

PRACTICE EXAM #1

Chem21, Introduction to Organic and Biochemistry

Instructions: Don't panic. There are three (3) total pages for this exam. For every question, read all given directions and follow them completely. Clearly and logically show all your work and reasoning where applicable. Box all final answers.

1.) An aqueous solution has a $[\text{OH}^-] = 1.35 \times 10^{-6} \text{ M}$. Recall that $K_w = 1.0 \times 10^{-14}$. (16 pts)

a.) Calculate $[\text{H}_3\text{O}^+]$, in M.

$$\frac{1.0 \times 10^{-14}}{1.35 \times 10^{-6}} = 7.404 \times 10^{-9} \rightarrow \mathbf{7.41 \times 10^{-9} \text{ M}}$$

b.) Calculate the pH.

$$\text{pH} = -\log(7.41 \times 10^{-9}) = 8.1303 \rightarrow \mathbf{8.130}$$

c.) Is the above solution *acidic*, *neutral*, or *basic*?

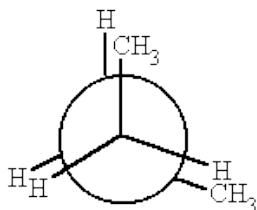
basic (pH > 7)

2.) Write the *balanced* equation for the combustion of liquid heptane. You may assume that all products formed are gases. (12 pts)



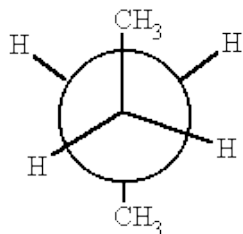
3.) Consider a molecule of normal butane, C_4H_{10} in a straight-chain. Draw the Newman projections down the bond between C_2 and C_3 . (22 pts)

a.) Show the *eclipsed* conformation for butane.



Eclipsed
Dihedral Angle = 120 degrees

b.) Show the *staggered* conformation for butane.



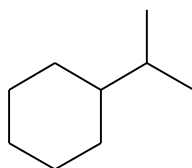
Anti (Staggered)
Dihedral Angle = 180 degrees

c.) Which of the above is *least* stable?

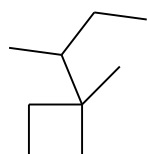
staggered

4.) Draw the line-angle structures for the following compounds. (27 pts)

a.) isopropylcyclohexane

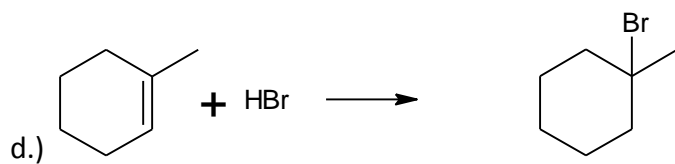
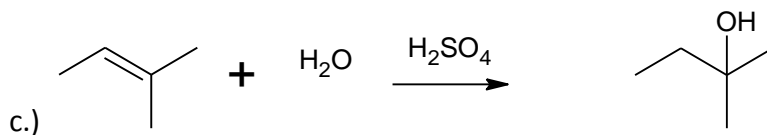
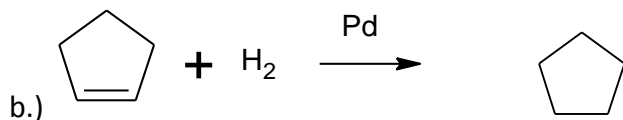
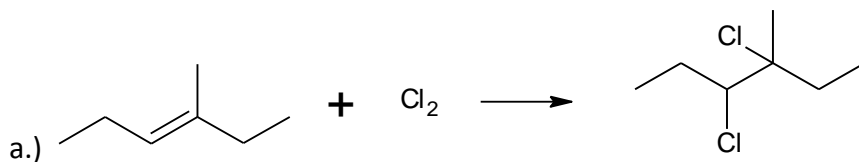


b.) 1-sec-butyl-1-methylcyclobutane



c.) Are the above compounds (a-b) *isomers* or *different* compounds? isomers

5.) Give the *structures* for the products formed from the reactions listed. (40 pts, 10 pts ea)



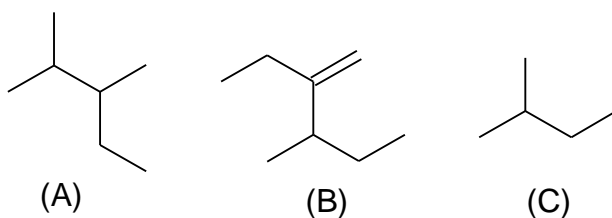
6.) Explain why alkanes exhibit conformational isomerization, but cycloalkanes and alkenes have cis-trans isomerization (there is a DIFFERENT reason for each). (12 pts)

Alkanes have **only single bonds**, which **rotate freely** at room temperature.

Cycloalkanes have **ring structures** that do not allow their single bonds to rotate.

Alkenes have a **double (pi) bond** above and below the single bond axis which do not allow it to rotate.

7.) Consider the following molecules. (24 pts)



a.) Give the correct IUPAC names for each structure.

(A) 2,3-dimethylpentane

(B) 2-ethyl-3-methyl-1-pentene

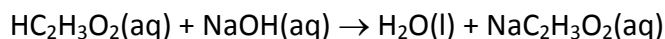
(C) 2-methylbutane

b.) Which of the above structures (A-C) are *nonpolar*? (A), (B), (C)

c.) Which of the above structures (A-C) do you expect to have the *lowest* boiling point? Explain, including what intermolecular forces are present in each.

(C). Since all are nonpolar, they only have **dispersion forces** present. Since 2-methylbutane has the **lowest molecular weight**, it has the weakest dispersion forces, making it boil at a lower temperature than the other two.

8.) Consider the following reaction. (12 pts)



a.) Identify the *Arrhenius base*. NaOH

b.) Identify the *conjugate base*. NaC₂H₃O₂

c.) Identify the *Brønsted-Lowry acid*. HC₂H₃O₂

d.) Identify the *conjugate acid*. H₂O