CHMY 121
EXAM #4 (CH 8 - 9.9)
March 31, 2010

Name: ____________________________
Also print your name on the back of the exam

PART I  MULTIPLE CHOICE. Choose the correct answer and fill in the scantron. (28 pts)

1. Water has a much higher boiling point than H₂S. Choose the best explanation for this.
   a) Water has stronger dispersion forces than H₂S
   b) Water has hydrogen bonding and H₂S does not.
   c) The S-H covalent bond is stronger than the O-H bond.
   d) H₂S is more polar than H₂O

2. A saturated solution contains
   a) only polar molecules
   b) the maximum amount of solvent
   c) the minimum amount of solute
   d) the maximum amount of solute
   e) the minimum amount of solute

3. We can increase the volume of a gas in an expandable container (such as a balloon) by
   a) increasing the pressure
   b) increasing the temperature
   c) allowing gas to escape
   d) leaving it alone

4. Which of the following processes is exothermic?
   a) A liquid evaporates
   b) A liquid freezes
   c) A solid sublimes
   d) A solid melts

5. Which of these molecules cannot form hydrogen bonds with another molecule of itself?
   a) CH₃CH₂OH
   b) H₃COCH₃
   c) H₃CNHCH₃
   d) HF

6. In the solution process
   a) solute-solute interactions are formed
   b) solute-solvent interactions formed
   c) solvent-solvent interactions are formed
   d) all of the above

7. Which of the following compounds is expected to have the highest boiling point?
   a) CH₃CH₂CH₃
   b) CH₃Cl
   c) CH₃CH₂OH
   d) H₃COCH₃

8. Which state of matter is characterized by random movement of particles within a definite
   volume?
   a) gas
   b) vapor
   c) liquid
   d) solid

9. When a swimmer exhales bubbles at the bottom of a 10 foot pool, as the bubbles travels to
   the surface of the pool the volume of the bubble:
   a) increases
   b) decreases
   c) stays the same
   d) not enough information given


10. Some fish die in warm water. Why?

a) The solubility of oxygen increases with increasing temperature  F
b) The warm water boils the fish  F
c) The solubility of oxygen decreases with increasing temperature  
(d) More diseases thrive in warm water than cold water

11. Nonpolar solvents such as gasoline

a) consist of molecules that are held together by hydrogen bonds.  F 
(b) will dissolve any other liquid  F 
c) consist of atoms linked by ionic bonds  F 
d) will dissolve polar liquids  F 
e) will dissolve nonpolar liquids  T

12. The atmosphere of the imaginary planet Gorp has the following partial pressures of its component gases: 427.7 mmHg O₂, 336.0 mmHg N₂, 38.1 mmHg CO₂, and 510.2 mmHg Ne.

What is the atmospheric pressure of Gorp?

a) 1.000 atm  
b) 760.0 mm Hg  
c) 640.7 mm Hg  
d) 1.726 atm

13. According to the Kinetic Molecular Theory of Gases

a) At lower temperatures gas molecules move faster.  F  
b) Gas molecules attract one another.  F  
c) Gas molecules occupy little or no volume.  T  
d) At low pressure the number of collisions with the container wall increases.  F

14. Which of the following is the strongest electrolyte solution

a) distilled water  
b) 1 M CH₃COOH solution  
c) 1 M sugar solution  
d) 1 M NaCl solution

PART II  SHORT ANSWER

15. (12 pts) Given H₂N-NH₂ and H₃C-CH₃, identify the major intermolecular force that is present in each substance and predict which liquid will have the lowest vapor pressure. Explain your reasoning.

H₂N-NH₂  ⇒  H-bonded to N and N has lone pair so Hydrogen bonding attractive force strongest attractive force harder for gas molecule to escape less gas above liquid so lower vapor pressure

H₃C-CH₃  ⇒  symmetrical molecule so nonpolar  ⇒  London attractive force easier for gas molecule to escape liquid so more gas above liquid therefore higher vapor pressure

H₂N-NH₂ has lowest vapor pressure  +3
PART III For the following problems, SHOW ALL YOUR WORK AND CIRCLE YOUR FINAL ANSWER. Be sure your work is legible. NO credit will be given if no work is shown even if answer is correct!!!

16. (12 pts) At STP it was found that a sample of pure \( \text{O}_2(\text{g}) \) occupied 3.24 L. What is the mass of \( \text{O}_2(\text{g}) \)?

\[
\frac{3.24 \text{ L} \text{O}_2}{22.4 \text{ L/mole O}_2} = 0.14455 \text{ mole O}_2
\]

\[
\text{mole O}_2 \times \frac{32 \text{ g O}_2}{1 \text{ mole O}_2} = 4.63 \text{ g O}_2
\]

17. (12 pts) 30.5mL of a 0.591 M \( \text{NaCl} \) solution must be diluted to make a 0.150 M \( \text{NaCl} \) solution for use in a hospital. What volume of water needs to be added to the stock solution?

\[
\frac{\text{C}_{\text{stock}} \times V_{\text{stock}}}{\text{C}_{\text{dil}}} = \frac{\text{C}_{\text{dil}} \times V_{\text{dil}}}{\text{C}_{\text{stock}}} + 2
\]

\[
\frac{0.591 \text{ M} \times 30.5 \text{ mL}}{0.150 \text{ M}} = 120.17 \text{ mL}
\]

\[
120.3 \text{ mL} = 30.5 \text{ mL} + V_{\text{H}_2\text{O}}
\]

\[
V_{\text{H}_2\text{O}} = 120.17 \text{ mL} - 30.5 \text{ mL} = 89.67
\]

\[
V_{\text{H}_2\text{O}} = 90.0 \text{ mL}
\]

18. (12 pts) A steel scuba tank is filled at 36°C and has a pressure of 1150. mmHg. What will the temperature of the air be in °C if the pressure raises to 4.78 atm?

\[
\frac{PV}{nRT} = \frac{P_1}{T_1} = \frac{nR}{V} = \frac{k}{T} = \frac{P_1}{T_1} = \frac{P_2}{T_2}
\]

\[
P_1 = 1150. \text{ mmHg} \times \left(\frac{1 \text{ atm}}{760 \text{ mmHg}}\right) = 4.78 \text{ atm}
\]

\[
T_1 = 36°C + 273 = 309 K + 1
\]

\[
T_2 = \frac{4.78 \text{ atm} \times 309 K}{1.513158 \text{ atm}} + 1
\]

\[
T_2 = 976 K + 1
\]

\[
K = °C + 273 + 1
\]

\[
°C = K - 273 = 976 K - 273 = 703°C + 1
\]
19. (12 pts) How many grams of sucrose ($C_{12}H_{22}O_{11}$) need to be added to 256.7 g of water to make a 16.1% wt sucrose solution?

\[ \frac{16.1 \text{ g sucrose}}{100 \text{ g soln}} = 16.1\% \text{ wt sucrose} \]

\[ \frac{16.1 \text{ g sucrose}}{256.7 \text{ g H}_2\text{O}} = \frac{x}{100 \text{ g H}_2\text{O}} \]

\[ x \approx 49.3 \text{ g sucrose} \]

20. (12 pt) How many grams of AgCl(s) can be produced in the following reaction using 3.20 L of 1.90 M CaCl$_2$(aq) solution and excess 2.0 M AgNO$_3$(aq) solution?

\[ \text{CaCl}_2(aq) + 2 \text{AgNO}_3(aq) \rightarrow 2 \text{AgCl(s)} + \text{Ca(NO}_3)_{2(aq)} \]

Molarity = \( \frac{\text{mol solute}}{\text{L soln}} \)

\[ 1.90 \text{ M CaCl}_2 \rightarrow \frac{1.90 \text{ mol CaCl}_2}{1 \text{ L soln}} \]

\[ 3.20 \text{ L soln} \times \frac{1.90 \text{ mol CaCl}_2}{1 \text{ L soln}} \times \frac{2 \text{ mol AgCl}}{1 \text{ mol CaCl}_2} \times \frac{143.35 \text{ g AgCl}}{1 \text{ mol AgCl}} = 1740 \text{ g AgCl} \]

EXTRA CREDIT: (10 PTS)
At what temperature, in °C, could a student collect 3.81 L of H$_2$(g), at 0.889 atm, when reacting 3.73 g Cr(s) and excess H$_2$SO$_4$(aq)?

\[ 2 \text{Cr(s)} + 3 \text{H}_2\text{SO}_4(aq) \rightarrow \text{Cr}_2(\text{SO}_4)_3(aq) + 3 \text{H}_2(g) \]

\[ T = \frac{pV}{nRT} + 1 \]

\[ T = \frac{0.889 \text{ atm} \times 3.81 \text{ L H}_2}{0.107 \text{ L atm/mol K} \times 3.73 \text{ g Cr} + 0.0821 \text{ L atm/mol K} + 1} + 1 \]

\[ T = 383 \text{ K} + 1 \]

\[ K = °C + 273 + 1 \]

\[ °C = K - 273 = 383 - 273 = 110 \text{ °C} + 1 \]