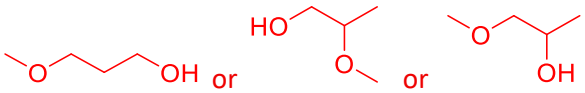
1. A compound has the molecular formula $C_4H_{10}O_2$. Which functional groups could be present? Provide one example for each positive answer. Briefly explain the negative answers.

amide: No N atom.

ether:



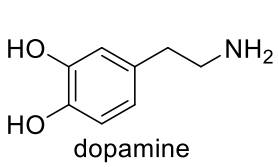
carboxylic acid: Too many H's. Zero degrees of unsaturation and you need one for the pi bond in the C=O of the carboxylic acid.

alcohol: See answer to "ether".

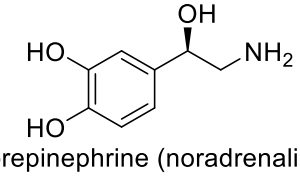
carboxylic ester: See answer to carboxylic acid.

benzene: Too few C's; need a minimum of 6 for a benzene ring.

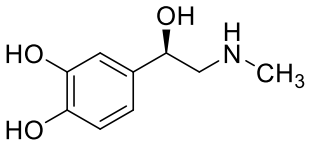
2. Catecholamines are an important class of neuroactive molecules. Three members of the group are shown below. Propose four different intermolecular forces that might allow catecholamines to interact with their protein neuroreceptor and elicit their biological response. Please be as precise as possible.



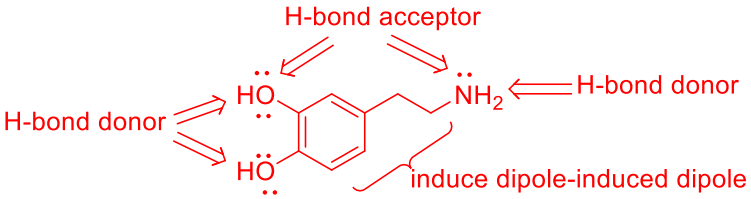
dopamine



norepinephrine (noradrenaline)

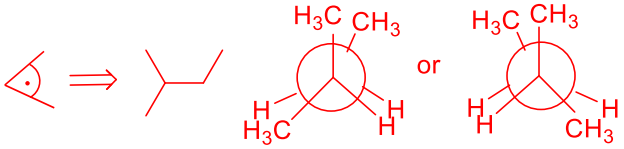


epinephrine (adrenaline)



3. Draw the Newman projection for the highest and lowest energy conformation of the C-2/C-3 bond of 2-methylbutane. Name these conformations using the conventions we discussed in class.

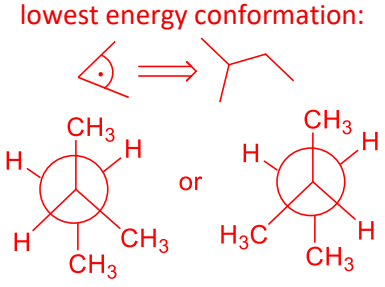
highest energy conformation:



other similar answers possible

syn eclipsed

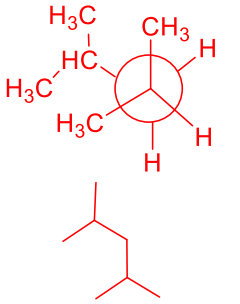
lowest energy conformation:



staggered

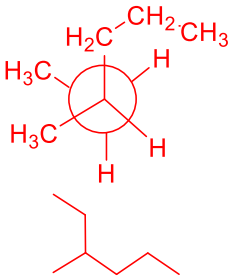
4. Convert the following Newman projections into condensed or skeletal structures and name them.

a)



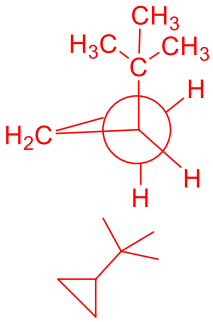
2,4-dimethylpentane

b)



3-methyl-hexane

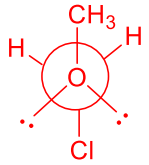
c)



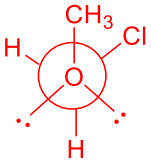
tert-butyl-cyclopropane

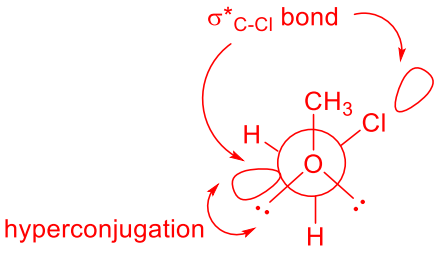
5. Another stereoelectronic effect (i.e. an effect involving electrons and their orientation in space) that is related to hyperconjugation in alkanes is called the gauche effect. The following question explores the gauche effect.

a) Draw the anti staggered Newman projection for the structure, CH_3OCH_2Cl, as viewed down the O-CH_2 bond. Put the O atom in the front of the Newman projection. Incorporate lone pairs where necessary.



b) In actuality, the favored conformation is gauche staggered. Draw a gauche conformation of CH_3OCH_2Cl, as viewed down the O-CH_2 bond.



c) Hyperconjugation is advanced as a reason for the lower energy gauche conformation. Suggest a hyperconjugation effect that could lead to stabilization of the gauche conformation. (*Caution:* SCARY problem!!)

There could be an electronic overlap between the lone pairs on the O and the $\sigma^*_{C\text{-}Cl}$ bond. This might lead to stabilization and a lower energy conformation for the gauche form, which actually brings the larger CH_3 and Cl group into closer proximity than in the anti form.