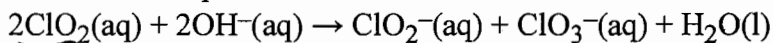


rate = k rate = k[A] rate = k[A]² [A]_t = -kt + [A]₀ ln[A]_t = -kt + ln[A]₀ R = 8.314 J/(mol•K)

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(k₁/k₂) = E_a/R (1/T₂ - 1/T₁) e=mc²

1. (4 Pts) Chlorine dioxide reacts in basic water to form chlorite and chlorate according to the following chemical equation:



Under a certain set of conditions, the initial rate of disappearance of chlorine dioxide was determined to be $2.30 \times 10^{-1} \text{ M/s}$. What is the initial rate of appearance of chlorite ion under those same conditions?

$$\text{rate} = \frac{-\Delta[\text{ClO}_2]}{2\Delta t} = \frac{\Delta[\text{ClO}_2^-]}{\Delta t}$$

$$\frac{2.30 \times 10^{-1} \text{ M}}{2} \Rightarrow 1.15 \times 10^{-1} \text{ M/s}$$

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

a. $\Delta[\text{C}]/\Delta t = -(1/2) \Delta[\text{A}]/\Delta t$

b. $\Delta[\text{C}]/\Delta t = \Delta[\text{A}]/\Delta t$

c. $\Delta[\text{C}]/\Delta t = -(3/2) \Delta[\text{B}]/\Delta t$

d. $\Delta[\text{C}]/\Delta t = -(2/3) \Delta[\text{B}]/\Delta t$

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

$$\text{so } \frac{\Delta\text{C}}{\Delta t} = \frac{-2\Delta[\text{A}]}{\Delta t} = \frac{-2\Delta[\text{B}]}{3\Delta t}$$

3. (2 Pts) Given the rate law for a reaction, $\text{rate} = k[\text{A}]^2 [\text{B}]^2$, where rate is measured in units of M s^{-1} , what are the units for the rate constant k?

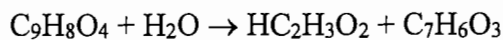
$$k = \frac{\text{rate}}{[\text{A}]^2 [\text{B}]^2} = \frac{\text{M}}{\text{s}} \frac{1}{\text{M}^2} \frac{1}{\text{M}^2} = \text{s}^{-1} \cdot \text{M}^{-3}$$

4. (4 Pts) The reaction $\text{A} + 2\text{B} \rightarrow \text{products}$ was found to follow the rate law: $\text{rate} = k[\text{A}]^2[\text{B}]$. Predict by what factor the rate of reaction will increase when the concentration of A is doubled, the concentration of B is tripled, and the temperature remains constant.

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

$$2^2 \cdot 3 = 12 \text{ fold}$$

5. Aspirin, $C_9H_8O_4$, slowly decomposes at room temperature by reacting with water in the atmosphere to produce acetic acid, $HC_2H_3O_2$, and 2-hydroxybenzoic acid, $C_7H_6O_3$ (this is why old bottles of aspirin often smell like vinegar):



Concentration and rate data for this reaction are given below.

	$[C_9H_8O_4]$ (M)	$[H_2O]$ (M)	Rate (M/s)
1	0.0100	0.0200	2.4×10^{-13}
2	0.0100	0.0800	9.6×10^{-13}
3	0.0200	0.0200	4.8×10^{-13}

General rate Law: $rate = k [C_9H_8O_4]^x [H_2O]^y$

- a. (6 Pts) Determine the rate law for the reaction.

For: $C_9H_8O_4$ use $\frac{Exp 3}{Exp 1}$ $\frac{4.8 \times 10^{-13}}{2.4 \times 10^{-13}} = \frac{k (0.0200)^x (0.0200)^y}{k (0.0100)^x (0.0200)^y}$

$2 = 2^x$ $x = 1$

For: H_2O use $\frac{Exp 2}{Exp 1}$ $\frac{9.6 \times 10^{-13}}{2.4 \times 10^{-13}} = \frac{k (0.0100)^x (0.0800)^y}{k (0.0100)^x (0.0200)^y}$

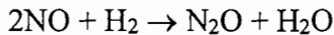
$4 = 4^y$ $y = 1$

$rate = k [C_9H_8O_4] [H_2O]$

- b. (2 Pts) Determine the value of the rate constant and its units.

use any Exp. $k = \frac{rate}{[C_9H_8O_4] [H_2O]} = 1.2 \times 10^{-9} M^{-1} \cdot s^{-1}$

6. (4 Pts) Use the following data to determine the rate law for the reaction shown below.



Expt. #	$[NO]_0$	$[H_2]_0$	Initial rate
1	0.021	0.065	1.46 M/min
2	0.021	0.260	1.46 M/min
3	0.042	0.065	5.84 M/min

General rate Law: $rate = k [NO]^x [H_2]^y$

For NO use $\frac{Exp 3}{Exp 1}$ $\frac{5.84}{1.46} = \frac{k (0.042)^x (0.065)^y}{k (0.021)^x (0.065)^y}$

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

For H_2 use $\frac{Exp 2}{Exp 1}$; since rate does not change $y = 0$

$rate = k [NO]^2$