CH302 Practice Quiz 2 on Kinetics
(It will be a miracle if I got all these calculations right--make sure you point out my errors while we work them)

1. One of the reactions used commercially to produce ammonia gas is

\[ 3\text{H}_2(g) + \text{N}_2(g) \rightarrow 2\text{NH}_3(g) \]

A proper expression for the rate of this reaction could be

1. \(-3\Delta [\text{NH}_3]/\Delta t\)
2. \(+\Delta [\text{NH}_3]/3\Delta t\)
3. \(-2\Delta [\text{NH}_3]/\Delta t\)
4. \(-\Delta [\text{NH}_3]/2\Delta t\)
5. \(+\Delta [\text{NH}_3]/2\Delta t\) correct

2. For the reaction

\[ 3\text{H}_2(g) + \text{N}_2(g) \rightarrow 2\text{NH}_3(g) \]

<table>
<thead>
<tr>
<th>Trial</th>
<th>[N(_2)]</th>
<th>[H(_2)]</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.2</td>
<td>0.3</td>
<td>11.8</td>
</tr>
<tr>
<td>2</td>
<td>0.4</td>
<td>0.3</td>
<td>11.8</td>
</tr>
<tr>
<td>3</td>
<td>0.4</td>
<td>0.9</td>
<td>318.6</td>
</tr>
</tbody>
</table>

Deduce the order with respect to \(\text{H}_2\), \(\text{N}_2\), and the rate constant (dimensions left out of the latter on purpose) based on the above data.

1. 0, 3, 437 correct
2. 0, 0, 437
3. 1, 2, 196
4. 0, 1, 196

3. If the rate of a reaction is \(\text{Rate} = k[A]^0\) then appropriate units for the rate constant \(k\) are

1. sec
2. sec\(^{-1}\)
3. mol\(^{-1}\)L sec\(^{-1}\)
4. mol L\(^{-1}\)sec\(^{-1}\)correct
5. L mol\(^{-1}\)sec\(^{-1}\)

4. The decomposition of sulfuryl chloride into sulfur dioxide and chlorine

\[ \text{SO}_2\text{Cl}_2(g) \rightarrow \text{SO}_2(g) + \text{Cl}_2(g) \]

has a rate constant of \(2.2 \times 10^6\) sec\(^{-1}\). If one started with a sample containing 2.8 moles of sulfuryl chloride per liter what concentration would be left after 2 days?

1. 1.9 M correct
2. 0.68 M
3. 0.12 M
4. 0.052 M
5. 0.15 M
5. Consider the potential energy diagram shown below.

![Potential Energy Diagram](image)

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

1. $300 \text{ kJ}$ **correct**
2. $-300 \text{ kJ}$
3. $50 \text{ kJ}$
4. $-100 \text{ kJ}$
5. $100 \text{ kJ}$

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

$$2A + 2B \rightarrow C + D$$

What is the rate law expression that would correspond to the following proposed mechanism?

$$A + B \rightarrow I \text{ (fast)}$$
$$I + B \rightarrow 2[A] + X \text{ (fast)}$$
$$X + A \rightarrow D \text{ (slow)}$$

1. Rate $= k [A]^2 [B]$  
2. Rate $= k [B]$  
3. Rate $= k [A] [B]$  
4. Rate $= k [A] [B]^2$  
5. Rate $= k [A]^2 [B]^2$  
6. Rate $= k [B]^2$ **correct**

7. Calculate the activation energy of a reaction if the rate constant is $0.014 \text{ sec}^{-1}$ at $100^\circ C$ and $0.65 \text{ sec}^{-1}$ at $200^\circ C$?

1. $56 \text{ J/mol}$ **correct**  
2. $68 \text{ kJ/mol}$  
3. $6.4 \text{ kJ/mol}$  
4. $77 \text{ kJ/mol}$

8. The activation energy

1. will increase with increasing temperature.  
2. will remain constant with changes in temperature **correct**  
3. will be larger if the rate constant is larger.  
4. is part of the change in enthalpy of a reaction  
5. can be positive or negative in value