Matter

Ions & Isotopes

Ions

- A neutral atom has the same number of __protons__ as __electrons__
- An ion is different because it has either lost or gained __electrons__ and is now a charged particle

Ions

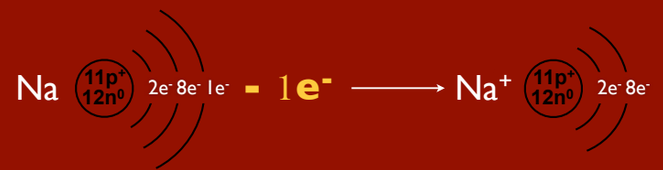
- An atom that has gained electrons is called an ___anion___ and has a __negative__ charge
- An atom that has lost electrons is called an __cation___ and has a ___positive___ charge

Ions

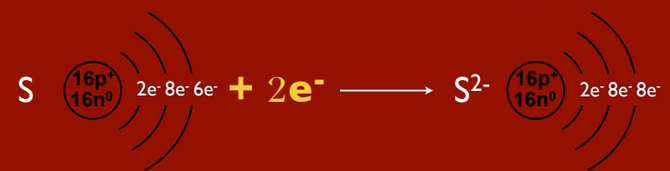
- Non-metals tend to __gain__ electrons
- Metals tend to __lose__ electrons
- **Bonus**: metals and non-metals form this kind of bond: __ionic__

Examples

Sodium



Sulfur



Practice

- Draw the following elements when they form ions:
  - nitrogen
  - beryllium

Isotopes

- Isotopes are atoms of an element that have the same number of __protons__ but a different number of __neutrons__
- Since they have the same number of __protons__ and __electrons__ they have similar __chemical__ properties
- Isotopes have different __masses__

Isotopes

- oxygen has three naturally occurring isotopes:
  - $^{16}_{8}O$ is also called oxygen-16
    # of neutrons = __8__
  - $^{17}_{8}O$ is also called oxygen-17
    # of neutrons = __9__
  - $^{18}_{8}O$ is also called oxygen-18
    # of neutrons = __10__

Radioisotopes

- Radioactive decay is the spontaneous change of one element into another
- All radioisotopes have a characteristic called a half-life
- A half-life is the time it takes for half of the number of original radioactive atoms to decay
- The half-life of radioisotopes varies considerably

Radioisotope	Half-life
Polonium-216	0.16s
Cesium-142	5×10^{15} a
Carbon-14	5730 a

The S.I. unit for half-life is "a" which means years from the Latin root "annum"

Radioisotope Use

- C-14: to date former living materials such as plants and animals
- K-40: to date non-living materials such as rocks
- Co-60: food irradiation to kill bacteria
- Ra-226: cancer treatment (along with Co-60

Problems with

- Radiation can cause normal cells to mutate or die
- Acute exposure causes severe burns to skin
- Chronic exposure can cause:
  - Birth defects
  - Cancer
  - Sterility in ALL animals

Average Atomic Mass (AAM)

- Most elements are made up of 2 or more isotopes
- magnesium has 3 naturally occurring isotopes in a specific ratio, they are:
  - 79% Mg-24
  - 10% Mg-25
  - 11% Mg-26

Average Atomic Mass (AAM)

- All elements are made of isotopes in specific ratios - this is called ***isotopic abundance***
- The ***average atomic mass (AAM)*** is the average of the masses (by abundance) of all the element's isotopes

Calculating AAM for Mg

Step 1: Convert the % abundance to a fraction

Mg-24 = 79% = 79/100 = **0.79**
Mg-25 = 10/100 = **0.10**
Mg-26 = **0.11**

Step 2: Substitute the values into the formulas

AAM = mass of Mg-24(fraction of Mg-24) + mass of Mg-25(fraction of Mg-25) + mass of Mg-26 (fraction of Mg-26)

AAM = 24(0.79) + 25(0.10) + 26(0.11)
= 18.96 + 2.5 + 2.86
= 24.32u