CHEM2311 Tutorial Questions

1. Suggest starting materials and possible synthetic schemes for the following polymers:

   - ![Chemical structure 1](image1)
   - ![Chemical structure 2](image2)
   - ![Chemical structure 3](image3)
   - ![Chemical structure 4](image4)
   - ![Chemical structure 5](image5)
   - ![Chemical structure 6](image6)

2. Justify the trends in glass transition temperature shown below (i.e., construct an argument from the physical properties of the polymers that might explain why their melting points are in the order they are)

<table>
<thead>
<tr>
<th>R</th>
<th>polyacrylates</th>
<th>polymethacrylates</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>106</td>
<td>228</td>
</tr>
<tr>
<td>CH₃</td>
<td>10</td>
<td>105</td>
</tr>
<tr>
<td>CH₂CH₃</td>
<td>-24</td>
<td>65</td>
</tr>
<tr>
<td>CH₂CH₂CH₂CH₂CH₂CH₃</td>
<td>-57</td>
<td>-5</td>
</tr>
</tbody>
</table>

2.2 Assuming the Flory-Fox constant $K = 10^5$ for the polymers given above, calculate the $T_g$ for polymer composed entirely of macromolecules of $M = 10000$.

2.3. What would be the $T_g$ of a 4:1 mixtures of high molecular weight ($M \sim \infty$) and low molecular weight ($M \sim 10000$) poly(methyl methacrylate)?

2.4 What combination of polymers (using the data in Table 2) would be suitable to provide a polymer with a $T_g$ of 37 °C?
3. What is the intrinsic viscosity of a polysaccharide of molecular weight 35000 with Mark-Houwink parameters \( K = 1.3 \times 10^{-6} \text{ m}^3/\text{kg} \) and \( a = 0.68 \)? What happens when you double the molecular weight?

3.2. Excel Exercise: Using the equations given in Lecture 2, calculate the hydrodynamic volume of the two polymers above. What concentration of the first polysaccharide is needed to completely fill a solution with polymer coils? What might you expect to happen as the concentration increases beyond this level? What concentration is required for the second polysaccharide?

3.3 Use your Excel code to find the amount of polyacrylamide of molecular weight 7000000 needed to fill Lake Hume, on the NSW-Victoria border, with extended polymer coils (full storage capacity about 3 million megalitres; \( K = 3 \times 10^{-5} \text{ m}^3/\text{kg}, a = 0.8 \)).