Exam 3

# Part 1: Multiple Choice (2 points each)

## Directions: Please circle the *best* answer for each of the following questions.

Answer the following questions about the reaction: MnO2 (l) + Al (l) 🡪 Mn (l) + Al2O3 (s)

1. What are the coefficients of the above reaction?
2. 3, 4, 3, 2
3. 6, 8, 6, 4
4. 1, 2, 1, 1
5. 1, 1, 1, 1
6. none of the above
7. Classify the following:
8. synthesis reaction
9. combustion reaction
10. decomposition reaction
11. single displacement rxn
12. precipitation reaction
13. Some solutes have solutions that conduct electricity, but poorly. Which of the following terms best describes these solutes?
    1. Highly charged ions
    2. Ions with fractional charges
    3. Nonconductor
    4. Weak electrolyte
    5. Cation solutions
14. How many moles of water can be formed from 2.10 moles of hydrogen and excess oxygen gas?

2 H2 (g) + O2 (g) → 2 H2O (l)

* 1. 1 mole water
  2. 1.10 moles water
  3. 2 moles water
  4. 2.10 moles water
  5. 5.50 moles water

1. Which of the following best describes a limiting reactant?
   1. The reactant that limits the rate (or speed) of a chemical reaction.
   2. The reactant the limits the position of equilibrium in a reversible chemical change.
   3. The reactant that remains at the end of the reaction.
   4. The reactant that can produce the greatest amount of product.
   5. The reactant that is completely used up by a reaction.
2. Find the limiting reactant if 1 mol Al reacts with 1 mol O2.

\_\_Al (s) + \_\_O2 (g) 🡪 \_\_Al2O3 (s)

Al

O2

both

neither

not enough information

1. The boiling point of water at sea level is 100 °C. At higher altitudes, the boiling point of water will be
   1. lower, because temperatures are lower.
   2. higher, because there are fewer water molecules in the air.
   3. lower, because the atmospheric pressure is lower.
   4. higher, because the altitude is greater.
   5. the same, because water always boils at 100 °C.
2. Convert 1.007 atm to torr.
3. 765.3 torr
4. 1.325 x 10-3 torr
5. 5.816 x 105 torr
6. 1.007 torr
7. none of the above
8. At STP conditions, one mole of an ideal gas will occupy a volume of
9. 1.000 mL
10. 1.000 L
11. 22.4 mL
12. 22.4 L
13. not enough information
14. Phenolphthalein is an acid basic indicator. In acidic conditions it is \_\_\_\_\_ and it is \_\_\_\_\_ in basic conditions.
    1. yellow, blue
    2. clear, red
    3. colorless, pink
    4. blue, red
    5. red, blue

# Part 2: Short Answer

## Directions: Answer each of the following questions. Be sure to use complete sentences where appropriate. For full credit be sure to show all of your work.

* + - 1. A 12.5 mg sample of ethene, a hydrocarbon, was burned in air. The products were 39.2 mg of CO2 and 16.1 mg of water (14 points).
         1. What is the empirical formula?

CxHy + O2 (g) → CO2 (g) + H2O (g)

Empirical formula is CH2

* + - * 1. If the molar mass of ethene is about 28 g/mol, what is the molecular formula (10 points)?

Molecular formula is (CH2)2 = C2H4

* + - * 1. What is the balanced combustion reaction?

C2H4 (g) + 3 O2 (g) → 2 CO2 (g) + 2 H2O (g)

* + - 1. When a clear, colorless solution of hydrochloric acid is mixed with a clear, colorless solution of potassium carbonate in a test tube the formation of a gas is observed in a clear, colorless solution. When a burning split is placed into the test the flame is extinguished (8 points).
         1. What gas is likely formed: H2, O2, or CO2? \_\_\_\_\_CO2
         2. Complete the balanced conventional equation:

HCl (aq) + K2CO3 (aq) →

2 HCl (aq) + K2CO3 (aq) → 2 KCl (aq) + H2CO3 (aq)

2 HCl (aq) + K2CO3 (aq) → 2 KCl (aq) + H2O (l) + CO2 (g)

* + - * 1. Write the balanced total ionic equation:

2 H+ (aq) + 2 Cl- (aq) + 2 K+ (aq) +CO32- (aq) → 2 K+ (aq) + 2 Cl- (aq) + H2O (l) + CO2 (g)

* + - * 1. Identify the spectator ions: \_\_\_\_\_\_2 K+ (aq) + 2 Cl- (aq)
        2. Write the balanced net ionic equation:

2 H+ (aq) CO32- (aq) → H2O (l) + CO2 (g)

* + - 1. Write the balanced equation for the following reaction (9 points):
         1. Hot lithium metal reacts in nitrogen atmosphere to produce lithium nitride solid.

6 Li (s) + N­2 (g) → 2 Li3N (s)

* + - * 1. The reaction of sodium oxide solid and water produces aqueous sodium hydroxide.

Na2O (s) + H2O (l) → 2 NaOH (aq)

* + - * 1. Diphosphorus pentaoxide solid and water produce phosphoric acid.

P2O5 (s) + 3 H2O (l) → 2 H3PO4 (aq)

* + - 1. Calcium cyanamide, CaCN2, is commonly used as fertilizer was first synthesized in 1898 by Adolph Frank and Nikodem Caro. It reacts with water to produce calcium carbonate and ammonia gas (18 points):
         1. Balance the unbalanced equation:

CaCN2 (s) + 3 H2O (l) → CaCO3 (s) + 2 NH3 (g)

* + - * 1. How many moles of water are required to react with 4.5751 moles of calcium cyanamide?
        2. What is the theoretical yield of calcium carbonate in g, if 75.0 g of calcium cyanamide is reacted with excess water?

* + - * 1. What is the actual yield if the percent yield of the reaction of 75.0 g of calcium cyamainde is 92.4%?
        2. How many moles of ammonia are produced from 4.56 × 1024 molecules of water?
      1. Gaseous chlorine dioxide is used to bleach wood pulp and in water treatment. It is produced by the reaction of chlorine with sodium chlorite (5 points).
         1. Balance the reaction: Cl2 (g) + 2 NaClO2 (g) → 2 ClO2 (g) + 2 NaCl
         2. How many liters of ClO2 will be produced by 283 L Cl2?
      2. A sample of a gas with an initial volume of 37.2 L at a pressure of 6.44 atm and a temperature of 41 °C is compressed to a new volume of 23.6 L at a temperature of 28°C. What is the new pressure of the gas (8 points)?
      3. What is the pressure in atmospheres of a 3.66 L sample of methane, CH4, gas containing 18.7 grams of methane at a temperature of 27°C (8 points)?
      4. 3.45 g of an unknown gas at 45 °C and 1.32 atm is stored in a 2.83 L flask (10 points).
         1. What is the density of the gas?

m = 3.45 g

T = 45 °C + 273.15 = 318.15 K ≈ 318 K

P = 1.32 atm

V = 2.83 L

* + - * 1. What is the molar mass of the gas?