

Chemistry 121  
Spring 2005  
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 (15 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. The standard reference conditions for studies of the gaseous state of matter has the values:

- a. temperature: 0.00 K; pressure: 1.000 standard atmosphere
- b. temperature: 0.00 °C; pressure: 1.000 standard millimeters of mercury
- C  c. temperature: 273 K; pressure: 1.000 standard atmosphere
- d. temperature: 298 K; pressure: 1.000 standard atmosphere
- e. none of the above

2. According to the kinetic theory of gases, the average kinetic energy of the gas particles in a gas sample

is directly proportional to the: (remember  $\bar{E}_{kinetic} = \frac{3RT}{2N_A}$ )

- a. Pressure
- b. Volume
- C  c. Temperature
- d. Molar mass
- e. None of the above.

3. What is the complimentary base pairing for the following molecule? AGCCGU

- a. UGCCAG
- b. UGCCGA
- D  c. TCGGCA
- d. UCGGCA
- a. UCGGCT

4. Which one of the following covalent compounds will exhibit hydrogen bonding in the liquid state?

- a. H<sub>2</sub>-C-F<sub>2</sub>
- B  b. Cl<sub>2</sub>-N-H
- c. H<sub>2</sub>-P-Cl
- d. H-Br
- e. NCl<sub>3</sub>

5. Which one of the following is not a component of DNA?

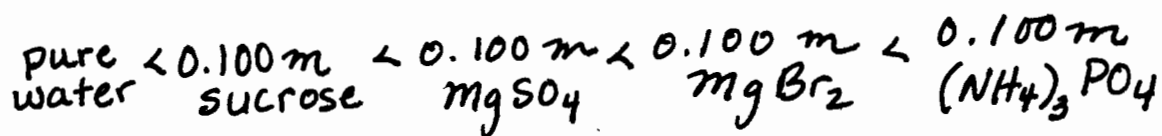
- a. Phosphate
- b. Sugar
- C  c. Ribose
- d. Thymine
- e. Hydrogen bonding

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.

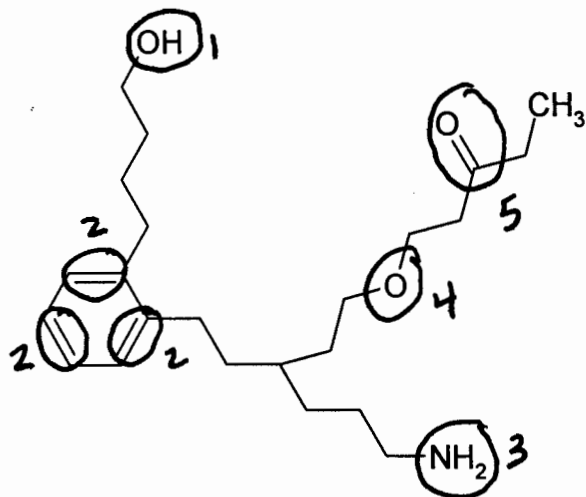
1. (10 pts) Arrange the following molecules in order of increasing intermolecular attractive forces:  $\text{GeCl}_4$ ,  $\text{CCl}_4$ ,  $\text{SiCl}_4$  and  $\text{SnCl}_4$ .



2. (10 pts) Rank the following solutions in order of increasing boiling point: 0.100 m  $\text{MgBr}_2$ , 0.100 m  $\text{MgSO}_4$ , pure water, 0.100 m  $(\text{NH}_4)_3\text{PO}_4$  and 0.100 m sucrose ( $\text{C}_{11}\text{H}_{22}\text{O}_{11}$ )



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



1. alcohol
2. alkene
3. amine
4. ether
5. ketone

4. (10 pts) Fill-in the blank

a. A single cell with 0.015M  $\text{K}^+$  inside and 0.0015M  $\text{K}^+$  outside is termed hypotonic.

b. Network solids are held together by covalent bonds.

c. A(n) ideal gas does not have any interactions between the molecules and does not have any molecular volume.

d. The movement of gases through a tiny opening in a vacuum is termed effusion.

e. Viscosity is resistance to flow.

5. (10 pts) A cylinder fitted with a movable piston and filled with a gas has a volume of 16.44 L at 22°C when the applied pressure is 772.2 mmHg. The temperature of the oil bath surrounding it was increased to 184°C, and the load on the piston was changed. Careful measurement now gave a value of 16.60 L for the volume. What is the final pressure in the system?

$$V_1 = 16.44 \text{ L}$$

$$T_1 = 22^\circ\text{C} + 273 = 295 \text{ K}$$

$$P_1 = 772.2 \text{ mmHg}$$

$$V_2 = 16.60 \text{ L}$$

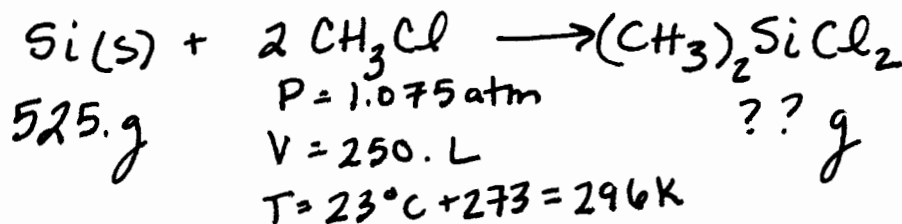
$$T_2 = 184^\circ\text{C} + 273 = 457 \text{ K}$$

$$P_2 = ??$$

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

$$P_2 = \frac{P_1 V_1 T_2}{V_2 T_1} = \frac{(772.2 \text{ mmHg})(16.44 \text{ L})(457 \text{ K})}{(16.60 \text{ L})(295 \text{ K})} = \boxed{1.18 \times 10^3 \text{ mmHg}}$$

6. (15 pts) Silicones are polymeric substances that are used as lubricants, as anti-static agents and in waterproof caulk. The starting place in making them is the reaction below. What mass (in grams) of  $(\text{CH}_3)_2\text{SiCl}_2$  is produced if 525. g Si is allowed to react with  $\text{CH}_3\text{Cl}$  gas at a pressure of 1.075 atm, a volume of 250. L and a temperature of 23°C? (MM of Si = 28.09 g/mol, MM of  $(\text{CH}_3)_2\text{SiCl}_2$  = 129.06 g/mol)



$$525 \text{ g Si} \times \frac{1 \text{ mol Si}}{28.09 \text{ g Si}} \times \frac{1 \text{ mol } (\text{CH}_3)_2\text{SiCl}_2}{1 \text{ mol Si}} \times \frac{129.06 \text{ g } (\text{CH}_3)_2\text{SiCl}_2}{1 \text{ mol } (\text{CH}_3)_2\text{SiCl}_2} = 2.41 \times 10^3 \text{ g } (\text{CH}_3)_2\text{SiCl}_2$$

$$n_{\text{CH}_3\text{Cl}} = \frac{PV}{RT} = \frac{(1.075 \text{ atm})(250. \text{ L})}{(0.08206 \frac{\text{L atm}}{\text{mol K}})(296 \text{ K})} = 11.1 \text{ mol CH}_3\text{Cl}$$

$$11.1 \text{ mol CH}_3\text{Cl} \times \frac{1 \text{ mol } (\text{CH}_3)_2\text{SiCl}_2}{2 \text{ mol CH}_3\text{Cl}} \times \frac{129.06 \text{ g } (\text{CH}_3)_2\text{SiCl}_2}{1 \text{ mol } (\text{CH}_3)_2\text{SiCl}_2} = \boxed{716 \text{ g } (\text{CH}_3)_2\text{SiCl}_2}$$

7. (10 pts) A flask contains a mixture of hydrogen and neon at a pressure of 739.2 mmHg. What are the partial pressures of hydrogen and neon if the mixture contains 0.992 mol of hydrogen and 0.397 mol of neon? Report the pressures in atmospheres (atm).

$$P_{\text{tot}} = 739.2 \text{ mmHg} \times \frac{1 \text{ atm}}{760 \text{ mmHg}} = 0.973 \text{ atm}$$

$$\chi_{\text{H}_2} = \frac{0.992 \text{ mol}}{0.992 \text{ mol} + 0.397 \text{ mol}} = 0.714$$

$$P_{\text{H}_2} = \chi_{\text{H}_2} P_{\text{tot}}$$

$$P_{\text{H}_2} = (0.714)(0.973 \text{ atm})$$

$$P_{\text{H}_2} = 0.695 \text{ atm}$$

$$P_{\text{Ne}} = P_{\text{tot}} - P_{\text{H}_2}$$

$$P_{\text{Ne}} = 0.973 \text{ atm} - 0.695 \text{ atm}$$

$$P_{\text{Ne}} = 0.278 \text{ atm}$$

8. (10 pts) Pick ONE of the following essay questions to answer in 5 - 6 grammatically correct sentences.
- Describe the two structures of carbon that we discussed and indicate the types of forces that hold each structure together.
  - Describe the three main components of RNA, the principal job of RNA, its structure and what holds the structure together.

See lecture notes.