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

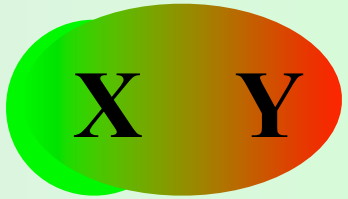
Points About Electronegativity

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

X :Y

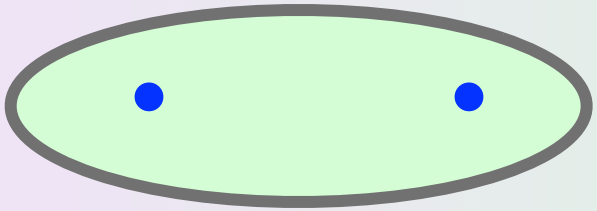


Polar Covalent Bonds

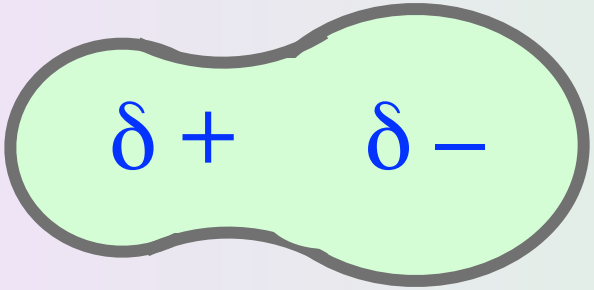
$$\overset{\delta+}{X} — \overset{\delta-}{Y}$$

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

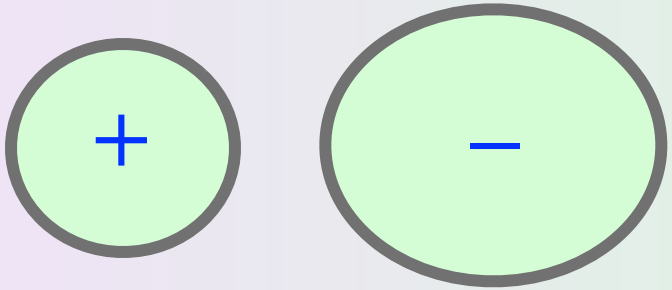
Three possible type of bonds



A covalent between identical atoms



A polar covalent bond



ionic bond

Covalent Bond

shared electron pair bonds two atoms

consider H_2, for example

H . . H

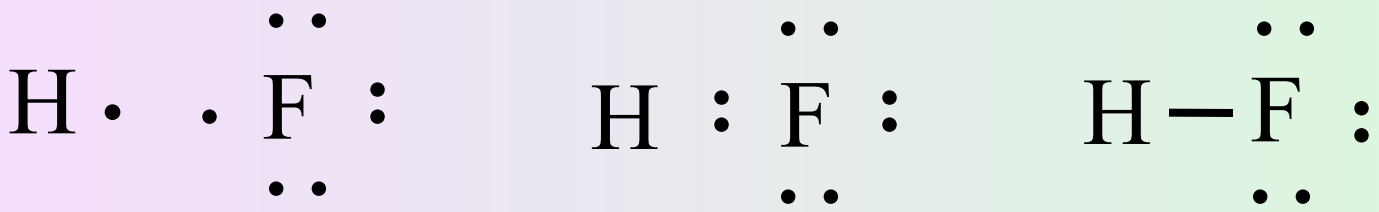
H : H

H — H

Convention

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

Count only valence electrons

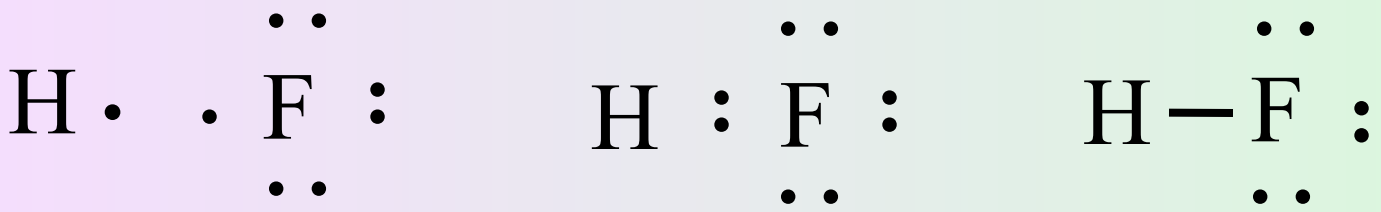


consider hydrogen fluoride (HF)

gives H the same electron configuration as He

gives F the same electron configuration as Ne

Count only valence electrons



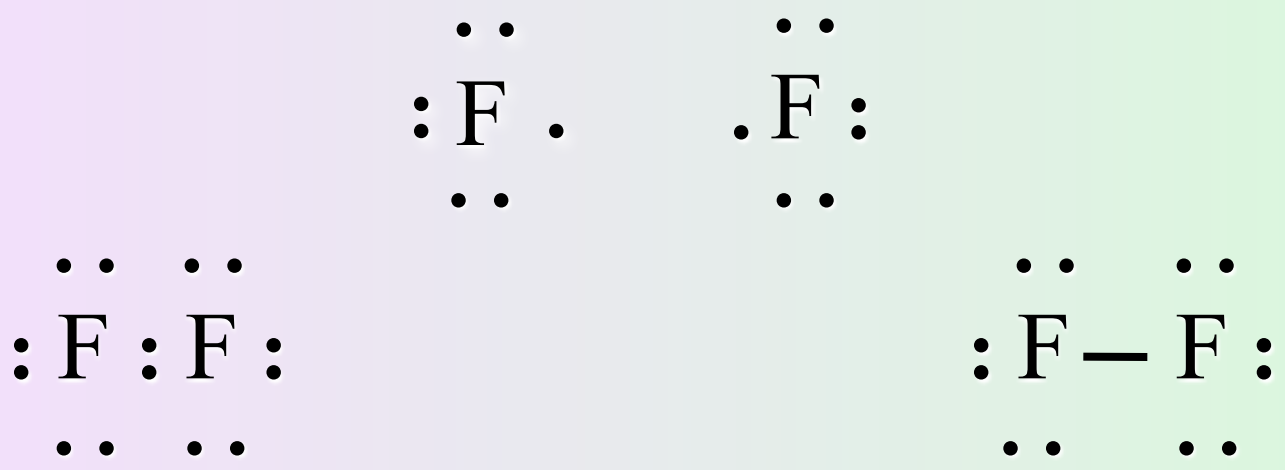
fluorine has three “lone pairs”

six “nonbonding electrons”

Octet rule

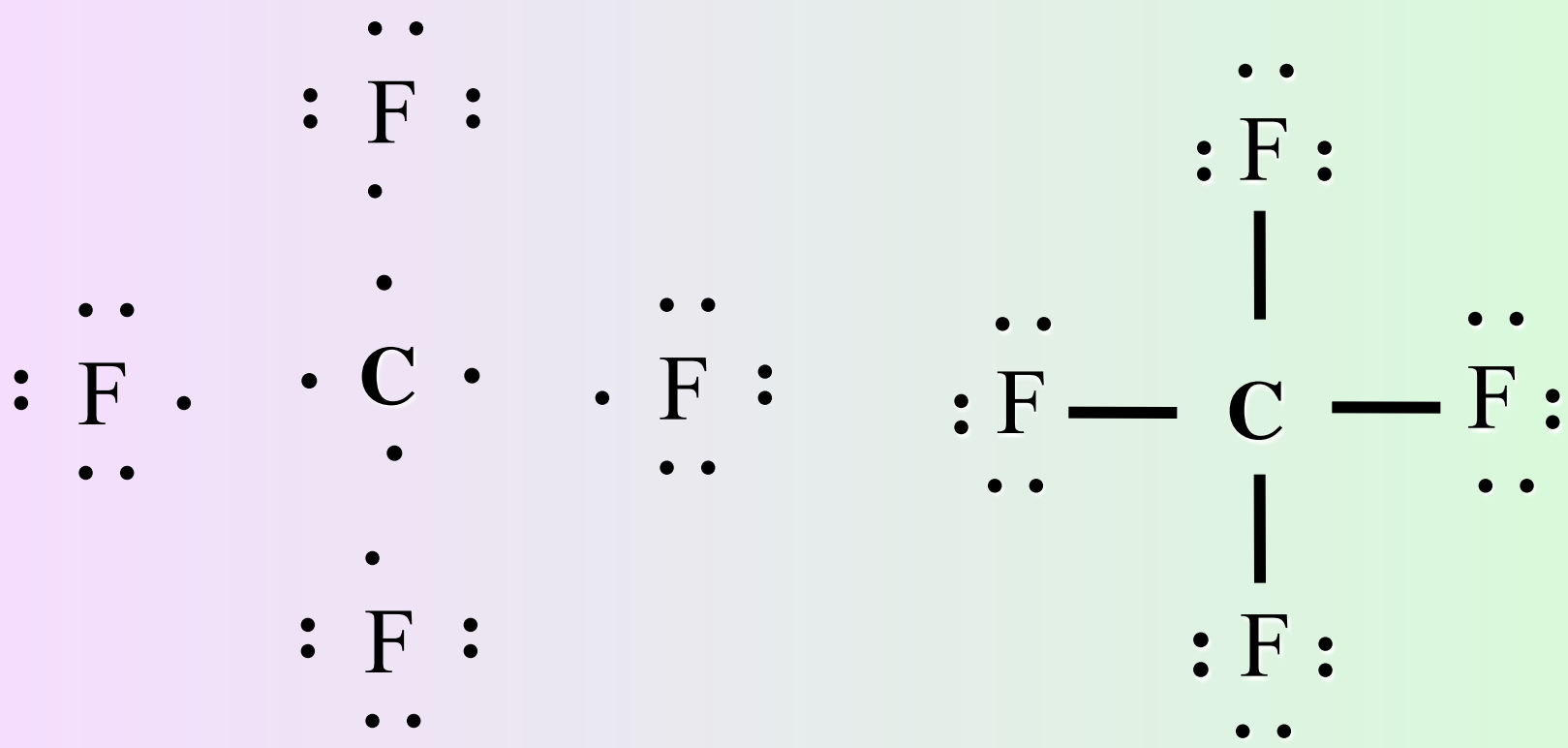
An atom other than hydrogen tends to form bonds until it is surrounded by eight valence electrons.

The octet rule and F_2



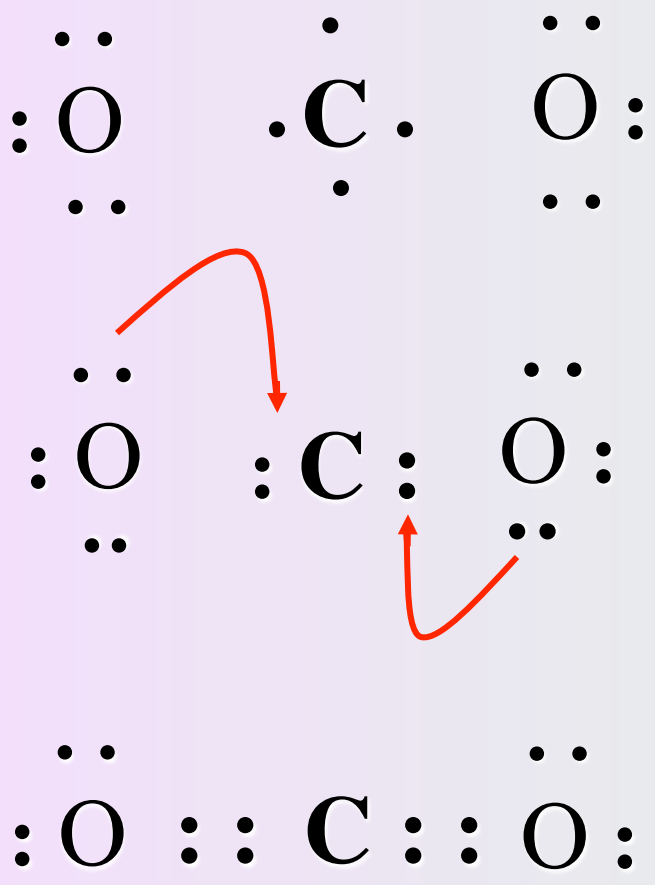
both F atoms have same electron configuration as Ne

The octet rule and CF_4



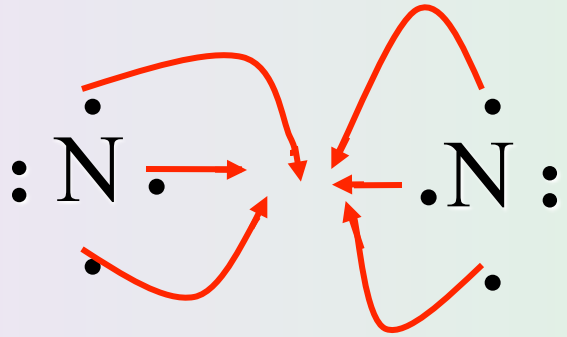
C and each F have same electron configuration as Ne

Double Bonds



C and each O have same electron configuration as Ne

Triple Bonds



:N:::N:

:N≡N:

Single-Bond Distances

H—F	H—Cl	H—Br	H—I
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
$HCBr_3$	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
CCl_4	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