Chemistry 222 Sample Exam II Cover Sheet

Winter XXXX

Name: _____

This exam consists of twenty-five (25) multiple-choice questions and three (3) short answer questions with five points of extra credit.

A periodic table and scratch paper are available for you to use on this exam.

Before you start:

- Write your first and last name in the space above
- Sign the integrity statement below. **Failing to sign the integrity statement on this exam imparts an immediate grade of zero.**
- For multiple choice questions: clearly enter your letter answer in the appropriate location. **Circle** the letter which corresponds to your answer.
- For short answer questions: clearly **circle** your final answer, showing all work.

Point values and your exam score will be summarized on the final page

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Integrity statement:

I have neither given nor received aid on this exam.

_____

Your signature

1. Of the following, _____ is the most volatile.

    a. CBr_4
    b. CCl_4
    c. CF_4
    d. CH_4
    e. C_6H_{14}

Letter answer to question #1: _____

2. Potassium metal crystallizes in a body-centered cubic structure with a unit cell edge length of 5.31 Å. The radius of a potassium atom is _____ Å.

    a. 1.33
    b. 1.88
    c. 2.30
    d. 2.66
    e. 5.31

Letter answer to question #2: _____

3. As a solid element melts, the atoms become _____ and they have _____ attraction for one another.

    a. more separated, more
    b. more separated, less
    c. closer together, more
    d. closer together, less
    e. larger, greater

Letter answer to question #3: _____

4. Which one of the following exhibits dipole-dipole attraction between molecules?

    a. XeF_4
    b. AsH_3
    c. CO_2
    d. BCl_3
    e. Cl_2

Letter answer to question #4: _____

5. Based on the following information, which compound has the strongest intermolecular forces?

Substance	ΔH_{vap} (kJ/mol)
Argon (Ar)	6.3
Benzene (C_6H_6)	31.0
Ethanol (C_2H_5OH)	39.3
Water (H_2O)	40.8
Methane (CH_4)	9.2

a. Argon
b. Benzene
c. Ethanol
d. Water
e. Methane

Letter answer to question #5: _____

6. The vapor pressure of any substance at its normal boiling point is

a. 1 bar
b. 1 torr
c. 1 atm
d. equal to atmospheric pressure
e. equal to the vapor pressure of water

Letter answer to question #6: _____

7. The solubility of oxygen gas in water at 25 °C and 1.0 atm pressure of oxygen is 0.041 g/L. The solubility of oxygen in water at 3.0 atm and 25 °C is _____ g/L.

a. 0.041
b. 0.014
c. 0.31
d. 0.12
e. 3.0

Letter answer to question #7: _____

8. A sample of potassium nitrate (49.0 g) is dissolved in 101 g of water at 100 °C with precautions taken to avoid evaporation of any water. The solution is cooled to 30.0 °C and a small amount of precipitate is observed. This solution is _____.

a. hydrated
b. placated
c. saturated
d. unsaturated
e. supersaturated

Letter answer to question #8: _____

9. The concentration of urea in a solution prepared by dissolving 16 g of urea in 39 g of H_2O is _____% by mass. The molar mass of urea is 60.0 g/mol.

    a. 29
    b. 41
    c. 0.29
    d. 0.41
    e. 0.48

Letter answer to question #9: _____

10. The concentration of KBr in a solution prepared by dissolving 2.21 g of KBr in 897 g of water is _____ molal.

    a. 2.46
    b. 0.0167
    c. 0.0207
    d. 2.07×10^{-5}
    e. 0.0186

Letter answer to question #10: _____

11. A solution is prepared by dissolving 15.0 g of NH_3 in 250.0 g of water. The density of the resulting solution is 0.974 g/mL. The molarity of NH_3 in the solution is _____.

    a. 0.00353
    b. 0.882
    c. 60.0
    d. 3.24
    e. 3.53

Letter answer to question #11: _____

12. The concentration of sodium chloride in an aqueous solution that is 2.23 M and that has a density of 1.01 g/mL is _____% by mass.

    a. 2.21
    b. 7.83
    c. 45.3
    d. 12.9
    e. 10.1

Letter answer to question #12: _____

13. The vapor pressure of pure water at 25 °C is 23.8 torr. What is the vapor pressure (torr) of water above a solution prepared by dissolving 18.0 g of glucose (a nonelectrolyte, MW = 180.0 g/mol) in 95.0 g of water?

    a. 24.3
    b. 23.4
    c. 0.451
    d. 0.443
    e. 23.8

Letter answer to question #13: _____

14. Determine the freezing point (°C) of a 0.015 molal aqueous solution of $MgSO_4$. The molal freezing-point-depression constant of water is 1.86 °C/m. *Note:* Check your van't Hoff factor!

    a.   -0.056
    b.   -0.028
    c.   -0.17
    d.   -0.084
    e.   0.000

Letter answer to question #14: _____

15. The equation which represents the number of atoms in a face-centered cubic unit cell is

    a. $8(1/8) + 4(1/2)$
    b. $4(1/4) + 4$
    c. $6(1/4) + 6(1/2)$
    d. $8(1/8) + 4(1/4) + 2(1/2)$
    e. $8(1/8) + 6(1/2)$

Letter answer to question #15: _____

16. Which of the following aqueous solutions would have the highest vapor pressure at 25 °C?

    a.   pure water
    b.   1 m glucose ($C_6H_{12}O_6$)
    c.   1 m $NaNO_3$
    d.   1 m $MgCl_2$
    e.   1 M $(NH_4)_2SO_4$

Letter answer to question #16: _____

17. What intermolecular force or bond is primarily responsible for the solubility of H_2S in water?

    a.   ion-dipole force
    b.   dipole-dipole force
    c.   ionic bonding
    d.   covalent bonding
    e.   hydrogen bonding

Letter answer to question #17: _____

18. What is the solute mole fraction of 1.98 m $Fe(NO_3)_3(aq)$? The molar mass of $Fe(NO_3)_3$ is 241.9 g/mol and the molar mass of water is 18.02 g/mol.

    a.   0.0345
    b.   0.0641
    c.   0.324
    d.   0.479
    e.   0.863

Letter answer to question #18: _____

19. Concentrated hydrofluoric acid is 28.9 M and has a density of 1.18 g/mL. What is the weight percent of concentrated HF?

    a.   24.5%
    b.   49.0%
    c.   51.0%
    d.   68.2%
    e.   75.5%

Letter answer to question #19: _____

20. The Henry's law constant for N_2 in water at 37 °C is 8.2×10^{-7} M/mm Hg. What is the equilibrium concentration of N_2 in water when the partial pressure of N_2 is 634 mm Hg?

    a. 1.3×10^{-9} M
    b. 5.2×10^{-4} M
    c. 1.9×10^{-2} M
    d. 1.9×10^{3} M
    e. 7.7×10^{8} M

Letter answer to question #20: _____

21. For $NH_4NO_3(aq)$, the solvent is

    a. NH_4NO_3
    b. NH_4^+
    c. NO_3^{1-}
    d.   water
    e.   Duff beer

Letter answer to question #21: _____

22. Which of the following exhibits hydrogen bonding in the liquid state?

    a. C_2H_5OH
    b. CH_4
    c. $CHCl_3$
    d. CHF_3
    e.   none of the above

Letter answer to question #22: _____

23. Which of the following exhibits ion-ion bonding in the solid state?

    a. P_2O_5
    b. SO_2
    c. $SiCl_4$
    d. NOF_2
    e. UF_6

Letter answer to question #23: _____

24. Of the following, _____ has the highest boiling point.

    a. N_2
    b. Br_2
    c. H_2
    d. Cl_2
    e. O_2

Letter answer to question #24: _____

25. Of the following, _____ is an exothermic process.

   a. melting
   b. subliming
   c. freezing
   d. boiling
   e. All of the above are exothermic.

Letter answer to question #25: _____

Part II: Short Answer / Calculation. *Show all work!*

1. The fluorocarbon $C_2Cl_3F_3$ has a normal boiling point of 47.6 °C. The specific heats of $C_2Cl_3F_3(l)$ and $C_2Cl_3F_3(g)$ are 0.910 J/g-K and 0.670 J/g-K, respectively. The heat of vaporization of the compound is 27.49 kJ/mol. Calculate the heat, q, required to convert 50.0 g of the compound from the liquid at 5.0 °C to the gas at 80.0 °C in **kilojoules** (kJ). (10 points)

2. What would be the value of q if the sample in problem #1, above, if the gas at 80.0 °C was cooled to a liquid at 5.0 °C? (5 points)

3. What is the molar mass of a nonelectrolyte if 6.02 grams dissolved in 30.0 grams of benzene freezes at −1.55 °C? The freezing point of pure benzene is 5.50 °C and the freezing point depression constant, K_{fp}, is −5.12 °C/m. (10 points)

4. Concentrated aqueous sulfuric acid has a density of 1.84 g/cm³ and is 95.0% by weight H_2SO_4. What is the molarity of this acid? What is the molality? (10 points)

Multiple choice questions:

_____   X *4 points per question*   =   _____ points
*number of multiple choice
questions correct*

Short answer questions:

_____ points

Total points on this exam:

_____ points

Grade	Percentage	Points on This Exam
A	90% - 100%	117 - 130
B	80% - 89%	104 - 116
C	67% - 79%	87 - 103
D	57% - 64%	74 - 86
F	0% - 56%	0 - 73

Part I: Multiple Choice Questions

1. D
2. C
3. B
4. B

5. D
6. C
7. D
8. C

9. A
10. C
11. D
12. D
13. B

14. A
15. E
16. A
17. B
18. A

19. B
20. B
21. D
22. A
23. E
24. B

25. C

Part II: Short Answer / Calculation.

1. 10.36 kJ
2. -10.36 kJ
3. 146 g/mol
4. 190 m, 17.8 M