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

\[ 2\text{H}_2\text{S}(g) + \text{O}_2(g) \rightarrow 2\text{S}(s) + 2\text{H}_2\text{O}(l) \]

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:

\[ 2\text{ClO}_2(\text{aq}) + 2\text{OH}^-(\text{aq}) \rightarrow \text{ClO}_2^-\text{(aq)} + \text{ClO}_3^-\text{(aq)} + \text{H}_2\text{O}(l) \]

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

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

\[
\begin{align*}
\ln[0.125] &= -0.150 s^{-1} (t) + \ln[0.350] \\
t &= 6.86 s
\end{align*}
\]

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

Assume the units for rate are \(\text{M/s}\).

\[
\begin{align*}
\text{Rate} &= k[\text{A}]^2[\text{B}] \\
\text{M/s} &= \frac{\text{M}^2 \text{M}}{\text{s}} \\
k \text{units} &= \text{s}^{-1} \text{M}^{-2}
\end{align*}
\]

*****More questions on back*****
5. (4 Pts) The reaction \( A + 2B \rightarrow \) 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.

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

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

\[
2\text{ClO}_2(aq) + 2\text{OH}^-(aq) \rightarrow \text{ClO}_2^-(aq) + \text{ClO}_3^-(aq) + \text{H}_2\text{O}(l)
\]

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

<table>
<thead>
<tr>
<th>Exp</th>
<th>[ClO\textsubscript{2}] (M)</th>
<th>[OH\textsuperscript{-}] (M)</th>
<th>rate (M/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.0500</td>
<td>0.100</td>
<td>5.75 \times 10\textsuperscript{-2}</td>
</tr>
<tr>
<td>2</td>
<td>0.100</td>
<td>0.100</td>
<td>2.30 \times 10\textsuperscript{-1}</td>
</tr>
<tr>
<td>3</td>
<td>0.100</td>
<td>0.0500</td>
<td>1.15 \times 10\textsuperscript{-1}</td>
</tr>
</tbody>
</table>

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

For \( \text{ClO}_2^- \): \( \frac{\text{rate}}{\text{[ClO}_2^-]} = \frac{5.75 \times 10^{-2}}{0.100} \), \( x = 2 \) \( (2 \text{nd order}) \)

For \( \text{OH}^- \): \( \frac{\text{rate}}{\text{[OH}^-]} = \frac{2.30 \times 10^{-1}}{0.100} \), \( y = 1 \) \( (1 \text{st order}) \)

So, \( \text{rate} = k \left[\text{ClO}_2^-\right]^2 \left[\text{OH}^-ight]^y \)

\( k = \frac{\text{rate}}{\left[\text{ClO}_2^-\right]^2 \left[\text{OH}^-ight]^y} = \frac{5.75 \times 10^{-2}}{(0.0500)^2 \times (0.100)} = 2.30 \text{ s}^{-1} \cdot \text{M}^{-2} \)