Chemistry 222 Sample Final Exam Cover Sheet

Winter XXXX

Name: _____

This exam consists of thirty-two (32) multiple-choice questions and five (5) short answer questions.

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

Before you start:

- **Turn in** the **Take Home Lab Final** and the **Final Exam Prep** worksheet ***before*** starting this exam
- 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.

Integrity statement:

I have neither given nor received aid on this exam.

_____

Your signature

1. Atomic number describes the number of _____ in an atom.

   a. protons
   b. neutrons
   c. electrons
   d. a and b
   e. all of the above

Letter answer to question #1: _____

2. Which of the following symbols represents an alpha particle?

   a. $^{4}_{2}\mathrm{He}$
   b. $^{2}_{4}\mathrm{He}$
   c. $^{0}_{+1}\mathrm{e}$
   d. $^{0}_{-1}\mathrm{e}$
   e. $^{1}_{0}\mathrm{n}$

Letter answer to question #2: _____

3. The most penetrating type of radiation is a(n)

   a. alpha particle
   b. beta particle
   c. gamma ray
   d. positron
   e. cathode ray

Letter answer to question #3: _____

4. If plutonium-244 decays by successive **α, β, β, α** emissions, what nucleus is produced?

   a. $^{236}_{88}\mathrm{Ra}$
   b. $^{236}_{89}\mathrm{Ac}$
   c. $^{236}_{90}\mathrm{Th}$
   d. $^{240}_{90}\mathrm{Th}$
   e. $^{236}_{92}\mathrm{U}$

Letter answer to question #4: _____

5. If Ag-106 decays by electron capture, what is the product?

a. $^{105}_{46}\text{Pd}$
b. $^{106}_{46}\text{Pd}$
c. $^{105}_{47}\text{Ag}$
d. $^{106}_{48}\text{Cd}$
e. $^{107}_{47}\text{Ag}$

Letter answer to question #5: _____

6. By what (single step) process does polonium-211 decay to lead-207?

a. α particle emission
b. β particle emission
c. positron emission
d. electron capture
e. neutron capture

Letter answer to question #6: _____

7. The decay of radioactive elements is a first-order process. The half-life of carbon-14 is 5730 years. How many years will it take for 5.0 g of carbon-14 to decay to 1.0 mg?

a. 5730 years
b. 17,200 years
c. 24,900 years
d. 57,300 years
e. 70,400 years

Letter answer to question #7: _____

8. Given the initial rate data for the reaction A + B → C, determine the rate expression for the reaction.

[A], M	[B], M	$\Delta[C]/\Delta t$ (initial) M/s
0.334	0.134	4.11×10^{-9}
0.334	0.187	8.00×10^{-9}
0.668	0.134	4.11×10^{-9}

a. $\frac{\Delta[C]}{\Delta t} = 2.75 \times 10^{-7}\ M^{-2}s^{-1}[A]^2[B]$
b. $\frac{\Delta[C]}{\Delta t} = 3.07 \times 10^{-8}\ s^{-1}[B]$
c. $\frac{\Delta[C]}{\Delta t} = 2.29 \times 10^{-7}\ M^{-1}s^{-1}[B]^2$
d. $\frac{\Delta[C]}{\Delta t} = 6.85 \times 10^{-7}\ M^{-2}s^{-1}[A][B]^2$
e. $\frac{\Delta[C]}{\Delta t} = 1.23 \times 10^{-8}\ s^{-1}[A]$

Letter answer to question #8: _____

9. For a zero order reaction, which of the following (if plotted versus time) should give a straight line?

   a. ln [A]
   b. ln k
   c. ln [1/A]
   d. 1/[A]
   e. [A]

Letter answer to question #9: _____

10. In basic solution, $(CH_3)_3CCl$ reacts according to the equation:

   $(CH_3)_3CCl + OH^- \rightarrow (CH_3)_3COH + Cl^-$

   The accepted mechanism for the reaction is

   $(CH_3)_3CCl \rightarrow (CH_3)_3C^+ + Cl^-$ (slow)

   $(CH_3)_3C^+ + OH^- \rightarrow (CH_3)_3COH$ (fast)

   What is a rate law that is consistent with the mechanism for this reaction?

   a. rate = $k[(CH_3)_3CCl]$
   b. rate = $k[(CH_3)_3CCl][OH^-]$
   c. rate = $k[(CH_3)_3C^+][OH^-]$
   d. rate = $k[(CH_3)_3CCl][OH^-]/[Cl^-]$
   e. rate = $k[(CH_3)_3CCl][OH^-]/[Cl^-]$

Letter answer to question #10: _____

11. The elementary steps for the catalyzed decomposition of dinitrogen monoxide are shown below.

   $2\ N_2O(g) + 2\ NO(g) \rightarrow 2\ N_2(g) + 2\ NO_2(g)$

   $2\ NO_2(g) \rightarrow 2\ NO(g) + O_2(g)$

   Which of the following statement(s) is/are CORRECT?

   1. The overall balanced reaction is $2\ N_2O(g) \rightarrow 2\ N_2(g) + O_2(g)$.
   2. NO(g) is a catalyst for the reaction.
   3. $N_2(g)$ is a reaction intermediate.

   a. 1 only
   b. 2 only
   c. 3 only
   d. 1 and 2
   e. 1, 2, and 3

Letter answer to question #11: _____

12. What is the half-life for a first-order reaction with a rate constant of 0.291 s^{-1}?

   a. 0.420 s
   b. 1.93 s
   c. 2.38 s
   d. 6.87 s
   e. 13.1 s

Letter answer to question #12: _____

13. The effect of adding a catalyst to a reaction is to

   a. increase the number of collisions between reactants
   b. increase the energy of the products
   c. increase the equilibrium constant of a reaction
   d. lower the activation energy of a reaction
   e. decrease the enthalpy change of a reaction

Letter answer to question #13: _____

14. If 0.3000 g of impure soda ash (Na_2CO_3) is titrated with 17.66 mL of 0.1187 M HCl, what is the percent purity of the soda ash?

$$Na_2CO_3(aq) + 2\ HCl(aq) \rightarrow 2\ NaCl(aq) + H_2O(l) + CO_2(g)$$

a. 11.11%
b. 22.22%
c. 57.91%
d. 37.03%
e. 74.06%

Letter answer to question #14: _____

15. Which of the following combinations is most likely to produce an ionic bond?

a. Cl and Br
b. P and S
c. N and O
d. B and O
e. Li and F

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. When 27.0 g of an unknown metal at 88.4 °C is placed in 115 g H_2O at 21.0 °C, the final temperature of the water is 23.7 °C. What is the specific heat capacity of the metal?

a. 0.34 J/g·K
b. 0.51 J/g·K
c. 0.74 J/g·K
d. 0.94J/g·K
e. 1.4 J/g·K

Letter answer to question #17: _____

18. Calculate the amount of heat required to change 50.0 g ice at –20.0 °C to steam at 135 °C. (Heat of fusion = 333 J/g; heat of vaporization = 2260 J/g; specific heat capacities: ice = 2.09 J/g·K, steam = 1.84 J/g·K)

a. 4.18 kJ
b. 32.4 kJ
c. 78.8 kJ
d. 135 kJ
e. 156 kJ

Letter answer to question #18: _____

19. Hydrazine, N_2H_4, is a liquid used as a rocket fuel. It reacts with oxygen to yield nitrogen gas and water: **$N_2H_4(l) + O_2(g) \rightarrow N_2(g) + 2\ H_2O(l)$** The reaction of 3.80 g N_2H_4 evolves 73.7 kJ of heat. Calculate the enthalpy change per mole of hydrazine combusted.

a. -8.74 kJ/mol
b. -19.4 kJ/mol
c. -2.80×10^2 kJ/mol
d. -622 kJ/mol
e. -8.98×10^3 kJ/mol

Letter answer to question #19: _____

20. Which of the following chemical equations corresponds to the standard molar enthalpy of formation of N_2O?

a. $NO(g) + 1/2\ N_2(g) \rightarrow N_2O(g)$
b. $N_2(g) + 1/2\ O_2(g) \rightarrow N_2O(g)$
c. $2N(g) + O(g) \rightarrow N_2O(g)$
d. $N_2(g) + O(g) \rightarrow N_2O(g)$
e. $2\ N_2(g) + O_2(g) \rightarrow 2\ N_2O(g)$

Letter answer to question #20: _____

21. Determine ΔH for the reaction: **$N_2(g) + 3\ H_2(g) \rightarrow 2\ NH_3(g)$** given the thermochemical equations below.

$N_2(g) + O_2(g) \rightarrow 2\ NO(g)$ $\Delta H = +180.8$ kJ
$4\ NH_3(g) + 5\ O_2(g) \rightarrow 4\ NO(g) + 6\ H_2O(g)$ $\Delta H = -906.2$ kJ
$2\ H_2(g) + O_2(g) \rightarrow 2\ H_2O(g)$ $\Delta H = -483.6$ kJ

a. -1209.0 kJ
b. -1189.0 kJ
c. -756.5 kJ
d. -241.8 kJ
e. -91.5 kJ

Letter answer to question #21: _____

22. My reaction 'feels hot', and scientists refer to this reaction as:

a. endothermic
b. exothermic
c. enthalpy disfavored
d. enthalpy wannabe
e. lame *(this is not the correct answer! :)*

Letter answer to question #22: _____

23. The empirical formula of a certain hydrocarbon is CH_2. When 0.120 mole of the hydrocarbon is completely combusted with excess oxygen, 17.7 L CO_2 gas is produced at 27 °C and 1.00 atm. What is the molecular formula of the hydrocarbon?

a. C_2H_2
b. C_2H_4
c. C_3H_6
d. C_5H_{10}
e. C_6H_{12}

Letter answer to question #23: _____

24. An unknown gaseous hydrocarbon contains 85.63 % C. Its density is 0.426 g/L at 0.465 atm and 373 K. What is the molecular formula of the gas?

    a. C_2H_4
    b. C_3H_6
    c. C_4H_8
    d. C_5H_{10}
    e. C_6H_{12}

Letter answer to question #24: _____

25. 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 #25: _____

26. 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 #26: _____

27. 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 #27: _____

28. 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 #28: _____

29. Which of the following species will have a Lewis structure most like that of a sulfate ion, SO_4^{2-}? Assume that the Lewis structure has no double bonds.
    a. NH_3
    b. CBr_4
    c. SO_3
    d. H_2CO
    e. H_2O

Letter answer to question #29: _____

30. Which intermolecular force is the strongest?

    a. induced dipole - induced dipole (ID-ID)
    b. ion-dipole
    c. hydrogen bonding
    d. dipole-dipole
    e. ion-ion

Letter answer to question #30: _____

31. 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 #31: _____

32. When making pasta, adding salt to water will _____ the boiling point of the water.

    a. increase
    b. decrease
    c. have no effect
    d. ionize
    e. more information is needed to answer this question

Letter answer to question #32: _____

Part II: Short Answer / Calculation, 20 points total. *Show all work!*

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1. List the following constants and values, and include units. (10 points)

   gas constant (R) when used with the ideal gas equation to five sig figs =

   gas constant (R) when used with the Arrhenius equation to five sig figs =

   Avogadro's number (N) to four sig figs =

   the molar mass of ammonia to four sig figs =

   the molar mass of water to four sig figs =

2. Convert the following using correct significant figures: (10 points)

   370 mL to L

   43 m to cm

   150 °C to K

   128 cm^3 to mL

   150 s to minutes

CH 222 Final Lecture Exam Point Distribution Sheet

*Avoid a point penalty - do **not** write on this page!*

Multiple choice questions:

_____ X *5 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%	162 - 180
B	80% - 89%	144 - 161
C	67% - 79%	120 - 143
D	57% - 64%	102 - 119
F	0% - 56%	0 - 101

Part I: Multiple Choice Questions

1. A
2. A
3. C
4. E

5. B
6. A
7. E
8. C

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

14. D
15. E
16. A
17. C
18. E

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

24. A
25. B
26. A
27. B
28. B

29. B
30. E
31. D
32. A

Part II: Short Answer / Calculation.

1. List the following constants, and include units, to four significant figures. (10 points)

   0.082057 L*atm/mol*K
   8.3145 J/mol*K
   6.022×10^{23} /mol
   17.04 g/mol
   18.02 g/mol

2. Convert the following using correct significant figures: (10 points)

   0.37 L
   4.3×10^{3} cm
   420 K
   128 mL
   2.5 minutes