

**City College, Chemistry Department
Chemistry 10301, sections T and T2, Prof. T. Lazaridis
First Midterm exam, Sep. 22, 2005**

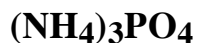
Name (last name first): _____

I.D. Number: _____

Workshop leader: _____

**Note: There are 7 questions in this exam (check both sides of the sheet).
Fill in your answer in the blank space provided immediately following each question. Half
a point will be subtracted every time you report a numerical result with an incorrect
number of significant figures. A copy of the periodic table is attached. Good luck!**

1. a. (4) What is the formula of ammonium phosphate?



- b. (4) What is the mass of one mole of methanol (CH₃OH) ?

$$12.01 + 4 \times 1.008 + 16.00 = 32.04 \text{ g}$$

- c. (4) How many protons and electrons does the sodium ion have?

11 protons, 10 electrons

- d. (4) What is the formula for magnesium hydroxide?



- e. (4) Write the atomic symbols of the elements:

Calcium: **Ca**

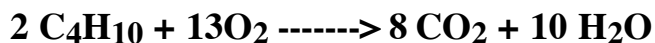
Copper: **Cu**

Silicon: **Si**

Sulfur: **S**

2. Write a balanced equation for each of the following reactions (it is not necessary to indicate the states of each substance):

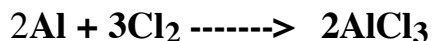
a. (6) Burning of butane (C₄H₁₀) in oxygen



b. (6) Reduction of cassiterite (SnO₂) by carbon to produce metal and carbon monoxide

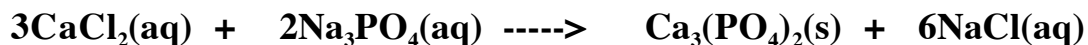


c. (6) Formation of aluminum chloride from aluminum powder and chlorine gas.

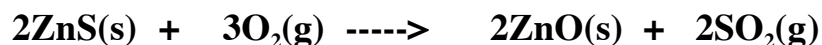


3. Balance the following chemical equations:

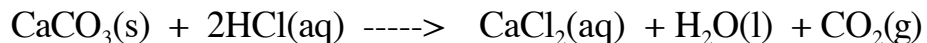
a. (6) CaCl₂(aq) + Na₃PO₄(aq) -----> Ca₃(PO₄)₂(s) + NaCl(aq)



b. (6) ZnS(s) + O₂(g) -----> ZnO(s) + SO₂(g)



4. (15) Consider the following reaction:



How many grams of calcium chloride will form if 40.0 g of calcium carbonate react with 0.500 mol of HCl, assuming 100% yield?

Molar mass of CaCO_3 : $40.08 + 12.01 + 3 \times 16.00 = 100.09$ g/mol

Molar mass of CaCl_2 : $40.08 + 2 \times 35.45 = 110.98$ g/mol

$40.0 \text{ g} / 100.09 \text{ (g/mol)} = 0.400 \text{ mol CaCO}_3$

0.400 mol CaCO_3 requires $2 \times 0.400 = 0.800$ mol HCl. We only have 0.500 mol HCl, therefore HCl is the limiting reactant and will react completely giving 0.250 mol of CaCl_2 .

$0.250 \text{ mol} \times 110.98 \text{ g/mol} = 27.7 \text{ g}$

5. (15) Calculate the percentage composition of Freon-12 (CCl_2F_2)

1 mole contains 12.01 g C, 2×35.45 g Cl, and 2×19.00 g F, total = 120.91 g

C: $12.01 / 120.91 \times 100\% = 9.933\%$

Cl: $2 \times 35.45 / 120.91 \times 100\% = 58.64\%$

F: $2 \times 19.00 / 120.91 \times 100\% = 31.43\%$

6. (10) The combustion of 9.29 g of phosphorus produced 21.29 g of a phosphorus oxide. Calculate the empirical formula of the oxide.

21.29 g of the oxide contains 9.29 g P and the rest (21.29-9.29=12.00 g) is oxygen. Convert to moles:

P: 9.29 g / 30.97 (g/mol) = 0.300 mol

O: 12.00 g / 16.00 (g/mol) = 0.7500 mol

Divide both by the smallest:

P: 0.300 / 0.300 = 1

O: 0.7500 / 0.300 = 2.50

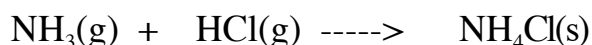
Since 2.50 is not a whole number multiple both by 2:

P: 2

O: 5

Empirical formula : P₂O₅

7. (10) Consider the reaction of ammonia and hydrogen chloride gases:



A reacting mixture contains 50.0 g of ammonia and 60.0 g of hydrogen chloride. Which one is the limiting reactant?

Molar mass of NH₃ : 14.01 + 3X1.008 = 17.03 g/mol

Molar mass of HCl : 1.008 + 35.45 = 36.46 g/mol

Convert to moles:

NH₃: 50.0 g / 17.03 (g/mol) = 2.94 mol

HCl: 60.0 g / 36.46 (g/mol) = 1.65 mol

1.65 mol of HCl requires 1.65 mol of ammonia. We have 2.94. Therefore ammonia is in excess and HCl is the limiting reactant.