Chem 111

Lecture 27

Announcement

- Recitation session, Wednesday 11/17 at HASA 126 (5-6pm)
- Delay on lecture notes going up

Homework

- Start Reading Chapter 8
- Owl Homework

Recap

TRENDS

- Atomic Radii
- Ionization Energy
- Electron configuration
- Electron Affinity

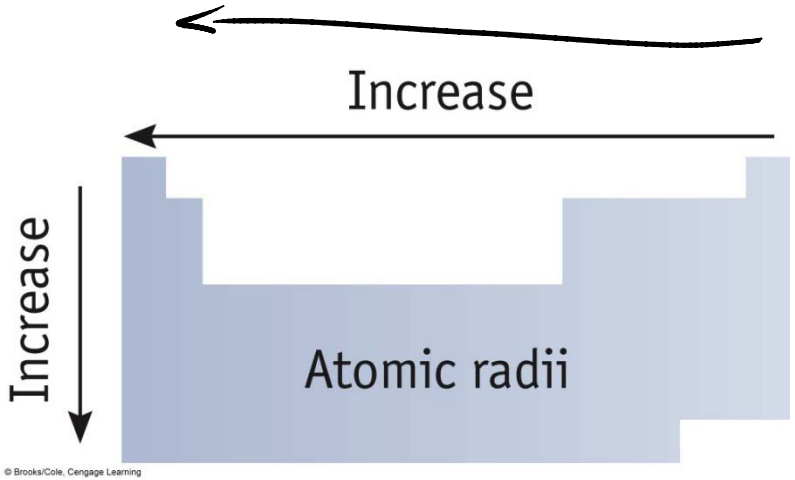
ions

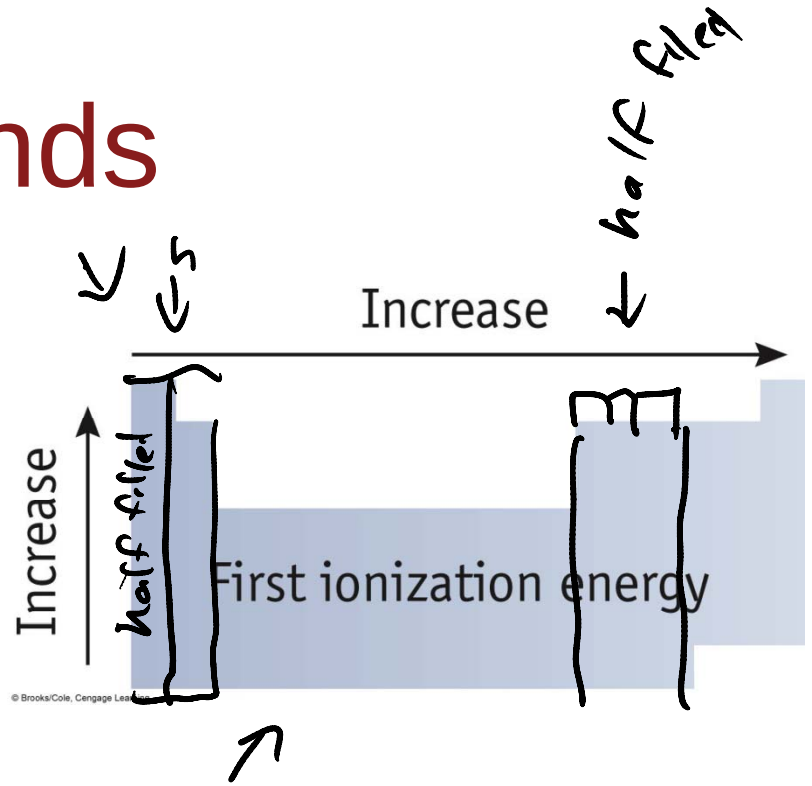
fill up ≠ taking away

highest n

highest l

Summary of Trends

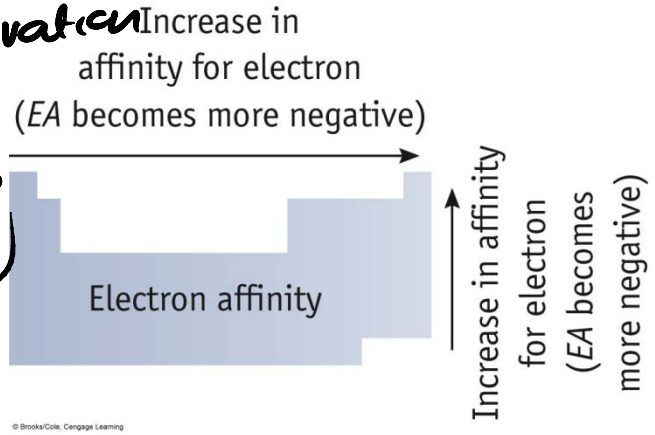




⇒ noble configuration

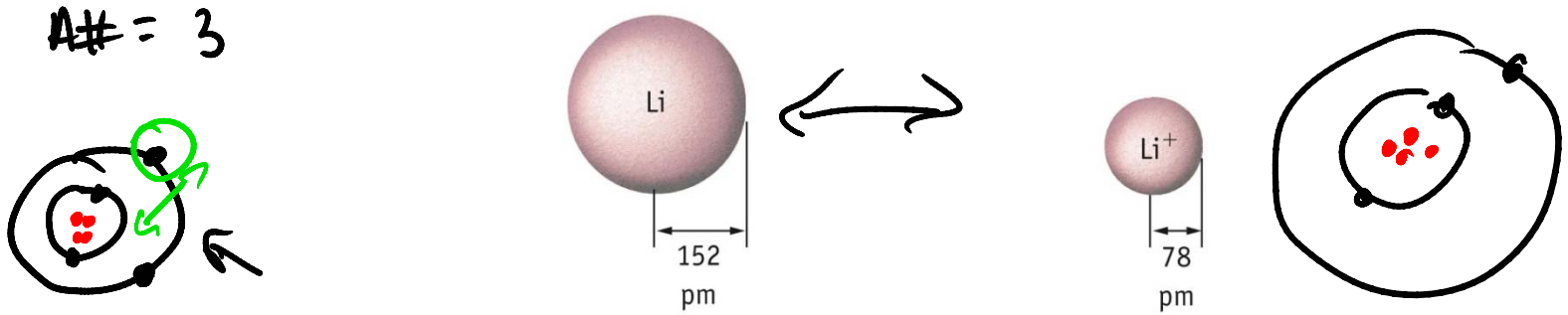
⇒ filled sub shells

⇒ half filled sub shells

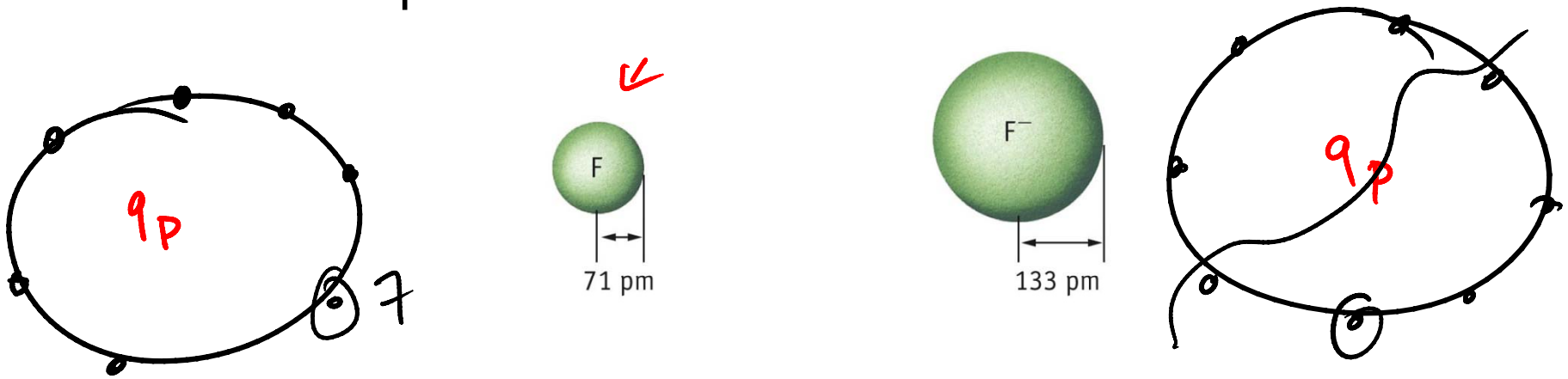


Trends in Ions Sizes

If an atom loses electrons, the resulting cation will be smaller in size than the parent atom.

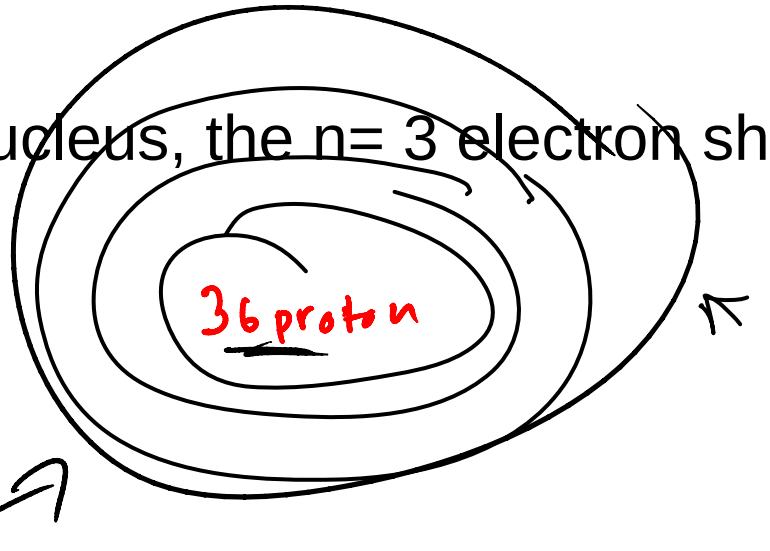


If an atom gains electrons, the resulting anion will be larger in size than the parent atom.



Let's Practice

Which will be closer to the nucleus, the n= 3 electron shell in Ar or the n=3 shell in Kr?



Kr - 36 ⇒ 36 protons

Ar - 18 ⇒ 18 protons

Arrange the following atoms in order of increasing first ionization energy: Ne, Na, P, Ar, K.

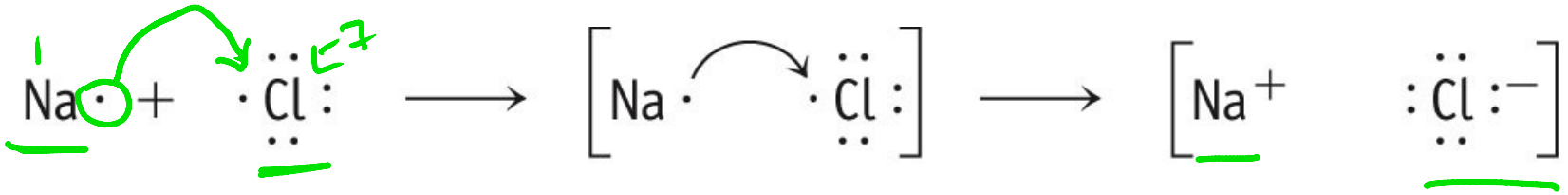
Na > K

Ne > Ar > P > Na > K

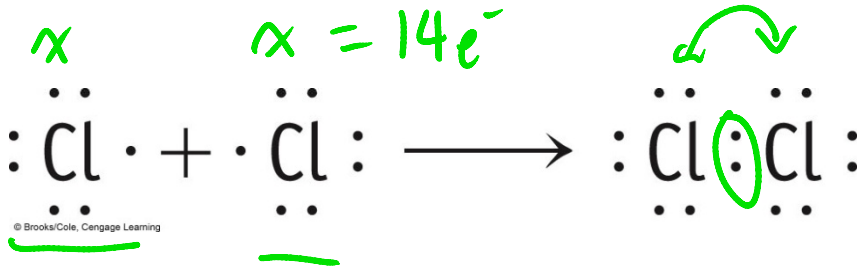
K < Na < P < Ar < Ne

Bonding

Ionic Bonds – refers to electrostatic forces that exist between ions of opposite charge. metal + non-metal

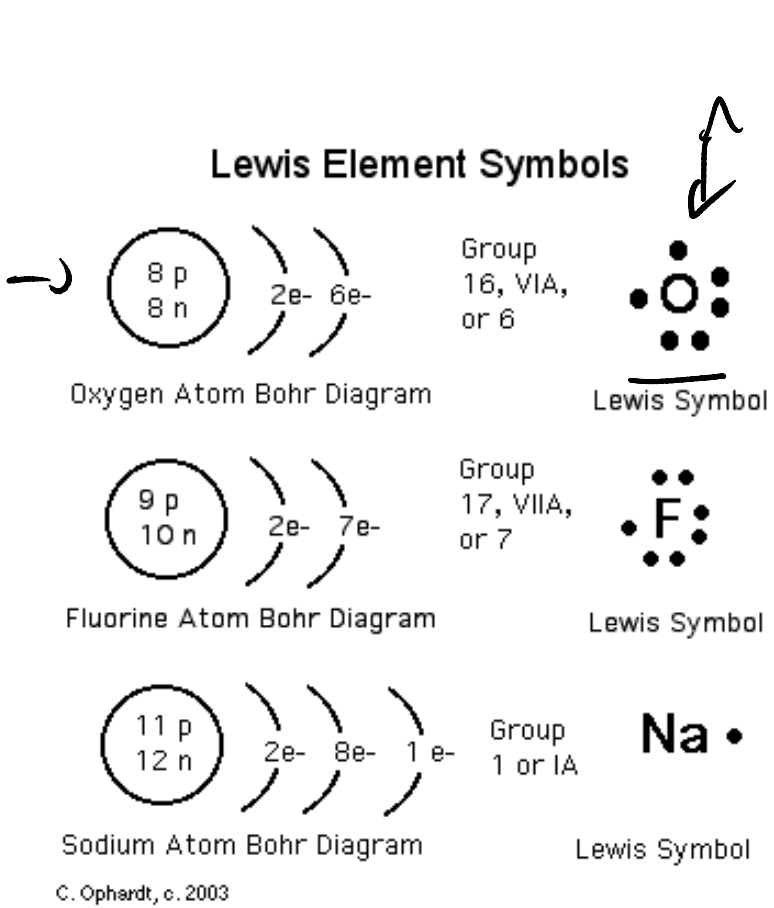


Covalent Bonds – results from the sharing of electrons between two or more atoms. non-metal + non-metal



The electron involved in bonding are the valance electrons.

Lewis Structure



electron in highest n

A# 8 $1s^2 2s^2 2p^4$ = ve = 6

A# 9 $1s^2 2s^2 2p^5$ = ve 7

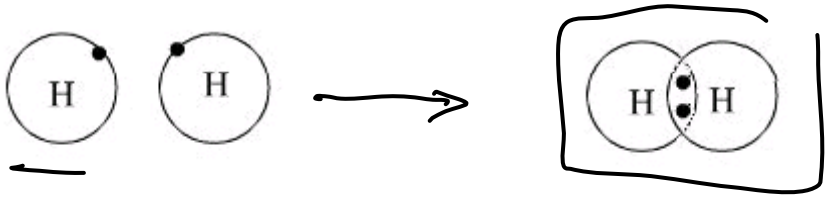
A# 12 $1s^2 2s^2 2p^6 3s^1$ = ve 1

Covalent Bond

Non metals (hydrogen & P-Block)

C, N, O, F, H

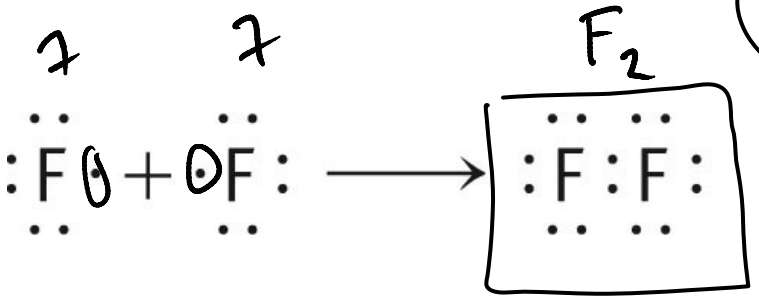
↑ organic chem



Electron pair bond

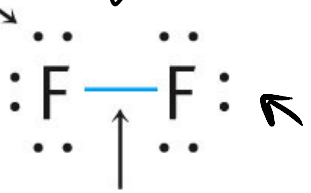
$H\cdot + H\cdot \rightarrow H:H \quad H—H$

2 electrons

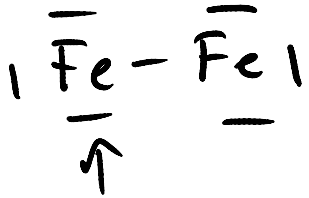


Lone pair of electrons

or



Shared or bonding electron pair



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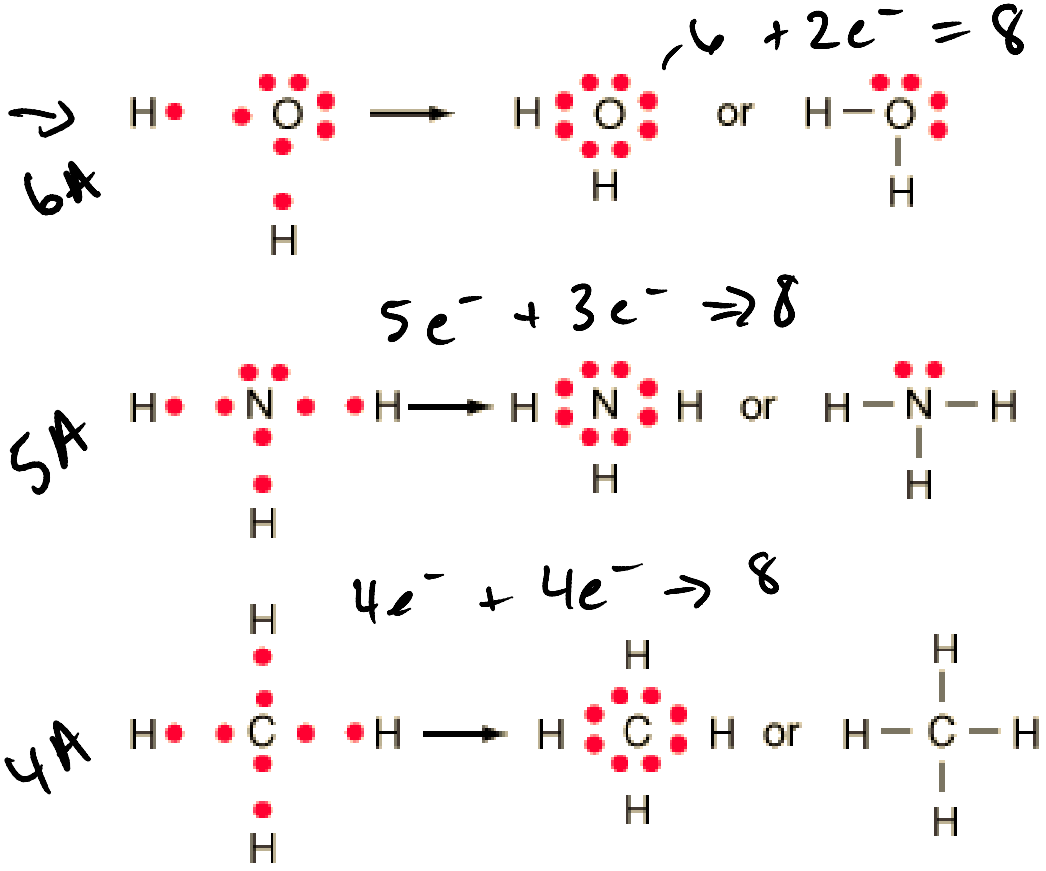
Octet TREND

Each atom wants to fill its valence shell (have a noble gas configuration). Lewis structures will (mostly) want an octet (8) - electrons around an atom.



Multiple Bonds

Single bond – refers to a pair of electrons being shared in a single covalent bond.

Double bond – refers to 2 electron pair being shared, two lines are drawn to represent a double bond:

Triple Bond – corresponds to the sharing of three pairs of electrons.

Bond	Bond Length
N-N	1.47 Å
N=N	1.24 Å
N≡N	1.10 Å

Lewis Structures

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1. **Determine the TOTAL number of valence electrons.**

→ Use the periodic table to help you.

→ If it is an anion, remember the extra electrons go in the valence shell. So add X electron for a X- charge

→ If it is a cation, remember the electrons are removed from the valence shell. So take away X electrons for a X+ charge.

PO_4^{3-} CO_2

Lewis Structures

2. Arrange the atoms and connect them with a single bond

→ In general, chemical formulas help depict connectivity. HCN

→ The central atom is usually written first.

→ C, N, P, S tend to be central atoms.

→ Halogens are often terminal (except when connected to O)

→ Hydrogen will often be terminal.

PO_4^{3-} CO_2

Lewis Structures

3. Complete the octets of atoms bonded to the central atom.

→ Remember hydrogen only need two electrons

→ Count the electron you used, if you have more place them on the central atom, even if it breaks the octet.

PO_4^{3-} CO_2

Lewis Structures

4. If you used too many electrons, try multiple bonds.

→ Multiple bonds are usually on the central atom

→ Change the lone pairs on terminal atoms to multiple bonds.

PO_4^{3-}

CO_2

Let’s Practice

Draw the Lewis Structure for phosphorus trichloride, PCl_3.

Let’s Practice

Draw the Lewis Structure for HCN.

Let’s Practice

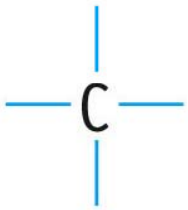
Draw the Lewis Structure for the BrO_3^- anoion.

Some Tips

Practice

Trends

Group 4A



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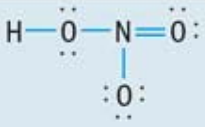
Group 5A

Group 6A

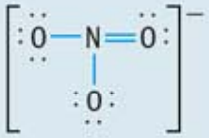
Group 7A

Oxoacids

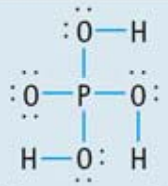
HNO_3
nitric acid



NO_3^-
nitrate ion



H_3PO_4
phosphoric acid



PO_4^{3-}
phosphate ion