CHEM164/261, A2 Practice Questions for the MidTerm Exam, Answers

2010 10 20
HT

Review the Practice Questions for the Quiz as well as the Answer Keys for the actual Quiz.

(all available on my website).

Here are some more questions. Remember this is not an exhaustive compilation.

1. Define the following terms by description, example , sketch …

a. optical isomers : *non-superposable mirror images*

b. antiperiplanar : *Can best be shown in a Newman projection. Let's assume that X is the substituent of interest on C1 and Y is the substituent of interest on C2. X and Y are antperiplanar if they form an angle of 180°; in other words, they form a dihedral angle of 180°.*

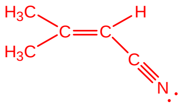
c. IR absorption : *absorption of electromagnetic radiation (emr) in the infrared range (approx. 4000 – 400 cm^{-1}), causing transition from one vibrational level to a higher vibrational level (increase in amplitude, but (ideally) not in frequency)*

d. wavenumber: *number of waves per unit length; customarily per cm*

e. meso*: refers to compounds that have "apparent stereogenic centers"(4 different substituents at a C atom), but have a plane of symmetry / superposable mirror images and that are consequently achiral*

d. angle strain: *results from geometric angle requirement (esp. in ring compounds) not allowing expression of the normal bond angles; e.g., 60° vs. 109° in cyclopropane*

2. Consider $(CH_3)_2C=CHCN$.



a. Determine the number of bond types:

$(sp^3,sp^3)\sigma$ 0 , $(sp,sp^2)\sigma$ 1 , $(sp^3,sp^2)\sigma$ 2 , $(sp^2,sp^2)\sigma$ 1 , $(sp,sp)\pi$ 0 , $(p,p)\pi$ 3

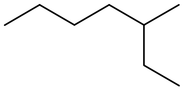
b. What other bond types are present? $(s,sp^3)\sigma$, $(sp,sp)\sigma$, $(s,sp^2)\sigma$

c. Which atoms lie in the same plane? Which ones are normally not in this plane.

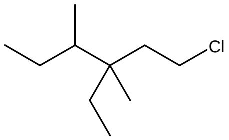
all atoms are in the same plane, except the H atoms of the methyl groups

3. For this question ignore R/S designation.

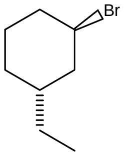
a. Provide systematic (IUPAC) names for the following.



3-methylheptane

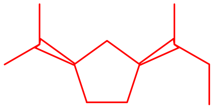


1-chloro-3-ethyl-3,4-dimethylhexane

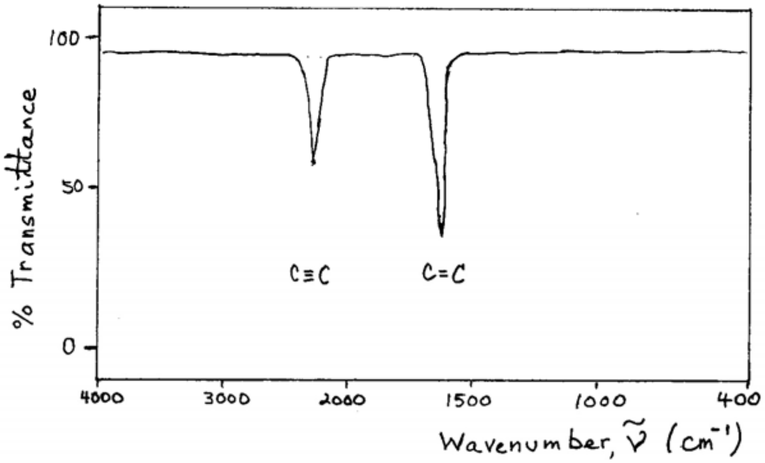


trans-1-bromo-3-ethylcyclohexane

b. Write a bond line structure for cis-1-sec-butyl-3-isopropylcyclopentane.



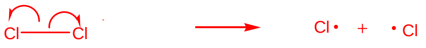
4. Sketch an IR chart with proper labeling of the x and y axes. Then indicate the relative positions of C,C double and C,C triple bond peaks on this chart.



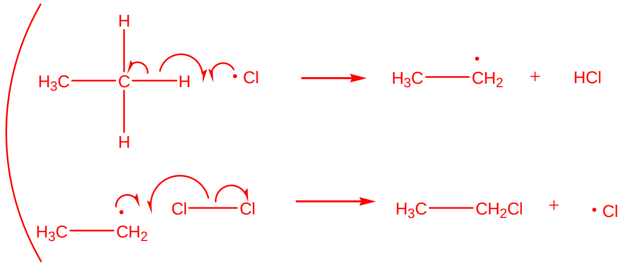
You don't need to know the absolute positions of the peaks, but the C,C triple bond peak must be at a larger wavenumber than the C,C double bond peak.

5. For the halogenation reaction of ethane write an example for each of an initiation, a propagation and a termination step. Use proper electron movement arrows.

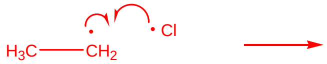
I :



P :

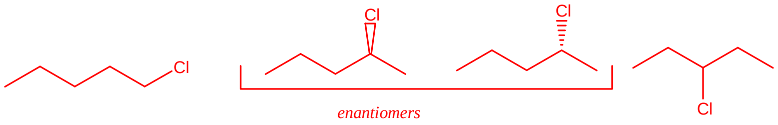


T :



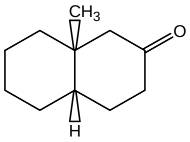
6. In the chlorination of pentane four (4) monochlorinated products are possible.

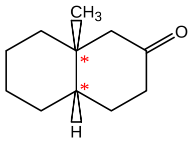
Show their bond line structure , incl. stereochemistry as required.



7.

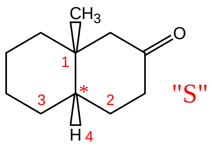
Consider

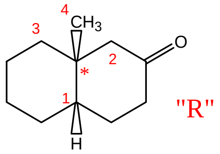




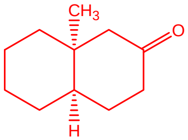
a. Is it chiral? *Yes*. Why? *2 stereogenic centers* , *no plane of symmetry*

b. OK, it is. Now, indicate the stereogenic center(s) and identify them as R or S.

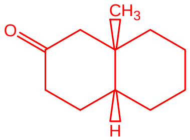




c. Draw its enantiomer.

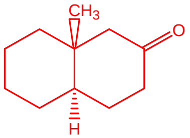


or

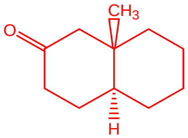


or ....

d. Draw a diastereomer if there is any. *There are two enantiomeric diastereomers.*



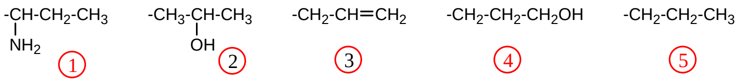
or



or ....

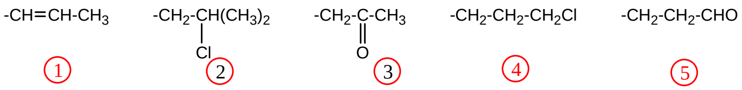
8. Rank the following groups in terms of C-I-P priority (highest first):

a.) $-(CH_2)_2CH_3$, $-CH_2CH(OH)CH_3$, $-(CH_2)_2CH_2OH$, $-CH_2CH{=}CH_2$, $-CH(NH2)CH_2CH_3$.



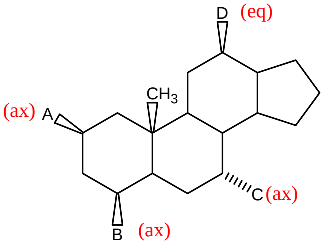
$-\underset{NH_2}{CH}-CH_2-CH_3$ ① $-CH_3-\underset{OH}{CH}-CH_3$ ② $-CH_2-CH{=}CH_2$ ③ $-CH_2-CH_2-CH_2OH$ ④ $-CH_2-CH_2-CH_3$ ⑤

b) $-(CH_2)_2CH_2Cl$, $-CH_2C({=}O)CH_3$, $-(CH_2)_2CHO$, $-CH{=}CHCH_3$, $-\ CH_2CCl(CH_3)_2$

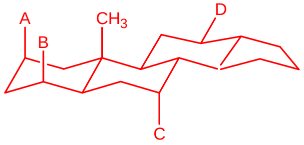


$-CH{=}CH-CH_3$ ① $-CH_2-\underset{Cl}{C}H(CH_3)_2$ ② $-CH_2-\underset{O}{\overset{\|}{C}}-CH_3$ ③ $-CH_2-CH_2-CH_2Cl$ ④ $-CH_2-CH_2-CHO$ ⑤

9. a. Determine whether the substituents A, B, C and D in this steroidal compound are equatorial or axial.(All rings are trans joined)

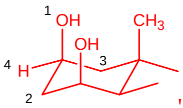


same as



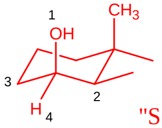
b. If A, B, C and D are all -OH groups, what is the R/S designation of the carbon atoms that these -OH groups are attached to.

A



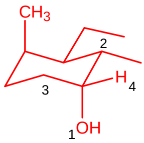
"S"

B



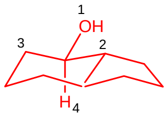
"S"

C



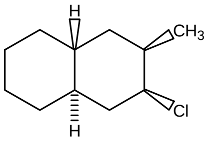
"R"

D

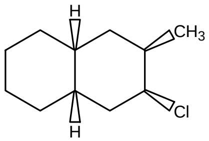


"R"

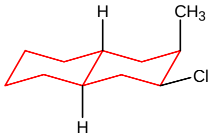
10. What positions (ax. or eq.) do the -Cl and -CH_3 groups occupy in the following molecules, preferentially?



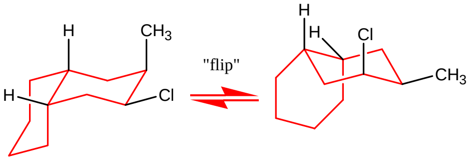
trans = "rigid"



cis = "mobile"

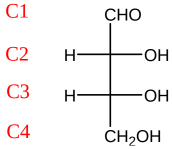


cannot flip!
-CH_3 ax.
-Cl eq.

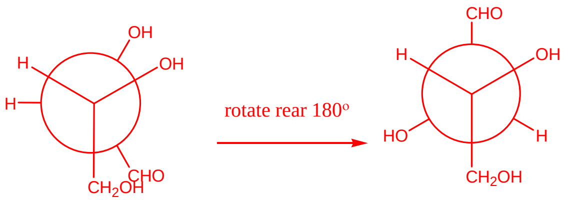


preferred conformation!
-CH_3 (more demanding) eq.
-Cl ax.

11. Consider the Fischer formula



a. Show a Newman projection (looking from C3 to C2) of this molecule in the conformation where the H's at C3 and C2 are antiperiplanar.

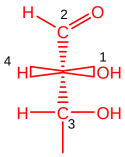


"eclipsed !"

"staggered"
H's antiperiplanar

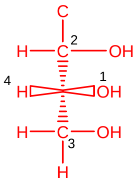
b. Determine R and S configuration at C2 and C3.

at C2



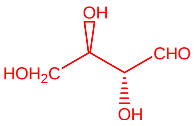
"R"

at C3

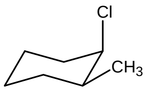


"R"

c. Show a 3-dimensionally correct "wedge and dash" structure of the above with a horizontal zigzag line and the aldehyde group up and to the right.

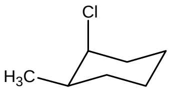


12. Consider



Compare the following with the reference structure and apply the labels :

identical structure, different conformer, enantiomer, diastereomer, constitutional isomer.



enantiomer

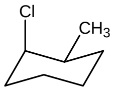
a.)

diastereomer

b.)

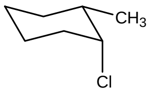
constit. isomer

c.)



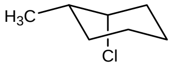
identical

d.)



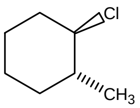
identical

e.)



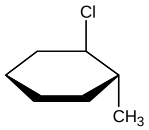
identical

f.)



diastereomer

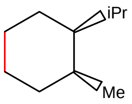
g.)



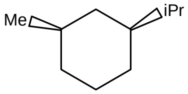
diastereomer

h.)

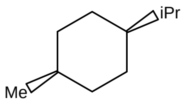
13. Write the preferred conformation for the following:



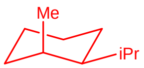
a.)

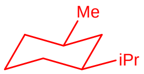


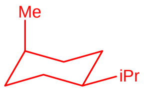
b.)



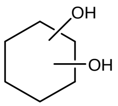
c.)





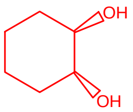


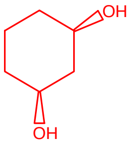
14. Consider

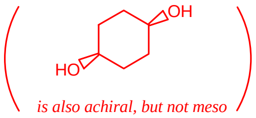


(which indicates 2 OH groups
attached to different C atoms on the ring)

Show two constitutional isomers, both meso, that have this general structure.







is also achiral, but not meso

15. What feature of the substrate structure is critical that will determine whether a substitution reaction will go by the S_N1 or S_N2 reaction mechanism? Why?

A primary substrate will favor S_N2(the reaction site is more approachable, less hindered); while a tertiary substrate favors S_N1(the carbocation intermediate and, acc. to the Hammond postulate, the transition state also) is more stable; secondary substrates occupy the middle ground.

16. Attempt to draw the σ* antibonding orbital that is involved in the S_N2 reaction of chloroethane.

The σ orbital responsible for the C–Cl bonding results from the in-phase overlap between the sp^3 orbital of the C atom and the p orbital of a Cl atom.
The σ* orbital can then be imagined to be the result of opposite-phase overlap of the same atomic orbitals.
Consider this to be a fairly crude approximation!