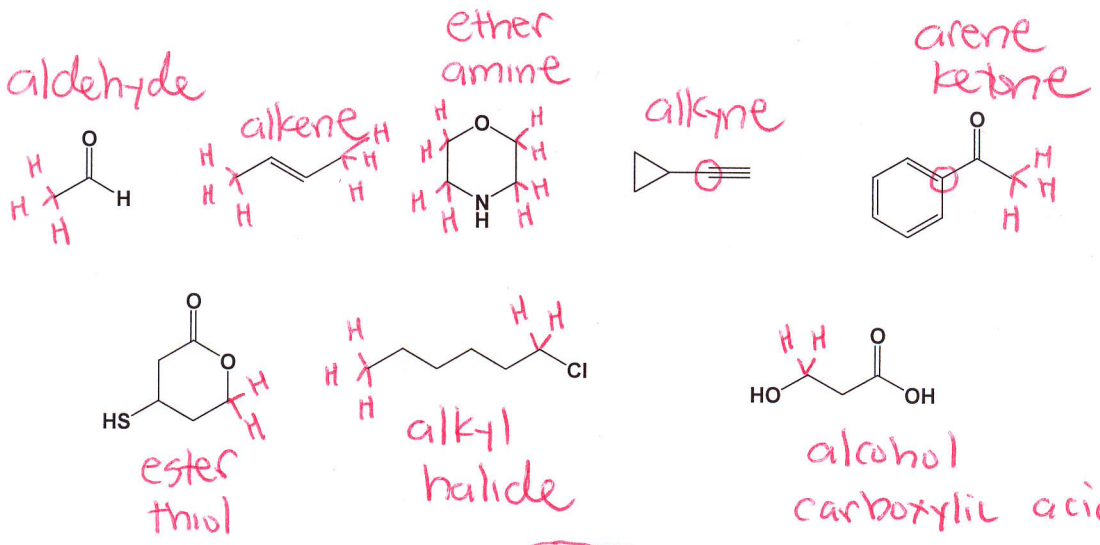
1. Provide the functional groups, excluding alkanes, present in each molecule:



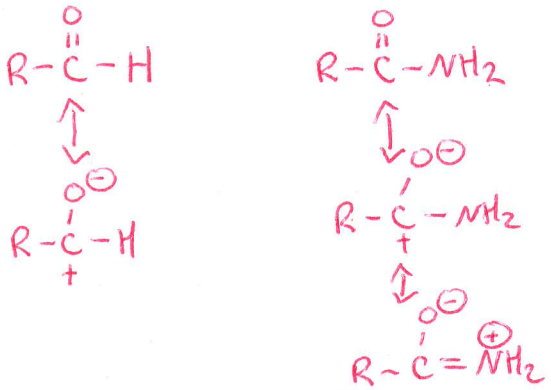
2. For the molecules in question 1, identify all 4° carbons and all 1° hydrogens. → drawn in above

for now: connect to 4 C ↘ on 1° carbon connect to 1 C

3. Consider the two functional groups, aldehyde and amide, to answer the following questions:

(a) Which do you think has a shorter C=O bond? Explain (hint, think resonance). Aldehyde

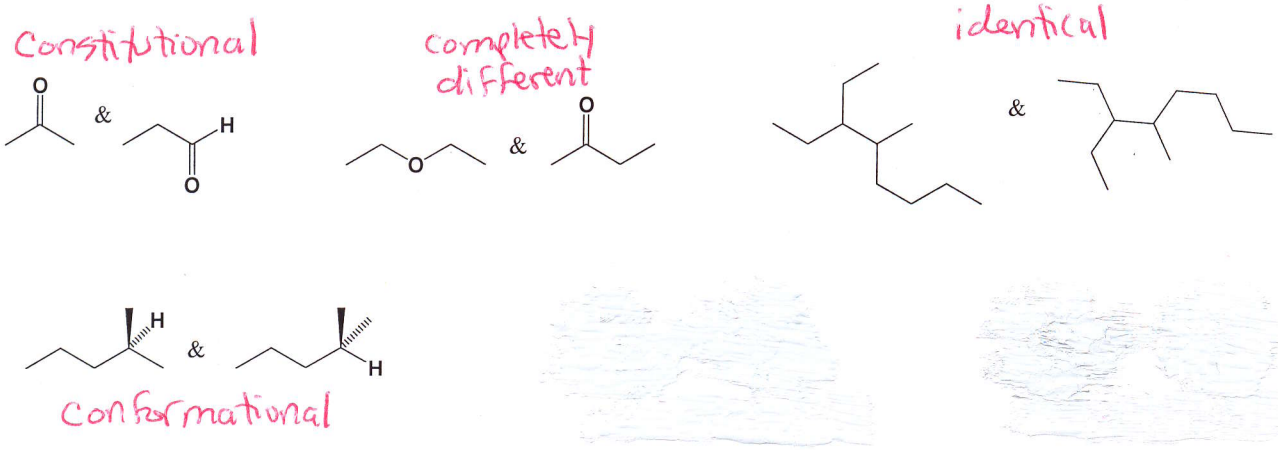
(b) Which do you think is a more reactive Lewis Acid? Explain. Aldehyde



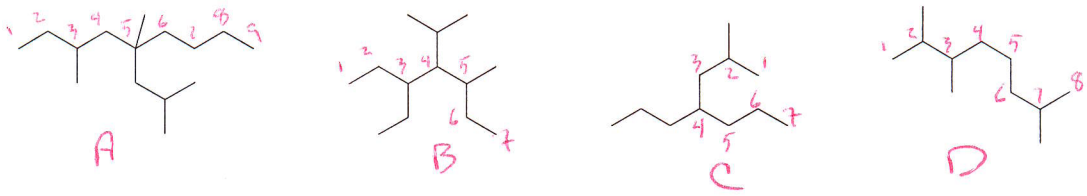
(a) Amides have significant resonance contribution from Nitrogen which weakens & lengthens C=O bond.

(b) Similarly, amides have donation from Nitrogen to carbonyl carbon making it a weaker Lewis Acid

4. Describe the relationship between the following pairs of molecules as identical, constitutional isomers, conformational isomers, or completely different compounds.



5. Provide the complete IUPAC name for each of the following compounds:



A = 5-isobutyl-3,5-dimethylnonane

B = 3-ethyl-4-isopropyl-5-methylheptane

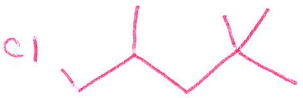
C = 2-methyl-4-propylheptane

D = 2,3,7-trimethyloctane

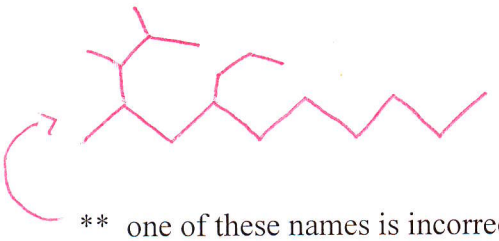
6. Draw the skeletal structure for each of the following compounds:

3,3-dimethylpentane

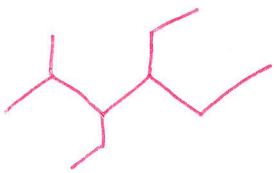
1-chloro-2,4,4-trimethylpentane



2-(1,2-dimethylpropyl)-4-propyldecane



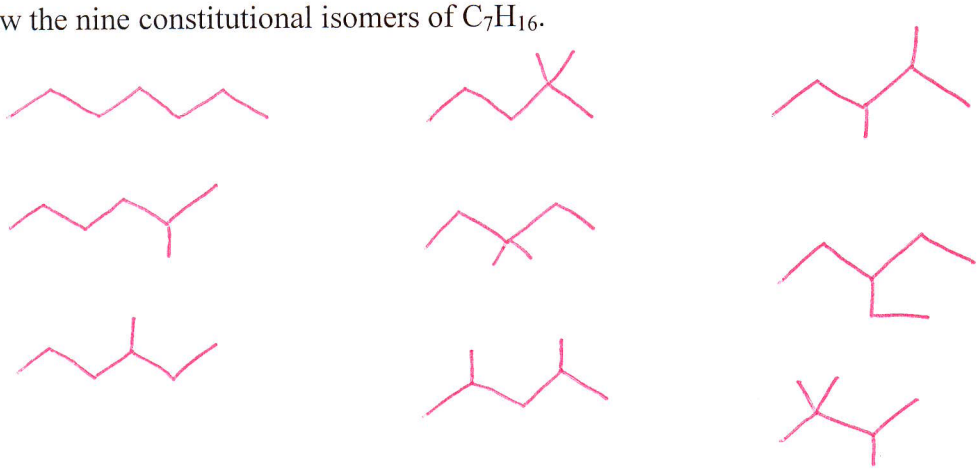
3,4-diethyl-2-methylhexane



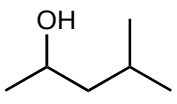
** one of these names is incorrect, which one is it?

longest chain = 12 not 10!

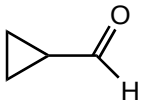
7. Draw the nine constitutional isomers of C_7H_{16}.



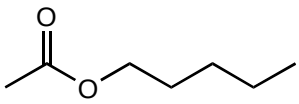
8. The following molecules only have a single functional group. Identify to which class of organic compounds each molecule belongs based on its functional group.



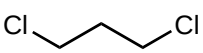
alcohol



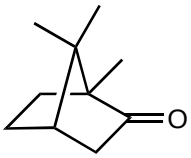
aldehyde



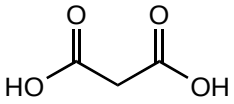
ester



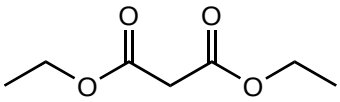
alkyl halide



ketone

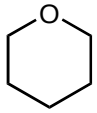


carboxylic acid



ester

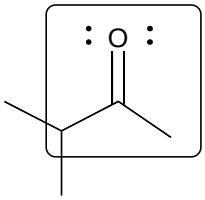
amine



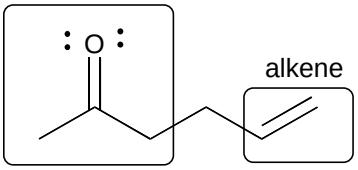
ether

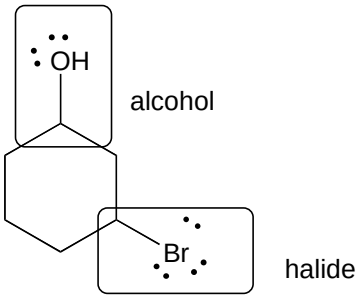
9. Label the functional groups in the molecules below. For each compound, fill in the assumed nonbonding electron pairs and the assumed hydrogens. All atoms are neutral unless a charge is shown. For additional practice, assign the hybridization/geometry for each atom.

ketone

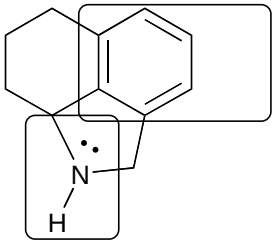


ketone

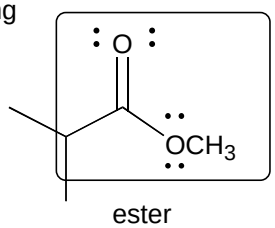




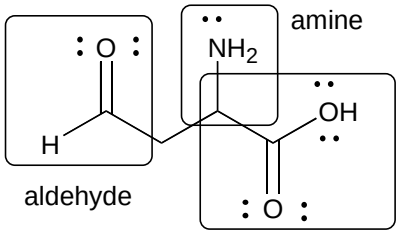
aromatic ring or arene ring



amine

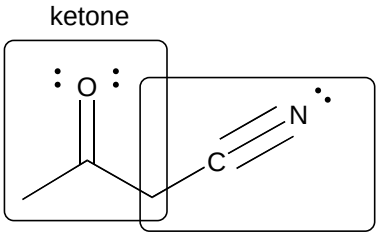


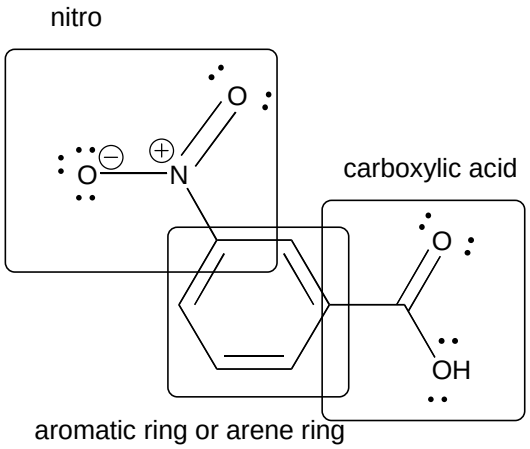
ester



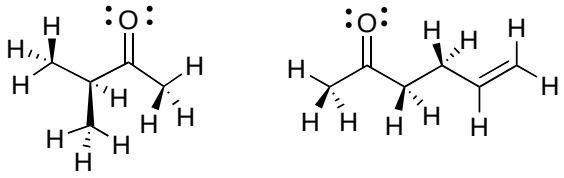
aldehyde

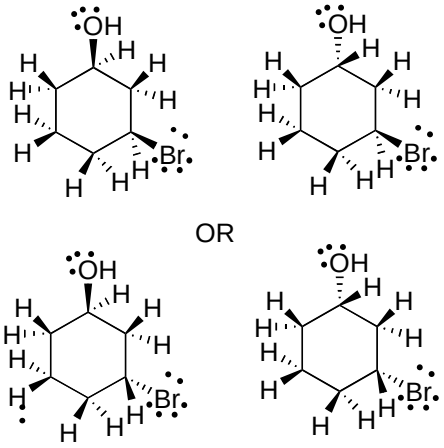
carboxylic acid

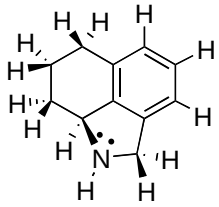




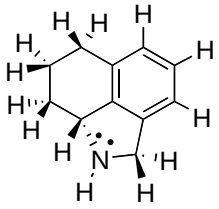
assumed hydrogens given with 3-D perspective



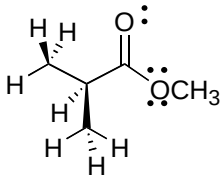


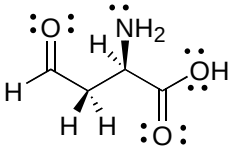


OR

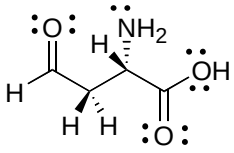


Stereoisomers

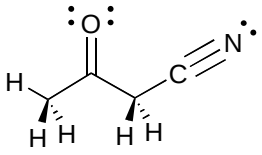


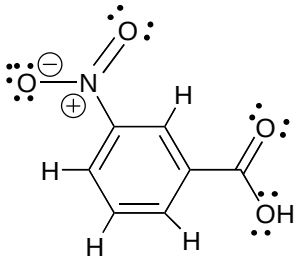


OR

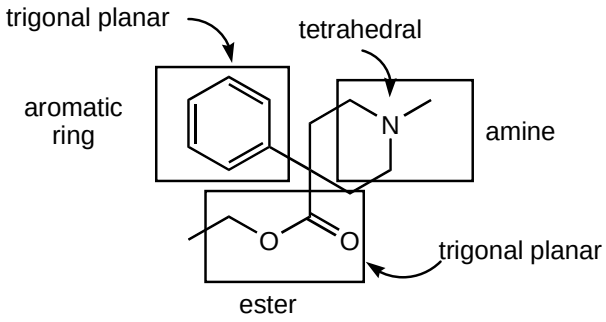


Stereoisomers



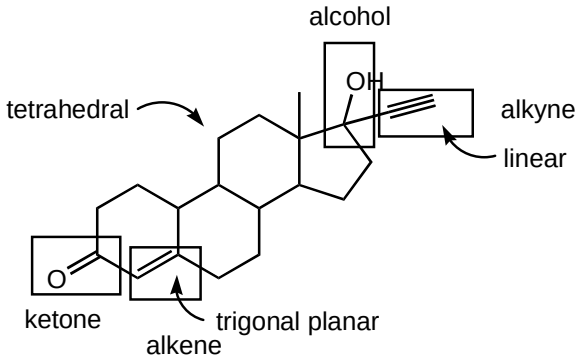


10. Below are shown two common pharmaceuticals: meperidine (Demerol), which is an analgesic (pain-killer), and norethindrone, a synthetic hormone used in birth control pills.
a. For each, circle and name any functional groups you can identify.
b. For each atom marked with an arrow, determine the local geometry.
c. Determine the molecular formula for each compound.



meperidine

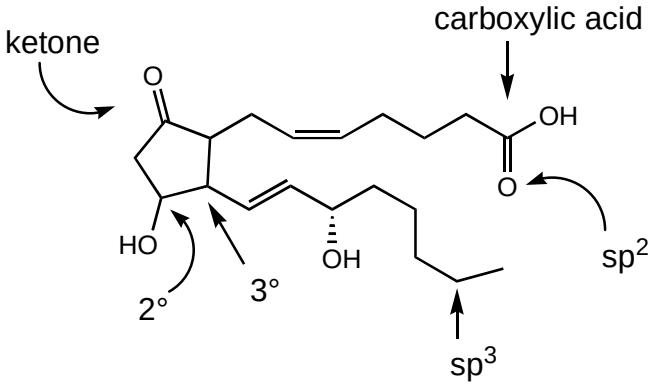
$C_{15}H_{21}NO_2$



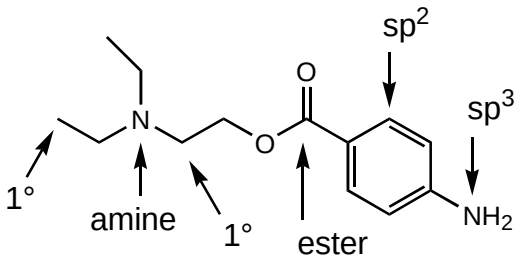
norethindrone

$C_{20}H_{26}O_2$

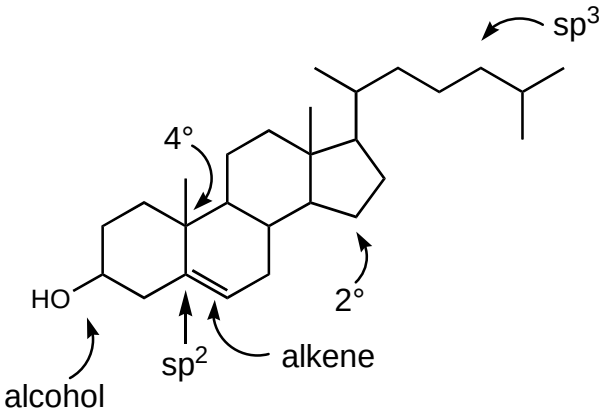
11. For the molecules below, give the information requested by the letter scheme.
a. name these functional groups.
b. give the degree of substitution for these carbons.
c. give the hybridization of these atoms.



Prostaglandin E_2

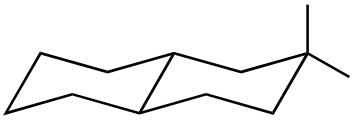


Novocain

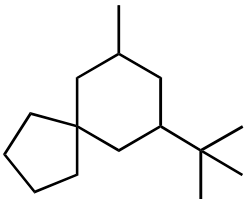


Cholesterol

12. For the molecules below, determine the number of 1°, 2°, 3°, and 4° substituted carbons.



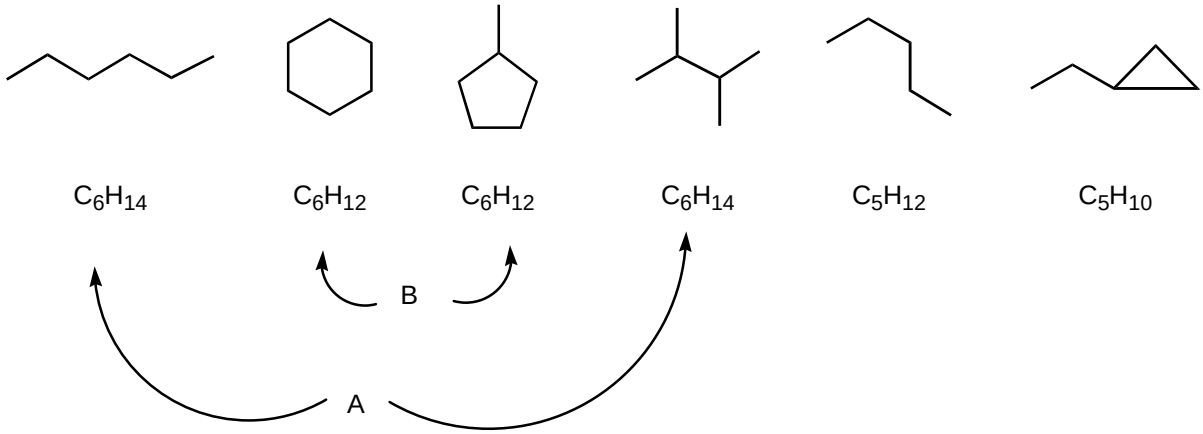
1° _2_ 2° _7_ 3° _2_ 4° _1_



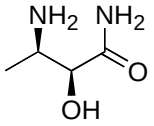
1° _4_ 2° _7_ 3° _2_ 4° _2_

13. For the following compounds below determine which are isomers of each other. What kind of isomers are they?

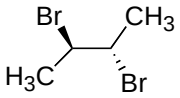
There are two sets of constitutional isomers, A and B.



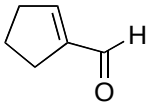
14. Label the functional groups in the molecules below.



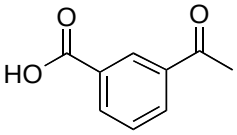
amine, alcohol, amide



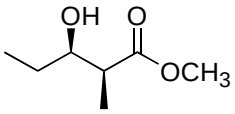
alkyl halide



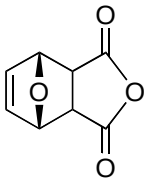
alkene, aldehyde



carboxylic acid, ketone
aromatic ring/arene ring



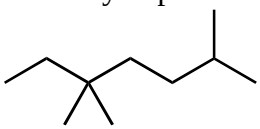
alcohol, ester



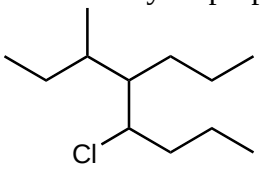
alkene, ether, anhydride

15. Name the following compounds using IUPAC nomenclature.

a. 2,5,5-trimethylheptane

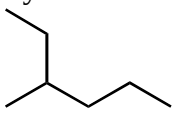


b. 5-chloro-3-methyl-4-propyloctane

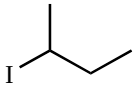


16. Name the following compounds using IUPAC nomenclature.

a. 3-methylhexane

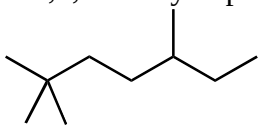


b. 2-iodobutane



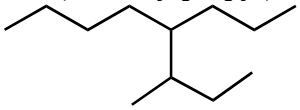
17. The names given for the following structures are wrong. Specify the errors in naming, and give the correct names.

a. 2,2,5-methylheptane



correct name: 2,2,5-trimethyl-heptane; tri was missing

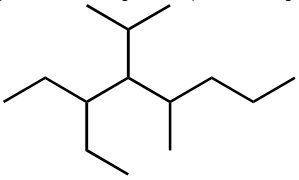
b. 5-(1-methylpropyl)octane



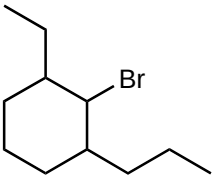
correct name: 3-methyl-4-propyloctane; parent is chosen to maximize branching/substituents, and numbering is chosen to give lowest numbers

18. Draw the skeletal (line/angle) formulas for the following.

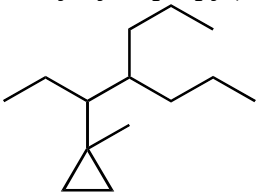
a. 3-ethyl-5-methyl-4-(1-methylethyl)octane



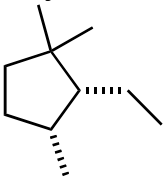
b. 2-bromo-1-ethyl-3-propylcyclohexane



c. 3-(1-methylcyclopropyl)-4-propylheptane

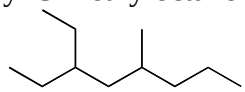


d. *cis*-2-ethyl-1,1,3-trimethylcyclopentane

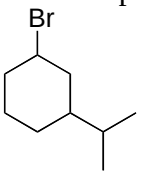


19. Draw the skeletal(line/angle) formulas for the following.

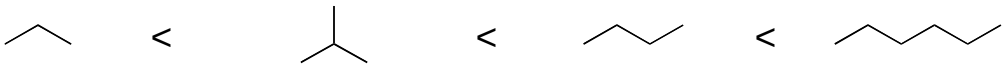
a. 3-ethyl-5-methyloctane



b. 1-bromo-3-isopropylcyclohexane



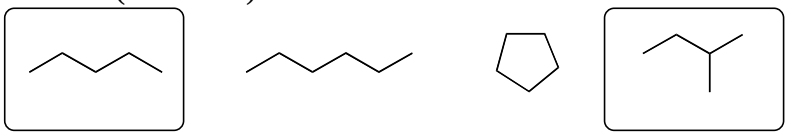
20. Rank the following compounds from lowest boiling point to highest boiling point. Justify your answers with brief explanations.



First trend: the larger the molecule (higher molecular weight), the higher the boiling point. Second trend, for 2-methylpropane vs butane (which are isomers): isomers that are more spherical have lower boiling points since they have weaker attractive forces between the molecules. The strength of dispersion forces between molecules depends on how much surface area is available where they collide; spherical molecules have less surface area for these weak attractive forces.

21. For each set, identify which compounds are isomers, and indicate what type of isomers they are.

a. constitutional (structural) isomers



b. constitutional (structural) isomers