Multiple Choice Questions: 50 points

1. Choose the order that has the following conformations of 2-methylbutane correctly arranged with respect to increasing stability.

   ![Conformations of 2-methylbutane]

   i
   ii
   iii

   A i ii iii
   B i iii ii
   C ii i iii
   D ii iii i
   E iii i ii
   F iii ii i

2. Select the choice that best describes the relationship between the following two structures.

   ![Structures]

   A same compound
   B constitutional isomers
   C diastereomers
   D enantiomers

3. Select the choice that best describes the relationship between the following two structures.

   ![Structures]

   A conformers
   B constitutional isomers
   C diastereomers
   D enantiomers

4. Which of the following compounds are achiral?

   ![Compounds]

   i
   ii
   iii
   iv

   A i
   B iv
   C i & ii
   D ii & iii
   E i & iv
   F ii, iii, & iv
5. Cyclobutane prefers to adopt a slightly folded conformation than a planar one. Select the source(s) of strain that is(are) alleviated when cyclobutane deviates from planarity.

- i. angle strain
- ii. steric strain
- iii. torsional strain

A i  B ii  C iii  D i & ii  E i & iii  F ii & iii

3 pt partial credit for E. 2 pt partial credit for F.

6. Choose the reaction with the faster rate, as well as the type of reaction mechanism.

\[
\begin{align*}
\text{(1)}: & \quad \text{Cl} & \quad \text{CH}_3\text{O}^- & \quad \text{DMF} \\
\text{(2)}: & \quad \text{Cl} & \quad \text{CH}_3\text{S}^- & \quad \text{DMF}
\end{align*}
\]

A (1), S_N1  B (2), S_N1  C (1), S_N2  D (2), S_N2  E (1) ≈ (2), S_N1  F (1) ≈ (2), S_N2

7. Select the other conformation of chair structure X.

A  B  C  D  E
8. Select the order that has the following bromides correctly arranged with respect to increasing reactivity toward CH$_3$OH to form the following general ether product.

\[
\begin{align*}
R - Br & \quad \xrightarrow{\text{CH}_3\text{OH}} \quad R - OCH_3 \\
\text{i} & \quad \text{Br} \\
\text{ii} & \quad \text{Br} \\
\text{iii} & \quad \text{Br}
\end{align*}
\]

A. \( i \) \( ii \) \( iii \) \( \text{increasing reactivity} \)  
B. \( i \) \( iii \) \( ii \) \( \text{increasing reactivity} \)  
C. \( \text{C} \) \( ii \) \( iii \) \( i \) \( \text{increasing reactivity} \)  
D. \( ii \) \( iii \) \( i \) \( \text{increasing reactivity} \)  
E. \( iii \) \( i \) \( ii \) \( \text{increasing reactivity} \)  
F. \( iii \) \( ii \) \( i \) \( \text{increasing reactivity} \)

9. Select the correct number of total stereoisomers for \( \beta \)-D-glucose (including \( \beta \)-D-glucose).

\[
\begin{align*}
\beta - \text{D-glucose}
\end{align*}
\]

A. 2  
B. 4  
C. 6  
D. 8  
E. 16  
F. 32

10. Choose the order that has the following solvents correctly arranged with respect to increasing reactivity of the following substitution reaction.

\[
\begin{align*}
\text{O-S-CF}_3 & \quad \xrightarrow{\text{N}_3, \text{solvent}} \quad \text{N}_3 \\
\text{i} & \quad \text{OH} \\
\text{ii} & \quad \text{NH}
\end{align*}
\]

A. \( \text{increasing reactivity} \)  
B. \( \text{increasing reactivity} \)  
C. \( \text{increasing reactivity} \)  
D. \( \text{increasing reactivity} \)  
E. \( \text{increasing reactivity} \)  
F. \( \text{increasing reactivity} \)
Short Answer Questions: 50 points

11. Give the correct IUPAC name for the following compound. 5 pts

(S)-2,3-dimethylpentane

12. Using a Newman projection about the indicated bond, draw the most stable conformation of 2,2,4,5-tetramethylhexane. Draw directly onto the Newman projection template that is on the scantron answer sheet. 5 pts

2,2,4,5-tetramethylhexane

13. Draw the structure(s) of the major product(s) of the following reaction, indicating stereochemistry where applicable using wedges and dashes. 5 pts

14. Draw the structure(s) of the major product(s) of the following reaction, indicating stereochemistry where applicable using wedges and dashes. 5 pts

*correct S_N2 product also received full credit.*
15. Draw the structure of the achiral alkene that would give meso 3,4-dimethylhexane as the major product, upon hydrogenation. HINT: hydrogenation proceeds by a syn addition of H₂. 10 pts

\[
\begin{align*}
\text{H}_2 & \quad \text{Pd-C} \\
\text{meso 3,4-dimethylhexane} & \quad 
\end{align*}
\]

16. Use the curved arrow formalism to show the bond breaking and bond making steps of the following reaction. 10 pts

17. Using the library of synthetic reactions on the cover page, propose a synthesis of the following compound from compounds containing four carbon atoms or less. 10 pts