1. The rate of the reaction

$$2NH_3 \rightarrow N_2 + 3H_2$$

is equal to

1. $$-3\frac{[NH_3]}{t}$$
2. $$+\frac{[NH_3]}{3t}$$
3. $$-2\frac{[NH_3]}{t}$$
4. $$-\frac{[NH_3]}{2t}$$
5. $$+\frac{[NH_3]}{2t}$$

2. What are the units of the rate constant for the reaction

$$POCl + Cl_2 \rightarrow POCl_3$$

With a rate expression: $$\text{rate} = k [POCl]$$

1. M$^2$ sec$^{-1}$
2. M$^1$ sec$^{-1}$
3. M$^0$ sec$^{-1}$
4. M sec$^1$
5. M$^0$ sec$^1$

3. The following data were collected for the reaction

$$A + B \rightarrow C$$

at a particular temperature. Three experiments yield the following data:

<table>
<thead>
<tr>
<th>Trial</th>
<th>Initial [A]</th>
<th>Initial [B]</th>
<th>Initial [C]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.4</td>
<td>0.2</td>
<td>4 x 10$^{-3}$</td>
</tr>
<tr>
<td>2</td>
<td>0.8</td>
<td>0.2</td>
<td>4 x 10$^{-3}$</td>
</tr>
<tr>
<td>3</td>
<td>0.8</td>
<td>1.2</td>
<td>144 x 10$^{-3}$</td>
</tr>
</tbody>
</table>

What is the rate-law expression for this reaction?

1. 0.1 M$^{-1}$s$^{-1}$[B]$^2$
2. 0.4 M$^{-1}$s$^{-1}$ [B][A]$^2$
3. 0.1 M$^{-1}$s$^{-1}$ [A][B]$^2$
4. 4 x 10$^{-3}$ M$^{-1}$s$^{-3}$ [B][A]$^2$

4 The reaction

$$2NH_3 \rightarrow N_2 + 3H_2$$

is second order. At a certain temperature it has a rate constant of 0.15 M$^{-1}$s$^{-1}$

At this temperature, how long would it take for 40% of a given sample to decompose?

1. 2.2 sec.
2. 5 sec.
3. 4.44 sec.
4. 10 sec.

5 Which of the following statements is true:

1. Activation energy increases with temperature.
2. Catalysts are used to decrease the pre-exponential factor in the rate expression
3. Reaction rate increases with increasing activation energy
4. Endothermic reactions have a higher activation energy than exothermic reactions
6. For a reaction the rate constant is $6 \times 10^5$ sec$^{-1}$ at 25°C. If $A$ is $6.2 \times 10^{12}$, what is the activation energy?

1. 40 kJ/mol
2. 40 J/mol
3. 3.3 kJ/mol
4. -40 kJ/mol
5. -3.3 kJ/mol

7. Consider the multi-step reaction that has the overall reaction

$$\text{NO}_2 + \text{CO} \rightarrow \text{NO} + \text{CO}_2$$

What would be the observed rate expression given the proposed reaction mechanism below?

\[ \text{NO}_2 + \text{NO}_2 \rightarrow \text{NO}_3 + \text{NO} \text{ fast} \]
\[ \text{NO}_3 + \text{CO} \rightarrow \text{NO}_2 + \text{CO}_2 \text{ slow} \]

1. Rate = $k[\text{NO}_2]$
2. Rate = $k[\text{NO}_2]^2$
3. Rate = $k[\text{NO}_2]^2[\text{CO}]/[\text{NO}]$
4. Rate = $k[\text{NO}_2][\text{CO}][\text{NO}]$
5. Rate = $k[\text{NO}_2][\text{CO}]/[\text{NO}]$

8. Consider the reaction coordinate for $A \rightarrow B$

![Reaction Coordinate Diagram]

What is the activation energy for $A \rightarrow B$?

1. 100 kJ/mol rxn
2. 200 kJ/mol rxn
3. 300 kJ/mol rxn
4. 150 kJ/mol rxn
5. 250 kJ/mol rxn