CHEM 1515.001
Exam II
John II. Gelder
October 17, 2001

Name _____

TA's Name _____

Lab Section _____

INSTRUCTIONS:

1. This examination consists of a total of 8 different pages. The last two pages include a periodic table, some useful mathematical equations and a solubility table. All work should be done in this booklet.

2. PRINT your name, TA's name and your lab section number now in the space at the top of this sheet. DO NOT SEPARATE THESE PAGES.

3. Answer all questions that you can and whenever called for show your work clearly. Your method of solving problems should pattern the approach used in lecture. You do not have to show your work for the multiple choice or short answer questions.

4. No credit will be awarded if your work is not shown in problems 3 and 4.

5. Point values are shown next to the problem number.

6. Budget your time for each of the questions. Some problems may have a low point value yet be very challenging. If you do not recognize the solution to a question quickly, skip it, and return to the question after completing the easier problems.

7. Look through the exam before beginning; plan your work; then begin.

8. Relax and do well.

	Page 2	Page 3	Page 4	Page 5	Page 6	TOTAL
SCORES	_____	_____	_____	_____	_____	_____
	(31)	(19)	(30)	(6)	(14)	(100)

(9) 1. Write the chemical formula(s) of the product(s) and balance the following reactions. Identify all products phases as either (g)as, (l)iquid, (s)olid or (aq)ueous. Soluble ionic compounds should be written in the form of their component ions.

a) $HCl_{(aq)} + NaOH_{(aq))} \rightarrow$

b) $Na_2SO_{4(aq)} + Ba(NO_3)_{2(aq)} \rightarrow$

c) $C_6H_{14(l)} + O_{2(g)} \rightarrow$

(4) 2. Write the ionic and net ionic chemical equations for 1b).

1b)

Ionic equation:

Net Ionic equation:

(18) 3. The half-life for the rearrangement reaction

$$CH_3NC_{(g)} \rightarrow CH_3CN_{(g)}$$

is 230 seconds at 250 ˚C. The reaction follows first order kinetics.

a) If the initial concentration of the reactant, methyl isonitrile, is 0.0485 M, calculate its concentration after 100 seconds. (8)

b) what fraction of methyl isonitrile remains after 400 seconds? (6)

c) At 450 ˚C the half-life of the reaction is 140 seconds. Calculate the rate constant at this temperature? (4)

(19) 4. A solution of magnesium chloride, $MgCl_2$, is prepared by dissolving 19.0 g of magnesium chloride in 250 mL of water.

a) calculate the weight percent of magnesium nitrate in the solution; (4)

b) the solution described above has a density of 1.05 g mL^{-1}. Calculate the molarity of the magnesium chloride in the solution; (6)

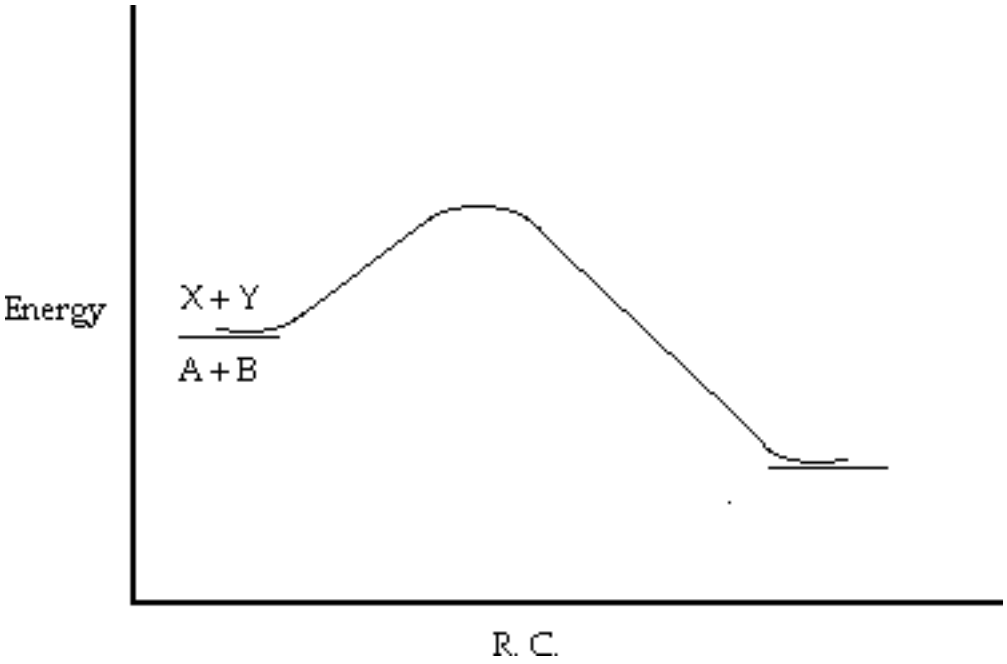
c) calculate the ideal freezing point of the solution; (6)

d) would you expect the experimental freezing point of this solution to be more negative or less negative than the ideal freezing point? Briefly explain the basis of your prediction. (3)

(31) 5.

$$A_{(g)} + B_{(g)} \rightarrow AB_{(g)}$$
$$X_{(g)} + Y_{(g)} \rightarrow XY_{(g)}$$

Two reactions are represent above. The potential energy diagram for the first reaction is shown below. The energy of the reactants for the second reaction is the same as the energy of the reactants for the first equation. The reaction between X and Y is endothermic and the activation energy for the reaction is higher than that of the reaction between A and B.



a) Complete the potential energy diagram for the reaction between X and Y in the diagram above. (6)

b) How is the rate of the reaction between A and B affected as the temperature is increased by 20 ˚C? Explain the basis of your prediction. (5)

c) Write the general rate law for the reaction between X and Y. Write an expression for the rate of the reaction in terms of one of the reactants. (6)

5. (CONTINUED)

d) Briefly describe an experiment(s) that can be conducted to determine the order of the reaction for X and for Y. (8)

e) From the information given, which reaction initially proceeds at the faster rate under the same conditions of concentration and temperature. Justify your answer(6)

(6) 6. Give the name or draw the Lewis structure for each of the following compounds.

	2,3,4,4-tetramethyloctane	2-bromo-1,2,3-trichloropropane

(10) 7. Draw and name all of the structural isomers for C_6H_{14}.

(4) 8. The rate law for the reaction;

$$NO_{2(g)} + CO_{(g)} \rightarrow NO_{(g)} + CO_{2(g)}$$

is rate = $k[NO_2]^2$. Suggest a mechanism for the reaction.

Periodic Table of the Elements

	IA												IIIA	IVA	VA	VIA	VIIA	VIIIA
1	1 **H** 1.008	IIA																2 **He** 4.00
2	3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
3	11 **Na** 22.99	12 **Mg** 24.30	IIIB	IVB	VB	VIB	VIIB	VIII			IB	IIB	13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
4	19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.88	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.38	31 **Ga** 69.72	32 **Ge** 72.59	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
5	37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
6	55 **Cs** 132.9	56 **Ba** 137.3	57 **La** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.8	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
7	87 **Fr** (223)	88 **Ra** 226.0	89 **Ac** 227.0	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (262)	108 **Hs** (265)	109 **Mt** (266)									

Lanthanides	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.2	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0
Actinides	90 **Th** 232.0	91 **Pa** 231.0	92 **U** 238.0	93 **Np** 237.0	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)

Useful Information

$\Delta T = i k_f m$ $\qquad k_f(H_2O) = 1.86 \frac{^\circ C}{m}$ $\qquad k_b(H_2O) = 0.512 \frac{^\circ C}{m}$

$R = 0.0821 \frac{L \cdot atm}{mol \cdot K} = 8.314 \frac{J}{mol \cdot K}$

$P_{solution} = \chi_{solvent} P^\circ_{solvent}$

density of $H_2O = 1.00 \frac{g}{cm^3}$ $\qquad 6.023 \times 10^{23}$

$\ln\left(\frac{k_1}{k_2}\right) = \frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$

$\ln\left(\frac{[A]_t}{[A]_o}\right) = -kt$ $\qquad \frac{1}{[A]_t} - \frac{1}{[A]_o} = kt$

6.023×10^{23}

Solubility Table

Ion	Solubility	Exceptions
NO_3^-	soluble	none
ClO_4^-	soluble	none
Cl^-	soluble	except Ag^+, Hg_2^{2+}, *Pb^{2+}
I^-	soluble	except Ag^+, Hg_2^{2+}, Pb^{2+}
SO_4^{2-}	soluble	except Ca^{2+}, Ba^{2+}, Sr^{2+}, Hg^{2+}, Pb^{2+}, Ag^+
CO_3^{2-}	insoluble	except Group IA and NH_4^+
PO_4^{3-}	insoluble	except Group IA and NH_4^+
^-OH	insoluble	except Group IA, *Ca^{2+}, Ba^{2+}, Sr^{2+}
S^{2-}	insoluble	except Group IA, IIA and NH_4^+
Na^+	soluble	none
NH_4^+	soluble	none
K^+	soluble	none

*slightly soluble