EXAM ONE **CHM 205 (Dr. Mattson)** **25 JANUARY 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. If you need more space, you may use the back of your data sheet — Write: "See attached" in box and then staple the data sheet to the exam when you turn it in (DocM has a stapler.) BOX YOUR ANSWERS! Write legibly.

CHAPTER 11. SOLUTIONS

1. (6 pts) Circle the solutes listed below that are expected to be soluble in water.

$(NH_4)_2SO_4$	$NaIO_3$	NH_3
CCl_4	C_5H_{12}	AgCl

2. A solution consists of 19.6 g NH_4I (0.171 mol) in 85.0 g H_2O (4.72 mol.)

(a) (5 pts) What is the mole fraction of the solute?

(b) (5 pts) What is the mass percent of the solute?

(c) (5 pts) What is the molality of the solute?

3. (6 pts) What is the mass percent of a solution of Br_2 (MM = 159.8 g/mol) in CCl_4 (MM = 153.8 g/mol) if the solution is 0.257 molal Br_2?

4. (6 pts) What is the molality of an aqueous solution of potassium bromide if the boiling point is raised by 5.7 degrees? [K_b = 0.51 deg/molal]

5. (5 pts) What is the mole fraction of a 1.237 molar nitric acid solution, HNO_3(aq) [MM = 63 g/mol], if its density is 1.057 g/mL?

6. (5 pts) Suppose 4.49 g of an unknown salt, thought to be a Group II nitrate (e.g. $Mg(NO_3)_2$) was dissolved in 60.00 g water and the freezing point was found to be –1.6 °C. What is the molar mass of the unknown? [K_f = 1.86 deg/molal]

7. (5 pts) A non-polar hydrocarbon solvent has a normal vapor pressure of 78.55 mmHg at 25 °C. Suppose a non-volatile solute was dissolved in this solvent and the vapor pressure dropped to 65.33 mmHg. What is the mole fraction of the solute?

8. (5 pts) The value of ***i***, the van't Hoff factor, is related to the % dissociation for weak acids, which are known to be weak electrolytes. If ***i*** is 1.00, the acid is 0% dissociated into ions, For example, if ***i*** = 1.32, the acid is 32% dissociated, and if ***i*** is 1.99, the acid is 99% dissociated. For 100% dissociated acids, ***i*** is 2.00. What is the percent dissociation of a 2.10 M acid that has an osmotic pressure of 55 atm at 298 K? [R = 0.0821 L atm/mol K]

CHAPTER 12. KINETICS

9. (5 pts) Consider the reaction:

$$N_2(g) + 3\ H_2(g) \rightarrow 2\ NH_3(g)$$

If the rate at some point was given by $-\Delta[N_2]/\Delta t = 5.5 \times 10^{-3}$ mol/L s, what is the rate in terms of $\Delta[NH_3]/\Delta t$ at the same point in time?

10. Consider the reaction:

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

(a) (5 pts) If the reaction proves to be second order in NO and first order in O_2, what is the rate law?

(b) (4 pts) How would the reaction rate change if both concentrations of O_2 and NO were doubled?

The rate would [Circle: increase/decrease] by a factor of [ ] times the original rate.

11. (6 pts) Consider the reaction, A → 2 B for which the following initial-concentration-initial rate data are provided. What is the rate law?

Expt	$[A]_o$(mol/L)	$-\Delta[A]/\Delta t_o$(mol/L s)
1	0.63	2.41×10^{-3}
2	0.92	2.43×10^{-3}

12. Consider the following reaction that gives a linear plot when $\ln[NO_2Cl]$ is plotted vs. time.

$$2\ NO_2Cl(g) \rightarrow 2\ NO_2(g) + Cl_2(g)$$

Time (s)	$[NO_2Cl]_t$(mol/L)
0	0.622
100	0.356
200	0.203
300	0.116

(a) (3 pts) What is rate law?

(b) (6 pts) What is the value of the rate constant (with units)?

(c) (6 pts) What is $[NO_2Cl]$ after 75 s?

(d) (5 pts) What is the half-life of the reaction, in seconds?

13. (6 pts) A reaction, R → P, is know to be second order with k = 0.0401 L/mol min. What is [R] after 20.0 min if it $[R]_o$ = 0.89 M?

I'm in: ☐ Section A (8:30) or ☐ Section F (12:30)
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Your exam score (100 possible): _____
Determine your grade:
A+ ≥ 95; A ≥ 90; B+ ≥ 85; B ≥ 80; C+ ≥ 75; C ≥ 70; D ≥ 60

ANSWERS:

CHAPTER 11. SOLUTIONS

1. Circled: $(NH_4)_2SO_4$, $NaIO_3$ and NH_3

2. (a) 0.035

(b) 18.7%

(c) 2.01 molal

3. 3.94 mass percent

4. 5.59 molal Br_2

5. 0.0222

6. 261 g/mol

7. 0.168

8. 7.0%

CHAPTER 12. KINETICS

9. $\Delta[NH_3]/\Delta t = 1.1 \times 10^{-2}$ mol/L s

10. (a) rate = $[NO]^2[O_2]$

(b) The rate would increase by a factor of $2^2*2 = 8$ times the original rate.

11. zero order; rate = k

12. (a) rate = $k[NO_2Cl]$

(b) $k = 5.6 \times 10^{-3}$ s^{-1}

(c) $[NO_2Cl] = 0.409$ M

(d) 124 s

13. $[R]_t = 0.52$ M?