Chapter 9 Reading Guide **Name:**
AP Chemistry 2016-2017 **Date:** **Per:**

Many of the concepts introduced in this chapter on chemical bonding are found in Big Idea 2 covering the structure and rearrangement of atoms, ions, molecules and the forces between them. Also covered are sections of Big Idea 5 on energy. Concepts in the chapter not in the AP chemistry curriculum include using formal charge to explain why certain molecules do not obey the octet rule and defending Lewis models based on the limitations of the model.

Introduction

1. What are the three models of bonding? Is one of the models "right"? Explain your answer.

9.1 Bonding Models and AIDS Drugs

2. What are Lewis structures used for?

9.2 Types of Chemical Bonds

3. What is meant by the term chemical bond? Is an electron in an atom a chemical bond? Why or why not

4. What forces are involved in forming a bond?

5. Fill in the following table:

Types of Atoms	Type of Bond	Characteristic of Bond
	Ionic	
		Electrons Shared
Metal and metal		

6. When a metal element combines with a nonmetal element, an ionic bond is usually formed. What happens to the potential energy when the atoms combine?

7. Explain how two nonmetal atoms usually combine to form covalent bonds. What happens to the potential energy when the atoms combine?

8. Explain how metal atoms combine to form metallic bonds. What happens to the potential energy when the atoms combine?

9.3 Representing Valence Electrons with Dots

9. Draw the Lewis dot symbols for each of the following atoms: Li, Be, B, C, N, O, F, and Ne.

10. What is the octet rule? What is it used for and what are its limitations?

11. Why are hydrogen and helium two exceptions to the octet rule?

9.4 Ionic Bonding: Lewis Symbols and Lattice Energies

12. Using K and Cl, use Lewis diagrams to show how the ionic compound KCl forms. Draw a two dimensional diagram of a 4 x 4 lattice structure of KCl(s).

13. When solid ionic compounds form, what type of structure is made?

14. Fill in the following table, using Na and Cl_2 forming NaCl as an example:

Step of Born-Haber Cycle	Source of ΔH for the Step	Is the Value Positive or Negative

15. What law is demonstrated by the Born-Haber cycle energies adding up the lattice energy?

16. Explain why the lattice energies decrease down a column in the periodic table. In your response, use the alkali metal chlorides from LiCl to CsCl as your example.

Metal Chloride	Lattice Energy kJ/mol
LiCl	-834
NaCl	-788
KCl	-701
CsCl	-657

17. The lattice energies of NaF and CaO are -910 kJ/mol and -3414 kJ/mol respectively. Explain the reason for this difference using Coulomb's law.

18. Explain why ionic compounds have higher melting points, are nonconductors as solids, and are conductors when liquid or dissolved in water. Include a diagram in your answer.

19. Give an example of an ionic compound containing a covalent bond. Explain how this example is considered and ionic compound.

9.5 Covalent Bonding: Lewis Structures

20. Draw molecules of O_2, N_2, and F_2 and circle the bonding electrons. Indicate if the bond is a single, double, or triple bond.

21. Explain the differences in strength and bond length of single, double, and triple bonds. For each type of bond, cite one example of a species that contains the bond.

22. What does it mean when ionic bonds are said to be nondirectional, whereas covalent bonds are said to be directional?

23. What is meant by a lone pair of electrons?

24. Using a diagram, explain the difference between ionic compounds and covalent molecules when they melt to form a liquid.

9.6 Electronegativity and Bond Polarity

25. Using HF as an example, describe a limitation of the Lewis model.

26. Write two separate ways of showing charge separation on a molecule of HF.

27. If charge separation occurs in some molecules, why do these molecules not have an ionic bond?

28. What evidence supports the claim that HF is polar?

29. Explain what a polar covalent bond is and how to know if one is present in a compound.

30. Define electronegativity. What data was used to assign electronegativity values to atoms?

31. Explain why electronegativity increases across a period and decreases down a family.

32. What is general relationship between size of the atom and electronegativity?

33. Draw a number line from 0 to 4 and indicate how the differences in electronegativity values between two atoms affects bond type.
Note: Using the difference in electronegativity values between two atoms to classify bonds is at best an approximation.

34. How are nonpolar and polar covalent bonds different? How would you know which is present in a molecule?

35. What is a dipole moment, what is its symbol, and what is its unit of measurement?

36. What is percent ionic character and how is it calculated?

37. What would happen to the electron in a bond with a 100% ionic character? If a bond is not 100% ionic, what is occurring?

38. In general, what percent ionic character is classified as an ionic bond?

9.7 Lewis Structures of Molecular Compounds and Polyatomic Ions

39. What are the steps for writing a Lewis structure?

40. Why are hydrogen atoms considered terminal and where are they placed in Lewis structure?

41. When drawing a simple Lewis structure, is the most electronegative atom or least electronegative atom most likely to be the central atom? Explain.

9.8 Resonance and formal charge

42. What is resonance?

43. Why do organic chemists use resonance structures to represent certain anions and molecule? Include in your explanation a short discussion of a comparison of bond length and bond strength.

44. Draw the three Lewis resonance structures for SO_2.

45. What is formal charge and how is it calculated?

9.9 Exceptions to the Octet Rule: Odd Electron Species, Incomplete Octets, and Expanded Octets

46. Identify three exceptions to the octet rule?

47. What elements tend to form compounds with incomplete octets?

48. Draw Lewis structure for each species involved in the following reaction: $BF_3 + NH_3 \rightarrow F_3BNH_3$

49. Identify four elements which tend to have expanded octets when forming compounds. Explain.

9.10 Bond Energies and Bond Lengths

50. Define Bond energy. Provide two examples of chemical bonds, one with a high value for bond energy and one with a low value for bond energy. Explain how to use bond energies to determine the enthalpy of a reaction.

51. What is the relationship between the bond energies of the reactants and products in an exothermic reaction? Endothermic?

52. Are bond energies considered positive or negative? Why?

53. What is the general relationship found between bond strength and bond length?

9.11 Bonding in Metals: The Electron Sea Model

54. Explain why solid metals can conduct an electric charge (electricity).

55. Metals conduct electricity, and are malleable and ductile. Using the electron sea model, explain why.

56. Draw the Lewis structure of ozone.