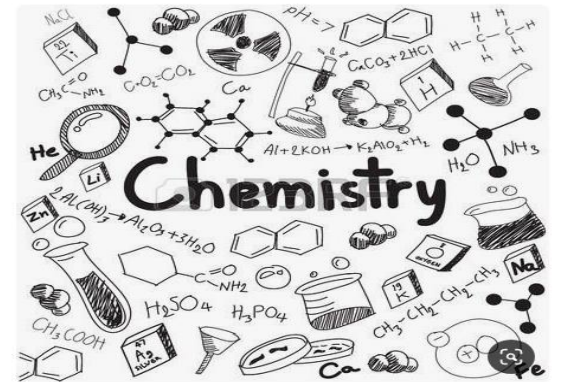
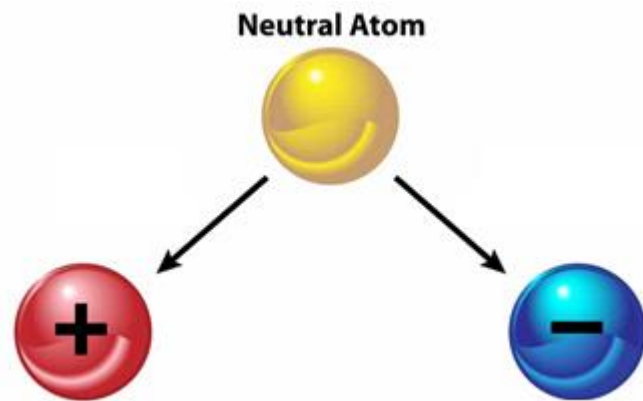




NOS

Ions, ionic bonds and ionic compounds

Study Sheet #2



Learning Objectives:

- Define ions, ionic bonds, and ionic compounds.
- Explain how ionic bonds form.
- Describe the properties of ionic compounds.
- Identify and name common ionic compounds.

Key words:

- ❖ Ions
- ❖ Cations
- ❖ Anions
- ❖ Octet Rule
- ❖ Ionic bonds
- ❖ Ionic compounds

What are ions?

Ions are electrically charged particles formed when atoms gain or lose electrons.

These charges can be positive or negative.

Cations (positive ions):

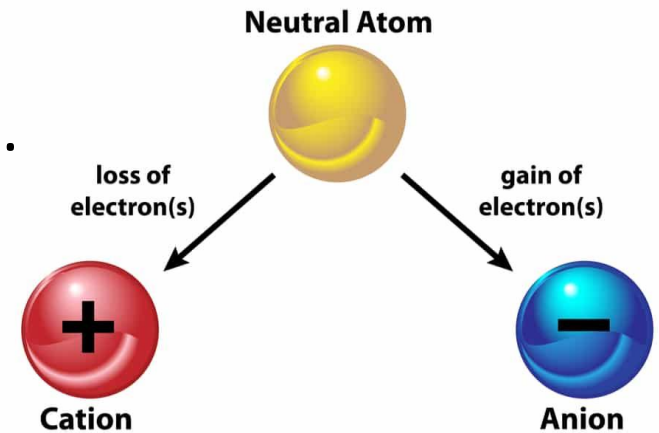
Atoms **lose** one or more electrons to become positively charged.

Metals often form cations as they have fewer electrons in the outermost energy level and readily give them away.

Anions (negative ions):

Atoms **gain** one or more electrons to become negatively charged.

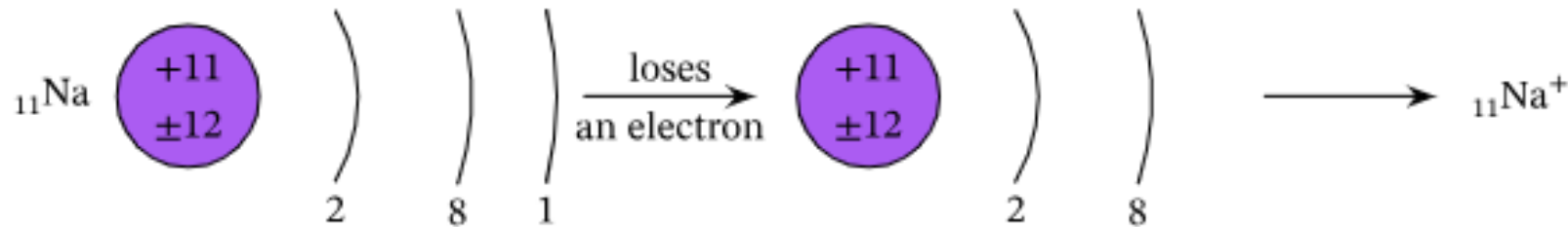
Nonmetals often form anions as they attract additional electrons.



- **Octet rule:** atoms tend to have a stable electron configuration, similar to noble gases, which typically have 8 electrons in their outermost energy level (except for elements in period#1 / Hydrogen and Helium).

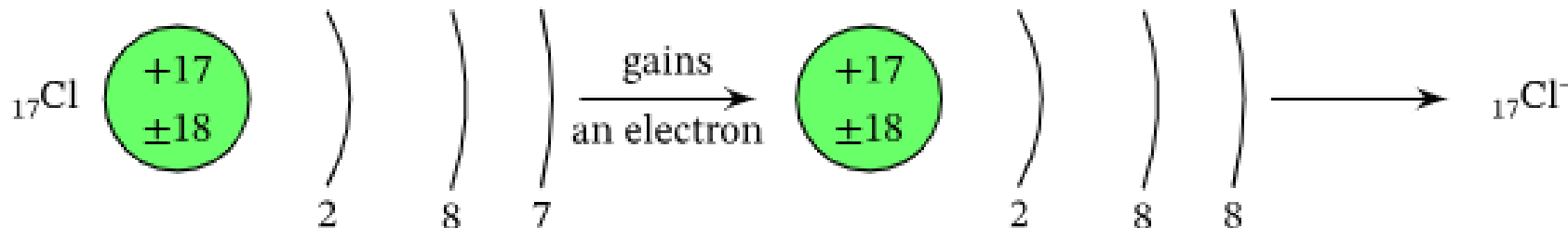
Atoms gain or lose electrons to reach this stable configuration.

Formation of sodium ion:



The **sodium** ion has **8** electrons in its outer shell. Its outer shell is full, so the ion is stable.

Formation of chloride ion:



The **chloride** ion has **8** electrons in its outer shell. Its outer shell is full, so the ion is stable.

You can use the periodic table to predict whether an atom will form an anion or a cation, and you can often predict the charge of the resulting ion.

The name of a metal ion is the same as the name of the metal atom from which it forms, so Ca^{2+} is called a calcium ion.

When naming a non-metal ion, the suffix *-ide* is added to the root name of the element.

O^{2-} is called an oxide ion.

1

2

3

4

5

6

7

8

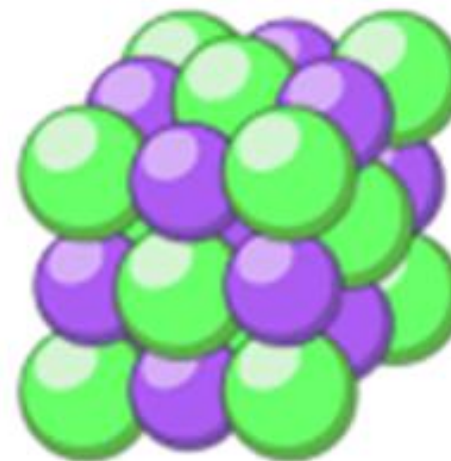
		<div style="border: 1px solid black; padding: 5px; display: inline-block;"> 1 H Hydrogen 1 </div>															
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	63.5 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	57-71	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	(209) Po Polonium 84	(210) At Astatine 85	(222) Rn Radon 86
(223) Fr Francium 87	(226) Ra Radium 88	89-103	(261) Rf Rutherfordium 104	(262) Db Dubnium 105	(266) Sg Seaborgium 106	(264) Bh Bohrium 107	(269) Hs Hassium 108	(268) Mt Meitnerium 109	(269) Ds Darmstadtium 110	(272) Rg Roentgenium 111	(285) Cn Copernicium 112	(286) Nh Nihonium 113	(289) Fl Flerovium 114	(289) Mc Moscovium 115	(293) Lv Livermorium 116	(294) Ts Tennessine 117	(294) Og Oganesson 118

Lanthanide Series	139 La Lanthanum 57	140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	(145) Pm Promethium 61	(150) Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	163 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
Actinide Series	(227) Ac Actinium 89	232 Th Thorium 90	231 Pa Protactinium 91	238 U Uranium 92	(237) Np Neptunium 93	(244) Pu Plutonium 94	(243) Am Americium 95	(247) Cm Curium 96	(247) Bk Berkelium 97	(251) Cf Californium 98	(252) Es Einsteinium 99	(257) Fm Fermium 100	(258) Md Mendelevium 101	(259) No Nobelium 102	(266) Lr Lawrencium 103

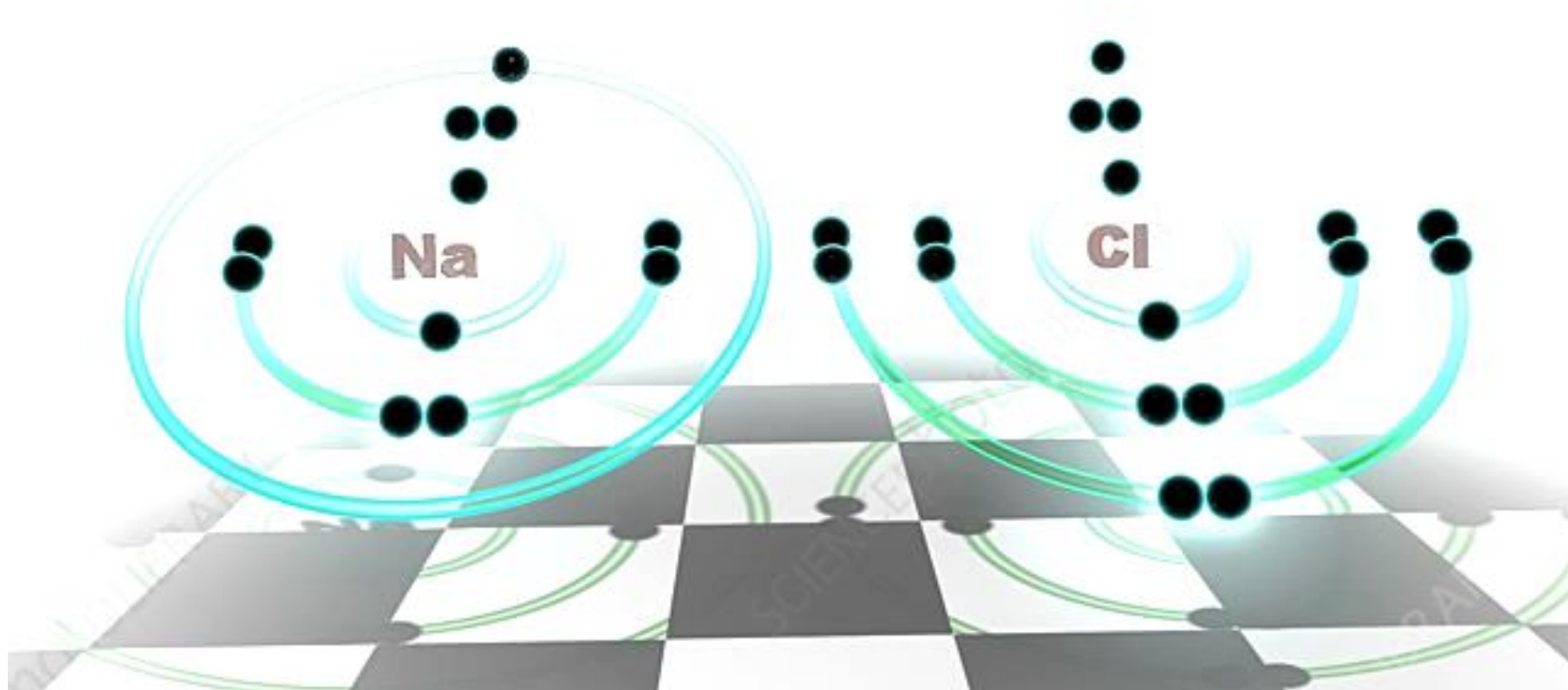
What is ionic bonding?

- ***Ionic bonding*** is the electrostatic attraction between positive and negative ions.
- In ionic bonds, the metal loses electrons to become a positively charged cation, whereas the nonmetal accepts those electrons to become a negatively charged anion.
- Ionic bonds require an electron donor, often a metal, and an electron acceptor, a nonmetal.

In sodium chloride, ionic bonds hold the ions together in a giant structure.



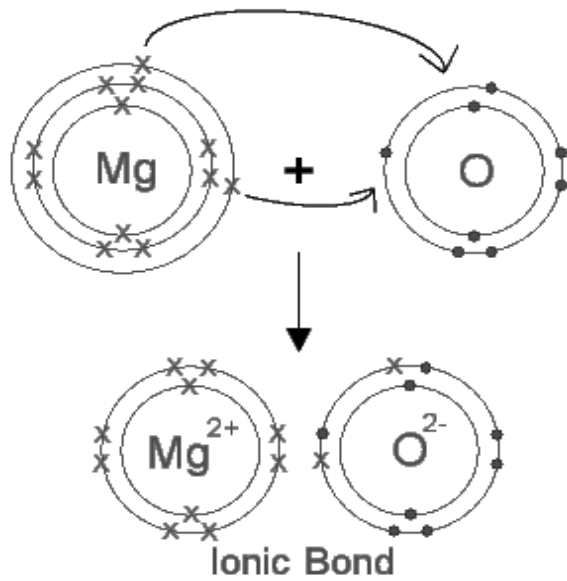
Formation of the ionic bond in Sodium chloride



- Examples of formation for 2 ionic compounds:

$_{12}\text{Mg}: 2,8,2$

$_{8}\text{O}: 2,6$

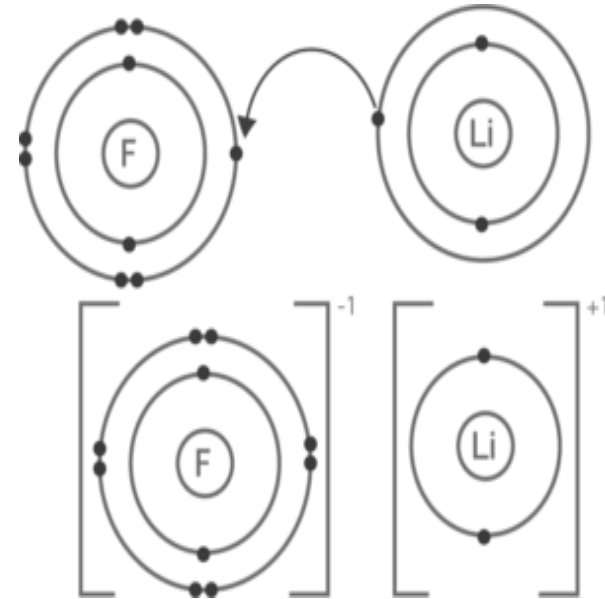


$_{12}\text{Mg}^{+2}: 2,8$

$_{8}\text{O}^{-2}: 2,8$

$_{3}\text{Li}: 2,1$

$_{9}\text{F}: 2,7$



$_{3}\text{Li}^{+1}: 2$

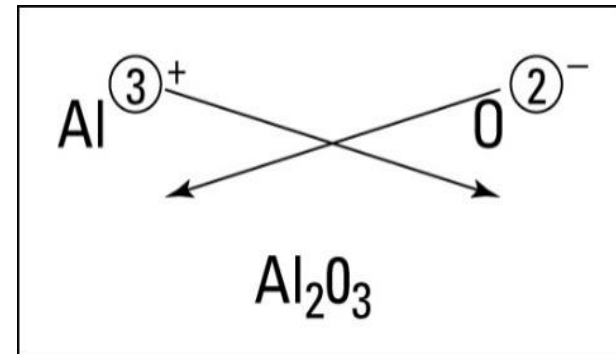
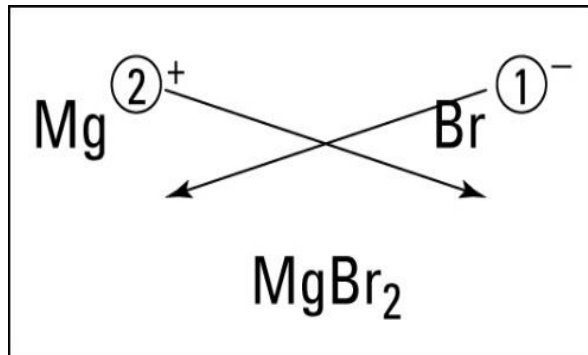
$_{9}\text{F}^{-1}: 2,8$

- Attraction forces between the positive and negative ions formed is called Ionic Bonding.

Chemical Formulae for Ionic Compounds:

- 1- Write the symbol and charge of the metal first and the non-metal second.
- 2- Transpose only the number of the positive charge to become the subscript of the non-metal, and the number of the negative charge to become the subscript of the metal.

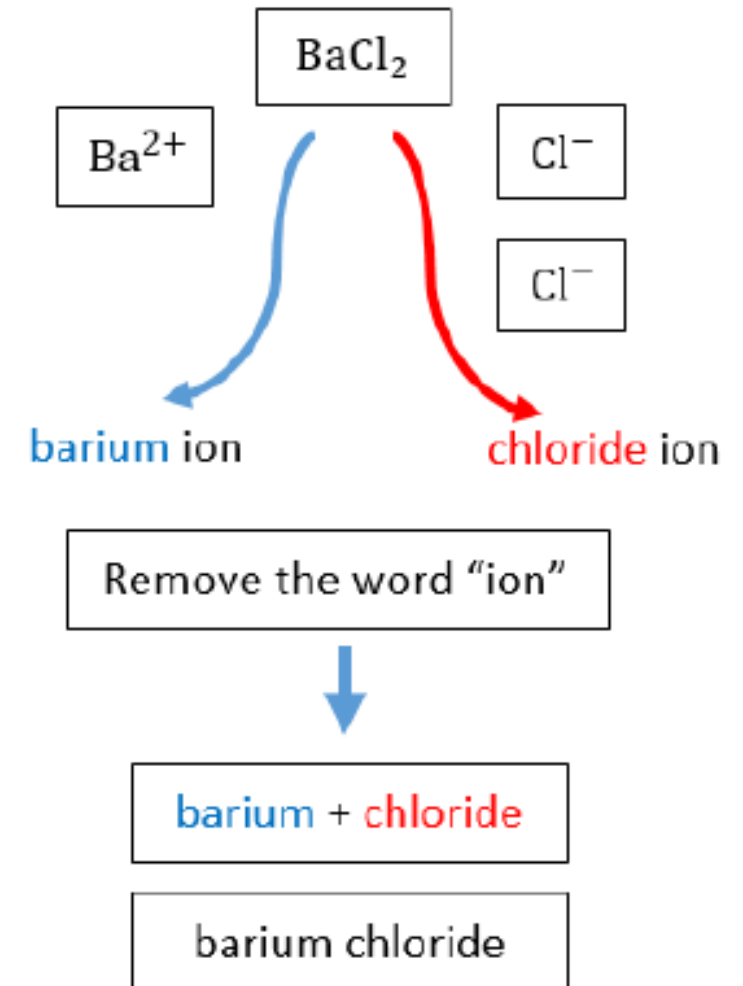
Examples of molecular formula for ionic compounds with single atomic ions:



Most compounds made up of a metal and a non-metal are ionic.

Naming Ionic Compounds:

- Always name the cation before the anion; in the chemical formula, the cation will always appear first as well.
- When naming the cation within an ionic compound, we don't include the word ion or the charge. We only have to name the element that the ion came from.
- When naming the anion within an ionic compound, the suffix *-ide* is added to the root name of the element.



Ionic bonding and physical properties

Ionic compounds have high melting points. This is because the electrostatic attraction between oppositely charged ions is strong.

Ionic compounds are brittle, If you drop a crystal of an ionic compound, it breaks between one row of ions and another. The broken pieces have straight ridges.

As ionic compounds are made of CHARGED IONS, they can CONDUCT ELECTRICITY but ONLY if the ions can MOVE.

