

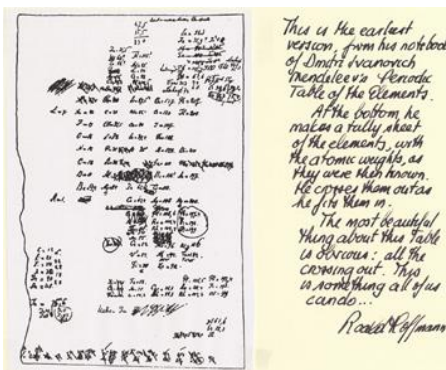
Physical Science

Chapter 18

Atoms and Bonding

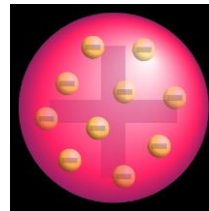
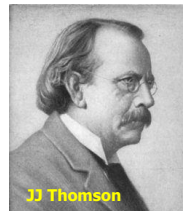
Dmitri Mendeleev - 1869

- Mendeleev was born in Siberia, Russia in the year 1834. He died in 1907
- He was a professor of Chemistry at the St. Petersburg University.
 - Trying to explain to his students how elements had similar properties, he started organizing the elements into rows and columns
- He observed that some elements have similar chemical & physical properties
- The first periodic table was organized by atomic mass
 - The masses were compared to Hydrogen, the lightest known element at the time.
- The modern Periodic Table is organized by Atomic number



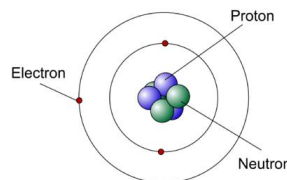
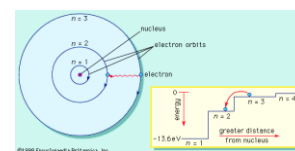
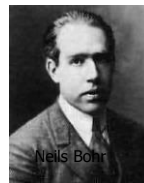
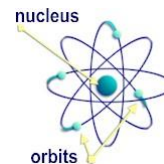
Atomic Models in History

- **Democritus**, Greek philosopher, around 400 BC used the term "**atomos**" which means "indivisible-unbreakable" to describe (where we get the word "atom")
- **John Dalton**, 1808 – very similar to Democritus said atoms were like **solid balls**
- **JJ Thomson**, 1897 – described the atom as a positively charged sphere with negatively charged electrons embedded inside to create a neutrally charged particle. Often described as a **muffin w/ berries scattered throughout**.



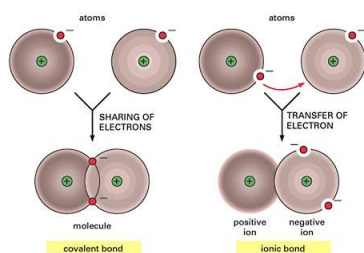
Atomic Models in History

- **Rutherford**, 1911 – refined Dalton's theory & stated atom is mostly empty space and the **negatively** charged electrons **randomly orbit** the **positively** charged **nucleus**.
- **Bohr**, 1913 – Said electron **NOT random** but in **specific layers** or energy levels. **Increasing in energy** the farther from the nucleus
- **Chadwick**, 1932 – realized the mass of the atoms didn't correspond to the mass suggested by Bohr's model. He discovered the neutron and determined they were in the nucleus with the protons
- **Modern Theory**, present – shows electrons not in orbits but specific **clouds**, each having their own level of energy



Chemical Bonds

- A **chemical bond** forms between two atoms when valence electrons move between them
- Two main types of chemical bonds
 - **Covalent Bonds**: occur between atoms when valence electrons are **shared**.
 - **Ionic Bonds**: occur when valence electrons are **transferred** (**stolen**) between atoms
- A third type of bond between atoms are **hydrogen bonds**



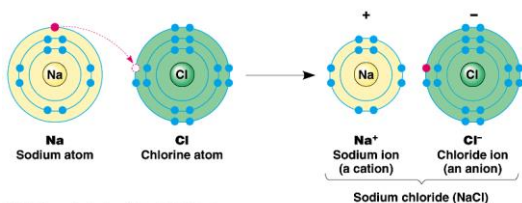
Ionic Bonding

- When an atom gains or loses an electron or two they no longer have a neutral charge. A charged atom is called an "ion"
- An ion w/ extra electrons makes it negatively charged, this is an Anion
- An ion w/ more protons than electrons makes it positively charged & is called a Cation.
- A "+" ion (**Cation**) is attracted to a (-) ion (**Anion**) just like two magnets are attracted to each other
- When ions get close enough together they form a chemical bond – an Ionic Bond!

Ding-a-Ling! Ding-a-Ling!
A metal and a nonmetal
will form Ionic Bonds
when chemically bonded
together!!

Naming Ionic compounds

1. The metal is named first
2. If the anion is an element, the end of its name is changed to "ide"
3. Polyatomic ions usually keep their names



Copyright © Pearson Education, Inc., publishing as Benjamin Cummings.

NTK - "Polyatomic" ions
 HCO_3^{-1} Bicarbonate
 NO_3^{-1} Nitrate
 O^{-2} Oxide
 SO_4^{-2} Sulfate
 CO_3^{-2} Carbonate

Counting Atoms in an Equation

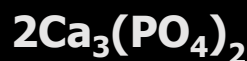
- If no subscript present it is assumed to be 1 atom
- If elements in brackets or parenthesis, treat same as in math.
- Coefficients multiple the entire molecule atoms
- You must add all reactant molecules together & compare w/ all molecules in the products



Ca=1
Cl=2



Ca=3
P=2
O=8



Ca=6
P=4
O=16

Use this to help with
worksheet pg. 51 –
Number of Atoms in a
Formula !!!

It's best to list the # of
atoms under the molecules
as we are doing in these

examples

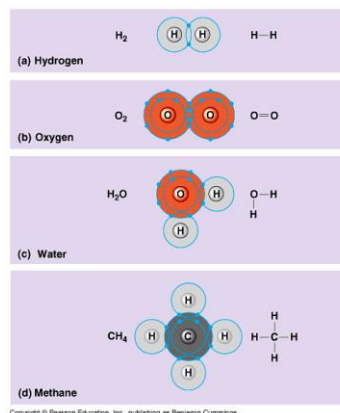
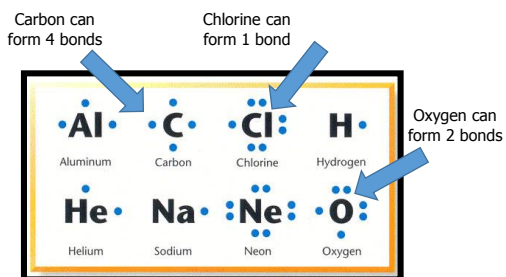
Writing Binary Formulas

- Ions build strong bonds that have a **net electrical charge of 0** (zero)
- Remember the **Cation** (+ ion) is listed 1st, the **Anion** (- ion) is 2nd
- You write how many of the ions you need as subscripts.
- A Sodium ion, Na^+ will bond with a Chlorine ion, $\text{Cl}^- \rightarrow \text{NaCl}$
- A Barium ion, Ba^{+2} , will bond with a Flourine ion, $\text{F}^- \rightarrow \text{BaF}_2$
 - How many Flourine ions do you need to balance the +2 charge on the Ba ion? ... you need 2 and you write the formula as a subscript on the Flourine ion.
- A Silver ion, Ag^+ will bond with an Oxygen ion, $\text{O}^{2-} \rightarrow \text{Ag}_2\text{O}$
 - You need 2 Ag^+ to balance the O^{2-} charge
- A Nickel ion, Ni^{+3} will bond with an Oxygen ion, $\text{O}^{2-} \rightarrow \text{Ni}_2\text{O}_3$
 - With this bond you need 2 Nickel⁺³s that have a total of a +6 electrical charge to balance 3 Oxygen⁻²s that will have a total of -6 electrical charge. A +6 added to a -6 = 0

Use this to help with
worksheet pg. 54 –
Writing Binary Formulas !!!

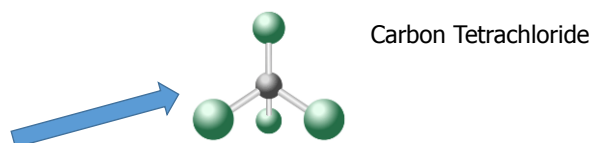
Covalent Bonding

- When valence electrons are “shared”, covalent bonds are formed
- They are generally weaker than Ionic bonds
- The number of bonds an atom can form is equal to the number of electrons needed to reach the required 8 valence electrons
- Hydrogen needs only 1 to be like Helium that has 2 and fills its “S” orbit.

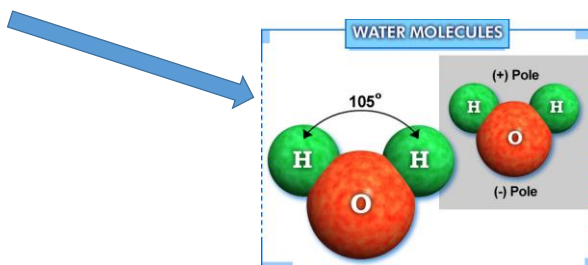


Ding-a-Ling! Ding-a-Ling!
Two or more nonmetals
will form Covalent Bonds
when chemically bonded
together!!

Polar or Nonpolar Covalent Bonding

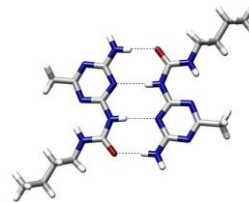
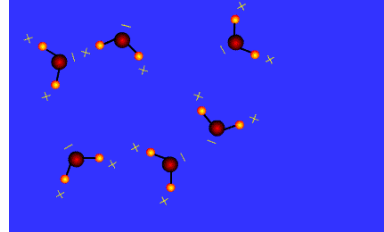
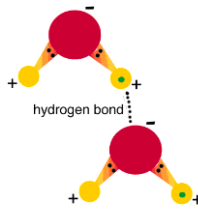
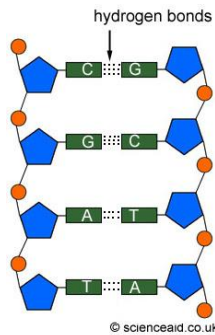


- Nonpolar Covalent Bonds - Equal sharing of electrons
- Polar Covalent Bonds – an unequal sharing of electrons
- Some atoms pull stronger on the “shared” electrons than other atoms
 - These electrons move closer to these atoms and they become more negatively charged
 - The atom that the shared electrons move away from become slightly positively charged



Hydrogen Bonds

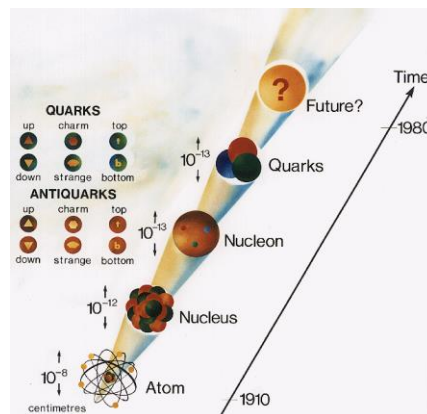
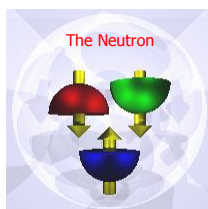
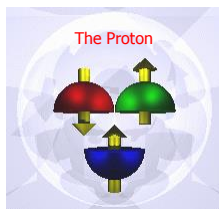
- The weak attractive force of a hydrogen atom and a negatively charged part of another molecule/atom.



Here's a little secret....Quarks!

- Protons** and **Neutrons** can be broken into smaller elemental particles called quarks!
- Quarks** – the building blocks of subatomic particles. These “FLAVORS” come in 3 pairs, so there are 6 different quarks: Up, Down, Top, Bottom, Charmed and Strange
- A **quark** has a mass of 1/3 AMU
- An **Up quark** has a 2/3 positive charge and a **Down quark** has a 1/3 negative charge
- A proton is made up of 2 “up” quarks and 1 “down” quark
 - Which gives it a net +1 electrical charge
- A neutron is made of 2 “Down” quarks and 1 “Up” quark.
 - Which gives it a net 0 electrical charge

The electron is also an elementary particle known as a “Lepton” & has a mass 1/612 that of a quark



No Mas!!
No Mas!!
We be done!!