This is a closed book exam. Answers must appear on the answer sheet. Only the answer sheet will be collected. Write your name on the answer sheet now.

Name the following compounds giving the R, S designation of chiral carbons.

1. 

![Image of compound 1]

2. 

![Image of compound 2]

3. Using the template on the right below draw the most stable conformation of the meso stereoisomer of the compound on the left below. The heavy line indicates the C-C bond shown explicitly in the template.

![Image of template]

![Image of compound 3]

2,2,3,4,5,5-Hexamethyl-hexane  template for answer

4. An unknown compound, X, has the formula C₆H₁₀.

   a) What does the formula tell you about the structure of the compound?

   X reacts with excess hydrogen gas on a 1:1 molar ratio yielding compound(s) of the formula C₆H₁₂?

   b) What can you conclude about the structure of the X?

   Upon careful distillation the product of the hydrogenation is found to yield two fractions, each containing only a single, optically inactive compound.

   c) What is a possible structure of X?
What are the missing products or reagents? Show the stereochemistry as possible.

5.

\[ \text{H}_3\text{C} - \text{O} - \text{Na}^+ + \text{H}_3\text{C} - \text{CH}_3 \rightarrow \text{H}_3\text{C} - \text{H} + \text{H}_5\text{C} - \text{CH}_3 \rightarrow \text{an ether} \]

6.

\[ \text{H} - \text{CH}_3 - \text{TsCl} \rightarrow \text{iodide ion} \rightarrow \text{S}_\text{N}2 \rightarrow \text{complete the template} \]

7.

\[ \text{H} - \text{OTs} - \text{CPh}_3 \rightarrow \text{acetic acid} \rightarrow \text{ester} \]

8.

\[ \text{Li} \rightarrow \text{CuX} \rightarrow \text{B} \rightarrow \text{2,4-dimethyl pentane} \]

What are A and B? A and B can have at most four carbons
9. Complete the template below to draw the most stable resonance structure for the \( \text{ClS}_3\text{N}_2^+ \) cation. Be sure to include formal charges. Assume the octet rule is obeyed.

10. Which of the following is the strongest base? Which the weakest?

\[
\text{CH}_4 \quad \text{NH}_3 \quad \text{OH}_2
\]

11. Equimolar amounts of ethane and 2,2-dimethyl propane are monochlorinated. What is the expected (initial) composition of the product mixture?

**For each of the following sets of reactions indicate by letter which should be fastest**

12.

A) methyl bromide reacting with iodide ion to yield methyl iodide

B) methyl bromide reacting with chloride ion to yield methyl chloride

C) isopropyl bromide reacting with iodide ion to yield isopropyl iodide

13.

A) \( \text{S}_N1 \) reaction of (CH\(_3\))\(_2\)CHCl and acetic acid to yield an ester

B) \( \text{S}_N1 \) reaction of (CH\(_3\))\(_2\)CHI and acetic acid to yield an ester

C) \( \text{S}_N1 \) reaction of (CH\(_3\))\(_3\)CCI and acetic acid to yield an ester

D) \( \text{S}_N1 \) reaction of (CH\(_3\))\(_3\)CI and acetic acid to yield an ester
14. Which of the following should have the highest boiling point? Answer by letter.

A) pure methanol at sea level

B) methanol at sea level with clean sand mixed into it.

C) a 50:50 mixture of methanol and water at sea level

D) pure methanol at the top of a mountain

15. You have 30 mL of an aqueous solution of a 0.100 molar solution of butanoic acid. Determine how much ether you should use to extract 90% of the butanoic acid into the ether layer. Assume that the distribution coefficient has a value of 0.50

16. Draw the transition state for the reaction of a chlorine atom with methane to yield a methyl radical and HCl. Also draw the transition state for the reaction of a bromine atom and methane to yield methyl radical and HBr. Clearly indicate the expected differences between the two transition states.

17. The following molecule is monochlorinated and the product mixture is carefully distilled. Characterize the fractions from the distillation by filling in the following table.

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Number of optically active fractions</td>
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<tr>
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<td>Number of fractions containing a single optically inactive compound</td>
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</tbody>
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Answer Sheet
All answers must appear on the answer sheet. Only the answer sheet will be collected. Write your name in the upper right corner on both sides of this sheet.

1

2

3.

4.
  a
  b
  c

5.

6.

7.

8 A B
9. \[\text{Cl}\quad \text{S}\quad \text{S}\quad \text{N}\quad \text{S}\quad \text{N}\quad \text{S}\quad \text{Cl}\]

10. strongest

11. weakest

12. 

13. 

14. 

15. show work

16. 

17. 

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