

Chemistry 1154 Spring 2011 Test 1

Wednesday, January 26, 2011

Time: 1 hour 50 minutes

Name: _____

Student Number: _____

*This exam consists of **nine** pages of questions, a periodic table, and a page of useful constants. Please ensure that you have a complete paper and, if you do not, obtain one from me immediately. There are **38** marks available. Good luck!*

1) **[4 marks]** "Compound X" is 40.918 percent carbon by mass, 4.578 percent hydrogen by mass, and the rest oxygen.

a) What is the empirical formula of "Compound X"?

b) As a gas, "Compound X" has a density of 2.267 g/L at 200°C and 0.500 atm of pressure. What is the molecular formula of "Compound X"?

2) **[6 marks]** A 996.8-mg sample of "Compound Y," known to contain carbon, hydrogen, and oxygen, was burned and 2112 mg of CO₂ (44.0 g/mol) and 324 mg of H₂O (18.0 g/mol) collected.

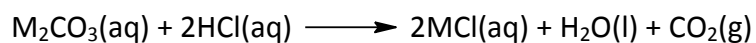
a) What is the empirical formula of "Compound Y"?

b) A fresh 1.6613-gram sample of "Compound Y" reacted completely with 25.0 mL of 0.80 M NaOH according to the (balanced) equation:



What is the molecular formula of "Compound Y"?

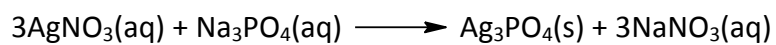
- 3) **[3 marks]** A 954-mg sample of M_2CO_3 was reacted with excess HCl and the resulting CO_2 collected and purified:



If the CO_2 collected occupied 201.73 mL at STP, what is the metal, M?

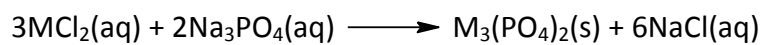
- 4) **[2 marks]** A bag of 0.900% (by mass) NaX solution ("X" is some unknown element) has a density of 1.007179 g/mL and a concentration of NaX of 0.1551 M. What is the element, "X"?

- 5) **[3 marks]** How many grams of 80.0-percent pure AgNO_3 (169.9 g/mol) are required to prepare 3.1393 grams of Ag_3PO_4 (418.6 g/mol) if the reaction



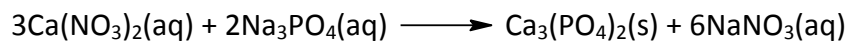
is known to proceed with 75.0 percent yield?

- 6) **[4 marks]** In one experiment, 760.5 mg of MCl_2 ("M" is an unknown element) was reacted with excess Na_3PO_4 and 715.0 mg of $M_3(PO_4)_2(s)$ were collected:



What is the metal, M?

- 7) **[5 marks total]** In one experiment, 20.00 mL of $\text{Ca}(\text{NO}_3)_2$ was mixed with 30.00 mL of 0.200 M Na_3PO_4

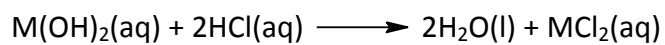


The resulting $\text{Ca}_3(\text{PO}_4)_2(\text{s})$ (310.2 g/mol) had a mass of 930.6 mg.

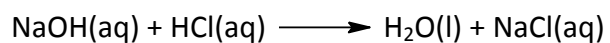
- a) **[3 marks]** If the concentration of the $\text{Ca}(\text{NO}_3)_2$ *after reaction* was 0.0200 M, what was it before reaction?

- b) **[2 marks]** What was the concentration of NaNO_3 after reaction?

- 8) **[4 marks]** A 1.1664 gram sample of $M(OH)_2$ was mixed with 25.00 mL of 3.000 M HCl and enough water added to make 100.0 mL of solution **A**.

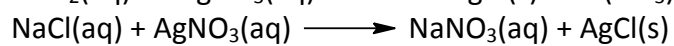
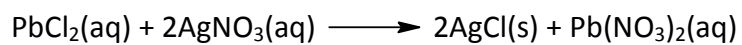


A 10.00 mL aliquot of solution **A** was taken and titrated with 20.00 mL of 0.1750 M NaOH.



What is the metal, M?

- 9) **[4 marks]** A mixture of PbCl_2 (278.1 g/mol) and NaCl (58.44 g/mol) of mass 570.3 mg was reacted with excess AgNO_3 and 1003.1 mg of AgCl (143.3 g/mol) collected:



What was the mole fraction of NaCl in the original mixture?

10) [3 marks] The following data were collected for the molar mass of aluminum, carried out in exactly the same way as the molar mass of magnesium lab:

Measurement	Value
Mass of Al (mg)	53.964
V_{gas} (mL)	76.4345
$T_{\text{sol'n}}$ ($^{\circ}\text{C}$)	21.0
$VP_{\text{sol'n}}$ (mmHg)	18.75
P_{atm} (mmHg)	758.75
$D_{\text{H}_2\text{O}}$ (g/mL)	1.00
D_{Hg} (g/mL)	13.6

What is the height of the column of water present after the experiment? The reaction between aluminum and hydrochloric acid is:

