SECTION 1:
1. $\text{KClO}_3$ decomposes according to the reaction: $2\text{KClO}_3 \rightarrow 2\text{KCl} + 3\text{O}_2$. The rate of decomposition of potassium chlorate at a certain time is determined to be $2.4 \times 10^{-2}$ mol s$^{-1}$. What is the rate of formation of $\text{O}_2$ at the same time?
   A) $7.2 \times 10^{-2}$ mol s$^{-1}$  B) $1.2 \times 10^{-2}$ mol s$^{-1}$  C) $3.6 \times 10^{-2}$ mol s$^{-1}$  D) $2.4 \times 10^{-2}$ mol s$^{-1}$  E) None

2. Choose the INCORRECT answer. The rate of a chemical reaction:
   A) is increased when the concentration of one of the reactants is increased for most reactions.
   B) is dependent on temperature
   C) is increased by the presence of a catalyst.
   D) will be very rapid if the activation energy is large
   E) none of the above

3. For the reaction $2\text{HgCl}_2 + \text{C}_2\text{O}_4^{2-} \rightarrow $ products, the rate law is:
   
   Rate $= [\text{HgCl}_2]^x [\text{C}_2\text{O}_4^{2-}]^y$

   and data are:

<table>
<thead>
<tr>
<th>[HgCl$_2$], M</th>
<th>[C$_2$O$_4^{2-}$], M</th>
<th>Init. rate of disapp. Of HgCl$_2$ M/hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0836</td>
<td>0.202</td>
<td>0.26</td>
</tr>
<tr>
<td>0.0836</td>
<td>0.404</td>
<td>1.04</td>
</tr>
<tr>
<td>0.0418</td>
<td>0.404</td>
<td>0.53</td>
</tr>
</tbody>
</table>

   A) $x = 2$ $y = 1$,  B) $x = 2$ $y = 2$  C) $x = 1$ $y = 2$  D) $x = 1$ $y = 1$  E) none of these

4) The overall order of a reaction with the rate constant of $9.3$ M$^{-2}$s$^{-1}$ should be $\text{__________}$
   A) 0  B) 1  C) 2  D) 3  E) none of these

5) The correct units of the specific rate constant for a zero order reaction are:
   A) L/mol·sec  B) sec$^{-1}$  C) sec  D) L$^2$/mol$^2$·sec  E) none of these
6) The following rate data were obtained at 25°C for the reaction \( 2 \text{A} + 3\text{B} \rightarrow 5\text{C} \)

<table>
<thead>
<tr>
<th>Experiment #</th>
<th>[A] (M)</th>
<th>[B] (M)</th>
<th>Rate = (-\Delta[B]/\Delta t) (M/s)</th>
<th>(-\Delta[A]/\Delta t) (M/s)</th>
<th>(\Delta[C]/\Delta t) (M/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.10</td>
<td>0.10</td>
<td>(2.00 \times 10^{-4})</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.20</td>
<td>0.10</td>
<td>(8.00 \times 10^{-4})</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.40</td>
<td>0.20</td>
<td>(9.05 \times 10^{-3})</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.30</td>
<td>0.30</td>
<td>?</td>
<td>?</td>
<td></td>
</tr>
</tbody>
</table>

Write the general rate-law expression for the above reaction using variables \(x\) and \(y\) for orders:

**Rate =**

a. Determine the order with respect to A using experiment # _____ & ______

b. Determine the order with respect to B using experiments ______ & ______

c. Determine the value of the rate constant and its units: ___________________ ______

d. Calculate the rate of disappearance of A in Experiment 1 and enter it in chart: ______
e. Calculate the rate of disappearance of B in Experiment 4 and enter it in chart

f. Calculate the rate of appearance of C in Experiment 4 and enter it in chart

SECTION 2:
These plots show the decomposition of a sample of NO₂ at 330°C as (a) the concentration of NO₂ versus t, (b) the natural logarithm of [NO₂] versus t, and (c) 1/[NO₂] versus t.

7. Answer the following questions from the above graphs about the NO₂ decomposition reaction:
a. This reaction is ______ order reaction because ____________________________________.

b. The rate constant for this reaction = _____________ using the data at 60 and 360 seconds as calculated below:

c. The unit of the above rate constant = ________________

d. The first half-life of this reaction = _______________ s

e. The concentration of the reactant at time zero = ______________ M

f. How long does it take for [NO₂] to become 3.0 x 10⁻³ M? ________.

8. If the half-life of a given reaction depends on the concentration of the reactant, then the reaction cannot be ________ order. If the rate of a reaction does not depend on the concentration of the reactant, then the reaction is ________ order with respect to that reactant.

   A) second    B) zero    C) first    D) third    E) none of these

9. The first order reaction A---→ products has t₁/₂ = 150. sec. What percent of the sample is reacted after 300. sec? ANSWER: __________
10. Given a reaction with $\Delta H_{\text{rxn}} = 12.5 \text{ kJ}$ and activation energy $E_a = 185 \text{ kJ/mol}$, What is the activation energy for the reverse reaction? ____________ kJ  Show the work with energy diagram.

11. The rate constant for a first-order reaction is $4.60 \times 10^{-4} \text{ s}^{-1}$ at 250°C. If the activation energy is $100.0 \text{ kJ/mol}$, calculate the rate constant at 300°C.  

   ANSWER: ____________

12. The first-order reaction $A \rightarrow \text{Products}$ has a half-life, $t_{1/2}$, of 55.0 min at 25 °C and 6.8 min at 100 °C. What is the activation energy for this reaction?  

   ANSWER: ____________

13. Identify the catalyst, any intermediates, and the overall equation for the following mechanism.

   $O_3 + NO \rightarrow O_2 + NO_2$
   $NO_2 + O \rightarrow NO + O_2$

   overall equation is:

<table>
<thead>
<tr>
<th>Intermediate</th>
<th>Catalyst</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>O$_2$</td>
<td>O$_2$</td>
</tr>
<tr>
<td>O$_3$</td>
<td>O$_3$</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>NO$_2$</td>
<td>NO$_2$</td>
</tr>
</tbody>
</table>