CHM152 Quiz 1 25 Pts Spring 2018 Name: Key

Show all Work to Receive Credit

rate = k rate = k[A] rate = $k[A]^2$ $[A]_t = -kt + [A]_0$ $\ln[A]_t = -kt + \ln[A]_0$ R= 8.314 J/(mol•K)

$1/[A]_t = kt + 1/[A]_0$ $t_{1/2} = [A]_0/2k$ $t_{1/2} = 0.693/k$ $t_{1/2} = 1/k[A]_0$ $\ln\frac{k_1}{k_2} = \frac{E_a}{R}(\frac{1}{T_2} - \frac{1}{T_1})$ $e=mc^2$

1. (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?

$\text{rate} = \frac{-\Delta[ClO_2]}{2\Delta t} = \frac{\Delta[ClO_2^-]}{\Delta t}$

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

2. (3 Pts) For the hypothetical reaction A + 3B → 2C, the rate of appearance of C given by (Δ[C]/Δt) may also be expressed as
   a. Δ[C]/Δt = –(1/2) Δ[A]/Δt
   b. Δ[C]/Δt = Δ[A]/Δt
   c. Δ[C]/Δt = –(3/2) Δ[B]/Δt
   d. Δ[C]/Δt = –(2/3) Δ[B]/Δt

$\text{rate} = \frac{-\Delta[A]}{\Delta t} = \frac{-\Delta[B]}{3\Delta t} = \frac{\Delta[C]}{2\Delta t}$

so $\frac{\Delta C}{\Delta t} = \frac{-2\Delta[A]}{\Delta t} = \frac{-2\Delta[B]}{3\Delta t}$

3. (2 Pts) Given the rate law for a reaction, rate = $k[A]^2[B]^2$, where rate is measured in units of M s^{-1}, what are the units for the rate constant k?

$k = \frac{\text{rate}}{[A]^2[B]^2} = \frac{M}{s}\,\frac{}{M^2}\,\frac{}{M^2} = s^{-1} \cdot M^{-3}$

4. (4 Pts) The reaction A + 2B → products was found to follow the rate law: rate = $k[A]^2[B]$. Predict by what factor the rate of reaction will increase when the concentration of A is doubled, the concentration of B is tripled, and the temperature remains constant.

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

$2^2 \cdot 3 = 12$ fold

******More questions on back

5. 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.

	$[C_9H_8O_4]$ (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}

General rate Law: $\text{rate} = k[C_9H_8O_4]^x[H_2O]^y$

a. (6 Pts) Determine the rate law for the reaction.

For; $C_9H_8O_4$ use $\frac{\text{Exp 3}}{\text{Exp 1}}$ $\frac{4.8 \times 10^{-13}}{2.4 \times 10^{-13}} = \frac{k}{k}\left(\frac{0.0200}{0.0100}\right)^x\left(\frac{0.0200}{0.0200}\right)^y$

$2 = 2^x$ $x = 1$

For: H_2O use $\frac{\text{Exp 2}}{\text{Exp 1}}$ $\frac{9.6 \times 10^{-13}}{2.4 \times 10^{-13}} = \frac{k}{k}\left(\frac{0.0100}{0.0100}\right)^x\left(\frac{0.0800}{0.0200}\right)^y$

$4 = 4^y$ $y = 1$

$\text{rate} = k[C_9H_8O_4][H_2O]$

b. (2 Pts) Determine the value of the rate constant and its units.

use any Exp. $k = \frac{\text{rate}}{[C_9H_8O_4][H_2O]} = 1.2 \times 10^{-9}\ M^{-1} \cdot s^{-1}$

6. (4 Pts) Use the following data to determine the rate law for the reaction shown below.

$2NO + H_2 \rightarrow N_2O + H_2O$

Expt. #	$[NO]_0$	$[H_2]_0$	Initial rate
1	0.021	0.065	1.46 M/min
2	0.021	0.260	1.46 M/min
3	0.042	0.065	5.84 M/min

General rate Law: $\text{rate} = k[NO]^x[H_2]^y$

For NO use $\frac{\text{Exp 3}}{\text{Exp 1}}$ $\frac{5.84}{1.46} = \frac{k}{k}\left(\frac{0.042}{0.021}\right)^x\left(\frac{0.065}{0.065}\right)^y$

$4 = 2^x$ $x = 2$

For H_2 use $\frac{\text{Exp 2}}{\text{Exp 1}}$; since rate does not change $y = 0$

$\text{rate} = k[NO]^2$