

Bonding Questions

- ___ 1. Which equation is correctly balanced? (1) $\text{CaO} + 2\text{H}_2\text{O} \rightleftharpoons \text{Ca}(\text{OH})_2$ (2) $\text{NH}_3 + 2\text{O}_2 \rightleftharpoons \text{HNO}_3 + \text{H}_2\text{O}$; (3) $\text{Ca}(\text{OH})_2 + 2\text{H}_3\text{PO}_4 \rightleftharpoons \text{Ca}_3(\text{PO}_4)_2 + 3\text{H}_2\text{O}$; (4) $\text{Cu} + \text{H}_2\text{SO}_4 \rightleftharpoons \text{CuSO}_4 + \text{H}_2\text{O} + \text{SO}_2$.
- ___ 2. Sodium hydride and sodium chloride both have bonds which are predominantly (1) metallic; (2) ionic; (3) covalent; (4) network.
- ___ 3. Hydrogen bonds would be strongest between the molecules of a compound of hydrogen and (1) I; (2) Br; (3) Cl; (4) F.
- ___ 4. The formula for nitrogen(II) oxide is (1) NO; (2) N_2O ; (3) NO_2 ; (4) N_2O_4 .
- ___ 5. The atoms in a molecule of hydrogen chloride are held together by (1) ionic bonds; (2) polar covalent bonds; (3) van der Waals forces; (4) dipole-dipole attraction.
- ___ 6. Which type of bond is formed when an ammonia molecule accepts a proton? (1) ionic; (2) metallic; (3) coordinate covalent; (4) electrovalent.
- ___ 7. As the distance between molecules increases the strength of the van der Waals forces (1) decreases; (2) increases; (3) remains the same.
- ___ 8. Which is the formula of a nonpolar molecule? (1) CCl_4 ; (2) CaCl_2 ; (3) FeCl_3 ; (4) HCl.
- ___ 9. Which compound has the same empirical and molecular formula? (1) H_2O_2 ; (2) NH_3 ; (3) C_2H_6 ; (4) Hg_2Cl_2 .
- ___ 10. Which is a characteristic of ionic solids? (1) They conduct electricity.; (2) They have high vapor pressures.; (3) They have high melting points.; (4) They are very malleable..
- ___ 11. Given the following: $\text{H}_2 + \text{Fe}_3\text{O}_4 \rightleftharpoons \text{Fe} + \text{H}_2\text{O}$. When this is completely balanced using smallest whole numbers, the coefficient of hydrogen gas would be (1) 1; (2) 2; (3) 3; (4) 4.
- ___ 12. The strongest hydrogen bonds are formed between molecules of (1) H_2Te ; (2) H_2Se ; (3) H_2O ; (4) H_2S .
- ___ 13. The correct formula for the thiosulfate ion is (1) SO_3^{2-} ; (2) SO_4^{2-} ; (3) SCN^{1-} ; (4) $\text{S}_2\text{O}_3^{2-}$.
- ___ 14. What type of bonds are present in a strip of magnesium ribbon? (1) covalent; (2) ionic; (3) metallic; (4) van der Waals.
- ___ 15. A molecule of ammonia, NH_3 contains (1) ionic bonds, only; (2) covalent bonds, only; (3) both covalent and ionic bonds; (4) neither covalent nor ionic bonds.
- ___ 16. When sodium reacts with chlorine to form sodium chloride, electrons are lost by (1) sodium, only; (2) chlorine, only; (3) both sodium and chlorine; (4) neither sodium nor chlorine.
- ___ 17. Sodium chloride will be produced by a reaction between sodium hydroxide and (1) chlorous acid; (2) chloric acid; (3) hydrochloric acid; (4) hypochlorous acid.

- ___ 18. Which bond has the greatest degree of ionic character? (1) Li-Br; (2) F-F; (3) H-Cl; (4) S-O.
- ___ 19. The weakest van der Waals forces exist between molecules of (1) $C_2H_6(l)$; (2) $C_3H_8(l)$; (3) $C_4H_{10}(l)$; (4) $C_5H_{12}(l)$.
- ___ 20. A pure substance melts at 38 degrees Celsius and does not conduct electricity in either the solid or liquid phase. The substance is classified as (1) electrovalent; (2) metallic; (3) ionic; (4) molecular.
- ___ 21. The attraction between nonpolar molecules is called (1) van der Waals forces; (2) hydrogen bonds; (3) electrovalent forces; (4) covalent bonds.
- ___ 22. Hydrogen bonds are strongest between molecules of (1) HF; (2) HCl; (3) HBr; (4) HI.
- ___ 23. The transfer of electrons from sodium atoms to chlorine atoms results in the formation of (1) coordinate covalent bonds; (2) polar covalent bonds; (3) nonpolar bonds; (4) ionic bonds.
- ___ 24. The correct formula for nickel(II) oxide is (1) NiO; (2) Ni_2O ; (3) NiO_2 ; (4) Ni_3O_2 .
- ___ 25. The carbon atoms in a diamond are held together by (1) metallic bonds; (2) hydrogen bonds; (3) ionic bonds; (4) covalent bonds.
- ___ 26. If the equation $?SiO_2 + ?C \rightarrow ?SiC + ?CO$ is correctly balanced using whole-number coefficients the sum of all the coefficients is (1) 6; (2) 7; (3) 8; (4) 9.
- ___ 27. The name for the compound $NaClO_3$ is (1) sodium chloride; (2) sodium chlorate; (3) sodium perchlorate; (4) sodium chlorite.
- ___ 28. The chemical bond in a hydrogen molecule is (1) nonpolar covalent; (2) polar covalent; (3) ionic; (4) electrovalent.
- ___ 29. Which is an empirical formula? (1) N_2O_4 ; (2) P_4O_{10} ; (3) $C_6H_{12}O_6$; (4) Al_2O_3 .
- ___ 30. Which compound has the lowest melting point? (1) HCl; (2) KCl; (3) NaCl; (4) LiCl.
- ___ 31. The correct formula for iron(II) oxide is (1) FeO_3 ; (2) Fe_2O_3 ; (3) FeO; (4) Fe_3O_2 .
- ___ 32. At 25 degrees Celsius hydrogen bonds are strongest between molecules of (1) CH_4 ; (2) NH_3 ; (3) H_2O ; (4) HCl.
- ___ 33. Which atom will form the most polar bond with hydrogen? (1) F; (2) Cl; (3) Br; (4) I.
- ___ 34. Which element will have the greatest attraction for bonding electrons? (1) lithium; (2) sulfur; (3) aluminum; (4) zinc.
- ___ 35. As the distance between two iodine molecules increases the attraction of the van der Waals forces between them (1) decreases; (2) increases; (3) remains the same.
- ___ 36. As the elements of Group VA are considered in order of increasing atomic radius their tendency to lose electrons (1) decreases; (2) increases; (3) remains the

same.

- ___ 37. An Na^{1+} ion is similar to a K^{1+} ion in that both ions have the same (1) nuclear charge; (2) number of electrons; (3) atomic mass; (4) oxidation number.
- ___ 38. Which compound is a network solid? (1) CH_4 ; (2) CO_2 ; (3) CaH_2 ; (4) SiO_2 .
- ___ 39. A compound formed from potassium and chlorine will have (1) a molecular crystal structure; (2) a high melting point; (3) good heat conductivity in the solid state; (4) poor electrical conductivity in solution.
- ___ 40. Which compound contains ionic bonds? (1) NaH(s) ; (2) $\text{C}_6\text{H}_{12}\text{O}_6\text{(s)}$; (3) $\text{CH}_3\text{OH(l)}$; (4) $\text{H}_2\text{O(l)}$.
- ___ 41. Which molecule is the most polar? (1) H_2O ; (2) H_2S ; (3) H_2Se ; (4) H_2Te .
- ___ 42. Which type of bonding involves positive ions immersed in a sea of mobile electrons? (1) ionic; (2) nonpolar covalent; (3) polar covalent; (4) metallic.
- ___ 43. Which sample of HCl most readily conducts electricity? (1) HCl(s) ; (2) HCl(l) ; (3) HCl(g) ; (4) HCl(aq) .
- ___ 44. The forces of attraction which exist between hydrogen molecules in liquid hydrogen are due to (1) ionic bonds; (2) hydrogen bonds; (3) molecule-ion forces; (4) van der Waals forces.
- ___ 45. Which is a property of ionic substances in the solid state? (1) electrical conductivity; (2) a high melting point; (3) malleability; (4) high vapor pressure.
- ___ 46. In which noble gas are van der Waals forces the greatest? (1) Ne ; (2) Xe ; (3) Kr ; (4) Ar .
- ___ 47. The abnormally high boiling point of HF as compared to HCl is primarily due to intermolecular forces of attraction called (1) network bonds; (2) electrovalent forces; (3) van der Waals forces; (4) hydrogen bonds.
- ___ 48. Hydrogen forms a negative ion when it combines with sodium to form NaH . This is primarily because hydrogen (1) loses an electron to sodium; (2) has a greater attraction for electrons than sodium has; (3) is a larger atom than sodium; (4) has a smaller ionization energy than sodium.
- ___ 49. What type of bond exists in a molecule of iodine? (1) ionic; (2) polar covalent; (3) nonpolar covalent; (4) metallic.
- ___ 50. A bond angle of 120 degrees will appear with a geometry of (1) linear; (2) triangular; (3) tetrahedral; (4) square.
- ___ 51. Which pair of elements will NOT form an ionic bond? (1) barium and chlorine; (2) calcium and sulfur; (3) potassium and oxygen; (4) carbon and chlorine.
- ___ 52. Which molecule will be unstable at room temperature? (1) BeH_2 ; (2) HI ; (3) NF_3 ; (4) CCl_4 .
- ___ 53. Which compound exhibits bonds having the least ionic character? (1) CsCl ; (2) CaS ; (3) KF ; (4) NaF .

- ___ 54. Which is the formula for the sodium salt of perchloric acid? (1) NaClO; (2) NaClO₂; (3) NaClO₃; (4) NaClO₄.
- ___ 55. As the difference in electronegativities decreases the tendency for elements to form covalently bonded compounds (1) decreases; (2) increases; (3) remains the same.
- ___ 56. Which molecule will have a linear shape? (1) Carbon tetrachloride; (2) Water; (3) Ammonia; (4) Carbon dioxide.
- ___ 57. Which molecule below will have a triple covalent bond? (1) F₂; (2) O₂; (3) N₂; (4) H₂.
- ___ 58. Which is a nonpolar molecule? (1) HCl; (2) CH₄; (3) HBr; (4) H₂O.
- ___ 59. Silicon carbide is an example of (1) an ionic compound; (2) a metallic substance; (3) a network solid; (4) a super-cooled liquid.
- ___ 60. Which compound will have resonance structures? (1) Carbon dioxide; (2) Sulfur trioxide; (3) Carbon tetrachloride; (4) Water.
- ___ 61. In which compound does the bond have the least degree of ionic character? (1) KBr; (2) HF; (3) MgO; (4) BrCl.
- ___ 62. Pure nitrogen combines directly with an active metal to form a (1) nitrate; (2) nitride; (3) nitrite; (4) pernitrate.
- ___ 63. Which element will form a double bond with oxygen? (1) H; (2) Na; (3) C; (4) Cl.
- ___ 64. Which molecule is impossible? (1) CH; (2) C₂H₂; (3) C₂H₄; (4) C₄H₈.
- ___ 65. Which formula represents an ionic compound? (1) H₂O(l); (2) NaCl(s); (3) NH₃(g); (4) CCl₄(l).
- ___ 66. Which formula represents a tetrahedral molecule? (1) CH₄; (2) CaCl₂; (3) HBr; (4) Br₂.
- ___ 67. What is the correct formula for sodium thiosulfate? (1) Na₂S₂O₄; (2) Na₂SO₃; (3) Na₂SO₄; (4) Na₂S₂O₃.
- ___ 68. Which formula represents a polar molecule containing polar covalent bonds? (1) H₂O; (2) CO₂; (3) NaCl; (4) Cl₂.
- ___ 69. Which compound has the lowest normal boiling point? (1) HCl; (2) H₂S; (3) NH₃; (4) CH₄.
- ___ 70. Which substance exists as a metallic crystal at STP? (1) Ar; (2) Au; (3) SiO₂; (4) CO₂.
- ___ 71. What is the correct formula of potassium hydride? (1) KH; (2) KH₂; (3) KOH; (4) K(OH)₂.
- ___ 72. Which compound is a poor conductor of heat and electricity and has a high melting point? (1) SiO₂; (2) KH₂; (3) CO₂; (4) N₂O.
- ___ 73. Which compound would most likely have the greatest ionic character? (1) CO; (2) KF; (3) CaO; (4) LiH.

- ___ 74. What is an example of a polar covalent molecule? (1) KCl; (2) LiCl; (3) NaCl; (4) HCl.
- ___ 75. Sodium atoms differ from sodium ions in that sodium atoms contain (1) one more proton; (2) one less proton; (3) one more electron; (4) one less electron.
- ___ 76. The correct formula for chlorous acid is (1) HClO; (2) HClO₂; (3) HClO₃; (4) HClO₄.
- ___ 77. Which is a nonpolar covalent substance? (1) CCl₄; (2) NH₃; (3) H₂O; (4) KCl.
- ___ 78. Which compound contains only ionic bonds? (1) HNO₃; (2) NH₄Cl; (3) H₂O; (4) Na₂O.
- ___ 79. Which element has an ionic radius that is larger than its atomic radius? (1) Li; (2) Cl; (3) Mg; (4) Al.
- ___ 80. Which of the following compounds contains sp hybrid orbitals? (1) CH₄; (2) NH₃; (3) H₂O; (4) BeF₂.
- ___ 81. Which formula would you expect when aluminum reacts with chlorine? (1) AlCl₂; (2) Al₂Cl₃; (3) AlCl₃; (4) Al₃Cl₂.
- ___ 82. Which element has the greatest tendency to lose electrons? (1) barium; (2) magnesium; (3) calcium; (4) strontium.
- ___ 83. The total number of electrons shared in carbon dioxide is (1) 8; (2) 2; (3) 6; (4) 4.
- ___ 84. Which best explains why a methane molecule is nonpolar? (1) Each carbon-hydrogen bond is polar.; (2) Carbon and hydrogen are both nonmetals.; (3) Methane is an organic compound.; (4) The methane molecule is symmetrical..
- ___ 85. Which is the smallest particle of a covalent compound that has the chemical properties of that compound? (1) ion; (2) atom; (3) electron; (4) molecule.
- ___ 86. A solid which is soft, a nonconductor, and which melts at a low temperature is most likely (1) an ionic solid; (2) a network solid; (3) a metallic solid; (4) a molecular solid.
- ___ 87. Which molecule has a pyramidal shape? (1) Carbon tetrachloride; (2) Carbon dioxide; (3) Boron trifluoride; (4) Ammonia.
- ___ 88. As the temperature of ethyl alcohol decreases its vapor pressure (1) decreases; (2) increases; (3) remains the same.
- ___ 89. As a sulfur atom becomes a sulfide ion the radius (1) decreases; (2) increases; (3) remains the same.
- ___ 90. Which of the following contains both covalent and ionic bonds? (1) CCl₄; (2) NaOH; (3) H₂O; (4) NaCl.
- ___ 91. Hydrogen bonds are formed between molecules in which hydrogen is covalently bonded to an element having (1) low electronegativity; (2) high electronegativity; (3) low ionization energy; (4) high atomic mass.

- ___ 92. The formula for nitrogen(IV) oxide is (1) N_2O ; (2) NO_2 ; (3) NO_4 ; (4) N_4O .
- ___ 93. When a metallic atom becomes an ion its radius (1) decreases; (2) increases; (3) remains the same.
- ___ 94. When a radioactive element forms a chemical bond with another element its half-life (1) decreases; (2) increases; (3) remains the same.
- ___ 95. Which property best accounts for the conductivity of metals? (1) the protons in metallic crystals; (2) the malleability of most metals; (3) the filled inner electron shells of most metals; (4) the free electrons in metallic crystals.
- ___ 96. Which type of bond exists between the carbon atoms in diamond? (1) ionic; (2) covalent; (3) metallic; (4) hydrogen.
- ___ 97. Which compound contains both covalent and ionic bonds? (1) KCl ; (2) H_2O ; (3) NH_4Cl ; (4) CCl_4 .
- ___ 98. Compounds with the greatest ionic character would form when fluorine reacts with (1) metalloids (semimetals); (2) alkali metals; (3) Group 13 (IIIA) elements; (4) noble gases.
- ___ 99. Which element is composed of atoms that can form more than one covalent bond with each other? (1) hydrogen; (2) helium; (3) carbon; (4) calcium.
- ___ 100. Which substance contains a polar covalent bond? (1) Na_3N ; (2) Mg_3N_2 ; (3) NH_3 ; (4) N_2 .
- ___ 101. What is the total number of moles of atoms represented by one mole of $(\text{CH}_3)_2\text{NH}$? (1) 5; (2) 8; (3) 9; (4) 10.
- ___ 102. Which kinds of bonds are found in a sample of water? (1) hydrogen bonds, only; (2) covalent bonds, only; (3) both ionic and hydrogen bonds; (4) both covalent and hydrogen bonds.
- ___ 103. When a salt is dissolved in water, the salt particles exist in the form of (1) hydrated molecules, only; (2) hydrated ions, only; (3) both hydrated ions and hydrated molecules; (4) neither hydrated ions nor hydrated molecules.
- ___ 104. A binary compound of sodium is (1) sodium chlorate; (2) sodium chlorite; (3) sodium perchlorate; (4) sodium chloride.
- ___ 105. An ionic bond forms between atoms of (1) I and Cl; (2) K and Cl; (3) P and Cl; (4) H and Cl.
- ___ 106. Which formulas could represent the empirical formula and the molecular formula of a given compound? (1) CH_2O , $\text{C}_4\text{H}_6\text{O}_4$; (2) CHO , $\text{C}_6\text{H}_{12}\text{O}_6$; (3) CH_4 , C_5H_{12} ; (4) CH_2 , C_3H_6 .
- ___ 107. Hydrogen bonds are strongest between molecules of (1) HF ; (2) HCl ; (3) HBr ; (4) HI .
- ___ 108. Which element is a molecular solid at STP? (1) fluorine; (2) bromine; (3) chlorine; (4) iodine.

- ___ 109. Which element exists as a monatomic gas molecule at STP? (1) nitrogen; (2) barium; (3) bromine; (4) neon.
- ___ 110. Water containing dissolved electrolyte conducts electricity because the solution contains mobile (1) electrons; (2) molecules; (3) atoms; (4) ions.
- ___ 111. A characteristic of ionic solids is that they (1) have high melting points; (2) have low boiling points; (3) conduct electricity; (4) are noncrystalline.
- ___ 112. Which is the formula for the compound that forms when magnesium bonds with phosphorus? (1) Mg_2P ; (2) MgP_2 ; (3) Mg_2P_3 ; (4) Mg_3P_2 .
- ___ 113. Mobile electrons are a distinguishing characteristic of (1) an ionic bond; (2) an electrovalent bond; (3) a metallic bond; (4) a covalent bond.
- ___ 114. Which is the correct formula for nitrogen (IV) oxide? (1) NO; (2) NO_2 ; (3) NO_3 ; (4) NO_4 .
- ___ 115. Which is an empirical formula? (1) C_2H_2 ; (2) C_2H_4 ; (3) Al_2Cl_6 ; (4) K_2O .
- ___ 116. Why is ammonia classified as a polar molecule? (1) NH_3 is a gas at STP.; (2) N-H bonds are nonpolar.; (3) Nitrogen and hydrogen are both nonmetals.; (4) NH_3 molecules have asymmetrical charge distributions..
- ___ 117. The greatest degree of ionic character would be found in a bond between sulfur and (1) oxygen; (2) chlorine; (3) bromine; (4) phosphorus.
- ___ 118. Helium may be liquified at low temperature and high pressure primarily because of (1) hydrogen bonding; (2) covalent bonds; (3) van der Waals forces; (4) ionic attraction.
- ___ 119. The strongest hydrogen bonds are formed between molecules in which hydrogen is covalently bonded to an element with (1) high electronegativity and large atomic radius; (2) high electronegativity and small atomic radius; (3) low electronegativity and large atomic radius; (4) low electronegativity and small atomic radius.
- ___ 120. The bonding in ammonia is most similar to the bonding in (1) H_2O ; (2) NaCl; (3) MgO; (4) KF.
- ___ 121. Which is the formula of an ionic compound? (1) SO_2 ; (2) CO_2 ; (3) CH_3OH ; (4) NaOH.
- ___ 122. Molecule-ion attractions are found in (1) Cu(s); (2) CO(g); (3) KBr(l); (4) NaCl(aq).
- ___ 123. Hydrogen bonds are strongest between the molecules of (1) HF(l); (2) HCl(l); (3) HBr(l); (4) HI(l).
- ___ 124. The bonds present in silicon carbide (SiC) are (1) covalent; (2) ionic; (3) metallic; (4) van der Waals.
- ___ 125. Element M has an electronegativity of less than 1.2 and reacts with bromine to form the compound MBr_2 . Element M could be (1) Al; (2) Na; (3) Ca; (4) K.
- ___ 126. What type of bonding is found in the molecule HBr? (1) ionic; (2) metallic;

(3) nonpolar covalent; (4) polar covalent.

- ___ 127. What is the name of the calcium salt of sulfuric acid? (1) calcium thiosulfate; (2) calcium sulfate; (3) calcium sulfide; (4) calcium sulfite.
- ___ 128. What is the formula of nitrogen (I) oxide? (1) NO; (2) N₂O; (3) NO₂; (4) N₂O₄.
- ___ 129. When a reaction occurs between atoms with ground state electron configurations 1s²,2s¹, and 1s²,2s²,2p⁵, the predominant type of bond formed is (1) polar covalent; (2) nonpolar covalent; (3) ionic; (4) metallic.
- ___ 130. Which represents both an empirical and molecular formula? (1) P₂O₅; (2) N₂O₄; (3) C₃H₆; (4) C₆H₁₂O₆.
- ___ 131. Which compound contains ionic bonds? (1) NaBr(s); (2) HBr(g); (3) C₆H₁₂O₆(s); (4) CO₂(g).
- ___ 132. Which molecule contains a nonpolar covalent bond? (1) HCl; (2) HBr(g); (3) F₂; (4) NH₃.
- ___ 133. Which type of solid does pure water form when it freezes? (1) ionic; (2) network; (3) metallic; (4) molecular.
- ___ 134. Which symbol represents a molecule at STP? (1) H; (2) N; (3) Kr; (4) Br.
- ___ 135. At 298 °K, the vapor pressure of water is less than the vapor pressure of carbon disulfide. The best explanation for this is that water has (1) larger molecules; (2) a larger molecular mass; (3) stronger ionic bonds; (4) stronger intermolecular forces.