2b below

CHM152/54 Quiz #2a 25 Pts Spring 05 Name: Key

show work where possible

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)

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

1a. (3 Pts) A decomposition reaction has a rate constant of 0.012 yr^{-1}. Determine the half-life. units show 1st order

$t_{1/2} = \frac{0.693}{k} = \frac{0.693}{0.012\,yr^{-1}} = 57.75\ yr$

b. (4) If the initial concentration of the react in (1a) is 0.120 M, what will the concentration be after 25 years?

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

$\ln[A]_t = -0.012\,yr^{-1}(25\,yr) + \ln[0.120] = -2.420..$

$[A]_t = e^{-2.420..} = $ **0.0889 M**

2. The table presents data for the reaction: $2H_2(g) + 2NO(g) \xrightarrow{k_1} 2H_2O(g) + N_2(g)$

Exp.	Initial Concentration (mol·L^{-1}) [NO] × 10^{-3}	[H_2] × 10^{-3}	Initial Rate M/s
I	6.0	1.0	18
II	6.0	2.0	36
III	1.0	6.0	3
IV	2.0	6.0	12

$rate = k[NO]^x[H_2]^y$

a. (5 Pts) What is the rate law for this reaction?

for NO use Exp IV / III : $\frac{12}{3} = \left(\frac{2.0}{1.0}\right)^x$ * (H_2) + k terms cancel

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

for H_2 use Exp II / I : $\frac{36}{18} = \left(\frac{2.0}{1.0}\right)^y$ $2 = 2^y$ **y = 1**

$rate = k[NO]^2[H_2]$

2b. (3 Pts) Determine the value of the rate constant for 2a.

use any Exp to solve for k : $18 = k[6.0\times10^{-3}]^2[1.0\times10^{-3}]$

$k = 5.0 \times 10^8\ M^{-2}\,s^{-1}$

3. (6 Pts) The rate constant of a reaction is 5.7 x 10^{-3} s^{-1} at 25°C. The activation energy is 44.6 kJ/mol. What is the value of the rate constant at 95°C?

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

$\ln\frac{k_1}{5.7\times10^{-3}} = \frac{44.6\times10^3\,J}{mol} \Big/ \frac{mol\cdot K}{8.314\,J}\left(\frac{1}{298} - \frac{1}{368}\right)K$

$k_1 = 0.175\ s^{-1}$

4. (4 Pts) List and explain (how) two factors that affect rate.

Sufficient energy

Correct geometry (orientation)

Concentration

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show work where possible

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**

1a. (3 Pts) A decomposition reaction has a rate constant of 0.012 yr^{-1}. Determine the half-life.

$t_{1/2} = \frac{0.693}{k} = \frac{0.693}{0.012\ yr^{-1}} = 57.75\ yr$

b. (4) If the initial concentration of the react in (1a) is 0.120 M, what will the concentration be after 85 years?

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

$\ln[A]_t = -0.012\ yr^{-1}(85\ yr) + \ln[0.120]$

$[A] = e^{-3.140}$ → 0.0433 M

2. The table presents data for the reaction: $2H_{2(g)} + 2NO_{(g)} \xrightarrow{k_1} 2H_2O_{(g)} + N_{2(g)}$

Exp.	Initial Concentration (mol·L^{-1}) [NO] × 10^{-3}	[H$_2$] × 10^{-3}	Initial Rate M/s
I	6.0	1.0	18
II	6.0	2.0	36
III	1.0	6.0	3
IV	2.0	6.0	12

a. (5 Pts) What is the rate law for this reaction? See Quiz 2a

rate = $k[NO]^2[H_2]$

2b. (3 Pts) Determine the value of the rate constant for 2a.

$k = 5.0 \times 10^{8}\ M^{-2}\ s^{-1}$

3. (6 Pts) The rate constant of a reaction is 6.7 x 10^{-3} s^{-1} at 25°C. The activation energy is 54.6 kJ/mol. What is the value of the rate constant at 95°C?

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

$\ln\frac{k_1}{6.7\times10^{-3}} = \frac{54.6\times10^3\ J}{1\ mol} \cdot \frac{mol \cdot K}{8.314\ J}\left(\frac{1}{298} - \frac{1}{368}\right)$

$k_1 = 0.443\ s^{-1}$

4. (4 Pts) List and explain (how) two factors that affect rate.

See Quiz 2a