Isotopes, Ions and Shell Diagrams

Isotope notation reveals the atom's mass number and atomic number. A mass number is the sum of protons and neutrons. The atomic number is simply the number of protons. One can look up the atomic number of an element in the periodic table. They are the numbers that go up one by one. H or hydrogen is 1, meaning that a hydrogen atom has one proton; He or helium is 2; Li is 3 with three protons etc. The atomic number is what identifies the element. In fact the *periodic law states that chemical properties are a function of atomic number*.

Example

$^{3}_{1}H$ has 1 proton and (3-1) = 2 neutrons
$^{1}_{1}H$ has 1 proton and (1-1) = 0 neutrons

Both isotopes of hydrogen burn to form water. But the heavier one is radioactive and of course has a higher mass.

Isotopes then are different mass-versions of the same element. They have almost identical chemical properties but different nuclear properties (radioactivity) and different physical properties because of their weight differences.

Isotopes have practical applications. Radioactive ones such as Co-60 can be used in small quantities to treat tumours.

Ions

An ion is a charged atom. That means that the number of protons does *not* equal the number of electrons, as it does in a neutral atom.

Remember the charges of subatomic particles:

Subatomic particle	charge
proton	+1
neutron	0
electron	-1

To calculate charge: charge = # of protons - electrons

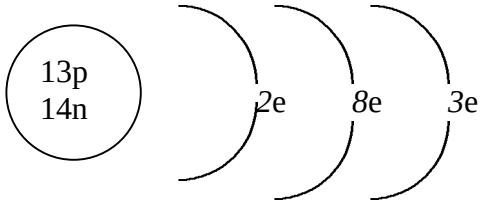
Example: If an atom of fluorine(atomic # 9) has 10 electrons, its charge is 9 - 10 = -1

Ions are chemically different from their neutral counterparts.
Example: F^{-1} (fluoride: in naming negative ions, we change the suffix of the neutral element's name to *ide*.) can be used in toothpaste to prevent cavities. F, however, is extremely poisonous. In fact it is the most poisonous gas of the periodic table.

Shell diagrams (known as Bohr-Rutherford models - in Quebec schools only)

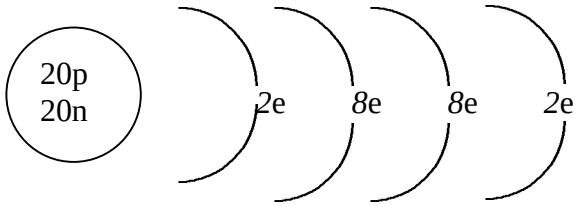
These include the number of protons and neutrons in a circle representing the nucleus, and the number of electrons in each energy level or shell, represented by arcs. For the first twenty elements you can obtain the number of electrons in each shell by counting the number of electrons in each periodic table -horizontal row leading to that element.

Example 1: ^{27}Al



Leading to Al, there are *2* elements in the first row of the periodic table, *8* in the second and then Al is the *3*rd element in its row!

Example 2: ^{40}Ca



Leading to Ca, there are *2* elements in the first row of the periodic table, *8* in the second, 8 in the third, and then Ca is the *2*nd element in its row!

More examples

Example	# of protons = atomic number from periodic table	# of neutrons = mass number - protons	# of electrons in 1st shell: maximum 2/ *Total # of electrons* = protons - charge	# of electrons in 2nd shell: maximum:8	# of electrons in 3rd shell: maximum 8 for first 20 elements	# of electrons in 4th shell:
^{2}H	1	1	1	0	0	0
^{9}Be	4	9 - 4 = 5	2	2	0	0
^{31}P	15	16	2	8	5	0
^{40}Ca	20	20	2	8	8	2