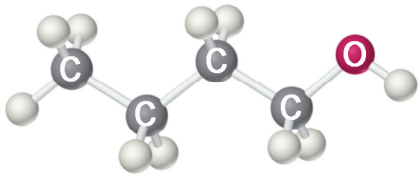
Exam One **CHM 205 (Dr. Mattson)** **30 January 2009**	***Academic Integrity Pledge:*** *In keeping with Creighton University's ideals and with the Academic Integrity Code adopted by the College of Arts and Sciences, I pledge that this work is my own and that I have neither given nor received inappropriate assistance in preparing it.* **Signature:**

Instructions: Show all work whenever a calculation is required! You will receive credit for <u>how</u> you worked each problem as well as for the correct answer. This exam is worth 100 points. BOX YOUR ANSWERS!

1. (6 pts) Circle the substances that are water-soluble?

KNO_3	CH_3NH_2	$CaCl_2$
CH_4	H_2S	C_2H_5OH

2. (4 pts) The structure of butanol, C_4H_9OH, is shown below. Butanol dissolves in both polar and non-polar solvents. Circle the region of the molecule that accounts for butanol's solubility in non-polar solvents and draw a box around the part of the molecule that accounts for butanol's solubility in polar solvents.



3 Xylose has the formula $C_5H_{10}O_5$ (MM = 150 g/mol). Suppose that 52.3 g xylose was dissolved in 75.0 g water.

(a) (5 pts) What is the molality?

(b) (5 pts) What is the mole fraction of xylose?

(c) (5 pts) What is the mass percent of xylose?

4. (6 pts) What is the mole fraction of magnesium bromide in an aqueous solution that is 0.5578 molal $MgBr_2$ (MM = 184.3 g/mol)?

5. (6 pts) Aqueous ammonia, NH_3(aq) (MM = 17 g/mol) is sold as a 14.8 M solution with a density known to be 0.90 g/mL. What is the molality of ammonia in this solution?

6. (5 pts) Chloroform has a normal boiling point of 61.7 ^oC. Its K_b value is 3.63 deg/molal. What is the boiling point of a 0.95 molal solution of naphthalene, a non-volatile solute, in chloroform?

7. (6 pts) Suppose that a solution containing 4.50 g naphthalene was dissolved in 25.0 g chloroform and the resulting solution exhibited a boiling point that was 5.10 degrees higher than that for pure chloroform. What is the MM for naphthalene? Note: K_b value is 3.63 deg/molal.

8. (2 pts) Consider the following aqueous solutions. Circle the solution with the highest expected freezing point. Draw a square around the solution with the lowest expected freezing point.

A. 0.20 molal $C_5H_{10}O_5$ B. 0.20 molal NaCl

C. 0.20 molal K_2S D. 0.20 molal Na_3PO_4

9. In class we studied the kinetics of the reaction below.
(a) (8 pts) Complete the table that follows.

$$2\ N_2O_5(g) \rightarrow 4\ NO_2(g) + O_2(g)$$

Time (s)	$[N_2O_5]$	$[NO_2]$	$[O_2]$
0	0.0200	0	0
300	0.0120		
600	0.0072		

(b) (4 pts) Suppose that under certain conditions, it was known that the rate of the reaction was

$$\text{rate} = -\Delta[N_2O_5]/\Delta t = 0.0038 \text{ mol } N_2O_5/\text{L s}.$$

Under these same conditions, what is the rate in terms of $\Delta[O_2]/\Delta t$?

(c) (3 pts) By doing a time - concentration study on these data, we can determine that the reaction follows first order kinetics. What is the rate law?

(d) (5 pts) Determine the value of the rate constant, k. Be sure to provide the correct units.

Note regarding parts (e) - (g): If you were unable to do part (d), use $k = 0.0019\ s^{-1}$ for the next two questions.

(e) (5 pts) Using the rate constant that you determined in part (d), determine the $[N_2O_5]$ after t = 425 s.

(f) (5 pts) Again using the rate constant that you determined in part (d), determine low long it takes for the concentration to drop from 0.0200 M to 0.0090 M

(g) (5 pts) What is the predicted rate of the reaction when $[N_2O_5] = 0.073$ M?

10. (5 pts) In order to determine the order of a certain reaction (A → B), an initial concentration – initial rate study was conducted yielding the following results: What is the order of the reaction?

Initial [A], $[A]_0$ (mol/L)	Initial rate = $-\Delta[A]/\Delta t$ (mol/L min)
0.038	1.07×10^{-4}
0.055	2.24×10^{-4}
0.091	6.14×10^{-4}

11. Consider the following data for the reaction A → B:

Time (min)	[A]
0	0.855
5	0.751
10	0.647
15	0.543

(a) (4 pts) What is the order of the reaction? Show work above. Circle: Zero First Second

(b) (2 pts) What is the rate law?

(c) (4 pts) What is the value of the rate constant?

Print your name here and sign Academic Integrity Statement.

	Lab Station:

Print your name on the data sheet and turn it in with the exam if you have done work on the data sheet <u>for me to grade</u>. If not, just place the data sheet in the separate pile when turning in the exam.

Do you want to receive grade reports via e-mail this semester? Circle: Yes or No.

Your exam score (100 possible): _____

Determine your grade:
A+ ≥ 95; A ≥ 90; B+ ≥ 85; B ≥ 80; C+ ≥ 75; C ≥ 70; D ≥ 60

Answers

1. Circle KNO_3, CH_3NH_2, $CaCl_2$, H_2S, C_2H_5OH

2. Circle the C_4H_9 region of the molecule and draw a box around the OH part of the molecule.

3

(a) 4.65 molal

(b) 0.077

(c) 41.1%

4. 0.00994

5. 22.8 molal

6. 65.2 ^oC

7. MM = 128 g/mol

8. Circle A and box D

9. In class we studied the kinetics of the reaction below.

(a) (8 pts) Complete the table that follows.

$$2\ N_2O_5(g) \rightarrow 4\ NO_2(g) + O_2(g)$$

Time (s)	**$[N_2O_5]$**	**$[NO_2]$**	**$[O_2]$**
0	0.0200	0	0
300	0.0120	0.0160	0.0040
600	0.0072	0.0256	0.0064

(b) rate = $-\Delta[O_2]/\Delta t$ = 0.0019 mol O_2/L s

(c) rate = $k[N_2O_5]$

(d) k = 1.70×10^{-3} s^{-1}

(e) $[N_2O_5]$ = 0.00971 M

(f) 469 s

(g) rate = 1.24×10^{-4} mol/L s

10. second order

11.

(a) Zero

(b) rate = k

(c) k = 0.0208 mol/L s