

CHE 2060: Module 1 practice problems

Review of essential prior knowledge

These first topics are covered in Melissa Maribel's **three videos** covering a general chemistry review to prep for organic chemistry. Have a look:

<https://www.youtube.com/watch?v=6AckfZFaU7s&t=32s>

Valence electrons and electron configuration

1. The electron configuration of a carbon atom is $1s^2 2s^2 2p^2$, or $\text{He}[2s^2 2p^2]$ and that of a sodium cation (Na^{+1}) is $1s^2 2s^2 2p^6$. Show the electron configuration for:
 - (a) a nitrogen atom
 - (b) an oxygen atom
 - (c) a fluorine atom
 - (d) a magnesium atom
 - (e) a magnesium cation (Mg^{+2})

Ionic vs. covalent bonds

2. Compare and contrast how ionic bonds form vs. how covalent bonds form. Your explanation should encapsulate the essential differences between ionic and covalent bonds. Feel free to use diagrams.
3. How can you differentiate between ionic, polar covalent and nonpolar covalent compounds? What would you have to know?

Lewis structures and formal charges

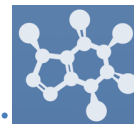
4. Draw Lewis structures for the following species (use lines to denote bonds, dots for lone-pair electrons). All atoms should have a complete valence shell of electrons. For now, do not worry about showing accurate bond angles.
 - (a) ammonia, NH_3
 - (b) ammonium ion, NH_4^{+1}
 - (c) amide ion, NH_2^{-1}
 - (d) formaldehyde, HCOH
 - (e) acetate ion, CH_3COO
 - (f) methylamine, CH_3NH_2

Polarity and electronegativity

5. Use electronegativity values to assess the polarity of each bond in the structures you created for the previous problem.
 - (a) Circle the most polar bond.
 - (b) Add polarity arrows to your structures to show the direction of electron pull in each bond.

VSPER and molecular geometry (3D structure)

No worries, we'll cover this in Module 2!



Formal charge and resonance (delocalization of electrons and charge)

6. These molecules have resonance. For each, draw all resonance structures (including formal charges) and the resonance hybrid.

- (a) NO_3^{-1}
- (b) O_3
- (c) HSO_4^{-1}

Orbital hybridization

No worries, we'll cover this in Module 2!

1.1A, B, C: Formal charges, bonding patterns, Lewis and line-bond structures

7. Draw Lewis or **line-bond structures** of these molecular formulas.

- (a) C_2H_6
- (b) C_2H_4
- (c) C_2H_2
- (d) CH_3OH
- (e) CH_2O

8. Draw Lewis or **line-bond structures** of these molecular formulas.

- (a) $\text{C}_3\text{H}_7\text{Br}$
- (b) $\text{C}_4\text{H}_{10}\text{O}$
- (c) $\text{C}_3\text{H}_6\text{F}_2$

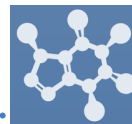
9. Draw Lewis or **line-bond structures** of these molecular formulas.

- (a) CO_2
- (b) HCN
- (c) N_2
- (d) H_2S

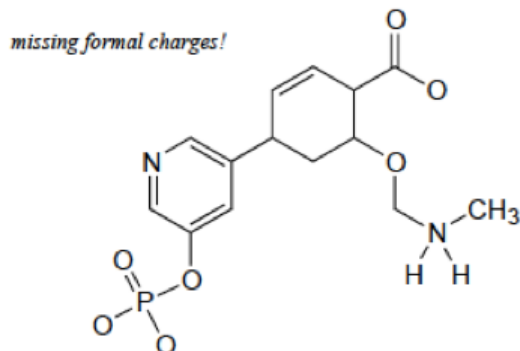
10. For each structure in the previous problem (a-d), assess the **polarity** of each bond and draw a **polarity arrow** for the most polar bond.

11. For each formula: (1) draw a Lewis or line-bond structure, and (2) calculate the formal charge on each atom.

- (a) CH_3^{+1}
- (b) NH_3BF_3
- (c) $:\text{CH}_3^{-1}$
- (d) $:\text{CH}_2$



12. This line-bond drawing isn't complete.
(a) Add missing lone pairs.
(b) Calculate and show formal charges.



1.1D. Constitutional (aka structural) isomers

13. Draw all structural isomers of C₆H₁₄.

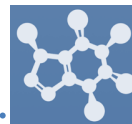
1.2A: Functional groups

Suggestion: Create a set of functional group flash cards with the name of the functional group on one side and the structure, with polarity arrows and formal charges, on the other side.

To make it a bit easier use colored codes, or add colored dots, to mark cards with the atom that the functional group is based on: C only, O, N, S, P, etc.,.

1.2B: Naming organic compounds

14. Create line-bond drawings of these alkanes.
- 3-ethyl-3-methylhexane
 - 4-ethyl-2-methylhexane
 - 2,2-dimethylbutane
 - 2,2,3-trimethylbutane
 - 2,2,3,3-tetramethylbutane
15. Create line-bond drawings of these alkyl halides
- 2-chlorobutane
 - 2-bromo-2-methylpropane
 - n-fluorobutane
 - 1,2-diiodobutane
16. Create line-bond drawings of these cycloalkanes
- 1-methylcyclopropane
 - 1,1-dimethylcyclobutane
 - 1,3-dimethylcyclopentane
 - 1,1,2-trimethylcyclohexane
 - 1-ethyl-4-methylcycloheptane



17. Create line-bond drawings of these **alkenes**.

- (a) 2-pentene
- (b) 5-methyl-3-heptene
- (c) 4,4-dimethyl-2-hexene
- (d) 3-methylcyclohexene
- (e) 1,4-hexadiene
- (f) 1,3-cyclohexadiene

18. Create line-bond drawings of these **alkynes**.

- (a) 2-pentyne
- (b) 3-hexyne

19. Create line-bond drawings of these mixed **alkene / alkynes**.

- (a) 1-hexen-4-yne
- (b) 2-hepten-5-yne
- (c) 3-ethyl-2,4,4-trimethyl-2-octen-5-yne
- (d) 2,4,6-nonatriyne

1.2C: Abbreviated organic structures

20. Use the abbreviation 'R' to draw one complete structure that could represent **every amino acid**.