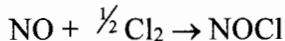


CHM152 Quiz 1 25 Pts Spring 2019 Name: Key  
 Show all work to receive credit.

rate = k    rate = k[A]    rate = k[A]<sup>2</sup>    [A]<sub>t</sub> = -kt + [A]<sub>0</sub>    ln[A]<sub>t</sub> = -kt + ln[A]<sub>0</sub>     $\ln \left[ \frac{[A]_0}{[A]_t} \right] = -kt$     1/[A]<sub>t</sub> = kt + 1/[A]<sub>0</sub>  
 t<sub>1/2</sub> = [A]<sub>0</sub>/2k    t<sub>1/2</sub> = 0.693/k    t<sub>1/2</sub> = 1/k[A]<sub>0</sub>

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



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

Expt. #	Rate (M/hr)	NO (M)	Cl <sub>2</sub> (M)
1	1.19	0.50	0.50
2	4.79	1.00	0.50
3	9.59	1.00	1.00

$$\text{rate} = k [\text{NO}]^x [\text{Cl}_2]^y$$

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

for NO:  $\frac{\text{Exp 2}}{\text{Exp 1}} \quad \frac{4.79}{1.19} = \left( \frac{1.00}{0.50} \right)^x$   
 $4 = 2^x \quad x = 2$  (2nd order)

for Cl<sub>2</sub>:  $\frac{\text{Exp 3}}{\text{Exp 2}} \quad \frac{9.59}{4.79} = \left( \frac{1.00}{0.50} \right)^y$      $2 = 2^y \quad y = 1$  (1st order)  
 rate = k [NO]<sup>2</sup> [Cl<sub>2</sub>]

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

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

2. (4 Pts) At 25°C the rate constant for the first-order decomposition of a pesticide solution is  $6.40 \times 10^{-3} \text{ min}^{-1}$ . If the starting concentration of pesticide is 0.0314 M, what concentration will remain after 62.0 min at 25°C?

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

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

$$[A]_t = 0.0211 \text{ M}$$

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

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

4. (4 Pts) For the reaction  $\text{BrO}_3^- + 5\text{Br}^- + 6\text{H}^+ \rightarrow 3\text{Br}_2 + 3\text{H}_2\text{O}$  at a particular time,  $-\Delta[\text{BrO}_3^-]/\Delta t = 1.5 \times 10^{-2} \text{ M/s}$ . What is  $-\Delta[\text{Br}^-]/\Delta t$  at the same instant?

$$\text{rate} = \frac{-\Delta [\text{BrO}_3^-]}{\Delta t} = \frac{-\Delta [\text{Br}^-]}{5 \Delta t}$$

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

More questions on back.

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

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

6. (3 Pts) The first-order decomposition,  $\text{A} \rightarrow \text{products}$ , has a rate constant of  $0.150 \text{ s}^{-1}$ . Starting with  $[\text{A}]_0 = 0.350 \text{ M}$ , how much time is required for  $[\text{A}]_t = 0.125 \text{ M}$ ?

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

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

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  $25^\circ\text{C}$ . 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.

$$\text{rate} = k$$

$$1/[A]_t = kt + 1/[A]_0$$

$$\text{rate} = k[A]$$

$$\text{rate} = k[A]^2$$

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

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

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

$$1/[A]_t = kt + 1/[A]_0$$

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

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.

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

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

then with 30% LEFT

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

$$t = 148 \text{ min}$$

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

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

3. (4 Pts) For the reaction  $\text{BrO}_3^- + 5\text{Br}^- + 6\text{H}^+ \rightarrow 3\text{Br}_2 + 3\text{H}_2\text{O}$  at a particular time,  $-\Delta[\text{BrO}_3^-]/\Delta t = 2.5 \times 10^{-2} \text{ M/s}$ . What is  $-\Delta[\text{Br}^-]/\Delta t$  at the same instant?

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

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

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

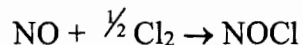
$$t = 6.86 \text{ sec}$$

More questions on back.

(16)

(Key)

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



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

Expt. #	Rate (M/hr)	NO (M)	Cl <sub>2</sub> (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?

$$9.52 \text{ hr}^{-1} \cdot \text{M}^{-2}$$

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

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

$$[A]_t = 0.0225 \text{ M}$$

7. (3 Pts) The reaction  $\text{A} + 2\text{B} \rightarrow \text{products}$  has the rate law,  $\text{rate} = k[\text{A}][\text{B}]^3$ . If the concentration of B is doubled while that of A is unchanged, by what factor will the rate of reaction increase?

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

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