

Chemistry 1105 R11 Fall 2011 Test 2

Friday, October 28, 2011

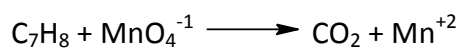
Time: 1 hour 50 minutes

Name: _____

Student Number: _____

*This test consists of **seven** pages of questions, a periodic table, and a page of useful constants. Please ensure you have a complete paper and, if you do not, obtain one from me **immediately**. There are **36** marks (and one bonus mark) available. Good luck!*

- 1) **[6 marks total]** Given the following (unbalanced) redox reaction, that occurs in acidic solution:



- a) **[3 marks]** Balance the reaction.

- b) **[1 mark]** Which species is the oxidizing agent?

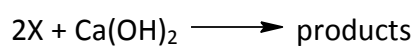
- c) **[1 mark]** Which species is reduced?

- d) **[1 mark]** How many electrons are in the reduction half-reaction?

2) **[4 marks]** "Compound X" is known to be 2.144 percent hydrogen by mass, 68.062 percent oxygen by mass, and the rest nitrogen.

a) **[2 marks]** What is the empirical formula of "Compound X"?

b) **[2 marks]** "Compound X" reacts with calcium hydroxide according to the (balanced) equation



It took 20.00 mL of 0.05000 M $\text{Ca}(\text{OH})_2$ to titrate 94.0 mg of "Compound X." What is the molecular formula of "Compound X"?

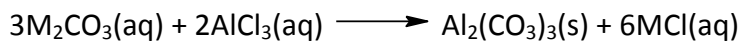
c) **[bonus - 1 mark]** What is the name of "Compound X"?

3) **[5 marks total]** "Compound Y" is known to contain carbon, hydrogen, and oxygen. A 1761-mg sample of "Compound Y" was burned and 720.6 mg of H₂O (18.015 g/mol) and 2640.54 mg of CO₂ (44.009 g/mol) collected.

a) **[3 marks]** What is the empirical formula of "Compound Y"?

b) **[2 marks]** As a gas, "Compound Y" has a density of 1.761 g/L at 336.18°C and 0.500 atm pressure. What is the molecular formula of "Compound Y"?

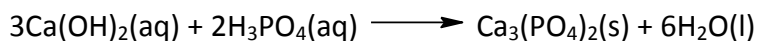
- 4) **[3 marks]** A 530.0-mg sample of a compound of formula M_2CO_3 (where M is an unknown element) was reacted with excess aluminum chloride:



A total of 390.0 mg of $Al_2(CO_3)_3$ (234.0 g/mol) were collected. What is the metal, M?

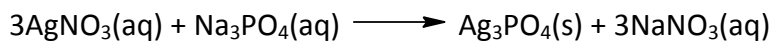
- 5) **[3 marks]** A 20.00 mL aliquot of solution **A** was taken and diluted to 500.0 mL to form solution **B**. A 15.00 mL aliquot of solution **B** was taken and diluted to 100.0 mL to form solution **C**. The concentration of KI in solution **B** was 0.02000 M. What were the concentrations of KI in solutions **A** and **C**?

6) **[3 marks]** It took 15.00 mL of $\text{Ca}(\text{OH})_2$ to titrate a 20.00 mL aliquot of H_3PO_4 :



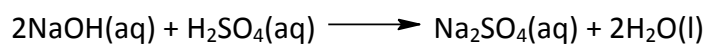
The mass of $\text{Ca}_3(\text{PO}_4)_2$ (310.2 g/mol) isolated was 77.55 mg. What was the concentration of the $\text{Ca}(\text{OH})_2$ before titration?

7) **[3 marks]** How many grams of 80.00-percent pure AgNO_3 (169.9 g/mol) are required to produce exactly 0.4186 grams of Ag_3PO_4 (418.6 g/mol) if the reaction:



Proceeds with a 60.00-percent yield?

8) **[5 marks total]** If 20.00 mL of 1.000 M H_2SO_4 are mixed with 30.00 mL of 1.000 M NaOH:



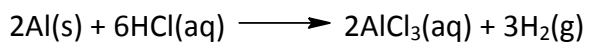
a) **[3 marks]** What will be the concentration of Na_2SO_4 after the reaction has taken place?

b) **[2 marks]** What will be the concentration of the excess reagent after the reaction has taken place?

- 9) [4 marks] The molar mass of aluminum was determined in exactly the same way as the molar mass of magnesium. The following data were collected:

Data (units)	Value
Mass Al (mg)	
V_{gas} (mL)	56.6
$T_{\text{sol'n}}$ ($^{\circ}\text{C}$)	20.8
VP H_2O (mmHg)	18.8
P_{atm} (mmHg)	754.1
h (mm H_2O)	204
$D_{\text{H}_2\text{O}}$ (kg/m^3)	1000

Given that the reaction between Al and HCl is:



and assuming that the experiment worked perfectly, how many milligrams of aluminum were used in the experiment?