

## Bonding and Naming Review

---

- Which type of chemical bond is formed between two atoms of bromine?  
A) metallic                      B) hydrogen  
C) ionic                            D) covalent
- Which of these formulas contains the most polar bond?  
A) H–Br   B) H–Cl   C) H–F   D) H–I
- Hexane (C<sub>6</sub>H<sub>14</sub>) and water do *not* form a solution. Which statement explains this phenomenon?  
A) Hexane is polar and water is nonpolar.  
B) Hexane is ionic and water is polar.  
C) Hexane is nonpolar and water is polar.  
D) Hexane is nonpolar and water is ionic.
- The strength of an atom's attraction for the electrons in a chemical bond is the atom's  
A) electronegativity    B) ionization energy  
C) heat of reaction    D) heat of formation
- Which of the following solids has the highest melting point?  
A) H<sub>2</sub>O(s)                      B) Na<sub>2</sub>O(s)  
C) SO<sub>2</sub>(s)                      D) CO<sub>2</sub>(s)
- A chemist performs the same tests on two homogeneous white crystalline solids, *A* and *B*. The results are shown in the table below.

	Solid A	Solid B
Melting Point	High, 801°C	Low, decomposes at 186°C
Solubility in H <sub>2</sub> O (grams per 100.0 g H <sub>2</sub> O at 0°C)	35.7	3.2
Electrical Conductivity (in aqueous solution)	Good conductor	Nonconductor

The results of these tests suggest that

- both solids contain only ionic bonds  
B) both solids contain only covalent bonds  
C) solid *A* contains only covalent bonds and solid *B* contains only ionic bonds  
D) solid *A* contains only ionic bonds and solid *B* contains only covalent bonds
- 

- Which type of bond is formed when electrons are transferred from one atom to another?  
A) covalent                      B) ionic  
C) hydrogen                      D) metallic
-

## Bonding and Naming Review

8. The bonds in the compound  $\text{MgSO}_4$  can be described as
- A) ionic, only
  - B) covalent, only
  - C) both ionic and covalent
  - D) neither ionic nor covalent
9. What is the total number of valence electrons in an atom of sulfur in the ground state?
- A) 6
  - B) 8
  - C) 3
  - D) 4
10. What is the correct IUPAC name for the compound  $\text{NH}_4\text{Cl}$ ?
- A) nitrogen chloride
  - B) nitrogen chlorate
  - C) ammonium chloride
  - D) ammonium chlorate
11. Which Lewis electron-dot structure is drawn correctly for the atom it represents?
- A)  $\text{:}\ddot{\text{N}}$
  - B)  $\text{:}\ddot{\text{F}}\text{:}$
  - C)  $\text{:}\ddot{\text{O}}\text{:}$
  - D)  $\text{:}\ddot{\text{Ne}}\text{:}$
12. Which of these substances has the strongest intermolecular forces?
- A)  $\text{H}_2\text{O}$
  - B)  $\text{H}_2\text{S}$
  - C)  $\text{H}_2\text{Se}$
  - D)  $\text{H}_2\text{Te}$
13. As two chlorine atoms combine to form a molecule, energy is
- A) absorbed
  - B) released
  - C) created
  - D) destroyed
14. Which particle has the same electron configuration as a potassium ion?
- A) fluoride ion
  - B) sodium ion
  - C) neon atom
  - D) argon atom
15. What is the correct formula for iron (III) phosphate?
- A)  $\text{FeP}$
  - B)  $\text{Fe}_3\text{P}_2$
  - C)  $\text{FePO}_4$
  - D)  $\text{Fe}_3(\text{PO}_4)_2$
16. The bond between Br atoms in a  $\text{Br}_2$  molecule is
- A) ionic and is formed by the sharing of two valence electrons
  - B) ionic and is formed by the transfer of two valence electrons
  - C) covalent and is formed by the sharing of two valence electrons
  - D) covalent and is formed by the transfer of two valence electrons
17. What occurs when an atom of chlorine and an atom of hydrogen become a molecule of hydrogen chloride?
- A) A chemical bond is broken and energy is released.
  - B) A chemical bond is broken and energy is absorbed.
  - C) A chemical bond is formed and energy is released.
  - D) A chemical bond is formed and energy is absorbed.
18. Which molecule is nonpolar?
- A)  $\text{H}_2\text{O}$
  - B)  $\text{NH}_3$
  - C)  $\text{CO}$
  - D)  $\text{CO}_2$
19. Which of the following compounds has the highest boiling point?
- A)  $\text{H}_2\text{O}$
  - B)  $\text{H}_2\text{S}$
  - C)  $\text{H}_2\text{Se}$
  - D)  $\text{H}_2\text{Te}$

## Bonding and Naming Review

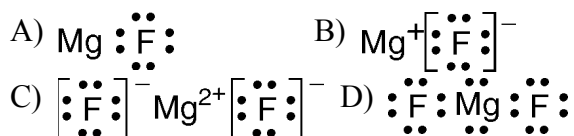
20. The data table below represents the properties determined by the analysis of substances *A*, *B*, *C*, and *D*.

Substance	Melting Point (°C)	Boiling Point (°C)	Conductivity
<i>A</i>	-80	-20	none
<i>B</i>	20	190	none
<i>C</i>	320	770	as solid
<i>D</i>	800	1250	in solution

Which substance is an ionic compound?

- A) *A*                      B) *B*                      C) *C*                      D) *D*

21. What is the correct Lewis electron-dot structure for the compound magnesium fluoride?



22. Covalent bonds are formed when electrons are

- A) transferred from one atom to another  
 B) captured by the nucleus  
 C) mobile within a metal  
 D) shared between two atoms

23. Element *X* is a solid that is brittle, lacks luster, and has six valence electrons. In which group on the Periodic Table would element *X* be found?

- A) 1      B) 2      C) 15      D) 16

24. The bonds between hydrogen and oxygen in a water molecule are classified as

- A) polar covalent              B) nonpolar covalent  
 C) ionic                          D) metallic

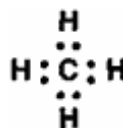
25. Which compound contains only covalent bonds?

- A) NaOH                          B) Ba(OH)<sub>2</sub>  
 C) Ca(OH)<sub>2</sub>                      D) CH<sub>3</sub>OH

26. Which characteristic is a property of molecular substances?

- A) good heat conductivity  
 B) good electrical conductivity  
 C) low melting point  
 D) high melting point

27. Given the Lewis electron-dot diagram:



Which electrons are represented by all of the dots?

- A) the carbon valence electrons, only  
 B) the hydrogen valence electrons, only  
 C) the carbon and hydrogen valence electrons  
 D) all of the carbon and hydrogen electrons

28. Molecules in a sample of NH<sub>3</sub>(*l*) are held closely together by intermolecular forces

- A) existing between ions  
 B) existing between electrons  
 C) caused by different numbers of neutrons  
 D) caused by unequal charge distribution

29. Which substance is correctly paired with its type of bonding?

- A) NaBr–nonpolar covalent  
 B) HCl–nonpolar covalent  
 C) NH<sub>3</sub>–polar covalent  
 D) Br<sub>2</sub>–polar covalent

30. Based on intermolecular forces, which of these substances would have the highest boiling point?

- A) He      B) O<sub>2</sub>      C) CH<sub>4</sub>      D) NH<sub>3</sub>

31. What is the chemical formula for copper(II) hydroxide?

- A) CuOH                          B) CuOH<sub>2</sub>  
 C) Cu<sub>2</sub>(OH)                      D) Cu(OH)<sub>2</sub>

## Bonding and Naming Review

32. Which compound contains both ionic and covalent bonds?  
A)  $\text{CaCO}_3$                       B)  $\text{PCl}_3$   
C)  $\text{MgF}_2$                          D)  $\text{CH}_2\text{O}$
33. Which formula represents a nonpolar molecule?  
A)  $\text{HCl}$    B)  $\text{H}_2\text{O}$    C)  $\text{NH}_3$    D)  $\text{CF}_4$
34. When a lithium atom forms an  $\text{Li}^+$  ion, the lithium atom  
A) gains a proton                B) gains an electron  
C) loses a proton                D) loses an electron
35. Which Lewis electron-dot diagram represents a boron atom in the ground state?  
A)  $\cdot\text{B}$                                 B)  $\begin{array}{c} \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \end{array} \text{B}$   
C)  $\begin{array}{c} \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \end{array} \text{B} \cdot$                         D)  $\begin{array}{c} \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \end{array} \text{B} \cdot$
36. An unknown element  $X$  can form a compound with the formula  $\text{XBr}_3$ . In which group on the Periodic Table would element  $X$  be found?  
A) 1    B) 2    C) 13    D) 14
37. A substance that does not conduct electricity as a solid but does conduct electricity when melted is most likely classified as  
A) an ionic compound  
B) a molecular compound  
C) a metal  
D) a nonmetal
38. What is the formula of titanium(II) oxide?  
A)  $\text{TiO}$                                 B)  $\text{TiO}_2$   
C)  $\text{Ti}_2\text{O}$                                 D)  $\text{Ti}_2\text{O}_3$
39. Which molecule contains a nonpolar covalent bond?  
A)  $\text{O}=\text{C}=\text{O}$                         B)  $\text{C}\equiv\text{O}$   
C)  $\text{Br}-\text{Br}$                                 D)  $\begin{array}{c} \text{Cl} \\ | \\ \text{Cl}-\text{C}-\text{Cl} \\ | \\ \text{Cl} \end{array}$
40. The correct chemical formula for iron(II) sulfide is  
A)  $\text{FeS}$                                 B)  $\text{Fe}_2\text{S}_3$   
C)  $\text{FeSO}_4$                                 D)  $\text{Fe}_2(\text{SO}_4)_3$
41. Which type of bonding is found in all molecular substances?  
A) covalent bonding    B) hydrogen bonding  
C) ionic bonding        D) metallic bonding
42. What is the total number of electrons shared in a double covalent bond between two atoms?  
A) 1    B) 2    C) 8    D) 4
43. Which formula represents a nonpolar molecule?  
A)  $\text{H}_2\text{S}$    B)  $\text{HCl}$    C)  $\text{CH}_4$    D)  $\text{NH}_3$
44. Based on Reference Table S, atoms of which of these elements have the strongest attraction for the electrons in a chemical bond?  
A) Al    B) Si    C) P    D) S
45. Which type of bond is found in sodium bromide?  
A) covalent                                B) hydrogen  
C) ionic                                        D) metallic
46. A solid substance was tested in the laboratory. The test results are listed below.
- dissolves in water
  - is an electrolyte
  - melts at a high temperature
- Based on these results, the solid substance could be  
A) Cu                                        B)  $\text{CuBr}_2$   
C) C                                         D)  $\text{C}_6\text{H}_{12}\text{O}_6$
47. Which type of bond results when one or more valence electrons are transferred from one atom to another?  
A) a hydrogen bond  
B) an ionic bond  
C) a nonpolar covalent bond  
D) a polar covalent bond
48. What is the total number of electrons shared in the bonds between the two carbon atoms in the molecule shown below?  
 $\text{H}-\text{C}\equiv\text{C}-\text{H}$   
A) 6    B) 2    C) 3    D) 8
49. Which formula represents a nonpolar molecule?  
A)  $\text{CH}_4$    B)  $\text{HCl}$    C)  $\text{H}_2\text{O}$    D)  $\text{NH}_3$

## Bonding and Naming Review

50. A compound is made up of iron and oxygen, only. The ratio of iron ions to oxide ions is 2:3 in this compound. The IUPAC name for this compound is
- A) triiron dioxide      B) iron(II) oxide  
C) iron(III) oxide      D) iron trioxide
51. Which substance contains bonds that involved the transfer of electrons from one atom to another?
- A) CO<sub>2</sub>   B) NH<sub>3</sub>   C) KBr   D) Cl<sub>2</sub>
52. What is the total number of pairs of electrons shared in a molecule of N<sub>2</sub>?
- A) one pair                  B) two pairs  
C) three pairs                D) four pairs
53. Which formula represents a nonpolar molecule containing polar covalent bonds?
- A) H<sub>2</sub>O   B) CCl<sub>4</sub>   C) NH<sub>3</sub>   D) H<sub>2</sub>
54. The degree of polarity of a chemical bond in a molecule of a compound can be predicted by determining the difference in the
- A) melting points of the elements in the compound  
B) densities of the elements in the compound  
C) electronegativities of the bonded atoms in a molecule of the compound  
D) atomic masses of the bonded atoms in a molecule of the compound
55. Based on electronegativity values, which type of elements tends to have the greatest attraction for electrons in a bond?
- A) metals                      B) metalloids  
C) nonmetals                 D) noble gases
56. Which statement explains why low temperature and high pressure are required to liquefy chlorine gas?
- A) Chlorine molecules have weak covalent bonds.  
B) Chlorine molecules have strong covalent bonds.  
C) Chlorine molecules have weak intermolecular forces of attraction.  
D) Chlorine molecules have strong intermolecular forces of attraction.
57. Based on bond type, which compound has the highest melting point?
- A) CH<sub>3</sub>OH                      B) C<sub>6</sub>H<sub>14</sub>  
C) CaCl<sub>2</sub>                         D) CCl<sub>4</sub>
58. Element *X* reacts with iron to form two different compounds with the formulas Fe*X* and Fe<sub>2</sub>*X*<sub>3</sub>. To which group on the Periodic Table does element *X* belong?
- A) Group 8                      B) Group 2  
C) Group 13                     D) Group 16
59. The balanced equation below represents a molecule of bromine separating into two bromine atoms.
- $$\text{Br}_2 \rightarrow \text{Br} + \text{Br}$$
- What occurs during this change?
- A) Energy is absorbed and a bond is formed.  
B) Energy is absorbed and a bond is broken.  
C) Energy is released and a bond is formed.  
D) Energy is released and a bond is broken.
60. Which two substances are covalent compounds?
- A) C<sub>6</sub> H<sub>12</sub> O<sub>6</sub> (s) and KI(s)  
B) C<sub>6</sub> H<sub>12</sub> O<sub>6</sub> (s) and HCl(g)  
C) KI(s) and NaCl(s)  
D) NaCl(s) and HCl(g)
61. What is the name of the polyatomic ion in the compound Na<sub>2</sub>O<sub>2</sub>?
- A) hydroxide                    B) oxalate  
C) oxide                         D) peroxide
62. Given the balanced equation:
- $$\text{I} + \text{I} \rightarrow \text{I}_2$$
- Which statement describes the process represented by this equation?
- A) A bond is formed as energy is absorbed.  
B) A bond is formed and energy is released.  
C) A bond is broken as energy is absorbed.  
D) A bond is broken and energy is released.
63. An oxygen molecule contains a double bond because the two atoms of oxygen share a total of
- A) 1 electron                    B) 2 electrons  
C) 3 electrons                  D) 4 electrons
64. At STP, fluorine is a gas and bromine is a liquid because, compared to fluorine, bromine has
- A) stronger covalent bonds  
B) stronger intermolecular forces  
C) weaker covalent bonds  
D) weaker intermolecular forces

## Bonding and Naming Review

---

65. Atoms of which element have the greatest tendency to gain electrons?
- A) bromine                      B) chlorine  
C) fluorine                      D) iodine
66. Which polyatomic ion contains the greatest number of oxygen atoms?
- A) acetate                      B) carbonate  
C) hydroxide                    D) peroxide
67. Which formula represents an ionic compound?
- A) H<sub>2</sub>                              B) CH<sub>4</sub>  
C) CH<sub>3</sub>OH                      D) NH<sub>4</sub>Cl
68. Given the balanced equation representing a reaction:  
 $\text{Cl}_2(\text{g}) \rightarrow \text{Cl}(\text{g}) + \text{Cl}(\text{g})$   
What occurs during this change?
- A) Energy is absorbed and a bond is broken.  
B) Energy is absorbed and a bond is formed.  
C) Energy is released and a bond is broken.  
D) Energy is released and a bond is formed.
69. At standard pressure, a certain compound has a low boiling point and is insoluble in water. At STP, this compound most likely exists as
- A) ionic crystals  
B) metallic crystals  
C) nonpolar molecules  
D) polar molecules
70. Which group on the Periodic Table of the Elements contains elements that react with oxygen to form compounds with the general formula  $X_2O$ ?
- A) Group 1                      B) Group 2  
C) Group 14                     D) Group 18

Base your answers to questions 71 through 74 on the information below.

Each molecule listed below is formed by sharing electrons between atoms when the atoms within the molecule are bonded together.

Molecule A: Cl<sub>2</sub>

Molecule B: CCl<sub>4</sub>

Molecule C: NH<sub>3</sub>

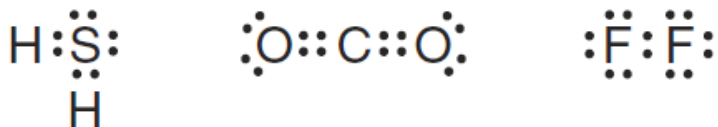
71. Draw the electron-dot (Lewis) structure for the NH<sub>3</sub> molecule.
72. Explain why CCl<sub>4</sub> is classified as a nonpolar molecule.
73. Explain why NH<sub>3</sub> has stronger intermolecular forces of attraction than Cl<sub>2</sub>.
-

## Bonding and Naming Review

---

74. Explain how the bonding in KCl is different from the bonding in molecules *A*, *B*, and *C*.

Base your answers to questions 75 through 77 on your knowledge of chemical bonding and on the Lewis electron-dot diagrams of H<sub>2</sub>S, CO<sub>2</sub>, and F<sub>2</sub> below.



75. Which atom, when bonded as shown, has the same electron configuration as an atom of argon?

76. Explain, in terms of structure and/or distribution of charge, why CO<sub>2</sub> is a nonpolar molecule.

77. Explain, in terms of electronegativity, why a C–O bond in CO<sub>2</sub> is more polar than the F–F bond in F<sub>2</sub>.

---

78. Base your answer to the following question on the information below.

A scientist in a chemistry laboratory determined the molecular formulas for two compounds containing nitrogen and oxygen to be NO<sub>2</sub> and N<sub>2</sub>O<sub>5</sub>

Write an IUPAC name for the compound N<sub>2</sub>O<sub>5</sub>.

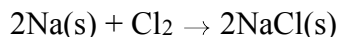
---

79. Base your answer to the following question on the information below.

Two alcohols that are used in our everyday lives are rubbing alcohol and ethylene glycol. Rubbing alcohol is used as an antiseptic. Ethylene glycol is the main ingredient in antifreeze, which is used in automobile cooling systems.

Explain, in terms of molecular polarity, why rubbing alcohol, 2-propanol, is soluble in water.

Base your answers to questions 80 and 81 on the balanced equation below.



80. Draw a Lewis electron-dot diagram for a molecule of chlorine, Cl<sub>2</sub>.

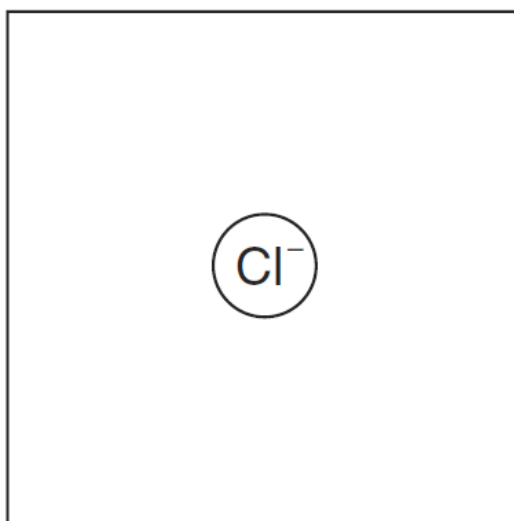
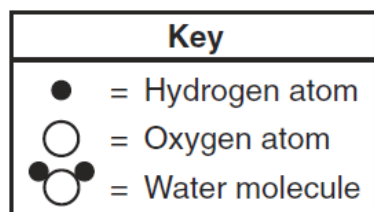
81. Explain, in terms of electrons, why the bonding in NaCl is ionic.

---

## Bonding and Naming Review

82. Base your answer to the following question on the information below.

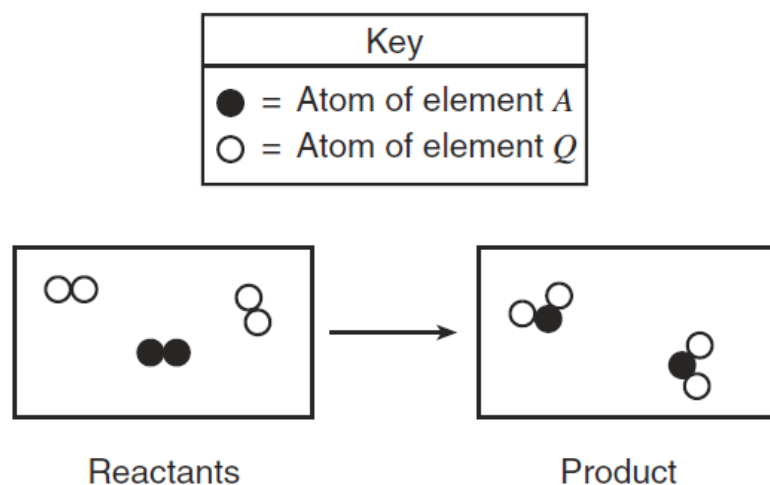
Given the balanced equation for dissolving  $\text{NH}_4\text{Cl}(s)$  in water:



Draw *at least two* water molecules in the box, showing the correct orientation of each water molecule when it is near the  $\text{Cl}^-$  ion in the aqueous solution.

83. Base your answer to the following question on the information below.

The particle diagrams below represent the reaction between two nonmetals,  $A_2$  and  $Q_2$ .



Identify the type of chemical bond between an atom of element  $A$  and an atom of element  $Q$ .

84. Explain, in terms of electronegativity, why a  $\text{P}-\text{Cl}$  bond in a molecule of  $\text{PCl}_5$  is more polar than a  $\text{P}-\text{S}$  bond in a molecule of  $\text{P}_2\text{S}_5$ .