Subatomic Particles

Subatomic Particles

- Subatomic particles-particles that are smaller than an atom, make up an atom
- Protons-positive particles
- Neutrons-neutral particles
- Electrons-negative particles

Location of particles

- Protons and neutrons are found in the nucleus of the atom. Dense, central area of an atom.
- Electrons are buzzing around the nucleus in the electron cloud or shell.
- The nucleus makes up 99.99% of the ***mass*** of the atom.
- You compared to pocket lint
- The nucleus is 1/100,000 of the ***volume*** of an atom. The volume is comprised by the electron cloud.
- a marble compared to a football stadium

Mass of particles

- Since subatomic particles are so small they cannot be measured in grams
- instead they are measured in atomic mass units or amu
- 1 amu = 1.61×10^{-24} g
- remember 1 g is about the mass of a paper clip

Table of particles

name	symbol	charge	location	mass
protons	p^+	positive	nucleus	1 amu
neutrons	n^o	neutral	nucleus	1 amu
electrons	e^-	negative	electron shell	.0006 amu

Determining the number of subatomic particles in an atom

Determining the number of protons

- **Atomic number** (the number the periodic table is arranged by) is the number of protons in an atom.
- This number cannot change for a given element without changing the element.
- Oxygen will always have 8 p^+, He will always have 2 p^+.

Determining electrons

- If the atom is neutral, the number of protons equal the number of electrons.
- Therefore copper has 29 e^-
- Krypton has 36 e^-
- Electrons are the easiest to add or remove from an atom.
- This number can be different from atom to atom

Ions

- Charged Particles (atoms that are not neutral)
- They can be made by changing the number of electrons NOT protons!!
- Sr^{2+} or Sr^{++} means strontium with a 2+ charge on it.
- Strontium with 38 protons and 36 electrons
- O^{2-} or O^{--}
- Oxygen with 8 protons and 10 electrons

Determining the number of neutrons in an atom

- The atomic mass number is the number of protons + the number of neutrons.
- mass number – atomic number = # of n^o
- Aluminum has a mass number of 27 and an atomic number of 13, how many neutrons?
- 14
- The number of neutrons is slightly variable in a given element.

Number of particles in an atom

- Chlorine has a mass number of 35 and an atomic number of 17, how many neutrons, protons and electrons?
- $n^o = 18$, $e^- = 17$, $p^+ = 17$
- Neon has a mass number of 20 and an atomic number of 10 how many neutrons, protons and electrons?
- $n^o = 10$, $e^- = 10$, $p^+ = 10$

Number of particles in an ion

- **Ion-** charged particle (atom with a different number of electrons)
- **Cl^-** mass number- 35
  atomic number- 17
- $n^o = 18$, $e^- = 18$, $p^+ = 17$
- **Be^{2+}** mass number- 9
  atomic number- 4
- $n^o = 5$, $e^- = 2$, $p^+ = 4$
- **B^{3+}** mass number- 11
  atomic number- 5
- $n^o = 6$, $e^- = 2$, $p^+ = 5$

Neutral atom Problem

Atomic number	Mass Number	p^+	n^o	e^-
			16	15
	4	2		
9	19			

Neutral atom Problem

Atomic number	Mass Number	p^+	n^o	e^-
15	31	15	16	15
2	4	2	2	2
9	19	9	10	9

Ion Problem

	Atomic number	Mass Number	p^+	n^o	e^-
O^{2-}	8	16			10
Fe^{3+}	26	56	26		
Cl^-	17	37	17		

Ion Problem

	Atomic number	Mass Number	p^+	n^o	e^-
O^{2-}	8	16	8	8	10
Fe^{3+}	26	56	26	30	23
Cl^-	17	37	17	20	18

Back to neutrons being slightly variable

- **Isotope**
- ~Atoms of the same element with a different number of neutrons.
- If you grabbed 100 Mg atoms you would find 30 had 13 n^o and 70 had 12 n^o.
- 70% of the atoms have a mass of 24 amu, 30% have a mass of 25 amu.

Decimal Mass numbers

- On the periodic table, mass numbers are decimals.
- They are averages.
- Mg
- 70 x 24 = 1680
- 30 x 25 = 750
- 2430 / 100 = 24.3

Another example

- Carbon
- out of 200 carbon atoms…
- 199 would have a mass of 12
- 1 would have a mass of 14
- so the mass number would be…

12x 199 = 2388
14 x 1 = 14
2402/200 = 12.01 amu

Quick Review

- protons- atomic number =# of p^+, this is the only number that cannot change for an element.
- electrons- if the atom is neutral then # of p^+= # of e^-. If it has a charge change this number to agree.
- neutrons- mass number – atomic number = # of n^o
- **Do not use the *mass number* from the periodic table.**