Name _____ Slayter Box _____

Hour Examination 2 February 13, 2003

***** Optional Retake *****

General Chemistry (CHEM 122-01)

Solution Properties, Kinetics

Dr. Bennett

Please do not open until instructed

Optional Retake—Test #2

Solution Properties, Kinetics

Notes:

* This exam consists of **many questions on 5 pages** (including this cover page). Please check to make sure that you have a complete copy of the exam.
** Please do not simply give me answers. Give me well-supported answers. Numerical answers that are not backed by supporting calculations will receive minimal credit.*
* Please write clearly; if I can't read your answer, I can't give you credit for your answer.
* Please note that different questions are worth different numbers of points. Plan your time accordingly.
* Remember to include units and significant figures where appropriate.
* No books or notes are to be used on this exam.
* Please do NOT share calculators; if you need a calculator but do not have one, please let me know!

** If you feel that you would be better able to answer **any** question if you had additional information, please do not hesitate to ask for it.* I will happily provide any information that I feel will help you answer the question without compromising the efficacy and fairness of the test.

Question	Possible	Score
1	36	
2	15	
3	15	
4	9	
TOTAL	70	
	percent:	

The Quadratic Equation

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Some equations you *might* use:

$S = k_H \times P$

Arrhenius equation: **$k = Ae^{-Ea/RT}$**

$P_A = P_A^\circ \times X_A$

$\Delta T_b = i\, K_b \times m$

Integrated rate laws:

zero-order **$[A]_t = -kt + [A]_o$**

$\Delta T_f = i\, K_f \times m$

first-order **$ln\,[A]_t = -kt + ln\,[A]_o$**

second-order **$1/[A]_t = kt + 1/[A]_o$**

[36]1. For each of the following situations, please answer the question in one or a few words, or indicate that there is INSUFFICIENT INFORMATION for you to be sure of the answer. Although you need not do so for full credit, if you would like to ensure that I understand the reasoning behind your answer, you may justify your choice in one short sentence.

a) Consider two beakers containing equal volumes of water. If 0.3 moles of ethanol are added to beaker A and 0.3 moles of hydrogen chloride are added to beaker B, will the contents of the two beakers boil at the same temperature? If not, which will boil at the **higher** temperature?

b) Consider the case of Joe. Joe has an aversion to bubbles in his cola, and will often shake a can of pop to remove most of the dissolved gas before drinking it. If Joe were given a choice between drinking a glass of cola that had been sitting at 25°C and one that had been sitting at 45°C, which would he choose? (Assume that Joe doesn't care about the temperature of his drinks and that good manners prevent him from shaking the contents of either glass.)

c) True or false: Breaking interactions between molecules liberates the energy "trapped" between them.

d) Which will boil at a **lower** temperature: a container of benzene at sea level or a container of benzene on a mountain at 3800 meters above sea level?

e) What intermolecular forces would you expect to find between molecules in a container of pure IF_5? Please arrange your list **from weakest** force **to strongest** force.

h) Toluene is less volatile than is water. Will its normal boiling point be above 100°C, below 100°C, or equal to 100°C?

f) If substance A has stronger dispersion forces between its molecules than does substance B, will A have a higher or lower melting point?

g) If the vapor pressure above a container of liquid is less than the ambient pressure, will increasing the temperature of the liquid increase the kinetic energy of molecules in the liquid?

h) here is a reaction that somebody once studied:

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

This reaction is second order with respect to NO_2. If two experiments are performed in which the $[CO]_0$ is kept constant, but the $[NO_2]_0$ is three times as high in experiment #2 as in experiment #1, how much faster would you expect the rate of reaction to be in experiment #2?

i) Consider the decomposition of dinitrogen pentoxide gas:

$$N_2O_{5(g)} \rightarrow 2\ NO_{2(g)} + 1/2\ O_{2(g)}$$

An experiment is performed in which it is found that nitrogen dioxide is formed at a rate of 3.6 M/sec. What would you predict to be the rate of formation of molecular oxygen in this experiment?

j) True or false: Mole for mole, sugar is less effective as a sidewalk de-icer than is salt because the sugar forms stong hydrogen bonds with the water molecules while the salt does not.

k) In the desert southwest, some people employ a kind of air-conditioner known as a swamp cooler. In this device, hot air is blown through a mist of water droplets. If the air *comes out cooler than it went in*, would you expect that the air: (A) causes the gaseous water vapor to condense into droplets, OR
(B) causes the water droplets to vaporize into gas?

l) Consider two reactions occurring at a certain temperature. In reaction A, the products of the reaction are more stable than the reactants; in reaction B, the reactants are more stable. Which reaction will be faster?

$_{15}$2. Each solute below has a better solubility in one of the two solvents listed for it. For each solute, identify the solvent in which it is more soluble. Then describe the principal intermolecular force(s) responsible for the higher solubility.

solute	**possible solvents** ***circle better solvent***	**principal intermolecular force(s)**
glucose ($C_6H_{12}O_6$), a sugar	water (H_2O) (or) cyclohexane (C_6H_{12})	
ammonia (NH_3)	ethanol (CH_3CH_2–OH) (or) benzene (C_6H_6)	
NaBr	methanol (CH_3–OH) (or) carbon tetrachloride (CCl_4)	

$_{15}$3. List three factors affecting solubility. Justify your answer with an example of each factor.

4. When fossil fuels are burned in air, nitric oxide (NO) is formed. Further reaction of nitric oxide with oxygen occurs according to the following equation:

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

At 25 °C, the following rate data were collected:

	initial concentrations (M)		
Experiment #	**[NO]**	**[O_2]**	**Initial rate (M/sec)**
1	0.0020	0.0010	2.8×10^{-5}
2	0.0040	0.0010	1.1×10^{-4}
3	0.0020	0.0020	5.6×10^{-5}

(a) Determine the rate law for the reaction.

(b) What is the rate constant for this reaction? (be sure to use proper units!)

(c) A fourth experiment was conducted for which initial concentrations were [NO] = 0.0125 M and [O_2] = 0.0060 M. What should be the initial rate of this reaction?