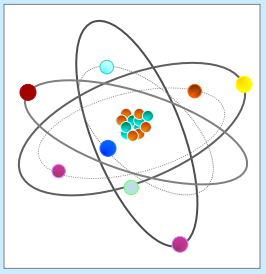
The Atom



Structure of the Atom

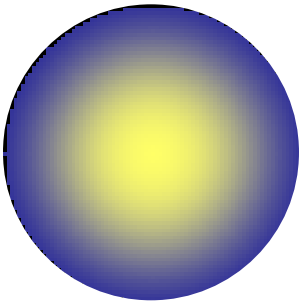
There are two regions

The nucleus

- With protons and neutrons

– Positive charge

– Almost all the mass



Electron cloud

– Most of the volume of an atom

– The region where the electron can be found

Most of the atom is empty space.

Size of an atom

- Atoms are incredibly tiny.
- Measured in picometers
- Nucleus is tiny and dense.
- IF the atom was the size of a stadium, the nucleus would be the size of a marble.

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Subatomic particles

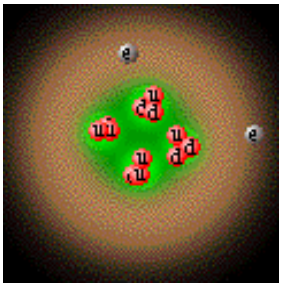
Name	Symbol	Charge	Relative mass	Actual mass (g)
Electron	e^-	-1	~0	9.11×10^{-28}
Proton	p^+	+1	1	1.67×10^{-24}
Neutron	n^o	0	1	1.67×10^{-24}

•Electrons and protons have equal but opposite charges

•Electrons are so tiny we say their mass is "negligible" and ignore it when doing calculations. This means that the mass of an atom comes from the protons and neutrons.

Subatomic Particles

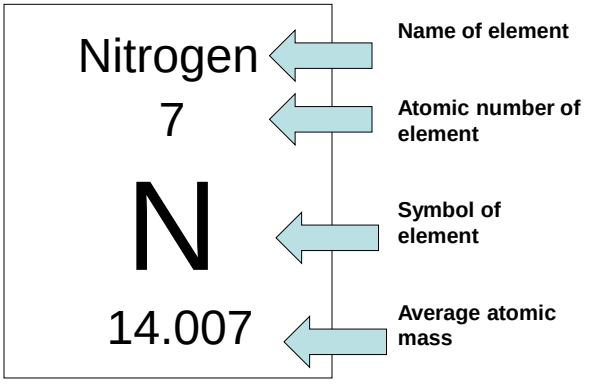
- **Quarks**
  - component of protons & neutrons
  - 6 types
  - 3 quarks = 1 proton or 1 neutron



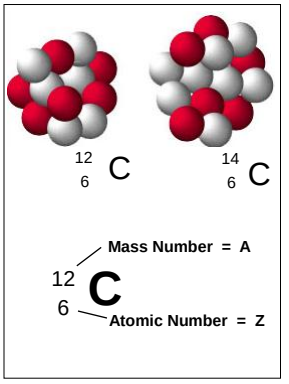
He

Courtesy Christy Johannesson www.nisd.net/communicationsarts/pages/chem

What does your periodic table tell you… how do you read it?



Counting the Pieces



Atomic Number = number of protons

# of protons determines kind of atom

Atomic Number=number of electrons in a neutral (uncharged) atom

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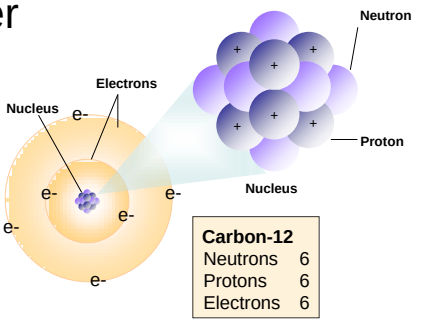
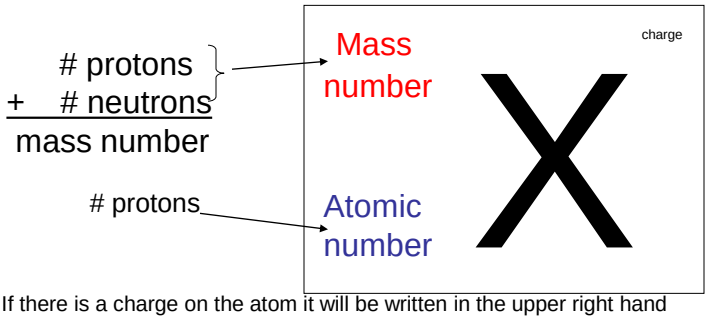
Mass Number

- mass Number = protons + neutrons
- always a whole number
- NOT on the Periodic Table!

(Periodic table has average masses, which are usually shown as decimal numbers. When you need to use the mass off the periodic table to find the number of protons or neutrons, you have to round it to the nearest whole number.)

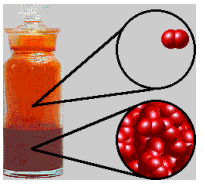


Isotope Notation



If there is a charge on the atom it will be written in the upper right hand corner- if there is nothing there assume that this is a neutral atom and the charge is zero.

Symbols



Find the

- number of protons = 35
- number of neutrons = 45
- number of electrons = 35
- Atomic number = 35
- Mass number = 80

$^{80}_{35}Br$

http://www.chem.purdue.edu/gchelp/liquids/bromine.gif

Symbols

If an element has an atomic number of 23 and a mass number of 52 what is the

- number of protons = 23
- number of neutrons = 29
- number of electrons = 23
- Complete symbol

$^{52}_{23}V$

*Notice that on the periodic table vanadium has a mass of 51. This is because of isotopes. (Much more about that later!) Use the mass number they give you in a problem, or if you need to calculate mass number add protons and neutrons together- you can't just look at the average mass on the periodic table and assume it is the mass number.

Symbols

If a neutral atom of an element has 78 electrons and 117 neutrons what is the

- Atomic number = 78
- Mass number = 195
- number of protons = 78
- Complete symbol

$^{195}_{78}Pt$

IONS

- IONS are atoms or groups of atoms which have lost or gained electrons to become positively or negatively charged

=> Have unequal numbers of protons and electrons

IONS

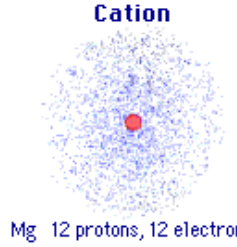
- Losing an electron from an atom gives a CATION with a positive charge
- Adding an electron to an atom gives an ANION with a negative charge.
- To tell the difference between an atom and an ion, look to see if there is a charge in the superscript!

Examples: Na^{+} Ca^{+2} I^{-} O^{-2}

Na Ca I O

Forming Cations & Anions

A CATION forms when an atom loses one or more electrons.



$Mg \rightarrow Mg^{2+} + 2\ e^-$

An ANION forms when an atom gains one or more electrons

$F + e^- \rightarrow F^-$

PREDICTING ION CHARGES

In general

- metals lose electrons ---> cations
- nonmetals gain electrons ---> anions

Symbols

Find the

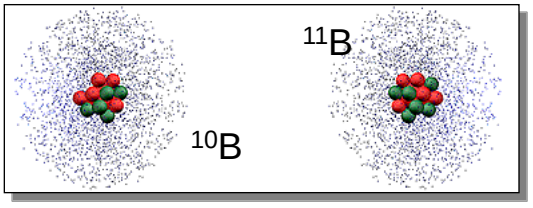
- number of protons = 11
- number of neutrons = 12
- number of electrons = 10
- Atomic number = 11
- Mass number = 23

$^{23}_{11}Na^{1+}$

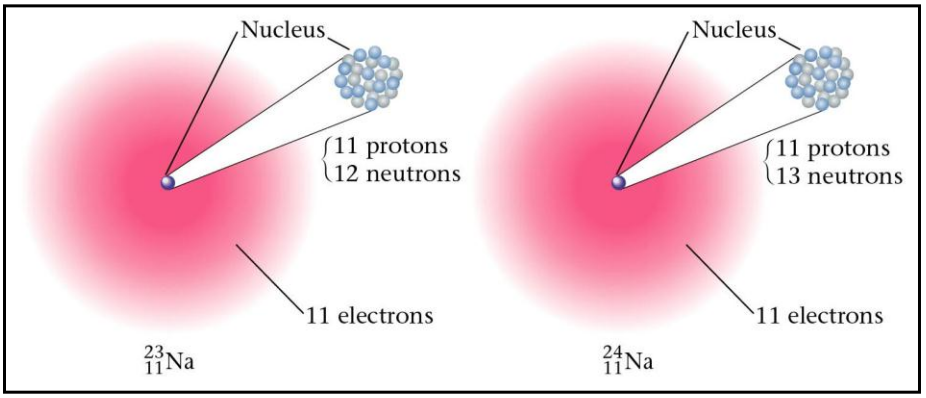
Sodium ion

Isotopes

- Atoms of the same element (same # of protons) but different mass number
- Caused by atoms having different numbers of neutrons
- Boron-10 (^{10}B) has 5 p and 5 n
- Boron-11 (^{11}B) has 5 p and 6 n



Example: Two isotopes of sodium.



Na-23 Na-24

Atomic Symbols

- Show the name of the element, a hyphen, and the mass number in hyphen notation

  sodium-23

- Show the mass number and atomic number in nuclear symbol form

  mass number → ^{23}Na

  atomic number → $_{11}$