

Chemistry 121
Fall 2004
Test 4, FORM A

Name: KEY

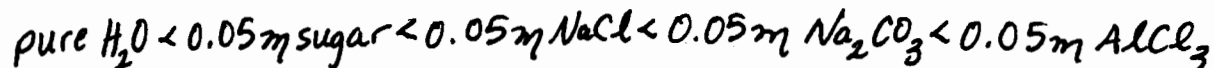
Instructions: You have 50 minutes to complete this 100-point exam. You may use a simple scientific calculator. No programmable calculators allowed.

I. MULTIPLE CHOICE: (25 pts, 5 points each) Carefully and clearly circle the best answer. If you circle two answers, *one of which is correct*, you will receive 3 points.

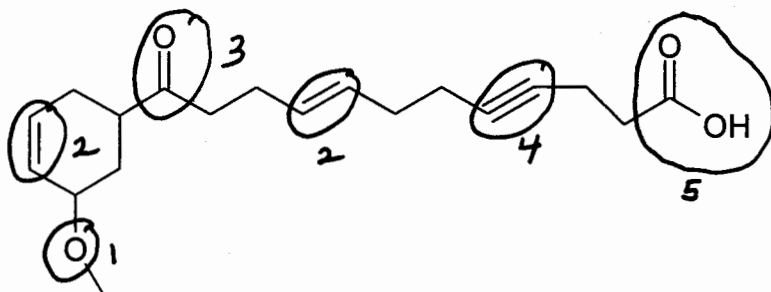
- Which of the following is a false statement?
 - Gases expand to fill their container.
 - Gases can be readily compressed.
 - Gases form homogenous mixtures with each other.
 - Individual gas molecules are relatively close together.
 - None of the above.
- The movement of gases through a tiny opening into a vacuum is:
 - Diffusion.
 - Effusion.
 - Heterogeneous.
 - Osmosis.
 - None of the above
- If the following gases are at the same temperature, which will have the fastest velocity (speed)?
 - He
 - Ne
 - Ar
 - Kr
 - Xe
- What type of forces hold network solids together?
 - Dispersion
 - Hydrogen bonding
 - Covalent
 - Coulombic
 - Delocalized bonding
- If the concentration of Na^+ inside a cell is 0.01M and the concentration of Na^+ outside the cell is 0.01M, the cell is:
 - Isotonic
 - Hypotonic
 - Hypertonic
 - Homogeneous
 - None of the above

II. Short Answer and Calculations (85 pts): Clearly indicate your answer in the space provided. Partial credit will be given for correct work. If I cannot read the work, it will not be graded.

1. (10 pts) Rank the following solutions in order of increasing boiling point. 0.05 m AlCl₃, 0.05 m sugar, 0.05 m Na₂CO₃, pure water and 0.05 m NaCl.



2. (10 pts) Circle and identify the functional groups in the following molecule.



1. ether
2. alkene
3. ketone
4. alkyne
5. carboxylic acid

3. (10 pts) What is the complimentary base pairing for the following molecule?

TCTAGGTCAA
AGATCCAGTT

4. (10 pts) Pick **ONE** of the following essay questions to answer in 4 – 5 grammatically correct sentences.
- a. Describe the chemistry of sulfur in the troposphere.
 - b. Describe the two types of secondary structure of RNA and what causes the structures to occur.
 - c. Describe the secondary and tertiary structures of proteins and what causes the structures to occur.

5. (15 pts) A relief valve on a 450. L industrial storage tank operates whenever the pressure of the enclosed carbon dioxide gas exceeds 110 atm. In December, the tank was filled with carbon dioxide at 100. atm when the ambient temperature was $-10.^{\circ}\text{C}$. On a hot summer day, the temperature rose to $5.^{\circ}\text{C}$.

(a) Calculate the pressure inside the tank.

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$V_1 = 450. \text{ L} \quad V_2 = 450. \text{ L}$$

$$P_1 = 100. \text{ atm} \quad P_2 = ?$$

$$T_1 = -10^{\circ}\text{C} + 273 = 263 \text{ K} \quad T_2 = 5^{\circ}\text{C} + 273 = 278 \text{ K}$$

$$P_2 = \frac{P_1 T_2}{T_1} = \frac{(100. \text{ atm})(278 \text{ K})}{263 \text{ K}} = 106. \text{ atm}$$

(b) Would the relief valve open? Explain your answer

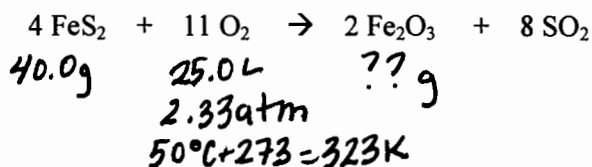
No, $106 \text{ atm} < 110 \text{ atm}$.

6. (10 pts) A closed tank contains 4.5 mol of F_2 and 2.0 mol of Cl_2 . If the total pressure of in the tank is 2.50 atm, what is the partial pressure of Cl_2 ?

$$X_{\text{Cl}_2} = \frac{n_{\text{Cl}_2}}{n_{\text{total}}} = \frac{2.0 \text{ mol Cl}_2}{4.5 \text{ mol} + 2.0 \text{ mol}} = 0.31$$

$$P_{\text{Cl}_2} = (0.31)(2.50 \text{ atm}) = 0.78 \text{ atm}$$

7. (15 pts) Iron pyrite, FeS_2 , is the form in which much of the sulfur occurs in coal. In the combustion of the coal, oxygen reacts with iron pyrite to produce iron (III) oxide and sulfur dioxide in the reaction below. Calculate the mass of Fe_2O_3 that is produced from the reaction of 40.0g of FeS_2 with 25.0 L of O_2 at 2.33 atm and $50.^{\circ}\text{C}$. (MM of $\text{FeS}_2 = 119.97 \text{ g/mol}$; MM of $\text{Fe}_2\text{O}_3 = 159.7 \text{ g/mol}$)



$$PV = nRT$$

$$n = \frac{PV}{RT}$$

$$40.0 \text{ g FeS}_2 \times \frac{1 \text{ mol FeS}_2}{119.97 \text{ g FeS}_2} \times \frac{2 \text{ mol Fe}_2\text{O}_3}{4 \text{ mol FeS}_2} \times \frac{159.7 \text{ g Fe}_2\text{O}_3}{1 \text{ mol Fe}_2\text{O}_3} = 26.6 \text{ g Fe}_2\text{O}_3$$

$$n = \frac{PV}{RT} = \frac{(2.33 \text{ atm})(25.0 \text{ L})}{(0.0821 \frac{\text{L atm}}{\text{mol K}})(323 \text{ K})} = 2.20 \text{ mol O}_2 \times \frac{2 \text{ mol Fe}_2\text{O}_3}{11 \text{ mol O}_2} \times \frac{159.7 \text{ g Fe}_2\text{O}_3}{1 \text{ mol Fe}_2\text{O}_3} = 63.9 \text{ g Fe}_2\text{O}_3$$

26.6 g Fe_2O_3 produced, FeS_2 is LR