

Modern Atomic Theory : Notes/W.S. - 60

We can draw pictures of atoms based on Bohr's model. This model is useful for students but is not quite correct. Electrons are really wave like and it is not possible to give a location for each electron. The structure of the modern atom depends on solutions of a complex equation called Schrödinger's equation. But this is beyond the scope of these notes.

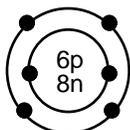
For now there are two ways to represent an atom visually; the Bohr planetary model and the Lewis-dot structure.

The Bohr representation shows the energy levels (but not the orbitals) with the electrons shown in each level. The number of protons and neutrons for the particular isotope is given. See the examples below.

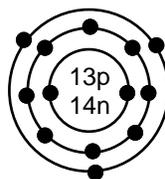
helium-4



carbon-14



aluminum-27



The number of electrons in the outermost shell for the atoms above are; 2, 4, and 3, respectively. In a Lewis-dot structure, these outer (valence) electrons are shown. See the examples below.

helium-4



carbon-14



aluminum-27



Problems.

1) Draw a picture of each of the following atoms showing the energy levels for each atom with the correct number of electrons in each level. Give the number of protons and neutrons in the nucleus.

a) beryllium-9

b) sodium-23

c) fluorine-19

2) Draw the Lewis-dot structure for each of the atoms in question 1.

3) Give the electron configuration. Assume that the atom is in the ground state.

a) Ne

b) K

4)a) Give the number of orbitals in the fifth energy level.

b) What is the maximum number of electrons in the fifth energy level?

c) How many electrons are in the 2p orbital of oxygen?

d) Why does the 4s orbital fill up with electrons before the 3d level?

e) Explain what is meant by the "octet" rule.

f) Find the number of valence electrons in:

i) Mg

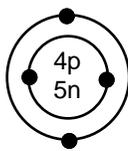
ii) P

iii) Ar

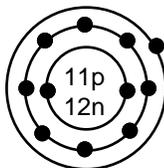
g) When the atoms in question 4f above become ions, how many electrons do they usually gain or lose?

Answers : 1)

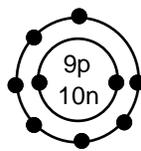
a)



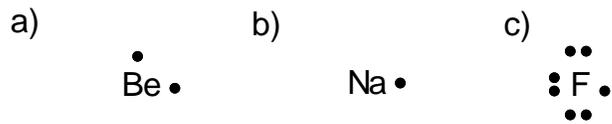
b)



c)



2)



3)a) $1s^2 2s^2 2p^6$, b) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$., 4)a) 5, b) 50, c) 4, d) It has a lower energy. Lower energy levels fill first., e) It is the tendency of an atom to "want" 8 electrons in its outermost energy level, like the noble gases., f)i) 2, ii) 5, iii) 8, g)i) lose 2, ii) gain 3 (usually), iii) do not gain or lose (usually).