CHM 152/54 Quiz #1a 25 Pts Fall 2014 Name: Key

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)

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

SHOW ALL WORK TO RECEIVE CREDIT.

1. (5 Pts) A nuclear stress test utilizes a gamma-emitting radioisotope such as thallium-201 to follow the flow of blood through the heart – first at rest, and then under stress. The first-order rate constant for the decay of thallium-201 is 9.5×10^{-3} hr^{-1}. Calculate how long it takes for the amount of thallium-201 to fall to 5.0% **of its original value**.

$\ln\frac{[A]_t}{[A]_0} = -kt$

$\ln\frac{5}{100} = -9.5 \times 10^{-3}\,(t)$

$t = 315$ hrs

2. (4 Pts) The reaction 2A + B → *products* is second order with respect to A and zero-order with respect to B. The concentration of A is tripled and the concentration of B is doubled. What is the effect on the reaction rate? (How many times faster?)

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

So $[3]^2 =$ 9 fold increase

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

$k = \frac{\text{rate}}{[A]^2} = \frac{M}{\text{min} \cdot M^2} = M^{-1} \cdot \text{min}^{-1}$

4. At a certain temperature, the data below were collected for the reaction below.

$2ICl + H_2 \rightarrow I_2 + 2HCl$.

Initial concentrations (M)		Inital Rate of Formation of I_2
[ICl]	[H_2]	Mol/L·s
0.10	0.10	0.0015
0.20	0.10	0.0030
0.10	0.050	0.00075

a. (6 Pts) Determine the rate law.

see 2a on "yellow key"

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b. (5 Pts) Determine the value and the units for the rate constant.

See "2 b" on yellow key.

5. (3 Pts) Nitrogen pentoxide decomposes by a first-order process yielding N_2O_4 and oxygen.

$$2N_2O_5 \rightarrow 2N_2O_4 + O_2$$

At a given temperature, the half-life of N_2O_5 is 0.90 hr. What is the first-order rate constant for N_2O_5 decomposition (be sure to include its units)?

See "1a" yellow key

yellow

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1. (3 Pts) Nitrogen pentoxide decomposes by a first-order process yielding N_2O_4 and oxygen.

   $2N_2O_5 \rightarrow 2N_2O_4 + O_2$

   At a given temperature, the half-life of N_2O_5 is 0.90 hr. What is the first-order rate constant for N_2O_5 decomposition (be sure to include its units)?

$t_{\frac{1}{2}} = \frac{\ln 2}{k}$ $k = \frac{\ln 2}{0.90} = 0.77\ hr^{-1}$

2. At a certain temperature, the data below were collected for the reaction below.

   $2ICl + H_2 \rightarrow I_2 + 2HCl$.

	Initial concentrations (M)		Inital Rate of Formation of I_2
	[ICl]	[H_2]	Mol/L·s
1	0.10	0.10	0.0015
2	0.20	0.10	0.0030
3	0.10	0.050	0.00075

a) (6 Pts) Determine the rate law. rate = $k[ICl]^x[H_2]^y$

For [ICl] use 1 & 2: $\frac{0.0030}{0.0015} = \frac{k[0.20]^x[0.10]^y}{k[0.10]^x[0.10]^y}$

$2 = \left(\frac{0.20}{0.10}\right)^x$ $2 = 2^x$ $x = 1$ 1st order

For [H_2] use 1 & 3 $\frac{0.0015}{0.00075} = \frac{k[0.10]^1[0.10]^y}{k[0.10]^1[0.050]^y}$ $2 = \left(\frac{0.10}{0.050}\right)^y$ $y = 1$

rate law: $rate = k[ICl]^1[H_2]^1$

b) (5 Pts) Determine the value and the units for the rate constant.

$k = \frac{rate}{[ICl][H_2]} = \frac{M/s}{M \cdot M} = M^{-1} \cdot s^{-1}$ or $L \cdot mol^{-1} \cdot s^{-1}$

Value: $k = \frac{0.0015}{[0.10][0.10]} = 0.15\ M^{-1} \cdot s^{-1}$

More Problems on Back of Page

Yellow Key

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$$\ln \frac{[A]_t}{[A]_0} = -kt$$

$$\ln\left(\frac{5}{100}\right) = -kt$$

$$\ln\left(\frac{5}{100}\right) = -9.5 \times 10^{-3}\, t$$

$t = 315$ hrs

4. (2 Pts) Given the rate law for a reaction, rate = $k[A]^2$, where rate is measured in units of M min^{-1}, what are the units for the rate constant k?

$$k = \frac{\text{rate}}{[A]^2} = \frac{M}{\text{min}\ M^2} = M^{-1} \cdot \text{min}^{-1}$$

5. (4 Pts) The reaction 2A + B $\rightarrow$ *products* is second order with respect to A and zero-order with respect to B. The concentration of A is tripled and the concentration of B is doubled. What is the effect on the reaction rate? (How many times faster?)

$$\text{rate} = k[A]^2[B]^0 = k[A]^2$$

(if [A] is tripled) $\text{rate} = k[3]^2 =$ 9 fold increase