

Department of Chemistry and Biochemistry

Chemistry 59-230/232

Time: 50 min.

Midterm #1  
Oct. 10, 2002

NAME SUGGESTED SOLUTIONS

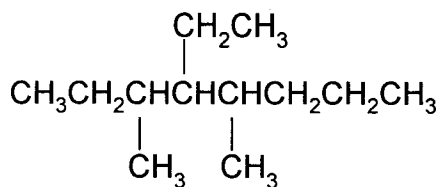
ID# \_\_\_\_\_

LAB SECTION (enter 'no lab' if in 232 or not taking one) \_\_\_\_\_

*Note: Please answer on the test paper. There is an extra sheet for rough work at the back, but it will not be marked. Tests written in pencil will be marked, but cannot be returned for remarking. For the 'promised' size ranking, see the intro to 5a.*

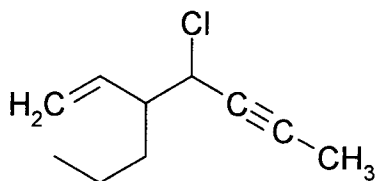
- I. Give correct IUPAC names for the following compounds. Include stereochemical descriptors where relevant. (5 marks each, total 20 marks)

a



4-ETHYL-3,5-DIMETHYLOCTANE

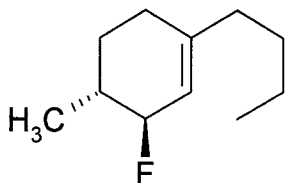
b.



4-CHLORO-3-PROPYLHEPT-1-EN-5-YNE  
OR

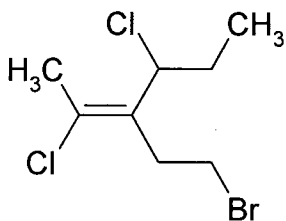
4-CHLORO-3-PROPYL-1-HEPTEN-5-YNE

c.



TRANS 1-BUTYL-3-FLUORO-4-METHYLCYCLOHEXENE

d.



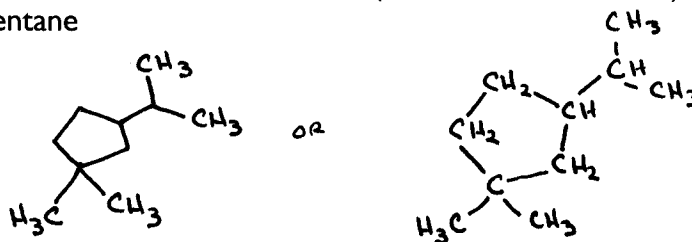
CIS OR

(E)-3-(2-BROMOETHYL)-2,4-DICHLORO-2-HEXENE

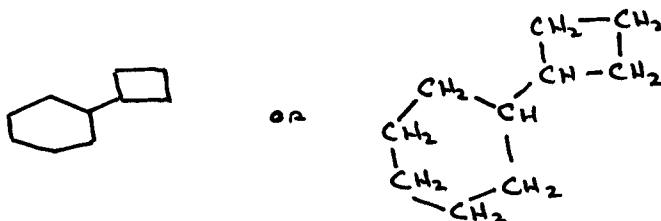
I'D ALSO TAKE ....DICHLOROHYDRO-2-ENE

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. (5 marks each, total 15)

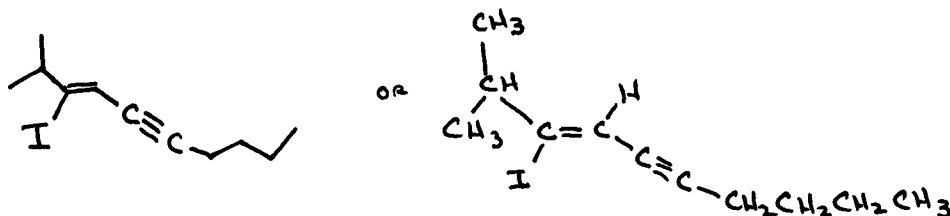
a. 1-isopropyl-3,3-dimethylcyclopentane



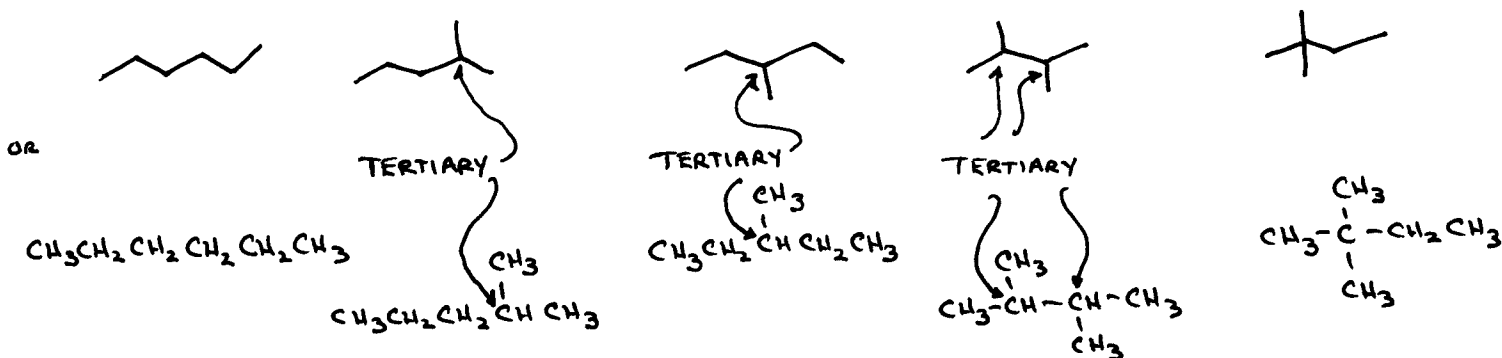
b. cyclobutylcyclohexane



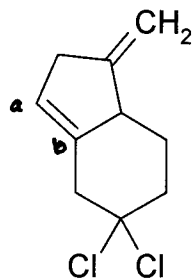
c. trans 2-methyl-3-iodo-3-decen-5-yne  
 NOTE NAME MISTAKE.... THIS SHOULD BE 3-iodo-2-methyl



3. a. Draw all the possible structural isomers of  $C_6H_{14}$ . Identify the tertiary carbon atoms in any drawings where they appear. (8 marks)



b. What is the index of hydrogen deficiency of the following compound? (2 marks)



2 RINGS + 2 DOUBLE BONDS

WORTH '1' EACH

TOTAL 4

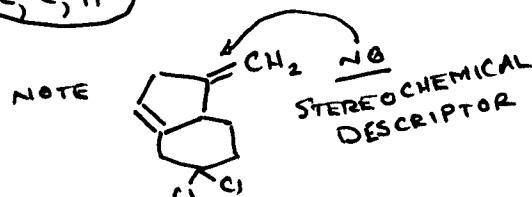
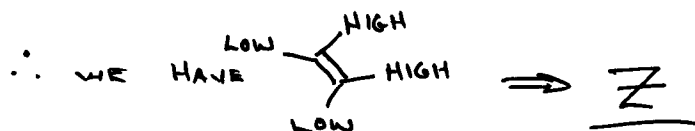
c. Apply the Z or E stereochemical descriptor where relevant in the above molecule.

Show how you arrived at the distinction. (5 marks)

ON CARBON I'VE LABELLED 'a' ATOMS H VS. C ← WINS

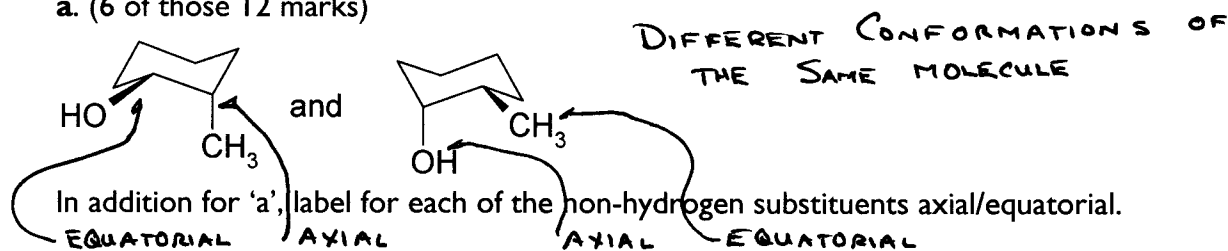
ON CARBON I'VE LABELLED 'b' 1<sup>ST</sup> ATOMS C VS. C

OFF IT, C, H, H VS. C, C, H ← WINS

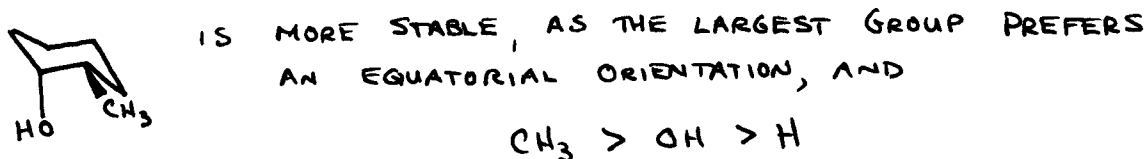


4. Assign the appropriate terminology (structural isomers, geometric isomers, configurational isomers, different conformations of the same molecule, identical) to the following. (Total 12 marks)

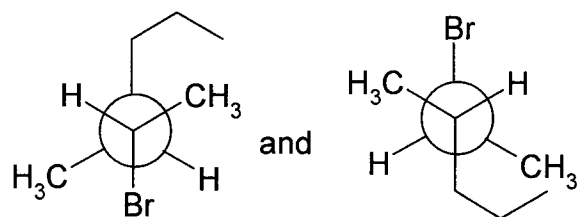
a. (6 of those 12 marks)



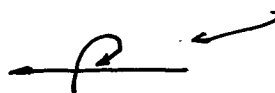
In (again) addition for 'a', which is the most stable structure? Why is this the case?



b. (4 of the 12 marks)



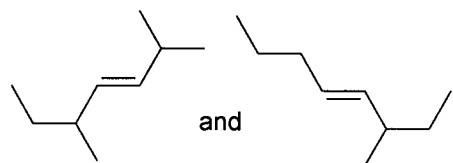
THESE ARE IDENTICAL, JUST ROTATED BY 180° ABOUT THIS AXIS



For 'b' what term describes the relationship between the bromine atoms and the propyl group?

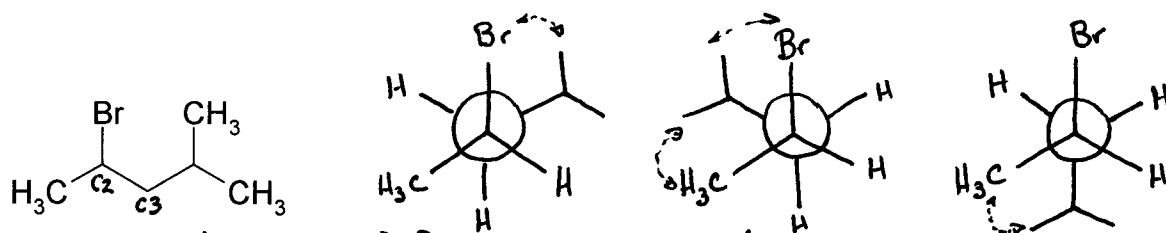
ANTI PERIPLANAR

c. (2 of the 12 marks)



STRUCTURAL ISOMERS

5. a. Draw the possible Newman projections of the possible staggered conformations of the following compound, viewed down the C1-C2 bond. Rank them in terms highest to lowest stability. (In terms of size,  $\text{C}(\text{CH}_3)_3 > \text{CH}(\text{CH}_3)_2 > \text{CH}_2\text{CH}_3 > \text{CH}_3 > \text{NH}_2 > \text{OH} > \text{F}, \text{Cl}, \text{Br}, \text{I} > \text{H}$ ) (12 marks)



SINCE IN SIZE  $-\text{CH}(\text{CH}_3)_2 > -\text{CH}_3 > -\text{Br}$

A SYNCLINAL  $-\text{CH}(\text{CH}_3)_2 \bar{\omega} -\text{CH}_3$  IS WORSE THAN  $-\text{CH}(\text{CH}_3)_2 \bar{\omega} -\text{Br}$

ONE SYNCLINAL (GAUCHE) INTERACTION  $-\text{CH}(\text{CH}_3)_2 \bar{\omega} -\text{Br}$

$\therefore$  HIGHEST STABILITY ①

TWO SYNCLINAL INTERACTIONS

$-\text{CH}(\text{CH}_3)_2 \bar{\omega} -\text{Br}$

$-\text{CH}(\text{CH}_3)_2 \bar{\omega} -\text{CH}_3$

$\therefore$  LOWEST STABILITY ③

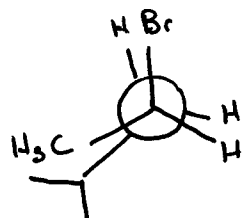
ONE SYNCLINAL INTERACTION

$-\text{CH}(\text{CH}_3)_2 \bar{\omega} -\text{CH}_3$

- WORSE THAN  $-\text{CH}(\text{CH}_3)_2 \bar{\omega} -\text{Br}$

$\therefore$  MIDDLE CASE ②

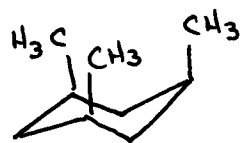
b. Draw the Newman projection of the worst possible conformation (from an energetic standpoint) of the above compound. (3 marks)



ECLIPSED, AND TWO BIGGEST GROUPS ARE SYNPERIPLANAR

$\therefore$  VERY BAD

c. Draw *cis,cis*-1,3,5-trimethylcyclohexane in its least stable possible chair form. (5 marks)



*CIS, CIS*, THEREFORE ALL 3 METHYLS ARE ON THE SAME SIDE (UP OR DOWN, YOUR CHOICE)

- CAN MAKE THEM ALL AXIAL, SINCE EACH METHYL HAS A 1,3-RELATIONSHIP TO THE 'NEXT' METHYL - OF COURSE THE MOLECULE DOESN'T LIKE IT

6. Consider the following reaction energy diagram, where **A** reacts to give **C** and can react with another species (**B**), to give **D**. The letter **I** stands for intermediate. (8 marks)

a) Which is the kinetic product of the reaction?

**C**, AS THE BARRIER (TRANSITION STATE) TO ITS FORMATION IS LOWEST

b) Which is the thermodynamic product?

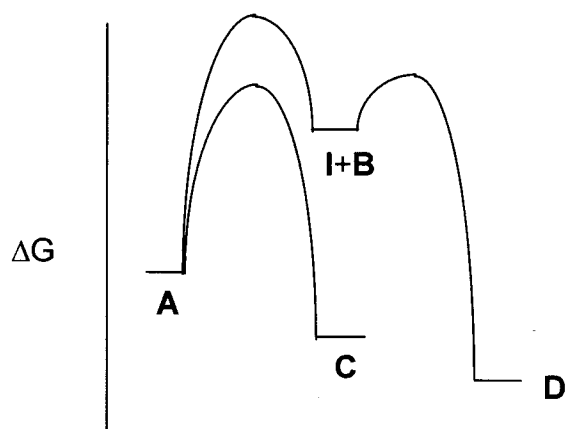
**D**, AS IT IS LOWEST ENERGY

c) What is the rate expression for the formation of **C**?

$$\text{RATE } (v) \propto [\text{A}] \quad \text{OR} = k[\text{A}]$$

d) What is the rate expression for the formation of **D**?

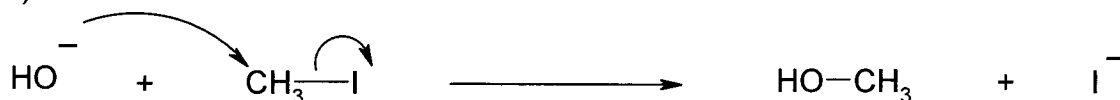
$$\text{RATE } (v) \propto [\text{A}] \quad \text{OR} = k[\text{A}] \quad \text{AS B DOESN'T COME IN UNTIL AFTER THE SLOW STEP.}$$



Reaction coordinate

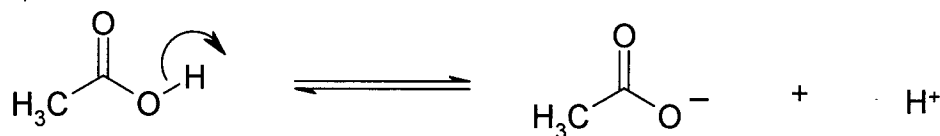
7. Which of the following are proper uses of the curved arrow, and which are not? (5 marks). For any incorrect ones, show what the arrows would indicate the product to be (no matter how unstable it looks).

a)



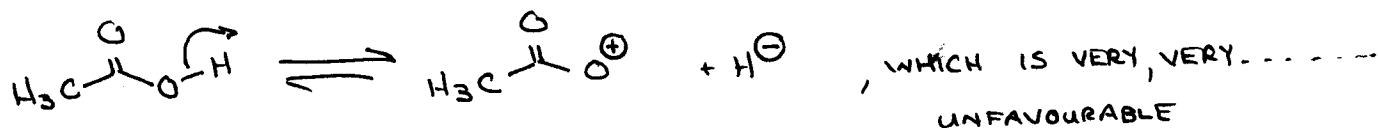
THIS IS PROPER

b)

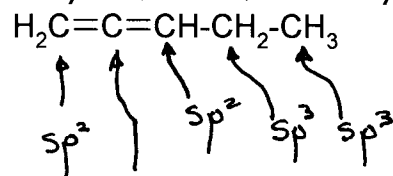


THIS IS NOT PROPER

THE APPLICATION OF THOSE ARROWS WOULD GIVE:



8. What is the hybridization of each of the carbon atoms in the following structure? (Yes, there is one tricky one, and no, it isn't a typo). (5 marks)



YES, THIS IS THE TRICKY ONE

THAT IS AN ALLENE, AND FOR THE CENTRAL ALLENE CARBON TO DOUBLE BOND TWICE, IT MUST...

