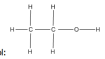
Ch. 9.3 Lewis structure

- apply to covalent molecules only
  - covalent molecules / compounds (cpd) = non-metal + non-metal
  - non-metal = right of "diagonal" in the periodic table
- can be used to determine a compound's structure / shape
  - value / importance: drug design
  - from bio: lock & key concept in enzyme-substrate interaction / binding
- like a molecule/cpd's structural formula

  shows which atom is connected to which atom in a molecule /cpd; e.g.

Structural Formula

A structural formula displays the atoms of the molecule in the order they are bonded. It also depicts how the atoms are bonded to one another, for example single, double, and triple covalent bond. Covalent bonds are shown using lines. The number of dashes indicate whether the bond is a single, double, or triple covalent bond. Structural formulas are helpful because they explain the properties and structure of the compound which empirical and molecular formulas cannot always represent.



Ex. Structural Formula for Ethanol:

Source: https://chem.libretexts.org/Courses/Purdue/Purdue%3A_Chem_26505%3A_Organic_Chemistry_I_(Lipton)/Chapter_1._Electronic_Structure_and_Chemical_Bonding/1.09_Representation_of_Molecular_Structure

1

review: periodic table & number of valence electrons in the s- & p- blocks

n = 1 2 3 4 5 6 7 8

2

"steps" in writing Lewis structures: for molecules with a single central atom

1. identify the central atom
   - the other atoms connect to it
   - usually the 1st atom (it's the least electronegative atom) in the chemical formula, except H
2. draw the structural formula
   - shows how other atoms connect to it
3. determine # of valence electrons in the molecule
4. account for charge (not always present)
5. account for bonds; recall: covalent bond = sharing electrons, there are two electrons for each bond
6. distribute electrons to outer atoms to satisfy the Octet rule
7. distribute remaining electrons to the central atom
8. Form multiple bonds as needed to satisfy the Octet rule

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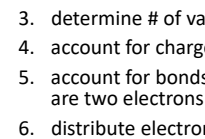
examples – 1 of 5

ex 1. CH_4

1. central atom = C
2. Sketch structural formula



3. # valence electrons = # atoms * $\frac{\#\ valence\ electrons}{atom}$

   C: 1 * 4 = 4

   H: 4 * 1 = 4

   total = 8
4. charge: 0
5. # bonds: - 8

   0

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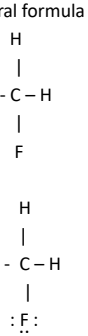
ex. 2 of 5: CH_3F

1. Central atom = C
2. Structural formula



3. # valence electrons
   - C: 1 * 4 = 4
   - H: 3 * 1 = 3
   - F: 1 * 7 = 7
   - total = 14
   - 4. charge: 0
   - 5. bonds: - 8
   - 6
   - 6. give to outer atoms: - 6
   - 0

5

ex. 3 of 5: H_2O

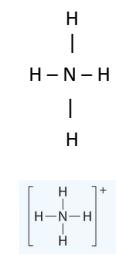
1. Central atom = O
2. Structural formula

3. # valence electrons
   - H: 2 * 1 = 2
   - O: 1 * 6 = 6
   - total = 8
   - 4. charge: 0
   - 5. bonds: - 4
   - 4
   - 6. give to outer atoms: 0
   - 7. give to central atom: - 4
   - 0

6

ex. 4 of 5: NH_4^+

1. Central atom = N
2. Structural formula



3. # valence electrons
   - N: 1 * 5 = 5
   - H: 4 * 1 = 4
   - total = 9
   - 4. charge: - 1
   - 5. bonds: - 8
   - 0

source: https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_Chemistry_-_The_Central_Science_(Brown_et_al.)/08._Basic_Concepts_of_Chemical_Bonding/8.5%3A_Drawing_Lewis_Structures

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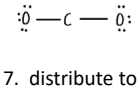
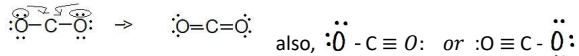
ex. 5 of 5: carbon dioxide = CO_2

1. Central atom = C
2. Structural formula



3. # valence electrons
   - C: 1 * 4 = 4
   - O: 2 * 6 = 12
   - total = 16
   - 4. charge: 0
   - 5. bonds: - 4
   - 12
   - 6. distribute to outer atoms: - 12
   - 7. distribute to central atom: none left 0
   - 8. form multiple bonds to satisfy Octet rule



also, - C ≡ *O*: *or* :O ≡ C -

source: https://geometryofmolecules.com/co2-lewis-structure/

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resonance structures: multiple valid Lewis structures

ex. CO_2

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