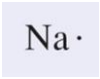
Test Bank for General Chemistry 10th Edition by Ebbing and Gammon

Chapter 9 - Ionic and Covalent Bonding

1. In which pair do both compounds exhibit predominantly ionic bonding?
   A) RbCl and CaO
   B) PCl_5 and HF
   C) KI and O_3
   D) Na_2SO_3 and BH_3
   E) NaF and H_2O

   ANS: A **PTS: 1** **DIF: easy** **REF: 9.1**
   OBJ: Define ionic bond. TOP: bonding | ionic bonding
   MSC: general chemistry

2. The following representation of an atom is called

   A) a Lewis dot structure.
   B) an ion.
   C) a structural formula.
   D) an electrostatic potential map.
   E) an ionic bond.

   ANS: A **PTS: 1** DIF: easy REF: 9.1 bonding |
   OBJ: Lewis electron-dot symbol. TOP: ionic bonding

3. Which of the following concerning Coulomb's law is/are correct?

   1. The energy of an ionic bond is proportional to the size of the ion charges.
   2. The energy of an ionic bond is inversely proportional to the distance between the charges.
   3. The size of an ion is not important in determining the energy of an ionic bond.

   A) 1 only
   B) 2 only
   C) 3 only
   D) 1 and 2

E) 1, 2, and 3

ANS: D **PTS: 1** DIF: easy REF: 9.1 bonding |
OBJ: Lewis electron-dot symbol. TOP: ionic bonding

4. When the cations Na^+, K^+, Rb^+, Cs^+ are combined with chloride ion in the gas phase to form ion pairs, which pair formation releases the greatest amount of energy?
   A) KCl
   B) All release the same amount of energy.
   C) RbCl
   D) NaCl
   E) CsCl

ANS: D **PTS: 1** **DIF: difficult** **REF: 9.1**
OBJ: Describe the energetics of ionic bonding.
TOP: bonding | ionic bonding KEY: properties of ionic substance
MSC: general chemistry

5. Which one of the following has an enthalpy change that is equal to the lattice energy of CaF_2?
   A) $CaF_2(s) \rightarrow Ca(g) + 2F(g)$
   B) $CaF_2(s) \rightarrow Ca(g) + F_2(g)$
   C) $CaF_2(s) \rightarrow Ca^{2+}(s) + 2F^-(g)$
   D) $CaF_2(s) \rightarrow Ca(s) + F_2(g)$
   E) $CaF_2(s) \rightarrow Ca^{2+}(g) + 2F^-(g)$

ANS: E **PTS: 1** **DIF: easy** **REF: 9.1**
OBJ: Define lattice energy. TOP: bonding | ionic bonding
KEY: Born-Haber cycle MSC: general chemistry

6. Which of the following statements concerning lattice energy is <u>false</u>?
   A) MgO has a larger lattice energy than NaF.
   B) The lattice energy for a solid with 2+ and 2– ions should be two times that for a solid with 1+ and 1– ions.
   C) MgO has a larger lattice energy than LiF.
   D) Lattice energy is often defined as the change in energy that occurs when an ionic solid is separated into isolated ions in the gas phase.
   E) All of these are true.

ANS: B **PTS: 1** **DIF: moderate** **REF: 9.1**
OBJ: Define lattice energy. TOP: bonding | ionic bonding
KEY: Born-Haber cycle MSC: general chemistry

7. Which of the following is a correct description of lattice energy?
   A) The energy change that occurs when electrons are removed from a lattice.
   B) The energy change that occurs when a gas condenses to a liquid.
   C) The energy change that occurs when a liquid freezes.
   D) The energy change that occurs when an ionic solid is separated into its ions in the gas phase.

E) The lattice energy of a substance is identical to the ionic bond energy determined from coulombs law.

ANS: D **PTS:** 1 DIF: moderate REF: 9.1
OBJ: Define lattice energy. TOP: bonding | ionic bonding

8. In the Born–Haber cycle for $NaBr(s)$, which of the following processes corresponds to the first ionization energy of Na?
A) $Na^-(g) \rightarrow Na(g) + e^-$
B) $Na(s) \rightarrow Na(g)$
C) $Na^+(g) + Br^-(g) \rightarrow NaBr(s)$
D) $Na(g) \rightarrow Na^+(g) + e^-$
E) $Na^+(g) + e^- \rightarrow Na(g)$

ANS: D **PTS: 1** **DIF: easy** **REF: 9.1**
OBJ: Describe the Born-Haber cycle to obtain a lattice energy from thermodynamic data.
TOP: bonding | ionic bonding KEY: Born-Haber cycle
MSC: general chemistry

9. In the Born–Haber cycle for $KBr(s)$, which of the following processes corresponds to the enthalpy of formation of $KBr(s)$? A) $K(s) + \frac{1}{2}Br_2(l) \rightarrow KBr(s)$
B) $K^+(aq) + Br^-(aq) \rightarrow KBr(s)$
C) $KBr(g) \rightarrow KBr(s)$
D) $2K(g) + Br_2(g) \rightarrow 2KBr(g)$
E) $KBr(aq) \rightarrow KBr(s)$

ANS: A **PTS: 1** **DIF: easy** **REF: 9.1**
OBJ: Describe the Born-Haber cycle to obtain a lattice energy from thermodynamic data.
TOP: bonding | ionic bonding KEY: Born-Haber cycle
MSC: general chemistry

10. In the Born–Haber cycle for $KF(s)$, which of the following processes corresponds to the electron affinity of F?
A) $F(g) \rightarrow F^+(g) + e^-$
B) $KF(s) \rightarrow K^+(g) + F^-(g)$
C) $F^-(g) \rightarrow F(g) + e^-$
D) $F_2(g) \rightarrow 2F(g)$
E) $F(g) + e^- \rightarrow F^-(g)$

ANS: E **PTS: 1** **DIF: easy** **REF: 9.1**
OBJ: Describe the Born-Haber cycle to obtain a lattice energy from thermodynamic data.
TOP: bonding | ionic bonding KEY: Born-Haber cycle
MSC: general chemistry

11. Which of the following processes is not exothermic? A) $Cs^+(g) + e^- \rightarrow Cs(g)$

B) $Cs^+(g) + Br^-(g) \rightarrow CsBr(s)$

C) $Br(g) + e^- \rightarrow Br^-(g)$

D) $Cs(g) \rightarrow Cs(s)$

E) $\frac{1}{2}Br_2(g) \rightarrow Br(g)$

ANS: E PTS: 1 DIF: moderate REF: 9.1
OBJ: Describe the Born-Haber cycle to obtain a lattice energy from thermodynamic data.
TOP: bonding | ionic bonding KEY: Born-Haber cycle
MSC: general chemistry

12. Calculate the lattice energy for LiF(*s*) given the following:

sublimation energy for Li(*s*)	+166 kJ/mol
D*Hf* for F(*g*)	+77 kJ/mol
first ionization energy of Li(*g*)	+520. kJ/mol
electron affinity of F(*g*)	–328 kJ/mol
enthalpy of formation of LiF(*s*)	–617 kJ/mol

A) 1052 kJ/mol
B) 285 kJ/mol
C) –650. kJ/mol
D) 800. kJ/mol
E) none of these

ANS: A PTS: 1 DIF: difficult REF: 9.1
OBJ: Describe the Born-Haber cycle to obtain a lattice energy from thermodynamic data.
TOP: bonding | ionic bonding KEY: Born-Haber cycle
MSC: general chemistry

13. Which of the following compounds has the most ionic bonding (has the highest percentage of ionic character)?
A) CaF_2
B) LiI
C) OF_2
D) CsF
E) LiF

ANS: D PTS: 1 DIF: easy REF: 9.1
OBJ: Describe some general properties of ionic substances.
TOP: bonding | ionic bonding KEY: properties of ionic substance
MSC: general chemistry

14. Which of the following compounds would be expected to have the lowest melting point?
A) AlF_3
B) RbF
C) NaF
D) MgF_2

E) CaF_2

ANS: B PTS: 1 DIF: easy REF: 9.1
OBJ: Describe some general properties of ionic substances.
TOP: bonding | ionic bonding KEY: properties of ionic substance
MSC: general chemistry

15. Which of the following compounds would be expected to have the highest melting point?
A) CsF
B) LiCl
C) LiF
D) NaBr
E) CsI

ANS: C PTS: 1 DIF: easy REF: 9.1
OBJ: Describe some general properties of ionic substances.
TOP: bonding | ionic bonding KEY: properties of ionic substance
MSC: general chemistry

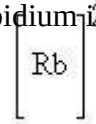
16. Which of the following compounds would be expected to have the highest melting point?
A) NCl_3
B) OCl_2
C) $MgCl_2$
D) LiCl
E) CCl_4

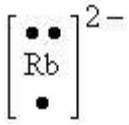
ANS: C PTS: 1 DIF: moderate REF: 9.1
OBJ: Describe some general properties of ionic substances.
TOP: bonding | ionic bonding KEY: properties of ionic substance
MSC: general chemistry

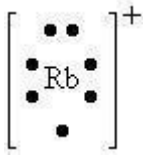
17. Atoms of an element X have the ground-state electron configuration $1s^2 2s^2 2p^6 3s^2 3p^4$. What type of ion is X most likely to form?
A) X^{6+}
B) X^{3-}
C) X^{4+}
D) X^{-}
E) X^{2-}

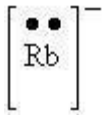
ANS: E PTS: 1 DIF: moderate REF: 9.2
OBJ: State the three categories of monatomic ions of the main-group elements.
TOP: bonding | ionic bonding
KEY: electron configurations of ions | ions of the main-group elements
MSC: general chemistry

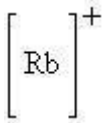
18. Which of the following is the Lewis dot structure for the rubidium ion? A)



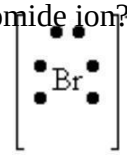
B) 

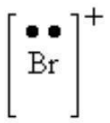
C) 

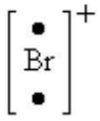
D) 

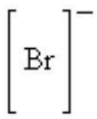
E) 

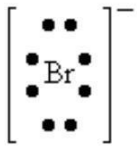
ANS: E PTS: 1 DIF: easy REF: 9.2
OBJ: Write the electron configuration and Lewis symbol for a main-group ion. (Example 9.2) TOP: bonding | ionic bonding
KEY: Lewis electron-dot symbol MSC: general chemistry

19. Which of the following is the Lewis dot structure for the bromide ion?~~+~~A) 

B) 

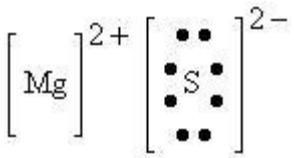
C) 

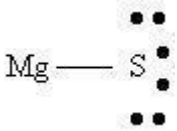
D) 

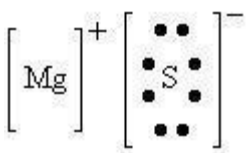
E) 

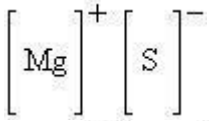
ANS: E PTS: 1 DIF: easy REF: 9.2
OBJ: Write the electron configuration and Lewis symbol for a main-group ion. (Example 9.2) TOP: bonding | ionic bonding
KEY: Lewis electron-dot symbol MSC: general chemistry

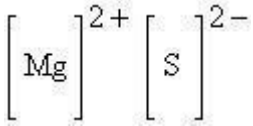
20. Which of the following is the Lewis dot structure for one formula unit of magnesium sulfide?

A) 

B) 

C) 

D) 

E) 

ANS: A PTS: 1 DIF: easy REF: 9.2
OBJ: Write the electron configuration and Lewis symbol for a main-group ion. (Example 9.2) TOP: bonding | ionic bonding
KEY: Lewis electron-dot symbol MSC: general chemistry

21. All of the following species have ground-state noble-gas electron configurations <u>except</u>
A) Ge^{4+}
B) K^{+}
C) Kr
D) I^{-}
E) P^{3-}

ANS: A PTS: 1 DIF: easy REF: 9.2
OBJ: Write the electron configuration and Lewis symbol for a main-group ion. (Example 9.2) TOP: bonding | ionic bonding
KEY: electron configurations of ions | ions of the main-group elements
MSC: general chemistry

22. Which of the following concerning the formation of ions is/are correct?

1. Elements with large electron affinities tend to form monoatomic anions.
2. No ionic compounds are found with positive ions having charges greater than the element group number.
3. Group 1A and 2A metals always have a positive charge equal to their group number in their ionic compounds.

A) 1 only
B) 2 only
C) 3 only
D) 1 and 2

E) 1, 2, and 3

ANS: E PTS: 1 DIF: easy REF: 9.2
OBJ: Describe some general properties of ionic substances.
TOP: bonding | ionic bonding

23. Which of the following concerning the formation of ions is/are correct?

1. Compounds of +4 ions are rare because of the large amount of energy required to form a +4 ion.
2. Some main group metals may have more than one possible positive charge because of the different energies required to remove s versus p valence electrons.
3. The nonmetals closest to the noble gases (Group 6A and 7A) tend to form monatomic anions with noble gas configurations.

A) 1 only
B) 2 only
C) 3 only
D) 1 and 2
E) 1, 2, and 3

ANS: E PTS: 1 DIF: easy REF: 9.2
OBJ: Describe some general properties of ionic substances.
TOP: bonding | ionic bonding

24. All of the following have ground-state noble-gas electron configurations <u>except</u>
A) Ar
B) N^{3-}
C) P^{3+}
D) Mg^{2+}
E) Cl^{-}

ANS: C PTS: 1 DIF: easy REF: 9.2
OBJ: Write the electron configuration and Lewis symbol for a main-group ion. (Example 9.2) TOP: bonding | ionic bonding
KEY: electron configurations of ions | ions of the main-group elements
MSC: general chemistry

25. The formation of which monatomic ion of sulfur is the most energetically favorable? A) S^{-}
B) S^{2-}
C) S^{-}
D) S^{6+}
E) S^{2+}

ANS: B PTS: 1 DIF: easy REF: 9.2
OBJ: Write the electron configuration and Lewis symbol for a main-group ion. (Example 9.2) TOP: bonding | ionic bonding
KEY: electron configurations of ions | ions of the main-group elements

MSC: general chemistry

26. What is the ground-state electron configuration of the Al^{3+} ion?
A) $1s^2 2s^2 2p^6 3s^2 3p^4$
B) $1s^2 2s^2 2p^3$
C) $1s^2 2s^2 2p^6$
D) $1s^2 2s^2 2p^1$
E) $1s^2 2s^2 2p^6 3s^2 3p^1$

ANS: C PTS: 1 DIF: easy REF: 9.2
OBJ: Write the electron configuration and Lewis symbol for a main-group ion. (Example 9.2) TOP: bonding | ionic bonding
KEY: electron configurations of ions | ions of the main-group elements
MSC: general chemistry

27. What is the ground-state electron configuration of the sulfide ion? A) $1s^2 2s^2 2p^6$
B) $1s^2 2s^2 2p^6 3s^2 3p^2$
C) $1s^2 2s^2 2p^6 3s^2 3p^6$
D) $1s^2 2s^2 2p^6 3s^2$
E) $1s^2 2s^2 2p^6 3s^2 3p^4$

ANS: C PTS: 1 DIF: easy REF: 9.2
OBJ: Write the electron configuration and Lewis symbol for a main-group ion. (Example 9.2) TOP: bonding | ionic bonding
KEY: electron configurations of ions | ions of the main-group elements
MSC: general chemistry

28. What is the electron configuration for Mn^{3+}?
A) $[Ar]3d^4$
B) $[Ar]4s^2 3d^7$
C) $[Ar]4s^1 3d^5$
D) $[Ar]4s^2 3d^2$
E) $[Ar]3d^3$

ANS: A PTS: 1 DIF: easy REF: 9.2
OBJ: Write electron configurations of transition-metal ions. (Example 9.3)
TOP: bonding | ionic bonding
KEY: electron configurations of ions | transition-metal ions MSC: general chemistry

29. The Cr^{2+} ion would be expected to have ____ unpaired electrons.
A) 4
B) 2

C) 3
D) 0
E) 1

ANS: A PTS: 1 DIF: easy REF: 9.2
OBJ: Write electron configurations of transition-metal ions. (Example 9.3)
TOP: bonding | ionic bonding
KEY: electron configurations of ions | transition-metal ions MSC: general chemistry

30. What is the electron configuration of Mn^{2+}?
A) $[Ar]3d^5$
B) $[Ar]3d^3 4s^2$
C) $[Ar]3d^4 4s^1$
D) $[Ar]3d^5 4s^2$
E) $[Ar]3d^5 4s^1$

ANS: A PTS: 1 DIF: easy REF: 9.2
OBJ: Write electron configurations of transition-metal ions. (Example 9.3)
TOP: bonding | ionic bonding
KEY: electron configurations of ions | transition-metal ions MSC: general chemistry

31. What is the ground-state electron configuration of Co^{3+}?
A) $[Ar]3d^5$
B) $[Ar]3d^4 4s^2$
C) $[Ar]3d^6$
D) $[Ar]3d^6 4s^1$
E) $[Ar]3d^5 4s^2$

ANS: C PTS: 1 DIF: easy REF: 9.2
OBJ: Write electron configurations of transition-metal ions. (Example 9.3)
TOP: bonding | ionic bonding
KEY: electron configurations of ions | transition-metal ions MSC: general chemistry

32. What is the ground-state electron configuration of V^{2+}?
A) $[Ar]3d^1 4s^2$
B) $[Ar]3d^2 4s^2$
C) $[Ar]3d^2 4s^1$
D) $[Ar]3d^1 4s^1$
E) $[Ar]3d^3$

ANS: E PTS: 1 DIF: easy REF: 9.2

OBJ: Write electron configurations of transition-metal ions. (Example 9.3)

33. What is the ground-state electron configuration of the copper(I) ion, Cu^{+}?
A) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^3$
B) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2$
C) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^9 4s^2$
D) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$
E) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$

ANS: D PTS: 1 DIF: easy REF: 9.2
OBJ: Write electron configurations of transition-metal ions. (Example 9.3)
TOP: bonding | ionic bonding
KEY: electron configurations of ions | transition-metal ions MSC: general chemistry

34. What is the ground-state electron configuration of Fe^{3+}?
A) $[Ar]3d^6 4s^2$
B) $[Ar]3d^3 4s^2$
C) $[Ar]3d^4 4s^1$
D) $[Ar]3d^5$
E) $[Ar]3d^6$

ANS: D PTS: 1 DIF: easy REF: 9.2
OBJ: Write electron configurations of transition-metal ions. (Example 9.3)
TOP: bonding | ionic bonding
KEY: electron configurations of ions | transition-metal ions MSC: general chemistry

35. All of the following ions have the ground-state electron configuration of a noble gas except which one?
A) Ca^{2+}
B) Cl^{-}
C) Ga^{3+}
D) Al^{3+}
E) H^{-}

ANS: C PTS: 1 DIF: easy REF: 9.3
OBJ: Define isoelectronic ions. TOP: bonding | ionic bonding
MSC: general chemistry

36. Which set of ions are isoelectronic in their ground-state electron configurations?
A) N, O, F, Ne
B) Na^{+}, K^{+}, Rb^{+}, Cs^{+}
C) F^{-}, Cl^{-}, Br^{-}, I^{-}
D) Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}
E) N^{3-}, O^{2-}, Mg^{2+}, Al^{3+}

ANS: E PTS: 1 DIF: easy REF: 9.3

OBJ: Define isoelectronic ions. TOP: bonding | ionic bonding
KEY: electron configurations of ions MSC: general chemistry

37. Which of the following species is isoelectronic with Kr?

A) K^+
B) Sr^{2+}
C) In^{3+}
D) S^{2-}
E) Ar

ANS: B PTS: 1 DIF: easy REF: 9.3
OBJ: Define isoelectronic ions. TOP: bonding | ionic bonding
KEY: ionic radii MSC: general chemistry

38. All of the following species are isoelectronic <u>except</u>

A) Ar
B) Ca^{2+}
C) Mg^{2+}
D) Cl^-
E) S^{2-}

ANS: C PTS: 1 DIF: easy REF: 9.3
OBJ: Define isoelectronic ions. TOP: bonding | ionic bonding
KEY: ionic radii MSC: general chemistry

39. Which pair of species is isoelectronic?

A) Na^+ and K^+
B) K^+ and Cl^-
C) Be^{2+} and Na^+
D) Ne and Ar
E) Li^+ and Ne

ANS: B PTS: 1 DIF: easy REF: 9.3
OBJ: Define isoelectronic ions. TOP: bonding | ionic bonding
KEY: ionic radii MSC: general chemistry

40. Which two species are isoelectronic?

A) Na^+ and K^+
B) Al^{3+} and Ne
C) P^- and Ca^+
D) Cl^- and F^-
E) Ca^{2+} and Mg^{2+}

ANS: B PTS: 1 DIF: easy REF: 9.3
OBJ: Define isoelectronic ions. TOP: bonding | ionic bonding
MSC: general chemistry

41. All of the following species are isoelectronic <u>except</u>

A) S^{2-}
B) K^+

C) Na^{+}
D) Ar
E) Cl^{-}

ANS: C PTS: 1 DIF: easy REF: 9.3
OBJ: Define isoelectronic ions. TOP: bonding | ionic bonding
MSC: general chemistry

42. All of the following species are isoelectronic except
A) O^{-}
B) Ne
C) N^{3-}
D) Mg^{2+}
E) F^{-}

ANS: A PTS: 1 DIF: easy REF: 9.3
OBJ: Define isoelectronic ions. TOP: bonding | ionic bonding
MSC: general chemistry

43. The following species, $^{31}_{15}P^{3-}$, $^{37}_{17}Cl^{-}$, and $^{40}_{20}Ca^{2+}$, all have the same number of
A) electrons.
B) nucleons.
C) neutrons.
D) protons.
E) isotopes.

ANS: A PTS: 1 DIF: moderate REF: 9.3
OBJ: Define isoelectronic ions. TOP: bonding | ionic bonding
KEY: ionic radii MSC: general chemistry

44. Rank the following ions in order of decreasing atomic radii: Mo^{4+}, Mo^{5+}, Mo^{6+}.
A) $Mo^{4+} > Mo^{5+} > Mo^{6+}$
B) $Mo^{6+} > Mo^{5+} > Mo^{4+}$
C) $Mo^{5+} > Mo^{4+} > Mo^{6+}$
D) $Mo^{6+} > Mo^{4+} > Mo^{5+}$
E) $Mo^{4+} > Mo^{6+} > Mo^{5+}$

ANS: A PTS: 1 DIF: easy REF: 9.3
OBJ: Use periodic trends to obtain relative ionic radii. (Example 9.4)
TOP: bonding | ionic bonding

45. Rank the following ions in order of decreasing atomic radii: Te^{2-}, Te^{4+}, Te^{6+}.
A) $Te^{2-} > Te^{4+} > Te^{6+}$
B) $Te^{6+} > Te^{4+} > Te^{2-}$
C) $Te^{4+} > Te^{2-} > Te^{6+}$
D) $Te^{2-} > Te^{6+} > Te^{4+}$
E) $Te^{4+} > Te^{6+} > Te^{2-}$

ANS: A PTS: 1 DIF: easy REF: 9.3
OBJ: Use periodic trends to obtain relative ionic radii. (Example 9.4)

TOP: bonding | ionic bonding

46. Which of the following species would you expect to have the largest radius?
A) S^{2-}
B) F
C) Na^{+}
D) Se^{2-}
E) Ca^{2+}

ANS: D PTS: 1 DIF: easy REF: 9.3
OBJ: Use periodic trends to obtain relative ionic radii. (Example 9.4)
TOP: bonding | ionic bonding KEY: ionic radii MSC: general chemistry

47. In which of the following lists do the ions <u>not</u> appear in order of increasing ionic radius?
A) $S^{2-} < Cl^{-} < K^{+}$
B) $Na^{+} < F^{-} < O^{2-}$
C) $Cl^{-} < Br^{-} < I^{-}$
D) $Li^{+} < Na^{+} < K^{+}$
E) $Al^{3+} < Mg^{2+} < Na^{+}$

ANS: A PTS: 1 DIF: easy REF: 9.3
OBJ: Use periodic trends to obtain relative ionic radii. (Example 9.4)
TOP: bonding | ionic bonding KEY: ionic radii MSC: general chemistry

48. Rank the following ions in order of decreasing ionic radius: S^{2-}, O^{2-}, F^{-}, Na^{+}, Mg^{2+}.
A) $S^{2-}, O^{2-}, F^{-}, Na^{+}, Mg^{2+}$
B) $O^{2-}, F^{-}, Na^{+}, Mg^{2+}, S^{2-}$
C) $O^{2-}, S^{2-}, F^{-}, Na^{+}, Mg^{2+}$
D) $Mg^{2+}, Na^{+}, F^{-}, O^{2-}, S^{2-}$
E) $Mg^{2+}, S^{2-}, Na^{+}, F^{-}, O^{2-}$

ANS: A PTS: 1 DIF: easy REF: 9.3
OBJ: Use periodic trends to obtain relative ionic radii. (Example 9.4)
TOP: bonding | ionic bonding KEY: ionic radii MSC: general chemistry

49. Rank the following species in order of decreasing radii: K^{+}, Cl^{-}, Se^{2-}, Br^{-}.
A) $Br^{-} > Se^{2-} > Cl^{-} > K^{+}$
B) $Se^{2-} > Br^{-} > Cl^{-} > K^{+}$
D) $Br^{-} > Cl^{-} > Se^{2-} > K^{+}$
E) $Cl^{-} > Se^{2-} > K^{+} > Br^{-}$

ANS: B PTS: 1 DIF: easy REF: 9.3
OBJ: Use periodic trends to obtain relative ionic radii. (Example 9.4)
TOP: bonding | ionic bonding

50. For which of the following pairs of species is the difference in radius the greatest?
A) C and F
B) K^{+} and Br^{-}
C) Li^{+} and I^{-}

D) Na and Mg
E) O^{2-} and F^{-}

ANS: C PTS: 1 DIF: moderate REF: 9.3
OBJ: Use periodic trends to obtain relative ionic radii. (Example 9.4)
TOP: bonding | ionic bonding KEY: ionic radii MSC: general chemistry

51. Which of the following is the best explanation for a covalent bond?
A) electrons simultaneously attracted by more than one nucleus
B) an interaction between outer electrons
C) the overlapping of unoccupied orbitals of two or more atoms
D) the overlapping of two electron-filled orbitals having different energies
E) a positive ion attracting negative ions

ANS: A PTS: 1 DIF: moderate REF: 9.4
OBJ: Describe the formation of a covalent bond between two atoms.
TOP: bonding | covalent bonding MSC: general chemistry

52. The formulas of many binary covalent compounds can be predicted on the basis
A) that a bond is formed by the overlapping of two filled orbitals.
B) that the number of bonds an atom can have is equal to the number of empty valence orbitals it has.
C) that a bond is formed by the overlapping of atomic orbitals.
D) that the number of bonds an atom can have is equal to the number of half-filled valence orbitals it can have.
E) that bonding electrons are simultaneously attracted by more than one nucleus.

ANS: D PTS: 1 DIF: moderate REF: 9.4
OBJ: Describe the formation of a covalent bond between two atoms.
TOP: bonding | covalent bonding MSC: general chemistry

53. During the formation of a chemical bond between two hydrogen atoms, which of the following statements is always true?
A) Energy is released during the formation of the bond.
B) A polar covalent bond is formed.
C) Electrons always are between the nuclei of the atoms.
D) One of the hydrogen atoms is ionized.
E) Resonance stabilizes the bond.

ANS: A PTS: 1 DIF: moderate REF: 9.4
OBJ: Describe the formation of a covalent bond between two atoms.
TOP: bonding | covalent bonding MSC: general chemistry

54. A bond in which both electrons of the bond are donated by one atom is called ____.
A) a coordinate covalent bond
B) a polar covalent bond
C) an ionic bond
D) a double bond
E) a triple bond

ANS: A PTS: 1 DIF: moderate REF: 9.4

OBJ: Define coordinate covalent bond.

55. A bond in which an electron pair is unequally shared by two atoms is
A) polar covalent.
B) coordinate covalent.
C) ionic.
D) nonpolar covalent.
E) metallic.

ANS: A **PTS: 1** **DIF: easy** **REF: 9.5**
OBJ: Define polar covalent bond. TOP: bonding | covalent bonding
KEY: electronegativity | polar covalent bond MSC: general chemistry

56. The measure of the attraction that an atom has for the electrons in a chemical bond is called
A) electronegativity.
B) lattice energy.
C) resonance energy.
D) ionization energy.
E) electron affinity.

ANS: A **PTS: 1** **DIF: easy** **REF: 9.5**
OBJ: Define electronegativity. TOP: bonding | covalent bonding
KEY: electronegativity MSC: general chemistry

57. Which of the following atoms is the most electronegative?
A) B
B) N
C) Al
D) Cs
E) Na

ANS: B **PTS: 1** **DIF: easy** **REF: 9.5**
OBJ: State the general periodic trends in the electronegativity.
TOP: bonding | covalent bonding KEY: electronegativity
MSC: general chemistry

58. An atom of which of the following elements has the highest electronegativity?
A) K
B) As
C) Ba
D) Si
E) Br

ANS: E **PTS: 1** **DIF: easy** **REF: 9.5**
OBJ: State the general periodic trends in the electronegativity.
TOP: bonding | covalent bonding KEY: electronegativity
MSC: general chemistry

59. Which of the following concerning electronegativity is/are correct?

1. Differences in element electronegativities may be used to predict the type of

bonding, ionic or covalent, in a substance.

2. The larger the differences in electronegativity between two bonded atoms the more polar the bond.
3. The electrons in a polar bond tend to spend more time around the least electronegative element.

A) 1 only
B) 2 only
C) 3 only
D) 1 and 2
E) 1, 2, and 3

ANS: D PTS: 1 DIF: moderate REF: 9.5
OBJ: Use electronegativity to obtain relative bond polarity. (Example 9.5)
TOP: bonding | covalent bonding

60. Which pair of elements would form a covalent bond that is the least polar?
A) S and Li
B) Al and N
C) O and H
D) O and F
E) S and Cs

ANS: D PTS: 1 DIF: easy REF: 9.5
OBJ: Use electronegativity to obtain relative bond polarity. (Example 9.5)
TOP: bonding | covalent bonding KEY: electronegativity | polar covalent bond
MSC: general chemistry

61. Rank the following covalent bonds in order of decreasing polarity: C-H, N-H, O-H, F-H.
A) F-H, O-H, N-H, C-H
B) O-H, F-H, N-H, C-H
C) N-H, F-H, O-H, C-H
D) C-H, N-H, O-H, F-H
E) C-H, F-H, O-H, N-H

ANS: A PTS: 1 DIF: easy REF: 9.5
OBJ: Use electronegativity to obtain relative bond polarity. (Example 9.5)
TOP: bonding | covalent bonding

62. Which of the following bonds would be the least polar yet still be considered polar covalent?
A) Mg-O
B) C-O
C) Si-O
D) O-O
E) N-O

ANS: E PTS: 1 DIF: moderate REF: 9.5
OBJ: Use electronegativity to obtain relative bond polarity. (Example 9.5)
TOP: bonding | covalent bonding KEY: electronegativity | polar covalent bond
MSC: general chemistry

63. In which of the following species is there the greatest unequal sharing of the bonding electrons?
A) SO_3^{2-}
B) SO_3
C) H_2S
D) H_2O
E) NH_4^+

ANS: D PTS: 1 DIF: easy REF: 9.5
OBJ: Use electronegativity to obtain relative bond polarity. (Example 9.5)
TOP: bonding | covalent bonding KEY: electronegativity | polar covalent bond
MSC: general chemistry

64. The Lewis formula for phosphine, PH_3, has
A) four lone pairs.
B) four bonding pairs.
C) two bonding pairs and two lone pairs.
D) three bonding pairs and one lone pair.
E) one bonding pair and three lone pairs.

ANS: D PTS: 1 DIF: easy REF: 9.6
OBJ: Write Lewis formulas with single bonds only. (Example 9.6)
TOP: bonding | covalent bonding KEY: Lewis dot formula
MSC: general chemistry

65. Which of the following concerning Lewis electron-dot formulae is/are correct?

1. A Lewis electron-dot formula (Lewis structure) is identical to a structural formula.
2. The skeleton of a molecule need not be known to draw the correct Lewis electron-dot structure.
3. Lewis electron-dot formulae show the location of bonding and nonbonding electrons in three dimensional space.

A) 1 only
B) 2 only
C) 3 only
D) 1, 2, and 3
E) none of the above

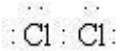
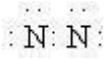
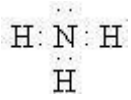
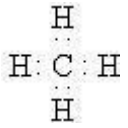
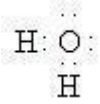
ANS: E PTS: 1 DIF: easy REF: 9.6 bonding
OBJ: Lewis electron-dot structures. TOP: | covalent bonding

66. What is the total number of valence electrons in N_2O_4?
A) 34
B) 11
C) 16
D) 17
E) 46

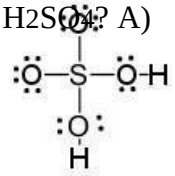
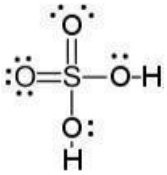
ANS: A PTS: 1 DIF: easy REF: 9.6
OBJ: Write Lewis formulas with single bonds only. (Example 9.6)
TOP: bonding | covalent bonding

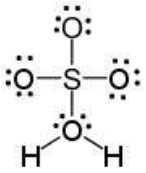
67. In the Lewis formula for difluorodiazine, N_2F_2, the total number of lone electron pairs around the two nitrogen atoms is
A) 4.
B) 0.
C) 3.
D) 1.
E) 2.

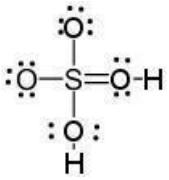
ANS: E PTS: 1 DIF: easy REF: 9.6
OBJ: Write Lewis formulas having including multiple bonds. (Example 9.7)
TOP: bonding | ionic bonding KEY: Lewis dot formula
MSC: general chemistry

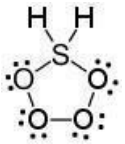
68. Which of the following Lewis formulas is <u>incorrect</u>?
A) 
B) 
C) 
D) 
E) 

ANS: B PTS: 1 DIF: easy REF: 9.6
OBJ: Write Lewis formulas having including multiple bonds. (Example 9.7)
TOP: bonding | covalent bonding KEY: Lewis dot formula
MSC: general chemistry

69. Which of the following is a correct Lewis electron-dot formula for H_2SO_4? A) 
B) 

C) 

D) 

E) 

ANS: A PTS: 1 DIF: easy REF: 9.6
OBJ: Write Lewis formulas having including multiple bonds. (Example 9.7)
TOP: bonding | covalent bonding

70. Which of the following is a correct Lewis electron-dot formula for CO?
A) 
B) 
C) 
D) 
E) 

ANS: A PTS: 1 DIF: easy REF: 9.6
OBJ: Write Lewis formulas having including multiple bonds. (Example 9.7)
TOP: bonding | covalent bonding

71. Which one of the following has a Lewis formula most similar to that of NO^-?
A) O_2^{2-}
B) O_2^-
C) O_2
D) NO^+
E) NO

ANS: A PTS: 1 DIF: moderate REF: 9.6
OBJ: Write Lewis formulas having including multiple bonds. (Example 9.7)
TOP: bonding | covalent bonding KEY: Lewis dot formula
MSC: general chemistry

72. The Lewis structure for each of the following <u>except</u> ____contains at least one double bond.
A) O_2
B) CS_2
C) C_2H_4

D) NO^+

E) N_2H_2

ANS: D PTS: 1 DIF: easy REF: 9.6
OBJ: Write Lewis formulas having including multiple bonds. (Example 9.7)
TOP: bonding | covalent bonding KEY: multiple bonding
MSC: general chemistry

73. The Lewis structure for each of the following species except ____ contains a triple bond.

A) N_3^-

B) N_2

C) HCCH

D) NO^+

E) O_2^{2+}

ANS: A PTS: 1 DIF: easy REF: 9.6
OBJ: Write Lewis formulas having including multiple bonds. (Example 9.7)
TOP: bonding | covalent bonding KEY: multiple bonds
MSC: general chemistry

74. How many valence electrons are present in the Lewis formula for the hypochlorite ion, ClO^-?

A) 20

B) 12

C) 18

D) 14

E) 16

ANS: D PTS: 1 DIF: easy REF: 9.6
OBJ: Write Lewis formulas for ionic species. (Example 9.8)
TOP: bonding | covalent bonding KEY: Lewis dot formula
MSC: general chemistry

75. What is the total number of valence electrons in the azide ion, N_3^-?

A) 20

B) 12

C) 16

D) 22

E) 18

ANS: C PTS: 1 DIF: easy REF: 9.6
OBJ: Write Lewis formulas for ionic species. (Example 9.8)
TOP: bonding | covalent bonding KEY: Lewis dot formula
MSC: general chemistry

76. What is the total number of valence electrons in the nitrosyl ion, NO^+?

A) 11

B) 13

C) 10

D) 12
E) 14

ANS: C PTS: 1 DIF: easy REF: 9.6
OBJ: Write Lewis formulas for ionic species. (Example 9.8)
TOP: bonding | covalent bonding KEY: Lewis dot formula
MSC: general chemistry

77. How many valence electrons are there in the tetraethylammonium ion, $(C_2H_5)_4N^+$?
A) 56
B) 32
C) 16
D) 57
E) 48

ANS: A PTS: 1 DIF: moderate REF: 9.6
OBJ: Write Lewis formulas for ionic species. (Example 9.8)
TOP: bonding | covalent bonding KEY: Lewis dot formula
MSC: general chemistry

78. What is the total number of valence electrons in the monohydrogen phosphate ion, HPO_4^{2-}?
A) 30
B) 28
C) 32
D) 34
E) 36

ANS: C PTS: 1 DIF: easy REF: 9.6
OBJ: Write Lewis formulas for ionic species. (Example 9.8)
TOP: bonding | covalent bonding KEY: Lewis dot formula
MSC: general chemistry

79. How many valence electrons does a nitrate ion have?
A) 30
B) 28
C) 24
D) 32
E) 22

ANS: C PTS: 1 DIF: moderate REF: 9.6
OBJ: Write Lewis formulas for ionic species. (Example 9.8)
TOP: bonding | covalent bonding KEY: Lewis dot formula
MSC: general chemistry

80. How many valence electrons are there in the acetate ion, CH_3COO^-?
A) 23
B) 24
C) 36

D) 38
E) 22

ANS: B PTS: 1 DIF: easy REF: 9.6
OBJ: Write Lewis formulas for ionic species. (Example 9.8)
TOP: bonding | covalent bonding KEY: Lewis dot formula
MSC: general chemistry

81. The total number of valence electrons in a peroxide ion, O_2^{2-}, is
A) 2.
B) 12.
C) 14.
D) 13.
E) 15.

ANS: C PTS: 1 DIF: moderate REF: 9.6
OBJ: Write Lewis formulas for ionic species. (Example 9.8)
TOP: bonding | covalent bonding KEY: Lewis dot formula
MSC: general chemistry

82. The number of valence electrons in the perfluoropropionate ion, $CF_3CF_2COO^-$, is
A) 60.
B) 62.
C) 66.
D) 80.
E) 58.

ANS: A PTS: 1 DIF: moderate REF: 9.6
OBJ: Write Lewis formulas for ionic species. (Example 9.8)
TOP: bonding | covalent bonding KEY: Lewis dot formula
MSC: general chemistry

83. The total number of valence electrons in the tetrathionate ion, $S_4O_6^{2-}$, is
A) 58.
B) 60.
C) 56.
D) 54.
E) 62.

ANS: E PTS: 1 DIF: moderate REF: 9.6
OBJ: Write Lewis formulas for ionic species. (Example 9.8)
TOP: bonding | covalent bonding KEY: Lewis dot formula
MSC: general chemistry

84. The number of valence electrons in the nitrite ion is
A) 22.
B) 16.
C) 23.
D) 18.
E) 24.

ANS: D PTS: 1 DIF: easy REF: 9.6
OBJ: Write Lewis formulas for ionic species. (Example 9.8)
TOP: bonding | covalent bonding KEY: Lewis dot formula
MSC: general chemistry

85. The total number of valence electrons in the phosphate ion is
A) 32.
B) 30.
C) 24.
D) 28.
E) 26.

ANS: A PTS: 1 DIF: easy REF: 9.6
OBJ: Write Lewis formulas for ionic species. (Example 9.8)
TOP: bonding | covalent bonding KEY: Lewis dot formula
MSC: general chemistry

86. What is the total number of valence electrons in the sulfite ion?
A) 30
B) 26
C) 24
D) 8
E) 32

ANS: B PTS: 1 DIF: moderate REF: 9.6
OBJ: Write Lewis formulas for ionic species. (Example 9.8)
TOP: bonding | covalent bonding KEY: Lewis dot formula
MSC: general chemistry

87. In the Lewis formula for hydrazinium ion, $N_2H_5^+$, the total number of lone electron pairs around the two nitrogen atoms is
A) 0.
B) 4.
C) 3.
D) 1.
E) 2.

ANS: D PTS: 1 DIF: easy REF: 9.6
OBJ: Write Lewis formulas for ionic species. (Example 9.8)
TOP: bonding | ionic bonding KEY: Lewis dot formula
MSC: general chemistry

88. In the Lewis formula for the hydroxide ion, OH^-, the number of lone pairs of electrons around the oxygen atom is
A) 3.
B) 1.
C) 2.
D) 0.
E) 4.

ANS: A PTS: 1 DIF: easy REF: 9.6
OBJ: Write Lewis formulas for ionic species. (Example 9.8)
TOP: bonding | covalent bonding

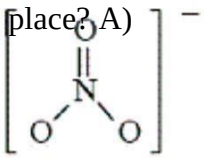
89. The concept of resonance describes molecular structures
A) that have several different geometric arrangements.
B) that have delocalized bonding.
C) that are formed from hybridized orbitals.
D) that have different molecular formulas.
E) that have electrons resonating.

ANS: B PTS: 1 DIF: easy REF: 9.7
OBJ: Define resonance description. TOP: bonding | covalent bonding
KEY: resonance MSC: general chemistry

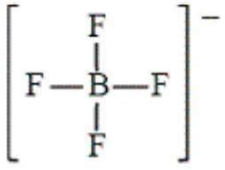
90. All the following statements about resonance are true except
A) A single Lewis formula does not provide an adequate representation of the bonding.
B) Resonance describes a more stable situation than does any one contributing resonance formula.
C) Resonance describes the oscillation and vibration of electrons.
D) The contributing resonance formulas differ only in the arrangement of the electrons.
E) Resonance describes the bonding as intermediate between the contributing resonance formulas.

ANS: C PTS: 1 DIF: easy REF: 9.7
OBJ: Define resonance description. TOP: bonding | covalent bonding
KEY: resonance MSC: general chemistry

91. In which of the following species is resonance most likely to take place? A)



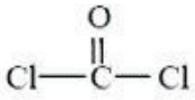
B)



C)

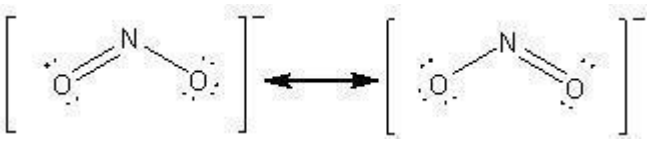
D) H–C≡N

E)



ANS: A PTS: 1 DIF: moderate REF: 9.7
OBJ: Write resonance formulas. (Example 9.9)
TOP: bonding | covalent bonding KEY: resonance MSC: general chemistry

92. For the resonance hybrid of the nitrite ion,



what is the average number of bonds between the nitrogen atom and an oxygen atom?
A) 3/2
B) 1
C) 4/3
D) 2
E) 5/3

ANS: A PTS: 1 DIF: easy REF: 9.7
OBJ: Write resonance formulas. (Example 9.9)
TOP: bonding | covalent bonding KEY: resonance MSC: general chemistry

93. Which one of the following species is best described by writing three equivalent Lewis formulas?
A) SO_3
B) SF_4^{2-}
C) SO_4^{2-}
D) SO_3^{2-}
E) SOF_4

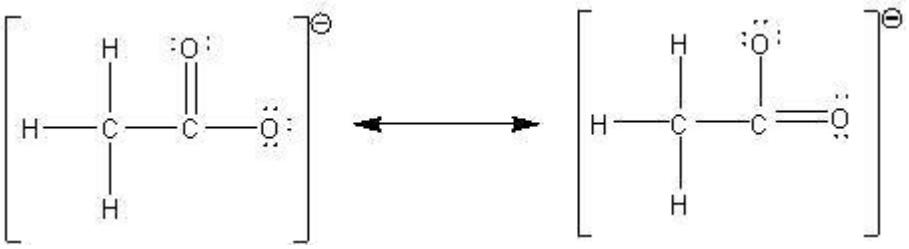
ANS: A PTS: 1 DIF: difficult REF: 9.7
OBJ: Write resonance formulas. (Example 9.9)
TOP: bonding | covalent bonding KEY: resonance | delocalization
MSC: general chemistry

94. For each of the following species except ____, the electronic structure may be adequately described by two resonance formulas.
A) O_3
B) SO_3^{2-}
C) NO_2^-
D) C_6H_6
E) SO_2

ANS: B PTS: 1 DIF: easy REF: 9.7
OBJ: Write resonance formulas. (Example 9.9)
TOP: bonding | covalent bonding KEY: resonance | delocalization
MSC: general chemistry

95. Which of the following are two appropriate resonance formulas for the acetate ion, $CH_3CO_2^-$?

A)



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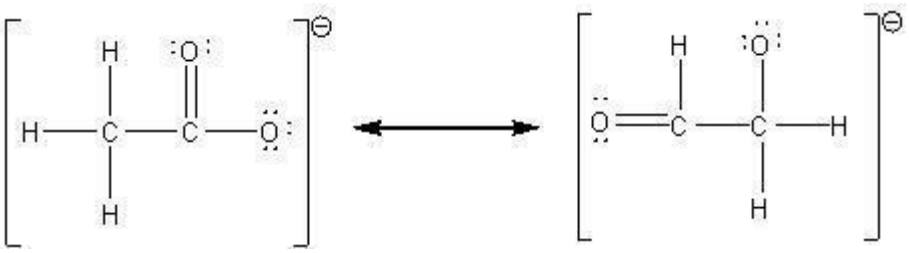

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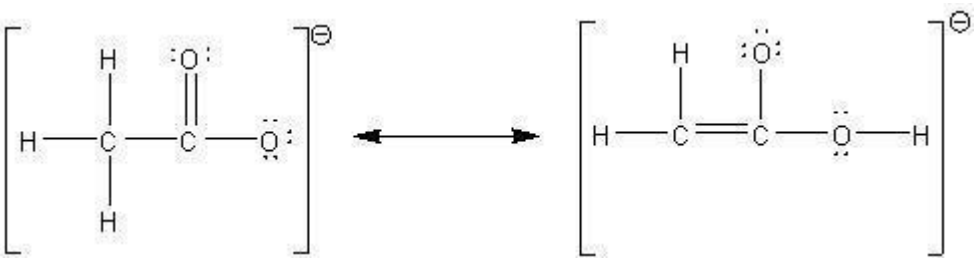
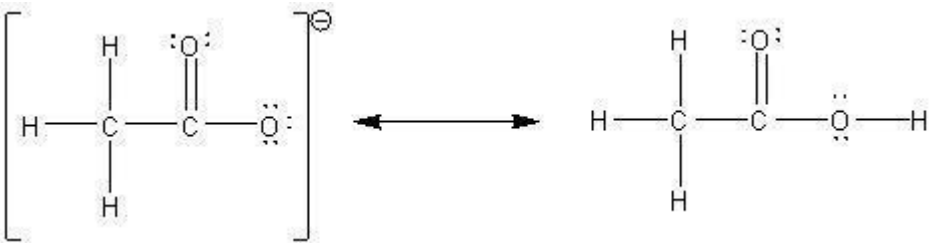
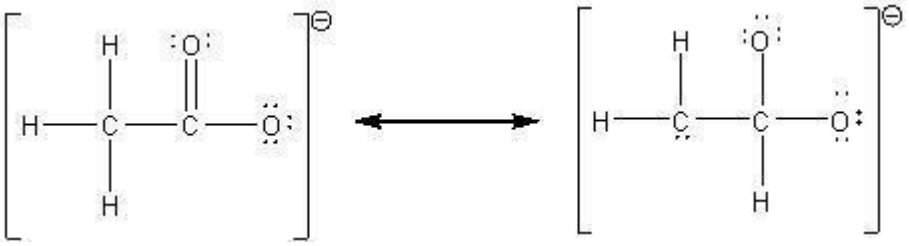


D)



E)



ANS: A PTS: 1 DIF: easy REF: 9.7
OBJ: Write resonance formulas. (Example 9.9)
TOP: bonding | covalent bonding KEY: resonance | delocalization
MSC: general chemistry

96. The electronic structure of which of the following species cannot be adequately described by a single Lewis formula?
A) CS_2
B) POF_3
C) $HNNH^-$
D) NO_3
E) H_2NNH_2

ANS: D PTS: 1 DIF: easy REF: 9.7
OBJ: Write resonance formulas. (Example 9.9)
TOP: bonding | covalent bonding KEY: resonance | delocalization
MSC: general chemistry

97. Which of the following species represents an exception to the octet rule?
A) SiO_2
B) HBr
C) SF_4
D) PCl_3
E) CO_2

ANS: C PTS: 1 DIF: easy REF: 9.8
OBJ: Write Lewis formulas (exceptions to the octet rule). (Example 9.10)
TOP: bonding | covalent bonding KEY: exceptions to the octet rule
MSC: general chemistry

98. The Lewis structure of a molecule has a high probability of violating the octet rule if

1. the molecule has an odd number of valence electrons.
2. the central atom is surrounded by more than four atoms or eight valence electrons.
3. the central atom is from Group 2A or 3A.

A) 1 only
B) 2 only
C) 3 only
D) 1 and 2
E) 1, 2, and 3

ANS: E PTS: 1 DIF: easy REF: 9.8
OBJ: Write Lewis formulas (exceptions to the octet rule). (Example 9.10)
TOP: bonding | covalent bonding

99. In which of the following molecules is the octet rule violated?
A) SF_6
B) OF_2
C) ClF
D) PF_3
E) SiF_4

ANS: A PTS: 1 DIF: easy REF: 9.8
OBJ: Write Lewis formulas (exceptions to the octet rule). (Example 9.10)
TOP: bonding | covalent bonding

100. The octet rule is violated by at least one atom in all the following compounds except
A) SF_6^-.
B) PF_6^-.
C) BrF_5.
D) ICl_2^-.

E) SiF_4.

ANS: E PTS: 1 DIF: easy REF: 9.8
OBJ: Write Lewis formulas (exceptions to the octet rule). (Example 9.10)
TOP: bonding | covalent bonding

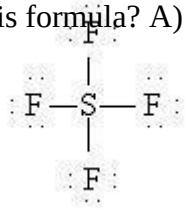
101. The Lewis formula of which species does <u>not</u> represent an exception to the octet rule?
A) SiF_5^-
B) SCl_6
C) SF_4
D) BF_3
E) CF_3^-
ANS: E PTS: 1 DIF: easy REF: 9.8 Write Lewis formulas (exceptions to
OBJ: the octet rule). (Example 9.10) bonding | covalent bonding
TOP:

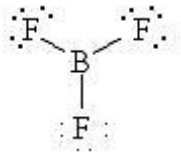
102. Which species has the largest number of lone pairs of electrons around the central atom?
A) XeF_2
B) XeF_6
C) $XeOF_4$
D) XeF_4
E) SiF_6^{2-}
ANS: A PTS: 1 DIF: moderate REF: 9.8
OBJ: Write Lewis formulas (exceptions to the octet rule). (Example 9.10)
TOP: bonding | covalent bonding KEY: exceptions to the octet rule
MSC: general chemistry

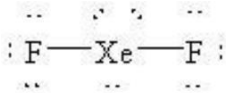
103. In the Lewis formula for ClF_3, how many lone pairs are around the central atom?
A) 0
B) 4
C) 3
D) 2
E) 1

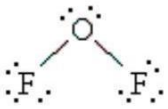
ANS: D PTS: 1 DIF: easy REF: 9.8
OBJ: Write Lewis formulas (exceptions to the octet rule). (Example 9.10)
TOP: bonding | covalent bonding KEY: exceptions to the octet rule
MSC: general chemistry

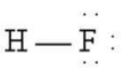
104. Which of the following molecules has an <u>incorrect</u>
Lewis formula? A)



B) 

C) 

D) 

E) 

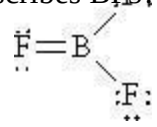
ANS: A PTS: 1 DIF: moderate REF: 9.8
OBJ: Write Lewis formulas (exceptions to the octet rule). (Example 9.10)
TOP: bonding | covalent bonding KEY: exceptions to the octet rule
MSC: general chemistry

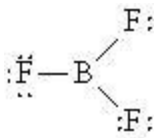
105. In the Lewis dot formula for ICl_2^-, the number of lone pairs of electrons around the central iodine atom is
A) 2.
B) 4.
C) 1.
D) 3.
E) 0.

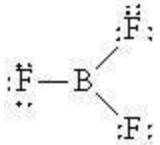
ANS: D PTS: 1 DIF: moderate REF: 9.8
OBJ: Write Lewis formulas (exceptions to the octet rule). (Example 9.10)
TOP: bonding | covalent bonding KEY: exceptions to the octet rule
MSC: general chemistry

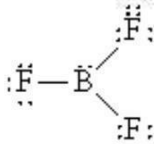
106. Which of the following has an incomplete octet in its Lewis structure?
A) SO_2
B) F_2
C) NO_2
D) ICl
E) CO_2

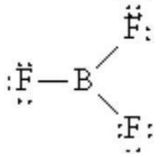
ANS: C PTS: 1 DIF: moderate REF: 9.8
OBJ: Write Lewis formulas (exceptions to the octet rule). (Example 9.10)
TOP: bonding | covalent bonding

107. Which of the following Lewis structures best describes BF_3? A) 

B) 

C) 

D) 

E) 

ANS: C PTS: 1 DIF: easy REF: 9.8
OBJ: Note exceptions to the octet rule in Groups IIA and Group IIIA elements.
TOP: bonding | covalent bonding KEY: exceptions to the octet rule
MSC: general chemistry

108. Which of the following species represents an exception to the octet rule?
A) BF_3
B) BF_4^-
C) CH_3OH
D) CCl_4
E) PH_3

ANS: A PTS: 1 DIF: easy REF: 9.8
OBJ: Note exceptions to the octet rule in Groups IIA and Group IIIA elements.
TOP: bonding | covalent bonding KEY: exceptions to the octet rule
MSC: general chemistry

109. From a consideration of the Lewis structure of the thiocyanate ion, SCN^-, in which carbon has a double bond with both the sulfur and nitrogen atoms, the formal charges on the sulfur, carbon, and nitrogen atoms are, respectively,
A) –1, +1, –1.
B) –2, 0, +1.
C) –1, 0, 0.
D) –2, +1, 0.
E) 0, 0, –1.

ANS: E PTS: 1 DIF: easy REF: 9.9
OBJ: State the rules for obtaining formal charge.
TOP: bonding | covalent bonding KEY: formal charge
MSC: general chemistry

110. Which of the following is/are true concerning formal charge?

1. The formal charge of each individual atom in a molecule or ion is an actual

atomic charge that can be experimentally determined.

2. The formal charge of each individual atom is always the same for each possible resonance form.
3. The sum of the formal charges of each atom in a molecule or ion equal the overall charge of the molecule or ion.

A) 1 only
B) 2 only
C) 3 only
D) 1 and 2
E) none

ANS: C PTS: 1 DIF: easy REF: 9.9
OBJ: State the rules for obtaining formal charge.
TOP: bonding | covalent bonding

111. In the Lewis formula that minimizes formal charge, what is the formal charge on the sulfur atom in sulfur trioxide, SO_3?
A) +2
B) +4
C) +6
D) –2
E) 0

ANS: A PTS: 1 DIF: easy REF: 9.9
OBJ: State the rules for obtaining formal charge.
TOP: bonding | covalent bonding KEY: formal charge
MSC: general chemistry

112. Which of the following statements is true concerning the Lewis formula that minimizes formal charge for H_2SO_4?
A) The formal charge of S is +2, the formal charge of each O is 0, and the formal charge H is 0.
B) The formal charge of S is +2, the formal charge of O is either 0 or –2, and the formal charge of H is +1.
C) The formal charge of S is +2, the formal charge of O is either 0 or –2, and the formal charge of H is 0.
D) The formal charge of S is +2, the formal charge of O is 0, and the formal charge of H is +1.
E) The formal charge of S is 0, the formal charge of O is 0, and the formal charge of H is 0.

ANS: E PTS: 1 DIF: easy REF: 9.9
OBJ: State the rules for obtaining formal charge.
TOP: bonding | covalent bonding KEY: formal charge
MSC: general chemistry

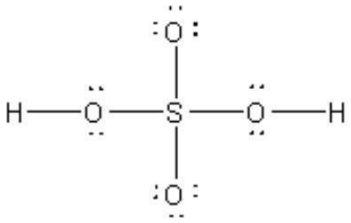
113. In which of the following species is the octet rule violated by the central atom when the central atom has a formal charge of zero?
A) $SOCl_2$

B) CCl_4
C) H_2S
D) PF_3
E) N_2F_4

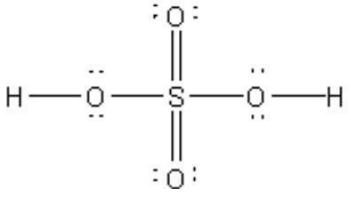
ANS: A PTS: 1 DIF: easy REF: 9.9
OBJ: State the rules for obtaining formal charge.
TOP: bonding | covalent bonding KEY: formal charge
MSC: general chemistry

114. What is the correct Lewis dot formula for sulfuric acid, H_2SO_4, that minimizes formal charge?

A)



B)



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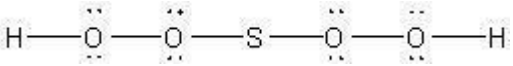

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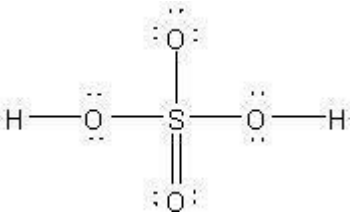
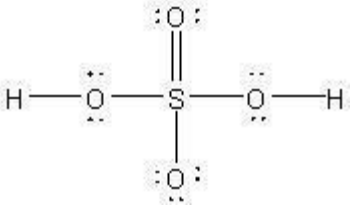


E)



ANS: B PTS: 1 DIF: moderate REF: 9.9
OBJ: Use formal charges to determine the best Lewis formula. (Example 9.11)
TOP: bonding | covalent bonding KEY: formal charge
MSC: general chemistry

115. What is the formal charge on the chlorine atom in the chlorate ion, ClO_3^-, in the Lewis dot formula that minimizes formal charge?
A) –2
B) +1
C) 0

D) –1
E) +2

ANS: C PTS: 1 DIF: moderate REF: 9.9
OBJ: Use formal charges to determine the best Lewis formula. (Example 9.11)
TOP: bonding | covalent bonding KEY: formal charge
MSC: general chemistry

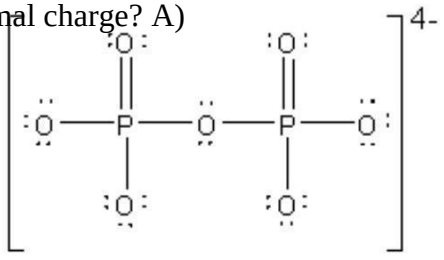
116. In the Lewis dot formula that minimizes formal charge, how many bonds are there in the tetrathionate ion, $S_4O_6^{2-}$?
A) 7
B) 9
C) 15
D) 11
E) 13

ANS: E PTS: 1 DIF: difficult REF: 9.9
OBJ: Use formal charges to determine the best Lewis formula. (Example 9.11)
TOP: bonding | covalent bonding KEY: formal charge
MSC: general chemistry

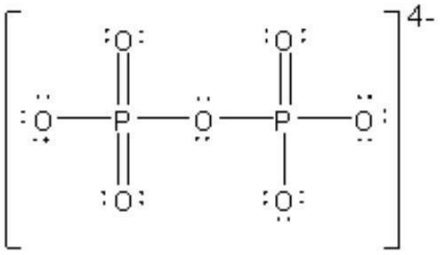
117. In the Lewis dot formula for the bromate ion (BrO_3^-) that minimizes formal charge, the central atom is surrounded by
A) two bonding pairs and two lone pairs of electrons.
B) four bonding pairs and one lone pair of electrons.
C) three bonding pairs and no lone pairs of electrons.
D) five bonding pairs and one lone pair of electrons.
E) three bonding pairs and one lone pair of electrons.

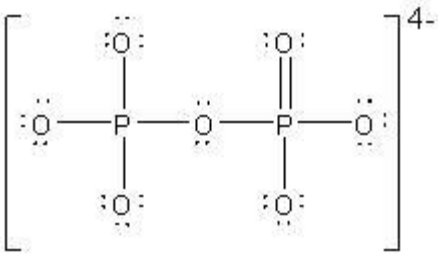
ANS: D PTS: 1 DIF: moderate REF: 9.9
OBJ: Use formal charges to determine the best Lewis formula. (Example 9.11)
TOP: bonding | covalent bonding KEY: formal charge
MSC: general chemistry

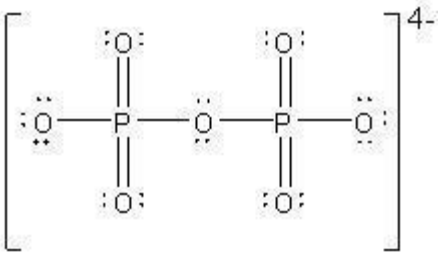
118. Which Lewis dot formula for pyrophosphate, $P_2O_7^{4-}$, minimizes formal charge? A)

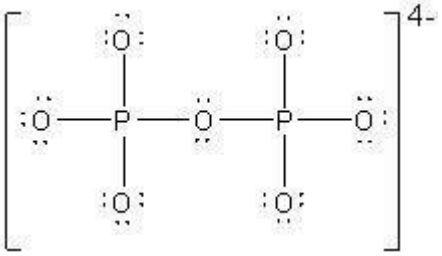


B)



C) 

D) 

E) 

ANS: A PTS: 1 DIF: moderate REF: 9.9
OBJ: Use formal charges to determine the best Lewis formula. (Example 9.11)
TOP: bonding | covalent bonding KEY: formal charge
MSC: general chemistry

119. As the number of bonds between two carbon atoms increases, which of the following decrease(s)?
A) only the bond length
B) only the bond energy
C) only the number of electrons between the carbon atoms
D) all of these
E) none of these

ANS: A PTS: 1 DIF: easy REF: 9.10
OBJ: Explain how bond order and bond length are related. (Example 9.12)
TOP: bonding | covalent bonding KEY: bond length MSC: general chemistry

120. Which of the following statements is true?
A) The triple bond in N_2 has a smaller bond order and a smaller bond length than the single bond in F_2.
B) The triple bond in N_2 has a larger bond order and a smaller bond length than the single bond in F_2.
C) The triple bond in N_2 has a smaller bond order and a larger bond length than the single bond in F_2.
D) The triple bond in N_2 has a larger bond order and a larger bond length than the single bond in F_2.
E) The triple bond in N_2 and the single bond in F_2 have the same bond order and the

same bond length.

ANS: B PTS: 1 DIF: easy REF: 9.10
OBJ: Explain how bond order and bond length are related. (Example 9.12)
TOP: bonding | covalent bonding KEY: bond order MSC: general chemistry

121. Which of the following species has the shortest bond distance?
A) F_2
B) Cl_2
C) Br_2
D) I_2
E) H_2

ANS: E PTS: 1 DIF: moderate REF: 9.10
OBJ: Explain how bond order and bond length are related. (Example 9.12)
TOP: bonding | covalent bonding KEY: bond length MSC: general chemistry

122. Which of the following diatomic species do you expect to have the longest bond length?
A) O_2^+
B) O_2^{2-}
C) O_2
D) O_2^-
E) they are all identical

ANS: B PTS: 1 DIF: moderate REF: 9.10
OBJ: Explain how bond order and bond length are related. (Example 9.12)
TOP: bonding | covalent bonding KEY: bond length MSC: general chemistry

123. Which of the following diatomic molecules has the greatest bond energy?
A) H_2
B) HCl
C) Cl_2
D) CO
E) HF

ANS: D PTS: 1 DIF: easy REF: 9.11
OBJ: Define bond energy. TOP: bonding | covalent bonding
KEY: bond energy MSC: general chemistry

124. Consider the reaction

$2HCl(g) \rightarrow H_2(g) + Cl_2(g)$; $\Delta H = 185$ kJ

Which of the following statements is <u>false</u>?

A) The reaction is endothermic.
B) $HCl(g)$ has a negative enthalpy of formation.
C) The products have more enthalpy than the reactants.
D) The HCl bond is longer than either the H_2 bond or the Cl_2 bond.
E) The bond order of each of the products is one.

ANS: D PTS: 1 DIF: easy REF: 9.11
OBJ: Define bond energy. TOP: bonding | covalent bonding

KEY: bond energy MSC: general chemistry

125. Using bond-energy data, what is D*H*° for the following reaction?

$CH_4(g) + 2Cl_2(g) \rightarrow CCl_4(g) + 2H_2(g)$

Bond	Bond Energy (kJ/mol)
C-H	413
H-H	432
Cl-Cl	242
C-Cl	328

A) –40 kJ
B) –150 kJ
C) 40 kJ
D) 1415 kJ
E) 150 kJ

ANS: A PTS: 1 DIF: easy REF: 9.11
OBJ: Estimate delta H from bond energies. (Example 9.13)
TOP: bonding | covalent bonding KEY: bond energy MSC: general chemistry

126. Using bond-energy data, what is D*H*° for the following reaction?

$CH_3OH(g) + H_2S(g) \rightarrow CH_3SH(g) + H_2O(g)$

Bond	Bond Energy (kJ/mol)
C-H	413
C-O	358
O-H	463
C-S	259
S-H	339

A) –25 kJ
B) -124 kJ
C) 25 kJ
D) –2763 kJ
E) 2738 kJ

ANS: A PTS: 1 DIF: easy REF: 9.11
OBJ: Estimate delta H from bond energies. (Example 9.13)
TOP: bonding | covalent bonding KEY: bond energy MSC: general chemistry

127. Based on the following data, what is the Br-Br bond energy? $\frac{1}{2}H_2(g) + \frac{1}{2}Br_2(g) \rightarrow HBr(g)$; D*H* = –36.44 kJ

Bond	Bond Energy (kJ/mol)
H-H	435
H-Br	362

A) 399 kJ/mol

B) 216 kJ/mol
C) –216 kJ/mol
D) –289 kJ/mol
E) 289 kJ/mol

ANS: B **PTS: 1** **DIF: moderate** **REF: 9.11**
OBJ: Estimate delta H from bond energies. (Example 9.13)
TOP: bonding | covalent bonding KEY: bond energy MSC: general chemistry

128. Based on the following data, what is the bond energy of the C=C bond in 1,1-difluoroethylene, CF_2CH_2?

$CH_4(g) \rightarrow C(g) + 4H(g)$; $\Delta H = 1656$ kJ

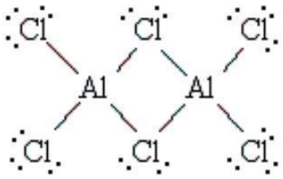
$CF_4(g) \rightarrow C(g) + 4F(g)$; $\Delta H = 1756$ kJ

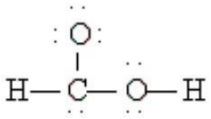
$CF_2CH_2(g) \rightarrow 2C(g) + 2H(g) + 2F(g)$; $\Delta H = 2317$ kJ

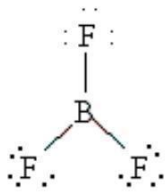
A) 611 kJ/mol
B) 845 kJ/mol
C) 820 kJ/mol
D) 1706 kJ/mol
E) 1910 kJ/mol

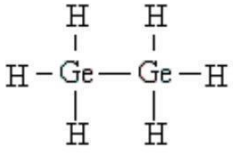
ANS: A **PTS: 1** **DIF: moderate** **REF: 9.11**
OBJ: Estimate delta H from bond energies. (Example 9.13)
TOP: bonding | covalent bonding KEY: bond energy MSC: general chemistry

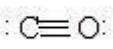
129. Which of the following covalent molecules does <u>not</u> have the proper Lewis dot formula?

A) 

B) 

C) 

D) 

E) 

ANS: B PTS: 1 DIF: difficult REF: 9.9
OBJ: Use formal charges to determine the best Lewis formula. (Example 9.11)
TOP: bonding | covalent bonding KEY: Lewis dot formula
MSC: general chemistry

130. Use the bond energies provided to complete the following statement.

_____ when all of the bonds in acetic acid (CH_3COOH) are broken.

Bond	Bond Energy (kJ/mol)
C-H	413
C-O	358
O-H	463
C=O	745
C-C	348
C=C	614

A) 3153 kJ/mol of energy is consumed
B) 3153 kJ/mol of energy is released
C) 2805 kJ/mol of energy is released
D) 2805 kJ/mol of energy is consumed
E) 2766 kJ/mol of energy is consumed

ANS: A PTS: 1 DIF: easy REF: 9.11
OBJ: Estimate delta H from bond energies. (Example 9.13)
TOP: bonding | covalent bonding