BONDING Notes

The types of bonds we will see include…

1 Ionic Bonds form between metal _____ and non metal _____

The electrons are _____

Cations and Anion charges sum to _____

All Ions get full outer orbitals, they are isoelectric to _____

2 Covalent bonds form between

The electrons are _____

There are never any _____ in covalent bonds.

Bonding atoms usually get _____ outer orbitals most of the time. There are some exceptions.

3 Metallic bonds - bonds that hold a _____ or _____ together as a solid.

These give rise to the 3 most important properties metals have.

Metal element atoms can bond together; or two or more metals can be melted together to form a _____

also called an _____.

4 Intermolecular Bonds (really attractions)

which are _____ attractions

That occur _____ particles (not inside a molecule).

There are _____ different kinds of these and they are way cool.

BONDING Notes

5. The outermost electrons are called the _____ electrons

6. The outermost electron orbital is the _____ _____.

7. Bonds always form when atoms or ions end up _____ to the noble gases.

LEWIS DOT DIAGRAMS

8. Dots represent _____

9. Lewis Dot diagrams show only _____ (not the inner electrons)

10	The first shell is small, it can only hold up to...	electrons
11	The second shell is larger, it can hold up to…	electrons
12	The 3rd orbital is trickier, it can be full with….	electrons
	Or, the 3rd orbital can stretch and hold up to…	electrons
	The 4th, 5th, 6th and 7th orbitals can stretch too.	
	Noble gases only have...	

14	Atom symbol	Lewis Dot (atom)	Ion Symbol	Lewis Dot (ion)
1	H		H^{+1}	
2	He		X	X
3	Li			

Atom number	Atom symbol	Lewis Dot (atom)	Ion Symbol	Lewis Dot (ion)
4				
5			X	X
6			X	X
7				
8				
9				
10			X	X
11				
12				
13				

Atom number	Atom symbol	Lewis Dot (atom)	Ion Symbol	Lewis Dot (ion)
14			X	X
15				
16				
17				
18			X	X
19				
20				

21. When sodium chloride forms from sodium metal and chlorine non-metal, the atoms form ions first.

To do this, the sodium _____ an electron to a chlorine atom .

22a. The sodium becomes a sodium cation with a _____ charge

22b. The chlorine becomes a chloride anion, with a _____ charge

23. Let's draw the Lewis dot diagrams for the atoms, the ions, and then the compound.

Atoms	Ions	Compound

24. It's important to note here, the sodium atom at 2-8-1 electron configuration becomes _____ as it loses one electron, becoming isoelectric to neon.

25. It loses enough electrons to get a perfect outer orbital, as defined by noble gases having the most perfect, or _____ electron orbitals of all.

26. The chlorine atom has a 2-8-7 configuration, gains one electron, and becomes _____,

making it isoelectric to the noble gas _____.

27. Both ions end up with perfect outer orbitals, both end up _____.

28. Almost all ions follow the _____ rule.

29. This is described as:

30. This is a rule, not the law. Exceptions include…

31. Fill in this chart.

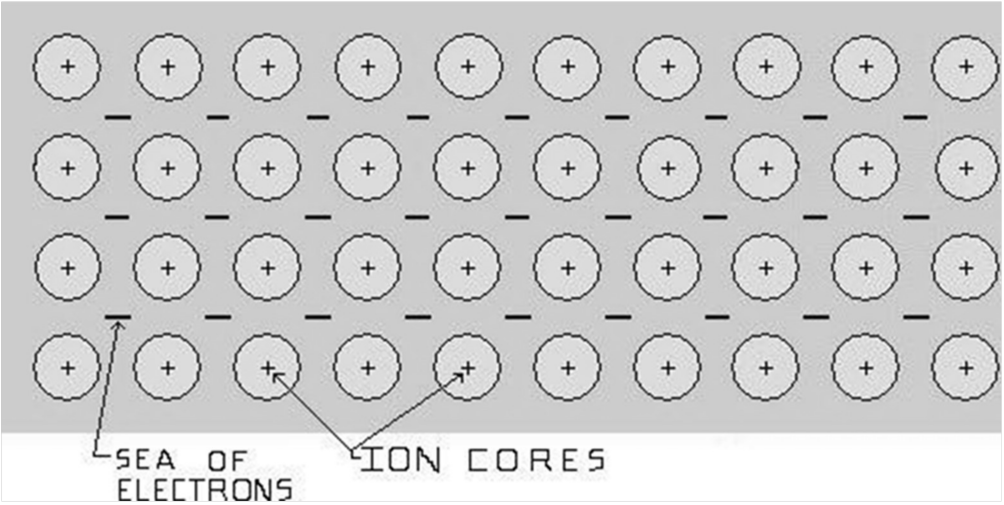
Compound name	Compound Formula	Cation	Anion	Lewis Dot Diagram
Magnesium oxide	MgO	Mg^{+2}	O^{-2}	
	LiF			
	$CaCl_2$			
Sodium			S^{-2}	
Cesium oxide				

32. Why is the formula for aluminum oxide Al_2O_3 and not some other ratio? (make this drawing)

33. Draw the (ugly) Lewis Dot diagrams for Magnesium Nitride and Aluminum Oxide. Squish the ions close!

34. Some metallic Properties that you should remember include…

35. Metals are understood to be…



36. Metals are made up of…

37. Smashing a piece of metal with a hammer:

38. The flow of electrons…

40. Covalent Bonding is

41. Atoms _____ electrons, like ions do.

42. With Ionic Bonding, there is a

43. In Covalent Bonding..

44. There are…

45. Atoms bond…

46. Molecules form using…

47. Draw Lewis Dot diagrams H_2 and F_2

48. In covalent bonds, all atoms get _____.

49. These bonds for H_2 and F_2 are all _____ BONDS because they only

share _____ AND _____

50. F_2 + H_2 have _____ bonds.

51. Draw Lewis Dot Diagram for HCl, and name the bond present.

52. Draw the Lewis Dot Diagram for H_2O, and name the bond present (there are 2 identical bonds in water)

53. Draw STRUCTURAL diagrams for HCl and water. (one dash means one pair of electrons being shared in a bond)

54. Draw the Lewis Dot Diagram, and
the Structural diagram for AMMONIA, NH_3.

55. Draw the Lewis Dot Diagram, and
the Structural diagram for METHANE, CH_4.

THINK: The greater the difference in electronegativity values between two atoms, the greater the polarity of the bond. Some polarities are stronger (a greater EN difference) and some polarities are weaker (a lesser EN difference).

56. Molecule formula + name	EN #1	EN #2	EN diff	Polarity rank	Structural diagrams
H_2 hydrogen	2.2	2.2	0		H—H
PCl_3					
OF_2					
HBr					
HI					

57. Draw 2 Lewis Dot Diagrams of atoms of oxygen.

58. How many electrons does EACH atom of oxygen need to complete the octet? _____
Can they do this for each other? _____

59. Draw the Lewis Dot Diagram for the Molecule of oxygen in the box MEMORIZE THIS ONE.

The O_2 molecule. Makes a _____ bond. Why is it nonpolar?

60. Draw structural diagrams and name the types of bonds in these HONClBrIF twins (leave N_2 for last)

H_2	O_2	F_2
Cl_2	Br_2	I_2

61. Draw a Lewis Dot Diagram for a nitrogen atom	How many electrons does each atom need to meet the octet rule?	Draw a Lewis Dot Diagram for another nitrogen atom

62. Draw a nitrogen molecule in the box
Memorize this one also!

63. Nitrogen molecules have a triple nonpolar covalent bond because...

		Dot diagram	Structural diagram	name all bonds present
64	C_2H_6			
65	C_2H_4			
66	C_2H_2			
67	C_3H_8			
68	CO_2			

		Dot diagram	Structural diagram	name all bonds present
69	$AsCl_3$			
70	C_4H_{10}			
71	OBr_2			
72	CCl_4			

73. Draw a Lewis Dot diagram for CaO calcium oxide, and tell what sort of bond or bonds are present. (tricky!)

74. Alloys:

75. Alloy examples:

76. In this NaCl model, each Na^{+1} is surrounded by 6 Cl^{-1} anions.

The _____ number for sodium cations is _____

The _____ number for chloride anions is _____

77. Since both coordination numbers are _____, we end up with a nice boxy shape.

78. Different coordination numbers form into different _____

79. Coordination number is…

80. Draw the Lewis dot diagram for a carbon atom	Draw the Lewis dot diagram for an oxygen atom	Draw the Lewis dot diagram for carbon monoxide, CO

81. The shorthand symbol for this bond is _____

82. CO forms a… _____ (and)

a _____ bond

This is an odd but important exception to the octet rule.
CO can kill you, it's poison, and you must memorize this molecule.

83. Phosphorous Pentachloride (PCl_5) is another weirdo compound. It breaks the octet rule also. Attempt it here:

Lewis dot diagram	Structural diagram	How does this break the octet rule?

84. BF_3

85. Oxygen & Ozone are both PURE FORMS of oxygen. Their formulas are: _____ + _____

86. Ozone is an _____ of oxygen.

87. Allotropes are:

88. Let's bond 3 oxygen atoms into OZONE here

89. We say these bonds _____ back and forth.

90. In reality, this switching back and forth is constant, and becomes, two _____ all the time. Draw these 1½ bonds here →

91. In reality…

92. Intermolecular bonds are:

93. There are ____ kinds of intermolecular bonds. All are _____ _____ than ionic, covalent or metallic bonds.

94. Weakest to strongest, these intermolecular bonds are

95. The weakest intermolecular bond is _____ which is caused by

96			
F_2 Fluorine	2-7 9 electrons per atom 18 electrons per F_2	Few electrons are "dispersed" at any one moment of time, makes for a very weak intermolecular attraction.	The strength of attraction between the F_2 molecules is very low; there are not many electrons. It is not a zero attraction, but so weak that F_2 is a GAS at STP.
Cl_2 Chlorine	2-8-7 17 electrons per atom 34 electrons per Cl_2	More electrons are "dispersed" at any one moment of time, makes for a slightly stronger but still very weak intermolecular attraction.	The strength of attraction between the Cl_2 molecules is very low; there are not many electrons. It is not a zero attraction, stronger than in F_2 but chlorine is still a GAS at STP.
Br_2 Bromine	2-8-18-7 35 electrons per atom 70 electrons per Cl_2	Many more electrons are "dispersed" at any one moment which, makes for a slightly stronger but still weak intermolecular attraction.	The strength of attraction between the Br_2 molecules is strengthening; there are many more electrons. It is much stronger than in F_2 and Cl_2. Bromine is a LIQUID at STP only because of this increasingly strong (but still weak) intermolecular attraction.
I_2 Iodine	2-8-18-18-7 53 electrons per atom 106 electrons per I_2	So many more electrons are "dispersed" at any one moment which, makes for an even stronger (still weak) intermolecular attraction.	The strength of attraction between the I_2 molecules is the strongest in group 17; there are so many more electrons. It is much stronger than in F_2 or Cl_2,or Br_2, At STP iodine is a SOLID only because of this increasingly strong (but still weak) intermolecular attraction.

97. Phases at STP	Halogens	98.
Gas		
Liquid		
Solid		

107.

99. A dipole occurs…	100a. SCl_2
	100b. CH_4

101 sulfur dichloride	102 methane

103. SCl_2 is a liquid at room temperature while CH_4 is a gas. Why???

104. Draw five SCl_2 molecules here. Show the dipole attraction forces with a dotted line using a colored pencil.

105. Hydrogen bonding is EXACTLY the same as _____ but the difference is that atoms of _____ must be present.

106. compound	atom 1 electronegativity	atom 1 electronegativity	Electronegativity difference	How polar are these molecules?
H_2O	H 2.2	O 3.4		
SCl_2	S 2.6	Cl 3.2		

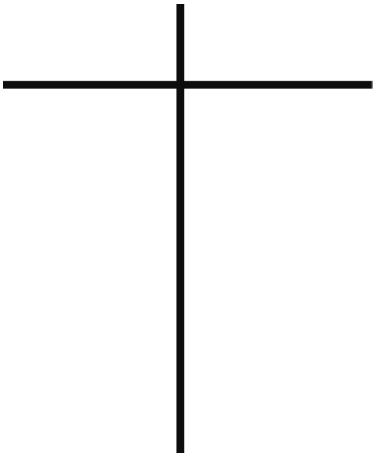
107a. Draw one SCl_2	107b. Draw one H_2O
SCl_2 has	H_2O has

108. Draw 6 water molecules randomly, using a different line to show the single polar covalent bonds and the intermolecular hydrogen bonding.

109. Bond types	example compound formulas
Ionic	
Single nonpolar covalent	
Single polar covalent	
Double nonpolar covalent	
Double polar covalent	
Triple non polar covalent	
Triple polar covalent	
Coordinate covalent	
Resonant	
Ionic + Covalent at the same time	
Breaks the octet rule (more than $8e^-$)	
Breaks the octet rule (less than $8e^-$)	

110. Relative Oxidation Numbers are:

111. Show all of the oxidation numbers for H and O, use the t-chart properly



112. What are the relative oxidation numbers for	
BF_3	
SiO_2	
HF	

ex	Sulfur dioxide	SO_2	S^{+4} O^{-2} O^{-2} = zero
ex	Chromate ion	CrO_4^{-2}	Cr^{+6} O^{-2} O^{-2} O^{-2} O^{-2} = -2
114	Permanganate ion		
115	Ammonia (not ammonium)		
116	Sodium hydroxide		
117	Potassium chlorate		
118	Carbon monoxide		
119	Carbon dioxide		
120	Dihydrogen sulfate		
121	Nitrate ion		
122	Nitrogen dioxide		
123	Phosphorus trichloride		

124. Explain the difference between bond polarity and molecular polarity.

125. Explain the resonating bonds in ozone.

126. Draw the CO, carbon monoxide molecule properly (dots and structurally).
Name the bond or bonds use color pencils or else!

127	Question	True or False?
A	Ionic bonds can form single, double or triple bonds.	
B	Covalent bonds are always polar.	
C	Oxygen molecules have one double polar covalent bond.	
D	Nitrogen molecules have one double *nonpolar covalent bonds.*	
E	Hydrogen atoms can make single or double bonds.	
F	Nonpolar molecules can't have polar bonding.	
G	Water can *sometimes form into a straight–line shape.*	
H	Oxygen atoms must make double bonds.	
I	Molecules with only nonpolar bonds cannot form polar molecules	
J	The weakest intermolecular bond is called dipole attraction.	
There are two more slides, for thinking…		