Exam 1 Chm 205 (Dr Mattson) 7 February 2014

Name:

Academic Integrity Pledge: In keeping with Creighton University's ideals and with the Academic Integrity Code, I pledge that this work is my own and that I have neither given nor received inappropriate assistance in preparing it.

Signature:

Circle your Folder group:

H   He   Li   Be   B   C   N   O   F   Ne   Na   Mg   Al   Si

Instructions: Show all work whenever a calculation box is provided! Write legibly. Include units whenever appropriate. 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 the data sheet provided — Write: "See attached" in the answer box and then hand in the data sheet with your exam. On your desk you are allowed only pencils (but no pencil pouch), an eraser, and a non-programmable calculator without a slipcover. Backpacks and purses must be closed and stored on the floor under the table. Cell phones must be OFF and placed in your backpack/purse – not in your pocket.

1. (1 pt) Which one hydrocarbon is incorrectly named?

   A. CH_4, methane   B. CH_3CH_3, ethane

   C. $CH_3CH_2CH_3$, triane   D. $CH_3CH_2CH_2CH_3$, butane

   E. $CH_3CH_2CH_2CH_2CH_3$, pentane

   F. $CH_3CH_2CH_2CH_2CH_2CH_3$, hexane

2. Use these compounds to answer Questions 2a-2c.

A   B   C
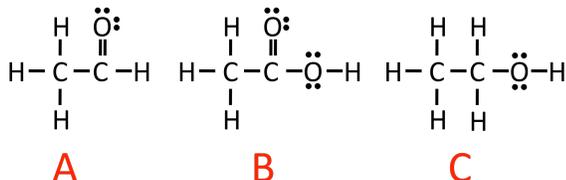
2a. (3 pts) Match the compound with functional group:

   A.   The aldehyde is: **A   B   C**

   B.   The alcohol is: **A   B   C**

   C.   The carboxylic acid is: **A   B   C**

2b. (3 pts) Which compound(s) exhibit hydrogen-bonding?
   Circle your choice(s):   **A   B   C**

2c. (3 pts) Are these the correct names for **A   B** and **C** ?

   A. **A** is methanal   **Circle: Yes** or **No**

   B. **B** ethanoic acid   **Circle: Yes** or **No**

   C. **C** ethanal   **Circle: Yes** or **No**

4. (2 pts) Which compound is more likely to be miscible with the solvent indicated.

   A. Miscible in water: **Circle:** propanol or hexanol

   B. Miscible in pentane: **Circle:** hexane or ethanoic acid

5. (4 pts) Predict which of these combinations of solute and solvent should form solutions. Circle **Yes** if the solute is soluble in the solvent.

   A. Methanoic acid and water   **Circle: Yes** or **No**

   B. Hexane and water   **Circle: Yes** or **No**

   C. Calcium nitrate and water   **Circle: Yes** or **No**

   D. Calcium nitrate and hexane   **Circle: Yes** or **No**

6. (1 pt) What is the formula you would use to solve problems involving osmotic pressure of an aqueous solution of an ionic substance? Hint: Π =

7. A 3.01 molal solution of NaCl (MM = 58.5 g/mol) in water (MM = 18.0 g/mol) has a density of 1.112 g/mL. (Optional: Use this grid to organize the information.)

	Mass	Moles	Volume

7a. (4 pts) What is the mass percent of the solute?

   Answer with units:_____

7b. (4 pts) What is the mole fraction of H_2O?

   Answer:_____

7c. (4 pts) What is the molarity of the solution?

   Answer with units:_____

7d. (4 pts) What is the freezing point of the solution, assuming complete dissociation? [K_f = 1.86 deg/molal]

   Answer with units:_____

8. (4 pts) When 7.10 g anthracene, a non-volatile, non-electrolyte, is dissolved in 55.0 g camphor, the freezing point drops by 27.2 deg. What is the MM of anthracene? [Given: K_f = 37.5 deg/molal]

   Answer with units:_____

9. (3 pts) The average concentration of Pb^{2+} (atomic mass 207.2 g/mol) in public drinking water in the US is 2.8 ppb. Express this concentration in units of molarity. Assume the density of water is 1.00 g/mL.

Answer with units:_____

10. (3 pts) The vapor pressure of CH_2Cl_2 is 349 mmHg at 20.0 ^oC. What is the vapor pressure of a solution consisting of 4.20 mol of naphthalene, a non-volatile solute, and 5.10 mol CH_2Cl_2?

Answer with units:_____

11. (4 pts) Use these initial concentration and initial rate data to determine the order for this reaction. Show your work for credit.

$CH_3CHO(g) \rightarrow CH_4 + CO(g)$

Initial $[CH_3CHO]_0$	Init Rate (mol/L s)
0.450 M	0.00068
0.625 M	0.00131
0.730 M	0.00179
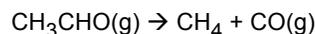
Order:_____

12. Consider the time and concentration table and graphs on the data page, describing the following reaction, which takes place at 500 ^oC: $CH_3CN(g) \rightarrow CH_3NC(g)$

12a. (4 pts) What is the order of the reaction? CAUTION! No partial credit! Use a straight edge (edge of this exam) to evaluate the graphs.

12b. (2 pts) What is the rate expression?

12c. (1 pt) What do you predict would occur if the reaction took place at 600 ^oC? The $[CH_3CN]$ would:

A. decrease faster.   B. decrease slower.

C. remain the same.   D. cannot predict.

13a. (4 pts) Consider the data for the reaction, known to be first order:

$C_4H_8 \rightarrow 2\ C_2H_4$
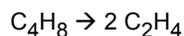
What is the rate constant, with proper units?

Time (s)	$[C_4H_8]$
0	1.000
10	0.894
20	0.799
30	0.714
40	0.638

Answer with units:_____

13b. (3 pts) Suppose rate = $-\Delta[C_4H_8]/ \Delta t$ = 0.00826 mol/L min. What is the rate in terms of $\Delta[C_2H_4]/ \Delta t$?

14. The following reaction is second order in NO_2, with a rate constant = 0.00473 L/mol min at a certain temperature.

$NO_2 + CO \rightarrow NO + CO_2$ rate = $k[NO_2]^2$

14a. (4 pts) Given $[NO_2]_0$ = 0.525 M, how long (in minutes) would it take for the $[NO_2]$ = 0.020 M?

Answer with units:_____

14b. (4 pts) What is $[NO_2]$ after 90.0 minutes?

Answer with units:_____

14c. (1 pt) Does this reaction proceed by an elementary mechanism? Circle: Yes or No or Need more info

14d. (1 pt) What would happen to the rate constant if one increased the temperature?

A. increases   B. decreases   C. remains unchanged

15a. (3 pts) Write the rate expression that accompanies this mechanism:

Step 1. $C_2H_4 + HCl \rightarrow C_2H_5^+ + Cl^-$ slow
Step 2. $C_2H_5^+ + Cl^- \rightarrow C_2H_5Cl$ fast
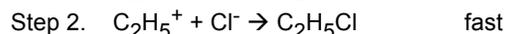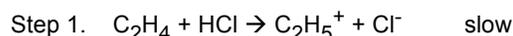
15b. (2 pts) What is the overall reaction?

15c. (1 pt) See the reaction profiles on the data page to answer Questions 15c and 15d. Which profile best represents the mechanism? Circle one: A   B   C   D

15d. (4 pts) Which profiles represent overall exothermic reactions? Circle all that apply: A   B   C   D

Subtotal from exam: _____

Folder work: (20 max)   _____

Total:

	Zero Order	First Order	Second Order
Rate Expression	rate = k	rate = k[A]	rate = $k[A]^2$
Time-Conc. Expression	$[A]_t = -kt + [A]_o$	$\ln([A]_o/[A]_t) = kt$	$1/[A]_t = kt + 1/[A]_o$
Linear Plot	$[A]_t$ vs t	$\ln[A]_t$ vs t	$1/[A]_t$ vs t
Half-life	$t_{1/2} = [A]_o/2k$	$t_{1/2} = 0.693/k$	$t_{1/2} = 1/k[A]_o$

Use the data and first three graphs on this page to answer Question 12 for the reaction: $CH_3CN(g) \rightarrow CH_3NC(g)$

Time (hrs)	$[CH_3CN(g)]$
0	1.000
5	0.794
10	0.631
15	0.501
20	0.398
25	0.316
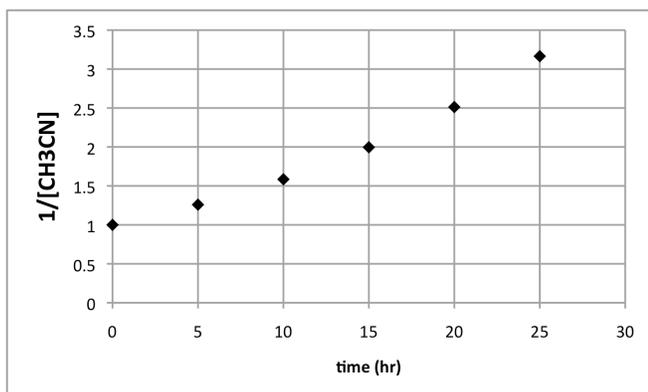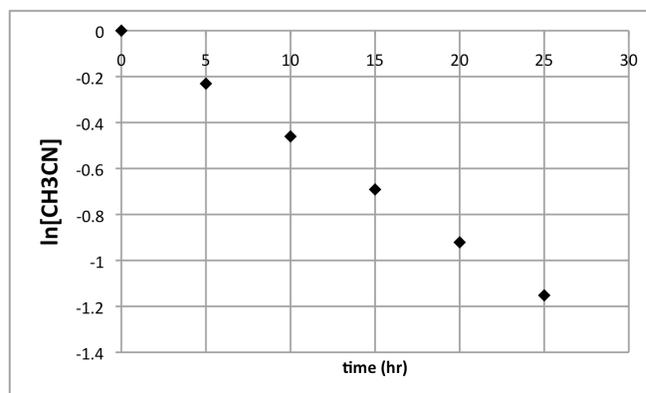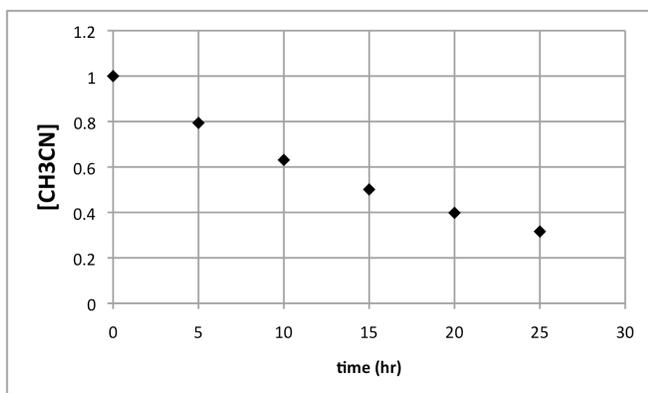
For Question 15c and 15d:
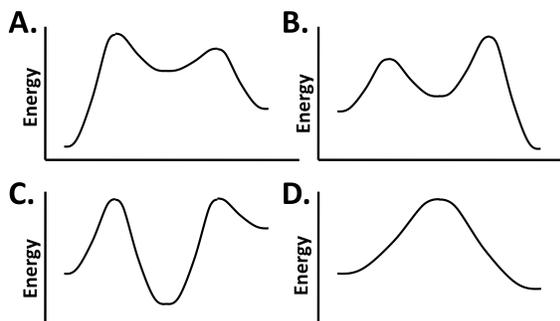
Answers

1. C

2a. A, C, B

2b. B, C

2c. No, Yes, Yes

4. A. propanol;   B. hexane

5. Yes, No, Yes, No

6. Π = MRTi

7a. 15%

7b. 0.949

7c. 2.85 M

7d. -11.2 ^oC

8. 178 g/mol

9. 1.35 x 10^{-8} M

10. 191 mmHg

11. 2nd order

12a. first order

12b. rate = k [CH_3CN]

12c. A

13a. 0.0112 s^{-1}

13b. rate = $\Delta[C_2H_4]/ \Delta t$ = 0.0165 mol/L min

14a. 10,200 min

14b. 0.429 M

14c. No

14d. A

15a. rate = k[C_2H_4][HCl]

15b. C_2H_4 + HCl → C_2H_5Cl

15c. A

15d. B and D