CHM152 Quiz 1b 25 Pts Fall 2016 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)

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

(5) 1. 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)	$-\Delta[ClO_2]/\Delta t$ (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}

a. Determine the rate law for this reaction (find the order of each reactant and write the rate law).

$\frac{rate 1}{Rate 2} = \frac{k[ClO_2]^x [OH^-]^y}{k[ClO_2]^x [OH^-]^y}$ $\frac{2.30\times10^{-1}}{5.75\times10^{-2}} = \frac{[0.100]^x}{[0.050]^x}$

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

$\frac{rate 2}{rate 3} = \frac{k[OH^-]^y}{k[OH^-]^y}$ $\frac{2.30\times10^{-1}}{1.15\times10^{-1}} = \left(\frac{0.100}{0.0500}\right)^y$ $2 = (2)^y$ $y = 1$

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

b. Determine the value of the rate constant and its units.

$k = \frac{rate}{[ClO_2]^2[OH^-]} = 230\ M^{-2}, s^{-1}$

(4) 2. At 25°C the rate constant for the first-order decomposition of a pesticide solution is 6.40×10^{-3} min^{-1}. If the starting concentration of pesticide is 0.0314 M, what concentration will remain after 62.0 min at 25°C?

$\ln[A]_t = -kt \ln[A]_0$

$\ln[A]_t = -6.40\times10^{-3}\,min^{-1}(62.0\,min) + \ln[0.0314]$

$e^{-3.858} = 0.0211$ 2.11×10^{-2} M

(4) 3. Concerning the rate law, Rate = k[A][B][C], what are appropriate units for the rate constant k?

$k = \frac{rate}{[A][B][C]} = \frac{M}{t}\cdot\frac{1}{M\cdot M\cdot M} = M^{-2}\cdot t^{-1}$

More questions on back

Key

(4) 4. The activation energy for the following first-order reaction is 102 kJ/mol.

$$N_2O_5(g) \rightarrow 2NO_2(g) + {}^1/_2O_2(g)$$

The value of the rate constant (k) is $1.35 \times 10^{-4}\ s^{-1}$ at 35**°C**. What is the value of k at **0°C**?

$$\ln \frac{k_1}{k_2} = \frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

$$\ln \frac{k}{1.35 \times 10^{-4}} = \frac{102 \times 10^3\ J}{8.314}\left(\frac{1}{308} - \frac{1}{273}\right) = -5.1067...$$

$k \simeq 8.2 \times 10^{-7}\ s^{-1}$

(4) 5. 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?

note 2:1 ratio

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

(4) 6. The reaction A + 2B → products was found to have the rate law, rate = $k[A][B]^2$. Predict by what factor the rate of reaction will increase when the concentration of A is doubled and the concentration of B is also doubled.

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

$[2][2]^2 = 8$ fold incre...