CHM152 Quiz 1 25 Pts Spring 2019 Name: Key

Show all work to receive credit.

rate = k rate = k[A] rate = k[A]^2 $[A]_t = -kt + [A]_0$ $\ln[A]_t = -kt + \ln[A]_0$ $\ln\left[\frac{[A]_0}{[A]_t}\right] = -kt$ $1/[A]_t = kt + 1/[A]_0$

$t_{1/2} = [A]_0/2k$ $t_{1/2} = 0.693/k$ $t_{1/2} = 1/k[A]_0$

1. (4 Pts) Nitric oxide gas (NO) reacts with chlorine gas according to the chemical equation given below.

   $NO + \frac{1}{2} Cl_2 \rightarrow NOCl$

   The following initial rates of reaction have been measured for the given reagent concentrations.

Expt. #	Rate (M/hr)	NO (M)	Cl_2 (M)
1	1.19	0.50	0.50
2	4.79	1.00	0.50
3	9.59	1.00	1.00

   rate = $k[NO]^x[Cl_2]^y$

   Determine the following is the rate law (rate equation) for this reaction?

   For NO: $\frac{Exp\,2}{Exp\,1}$ $\frac{4.79}{1.19} = \left(\frac{1.00}{0.50}\right)^x$

   $4 = 2^x$ $x = 2$ (2nd order)

   For Cl_2 $\frac{Exp\,3}{Exp\,2}$ $\frac{9.59}{4.79} = \left(\frac{1.00}{0.50}\right)^y$ $y = 1$ (1st order)

   $2 = 2^y$

   rate = $k[NO]^2[Cl_2]$

   What is the value (and units) of the rate constant?

   $k = \frac{M}{hr \cdot M^2 \cdot M} = 9.52\ hr^{-1} \cdot M^{-2}$

2. (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?

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

   $\ln[A]_t = -6.40 \times 10^{-3}(62.0) + \ln 0.0314 = -3.858$

   $[A]_t = 0.0211\ M$

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?

   $[1][2]^3 =$ 8 fold increase

4. (4 Pts) For the reaction $BrO_3^- + 5Br^- + 6H^+ \rightarrow 3Br_2 + 3H_2O$ at a particular time, $-\Delta[BrO_3^-]/\Delta t = 1.5 \times 10^{-2}$ M/s. What is $-\Delta[Br^-]/\Delta t$ at the same instant?

   rate = $\frac{-\Delta[BrO_3^-]}{\Delta t} = \frac{-\Delta[Br^-]}{5\,\Delta t}$

   So: $5 \times 1.5 \times 10^{-2} = 0.075$ M/s

More questions on back.

5. (3 Pts) Concerning the rate law, Rate = $k[A]^2[B]$, what are appropriate units for the rate constant k?

$$k = \frac{\text{Rate}}{[A]^2[B]} = \frac{M}{t} \cdot \frac{}{M^2} \cdot \frac{}{M} = t^{-1} \cdot M^{-2}$$

6. (3 Pts) The first-order decomposition, A → *products*, has a rate constant of 0.150 s^{-1}. Starting with $[A]_o = 0.350$ M, how much time is required for $[A]_t = 0.125$ M?

$$\ln[0.125] = -0.150(t) + \ln[0.350]$$

$$t = 6.86 \text{ sec.}$$

7. (4 Pts) It takes 42.0 min for the concentration of a reactant in a first-order reaction to drop from 0.45 M to 0.32 M at 25°C. How long will it take for the reaction to be 80% complete?

1st. Find k

$$\ln[0.32] = -k(42.0) + \ln[0.45]$$

$$k = 0.00812 \text{ min}^{-1}$$

then with 20% LEFT

$$\ln\left(\frac{20}{100}\right) = -(0.00812)\,t$$

$$t = 198 \text{ min}$$

Green

CHM152 Quiz 1b 25 Pts Spring 2019 Name: Key

Show all work to receive credit.

rate = k rate = k[A] rate = k[A]^2 $[A]_t = -kt + [A]_0$ $\ln[A]_t = -kt + \ln[A]_0$ $\ln\left[\frac{[A]_0}{[A]_t}\right] = -kt$ $1/[A]_t = kt + 1/[A]_0$

$t_{1/2} = [A]_0/2k$ $t_{1/2} = 0.693/k$ $t_{1/2} = 1/k[A]_0$

1. (4 Pts) It takes 42.0 min for the concentration of a reactant in a first-order reaction to drop from 0.45 M to 0.32 M at 25°C. How long will it take for the reaction to be 70% complete?

1st find k:

$\ln[0.32] = -k(42.0) + \ln[0.45]$

$k = 0.00812\ min^{-1}$

then with 30% LEFT

$\ln\frac{30}{100} = -0.00812(t)$

$t = 148\ min$

2. (3 Pts) Concerning the rate law, Rate = k[A]^2[B], what are appropriate units for the rate constant k?

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

3. (4 Pts) For the reaction $BrO_3^- + 5Br^- + 6H^+ \rightarrow 3Br_2 + 3H_2O$ at a particular time, $-\Delta[BrO_3^-]/\Delta t = 2.5 \times 10^{-2}$ M/s. What is $-\Delta[Br^-]/\Delta t$ at the same instant?

$2.5 \times 10^{-2} \times 5 = 0.125\ M/s$

4. (3 Pts) The first-order decomposition, A → *products*, has a rate constant of 0.150 s^{-1}. Starting with $[A]_0 = 0.350$ M, how much time is required for $[A]_t = 0.125$ M?

$\ln[0.125] = -0.150(t) + \ln[0.350]$

$t = 6.86\ sec$

More questions on back.

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Key

5. (4 Pts) Nitric oxide gas (NO) reacts with chlorine gas according to the chemical equation given below.

$$NO + \tfrac{1}{2} Cl_2 \rightarrow NOCl$$

The following initial rates of reaction have been measured for the given reagent concentrations.

Expt. #	Rate (M/hr)	NO (M)	Cl_2 (M)
1	1.19	0.50	0.50
2	4.79	1.00	0.50
3	9.59	1.00	1.00

Determine the following is the rate law (rate equation) for this reaction?

see other Key

What is the value (and units) of the rate constant? $9.52\ hr^{-1} \cdot M^{-2}$

6. (4 Pts) At 25°C the rate constant for the first-order decomposition of a pesticide solution is $6.40 \times 10^{-3}\ min^{-1}$. If the starting concentration of pesticide is 0.0314 M, what concentration will remain after 52.0 min at 25°C?

$$\ln [A]_t = -6.40 \times 10^{-3}(52.0) + \ln(0.0314)$$

$$[A]_t = 0.0225\ M$$

7. (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?

$$\text{rate} = k[A][B]^3$$

$$[1][2]^3 = 8 \text{ Fold increase}$$