Chemistry 51 - Summer 2001

Exam 2
This is a closed book exam. All answers must appear on the answer sheet. Only the answer sheet will be collected at the end of the exam. Write your name on both sides of the answer sheet at this time.

What are the products of the following reactions? Show stereochemistry. If there is no reaction write NR.

1. 
\[
\text{Br} \quad \text{excess} \quad \text{NaOEt} \\
H \quad \text{CH}_2\text{CH}_2\text{Br} \quad \text{Ph}
\]

2. 
\[
\text{Et} \quad \text{H}_3\text{C} \quad \text{CH}_3 \quad \text{Ph} \quad \text{H}^+ \quad \text{I}^- \\
\quad \text{polar solvent}
\]

3. 
\[
\text{NBS} \\
\text{CH}_3 \quad \text{CH}_3
\]

4. 
\[
\text{excess methyl magnesium bromide}
\]

\[
\text{CO}_2\text{Et} \\
\text{Ph}
\]
5. propyne → HgSO₄, H₂SO₄, H₂O

6. H₂, metal catalyst

7. Br₂, CCl₄

8. excess sodium dichromate
   acid, 30 deg.

9. PrOH
   two isomeric ethers
10. 

```
  CH₃
 /     \
\CH₃   CKMnO₄
     \cold, dil. alkaline

CH₃
 /     \
\CH₃   CH₃HIO₄
     \cold, dil. alkaline
```

11. 

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  CH₃COCl
 /     \
\AlCl₃   Zn (Hg), HCl

CH₃
 /     \
\CH₃   CH₃
     \cold, dil. alkaline
```

12. When optically active sec-butyl tosylate, 11, is heated with ethanol the product has low optical activity. If sodium ethoxide, NaOEt, is present in the alcohol the product has the same boiling point as before but the optical activity is substantially higher. Give a brief explanation using chemical reactions.

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CH₃CHOTsCH₂CH₃
11
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13. Give the mechanism for the acid catalyzed conversion of the hemiacetal formed from propanal and ethanol to the acetal. Show resonance structures for any intermediates involved.

14. Write a balanced reaction wherein formic acid, HCO₂H, is oxidized by dichromate ion, Cr₂O₇²⁻, to carbon dioxide and Cr³⁺.

15. A student attempts to prepare 1-bromobutane from 1-butanol (density = 0.90 g/mL), excess sodium bromide and acid.
   a) What is the role of the acid?
   b) The student started with 5.0 mL of the 1-butanol and finally isolated 2.5 g of the 1-bromobutane. What is the percent yield?

16. How would you convert cis-2-butene to the racemic mixture of 2,3-butanediol?
17. A student was attempting the following reaction in the laboratory.

$$\begin{align*}
\text{CH}_2\text{OH} & \quad \text{CH}_3\text{MgBr} \\
\text{ether} & \\
\text{CH}_2\text{OH} & \quad \text{HO} \quad \text{CH}_2\text{OH}
\end{align*}$$

However the desired product was not obtained. During the reaction bubbles of gas were noticed. The original compound 17 was recovered unchanged by the reaction.

Provide a synthesis of the compounds below. All of the atoms in the requested molecules should originate in alcohols having four or fewer carbons. You may use any solvents or inorganic material. (8 pts each)

18. 2-methyl-2-pentene.

19. 2,3-dimethyl-2,3-butanediol.