Electrons & Compounds

LaBrake subbing for McCord

CH301

Important Information

DO YOUR SAPLING HW

YOU HAVE AN EXAM NEXT TH EVENING

What are we going to learn today?

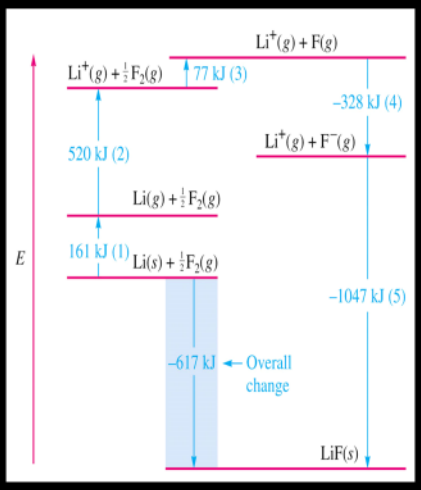
Electron Configuration and Bonding

QUIZ: CLICKER QUESTION 1

Referring to the position of Sr and P on the periodic table, would you predict these elements would come together to:

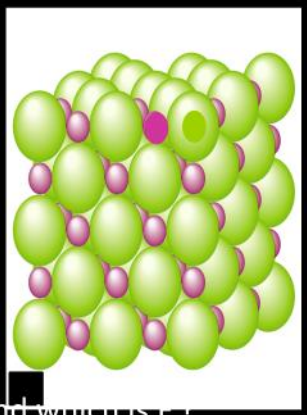
A) Form a metallic compound
B) Form a covalent compound
C) Form an ionic compound

Formation of an Ionic Compound (LiF)



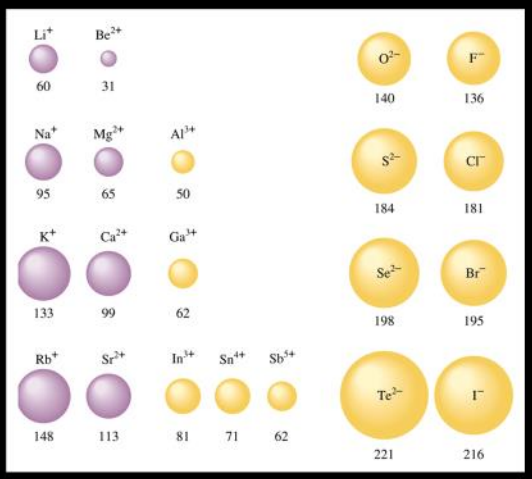
Ionic Compounds

- Ionic compounds are not a discrete pair of ions. It is often an entire collection of ions.



- Which is Li^+ and which is F^-?

Review: Ionic Radius



Question

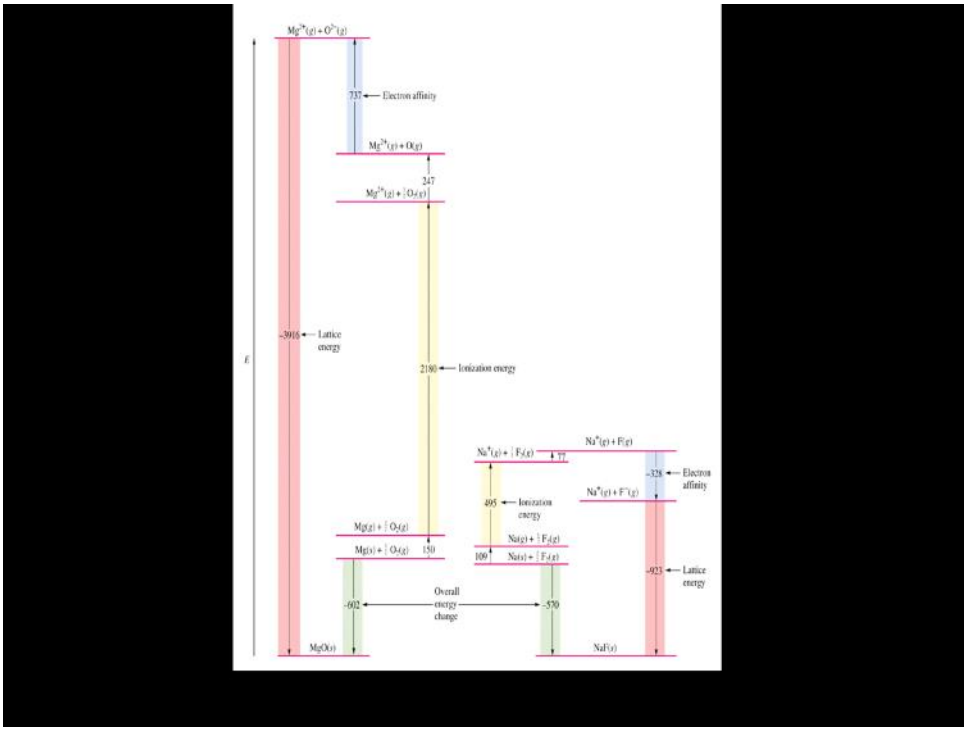
- Which would you predict would have the larger lattice energy?

A. CaS Ca^{2+} S^{2-}

B. NaCl Na^{+} Cl^{-}

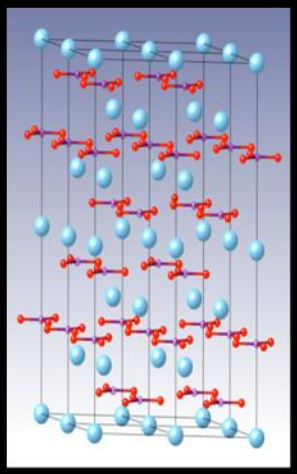
Lattice Energy → amount of E it takes to vaporize 1 mole of solid ionic compound

AU Reg 4.1 rev



Polyatomic Ions

- You need to know the names and formulas for all the common polyatomic ions.
- See the Data & Tables section on the eBook.



- This is the crystal structure of Calcium Carbonate
  - Calcium (Ca^{2+})
  - Carbonate (CO_3^{2-})

Question

- Choose the formula that corresponds to sodium oxide.

A. NaO
B. NaO_2
C. Na_2O
D. Na_2O_2

AU_Reg_14

Naming Ionic Compounds

- You need to be able to name common ionic compounds with elemental ions and polyatomic ions.
- If you do not feel comfortable naming compounds, please visit the eBook Unit 0 (Fundamentals).

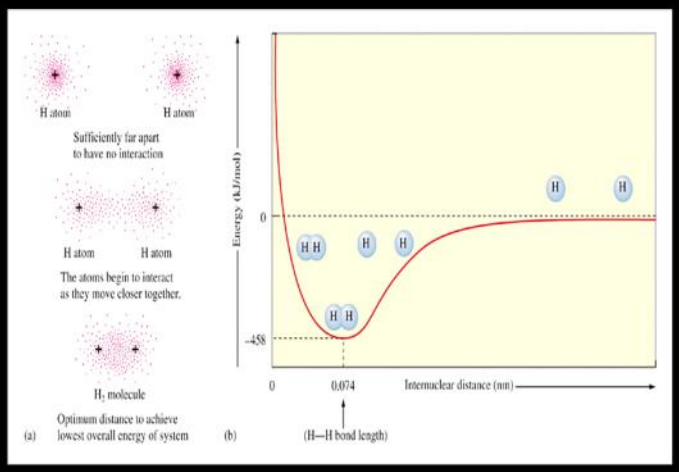
Ionic Bonding Summary

- Electrons transferred from one element to another.
- Forms *lattice* of anions (negative ions) and cations (positive ions) held together by a (strong) electrostatic attraction.

What about Covalent Compounds?

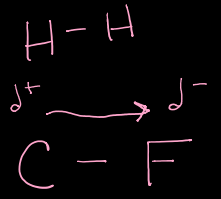
- Atoms **share** electrons to achieve noble gas electron configuration.
- We view sharing of electrons as sharing regions of electron density.
- What types of elements will form covalent compounds?

Energy Diagram of H_2



Covalent Compounds

- Are the electron pairs shared equally?
  - YES, then they are pure covalent
  - NO, then they are polar covalent



QUIZ: CLICKER QUESTION 2

Choose the formula that corresponds to:
strontium and phosphorus.

a) SrP
b) SrP_2
c) Sr_2P
d) Sr_3P_2
e) Sr_2P_3

QUIZ: CLICKER QUESTION 3

Choose the formula that corresponds to:
potassium dichromate.

a) $KCrO_4$
b) KCr_2O_7
c) K_2CrO_4
d) $K_2Cr_2O_7$
e) K_3Cr_2O

QUIZ: CLICKER QUESTION 4

Choose the formula that corresponds to:
sulfur trioxide.

a) SO
b) SO_3^{2-}
c) SO_3
d) S_2O_3
e) SO_4^{2-}

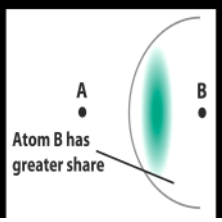
QUIZ: CLICKER QUESTION 5

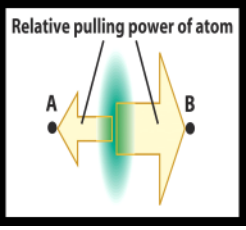
Choose the formula that corresponds to:
sulfite.

a) SO
b) SO_3^{2-}
c) SO_3
d) S_2O_3
e) SO_4^{2-}

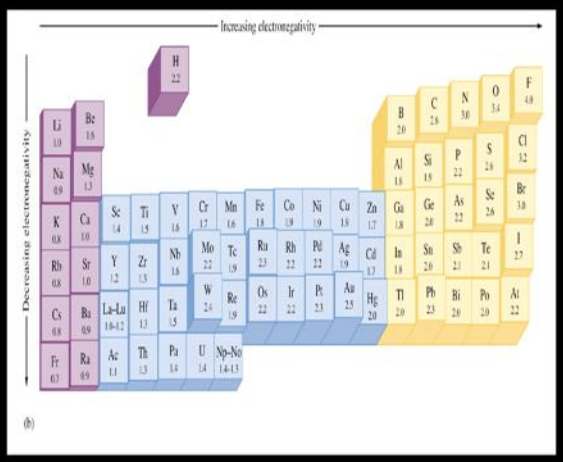
Electronegativity

- Electronegativity can be defined as the electron pulling power of an atom when it is part of a molecule.
  - When one atom is more electronegative than another atom in a bond, a polar covalent bond is formed
  - The degree of polarity is dependent on the difference in electronegativities.





Electronegativity



Naming Covalent Compounds

- Please visit the eBook Unit 0 (Fundamentals) for more information.

Prefix	Number Indicated
mono-	1
di-	2
tri-	3
tetra-	4
penta-	5
hexa-	6
hepta-	7
octa-	8

- HINT: Memorize this for our next class period.

Question

Which of the following bonds would you expect to be classified as polar covalent?

KF CO O_2

A. KF, with the F end having a partial negative charge.
B. KF, with the K end having a partial negative charge.
C. CO, with the O end having a partial negative charge.
D. CO, with the C end having a partial negative charge.
E. O_2, with neither end having a partial negative charge.

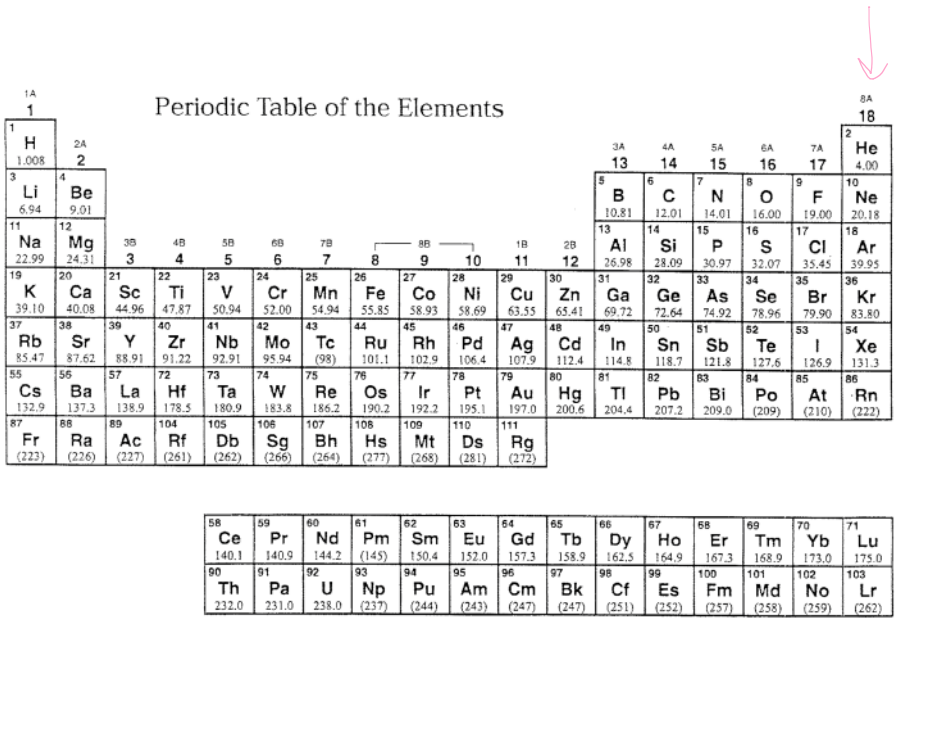
AU Reg 4.2 rev

Drawing Compounds: Two simple examples

Hydrogen (H_2)

Methane (CH_4)

- Things to consider: (We will study this much more thoroughly next time!)
  1. You must use all the valence electrons in the molecule.
  2. Bonds are shown with a dash, which represents two electrons
  3. Most atoms want to fill their octet.
  4. Lone pairs are shown with two dots.



Characterize the bond….

Bond Length

Bond Strength

Electron Pair Shared Equally?

YES – PURE COVALENT

NO – POLAR COVALENT

POLL: CLICKER QUESTION 7

When drawing molecular structures a little dash between two atoms in the structure is representing:

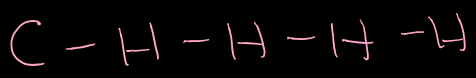
a) An ionic “bond”
b) A shared pair of electrons
c) A little stick or spring that you would use with a molecular model kit

attached to what?

Valence electrons – Lewis symbols – Lewis Structure – Satisfy the Octet

H_2

CH_4



LEWIS STRUCTURE RULES

Determine total number of valence electrons

Predict total number of Bonds : S = N – A rule

Draw Skeletal Structure

Place nonbonding electrons

Fix the number of bonds

Demonstrate using the rules

CH_4

C_2H_6

Examples from Activity

C_2H_4

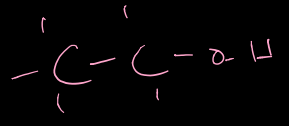
C_2H_2

Take a little moment….

	Bond Strength	Bond Length
Single		
Double		
Triple		

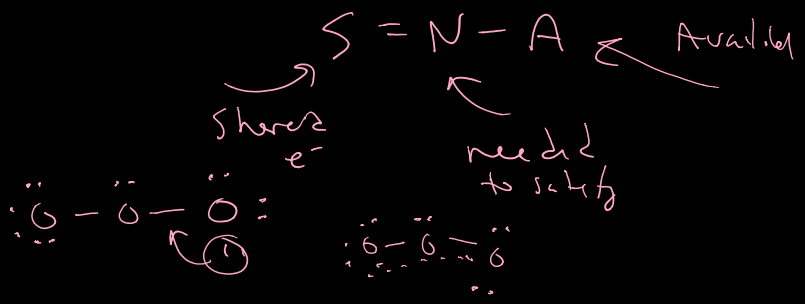
Condensed Structural Formula Indicates Bonding

C_2H_6O



CH_3OCH_3

C_2H_5OH



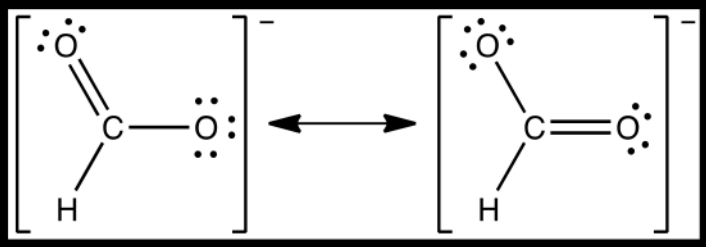
Draw the Lewis Structure for nitrate anion

NO_3^-

Resonance structures for the formate ion are shown below. POLL: CLICKER QUESTION 8

An average C-O single bond is 0.143 nm in length
An average C=O double bond is 0.123 nm in length.

Which choice describes the actual bond lengths for the carbon-oxygen bonds in a formate ion?



A. Both carbon-oxygen bonds are 0.133 nm.
B. Both carbon-oxygen bonds are 0.143 nm.
C. One carbon-oxygen bond is 0.143 nm and the other is 0.123 nm.
D. Both carbon-oxygen bonds switch between 0.123 nm and 0.143 nm

Think about it …. Ionic or covalent?

NaOH

Just when you were sure you had it nailed…

$RnCl_2$ $BeCl_2$

Periodic Table of the Elements

1A												3A	4A	5A	6A	7A	8A
1												13	14	15	16	17	18
1 H 1.008	2A 2																2 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31	3B 3	4B 4	5B 5	6B 6	7B 7	8	8B 9	10	1B 11	2B 12	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.41	31 Ga 69.72	32 Ge 72.64	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (277)	109 Mt (268)	110 Ds (281)	111 Rg (272)							

58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)

McCord (2006)

Learning Outcomes

Draw the Lewis structures for molecular compounds and ions.

Use Lewis structures to predict and explain the relative bond Strength and lengths in compounds.

Recognize and apply exceptions to the octet rules.

Draw resonance structures for a molecule or polyatomic ion.

Apply formal charges to structures and use them to predict