Chem 10113, Exam 1 Name: ______________________________
September 25, 2019 (Please Print)

1. Write a ***complete, balanced chemical equation*** for each of the following processes.
   (a) (3 points) The combustion of acetone, $(CH_3)_2CO$.

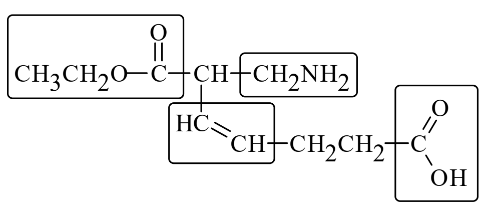
   (b) (3 points) The preparation of barium phosphate by a ***neutralization*** reaction.

   (c) (3 points) The addition of $HBrO_3$ to water.

2. (18 points) Write the chemical formula for each of the following compounds.

Name	Formula
lead(IV) oxalate	
aluminum permanganate	
ammonium tellurite	
hydrosulfuric acid	
copper(II) thiosulfate tetrahydrate	
nickel(III) cyanate	
bromic acid	
calcium peroxide	
diantimony pentasulfide	

3. (4 points) In the following organic compound, identify the functional groups by writing the appropriate family name (i.e., alcohol, ether, ketone, etc.) next to each box.



4. (8 points) **SHOW ALL WORK.** A certain hydrate has the formula $Fe(NO_3)_3{\cdot}xH_2O$. The water in a 2.787 g sample of the hydrate was driven off by heating. The remaining sample had a mass of 1.668 g. Determine the number of waters of hydration (x) in the hydrate.
{molar masses: H_2O = 18.0, $Fe(NO_3)_3$ = 241.2}

5. Boron carbide, **B_4C (specific gravity = 2.52)**, is a high-tech, super-hard ceramic material that is used in armor plating and similar applications. (***Note***: *The following four questions are all related to B_4C but they can be answered independently of each other!*)

(a) (7 points) **SHOW ALL WORK.** Determine the number of boron atoms in 5.00 *femto*grams of B_4C (molar mass = 55.25).

(b) (3 points) Boron carbide is prepared commercially by the high-temperature reaction of boron oxide and graphite as follows. Balance this chemical equation.

$$\_\_\_\_\_ \; B_2O_3 \; + \; \_\_\_\_\_ \; C \; \longrightarrow \; \_\_\_\_\_ \; CO \; + \; \_\_\_\_\_ \; B_4C$$

(c) (10 points) **SHOW ALL WORK.** Boron carbide can be deposited on surfaces as extremely thin films. Imagine that 3.00 mg of B_4C covers a 5.00 x 7.00 inch index card in a thin, even layer. Determine the thickness of the layer in *nano*meters.

(d) (10 points) **SHOW ALL WORK.** In the laboratory, B_4C can be prepared by the reaction of a boron hydride such as decaborane, $B_{10}H_{14}$, with acetylene, C_2H_2, as shown in the following balanced equation. In one such experiment, when 100.0 g of $B_{10}H_{14}$ and 30.0 g of C_2H_2 were allowed to react, the chemist obtained 106 g of pure B_4C. Determine the percentage yield of the reaction. (molar masses: $B_{10}H_{14}$ = 122.2, C_2H_2 = 26.04, B_4C = 55.25)

$$4\,B_{10}H_{14} \; + \; 5\,C_2H_2 \; \longrightarrow \; 10\,B_4C \; + \; 33\,H_2$$

6. (9 points) **SHOW ALL WORK.** A mixture of carbon and sulfur has a total mass of 5.0 g. Complete combustion with an excess of O_2 gives 13 g of a mixture of CO_2 and SO_2. Determine the mass of carbon in the original mixture. (***Hint***: ***Think <u>moles</u>*** as well as grams. For simplicity, round any atomic masses that you use to just two significant figures.)

7. (8 points) **SHOW ALL WORK.** An aqueous solution of nitric acid is 50.0 % HNO_3 by mass. The density of this solution is 1.310 g/mL. Determine the molarity of the solution.
(molar masses: H_2O = 18.02, HNO_3 = 63.02)

8. Many metals react with acids to produce hydrogen gas as illustrated by the following reaction. (molar masses: Al = 26.98, H_2SO_4 = 98.09, H_2 = 2.02)

$$2\ Al_{(s)} + 3\ H_2SO_{4(aq)} \longrightarrow Al_2(SO_4)_{3(aq)} + 3\ H_{2(g)}$$

(a) (9 points) **SHOW ALL WORK.** Determine the mass of Al (in grams) that is required to react exactly with 300.0 mL of 1.50 M H_2SO_4 solution.

(b) (5 points) **SHOW ALL WORK.** Determine the volume (in mL) of 15.0 M H_2SO_4 that is required to prepare the 300.0 mL of 1.50 M H_2SO_4 used in part (a).
Note: The answer to part (a) is not required here!