# General Chemistry Worksheet

Organic Chemistry Tutor

1. How many protons, electrons, and neutrons are found in the ion shown below?


A. 13p, 14n, 13e
B. 13p, 14n, 10e
C. 14p, 13n, 10e
D. 14p, 13n, 16e

2. What is the correct name for the compound $N_2O_5$?

A. Nitrogen Oxide
B. Dinitrogen Tetroxide
C. Nitrogen Oxygen
D. Dinitrogen Pentoxide

3. Calculate the percent composition of Aluminum in Aluminum Sulfite $Al_2(SO_3)_3$.

A. 18.3%
B. 9.18%
C. 20.2%
D. 40.3%

4. Nitrogen gas reacts with Hydrogen gas to form Ammonia. Calculate the mass of Ammonia ($NH_3$) produced if 15 g of Nitrogen gas reacts with excess Hydrogen gas.

A. 18.2 g
B. 9.11 g
C. 4.55 g
D. 36.4 g

5. 15 g of Sodium Hydroxide is dissolved in enough water to produce a 250 mL solution. Calculate the molarity of the solution.

A. 0.938 M
B. 1.50 M
C. 15.0 M
D. 1.24 M

6. How many mL of water must be added to 200 mL of a 0.75 M solution of NaOH to dilute the concentration to 0.25 M?

A. 66.7 mL
B. 133 mL
C. 400 mL
D. 600 mL

7. What is the correct oxidation state of Chromium in Sodium Dichromate ($Na_2Cr_2O_7$)?

A. +1
B. -2
C. +6
D. +12

8. 38.6 mL of a 0.249 M NaOH solution was required to completely titrate 44.7 mL of a Sulfuric Acid ($H_2SO_4$) solution. Determine the unknown concentration of the Sulfuric Acid solution.

A. 0.108 M
B. 0.215 M
C. 0.288 M
D. 0.430 M

9. A 250 mL sample of Argon gas has a pressure of 1.25 atm at a temperature of 300 K. Calculate the new pressure if the temperature is increased to 500 K and the volume is decreased to 100 mL.

A. 0.833 atm
B. 1.88 atm
C. 2.89 atm
D. 5.21 atm

10. Calculate the density of Oxygen gas ($O_2$) at STP.

A. 2.86 g/L
B. 0.714 g/L
C. 1.59 g/L
D. 1.43 g/L

11. Calculate the partial pressure of Ammonia ($NH_3$) if 24 g of Nitrogen gas reacts with excess Hydrogen gas at 298 K inside a 2.50 L container.

A. 5.69 atm
B. 9.34 atm
C. 16.8 atm
D. 21.4 atm

12. 4.722 g of an unknown gas is collected over water inside a 2.75 L container at 298 K. The total pressure inside the container is 749 torr and the vapor pressure of water is 23.76 torr. Determine the identity of the unknown gas.

A. $H_2$
B. $CO_2$
C. $N_2$
D. Xe

13. Which of the following statements is not correct?

A. The average kinetic energy of a sample of gas is dependent on temperature.

B. The pressure inside a container is dependent on the total number of moles of gas particles inside the container.

C. Heavier gas particles exert a greater pressure on the walls inside of the container.

D. The average velocity of gas particles is dependent on temperature.

14. Which of the following conditions will allow a real gas to behave more like an ideal gas?

A. High Temperature, Low Pressure
B. High Temperature, High Pressure
C. Low Temperature, High Pressure
D. Low Temperature, Low Pressure

15. How much energy is required to heat 75 g of water from $25^0$C to $74^0$C? The specific heat capacity of water is 4.184 J/g $^0$C.

A. 4.37 kJ
B. 7.39 kJ
C. 11.6 kJ
D. 15.4 kJ

16. How much heat energy is required to melt 25.0 g of ice? The heat of fusion for ice is 6.01 kJ/mol?

A. 3.14 kJ
B. 8.35 kJ
C. 12.7 kJ
D. 20.4 kJ

17. Which of the following represents the phase change from a gas to a solid?

A. Deposition
B. Condensation
C. Sublimation
D. Freezing

18. Calculate the enthalpy of the combustion of ethanol using the following information:

$C_2H_5OH(l) + 3O_2(g) \text{ ----> } 2CO_2(g) + 3H_2O(l)$

| | |
|---|---|
| $C_2H_5OH(l)$ | -277 kJ/mol |
| $CO_2(g)$ | -393.5 kJ/mol |
| $H_2O(l)$ | -285.9 kJ/mol |

A. -1,368 kJ/mol
B. -1,922 kJ/mol
C. +1,922 kJ/mol
D. -401.7 kJ/mol

19. Calculate the amount of heat energy released if 10.5 g of Propane ($C_3H_8$) reacts with excess Oxygen gas according to the following chemical equation:

$C_3H_8 + 5O_{2(g)} \text{ ----> } 3CO_{2(g)} + 4H_2O_{(l)} \quad \Delta H = -2{,}200.\ kJ$

A. -530 kJ
B. -785 kJ
C. -917 kJ
D. -1,210 kJ

20. Calculate the energy of a photon that has a wavelength of 451 nm.

A. $1.37 \times 10^{-18}$ J
B. $4.41 \times 10^{-19}$ J
C. $7.21 \times 10^{-19}$ J
D. $4.17 \times 10^{-18}$ J

21. What is the ground state electron configuration of Fluorine?

A. $1s^2\ 2s^2\ 2p^3$
B. $1s^2\ 2s^1\ 2p^5$
C. $1s^2\ 2s^2\ 2p^5$
D. $1s^2\ 2s^2\ 2p^6$

22. Which of the following four sets of quantum numbers correspond to the last electron found in Ni?

A. $n = 3, l = 2, m_l = 0, m_s = -1/2$
B. $n = 4, l = 0, m_l = 0, m_s = -1/2$
C. $n = 3, l = 1, m_l = -1, m_s = +1/2$
D. $n = 3, l = 2, m_l = -2, m_s = +1/2$

23. Which of the following four sets of quantum numbers are incorrect?

A. $n = 3, l = 2, m_l = 0, m_s = +1/2$
B. $n = 4, l = 0, m_l = -1, m_s = -1/2$
C. $n = 3, l = 2, m_l = -1, m_s = -1/2$
D. $n = 4, l = 3, m_l = -1, m_s = -1/2$

24. How many orbitals are in the n = 4 principal energy level?

A. 1
B. 4
C. 9
D. 16

25. Which of the following choices correctly ranks the different forms of electromagnetic radiation in order of increasing wavelength?

A. Gamma Rays < X-Rays < UV Rays < Light Waves
B. Light Waves < UV Rays < X-Rays < Gamma Rays
C. Light Waves < UV Rays < Gamma Rays < X-Rays
D. Light Waves < X-Rays < UV Rays < Gamma Rays

26. Which of the following elements has the highest first ionization energy?

A. Helium
B. Fluorine
C. Oxygen
D. Chlorine

27. Which of the following molecules has a trigonal planar molecular geometry?

A. $SO_2$
B. $CH_4$
C. $BF_3$
D. $NH_3$

28. Which of the following molecules has $SP^3$ hybridization around the central atom?

A. $H_2O$
B. $BF_3$
C. $BrF_3$
D. $SF_6$

29. Which of the following molecules is polar?

A. $CH_4$
B. $CO_2$
C. $BF_3$
D. $NF_3$

30. Rank the following intermolecular forces in order of decreasing strength:

A. Dipole-Dipole > H. Bonding > Dispersion Forces
B. H. Bonding > Dipole-Dipole > Dispersion Forces
C. H. Bonding > Dispersion Forces > Dipole-Dipole
D. Dispersion Forces > H. Bonding > Dipole-Dipole

31. Which of the following molecules has the highest boiling point?

A. $CH_3CH_2CH_3$
B. $CH_3SH$
C. $CH_3OH$
D. $CH_3CH_3$

32. 25.0 g of NaOH is dissolved in 300. g of water. Calculate the molality of the solution.

A. 0.242 m
B. 0.574 m
C. 1.28 m
D. 2.08 m

33. Calculate the molality of a 24% HCl aqueous solution.

A. 1.41 m
B. 3.72 m
C. 7.46 m
D. 8.66 m

34. Determine the molarity of a 27% HI solution with a density of 1.21 g/mL.

A. 0.452 M
B. 1.73 M
C. 2.55 M
D. 4.91 M

35. Determine the boiling point of a 1.24 m aqueous solution of $AlCl_3$. The $K_b$ for water is 0.512 $^0C/m$.

A. $100.6^0C$
B. $101.9^0C$
C. $102.5^0C$
D. $103.4^0C$

36. 32.0 g of an unknown nonelectrolyte solute was dissolved in 345 mL of solution. The osmotic pressure of the resulting solution is 27.1 atm at 298 K. Calculate the molar mass of the unknown solute.

A. 17.2 g/mol
B. 32.0 g/mol
C. 44.1 g/mol
D. 83.7 g/mol

37. 35.1 g of NaCl is dissolved in 200. g of water. The vapor pressure of pure water 23.76 torr at $25^0C$. Calculate the vapor pressure of the solution.

A. 20.5 torr
B. 21.4 torr
C. 23.7 torr
D. 25.1 torr

38. Calculate the average atomic mass of Boron if the relative percent abundance of isotopes B-10 and B-11 are 19% and 81% respectively.

A. 10.19
B. 10.81
C. 10.65
D. 10.93

39. 15.5 g of Magnesium metal reacts with excess Nitrogen gas to produce 18.2 g of Magnesium Nitride. Calculate the percent yield of Magnesium Nitride.

A. 28.3%
B. 42.7%
C. 84.8%
D. 91.3%

40. Calculate the pH of a $5.43 \times 10^{-3}$ M solution of $Ba(OH)_2$.

A. 12.0
B. 11.7
C. 2.27
D. 1.96

41. The average atomic mass of Chlorine is 35.45 amu which is based on isotopes Cl-35 and Cl-37. Calculate the relative % abundance of the isotope Cl-35.

A. 22.5%
C. 77.5%
B. 35.5%
D. 81.2%

42. How many molecules of $SF_4$ are there in a 25.0-g sample?

A. $2.94 \times 10^{23}$
C. $1.23 \times 10^{24}$
B. $1.39 \times 10^{23}$
D. $2.60 \times 10^{24}$

43. How many atoms of Fluorine are there in a 25.0-g sample of $SF_4$?

A. $1.39 \times 10^{23}$
C. $5.57 \times 10^{23}$
B. $2.94 \times 10^{23}$
D. $1.18 \times 10^{24}$

44. Determine the empirical formula of a compound that is made up of 55.8% Carbon, 7.703% Hydrogen, and 37.17% Oxygen.

A. $C_3H_5O$
C. $C_5H_{12}O_3$
B. $C_4H_8O_3$
D. $C_2H_3O$

45. The empirical formula of a compound is $CH_2O$. Determine the molecular formula of this compound given that its molar mass is 180 g/mol.

A. $C_2H_4O_2$
C. $C_5H_{10}O_5$
B. $C_3H_6O_3$
D. $C_6H_{12}O_6$

46. A 4.532 g compound consisting only of Carbon and Hydrogen produced 13.851 g of $CO_2$ and 6.798 g of $H_2O$ during combustion analysis. Determine the empirical formula of this compound.

A. $C_3H_8$
C. $C_5H_{12}$
B. $CH_4$
D. $C_7H_{12}$

47. 40.0 g of Iron metal reacts with 20.0 g of Oxygen gas to produce Iron (III) Oxide. Calculate the mass of the excess reactant that remains after the reaction is complete.

A. 2.81 g
C. 22.5 g
B. 17.2 g
D. 34.5 g

48. 30.0 g of Aluminum metal reacts with 38.0 g of Fluorine gas to form Aluminum Fluoride. Calculate the theoretical yield of Aluminum Fluoride.

A. 51.1 g
C. 84.0 g
B. 93.4 g
D. 56.0 g

49. Which of the following is a homogeneous mixture?

I. Air
II. Oil and Water
III. Sodium Chloride and Water

A. I Only
B. II & III
C. I & II
D. I & III

50. Which of the following is not a representative element?

A. Na
B. Al
C. S
D. Fe

51. Calculate the mass of Sodium Fluoride required to make a 0.350 M solution of NaF in 200. mL of water.

A. 0.070 g NaF
B. 0.746 g NaF
C. 2.94 g NaF
D. 73.5 g NaF

52. Which of the following is a chemical change?

A. Distillation
B. Melting Ice
C. Burning Coal
D. Boiling Water

53. Which of the following compounds is insoluble?

A. $Pb(C_2H_3O_2)_2$
B. $AgNO_3$
C. $Na_2SO_3$
D. MgS

54. Which of the following species is the reducing agent in the reaction shown below?

$Cr(s) + 2HCl(aq) \text{ -----> } CrCl_2(aq) + H_2(g)$

A. Cr
B. HCl
C. $CrCl_2$
D. $H_2$

55. Calculate the new volume of a 245-mL sample of gas if the temperature increased from $25.0^0$C to $83.0^0$C.

A. 205 mL
B. 293 mL
C. 356 mL
D. 813 mL

56. Which of the following represents the correct formula for Copper (I) Sulfite?

A. $Cu_2SO_3$
B. $CuSO_3$
C. CuS
D. $CuSO_4$

57. Calculate the volume necessary to produce a 0.75 M solution using 15 g of Potassium Fluoride (KF).

A. 194 mL
B. 465 mL
C. 258 mL
D. 344 mL

58. Calculate the mass of AgCl that will be produced from mixing a solution of 48.6 mL of 0.255 M $MgCl_2$ with 72.8 mL of 0.186 M $AgNO_3$.

A. 1.78 g
B. 1.94 g
C. 2.61 g
D. 3.55 g

59. Which of the following is not a redox reaction?

A. $Mg(s) + 2HBr(aq) \text{ -----> } MgBr_2(aq) + H_2(g)$
B. $C_5H_{12}(l) + 8O_2(g) \text{ -----> } 5CO_2(g) + 6H_2O(l)$
C. $H_2(g) + I_2(s) \text{ -----> } 2HI(g)$
D. $AgNO_3(aq) + NaI(aq) \text{ -----> } AgI(s) + NaNO_3(aq)$

60. Which of the following represents a precipitation reaction?

A. $NaOH(aq) + HBr(aq) \text{ -----> } H_2O(l) + NaBr(aq)$

B. $H_2SO_3(g) \text{ -----> } H_2O(l) + SO_2(g)$

C. $NH_4Cl(aq) + NaOH(aq) \text{ -----> } H_2O(l) + NaCl(aq) + NH_3(g)$

D. $AgNO_3(aq) + NaBr(aq) \text{ -----> } AgBr(s) + NaNO_3(aq)$

61. A 5.00 g sample of an unknown metal M reacts with excess Nitrogen gas to produce 0.04158 mol of the metal nitride $M_3N_2$. What is the metal?

A. Na
B. Ca
C. Mg
D. Al

62. A metal reacts with Oxygen gas to produce a compound with the molecular formula $MO_2$. What is the molecular formula of the compound that is produced when the Metal reacts with Chlorine gas?

A. MCl
B. $MCl_2$
C. $MCl_3$
D. $MCl_4$

63. Calculate the pressure inside a 450 mL container at a temperature of 298 K if 42.5 g of Nitrogen gas ($N_2$) was added to it.

A. 82.5 atm
B. 165 atm
C. 0.0825 atm
D. 0.165 atm

64. Calculate the density of Oxygen gas at 325 K if the pressure is found to be 825 torr.

A. 2.47 g/L
B. 1.30 g/L
C. 1.69 g/L
D. 0.521 g/L

65. A sample of gas has a density of 1.556 g/L at a pressure and temperature of 724 mm Hg and 298 K respectively. Determine the identity of the unknown gas.

A. Ar
B. Ne
C. $N_2$
D. $CO_2$

66. The total pressure of a sample containing $N_2$, $O_2$, and Ar is 755 torr. The partial pressure of $N_2$ and $O_2$ are 615 torr and 121 torr respectively. Calculate the partial pressure of Ar.

A. 12.3 torr
B. 17.4 torr
C. 19.0 torr
D. 22.0 torr

67. A sample contained a mixture of $N_2$, $O_2$, and Ne. The mole fraction of $N_2$ and $O_2$ are 0.625 and 0.219 respectively. Calculate the partial pressure of Ne if the total pressure in the sample is 785 torr.

A. 76.4 torr
B. 122 torr
C. 189 torr
D. 232 torr

68. Calculate the volume of Sulfur Trioxide produced if 21.0 g of Oxygen gas reacts with excess Sulfur Dioxide gas at STP.

A. 3.48 L
B. 17.5 L
C. 29.4 L
D. 41.2 L

69. Calculate the mass of Hydrogen gas ($H_2$) collected over water if the total pressure inside the 2.00 L container is 765 torr at a temperature of $25^0$C. The vapor pressure of water at this temperature is 23.76 torr.

A. 0.161 g
B. 0.385 g
C. 0.749 g
D. 1.27 g

70. Calculate the root mean square velocity of a sample of Argon gas at 343 K.

A. 14.6 m/s
B. 46.0 m/s
C. 463 m/s
D. 763 m/s

71. The rate of effusion of Neon was measured to be 0.158 mol/s at a certain temperature. Calculate the rate of effusion of Nitrogen gas ($N_2$) at this temperature.

A. 0.0953 mol/s
B. 0.134 mol/s
C. 0.190 mol/s
D. 0.218 mol/s

72. An unknown gas has a rate of effusion that is 2.646 times faster than Nitrogen gas ($N_2$). Determine the identity of this gas.

A. $H_2$
B. He
C. $O_2$
D. $CO_2$

73. It takes 2.15 seconds for a sample of Argon to effuse from one compartment into another at a certain temperature. Determine the time it takes for an equivalent sample of Xenon to do the same job.

A. 1.19 s
B. 2.75 s
C. 3.15 s
D. 3.90 s

74. Which of the following statement(s) is correct?

I. Pressure decreases as the volume increases
II. Pressure decreases as the temperature increases
III. Volume increases as the temperature increases

A. I & II
B. I & III
C. II & III
D. I, II, & III

75. Which of the following gases has the highest root mean square velocity at any given temperature?

A. $H_2$
B. He
C. $N_2$
D. Ne

76. Which of the following is not a postulate of the kinetic molecular theory of gases?

A. The volume of all molecules in a gas is negligible compared to the total volume of the container.

B. Attractive and repulsive forces between gas molecules are negligible.

C. Molecular collisions are perfectly elastic.

D. All of the above statements are true.

77. Which of the following compounds contain ionic and covalent bonds?

A. $MgCl_2$
B. $CS_2$
C. $KNO_3$
D. $C_6H_{12}O_6$

78. A gas absorbs 780 J of heat and expands from 1.20 L to 1.60 L at a pressure of 2.30 atm. Calculate the change in the internal energy of the system.

A. -93.2 J
B. +93.2 J
C. +873 J
D. +687 J

79. It takes 121.6 J of energy to heat a 12.5-g sample of an unknown metal from 21.2$^0$C to 44.2$^0$C. Determine the specific heat capacity of the unknown metal.

A. 0.283 J/g $^0$C
B. 0.423 J/g $^0$C
C. 0.625 J/g $^0$C
D. 0.839 J/g $^0$C

80. 40.0 mL of water at 25.0$^0$C is mixed with 100 mL of water at 82.0$^0$C. The density of water is 1 g/mL. Determine the final temperature of the water.

A. 38.4$^0$C
B. 47.5$^0$C
C. 59.2$^0$C
D. 65.7$^0$C

81. Which of the following correct represents the heat of formation of Ammonia ($NH_3$)?

A. $NH_4^+(aq) + OH^-(aq) \text{ ----> } NH_3(g) + H_2O(l)$
B. $N_2(g) + 3H_2(g) \text{ ----> } 2NH_3(g)$
C. $\frac{1}{2} N_2(g) + 3/2\ H_2(g) \text{ -----> } NH_3(g)$
D. $N(g) + 3H(g) \text{ -----> } NH_3(g)$

82. Use Hess Law to determine the enthalpy of the combustion of Methane using the following information:

$4H_2O(l) + 2CO(g) \text{ ---> } 3O_2(g) + 2CH_4(g) \quad \Delta H = 1215 \text{ kJ}$
$CO_2(g) \text{ ----> } \frac{1}{2} O_2(g) + CO(g) \quad \Delta H = +283.0 \text{ kJ}$
$CH_4(g) + 2O_2(g) \text{ ----> } 2H_2O(l) + CO_2(g) \quad \Delta H = ?$

A. +1,498 kJ/mol
B. +932.0 kJ/mol
C. -890.5 kJ/mol
D. -1,498 kJ/mol

83. Sulfur Dioxide reacts with Oxygen gas to produce Sulfur Trioxide as shown in the following chemical equation:

$2SO_2(g) + O_2(g) \text{ -----> } 2SO_3(g) \quad \Delta H = -196.6 \text{ kJ}$

Calculate the amount of Sulfur Trioxide produced if 742.0 kJ of heat energy was released.

A. 235.1 g
B. 372.5 g
C. 514.2 g
D. 604.3 g

84. 20.0 g of KOH was dissolved in 75.63 mL of water. The temperature increased from $25.0^0$C to $90.0^0$C. The density of water is 1 g/mL and the specific heat capacity of water is 4.184 J/g $^0$C. Calculate the enthalpy of the reaction shown below:

$KOH(s) \text{ ----> } K^+(aq) + OH^-(aq)$

A. -57.7 kJ/mol
B. -32.4 kJ/mol
C. -26.1 kJ/mol
D. -14.9 kJ/mol

85. Calculate the energy of a photon released if an electron in a hydrogen atom falls from the n = 4 state into the n = 2 energy level.

A. $-3.58 \times 10^{-19}$ J
B. $-4.08 \times 10^{-19}$ J
C. $-7.12 \times 10^{-19}$ J
D. $-1.02 \times 10^{-18}$ J

86. A ground state electron inside a hydrogen atom absorbs a photon that has a wavelength of 102.7 nm. Into what final state will the electron jump to?

A. n = 2
B. n = 3
C. n = 4
D. n = 5

87. What is the electron configuration of Copper using noble gas notation?

A. [Ar] $4s^2\ 3d^9$
B. [Ar] $4s^1\ 3d^{10}$
C. [Ar] $4s^2\ 3d^{10}$
D. [Ar] $4s^2\ 3d^8$

88. Which of the following corresponds to the quantum letter l?

A. Principal Quantum Number
B. Angular Momentum Quantum Number
C. Magnetic Quantum Number
D. Electron Spin

89. Which of the following principles states that "no two electrons can have the same set of four quantum numbers?"

A. Hund's Rule
B. Heisenberg's Uncertainty Principle
C. Aufbau's Principle
D. Pauli's Exclusion Principle

90. Which of the following correctly list the elements S, F, and Se in order of increasing electronegativity?

A. S < Se < F
B. Se < S < F
C. S < F < Se
D. F < S < Se

91. Which of the following correctly lists the elements Mg, S, Cs, and Ag in order of increasing atomic radius?

A. S < Mg < Ag < Cs
B. Mg < S < Ag < Cs
C. Mg < S < Cs < Ag
D. S < Mg < Cs < Ag

92. Which of the following correctly lists the ions $O^{2-}$, $Na^{+}$, $Mg^{2+}$, and $F^{-}$ in order of increasing ionic radius?

A. $Na^{+} < F^{-} < Mg^{2+} < O^{2-}$
B. $O^{2-} < F^{-} < Na^{+} < Mg^{2+}$
C. $Mg^{2+} < Na^{+} < F^{-} < O^{2-}$
D. $F^{-} < O^{2-} < Mg^{2+} < Na^{+}$

93. Which of the following elements has the most metallic character?

A. Ba
B. Mg
C. Al
D. Zn

94. Which of the following processes is associated with the energy change that occurs during the addition of an electron to a gaseous atom?

A. Ionization Energy
B. Electron Affinity
C. Electronegativity
D. Lattice Energy

95. Which group of elements has a valence shell electron configuration of $ns^2$?

A. Alkali Metals
B. Alkaline Earth Metals
C. Noble Gases
D. Halogens

96. Which pair is isoelectronic?

A. Ca, $K^+$
B. $Mg^{2+}$, $F^-$
C. Cl, $Rb^+$
D. $K^+$, $O^{2-}$

97. Which of the following elements is most similar to Oxygen in chemical reactivity?

A. N
B. F
C. Se
D. Cl

98. Which of the following elements has the highest fourth ionization energy?

A. Al
B. Si
C. P
D. F

99. Which of the following species is not paramagnetic?

A. Mn
B. Cr
C. Zn
D. $Fe^{2+}$

100. Which energy level transition within a Hydrogen atom occurs at the highest frequency?

A. n = 10 to n = 6
B. n = 9 to n = 7
C. n = 2 to n = 1
D. n = 6 to n = 2

101. Which of the following represents the molecular geometry of the $SF_4^{2-}$ ion?

A. Square Planar
B. Square Pyramidal
C. Octahedral
D. Trigonal Bipyramidal

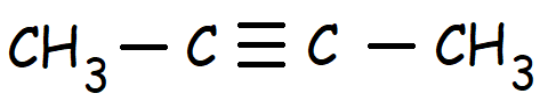
102. Which of the following molecules has the longest bond length?

A. HCl
B. HBr
C. HF
D. HI

103. Which of the following statements is incorrect?

A. Triple bonds are stronger than single bonds.
B. Triple bonds are longer than single bonds.
C. Single bonds are weaker than double bonds.
D. Double bonds are shorter than single bonds.

104. Determine the correct number of sigma and pi bonds in the following structure:



A. 2 θ and 3 π bonds
B. 3 θ and 2 π bonds
C. 9 θ and 2 π bonds
D. 10 θ and 2 π bonds

105. Which of the following compounds has the highest melting point?

A. NaF
B. MgO
C. CaS
D. KF

106. Which of the following molecules has the largest dipole moment?

A. $SF_4$
B. $SF_6$
C. $PCl_5$
D. $XeF_4$

107. Which of the following molecules has a bond order of 3?

A. $F_2$
B. $O_2$
C. $N_2$
D. $H_2$

108. Which of the following types of compounds has the lowest melting and boiling point?

A. Ionic Compounds
B. Network Solids
C. Metals
D. Molecular Compounds

109. Which of the following is not conductive to electricity?

A. NaCl (s)
B. NaCl (aq)
C. NaCl (l)
D. Cu

110. Which of the following elements is a liquid at room temperature at 1atm?

A. $F_2$
B. $Cl_2$
C. $Br_2$
D. $I_2$

111. Which of the following statements is/are correct?

A. Ionic compounds dissolved in water or the liquid state conducts electricity due to the presence of free-flowing ions.

B. Metals conduct electricity due to the presence of a free-flowing sea of valence electrons.

C. Graphite conducts electricity due to the delocalization of free-flowing pi electrons.

D. Diamond is an excellent conductor of heat but not electricity.

E. All of the above statements are true.

112. Which of the following is not an allotrope of Carbon?

A. Graphite
B. Buckminsterfullerene
C. Diamond
D. Moissanite

113. Which of the following compounds will form a clear solution when dissolved in water?

A. KBr
B. $CuSO_4$
C. $KMnO_4$
D. $NiCl_2$

114. Which of the following gases is least soluble in water?

A. $NH_3$
B. $CO_2$
C. $N_2$
D. CO

115. Which of the following compounds has the name Sodium Superoxide?

A. $Na_2O$
B. NaO
C. $NaO_2$
D. None of the above

116. Which of the following halogens is most reactive?

A. $F_2$
B. $Cl_2$
C. $Br_2$
D. $I_2$

117. Which of the following elements is most electropositive?

A. Cs
B. Mg
C. Zn
D. $F_2$
E. $S_8$

118. Which of the following metals is resistant to corrosion by Oxygen?

A. Na
B. Al
C. Fe
D. Zn

119. Which of the following statements is/are correct?

A. Photosynthesis is a process that uses sunlight, carbon dioxide, and water to produce oxygen gas and carbohydrates.

B. Nitrogen ($N_2$) fixation occurs during lightning storms.

C. Transition metals usually possess a variable oxidation number.

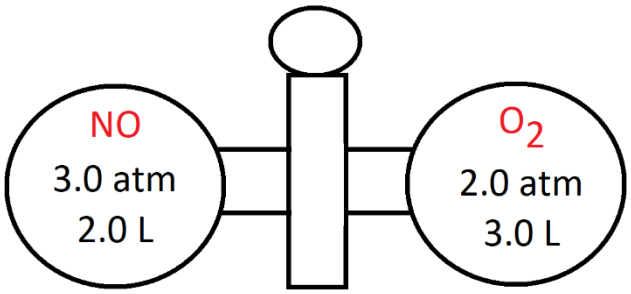
D. Soap reacts with ions in hard water such as $Ca^{2+}$ to form a scummy precipitate.

E. All of the above statements are true.

120. 45.0 mL of a solution of 0.275 M NaOH was mixed with 85.0 mL of a 0.950 M solution of NaOH. What is the concentration / molarity of the final solution?

A. 0.318 M
B. 0.473 M
C. 0.642 M
D. 0.716 M

121. Nitrogen Monoxide reacts with Oxygen gas to produce Dinitrogen Pentoxide when the stopcock valve is released. Calculate the partial pressure of $N_2O_5$ when the reaction is complete at 298 K.




A. 0.250 atm
B. 0.600 atm
C. 1.25 atm
D. 2.75 atm

122. 35.0 grams of Ethane reacts with excess Oxygen gas to produce Carbon Dioxide and Water. If this process is 80% efficient, how many grams of Carbon Dioxide should you expect to collect in this reaction?

A. 37.6 g
B. 71.5 g
C. 82.0 g
D. 114 g

123. Which of the following compounds contain the greatest percentage of Oxygen?

A. $C_5H_{10}O_3$
B. $C_2H_4O_2$
C. $CH_4O$
D. $C_2H_6O$

124. What volume of 0.350 M KI (aq) is needed to titrate 73.0 mL of 0.225 M $KMnO_4$ (aq) according to the net ionic equation shown below?

$$10I^- + 2MnO_4^- + 16H^+ \text{-----> } 2Mn^{2+} + 8H_2O + 5I_2$$

A. 9.39 mL
B. 56.1 mL
C. 174 mL
D. 235 mL

125. Use the bond dissociation energies to estimate the enthalpy of the reaction shown below:

$$C(s) + 2Cl_2(g) \text{ --------> } CCl_4(g)$$

| | |
|---|---|
| Cl-Cl | 242 kJ/mol |
| C-Cl | 328 kJ/mol |

A. -828 kJ/mol
B. +828 kJ/mol
C. -86.0 kJ/mol
D. +86.0 kJ/mol

126. Use the bond dissociation energies to estimate the enthalpy of the reaction shown below:

$2C_2H_2(g) + 5O_2(g) \text{ -----> } 4CO_2(g) + 2H_2O(l)$

| | |
|---|---|
| C = C | 839 kJ/mol |
| C – H | 413 kJ/mol |
| O = O | 495 kJ/mol |
| C = O | 799 kJ/mol |
| O - H | 463 kJ/mol |

A. +1,475 kJ/mol
B. -2,439 kJ/mol
C. +2,439 kJ/mol
D. -1,475 kJ/mol

127. Rank the following molecules in order of increasing boiling point:

$Cl_2$ $Br_2$ $I_2$ $F_2$

A. $F_2 < Cl_2 < Br_2 < I_2$
B. $F_2 < Br_2 < Cl_2 < I_2$
C. $Br_2 < F_2 < I_2 < Cl_2$
D. $I_2 < Br_2 < Cl_2 < F_2$

128. Which of the following molecules has the highest boiling point?

A. HCl
B. HI
C. HBr
D. HF

129. Which of the following molecules has the lowest vapor pressure?

A. $CH_4$
B. $H_2O$
C. $Cl_2$
D. $CF_4$

130. Which of the following statements is incorrect?

A. The vapor pressure of a solution increases with increasing temperature.

B. Substances with high boiling points usually have lower vapor pressures.

C. The boiling point of a solution increases with elevation.

D. Substances with high intermolecular forces usually have lower vapor pressures.

131. Which choice shown below correctly ranks the following molecules in order of increasing boiling point?

$NH_3$ $PH_3$ $AsH_3$

A. $NH_3 < PH_3 < AsH_3$
B. $AsH_3 < PH_3 < NH_3$
C. $PH_3 < AsH_3 < NH_3$
D. $NH_3 < AsH_3 < PH_3$

132. Which choice shown below correctly ranks the following molecules in order of increasing vapor pressure?

$H_2O$ $H_2S$ $H_2Se$

A. $H_2O < H_2S < H_2Se$
B. $H_2S < H_2Se < H_2O$
C. $H_2Se < H_2S < H_2O$
D. $H_2O < H_2Se < H_2S$

133. Which of the following terms represents the tendency of a liquid to form droplets due to the presence of unbalanced forces?

A. Cohesive Forces
B. Adhesive Forces
C. Polarizability
D. Surface Tension

134. The vapor pressure of an unknown solvent is found to be 8.76 torr at 298 K and 42.1 torr at 356 K. Calculate the heat of vaporization of this solvent.

A. 23.9 kJ/mol
B. 41.1 kJ/mol
C. 61.5 kJ/mol
D. 82.3 kJ/mol

135. Which of the following statements is incorrect?

A. The conductivity of metals increases with temperature.

B. The conductivity of metals decreases with temperature.

C. The conductivity of semiconductors increases with temperature.

D. The conductivity of semiconductors increases with increased dopant impurities.

136. 35.1 g of Sodium Sulfate is dissolved in 250 mL of water. Calculate the molality of the solution if the density of water is 1 g/mL.

A. 0.753 m
B. 0.988 m
C. 1.75 m
D. 2.37 m

137. Which of the following statements are correct?

I. Vapor pressure is dependent on surface area.

II. Vapor pressure is defined as the partial pressure of a solution at which the rate of evaporation equals the rate of condensation.

III. The normal boiling point is the temperature at which the vapor pressure of the solution equals the atmospheric pressure.

IV. The boiling point of a solution increases with elevation.

A. I & II
B. II & III
C. I & IV
D. II, III, & IV

138. Calculate the molality of a 0.355 M aqueous solution of KI having a density of 1.1 g/mL.

A. 0.341 m
B. 0.326 m
C. 0.349 m
D. 0.361 m

139. Calculate the molarity of a 0.422 m NaBr solution having a density of 1.07 g/mL.

A. 0.433 M
B. 0.975 M
C. 0.991 M
D. 1.022 M

140. Determine the freezing point of a solution made by dissolving 70.1 g of $CaCl_2$ with 200. g of water. The $K_F$ for water is -1.86 $^0C*kg/mol$.

A. 3.57 $^0C$
B. -5.88 $^0C$
C. -12.1 $^0C$
D. -17.6 $^0C$

141. Which of the following is not a colligative property?

A. Boiling Point
B. Temperature
C. Molality
D. Vapor Pressure

142. 5.12g of Ethanol ($C_2H_5OH$) is dissolved in 40.1 g of Benzene ($C_6H_6$). The freezing point of Benzene is $5.5^0$C. Calculate the freezing point of the solution. The $K_F$ of Benzene is $5.12^0$ C/m.

A. $-8.69\ ^0$C
B. $+14.2\ ^0$C
C. $+19.7\ ^0$C
D. $-15.4\ ^0$C

143. Which of the following combinations are miscible?

A. $H_2O$ and $I_2$
B. $CCl_4$ and $Br_2$
C. $NH_3$ and $CH_4$
D. $SO_2$ and $CO_2$

144. Determine the mass percent of a 0.455 m NaCl solution.

A. 2.59 %
B. 2.66 %
C. 2.89 %
D. 3.01 %

145. Which of the following statements is incorrect?

A. The solubility of a gas in a solution decrease with increasing temperature.

B. The solubility of most ionic compounds increases in an aqueous solution with increasing temperature.

C. The solubility of a gas in a solution decrease with increasing external pressure.

D. Molarity is a colligative property.

146. The solubility of a gas is 0.0246 M at a pressure of 1.5 atm. Calculate the solubility of the gas if the pressure above the solution is increased to 5.5 atm.

A. 0.203 M
B. 0.00671 M
C. 0.105 M
D. 0.0902 M

147. Calculate the osmotic pressure of a 2.25 M $MgCl_2$ solution at $35^0$C.

A. 171 atm
B. 56.9 atm
C. 19.4 atm
D. 6.46 atm

148. Which of the following solutions will have the highest boiling point in water?

A. 0.60 m $C_6H_{12}O_6$
B. 0.25 m $Na_2SO_4$
C. 0.35 m $AlCl_3$
D. 0.25 m $Mg_3(PO_4)_2$

149. Which of the following solutions will have the highest freezing point?

A. 0.30 m KI
B. 0.45 m $MgF_2$
C. 0.35 m $Al_2(SO_4)_3$
D. 0.55 m $Na_2SO_4$

150. 197.4 g of an unknown nonelectrolyte solute was dissolved in 432 g of water. The boiling point of the resulting solution is 101.3$^0$C. Identify the unknown solute. The $K_B$ of water is 0.512 $^0$C/m.

A. $C_6H_6$
B. $C_6H_{12}O_6$
C. $C_{12}H_{12}O_{11}$
D. $C_2H_5OH$

151. Calculate the vapor pressure of the solution if 2 moles of Methanol are mixed with 3 moles of Diethyl Ether. Assume the vapor pressures of Methanol and Diethyl Ether are approximately 100 mm Hg and 470 mm Hg at a certain temperature.

A. 40.0 mm Hg
B. 282 mm Hg
C. 322 mm Hg
D. 242 mm Hg

152. The partial pressures of CO, $H_2$, and $O_2$ are 74.5 mm Hg, 35.2 mm Hg, and 214 mm Hg respectively. Calculate the mole fraction of CO.

A. 0.230
B. 0.109
C. 0.355
D. 0.661

153. Which of the following represents the condition where solid, liquid, and gas phases coexist?

A. Critical Point
B. Triple Point
C. Melting Point
D. Boiling Point

154. Which of the following statements is true concerning the density of water?

A. The density of the liquid is greater than the solid because the melting point line has a positive slope.

B. The density of the liquid is greater than the solid because the melting point line has a negative slope.

C. The density of the solid is greater than the liquid because the melting point line has a negative slope.

D. The density of the solid is greater than the liquid because the melting point line has a positive slope.

155. A 4.78 g rock was dropped into a graduated cylinder containing 24.3 mL of water. The final volume of the mixture was 25.9 mL. Calculate the density of the rock in kg/m$^3$.

A. 2.99 kg/m$^3$
B. 0.00299 kg/m$^3$
C. 299 kg/m$^3$
D. 2990 Kg/m$^3$

156. John, Sally, and Susan performed different experiments to measure the density of Aluminum which has an experimental density of 2.70 g/mL. Which student's data is accurate but not precise?

| Trial | John's Data | Sally's Data | Susan's Data |
|---|---|---|---|
| 1 | 2.731 g/mL | 3.102 g/mL | 2.701 g/mL |
| 2 | 2.645 g/mL | 3.101 g/mL | 2.699 g/mL |
| 3 | 2.698 g/mL | 3.103 g/mL | 2.702 g/mL |

A. John
B. Sally
C. Susan
D. None

157. Which of the following statements is incorrect?

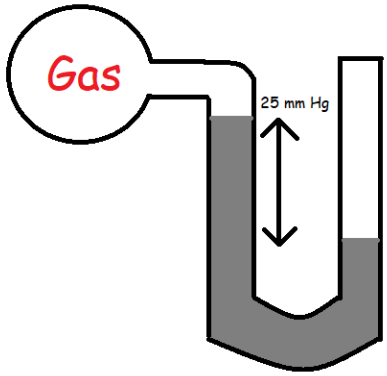
A. An aqueous solution of KOH will turn litmus paper blue.

B. An aqueous solution of HCl containing Phenolphthalein will appear pink.

C. The endpoint of a titration is determined by the color change of an indicator.

D. The equivalence point occurs when equal molar amounts of acid and base are mixed in a solution.

158. What is the pressure of the gas inside the open-ended mercury manometer if the atmospheric pressure is 740 torr? The height difference of the mercury column is 25 mm Hg.




A. 740 torr
B. 765 torr
C. 715 torr
D. 25 torr

159. Which of the elements shown below can have the following first four ionization energies? 578 kJ/mol, 1817 kJ/mol, 2745 kJ/mol, and 11577 kJ/mol.

A. Mg
B. Al
C. K
D. Si

160. An unknown compound was added to an Erlenmeyer flask containing a solution of KCl. A white precipitate formed. Which of the following is the unknown compound?

A. $Ba(OH)_2$
B. $AgNO_3$
C. $Al_2(SO_4)_3$
D. $NH_4Br$

**Answers:**

1. B
2. D
3. A
4. A
5. B
6. C
7. C
8. A
9. D
10. D
11. C
12. B
13. C
14. A
15. D
16. B
17. A
18. A
19. A
20. B
21. C
22. A
23. B
24. D
25. A
26. A
27. C
28. A
29. D
30. B
31. C
32. D
33. D
34. C
35. C
36. D
37. B
38. B
39. C
40. A
41. C
42. B
43. C
44. D
45. D
46. C
47. A
48. D
49. D
50. D
51. C
52. C
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58. B
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62. D
63. A
64. B
65. A
66. C
67. B
68. C
69. A
70. C
71. B
72. B
73. D
74. B
75. A
76. D
77. C
78. D
79. B
80. D
81. C
82. C
83. D
84. A
85. B
86. B
87. B
88. B
89. D
90. B
91. A
92. C
93. A
94. B
95. B
96. B
97. C
98. A
99. C
100. C
101. A
102. D
103. B
104. C
105. B
106. A
107. C
108. D
109. A
110. C
111. E
112. D
113. A
114. C
115. C
116. A
117. A
118. B
119. E
120. D
121. B
122. C
123. B
124. D
125. A
126. B
127. A
128. D
129. B
130. C
131. C
132. D
133. D
134. A
135. A
136. B
137. B
138. A
139. A
140. D
141. B
142. A
143. B
144. A
145. C
146. D
147. A
148. C
149. A
150. B
151. C
152. A
153. B
154. B
155. D
156. A
157. B
158. C
159. B
160. B