CHM152 Quiz 1a 25 Pts Spring 2017 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. (5 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?

$t_{1/2} = \frac{0.693}{k}$ $k = 0.77\ hr^{-1}$

2. (5 Pts) At a certain temperature, the data below were collected for the reaction below.

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

Determine the rate law and the rate constant along with its units for the reaction.

	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. Rate law: General rate Law: $rate = k[ICl]^x[H_2]^y$

For ICl use ② ÷ ① $\frac{0.0030}{0.0015} = \frac{k}{k}\left(\frac{0.20}{0.10}\right)^x\left(\frac{0.10}{0.10}\right)^y$

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

For H_2 use ① ÷ ③ $\frac{0.0015}{0.00075} = \left(\frac{0.10}{0.050}\right)^y$ $2 = 2^y$ $y = 1$.

$rate = k[ICl][H_2]$

b. Value of k and its units:

$k = \frac{rate}{[ICl][H_2]} = \frac{0.0015}{[0.10][0.10]} = 0.15\ M^{-1}\cdot s^{-1}$

$\frac{M}{s}\frac{}{M}\frac{}{M} = s^{-1}\cdot M^{-1}$

***More Questions on Back

Key

3. (5 Pts) The rate constant for the first-order decomposition of C_4H_8 at 500°C is $9.2 \times 10^{-3}\ s^{-1}$. How long will it take for 10.0% of a 0.100 M sample of C_4H_8 to decompose at 500°C?

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

or $\ln \frac{[A]_t}{[A]_0} = -kt$ $\quad \ln\left(\frac{90}{100}\right) = -9.2\times10^{-3}s^{-1}(t)$

$t = 11.4$ sec

4. (5 Pts) What is the rate law that corresponds to the data shown for the reaction $2A + B \rightarrow C$?

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

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

for A use 2 + 3: no change in rate shows 0 order

for B use 4 ÷ 3: $\frac{1.125}{0.500} = \frac{k}{k}\left(\frac{0.066}{0.044}\right)^y$

$2.25 = (1.5)^y$

$\ln 2.25 = y \ln 1.5 \quad y = 2$

$rate = k[B]^2$

5. (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 $9.5 \times 10^{-3}\ hr^{-1}$. Calculate how long it takes for the amount of thallium-201 to fall to 5.0% of its original value.

1st order

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

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

$\ln\left(\frac{5}{100}\right) = -9.5\times10^{-3}hr^{-1}(t)$

$t = 315$ hr