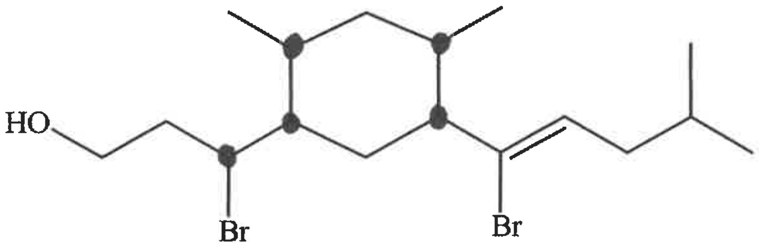
Names of all students (please print) Answer Key

CHEM 243 Organic Chemistry I **Points** ________ **(10 max)**

Worksheet #11: October 4, 2021. Complete the following worksheet by collaborating with a group of 3-4 students. You can use a text book or your lecture video notes. You must work together, with the names of all students included on **ONE** sheet and turned in for a group grade.

Please take a few minutes of class time to complete the class survey using the URL link in Blackboard (also emailed to you). Let me know if you need to borrow a laptop in class (https://forms.gle/1UxkySCWz78qLpDB8).

(1) Chiral Carbons. Place a dot (●) on each chiral carbon in the molecule drawn at the right. **REMEMBER:** Chiral carbons must be sp3 hybridized, and bonded to 4 different atoms or groups. **HINT:** Start by focusing on carbons where you "see" either 3 or 4 bonds in the zig-zag structure.



(2) Stereoisomers – Introduction to Diastereomers.

(a) Diastereomers are best described as stereoisomers that have 2 or more chiral carbons and are not mirror images of each other. In other words, stereoisomers that are not enantiomers. [✓ **TRUE**] **or FALSE (circle)**

(b) You can predict the maximum number of diastereomers using 2^n, where "n" is the number of chiral carbons. If a molecule has 5 chiral carbons, the maximum number of diastereomers = $2^5 = 32$

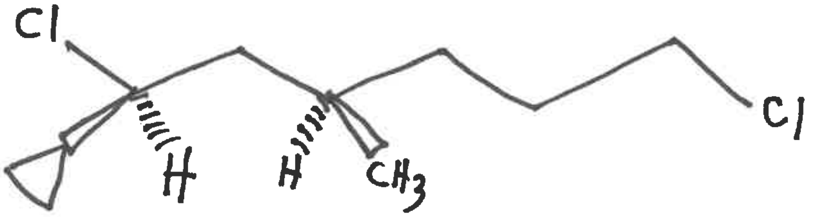
(c) Two compounds (A and B) are **stereoisomers**, and may be either enantiomers or diastereomers. Each compound (A and B) has three chiral carbons, but different melting points, boiling points and solubilities.

Answer the following as TRUE or FALSE:

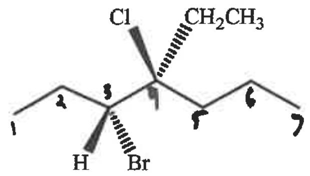
T These two compounds must have the same formula and connectivity
F The three chiral carbons must all have planar geometry
T These two compounds must be diastereomers
T One pair of diastereomers could have the configurations of (R, S, S), and (R, R, R)
T There are a maximum of 8 stereoisomers that include enantiomers and diastereomers
T An example of one pair of enantiomers could have the configurations R,S,R and S, R, S

(3) Nomenclature of Diastereomers. If a name is given, draw the correct chemical structure. If a structure is given, give the IUPAC name. **Don't forget to include the proper 3D configuration at each chiral carbon (using R/S designations, or wedge/dash bonds).**

(a) (1S, 3R)-1,6-dichloro-1-cyclopropyl-3-methyl hexane

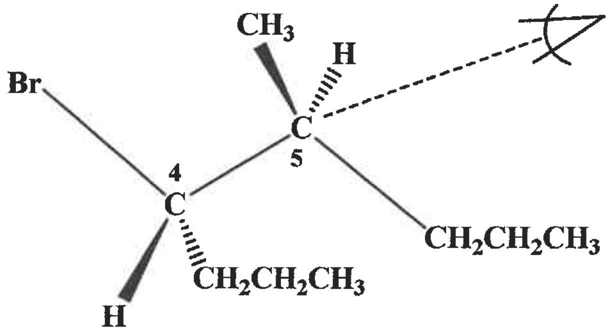


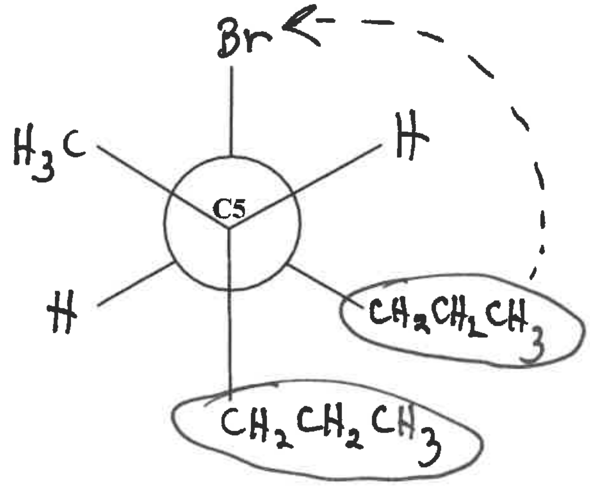
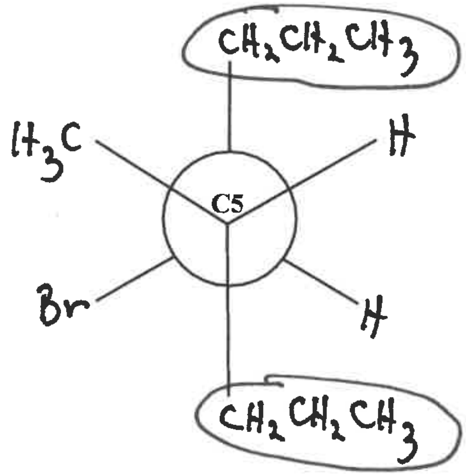
(c)



(3R, 4S) – 3-bromo – 4 – chloro – 4 – ethyl heptane

(4) Newman Projections of Diastereomers. Consider the 3D "zig-zag" structure for the compound drawn at the right, and the view **looking at C5** and down the C5-C4 bond:



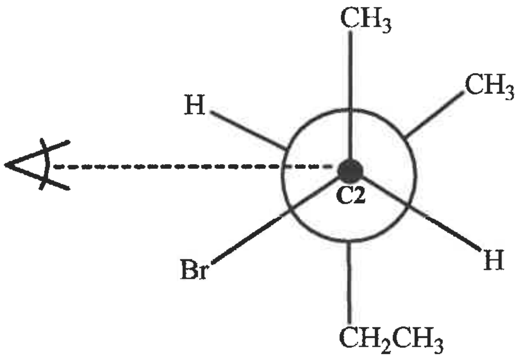
(a) **CONFORMER A.** Using the template below, draw a Newman Projection looking **at C5** and down the C5-C4 bond. Be careful, as the configuration at C5 (S) and at C4 (S) must be accurately represented in the Newman Projection.	(b) **CONFORMER B.** Is Conformer A the most stable conformer? If not, draw the most stable conformer below:
 	

(c) After you did the bond rotation from Conformer A to Conformer B, did the configurations at either C4 or C5 change? Explain your answer.

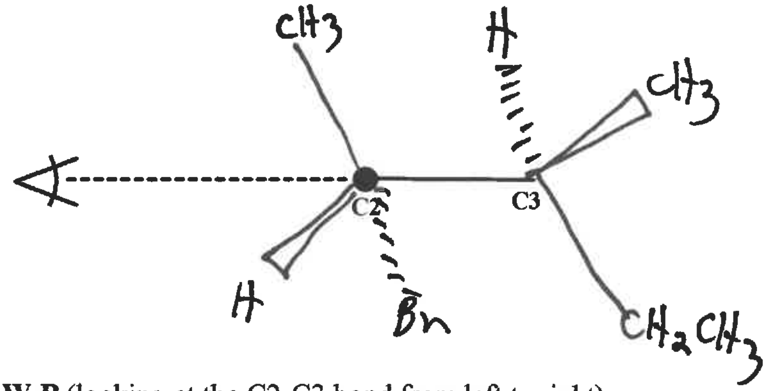
No, the configuration did not change as we only did a bond rotation. We did not break & re-make any bonds.

(5) Converting a Newman Projection into a 3D Zig-Zag drawing. Consider the Newman Projection drawn below. Draw a zig-zag structure for this compound in the space at the right. Be sure to show the proper stereochemistry at all chiral centers using wedge and dashed bonds.

HINT: This is tricky, but an excellent exercise to train your mind to "see" 2D structures in 3D.
1) Can you see in the Newman Projection that both C2 and C3 are chiral carbons?
2) In View A your eye is looking at C2 from above, and down the C2-C3 bond. We can't see C3 which is behind C2.
3) In View B, we have turned the C2-C3 bond 90° to the left. You are still looking at C2 which is on the left, and C3 is on the right.
4) We need to now add 3 bonds to C2 and C3. One bond in the plane of the paper, one wedge bond coming forward, and one dashed bond going back. Lets start with the bonds in the plane of the paper. In the Newman projection the bonds in the plane of the paper are the bonds going up and down. For C2 the bond is going "up" to the -CH_3. For C3 the bond is going "down" to the -CH_2CH_3.
5) Now for the wedge and dashed bonds. For C2 these will be the -Br and -H. In the Newman Projection (View A) the -Br is down and to the left. As you change to View B, the -Br bond will be down but is it going "back" (dashed bond) or coming "forward" (wedge bond).
6) Do the same analysis for C3 to finish.



VIEW A (looking down at C2)

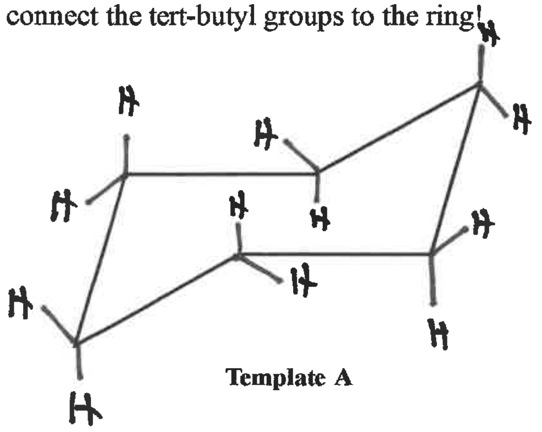


VIEW B (looking at the C2-C3 bond from left to right)

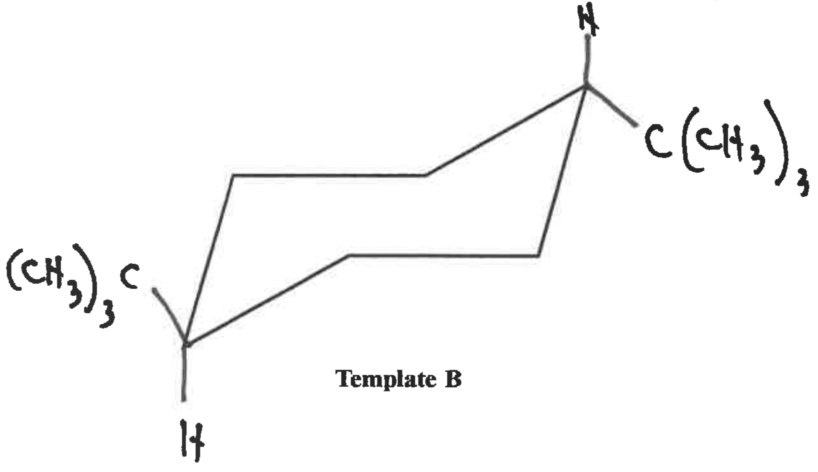
(6) PRACTICE - Cyclohexane Structure: Drawing in Axial and Equatorial Bonds.

(a) On **Template A** below, draw in the axial and equatorial bonds, using H atoms. We need practice in correctly drawing Axial and equatorial that point in the correct direction.

(b) On **Template B**, draw in 1,4-tert-butyl groups, -$C(CH_3)_3$ to give the most stable conformation. Be careful how you connect the tert-butyl groups to the ring!



Template A



Template B