Show your work. Write your answer in the indicated space. The points of credit are shown for each problem. 10% of each problem will be deducted if you have the incorrect number of significant figures or if you have a math error with a correct setup. You should have a copy of the Periodic Table given to you. Some useful constants: \( \ln(10) = 2.303, \ln(2) = 0.693, R = 0.08206 \text{ L} \cdot \text{atm/mol} \cdot \text{K} \).

1. What is the osmotic pressure for a 0.20 M solution of \( \text{Mg(NO}_3\text{)}_2 \) at 25\(^\circ\)C? Include the correct units. (30 points)

Since \( \text{Mg(NO}_3\text{)}_2 \longrightarrow \text{Mg}^{2+} + 2\text{NO}_3^- \), the total conc. of ions is \( 3(0.20 \text{ M}) = 0.60 \text{ M} \)

\[
\Pi = MRT = (0.60 \text{ M})(0.08206 \text{ L} \cdot \text{atm/mol} \cdot \text{K})(25 + 273) = 15 \text{ atm} \quad (2 \text{ sig. fig.)}
\]

2. Ozone (\( \text{O}_3 \)) is very reactive, and will attack many organic compounds (tires, windscreen wipers, mucous membranes). The following initial rate data were obtained for the reaction of ozone with pentane (\( \text{C}_5\text{H}_{12} \)). Determine the rate law and calculate the value of the rate constant (include the correct units). (40 points)

<table>
<thead>
<tr>
<th>Exp. #</th>
<th>([\text{C}<em>5\text{H}</em>{12}]_i) (M)</th>
<th>([\text{O}_3]_i) (M)</th>
<th>Initial rate (M/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00\times10^{-2}</td>
<td>2.80\times10^{-3}</td>
<td>2.6</td>
</tr>
<tr>
<td>2</td>
<td>0.50\times10^{-2}</td>
<td>2.80\times10^{-3}</td>
<td>1.3</td>
</tr>
<tr>
<td>3</td>
<td>1.00\times10^{-2}</td>
<td>5.60\times10^{-3}</td>
<td>5.2</td>
</tr>
</tbody>
</table>

General rate law: \( \text{rate} = k[\text{C}_5\text{H}_{12}]^n [\text{O}_3]^m \)

From Exp. # 2 & 1, doubling the conc. of pentane doubles the rate; hence, \( n = 1 \). Likewise, from Exp. # 1 & 3, doubling the conc. of ozone doubles the rate; hence, \( m = 1 \).

Rate law: \( \text{rate} = k[\text{C}_5\text{H}_{12}] [\text{O}_3] \)

Rate constant \( k = 9.3\times10^4/(\text{M} \cdot \text{s}) \) \quad (2 \text{ sig. fig.)}

From Exp. # 1: \( 2.6 \text{ M/s} = k(1.00\times10^{-2} \text{ M})(2.80\times10^{-3} \text{ M}) \)

3. The rate constant for the decomposition of an acid (which is 1\(^\text{st}\) order) is 5.48\times10^{-2}/s. What percentage of the acid remains after 100. s? (30 points)

\[
\log([A]/[A]_0) = -kt/2.303 = -(5.48\times10^{-2}/\text{s})(100. \text{ s})/2.303 = -2.38
\]

\[
[A]/[A]_0 = 10^{-2.38} = 0.0042 \times 100\% = 0.42 \% \quad (2 \text{ sig. fig.)}
\]