

Chemistry 1105 Spring 2011 test 2

Friday, February 25, 2011

Time: 1 hour 50 minutes

Name: _____

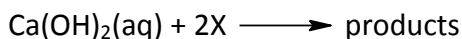
Student number: _____

*This test consists of **seven** pages of questions, a page of useful constants, and a periodic table. Please ensure you have a complete paper and, if you do not, obtain one from me immediately. There are **30** marks (and four bonus marks) available. Good luck!*

1) **[5 marks total]** "Compound X" is known to be 40.0010 percent carbon by mass, 53.2852 percent oxygen by mass, and the rest hydrogen.

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

b) **[3 marks]** "Compound X" reacts with calcium hydroxide according to the balanced reaction:



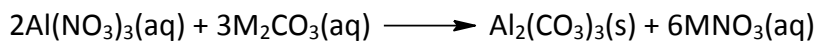
A 0.1201-gram sample of "Compound X" required 20.0 mL of 0.0500 M Ca(OH)_2 for complete reaction. What is the molecular formula of "Compound X"?

2) **[6 marks]** A 0.2763-gram sample of "Compound Y" was burned in excess oxygen and 0.3961 g of CO_2 (44.01 g/mol) and 0.2162 g of H_2O (18.02 g/mol) collected.

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

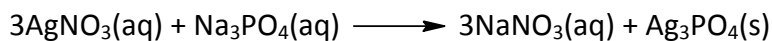
b) As a gas, "Compound Y" has a density of 1.882 g/L at 25°C and 0.500 atm pressure. What is the molecular formula of "Compound Y"?

- 3) **[3 marks]** A 0.6359-gram sample of M_2CO_3 (where "M" is an unknown metal) gave 0.4680 grams of $Al_2(CO_3)_3$ (234.0 g/mol) when reacted with excess $Al(NO_3)_3$:



What is the metal, M?

- 4) **[3 marks]** How many grams of 80.0-percent pure $AgNO_3$ (pure $AgNO_3$ molar mass 169.9 g/mol) are necessary to prepare 41.86 grams of Ag_3PO_4 (418.6 g/mol) if the reaction

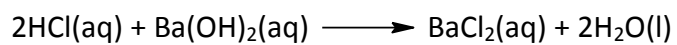


is known to proceed with a 62.5 percent yield?

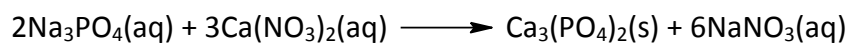
5) **[2 marks]** A 10.00-mL aliquot of solution **A** was diluted to 100.0 mL to form solution **B**. If solution **B** had an $[\text{NaCl}] = 1.0 \times 10^{-3} \text{ M}$, what was the $[\text{NaCl}]$ in solution **A**?

6) **[3 marks]** A solution of HX (where "X" is some unknown element) has a concentration of 12.39 M, a density of 1.189 g/cm^3 , and is 38 percent HX by mass. What is the element, X?

- 7) **[2 marks]** How many millilitres of 0.0500 M Ba(OH)₂ are needed to react with 40.00 mL of 0.0750 M HCl?



- 8) **[6 marks]** A 20.0-mL aliquot of 0.200 M Na_3PO_4 was mixed with 27.0 mL of 0.200 M $\text{Ca}(\text{NO}_3)_2$:

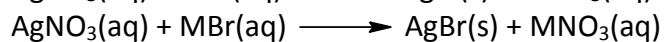
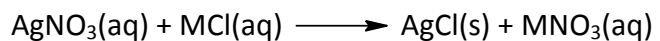


- a) How many grams of $\text{Ca}_3(\text{PO}_4)_2$ (310.2 g/mol) should be collected, assuming 100 percent yield?

- b) What is the excess reagent, and what should its concentration be after reaction?

Bonus question

[4 marks] When a certain mass of MCl (“M” is an unknown metal) is reacted with excess AgNO₃, 1.4332 grams of AgCl (143.32 g/mol) are collected. When the exact same mass of MBr (“M” is the same unknown metal) is used, 0.9165 grams of AgBr (187.77 g/mol) are collected. What is the unknown metal, M?



Useful constants

| Constant | Value |
|----------|---|
| R | $0.0820575 \frac{L \cdot atm}{mol \cdot K}$ |
| | $62.3637 \frac{L \cdot torr}{mol \cdot K}$ |
| | $8.314472 \frac{J}{mol \cdot K}$ |
| 1 atm | 101325 Pa |
| | 760 mmHg |
| K | $^{\circ}C + 273.15$ |