1. The percent by mass of oxygen in Na₂SO₄ (formula mass = 142) is closest to
   1) 11% 3) 45%
   2) 22% 4) 64%

2. Given the unbalanced equation:
   \[ \text{\underline{____}Al(s) + \underline{__}O_2(g) \rightarrow \underline{____}Al_2O_3(s)} \]
   balance the equation using smallest whole number coefficients.

3. The percent by mass of aluminum in Al₂O₃ is approximately
   1) 18.9 3) 47.1
   2) 35.4 4) 52.9

4. What is the approximate percent composition by mass of CaBr₂ (formula mass = 200)?
   1) 20% calcium and 80% bromine
   2) 25% calcium and 75% bromine
   3) 30% calcium and 70% bromine
   4) 35% calcium and 65% bromine

5. What is the empirical formula for C₃H₆?
   1) CH
   2) CH₂
   3) CH₃
   4) CH₆

6. Which represents both an empirical and a molecular formula?
   1) P₂O₅
   2) N₂O₄
   3) C₃H₆
   4) C₆H₁₂O₆

7. The number of atoms in 2 grams of calcium is equal to
   1) \( \frac{2 \times 6.02 \times 10^{23}}{40} \)
   2) \( \frac{40 \times 6.02 \times 10^{23}}{2} \)
   3) \( \frac{6.02 \times 10^{23}}{2 \times 40} \)
   4) \( 2 \times 40 \times 6.02 \times 10^{23} \)

8. At STP, 32 grams of O₂ would occupy the same volume as
   1) 64 g of H₂
   2) 32 g of SO₂
   3) 8.0 g of CH₄
   4) 4.0 g of He

9. Which compound has the empirical formula CH₂O?
   1) CH₃OH
   2) CH₃CH₂OH
   3) HCOOH
   4) CH₃COOH

10. Which list consists of types of chemical formulas?
    1) atoms, ions, molecules
    2) metals, nonmetals, metalloids
    3) empirical, molecular, structural
    4) synthesis, decomposition, neutralization

11. What is the total number of neon atoms contained in 20.2 grams of neon gas?
    1) \( 1.01 \times 10^{24} \)
    2) \( 2.02 \times 10^{24} \)
    3) \( 3.01 \times 10^{23} \)
    4) \( 6.02 \times 10^{23} \)

12. Given the balanced equation:
    \[ X + Cl_2 \rightarrow C_2H_5Cl + HCl \]
    Which molecule is represented by \( X \)?
    1) C₂H₄
    2) C₂H₆
    3) C₃H₆
    4) C₅H₈

13. Which equation is correctly balanced?
    1) \( H_2 + O_2 \rightarrow H_2O \)
    2) \( Ca + Cl_2 \rightarrow CaCl \)
    3) \( 2 H_2 + O_2 \rightarrow 2 H_2O \)
    4) \( Ca + Cl_2 \rightarrow Ca_2Cl \)

14. Given the unbalanced equation:
    \[ \underline{____}Al_2(SO_4)_3 + \underline{__}Ca(OH)_2 \rightarrow \underline{____}Al(OH)_3 + \underline{____}CaSO_4 \]
    Balance the equation using smallest whole number coefficients.
15. At STP, 25.0 liters of a gas has a mass of 50.0 grams. What is the gram molecular mass of the gas?
   1) 75.0 g  3) 25.0 g  
   2) 44.8 g  4) 11.2 g

16. In which compound is the percent by mass of oxygen greatest?
   1) BeO  3) CaO  
   2) MgO  4) SrO

17. What is the total mass of oxygen in 1.00 mole of Al₂(CrO₄)₃?
   1) 192 g  3) 64.0 g  
   2) 112 g  4) 48.0 g

18. The percentage by mass of Br in the compound AlBr₃ is closest to
   1) 10%  3) 75%  
   2) 25%  4) 90%

19. Given the unbalanced equation:
   \[ \text{C}_3\text{H}_8(g) + \_\text{O}_2(g) \rightarrow \text{H}_2\text{O}(g) + \text{CO}_2 \]
   Balance the equation using smallest whole number coefficients.

20. In a laboratory experiment, a student determined the mass of the product, NaNO₃(s), to be 0.105 grams.
   a. Calculate the gram formula mass of NaNO₃(s). Round atomic masses from the Periodic Table to the nearest tenth. [Show all work. Indicate the correct answer in proper significant figures and include an appropriate unit.]
   b. Calculate the number of moles of NaNO₃(s) produced. [Show all work. Indicate the correct answer in proper significant figures.]

21. Which sample contains the same number of atoms as 24 grams of carbon?
   1) 80 g Ar  3) 10 g Ne  
   2) 24 g Mg  4) 4.0 g He

22. Given the reaction:
   \[ 2 \text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2 \text{H}_2\text{O} \]
   What is the total number of moles of NaOH needed to react completely with 2 moles of H₂SO₄?
   1) 1  3) 0.5  
   2) 2  4) 4

23. What is the total number of atoms represented in the formula CuSO₄ • 5H₂O?
   1) 8  3) 21  
   2) 13  4) 27

24. How many molecules are in 0.25 mole of O₂?
   1) \(12 \times 10^{23}\)  3) \(3.0 \times 10^{23}\)  
   2) \(6.0 \times 10^{23}\)  4) \(1.5 \times 10^{23}\)

25. Which substance can be decomposed by a chemical change?
   1) Co  3) Cr  
   2) CO  4) Cu

26. What is the total number of molecules of hydrogen in 0.25 mole of hydrogen?
   1) \(6.0 \times 10^{23}\)  3) \(3.0 \times 10^{23}\)  
   2) \(4.5 \times 10^{23}\)  4) \(1.5 \times 10^{23}\)
27. What is the total number of moles of oxygen atoms in 1 mole of ozone? (Molecular mass = 48)
   1) 1  3) 3
   2) 2  4) 4

28. The percent by mass of calcium in the compound calcium sulfate (CaSO₄) is approximately
   1) 15%  3) 34%
   2) 29%  4) 47%

29. Which is an empirical formula?
   1) P₂O₅
   2) P₄O₆
   3) C₂H₄
   4) C₃H₆

---

30. Which particle diagram represents a mixture of element X and element Z, only?

   Key
   ● = atom of X
   ○ = atom of Z

1)

2)

3)

4)
31. \[ \text{Cu}(s) + 2 \text{HCl}(aq) \leftrightarrow \text{CuCl}_2(aq) + \text{H}_2(g) \]

What type of reaction is shown above?
1) synthesis 3) single replacement
2) decomposition 4) double replacement

32. Given the compound \( \text{C}_4\text{H}_{10}\text{O}_8 \).
   
   a Calculate the molar mass of the compound.
   
   b Calculate the number of moles in 17.7 grams of the compound.
   
   c What is the empirical formula for this compound?

33. What is the gram formula mass of \( \text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O} \)?
   1) 106 g 3) 266 g
   2) 142 g 4) 286 g

34. Given the reaction:
   
   \[ 2 \text{Al} + 3 \text{H}_2\text{SO}_4 \rightarrow 3 \text{H}_2 + \text{Al}_2(\text{SO}_4)_3 \]
   
   The total number of moles of \( \text{H}_2\text{SO}_4 \) needed to react completely with 5.0 moles of \( \text{Al} \) is
   1) 2.5 moles 3) 7.5 moles
   2) 5.0 moles 4) 9.0 moles

35. Given the reaction:
   
   \[ \text{C}_6\text{H}_{12}\text{O}_6(s) + 6 \text{O}_2(g) \rightarrow 6 \text{CO}_2(g) + 6 \text{H}_2\text{O}(l) \]
   
   How many moles of \( \text{C}_6\text{H}_{12}\text{O}_6(s) \) are needed to produce 24 moles of carbon dioxide?
   1) 1.0 moles 3) 24 moles
   2) 12 moles 4) 4.0 moles

36. Which substance has the greatest molecular mass?
   1) \( \text{H}_2\text{O}_2 \)
   2) \( \text{NO} \)
   3) \( \text{CF}_4 \)
   4) \( \text{I}_2 \)

37. Given the equation:
   
   \[ 2 \text{H}_2(g) + \text{O}_2(g) \rightarrow 2 \text{H}_2\text{O}(g) \]
   
   If 8.0 moles of \( \text{O}_2 \) are completely consumed, what is the total number of moles of \( \text{H}_2\text{O} \) produced?

38. According to the reaction
   
   \[ \text{H}_2 + \text{Cl}_2 \rightarrow 2 \text{HCl}, \]
   
   the production of 2.0 moles of \( \text{HCl} \) would require 70. grams of \( \text{Cl}_2 \) and
   1) 1.0 g of \( \text{H}_2 \)
   2) 2.0 g of \( \text{H}_2 \)
   3) 3.0 g of \( \text{H}_2 \)
   4) 4.0 g of \( \text{H}_2 \)

39. A compound contains 57% sulfur and 43% oxygen by mass. What is the empirical formula of this compound?
   1) \( \text{SO} \)
   2) \( \text{SO}_2 \)
   3) \( \text{SO}_3 \)
   4) \( \text{S}_2\text{O}_3 \)

40. Which quantity of helium may be represented by the symbol \( \text{He} \)?
   1) 1 gram 3) \( 6 \times 10^{23} \) atoms
   2) 2 moles 4) 4 liters

41. Based on your reference tables, which compound could form a concentrated solution?
   1) \( \text{AgBr} \)
   2) \( \text{AgCl} \)
   3) \( \text{Ag}_2\text{CO}_3 \)
   4) \( \text{AgNO}_3 \)
42. When a battery is in use, stored chemical energy is first changed to
   1) electrical energy  3) light energy
   2) heat energy       4) mechanical energy

43. According to Reference Table F, which compound is most soluble in water?
   1) BaCO₃
   2) BaSO₄
   3) ZnCO₃
   4) ZnSO₄

44. When 200 grams of water cools from 50°C to 25°C, the total amount of heat energy released by the water is
   1) 10,000 calories
   2) 5,000 calories
   3) 8 calories
   4) 4 calories

45. A sample of pure water at 50.°C has a vapor pressure closest to
   1) 5.0 kPa
   2) 12 kPa
   3) 50 kPa
   4) 101.3 kPa

46. A sample of water is heated from 10ºC to 15ºC by the addition of 30. calories of heat. What is the mass of the water?
   1) 5.0 g
   2) 6.0 g
   3) 30. g
   4) 150 g

47. Which type of attraction results from the formation of weak momentary dipoles?
   1) ionic
   2) metallic
   3) molecule-ion
   4) van der Waals forces

48. A gas occupies a volume of 40.0 milliliters at 20°C. If the volume is increased to 80.0 milliliters at constant pressure, the resulting temperature will be equal to
   \[
   20°C \times \frac{80.0\text{mL}}{40.0\text{mL}} = 40°C
   \]

49. At 25°C, iodine exists as a solid and bromine as a liquid. This difference in phase is due to the presence of stronger
   1) covalent bonds in iodine
   2) covalent bonds in bromine
   3) van der Waals forces in iodine
   4) van der Waals forces in bromine

50. In which equation does the term “heat” represent heat of fusion?
   1) NaCl(s) + heat → NaCl(ℓ)
   2) NaOH(aq) + HCl(aq) → NaCl(aq) + H₂O(ℓ) + heat
   3) H₂O(ℓ) + heat → H₂O(g)
   4) H₂O(ℓ) + HCl(g) → H₃O⁺(aq) + Cl⁻(aq) + heat

51. As a solid is heated, its temperature increases from 10°C to 25°C, remains at 25°C for 5 minutes, and then increases to beyond 45°C. Based on this information, what conclusion can be drawn about the substance?
   1) Its melting point is 45°C.
   2) Its boiling point is 45°C.
   3) Its melting point is 25°C.
   4) Its boiling point is 25°C.
52. A student determined the mass, in grams, of compound $X$ that would saturate 30 grams of water over a temperature range of 40°C in 10-degree intervals. The results are tabulated below.

<table>
<thead>
<tr>
<th>Grams of Dissolved Compound $X$</th>
<th>Solubility in grams/100 ml H$_2$O</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0 g</td>
<td>1</td>
</tr>
<tr>
<td>4.0 g</td>
<td></td>
</tr>
<tr>
<td>8.0 g</td>
<td></td>
</tr>
<tr>
<td>16 g</td>
<td></td>
</tr>
<tr>
<td>32 g</td>
<td></td>
</tr>
</tbody>
</table>

If this solubility trend continues, total number of grams of compound $X$ that will dissolve in 30 grams of water at 60°C?

1) 16  3) 48
2) 32  4) 64

53. Which intermolecular force of attraction accounts for the relatively high boiling point of water?

1) hydrogen bonding  3) metallic bonding
2) covalent bonding   4) ionic bonding

54. An unsaturated aqueous solution of NH$_3$ is at 90°C in 100 grams of water. According to Reference Table $G$, how many grams of NH$_3$ could this unsaturated solution contain?

1) 5 g  3) 15 g
2) 10 g  4) 20 g

55. 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 $X$?

1) $A$  3) $C$
2) $B$  4) $D$

56. When heat energy is lost by a pure substance at its freezing point, its potential energy

1) decreases  3) remains the same
2) increases

57. At STP, which of the following gases will diffuse most rapidly?

1) hydrogen  3) fluorine
2) nitrogen  4) oxygen
58. Base your answer to the following question on the table below, which shows the solubility of a solid solute.
Solubility Curve

The Solubility of Various Substances

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>80</td>
</tr>
<tr>
<td>100</td>
</tr>
</tbody>
</table>

Temperature (°C)
59. Which formula represents a homogeneous mixture?
   1) H₂O(ℓ)  3) NaH(s)
   2) H₂S(g)  4) HCl(aq)

60. Hydrogen bonds are formed between molecules when hydrogen is covalently bonded to an element that has a
   1) small atomic radius and low electronegativity
   2) large atomic radius and low electronegativity
   3) small atomic radius and high electronegativity
   4) large atomic radius and high electronegativity
61. Given the data table below showing the solubility of salt $X$:

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Solubility of Solute per 100 g of H$_2$O (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>107</td>
</tr>
<tr>
<td></td>
<td>135</td>
</tr>
</tbody>
</table>

- Which salt on Table $G$ is most likely to be salt $X$?
- Scale and label the y-axis including appropriate units.
- Plot the data from the data table. Surround each point with a small circle and draw a best-fit curve for the solubility of salt $X$.
- Using your graph, predict the solubility of salt $X$ at 50°C.
- If the pressure on the salt solution was increased, what effect would this pressure change have on the solubility of the salt?
A substance is a solid at 15°C. A student heated a sample of the solid substance and recorded the temperature at one-minute intervals in the data table below.

<table>
<thead>
<tr>
<th>(°C)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15</td>
<td>32</td>
<td>46</td>
<td>53</td>
<td>53</td>
<td>53</td>
<td>53</td>
<td>53</td>
<td>53</td>
<td>53</td>
</tr>
</tbody>
</table>

The heat of fusion for this substance is 122 joules per gram. How many joules of heat are needed to melt 7.50
grams of this substance at its melting point?

63. At standard pressure when NaCl is added to water, the solution will have a
1) higher freezing point and a lower boiling point than water
2) higher freezing point and a higher boiling point than water
3) lower freezing point and a higher boiling point than water
4) lower freezing point and a lower boiling point than water

64. Which solution contains exactly 0.50 mole of H₂SO₄?
1) 1.0 L of a 1.0 M solution
2) 2.0 L of a 1.0 M solution
3) 1.0 L of a 0.50 M solution
4) 2.0 L of a 0.50 M solution

65. Based on Reference Table G, which solution could contain 42 grams of solute per 100 grams of water at 40ºC?
1) a saturated solution of KClO₃
2) a saturated solution of KCl
3) an unsaturated solution of NaCl
4) an unsaturated solution of NH₄Cl

66. What is the minimum number of kiloJoules needed to change 40.0 grams of water at 100ºC to steam at the same temperature and pressure?
1) 1,810
2) 904
3) 2.26
4) .400

67. Based on Reference Table F, which of the following saturated solutions would be the least concentrated?
1) sodium sulfate
2) potassium sulfate
3) copper (II) sulfate
4) barium sulfate

68. Which substance will readily sublime at STP?
1) Fe(s)
2) C₆H₁₂O₆(s)
3) NaCl(s)
4) CO₂(s)

69. In an experiment using a calorimeter, the following data were obtained:

<table>
<thead>
<tr>
<th>Mass of calorimeter + water</th>
<th>Mass of calorimeter</th>
<th>Initial temperature of water</th>
<th>Final temperature of water</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>100</td>
<td>25</td>
<td>55</td>
</tr>
</tbody>
</table>

What is the total number of calories absorbed by the water?
1) 1,000
2) 1,500
3) 3,000
4) 4,500

70. A sample of glass is a supercooled liquid rather than a true solid because it has
1) a definite volume
2) no definite volume
3) a crystalline structure
4) no crystalline structure
71. Base your answer to the following question on the diagrams below of four sealed flasks, each of which contains \( \text{H}_2\text{O}(\ell) \) at the temperature shown.

In which flask do the molecules of \( \text{H}_2\text{O} \) have the greatest average kinetic energy?
1) 1 3) 3  
2) 2 4) 4

72. The process of separating petroleum into components based on differences in their boiling points is called
1) cracking  
2) hydrogenation  
3) destructive distillation  
4) fractional distillation

73. Which sample of \( \text{Fe} \) contains particles having the highest average kinetic energy?
1) 5 g at 10ºC 3) 5 g at 400 K  
2) 10 g at 25ºC 4) 10 g at 300 K

74. Which phase change is endothermic?
1) \( \text{H}_2\text{O}(\ell) \rightarrow \text{H}_2\text{O}(g) \)  
2) \( \text{I}_2(g) \rightarrow \text{I}_2(s) \)  
3) \( \text{Hg}(\ell) \rightarrow \text{Hg}(s) \)  
4) \( \text{H}_2\text{S}(g) \rightarrow \text{H}_2\text{S}(\ell) \)

75. As the space between molecules in a gas sample decreases, the tendency for the behavior of this gas to deviate from the ideal gas laws increases.
1) decreases 3) remains the same  
2) increases

76. Which compound has a high melting point?
1) \( \text{SiO}_2 \)  
2) \( \text{CO}_2 \)  
3) \( \text{SO}_2 \)  
4) \( \text{NO}_2 \)

77. Under which conditions does a real gas behave most like an ideal gas?
1) at low temperatures and high pressures  
2) at low temperatures and low pressures  
3) at high temperatures and high pressures  
4) at high temperatures and low pressures

78. Under the same conditions of temperature and pressure, which gas will diffuse at the slowest rate?
1) \( \text{He} \) 3) \( \text{Ar} \)  
2) \( \text{Ne} \) 4) \( \text{Rn} \)

79. What is the molarity of a solution of \( \text{NaOH} \) if 2 liters of the solution contains 4 moles of \( \text{NaOH} \)?
1) 0.5 M 3) 8 M  
2) 2 M 4) 80 M

80. The average kinetic energy of water molecules increases when
1) \( \text{H}_2\text{O}(s) \) changes to \( \text{H}_2\text{O}(\ell) \) at 0ºC  
2) \( \text{H}_2\text{O}(\ell) \) changes to \( \text{H}_2\text{O}(s) \) at 0ºC  
3) \( \text{H}_2\text{O}(\ell) \) at 10ºC changes to \( \text{H}_2\text{O}(\ell) \) at 20ºC  
4) \( \text{H}_2\text{O}(\ell) \) at 20ºC changes to \( \text{H}_2\text{O}(\ell) \) at 10ºC

81. When 1.255 grams of \( X \) reacts completely with 3.2 grams of \( Y \), \( Z \) is the only product of the reaction. What is the total mass of \( Z \), expressed to the proper number of significant figures?
1) 4.455 g 3) 4.5 g  
2) 4.46 g 4) 5 g

82. In a laboratory experiment, the melting point of compound \( A \) was determined to be 82.6ºC. If the accepted value is 80.5ºC, what is the percent error in this determination? (Show proper significant figures)
1) 2.5 3) 2.6  
2) 2.54 4) 2.71

83. One kiloJoule is the same as
1) 0.001 Joule 3) 100 Joules  
2) 0.01 Joule 4) 1,000 Joules
84. Which kelvin temperature is equivalent to –24°C?
   1) 226 K  
   2) 249 K  
   3) 273 K  
   4) 297 K

85. In a laboratory exercise, 0.03 grams of magnesium metal reacts with excess dilute hydrochloric acid. The hydrogen gas produced is to be collected and its volume measured. Which device would be most suitable to measure the volume of the hydrogen gas collected?
   1) Erlenmeyer flask  
   2) volumetric flask  
   3) beaker  
   4) eudiometer tube

86. Which quantity is equivalent to 50 kilojoules?
   1) 5000 J  
   2) 0.05 J  
   3) $5 \times 10^3$ J  
   4) $5 \times 10^4$ J

The diagram below shows a laboratory setup that can be used in a titration.

Which pieces of equipment are indicated by arrows A and B, respectively?
   1) buret and Erlenmeyer flask  
   2) buret and volumetric flask  
   3) pipet and Erlenmeyer flask  
   4) pipet and volumetric flask
88. Using a triple beam balance and a graduated cylinder, a student collected data on a sample of an element:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass of sample</td>
<td>10.9 g</td>
</tr>
<tr>
<td>Volume of water</td>
<td>30.0 ml</td>
</tr>
<tr>
<td>Volume of water and sample</td>
<td>34.0 ml</td>
</tr>
</tbody>
</table>

a) Calculate the density of the sample. Show all work and use significant figures and units.

b) Based on Reference Table S, what element might the sample be?

89. Which piece of laboratory equipment is represented by the diagram below?

1) crucible tongs  
2) beaker tongs  
3) test tube clamp  
4) pinch clamp

90. What is the sum of 0.0421 g + 5.263 g + 2.13 g to the correct number of significant digits?

1) 7 g  
2) 7.4 g  
3) 7.44 g  
4) 7.435 g

91. A student in a laboratory determined the boiling point of a substance to be 71.8°C. The accepted value for the boiling point of this substance is 70.2°C. What is the percent error of the student's measurement?

1) 1.60%  
2) 2.28%  
3) 2.23%  
4) 160%

92. The following weighings were made during a laboratory exercise:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass of evaporating dish</td>
<td>59.260 g</td>
</tr>
<tr>
<td>Mass of sugar sample</td>
<td>1.61 g</td>
</tr>
</tbody>
</table>

What is the total mass of the evaporating dish plus the sample, expressed to the proper number of significant figures?

1) 60.870 g  
2) 60.87 g  
3) 60.9 g  
4) 61 g

93. In an experiment the gram atomic mass of magnesium was determined to be 24.7. Compared to the accepted value 24.3, the percent error for this determination was

1) 0.400  
2) 1.65  
3) 24.7  
4) 98.4
94. Which diagram represents a graduated cylinder?

1)  

3)  

2)  

4)  

95. The accepted value for the molar volume of a gas is 22.4 liters. In a laboratory experiment, a student determines the value to be 24.8 liters. What is the percent error of the student's measurement?

1) 0.120%  
3) 10.7%  
2) 0.107%  
4) 12.0%  

96. The solid object shown below has a mass of 162.2 grams.

What is the density of the object to the correct number of significant figures?

1) 0.22 g/cm³  
3) 4.5 g/cm³  
2) 0.2219 g/cm³  
4) 4.505 g/cm³  

97. Expressed to the correct number of significant figures, the sum of two masses is 445.2 grams. Which two masses produce this answer?

1) 210.10 g + 235.100 g  
2) 210.100 g + 235.10 g  
3) 210.1 g + 235.1 g  
4) 210.10 g + 235.10 g  

98. What is the safest method for diluting concentrated sulfuric acid with water?

1) add the acid to the water quickly  
2) add the water to the acid quickly  
3) add the acid to the water slowly while stirring  
4) add the water to the acid slowly while stirring
99. Which diagram represents a crucible?

1) 

2) 

3) 

4) 

100. A Bunsen burner flame is sooty black and mixed with an orange-yellow color. Which is the probable reason for this condition?

1) No oxygen is mixing with the gas.
2) No gas is mixing with the oxygen.
3) Insufficient oxygen is mixing with the gas.
4) Insufficient gas is mixing with the oxygen.
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<th>Electronegativity</th>
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<th>Boiling Point (°C)</th>
<th>Density** (g/cm³)</th>
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### Reference Tables

#### Table E

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## Reference Tables

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2. \( 4 \text{Al(s)} + 3\text{O}_2(g) \rightarrow 2\text{Al}_2\text{O}_3(s) \)
3. 4
4. 1
5. 2
6. 1
7. 1
8. 4
9. 4
10. 3
11. 4
12. 2
13. 3
14. \( \frac{1}{2}\text{Al}_2\text{(SO}_4)_3 + \frac{3}{2}\text{Ca(OH})_2 \rightarrow \frac{2}{2}\text{Al(OH})_3 + \frac{3}{2}\text{CaSO}_4 \)
15. 2
16. 1
17. 1
18. 4
19. \( \frac{1}{2}\text{C}_3\text{H}_8(g) + \frac{5}{2}\text{O}_2(g) \rightarrow \frac{4}{2}\text{H}_2\text{O}(g) + \frac{3}{2}\text{CO}_2(g) \)
20. a) \( 23.0 + 14.0 + 3(16.0) = 85.0 \text{ g} \)
   b) \( 0.105 \text{g} \times 1.00 \text{ mole/85.0g} = 0.00124 \text{ mole} \)
21. 1
22. 4
23. 3
24. 4
25. 2
26. 4
27. 3
28. 2
29. 1
30. 4
31. 3
32. a) 186 grams  
   b) 0.095 moles  
   c) \( \text{C}_2\text{H}_5\text{O}_4 \)
33. 4
34. 3
35. 4
36. 4
37. 16 or 16.0
38. 2
39. 4
40. 3
41. 4
42. 1
43. 4
44. 2
45. 2
46. 2
47. 4
48. 3
49. 3
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51. 3  
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53. 1  
54. 1  
55. 4  
56. 1  
57. 1  
58. 

Example: 

59. 4  
60. 3  
61. 

62. 915 J  
63. 3  
64. 3  
65. 4  
66. 2  
67. 4  
68. 4  
69. 2  
70. 4  
71. 4  
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78. 4  
79. 2  
80. 3  
81. 3  
82. 3  
83. 4  
84. 2  
85. 4  
86. 4  
87. 1  
88. a) 2.7 g/ml  b) Al
89. 1
90. 3
91. 2
92. 2
93. 2
94. 1
95. 3
96. 3
97. 3
98. 3
99. 3
100. 3