Valence Electrons

Valence Electrons

- Valence electrons
  - the electrons that are in the highest (outermost) energy level
  - that level is also called the valence shell of the atom
  - they are held most loosely

- The number of valence electrons in an atom determines:
  - The properties of the atom
  - The way that atom will bond chemically
- As a rule, the fewer electrons in the valence shell, the more reactive the element is.
- When an atom has eight electrons in the valence shell, it is stable.

- Atoms usually react in a way that

- There are two ways this can happen:
  - <u>The number of valence electrons increases to eight</u>
  - <u>Loosely held valence electrons are given up</u>

Chemical Bonds

- A chemical bond is the force of attraction that holds two atoms together as a result of the rearrangement of electrons between them.
- There are two types of chemical bonds:
  - Ionic
  - Covalent

Valence Electrons by Group

Group #	Group Name	# of valence electrons
1	Alkali Metals	1
2	Alkaline Earth Metals	2
3-12	Transition Metals	1 or 2
13	Boron Group	3
14	Carbon Group	4
15	Nitrogen Group	5
16	Oxygen Group	6
17	Halogens	7
18	Noble Gases	8

Patterns on the Periodic Table

- The number of valence electrons increases as you go across the periodic table.
- When you start each new period, the number of valence electrons drops down to one and begins incr

Drawing Atoms

- When scientists draw atoms to show how they chemically bond, they only draw the valence electrons.
- We only use the valence electrons because those are the only ones involved in chemical bonding.

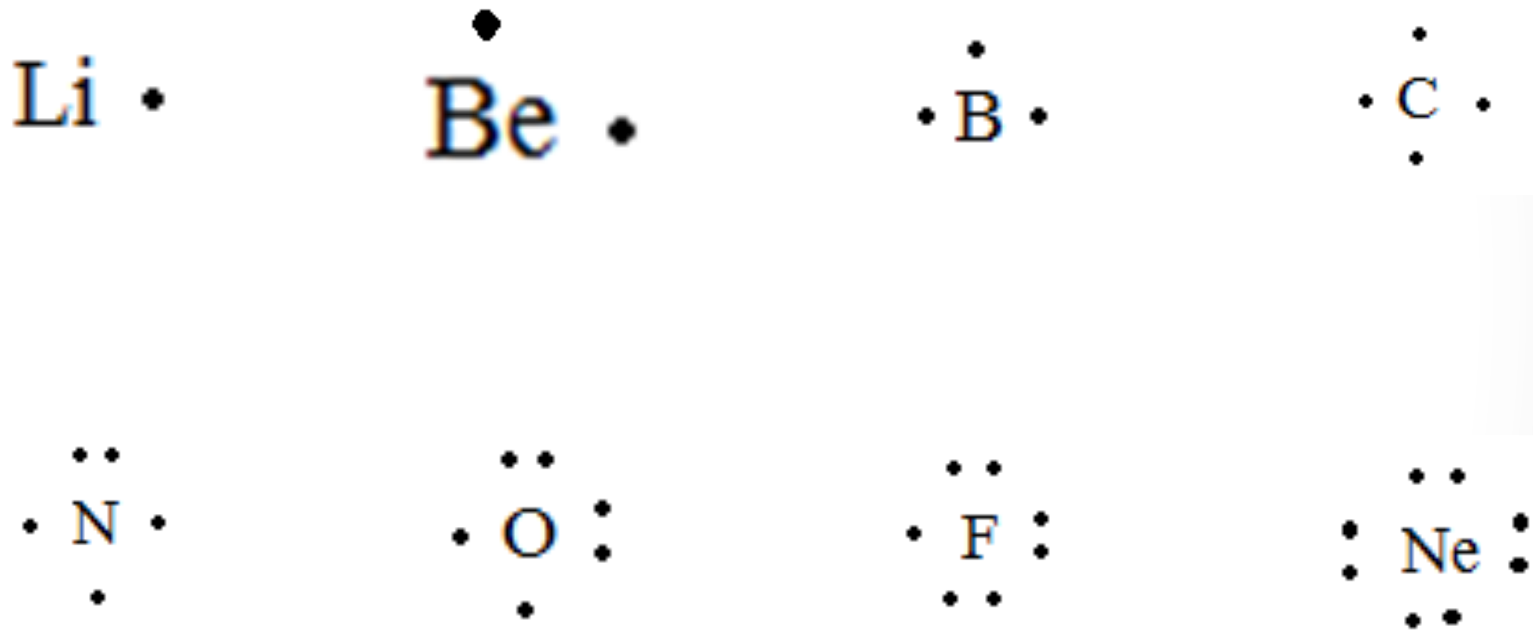
Electron Dot Diagrams

- Electron Dot Diagrams are drawings that include the chemical symbol for the element surrounded by dots.
- Each dot stands for one valence electron.
- These are also sometimes called Lewis Dot Diagrams.

- All atoms want a full valence shell (because that is how they become stable!)
- So, they will share or transfer electrons with other atoms to achieve stability.
- Negative ions form when atoms gain electrons.
- Positive ions form when atoms lose electrons.

Steps for drawing an Electron Dot Diagram

1. Write the element's chemical symbol
2. Look on the periodic table to see what group the element is in
3. Use the chart in your notes to determine how many valence electrons the element has
4. Draw the dots around the chemical symbol starting at the top and moving clockwise around the symbol


Li
Be
B
C
N
O
F
Ne

Try these on your own:

Na Al S Cl

Mg Si Ar P

Electron Configuration: Ions and Excite State

Electron Configuration - Cations

- Cations – atoms that lose electrons - metals
- Electron Configuration:
  - Magnesium – 12 electrons in its neutral state
    - $1s^2 2s^2 2p^6 3s^2$
  - ***Magnesium ion***
    - ***Loses 2 electrons***
    - New configuration: $1s^2 2s^2 2p^6$
    - Notice that the electron configuration is the same as the noble gas Neon

Electron Configuration - Anions

- Anions – gain electrons – non-metals
- Electron Configuration:
  - Chlorine – 17 electrons in its neutral state
    - $1s^2 2s^2 2p^6 3s^2 3p^5$
  - ***Chlorine ion***
    - ***Gains 1 electron***
    - New configuration: $1s^2 2s^2 2p^6 3s^2 3p^6$
    - Notice that the electron configuration is the same as the noble gas Argon
    - This indicates that by gaining 1 electron, it obtains an outer octet (stable valence configuration!)

Electron Configuration

- Both ions obtain a noble gas configuration
- This makes the ion and the noble gas **isoelectronic**
- Isoelectronic: when two elements and/or ions have the same electronic configurations with one another
- They tend to have similar chemical properties.

Isoelectric Examples

- Li^{+1} $1s^2$
- He $1s^2$

- S^{-2} $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$
- Ar $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

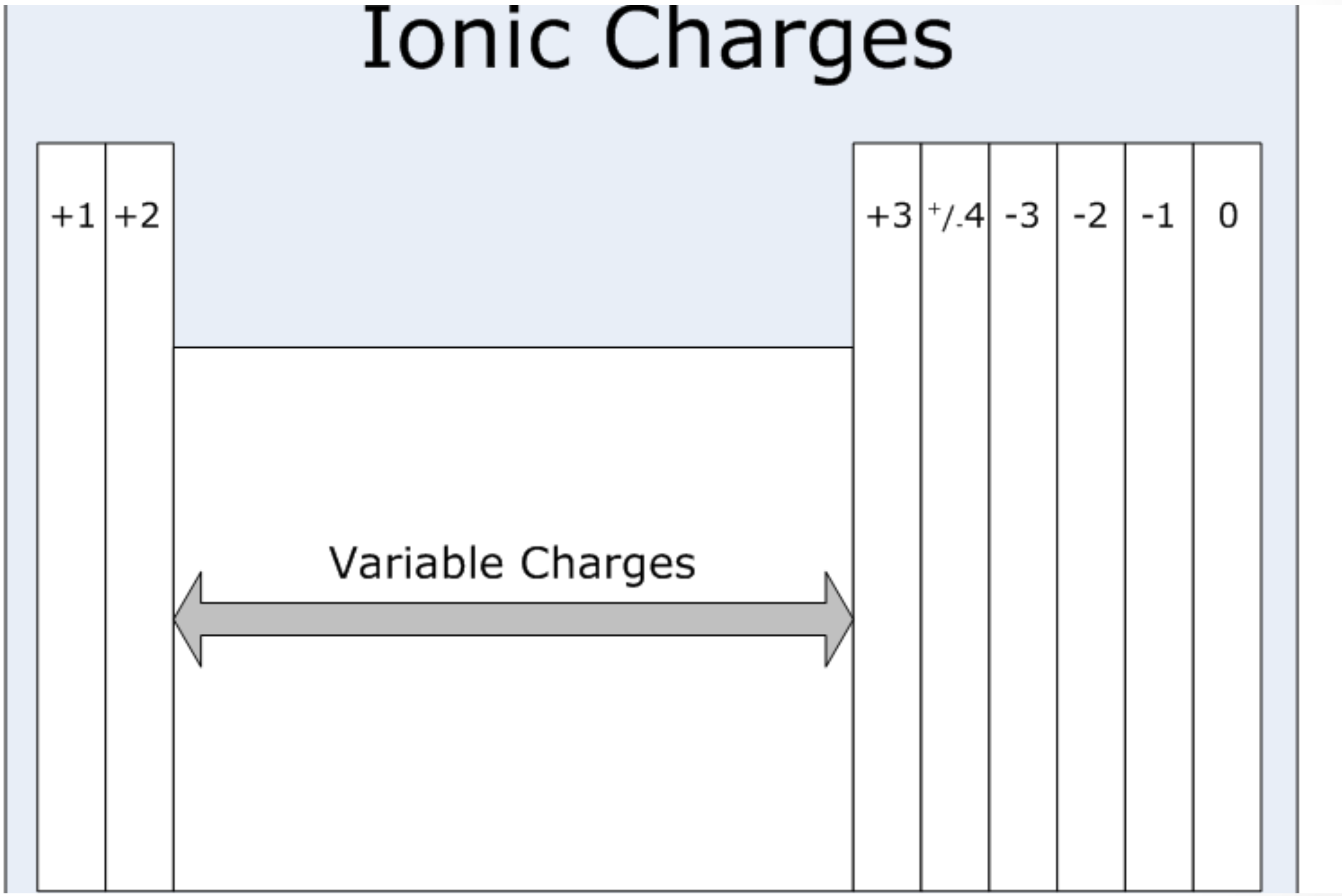
Ionic configuration problems

Cations

- Determine the electron configuration for:
- Aluminum - Al^{+3}
- Calcium – Ca^{+2}
- Potassium - K^{+1}

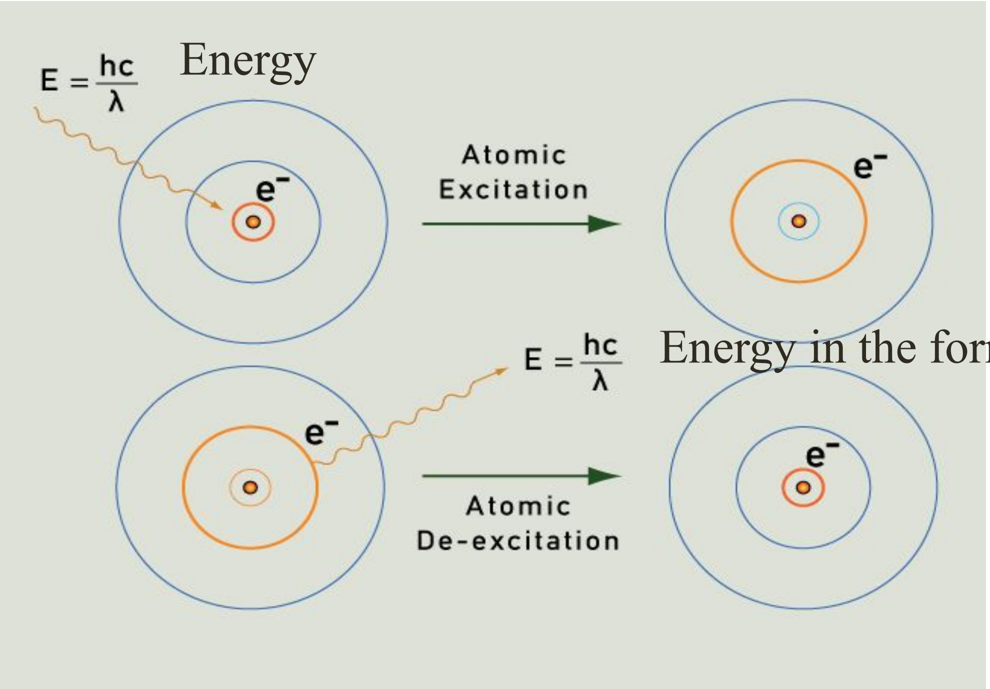
Anions

- Determine the electron configuration for:
- Nitrogen – N^{-3}
- Fluorine – F^{-1}
- Oxygen - O^{-2}


Ionic Charges
+1
+2
+3
+/-4
-3
-2
-1
0
Variable Charges

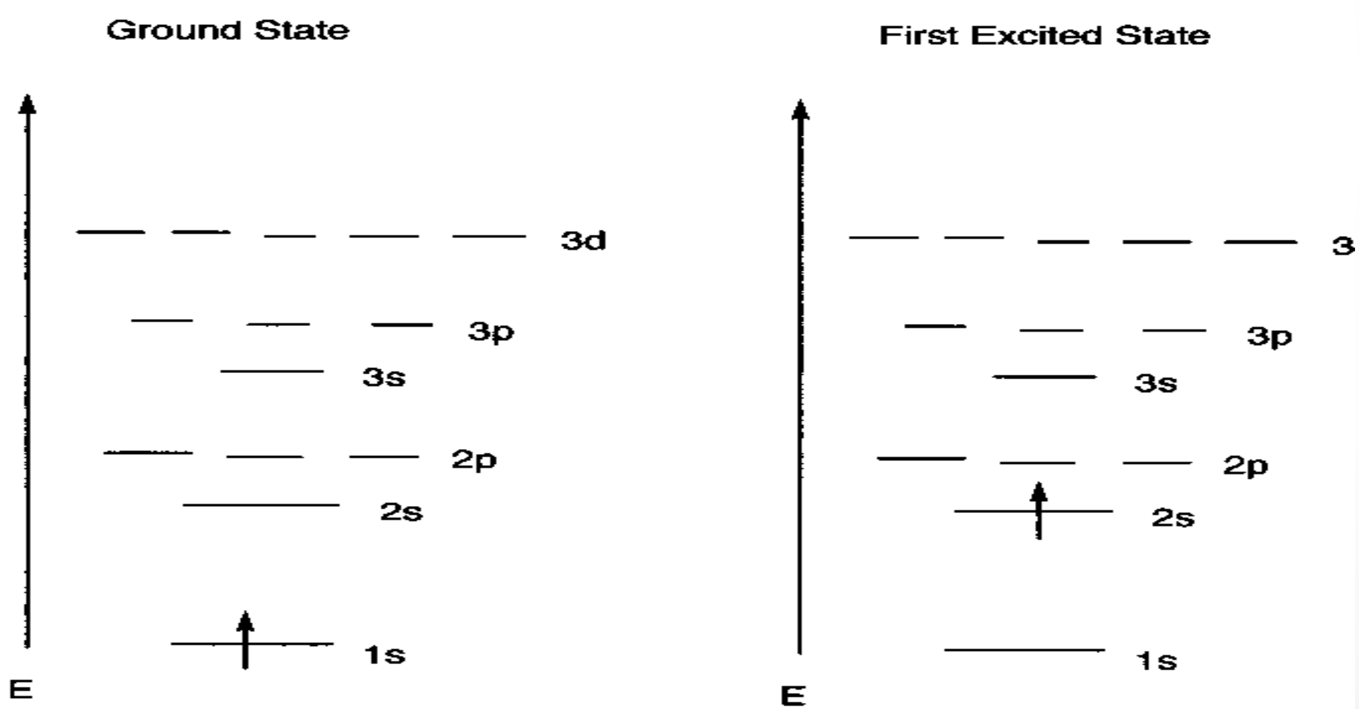
Excited State Electrons

- When an electron absorbs energy, it jumps to a higher energy level, then drop back down giving off energy in the form of light and heat



Excited State Electrons

- The electron configuration for an excited state electron shows one or more electrons in a higher energy level



Excited State Electrons

- You need to be able to determine an electron in the excited state
- Ex:

Element	Ground State	Excited State
Fluorine	$1s^2\ 2s^2\ 2p^5$	$1s^2\ 2s^2 2p^4\ 3s^1$
Sodium	$1s^2\ 2s^2\ 2p^6\ 3s^1$	$1s^2\ 2s^2\ 2p^6\ 3p^1$