NAME: HONORS CHEMISTRY

SECTION: REVIEW SHEET: CHEMICAL BONDING

After studying chapters 12.1, 13, and 14.1, you should be able to:

- Explain why most atoms form chemical bonds.
- Differentiate among properties of ionic, covalent, and metallic bonds.
- Compare and contrast the properties of ionic and molecular compounds.
- Classify bonds as ionic, covalent, or polar based on electronegativity differences.
- Create Lewis structures for covalent compounds containing single, double, and triple bonds, including resonance structures and exceptions to the octet rule.
- Explain the modern interpretation of resonance bonding.
- Calculate the formal charge on atoms in molecules and evaluate Lewis structures on the basis of formal charge.
- Describe the shapes of simple covalently bonded molecules using VSEPR theory.
- Use bond dipoles to predict molecular dipoles.
- Define dipole and compare the strengths of intermolecular forces based on dipole moments.
- Describe hybrid orbitals and use hybridization theory to explain the bond angles in compounds.
- Differentiate sigma and pi bonding, and saturated and unsaturated carbon compounds.
- Define, explain, and give examples of isomerism.
- Use molecular orbital theory to discuss bonding in diatomic molecules
- Determine bond order and correlate bond order, bond energy, and bond length.

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1. What is the difference between an ionic and a covalent bond? (pp. 306-307)

2. Many metals will stand a great deal of distortion without breaking. They can be bent, folded, rolled thin into sheets of foil, drawn through progressively smaller dies into thin wire, and can be beaten into various shapes. How does the metallic bonding model account for these properties? (p. 309)

3. Explain how $NaNO_3$ is an example of two different types of bonding. (p. 311)

4. Indicate whether each property listed below is characteristic of ionic (I) or covalent (C) compounds. (pp. 306-307)

a)	high melting points	e)	crystal lattice
b)	poor electrolytes	f)	dissolves readily in water
c)	found as molecules	g)	low melting points
d)	found as solids at room temperature	h)	low solubility in water
		i)	good electrolytes

5. Predict whether the bonds between the following pairs of elements are ionic, polar covalent, or nonpolar covalent.

a) Al, O _____
b) Al, S _____
c) Bi, Cl _____
d) Bi, O _____
e) C, Cl _____
f) N, O _____
g) Na, S _____
h) P, O _____
i) S, O _____
j) Ti, Br _____

6. Draw the Lewis structures for the following molecules. In each case, the carbon atom is the central atom.

a) CH_3Cl b) CH_2Cl_2 c) $CHCl_3$

7. Draw the Lewis structures for the following polyatomic ions. Calculate formal charges for the atoms in each.

a) IO_4^-
b) IO_3^-
c) IO_2^-
d) IO^-
e) SiO_4^{4-}
f) PCl_4^+

8. What is the Lewis structure for the following isoelectronic species? (*Isoelectronic* means that they have the same number of valence electrons)

a) N_2
b) CN^-
c) NO^+
d) CO

9. Explain why each of the following molecules is an exception to the octet rule.

a) NO
b) BeH_2
c) XeF_2
d) $TeCl_4$

10. What is resonance? Give an example of a molecule with resonance. Explain your choice.

11. Write the Lewis structures for each of the resonance forms for these species. Include formal charges where appropriate.
    a) SO_3

    b) NO_2^-

    c) O_3

    d) HCO_2^- (carbon is the central atom)

12. Briefly explain how the valence shell electron pair repulsion theory (VSEPR) is used to predict the arrangement of the electron pairs around the central atom. (pp. 323-327)

13. Describe the arrangement of the electron pairs for each of the following molecules. How many electron domains surround each central atom? (pp. 323-327)
    a) CCl_4

    b) SiH_4

    c) AsH_3

    d) H_2Se

    e) CS_2

14. Predict the geometry around the central atom for each of the molecules in the previous problem. (pp. 323-327)

15. Predict the shapes of the following molecules. Each is an exception to the octet rule.
    a) BCl_3
    b) BeH_2

16. Consider the molecules phosphorus pentachloride, PCl_5, and sulfur hexachloride, SCl_6. How are these molecules different from others you have studied in terms of their geometry and the bond angles of the atoms around the central atom?

17. What happens in hybridization? (pp. 328-329)

18. How many hybrid orbitals of the following types can an atom have? (pp. 328-329)
    a). sp^3 b) sp^2 c) sp

19. In the molecular orbital theory, how do bonds form? Compare the bonding in sigma (σ) and pi (π) bonds. (pp. 330-331)

20. In the HCN molecule, the bonds are H-C and C≡N. Predict the shape of the molecule, the hybridization of the orbitals on the carbon atom, and the type (σ or π) of each bond. (pp. 330-331)

21. Why is benzene a particularly stable compound? (pp. 333-334)

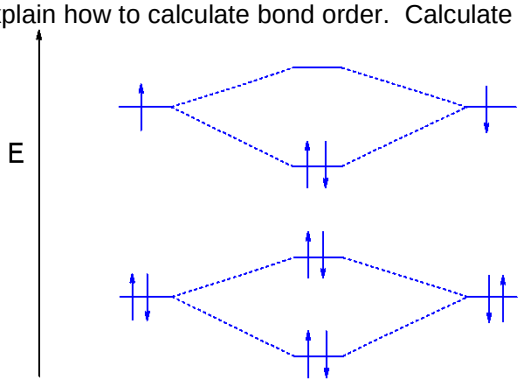
22. What is the difference between a polar bond and a nonpolar bond? (pp. 350-352)

23. Can a molecule with only nonpolar bonds be a polar molecule? Explain your answer. (pp. 350-352)

24. Show the bond dipoles (using arrows or $\delta+$ and $\delta-$) and predict the molecular polarity of each of the molecules in question 13.

25. BF_3 is a flat, nonpolar molecule, and NF_3 is a trigonal pyramidal, polar molecule. Explain the reason that these two four-atom molecules have different properties.

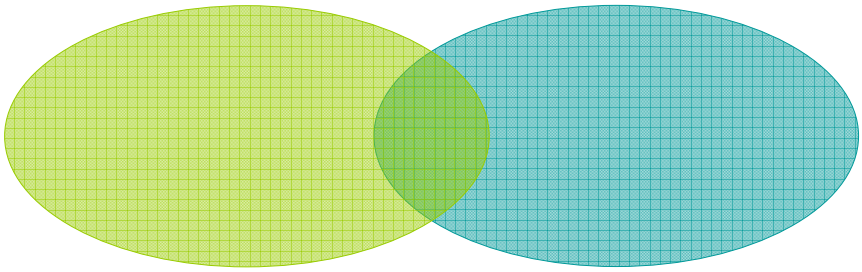
26. Explain how to calculate bond order. Calculate bond order for the following:



27. Complete the following Venn diagram for ionic and covalent bonding

TERMS TO INCLUDE:

Electronegativity difference
Metals/nonmetals
Melting points
Solubility in water
Electrical conductivity
Polar/non-polar
Lattice/molecule
Sharing/transferring electrons
Charges (ions? Partially charged?)
Bonus: anything else you can think of



28. Draw each molecule using lines to represent bonds and dots to represent lone pairs. Indicate the geometry of the molecule. Use electronegativity differences of the atoms involved and determine if whether each bond is polar. If it is polar, add an arrowhead to the lines representing the bonds, pointing toward the more electronegative atom. Finally, decide whether the molecule as a whole is polar. (Hint: Do the arrows cancel out or not?) If it is, draw a large arrow near the molecule to indicate the direction of polarity. The first substance has been done as an example.

Formula	Representation	Shape	Polarity of Bonds	Polarity of Molecule
NF_3				
NCl_3				
BCl_3 (note: does not obey octet rule for B)				
CCl_4				
CH_3Cl				