CHM 152 Quiz #2a 25 Pts Spring 2012 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)

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

SHOW ALL WORK TO RECEIVE CREDIT

1. (8 Pts) The activation energy, E_a, for the reaction $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$ is 102kJ/mol. The observed rate constant at 25 °C is $3.46 \times 10^{-5}\ s^{-1}$. Determine the value of the rate constant at 55 °C.

$$\ln\frac{k_2}{3.46\times10^{-5}} = \frac{102\times10^3\ J/mol}{8.314\ J/mol.K}\left(\frac{1}{298} - \frac{1}{328}\right)$$

$$\ln\frac{k_2}{3.46\times10^{-5}} = 3.7654..$$

$$\frac{k_2}{3.46\times10^{-5}} = e^{3.76548}$$

$$k_2 = 1.49 \times 10^{-3}\ s^{-1}$$

2. (8 Pts) The reaction $2NOCl(g) \rightarrow 2NO(g) + Cl_2(g)$ has $k = 9.3 \times 10^{-5}\ L{\cdot}mol^{-1}{\cdot}s^{-1}$ at 100°C and $k = 1.3 \times 10^{-3}\ L{\cdot}mol^{-1}{\cdot}s^{-1}$ at 130°C. Determine E_a for the reaction in kJ/mol.

Same as quiz 2a.

3. (5 Pts) The reaction, $SO_2Cl_2(g) \rightarrow SO_2(g) + Cl_2(g)$ has a *first order* rate constant of $2.2 \times 10^{-5}\ s^{-1}$ at 593K. If the initial concentration of SO_2Cl_2 is 0.0040 M, what will its concentration be after 7.00 hours?

$$\ln[SO_2Cl_2]_t = -2.2\times10^{-5}(25{,}000) + \ln[0.0040]$$

$$\ln[SO_2Cl_2]_t = -6.076..$$

$$[SO_2Cl_2]_t = e^{-6.076..} = 0.0023\ M$$

4. (4 Pts) A second order reaction has a rate constant of $1.6 \times 10^{-3}\ L{\cdot}mol^{-1}{\cdot}s^{-1}$ at 700°C. If the initial concentration of the reactant is 3.4×10^{-2} M, how many minutes will it take for the concentration to be reduced to 7.0×10^{-4} M?

$$\frac{1}{7.0\times10^{-4}} = 1.6\times10^{-3}\,t + \frac{1}{3.4\times10^{-2}}$$

$$t = 874{,}474\ sec = 14{,}575\ min$$

$$1.5\times10^4\ min$$

CHM 152 Quiz #2b 25 Pts Spring 2012 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)

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

SHOW ALL WORK TO RECEIVE CREDIT

1. (8 Pts) The reaction $2NOCl(g) \rightarrow 2NO(g) + Cl_2(g)$ has $k = 9.3 \times 10^{-5}\ L\cdot mol^{-1}\cdot s^{-1}$ at 100°C and $k = 1.3 \times 10^{-3}\ L\cdot mol^{-1}\cdot s^{-1}$ at 130°C. Determine E_a for the reaction in kJ/mol.

$$\ln\frac{9.3\times10^{-5}}{1.3\times10^{-3}} = \frac{E_a}{8.314}\left(\frac{1}{403} - \frac{1}{373}\right)$$

$$E_a = 109874\ J/mol = 110\ kJ/mol$$

2. (8 Pts) The activation energy, E_a, for the reaction $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$ is 102kJ/mol. The observed rate constant at 25 °C is $3.46 \times 10^{-5}\ s^{-1}$. Determine the value of the rate constant at 45 °C.

$$\ln\frac{k_2}{3.46\times10^{-5}} = \frac{102\times10^3\ J/mol}{8.314\ \frac{J}{mol\cdot K}}\left(\frac{1}{298} - \frac{1}{318}\right)$$

$$\ln\frac{k_2}{3.46\times10^{-5}} = 2.5893..$$

$$\frac{k_2}{3.46\times10^{-5}} = e^{2.589..}$$

$$k_2 = 4.6\times10^{-4}\ s^{-1}$$

3. (5 Pts) The reaction, $SO_2Cl_2(g) \rightarrow SO_2(g) + Cl_2(g)$ has a *first order* rate constant of $2.2 \times 10^{-5}\ s^{-1}$ at 593K. If the initial concentration of SO_2Cl_2 is 0.0040 M, what will its concentration be after 12.00 hours?

$$\ln[SO_2Cl_2]_t = -2.2\times10^{-5}(43200) + \ln[0.0040]$$

$$\ln[SO_2Cl_2]_t = -6.472....$$

$$[SO_2Cl_2]_t = e^{-6.472...} = 0.00154\ M$$

4. (4 Pts) A second order reaction has a rate constant of $1.6 \times 10^{-3}\ L\cdot mol^{-1}\cdot s^{-1}$ at 700°C. If the initial concentration of the reactant is 4.4×10^{-2} M, how many minutes will it take for the concentration to be reduced to 6.0×10^{-4} M?

$$\frac{1}{6.0\times10^{-4}} = 1.6\times10^{-3}\ L\cdot mol^{-1}\cdot s^{-1}\ t + \frac{1}{4.4\times10^{-2}}$$

t: 1,027,462 sec = 17,124 min

1.7×10^4 min