Exam # 2

Name (PRINT)_____

Signature_____

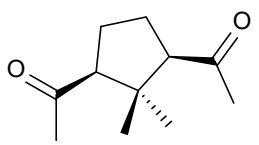
My signature indicates that I have not consulted any person outside the class or electronic resource.

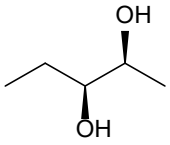
Disclaimer: though this was very funny, and is in no way meant as a political statement.

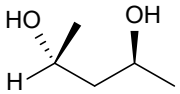
- Please read the instructions thoroughly and carefully before beginning each section.
- There are 10 pages on this exam including this cover sheet. Please check to make sure that you have all the pages.
- Be certain that your answers are clear and structures are drawn neatly. Unclear or ambiguous answers will be considered incorrect.

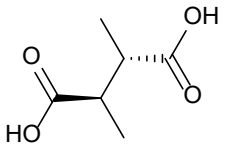
General Multiple Choice. Each question is worth 3 points.

1. Of the four molecules below, how many represent optically inactive compounds?



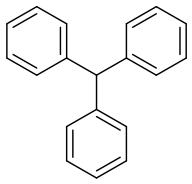
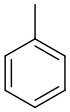
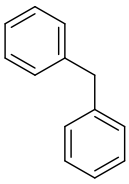






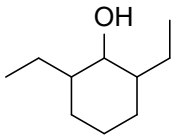
A. 0	B. 1	C. 2	D. 3	E. 4

2. Rank the species below in order of increasing reactivity when subjected to NBS and light.


A

B

C

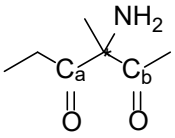
A.	A, B, C
B.	C, B, A
C.	B, C, A
D.	A, C, B
E.	C, A, B

3. How many stereoisomers are possible in the molecule shown below?



a. 0
b. 2
c. 3
d. 4
e. 8

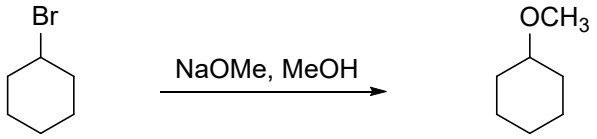
4. In the molecule below, rank the groups in order of increasing priority (lowest priority first) that are attached to the indicated stereocenter.



A. NH_2, C_a, C_b, CH_3	B. CH_3, NH_2, C_a, C_b	C. CH_3,C_b,C_a, NH_2	D. NH_2, C_b, C_a, CH_3	E. CH_3, NH_2, C_b, C_a

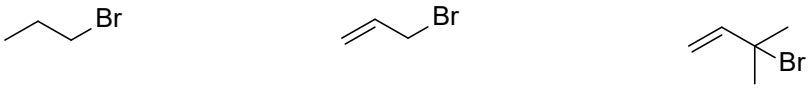
General Multiple Choice (*continued*).

5. What is the rate law for the reaction below?



A. rate=k[RBr][MeOH]	B. rate=k[RBr]	C. rate=k[MeOH]	D. rate=k[RBr][NaOMe]

6. Rank the alkyl halides below in order of increasing rate of reactivity when treated with ethanol.



A B C

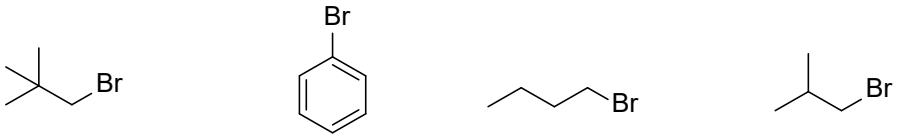
A. A, B, C	B. A, C, B	C. C, B, A	D. C, A, B	E. B, C, A

7. Rank the species below in order of decreasing nucleophilic strength.

A B C D

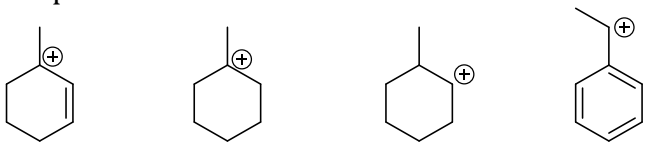
A. B, A, D, C	B. C, D, A, B	C. B, D, A, C	D. C, A, D, B	E. D, B, C, A

8. When subjected to sodium hydroxide, which alkyl halide below would give the relatively fastest substitution reaction?



A B C D

9. Rank the carbocations below in order of increasing stability. Write your ranking in the box provided.



A B C D

10. An *exothermic* reaction that is *spontaneous* is one that has a _____ value and a ___ value.

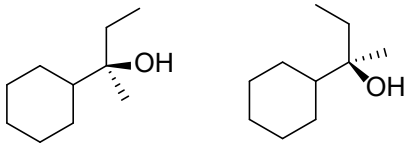
    a. - ΔH , + ΔG
    b. + ΔH , - ΔG
    c. - ΔH , - ΔG
    d. - ΔG, + ΔH
    e. + ΔG, - ΔH

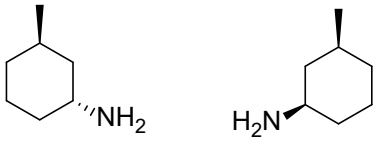
11. In a reaction, a reactive intermediate . . .

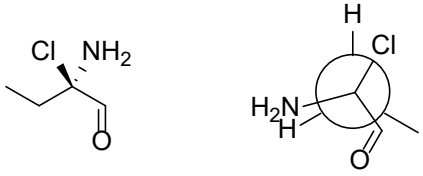
    a. Is an energy maximum between 2 transition states.
    b. Can never be isolated due to its high energy.
    c. Is an energy minimum between a reactant and a product.
    d. Is an energy minimum between 2 transition states.
    e. Is always equal to the number of steps in a reaction.

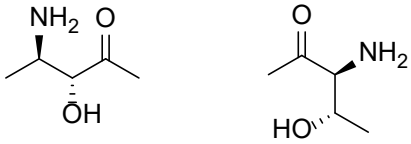
Molecular Relationships. *Write your answer and only your answer in the box provided.*

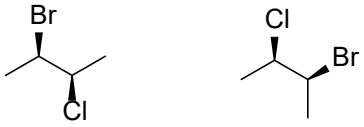
Identify the relationship between each of the following pairs of molecules. They can be one of the following: (**A**) enantiomers, (**B**) diastereomers, (**C**) structural isomers, (**D**) different molecules that are not isomers or (**E**) the same compound. 5 points each.

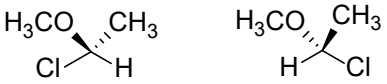
12. 

17. 

13. 

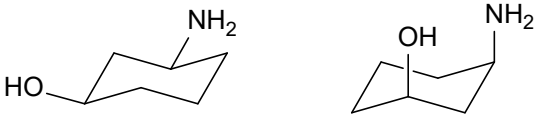
18. 

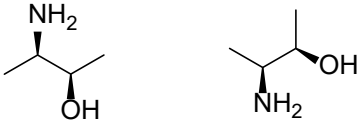
14. 

19. 

15. 

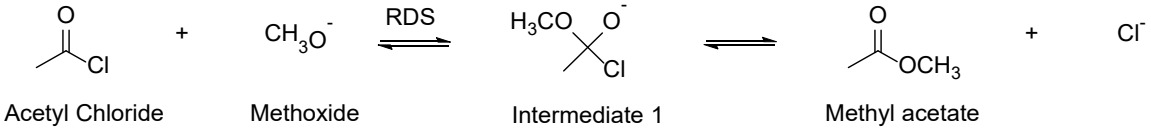
20. 

16. 

21. 

Organic Reactions.

The conversion of acetyl chloride to methyl acetate occurs via the following 2-step mechanism:



Acetyl Chloride Methoxide Intermediate 1 Methyl acetate

a. Draw the electron arrows that would accomplish the formation of intermediate 1 (step 1) and methyl acetate (step 2). Redraw each species below. 5 points each step.

Step 1:

Step 2:

b. Draw the transition state for step 1 and step 2. 5 points total.

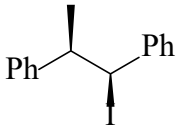
c. Is this reaction an addition, elimination or substitution (circle the appropriate choice)? 3 points.

d. In step 1, the methoxide acts as the _____ and the acetyl chloride acts as the _____. 2 points.

e. Write the equilibrium constant (K_{eq})expression for the overall reaction. 3 points.

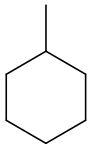
Predict the Products. Predict the final organic product(s) for each reaction below. 4 points each part.

a.



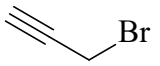
$(CH_3)_3COK$, $(CH_3)_3COH$ →

b.



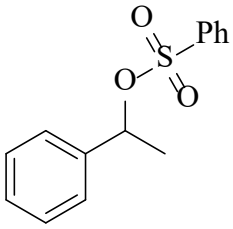
1. Br_2, light
2. NaN_3 →

c.



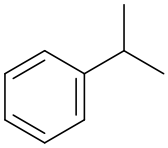
1. NaOH, H_2O
2. NaH
3. CH_3I →

d.



KO^tBu, HO^tBu →

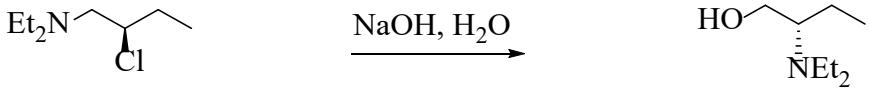
e.



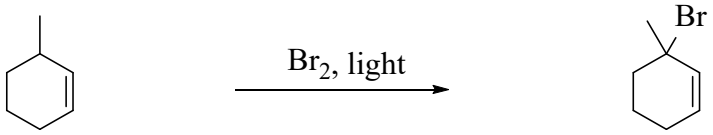
1. Br_2, light
2. KCN, CH_3CN,
18-crown-6 →

Mechanisms. 10 points each

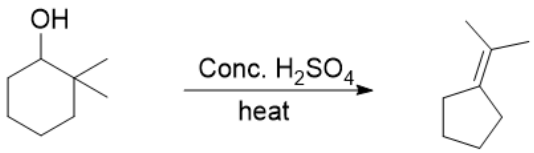
1.



2.

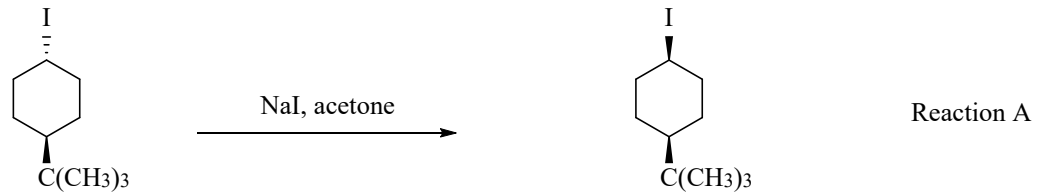


3.

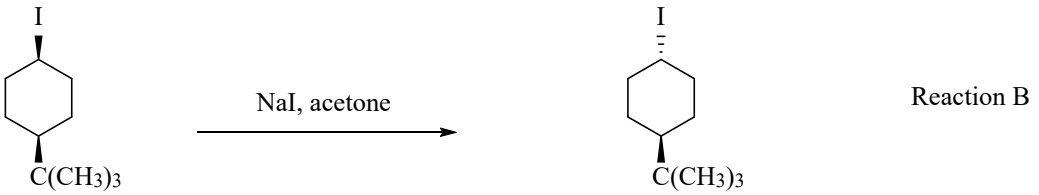


Explanations. 10 Points each part

1. Answer the questions that follow about the Sn2 reactions below. There is no typo. Iodide will replace itself fairly well.



Reaction A

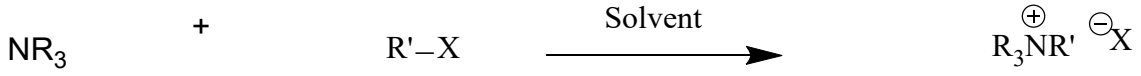


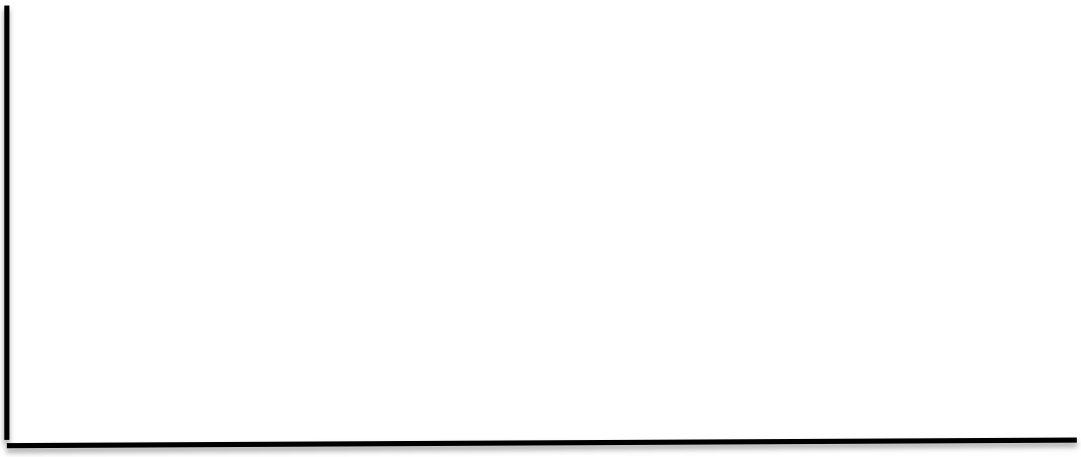
Reaction B

   a. Which reaction occurs at a faster rate? It may help to do part b before part a.

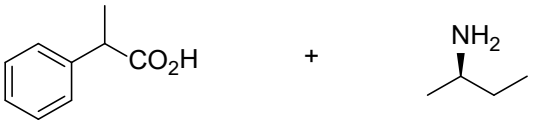
   b. Using more structures and some words, defend your answer to part a. Look at substrate, transition state, product, etc.

2. As you are aware, reactions of amines with alkyl halides always yield an ammonium salt. This reaction rate is highly solvent dependent. Draw a reaction coordinate diagram for this process in a polar solvent and non-polar solvent, on the same coordinate, that clearly indicates with would be faster. Explain with a few words why the one is faster than the other.





3. An acid/base reaction of enantiopure (*R*)-sec-butylamine and a racemic mixture (1:1 mixture of enantiomers) of 2-phenylpropanoic acid forms 2 products having different melting points. Draw the products and explain why these products' melting points differ. 10 Points.



2-phenylpropanoic acid (R)-sec-butylamine

Extra Credit (2 points): What kind of bear dissolves in water?