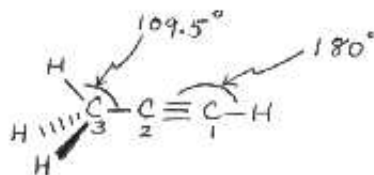


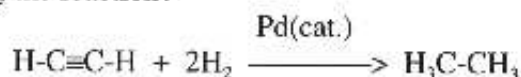
1. (10 points) Circle ALL the **correct** statements:



(i) In propyne, $\overset{3}{\text{H}_3\text{C}}-\overset{2}{\text{C}}\equiv\overset{1}{\text{C}}\text{H}$,

- A. the H-C-C bond angle involving carbon atoms 2 and 3 is 180° .
- B. the hybridization of carbon atoms 1, 2, and 3 are sp , sp , and sp^3 , respectively.
- C. there are three pi (π) bonds.
- D. The hydrogen atom on carbon 1 is acidic.

(ii) The reaction of acetylene with $\text{H}_2(g)$ is shown below. Which statement(s) is (are) true concerning the reaction?


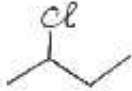

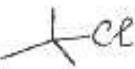


- A. Acetylene is oxidized to ethane.
- B. Acetylene is reduced to ethane.
- C. Carbon changes oxidation state from -1 to -3.
- D. Hydrogen (from H_2) changes oxidation state from 0 to +1.

2. (10 points) When the weak acids H-OCN (cyanic acid) and H-NCO (isocyanic acid) ionize in aqueous solution, they produce the same anion. Write the Lewis dot structure for the anion formed, including a resonance form of this anion. You may use a line for each bonding pair of electrons, but show lone pairs and formal charges clearly.

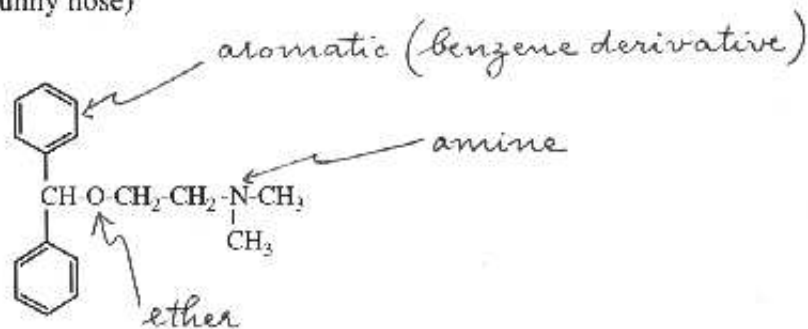


3. (10 points) Write structural formulas for all the constitutionally isomeric alkyl halides with the molecular formula C_4H_9Cl . Name each isomer according to **substitutive IUPAC nomenclature**.

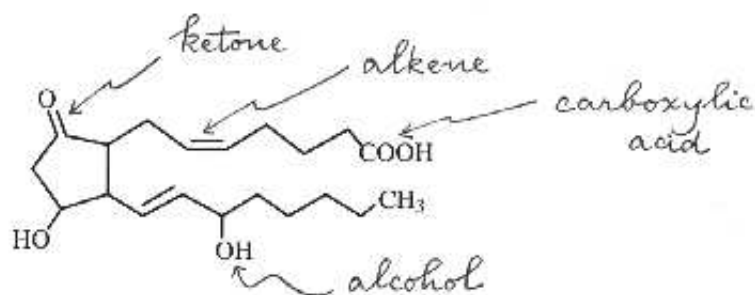
| <u>Structure</u> | <u>IUPAC name (Substitutive nomenclature)</u> |
|---|---|
|  | 1-chlorobutane |
|  | 2-chlorobutane |
|  | 1-chloro-2-methylpropane |
|  | 2-chloro-2-methylpropane |

4. (7 points) Name the functional groups (excluding alkyl groups) in the molecules shown below:

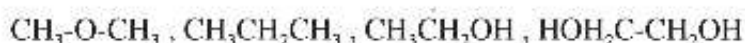
Diphenylhydramine (an antihistamine which relieves the symptoms of allergies: sneezing, itchy eyes, and runny nose)



Prostaglandin PGE₂ (Prostaglandins act as mediators of hormone action. They regulate smooth muscle activity, blood flow, and secretion of various substances)



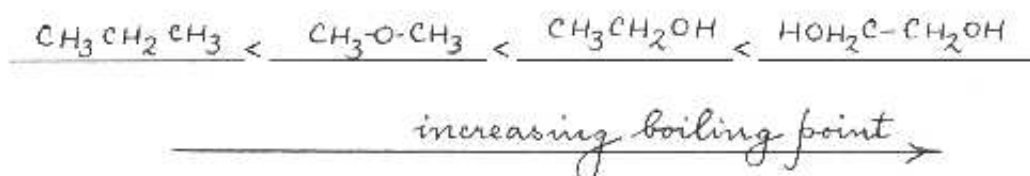
5. (8 points) Physical properties of organic molecules can be explained on the basis of their structures. Arrange the following compounds (**in the space provided below**) in order of **increasing** boiling point:



For each compound, list the major intermolecular forces of attraction.

| Compound | Major intermolecular forces of attraction |
|--------------------------------------|--|
| $\text{CH}_3\text{-O-CH}_3$ | dipole-dipole (van der Waals) |
| $\text{CH}_3\text{CH}_2\text{CH}_3$ | induced dipole-induced dipole or London (dispersion) forces, van der Waals |
| $\text{CH}_3\text{CH}_2\text{OH}$ | hydrogen bonding |
| $\text{HOH}_2\text{C-CH}_2\text{OH}$ | hydrogen bonding |

Ranking:

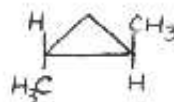
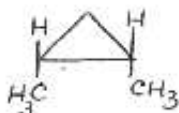
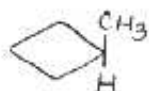


6. (10 points) Arrange the following compounds in order of **increasing** heat of combustion (kJ/mol)

methylcyclobutane, cyclopentane, cis-1,2-dimethylcyclopropane, and trans-1,2-dimethylcyclopropane

cyclopentane < methylcyclobutane < trans-1,2-dimethylcyclopropane < cis-1,2-dimethylcyclopropane

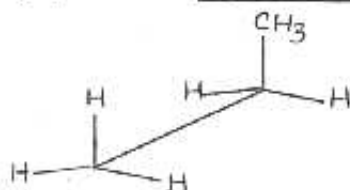
Draw correct structures for the compounds listed above.



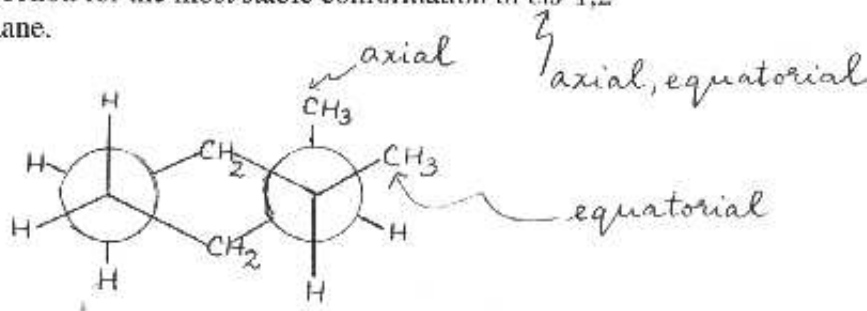
Methylcyclobutane Cyclopentane cis-1,2-Dimethylcyclopropane trans-1,2-Dimethylcyclopropane

7. (10 points) Draw the following projection formulas:

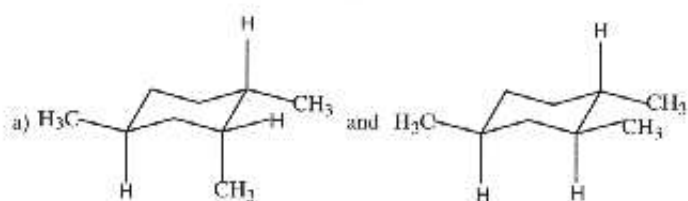
(A) Sawhorse drawing of propane in the least stable conformation. *eclipsed*



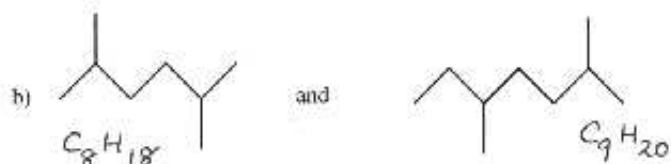
(B) The Newman projection for the most stable conformation of cis-1,2-dimethylcyclohexane.



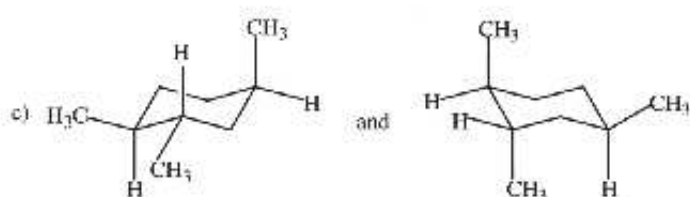
8 (15 points) For each of the following pairs of compounds, indicate whether they are constitutional isomers, stereoisomers, conformers (or rotamers), or different compounds with different compositions.



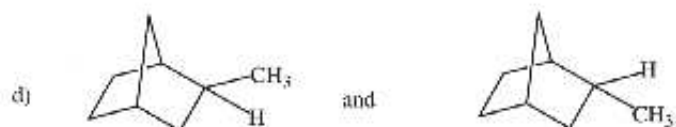
stereoisomers



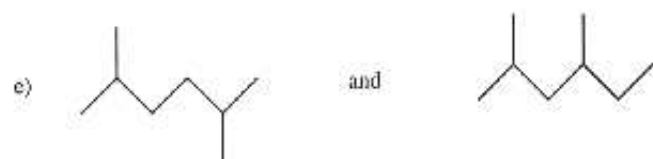
different compounds



conformers



stereoisomers



constitutional isomers

9. (20 points) Draw the Newman projections for each 60° conformation between 0° and 360° and sketch an appropriate potential energy diagram for rotations about the C2-C3 bond in 2,3-dimethylbutane. Start at 0° with the lowest energy conformation, and show the conformations (and place appropriately in energy diagram) as you rotate clockwise in increments of 60°.

