

**Chemistry 121**  
**Test 2**  
**Spring 2007**

You have 75 minutes to complete this 100 point test. Please mark each answer clearly and show all work. You may use a simple scientific calculator. NO GAPHING CALCULATORS.

**I. (10 pts) Multiple Choice: Circle the best answer**

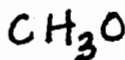
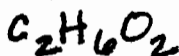
1. How many moles of aluminum atoms are there in 1.0 mol of aluminum oxide?

- a. 1.0 mol Al  
 B  b. 2.0 mol Al  
 c. 3.0 mol Al  
 d. 4.0 mol Al



2. What is the empirical formula of ethylene glycol, HOCH<sub>2</sub>CH<sub>2</sub>OH?

- a. CHO  
 C  b. C<sub>2</sub>H<sub>6</sub>O<sub>2</sub>  
 c. CH<sub>3</sub>O  
 d. None of the above



3. What precipitate will be formed by the reaction of barium nitrate with sodium sulfate?

- a. Na<sub>2</sub>SO<sub>4</sub>  
 D  b. NaNO<sub>3</sub>  
 c. Ba(NO<sub>3</sub>)<sub>2</sub>  
 d. BaSO<sub>4</sub>

4. Which one of the following is the correct dissociation equation for ammonium carbonate in water?

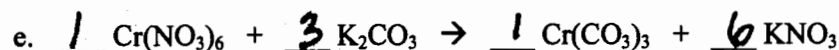
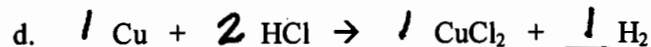
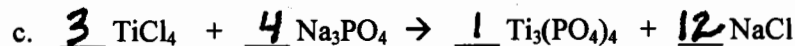
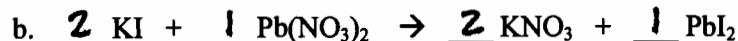
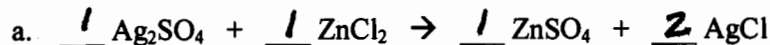
- a. (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> → 6 N + 8 H + C + 3 O  
 C  b. (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> → NH<sub>4</sub><sup>+</sup> + 2 CO<sub>3</sub><sup>2-</sup>  
 c. (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> → 2 NH<sub>4</sub><sup>+</sup> + CO<sub>3</sub><sup>2-</sup>  
 d. (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> → (NH<sub>4</sub><sup>+</sup>)<sub>2</sub> + CO<sub>3</sub><sup>2-</sup>

5. Which of the following statements is correct?

- a. In a balanced equation, molecules are balanced.  
 B  b. In a supersaturated solution, the solute is dissolved at high temperature and then cooled.  
 c. Weak acids are strong electrolytes.  
 d. None of the above

**II. Short Answer and Balanced Equations: Clearly show all work for full credit.**

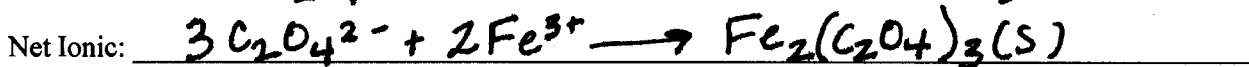
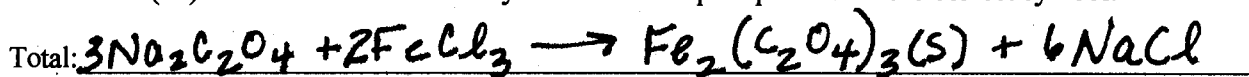
1. (10 pts) Balance the following equations



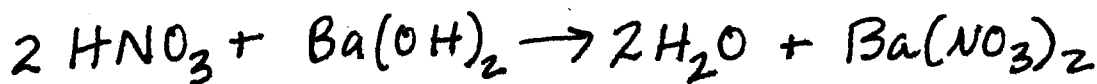
2. (10 pts) Indicate whether the following ionic compounds are soluble (S) or insoluble (IS) in water.

- |                            |           |
|----------------------------|-----------|
| a. $\text{NaNO}_3$         | <u>S</u>  |
| b. $\text{CaSO}_4$         | <u>IS</u> |
| c. $\text{PbBr}_2$         | <u>IS</u> |
| d. $\text{Ti(OH)}_2$       | <u>IS</u> |
| e. $\text{K}_2\text{CO}_3$ | <u>S</u>  |

3. (15 pts) Write the complete, ionic and net ionic equations for the reaction of sodium oxalate with iron(III) chloride. Make sure that you indicate the precipitate with the correct symbol.

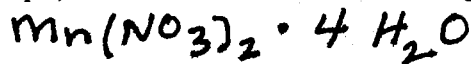


4. (5 pts) Write the complete balanced equation (just the complete) for the reaction of  $\text{HNO}_3$  with  $\text{Ba(OH)}_2$ .



III. Calculations: Make sure you show all work for full credit.

1. (10 pts) Calculate the molar mass of manganese (II) nitrate tetrahydrate.



1 Mn	54.94	} + = 251.0 g/mol
2 N	2(14.01) = 28.02	
10 O	10(16.00) = 160.0	
8 H	8(1.008) = 8.064	

2. (5pts) What is the mass (in grams) of  $2.54 \times 10^{23}$  molecules of chloroform,  $\text{CHCl}_3$ ? (MM of  $\text{CHCl}_3 = 119.37 \text{ g/mol}$ )

$$2.54 \times 10^{23} \text{ molecules CHCl}_3 \times \frac{1 \text{ mol CHCl}_3}{6.02 \times 10^{23} \text{ molecules}} \times \frac{119.37 \text{ g CHCl}_3}{1 \text{ mol CHCl}_3} = 50.4 \text{ g CHCl}_3$$

3. (5 pts) How many grams of solute are needed to make 25.0 mL of 0.525 M NaOH? (MM of NaOH = 40.00 g/mol)

$$25.0 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{0.525 \text{ mol NaOH}}{1 \text{ L}} \times \frac{40.00 \text{ g NaOH}}{1 \text{ mol NaOH}} = 0.525 \text{ g NaOH}$$

4. (15 pts) Indigo, the dye for blue jeans is composed of carbon, hydrogen, nitrogen and oxygen. It has percent composition by mass of 73.27% C, 3.84% H, 10.68% N and the remainder is oxygen. The molar mass of indigo is 262.3 g/mol. What are the empirical formula and the molecular formula of indigo?

Assume 100 g - 73.27 - 3.84 - 10.68 = 12.21 g O

$$73.27 \text{ g C} \times \frac{1 \text{ mol C}}{12.01 \text{ g C}} = 6.101 \text{ mol C}$$

$$10.68 \text{ g N} \times \frac{1 \text{ mol N}}{14.01 \text{ g N}} = 0.7623 \text{ mol N}$$

$$3.84 \text{ g H} \times \frac{1 \text{ mol H}}{1.008 \text{ g H}} = 3.810 \text{ mol H}$$

$$12.21 \text{ g O} \times \frac{1 \text{ mol O}}{16.00 \text{ g O}} = 0.7631 \text{ mol O}$$

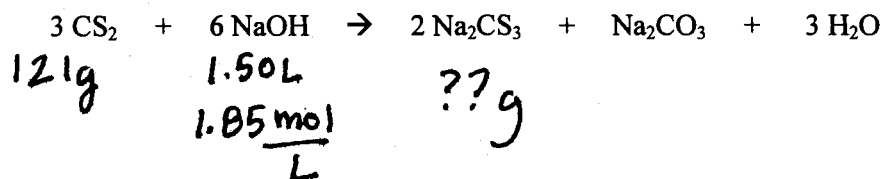
$$\frac{C_{6.101} H_{3.810} N_{0.7623} O_{0.7631}}{0.7623 \ 0.7623 \ 0.7623 \ 0.7623} = \boxed{C_8 H_5 N O} \text{ Empirical Formula}$$

$$8(12.01) + 5(1.008) + 14.01 + 16.00 = 131.139 \text{ g/mol}$$

$$\frac{\text{MM of MF}}{\text{MM of EF}} = \frac{262.3}{131.13} = 2$$

$$\boxed{C_{16} H_{10} N_2 O_2} \text{ Molecular Formula}$$

5. (15 pts) Below is a side reaction in the manufacture of rayon. How many grams of  $\text{Na}_2\text{CS}_3$  are produced in the reaction of 121 g of  $\text{CS}_2$  and 1.50 L of 1.85 M NaOH? (MM of  $\text{CS}_2 = 76.13$  g/mol, MM of  $\text{Na}_2\text{CS}_3 = 154.17$  g/mol)



$$121 \text{ g CS}_2 \times \frac{1 \text{ mol CS}_2}{76.13 \text{ g CS}_2} \times \frac{2 \text{ mol Na}_2\text{CS}_3}{3 \text{ mol CS}_2} \times \frac{154.17 \text{ g Na}_2\text{CS}_3}{1 \text{ mol Na}_2\text{CS}_3} = 163 \text{ g Na}_2\text{CS}_3$$

$$1.50 \text{ L} \times \frac{1.85 \text{ mol NaOH}}{1 \text{ L}} \times \frac{2 \text{ mol Na}_2\text{CS}_3}{6 \text{ mol NaOH}} \times \frac{154.17 \text{ g Na}_2\text{CS}_3}{1 \text{ mol Na}_2\text{CS}_3} = \boxed{143 \text{ g Na}_2\text{CS}_3}$$

