8/29/24

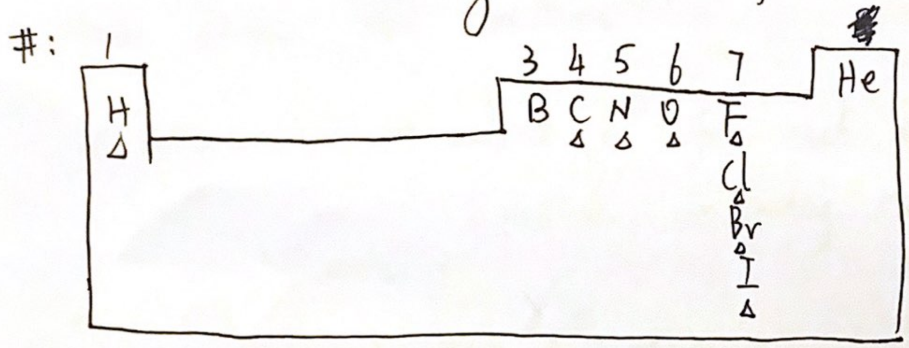
MTW

Topics: Lewis Dot Structures

Octet Rule

Formal Charge

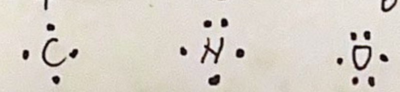
Drawing stuctures from condensed formula



Δ: These are the atoms that we care about in Ochem

(1~7): # of valence $e^{\ominus}$ that atom has in its neutral, non-bonding state.

ex: "4" "5" "6"



Lewis Dot structures ⟶ illustrate valence $e^{\ominus}$ and bonding in molecules.

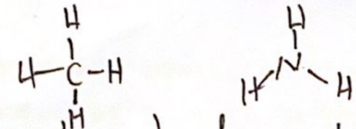
"illustration"

"representation"

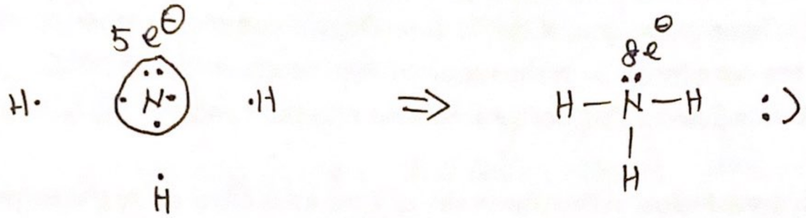
Symbol of elements (letters) surrounded by # of valence $e^{\ominus}$s.

Octet rule: Atom like to have filled valence shell.

For the atoms mentioned above, they react to reach <u>8</u> valence $e^{\ominus}$s. (except for H. He)



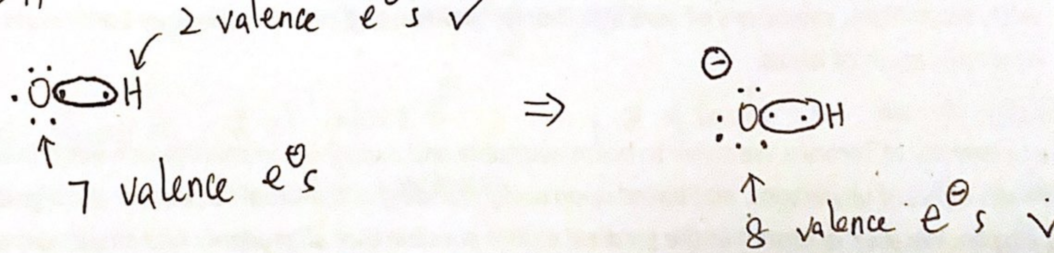
Covalent bond : atoms share $e^{\ominus}$s to fill their valence shells.



Make Lewis Dot structures :

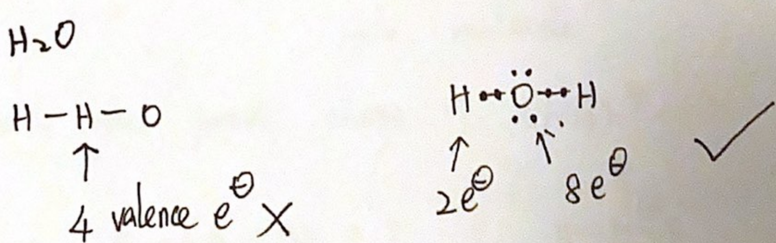
① Determine # of valence $e^{\ominus}$ for each atom. (neutral, non-bonding state)

ex: OH

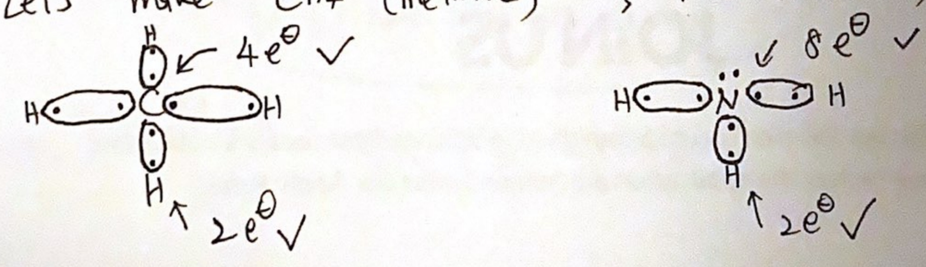


② Determine connectivity of atoms

ex: H_2O



Let's make CH_4 (methane) , NH_3 (Ammonia)



Formal charge: A book keeping tool for counting keeping track of the # of $e^{\ominus}$

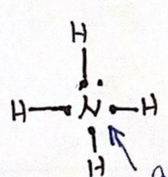
To calculate:

1. Draw the correct lewis dot structure
2. Assign each atom:
   - $1 e^{\ominus}$ from each covalent bond (line)
   - all unshared / non-bonding $e^{\ominus}$ (dots)
3. Compare this # with the # of valence $e^{\ominus}$ in neutral, non-bonding state.

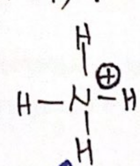
Formal charge = # of valence $e^{\ominus}$ in neutal, non-bonding state − (# of bonds + ~~# of unshared $e^{\ominus}$~~ # of lone pairs $e^{\ominus}$ in)

Overall molecular charge: the sum of all formal charges in the molecule.

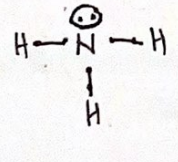
EX: what's the formal charge of (NH_4)?



$5-(4+0) = 1$

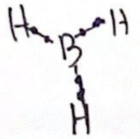


$9e^{\ominus}$s! have to give up $1 e^{\ominus}$

NH_3? 

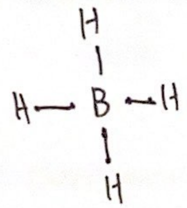
$5-(3+2) = 0$

BH_3 : $3 - (0 + 3) = 0$

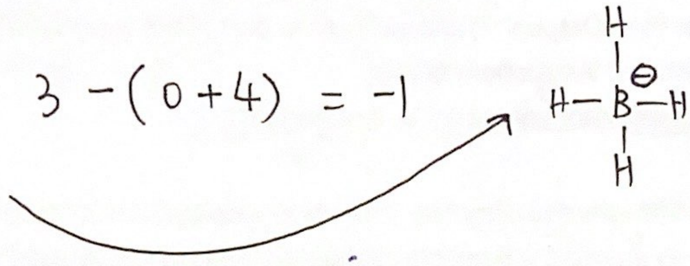


no Lp

BH_4 ?

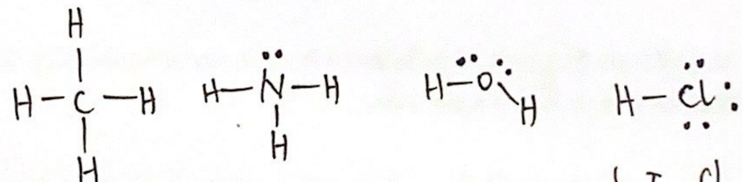


$3 - (0 + 4) = -1$



To make our lifes easier:

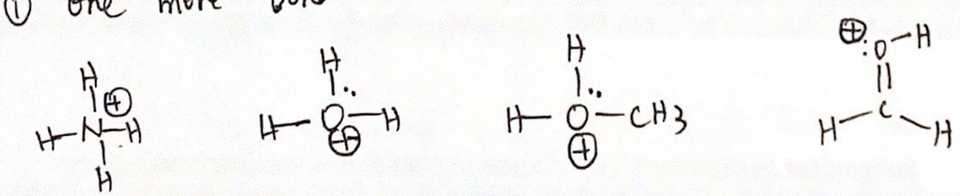
Memorize these as the neutral bonding patterns for C, N, O, X
X = (F, cl, Br, I)



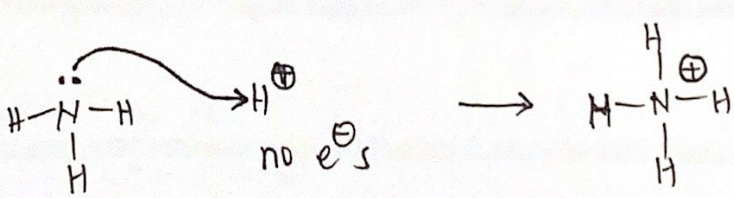
(F, Cl, Br, I)

For atoms with full octet:

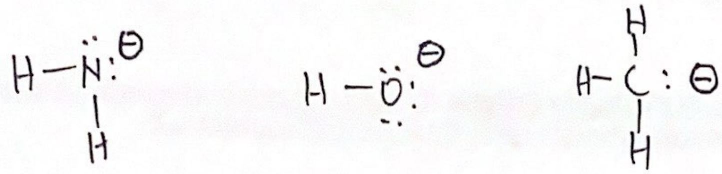
① one more bond than the neutral state => ⊕



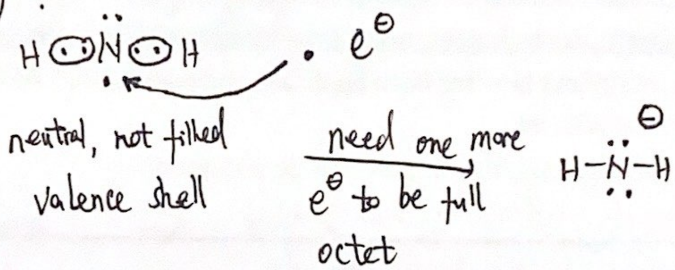
ex:



② 1 fewer bond than the neutral form ⇒ ⊖

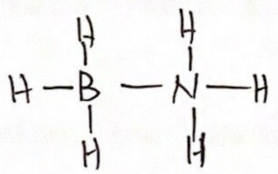


(what's drawn ~~here~~ below is not ~~correct~~ necessarily true, but I'd like to think in this way :



)

Assign formal charge below :



FC of B : $3-(0+4) = -1$

FC of N : $5-(0+4) = +1$

→ Lewis structures from condensed formula :

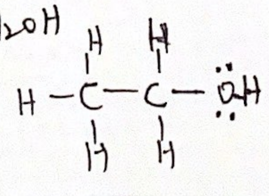
↳ $CH_3CHOHCH_3$

① Determine the bonding btw atoms

↳ read left to right

↳ keep in mind # of bonds / LPs for each atom to have a filled valence

ex : CH_3CH_2OH

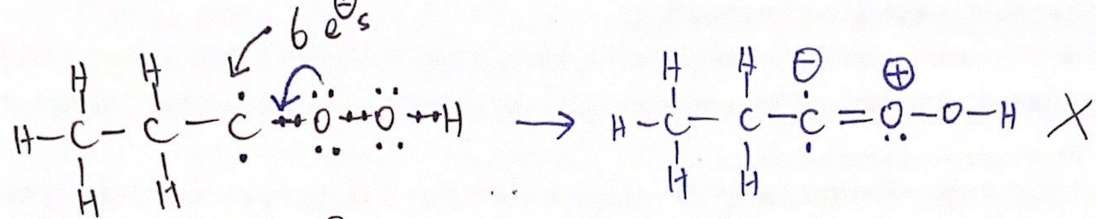


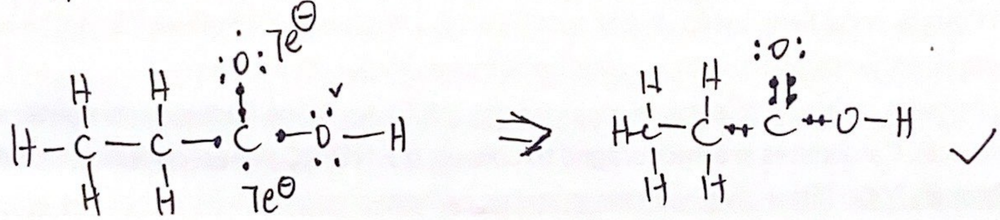
② Add bonds to eliminate unbonded $e^{\ominus}$s

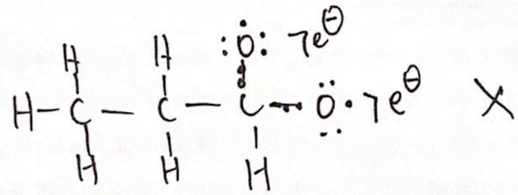
↳ Draw non-bonded $e^{\ominus}$s as LPs.

↳ Avoid charges when possible

ex1. CH_3CH_2COOH

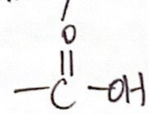






$-COOH$ or $-CO_2H$

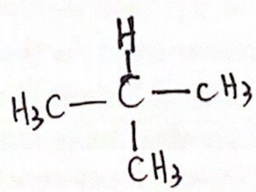
"carboxylic acid"



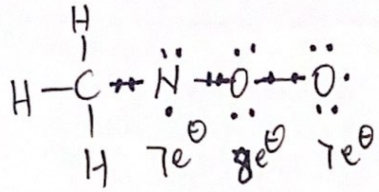
ex2. $(CH_3)_3CH$

↑

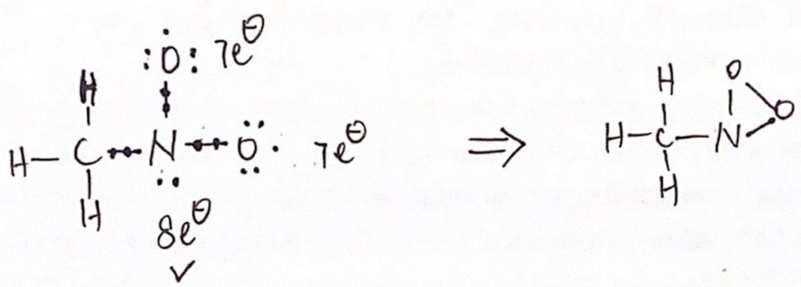
branches



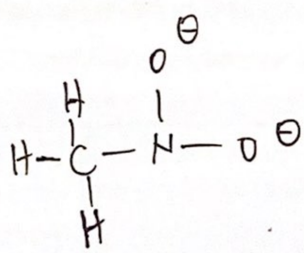
ex3: CH_3NO_2

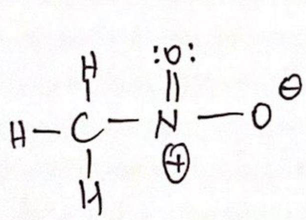


Bad!

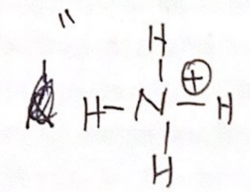


Bad!





Recall



ex4: CH_2CH_2