

## Exam 4 Chm 203 (Dr Mattson) 6 December 2012

**Academic Integrity Pledge:** In keeping with Creighton University's ideals and with the Academic Integrity Code, I pledge that this work is my own and that I have neither given nor received inappropriate assistance in preparing it.

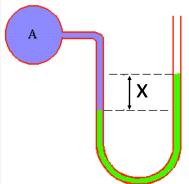
**Signature:**

**Instructions:** Show all work whenever a calculation box is provided! Write legibly. Include units whenever appropriate. **BOX YOUR ANSWERS!** You will receive credit for how you worked each problem as well as for the correct answer. If you need more space, you may use the back of your periodic table — Write: "See PT" in the answer box and then attach the periodic table. At your desk you are allowed only pencils (but no pencil pouch), an eraser, and a non-programmable calculator without a slipcover. Backpacks and purses must be stored in the front of the room. Cell phones must be OFF and placed at the front of the room.

**Given:  $R = 0.0821 \text{ L atm / mol K} = 8.314 \text{ J mol / K}$**

1. (4 pts) At what temperature does 38 g neon occupy 40.0 L at 770 mmHg?

2. (3 pts) An open-air manometer contains xenon gas. The column of mercury in the U-tube is 3.20 cm higher on the side open to the air. If the barometric pressure is 722 mmHg, what is the pressure of xenon?



3. (4 pts) What is the density of carbon dioxide at 22.3 °C and 744.2 mmHg?

4. (4 pts) Suppose a 543.0 mL vessel contains 4.142 g of an unknown gas at 0.947 atm and 23.7 °C. What is the molar mass of the unknown gas?

5. (2 pts) Circle the condition in ( ) that is most likely to cause the gas to behave most like an ideal gas.
- A. 1 mol  $\text{NH}_3$  at 1000 K and (10.0 atm or 1 atm)
- B. 1 mol  $\text{O}_2$  at (100 K or 400 K) and 1000 mmHg

6. (4 pts) A sample of gas occupies 32.67 mL at 102.44 kPa and 26 °C. What is its volume at 99.10 kPa and 86 °C?

7. A room has dimensions of 5.0 m x 4.5 m x 2.6 m.

- 7a. (4 pts) How many moles of air are present at 20.0 °C and 780 mmHg?

- 7b (4 pts) Suppose 825 g  $\text{CO(g)}$  ( $\text{MM} = 28 \text{ g/mol}$ ) were released into the room described in the previous problem. What is the mole fraction of  $\text{CO(g)}$ ?

- 7c (4 pts) What is the partial pressure of the  $\text{CO(g)}$  in mmHg?

8. (4 pts) According to kinetic-molecular theory of gases, which statement(s) are true?
- T F All molecules have the same average kinetic energy at constant temperature.
- T F Lighter molecules have a larger average kinetic energy than heavier molecules at constant temperature.
- T F At any given temperature, some molecules of a gas have large speeds and others have small.
- T F As temperature increases, the average molecular speed increases.

9. (3 pts) Which of these gases effuses/diffuses 2.0 times slower than  $\text{CH}_4$ ? Show work for credit.

Circle answer:  $\text{H}_2\text{S}$     $\text{SO}_2$     $\text{SO}_3$     $\text{COS}$     $\text{CS}_2$

10. (6 pts) Use these molecules to answer the following questions.

A. $\text{CH}_4$ (MM = 16 g/mol)	B. $\text{H}_2\text{S}$ (MM = 34 g/mol)
C. $\text{NH}_3$ (MM = 17 g/mol)	D. $\text{CO}_2$ (MM = 44 g/mol)
E. $\text{SF}_2$ (MM = 70 g/mol)	F. $\text{C}_2\text{H}_6$ (MM = 30 g/mol)

- 10a. (3 pts) Which of these molecules is/are non-polar? Circle your choices: A B C D E F

- 10b. (3 pts) Which of these molecules has/have hydrogen bonding? Circle your choices: A B C D E F

- 10c. (1 pt) Which of these molecules has the largest London dispersion forces? Circle one choice:

A B C D E F

11. (4 pts) How much heat is released when a glass containing 250 mL water at  $25.0^\circ\text{C}$ , freezes and continues to cool to  $-7.0^\circ\text{C}$ ? [Given:  $\text{density}_{\text{H}_2\text{O}(\text{l})} = 1.0 \text{ g/mL}$ ;  $\text{SH}_{\text{H}_2\text{O}(\text{s})} = 2.10 \text{ J/g deg}$ ;  $\text{SH}_{\text{H}_2\text{O}(\text{l})} = 4.18 \text{ J/g deg}$ ;  $\text{SH}_{\text{H}_2\text{O}(\text{g})} = 1.80 \text{ J/g deg}$ ;  $\Delta H_{\text{fus}} = 6.0 \text{ kJ/mol}$ ;  $\Delta H_{\text{vap}} = 40.7 \text{ kJ/mol}$ ]

12. (4 pts) Ethanol has a higher vapor pressure than water. What can we conclude from this statement? Circle all that are true.

- T F Ethanol has a higher boiling point than water.  
T F The mole fraction of ethanol in the gas phase is larger than that of water at the same temperature.  
T F Intermolecular forces are stronger in water than in ethanol.  
T F Ethanol must be a network-covalent molecule.

13. Polonium, Po, is one of the few examples of a metal that utilizes the simple cubic unit cell. Given the radius of Po is 140 pm, answer the following questions.

- 13a. (4 pts) What is the volume of the polonium unit cell?

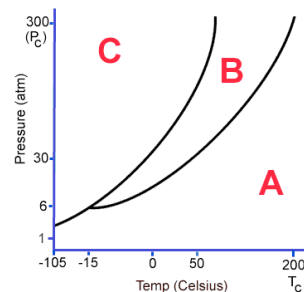
- 13b. (1 pt) How many polonium atoms are present in each unit cell? Circle answer: 0 1 2 3 4 5 6 7 8 9

- 13c. (4 pts) What is the density of polonium in  $\text{g/cm}^3$ ?

14. (4 pts) An oxide of a metal M, exists with the oxides forming a face-centered cubic sub-lattice. The metal cations occupy all of the edge-centers. What is the formula of the oxide?

15. (1 pt) Sodium chloride exhibits a fcc sublattice of chlorides. How many sodium cations are present in each unit cell? Circle: 0 1 2 3 4 5 6 7 8 9

16. Use the phase diagram to answer the following questions.



- 16a. (1 pt) What phase is this substance under standard conditions? Circle: SOLID or LIQUID or GAS

- 16b. (1 pt) This substance is a solid at:

- A. 30 atm,  $-50^\circ\text{C}$       B. 30 atm,  $+50^\circ\text{C}$   
C. 30 atm,  $+25^\circ\text{C}$       D. 300 atm,  $250^\circ\text{C}$

- 16c. (1 pt) Circle the triple point.

- 16d. (1 pt) Draw an arrow pointing to the solid-liquid interface.

- 16e. (1 pt) What is the critical temperature?

- 16f. (1 pt) Is the solid phase more dense than the liquid phase? Circle: YES or NO

**For DocM to complete:**

**Subtotal from exam:** \_\_\_\_\_

**Folder work: (20 max)** \_\_\_\_\_

**Total:** \_\_\_\_\_

## Answers:

1. 262 K
2. 754 mmHg
3. 1.78 g/L
4. 196 g/mol
5. A. 1 atm; B. 400 K
6. 40.55 mL
- 7a. 2500 moles of air
- 7b 0.0118
- 7c 9.20 mmHg?
8. T F T T
9. SO<sub>2</sub>
10. A. AB<sub>4</sub>; B. AB<sub>2</sub>E<sub>2</sub>; C. AB<sub>3</sub>E; D. AB<sub>2</sub>; E. AB<sub>2</sub>E<sub>2</sub>; F.  
each carbon is AB<sub>4</sub>
- 10a. A, D, F
- 10b. C
- 10c. E
11. 113 kJ heat released (or q = -113 kJ)
12. F T T F
- 13a.  $2.20 \times 10^{-23} \text{ cm}^3$
- 13b. 1
- 13c. 15.8 g/cm<sup>3</sup>
14. M<sub>3</sub>O<sub>4</sub>
15. 4
- 16a. GAS
- 16b. A
- 16c. place where wishbone joins, ca. -15° and 4 atm
- 16d. The line between B and C
- 16e. 200 °C
- 16f. YES