Brief Instructions

An electron configuration is a method of indicating the arrangement of electrons about a nucleus. A typical electron configuration consists of numbers, letters, and superscripts with the following format:

1. A number indicates the energy level (The number is called the principal quantum number.).
2. A letter indicates the type of orbital; s, p, d, f.
3. A superscript indicates the number of electrons in the orbital. Example: ls^2 means that there are two electrons in the 's' orbital of the first energy level. The element is helium.

How To write an electron configuration:

A. Determine the total number of electrons to be represented.

B. Use the Aufbau process to fill the orbitals with electrons. The Aufbau process requires that electrons fill the lowest energy orbitals first. In another words, atoms are built from the ground upwards.

C. The sum of the superscripts should equal the total number of electrons. Example: $_{12}Mg\ ls^2\ 2s^2\ 2p^6\ 3s^2$

Configuration Writing Practice

Write a **ground state** electron configuration for each neutral atom. **Ground state** means that all of the lowest possible energy levels (up to the proper number of electrons for the element) are filled.

1. Na
2. Pb
3. Sr
4. U
5. N
6. Ag
7. Ti
8. Ce
9. Cl
10. Hg

Write a ground state electron configuration for these ions. Remember that ions have a change in the total number of electrons (positive have lost electrons and negative have gained). Example: N^{3-} is $1s^2\ \ 2s^2\ 2p^6$. It has three extra electrons

11. O^{2-}
12. Fe^{2+}
13. B^{3+}
14. Ni^{2+}
15. K^+
16. Co^{3+}
17. If each orbital can hold a maximum of two electrons, how many electrons can each of the following hold?
    a. 2s
    b. 5p
    c. 4f
    d. 3d
    e. 4d
18) Isoelectronic species have similar electron configurations. Which of these are isoelectronic?
    a) Li^+, H^-, He
    b) Ca^{2+}, Ne, S^2

For the following electron configurations choose 3 possible elements (or ions) they may represent

19) $1s^2\ 2s^2 2p^6\ 3s^2 3p^6\ 4s^2\ 3d^{10}\ 4p^4$
20) $1s^2\ 2s^2 2p^6\ 3s^2 3p^6\ 4s^2\ 3d^{10}\ 4p^5$
21) $1s^2\ 2s^2 2p^6\ 3s^2 3p^6\ 4s^2\ 3d^{10}\ 4p^6$
22) $1s^2\ 2s^2 2p^6\ 3s^2 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2\ 4f^{14}\ 5d^{10}\ 6p^6\ 7s^1$
23) $1s^2\ 2s^2 2p^6\ 3s^2 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2 4\ d^{10}\ 5p^6\ 6s^2\ 4f^{14}\ 5d^{10}\ 6p^6\ 7s^2\ 5f^{14}\ 6d^8$
24) $1s^2\ 2s^2 2p^6\ 3s^2 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2\ 4f^{10}$
25) $1s^2\ 2s^2 2p^6\ 3s^2 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2\ 4f^{14}\ 5d^{10}\ 6p^4$
26) $1s^2\ 2s^2 2p^6\ 3s^2 3p^6\ 4s^2\ 3d^5$
27) $1s^2\ 2s^2 2p^6\ 3s^2 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^2$
28) $[Kr]\ 5s^2\ 4d^{10}\ 5p^3$
29) $[Kr]\ 5s^2\ 4d^{10}\ 5p^6$
30) $[Ar]\ 4s^1$
31) $[Xe]\ 6s^2\ 4f^{10}$
32) $[Xe]\ 6s^2\ 4f^{14}\ 5d^7$
33) $[Ne]\ 3s^2\ 3p^1$

Writing Electron Configurations

1. Electrons occupy the lowest energy orbital first, then move to the next one and so on. (The "Aufbau" Princple)
2. Orbitals are considered to be in the same shell if they have the same first number (no matter in what order filling is done).
3. An atom will gain or lose electrons in order to have eight electrons in its outer shell. (The "Octet" Rule)
4. The outer shell is the highest numbered shell which has electrons in it. Only s and p orbitals are part of the outer shell.

An atom has the tendancy to lose electrons (to another atom) or to gain electrons (from another atom) in order to make the outer shell complete with eight electrons. Atoms with a complete outer shell (eight electrons) are considered stable. Some atoms naturally have eight electrons in their outer shell and are very stable. (Helium is the exception being stable with two electrons in its outer shell.)
Complete the following chart:

Element	Atomic Number	Number of e^- in each E Level	ElectronConfiguration	Number of e- probally lost or gained	Number of e^- left after loss or gain	Charge on Ion
O						
Na						
S						
K						
Al						
Cl						
Sr						
Ca						
F						
Br						
N						
I						

Electron Configuration Practice Worksheet

In the space below, write the full (unabbreviated) electron configurations of the following elements:

1) sodium _____

2) iron _____

3) bromine _____

4) barium _____

5) neptunium _____

In the space below, write the Noble Gas (abbreviated) electron configurations of the following elements:

6) cobalt _____

7) silver _____

8) tellurium _____

9) radium _____

10) lawrencium _____

Determine what elements are denoted by the following electron configurations:

11) $1s^2 2s^2 2p^6 3s^2 3p^4$ _____

12) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^1$ _____

13) [Kr] $5s^2 4d^{10} 5p^3$ _____

14) [Xe] $6s^2 4f^{14} 5d^6$ _____

15) [Rn] $7s^2 5f^{11}$ _____

Determine which of the following electron configurations are not valid: State which rule has been violated.

16) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4d^{10} 4p^5$ _____

17) $1s^2 2s^2 2p^6 3s^3 3d^5$ _____

18) [Ra] $7s^2 5f^8$ _____

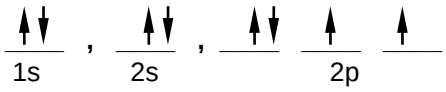
19) [Kr] $5s^2 4d^{10} 5p^5$ _____

20) [Xe] _____

Name _____ Electron Arrangements

There are three ways to indicate the arrangement of electrons around an atom:

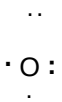
1. Orbital Filling Diagram (gives the most information)

   Ex. O_2 

2. Electron Configuration (quicker to draw than orbital filling diagrams)

   Ex. O_2 $1s^2\ 2s^2\ 2p^4$

3. Electron Dot shows only the valence *(outer energy level)* electrons

   Ex. Oxygen atom 

1. Write orbital filling diagrams, electron configurations, and electron dot diagrams for the following elements.

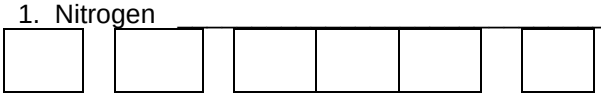
Table:

Element	Orbital Filling Diagram	Electron Configuration	Electron Dot Diagram
a. Boron			
b. Silicon			
c. Sulfur			
d. Calcium			
e. Iodine			
f. Rubidium			
g. Chromium			
h. Gallium			

Where are the Electrons?

Write the full electron configuration, short-hand electron configuration, and fill in the orbital diagrams, for the following elements.

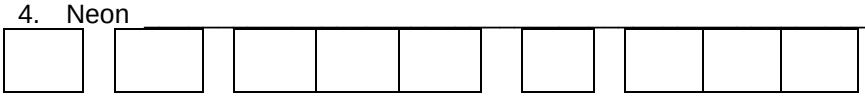
1. Nitrogen _____



2. Chlorine_____

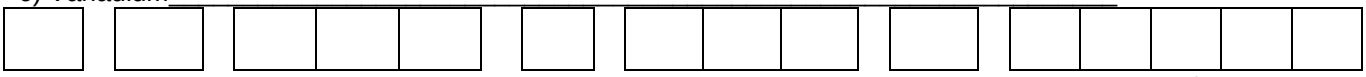
3. Sodium _____

4. Neon _____

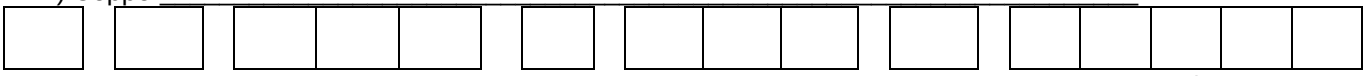


5. Nickel _____

6) Vanadium_____



7) Copper_____



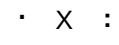
V. Conclusions:

1. Why are the outer-most electrons the only ones included in the electron dot diagram?

2. The orbital filling diagram has arrows pointing in opposite directions when two electrons occupy the same orbital. What do these arrows indicate?

3. How many electrons do the elements in Group IIA of the periodic table have in their electron dot diagrams?

4. Element "X" has an electron dot diagram:



Name at least two elements which could be X.

5. Identify the element which has the following orbital filling diagram.