CHM 152/54 Quiz #2a 25 Pts Fall 05 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)

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

1. (4 Pts) For the reaction: $BrO_3^- + 5Br^- + 6H^+ \rightarrow 3Br_2 + 3H_2O$

$-\Delta[BrO_3^-]/\Delta t = 1.5 \times 10^{-2}$ M/s at a particular time. What is $-\Delta[Br^-]/\Delta t$ at the same instant?

$$\text{rate} = \frac{-\Delta[BrO_3^-]}{\Delta t} = \frac{-\Delta[Br^-]}{5\Delta t} \quad \text{so: } 5(1.5\times10^{-2}\tfrac{M}{s}) = 0.075\tfrac{M}{s}$$

2. (4 Pts) For the hypothetical reaction A + 3B → 2C, the rate of appearance of C given by ($\Delta[C]/\Delta t$) may also be expressed as

a. $\frac{\Delta[C]}{\Delta t} = \frac{\Delta[A]}{\Delta t}$ b. $\frac{\Delta[C]}{\Delta t} = \frac{-\Delta[B]}{2/3\,\Delta t}$ c. $\frac{\Delta[C]}{\Delta t} = \frac{-2/3\,\Delta[B]}{\Delta t}$ d. $\frac{\Delta[C]}{\Delta t} = \frac{-1/2\,\Delta[A]}{\Delta t}$

$$\text{rate} = \frac{-\Delta[A]}{\Delta t} = \frac{-\Delta[B]}{3\Delta t} = \frac{+\Delta C}{2\Delta t} \quad \text{So} \quad \frac{-2[B]}{3\Delta t} = \frac{\Delta[C]}{\Delta t}$$

3. (3 Pts) The reaction A + 2B → products has the rate law, rate = $k[A][B]^3$. If the concentration of B is doubled while that of A is unchanged, by what factor will the rate of reaction increase?

$$\text{rate} = k[1][2]^3 = 8 \text{ fold increase}$$

4. (4 Pts) 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?

$$\ln[A]_t = -kt + \ln[A]_0$$
$$= -6.40\times10^{-3}(62) + \ln[0.0314]$$
$$\ln[A]_t = -3.8577..$$
$$[A]_t = e^{-3.8577..} = 0.02112\ M$$

5. (4 Pts) The reaction $2NO_2(g) \rightarrow 2NO(g) + O_2(g)$ is suspected to be second order in NO_2. Which of the following kinetic plots would be the most useful to prove whether or not the reaction is second order?

A. a plot of $[NO_2]^{-1}$ vs. t   B. a plot of ln $[NO_2]$ vs. t   C. a plot of $[NO_2]$ vs. t   D. a plot of $[NO_2]^2$ vs. t

6. (6 Pts) 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 1.35×10^{-4}/s at 35°C. What is the value of k at 0°C?

$$\ln\frac{k_1}{1.35\times10^{-4}} = \frac{102\times10^3\ J/mol}{8.314\ J/mol\cdot K}\left(\frac{1}{273+35} - \frac{1}{273}\right)$$
$$= -5.1067..$$
$$\frac{k_1}{1.35\times10^{-4}} = e^{-5.1067..} \qquad k_1 = 8.175\times10^{-7}\ s^{-1}$$

CHM 152/54 Quiz #2b 25 Pts Fall 05 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)

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

1. (4 Pts) For the reaction: $BrO_3^- + 5Br^- + 6H^+ \rightarrow 3Br_2 + 3H_2O$

$-\Delta[BrO_3^-]/\Delta t = 1.5 \times 10^{-2}$ M/s at a particular time. What is $-\Delta[Br^-]/\Delta t$ at the same instant?

$$rate = \frac{-\Delta[BrO_3^-]}{\Delta t} = \frac{-\Delta[Br^-]}{5\Delta t}$$ so: $5(1.5\times10^{-2}\ \frac{M}{s}) = 0.075\ \frac{M}{s}$

2. (4 Pts) For the hypothetical reaction A + 3B → 2C, the rate of appearance of C given by ($\Delta[C]/\Delta t$) may also be expressed as

a. $\frac{\Delta[C]}{\Delta t} = \frac{\Delta[A]}{\Delta t}$ b. $\frac{\Delta[C]}{\Delta t} = \frac{-\Delta[B]}{2/3\ \Delta t}$ c. $\frac{\Delta[C]}{\Delta t} = \frac{-2/3\ \Delta[B]}{\Delta t}$ d. $\frac{\Delta[C]}{\Delta t} = \frac{-1/2\ \Delta[A]}{\Delta t}$

see Quiz 2a Key

3. (3 Pts) The reaction A + 2B → products has the rate law, rate = $k[A][B]^3$. If the concentration of B is doubled while that of A is doubled, by what factor will the rate of reaction increase?

$rate = k[2][2]^3$ $2^4 = 16$

4. (4 Pts) 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 82.0 min at 25°C?

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

$= (-6.40\times10^{-3})(82) + \ln[0.0314]$

$\ln[A]_t = -3.9857..$

$[A]_t = 0.01857$ M

5. (4 Pts) The reaction $2NO_2(g) \rightarrow 2NO(g) + O_2(g)$ is suspected to be second order in NO_2. Which of the following kinetic plots would be the most useful to prove whether or not the reaction is second order?

A. a plot of $[NO_2]^2$ vs. t B. a plot of ln $[NO_2]$ vs. t C. a plot of $[NO_2]$ vs. t D. a plot of $[NO_2]^{-1}$ vs. t

6. (6 Pts) The activation energy for the following first-order reaction is 202 kJ/mol.

$N_2O_5(g) \rightarrow 2NO_2(g) + 1/2O_2(g)$

The value of the rate constant (k) is 1.35×10^{-4}/s at 45°C. What is the value of k at 0°C?

$$\ln\frac{k_1}{1.35\times10^{-4}} = \frac{202\times10^3\ \cancel{J}/mol}{8.314\ \cancel{J}/mol\cdot K}\left(\frac{1}{45+273} - \frac{1}{273}\right)$$

$= -12.594...$

$$\frac{k_1}{1.35\times10^{-4}} = e^{-12.594...}$$

$k_1 = 4.58 \times 10^{-10}$