

Chemical Bonding

Octet Rule - an atom will react so that its electron configuration resembles that of a noble gas.

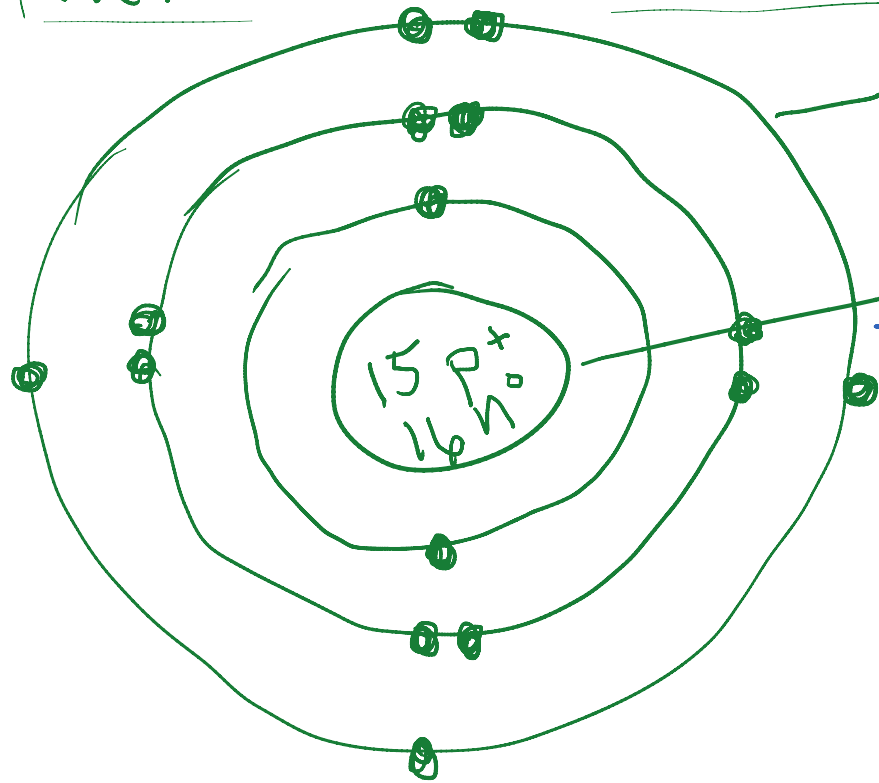
→ either 2 or 8 valence electrons surround an atom.

Group 18



Electron Dot Structure
→ shows the distribution of valence electrons (outer shell electrons)

Review of atomic Structure :



energy levels
(or electron shells)

nucleus

P^+ = protons
 n° = neutrons

Valence electrons =
outer shell
electrons.

Energy Level

e^-

1st

$2e^-$

2nd

$8e^-$

3rd

$18e^-$

4th

$32e^-$

⋮

7th

groups



Atomic Structure for
Phosphorus
(group 15 on
periodic table)

Using the Periodic Table to Determine Valence Electrons

PERIODIC TABLE OF ELEMENTS

1
H
Hydrogen

2
He
Helium

3
Li
Lithium

4
Be
Beryllium

5
B
Boron

6
C
Carbon

7
N
Nitrogen

8
O
Oxygen

9
F
Fluorine

10
Ne
Neon

11
Na
Sodium

12
Mg
Magnesium

13
Al
Aluminum

14
Si
Silicon

15
P
Phosphorus

16
S
Sulfur

17
Cl
Chlorine

18
Ar
Argon

19
K
Potassium

20
Ca
Calcium

21
Sc
Scandium

22
Ti
Titanium

23
V
Vanadium

24
Cr
Chromium

25
Mn
Manganese

26
Fe
Iron

27
Co
Cobalt

28
Ni
Nickel

29
Cu
Copper

30
Zn
Zinc

31
Ga
Gallium

32
Ge
Germanium

33
As
Arsenic

34
Se
Selenium

35
Br
Bromine

36
Kr
Krypton

37
Rb
Rubidium

38
Sr
Strontium

39
Y
Yttrium

40
Zr
Zirconium

41
Nb
Niobium

42
Mo
Molybdenum

43
Tc
Technetium

44
Ru
Ruthenium

45
Rh
Rhodium

46
Pd
Palladium

47
Ag
Silver

48
Cd
Cadmium

49
In
Indium

50
Sn
Tin

51
Sb
Antimony

52
Te
Tellurium

53
I
Iodine

54
Xe
Xenon

55
Cs
Cesium

56
Ba
Barium

57
La
Lanthanum

58
Ce
Cerium

59
Pr
Praseodymium

60
Nd
Neodymium

61
Pm
Promethium

62
Sm
Samarium

63
Eu
Europium

64
Gd
Gadolinium

65
Tb
Terbium

66
Dy
Dysprosium

67
Ho
Holmium

68
Er
Erbium

69
Tm
Thulium

70
Yb
Ytterbium

71
Lu
Lutetium

72
Hf
Hafnium

73
Ta
Tantalum

74
W
Tungsten

75
Re
Rhenium

76
Os
Osmium

77
Ir
Iridium

78
Pt
Platinum

79
Au
Gold

80
Hg
Mercury

81
Tl
Thallium

82
Pb
Lead

83
Bi
Bismuth

84
Po
Polonium

85
At
Astatine

86
Rn
Radon

87
Fr
Francium

88
Ra
Radium

89
Ac
Actinium

90
Th
Thorium

91
Pa
Protactinium

92
U
Uranium

93
Np
Neptunium

94
Pu
Plutonium

95
Am
Americium

96
Cm
Curium

97
Bk
Berkelium

98
Cf
Californium

99
Es
Einsteinium

100
Fm
Fermium

101
Md
Mendelevium

102
No
Nobelium

103
Lr
Lawrencium

104
Rf
Rutherfordium

105
Db
Dubnium

106
Sg
Seaborgium

107
Bh
Bohrium

108
Hs
Hassium

109
Mt
Meitnerium

110
Ds
Darmstadtium

111
Rg
Roentgenium

112
Cn
Copernicium

113
Nh
Nihonium

114
Fl
Flerovium

115
Mc
Moscovium

116
Lv
Livermorium

117
Ts
Tennessine

118
Og
Oganesson

PubChem

Not predictable.

2

13

14

15

16

17

Group 16



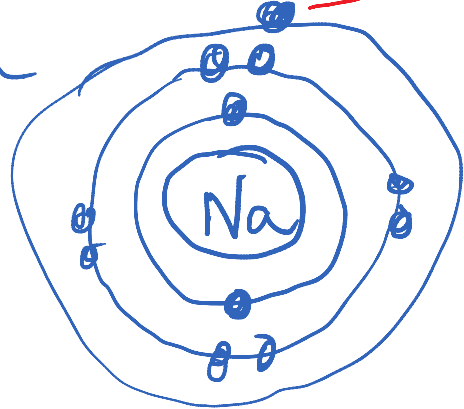
electron dot structure

2 Ways Atoms React to Become Stable (Surrounded by 2 or 8 valence electrons)

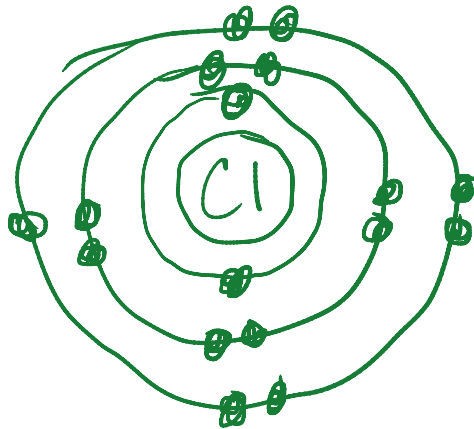
- 1) Ion Formation - electrons are gained or lost to form charged particles
- 2) Covalent Bonding - electrons are shared so that each atom is surrounded by 2 or 8 electrons.

Ion Formation

Sodium



1 valence e^-

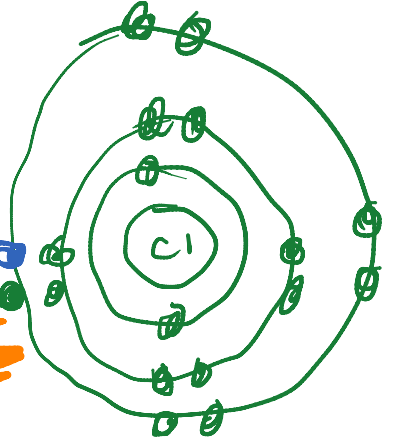


$11p^+$
 $10e^-$



+1 Ion

$17p^+$
 $18e^-$



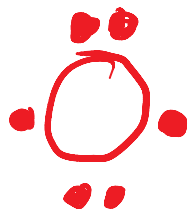
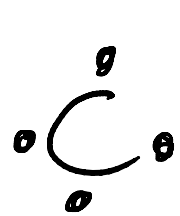
-1 Ion

electrostatic attraction



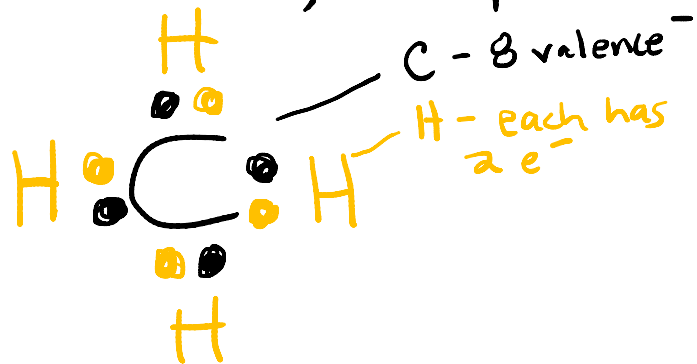
Covalent Bonding - electrons are shared.

Looking at electron dot structures helps to visualize covalent bonding.

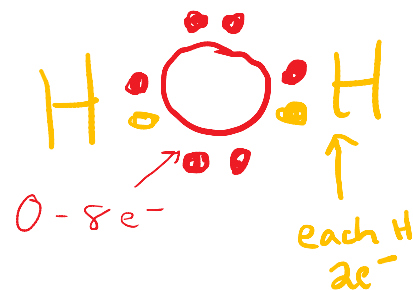


← [Common Organic Elements]

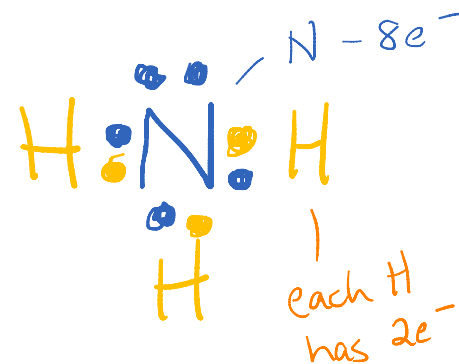
Methane, CH_4



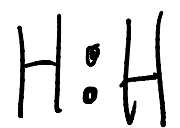
Water, H_2O



Ammonia, NH_3

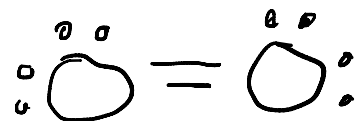
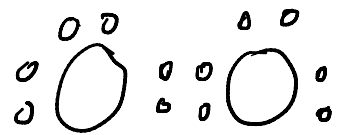


Single Covalent Bond - 1 pair of electrons
Shared

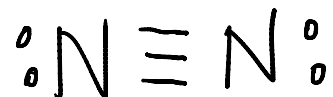


shared pair of electrons

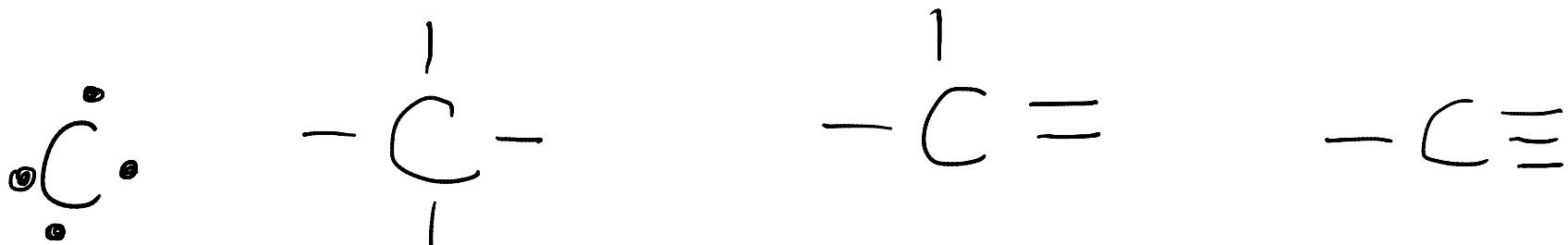
Double Covalent Bond - 2 shared pairs.



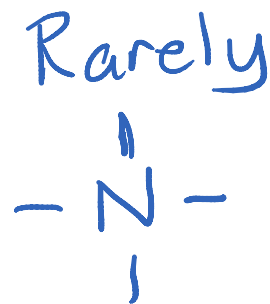
Triple Covalent Bond - 3 shared pairs



Common Bonding Patterns in Organic Chemistry



Never triple bonds
with oxygen!



2 types of Covalent Bonds

→ categorized because of electronegativity differences between atoms in a bond.

Electronegativity - the ability of an atom in a bond to attract electrons towards it.

Most electronegative element = Fluorine (4.0)

Oxygen - 3.5

Nitrogen - 3.0

Hydrogen - 2.1

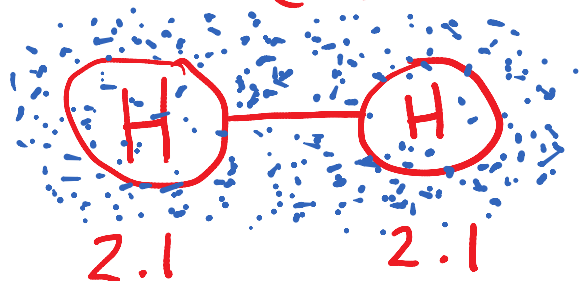
Carbon - 2.5

Types

1) Nonpolar Covalent Bonds

→ electrons are shared equally between atoms with the same (or similar) electronegativities.

H:H



Note: nonpolar substances will not dissolve in water.

In organic chemistry, the C-H bond is considered Non-polar.

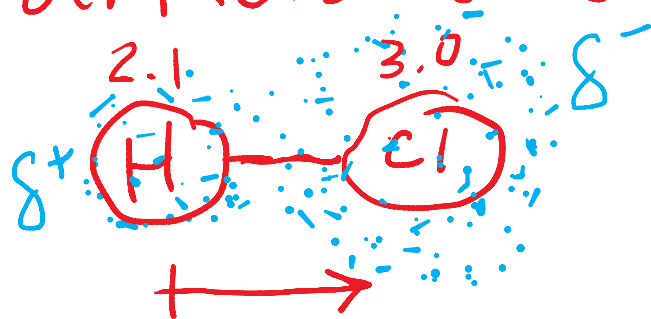
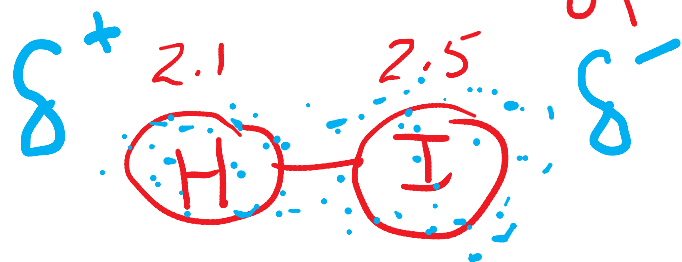
Examples of Nonpolar Substances

→ oils, fats, hydrocarbons (crude oil), fossil fuels, solvents like turpentine
Kerosene

2) Polar Covalent Bonds

Note: water is the MOST polar substance!!

→ electrons are shared unequally because of different electronegativities -



Dipole Symbol

- points to the more electronegative element (where the electrons are more likely to be)

δ^+ - partial positive

δ^- - partial negative



Nonpolar
(has no regions
of charge)

Note: molecules
with more
regions of charge
will be more
polar than
molecules with
fewer regions
of charge.



Polar
(has regions
of charge)

oil

Polarity

Water

Least Most substances fall in between Most

→ Increasing Polarity →

