Chemistry 112A, Midterm 2

Thursday, November 13, 2008

Student name: Answer Key

Student signature: _____

Write TA's full name (section number) or Lecture Only: _____

1. Please make sure that the exam has 8 pages including this one.
2. Please write your answers in the spaces provided.
3. Write clearly; illegible or ambiguous answers will be considered incorrect.
4. Only writing implements are allowed **(No Calculators)**.

GOOD LUCK!

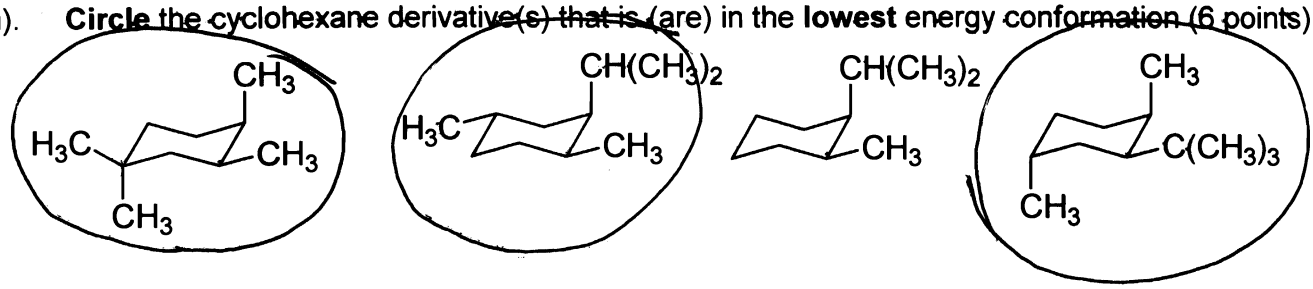
1.	60 points	_____
2.	25 points	_____
3.	10 points	_____
4.	34 points	_____
5.	25 points	_____
6.	14 points	_____
7.	7 points	_____
Total	**175 points**	_____

MINI-PERIODIC TABLE

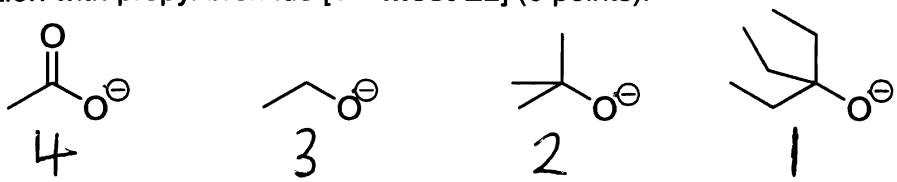
I	II	III	IV	V	VI	VII	VIII
H							He
Li	Be	B	C	N	O	F	Ne
Na	Mg	Al	Si	P	S	Cl	Ar
K	Ca	Ga	Ge	As	Se	Br	Kr

1. Answer the following questions. Every wrong answer cancels a correct answer (60 points).

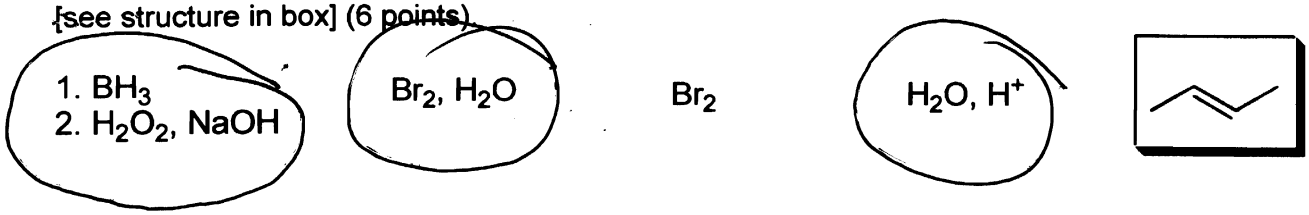
(a). **Circle** the cyclohexane derivative(s) that is (are) in the **lowest** energy conformation (6 points):



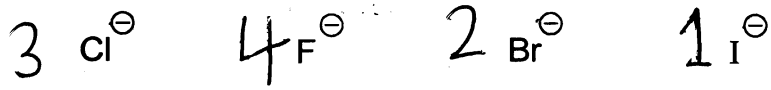
(b). **Number** the nucleophiles from 1 to 4 based on the highest to lowest E2 to S_N2 ratio obtained upon reaction with propyl bromide [1 = **most E2**] (6 points).



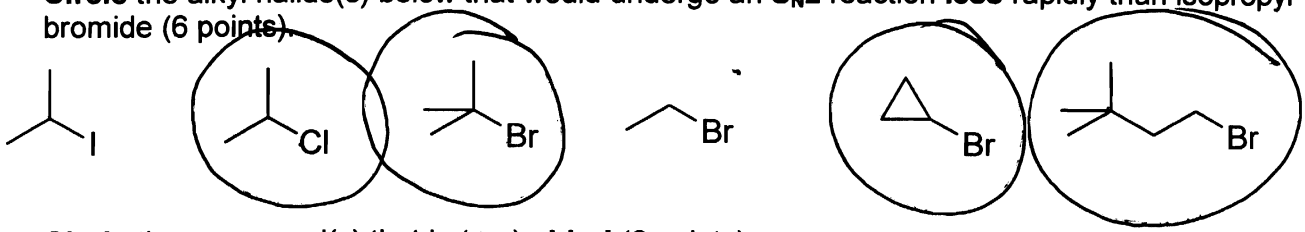
(c). **Circle** the reagents below that would produce a **chiral** product upon reaction with *E*-2-butene [see structure in box] (6 points).



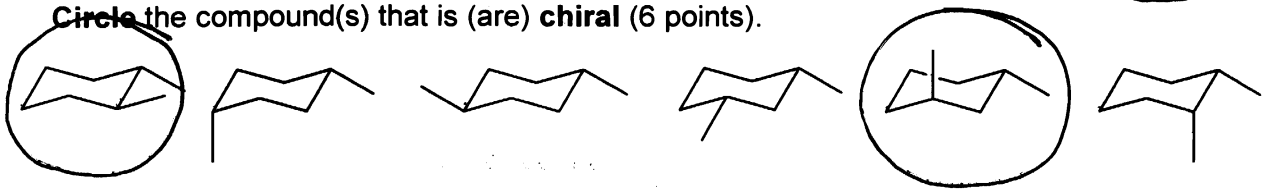
(d). **Number** the nucleophiles that provide the fastest to slowest S_N2 reaction with **methanol** as solvent [1 = **fastest S_N2**] (6 points).



(e). **Circle** the alkyl halide(s) below that would undergo an **S_N2** reaction **less** rapidly than isopropyl bromide (6 points).



(f). **Circle** the compound(s) that is (are) **chiral** (6 points).

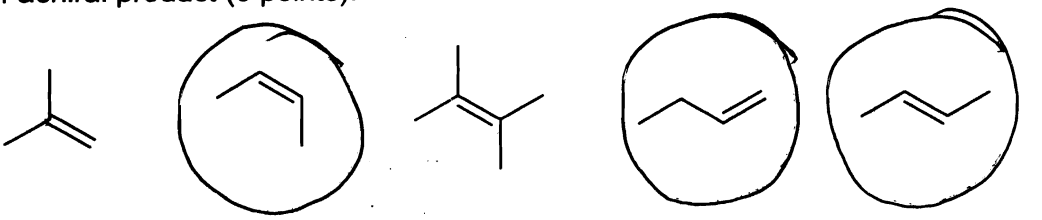


(g). **Circle** the correct statement(s) (6 points).

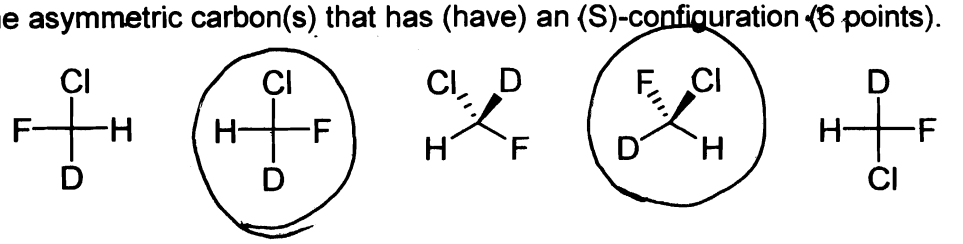
1. A molecule with **only** one stereocenter must be chiral.
2. A molecule with **only** one asymmetric carbon must be chiral.
3. A molecule with **more** than one asymmetric carbon must be chiral.
4. If a chiral product is produced from an achiral substrate and achiral reagents it **must** be racemic.
5. If two compounds are stereoisomers, then at least one of the compounds **must** be chiral.

Difficult question - will not mark off if not circled

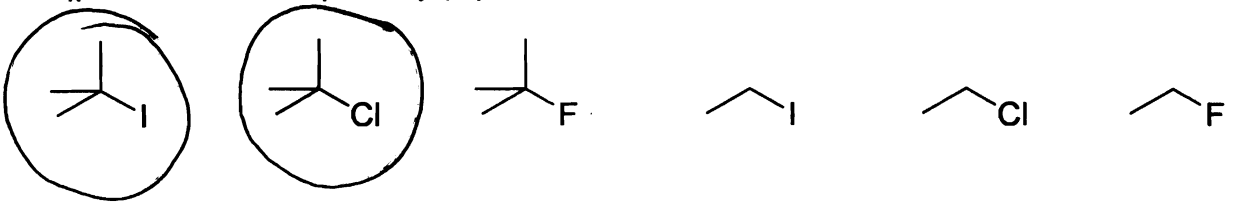
(h). **Circle** the alkene(s) listed below that upon reaction with HCl would give a **chiral** product rather than an achiral product (6 points).



(i). **Circle** the asymmetric carbon(s) that has (have) an (S)-configuration (6 points).

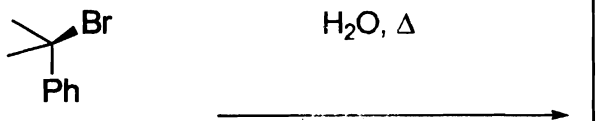


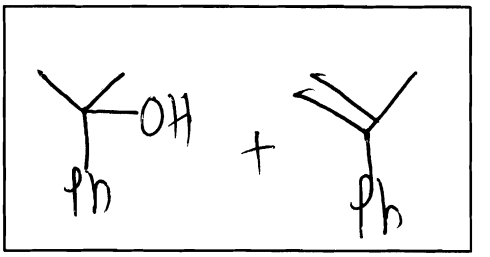
(j). **Circle** the halide(s) listed below that upon heating in methanol would undergo a reaction by an $S_N1/E1$ mechanistic pathway (6 points)



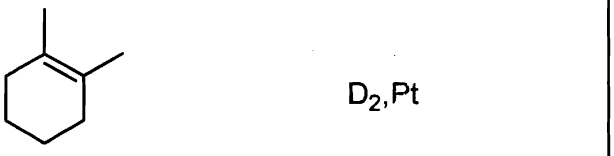
2. For each of the following reactions supply the missing starting materials, reagents, or **major** organic product(s) in the space provided. Show the stereochemistry of the product. If the product is chiral indicate whether or not it is racemic (25 points total).

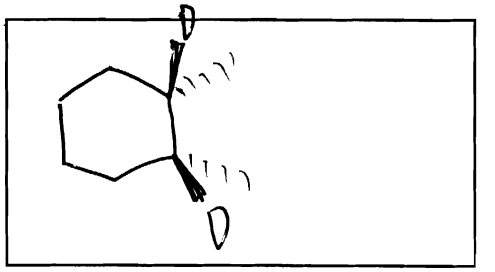
(a)



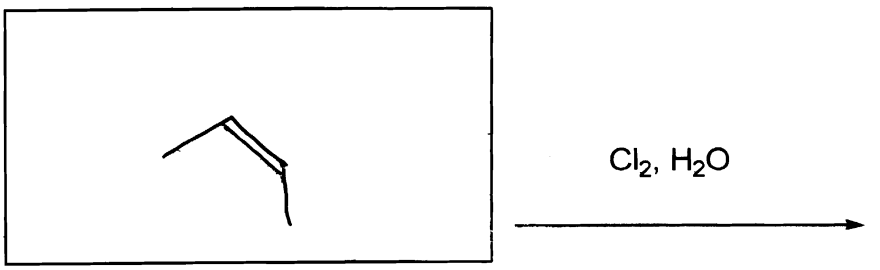


(b)

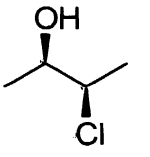




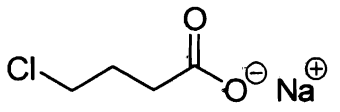
(c)

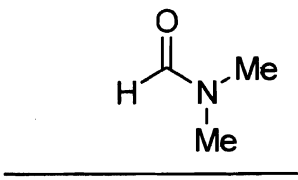


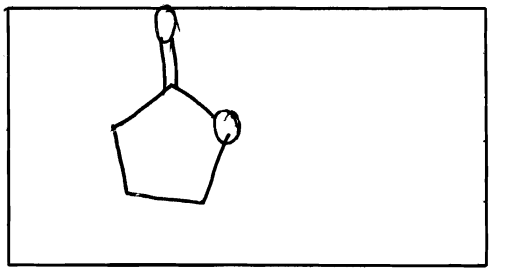
(±)



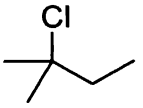
(d)

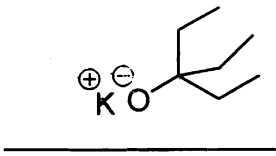


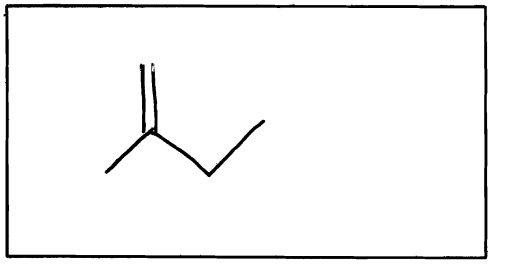




(e)

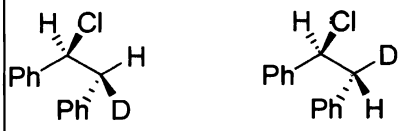




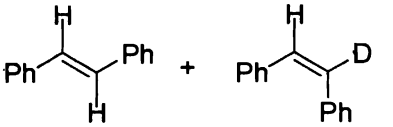


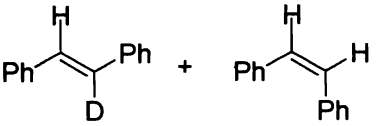
3. You have been given bottles of diastereomeric alkyl chlorides (structures shown in box). Based upon the illustrated chemical reactions, **assign** which structure is Diastereomer A and which structure is Diastereomer B. **Using** the mechanism for the E2 reaction, show how you assigned the stereochemistry (10 points).

Diastereomeric alkyl chlorides



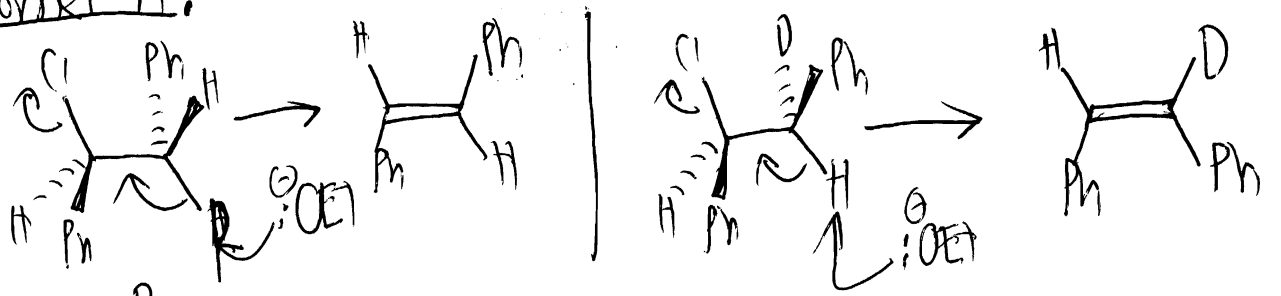
A B

Diastereomer A $\xrightarrow{NaOEt}$  (major)

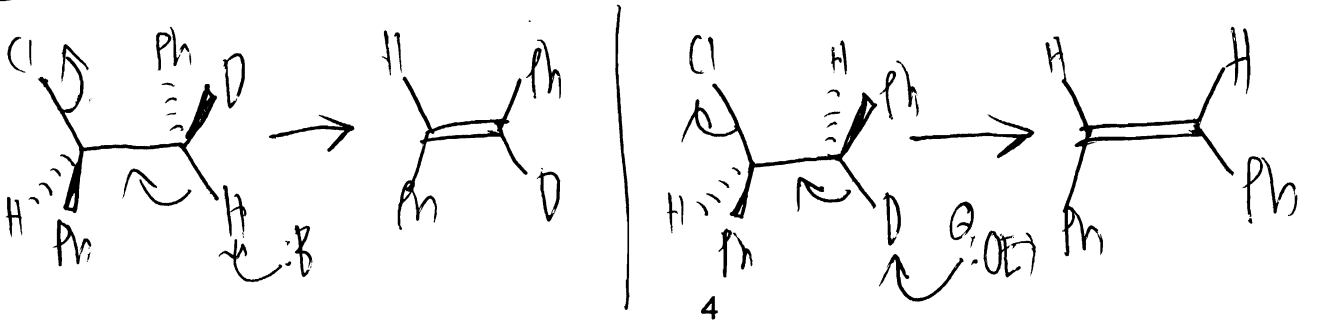
Diastereomer B $\xrightarrow{NaOEt}$  (major)

Antiperiplanar mech is key to problem!

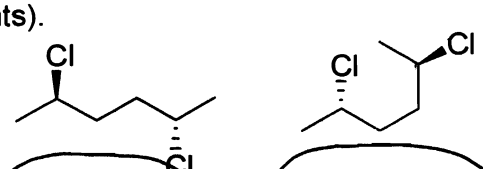
Diastereomer A:



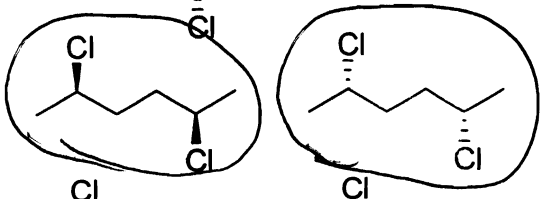
Diastereomer B:



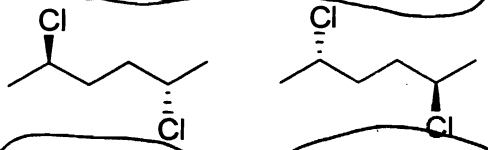
4. For each of the following stereoisomer pairs, **assign** the isomeric relationship, i.e., diastereomeric, enantiomeric, or identical (includes conformational). In addition, **circle** all of the compounds that are chiral (34 points).

(a) 

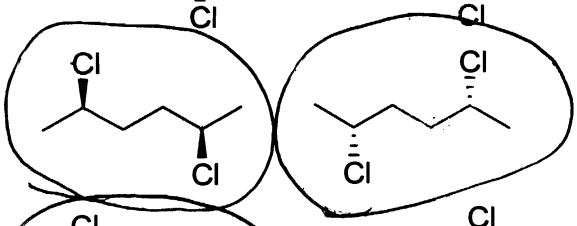
identical

(b) 

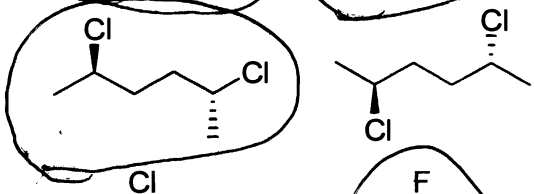
enantiomers

(c) 

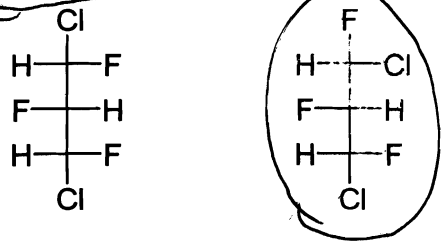
identical

(d) 

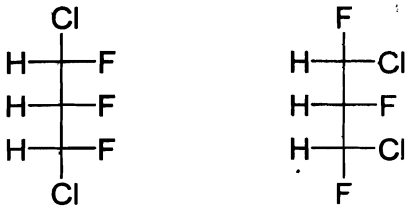
identical

(e) 

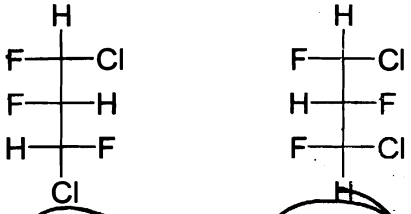
diastereomers

(f) 

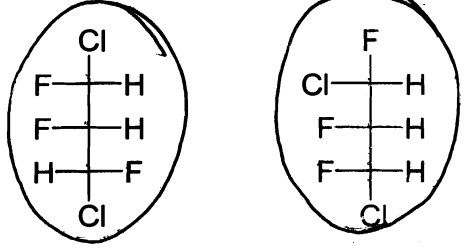
diastereomers

(g) 

diastereomers

(h) 

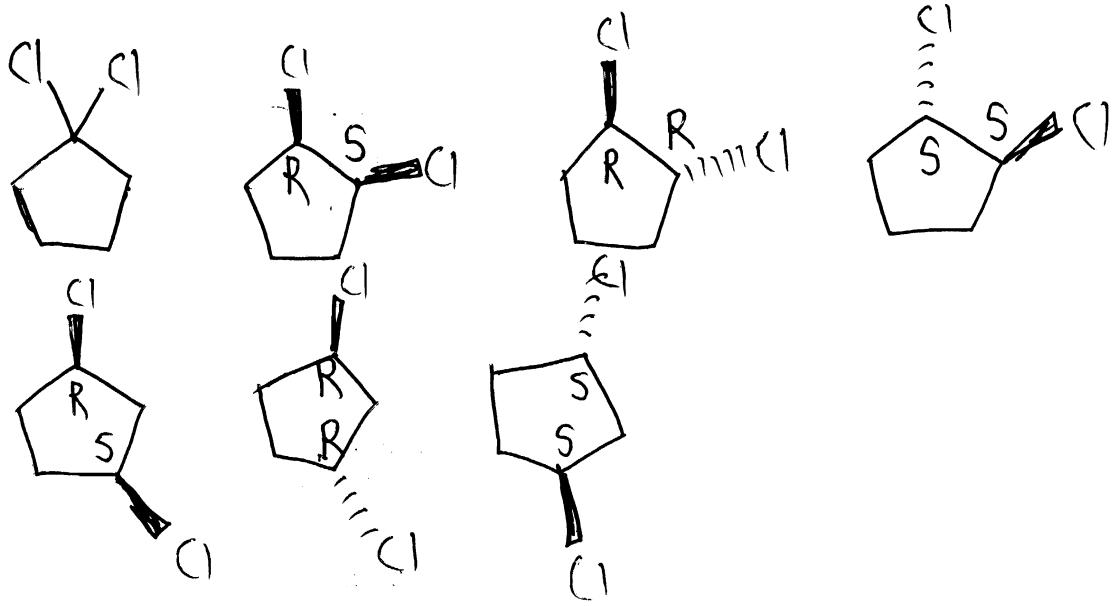
diastereomers

(i) 

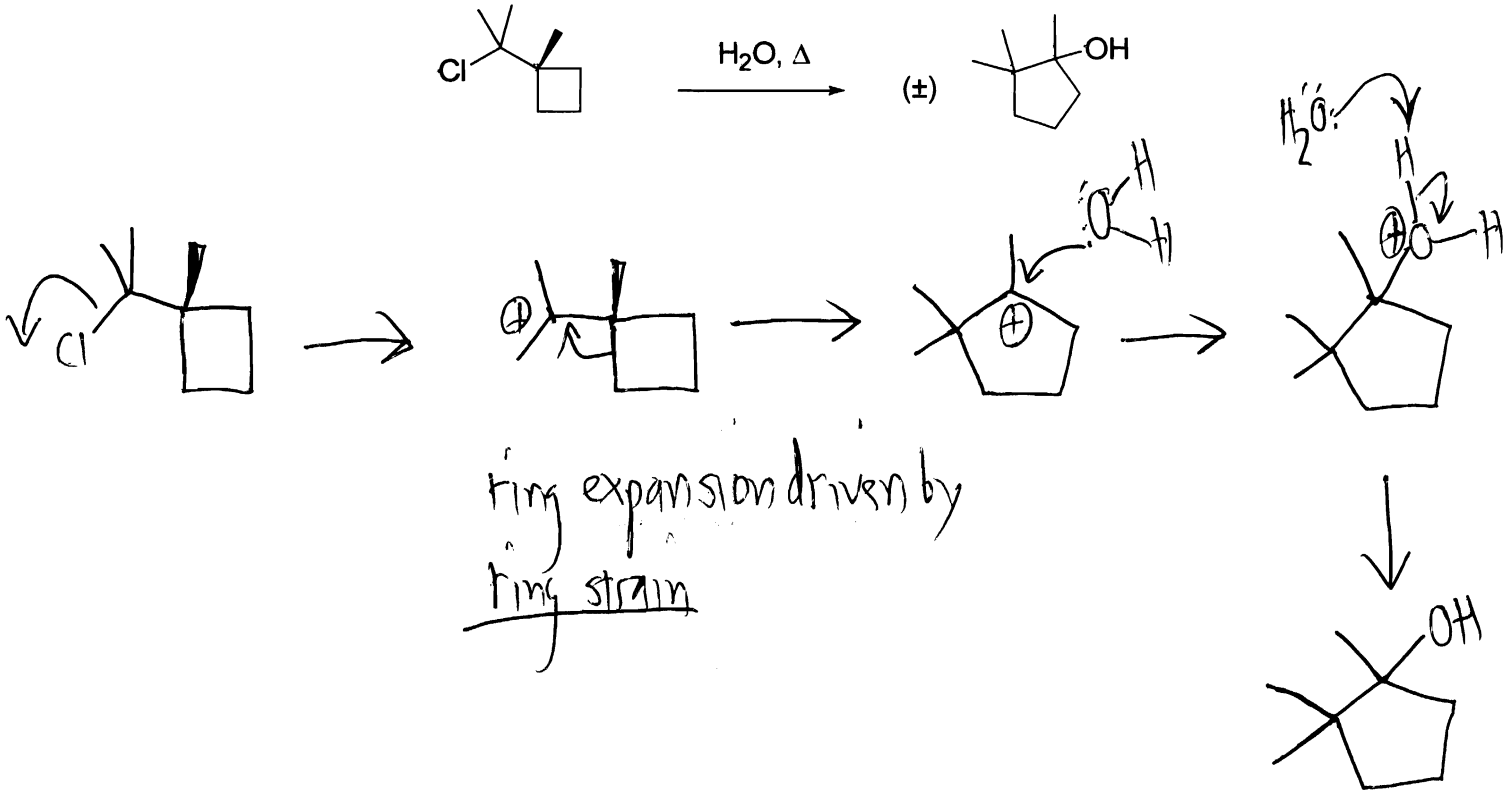
enantiomers

5a. Draw **all** of the possible isomers of dichlorocyclopentane (**five**-carbon ring with **two** chlorines attached). List enantiomers, but points will be marked off for writing the same structure twice (13 points).

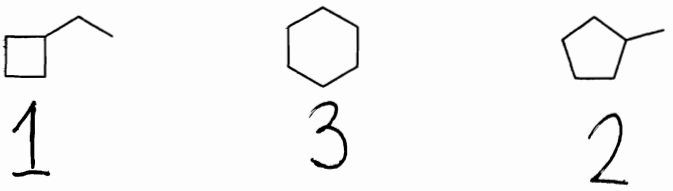
5b. Assign the absolute configuration for each asymmetric carbon (12 points).



6. Upon heating the below illustrated alkyl chloride in water, the alcohol shown is produced as one of the major products. Provide a mechanism for its formation (14 points).



7. Rank the constitutional isomers listed below based upon heat of formation (1 = **largest** ΔH_f°, i.e., requires the **most** energy to formally produce from the elements in their standard states). **Briefly** explain your ranking (7 points).



1 3 2

The isomer with the most ring strain (cyclobutyl) has the largest ΔH_f°. Cyclohexane has no ring strain, and would have the smallest ΔH_f°. (actually is a negative #)