

**Exam Six**  
**CHM 203 (Dr. Mattson)**  
**5 December 2008**

**Academic Integrity Pledge:**

*In keeping with Creighton University's ideals and with the Academic Integrity Code adopted by the College of Arts and Sciences, 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 is required! You will receive credit for how you worked each problem as well as for the correct answer. This exam is worth 100 points. **BOX YOUR ANSWERS!**

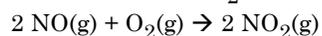
1. (5 pts) What is the temperature of an ideal gas if 25 moles occupy 10.0 L at 150 atm? [Given:  $R = 0.0821 \text{ L atm/mol K}$ ]

2. (5 pts) What volume would 50 g argon occupy at 800 mmHg and 30 °C?

3. (5 pts) Start with the ideal gas law, derive an equation for gas density, making the necessary substitutions and rearrangements and showing all work.

4. (5 pts) Use the equation you generated in the previous problem in order to calculate the density of  $\text{CS}_2(\text{g})$  ( $\text{MM} = 76 \text{ g/mol}$ ) at STP.

5. (5 pts) In class, we observed a demonstration in which I combined  $\text{NO}(\text{g})$  with  $\text{O}_2(\text{g})$ . The reaction was very fast and yielded  $\text{NO}_2$ :



What volume of oxygen would be required to react with 42 mL nitrogen monoxide under constant temperature and pressure?

6. (5 pts) Much of the world reports pressures in kPa. Suppose that the barometer in the Chemistry Department reads 729.8 mmHg one day. Convert this pressure into kPa.

7. (5 pts) An open-end manometer like those pictured in your book and class notes contains a sample of gas. On this particular day, the barometric pressure is 723.3 mmHg. You observed that the mercury in the leg open to the atmosphere is higher than the leg connected to the bulb by about 2.5 inches. What is the approximate pressure inside the flask in mmHg? [Given 1 inch = 2.54 cm]

8. (5 pts) The volume of one mole of gas (the molar volume) on earth is 22.4 L at STP. What is the molar volume on Venus where the atmospheric temperature is 740 K and the atmospheric pressure is 90 atm?

9. (5 pts) A gas sample occupies 5.0 L at 27 °C and 101.3 kPa. What is its volume at 400 K and 14.9 kPa?

10. (5 pts) Carbon dioxide effuses through a pinhole 2.6 times as fast as an unknown gas under identical conditions. What is the molar mass of the unknown gas?

11. A gas mixture contains 3.00 moles Ar, 4.00 moles Xe and 2.00 moles Kr. The gases are held in a 2.00 L canister at 25 °C.

11a. (5 pts) What is the mole fraction of xenon?

11b. (5 pts) What is the partial pressure of krypton?

12. (10 pts) Which of these molecules is/are polar? Support your answer with a Lewis dot structure.

	Lewis dot	Polar?
CH <sub>4</sub>		Yes No
NH <sub>3</sub>		Yes No
SO <sub>2</sub>		Yes No
SO <sub>3</sub>		Yes No
CO <sub>2</sub>		Yes No

13. (6 points) Underline all molecules with London dispersion forces and circle all molecules with hydrogen bonding.

- A. CH<sub>4</sub>      B. NH<sub>3</sub>      C. N<sub>2</sub>  
 D. SH<sub>2</sub>      E. CH<sub>3</sub>OH      F. SO<sub>2</sub>

14. (5 pts) How much heat is required to melt a 42 g ice cube at 0 °C? Given: ΔH<sub>fus</sub> = 6.01 kJ/mol.

15. (5 pts) Which of the following values would you need in order to calculate the amount of heat required to convert 40 g ice at -25 °C into water at 85 °C? Circle all values that you would need.

- S.H.<sub>H<sub>2</sub>O(s)</sub> = 2.10 J/ g deg      ΔH<sub>fus</sub> = 6.01 kJ/mol  
 S.H.<sub>H<sub>2</sub>O(l)</sub> = 4.18 J/ g deg      ΔH<sub>vap</sub> = 40.7 kJ/mo  
 S.H.<sub>H<sub>2</sub>O(g)</sub> = 1.80 J/ g deg

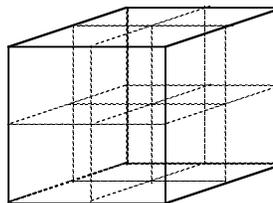
16. (4 pts) Predict the sign of ΔH for each of these phase changes.

	ΔH is
SO <sub>2</sub> (l) → SO <sub>2</sub> (g)	> 0 or < 0
H <sub>2</sub> O(l) → H <sub>2</sub> O(s)	> 0 or < 0
CO <sub>2</sub> (s) → CO <sub>2</sub> (g)	> 0 or < 0
H <sub>2</sub> O(g) → H <sub>2</sub> O(l)	> 0 or < 0

17. (4 pts) Iron forms body-centered unit cells while nickel forms face-centered unit cells. How many atoms are present within each type of unit cell?

Fe	Ni
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18. (5 pts) Perovskite, a mineral containing calcium, oxygen and titanium crystallizes with calcium ions at the corner positions, oxygen ions at the face-centered positions and a titanium ion at the body-centered position. What is the formula for perovskite? Use the format Ca<sub>x</sub>Ti<sub>y</sub>O<sub>z</sub>.



(1 pt) Print your name here:

Answers:

1. 731 K

2. 29.6 L

$$3. d = \frac{MM \times P}{R \times T}$$

4. 3.39 g/L

5. 21 mL O<sub>2</sub>(g)

6. 97.3 kPa

7. 786.8 mmHg

8. 0.675 L

9. 45.3 L

10. 297 g/mol

11a. 0.444

11b. 24.4 L

12.

	Lewis dot	Polar?
CH <sub>4</sub>	AB <sub>4</sub>	No
NH <sub>3</sub>	AB <sub>3</sub> E	Yes
SO <sub>2</sub>	AB <sub>2</sub> E	Yes
SO <sub>3</sub>	AB <sub>3</sub>	No
CO <sub>2</sub>	AB <sub>2</sub>	No

13. Underline all molecules with London dispersion forces: two responses accepted: underline all six OR just the non-gases (LDF are not operative for gases). Circle all molecules with hydrogen bonding: B and E

- A. CH<sub>4</sub>      B. NH<sub>3</sub>      C. N<sub>2</sub>  
D. SH<sub>2</sub>      E. CH<sub>3</sub>OH      F. SO<sub>2</sub>

14. 14kJ

15. Circle:

$$\text{S.H.}_{\text{H}_2\text{O(s)}} = 2.10 \text{ J/g deg} \quad \Delta H_{\text{fus}} = 6.01 \text{ kJ/mol}$$

$$\text{S.H.}_{\text{H}_2\text{O(l)}} = 4.18 \text{ J/g deg}$$

16. > 0; < 0; > 0; and < 0

17. 2 atoms; 4 atoms

18. Ca<sub>1</sub>Ti<sub>1</sub>O<sub>3</sub>