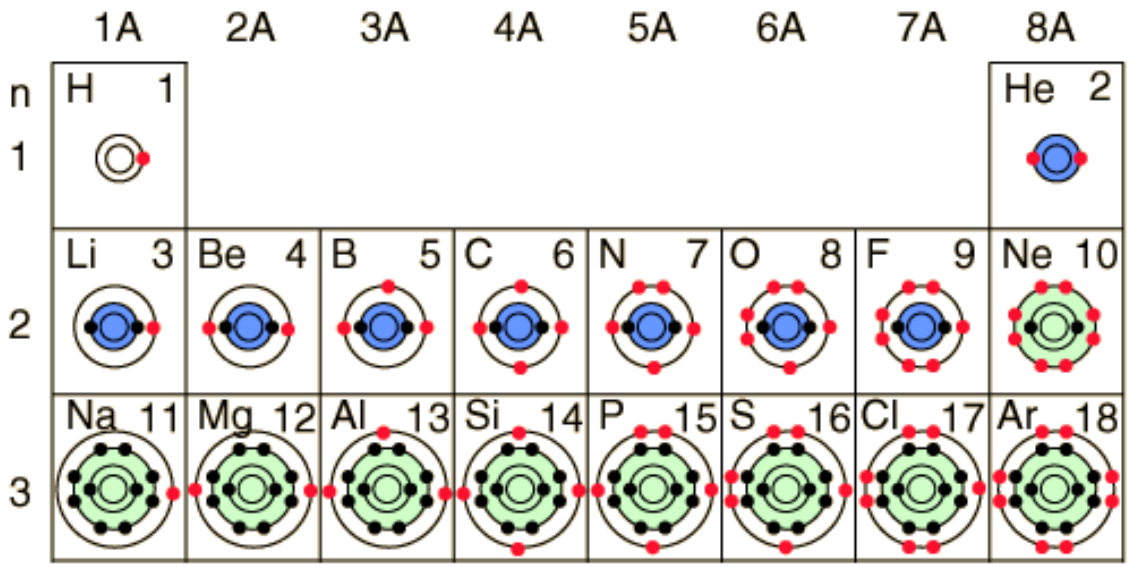
Grade 9 Science

Atoms, Elements and Compounds

Class 3

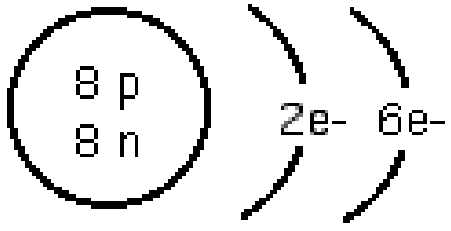


Patterns in the Periodic Table

- As you go down the family, what do you see?
  - Number of orbits increases
  - Number of electrons in the outer orbit is the same
- The outer electrons (valence electrons) are held loosely the farther they are from the nucleus
- As you go across a period, what do you see?
  - Number of valence electrons increases

Condensed Notation: Bohr-Rutherford Diagrams

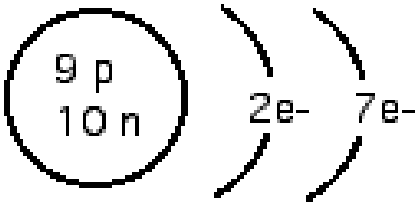
- Drawing Bohr-Rutherford Diagrams can become cumbersome
- Instead of drawing full circular orbitals and all the electrons, the condensed notation shows partial orbits and the number of electrons in each shell



How to Draw a Condensed Notation B-R Diagram

Draw the Condensed Notation BR Diagram for Fluorine

1) Draw the nucleus and write the number of protons and neutrons inside
2) Draw the half orbitals and label the number of electrons in each shell



Checkpoint

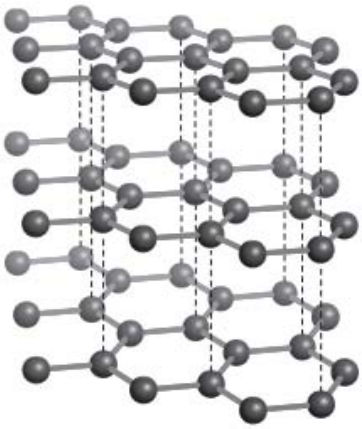
Draw the Condensed Notation Bohr-Rutherford Diagram of:

a) Magnesium
b) Argon

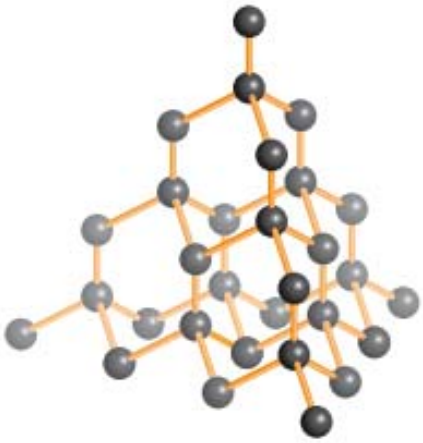
Charcoal to Diamonds



- Charcoals, graphite and diamonds are all made of carbon but differ in the arrangement
  - Charcoal – random arrangement
  - Graphite – sheets of carbon atoms
  - Diamond – 3D arrangement of carbon atoms



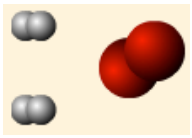
Graphite



Diamond

Atoms and Molecules

- Molecules – 2 or more atoms of the same or different elements that are chemically joined together in a unit
  - Molecular Elements – molecule consisting of atoms of the **same element** (ex: H_2, O_2, F_2, Br_2, I_2, N_2, Cl_2)



  - Molecular Compound – molecule consisting of atoms of different elements (ex: H_2O, CO_2)

Checkpoint

Consider the following substances:

H_2 CO_2 Ne C_3H_8

Which substances are:

a) Elements

b) Compounds

c) Atom

d) Molecule

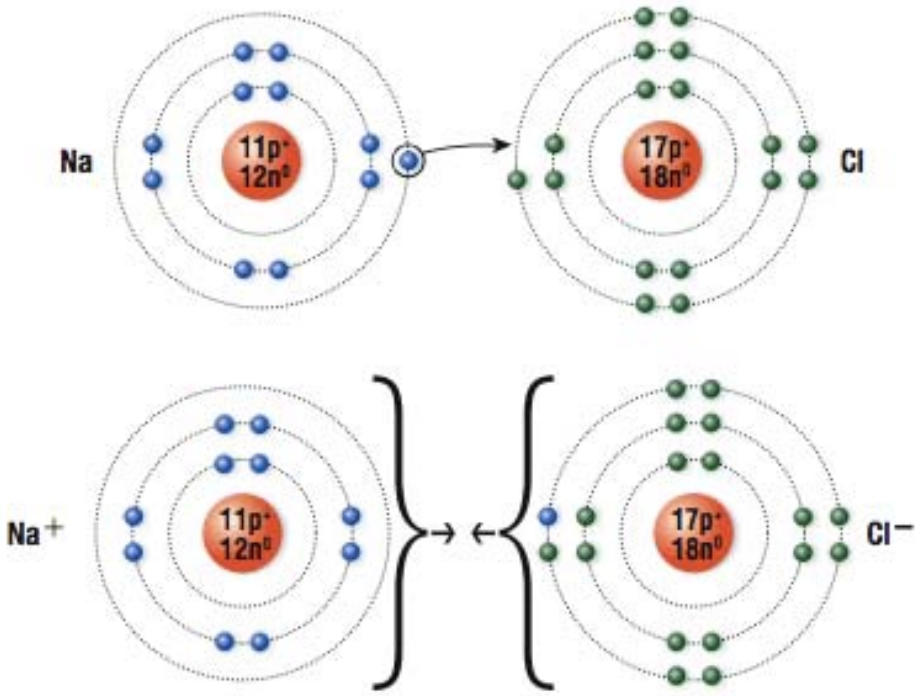
How Atoms Combine

- Atoms combine to become more stable
  - Metal + Metal (alloy) ex: sterling silver – 92.5% silver and 7.5% copper
  - Metal + Nonmetal (ionic compound) ex: NaCl
  - Nonmetal + Nonmetal (covalent compound) ex: H_2

Ionic Compounds

- Ionic compounds: made up of charged particles called ions; metal + nonmetal
  - Cation – positively charged ion (ex: Na^+, Mg^{2+})
  - Anion – negatively charged ion (ex: Cl^-, O^{2-})
- Atoms become ions due to a loss/gain of electrons

	Sodium, Na^+	Chloride, Cl^-
positive charge (protons)	+11	+17
negative charge (electrons)	−10	−18
ionic charge	+1	−1



Checkpoint

Find the molecular formula of sodium sulfide using a complete Bohr-Rutherford Diagram.

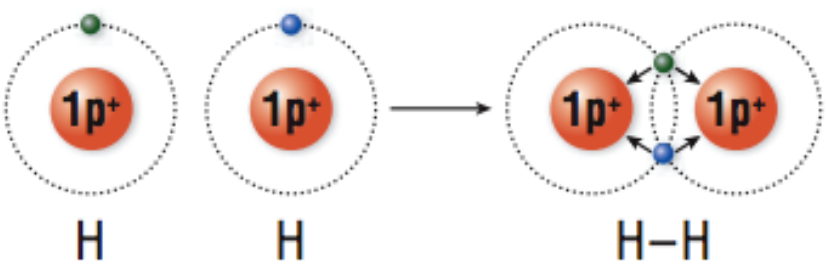
Naming Ionic Compounds

1. Write the name of the metal and nonmetal
2. Change the ending of the nonmetal to -ide

Chemical formula	Chemical name	Common name	Common use
NaCl	sodium chloride	table salt/road salt	food seasoning, melting road ice
KCl	potassium chloride	potash	fertilizer
CaO	calcium oxide	quicklime	masonry
NaOH	sodium hydroxide	lye	drain cleaner
$CaCO_3$	calcium carbonate	limestone, chalk	building materials
$NaHCO_3$	sodium hydrogen carbonate	baking soda	rising agent in baking
$Mg(OH)_2$	magnesium hydroxide	milk of magnesia	antacid
$CuSO_4$	copper(II) sulfate	bluestone	algicide and fungicide

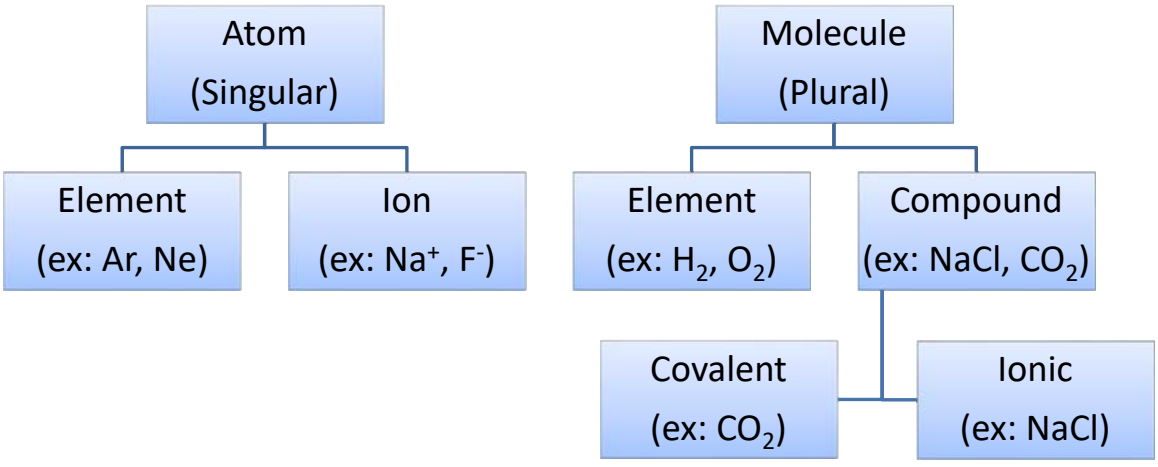
Covalent Compounds

- Unlike ions, nonmetals do not feel a strong pull for electrons
- They share the electrons and form a covalent bond



Chemical formula	Chemical name	Common name	Common use/Source
N_2	nitrogen	nitrogen	• approximately 80 % of air
O_2	oxygen	oxygen	• approximately 20 % of air
O_3	trioxygen	ozone	• in stratosphere • absorbs ultraviolet light
H_2O	dihydrogen oxide	water	• needed in all cells • home for aquatic organisms
CO_2	carbon dioxide	dry ice (solid)	• carbonated beverages • refrigeration
HCl	hydrogen chloride	muriatic acid (solution)	• stomach acid • important industrial chemical
CH_4	methane	natural gas	• fuel
NH_3	nitrogen trihydride	ammonia	• used in fertilizers and household cleaners
C_3H_8	propane	propane	• fuel
$C_2H_4O_2$	acetic acid	vinegar	• used in cooking • preservative
$C_9H_8O_4$	acetylsalicylic acid (ASA)	Aspirin	• blood thinner • for pain

Concept Map



Gas Tests

- Oxygen is essential for burning; things burn more vigorously in oxygen
- Hydrogen ignited in air causes an explosive "pop" sound because the H combines with O_2 to form water vapour
- Carbon dioxide does not burn; extinguishes the flame

Oxygen Gas Test

- Hydrogen peroxide will decompose into water and oxygen gas with a manganese catalyst

$$2H_2O_2 \xrightarrow{Mn} 2H_2O + O_2$$

- Presence of oxygen will cause your glowing splint to re-ignite

Hydrogen Gas Test

- Magnesium metal and hydrochloric acid will cause the Mg to dissolve and form hydrogen bubbles

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

- The hydrogen gas will cause the splint to make a “pop” sound

Carbon Dioxide Gas Test

- Hydrochloric acid and baking soda will break into sodium chloride, water and carbon dioxide

$$HCl + NaHCO_3 \rightarrow NaCl + H_2O + CO_2$$

- Formation of carbon dioxide will extinguish your burning flame

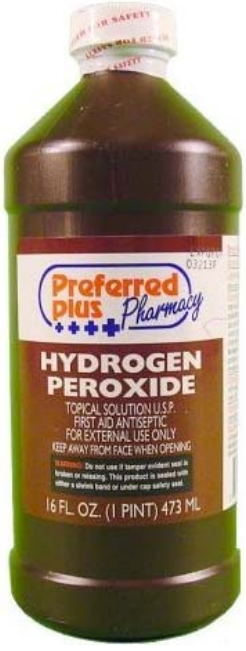
Checkpoint

Why do think:

a) Birthday balloons are filled with Helium instead of Hydrogen?

b) During surgery with oxygen chambers, why do medical staff wear coverings over their shoes to eliminate sparks due to static electricity?

Hydrogen Peroxide H_2O_2



- Found in teeth whiteners, hair bleach, disinfectant, contact lens solutions
- Hydrogen Peroxide easily breaks into a more stable hydrogen and oxygen
  - The oxygen released can bleach many chemicals
- Bought in plastic, brown bottles to prevent explosions