More on Ions

Record into your notes

Achieving Noble Gas Electron Configuration

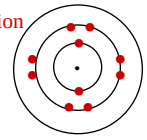
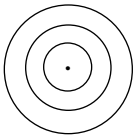
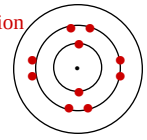
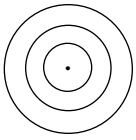
An ion forms when an atom

- loses electrons (OIL, oxidation) or gains electrons (RIG, reduction) to achieve noble gas electron configuration

  Recognize the appearance of Bohr's Model after an atom loses or gains electrons to form ions and/or how two atom share their electrons covalently to achieve noble gas electron configuration.

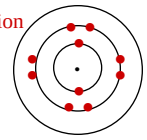
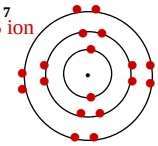
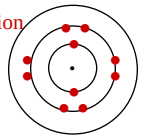
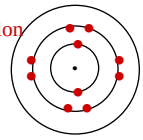
Supplemental packet page 50

Ionic Structure

Atomic Number: **11** Name: sodium-23 ion Symbol: $^{23}_{11}Na^{1+}$  mass # **23** # p 11 # n 12 # e 10 More protons than electrons Electronic Configuration: **$1s^2$ $2s^2$ $2p^6$ $3s^0$** Physical Properties: metal cation positive ion 1+ charge Chemical Properties: combines w/ anions Lewis Dot: **$[Na]^{1+}$**	Atomic Number: **17** Name: Symbol:  mass # **35** # p _____ # n _____ # e _____ Electronic Configuration: Physical Properties: Chemical Properties: Lewis Dot:
Atomic Number: **12** Name: magnesium-24 ion Symbol: $^{24}_{12}Mg^{2+}$  mass # **24** # p 12 # n 12 # e 10 More protons than electrons Electronic Configuration: **$1s^2$ $2s^2$ $2p^6$ $3s^0$** Physical Properties: metal cation positive ion 2+ charge Chemical Properties: combines w/ anions Lewis Dot: **$[Mg]^{2+}$**	Atomic Number: **8** Name: Symbol:  mass # **16** # p _____ # n _____ # e _____ Electronic Configuration: Physical Properties: Chemical Properties: Lewis Dot:

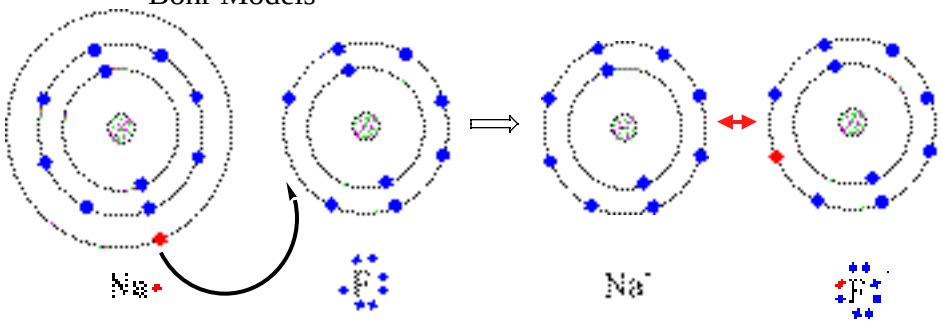
Supplemental packet page 50

Ionic Structure

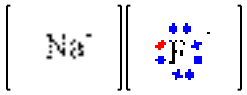
Atomic Number: **11** Name: sodium-23 ion Symbol: $^{23}_{11}Na^{1+}$  mass # **23** # p 11 # n 12 # e 10 More protons than electrons Electronic Configuration: **$1s^2$ $2s^2$ $2p^6$ $3s^0$** Physical Properties: metal cation positive ion 1+ charge Chemical Properties: combines w/ anions Lewis Dot: **$[Na]^{1+}$**	Atomic Number: **17** Name: chloride-35 ion Symbol: $^{35}_{17}Cl^{1-}$  mass # **35** # p 17 # n 18 # e 18 More electrons than protons Electronic Configuration: **$1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$** Physical Properties: nonmetal anion negative ion 1- charge Chemical Properties: combines w/ cations Lewis Dot: **$[:\ddot{Cl}:]^{1-}$**
Atomic Number: **12** Name: magnesium-24 ion Symbol: $^{24}_{12}Mg^{2+}$  mass # **24** # p 12 # n 12 # e 10 More protons than electrons Electronic Configuration: **$1s^2$ $2s^2$ $2p^6$ $3s^2$** Physical Properties: metal cation positive ion 2+ charge Chemical Properties: combines w/ anions Lewis Dot: **$[Mg]^{2+}$**	Atomic Number: **8** Name: oxygen-16 ion Symbol: $^{16}_{8}O^{2-}$  mass # **16** # p 8 # n 8 # e 10 More electrons than protons Electronic Configuration: **$1s^2$ $2s^2$ $2p^6$ $3s^0$** Physical Properties: nonmetal anion negative ion 2- charge Chemical Properties: combines w/ cations Lewis Dot: **$[:\ddot{O}:]^{2-}$**

Please note the movement of the red colored valence (outermost) electron on sodium. It is transferred over to the fluorine atom.

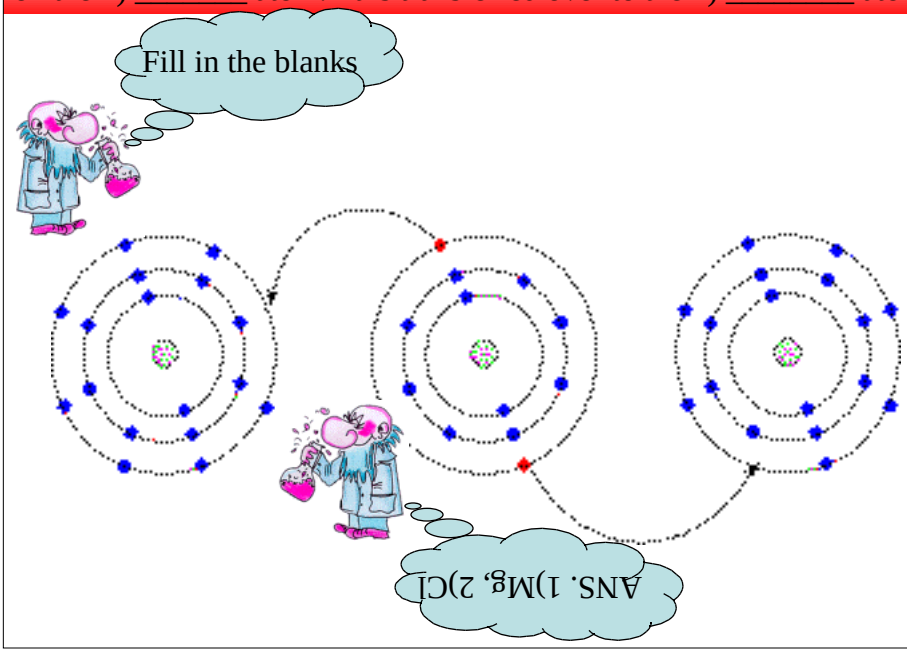
Bohr Models



Lewis dot structures



Please note the movement of the red colored valence (outermost) electron on the 1) _____ atom. It is transferred over to the 2) _____ atom.



Record into your notes

Ions isoelectronic ("same electronic configuration") with noble gases

[Ne] **[Na]$^{1+}$** $1s^2\ 2s^2\ 2p^6$

[Ar] **[Cl]$^{1-}$** $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

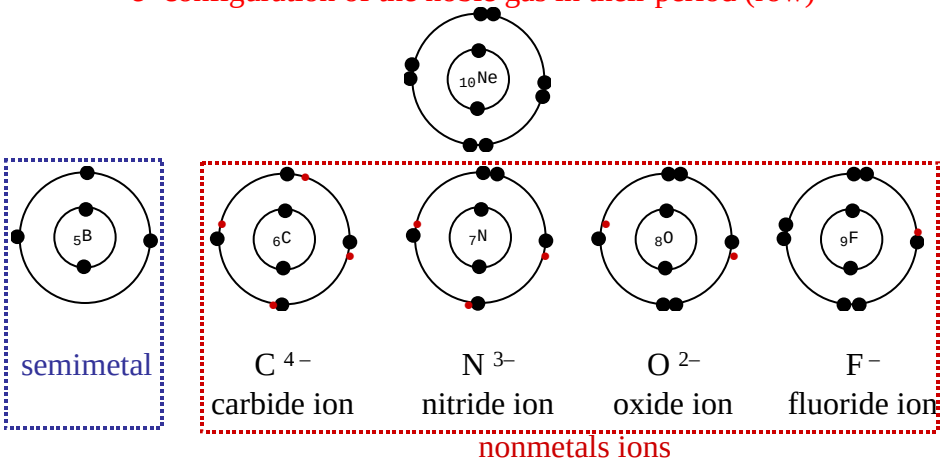
[Ne] **[Mg]$^{2+}$** $1s^2\ 2s^2\ 2p^6$

[Ne] **[O]$^{2-}$** $1s^2\ 2s^2\ 2p^6$

Please note the addition of the red colored valence (outermost) electrons to each atom listed. Recognize boron, B, is a semimetal, not a nonmetal.

Draw the following into your notes opposite page 64

nonmetals gain just enough electrons to achieve noble gas e- configuration of the noble gas in their period (row)



semimetal

C $^{4-}$ carbide ion

N $^{3-}$ nitride ion

O $^{2-}$ oxide ion

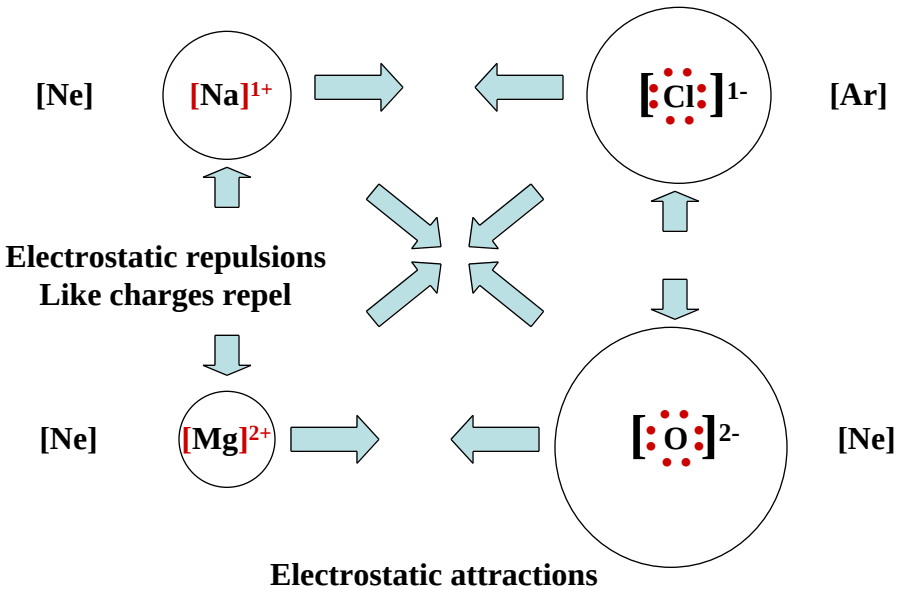
F $^{-}$ fluoride ion

nonmetals ions

Please Note: the nonmetals like to gain electrons & the stability of these ions is associated with 8 valence electrons (an octet)

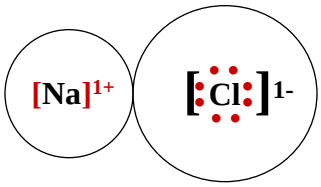
Chapter 5 - Introduction to Chemical Bonding

Ions isoelectronic ("same electronic configuration") with noble gases

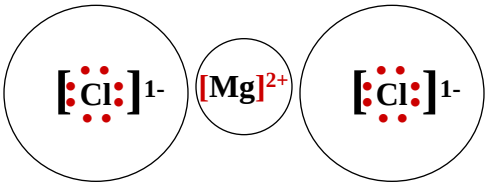


Ionic Bonding (transferring electrons to achieve noble gas electron configuration)

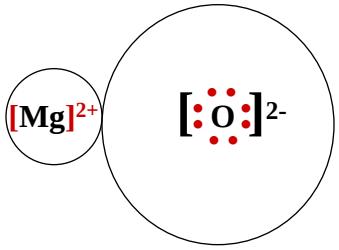
1. Opposites attract (cation attracts an anion)
2. Brought together by electrostatics
3. Ions coming together to balance charge



sodium chloride



magnesium chloride



magnesium oxide

Looking ahead to Chapter 6

Covalent Bonding (*sharing* electrons to achieve noble gas electron configuration)

1. Bonding for FONCl BrISCH nonmetals
2. Brought together by sharing of electrons
3. Achieving an OCTET of valence electrons

versus Chapter 5 - Ionic Bonding

Ionic Bonding (*transferring* electrons to achieve noble gas electron configuration)

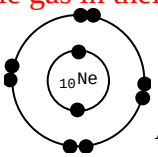
1. Opposites attract (cation attracts an anion)
2. Brought together by electrostatics
3. Ions coming together to balance charge

Please note the addition of the red colored valence (outermost) electron by the in coming hydrogen atom which will be shared by both atoms.

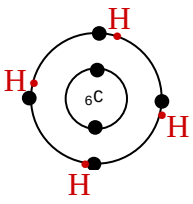
Covalent Bonding (sharing electrons to achieve noble gas electron configuration)

nonmetals bond to hydrogen to achieve noble gas e- configuration of the noble gas in their period (row)

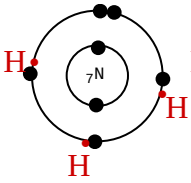
Addition of hydrogen



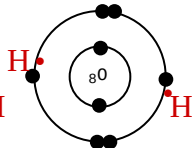
Achieving an OCTET valence



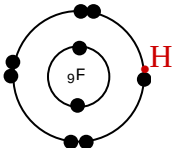
CH_4
methane gas



NH_3
ammonia gas



H_2O
water



HF
hydrogen fluoride

molecules of nonmetals hydrides

Looking ahead to Chapter 6

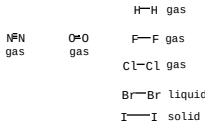
Ionic substances

Supplemental packet page 64

Ionic compounds are held together by strong electrical forces between oppositely charged ions (e.g., Na^+, Cl^-). These forces are referred to as **ionic bonds**. Typically, ionic compounds (**ionic salts**) have relative high melting points (mp NaCl = 801 °C).and exist physically as solids at room temperature. It takes a lot of energy to break an ionic bond. Can you give additional examples of ionic compounds?

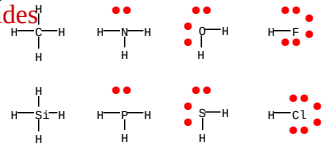
Molecular compounds. Two or more atoms may combine with one another to form an uncharged molecule. The atoms involved are unusually those of nonmetallic elements. Within the molecule, atoms are held to one another by strong forces called **covalent bonds**.

diatomic molecules - there are **seven diatomic molecules** that behave as discrete units. The physical states for these molecules at room temperature are variable.



molecules with multiple bonding patterns

molecules of nonmetals hydrides



Summary

What is the favorite charge of these elements as ions? Indicate charge. Is there a relationship between the type of element that likes to have positive charge? a negative charge?

	Li	Be	B	C	N	O	F
ion charge:	1+	2+	3+	4-	3-	2-	1-

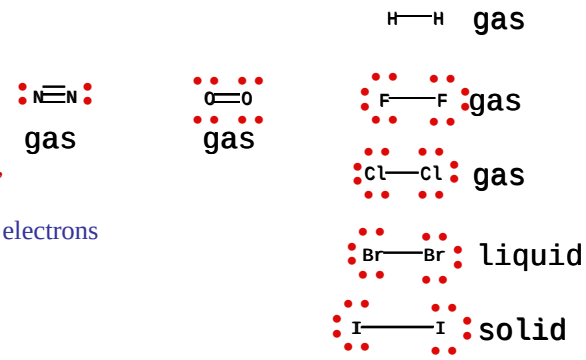
How many atoms will each element bond to in order to be stable? Indicate the number of bonds that each element will make.

	Li	Be	B	C	N	O	F
number of bonds:	1	2	3	4	3	2	1

Is there a relationship between ion charge and the number of bonds an element will make? If so, describe the relationship.

Supplemental packet page 64

To these molecules,
Add missing
nonbonding pair of electrons



Favorite bonding modes for nonmetals C, N,O, halogen, H

•Know the preferred total number of bonds to these elements

C	N	O	F	H
4	3	2	1	1

•**N O ,** nitrogen and oxygen may have variable number of bonds

(2) (1)
(4) (3)

Supplemental packet page 68

VSEPR = valence shell electron pair repulsion

Determine the angles between bonds, name the geometry about the central atom and give the its hybridization.

Ideal bonding for carbon = Four bonds to carbon - Four bonding modes

Ideal Geometries

bond angles	109.5 109.5 109.5 109.5	120 120 120	180	180
geometric name	tetrahedral	trigonal planar	linear	linear

Ideal bonding angles for carbon

Non-Ideal Geometries

bond angles	107.5 107.5	θ<120	
geometric name	pyramidal or trigonal pyramid	bent	
bond angles	104.5		
geometric name	bent		

Bond angles are less than ideal angle
Electron pair occupies a lot of space & is held close to nucleus of central atom