

Chemistry 121
Spring 2004
Test 4
FORM A

Name: KEY

Instructions: You have 75 minutes to complete this 100-point exam. You may use a simple scientific calculator. No programmable calculators allowed.

I. MULTIPLE CHOICE: (30 pts, 3 points each) Carefully and clearly circle the best answer. If you circle two answers, *one of which is correct*, you will receive 1 point.

1. Under which of the following conditions would you expect a gas to have the least ideal behavior?
- a. High temperature and high pressure
 - b. High temperature and low pressure
 - D c. Low temperature and low pressure
 - d. Low temperature and high pressure

2. What are STP conditions for gases?
- a. 0°C and 1 torr
 - b. 0 K and 760 torr
 - D c. 0°C and 760 atm
 - d. 0°C and 1 atm

3. If the volume of a confined gas were doubled while the temperature remains constant, what change (if any) would be observed in pressure? (Use the combined gas law)
- a. It would be half as large.
- A b. It would double
- c. It would be 1/4 as large
- d. It would remain the same
- $$P_1 V_1 = P_2 V_2 \quad P_2 = \frac{P_1 \cdot V_1}{V_2} = \frac{P_1 \cdot 1}{2}$$

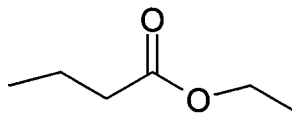
4. Which of the following gases effuses the fastest?
- a. Cl₂ 70
 - b. O₂ 32
 - C c. N₂ 28
 - d. Ar 40

5. Which of the following would be expected to have the highest boiling point?
- a. NH₃ H-bonding
- A b. PH₃
- c. AsH₃
- d. SbH₃

6. Liquids with high surface tension tend to have:
- B b. Strong intermolecular forces
- c. Strong cohesive forces
- d. Strong adhesive forces

7. Inside a cell, the concentration of K^+ is 0.01M, but outside the cell it is 0.0001M. The cell is considered:
- B a. Isotonic.
 b. Hypotonic.
 c. Hypertonic
 d. Sublimed.

8. What functional group is present in the following molecule?
- B a. Carboxylic acid
 b. Ester
 c. Ketone
 d. Ether



9. Which of the following is not found in RNA?
- C a. Guanine
 b. Adenine
 c. Thymine
 d. Cytosine

10. Macromolecular carbohydrates that store large amounts of energy are called:
- D a. Monosaccharides.
 b. Monomers.
 c. Nucleotides.
 d. Polysaccharides.

II. Short Answer and Calculations (80 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.

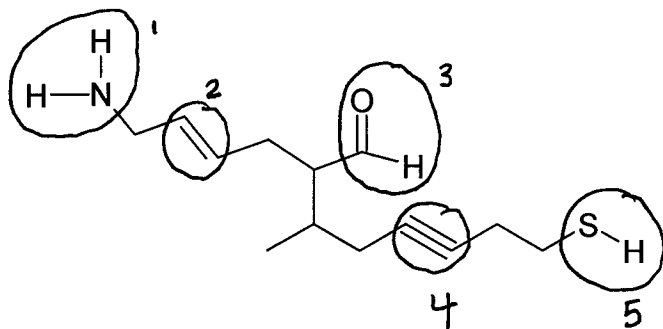
1. (10 pts) What is the complimentary base pairing for the following RNA molecule?

ACCAGGAGAC
UGGUCUCUG

2. (5pts) What two assumptions does Kinetic Molecular Theory make?

- a. no interactions between gas molecules
 b. molecules do not have any volume

3. (10 pts) Circle and identify the functional groups in the following molecule



1. amine
 2. alkene
 3. aldehyde
 4. alkyne
 5. thiol

4. (10 pts) Rank the following solutions from lowest boiling point to highest boiling point.

0.2 m K_2SO_4 , pure water, 0.2 m $(NH_4)_3PO_4$, 0.2 m LiBr, 0.2 m methanol (CH_3OH)

pure H_2O < 0.2 m CH_3OH < 0.2 m LiBr < 0.2 m K_2SO_4 < 0.2 m $(NH_4)_3PO_4$

5. (10 pts) A sealed room is filled with 1.50×10^5 moles of helium and 2.79×10^5 moles of oxygen. If the pressure of the room is 0.50 atm, what is the partial pressure of oxygen? Your lungs can tolerate an oxygen partial pressure of 0.21 – 0.35 atm. Would you be able to breathe in the room?

$$n_{O_2} = 2.79 \times 10^5 \text{ mol}$$

$$n_{He} = 1.50 \times 10^5 \text{ mol}$$

$$n_{total} = 4.29 \times 10^5 \text{ mol}$$

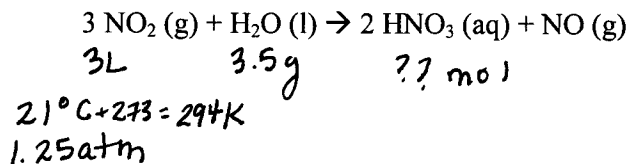
$$\chi_{O_2} = \frac{2.79 \times 10^5 \text{ mol } O_2}{4.29 \times 10^5 \text{ mol total}} = 0.653$$

$$P_{O_2} = \chi_{O_2} P_{total} = (0.653)(0.50 \text{ atm})$$

$$P_{O_2} = 0.33 \text{ atm}$$

Yes, you would be able to breathe.

6. (15 pts) Nitric acid is formed when NO_2 is dissolved in water. How many moles of nitric acid are formed from 3.5 g of H_2O and 3L of NO_2 at $21^\circ C$ and 1.25 atm?



$$3.5 \text{ g } H_2O \times \frac{1 \text{ mol } H_2O}{18.02 \text{ g } H_2O} \times \frac{2 \text{ mol } HNO_3}{1 \text{ mol } H_2O} = 0.39 \text{ mol } HNO_3$$

$$PV = n_{NO_2} RT$$

$$n_{NO_2} = \frac{PV}{RT} = \frac{(1.25 \text{ atm})(3.0 \text{ L})}{(0.0821 \frac{\text{L atm}}{\text{mol K}})(294 \text{ K})} = 0.16 \text{ mol } NO_2 \times \frac{2 \text{ mol } HNO_3}{3 \text{ mol } NO_2}$$

Limiting Reactant

$$= 0.11 \text{ mol } HNO_3$$

7. (10 pts) What must be the new volume of a sample of nitrogen (in L) if 2.68 L at 745 mmHg and 24.0°C is heated to 375.0°C under conditions that change the pressure to 760 mmHg?

$$V_1 = 2.68 \text{ L}$$

$$P_1 = 745 \text{ mmHg}$$

$$T_1 = 24^\circ\text{C} + 273 = 297 \text{ K}$$

$$V_2 = ?$$

$$P_2 = 760 \text{ mmHg}$$

$$T_2 = 375.0^\circ\text{C} + 273 = 648 \text{ K}$$

solve
↓

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

$$V_2 = \frac{P_1 V_1 T_2}{P_2 T_1} = \frac{(745 \text{ mmHg})(2.68 \text{ L})(648 \text{ K})}{(760 \text{ mmHg})(297 \text{ K})}$$

$$V_2 = 5.73 \text{ L}$$

8. (10 pts) Pick **ONE** of the following essay questions to answer in 3-4 grammatically correct sentences.
- Describe the four types of solids and the forces that hold them together.
 - Describe the primary and secondary structure of DNA and any forces associated with the structure.
 - Define relative humidity and explain the relationship between relative humidity and dew point.