Unit 3: Ionic and Covalent Compounds

Chapter 5: Atoms and Moles

(Chapter Review on pg. 183 to 184)

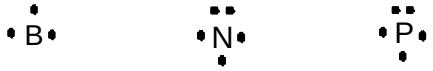
1. It has different number of electrons.
2. It needs to lose one or more electrons.
3. It needs to gain one or more electrons.
4. Atoms gain or lose electrons to fill their outer *s* and *p* orbitals with eight electrons.
5. Enough energy is released to make the overall process spontaneous.
6. The parentheses reflect the fact that the polyatomic ion functions as a single unit.
7. five; As^{3-}
8. Chemical properties depend on electron configuration. By either gaining or losing electrons, an atom changes its electron configuration and therefore its chemical properties also changes.
9. The atoms of an element will react to achieve a noble-gas configuration. The atoms will either gain or lose electrons to achieve such a configuration.
10. With seven valence electrons, a halogen needs only one additional electron to form a stable ion.
11. Helium is inert because its one energy level, 1*s*, is filled with the maximum number of electrons.
12. With one, two, or three valence electrons, metals generally lose electrons to achieve a noble gas configuration. More energy would be required for them to gain the necessary electrons. With five, six, or seven valence electrons, non-metal elements tend to gain electrons.
13. The diagram with 18 electrons.
14. The electrical attraction between cations and anions in the crystal lattice is strong. Therefore, a high temperature is required to break down the lattice and change the solid crystal into a liquid. Ions still have strong attractions in the liquid state. Therefore, an even higher temperature is required to separate the ions into a gas.
15. Lattice energy provides enough energy to drive all the endothermic steps, such as the sublimation of solid metal to gaseous metal (sublimation energy), the formation of cations (ionization energy), and the bond energy to break the diatomic non-metal elements, that are involved in the formation of a crystal lattice.
16. Both are metals and form cations. An ionic bond forms only between ions of opposite charges.
17. The chlorate ion, ClO_3^-, contains three O atoms while the chlorite ion, ClO_2^-, contains only two O atoms.
18. **(a)** sodium ion (Na^+) and nitrate (NO_3^-) **(b)** potassium ion (K^+) and sulfite (SO_3^{2-})
(c) ammonium (NH_4^+) and chromate (CrO_4^-) **(d)** aluminium ion (Al^{3+}) and sulfate (SO_4^{2-})
19. **(a)** copper (II) phosphate **(b)** iron (III) nitrate **(c)** copper (I) oxide **(d)** copper (II) oxide
20. **(a)** Li_2SO_4 **(b)** $Sr(NO_3)_2$ **(c)** NH_4CH_3COO **(d)** $Ti_2(SO_4)_3$
22. **(a)** peroxide **(b)** chromate **(c)** ammonium **(d)** carbonate
24. **(a)** CN^- **(b)** SO_4^{2-} **(c)** NO_2^- **(d)** MnO_4^-
26. Most metals are active elements that lose electrons to form ionic compounds that are found in ores.
27. Nuclear processes do not occur in chemical reactions. Chemical reactions involve the rearrangement of electrons, not protons or neutrons.
28. Elements in this group do not normally form ions. They all have stable outer energy levels.
29. Compound A is probably ionic because it has the higher melting and boiling points. In addition, compound A does not vaporize as readily. These properties are the result of strong ionic bonds.

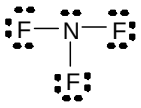
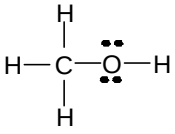
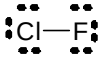
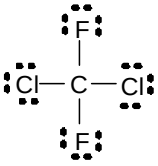
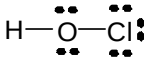
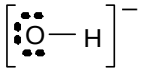
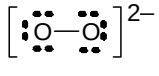
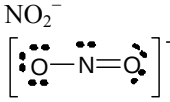
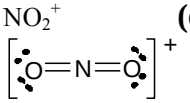
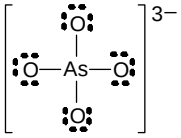
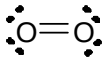
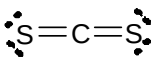
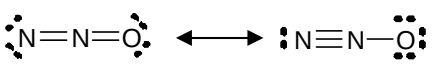
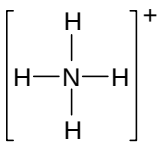
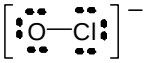
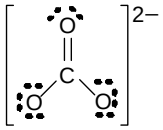
(Standardize Test Prep on pg. 186 & 187)

1. D **2.** H **3.** C **4.** F
5. Metals lose their outer electrons easily to form ionic compounds with other elements.
6. Elements that have only a few valence electrons form cations because it takes less energy to lose electrons. Elements with an outer level is close to filled form anions.
7. B **8.** F **9.** C **10.** H **11.** C **12.** 2

Chapter 6: Atoms and Moles

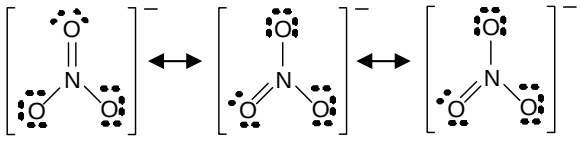
(Chapter Review on pg. 216 to 218)

11. An ionic bond results from transfer of electrons. A covalent bond results from the sharing of electrons/
12. As bond energy generally increases, bond strength generally increases.
13. Like a spring, a covalent bond can stretch and compress.
14. As two atoms come together to form a bond, their potential energy decreases until it is at a minimum. The distance between the atoms at the minimum potential energy is defined as the bond length.
15. **(a)** ionic **(b)** polar covalent **(c)** non-polar covalent **(d)** polar covalent **(e)** covalent
16. The bonding electrons are found in a molecular orbital that is formed by overlap of two atomic orbitals.
17. from least to most polar: I−Cl, H−Br, H−F
18. The electronegativity difference between the two atoms determines the bond's electron distribution. The more electronegative atom holds electrons more closely than the less electronegative atom.
19. Attractive forces between molecules are generally much weaker than those between ions in an ionic solid. As a result, more energy must be supplied to separate the ions, giving ionic compounds generally higher melting and boiling points.
20. 

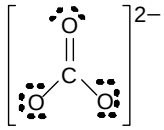
21. Placing the dots to show valence electrons might give the impression that the exact location of an electron at any particular time can be determined. For some molecules, a single Lewis structure cannot adequately explain the molecule's structure.
22. The dots represent valence electrons.
23. Two long dashes, representing a double bond, are used.
24. A single Lewis structure cannot account for how the electrons are arranged in a molecule.
25. **(a)** sulphur tetrafluoride **(b)** xenon tetrafluoride **(c)** phosphorus pentabromide **(d)** dinitrogen pentaoxide **(e)** trisilicon tetranitride
26. Electrons are negatively charged and therefore repel each other. Electron pairs are arranged as far apart as possible to minimize the repulsion between them.
27. tetrahedral linear trigonal planar
28. No, shape can determine both physical and chemical properties.
29. **(a)** The unshared electron pairs (lone pairs) in the O atom are arranged so tat they are as far apart as possible from the two shared electron pairs (bonding pairs), giving the molecule a bent shape.
(b) The bent molecule has an overall polarity, because the dipoles of the two bonds are oriented at an angle.
30. **(a)**  **(b)**  **(c)**  **(d)**  **(e)** 
31. **(a)**  **(b)**  **(c)**  **(d)**  **(e)** 
32. **(a)**  **(b)**  **(c)** 
33. **(a)** tetrahedral **(b)** bent
34. **(a)**  **(b)**  **(c)** 

35. **(a)** SCl_2 is bent. Both PF_3 and NCl_3 are trigonal pyramids.
(b) The bond angles of all three molecules are similar. However, the electronegativity difference is greatest between P and F, so PF_3 is the most polar.

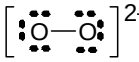
36.



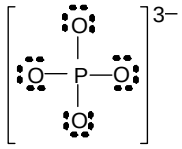
37. (a)



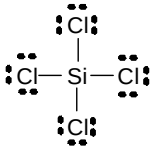
(b)



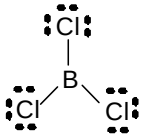
(c)



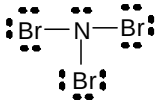
38. **(a)** silicon tetrachloride (tetrahedral)



(b) boron trichloride (trigonal planar)



(c) nitrogen tribromide (trigonal pyramid)



39. Ionic compounds are composed of positive and negative ions that are strongly attracted to one another, while covalent compounds are composed of separate molecules that are generally less strongly attracted to one another. Ionic substances tend to have higher melting and boiling points than covalent compounds.

40. When a halogen forms a single bond, it achieves a full octet. If the halogen formed a double bond, it would no longer have an octet of valence electrons.

42. **(a)** metals and non-metals **(b)** non-metals **(c)** metals

44. F has the highest electronegativity and therefore has the greatest attraction for the electrons it shares in a covalent bond.

45. **(a)** Xe is surrounded by 10 electrons – 4 are bonding with O atoms, 2 are bonding with F atoms, and 2 are in a lone pair.
(b) 13 **(c)** In four single bonds, there are 8 electrons forming the shared or bonding pairs.

46. Because of its shape (tetrahedral), methane is a non-polar molecule. As a result, CH_4 molecules are not strongly attracted to one another. In contrast, ammonia is a polar molecule. As a result, NH_3 molecules are attracted to one another. Therefore, it takes more energy to separate ammonia molecules and change ammonia to a gas than to separate methane molecules.

48. The triple bond (C≡C) in C_2H_2 is the strongest, making this bond the shortest of the three. The single bond (C−C) in C_2H_6 is the weakest, making this bond the longest of the three. C_2H_4 forms a double bond (C=C).

(Standardize Test Prep on pg. 220 & 221)

1. C **2.** I **3.** B

4. Ammonia is a polar molecule because nitrogen has a pair of electrons that are not involved in a covalent bond, while methane is a non-polar molecule. The attraction between polar ammonia molecules causes the higher boiling point.

5. Because HCl has two atoms, the shape can only be linear.

6. Attractive forces exist between each electron and each nucleus, Repulsive forces exist between electrons and between nuclei. In a covalent bond, the total attractive and repulsive forces are balanced.

7. F **8.** C

9. Because even a small amount of ionic compounds dissolved in water makes it a good conductor. The salts in your body or on the ground are enough to cause the water to carry a current.

10. H **11.** D **12.** H

13. A stronger bond is indicated by greater bond energy, so the strength of the bond increases as electronegativity increases.