NAME JOE BRUIN

Student ID# KEY

Circle your TA's name: José Ryan Amy Ben

CHEM 30A Fall 2007
Midterm Exam #2 November 21, 2007

Please sign the following HONOR STATEMENT below before beginning. No regrade requests will be honored if the signature space is left blank.

The answers in this examination booklet are entirely my own work. I neither gave nor received information or assistance in writing this examination. I understand that sharing information during this examination, or using materials not explicitly allowed by the instructor, will result in a failing grade on this exam, and possibly in additional action that may affect my ability to continue attending UCLA.

SIGNATURE_____

PLEASE READ THE FOLLOWING INSTRUCTIONS *BEFORE* BEGINNING.

1. Please verify that your cell-phone and/or pager are OFF. If your device rings or vibrates during the exam, 5 points will be deducted from your score.

2.The exam consists of 9 questions on 10 pages. Please verify NOW that you have all pages, and raise your hand for assistance if you do not.

3. Please write your name at the top of EVERY page NOW.

4. To receive full credit, your answers must be legible, structures readable, chemical names spelled and punctuated correctly, and numerical answers given to the correct number of significant figures. To receive partial credit on problems for which it is given, you must show your work. *.Always indicate clearly if your work continues onto the back of a page!* If there is no such indication, graders will not look at the page backs.

Question	Credit	Score
1.	18	
2.	20	
3.	12	
4.	22	
5.	12	
6.	27	
7.	12	
8.	15	
9.	12	
TOTAL	150	
Scaled to 100 and rounded up		

$R = 8.314\ J \cdot K^{-1}mol^{-1}$

$R = 0.0821\ L \cdot atm \cdot mol^{-1}K^{-1}$

$1\ kcal = 4.184\ kJ$

$k_B = 1.381 \cdot 10^{-23} J \cdot K^{-1}$

$1\ erg = 10^{-7}\ J$

$1\ L atm = 101.325\ J$

$1\ Noggin = 142.1\ cm^3$

$$\Delta G_{T,P} = \Delta H - T\Delta S$$

$$\Delta G = \Delta G^\circ + RT \ln Q$$

$$\Delta G^\circ = -RT \ln K$$

$$k = Ae^{-E_a/RT}$$

$$k = Ce^{-\Delta G^\ddagger/RT}$$

$$\Delta G^\circ_{rxn} = \sum_{products} \Delta G^\circ_f - \sum_{reactants} \Delta G^\circ_f$$

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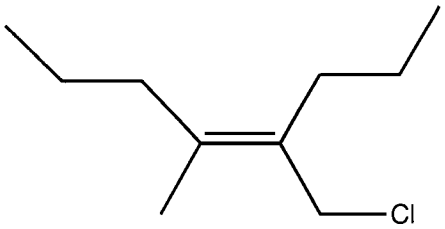
1. (18)

a) (5) A new plant species has just been discovered. The sample contains both (+)-carvone and (-)-carvone, with the (+)-enantiomer present in 80% e.e. What is the ratio of (+)-carvone to (-)-carvone in the sample?

80% excess (+)
Remaining 20% is racemic (10%(+), 10%(-)), so 90%(+) altogether.
[OR: $80 = \frac{90-10}{100}$]

9:1

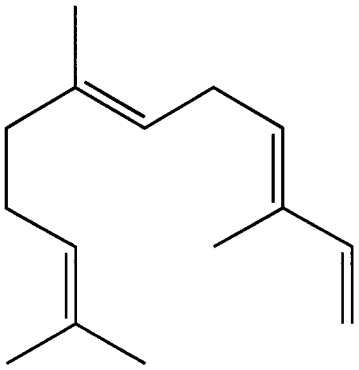
b) (5) Using the *E,Z* system, name the following alkane



(E)-4-(chloromethyl)-5-methyloct-4-ene
[or (E)-4-(chloramethyl)-5-methye-4-octere]

Is this compound *cis* or *trans*? cis

c) (3) ∝-Farnesene is found in apple skins. How many isoprene units is it made from?



∝-Farnesene

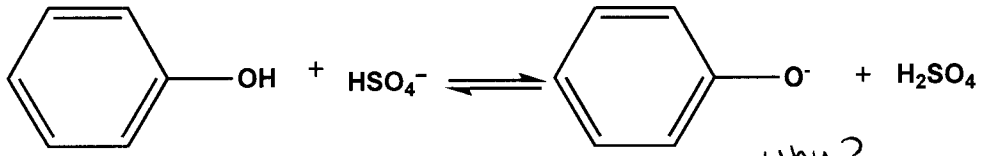
3

d) (3) What is the full name for DMSO? dimethylsulfoxide

e) (2) True or false: Branched alkanes have lower boiling points than unbranched ones with the same number of carbon atoms.

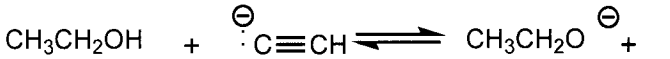
TRUE

2. (20) Read this question carefully!
In each part below, an acid-base equilibrium reaction is shown. Circle the statement below the reaction that best describes the position of the equilibrium. No explanation is necessary.

a) (4) 

Equilibrium favors products (lies to the right).
or
Equilibrium favors reactants (lies to the left).

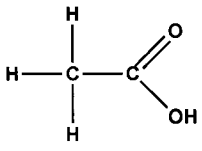
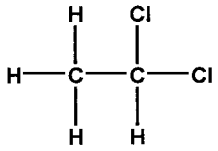
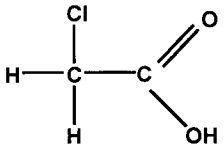
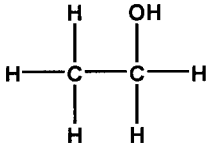
why? H_2SO_4 is a stronger acid than OH.

b) (4) 

Equilibrium favors products (lies to the right).
or
Equilibrium favors reactants (lies to the left).

why? CH_3CH_2OH is a stronger acid than acetylene

c) (4) Rank the following with respect to relative acidity. Put a **1** under the molecule that is most acidic and a **4** under the molecule that is least acidic.

relative rank: 2 4 1 3

d) (4) Rank the following with respect to relative nucleophilicity in aprotic solvents. **1** = most nucleophilic, **4** = least nucleophilic.

$CH_3CO_2^-$	NH_4^+	H_2O	CN^-
relative rank: 2	4	3	1

e) (4) The equilibrium constant (K_{eq}) for the reaction shown below is...? (multiple choice)

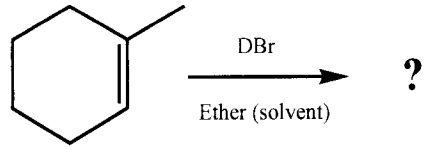
Acid + Base ⇌ Conjugate Acid + Conjugate Base
$pK_a = -2$ $pK_a = 2$

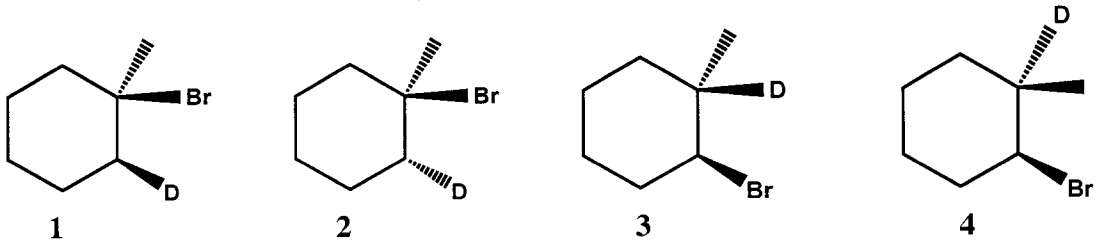
A: 10,000 **B**: 0 **C**: -1 **D**: 4 **E**: 0.0001

A

3. (12)

a) Assuming that the reaction of 1-methylcyclohexene with D-Br (the deuterium labeled version of H-Br) proceeds with absolute Markovnikov selectivity, what will the major product(s) of the reaction be?

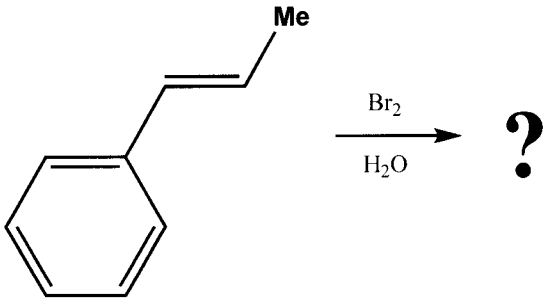


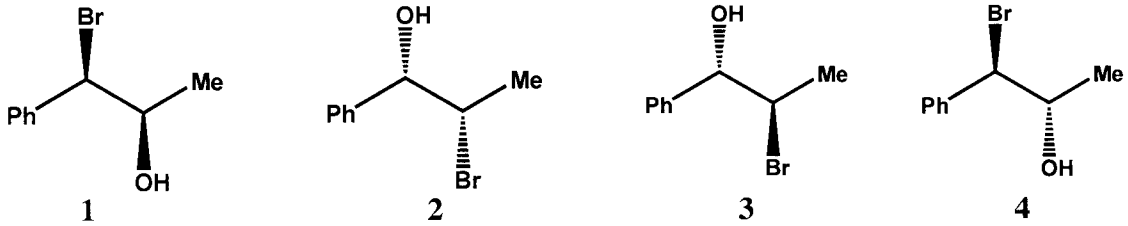


A Only 3 and 4
B Only 2 and 4
C Only 1 and 2
D All of them
E Only 1 and 3

C

b) The major product(s) of the reaction of the *trans*-alkene shown below with bromine in water are? [Note Ph = ⬡]

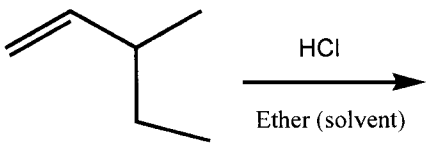




A Only 2 and 3
B Only 2
C Only 3
D Only 1 and 4
E Only 3 and 4

E

c) What is the major product of the reaction shown below? (Pick one from the choices below.)

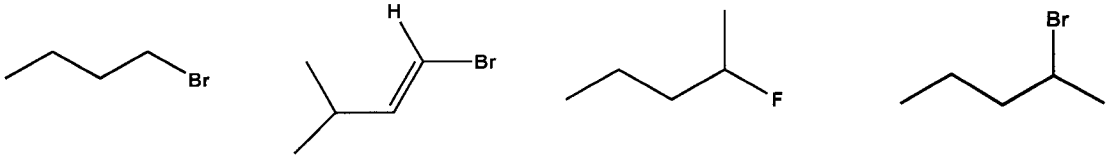


A 1-chloro-3-methylpentane
B 2-chloro-3-ethylbutane
C 3-chloro-3-methylpentane
D 3-chloro-2-methylpentane
E 2-chloro-3-methylpentane

C

4. (22)

a. (4) Rank the following in order of decreasing reactivity toward nucleophilic substitution by the SN2 mechanism. **1** = most reactive, **4** = least reactive



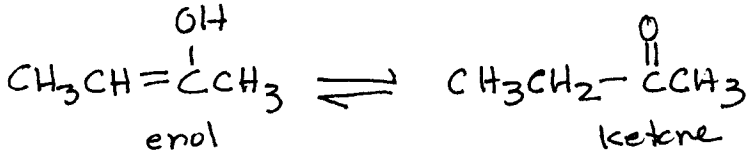
	A	**B**	**C**	**D**
relative rank	1	4	3	2

Please answer the following questions, using word definitions or structures as requested.

b.(4) Define hyperconjugation.

Interaction of electrons in a sigma-bonding orbital with the vacant 2p orbital of an adjacent positively charged carbon.
[More generally: electron delocalization, via orbital overlap, from a filled bonding orbital to an adjacent unfilled orbital.]

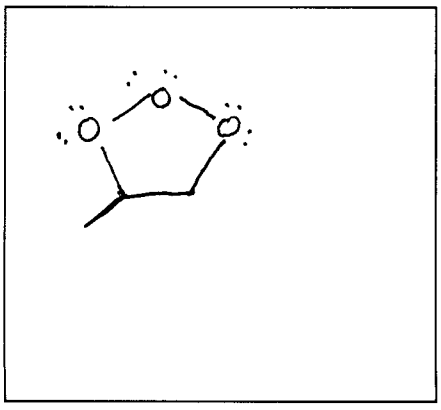
c.(4) Give an example of keto-enol tautomerism. Show structures, but not the detailed mechanism.



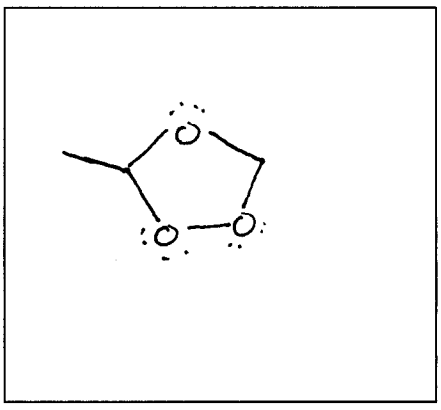
d.(4) What is a stereospecific reaction (definition)?

A reaction in which one stereoisomer is formed (or destroyed) to the exclusion of all others.

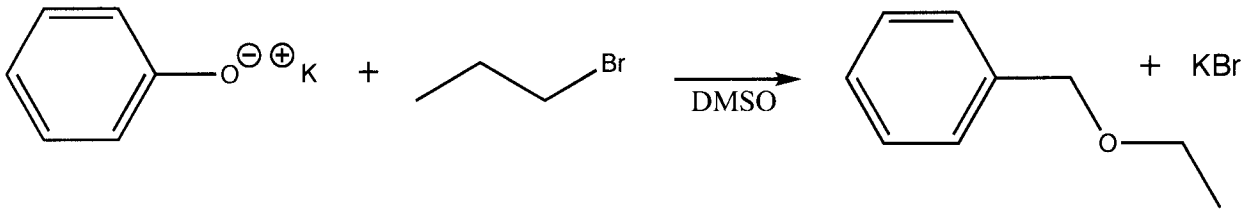
3.(6) Draw the molozonide that forms after ozone reacts with propene:



Draw the ozonide that then forms:

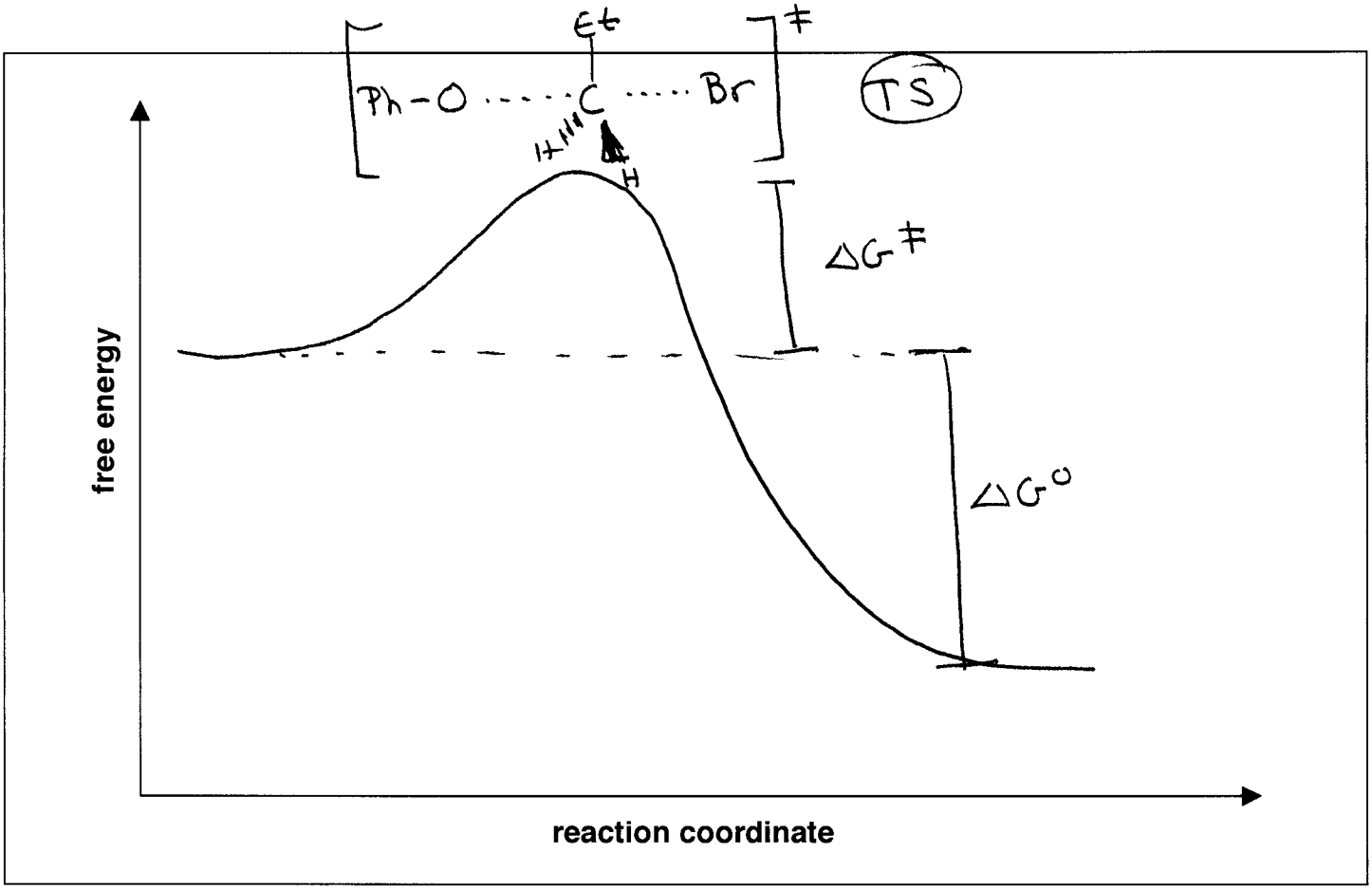


5. (12) The phenoxide anion reacts with 1-bromopropane to form an ether, as shown below.

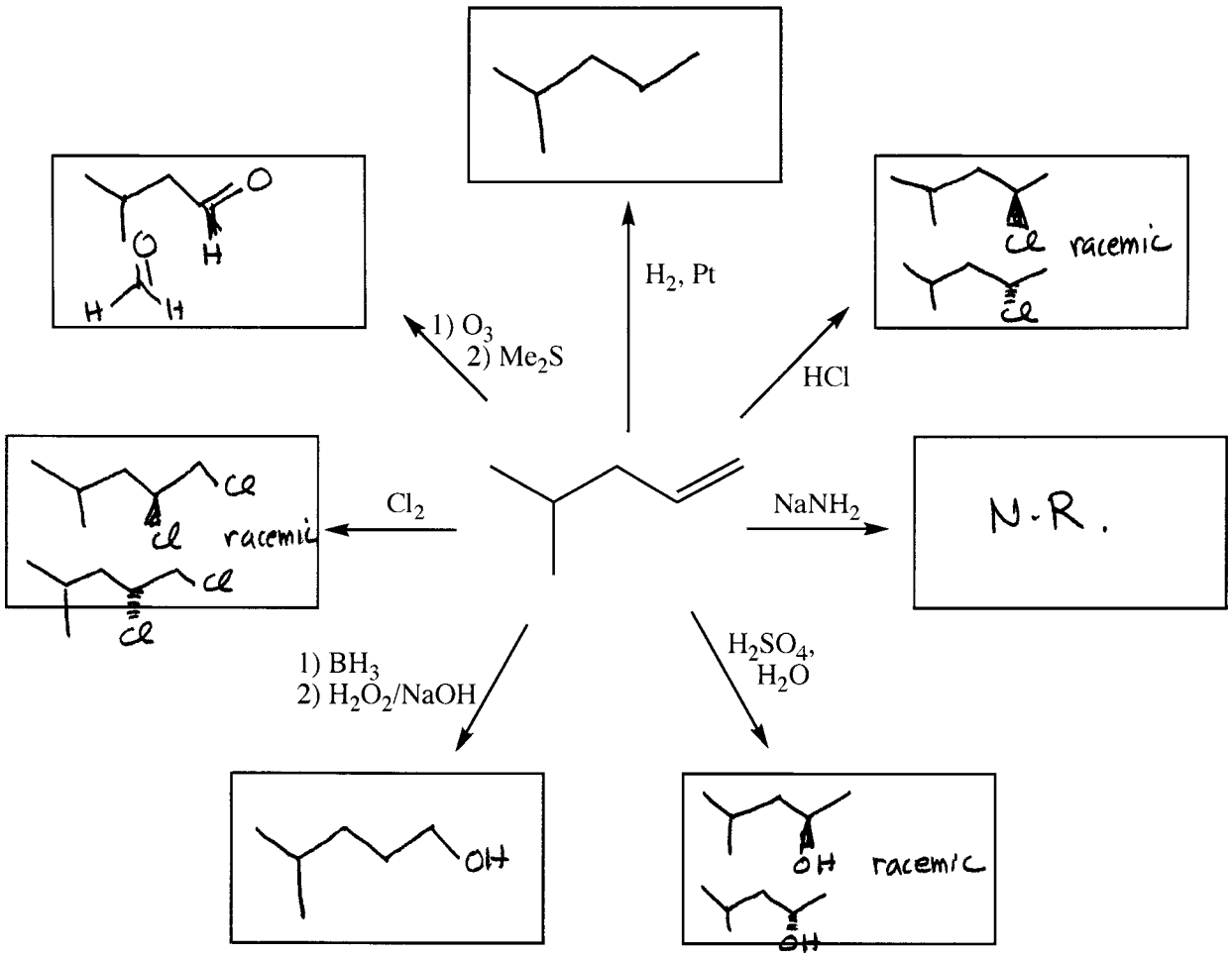


In the box below:

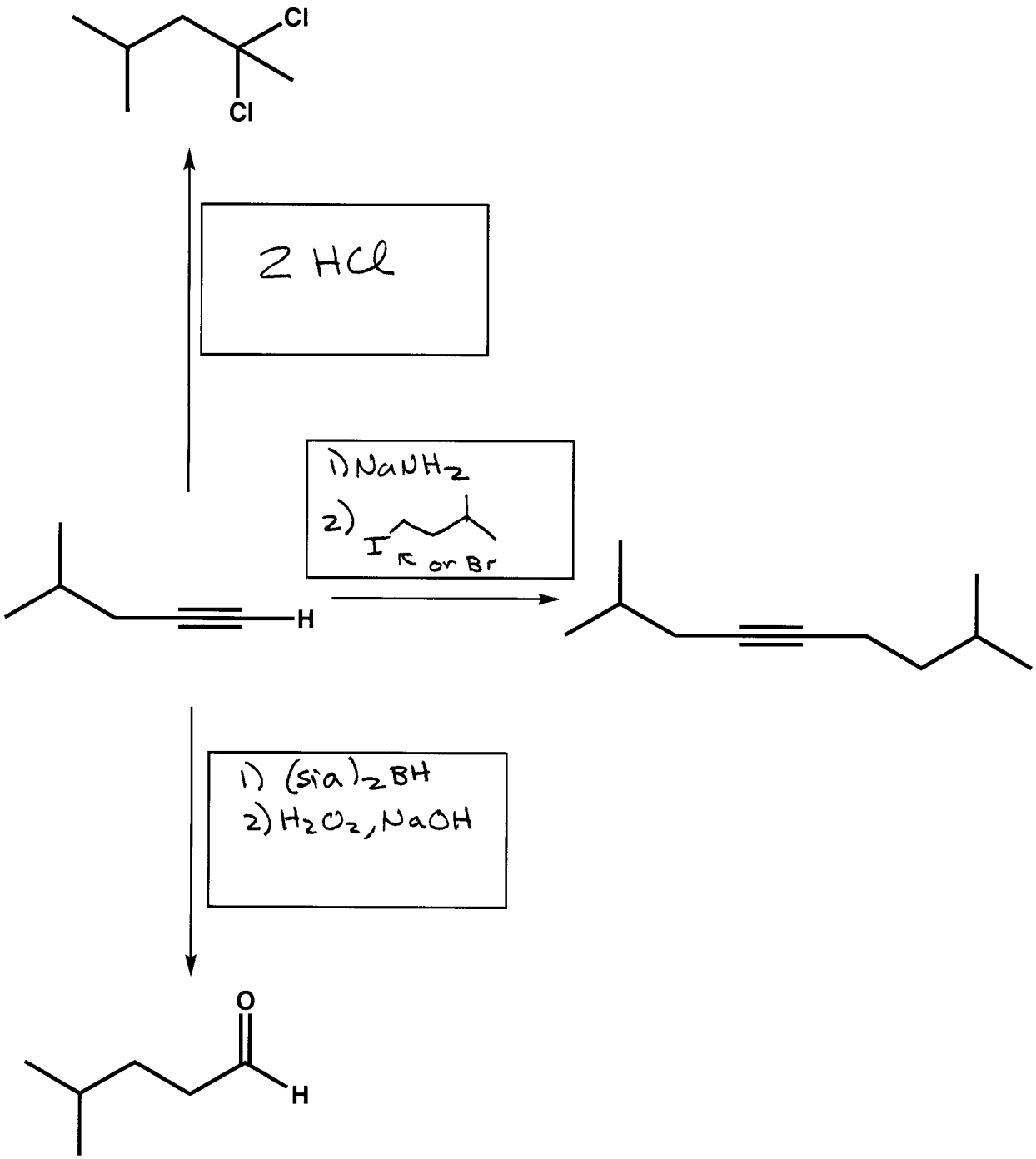
1) Draw the energy profile for this reaction.
2) Draw the structures of any proposed transition states or intermediates and label them **TS** or **INT** as appropriate.
3) Label any activation energy barriers to show **ΔG‡**.
4) Label the Gibbs free energy change (**ΔG°**) associated with the reaction.



6. (27) (3 to 5 points each)
For each of the following, complete the reaction with the predominant product or products. You must indicate stereochemistry with wedges and dashes. If a racemic mixture is created, you must write "racemic" under the structures. If no reaction, write "N.R."



7.(12) For each of the following, write in the box the reagents, conditions, and additional reactants (if any) needed to convert the reactant into the product.

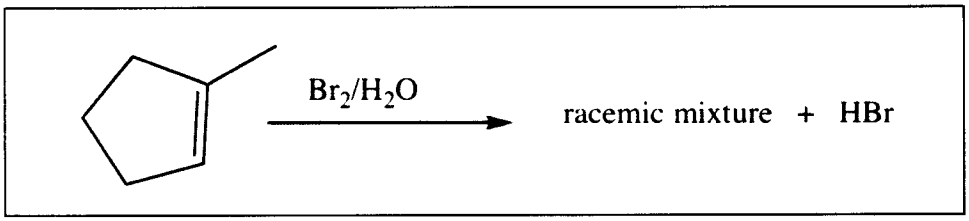


8. (15) **READ THESE DIRECTIONS CAREFULLY!**

Carefully examine the reaction in the box.

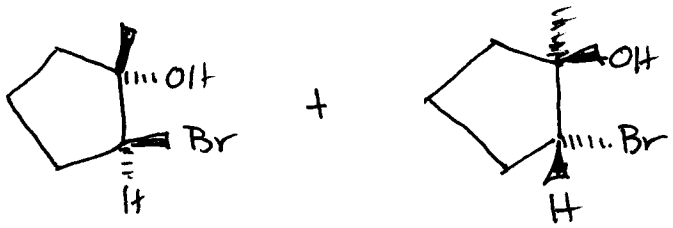
a) Write the products in the designated box.

b) In the large box, write the mechanism for the formation of *one* of the products. Use arrows to show how pairs of electrons are moved to make and break bonds during the reaction. Make sure to draw all lone pairs of electrons, all formal charges, and all products produced at each step.



5 pts

Products:

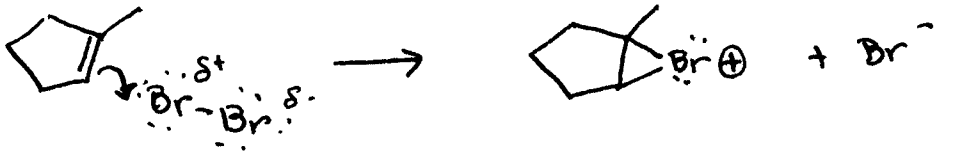


SEE P. 224 of BFI 4th edition!

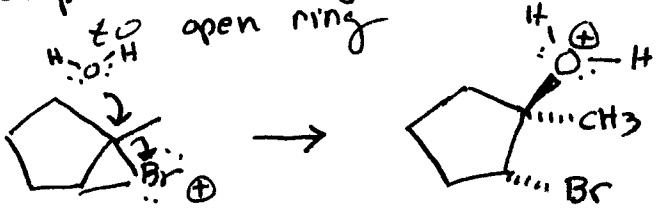
3+4+3 pts

Mechanism: 3 steps

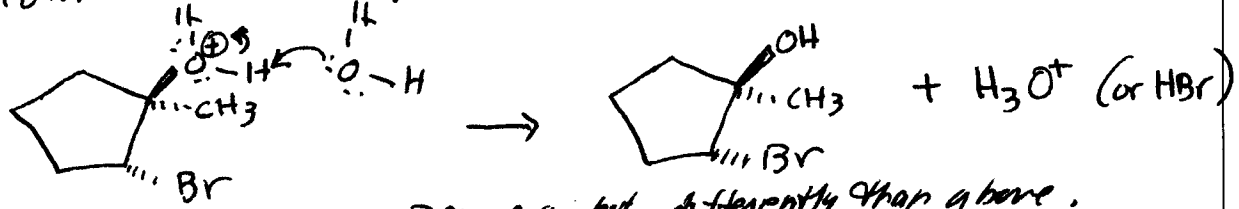
① Formation of bridged bromonium ion intermediate



② Nucleophilic attack by water on more substituted carbon to open ring

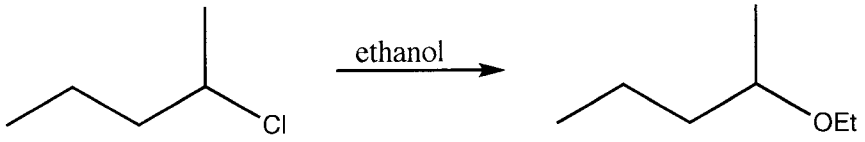


③ Proton abstraction by water (or Br^-)

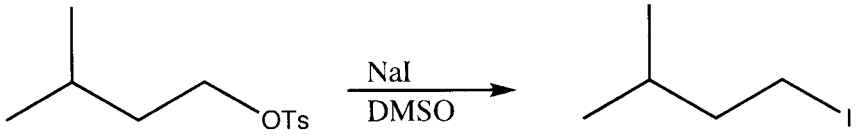


Drawn a bit differently than above. Key is that Br & Me use 'Z's.

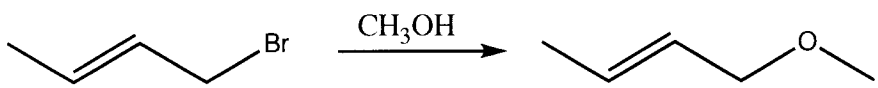
9. (12) For each of the following reactions, indicate in the box at right whether it proceeds by an **SN1** mechanism, **SN2** mechanism, or that there is no reaction, **N.R.**

a. 

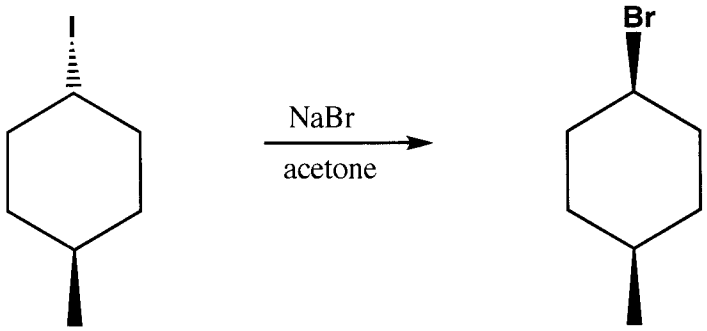
SN1

b. 

SN2

c. 

SN1

d. 

SN2