1. The units for a fourth-order rate constant are: [2 pts]
   a) $M^5 s^{-1}$  
   b) $M^{-1} s^{-1}$  
   c) $s^{-1}$  
   d) $M^{-2} s^{-1}$  
   e) $M^3 s^{-1}$

2. Consider the integrated rate law for a 1st order reaction. A plot of $\ln[A]$ versus time would be a straight line. The slope of the line will equal $-k$. [3 pts]

3. True or False. The half-life of a second-order reaction depends on the initial reactant concentration. [2 pts]
   TRUE

4. The following data were collected for the rate of disappearance of NO in the reaction
   
   $$2 \text{ NO (g)} + \text{ O}_2 \text{(g)} \rightarrow 2 \text{ NO}_2 \text{(g)}$$

<table>
<thead>
<tr>
<th>Experiment</th>
<th>[NO]$_0$ (mol/L)</th>
<th>[O$_2$]$_0$ (mol/L)</th>
<th>Initial Rate (M/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.0126</td>
<td>0.0125</td>
<td>0.0141</td>
</tr>
<tr>
<td>2</td>
<td>0.0252</td>
<td>0.0250</td>
<td>0.113</td>
</tr>
<tr>
<td>3</td>
<td>0.0252</td>
<td>0.0125</td>
<td>0.0564</td>
</tr>
</tbody>
</table>

   a) What is the rate law? SHOW WORK! [3 pts]

   NO, Compare Exp. 1 and 3
   
   Rate 3 = $\left(\frac{\text{[NO]}_3}{\text{[NO]}}\right)^x$
   
   $\frac{0.0564}{0.0141} = \left(\frac{0.0252}{0.0126}\right)^x$
   
   $4 = 2^x$
   
   $x = 2$

   Rate = $k[\text{NO}]^2[\text{O}_2]$

   O$_2$, Compare Exp. 2 and 3
   
   Rate 2 = $\left(\frac{\text{[O}_2]_2}{\text{[O}_2]}\right)^y$
   
   $\frac{0.113}{0.0564} = \left(\frac{0.0250}{0.0125}\right)^y$
   
   $2 = 2^y$
   
   $y = 2$

   b) What is the value of the rate constant? [2 pts]

   Using data from Trial 1,
   
   Rate = $k[\text{NO}]^2[\text{O}_2]$
   
   $0.0141 \text{ M/s} = k(0.0126)^2(0.0125)$
   
   $k = 7.11 \times 10^3 \text{ 1/M}^2\cdot\text{s}$
c) What is the rate if [NO] = 0.0500 M and [O_2] = 0.0300 M? [Hint: Plug into your rate law] [2 pts]

\[
\text{Rate} = k[\text{NO}]^2[\text{O}_2]
\]
\[
\text{Rate} = (7.11 \times 10^3 \text{ M}^{-2} \cdot \text{s})(0.0500 \text{ M})^2(0.0300 \text{ M})
\]
\[
\text{Rate} = 0.533 \text{ M/s}
\]

5. Does the rate constant, \( k \), depend on the following quantities? Please answer yes or no. [2 pts]
   a) concentrations of reactants \( \text{NO} \)
   b) temperature \( \text{YES} \)

6. For the reaction, \( A \rightarrow \text{products} \), a plot of \( \ln[A] \) vs. time produces a straight line? Which of the following statements is true? [3 pts]
   a) The rate of the reaction does not depend on the concentration of A.
   b) The initial concentration of A can be calculated from the intercept on the horizontal axis.
   c) The rate constant for the reaction can be obtained from the value of the intercept on the vertical axis.
   d) The rate constant can be determined from the slope of the line.
   e) All of the above statements are true.

7. A certain substance, initially at 0.25 M in solution, decomposes by second-order kinetics. If the rate constant for this process in \( 4.0 \times 10^{-1} \text{ M}^{-1} \text{ min}^{-1} \), how much time is required for the concentration to reach 0.015 M? [3 pts]

\[
\frac{1}{[A]_t} = kt + \frac{1}{[A]_0}
\]
\[
\frac{1}{0.015 \text{ M}} = (0.40 \text{ M}^{-1} \text{ min}^{-1})t + \frac{1}{0.25 \text{ M}}
\]
\[
t = 157 \text{ min}
\]

8. A certain 1st order reaction has a half-life of 4.8 hours.
   a) Calculate the rate constant, \( k \), for the reaction. [2 pts]

\[
t_\frac{1}{2} = \frac{0.693}{k}
\]
\[
4.8 \text{ hr} = \frac{0.693}{k}
\]
\[
k = 0.144 \text{ 1/hr}
\]
   b) Starting the reaction with a concentration of 0.150 M, what is the concentration after 3.75 hours? [4 pts]

\[
\ln[A]_t = -kt + \ln[A]_0
\]
\[
\ln[A]_t = -(0.144 \text{ 1/hr})(3.75 \text{ hr}) + \ln(0.150 \text{ M})
\]
\[
\ln[A]_t = -2.44
\]
\[
e^{\ln[A]_t} = e^{-2.44}
\]
\[
[A]_t = 0.0874 \text{ M}
\]