

The Covalent Bond

The concept of bonding

It is a human invention

It provides a method for dividing up the energy released when stable compounds are formed

Electronegativity

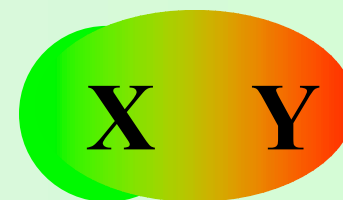
measure of an element to attract electrons toward itself when bonded to another element

Points About Electronegativity

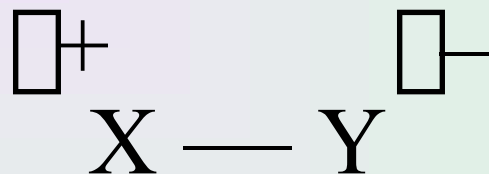
in general:

the greater the difference in electronegativity between two bonded atoms, the more polar the bond

atoms of elements with widely different electronegativities tend to form ionic compounds

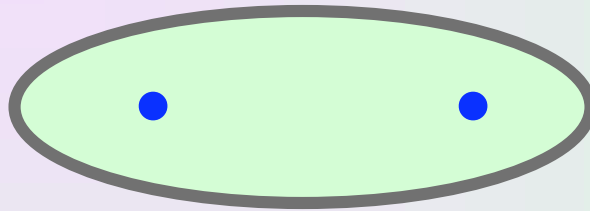


Polar Covalent Bonds

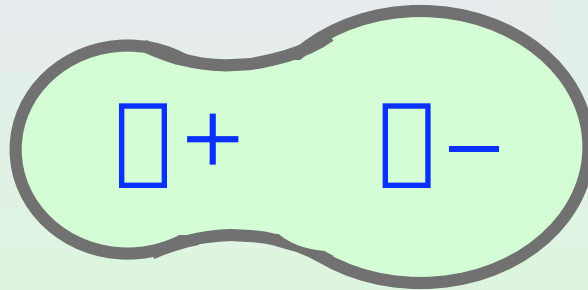


The concept of *electronegativity* guides our thinking about the polarity of bonds and the polarity of molecules.

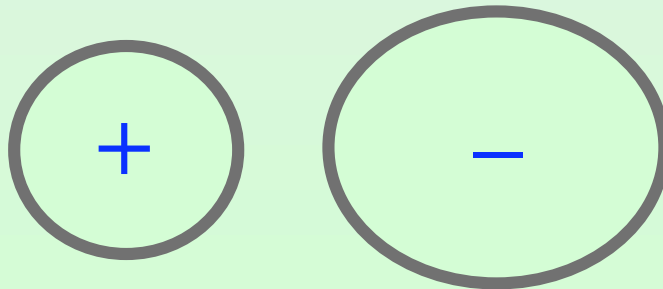
Three possible type of bonds



A covalent between identical atoms



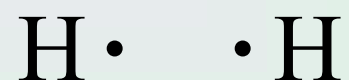
A polar covalent bond



ionic bond

Covalent Bond

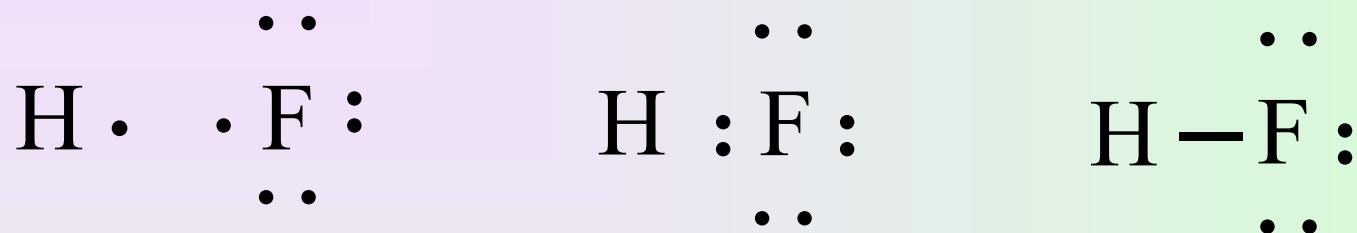
shared electron pair bonds two atoms
consider H₂, for example



Convention

it is customary to represent a covalent bond (shared-electron-pair bond) by a line

Count only valence electrons

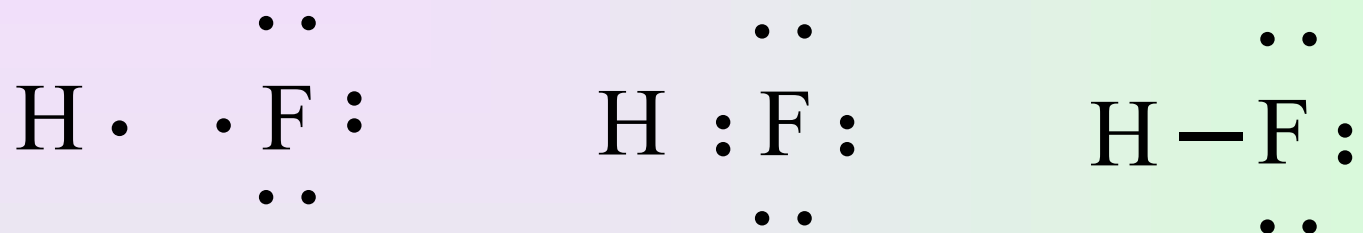


consider hydrogen fluoride (HF)

gives H the same electron
configuration as He

gives F the same electron
configuration as Ne

Count only valence electrons



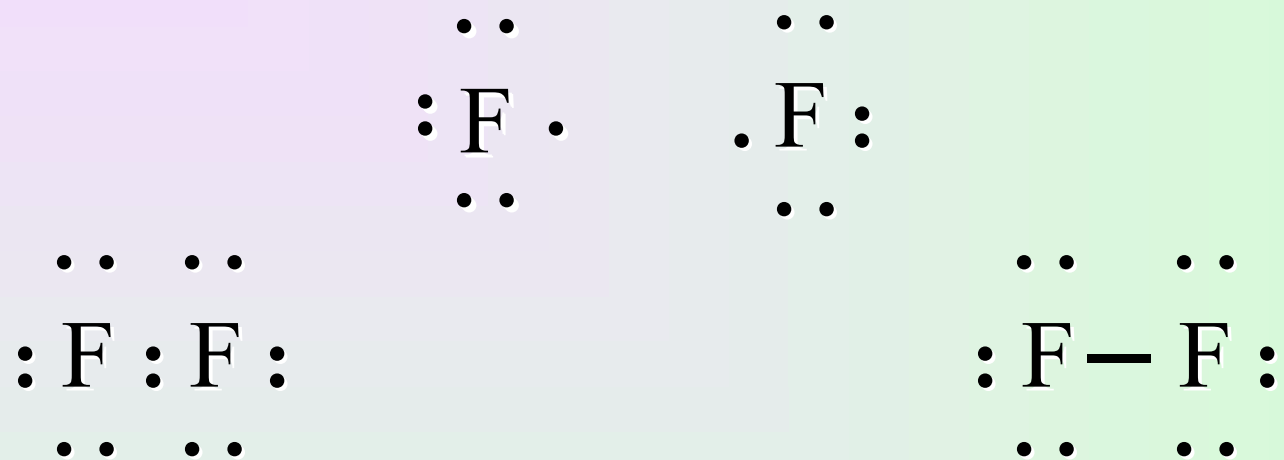
fluorine has three “lone pairs”

six “nonbonding electrons”

Octet rule

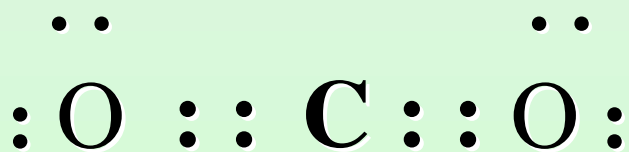
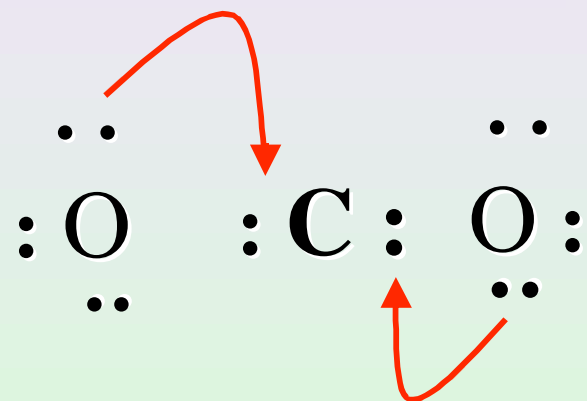
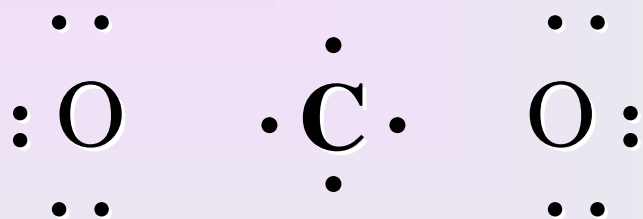
An atom other than hydrogen tends to form bonds until it is surrounded by eight valence electrons.

The octet rule and F₂



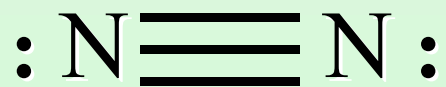
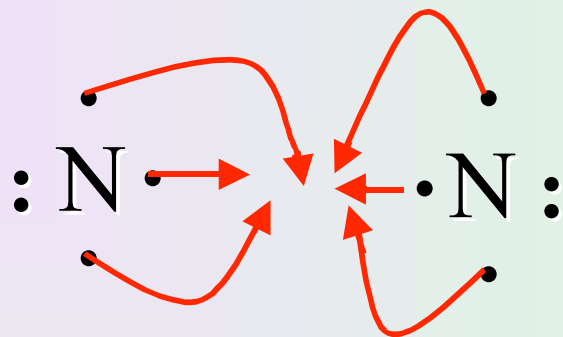
both F atoms have same electron configuration as Ne

Double Bonds

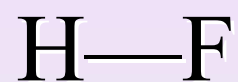


C and each O have
same electron
configuration as Ne

Triple Bonds



Single-Bond Distances



92 pm

127 pm

141 pm

161 pm

Bond Distances

Bond type	Bond length (pm)
C—O	143
C=O	123
C—C	154
C=C	134
C≡C	120
C—N	143
C=N	138
C≡N	116

Bond energies

Bond type	Bond energy in kJ/mol
C—H	413
C—O	358
C=O	745
C—C	374
C=C	614
C≡C	839
C—N	305
C=N	615
C≡N	891

C – H bond energies

Molecule	Bond energy in kJ/mol
HCBBr_3	380
HCCl_3	380
HCF_3	430
C_2H_6	410

This data shows that C – H bond varies significantly with its environment

Properties of Ionic Versus Covalent Compounds

Appearance

NaCl

white solid

CCl₄

colorless liquid

Properties of Ionic Versus Covalent Compounds

	Melting Point	Boiling Point
NaCl	801°C	1413 ° C
CCl ₄	-23°C	76.5 ° C

Properties of Ionic Versus Covalent Compounds

	Heat of fusion	Heat of vaporization
NaCl	39.2 kJ/mol	600 kJ/mol
CCl ₄	2.5 kJ/kmol	30 kJ/mol