CHM152 Quiz 1b 25 Pts Fall 2013 Name: Key

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1. (3 Pts) For the overall chemical reaction shown below, which one of the following statements can be rightly assumed?

$$2H_2S(g) + O_2(g) \rightarrow 2S(s) + 2H_2O(l)$$

A) The reaction is third-order overall.
B) The reaction is second-order overall.
C) The rate law is, rate = $k[H_2S]^2[O_2]$.
D) The rate law is, rate = $k[H_2S][O_2]$.
E) The rate law cannot be determined from the information given.

2. (4 pts) Chlorine dioxide reacts in basic water to form chlorite and chlorate according to the following chemical equation:

$$2ClO_2(aq) + 2OH^-(aq) \rightarrow ClO_2^-(aq) + ClO_3^-(aq) + H_2O(l)$$

Under a certain set of conditions, the initial rate of disappearance of chlorine dioxide was determined to be 2.30×10^{-1} M/s. What is the initial rate of appearance of chlorite ion under those same conditions?

so $[ClO_2^-]$ appears half as fast as the disappearance of $[ClO_2]$

1.15×10^{-1} M/s

3. (4 Pts) The first-order decomposition, A → *products*, has a rate constant of 0.150 s^{-1}. Starting with $[A]_o = 0.350$ M, how much time is required for $[A]_t = 0.125$ M?

(rate = k rate = k[A] rate = $k[A]^2$ $[A]_t = -kt + [A]_0$ $\ln[A]_t = -kt + \ln[A]_0$)

$$\ln[0.125] = -0.150\,s^{-1}(t) + \ln[0.350]$$

$t = 6.86$ s

4. (4 Pts) Concerning the rate law, Rate = $k[A]^2[B]$, what are appropriate units for the rate constant k? Assume the units for rate are M/s.

$$\text{rate} = k[A]^2[B]$$

$$\frac{M}{s} = \_\_\_ \; M^2 \; M$$

k units = $s^{-1} \cdot M^{-2}$

*****More questions on back*****

5. (4 Pts) The reaction A + 2B → products has been found to have the rate law, rate = k[A] $[B]^2$. While holding the concentration of A constant, the concentration of B is increased from x to $3x$. Predict by what factor the rate of reaction increases.

rate = [1] $[3]^2$ = 9 (9 fold increase)

6. (6 Pts) Chlorine dioxide reacts in basic water to form chlorite and chlorate according to the following chemical equation:

$$2ClO_2(aq) + 2OH^-(aq) \rightarrow ClO_2^-(aq) + ClO_3^-(aq) + H_2O(l)$$

A kinetic study of this reaction under a certain set of conditions yielded the data below.

Exp	$[ClO_2]$ (M)	$[OH^-]$ (M)	rate (M/s)
1	0.0500	0.100	5.75×10^{-2}
2	0.100	0.100	2.30×10^{-1}
3	0.100	0.0500	1.15×10^{-1}

Determine the rate law and the value of the rate constant.

for ClO_2: $\frac{exp\,2}{exp\,1} : \frac{rate_2}{rate_1} = \frac{k[ClO_2]^x[OH^-]^y}{k[ClO_2]^x[OH^-]^y}$

$\frac{2.30 \times 10^{-1}}{5.75 \times 10^{-2}} = \left(\frac{0.100}{0.050}\right)^x$

$4 = 2^x$

$x = 2$ (2nd order)

for OH^-: $\frac{exp\,2}{exp\,3} = \frac{2.30 \times 10^{-1}}{1.15 \times 10^{-1}} = \left(\frac{0.100}{0.0500}\right)^y$

$2 = 2^y$

$y = 1$ (1st order)

so: rate = $k[ClO_2]^2[OH^-]$

$k = \frac{rate}{[ClO_2]^2[OH^-]} = \frac{5.75 \times 10^{-2}}{[0.0500]^2[0.100]} = 230\ s^{-1} \cdot M^{-2}$