WORKSHEET: SACCHARIDES - SOLUTIONS

1. Classify the following saccharides by the number of C atoms and the functional group:

   a)                     b)                      c)
   CHO
   H----OH
   H----OH
   H----OH
   CH₂OH

   aldopentose

   CH₂OH
   C==O
   HO----H
   H----OH
   CH₂OH

   ketotriose

   CHO
   HO----H
   H----OH
   CH₂OH

   ketohexose

2. Identify the stereocenters (*) in the following monosaccharides:

   a)                     b)                      c)                     d)
   H_\text{C=O}
   H*---OH
   HO*---H
   HO*---H
   CH₂OH

3. Identify the following monosaccharides as D- or L-enantiomers.

   a) D                     b) D                     c) D                     d) L

4. Which of the following structures are enantiomers?

   b) and d) are non-superimposable mirror images

   Which are diastereomers?

   all others are diastereomers (C_\text{\textsubscript{6}}H_{\text{12}}O_\text{6})
5. Draw the intermediates and product of the following **nucleophilic addition** reaction:

\[
\text{CH}_3\text{C}=\text{O} + \text{CH}_2\text{OH} \xrightarrow{\text{H}^+} \text{CH}_3\text{C}^\ominus \text{OH} + \text{CH}_3\text{OH} \rightarrow \text{CH}_3\text{C}^\ominus \text{O}^\ominus \text{CH}_3 + \text{H}^+ 
\]

6. Draw the **Haworth projections** of the intramolecular cyclic hemi-acetals formed in the reaction between the circled functional groups of the following two monosaccharides: *(hint: they will be six-membered rings)*.

![Haworth projections of D-mannose and D-galactose](image)

D-mannose

D-galactose

7. Draw the **chair** conformations of the two monosaccharides in the previous problem:

![Chair conformations of D-mannose and D-galactose](image)

D-mannose

D-galactose

8. Draw the product of the **condensation** reaction between the following alcohol and hemi-acetal:

\[
\begin{align*}
\text{CH}_3\text{C} & \equiv \text{O} \equiv \text{CH}_3 \\
\text{H} & \equiv \text{CH}_3
\end{align*}
\]
9. Draw the product of the condensation reaction between two glucose molecules, to form the disaccharide, maltose. The bond joining the two is an $\alpha-1,4$ glycosidic bond.

10. Draw the product when another equivalent of $\alpha$-D-glucose is added to maltose in a condensation reaction.

11. Identify the glycosidic bonds in the following saccharides and designate which ones are reducing sugars (hint: look for unstable hemiacetals or hemiketals):

   a) hemiacetal - reducing $\beta-1,4$
   b) hemiacetal - reducing $\alpha-1,6$
   c) acetal - nonreducing $\alpha,\alpha-1,1$