CHM152 Quiz 1a 25 Pts Spring 2014 Name: Key

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1. (4 Pts) The reaction A + 2B → products has been found to have the rate law, rate = k[A] $[B]^2$. If the concentration of A is tripled and the concentration of B is doubled. Predict by what factor the rate of reaction increases.

rate = k [3] [2]^2 (12 Fold)

2. (5 Pts) Given the rate law for a reaction, rate = k[A][B]^2, where rate is measured in units of M s^{-1}, what are the units for the rate constant k?

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

3. (5 Pts) What is the rate law that corresponds to the data shown for the reaction 2A + B → C?

Exp.	Initial [A]	Initial [B]	Initial rate
1	0.015	0.022	0.125
2	0.030	0.044	0.500
3	0.060	0.044	0.500
4	0.060	0.066	1.125

rate = k $[A]^0$ $[B]^2$

rate = k $[B]^2$

General rate law: rate = k $[A]^x$ $[B]^y$

for [A] experiments 2 & 3 show no change in rate, so zero order

For [B] $\frac{Exp\ 4}{Exp\ 3}$: $\frac{1.125}{0.500} = \frac{k\,(A)^x\,[0.066]^y}{k\,(A)^x\,[0.044]^y}$ $2.25 = [1.5]^y$

$y = 2$

4. (6 Pts) Aspirin, $C_9H_8O_4$, slowly decomposes at room temperature by reacting with water in the atmosphere to produce acetic acid, $HC_2H_3O_2$, and 2-hydroxybenzoic acid, $C_7H_6O_3$ (this is why old bottles of aspirin often smell like vinegar):

$$C_9H_8O_4 + H_2O \rightarrow HC_2H_3O_2 + C_7H_6O_3$$

Concentration and rate data for this reaction are given below.

Exp	$[C_9H_8O_4]$ (M)	$[H_2O]$ (M)	Rate (M/s)
1	0.0100	0.0200	2.4×10^{-13}
2	0.0100	0.0800	9.6×10^{-13}
3	0.0200	0.0200	4.8×10^{-13}

rate = k $[C_9H_8O_4]^x$ $[H_2O]^y$

Write the rate law for this reaction and calculate k (be sure to include the correct units).

for $[C_9H_8O_4]$: $\frac{Exp\ 3}{Exp\ 1}$ $\frac{4.8 \times 10^{-13}}{2.4 \times 10^{-13}} = \frac{k\,[0.200]^x\,[0.0200]^y}{k\,[0.0100]^x\,[0.0200]^y}$ $2 = 2^x$ $x = 1$

For $[H_2O]$: $\frac{Exp\ 2}{Exp\ 1}$ $\frac{9.6 \times 10^{-13}}{2.4 \times 10^{-13}} = \frac{k\,(0.0100)^x\,[0.0800]^y}{k\,(0.0100)^x\,[0.0200]^y}$ $4 = 4^y$ $y = 1$

rate = k $[C_9H_8O_4]$ $[H_2O]$

*******There is one more problem on the back.*****

$k = \frac{2.4 \times 10^{-13}\ M}{5 \cdot 0.0100\ M \cdot 0.0200\ M} = 1.2 \times 10^{-9}\ M^{-1} \cdot s^{-1}$

5. (5 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?

Since there is a 2:1 ratio, the ClO_2^- is appearing at ½ the rate of disappearance of ClO_2.

$$\frac{2.30 \times 10^{-1}}{2} = 1.15 \times 10^{-1} \text{ M/s}$$