Unit 3 & 4 Review Packet Name Key

1) Write the general formula for the 5 types of synthesis reactions (parts 1-4 in notes).

1) Metal + Non-Metal → Salt
2) Metallic Oxide + Water → A Base
3) Nonmetallic Oxide + Water → An Acid
4) Metallic Oxide + Nonmetallic Oxide → Salt
5) Boron compound + e⁻pair donor → Covalent Complex

2) Write the general formula for the 4 types of decomposition reactions (parts 1-2 in notes).

1) Salt → Metal + Non-Metal
2) Oxyacid → Non-Metallic Oxide + Water
3) Metallic Carbonate → Metallic Oxide + Carbon Dioxide
4) Metallic Chlorates → Metallic Chloride + Oxygen

3) Review and understand the specific synthesis & decomposition reactions covered in the notes.

4) Write the general formula for the 3 types of single displacement reactions.

1) Metal + Salt → Metal (New) + Salt (New)
2) Non-Metal + Salt → Non-Metal (New) + Salt (New)
3) Metal + Water or Acid → Salt + Hydrogen

5) Explain how to determine whether a SD reaction will occur or not.

The displacing (neutral) element must be more reactive than the ionic element it is attempting to displace.

6) Write the general formula for the 4 types of double displacement reactions (precipitation, strong acid/strong base, strong acid/carbonate, and strong acid/weak base).

1) Salt (aq) + Salt (aq) → Salt (s) + Salt (aq)

2) Acid + Base → Salt + H_2O

3) Acid + Carbonate → salt + CO_2 + H_2O

4) Acid + Ammonia → Salt

7) Explain how to determine whether a double displacement reaction will occur or not.

A new solid, liquid or gas is created. Proven using a net ionic equation.

8) Write the general formula for the 2 types of combustion reactions.

Alcohol + O_2 → CO_2 + H_2O

Hydrocarbon + O_2 → CO_2 + H_2O

9) Compare and contrast dissolution, ionization, and dissociation.

Dissolution = dissolving of a covalent compound. (ex = sugar, ethanol, etc.)

Ionization = dissolving of a covalent compound that creates ions. (ex = strong & weak acids)

Dissociation = dissolving of ionic compounds that results in individual ions. (ex = soluble salts)

10) Know the role and importance of total ionic and net ionic equations. (Include simplifying equations in your answer)

- Identify the species in the equation actually involved in a reaction. (Net)
- Accurately shows (aq) salts/acids as dissociated/ionized. (Total

11) Identify the solubility of the following ionic species:

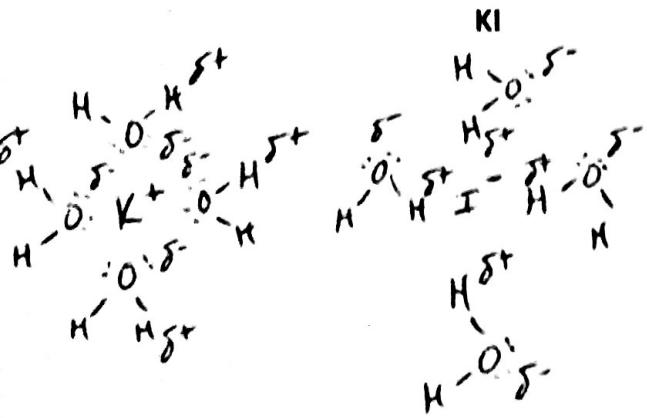
a) Li^+, Na^+, K^+, Rb^+, Cs^+, Fr^+ soluble
b) NH_4^+ soluble
c) Cl^-, Br^-, I^- soluble (except Ag, Hg, Pb)
d) CO_3^{2-} Insoluble
e) SO_4^{2-} soluble (except heavy group 2, Ag,
f) PO_4^{3-} Insoluble
g) NO_3^- soluble
h) $C_2H_3O_2^-$ soluble

12) Relate electrolytes to the concept of solubility.

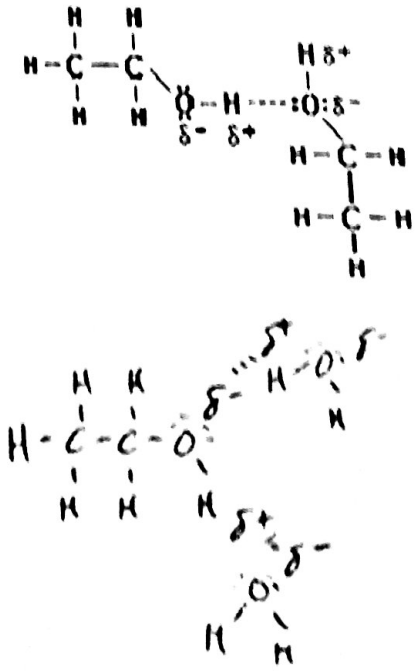
A strong electrolyte solution contains a high concentration of dissolved ions, giving it the ability to conduct a current. Therefore, soluble salts and strong acids/bases create strong electrolyte solutions.

13) Diagram how the following molecules would be dissolved by water.

Potassium Iodide



Ethanol (C_2H_5OH)



14) Identify the 6 strong acids and rule for determining strong bases.

- HCl, HBr, HI, H_2SO_4, HNO_3, $HClO_4$
- OH^- paired w/ a group 1 metal or heavy group 2 metal

15) Relate strong acids and bases to solubility.

Strong = always dissociates/ionizes in water, or in other words is highly soluble.

16) Predict the products of and balance the following reactions. If no reaction occurs, write "no rxn".

Bad Examples →

a. ___3___ $NaBr$ + ____ H_3PO_4 ⟶ $3HBr\,(aq) + Na_3(PO_4)\,(aq)$ (no rxn)

Type of reaction: D.D.

↳ b. ____ $Ca(OH)_2$ + ____ $Al_2(CO_3)_3$ ⟶ no reaction (acid + base → salt + CO_2 + H_2O (carbonate))

Type of reaction: _____

c. ___3___ Mg + ____ Fe_2O_3 ⟶ $3MgO\,(s) + 2Fe\,(s)$

Type of reaction: S.D.

d. ____ C_2H_4 + ___3___ O_2 ⟶ $2CO_2\,(g) + 2H_2O\,(g)$

Type of reaction: Combustion

e. ____ $PbSO_4$ ⟶ $PbO\,(s) + SO_3\,(g)$

Type of reaction: Decomp.

f. $2\ NH_3 + 3\ I_2 \longrightarrow 2NI_3\ (s) + 3H_2\ (g)$

Type of reaction: S.D.

g. $\_\_\ H_2O + \_\_\ SO_3 \longrightarrow H_2SO_4\ (aq)$

Type of reaction: Synthesis

h. $\_\_\ P_4O_6 + 6\ H_2O \longrightarrow 4H_3PO_3\ (aq)$

Type of reaction: Synthesis

i. $\_\_\ H_2SO_4 + 2\ NH_4OH \longrightarrow (NH_4)_2SO_4\ (aq) + 2H_2O\ (l)$

Type of reaction: D.D.

j. $2\ Fe + 6\ H_2O \longrightarrow 2Fe(OH)_3\ (s) + 3H_2\ (g)$

Type of reaction: Synthesis

k. $\_\_\ (NH_4)_2CO_3 \longrightarrow NH_3\ (g) + H_2O\ (l) + CO_2\ (g)$

Type of reaction: Decomp

l. $\_\_\ Na_2O + \_\_\ H_2O \longrightarrow 2NaOH\ (aq)$

Type of reaction: Synthesis

m. $\_\_\ C_3H_8 + 5\ O_2 \longrightarrow 3CO_2\ (g) + 4H_2O\ (g)$

Type of reaction: Combustion

17) For the following problems, write the molecular, total ionic and net ionic equations for the reaction described. Solve for the requested value.

a. 13.9g of ammonia gas is bubbled through 1.80M hydrochloric acid.

$$NH_3(g) + HCl(aq) \rightarrow NH_4Cl(aq)$$

$$NH_3(g) + H^+(aq) + Cl^-(aq) \rightarrow NH_4^+(aq) + Cl^-(aq)$$

$$NH_3(g) + H^+(aq) \rightarrow NH_4^+(aq)$$

1. How many milliliters of acid would be required to completely react the ammonia?

$$13.9\ g\ NH_3 \left(\frac{1\ mol\ NH_3}{17.03\ g}\right)\left(\frac{1\ mol\ HCl}{1\ mol\ NH_3}\right)\left(\frac{1\ L}{1.80\ mol\ HCl}\right)\left(\frac{1000\ mL}{1\ L}\right) = \boxed{453\ mL\ HCl}$$

2. How many grams of salt would be produced if the ammonia is completely reacted?

$$13.9\ g\ NH_3 \left(\frac{1\ mol\ NH_3}{17.03\ g}\right)\left(\frac{1\ mol\ NH_4Cl}{1\ mol\ NH_3}\right)\left(\frac{53.49\ g}{1\ mol\ NH_4Cl}\right) = \boxed{43.7\ g\ NH_4Cl}$$

b. 25.0mL of 1.44M sodium hydroxide is spilled on the lab bench and neutralized with 0.885M sulfuric acid.

$$2NaOH(aq) + H_2SO_4(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$$

$$2Na^+(aq) + 2OH^-(aq) + 2H^+(aq) + SO_4^{2-}(aq) \rightarrow 2Na^+(aq) + SO_4^{2-}(aq) + 2H_2O(l)$$

$$2H^+(aq) + 2OH^-(aq) \rightarrow 2H_2O(l)$$

1. If 13.4 mL of sulfuric acid are used to neutralize the spill, how many grams of water will be produced?

$$13.4\ mL\ H_2SO_4 \left(\frac{1\ L}{1000\ mL}\right)\left(\frac{0.885\ mol\ H_2SO_4}{1\ L}\right)\left(\frac{2\ mol\ H_2O}{1\ mol\ H_2SO_4}\right)\left(\frac{18.02\ g}{1\ mol\ H_2O}\right) = \boxed{0.427\ g\ H_2O}$$

2. If the 13.4 mL of sulfuric acid were used, is the final solution neutral? If yes, use a calculation to show neutrality. If no, support with a calculation that shows how many mL of the limiting reagent should be added to get to neutral.

① $25.0\ mL\ NaOH \left(\frac{1\ L}{1000\ mL}\right)\left(\frac{1.44\ mol}{1\ L}\right) = 0.0360\ mol\ NaOH$

$13.4\ mL\ H_2SO_4 \left(\frac{1\ L}{1000\ mL}\right)\left(\frac{0.885\ mol}{1\ L}\right) = 0.0118\ mol\ H_2SO_4$ HAVE

② $0.0360\ mol\ NaOH \left(\frac{1\ mol\ H_2SO_4}{2\ mol\ NaOH}\right) = 0.0180\ mol\ H_2SO_4$ NEED

③ $0.0180\ mol - 0.0118\ mol = 0.00620\ mol\ H_2SO_4$

④ $0.00620\ mol\ H_2SO_4 \left(\frac{1\ L}{0.885\ mol}\right)\left(\frac{1000\ mL}{1\ L}\right) = 7.01\ mL\ H_2SO_4$

c. 15.0 g of magnesium is placed into a solution of silver nitrate.

$$Mg(s) + 2AgNO_3(aq) \rightarrow Mg(NO_3)_2(aq) + 2Ag(s)$$

$$Mg(s) + 2Ag^+(aq) + 2NO_3^-(aq) \rightarrow Mg^{2+}(aq) + 2NO_3^-(aq) + 2Ag(s)$$

$$Mg(s) + 2Ag^+(aq) \rightarrow Mg^{2+}(aq) + 2Ag(s)$$

1. If the volume of solution is 130.0mL, what would be the minimum concentration required to completely react the magnesium?

$15.0\ g\ Mg \left(\frac{1\ mol}{24.31\ g}\right)\left(\frac{2\ mol\ AgNO_3}{1\ mol\ Mg}\right) = 1.23\ mol\ AgNO_3$

$M = \frac{mol}{L} = \frac{1.23\ mol}{0.130\ L} = 9.49\ M\ AgNO_3$

2. If the concentration of the solution is actually 0.015M silver nitrate, how much solid product will be produced?

$130.0\ mL\ AgNO_3 \left(\frac{1\ L}{1000\ mL}\right)\left(\frac{0.015\ mol\ AgNO_3}{1\ L}\right)\left(\frac{2\ mol\ Ag}{2\ mol\ AgNO_3}\right)\left(\frac{107.87\ g}{1\ mol\ Ag}\right) = 0.210\ g\ Ag$

18) A lab procedure requires 500.0mL of a 0.350M sodium acetate solution. Describe the steps you would take to make this solution from a 3.00M sodium acetate solution.

• Dilution $(M_1V_1 = M_2V_2)$

$(3.00\ M)V_1 = (0.350\ M)(500.0\ mL)$

$V_1 = 58.3\ mL$

1) With a 100 mL grad. cyl., measure 58.3 mL of stock Aq. $NaC_2H_3O_2$
2) Quantitatively transfer to a 500 mL volumetric flask
3) Fill to mark w/ di H_2O, invert to mix.

19) Discuss and relate the following concepts: standard curve, absorbance, concentration.

Absorbance & Concentration show a linear relationship which can be graphically displayed and quantified by testing the absorbance of solutions of known concentration. Plotting Abs vs. Conc. and applying a best fit line will provide the means to calculate the concentration of any unknown concentration solution.

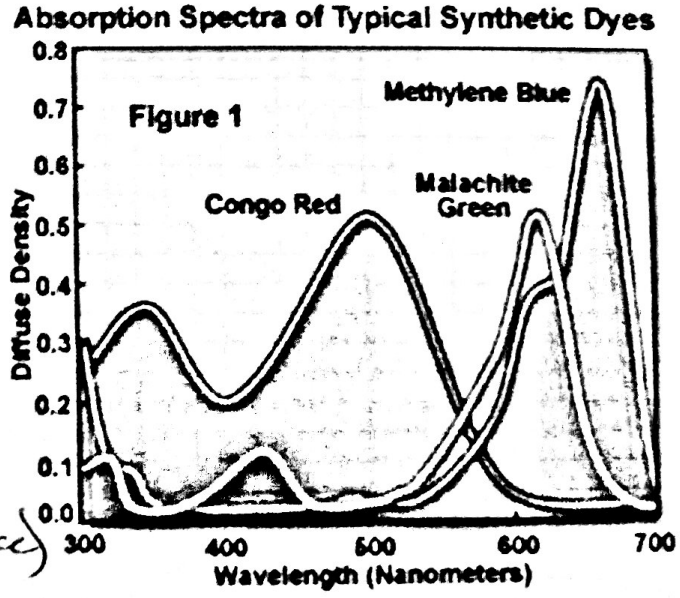
20) Reference the following absorption spectrum to answer questions a & b.

a. What wavelength would you choose to analyze the Congo Red?

500 nm, good/wide absorbance & no ~~##~~ interference with other molecules

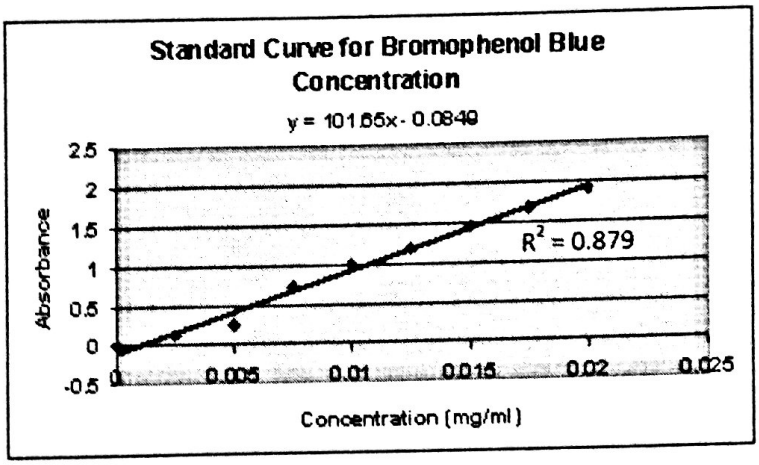
b. Explain why a solution of malachite green and methylene blue would be difficult to analyze.

Similar absorbance over similar ranges of λ (interference)



21) Use the following standard curve to answer questions a & b.

a. Identify 2 "flags" that would cause you to not trust the standard curve.



- Poor correlation (R^2)
- Most of curve is outside of accurate absorbance range (>1.0)

b. Assuming the curve is reliable, what concentration would an unknown bromothemal blue solution have if it elicits an absorbance of 1.40?

$y = 101.65x - 0.0849$

$1.40 = 101.65x - 0.0849$

$1.4849 = 101.65x$

$\boxed{x = 0.0146\ M}$

c. An unknown bromothemal blue solution gives an absorbance of 2.45. What could be done to determine the concentration of the solution?

As it is outside of the standard curve range (max < 2.0), the sample must be diluted so that it falls w/in the calibrated range of the curve. Since the relationship is linear, diluting the sample to 50% concentration should give 50% abs, or a value near 1.23 Abs which is w.thin the curve.