

AP Chemistry  
REVIEW OF ATOMIC THEORY, BONDING, AND IM FORCES

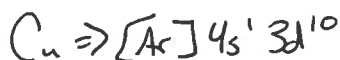
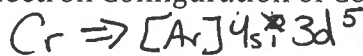
Heisenberg Uncertainty Principle one can never know the momentum & location of an electron at the same time

Hund's Rule ~~the lowest energy configuration~~ the lowest energy configuration of an atom has the most unpaired electrons

Aufbau Principle as protons are added to the nucleus to create new atoms, electrons are added to orbitals of increasing energy

Pauli Exclusion Principle no two electrons can have the same 4 quantum numbers; two electrons in the same orbital must have opposite spins

Electron Configuration of Copper and Chromium



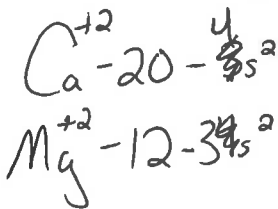
Ionization Energy energy to remove an electron from the gaseous state  
↑ →

Electronegativity the pull by an atom in a covalent bond on a shared electron  
↑ →

Atomic Radius distance from the center of the nucleus to the outermost electron  
↓ ←

Example:

In terms of atomic structure, explain why the first ionization energy of calcium is less than that of magnesium.



Magnesium's valence e-'s are closer to the nucleus making them harder to remove... therefore more energy is required to remove an electron from magnesium than calcium

Example:

For chlorine,

a. Write the extended electron configuration.  $1s^2 2s^2 2p^6 3s^2 3p^5$

b. Write the abbreviated electron configuration.  $[Ne] 3s^2 3p^5$

c. Tell how many valence electrons it has. 7

d. Write the *abbreviated* orbital diagram.  $[Ne] \boxed{\uparrow\downarrow} \boxed{\uparrow\downarrow\uparrow}$

e. Tell how many unpaired electrons it has. ①

f. Write a possible set of quantum numbers ( $n, l, m_l, m_s$ ) for a valence electron of chlorine.  $3, 1, -1, \pm \frac{1}{2}$

g. Is chlorine paramagnetic or diamagnetic?

h. Name two atoms/ions with which the chlorine ion is isoelectronic.  $S^{-2}, Ar, K^+, Ca^{+2}$

i. In terms of atomic structure, explain why the atomic radius of chlorine is smaller than that of phosphorus. Cl & P have valence  $e^-$ 's in the

same energy level, but Cl has more protons & electrons making the attraction between the nucleus & the electrons stronger in Cl than P. Cl's effective nuclear charge is greater because of this, and its radius is smaller.

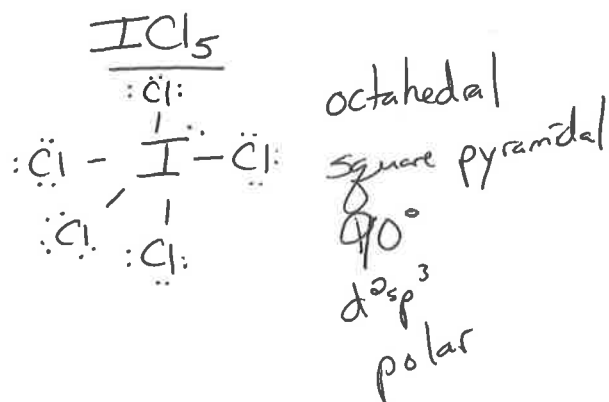
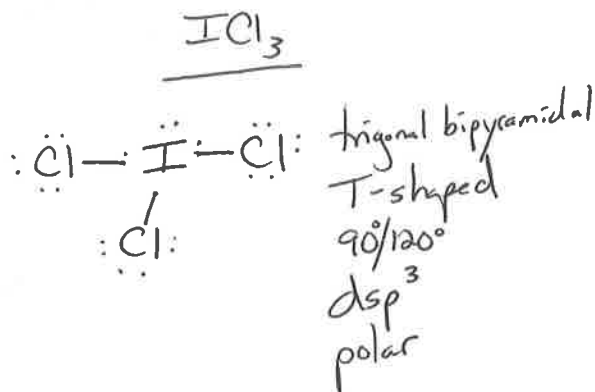
Electron-Pair Arrangement	Molecular Geometry	Hybridization	Bond Angle
Linear	linear	$sp$	$180^\circ$
Trigonal Planar	trigonal planar bent	$sp^2$	$120^\circ$
Tetrahedral	tetrahedral trigonal pyramidal bent	$sp^3$	$109.5^\circ$
Trigonal Bipyramidal	trigonal bipyramidal see-saw T-shaped linear	$90^\circ$ ax-eg $120^\circ$ eg-eg $\longleftrightarrow dsp^3$	
Octahedral	octahedral square pyramidal square planar	$d^2sp^3$	$90^\circ$

Example:

Consider the molecules  $ICl_3$  and  $ICl_5$ .

- Draw an acceptable Lewis structure for these compounds.
- Name the electron-pair geometry and the molecular geometry of each compound.
- Name the hybridization of I in these molecules.
- What is the major bond angle in each molecule?
- Tell whether each of these molecules is polar or nonpolar. (Remember, lone pairs affect dipole moments!)
- What allows I to have more than an octet?

f) empty d orbitals



IM Forces

Ion-Dipole

Hydrogen Bonding NOF

Dipole-Dipole

Dipole-Induced Dipole

London Dispersion Forces

Example:

Explain why the boiling temperature of ethanol ( $C_2H_5OH$ ) at 1atm is  $78^\circ C$  while water boils at  $100^\circ C$  at 1atm.

↓  
2 H bonding sites

→ 1 H bonding site  
 $H_2O$  has stronger IM forces

Example:

Determine whether isopropyl alcohol (aka "rubbing alcohol,  $C_3H_7OH$ ) or water is more volatile. Explain your answer.

↓  
only 1 H bonding site ( $H_2O$  has 2) so weaker IM forces

weaker IM = higher VP = more volatile