Department of Chemistry and Biochemistry

Chemistry 59-230/232 **Midterm #1**
Time: 50 min. **Oct. 22, 2008**

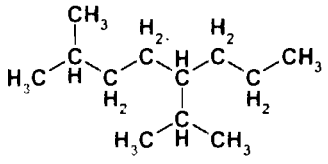
NAME _____ **ID#**_____

LAB SECTION – enter day/time/TA_____

*Note: **Please answer on the test paper.** There is an extra sheet for rough work at the back, but it will not be marked unless you specifically ask me to. Tests written in pencil will be marked, but cannot be returned for remarking. For the 'promised' size ranking, see the intro to **4a**. There are 80 marks on this exam.*

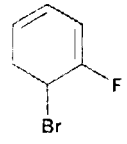
1. Give correct IUPAC names for the following compounds. Include stereochemical descriptors where relevant. (4 marks each, total 16 marks)

a



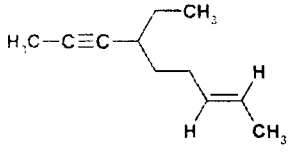
5-ISOPROPYL-2-METHYLOCTANE
OR 2-METHYL-5-METHYLETHYLOCTANE

b.



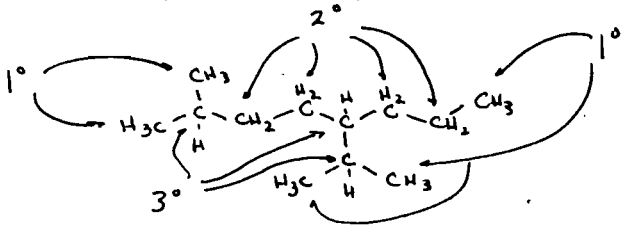
6-BROMO-1-FLUORO-1,3-CYCLOHEXADIENE
OR 6-BROMO-1-FLUOROCYCLOHEXA-1,3-DIENE

c.



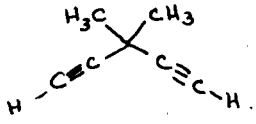
trans- or
(E)- 6-ETHYL-2-NONEN-7-YNE
OR NON-2-EN-7YNE

d. Indicate for the structure in **1a** which carbon atoms are primary, secondary, tertiary and quaternary. You may redraw the structure *or* indicate with arrows (4 marks).

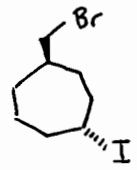


2. Draw structures which correspond to the following given names. Drawings showing only carbons and other non-hydrogen atoms are acceptable. Please include the appropriate stereochemical aspects of the structure where it is needed. (4 marks each, total 12)

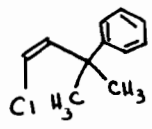
a. 3,3-dimethyl-1,4-pentadiyne



b. *trans*-1-bromomethyl-4-iodocycloheptane

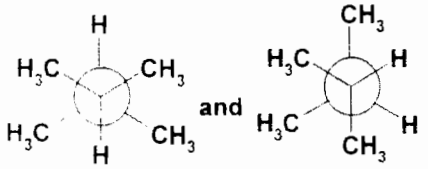


c. *(Z)*- 1-chloro-3-methyl-3-phenyl-1-butene



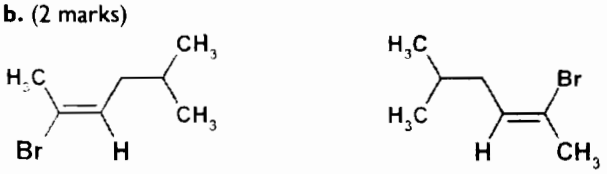
3. (Total 21 marks) For each of the (a-d) below, assign the appropriate terminology (structural isomers, geometric (cis/trans) isomers, different conformations of the same molecule, identical, not isomers at all) to the following.

a. (2 marks)



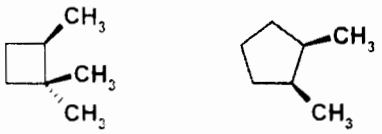
DIFF. CONFORMERS

b. (2 marks)



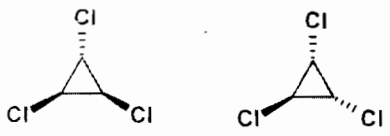
GEOMETRIC ISOMERS

c. (2 marks)



STRUCTURAL ISOMERS

d. (2 marks)

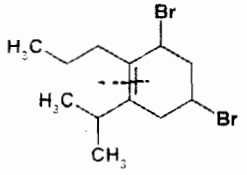


IDENTICAL

e. Assign the Z- or E- stereochemical descriptor to the following systematically. Show your work. Do *not* give the complete name of the compound (6 marks).

AT TOP C
ON LEFT C
ON THAT C ATOM C, H, H

ON RIGHT C ⇒ TIE
ON THAT C ATOM Br, C, H
Br "WINS"
∴ RIGHT SIDE HAS HIGHER PRIORITY



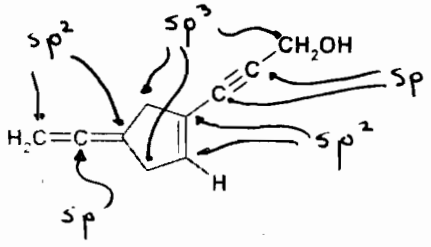
AT BOTTOM C
ON LEFT C
ON THAT C ATOM C, C, H
"WINS"

ON RIGHT C ⇒ TIE
ON THAT C ATOM C, H, H

∴ LEFT SIDE HAS HIGHER PRIORITY

HIGHER PRIORITY GROUPS ARE ON OPPOSITE SIDES ∴ (E) -

f. Indicate the hybridization of each carbon atom in the following structure . (5 marks)

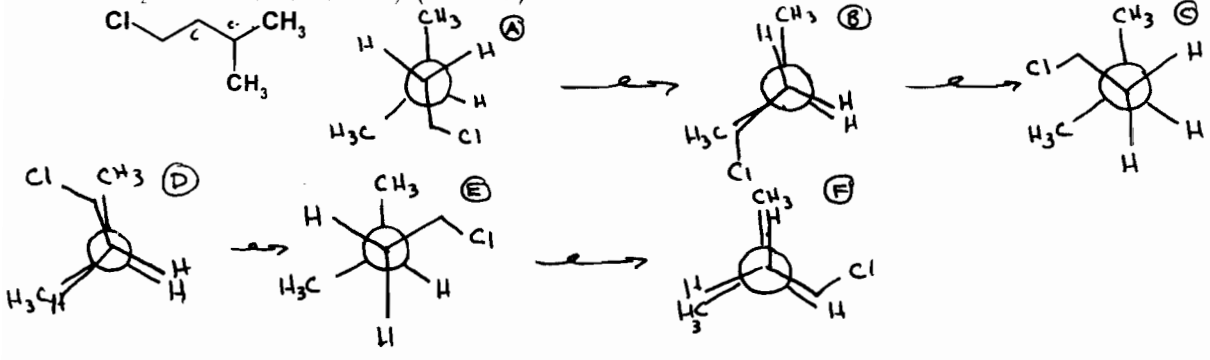


g. What is the index of hydrogen deficiency of the structure in **f** (2 marks)?

6 (3 C=C'S 3×1 = 3
1 C≡C 1×2 = 2
1 RING 1×1 = 1)
TOT 6

4 (Total 20 marks)

a. Draw the possible Newman projections of *all* the possible staggered and eclipsed conformations of the following compound, viewed down the C2-C3 bond. Rank them in terms highest to lowest stability. (In terms of size, $C(CH_3)_3 > CH(CH_3)_2 > CH_2CH(CH_3)_2 \approx CH_2CH_3 > CH_3 \approx CH_2Cl > NH_2 > OH > F, Cl, Br, I > H$) (16 marks)



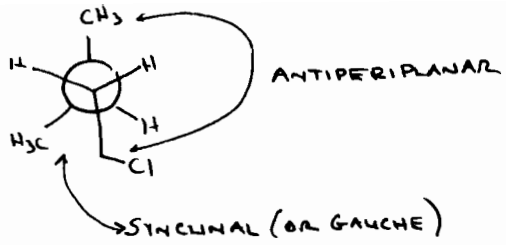
STABILITY BEST (A) & (E) TIED - STAGGERED, ONLY ONE CH_2Cl/CH_3 GAUCHE INTERACTION IN EACH

NEXT (C) - STAGGERED, BUT TWO CH_2Cl/CH_3 GAUCHE INTERACTIONS.

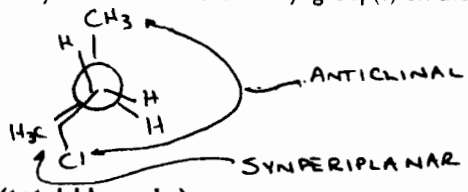
NEXT (F) - ECLIPSED, BUT BIGGEST GROUPS ON EACH END 'ONLY' SYNPERIPLANAR WITH H'S.

WORST (B) + (D) TIED - ECLIPSED, AND A CH_2Cl/CH_3 SYNPERIPLANAR INTERACTION IN EACH

b. In the lowest energy conformation in **4a**, what is the relationship in orientation between the chloromethyl group and the methyl group(s) on the neighbouring carbon atom? (2 marks) Note: I am looking for terminology *more* detailed than staggered/eclipsed.

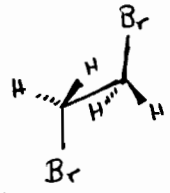


c. In the highest energy conformation **4a**, what is the relationship in orientation between the chloromethyl function and the methyl group(s) on the neighbouring carbon atom? (2 marks)

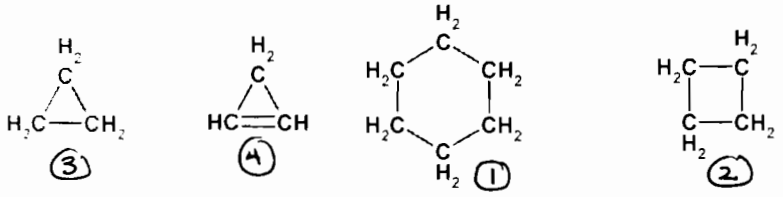


5 (total 11 marks)

a. Draw 1,2-dibromoethane in the sawhorse projection of its most stable conformation (5 marks). (For size rankings, see **4a**)



b. Rank the following compounds in terms of stability of the compound. Give your reasoning for your ranking. (6 marks)



(1) CYCLOHEXANE - C-C-C BOND ANGLES V. CLOSE TO 'NATURAL' ANGLES

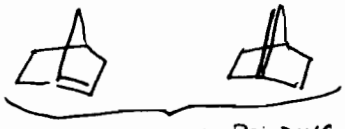
(2) CYCLOBUTANE C-C-C BOND ANGLES FORCED TO BE ~90°, CA. 20° FROM 'NATURAL' ANGLE - SIGNIFICANT ANGLE STRAIN

(3) CYCLOPROPANE C-C-C BOND ANGLES FORCED TO BE ~60°, CA 50° FROM 'NATURAL' ANGLE - VERY SIGNIFICANT ANGLE STRAIN

(4) CYCLOPROPENE - IN ADDITION TO THAT OF (3) 2 BOND ANGLES ARE AT sp^2 C'S (NATURAL 120°) - EVEN MORE ANGLE STRAIN

Bonus. (Up to 5 additional marks) Only one possible *alkene* analogue of the following alkane (norbornane or bicyclo[2.2.1]heptane) is a known compound (i.e., a double bond can only be 'put' in one type of place). Which one is it (1 mark) and what is wrong with the other possibilities (the other 4 marks)?

VERY POSSIBLE COMMERCIALLY AVAILABLE



TOO MUCH BENDING REQUIRED AT DOUBLE BOND - NOT STABLE AT 'BRIDGEHEAD' (sp^2)

PROBLEM IS THAT YOU HAVE π BONDS AT ONE END AND BONDS AT THE OTHER END ALMOST PERPENDICULAR - p ORBITALS CAN'T REALLY OVERLAP.

THIS IS CALLED BREDT'S RULE, BY THE WAY.