EXAM ONE **CHM 205 (Dr. Mattson)** **2 FEBRUARY 2011**	***Print your name:*** ***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 periodic table — Write: "See PT" in box and then attach the periodic table. BOX YOUR ANSWERS! Write legibly.

1. (4 pts) One member of each group is far more water-soluble than the other two. In each case, circle the water-soluble compound.

A.	NH_3	CH_4	MgO
B.	Mg	$MgCl_2$	MgS
C.	NaCl	CCl_4	SF_6
D.	H_2	HCl	Cl_2

2. (4 pts) Circle the one member of each group that is far more soluble in non-polar solvents such as CCl_4 than the other two.

A.	CH_3OH	C_5H_{12}	KBr
B.	$SiCl_4$	NH_3	$FeCl_2$
C.	C_6H_6	OH_2	NaF
D.	NH_4NO_3	C_2Cl_4	$HC_2H_3O_2$

3. A 12-ounce soft drink contains 19 g fructose, 15 g glucose in 320 g water (along with a number of other ingredients present at low concentrations). Fructose and glucose are both sugars with the same formula, $C_6H_{12}O_6$, MM = 180 g/mol.

(a) (3 pts) Calculate the mass % of fructose.

(b) (3 pts) Calculate the mole fraction of glucose.

(c) (3 pts) Calculate the molality of fructose.

4. (4 pts) Coumadin, $C_{19}H_{16}O_4$, MM = 308 g/mol, is an anticoagulant used as a rodenticide and, at low doses, to prevent blood clots in humans. A typical dose for adults is 2.0 mg. Assuming the volume of blood in a patient is 5.0 L, and blood has a density of 1.06 g/mL, what is the concentration of coumadin in the patient's blood in units of ppm after one dose has been given?
Given: Conc(ppm) = 10^6 X m_{solute}/m_{tot}

5. (4 pts) A concentrated solution of potassium hydroxide, KOH, MM = 56 g/mol, contains 45% by mass KOH and has a density of 1.46 g/mL. What is the molarity?

6. (3 pts) Sodium acetate is very soluble in water and its solubility increases with temperature. Suppose a solution of sodium acetate found in the lab contained some solid sodium acetate on the bottom.

(a) This solution is [Circle:
unsaturated saturated or supersaturated]

(b) Upon heating the solution in (a), the solid dissolves. If the solution were heated some more (another 10 degrees for example), the solution is [Circle:
unsaturated saturated or supersaturated]

(c) After the solution described in (b) is cooled to room temperature, no solid crystallizes out of solution. This solution is [Circle:
unsaturated saturated or supersaturated]

7. (4 pts) The vapor pressure of water is 24.0 mmHg at 25 ^oC. What is the vapor pressure of a solution that consists of 15.0 g CON_2H_4 (non-volatile, MM = 60.0 g/mol) and 100.0 g H_2O, MM = 18 g/mol?

8. (4 pts) What is the predicted freezing point of the solution in Question 7? [Given K_f = 1.86 deg/molal]

9. (4 pts) A non-electrolytic solid dissolves in water. What is the MM of the solid if 11.5 g dissolved in 40.0 g water results in ΔT_b = 1.42 deg? [Given: K_b = 0.51 deg/molal]

10. (4 pts) Ammonia is manufactured in large amounts by the Haber process. Circle ***all*** of the following equalities that are true regarding the relative rates.

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

A. $-\Delta[N_2]/\Delta t = \Delta[NH_3]/2\Delta t$ B. $\Delta[N_2]/3\Delta t = \Delta[H_2]/\Delta t$

C. $\Delta[NH_3]/2\Delta t = -\Delta[H_2]/3\Delta t$ D. $\Delta[N_2]/\Delta t = \Delta[H_2]/3\Delta t$

11. (3 pts) The Haber process is known to be first order in $[N_2(g)]$. What would happen if the pressure of nitrogen, hence the concentration of $N_2(g)$, were increased?

(a) The rate would [Circle one:
increase decrease or stay the same]

(b) The rate constant would [Circle one:
increase decrease or stay the same]

(c) Ammonia would be formed [Circle one:
faster slower or at the same rate as before]

12. (6 pts) The following reaction is second order in NO(g) and first order in $H_2(g)$:

$$2\ NO(g) + 2\ H_2(g) \rightarrow N_2(g) + 2\ H_2O(g)$$

(a) Write the rate law.

(b) What are the units for rate?

(c) What are the units for the rate constant?

13. (3 pts) Acetone converts to ketene at high 600 ^oC:

$$2\ C_3H_6O(g) \rightarrow C_2H_2O(g) + CH_4(g)$$

Use the data below in order to determine the rate law.

Expt	Initial $[C_3H_6O(g)]$	Initial rate, $\Delta[C_3H_6O(g)]/\Delta t$
1	6.0×10^{-3} mol/L	5.2×10^{-5} mol/L s
2	9.0×10^{-3} mol/L	7.8×10^{-5} mol/L s

Show all work!

14. A rate of a reaction, known to be first order in [A], decreases by 40% after 20 minutes.
(a) (3 pts) What is the value of the rate constant?

(b) (3 pts) What is the half-life of the reaction?

15. Given: rate = $k[B]^2$ for the reaction B → C + D. Suppose it was determined that [B] decreases from 0.100 mol/L to 0.081 mol/L in 50.0 minutes.
(a) (3 pts) What is the rate constant? Include units

(b) (3 pts) What is $[B]_t$ after 20 min?

(c) (3 pts) How long does it take for $[B]_t$ = 0.030 mol/L?

16. Consider the mechanism given here:

Step 1. $NO_2(g) + NO_2(g) \rightarrow NO_3(g) + NO(g)$
Step 2. $NO_3(g) + CO(g) \rightarrow CO_2(g) + NO_2(g)$

(a) (2 pts) What is the overall reaction?

(b) (2 pts) What is the rate law if the first step is the slow?

Use figure on Information Sheet to answer (c) and (d). Answers should have the format: "a minus b", etc.

(c) (1 pt) What is the energy associated with the energy of activation for the slow step?

(d) (1 pt) What is the overall energy change, ΔH for the reaction?

(e) (1 pt) Is there an intermediate? Circle: Yes or No

(f) (1 pt) Is there a catalyst? Circle: Yes or No

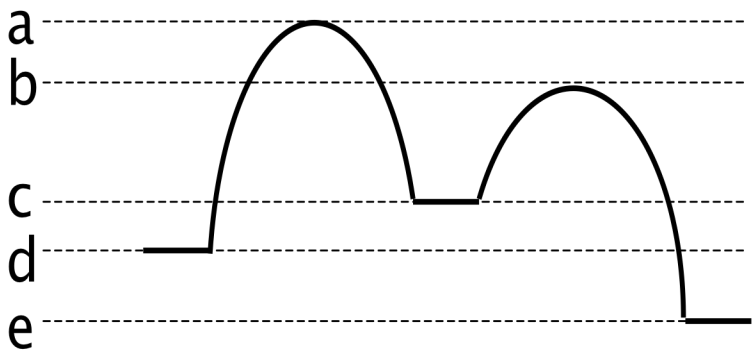
(1 pt) ***Print*** your name below:

Subtotal from exam: _____

Homework: _____

Total: _____

Use this figure to answer Question 16(c) and (d):



	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	$t_{1/2} = [A]_o/2k$	$t_{1/2} = 0.693/k$	$t_{1/2} = 1/k[A]_o$

1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110	111	112		114		116		118

58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

Answers:

1.
   A. NH_3
   B. $MgCl_2$
   C. NaCl
   D. HCl

2.
   A. C_5H_{12}
   B. $SiCl_4$
   C. C_6H_6
   D. C_2Cl_4

3. (a) mass % = 5.37% fructose

(b) mole fraction = 0.0046 glucose.

(c) molality of fructose = 0.3299 mol fructose/kg H_2O

4. Conc of coumadin (ppm) = 0.377 ppm

5. Molarity = 11.7 M

6. (a) saturated

(b) unsaturated

(c) supersaturated

7. $P_{sol'n}$= is 22.97 mmHg

8. T_f = -4.65 ^oC

9. MM = 103 g/mol

10. A, C, D

11. (a) increase; (b) stay the same; (c) faster

12. (a) rate = $k[NO]^2[H_2]$

   (b) mol/L time or mol L^{-1} $time^{-1}$, M/time, etc. (time can be s, min, hr, etc.)

   (c) L^2/mol^2 time or L^2 mol^{-2} $time^{-1}$, M^{-2} $time^{-1}$etc. (time can be s, min, hr, etc.)

13. rate = $k[C_3H_6O]^1$

14. (a) k = 0.0255 min^{-1}; (b) 27 min

15. (a) k = 4.69 x 10^{-2} L/mol min; (b) $[B]_t$ = 0.0914 M; (c) 498 min

16. (a) $NO_2(g) + CO(g) \rightarrow CO_2(g) \rightarrow NO_2(g)$

(b) rate = $k[NO_2]^2$; (c) a – d; (d) ΔH = d – e; (e) Yes; (f) No (a catalyst is never a reactant)