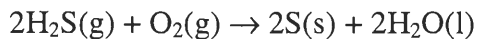


Show all work to receive credit

1. (3 Pts) For the overall chemical reaction shown below, which one of the following statements can be rightly assumed?



- A) The reaction is third-order overall.
- B) The reaction is second-order overall.
- C) The rate law is, rate = $k[\text{H}_2\text{S}]^2 [\text{O}_2]$.
- D) The rate law is, rate = $k[\text{H}_2\text{S}] [\text{O}_2]$.
- E) The rate law cannot be determined from the information given.

2. (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?

so $[\text{ClO}_2^-]$ appears half as fast as the disappearance of $[\text{ClO}_2]$
 $1.15 \times 10^{-1} \text{ M/s}$

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

(rate = k

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

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

$[\text{A}]_t = -kt + [\text{A}]_0$

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

$$\ln[0.125] = -0.150 \text{ s}^{-1}(t) + \ln[0.350]$$

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

4. (4 Pts) Concerning the rate law, Rate = $k[\text{A}]^2[\text{B}]$, what are appropriate units for the rate constant k? Assume the units for rate are M/s.

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

$$\frac{\text{M}}{\text{s}} = \text{---} \text{ M}^2 \text{ M}$$

$$k_{\text{units}} = \text{s}^{-1} \cdot \text{M}^{-2}$$

5. (4 Pts) The reaction $A + 2B \rightarrow \text{products}$ has been found to have the rate law, $\text{rate} = k[A][B]^2$. While holding the concentration of A constant, the concentration of B is increased from x to $3x$. Predict by what factor the rate of reaction increases.

$$\text{rate} = [1] [3]^2 = 9 \text{ (9 fold increase)}$$

6. (6 Pts) Chlorine dioxide reacts in basic water to form chlorite and chlorate according to the following chemical equation:



A kinetic study of this reaction under a certain set of conditions yielded the data below.

Exp	$[\text{ClO}_2]$ (M)	$[\text{OH}^-]$ (M)	rate (M/s)
1	0.0500	0.100	5.75×10^{-2}
2	0.100	0.100	2.30×10^{-1}
3	0.100	0.0500	1.15×10^{-1}

Determine the rate law and the value of the rate constant.

for ClO_2 : $\frac{\text{exp 2}}{\text{exp 1}} = \frac{\text{rate}_2}{\text{rate}_1} = \frac{k[\text{ClO}_2]^x [\text{OH}^-]^y}{k[\text{ClO}_2]^x [\text{OH}^-]^y}$

$$\frac{2.30 \times 10^{-1}}{5.75 \times 10^{-2}} = \left(\frac{0.100}{0.0500}\right)^x$$

$$4 = 2^x$$

$$x = 2 \text{ (2nd order)}$$

for OH^- : $\frac{\text{exp 2}}{\text{exp 3}} = \frac{2.30 \times 10^{-1}}{1.15 \times 10^{-1}} = \left(\frac{0.100}{0.0500}\right)^y$

$$2 = 2^y$$

$$y = 1 \text{ (1st order)}$$

so: $\text{rate} = k[\text{ClO}_2]^2 [\text{OH}^-]$

$$k = \frac{\text{rate}}{[\text{ClO}_2]^2 [\text{OH}^-]} = \frac{5.75 \times 10^{-2}}{[0.0500]^2 [0.100]} = 230 \text{ s}^{-1} \cdot \text{M}^{-2}$$