq) \rightarrow$

Practice 11

Write the oxidation and reduction half reactions for the following:

1. $MnO_4^-(aq) + C_2O_4^-(aq) \rightarrow Mn^{2+}(aq) + 2\ CO_2(g)$

2. $Cr_2O_7^{2-}(aq) + 2Cl^-(aq) \rightarrow 2\ Cr^{3+}(aq) + Cl_2(g)$