

Name: _____

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First

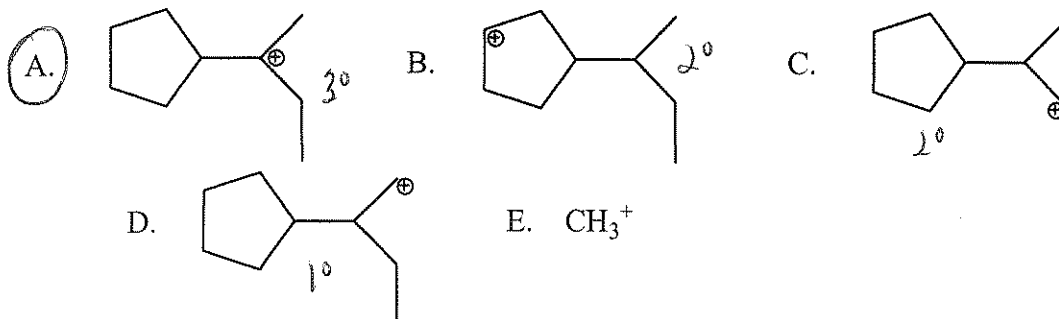
MI

Multiple Choice (Choose the one best answer for each of the following. Using a #2 pencil, record this answer on the scantron provided.)

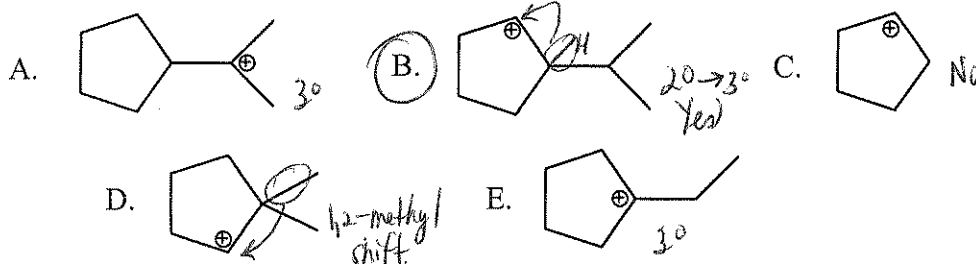
1. Which one of the following groups has the highest priority?

- (A) $-\text{CH}(\text{Br})\text{CH}_2\text{CH}_3$ B. $-\text{CH}_2\text{CH}=\text{CH}_2$ C. $-\text{CH}_3$
D. $-\text{CH}_2\text{CH}(\text{CH}_3)_2$ E. $-\text{CH}_2\text{CH}_2\text{CH}_3$

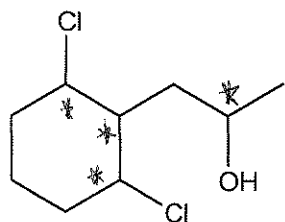
2. Which one of the following is the most stable carbocation?



3. Which one of the carbocations shown below is MOST likely to undergo a 1,2-hydride shift?

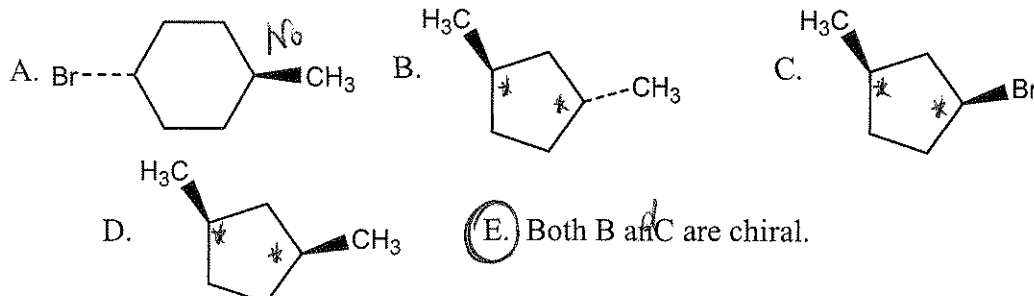


4. How many chirality centers in the molecule shown below? Be careful!



- A. zero
B. one
C. three ← if Cls are cis to each other
D. two
E. four ← if Cls are trans to each other.

Which of the following compound(s) is/are chiral?



*Accept 0/1/2
could also be 4 if the Cls are trans to each other.*

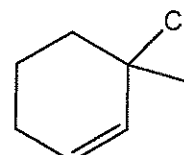
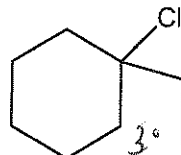
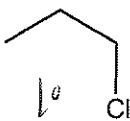
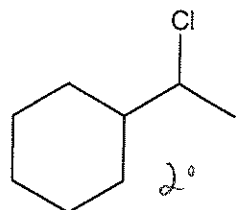
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12. List the following compounds in order of decreasing S_N1 reactivity. The correct order is:



A. I > III > IV > II

B. II > IV > I > III

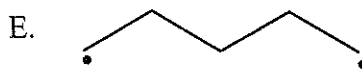
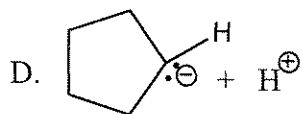
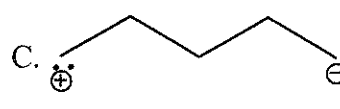
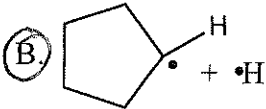
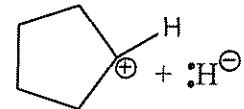
C. III > I > II > IV

(D) IV > III > I > II

E. IV > II > I > III

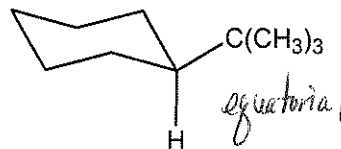
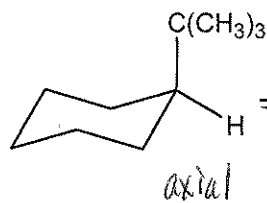
IV > III > I > II

13. Homolysis of a C-H bond in cyclopentane (draw it!) would give:



14. An equilibrium mixture of *t*-butylcyclohexane contains the two conformational isomers shown. Since at 25°C $\Delta G^\circ = -20.5 \text{ kJ/mol}$ for interconversion between conformations, the numerical value of K_{eq} for this process is _____ and the _____ conformation is favored at equilibrium.

Forward rxn favored and $K_{eq} > 1$ at eq + equatorial favored!



$\Delta G = -20.5 \text{ kJ/mol}$

A. 3920; axial

B. 0.000255; axial

(C) 3920; equatorial

D. 0.000255; equatorial

E. 682; neither

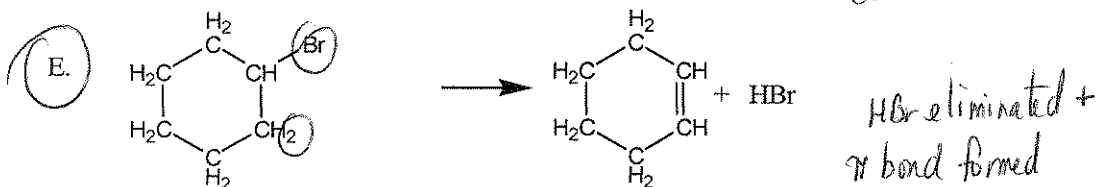
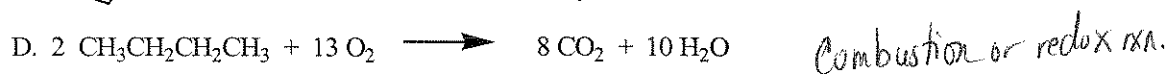
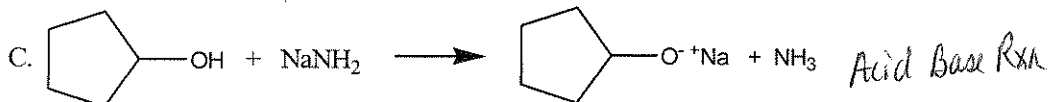
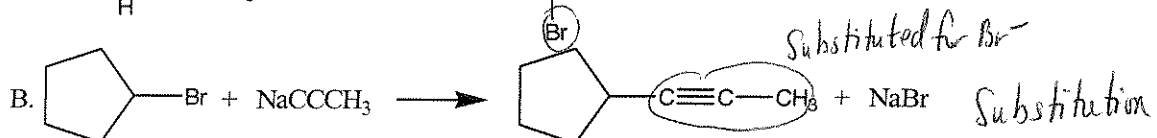
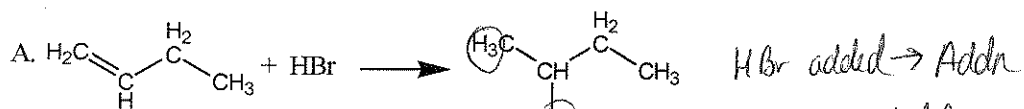
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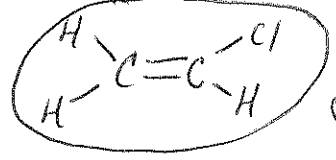
15. Which one of the following is an elimination reaction?



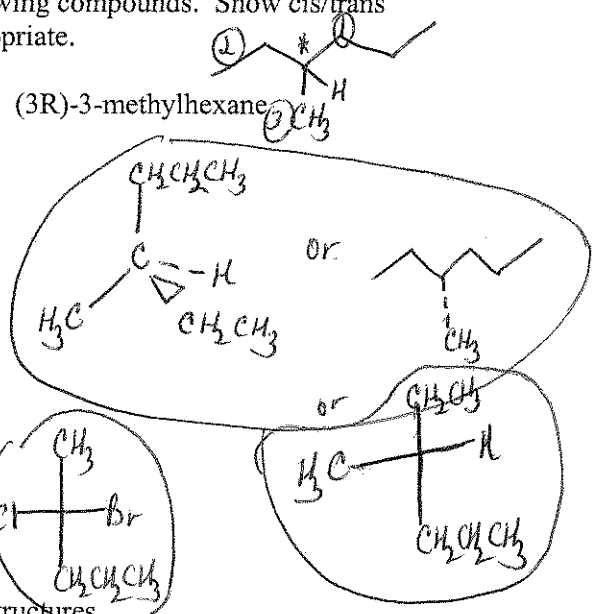
Partial Credit (Fill out the remaining questions on the exam itself. Show all work, provide complete explanations, and circle the answer(s) to be graded.)

16. Give a structure (line or structural) for each of the following compounds. Show cis/trans or R/S stereochemistry (3-D directionality) where appropriate.

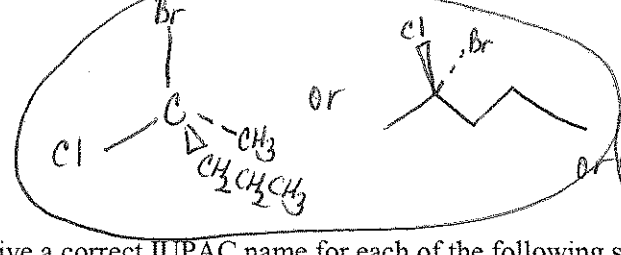
A. vinyl chloride



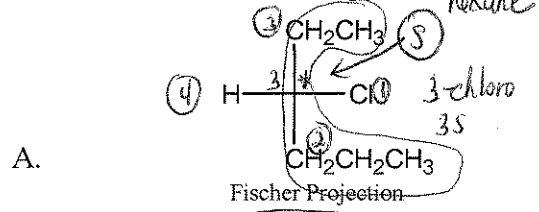
B. (3R)-3-methylhexane



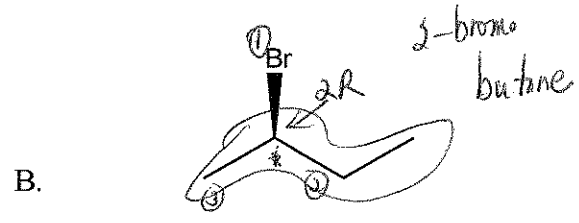
C. (2S)-2-bromo-2-chloropentane



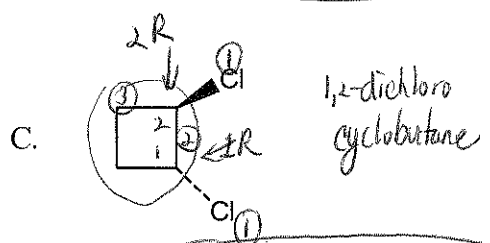
17. Give a correct IUPAC name for each of the following structures.



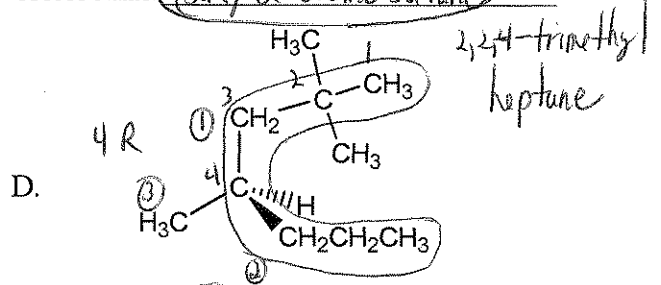
IUPAC Name: (3S)-3-chlorohexane



IUPAC Name: (2R)-2-bromobutane

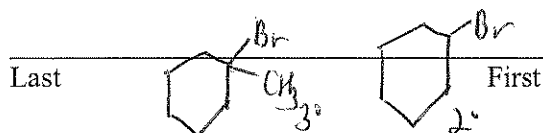


IUPAC Name: (1R,2R)-1,2-dichlorocyclobutane



IUPAC Name: (4R)-2,2,4-trimethylheptane

Name: _____



18. Circle which one of each of the following pairs will proceed faster by an S_N2 mechanism. If both proceed at the same rate, circle both. $Rate = k[RX][Nu]$
methyl $1^\circ > 2^\circ > 3^\circ$

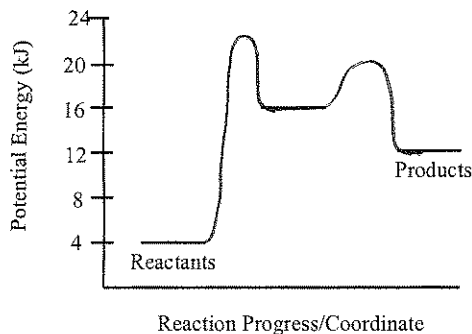
- A. 1-bromo-1-methylcyclohexane + H_2S vs. bromocyclohexane + H_2S $2^\circ > 3^\circ$
- B. $CH_3CH_2Br + NaSH$ vs. $CH_3CH_2I + NaSH$ $I^- > Br^-$ As LG strength \uparrow S_N2 rate \uparrow
- C. bromocyclohexane + $NaOCH_3$ vs. bromocyclohexane + $HOCH_3$ As Nu strength \uparrow rate \uparrow
- D. $CH_3CH_2Br + NaSCH_3$ (polar protic solvent) vs. $CH_3CH_2Br + NaSCH_3$ (polar aprotic solvent) aprotic solvent increases Nu strength
- E. $CH_3CH_2Br + NaSCH_3$ vs. $(CH_3)_3CCH_2Br + NaSCH_3$

19. Circle which one of each of the following pairs will proceed faster by an S_N1 mechanism. If both proceed at the same rate, circle both. $Rate_{S_N1} = k[RX]$
 1° hindered backside

- A. bromocyclohexane + $HOCH_3$ (polar protic solvent) vs. bromocyclohexane + $HOCH_3$ (non-polar solvent) $3^\circ > 2^\circ > 1^\circ$
- B. $CH_3CH(Br)CH_3 + H_2O$ vs. $CH_3CH(Br)CH_3 + NaOH$ S_N1 no dependence on Nu strength.
- C. high conc. $(CH_3)_3C-I + NH_3$ vs. low conc. $(CH_3)_3C-I + NH_3$
- D. $CH_3CH(Cl)CH_3 + H_2O$ vs. $(CH_3)_3C-Cl + H_2O$

stabilizes the intermediate carbocation \leftarrow

20. Given the reaction profile shown below, determine the following.



- A. How many elementary steps are involved in the overall reaction?
- B. How many transition state species are involved in the overall reaction?
- C. How many intermediates are involved in this reaction?
- D. Is the overall reaction exothermic or endothermic?
- E. Which step is the slow step (first, second, third, fourth step)? How do you know? Explain.

Answers

2
2
1
endothermic
first step
This step has the highest activation energy.

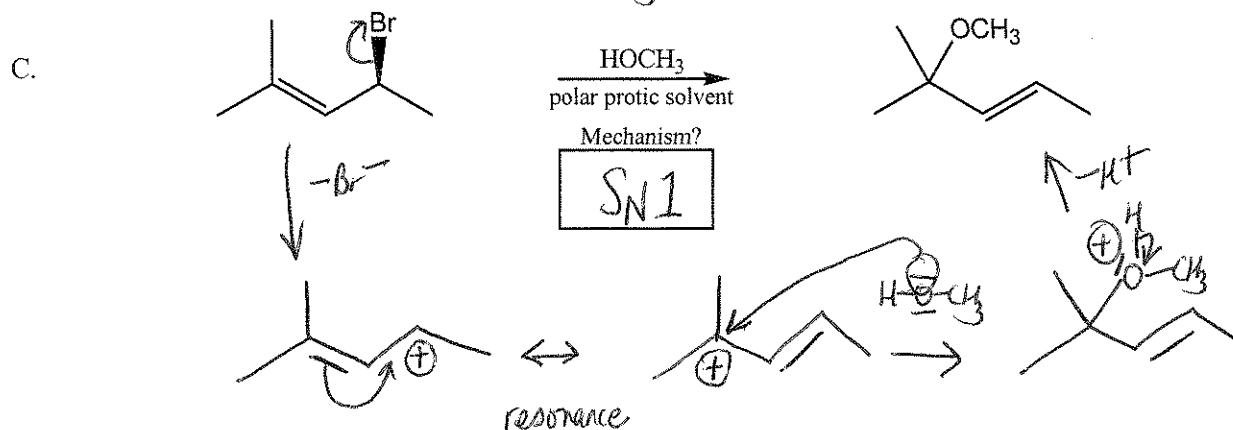
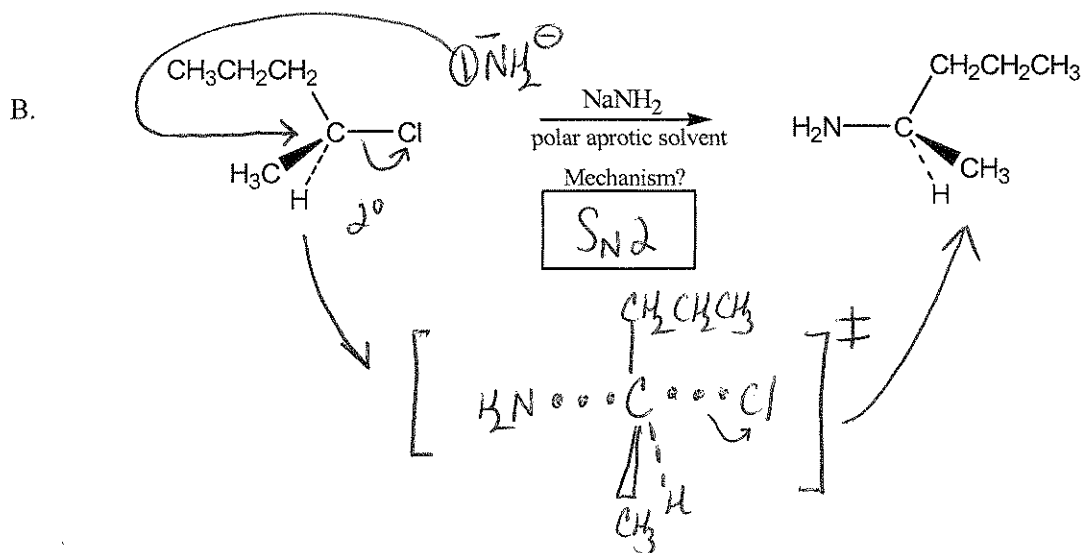
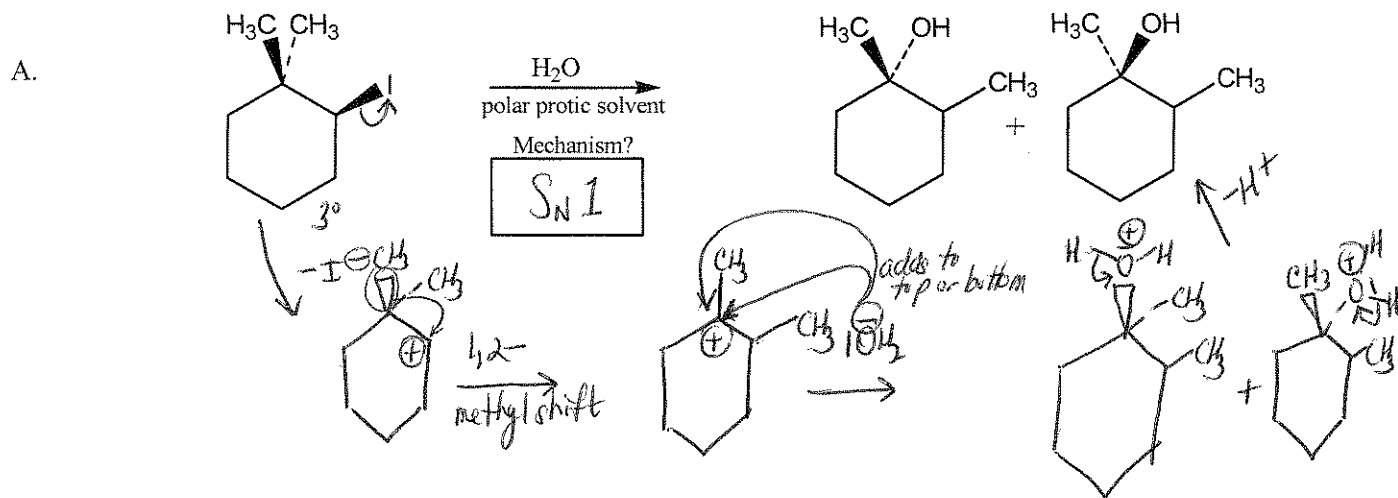
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21. Specify the mechanism type (S_N1 or S_N2) and show detailed step-by-step mechanisms for obtaining the given products. Give as much information as possible and be sure to show movement of electrons using curved arrows, positive or negative formal charges, intermediates, etc. For S_N2 mechanisms, show the transition state species. Don't skip any steps in the mechanism.



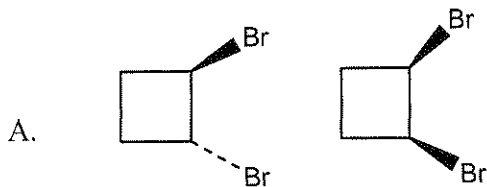
Name: _____

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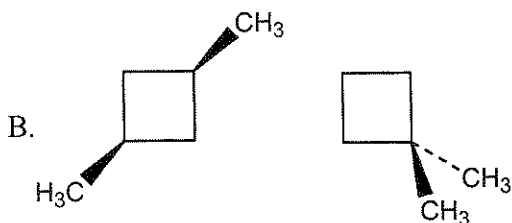
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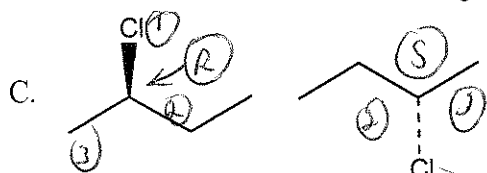
22. Consider the following pairs of compounds. Label how the compounds are related. Are they constitutional isomers, conformational isomers, diastereomers, enantiomers, or identical?
(5)



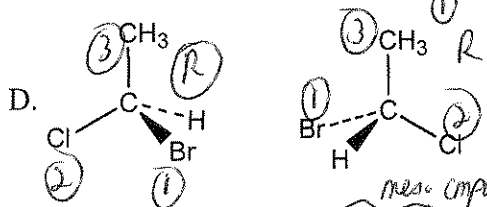
Relationship? diastereomers



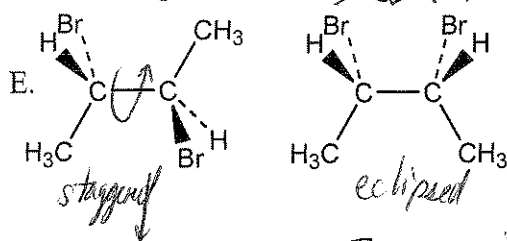
Relationship? constitutional isomers



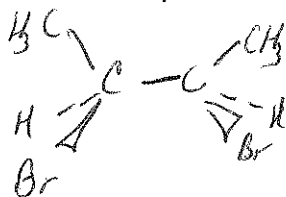
Relationship? enantiomers



Relationship? identical



Relationship? conformational isomers
if say both conformational isomers + identical \rightarrow or



These are identical
except they are different
conformations