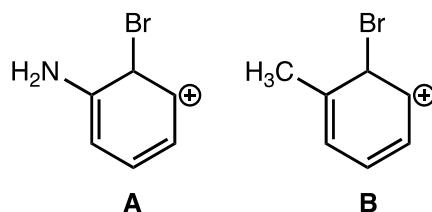


CHEM 2311 Final Review Worksheet

I. Multiple-choice Questions

- Which of the following compounds is the weakest base?
 - CH_3CO_2^-
 - $\text{CH}_3\text{CH}_2\text{OH}$
 - NH_3
 - CH_3O^-
 - NH_2^-
- Which of the following functional groups is indicated by a strong and broad infrared absorption around 3300 cm^{-1} ?
 - Carbonyl
 - Alkene
 - Alkane
 - Alcohol
 - Amine
- A particular signal within a ^1H NMR spectrum has the shape of a quartet. How many equivalent (or nearly equivalent) protons are within coupling distance of the protons corresponding to this signal?
 - 1
 - 2
 - 3
 - 4
 - Additional information is required to answer this question.
- What type of information is provided by a ^{13}C DEPT experiment?
 - Information about which protons are connected to which carbons
 - The number of hydrogens linked to each carbon
 - The electron density at or near each carbon
 - The connectivity of the carbon skeleton of the molecule
 - The hybridization of each carbon
- Two molecular ion peaks of nearly equal height separated by two m/z units in a mass spectrum is indicative of which of the following elements?
 - Silicon
 - Nitrogen
 - Bromine
 - Boron
 - Chlorine

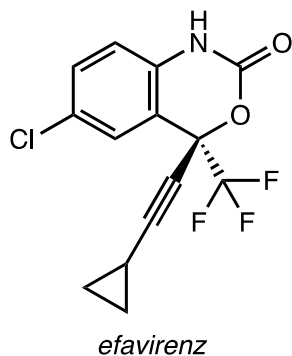
6. Which stability factor best accounts for the greater stability of **A** relative to **B**?



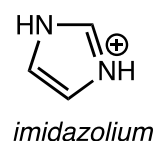
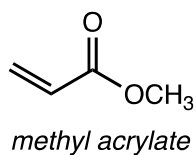
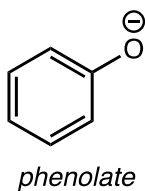
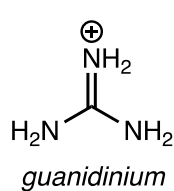
- Electronegativity of the charge-bearing atoms
 - Resonance delocalization
 - Hybridization
 - Inductive effects
 - Steric effects
7. Which of the following electrophiles cannot react (i.e., reacts extremely slowly) with a nucleophile by an $\text{S}_{\text{N}}2$ mechanism?
- CH_3Br
 - $\text{CH}_3\text{CH}_2\text{Br}$
 - Br_2
 - $(\text{CH}_3)_3\text{CBr}$
 - $(\text{CH}_3)_2\text{CHBr}$
8. Which of the following groups directs electrophilic aromatic substitution to the *ortho* and *para* positions exclusively?
- $-\text{NO}_2$
 - $-\text{SO}_3\text{H}$
 - $-\text{CN}$
 - $-\text{OCH}_3$
 - $-\text{CO}_2\text{CH}_3$
9. Which of the following reaction conditions produces a *trans* alkene from an alkyne?
- $\text{Li}, \text{NH}_3(l)$
 - H_2, Pt
 - $\text{H}_2, \text{Lindlar catalyst}$
 - $\text{H}_3\text{O}^+ (\text{cat.}), \text{H}_2\text{O}$
 1. BH_3 ; 2. $\text{NaOH}, \text{H}_2\text{O}_2$
10. Which of the following best describes the structure of the key Lewis acid in electrophilic substitution of benzene using HNO_3 and H_2SO_4 ?
- HNO_3
 - Benzene
 - NO_2^+
 - H_2SO_4
 - NO^+

II. Short-answer Questions

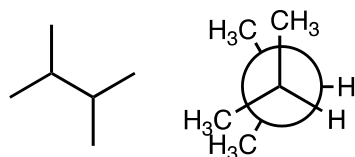
1. Draw a Lewis structure for efavirenz that includes all implied hydrogen atoms and lone pairs. Then, identify the hybridization and geometry of each atom in efavirenz.



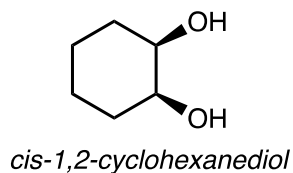
2. Draw important alternative resonance forms of the molecules below.



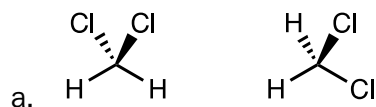
3. Draw a conformation versus potential energy diagram for 2,3-dimethylbutane, using the Newman projection below as a reference for the 0° dihedral point. Recall that in these diagrams, energy is plotted on the y-axis and dihedral angle on the x-axis.

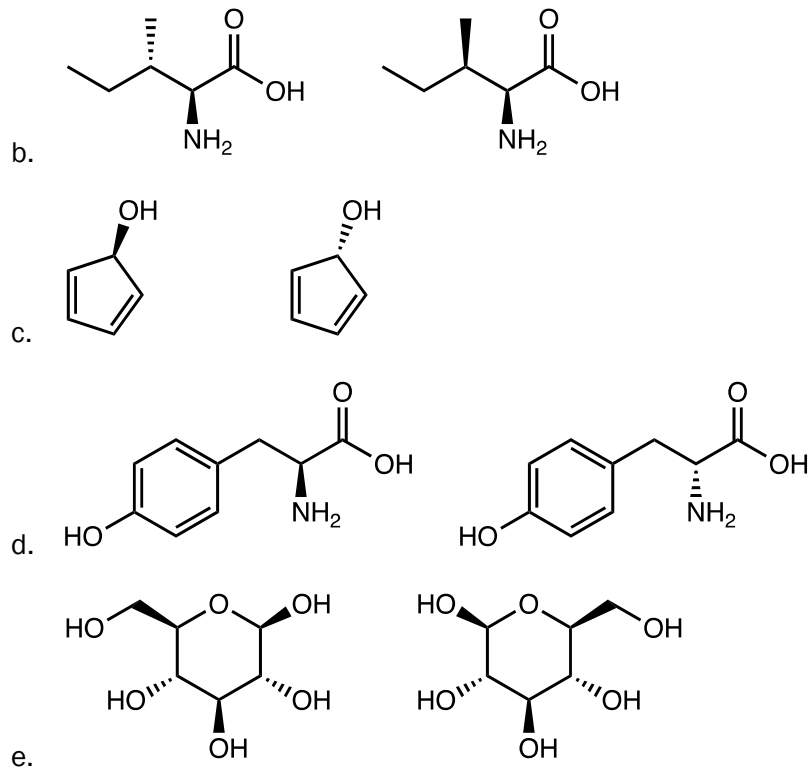


4. Draw the most stable chair conformer of cis-1,2-cyclohexanediol.

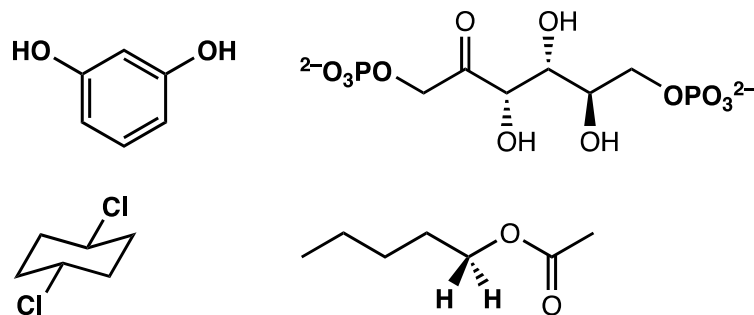


5. Identify the stereoisomeric relationship between each pair of molecules below.





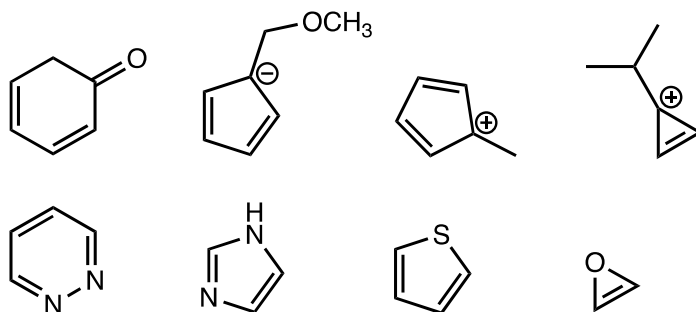
6. Identify the stereotopic relationship between the highlighted groups within each molecule.



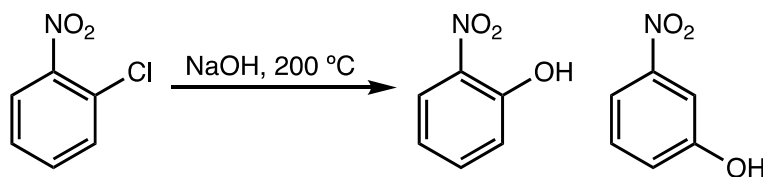
7. Propose structures consistent with the sets of data below. Consult correlation charts for infrared and NMR spectroscopy.

a. $C_9H_{10}O$	1H NMR Spectrum singlet δ 2.0 (3H) singlet δ 3.75 (2H) singlet δ 7.2 (5H)	Infrared Spectrum (Key Peaks) 3100, 3000, 1720, 740, 700 cm^{-1}
b. $C_5H_7NO_2$	1H NMR Spectrum triplet δ 1.2 (3H) singlet δ 3.5 (2H) quartet δ 4.2 (2H) This molecule contains a nitro ($-NO_2$) group.	Infrared Spectrum (Key Peaks) 2980, 2260, 1750 cm^{-1}

8. Using a pK_a table such as the one we have been referring to throughout the course, select two acids and write an acid-base equilibrium involving these species for which the *reactants* are favored. Explain why the reactants are favored using one of the five stability factors.
9. Using a pK_a table such as the one we have been referring to throughout the course, select two *different* acids and write an acid-base equilibrium involving these species for which the *products* are favored. Explain why the products are favored using one of the five stability factors.
10. Draw the structure of an alkyl bromide that would be expected to engage in rearrangement when reacted with water in an S_N1 reaction.
11. Draw the structure of an alkene that would be expected to engage in rearrangement when reacted with hydrobromic acid.
12. Determine whether each of the molecules below is aromatic, antiaromatic, or nonaromatic.

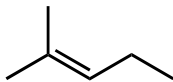


13. In the reaction below, a mixture of the *ortho* and *meta* products was obtained. Explain why by drawing the structure of a key intermediate in this reaction.



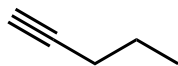
III. Write Reagents and/or Predict the Products

1. Write the reagents and draw the products for each of the following reaction types, starting from 2-methyl-2-pentene. Include stereochemistry where necessary.



2-methyl-2-pentene

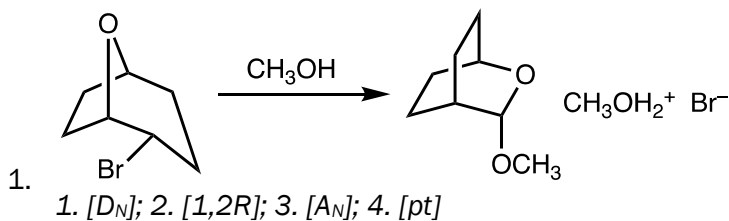
- Ionic hydrochlorination
 - Hydroboration-oxidation
 - Oxidative cleavage
 - Acid-catalyzed hydration
 - Oxymercuration-demercuration
 - Ozonolysis
 - Radical hydrobromination
 - Epoxydation
 - syn*-1,2-dihydroxylation
2. Write the reagents and draw the products for each of the following reaction types, starting from 1-pentyne. Include stereochemistry where necessary.

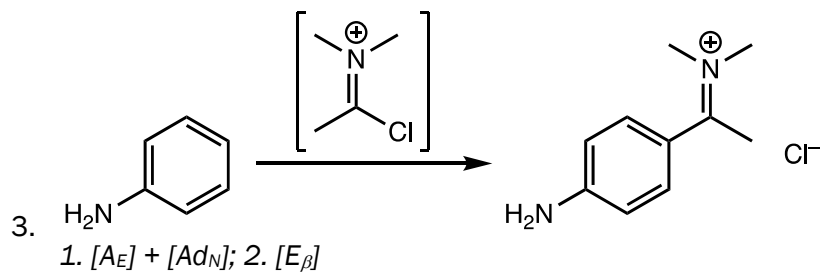
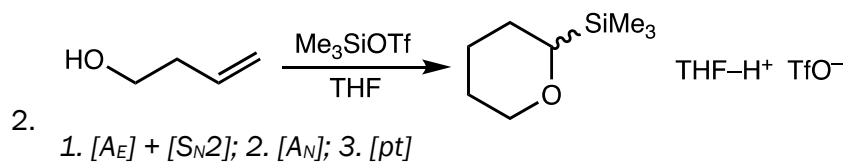


1-pentyne

- Deprotonation
- Ionic hydrochlorination
- Ionic hydrochlorination (2 equivalents)
- Hydroboration-oxidation
- Oxidative cleavage
- Acid-catalyzed hydration
- Oxymercuration-demercuration
- Ozonolysis
- Radical hydrobromination
- Radical hydrobromination (2 equivalents)

IV. Reaction Mechanisms





V. Multi-step Synthesis

