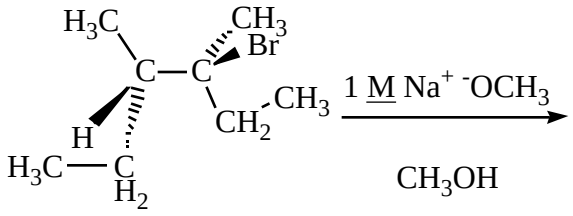
Problem Set 3 Out: November 23, 1998 Due Back: December 7, 1998

Chemistry 221, 1998

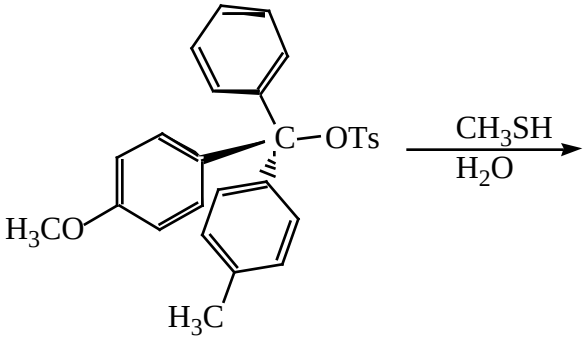
Answers to the following problems should be written, in order and labeled, on 8 1/2 x 11 inch paper. Answers written on the problem set itself will not be graded.

A. For each of the following 2 reactions, provide the mechanism type which best fits the situation and evidence as you see it. Clearly but briefly justify your choice by interpreting the facts given about these reactions. The explanation of the mechanism will be more important than your choice, so try to be clear and complete. Don't forget to read the structures and include the relevant information into your answers.

1)



2)



Questions to Answer for Each Reaction:

a. **Reaction type** (S_N1, S_N2, E1, E2).

b. Draw the structure of the **major product**. Be sure to specify stereochemistry, if appropriate.

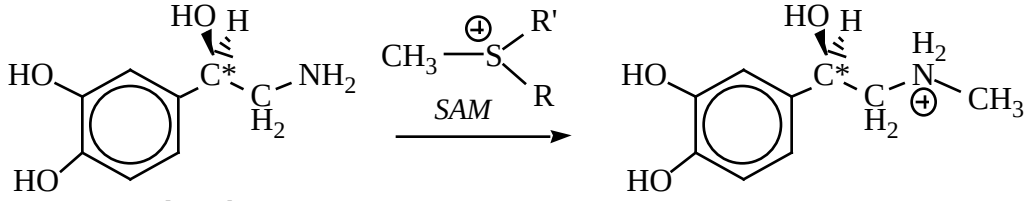
c. Show the **stepwise mechanism** of the reaction.

d. Draw a **reaction energy diagram** (energy vs. reaction progress).

e. Describe the **stereochemical outcome** of the reaction, using words or structures as needed.

f. Describe **one experiment** you could do to prove your idea about the mechanism type. Be sure to include both the description of the experiment **and** what results you expect to get.

B. The chemical neurotransmitter norepinephrine (noradrenaline) is converted in the body to epinephrine (adrenaline) by the molecule *S*-adenosyl methionine (SAM). Answer the following questions about this S_N2 substitution reaction.



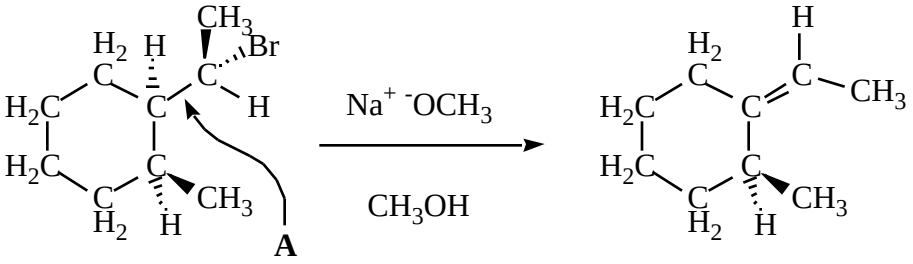
Noradrenaline *Adrenaline*

1. What happens to the rest of the SAM molecule after the CH_3 group is transferred? Show a structure, using the R, R' abbreviations. *Hint: the leaving group may be unfamiliar. Use reaction arrows to figure it out, remembering where the new bond is formed.*

2. Give **two** reasons that the SAM molecule is a good S_N2 substrate [noradrenaline is the nucleophile].

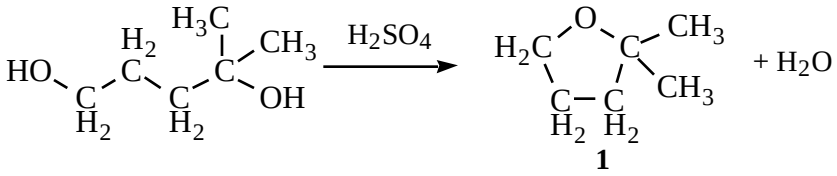
3. What is the absolute configuration of the carbon with the asterisk (*) in adrenaline?

C. Consider the reaction of the compound below (a single enantiomer was used) with $NaOCH_3$ in methanol solvent:



1. Identify each chiral center appropriately with *R* or *S*. Mark the alkene with *E* or *Z*.
2. Is the product chiral?
3. Is the solution optically active at the end of the reaction?
4. Briefly explain your choice for questions 2 and 3.
5. Draw a Newman projection of the three staggered conformations about the bondbetween the ring and the bromoethyl substituent (labeled "**A**" above). You may need to abbreviate part of the structure with "R" groups.
6. Explain, using structures, if necessary, why the double bond isomer shown is the only one to be formed in significant amounts if the concentration of $NaOCH_3$ is about 1M, while both double bond isomers are formed when the concentration of $NaOCH_3$ is about 0.01M.

D. The following reaction occurs when the diol shown is treated with sulfuric acid.



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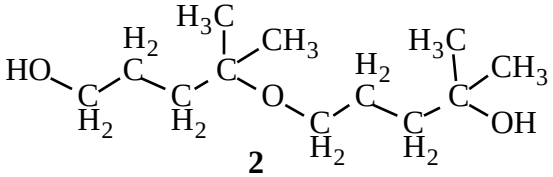
1. Propose a plausible stepwise mechanism for this reaction. It will be helpful to use reaction arrows.
2. Which oxygen remains after the reaction, and which is likely to be lost as water? Explain briefly.
3. Another product, compound **2**, did **not** form in significant amounts. Why did compound **1** form, rather than compound **2**?



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