

Introduction to Chemical Bonding

Section Review 6.1

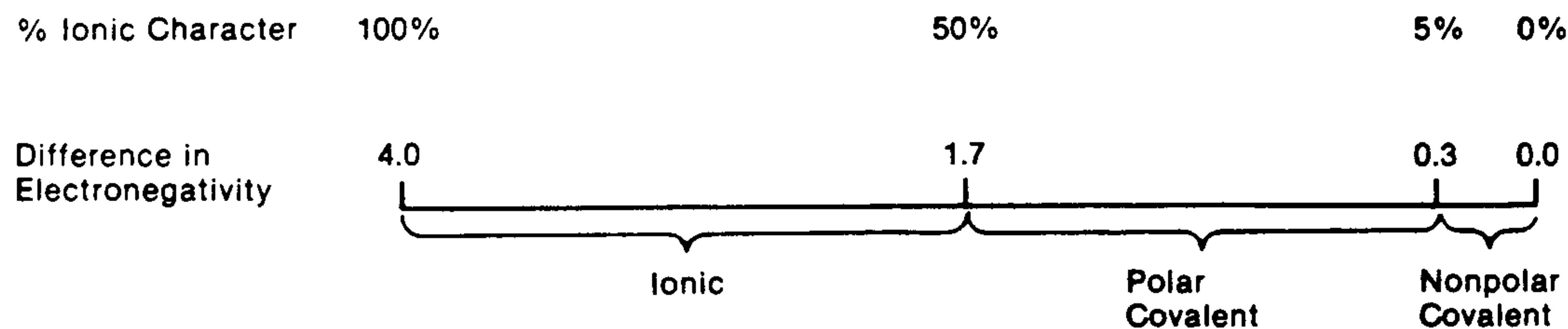
DIRECTIONS: Write on the line at the right of each statement the letter preceding the word or expression that best completes the statement.

1. In a chemical bond, the link between atoms results from the attraction between electrons and _____ 1
(a) Lewis structures; (b) nuclei; (c) van der Waals forces; (d) isotopes.
2. A covalent bond consists of (a) a shared electron; (b) a shared electron pair; _____ 2
(c) two electrovalent ions; (d) an octet of electrons.
3. If two covalently bonded atoms are identical, the bond is identified as (a) nonpolar covalent; _____ 3
(b) polar covalent; (c) nonionic; (d) coordinate covalent.
4. A covalent bond in which there is an unequal attraction for the shared electrons is _____ 4
(a) nonpolar; (b) polar; (c) ionic; (d) dipolar.
5. Atoms with a strong attraction for electrons they share with another atom exhibit (a) zero _____ 5
electronegativity; (b) low electronegativity; (c) high electronegativity; (d) Lewis electronegativity.
6. Bonds with between 5% and 50% ionic character are considered to be (a) ionic; _____ 6
(b) pure covalent; (c) polar covalent; (d) nonpolar covalent.
7. A nonpolar covalent bond is likely to exist between (a) a metal and a nonmetal; (b) two ions; _____ 7
(c) two identical atoms; (d) an atom and an ion.
8. The greater the electronegativity difference between two bonded atoms, the greater the _____ 8
percentage of (a) ionic character; (b) covalent character; (c) metallic character;
(d) electron sharing.
9. In which of these compounds is the bond between the atoms NOT a nonpolar covalent bond? _____ 9
(a) Cl_2 (b) H_2 (c) HCl (d) O_2

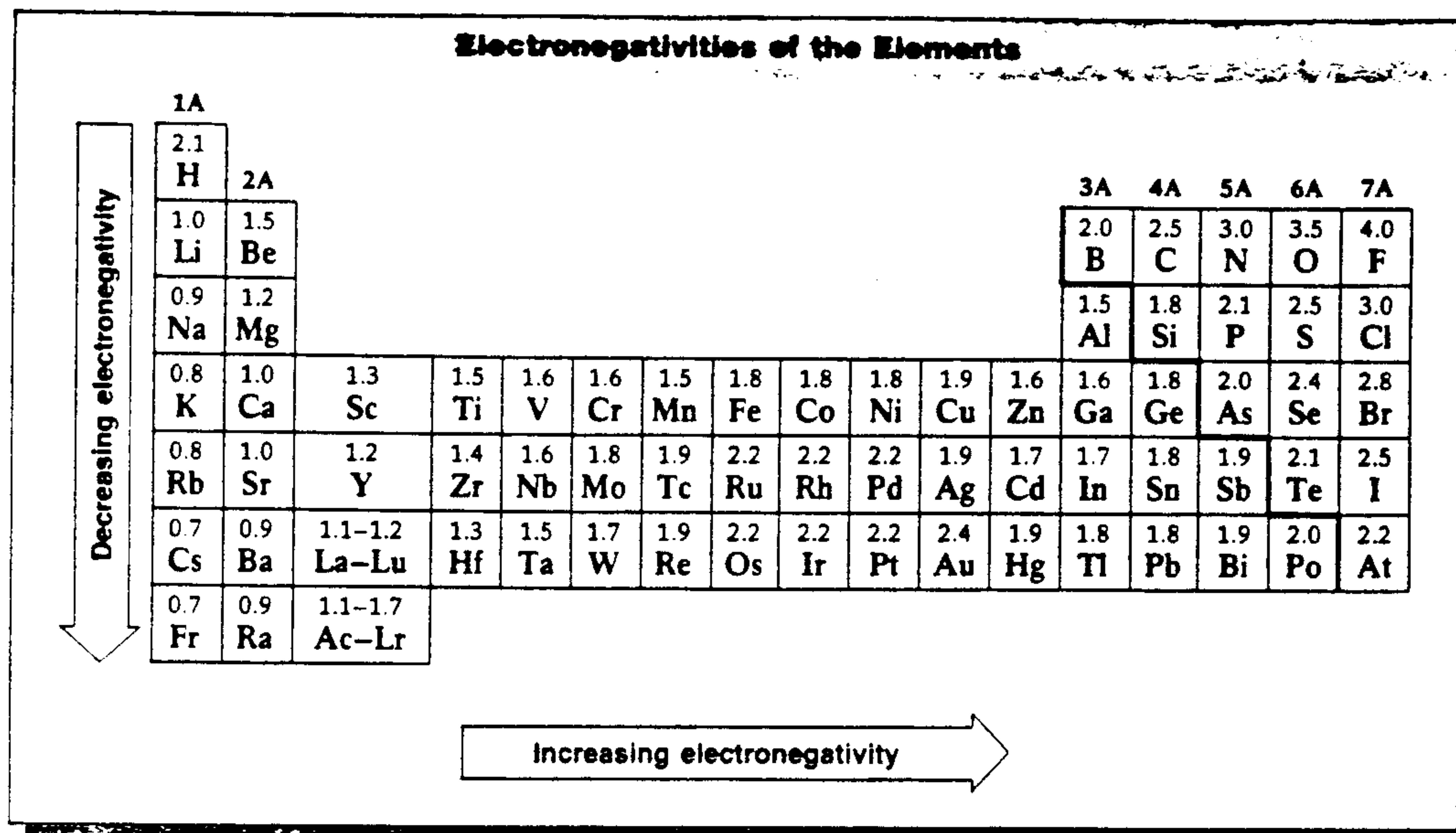
DIRECTIONS: Complete the following statements, forming accurate sentences.

10. The electrons involved in the formation of a chemical bond are called _____ . 10
11. A chemical bond resulting from electrostatic attraction between positive and negative ions is called a(n) _____ . 11
12. If the electrons involved in bonding spend most of the time close to one atom rather than the other, the bond is _____ . 12

DIRECTIONS: Questions 13 and 14 refer to the following graph.



13. The difference in electronegativity and the type of bond for the Li-Cl bond in LiCl (electronegativity for Li = 1.0; electronegativity for Cl = 3.0) is _____ . 13
14. The difference in electronegativity and the type of bond for the Br-Br bond in Br_2 (electronegativity for Br = 2.8) is _____ . 14



1. Why is no electronegativity shown for element 10?

2. Calculate the electronegativity difference for the atoms that are bonded in the following diatomic molecules. Then tell whether the bond is nonpolar covalent, polar covalent, or ionic and which atom has the greater share of the bonding electrons.

Formula	Electronegativity Difference	Type of Bond	Atom With Greater Electron Share
NO			
MgO			
Br ₂			
LiH			

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Element	Electron Configuration	Electron Dot Symbol	Electrons to Lose or Gain
Li			
N			
Ne			
P			

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Activity 4-5

The Chemical Bond II

Covalent bonds

1. What role do valence electrons play in covalent bonding? _____

2. When atoms are bonded together covalently, what two kinds of structures may result?
 _____, _____
3. What is a single covalent bond? _____ : _____

4. What is a double covalent bond? _____

5. What is a triple covalent bond? _____

6. How is a coordinate covalent bond different from an ordinary covalent bond? _____

7. What kind of compound frequently shows coordinate covalent bonds? _____

Dot diagrams for molecules and polyatomic ions

8. Choose words from the word list to fill in the blanks in the following paragraphs relating to the construction of dot diagrams. The list groups words that have contrasting or related meanings.

Word List	
atom(s)/ion(s)/molecule(s)	metal/nonmetal
eight/four	O(oxygen)
error	pairs
kernel/valence	share/transfer

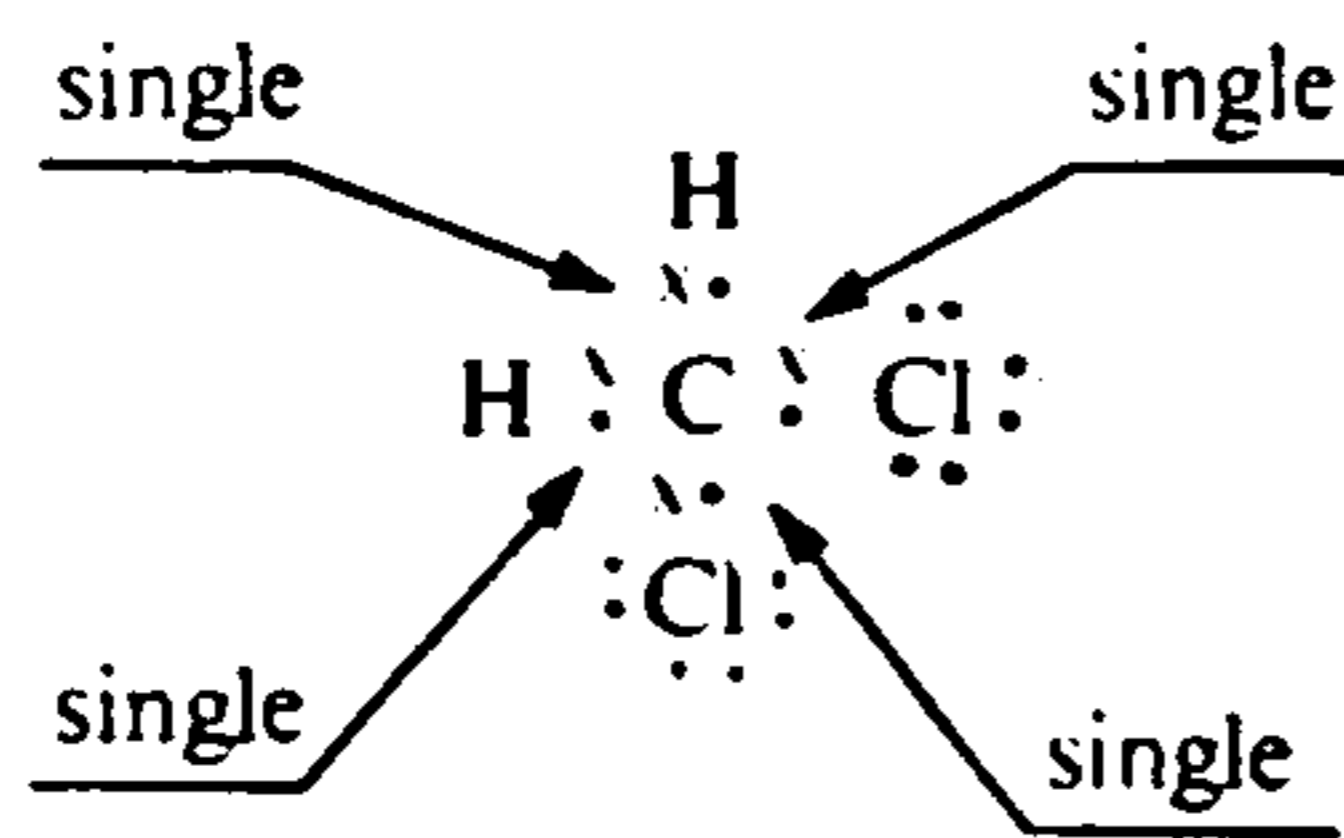
When atoms are held together by covalent bonds, a _____ or a polyatomic _____ is formed. The electron-dot symbols for individual atoms can

be used to construct dot diagrams for molecules and polyatomic _____. The symbol for each element represents the nucleus and _____ electrons. When atoms form covalent (or coordinate covalent) bonds, each atom must share enough electrons to fill its _____ shell with at least a share in the total of _____ electrons, that is, _____ pairs of electrons.

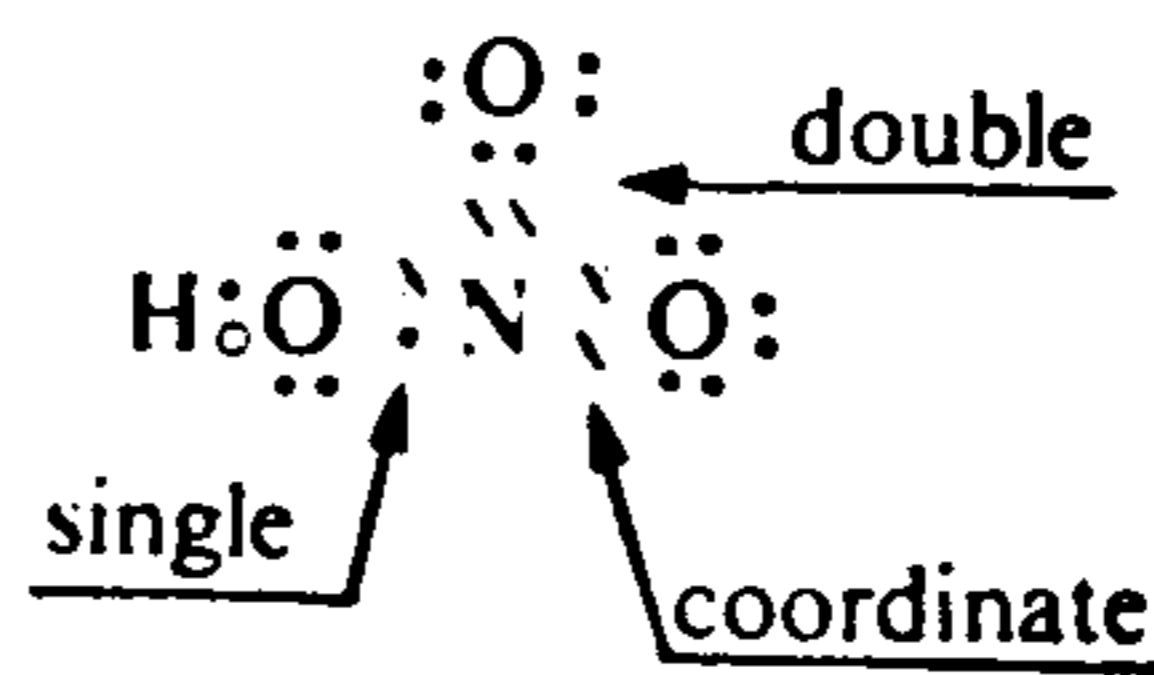
Constructing dot diagrams becomes a trial and _____ process until a reasonable structure is drawn. The following suggestions will help reduce the number of trials and errors.

- Choose a central atom, generally a(n) _____ other than H or O, which is bonded to not more than _____ other atoms.
- In ternary compounds, H atoms are generally bonded to _____ atoms.
- Arrange atoms as symmetrically as possible around the central atom; try to represent the _____ electrons of all atoms as _____ of shared and unshared electrons.

The diagrams below represent CH_2Cl_2 and HNO_3 .



CH_2Cl_2



HNO_3

Molecules

Construct dot diagrams for the following molecules. For molecules 11, 20, 21, 25, and 27, identify bond types as shown above.

9. CH_4

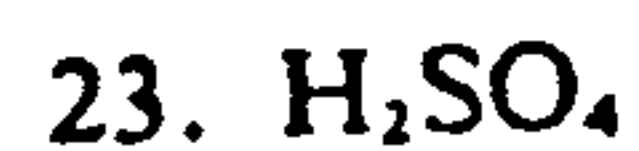
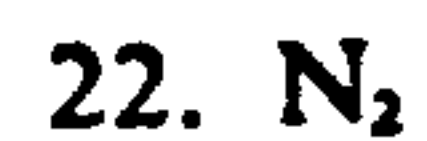
12. Cl_2

10. H_2

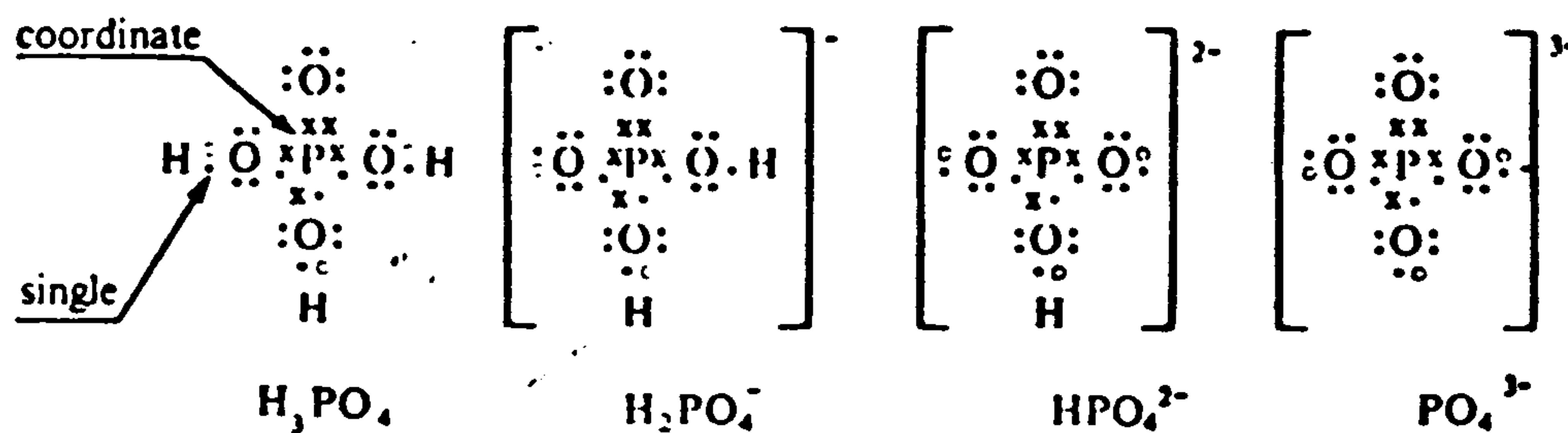
11. PH_3

CONSTRUCT LEWIS DOT DIAGRAMS FOR THE FOLLOWING MOLECULES

Name _____ Class _____ Date _____



Atoms can bond together to form polyatomic ions as well as molecules. It is usually most convenient to regard polyatomic ions as derivatives of their related ternary acids. A diagram can then be constructed for the ternary acid as described above. Removal of one or more H atoms will yield the diagram for the polyatomic ion. The diagrams below represent H_3PO_4 and related polyatomic ions: H_2PO_4^- , HPO_4^{2-} , and PO_4^{3-} .



Construct dot diagrams for the following molecules and polyatomic ions. For ions 32, 34, and 38, identify bond types as shown above.



Covalent Bonding and Molecular Compounds

Section Review 6.2

DIRECTIONS: Write on the line at the right of each statement the letter preceding the word or expression that best completes the statement.

1. Of the following reactions, the exothermic reaction is _____ 1
 (a) 1 mole $H_2 \rightarrow 2$ moles H;
 (b) 1 mole $Cl_2 \rightarrow 2$ moles Cl;
 (c) 1 mole H + 1 mole Cl \rightarrow 1 mole HCl;
 (d) 1 mole HCl \rightarrow 1 mole H + 1 mole Cl.
2. When an atom of one element combines chemically with an atom of another element, both atoms usually attain the stable highest-energy-level configuration of a (a) metal; (b) nonmetal; (c) noble gas; (d) metalloid. _____ 2
3. In a molecule of fluorine, the two shared electrons give each fluorine atom _____ electrons in the outer energy level. (a) 1 (b) 2 (c) 8 (d) 32 _____ 3
4. In writing a Lewis structure, each nonmetal atom except hydrogen should be surrounded by (a) 2 electrons; (b) 4 electrons; (c) 8 electrons; (d) 10 electrons. _____ 4
5. In writing a Lewis structure, the central atom is the (a) atom with the greatest mass; (b) atom with the highest atomic number; (c) atom with the fewest electrons; (d) least electronegative atom. _____ 5
6. To draw the electron-dot symbols for each atom in a Lewis structure, one must know the (a) number of valence electrons in each atom; (b) atomic mass of each atom; (c) bond length of each atom; (d) electronegativity of each atom. _____ 6
7. In the Lewis structure for the ammonium ion, there are _____ valence electrons. (a) 2 (b) 4 (c) 8 (d) 12 _____ 7
8. If, after drawing a Lewis structure, too many valence electrons have been used, the molecule probably contains (a) too many atoms; (b) one or more multiple covalent bonds; (c) too many lone electron pairs; (d) an ionic bond. _____ 8
9. The substance whose Lewis structure indicates three covalent bonds is (a) H_2O ; (b) CH_2Cl_2 ; (c) NH_3 ; (d) CCl_4 . _____ 9
10. How many double bonds are in the Lewis structure for hydrogen fluoride, which contains one hydrogen atom and one fluorine atom? (a) none (b) one (c) two (d) three _____ 10
11. The phosphate ion, PO_4^{3-} , contains how many extra electrons in its Lewis structure? (a) 0 (b) 2 (c) 3 (d) 4 _____ 11

DIRECTIONS: Complete the following statements, forming accurate sentences.

- omit ~~12.~~ According to the equation $1 \text{ mol } H_2O + 928 \text{ kJ} \rightarrow 2 \text{ mol H} + 1 \text{ mol O}$, the O-H bond energy is _____ 12
13. In the formation of a covalent bond, as the distance between two atoms begins to decrease, the potential energy _____ 13
14. When sodium (electron configuration $1s^2 2s^2 2p^6 3s^1$) combines with chlorine to form sodium chloride, the sodium attains the electron configuration _____ 14
15. The bonds within polyatomic ions are predominantly _____ 15