

Chapter 9: Chemical Bonding I: Basic Concepts

1. Which one of the following is most likely to be an ionic compound?
A) CaCl_2 B) CO_2 C) CS_2 D) SO_2 E) OF_2
Ans: A Category: Easy Section: 9.2
2. Which one of the following is most likely to be an ionic compound?
A) ClF_3 B) FeCl_3 C) NH_3 D) PF_3 E) SO_3
Ans: B Category: Easy Section: 9.2
3. Which one of the following is most likely to be an ionic compound?
A) NCl_3 B) BaCl_2 C) CO D) SO_2 E) SF_4
Ans: B Category: Easy Section: 9.2
4. Which of the following pairs of elements would be most likely to form an ionic compound?
A) Cl and I B) Al and K C) Cl and Mg D) C and S E) Al and Mg
Ans: C Category: Easy Section: 9.2
5. Which one of the following is most likely to be a covalent compound?
A) Rb_2O B) BaO C) SrO D) SeO_2 E) MnO_2
Ans: D Category: Easy Section: 9.4
6. Which one of the following is most likely to be a covalent compound?
A) KF B) CaCl_2 C) SF_4 D) Al_2O_3 E) CaSO_4
Ans: C Category: Easy Section: 9.4
7. Which one of the following is most likely to be a covalent compound?
A) CsOH B) NF_3 C) $\text{Sr}(\text{NO}_3)_2$ D) CaO E) LiF
Ans: B Category: Easy Section: 9.4
8. Complete this statement: Coulomb's law states that the magnitude of the force of interaction between two charged bodies is
A) directly proportional to the product of the charges on the bodies and directly proportional to the distance separating them.
B) directly proportional to the product of the charges on the bodies, and inversely proportional to the square of the distance separating them.
C) inversely proportional to the product of the charges on the bodies, and directly proportional to the square of the distance separating them.
D) directly proportional to the sum of the charges on the bodies, and inversely proportional to the square of the distance separating them.
Ans: B Category: Medium Section: 9.4

9. The Lewis dot symbol for the a lead atom is
 A) $\cdot\text{Pb}\cdot$ B) $\text{Pb}\cdot$ C) $\cdot\overset{\cdot}{\text{Pb}}\cdot$ D) $:\overset{\cdot}{\text{Pb}}\cdot$ E) $\cdot\overset{\cdot}{\text{Pb}}\cdot$
 Ans: C Category: Medium Section: 9.1
10. The Lewis dot symbol for the S^{2-} ion is
 A) $:\ddot{\text{S}}:$ B) $:\ddot{\text{S}}:^{2-}$ C) S^{2-} D) $—\overset{\cdot}{\text{S}}—^{2-}$ E) $:\ddot{\text{S}}—$
 Ans: B Category: Medium Section: 9.2
11. The Lewis dot symbol for the chloride ion is
 A) $:\ddot{\text{Cl}}\cdot$ B) $:\ddot{\text{Cl}}:^{-}$ C) $:\text{Cl}^{-}$ D) $:\overset{\cdot}{\text{Cl}}:^{-}$ E) Cl^{-}
 Ans: B Category: Medium Section: 9.2
12. The Lewis dot symbol for the calcium ion is
 A) $:\text{Ca}:^{2+}$ B) $—\text{Ca}—$ C) $:\overset{\cdot}{\text{Ca}}:^{2+}$ D) Ca^{2+} E) Ca
 Ans: D Category: Medium Section: 9.2
13. Which one of the following ionic solids would have the largest lattice energy?
 A) NaCl B) NaF C) CaBr_2 D) CsI E) CaCl_2
 Ans: E Category: Medium Section: 9.3
14. Which of the following ionic solids would have the largest lattice energy?
 A) SrO B) NaF C) CaBr_2 D) CsI E) BaSO_4
 Ans: A Category: Medium Section: 9.3
15. Which of the following ionic solids would have the largest lattice energy?
 A) KF B) KI C) LiF D) LiI E) NaF
 Ans: C Category: Medium Section: 9.3
16. Which of the following solids would have the highest melting point?
 A) NaF B) NaCl C) NaBr D) NaI
 Ans: A Category: Medium Section: 9.3
17. Which of the following solids would have the highest melting point?
 A) NaI B) NaF C) MgO D) MgCl_2 E) KF
 Ans: C Category: Medium Section: 9.3
18. Which of the following solids would have the lowest melting point?
 A) KI B) KBr C) KCl D) KF
 Ans: A Category: Medium Section: 9.3

22. Use the Born-Haber cycle to calculate the lattice energy of MgO (s) given the following data:

$$\Delta H(\text{sublimation}) \text{ Mg} = 130 \text{ kJ/mol}$$

$$I_1 (\text{Mg}) = 738.1 \text{ kJ/mol}$$

$$I_2 (\text{Mg}) = 1450 \text{ kJ/mol}$$

$$\text{Bond energy (O=O)} = 498.7 \text{ kJ/mol}$$

$$\text{EA (O)} = 141 \text{ kJ/mol}$$

$$\text{EA (O}^-) = -780 \text{ kJ/mol}$$

$$\Delta H_f^\circ (\text{MgO(s)}) = -601.8 \text{ kJ/mol}$$

A) 2200 kJ/mol

D) 3800 kJ/mol

B) 2800 kJ/mol

E) 4100 kJ/mol

C) 3200 kJ/mol

Ans: D Category: Difficult Section: 9.3

23. Use the Born-Haber cycle to calculate the standard enthalpy of formation (ΔH_f°) for LiCl(s) given the following data:

$$\Delta H(\text{sublimation}) \text{ Li} = 155.2 \text{ kJ/mol}$$

$$I_1 (\text{Li}) = 520 \text{ kJ/mol}$$

$$\text{Bond energy (Cl-Cl)} = 242.7 \text{ kJ/mol}$$

$$\text{EA (Cl)} = 349 \text{ kJ/mol}$$

$$\text{Lattice energy (LiCl(s))} = 828 \text{ kJ/mol}$$

A) 440 kJ/mol

D) -380 kJ/mol

B) 320 kJ/mol

E) -1420 kJ/mol

C) -260 kJ/mol

Ans: D Category: Difficult Section: 9.3

24. Which of the elements listed below has the *greatest* electronegativity?

A) Na B) As C) Ga D) Cs E) Sb

Ans: B Category: Medium Section: 9.5

25. Which of the atoms listed below is the *most* electronegative?

A) Li B) Cs C) P D) As E) Ge

Ans: C Category: Medium Section: 9.5

26. Which of the elements listed below has the *greatest* electronegativity?

A) Se B) Sb C) K D) Ga E) Fe

Ans: A Category: Medium Section: 9.5

27. Which of the elements listed below is the *least* electronegative?

A) Sr B) V C) Ni D) P E) I

Ans: A Category: Medium Section: 9.5

28. Which of the elements listed below has the *greatest* electronegativity?

A) Mg B) Ga C) Si D) Ba E) Pb

Ans: C Category: Medium Section: 9.5

29. A polar covalent bond would form in which one of the following pairs of atoms?
 A) Cl—Cl B) Si—Si C) Ca—Cl D) Cr—Br E) P—Cl
 Ans: E Category: Medium Section: 9.5
30. Which one of these polar covalent bonds would have the greatest *percent ionic character*?
 A) H—Br B) H—Cl C) H—F D) H—I
 Ans: C Category: Medium Section: 9.5
31. What type of chemical bond holds the atoms together within a water molecule?
 A) Ionic bond C) Polar covalent bond
 B) Nonpolar covalent bond D) Coordinate covalent bond
 Ans: C Category: Medium Section: 9.5
32. A *nonpolar* covalent bond (i.e., pure covalent) would form in which one of the following pairs of atoms?
 A) Na—Cl B) H—Cl C) Li—Br D) Se—Br E) Br—Br
 Ans: E Category: Medium Section: 9.5
33. Which of the bonds below would have the *greatest* polarity (i.e., highest percent ionic character)?
 A) Si—P B) Si—S C) Si—Se D) Si—Cl E) Si—I
 Ans: D Category: Medium
34. Which of the following covalent bonds is the *most polar* (i.e., highest percent ionic character)?
 A) Al—I B) Si—I C) Al—Cl D) Si—Cl E) Si—P
 Ans: C Category: Medium Section: 9.5
35. The covalent bond with the *greatest* polarity would form in which of the atom pairs below?
 A) Br—Br B) S—O C) C—P D) C—O E) B—O
 Ans: E Category: Medium Section: 9.5
36. The bond in which one of the following pairs of atoms would be the *most polar*?
 A) B—C B) C—N C) C—O D) Si—O E) C—C
 Ans: D Category: Medium Section: 9.5
37. The bond in which of the following pairs of atoms would have the *greatest* percent ionic character (i.e., most polar)?
 A) C—O B) S—O C) Na—I D) Na—Br E) F—F
 Ans: D Category: Medium Section: 9.5

38. The bond in which of the following pairs of atoms would be the *least* polar (i.e., lowest percent ionic character)?

A) C—Cl B) C—C C) C—H D) O—C E) N—C

Ans: B Category: Medium Section: 9.5

39. Classify the O—H bond in CH₃OH as ionic, polar covalent, or nonpolar covalent.

A) ionic B) polar covalent C) nonpolar covalent

Ans: B Category: Medium Section: 9.5

40. Classify the C—Cl bond in CCl₄ as ionic, polar covalent, or nonpolar covalent.

A) ionic B) polar covalent C) nonpolar covalent

Ans: B Category: Medium Section: 9.5

41. Classify the Ca—Cl bond in CaCl₂ as ionic, polar covalent, or nonpolar covalent.

A) ionic B) polar covalent C) nonpolar covalent

Ans: A Category: Medium Section: 9.5

42. The electron dot formula for O₂ shows

A) a single covalent bond D) a total of $8 \times 2 = 16$ electron dots

B) a double covalent bond E) a total of 32 electron dots

C) an ionic bond

Ans: B Category: Medium Section: 9.4

43. The number of lone electron pairs in the N₂ molecule is ____.

A) 1 B) 2 C) 3 D) 4 E) 5

Ans: B Category: Medium Section: 9.4

44. The number of lone electron pairs in the NO₂⁻ ion is ____.

A) 4 B) 5 C) 6 D) 7 E) 8

Ans: C Category: Medium Section: 9.4

45. The number of lone electron pairs in the CO₃²⁻ ion is ____.

A) 4 B) 5 C) 6 D) 7 E) 8

Ans: E Category: Medium Section: 9.4

46. The electron dot structure for AsCl₃ shows

A) a total of 84 electron dots

B) three single bonds and 10 lone pairs

C) two single bonds, one double bond, and 9 lone pairs

D) one single bond, two double bonds, and 8 lone pairs

E) three single bonds and one lone pair

Ans: B Category: Medium Section: 9.6

47. The total number of bonding electrons in a molecule of formaldehyde (H_2CO) is
 A) 3 B) 4 C) 6 D) 8 E) 18

Ans: D Category: Medium Section: 9.6

48. The total number of lone pairs in NCl_3 is

A) 6 B) 8 C) 9 D) 10 E) 13

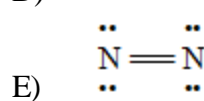
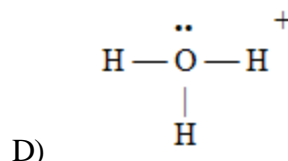
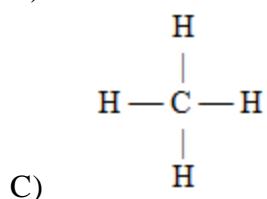
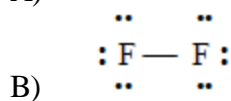
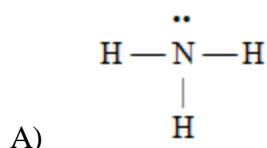
Ans: D Category: Medium Section: 9.6

49. The Lewis structure for CS_2 is:

A) $\begin{array}{c} \text{C} \\ \text{C}=\ddot{\text{S}}-\ddot{\text{S}} \\ \text{C} \end{array}$ B) $\begin{array}{c} \text{S} \\ \text{S}-\text{C}-\text{S} \\ \text{S} \end{array}$ C) $\begin{array}{c} \text{S} \\ \text{S}=\text{C}=\text{S} \\ \text{S} \end{array}$ D) $\begin{array}{c} \text{S} \\ \text{S}=\text{C}-\text{S} \\ \text{S} \end{array}$

Ans: C Category: Medium Section: 9.6

50. Which of the following Lewis structures is incorrect?



Ans: E Category: Medium Section: 9.6

51. The number of resonance structures for the sulfur dioxide molecule that satisfy the octet rule is

A) 1 B) 2 C) 3 D) 4 E) None of these

Ans: B Category: Difficult Section: 9.8

52. The number of resonance structures for the nitrate ion that satisfy the octet rule is

A) 1 B) 2 C) 3 D) 4 E) None of these

Ans: C Category: Difficult Section: 9.8

53. The azide ion, N_3^- , is very reactive although it is isoelectronic with the very stable CO_2 molecule. This reactivity is reasonable inasmuch as
- A) a Lewis structure cannot be written for the azide ion that has nitrogen formal charges of zero.
 - B) there is no valid Lewis structure possible for the azide ion.
 - C) there are resonance structures for azide ion but not for carbon dioxide.
 - D) nitrogen cannot form multiple bonds.
 - E) charged species always decompose in solution.
- Ans: A Category: Difficult Section: 9.7
54. Assuming the octet rule is obeyed, how many covalent bonds will a nitrogen atom form to give a formal charge of zero?
- A) 0 B) 1 C) 2 D) 3 E) 4
- Ans: D Category: Medium Section: 9.7
55. Assuming the octet rule is obeyed, how many covalent bonds will an oxygen atom form to give a formal charge of zero?
- A) 0 B) 1 C) 2 D) 3 E) 4
- Ans: C Category: Medium Section: 9.7
56. Assuming the octet rule is obeyed, how many covalent bonds will a carbon atom form to give a formal charge of zero?
- A) 0 B) 1 C) 2 D) 3 E) 4
- Ans: E Category: Medium Section: 9.7
57. Assuming the octet rule is obeyed, how many covalent bonds will a neon atom form to give a formal charge of zero?
- A) 0 B) 1 C) 2 D) 3 E) 4
- Ans: A Category: Medium Section: 9.7
58. Which of the following is a useful guideline for the application of formal charges in neutral molecules?
- A) A Lewis structure in which there are no formal charges is preferred.
 - B) Lewis structures with large formal charges (e.g., +2,+3 and/or -2,-3) are preferred.
 - C) The preferred Lewis structure is one in which positive formal charges are on the most electronegative atoms.
- Ans: A Category: Easy Section: 9.7
59. What is the formal charge on the oxygen atom in N_2O (the atomic order is N–N–O)?
- A) 0 B) +1 C) -1 D) -2 E) +2
- Ans: C Category: Difficult Section: 9.7
60. The formal charge on the bromine atom in BrO_3^- drawn with three single bonds is
- A) -2 B) -1 C) 0 D) +1 E) +2
- Ans: E Category: Medium Section: 9.7

61. How many covalent bonds will be drawn to bromine in BrO_3^- for the dot structure that expands the octet to minimize formal charge and if necessary places negative formal charges on the most electronegative atom(s).
 A) 3 B) 4 C) 5 D) 6 E) 7
 Ans: C Category: Difficult Section: 9.9
62. How many covalent bonds will be drawn to phosphorous in PO_4^{3-} for the dot structure that expands the octet to minimize formal charge and if necessary places negative formal charges on the most electronegative atom(s).
 A) 4 B) 5 C) 6 D) 7 E) 8
 Ans: B Category: Difficult Section: 9.9
63. The formal charge on the sulfur atom in the resonance structure of sulfur dioxide which has one single bond and one double bond is
 A) 0 B) +1 C) -1 D) +2 E) -2
 Ans: B Category: Difficult Section: 9.7
64. What is the formal charge on sulfur in the best Lewis structure for the SCN^- (thiocyanate) ion?
 A) +2 B) -2 C) +1 D) -1 E) 0
 Ans: E Category: Difficult Section: 9.7
65. What is the formal charge on the singly bonded oxygens in the Lewis structure for the carbonate ion?
 A) -2 B) -1 C) 0 D) +1 E) +2
 Ans: B Category: Difficult Section: 9.7
66. What is the formal charge on phosphorus in a Lewis structure for the phosphate ion that satisfies the octet rule?
 A) -2 B) -1 C) 0 D) +1 E) +2
 Ans: D Category: Difficult Section: 9.7
67. Nitrous oxide, N_2O , is sometimes called “laughing gas”. What is the formal charge on the central nitrogen atom in the best Lewis structure for nitrous oxide? (The atom connectivity is N-N-O.)
 A) -2 B) -1 C) 0 D) +1 E) +2
 Ans: D Category: Difficult Section: 9.7
68. In the best Lewis structure for the fulminate ion, CNO^- , what is the formal charge on the central nitrogen atom?
 A) +2 B) +1 C) 0 D) -1 E) -2
 Ans: B Category: Difficult Section: 9.7

69. In the Lewis structure of the iodate ion, IO_3^- , that satisfies the octet rule, the formal charge on the central iodine atom is
 A) +2 B) +1 C) 0 D) -1 E) -2
 Ans: A Category: Medium Section: 9.7
70. BeF_4^{2-} is called the fluoberyllate ion. The formal charge on the beryllium atom in this ion is
 A) -2 B) -1 C) 0 D) +1 E) +2
 Ans: A Category: Medium Section: 9.7
71. Each of the three resonance structures of NO_3^- has how many lone pairs of electrons?
 A) 7 B) 8 C) 9 D) 10 E) 13
 Ans: B Category: Medium Section: 9.8
72. For which of these species does the best Lewis structure have two or more equivalent resonance structures?
 A) HCO_2^- B) SCN^- C) CNO^- D) N_3^- E) CO_2
 Ans: A Category: Medium Section: 9.8
73. What is total number of lone pairs in the best Lewis structure for SOF_4 that exceeds the octet rule (S is the central atom)?
 A) 0 B) 2 C) 14 D) 16 E) 18
 Ans: C Category: Medium
74. Which of the following substances will display an incomplete octet in its Lewis structure?
 A) CO_2 B) Cl_2 C) ICl D) NO E) SO_2
 Ans: D Category: Medium Section: 9.9
75. Which of the elements listed below is most likely to exhibit an expanded octet in its compounds?
 A) O B) S C) Na D) C E) N
 Ans: B Category: Easy Section: 9.9
76. Which one of the following compounds does not follow the octet rule?
 A) NF_3 B) CF_4 C) PF_5 D) AsH_3 E) HCl
 Ans: C Category: Easy Section: 9.9
77. Which one of the following compounds does not follow the octet rule?
 A) NF_3 B) CO_2 C) CF_4 D) Br_2 E) NO
 Ans: E Category: Medium Section: 9.9

78. Which response includes all the molecules below that do not follow the octet rule?

(1) H_2S (2) BCl_3 (3) PH_3 (4) SF_4

A) (2) and (4) B) (2) and (3) C) (1) and (2) D) (3) and (4) E) (1) and (4)

Ans: A Category: Medium Section: 9.9

79. Which one of the following molecules has an atom with an incomplete octet?

A) NF_3 B) H_2O C) AsCl_3 D) GeH_4 E) BF_3

Ans: E Category: Medium Section: 9.9

80. Which one of the following molecules has an atom with an expanded octet?

A) HCl B) AsCl_3 C) ICl D) NCl_3 E) Cl_2

Ans: B Category: Medium Section: 9.9

81. Which molecule has a Lewis structure that does not obey the octet rule?

A) N_2O B) CS_2 C) PH_3 D) CCl_4 E) NO_2

Ans: E Category: Medium Section: 9.9

82. Estimate the enthalpy change for the reaction $2\text{CO} + \text{O}_2 \rightarrow 2\text{CO}_2$ given the following bond energies.

$\text{BE}(\text{C}\equiv\text{O}) = 1074 \text{ kJ/mol}$

$\text{BE}(\text{O}=\text{O}) = 499 \text{ kJ/mol}$

$\text{BE}(\text{C}=\text{O}) = 802 \text{ kJ/mol}$

A) +2380 kJ/mol

D) -561 kJ/mol

B) +744 kJ/mol

E) -744 kJ/mol

C) +1949 kJ/mol

Ans: D Category: Difficult Section: 9.10

83. Estimate the enthalpy change for the combustion of one mole of acetylene, C_2H_2 , to form carbon dioxide and water vapor.

$\text{BE}(\text{C}-\text{H}) = 456 \text{ kJ/mol}$

$\text{BE}(\text{C}\equiv\text{C}) = 962 \text{ kJ/mol}$

$\text{BE}(\text{O}=\text{O}) = 499 \text{ kJ/mol}$

$\text{BE}(\text{C}=\text{O}) = 802 \text{ kJ/mol}$

$\text{BE}(\text{O}-\text{H}) = 462 \text{ kJ/mol}$

A) -1759 kJ/mol

D) -1010 kJ/mol

B) +653 kJ/mol

E) -155 kJ/mol

C) +1010 kJ/mol

Ans: D Category: Difficult Section: 9.10

84. Use bond energies to estimate the enthalpy of formation of HBr(g) .

$$\text{BE(H-H)} = 436 \text{ kJ/mol}$$

$$\text{BE(Br-Br)} = 192 \text{ kJ/mol}$$

$$\text{BE(H-Br)} = 366 \text{ kJ/mol}$$

A) +262 kJ/mol

D) +104 kJ/mol

B) -52 kJ/mol

E) +52 kJ/mol

C) -104 kJ/mol

Ans: B Category: Difficult Section: 9.10

85. Use bond energies to estimate the enthalpy change for the reaction of one mole of CH_4 with chlorine gas to give CH_3Cl and hydrogen chloride.

$$\text{BE(C-H)} = 414 \text{ kJ/mol}$$

$$\text{BE(C-Cl)} = 326 \text{ kJ/mol}$$

$$\text{BE(H-Cl)} = 432 \text{ kJ/mol}$$

$$\text{BE(Cl-Cl)} = 243 \text{ kJ/mol}$$

A) -101 kJ/mol

D) +106 kJ/mol

B) -106 kJ/mol

E) +101 kJ/mol

C) +331 kJ/mol

Ans: A Category: Difficult Section: 9.10

86. Use the bond enthalpy data given to estimate the heat released when 6.50 g of nitrogen gas reacts with excess hydrogen gas to form ammonia at 25°C .

$$\text{BE(N}\equiv\text{N)} = 941.4 \text{ kJ/mol}$$

$$\text{BE(H-H)} = 436.4 \text{ kJ/mol}$$

$$\text{BE(N-H)} = 393 \text{ kJ/mol}$$

A) 228 kJ B) 340 kJ C) 107 kJ D) 46.1 kJ E) 24.9 kJ

Ans: E Category: Difficult Section: 9.10

87. Use the bond enthalpy data given to estimate the heat released when 50.0 g of propane gas, C_3H_8 , burns in excess oxygen to yield carbon dioxide and water vapor at 25°C .

$$\text{BE(C-C)} = 347 \text{ kJ/mol}$$

$$\text{BE(C=O in CO}_2\text{)} = 799 \text{ kJ/mol}$$

$$\text{BE(C-H)} = 414 \text{ kJ/mol}$$

$$\text{BE(O-H)} = 460 \text{ kJ/mol}$$

$$\text{BE(O=O)} = 498.7 \text{ kJ/mol}$$

A) 1360 kJ B) 2240 kJ C) 2370 kJ D) 1540 kJ E) 1970 kJ

Ans: B Category: Difficult Section: 9.10

88. Use the bond enthalpy data given to estimate the heat released when 25.0 g of acetylene gas, C_2H_2 , burns in excess oxygen to yield carbon dioxide and water vapor at $25^\circ C$.

$$BE(C-C) = 347 \text{ kJ/mol}$$

$$BE(C\equiv C) = 812 \text{ kJ/mol}$$

$$BE(C=O \text{ in } CO_2) = 799 \text{ kJ/mol}$$

$$BE(C-H) = 414 \text{ kJ/mol}$$

$$BE(O-H) = 460 \text{ kJ/mol}$$

$$BE(O=O) = 498.7 \text{ kJ/mol}$$

A) 1180 kJ B) 447 kJ C) 364 kJ D) 1230 kJ E) 16.8 kJ

Ans: A Category: Difficult Section: 9.10

89. The standard enthalpy of formation of ammonia at $25^\circ C$ is -46.3 kJ/mol . Estimate the N-H bond enthalpy at this temperature.

(Given: $BE(N\equiv N) = 941.4 \text{ kJ/mol}$, $BE(H-H) = 436.4 \text{ kJ/mol}$)

A) 383 kJ/mol

D) 391 kJ/mol

B) 475 kJ/mol

E) 459 kJ/mol

C) 360 kJ/mol

Ans: D Category: Difficult Section: 9.10

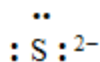
90. Write the Lewis dot symbol for the chloride ion.



Ans: $\cdot\cdot$

Category: Medium

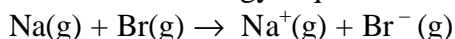
91. Write the Lewis dot symbol for the sulfide ion.



Ans: $\cdot\cdot$

Category: Medium

92. Calculate the energy required for the gas phase process represented by



Given: Ionization energy (Na) = 496 kJ/mol

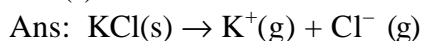
Electron affinity (Br) = 324 kJ/mol

Electron affinity (Na) = 53 kJ/mol

Ans: 172 kJ/mol

Category: Medium Section: 9.3

93. Write the chemical equation for which the enthalpy of reaction is the lattice energy of $KCl(s)$.



Category: Medium Section: 9.3

94. Use the Born-Haber cycle to calculate the lattice energy of NaBr(s) given the following data:

$$\Delta H(\text{sublimation}) \text{ Na} = 109 \text{ kJ/mol}$$

$$I_1 (\text{Na}) = 496 \text{ kJ/mol}$$

$$\text{Bond energy (Br-Br)} = 192 \text{ kJ/mol}$$

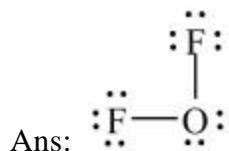
$$\text{EA (Br)} = 324 \text{ kJ/mol}$$

$$\Delta H_f (\text{NaBr(s)}) = -361 \text{ kJ/mol}$$

$$\text{Ans: } 738 \text{ kJ/mol}$$

Category: Difficult Section: 9.3

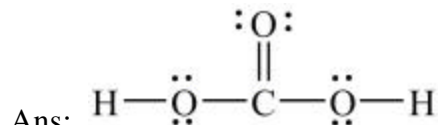
95. Write a Lewis structure for OF₂.



Ans:

Category: Medium Section: 9.6

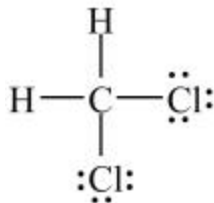
96. Carbonic acid, H₂CO₃, is a weak acid that contributes to the taste and produces the carbon dioxide bubbles in all carbonated beverages. Write a Lewis structure for H₂CO₃,



Ans:

Category: Medium Section: 9.6

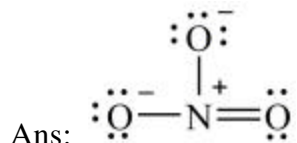
97. Dichloromethane, CH₂Cl₂, is an important solvent in synthetic chemistry. Write a Lewis structure for CH₂Cl₂.



Ans:

Category: Medium Section: 9.6

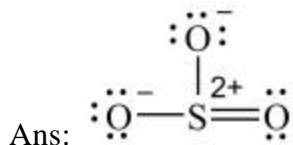
98. Write a Lewis structure for the nitrate ion, NO₃⁻, showing all non-zero formal charges.



Ans:

Category: Medium Section: 9.7

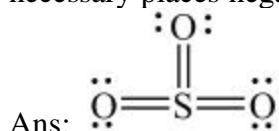
99. Write a Lewis structure for SO_3 that obeys the octet rule, showing all non-zero formal charges, and give the total number of resonance structures for SO_3 that obey the octet rule.



Total number of resonance structures of this type (that obey the octet rule) = 3.

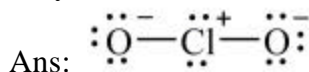
Category: Medium Section: 9.8

100. Write a Lewis structure for SO_3 that expands the octet to minimize formal charge and if necessary places negative formal charges on the most electronegative atom(s).



Category: Medium Section: 9.9

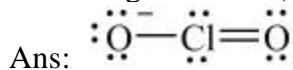
101. Write a Lewis structure for the chlorite ion, ClO_2^- , that obeys the octet rule, showing all non-zero formal charges, and give the total number of resonance structures for ClO_2^- that obey the octet rule.



Total number of resonance structures of this type (that obey the octet rule) = 1.

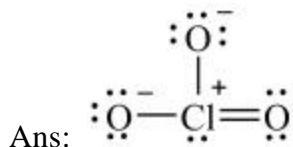
Category: Medium Section: 9.8

102. Write a Lewis structure for the chlorite ion, ClO_2^- , that expands the octet to minimize formal charge and if necessary places negative formal charges on the most electronegative atom(s).



Category: Medium Section: 9.9

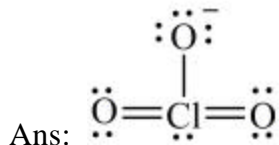
103. Write a Lewis structure for the chlorate ion, ClO_3^- , that obeys the octet rule, showing all non-zero formal charges, and give the total number of resonance structures for ClO_3^- that obey the octet rule.



Total number of resonance structures of this type (that obey the octet rule) = 3.

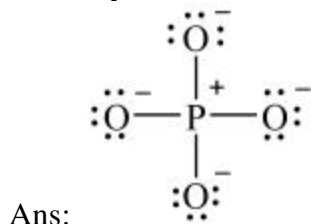
Category: Medium Section: 9.8

104. Write a Lewis structure for the chlorate ion, ClO_3^- , that expands the octet to minimize formal charge and if necessary places negative formal charges on the most electronegative atom(s).



Category: Medium Section: 9.9

105. Write a Lewis structure for the phosphate ion, PO_4^{3-} , that obeys the octet rule, showing all non-zero formal charges, and give the total number of resonance structures for PO_4^{3-} that obey the octet rule.

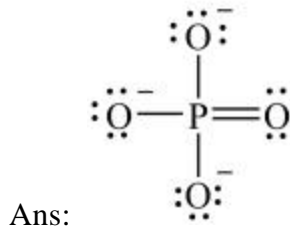


Ans:

Total number of resonance structures of this type (that obey the octet rule) = 1.

Category: Medium Section: 9.8

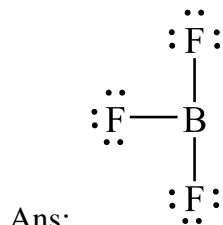
106. Write a Lewis structure for the phosphate ion, PO_4^{3-} , that expands the octet to minimize formal charge and if necessary places negative formal charges on the most electronegative atom(s).



Ans:

Category: Medium Section: 9.9

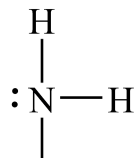
107. Write the Lewis structure of boron trifluoride.



Ans:

Category: Medium Section: 9.6

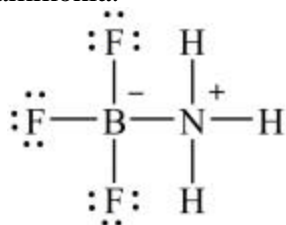
108. Write the Lewis structure of ammonia (nitrogen trihydride).



Ans: H

Category: Medium Section: 9.6

109. Write the Lewis structure for the product that forms when boron trifluoride combines with ammonia.



Ans:

Category: Difficult Section: 9.7

110. Consider the hypothetical element X with electron-dot formula



Give the formula for the simplest compound this element forms with chlorine.

Ans: XCl_4

Category: Medium Section: 9.2

111. Consider the hypothetical element Y with electron-dot formula



Give the formula for the simplest compound this element forms with chlorine.

Ans: YCl_3

Category: Medium Section: 9.2

112. Consider the hypothetical element Z with electron-dot formula



Give the formula for the simplest compound this element forms with chlorine.

Ans: ZCl_2

Category: Medium Section: 9.2

113. The polarity of covalent bonds increases as the percent ionic character increases.

Ans: True Category: Medium Section: 9.5

114. A charge of $2+$ is most likely to occur for an ion formed from an atom whose electron configuration is $1s^2 2s^2 2p^6 3s^2 3p^4$.

Ans: False Category: Medium Section: 9.???

115. Of the following substances, KCl, KBr, and KF, KF will have the highest melting point.

Ans: True Category: Medium Section: 9.3

116. The bond in F_2 is described as *polar covalent*.

Ans: False Category: Medium Section: 9.5

117. Of the species NO_2 , NO , and N_2 , only NO_2 is an exception to the octet rule.

Ans: False Category: Medium Section: 9.

118. The Si — Cl bond has less ionic character than the C — Cl bond.

Ans: False Category: Medium Section: 9.5