Chemistry 1B, Exam I   Name

February 17, 2010
Professor R.J. Saykally   TA

1.   (15)

2.   (20)

3.   (15)

4.   (15)

5.   (20)

6.   (15)

TOTAL EXAM SCORE (100)

<u>Rules:</u>
- Work all problems to 3 significant figures
- No lecture notes or books permitted

- No word processing calculators
- Time: 50 minutes
- Show all work to get partial credit
- Periodic Table, Tables of Physical Constants, and Conversion Factors included

1. **(5 points each)** The following kinetic data were obtained for the reaction $2\ ICl(g) + H_2(g) \rightarrow I_2(g) + 2\ HCl(g)$.

Initial concentration (mmol·L^{-1})

Experiment	[ICl]$_0$	[H$_2$]$_0$	Initial rate (mol·L^{-1}·s^{-1})
1	1.5	1.5	3.7 X 10^{-7}
2	3.0	1.5	7.4 X 10^{-7}
3	3.0	4.5	2.2 X 10^{-6}
4	4.7	2.7	?

(a) Write the differential rate law for the reaction.

(b) From the data, determine the value of the rate constant (with proper units).

(c)　　Use the data to predict the reaction rate for Experiment 4.

2. **(5+15 points)** The mechanism proposed for the oxidation of iodide ion by the hypochlorite ion in aqueous solution is as follows:

Step 1 $ClO^- + H_2O \rightarrow HClO + OH^-$ and its reverse (both fast)

Step 2 $I^- + HClO \rightarrow HIO + Cl^-$ (slow)

Step 3 $HIO + OH \rightarrow IO^- + H_2O$ (fast)
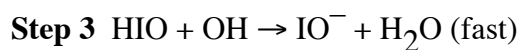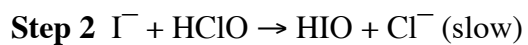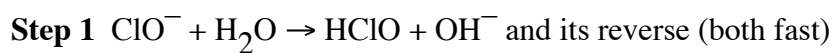
(a) Write down the balanced equation for the overall reaction.

(b) Write the rate law for the formation of HIO implied by this mechanism.

3. **(15 points)** Raw milk sours in about 4 h at 28°C but in about 48 h in a refrigerator at 5°C. What is the activation energy for the souring of milk?

4.   (5+10 points)   The activation energy for the disproportionation of hydrogen peroxide is 76 kJ/mol and the process is exothermic by 285 kJ/mol.

(a)   What is the activation energy for the reverse reaction?

(b)   Calculate the fraction of peroxide molecules with sufficient energy to react at 25°C.

5.   (4 points each)   Short Answer

(a)   (True or False)   The rates of all elementary reactions increase with increasing temperature.

(b)   Define a "transition state" or "activated complex."

(c)   For a second order reaction, a plot of _____ vs. time yields a straight
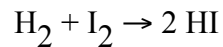
line with

slope _____.

(d)   What is the "Principle of Detailed Balance?"

(e)   The total world energy consumption is presently about _____, 90% of which is obtained from chemical reactions.

6.   (15 points)   The rate of the gas-phase reaction

$$H_2 + I_2 \rightarrow 2 \text{ HI}$$

is given by

EMBED Equation.3

With $k = 0.0242$ L mol^{-1} s^{-1} at 400°C. If the initial concentration of H_2 is 0.081 mol L^{-1} and that of I_2 is 0.036 mol L^{-1}, calculate the initial rate at which heat if absorbed or emitted during the reaction. The enthalpy of the reaction as written is -9.48 kJ/mol.

PAGE

PAGE 2