HW 5 – Electron configurations – electron donors and electron acceptors

Electrons in an atom occupy shells (energy levels represented by the letter "n") around the nucleus starting from the shell that is the closest to the nucleus (n=1). Shells can have sub-shells. The further from the nucleus, the more subshells are in each shell.

The number of the subshells in each shell is equal to the shell number "n". Subshells are called "s", "p", "d", "f".

Shell number (n)	Sub-shell
1	s
2	s, p
3	s, p, d
4	s, p, d, f

Subshells are made of orbitals. All orbitals of the same subshell have the same energy. Each orbital can be occupied by one or two electrons.

Sub-shell	Number of orbitals	Maximum number of electrons
s	1	2
p	3	6
d	5	10
f	7	14

For most elements the order of placing electrons into the subshell is:

1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, 4d, 5p, 6s, 4f, 5d, 6p, 7s, 5f, 6d,…

Rules of filling electrons' shells

1. Decide the total number of electrons to be placed (it should be equal to the number of protons, which is its atomic number)
2. Add electrons to each orbital starting with that of the lowest energy level and keeping in mind that we cannot place more than 2 electrons on each orbital

For example, for nitrogen "N" (atomic number 7) we will have to place 7 electrons into the shells, subshells, and orbitals. We will follow the order above keeping in mind how many electrons we can place in each orbital (see the table above). The **electron configuration** for this element will look like this:

$1s^2 2s^2 2p^3$

This means that the first shell "1" with one subshell "s" will be occupied by 2 electrons (the superscript shows the number of the electrons in the subshell); the second shell "2" with 2 subshells (s and p) will be occupied by the rest of the electrons (7-2 = 5). Two of these 5 electrons will be on subshell 2s (superscript 2) and 3 electrons on subshell 2p (superscript 3).

Answer the following questions:

1. Write down the electron configuration of $_8O$, $_9F$, $_{16}S$, $_{21}Sc$ (Note that the number next to the element symbol is the element's atomic number).
2. What elements have the following electron configurations: a) $1s^2 2s^2 2p^4$; b) $1s^2 2s^2 2p^6 3s^2 3p^1$, c) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s^2$?
3. What element has the outer most orbital …$3p^3$?
4. Write down electron configuration of an element with the nucleus charge = 12.
5. Which of the following atoms and ions have the same electron configuration as $_{18}Ar$: Ca^{2+}, Cl^-, K, Na^+, S^{2-}, As^{3-}, Al^{3+}?

RULE OF EIGTH: at atom tends to pick up or give away just enough electrons to make eight in its outer shell – AN **ELECTRON OCTET**.

The donors tend to achieve the octet by giving up the electrons from their outer shell and the electron acceptors tend to get octet by accepting the electrons to their outer shells.

Let's look at $_{11}Na$ and $_9F$:

F: $1s^2 \underline{2s^2 2p^5}$

Na: $1s^2 2s^2 2p^6 \underline{3s^1}$

To get 8 electrons in its outer shell F will accept one electron forming an ion F^- (with 8 electrons in its outer shell) and Na will lose one electron forming an ion Na^+ (with 8 electrons in its outer shell). Fluorine (F) is electron accepter and sodium (Na) is an electron donor.

Answer the following questions:

1. How many electrons and protons are in the molecule of ammonia, NH_3?
2. Which element is the better electron donor – the one with the nucleus charge of 3 or 19?
3. Separate the following elements into electron donors and electron acceptors: O, Na, Al, Mg, F. How many electrons each of them should give or accept to have the electron shell of neon?