

Name: KEY

Chemistry 121  
Spring 2003  
Exam IV  
50 minutes/100 pts

I. MULTIPLE CHOICE: (30 pts, 3 points each) Carefully and clearly circle the best answer.

1. Which of the following is not a component of Kinetic Molecular Theory?

- C
- a. Gases consist of molecules whose separation is much greater than the size of the molecules themselves.
  - b. The molecules of gas are in continual, random and rapid motion.
  - c. The molecules of gas in a container are very close together.
  - d. All gases, regardless of their molecular mass have the same average kinetic energy at the same temperature.
  - e. Gas molecules collide with each other and walls of the container without loss of energy.

2. Which of the following gas molecules would effuse the quickest?

- D
- a.  $C_5H_{12}$
  - b.  $HNO_3$
  - c.  $Br_2$
  - d.  $CH_3OH$
  - e.  $CO_2$

3. What are standard temperature and pressure conditions for gases?

- E
- a.  $0^\circ C$  and 0 torr
  - b. 0 K and 760 torr
  - c.  $-273^\circ C$  and 1 atm
  - d.  $0^\circ C$  and 1 torr
  - e. 273 K and 1 atm

4. The device used to measure the pressure of a gas in a closed container is called a:

- B
- a. Thermometer
  - b. Manometer
  - c. Barometer
  - d. Tensiometer
  - e. Speedometer

5. At dynamic equilibrium, the pressure of a gas in a closed container is call the:

- B
- a. Gas Pressure
  - b. Vapor Pressure
  - c. Humidity
  - d. Atmosphere
  - e. Dew Point

6. Which of the following elements would be expected to have the lowest boiling point?

- A
- a. He
  - b. Ne
  - c. Ar
  - d. Kr
  - e. Xe

7. Which of the following molecules would exhibit hydrogen bonding in the liquid state?

- a.  $\text{CH}_4$
- b.  $\text{H}_2$
- c.  $\text{NH}_3$
- d.  $\text{H}_2\text{S}$
- e.  $\text{CH}_3\text{F}$

C

8. There are four major types of solids. Which of the following is NOT one of them?

- a. Molecular Solids
- b. Network Covalent Solids
- c. Metallic Solids
- d. Ideal Solids
- e. Ionic Solids

D

9. If the solution outside a cell has a higher concentration than inside the cell, then the solution is termed a

- a. Isotonic solution.
- b. Hypotonic solution.
- c. Hypertonic solution.
- d. Heterogeneous mixture.
- e. Solid.

C

10. Which of the following compounds will be soluble in water?

- a.  $\text{C}_2\text{H}_6$
- b.  $\text{CH}_3\text{OH}$
- c.  $\text{CH}_4$
- d.  $\text{C}_5\text{H}_{12}$
- e.  $\text{C}_{10}\text{H}_{22}$

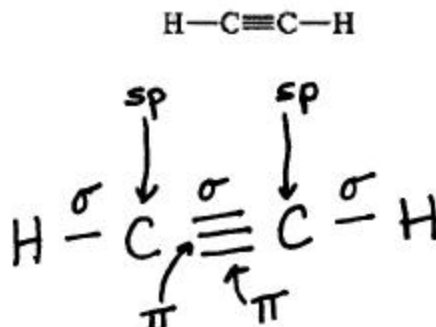
B

**II. Short Answer (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. Under what two conditions does the ideal gas law fail? (i.e. When is it necessary to use the Van der Waal's equation?)

- a. High Pressure
- b. Low Temperature

2. Describe the bonding in the following molecule.



3. What is viscosity?

resistance to flow

4. What does it mean to say "normal freezing point"?

the temperature at which solid and liquid phases coexist at equilibrium at a pressure of 1 atm.

5. What would be the boiling point of an aqueous solution that is made by dissolving 2.00 mol of ethanol in 2.00 kg of water? ( $K_b = 0.512^\circ\text{C kg/mol}$ )

$$\begin{aligned}\Delta T &= K_b C_m \\ &= \frac{0.512^\circ\text{C kg}}{\text{mol}} \left( \frac{2.00 \text{ mol}}{2.00 \text{ kg}} \right) \\ &= 0.512^\circ\text{C}\end{aligned}$$

$$T_b = 100^\circ\text{C} + 0.512^\circ\text{C} = 100.512^\circ\text{C}$$

6. A mixture of 0.080 mol of  $\text{O}_2$  and 0.045 mol of He has a total pressure of 1.75 atm. Determine the partial pressure of each gas in the mixture.

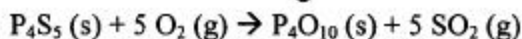
$$\begin{aligned}\chi_{\text{O}_2} &= \frac{0.080}{0.045 + 0.080} = 0.64 & \chi_{\text{He}} &= \frac{0.045}{0.080 + 0.045} \\ & & &= 0.36\end{aligned}$$

$$\begin{aligned}P_{\text{O}_2} &= \chi_{\text{O}_2} P_{\text{total}} \\ &= (0.64)(1.75 \text{ atm}) \\ &= 1.12 \text{ atm}\end{aligned}$$

$$\begin{aligned}P_{\text{He}} &= \chi_{\text{He}} P_{\text{total}} \\ &= (0.36)(1.75 \text{ atm}) \\ &= 0.63 \text{ atm}\end{aligned}$$

7. Sulfur dioxide ( $\text{SO}_2$ ) can be produced from the reaction tetraphosphorous pentasulfide. If 0.300 moles of  $\text{P}_4\text{S}_5$  react with  $\text{O}_2$  gas at a pressure of 1.20 atm, a temperature of  $20^\circ\text{C}$  and a volume of 10.0 L, how many moles of  $\text{SO}_2$  are produced?

Limiting Reactant Problem



$$0.300 \text{ mol} \quad P = 1.20 \text{ atm}$$

$$V = 10.0 \text{ L}$$

$$T = 20^\circ\text{C} + 273 = 293 \text{ K}$$

$$0.300 \text{ mol } \text{P}_4\text{S}_5 \times \frac{5 \text{ mol } \text{SO}_2}{1 \text{ mol } \text{P}_4\text{S}_5} = 1.50 \text{ mol } \text{SO}_2$$

$$PV = nRT$$

$$n_{\text{O}_2} = \frac{PV}{RT} = \frac{(1.20 \text{ atm})(10.0 \text{ L})}{(0.0821 \frac{\text{L atm}}{\text{mol K}})(293 \text{ K})} = 0.499 \text{ mol } \text{O}_2$$

$$0.499 \text{ mol } \text{O}_2 \times \frac{5 \text{ mol } \text{SO}_2}{5 \text{ mol } \text{O}_2} = \boxed{0.499 \text{ mol } \text{SO}_2}$$

$\text{O}_2$  is limiting reactant.

8. In 3-4 grammatically correct sentences, describe how sulfur is introduced unto the atmosphere and how  $\text{SO}_3$  is formed. Make sure you include all appropriate chemical reactions.

Sulfur is one of the many impurities in coal that is released on burning. The free sulfur reacts with oxygen to form  $\text{SO}_2$  ( $\text{S} + \text{O}_2 \rightarrow \text{SO}_2$ ) In the presence of dust particles or UV light,  $\text{SO}_2$  will further react with  $\text{O}_2$  to make  $\text{SO}_3$ . ( $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$ )