1. What is the atomic number of the element whose atoms bond to each other in chains, rings, and networks?  
   A) 10  B) 8  C) 6  D) 4

2. Which statement describes a chemical property of aluminum?  
   A) Aluminum is malleable.  
   B) Aluminum reacts with sulfuric acid.  
   C) Aluminum conducts an electric current.  
   D) Aluminum has a density of 2.698 g/cm³ at STP.

3. Which statement describes a chemical property of the element magnesium?  
   A) Magnesium is malleable.  
   B) Magnesium conducts electricity.  
   C) Magnesium reacts with an acid.  
   D) Magnesium has a high boiling point.

4. Which pair represents two forms of an element in the same phase at STP but with different structures and different properties?  
   A) I₂(s) and I₂(g)  
   B) O₂(g) and O₃(g)  
   C) H₂(g) and Hg(g)  
   D) H₂(s) and H₂O(ℓ)

5. Which substance can be decomposed by chemical means?  
   A) aluminum  
   B) octane  
   C) silicon  
   D) xenon

6. Which substance can be broken down by chemical means?  
   A) CO  
   B) Ce  
   C) Ca  
   D) Cu

7. Which transfer of energy occurs when ice cubes are placed in water that has a temperature of 45°C?  
   A) Chemical energy is transferred from the ice to the water.  
   B) Chemical energy is transferred from the water to the ice.  
   C) Thermal energy is transferred from the ice to the water.  
   D) Thermal energy is transferred from the water to the ice.

8. Which process increases the potential energy of the particles of a sample?  
   A) condensation  
   B) deposition  
   C) solidification  
   D) vaporization

9. Which type of energy is associated with the random motion of atoms and molecules in a sample of air?  
   A) chemical energy  
   B) electrical energy  
   C) nuclear energy  
   D) thermal energy

10. At 101.3 kPa and 298 K, what is the total amount of heat released when one mole of aluminum oxide, Al₂O₃(s), is formed from its elements?  
    A) 393.5 kJ  
    B) 837.8 kJ  
    C) 1676 kJ  
    D) 3351 kJ

11. The energy absorbed when ammonium chloride dissolves in water can be measured in  
    A) degrees  
    B) kiloJoules  
    C) parts per million  
    D) liters per mole

12. At which conditions of temperature and pressure would the molecules of a gas have the greatest average kinetic energy?  
    A) 0°C and 3 atm  
    B) 10°C and 2 atm  
    C) 50°C and 4 atm  
    D) 100°C and 1 atm

13. The molecules of which substance have the highest average kinetic energy?  
    A) He(g) at 0°C  
    B) CO₂(g) at 20°C  
    C) HCl(g) at 40°C  
    D) N₂(g) at 60°C

14. A flask containing molecules of gas A and a separate flask containing molecules of gas B are both at the same temperature. Gases A and B must have equal  
    A) volumes  
    B) masses  
    C) pressures  
    D) average kinetic energies

15. At which temperature does an aqueous solution of LiCl have the highest average kinetic energy?  
    A) 100°C  
    B) 200°C  
    C) 273 K  
    D) 373 K

16. Which Kelvin temperature is equal to –73°C?  
    A) 100 K  
    B) 173 K  
    C) 200 K  
    D) 346 K

17. Which temperature is equal to +20 K?  
    A) –253°C  
    B) –293°C  
    C) 253°C  
    D) 293°C
18. The boiling point of a liquid is the temperature at which the vapor pressure of the liquid is equal to the pressure on the surface of the liquid. What is the boiling point of propanone if the pressure on its surface is 48 kilopascals?

A) 25°C  B) 30.0°C  C) 35°C  D) 40.0°C

19. What is the total amount of heat required to vaporize 1.00 gram of H\textsubscript{2}O(\ell) at 100.0°C and 1 atmosphere?

A) 4.18 J  B) 334 J  C) 373 J  D) 2260 J

20. Which change results in a release of energy?

A) the melting of H\textsubscript{2}O(s)  
B) the boiling of H\textsubscript{2}O(\ell)  
C) the evaporation of H\textsubscript{2}O(\ell)  
D) the condensation of H\textsubscript{2}O(g)

21. Which 1.0-mole sample at 1 atm has particles with the greatest entropy?

A) CH\textsubscript{4}(g) at 25°C  
B) H\textsubscript{2}S(g) at 40°C  
C) CH\textsubscript{4}(g) at 300 K  
D) H\textsubscript{2}S(g) at 310 K

22. At STP, a sample of which element has the highest entropy?

A) Na(s)  
B) Hg(\ell)  
C) Br\textsubscript{2}(\ell)  
D) F\textsubscript{2}(g)

23. As a system becomes less random, its entropy

A) decreases  
B) increases  
C) remains the same

24. An assumption of the kinetic theory of gases is that the particles of a gas have

A) little attraction for each other and a significant volume  
B) little attraction for each other and an insignificant volume  
C) strong attraction for each other and a significant volume  
D) strong attraction for each other and an insignificant volume

25. A sample of a gas is contained in a closed rigid cylinder. According to kinetic molecular theory, what occurs when the gas inside the cylinder is heated?

A) The number of gas molecules increases.  
B) The number of collisions between gas molecules per unit time decreases.  
C) The average velocity of the gas molecules increases.  
D) The volume of the gas decreases.

26. The concept of an ideal gas is used to explain

A) the mass of a gas sample  
B) the behavior of a gas sample  
C) why some gases are monatomic  
D) why some gases are diatomic

27. Which diagram best represents a gas in a closed container?

A)  
B)  
C)  
D) 

28. Under which conditions of temperature and pressure would a real gas behave most like an ideal gas?

A) 200. K and 50.0 kPa  
B) 200. K and 200.0 kPa  
C) 600. K and 50.0 kPa  
D) 600. K and 200.0 kPa

29. Which gas would behave most nearly like an ideal gas at STP?

A) CO\textsubscript{2}  
B) H\textsubscript{2}  
C) Cl\textsubscript{2}  
D) NH\textsubscript{3}
30. A real gas behaves more like an ideal gas when the gas molecules are
A) close and have strong attractive forces between them
B) close and have weak attractive forces between them
C) far apart and have strong attractive forces between them
D) far apart and have weak attractive forces between them

31. The diagrams below represent four 500-milliliter flasks. Each flask contains the gas represented by its symbol. All gas samples are at STP.

Each flask contains the same number of
A) atoms, only
B) molecules, only
C) atoms and molecules

32. The table below shows data for the temperature, pressure, and volume of four gas samples.

<table>
<thead>
<tr>
<th>Gas Sample</th>
<th>Temperature (K)</th>
<th>Pressure (atm)</th>
<th>Volume (mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>100.</td>
<td>2</td>
<td>400.</td>
</tr>
<tr>
<td>B</td>
<td>200.</td>
<td>2</td>
<td>200.</td>
</tr>
<tr>
<td>C</td>
<td>100.</td>
<td>2</td>
<td>400.</td>
</tr>
<tr>
<td>D</td>
<td>200.</td>
<td>4</td>
<td>200.</td>
</tr>
</tbody>
</table>

Which two gas samples have the same total number of molecules?
A) A and B
B) A and C
C) B and C
D) B and D

33. At constant temperature, the relationship between the volume \( V \) of a given mass of gas and its pressure \( P \) is
A) \( V = kP \)
B) \( P = kV \)
C) \( PV = k \)
D) \( \frac{V}{P} = k \)

34. A cylinder with a tightly fitted piston is shown in the diagram below.

As the piston moves downward, the number of molecules of air in the cylinder
A) decreases
B) increases
C) remains the same

35. A 3.00-liter sample of gas is at 288 K and 1.00 atm. If the pressure of the gas is increased to 2.00 atm and its volume is decreased to 1.50 liters, the Kelvin temperature of the sample will be
A) 144 K
B) 288 K
C) 432 K
D) 576 K

36. As the pressure of a gas at 150 kPa is changed to 100 kPa at constant temperature, the volume of the gas
A) decreases
B) increases
C) remains the same

37. The partial pressures of gases \( A \), \( B \), and \( C \) in a mixture are 0.750 atmosphere, 0.250 atmosphere, and 1.25 atmospheres, respectively. What is the total pressure of the gas mixture in kPa?
A) 2.25 kPa
B) 202 kPa
C) 228 kPa
D) 301 kPa

38. The stoppered tubes below, labeled \( A \) through \( D \), each contain a different gas.

When the tubes are unstoppered at the same time and under the same conditions of temperature and pressure, from which tube will gas diffuse at the fastest rate?
A) \( A \)
B) \( B \)
C) \( C \)
D) \( D \)
39. Given the cooling curve of a substance:

During which intervals is potential energy decreasing and average kinetic energy remaining constant?

A) AB and BC  B) AB and CD  
C) DE and BC  D) DE and EF

40. The graph below represents the relationship between temperature and time as heat is added uniformly to a substance, starting when the substance is a solid below its melting point.

Which portions of the graph represent times when heat is absorbed and potential energy increases while kinetic energy remains constant?

A) A and B  B) B and D  
C) A and C  D) C and D

41. A student obtained the following data while cooling a substance. The substance was originally in the liquid phase at a temperature below its boiling point.

<table>
<thead>
<tr>
<th>Time (minutes)</th>
<th>0.5</th>
<th>1.0</th>
<th>1.5</th>
<th>2.0</th>
<th>2.5</th>
<th>3.0</th>
<th>3.5</th>
<th>4.0</th>
<th>4.5</th>
<th>5.0</th>
<th>5.5</th>
<th>6.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°C)</td>
<td>70.</td>
<td>63.</td>
<td>57.</td>
<td>54.</td>
<td>53.</td>
<td>53.</td>
<td>53.</td>
<td>53.</td>
<td>52.</td>
<td>51.</td>
<td>48.</td>
<td></td>
</tr>
</tbody>
</table>

What is the freezing point of the substance?

A) 70°C  B) 59°C  C) 53°C  D) 48°C
42. The graph below represents the uniform cooling of a substance, starting as a gas at 160°C. At which temperature does a phase change occur for this substance?

A) 0°C  B) 40°C  C) 80°C  D) 140°C

![Graph showing uniform cooling](image)

43. The graph below represents changes of state for an unknown substance.

What is the boiling temperature of the substance?

A) 0°C  B) 20°C  C) 70°C  D) 40°C

![Graph showing changes of state](image)

44. When a 500.-gram sample of water at 19°C absorbs 2000. calories of heat, the temperature of the water will change to

A) 23°C  B) 19°C  C) 15°C  D) 4.0°C

45. Which quantity is equivalent to 50 kilocalories?

A) 5000 cal  B) 0.05 cal  C) $5 \times 10^3$ cal  D) $5 \times 10^4$ cal

46. How many Joules of heat energy are absorbed in raising the temperature of 10. grams of water from 5.0°C to 20.°C?

A) $1.1 \times 10^3$  B) $8.4 \times 10^2$
C) $6.3 \times 10^2$  D) $2.1 \times 10^2$

47. The temperature of a sample of water changes from 10.°C to 20.°C when the water absorbs 420 Joules of heat. What is the mass of the sample?

A) 1.0 g  B) 10. g  C) 100 g  D) 1000 g

48. The heat of fusion of a compound is 126 Joules per gram. What is the total number of Joules of heat that must be absorbed by a 15.0-gram sample to change the compound from solid to liquid at its melting point?

A) 111 J  B) 141 J  C) 110 J  D) 1,890 J

49. What is the total number of kiloJoules of heat needed to change 150. grams of ice to water at 0°C?

A) 50.1  B) 2.22  C) 184  D) 484

50. The heat of fusion is defined as the energy required at constant temperature to change 1 unit mass of a

A) gas to a liquid  B) gas to a solid  C) solid to a gas  D) solid to a liquid

51. The diagram above represents the uniform heating of a substance that is a solid at $t_0$. What is the freezing point of the substance?

A) 1°C  B) 12°C  C) 60°C  D) 100°C

52. What is the total number of joules released when a 5.00-gram sample of water changes from liquid to solid at 0°C?

A) 334 J  B) 1670 J  C) 2260 J  D) 11300 J
53. A liquid has a vapor pressure of 90 kPa at 75°C and a vapor pressure of 120 kPa at 90°C. At standard atmospheric pressure, the liquid will boil

A) at 75°C  
B) above 75°C but below 90°C  
C) at 90°C  
D) above 90°C but below 100°C

54. How much energy is required to vaporize 10.00 grams of water at its boiling point?

A) 2.26 kJ  
B) 3.34 kJ  
C) 4.2 kJ  
D) 22.6 kJ

55. What is the boiling point of water when the atmospheric pressure exerted on the water is 81 kPa?

A) 50°C  
B) 90°C  
C) 100°C  
D) 110°C

56. At 1 atmosphere of pressure, 25.0 grams of a compound at its normal boiling point is converted to a gas by the addition of 34,400 Joules. What is the heat of vaporization for this compound, in Joules per gram?

A) 25.0 J/g  
B) 1376 J/g  
C) 2,260 J/g  
D) 34,400 J/g

57. The heat required for water to become steam at its normal boiling point is

A) 1 J  
B) 4.2 J  
C) 333.6 J  
D) 2,259 J

58. The phase change represented by the equation

\[ \text{I}_2(\text{s}) \rightarrow \text{I}_2(\text{g}) \]

is called

A) sublimation  
B) condensation  
C) melting  
D) boiling

59. Which substance will sublime at room temperature (20°C)?

A) C_{12}H_{22}O_{11}(s)  
B) C_6H_{12}O_6(s)  
C) SiO_2(s)  
D) CO_2(s)

60. Which equation represents sublimation?

A) \text{H}_2\text{O}(\ell) \rightarrow \text{H}_2\text{O}(\text{g})  
B) \text{H}_2\text{O}(\text{s}) \rightarrow \text{H}_2\text{O}(\ell)  
C) \text{H}_2\text{O}(\ell) \rightarrow \text{H}_2\text{O}(\text{g})  
D) \text{H}_2\text{O}(\text{g}) \rightarrow \text{H}_2\text{O}(\ell)

61. Which compound is the most polar?

A) \text{H}_2\text{O}  
B) \text{H}_2\text{S}  
C) \text{H}_2\text{Te}  
D) \text{H}_2\text{Se}

62. The graph below shows the boiling points for the compounds whose molecular formulas are given.

[Graph showing molecular masses and boiling points for different compounds]

Which factor is responsible for the unusually high boiling point of water?

A) polar covalent bonds  
B) nonpolar covalent bonds  
C) ionic attractions  
D) hydrogen bonds

63. At 50.°C and standard pressure, intermolecular forces of attraction are strongest in a sample of

A) ethanoic acid  
B) ethanol  
C) propanone  
D) water

64. When the temperature of a sample of water is changed from 45ºC to 70.ºC, the change in its vapor pressure is

A) 1.0 kPa  
B) 20. kPa  
C) 25 kPa  
D) 101.3 kPa

65. Liquid \( A \) is confined in a container as shown in the diagram above. The equilibrium vapor pressure of liquid \( A \) depends on the

A) amount of vapor in the container  
B) amount of liquid in the container  
C) temperature of liquid \( A \)  
D) size of the confining container

66. When the vapor pressure of a liquid is equal to the atmospheric pressure, the liquid will

A) freeze  
B) boil  
C) melt  
D) condense
67. Which statement explains why Br₂ is a liquid at STP and I₂ is a solid at STP?
A) Molecules of Br₂ are polar, and molecules of I₂ are nonpolar.
B) Molecules of I₂ are polar, and molecules of Br₂ are nonpolar.
C) Molecules of Br₂ have stronger intermolecular forces than molecules of I₂.
D) Molecules of I₂ have stronger intermolecular forces than molecules of Br₂.

68. The phase of a sample of a molecular substance at STP is not determined by its
A) arrangement of molecules
B) intermolecular forces
C) number of molecules
D) molecular structure

69. What happens when NaCl(s) is dissolved in water?
A) Cl⁻ ions are attracted to the oxygen atoms of water molecules.
B) Na⁺ ions are attracted to the oxygen atoms of water molecules.
C) Cl⁻ ions are repelled by the hydrogen atoms of water molecules.
D) Na⁺ ions are repelled by the oxygen atoms of water molecules.

70. The kind of attractions that result in the dissolving of sodium chloride in water are
A) ion-ion
B) molecule-ion
C) atom-atom
D) molecule-atom

71. The diagrams below represent an ionic crystal being dissolved in water.

According to the diagrams, the dissolving process takes place by
A) hydrogen bond formation
B) network bond formation
C) van der Waals attractions
D) molecule-ion attractions

72. Solid Potassium Chloride will most likely dissolve in
A) CCl₄(ℓ), which is a nonpolar solvent
B) CCl₄(ℓ), which is a polar solvent
C) H₂O(ℓ), which is a nonpolar solvent
D) H₂O(ℓ), which is a polar solvent

73. As the elements in Group 17 (VIIA) are considered in order from top to bottom, the strength of the van der Waals forces between the atoms of each successive element is
A) less
B) greater
C) the same

74. Which type of attraction results from the formation of weak momentary dipoles?
A) ionic
B) metallic
C) molecule-ion
D) van der Waals forces

75. Which sequence of Group 18 elements demonstrates a gradual decrease in the strength of the van der Waals forces?
A) H₂O(s)
B) H₂O(ℓ)
C) CO₂(g)
D) CO₂(aq)

76. Which sample of matter is classified as a solution?
A) A mixture can consist of a single element.
B) A mixture can be separated by physical means.
C) A mixture must have a definite composition by weight.
D) A mixture must be homogeneous.

77. Which statement is an identifying characteristic of a mixture?
A) A mixture can consist of a single element.
B) A mixture can be separated by physical means.
C) A mixture must have a definite composition by weight.
D) A mixture must be homogeneous.

78. A sample is prepared by completely dissolving 10.0 grams of NaCl in 1.0 liter of H₂O. Which classification best describes this sample?
A) homogeneous compound
B) homogeneous mixture
C) heterogeneous compound
D) heterogeneous mixture
79. A 1-gram sample of a compound is added to 100 grams of \( \text{H}_2\text{O}(\ell) \) and the resulting mixture is then thoroughly stirred. Some of the compound is then separated from the mixture by filtration. Based on Table \( F \), the compound could be

A) \( \text{AgCl} \)  B) \( \text{CaCl}_2 \)  
C) \( \text{NaCl} \)  D) \( \text{NiCl}_2 \)

80. A bottle of rubbing alcohol contains both 2-propanol and water. These liquids can be separated by the process of distillation because the 2-propanol and water

A) have combined chemically and retain their different boiling points  
B) have combined chemically and have the same boiling point  
C) have combined physically and retain their different boiling points  
D) have combined physically and have the same boiling point

81. Which barium salt is insoluble in water?

A) \( \text{BaCO}_3 \)  B) \( \text{BaCl}_2 \)  
C) \( \text{Ba(ClO}_4)_2 \)  D) \( \text{Ba(NO}_3)_2 \)

82. According to Reference Table \( F \), which substance is most soluble?

A) \( \text{AgI} \)  B) \( \text{CaSO}_4 \)  
C) \( \text{PbCl}_2 \)  D) \( \text{(NH}_4)_2\text{CO}_3 \)

83. According to Reference Table \( G \), a temperature change from 10°C to 30°C would have the least effect on the solubility of

A) \( \text{NaCl} \)  B) \( \text{KClO}_3 \)  
C) \( \text{NH}_3 \)  D) \( \text{SO}_2 \)

84. According to Table \( F \), which of these salts is least soluble in water?

A) \( \text{LiCl} \)  B) \( \text{RbCl} \)  
C) \( \text{FeCl}_2 \)  D) \( \text{PbCl}_2 \)

85. According to Reference Table \( G \), which of these substances is most soluble at 60°C?

A) \( \text{NaCl} \)  B) \( \text{KCl} \)  
C) \( \text{KClO}_3 \)  D) \( \text{NH}_4\text{Cl} \)

86. Which compound is least soluble in 100 grams of water at 40°C?

A) \( \text{SO}_2 \)  B) \( \text{NaCl} \)  
C) \( \text{KClO}_3 \)  D) \( \text{NH}_4\text{Cl} \)

87. Which compound decreases in solubility as the temperature of the solution is increased from 10°C to 50°C?

A) \( \text{NH}_4\text{Cl} \)  B) \( \text{NaCl} \)  
C) \( \text{NH}_3 \)  D) \( \text{NaNO}_3 \)

88. Base your answer to the following question on the diagram below which represents the solubility curve of salt \( X \). The four points on the diagram represent four solutions of salt \( X \).

Which point represents the most concentrated solution of salt \( X \)?

A) \( A \)  B) \( B \)  C) \( C \)  D) \( D \)

89. According to Reference Table \( G \), how does a decrease in temperature from 40°C to 20°C affect the solubility of \( \text{NH}_3 \) and \( \text{KCl} \)?

A) The solubility of \( \text{NH}_3 \) decreases, and the solubility of \( \text{KCl} \) decreases.  
B) The solubility of \( \text{NH}_3 \) decreases, and the solubility of \( \text{KCl} \) increases.  
C) The solubility of \( \text{NH}_3 \) increases, and the solubility of \( \text{KCl} \) decreases.  
D) The solubility of \( \text{NH}_3 \) increases, and the solubility of \( \text{KCl} \) increases.

90. At which temperature can water contain the most dissolved oxygen at a pressure of 1 atmosphere?

A) \( 10.\degree \text{C} \)  B) \( 20.\degree \text{C} \)  C) \( 30.\degree \text{C} \)  D) \( 40.\degree \text{C} \)

91. As the pressure on a gas confined above a liquid increases, the solubility of the gas in the liquid

A) decreases  B) increases  C) remains the same
92. The solubility of KCl(s) in water depends on the
   A) pressure on the solution
   B) rate of stirring
   C) size of the KCl sample
   D) temperature of the water

93. According to Reference Table G, how many grams of NH₄Cl must be dissolved in 100 grams of H₂O at 70°C to reach solution equilibrium?
   A) 52 g   B) 56 g   C) 62 g   D) 86 g

94. According to Reference Table G, which is the best description of the system prepared by dissolving 30 grams of NH₃(g) in 100 grams of water at 20°C?
   A) a saturated solution of NH₃ with no excess NH₃(g)
   B) a saturated solution of NH₃ in contact with excess NH₃(g)
   C) an unsaturated solution of NH₃ with no excess NH₃(g)
   D) an unsaturated solution of NH₃ in contact with excess NH₃(g)

95. A solution containing 60. grams of NaNO₃ completely dissolved in 50. grams of water at 50°C is classified as being
   A) saturated
   B) supersaturated
   C) dilute and unsaturated
   D) dilute and saturated

96. A solution contains 35 grams of KNO₃ dissolved in 100 grams of water at 40°C. How much more KNO₃ would have to be added to make it a saturated solution?
   A) 29 g   B) 24 g   C) 12 g   D) 4g

97. A solute is added to water and a portion of the solute remains undissolved. When equilibrium between the dissolved and undissolved solute is reached, the solution must be
   A) dilute    B) saturated
   C) unsaturated   D) supersaturated

98. A student prepares four aqueous solutions, each with a different solute. The mass of each dissolved solute is shown in the table below.

<table>
<thead>
<tr>
<th>Solution Number</th>
<th>Solute</th>
<th>Mass of Dissolved Solute (per 100. g of H₂O at 20°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>KI</td>
<td>120. g</td>
</tr>
<tr>
<td>2</td>
<td>NaNO₃</td>
<td>88 g</td>
</tr>
<tr>
<td>3</td>
<td>KCl</td>
<td>25 g</td>
</tr>
<tr>
<td>4</td>
<td>KClO₃</td>
<td>5 g</td>
</tr>
</tbody>
</table>

Which solution is saturated?
   A) 1   B) 2   C) 3   D) 4

99. Which unit can be used to express solution concentration?
   A) J/mol   B) L/mol
   C) mol/L   D) mol/s

100. What is the molarity of a solution that contains 20. grams of CaBr₂ in 0.50 liter of solution?
    A) 0.50 M   B) 0.20 M
    C) 5.0 M    D) 10. M

101. What is the molarity of a solution of KNO₃ (molecular mass = 101) that contains 404 grams of KNO₃ in 2.00 liters of solution?
     A) 1.00   B) 2.00   C) 0.500   D) 4.00

102. The data collected from a laboratory titration are used to calculate the
     A) rate of a chemical reaction
     B) heat of a chemical reaction
     C) concentration of a solution
     D) boiling point of a solution

103. What is the concentration of a solution which contains 1 mole of CaCl₂ dissolved in 2,000 milliliters of solution?
     A) 1 M   B) 2 M
     C) 0.5 M   D) 0.25 M

104. What is the total number of grams of KCl (formula mass = 74.6) in 1.00 liter of 0.200 molar solution?
     A) 7.46 g   B) 14.9 g
     C) 22.4 g   D) 29.8 g
105. Molarity is defined as the
A) moles of solute per kilogram of solvent
B) moles of solute per liter of solution
C) mass of a solution
D) volume of a solvent

106. What is the molarity of 1.5 liters of an aqueous solution that contains 52 grams of lithium fluoride, LiF, (gram-formula mass = 26 grams/mole)?
A) 1.3 M  B) 2.0 M  C) 3.0 M  D) 0.75 M

107. What is the total number of grams of NaI(s) needed to make 1.0 liter of a 0.010 M solution?
A) 0.015  B) 0.15  C) 1.5  D) 15

108. A student wants to prepare a 1.0-liter solution of a specific molarity. The student determines that the mass of the solute needs to be 30. grams. What is the proper procedure to follow?
A) Add 30. g of solute to 1.0 L of solvent.
B) Add 30. g of solute to 970. mL of solvent to make 1.0 L of solution.
C) Add 1000. g of solvent to 30. g of solute.
D) Add enough solvent to 30. g of solute to make 1.0 L of solution.

109. How many grams of NaCl are needed to be dissolved in water to make 1.0 gram of a 100.0 ppm solution?
A) $1.0 \times 10^{-4}$ g  B) $1.0 \times 10^{-3}$ g  C) $1.0 \times 10^{-2}$ g  D) $1.0 \times 10^{-1}$ g

110. How many grams of KOH should be dissolved in water to make 2000.0 grams of a 10.0 ppm solution?
A) 2.00 g  B) $2.0 \times 10^{-1}$ g  C) $2.0 \times 10^{-2}$ g  D) $2.0 \times 10^{-3}$ g

111. Which $K_{sp}$ value indicates a salt with the greatest solubility in water?
A) $1.0 \times 10^{-4}$  B) $2.0 \times 10^{-6}$  C) $3.0 \times 10^{-8}$  D) $4.0 \times 10^{-10}$

112. Which sulfide forms the most concentrated saturated solution at 25°C?
A) CdS ($K_{sp} = 3.6 \times 10^{-29}$)
B) CoS ($K_{sp} = 3.0 \times 10^{-23}$)
C) FeS ($K_{sp} = 1.3 \times 10^{-17}$)
D) HgS ($K_{sp} = 2.4 \times 10^{-52}$)

113. Given the $K_{sp}$ expression: $K_{sp} = [A^{3+}]^2 [B^{2-}]^3$ Which reaction is represented by the expression?
A) $A_2B_3(s) \leftrightarrow 3 A^{3+}(aq) + 2 B^{2-}(aq)$
B) $A_2B_3(s) \leftrightarrow 2 A^{3+}(aq) + 3 B^{2-}(aq)$
C) $A_3B_2(s) \leftrightarrow 3 A^{3+}(aq) + 2 B^{2-}(aq)$
D) $A_3B_2(s) \leftrightarrow 2 A^{3+}(aq) + 3 B^{2-}(aq)$

114. Which concentration of a solution of CH₃OH in water has the lowest freezing point?
A) 0.1 M  B) 0.01 M  C) 0.001 M  D) 0.0001 M

115. Which solution will freeze at the lowest temperature?
A) 1 mole of sugar in 500 g of water  B) 1 mole of sugar in 1,000 g of water  
C) 2 moles of sugar in 500 g of water  D) 2 moles of sugar in 1,000 g of water

116. Which solution has the lowest freezing point?
A) 10. g of KI dissolved in 100. g of water  B) 20. g of KI dissolved in 200. g of water  
C) 30. g of KI dissolved in 100. g of water  D) 40. g of KI dissolved in 200. g of water

117. How do the boiling point and freezing point of a solution of water and calcium chloride at standard pressure compare to the boiling point and freezing point of water at standard pressure?
A) The freezing point decreases and the boiling point decreases.
B) The freezing point decreases and the boiling point increases.
C) The freezing point increases and the boiling point decreases.
D) The freezing point increases and the boiling point increases.

118. As a solute is added to a solvent, what happens to the freezing point and the boiling point of the solution?
A) The freezing point decreases and the boiling point decreases.
B) The freezing point decreases and the boiling point increases.
C) The freezing point increases and the boiling point decreases.
D) The freezing point increases and the boiling point increases.
119. A 1 molal solution of MgCl₂ has a higher boiling point than a 1 molal solution of
   A) FeCl₃   B) CaCl₂   C) BaCl₂   D) NaCl

120. The freezing point of a 1.00-molal solution of C₂H₄(OH)₂ is closest to
   A) +1.86°C   B) −1.86°C   C) −3.72°C   D) +3.72°C

121. A 0.100-molal aqueous solution of which compound has the lowest freezing point?
   A) C₆H₁₂O₆   B) CH₃OH   C) C₁₂H₂₂O₁₁   D) NaOH

122. A 2.0-molal sugar solution has approximately the same freezing point as a 1.0-molal solution of
   A) CaCl₂   B) CH₃COOH   C) C₂H₅OH   D) NaCl
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