

OpenCourseWare (2023)

CHEMISTRY II

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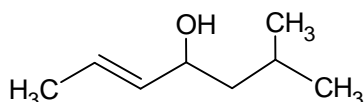
EXERCISES OF ORGANIC CHEMISTRY: INTRODUCTION



CHARACTERISTIC GROUPS AND NOMENCLATURE OF ORGANIC CHEMISTRY

Exercise 1. Arrange the following characteristic groups in decreasing order and write the formula for each group in order of decreasing seniority: acid halides, alcohols, aldehydes, amines, amides, carboxylic acids, carboxylates, esters, ketones, nitriles and thiols.

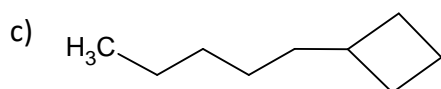
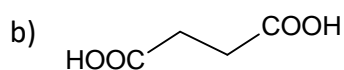
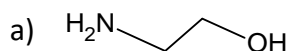
Exercise 2. Indicate the steps required for the formation of a systematic name. Use the following compound as an example:



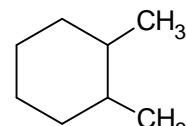
Exercise 3. Formulate the following organic compounds from the preferred IUPAC name (PIN).

- 7-(2,4-dimethylpentyl)-5-ethyltridecane
- 4-ethenylnonane
- pent-3-en-1-yne
- 1,2-dimethyl-3-propylbenzene
- 3-ethylpentan-2-ol
- benzene-1,2-diol
- 2-methylcyclohexan-1-amine
- N-ethyl-N-methylpropan-1-amine
- 1-bromo-2-(2-chloroethoxy)ethane
- prop-2-enoic acid
- 2-hydroxypropanoic acid
- 4-aminobenzoic acid
- butan-2-one
- 3-methylbutanal

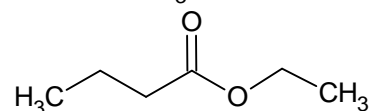
Exercise 4. Give IUPAC names for the following compounds:



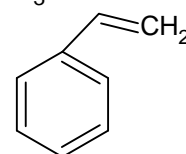
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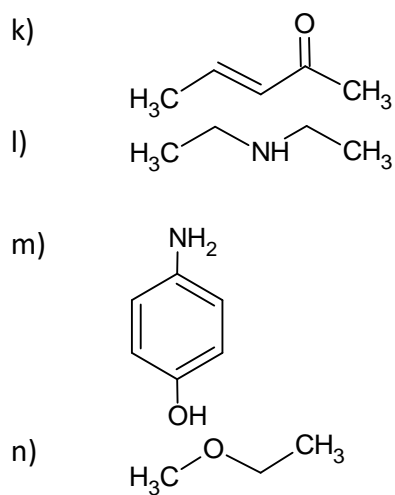
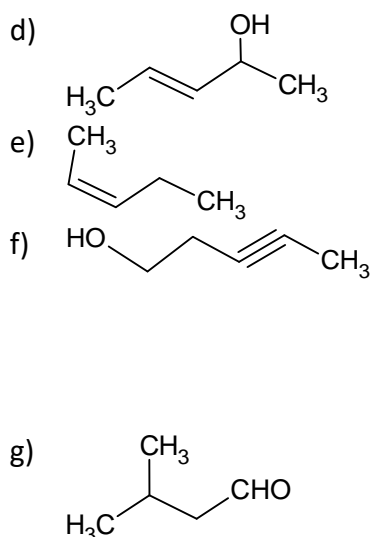


i)



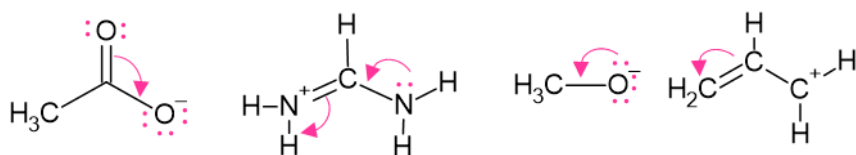
j)





PROPERTIES, STRUCTURE AND REACTIVITY

Exercise 5. Consider the following molecules. Evaluate whether the arrow pushing in each structure leads to an acceptable resonance form. If so, draw it and explain your answer.



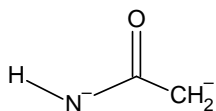
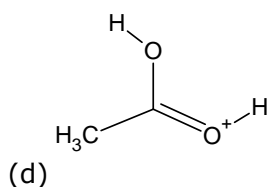
Exercise 6. Arrange in order of acidity the following compound: acetic acid, acetone, phenol, acetaldehyde, ethanol, ethyl acetate, 2,4-pentanedione, trifluoroacetic acid.

Exercise 7. Tell how many hydrogens are bonded to each carbon in the following compounds and give the molecular formula of each substance: a) adrenalin; b) estrone; c) tryptophan; d) serotonin; e) melatonin.

Exercise 8. For the molecules from the previous exercise, how many sp^3 and sp^2 -hybridized carbons does each molecule have?

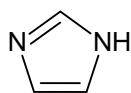
Exercise 9. Draw octet resonance forms for the following molecules. Indicate the strongest resonance contributor (if any) in each case.

- CNO^-
- NO^-
-

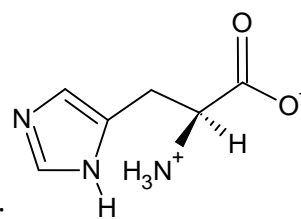


Exercise 10. Imidazole forms part of the structure of the amino acid histidine and can act as both an acid and a base. Draw structures for the resonance forms of the products that result when imidazole is protonated by an acid and deprotonated by a base.

Imidazole:

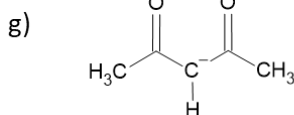
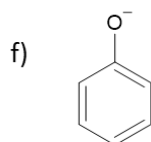
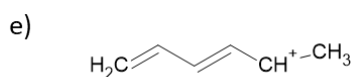
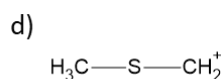
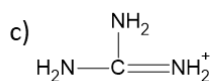
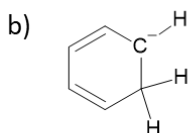
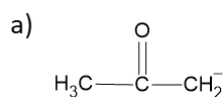


Histidine:



Hint: The most basic nitrogen atom is the N which forms part of the double bond. The most acidic hydrogen atom is the H bonds to N.

Exercise 11. Draw as many resonance structures as you can for the following species:

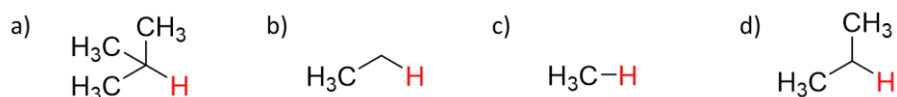


Exercise 12. Based on its structure, arrange in increasing order of acidity each series

a) acetic acid, fluoroacetic acid, difluoroacetic acid, and trifluoroacetic acid.

b) butanoic acid, 4-chlorobutanoic acid, 3-chlorobutanoic acid, and 2-chlorobutanoic acid.

Exercise 13. Explain which of follow C-H bond is the weakest:

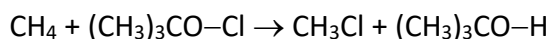


Exercise 14. Order the following series in increasing order of acidity, explaining the response, and when necessary, draw the resonant structures.

- a) methanol, acetic acid (CH_3COOH), and chloroacetic acid (ClCH_2COOH)
 b) methanol, ethanol, isopropanol ($(\text{CH}_3)_2\text{CHOH}$), and tert-butanol ($(\text{CH}_3)_3\text{COH}$)
 c) ethanol and phenol ($\text{C}_6\text{H}_5\text{OH}$).

Exercise 15. Indicate, based on the corresponding resonant forms, how the functional group (electron-donor or electron-acceptor of charge) affects the hydrocarbon structures: a) nitrobenzene; b) phenol; c) aniline; d) toluene.

Exercise 16. An alternative to chlorine in radical halogenations of methane is tert-butyl hypochlorite, $(\text{CH}_3)_3\text{COCl}$:



- (a) Using the bond-dissociation energies provided, calculate the ΔH^0 value for the reaction.
 (b) The reaction is initiated by the photolytic cleavage of the O–Cl bond. Formulate the two propagation steps of the radical chain leading to the products.

Data: Bond-dissociation energies ($\Delta H^0/\text{Kcal mol}^{-1}$): (O–Cl) = 55; (O–H) = 118; (CH_3-H) = 105; (CH_3-Cl) = 85.

IMAGE CREDITS

- Images of all exercises were made by authors.