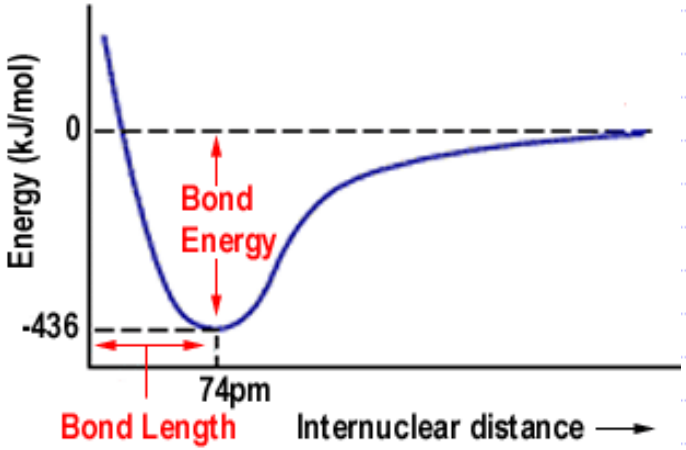
3.7 What Is a Covalent Bond and How Does One Form?

A The Pro's and Cons of Orbital Overlap



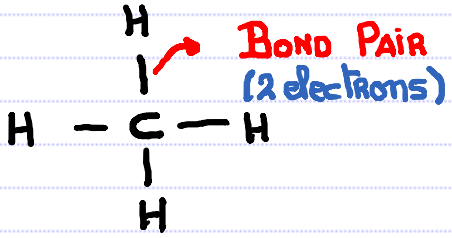
3.7 What Is a Covalent Bond and How Does One Form?

C Drawing Lewis Structures of Covalent Compounds

Group I: Bond Pair and Lone Pair Electrons

CH_4

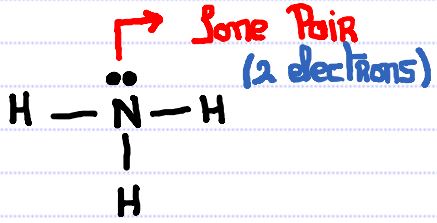
C: 4
H: 4(1)
8
4x B.P. −8
0



B.P. = Bond Pair

NH_3

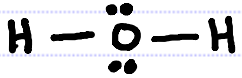
N: 5
H: 3(1)
8
3x B.P. −6
2
1x L.P. −2
0



L.P. = Lone Pair

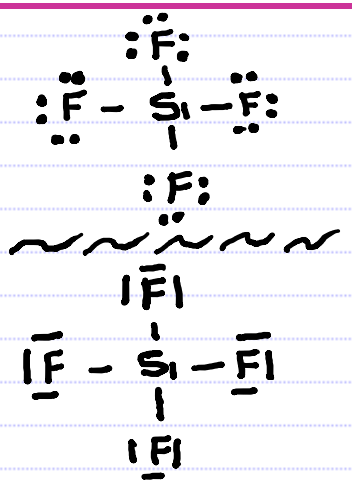
H_2O

O: 6
H: 2(1)
8
2xB.P. −4
4
2x L.P. −4
0



SiF_4

Si: 4
F: 4(7)
32
4x B.P. −8
24
12x L.P. −24
0



— = ••

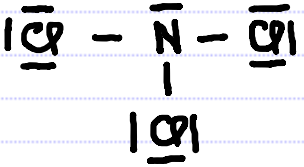
3.7 What Is a Covalent Bond and How Does One Form?

C Drawing Lewis Structures of Covalent Compounds

Group I: Bond Pair and Lone Pair Electrons

NCl_3

N:	5
Cl:	3(7)
	26
3x B.P.	- 6
	20
9x L.P.	- 18
	2
1x L.P.	- 2
	0



Lone pairs on Cl?

a) 1

b) 9

c) 3 ✓

Notes

1) The least electronegative atom in the center ... Why? ... unless otherwise indicated

2) Hydrogen, 2 ... [He] : all other atoms, 8 ... [Ne] → [Rn]

3) Allocate electrons to the outer atoms first, then attend to the central atom.

4) Acceptable shorthand, — = ••

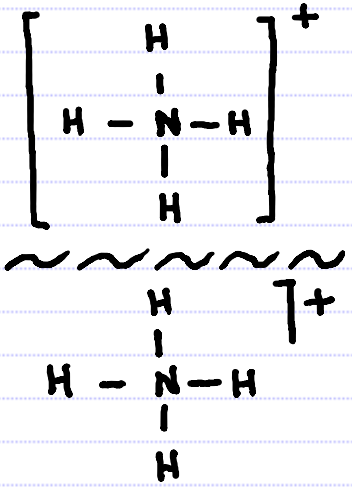
3.7 What Is a Covalent Bond and How Does One Form?

C Drawing Lewis Structures of Covalent Compounds

Group II: Dealing With Charges

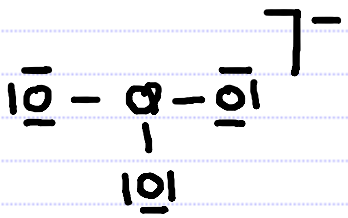
NH_4^+

N: 5
H: 4(1)
+: -1
8
4x B.P. -8
0



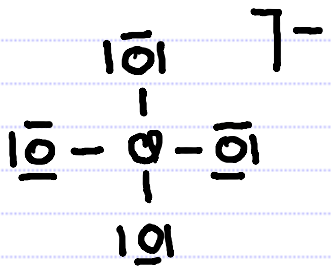
ClO_3^-

Cl: 7
O: 3(6)
-: 1
26
3x B.P. -6
20
9x L.P. -18
2
1x L.P. -2
0



ClO_4^-

Cl: 7
O: 4(6)
-: 1
32
4x B.P. -8
24
12x L.P. -24
0



Notes

1) Negative charges increases the valence electron total.

2) Positive charges decreases the valence electron total.

3) Always use parenthesis, either [ ] or ⁷, for ions.
The most common omission on exams!

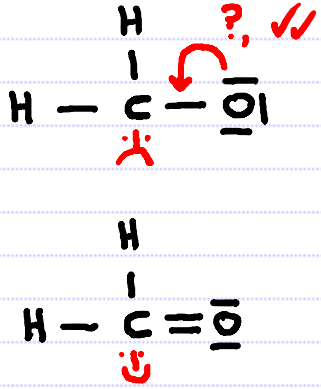
3.7 What Is a Covalent Bond and How Does One Form?

C Drawing Lewis Structures of Covalent Compounds

Group III: Shortage of Electrons … Multiple Bonds

H_2CO

C: 4
H: 2(1)
O: 6
12
3 x B.P. − 6
6
3 x L.P. − 6
0



Can we fix the :C atom?
Depends on a yes answer to two questions.

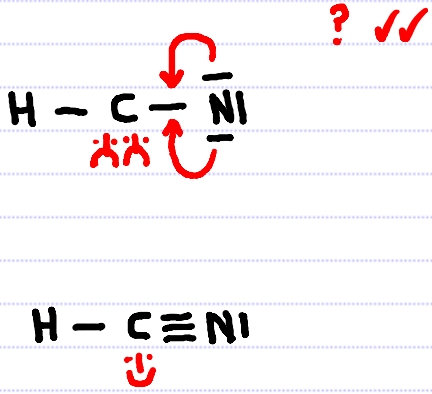
1) Do you have a terminal atom with at least one lone pair on it?

2) Are both atoms that are about to make a multiple bonds members of the CNOPS club.

If yes to both questions, then go ahead and turn a lone pair into a second bond.

HCN

H: 1
C: 4
N: 5
10
2 x B.P. − 4
6
3 x L.P. − 6
0



3.7 What Is a Covalent Bond and How Does One Form?

C Drawing Lewis Structures of Covalent Compounds

Group III: Shortage of Electrons … Multiple Bonds

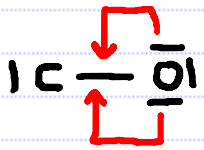
CO Class Homework Exercise.

C:	4
O:	6
	10
1 x B.P.	- 2
	8
3 x L.P.	- 6
	2
1 x L.P.	- 2
	0

C — O

↳ Considered the central atom as it is the least electronegative of the two.

? ✓✓



:C≡O:

Notes

Multiple bonds a possibility when the central atom does not have an octet when all the valence electrons have been distributed if __

a) There is a terminal atom with at least one lone pair of electrons and

b) The atoms forming the multiple bond both are members of C, N, O, P, S. Carbon, Nitrogen, Oxygen, Phosphorus and Sulfur.

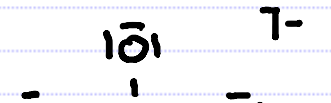
3.9 What is Resonance?

Drawing Lewis Structures of Covalent Compounds

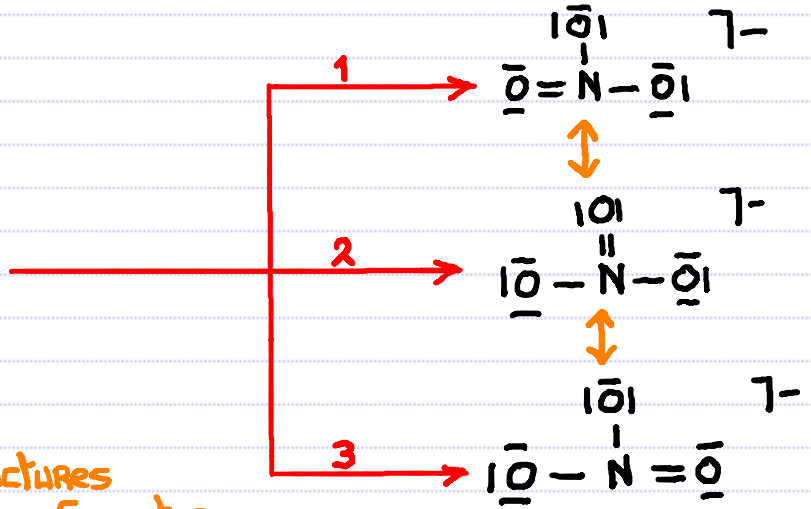
Group IV: Choices When Forming Multiple Bonds ... Resonance

NO_3^-

N:	5
O:	3(6)
−:	1
	24
3 × B.P.	−6
	18
9 × L.P.	−18
	0



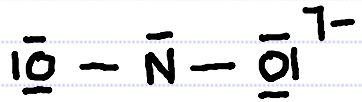
'Three choices'



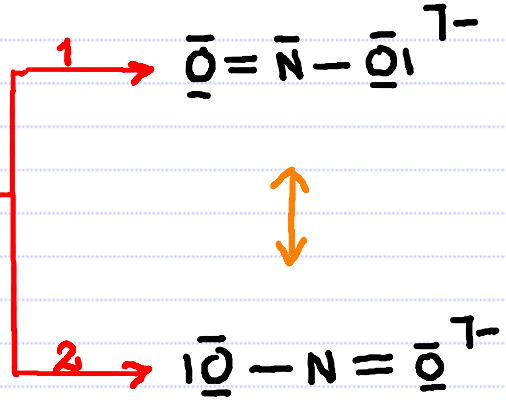
↔ : Denotes that the structures depicted are Resonance Structures

NO_2^-

N:	5
O:	2(6)
−:	1
	18
2 × B.P.	−4
	14
6 × L.P.	−12
	2
1 × L.P.	−2
	0



'Two choices'



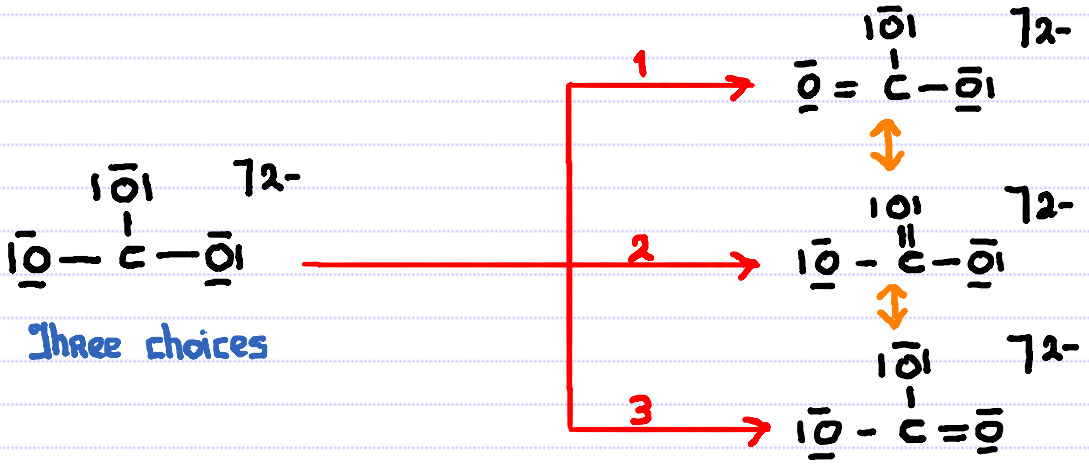
3.9 What is Resonance?

Drawing Lewis Structures of Covalent Compounds

Group IV: Choices When Forming Multiple Bonds … Resonance

CO_3^{2-}

C:	4
O:	3(6)
2-:	2
	24
3 x B.P	-6
	18
9 x L.P.	-18
	0



Notes

1) ↔ Used to denote that a set of Lewis Structures are Resonance Structures.

2) Resonance Structures are Not "Real" structures – they are extremes – the actual structure is the weighted average of all Reasonable Resonance Structures.
   ↳ We will not be delving into what constitutes a Reasonable Lewis Structure.