# Honors Chemistry Final 2015

# ANSWERS to the FINAL EXAM REVIEW

## Chapter 10: Stoichiometry

1. Use the following balanced equation to answer questions (2 points each)

**$2Al_2(CO_3)_3$ + $3H_2SO_4$ → $2Al_2(SO_4)_3$ + $3\ H_2O$ + $3CO_2$**

a. 2:3 — What is the molar ratio for $Al_2(CO_3)_3$ and $H_2O$?

b. 3 mol — How many moles of $CO_2$ are produced when 3 moles of $H_2SO_4$ react?

c. 2 mol — How many moles of $H_2O$ are produced when 2 moles of $H_2SO_4$ reacts?

2. How many moles of oxygen are needed to react with 87g of lithium?

$4Li + O_2 \rightarrow 2Li_2O$

**87g Li x 1 mol / 6.94g Li x 1 mol $O_2$ / 4 mol Li = 3.13 mol $O_2$**

3. Use the equation to determine what mass of FeS must react to form 326g of $FeCl_2$.

$FeS + 2HCl \rightarrow H_2S + FeCl_2$

**326 g $FeCl_2$ x 1 mol / 126.75g $FeCl_2$ x 1 mol FeS / 1 mol $FeCl_2$ x 87.91g FeS / 1 mol = 226 g FeS**

4. If a piece of magnesium with a mass of 2.76g is added to a solution of hydrochloric acid (HCl), what mass of hydrogen gas would be produced?

$Mg + 2\ HCl \rightarrow MgCl_2 + H_2$

**2.76g Mg x 1 mol / 24.31g Mg x 1 mol $H_2$ / 1 mol Mg x 2.02 g $H_2$ / 1 mol = .229 g $H_2$**

5. How many grams Au can be produced when 500 g of Rb is used to reduce it:

$Au_2O_3 + 6Rb \rightarrow 3Rb_2O + 2Au$

**500 g Rb x 1 mol / 85.47 g Rb x 2 mol Au / 6 mol Rb x 196.97g Au / 1 mol = 384 g Au = 400 g (Sig Figs)**

6. How many grams of $CO_2$ are liberated when 400 g of Propane is burned?

$C_3H_8 + 5O_2 \rightarrow 4H_2O + 3CO_2$

**400 g $C_3H_8$ x 1 mol / 44.11 g $C_3H_8$ x 3 mol $CO_2$ / 1 mol Mg x 44.01 g $CO_2$ / 1 mol = 1197 g $CO_2$ = 1000 g (Sig Figs)**

7. How many grams in 4.2 moles of $KNO_2$?

**4.2 mol x 85.11g / 1 mol = 357.46 g = 360 g (Sig Figs)**

# Chapter 11: Heat & Energy

**Practice Problems:**

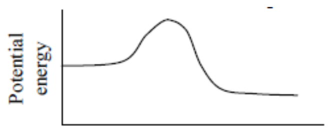
1. Label each example as exothermic or endothermic

   a. $2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$ $\Delta H° = -243$ kJ exothermic ($\Delta H$ is negative)

   b. $H_2B_4O_7(s) \rightarrow B_2O_3(s) + H_2O(l)$ feels warm exothermic (exo = warm)

   c. $H_2B_4O_7(s) + H_2O(l) \rightarrow 4HBO_2(aq) + 11.3$ kJ exothermic (energy is a product)

   d.




   exothermic

2. How much heat is required to heat 40.0g of water from 25.0°C to 75°C? (C=4.18 J/g°C)

   $q = mC\Delta T$

   $q = 40.0g\ (4.18\ J/g°C)\ (75-25°C)$

   $q = 8360$ J

3. Be able to interpret a phase change diagram.

   the flat sections represent phase changes – heat energy is still being applied as phase changes (though there is no change in temp)

   Recognize phase change vocab: melting, freeze, fusion, evaporation, condensation

# Chapter 12: Gases

1. Compare the characteristics of solids/ liquids/ gases:
   - Solids — definite shape, definite volume; particles vibrate in position
   - Liquids — indefinite shape, definite volume
   - Gases — indefinite shape, indefinite volume; particles are far apart (low density, compressible); particles move in straight lines and collide with walls of the container

2. **91 K** A 3.00 liter ($V_1$) sample of neon gas at 0°C ($T_1$ = 273 K) and 1.25 atm ($P_1$) is compressed into a 1.00 liter ($V_2$) container. If the pressure remains constant, what temperature will the container be?

   $$T_2 = \frac{P_2V_2T_1}{P_1V_1} \rightarrow T_2 = \frac{V_2T_1}{} = \frac{1.00\text{L} \times 273\text{ K}}{} = 91\text{ K}$$

3. **96.22atm** What is the pressure (**P = ?**) exerted by 64 grams (**convert to moles - n**) of oxygen confined to a volume of 500 mL (**V = .500L**) at 20 °C (**T = 293 K**)?

   $$64\text{ g } O_2 \times \frac{1\text{ mol}}{32.00\text{ g}} = 2.0\text{ mol (n)}$$

   $$P = \frac{nRT}{V} = \frac{2.0\text{mol} \times .0821 \times 293\text{ K}}{.500\text{L}} = 96.22\text{atm}$$

4. **1.3 mol** How many moles of gas are in a 52 L (**V**) sample collected at 220 K (**T**) and .444atm?

   $$n = \frac{PV}{TR} = \frac{.444\text{atm} \times 52\text{L}}{220\text{K} \times .0821} = 1.3\text{ mol}$$

5. **4.9 L** Find the new volume (**$V_2$ = ?**) when a 2.1 L (**$V_1$**) sample of a gas collected at 245 Kelvin (**$T_1$**) and 2.1atm (**$P_1$**) is changed to standard conditions (**STP: $T_2$ = 273 K, $P_2$ = 1 atm**).

   $$V_2 = \frac{P_1V_1T_2}{T_1P_2} = \frac{2.1\text{ atm} \times 2.1\text{ L} \times 273\text{ K}}{245\text{ K} \times 1\text{ atm}} = 4.9\text{ L}$$

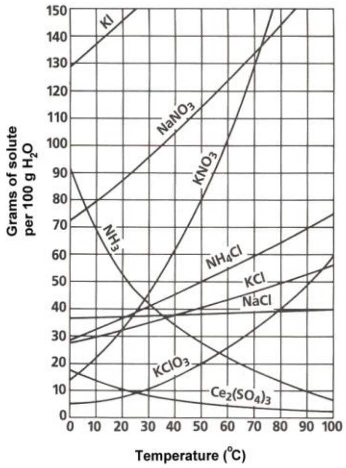
6. **23 mL** Find the new volume (**$V_2$= ?**) of a gas that changes 65 ml (**$V_1$**) at 150 mmHg (**$P_1$**) to 425 mmHg (**$P_2$**).

   $$V_2 = \frac{P_1V_1T_2}{T_1P_2} = V_2 = \frac{P_1V_1}{P_2} = \frac{150\text{ mmHg} \times 65\text{ mL}}{425\text{ mmHg}} = 23\text{ mL}$$

7. Explain the relationship between each of the variables for the following gas laws:
   - Boyle's Law: as P increases, V must increase if T and n are constant
   - Charles' Law: as T increases, P increases (greater T = more movement = more collisions)
   - Avogadro's Law: as n (moles) increases, V increases (think about blowing up a balloon)

# Chapter 13: Solutions

1. Interpret solubility curves:




   a. What substance is most soluble at 20$^oC$?
      $KClO_3$
   b. What substance is least soluble at 90 $^oC$?
      $Ce_2(SO_4)_3$
   c. What is the solubility of $KNO_3$ at 50 $^oC$?
      80 g
   d. How many grams of $NaNO_3$ can dissolve in 100 grams of water at 60° C?
      122 - 123 g
   e. If 70g of KCl is dissolved at 70 $^oC$, is the solution saturated, unsaturated, or supersaturated?
      supersaturated

2. .33M Calculate the molarity when 2 mol of $CuSO_4$ dissolves in 6L of water.
   **2 mol = .33M**
   **6 L**
3. .14M Find the molarity of NaCl when 20 grams are mixed with 2500 ml of water.
   **20 g x 1 mol = .3422mol**
   **58.44g**
   **.3422mol = .14M**
   **2.500 L**
4. .18g What mass of HCl is needed to prepare 1.5 L of a 0.010 M solution.
   **1.5L x .010 mol = .015mol**
   **1L**
   **.015mol x 36.46g = .55g**
   **1 mol**

# Chapter 15:  Acids and Bases:

**Practice Problems:**

1. Label the properties of acids and bases:

| | **Acids** | **Bases** |
|---|---|---|
| Dissociates into ____ ions | $H^+$ | $OH^-$ |
| pH range? | 0-7 | 7-14 |
| Taste? | Sour | Bitter |
| Feels? | | Slipper |
| Conducts Electricity? | Yes | Yes |
| Turns Phenolphthalein ______ | Clear | Pink |

2. 3 Find the pH of a 1.0 x $10^{-3}$ M solution of HCl

   pH = -log [1.0 x $10^{-3}$] = 3

3. 11.70 Find the pH of a .005 M NaOH solution.

   pOH = -log [.005] = 2.30
   pH + pOH = 14
   pH = 14 – 2.30
   pH = 11.7

4. 2 M What is the unknown concentration of base if 40mL of NaOH is titrated with 80mL of 1M solution of standardized HCl?

   $M_aV_a = M_bV_b$
   1 M (80mL) = $M_b$ (40mL)

5. Write the neutralization reaction for the reaction of KOH and HBr:

   KOH + HBr → $H_2O$ + KBr

# Chapter 16: Reaction Rates

1. What are the two conditions for a successful reaction?
   Orientation of molecules
   Enough energy to overcome the activation energy for the reaction to occur

2. Explain how the following factors change reaction rates:
   - surface area of a solid reactant
     increase surface area (powder) because a greater surface area means there are more possible sites for collisions = faster reaction
   - concentration of a reactant
     increase concentration so that there are more reactant particles which means more collisions = faster reaction
   - temperature
     increase temperature because temperature is a measure of the average kinetic energy, so particles move faster and collide more often = faster reaction
   - presence of a catalyst
     catalysts speed up reactions by lowering the activation energy