FINAL QUESTION PAPER

1. 123. First ionization energy is the energy required to remove one electron from a gaseous atom. How does first ionization energy generally change as you move from left to right across a period? (a) It generally decreases because atomic size increases. (b) It generally increases because atomic size decreases and effective nuclear charge increases. (c) It generally decreases because effective nuclear charge decreases. (d) It remains relatively constant across a period.

2. 128. Among the elements Mg, Ca, Sr, and Ba, which one would be expected to be the most metallic? (a) Magnesium (Mg) (b) Calcium (Ca) (c) Strontium (Sr) (d) Barium (Ba)

3. 44. Which of the following processes would result in the formation of a compound from elements? (a) Dissolving salt in water (b) Melting ice (c) Burning magnesium in air (d) Filtering sand from water

4. 33. Which of the following is an example of a chemical compound? (a) Oxygen gas (O2) (b) Nitrogen (N2) (c) Carbon dioxide (CO2) (d) Air

5. 69. Which of the following particles is located outside the nucleus of an atom? (a) Proton (b) Neutron (c) Electron (d) Nucleon

6. 308. Which statement correctly describes a reducing agent? a) It gains electrons. b) It causes reduction of another substance. c) It itself gets reduced. d) It accepts oxygen.

7. 51. When a piece of paper burns, what type of property is demonstrated? (a) Solubility (b) Ductility (c) Flammability (d) Malleability

8. 223. In a chemical equation, what does a coefficient placed in front of a chemical formula primarily indicate? (a) The number of atoms of a specific element within the compound (b) The molar mass of the compound (c) The number of molecules or moles of that substance (d) The type of chemical bond present in the compound

9. 250. What volume would 0.75 moles of oxygen gas (O2) occupy at Standard Temperature and Pressure (STP)? a) 16.8 L b) 22.4 L c) 33.6 L d) 11.2 L

10. 311. If a substance acts as an oxidizing agent, then it must be: a) Losing electrons b) Getting oxidized c) Getting reduced d) Causing reduction

11. 73. The atomic mass unit (amu) is approximately equal to the mass of a: (a) Proton only (b) Electron only (c) Proton or a neutron (d) Proton, neutron, and electron combined

12. 153. Which noble gas configuration does a chloride ion (Cl-) achieve? (a) Helium (b) Neon (c) Argon (d) Krypton

13. 216. In the balanced chemical equation 2Al + 3H2SO4 -> Al2(SO4)3 + XH2, what is the value of X? (a) 1 (b) 2 (c) 3 (d) 4

14. 82. The mass number of an atom represents the total count of which subatomic particles? a) Protons and electrons b) Neutrons and electrons c) Protons and neutrons d) Protons, neutrons, and electrons

15. 103. The atomic number of an element is determined by the number of protons in its nucleus. If an element has isotopes, how does this affect its atomic number? a) The atomic number varies for each isotope of an element. b) The atomic number remains constant for all isotopes of an element. c) The atomic number is the average of the mass numbers of its isotopes. d) The atomic number is determined by the most abundant isotope.

16. 325. How many atoms of oxygen are present in one molecule of sulfuric acid, H_2SO_4? a) 1 b) 2 c) 4 d) 7

17. 298. When barium hydroxide octahydrate and ammonium thiocyanate are mixed, the temperature of the surroundings drops significantly. This observation suggests the reaction is: a) Exothermic, releasing energy to the surroundings. b) Endothermic, absorbing energy from the surroundings. c) A combustion reaction, producing heat. d) A neutralization reaction, releasing water.

18. 275. A supersaturated solution is typically prepared by: (a) Heating a solvent, dissolving excess solute, and then slowly cooling it without disturbance. (b) Continuously stirring a solvent while adding solute at a low temperature. (c) Adding a very small amount of solute to a large volume of solvent. (d) Evaporating most of the solvent from a dilute solution.

19. 302. In the context of hydrogen transfer, reduction is defined as the: a) Removal of hydrogen b) Addition of oxygen c) Addition of hydrogen d) Loss of electrons

20. 264. A solution that contains more solute than a saturated solution at the same temperature and pressure is called a: (a) Unsaturated solution (b) Dilute solution (c) Concentrated solution (d) Supersaturated solution

21. 175. Which property of atoms is primarily responsible for determining the polarity of a covalent bond? (a) Atomic mass (b) Ionization energy (c) Electronegativity (d) Atomic radius

22. 66. Which of the following statements about a neutral atom is correct? (a) The number of protons is equal to the number of neutrons. (b) The number of electrons is equal to the number of neutrons. (c) The number of protons is equal to the number of electrons. (d) The mass number is equal to the atomic number.

23. 52. A student observes that a certain liquid has a distinct odor and a boiling point of 78 degrees Celsius. These observations describe the liquid's: (a) Chemical properties (b) Extensive properties (c) Physical properties (d) Intensive chemical properties

24. 330. A chemical reaction that releases heat into its surroundings is called: a) An endothermic reaction b) An exothermic reaction c) A decomposition reaction d) A synthesis reaction

25. 96. Which property is most likely to be different for isotopes of the same element? a) Melting point. b) Density. c) Chemical reactivity. d) Number of valence electrons.

26. 30. Evaporation causes cooling because: (a) The escaping particles absorb heat from the surroundings. (b) The remaining particles gain kinetic energy. (c) The density of the liquid increases. (d) The intermolecular forces become stronger.

27. 78. Which subatomic particle contributes to the atomic number of an element? a) Neutron b) Electron c) Proton d) Positron

28. 140. Which of the following statements correctly differentiates between ionic and covalent bonding? (a) Ionic bonds involve sharing of electrons, while covalent bonds involve transfer of electrons. (b) Ionic bonds occur between two nonmetals, while covalent bonds occur between a metal and a nonmetal. (c) Ionic bonds involve transfer of electrons, while covalent bonds involve sharing of electrons. (d) Both ionic and covalent bonds involve

the complete transfer of electrons.

29. 74. If an atom gains two electrons, what type of ion is formed? (a) A cation with a +2 charge (b) An anion with a -2 charge (c) A cation with a -2 charge (d) Anion with a +2 charge

30. 251. A sample of hydrogen gas (H2) occupies 5.6 litres at STP. How many moles of hydrogen gas are present? a) 0.25 mol b) 0.5 mol c) 1 mol d) 2 mol

31. 284. A solution that is 'dilute' compared to another implies it has a: (a) Higher boiling point. (b) Lower concentration of solute. (c) Higher concentration of solute. (d) Greater density.

32. 149. The formation of a chemical bond between two atoms generally leads to a state of: (a) Higher potential energy for the system. (b) Lower potential energy for the system. (c) Unchanged potential energy for the system. (d) Higher kinetic energy for the system.

33. 326. What is the correct chemical name for the compound FeCl3? a) Iron chloride b) Iron(I) chloride c) Iron(III) chloride d) Iron trichloride

34. 167. In a molecule of methane (CH4), how many pairs of electrons are shared between the carbon atom and the four hydrogen atoms? (a) 1 pair (b) 2 pairs (c) 4 pairs (d) 8 pairs

35. 270. A chemist prepared a solution by heating a substance in water until no more would dissolve. When the solution was allowed to cool slowly, crystals of the substance formed. What type of solution was likely formed when it was hot, and then when it cooled? (a) Unsaturated when hot, saturated when cooled. (b) Saturated when hot, unsaturated when cooled. (c) Supersaturated when hot, saturated when cooled. (d) Saturated when hot, supersaturated when cooled.

36. 148. Which pair of elements would most likely form an ionic compound? (a) Carbon and Oxygen (b) Nitrogen and Hydrogen (c) Lithium and Fluorine (d) Sulfur and Chlorine

37. 119. An element in Group 17, Period 4 would be expected to have properties most similar to which other element? (a) Bromine (Br) (b) Potassium (K) (c) Argon (Ar) (d) Sulfur (S)

38. 265. How does increasing the surface area of a solid solute affect its rate of dissolution in a liquid solvent?

39. 274. Which statement accurately describes a saturated solution? (a) It can still dissolve a large amount of solute. (b) It contains less solute than it is capable of holding at that temperature. (c) It contains the maximum amount of solute that can be dissolved at a given temperature. (d) It contains more solute than it can theoretically hold, making it unstable.

40. 206. Which compound correctly represents the combination of a Group 2 element and a Group 17 element? (a) NaF: Sodium fluoride (b) MgBr2: Magnesium bromide (c) AlCl3: Aluminum chloride (d) SiO2: Silicon dioxide

41. 238. Which type of reaction results in two ionic compounds exchanging their ions to form two new compounds, often leading to the formation of a precipitate, gas, or water? (a) Combination (b) Single displacement (c) Double displacement (d) Decomposition

42. 27. When pressure is applied to a gas, what typically happens to its volume? (a) It increases. (b) It decreases. (c) It remains unchanged. (d) It depends on the temperature.

43. 199. What is the systematic name for FeCl3? (a) Iron chloride (b) Iron (II) chloride (c) Iron (III) chloride (d) Ferric chloride

44. 95. How do isotopes of an element differ in their chemical properties? a) They have significantly different chemical properties due to mass differences. b) They have identical chemical properties because they have the same number of protons and electrons. c) They react differently only at very high temperatures. d) They only differ in their ability to form ionic bonds.

45. 309. A redox reaction is a chemical reaction in which: a) Only oxidation occurs b) Only reduction occurs c) Both oxidation and reduction occur simultaneously d) Neither oxidation nor reduction occurs

46. 290. Photosynthesis is a chemical process where plants convert carbon dioxide and water into glucose and oxygen using sunlight. This process is best classified as: a) An exothermic reaction b) An endothermic reaction c) A combustion reaction d) A decomposition reaction

47. 56. When vinegar (acetic acid) reacts with baking soda (sodium bicarbonate) to produce carbon dioxide gas, this demonstrates: (a) A physical change only (b) A change in state only (c) A chemical property of both substances (d) An intensive physical property

48. 295. If the energy required to break bonds in reactants is greater than the energy released when new bonds are formed in products, the reaction will be: a) Exothermic b) Endothermic c) Neutral d) Spontaneous without activation energy

49. 292. The minimum amount of energy required to initiate a chemical reaction is known as the: a) Heat of reaction b) Enthalpy change c) Activation energy d) Bond energy

50. 257. In a sugar solution prepared by dissolving sugar in water, the solvent is: (a) Sugar (b) Water (c) The entire solution (d) Both sugar and water

51. 271. Which term best describes a solution containing a small amount of solute relative to the maximum amount that can be dissolved? (a) Saturated (b) Dilute (c) Concentrated (d) Supersaturated

52. 202. The chemical formula for ammonium sulfate is: (a) NH4SO4 (b) (NH4)2SO4 (c) NH4(SO4)2 (d) N2H8SO4

53. 166. Which statement best describes the formation of a covalent bond? (a) One atom gains electrons while another atom loses electrons. (b) Atoms share one or more pairs of electrons to achieve a stable electron configuration. (c) Electrostatic forces attract oppositely charged ions. (d) Metallic atoms form a lattice with a 'sea' of delocalized electrons.

54. 203. Which of the following compounds is correctly named? (a) CuCl2: Copper (I) chloride (b) MnO2: Manganese (IV) oxide (c) PbS: Lead (IV) sulfide (d) NiF2: Nickel (I) fluoride

55. 305. Consider the reaction: 2Mg(s) + O2(g) -> 2MgO(s). In this reaction, magnesium is: a) Oxidized b) Reduced c) Neither oxidized nor reduced d) Acting as an oxidizing agent

56. 130. Which of the following elements is generally considered to be the most reactive non-metal? (a) Iodine (I) (b) Chlorine (Cl) (c) Bromine (Br) (d) Fluorine (F)

57. 156. What is the chemical formula for the ionic compound formed between calcium (Ca) and oxygen (O)? (a) CaO2 (b) CaO (c) Ca2O (d) Ca2O3

58. 215. For the complete combustion of propane (C_3H_8), the unbalanced equation is: $C_3H_8 + O_2 \rightarrow CO_2 + H_2O$. When balanced, what are the coefficients for O_2, CO_2, and H_2O respectively? (a) 3, 5, 4 (b) 5, 3, 4 (c) 4, 3, 5 (d) 3, 4, 5

59. 136. Which of the following best describes a chemical bond? (a) The force that holds atoms together in a molecule or compound. (b) The energy released when two atoms combine. (c) The attraction between a nucleus and its electrons. (d) The process of forming new substances from reactants.

60. 101. Why do stable isotopes not undergo radioactive decay? a) They have an unstable nucleus. b) They have an unfavorable neutron to proton ratio. c) They have a stable nucleus. d) They have too many electrons.

61. 239. An acid-base reaction, where an acid reacts with a base to form a salt and water, is a specific type of: (a) Combination reaction (b) Decomposition reaction (c) Single displacement reaction (d) Double displacement reaction

62. 14. Define the term 'mole' in chemistry and state its approximate numerical value (Avogadro's number).

63. 142. What is the stable electron configuration that most atoms attempt to achieve when forming chemical bonds? (a) Duet rule (2 valence electrons) (b) Triplet rule (3 valence electrons) (c) Octet rule (8 valence electrons) (d) Hexet rule (6 valence electrons)

64. 93. What is the defining characteristic that all isotopes of a given element share? a) The same mass number. b) The same number of neutrons. c) The same number of protons. d) The same number of electrons in their outermost shell.

65. 134. Which property is most directly responsible for the increase in atomic radius down a group? (a) Increase in nuclear charge. (b) Increase in effective nuclear charge. (c) Increase in the number of electron shells. (d) Increase in electronegativity.

66. 79. The atomic mass unit (amu) is approximately equal to the mass of which subatomic particle? a) Electron b) Proton c) Photon d) Neutrino

67. 253. Which of the following is the empirical formula for glucose ($C_6H_{12}O_6$)? a) $C_6H_{12}O_6$ b) $C_3H_6O_3$ c) CH_2O d) CHO

68. 213. When the equation $Fe_2O_3 + CO \rightarrow Fe + CO_2$ is balanced with the smallest whole number coefficients, what is the coefficient for CO? (a) 1 (b) 2 (c) 3 (d) 4

69. 5. In the periodic table, elements in the same group (column) generally have: (a) The same atomic mass (b) Similar chemical properties (c) The same number of electron shells (d) Increasing reactivity down the group
Section: True or False Questions

70. 193. The chemical formula for table salt is: a) KCl b) $CaCl_2$ c) NaCl d) $MgCl_2$

71. 158. An ion with a positive charge is called a: (a) Anion (b) Cation (c) Isotope (d) Molecule

72. 228. In the reaction $Fe(s) + CuSO_4(aq) \dashrightarrow FeSO_4(aq) + Cu(s)$, which type of chemical reaction is occurring? (a) Double displacement (b) Combination (c) Single displacement (d) Decomposition

73. 138. Which type of electrons are primarily involved in the formation of chemical bonds between atoms? (a) Core electrons (b) Inner shell electrons (c) Valence electrons (d) Proton electrons

74. 22. How does boiling differ from evaporation? (a) Boiling occurs only at the surface, while evaporation occurs throughout the liquid. (b) Boiling occurs at a specific temperature, while evaporation can occur at any temperature below the boiling point. (c) Boiling is a slow process, while evaporation is a rapid process. (d) Boiling does not require heat, while evaporation requires heat.

75. 127. Metallic character refers to the tendency of an element to lose electrons and form positive ions. As you move across a period from left to right, how does metallic character generally change? (a) It increases. (b) It decreases. (c) It remains constant. (d) It first increases then decreases.

76. 236. The burning of a candle, which releases light and heat, is an example of an: (a) Endothermic reaction (b) Decomposition reaction (c) Exothermic reaction (d) Double displacement reaction

77. 146. Which of the following statements is a characteristic property of compounds formed by ionic bonds? (a) They typically have low melting and boiling points. (b) They are generally poor conductors of electricity in their solid state. (c) They are usually liquids or gases at room temperature. (d) They dissolve poorly in water.

78. 241. Which of the following statements correctly defines one mole of a substance? a) It is the amount of substance having a mass equal to its atomic number in grams. b) It is the amount of substance that contains Avogadro's number of particles. c) It is the volume occupied by 1 gram of any substance at STP. d) It is the concentration of a solution containing 1 gram of solute per litre.

79. 38. Consider a clear, colorless liquid that boils at exactly 100 degrees Celsius at standard atmospheric pressure and freezes at 0 degrees Celsius. This liquid is most likely: (a) A heterogeneous mixture (b) A solution (c) A pure compound (d) An element

80. 258. Which of the following factors increases the solubility of a gas in a liquid? (a) Increasing temperature (b) Decreasing pressure (c) Increasing pressure (d) Decreasing the surface area of the liquid

81. 62. Which subatomic particle has a negligible mass compared to protons and neutrons? (a) Proton (b) Neutron (c) Electron (d) Nucleus

82. 26. Which of the following is an example of a Bose-Einstein Condensate (BEC)? (a) Water vapor (b) Supercooled helium (c) Extremely hot gas (d) Interstellar clouds

83. 176. Which of these substances is an example of a network covalent solid? (a) Water (H_2O) (b) Sodium chloride (NaCl) (c) Diamond (C) (d) Carbon dioxide (CO_2)

84. 280. A concentrated solution differs from a dilute solution primarily in the: (a) Type of solvent used. (b) Relative amount of solute present. (c) Temperature at which the solution was prepared. (d) Physical state of the solute.

85. 131. The shielding effect (or screening effect) is most prominent for which of the following? (a) Inner shell electrons shielding outer shell electrons from the nucleus. (b) Outer shell electrons shielding inner shell electrons from the nucleus. (c) Protons shielding neutrons in the nucleus. (d) Neutrons shielding protons in the nucleus.

86. 205. What is the chemical name for PCl_5? (a) Phosphorus chloride (b) Phosphorus pentachloride (c) Pentaphosphorus chloride (d) Phosphorous (V) chloride

87. 242. What is the molar mass of water (H_2O)? (Atomic masses: H=1, O=16) a) 17 g/mol b) 18 g/mol c) 19 g/mol d) 34 g/mol

88. 208. Which pair of compounds has a naming error? (a) N_2O: Dinitrogen monoxide; NO_2: Nitrogen dioxide (b) SO_2: Sulfur dioxide; SO_3: Sulfur trioxide (c) Cu_2O: Copper (I) oxide; CuO: Copper (II) oxide (d) $PbCl_2$: Lead (II) chloride; $PbCl_4$: Lead (II) tetrachloride

89. 315. Consider the reaction: $Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$. In this reaction, copper (Cu^{2+} in $CuSO_4$) is: a) Oxidized by zinc b) Reduced by zinc c) Acting as a reducing agent d) Undergoing no change

90. 124. Consider the elements Lithium (Li), Sodium (Na), and Potassium (K). Which of these elements would have the lowest first ionization energy? (a) Lithium (b) Sodium (c) Potassium (d) All have similar first ionization energies.

91. 328. The reaction $2H_2O \rightarrow 2H_2 + O_2$ is an example of a: a) Combination reaction b) Decomposition reaction c) Single displacement reaction d) Double displacement reaction

92. 307. An oxidizing agent is a substance that: a) Itself gets oxidized b) Causes oxidation of another substance c) Gains hydrogen d) Loses electrons

93. 316. Which of the following is a physical property of matter? a) Reactivity with acid b) Ability to burn c) Melting point d) Tendency to rust

94. 214. Balance the following chemical equation: $NH_3 + O_2 \rightarrow NO + H_2O$. What is the coefficient for O_2? (a) 3 (b) 5 (c) 2 (d) 4

95. 194. Which of the following chemical formulas is written incorrectly? a) H_2SO_4 b) KOH c) $AlCl_3$ d) $Na(OH)_2$

96. 303. According to the electronic concept, oxidation involves: a) Gain of electrons b) Loss of electrons c) Gain of oxygen d) Loss of hydrogen

97. 61. What determines the identity of an element? (a) Number of neutrons (b) Number of protons (c) Number of electrons (d) Mass number

98. 171. The octet rule states that atoms tend to form bonds until they are surrounded by how many valence electrons? (a) 2 (b) 4 (c) 6 (d) 8

99. 323. Atoms bond with each other primarily to: a) Gain a positive charge b) Achieve a stable electron configuration c) Increase their atomic mass d) Become radioactive

100. 34. A mixture differs from a compound in that a mixture: (a) Has components that are chemically bonded together. (b) Has a fixed composition by mass. (c) Can be separated into its components by physical methods. (d) Exhibits properties entirely different from its constituents.

101. 320. Which subatomic particle has a negative charge and is found outside the nucleus? a) Proton b) Neutron c) Electron d) Nucleus

102. 141. When an atom loses one or more electrons, it forms a: (a) Neutral atom. (b) Anion. (c) Cation. (d) Isotope.

103. 155. In which state will an ionic compound conduct electricity? (a) Solid state (b) Gaseous state (c) Molten state (d) Both solid and gaseous states

104. 135. Based on periodic trends, arrange the following elements in increasing order of their first ionization energy: Al, Si, P, Na. (a) Na < Al < Si < P (b) P < Si < Al < Na (c) Al < Na < Si < P (d) Na < P < Si < Al

105. 10. The process where a solid changes directly into a gas without passing through a liquid state is called _____.

106. 248. How many oxygen atoms are present in 0.2 moles of calcium carbonate (CaCO3)? a) 1.2044 x 10^23 atoms b) 3.6132 x 10^23 atoms c) 6.022 x 10^23 atoms d) 1.8066 x 10^24 atoms

107. 12. Distinguish between an ionic bond and a covalent bond based on how electrons are involved in their formation.

108. 190. Which of the following chemical formulas shows the simplest whole-number ratio of atoms in a compound? a) C6H12O6 (glucose) b) H2O2 (hydrogen peroxide) c) N2O4 (dinitrogen tetroxide) d) CH4 (methane)

109. 230. Which of the following equations represents a combustion reaction? (a) H2O(l) + energy ----> H2(g) + O2(g) (b) CH4(g) + 2O2(g) ----> CO2(g) + 2H2O(l) (c) CaCO3(s) ----> CaO(s) + CO2(g) (d) HCl(aq) + NaOH(aq) ----> NaCl(aq) + H2O(l)

110. 7. The Law of Conservation of Mass states that mass is created or destroyed during a chemical reaction.

111. 16. Which of the following statements best describes the particles in a liquid? (a) Particles are tightly packed and vibrate in fixed positions. (b) Particles are far apart and move randomly at high speeds. (c) Particles are closely packed but can slide past one another. (d) Particles are arranged in a regular, repeating pattern.

112. 196. What is the correct chemical name for the compound with the formula Li2O? (a) Lithium oxide (b) Dilithium monoxide (c) Lithium dioxide (d) Dilithium oxide

113. 219. Consider the reaction between zinc and hydrochloric acid: Zn(s) + HCl(aq) -> ZnCl2(aq) + H2(g). When balanced using the smallest whole number coefficients, what is the coefficient for HCl? (a) 1 (b) 2 (c) 3 (d) 4

114. 122. As you move down a group in the periodic table, what is the general trend observed for atomic radius? (a) It decreases due to increased nuclear charge. (b) It increases due to increased electron-electron repulsion. (c) It decreases due to increased shielding effect. (d) It increases due to the addition of new electron shells.

115. 49. The ability of iron to combine with oxygen to form rust is an example of a: (a) Physical property (b) Chemical property (c) Intensive property (d) Extensive property

116. 285. Which qualitative term describes a solution that could still dissolve additional solute at a given temperature? (a) Saturated (b) Concentrated (c) Unsaturated (d) Precipitate

117. 317. A homogeneous mixture is also known as a: a) Compound b) Element c) Solution d) Suspension

118. 179. Compared to ionic compounds, simple covalent compounds generally have: (a) Higher electrical conductivity in molten state. (b) Stronger forces between individual molecules. (c) Weaker forces between individual molecules. (d) Greater solubility in water.

119. 88. If an atom has an atomic number of 9 and a mass number of 19, how many neutrons does it have? a) 9 b) 10 c) 19 d) 28

120. 11. A chemical reaction that absorbs energy from its surroundings is known as a(n) _____ reaction. Section: Short Answer and Problem Solving Questions

121. 35. A homogeneous mixture is characterized by: (a) Having components that are visibly distinct. (b) Possessing a uniform composition throughout. (c) Allowing its components to settle out over time. (d) Being easily separated by filtration.

122. 237. In the reaction 2Na(s) + Cl2(g) ----> 2NaCl(s), sodium changes from an oxidation state of 0 to +1, and chlorine changes from 0 to -1. This type of reaction is generally classified as: (a) Neutralization (b) Precipitation (c) Single displacement (d) Oxidation-reduction (Redox)

123. 200. Which of the following represents the formula for sulfur hexafluoride? (a) SF6 (b) S6F (c) SF5 (d) S5F

124. 157. Which of the following compounds is most likely to be ionic? (a) CH4 (Methane) (b) CO2 (Carbon dioxide) (c) KCl (Potassium chloride) (d) H2O (Water)

125. 277. You observe undissolved solid at the bottom of a beaker containing a sugar solution. This indicates the solution is most likely: (a) Dilute (b) Unsaturated (c) Supersaturated (d) Saturated

126. 71. An ion has 17 protons, 18 neutrons, and 18 electrons. What is the charge of this ion? (a) +1 (b) -1 (c) 0 (d) +2

127. 294. Consider the combustion of methane ($CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$). This reaction typically releases a significant amount of heat and light. It is an example of a(n): a) Endothermic process b) Energy-neutral process c) Exothermic process d) Photosynthetic process

128. 145. In a Lewis electron dot structure, the dots represent the: (a) Total number of electrons in the atom. (b) Number of protons in the nucleus. (c) Number of valence electrons. (d) Number of neutrons in the atom.

129. 137. Atoms tend to form chemical bonds primarily to: (a) Increase their mass and density. (b) Achieve a more stable electron configuration, similar to noble gases. (c) Become electrically neutral, regardless of stability. (d) Reduce their kinetic energy to absolute zero.

130. 37. A substance X cannot be broken down into simpler substances by heating, electrolysis, or chemical reactions. It is most likely: (a) A compound (b) An element (c) A homogeneous mixture (d) A heterogeneous mixture

131. 234. When an aqueous solution of sodium iodide is mixed with an aqueous solution of lead(II) nitrate, a precipitate of lead(II) iodide is formed. The other product in this double displacement reaction is: (a) Lead(II) hydroxide (b) Sodium nitrate (c) Iodine gas (d) Sodium sulfide

132. 87. Which of the following statements about subatomic particles is FALSE? a) Protons and neutrons are found in the nucleus. b) Electrons occupy shells or orbitals around the nucleus. c) Neutrons carry a positive charge. d) The nucleus accounts for most of an atom's mass.

133. 46. Which of the following is an example of a physical property? (a) Reactivity with acid (b) Flammability (c) Boiling point (d) Ability to rust

134. 172. When two identical non-metal atoms bond together, what type of bond is formed? (a) Polar covalent bond (b) Non-polar covalent bond (c) Ionic bond (d) Metallic bond

135. 174. Why do atoms form covalent bonds? (a) To transfer electrons to become charged ions. (b) To achieve a full outer electron shell, typically an octet. (c) To increase their individual energy levels. (d) To become more reactive with other elements.

136. 300. The law of conservation of energy states that energy cannot be created or destroyed, only transformed. How does this law apply to energy changes in chemical reactions? a) The total energy of reactants is always less than the total energy of products. b) The heat released or absorbed is a form of energy transformation, where the total energy of the system and surroundings remains constant. c) Energy is always lost as heat during a chemical reaction. d) Chemical energy is converted into mass during reactions.

137. 102. Which statement about the atomic structure of isotopes of the same element is true? a) They have the same number of protons and electrons, but different numbers of neutrons. b) They have the same number of protons and neutrons, but different numbers of electrons. c) They have different numbers of protons, neutrons, and electrons. d) They have the same number of neutrons and electrons, but different numbers of protons.

138. 132. The effective nuclear charge experienced by the valence electrons generally increases across a period because: (a) The number of core electrons increases, leading to more repulsion. (b) The number of electron shells increases, increasing distance from the nucleus. (c) The number of protons increases while the number of inner shell electrons remains constant. (d) The total number of electrons increases, causing more electron-electron repulsion.

139. 201. The formula for potassium iodide is: (a) K2I (b) KI2 (c) KI (d) K(I)

140. 318. Which statement accurately describes a chemical change? a) Water boiling into steam b) Ice melting into liquid water c) Wood burning to ash and smoke d) Sugar dissolving in water

141. 183. What is the correct chemical formula for sodium chloride? a) NaCl2 b) Na2Cl c) NaCl d) Na(Cl)2

142. 154. Ionic compounds typically have high melting and boiling points due to: (a) Weak intermolecular forces of attraction. (b) Strong electrostatic forces between oppositely charged ions. (c) The presence of delocalized electrons. (d) Their tendency to sublimate at room temperature.

143. 182. How many hydrogen atoms are present in one molecule of ammonia, NH3? a) 1 b) 2 c) 3 d) 4

144. 225. A student balances the equation for the combustion of butane: C4H10 + O2 -> CO2 + H2O. What is the sum of the coefficients of the products (CO2 and H2O) in the correctly balanced equation using the smallest whole numbers? (a) 10 (b) 13 (c) 18 (d) 23

145. 23. The spreading out and mixing of a substance with another substance due to the motion of its particles is known as: (a) Osmosis (b) Diffusion (c) Capillarity (d) Sedimentation

146. 111. Which block of the periodic table contains elements that are generally characterized by variable oxidation states and colorful compounds? (a) s-block (b) p-block (c) d-block (d) f-block

147. 57. The property of conductivity, which allows electricity to pass through a substance, is primarily a: (a) Chemical property (b) Physical property (c) Reactive property (d) Extensive property

148. 31. Which of the following best describes a pure substance? (a) It has variable composition and properties. (b) It can be separated into simpler substances by physical means. (c) It has a fixed chemical composition and distinct properties. (d) It is always a mixture of two or more elements.

149. 185. Which of the following is the correct chemical formula for carbon dioxide? a) CO b) CO2 c) C2O d) C2O2

150. 189. In the chemical formula C6H12O6, how many different elements are present? a) 3 b) 6 c) 12 d) 24

151. 263. Differentiate between a true solution and a suspension based on their physical characteristics.

152. 144. Which of the following compounds is primarily held together by covalent bonds? (a) Sodium chloride (NaCl) (b) Magnesium oxide (MgO) (c) Carbon dioxide (CO2) (d) Calcium fluoride (CaF2)

153. 276. How does increasing the temperature generally affect the solubility of most solid solutes in a liquid solvent? (a) It decreases solubility. (b) It has no effect on solubility. (c) It increases solubility. (d) It causes precipitation.

154. 116. An element belongs to Period 3 and Group 2 of the periodic table. How many valence electrons does it have? (a) 1 (b) 2 (c) 3 (d) 8

155. 163. What is the formula for the ionic compound formed between Magnesium (Mg2+) and Sulfate (SO4 2-)? (a) MgSO4 (b) Mg2SO4 (c) Mg(SO4)2 (d) Mg2(SO4)2

156. 17. According to the kinetic theory of matter, which state has particles with the highest kinetic energy on average at a given temperature? (a) Solid (b) Liquid (c) Gas (d) Plasma

157. 293. Which statement correctly describes the overall energy change in a chemical reaction? a) Energy is always created or destroyed. b) The energy released from bond formation is always less than the energy absorbed for bond breaking. c) The net energy change is the difference between energy absorbed for breaking bonds and energy released from forming new bonds. d) All chemical reactions absorb energy.

158. 32. An element is a substance that: (a) Can be broken down into simpler substances by chemical means. (b) Is composed of two or more different types of atoms chemically bonded together. (c) Consists of only one type of atom and cannot be decomposed by chemical methods. (d) Always exists as a gas at room temperature.

159. 259. Define the term "saturated solution".

160. 272. A solution is formed by dissolving 50g of sugar in 100mL of water at room temperature. Another solution is formed by dissolving 10g of sugar in 100mL of water at the same temperature. Compared to the second solution, the first solution is considered: (a) More dilute (b) Unsaturated (c) More concentrated (d) Less soluble

161. 224. Which of the following represents the correctly balanced decomposition reaction of hydrogen peroxide? (a) H2O2 -> H2 + O2 (b) 2H2O2 -> 2H2O + O2 (c) H2O2 -> H2O + O (d) H2O2 -> H2O + O2

162. 240. Rusting of iron, where iron reacts with oxygen and water to form iron oxides, is a slow process that falls under the general category of: (a) Neutralization (b) Oxidation (c) Photodecomposition (d) Saponification

163. 226. Which of the following is an example of a combination reaction? (a) 2HgO(s) ----> 2Hg(l) + O2(g) (b) N2(g) + 3H2(g) ----> 2NH3(g) (c) Zn(s) + CuSO4(aq) ----> ZnSO4(aq) + Cu(s) (d) BaCl2(aq) + Na2SO4(aq) ----> BaSO4(s) + 2NaCl(aq)

164. 314. When hydrogen sulfide gas (H2S) burns in air, it produces sulfur dioxide (SO2) and water (H2O). 2H2S(g) + 3O2(g) -> 2SO2(g) + 2H2O(l) In this reaction, which substance is oxidized? a) H2S b) O2 c) SO2 d) H2O

165. 245. What is the mass of 2 moles of sodium chloride (NaCl)? (Atomic masses: Na=23, Cl=35.5) a) 29.25 g b) 58.5 g c) 117 g d) 234 g

166. 24. In which state of matter are the intermolecular forces of attraction strongest? (a) Solid (b) Liquid (c) Gas (d) Plasma

167. 281. When sugar is stirred into water, it dissolves. If you keep adding sugar and stirring, eventually no more sugar dissolves and some solid sugar remains at the bottom. At this point, the solution is best described as: (a) Dilute (b) Unsaturated (c) Supersaturated (d) Saturated

168. 233. According to the activity series, which of the following reactions will occur? (a) Cu(s) + ZnSO4(aq) ----> (b) Ag(s) + KNO3(aq) ----> (c) Mg(s) + FeSO4(aq) ----> (d) Au(s) + HCl(aq) ---->

169. 247. Calculate the molar mass of hydrated copper(II) sulfate, CuSO4.5H2O. (Atomic masses: Cu=63.5, S=32, O=16, H=1) a) 159.5 g/mol b) 185.5 g/mol c) 249.5 g/mol d) 273.5 g/mol

170. 60. A substance is observed to be brittle, has a high melting point, and conducts electricity when molten but not when solid. These characteristics primarily describe: (a) An ionic compound (b) A metallic element (c) A covalent network solid (d) A molecular compound

171. 48. Which of these changes represents a physical change? (a) Burning of wood (b) Rusting of iron (c) Melting of ice (d) Digestion of food

172. 151. Which of the following best describes ionic bonding? (a) Sharing of electrons between two non-metal atoms. (b) Transfer of electrons from a metal atom to a non-metal atom. (c) Attraction between positive nuclei and a 'sea' of delocalized electrons. (d) Formation of hydrogen bonds between polar molecules.

173. 324. Which type of bond involves the transfer of electrons between atoms? a) Covalent bond b) Metallic bond c) Hydrogen bond d) Ionic bond

174. 173. Which of the following molecules contains a triple covalent bond? (a) O2 (Oxygen gas) (b) H2O (Water) (c) N2 (Nitrogen gas) (d) CO2 (Carbon dioxide)

175. 143. Consider the elements Potassium (K) and Chlorine (Cl). What type of chemical bond is expected to form between them? (a) Covalent bond, due to sharing of electrons. (b) Ionic bond, due to transfer of electrons. (c) Metallic bond, due to delocalized electrons. (d) Hydrogen bond, due to electrostatic attraction.

176. 255. Given the reaction: N2 + 3H2 -> 2NH3. If 2 moles of N2 react, what mass of NH3 will be produced? (Atomic masses: N=14, H=1) a) 17 g b) 34 g c) 51 g d) 68 g

177. 289. When chemical bonds are broken during a reaction, which of the following typically occurs? a) Energy is released. b) Energy is absorbed. c) No energy change occurs. d) Energy is converted into matter.

178. 329. What is the approximate molar mass of water (H_2O)? (Atomic masses: H=1 amu, O=16 amu) a) 17 g/mol b) 18 g/mol c) 32 g/mol d) 34 g/mol

179. 266. Which of the following is a characteristic of a true solution? (a) Its particles scatter a beam of light. (b) Its particles settle down on standing. (c) It is transparent and does not scatter light. (d) Its components can be separated by simple filtration.

180. 327. When the equation $Al + O_2 \rightarrow Al_2O_3$ is balanced, what is the coefficient for Al? a) 1 b) 2 c) 3 d) 4

181. 107. Elements in the same period of the periodic table share which of the following characteristics? (a) The same number of valence electrons (b) Similar chemical properties (c) The same number of electron shells (d) The same physical state at room temperature

182. 54. Which statement is true regarding chemical properties? (a) They can be observed without changing the substance's composition. (b) They describe how a substance interacts with energy. (c) They are measured only at high temperatures. (d) They describe a substance's potential to undergo chemical reactions.

183. 25. A state of matter that consists of super-energetic and super-excited particles, often found in stars and lightning, is called: (a) Liquid (b) Gas (c) Bose-Einstein Condensate (d) Plasma

184. 65. What is the maximum number of electrons that can occupy the first electron shell (n=1)? (a) 2 (b) 8 (c) 18 (d) 32

185. 262. For most solid solutes, what happens to their solubility in a liquid solvent as the temperature of the solvent increases? (a) It decreases (b) It increases (c) It remains unchanged (d) It first decreases then increases

186. 186. What is the chemical formula for calcium carbonate? (Calcium ion is Ca^{2+}, Carbonate ion is CO_3^{2-}) a) $CaCO_3$ b) $Ca(CO_3)_2$ c) Ca_2CO_3 d) $CaCO_2$

187. 2. An atom of an element has 6 protons, 6 neutrons, and 6 electrons. What is its atomic mass number? (a) 6 (b) 12 (c) 18 (d) It cannot be determined from the given information.

188. 109. An element is found to be a good conductor of heat and electricity, ductile, and malleable. It reacts vigorously with water to produce hydrogen gas. To which class of elements does it most likely belong? (a) Non-metals (b) Metalloids (c) Alkali metals (d) Noble gases

189. 192. What is the correct name for the compound N_2O_5? a) Dinitrogen pentoxide b) Nitrogen oxide c) Dinitrogen oxide d) Pentanitrogen dioxide

190. 64. Isotopes are atoms of the same element that differ in their: (a) Number of protons (b) Number of electrons (c) Number of neutrons (d) Atomic number

191. 180. Which of the following statements about valence electrons in covalent bonding is correct? (a) Valence electrons are transferred from one atom to another. (b) Valence electrons are shared equally between all atoms in a molecule. (c) Valence electrons are involved in the formation of shared pairs between atoms. (d) Valence electrons become delocalized and form a 'sea' around positive ions.

192. 20. Which state of matter is highly compressible due to large intermolecular spaces? (a) Solid (b) Liquid (c) Gas (d) Both liquid and gas

193. 306. In the reaction: CuO(s) + H2(g) -> Cu(s) + H2O(l), which substance undergoes reduction? a) CuO b) H2 c) Cu d) H2O

194. 296. A reaction profile diagram shows the energy of reactants and products. For an exothermic reaction, how would the energy level of the products compare to the reactants on such a diagram? a) Products would be at a higher energy level. b) Products would be at a lower energy level. c) Products and reactants would be at the same energy level. d) The diagram would only show activation energy.

195. 268. What effect does decreasing the partial pressure of a gas above a liquid have on the solubility of that gas in the liquid?

196. 89. The discovery of the electron is famously attributed to: a) Ernest Rutherford b) Niels Bohr c) J.J. Thomson d) James Chadwick

197. 47. What type of property describes a substance's ability to undergo a chemical reaction to form new substances? (a) Physical property (b) Chemical property (c) Intensive property (d) Extensive property

198. 99. Deuterium (2/1 H) and Protium (1/1 H) are isotopes of hydrogen. How many neutrons does Deuterium have? a) 0 b) 1 c) 2 d) 3

199. 231. When magnesium metal reacts with oxygen gas, the product formed is magnesium oxide. This reaction type is: (a) Decomposition (b) Combination (c) Single displacement (d) Double displacement

200. 191. An element X from Group 13 forms a compound with an element Y from Group 17. What is the most likely chemical formula for this compound? a) XY b) X2Y c) XY3 d) X3Y

201. 254. In the balanced chemical equation: 2H2 + O2 -> 2H2O, how many moles of oxygen are needed to react completely with 4 moles of hydrogen? a) 1 mole b) 2 moles c) 3 moles d) 4 moles

202. 227. The decomposition of potassium chlorate (KClO3) into potassium chloride (KCl) and oxygen gas (O2) is represented by which of the following equations? (a) KClO3(s) + O2(g) ----> KCl(s) + 2O2(g) (b) 2KClO3(s) ----> 2KCl(s) + 3O2(g) (c) KCl(s) + 3O2(g) ----> KClO3(s) (d) 2KClO3(s) ----> 2KCl(s) + O2(g)

203. 29. If the kinetic energy of particles in a substance decreases significantly, what is the most likely phase change to occur? (a) Melting (b) Evaporation (c) Freezing (d) Sublimation

204. 282. Which of the following statements is true regarding the solubility of gases in liquids? (a) Solubility of gases generally increases with increasing temperature. (b) Solubility of gases generally decreases with increasing temperature. (c) Temperature has no significant effect on gas solubility. (d) Solubility of gases is independent of pressure.

205. 278. Which of the following is an example of increasing the dilution of a solution? (a) Adding more solute to the solution. (b) Evaporating some solvent from the solution. (c) Adding more solvent to the solution. (d) Cooling the solution to decrease solubility.

206. 299. In many industrial processes, catalysts are used to speed up chemical reactions. Catalysts achieve this by: a) Increasing the overall energy change of the reaction. b) Decreasing the activation energy of the reaction. c) Making the reaction more endothermic. d) Providing more energy to the reactants.

207. 18. The process by which a solid directly changes into a gas without passing through the liquid state is called: (a) Condensation (b) Evaporation (c) Sublimation (d) Freezing

208. 310. Rusting of iron is an example of a redox reaction. In this process, iron is: a) Reduced by oxygen b) Oxidized by oxygen c) Reduced by water d) Oxidized by hydrogen

209. 207. Which of the following names clearly indicates a covalent compound? (a) Calcium chloride (b) Iron (III) oxide (c) Dihydrogen monoxide (d) Potassium nitrate

210. 184. Magnesium belongs to Group 2 and Oxygen belongs to Group 16 of the periodic table. What is the chemical formula for magnesium oxide? a) MgO2 b) Mg2O c) MgO d) Mg(OH)2

211. 321. Isotopes of an element have the same number of: a) Neutrons but different numbers of protons b) Protons but different numbers of neutrons c) Electrons but different numbers of protons d) Protons and neutrons

212. 229. When aqueous solutions of silver nitrate and sodium chloride are mixed, a white precipitate of silver chloride is formed. This is an example of a: (a) Single displacement reaction (b) Neutralization reaction (c) Combustion reaction (d) Double displacement reaction

213. 319. The nucleus of an atom contains: a) Protons and electrons b) Neutrons and electrons c) Protons and neutrons d) Protons, neutrons, and electrons

214. 76. Which of the following is considered a fundamental subatomic particle found in all atoms (excluding hydrogen-1's nucleus)? a) Alpha particle b) Photon c) Neutron d) Deuteron

215. 98. The notation (A/Z)X is used to represent an atom, where X is the element symbol, A is the mass number, and Z is the atomic number. For isotopes, which values would typically change? a) Only Z. b) Only A. c) Both A and Z. d) Neither A nor Z.

216. 261. Explain the principle "like dissolves like" in the context of solutions.

217. 112. An element has an atomic number of 18. Based on its position in the periodic table, what can be predicted about its reactivity? (a) It is highly reactive and forms ionic compounds. (b) It is moderately reactive and forms covalent compounds. (c) It is unreactive and does not readily form compounds. (d) It is highly reactive and forms acidic oxides.

218. 21. Naphthalene balls disappear over time without leaving any residue. This phenomenon is an example of: (a) Melting (b) Condensation (c) Evaporation (d) Sublimation

219. 204. The systematic name for H2SO4 is: (a) Hydrosulfuric acid (b) Sulfurous acid (c) Sulfuric acid (d) Hydrogen sulfate

220. 147. A molecule of oxygen (O2) is formed when two oxygen atoms share two pairs of electrons. This type of bond is known as a: (a) Single covalent bond. (b) Double covalent bond. (c) Triple covalent bond. (d) Ionic bond.

221. 188. What is the correct chemical formula for iron(III) oxide? a) FeO b) Fe2O3 c) Fe3O2 d) FeO3

222. 19. What effect does increasing the temperature typically have on the rate of evaporation of a liquid? (a) It decreases the rate of evaporation. (b) It increases the rate of evaporation. (c) It has no effect on the rate of evaporation. (d) It first decreases, then increases the rate of evaporation.

223. 169. Carbon dioxide (CO_2) is an example of a molecule containing which type of covalent bond(s)? (a) Only single bonds (b) Only double bonds (c) Both single and double bonds (d) One triple bond

224. 94. Carbon-12 and Carbon-14 are isotopes of carbon. What is the difference between these two atoms? a) Carbon-14 has two more protons than Carbon-12. b) Carbon-14 has two more electrons than Carbon-12. c) Carbon-14 has two more neutrons than Carbon-12. d) Carbon-12 has two more neutrons than Carbon-14.

225. 1. Which of the following is a physical property of matter? (a) Flammability (b) Reactivity with acid (c) Density (d) Ability to rust

226. 114. Which statement accurately describes the metallic character of elements across a period from left to right? (a) Metallic character increases. (b) Metallic character decreases. (c) Metallic character remains constant. (d) Metallic character increases, then decreases.

227. 164. The overall process of forming an ionic bond involves the release of energy, mainly due to the formation of the crystal lattice. This energy is known as: (a) Ionization energy (b) Electron affinity (c) Lattice energy (d) Bond dissociation energy

228. 13. Balance the following chemical equation: N_2 (g) + H_2 (g) ----------> NH_3 (g)

229. 120. How many electron shells does an element in Period 5 of the periodic table possess? (a) 1 (b) 3 (c) 5 (d) 7

230. 159. The repeating arrangement of positive and negative ions in an ionic compound is known as a: (a) Molecular lattice (b) Metallic lattice (c) Covalent network (d) Crystal lattice

231. 43. A student mixes sand and water in a beaker. This combination represents a: (a) Homogeneous mixture (b) Solution (c) Compound (d) Heterogeneous mixture

232. 118. Which of the following elements is a metalloid, exhibiting properties of both metals and non-metals? (a) Sodium (Na) (b) Silicon (Si) (c) Oxygen (O) (d) Neon (Ne)

233. 80. In a neutral atom, the number of electrons is always equal to the number of which subatomic particle? a) Neutrons b) Protons c) Quarks d) Isotopes

234. 304. A substance is said to be reduced if it: a) Gains oxygen b) Loses hydrogen c) Loses electrons d) Gains electrons

235. 161. The strength of an ionic bond is primarily dependent on: (a) The size of the atoms involved only. (b) The number of valence electrons only. (c) The charge of the ions and the distance between their nuclei. (d) The electronegativity difference between identical atoms.

236. 279. The term "concentration" in chemistry qualitatively refers to the: (a) Mass of the solvent. (b) Volume of the solution. (c) Amount of solute dissolved in a given amount of solvent or solution. (d) Purity of the solvent.

237. 113. As you move down a group in the periodic table, what generally happens to the atomic radius? (a) It decreases due to increased nuclear charge. (b) It increases due to the addition of new electron shells. (c) It remains constant as the number of valence electrons is the same. (d) It varies unpredictably due to differing isotopes.

238. 53. The process of evaporating water from a salt solution to obtain pure salt relies on which type of property difference? (a) Chemical properties (b) Intensive chemical properties (c) Physical properties (d) Reactivity properties

239. 126. Which of the following elements is expected to have the highest electronegativity? (a) Cesium (Cs) (b) Fluorine (F) (c) Oxygen (O) (d) Nitrogen (N)

240. 36. Which of the following is a heterogeneous mixture? (a) Sugar dissolved in water (b) Salt dissolved in water (c) Milk (d) Brass (an alloy of copper and zinc)

241. 288. Which of the following is an example of an endothermic process? a) Burning of wood b) Neutralization of an acid by a base c) Melting of ice d) Respiration in living organisms

242. 269. Explain why oil and water do not mix to form a homogeneous solution.

243. 217. Which of the following chemical equations is already balanced? (a) C2H6 + O2 -> CO2 + H2O (b) N2 + 3H2 -> 2NH3 (c) KClO3 -> KCl + O2 (d) H2SO4 + NaOH -> Na2SO4 + H2O

244. 150. Which noble gas configuration is achieved by the fluoride ion (F-) in an ionic compound? (a) Helium configuration (b) Neon configuration (c) Argon configuration (d) Krypton configuration

245. 75. The nucleus of an atom contains: (a) Protons and electrons (b) Neutrons and electrons (c) Protons and neutrons (d) Protons, neutrons, and electrons

246. 97. How are isotopes of an element represented on the periodic table? a) Each isotope has its own unique box on the periodic table. b) Only the most abundant isotope is represented. c) All isotopes are grouped together in one box, represented by the average atomic mass. d) Isotopes are listed as sub-entries under the main element.

247. 110. The elements Fluorine (F), Chlorine (Cl), Bromine (Br), and Iodine (I) are all found in the same group on the periodic table. Which property do they most likely share? (a) They are all gases at room temperature. (b) They tend to form positive ions in reactions. (c) They have seven valence electrons. (d) They are unreactive.

248. 133. When comparing the reactivity of metals in Group 1 of the periodic table, what trend is observed as you move down the group? (a) Reactivity decreases because atomic size increases, making it harder to lose electrons. (b) Reactivity increases because atomic size increases, making it easier to lose electrons. (c) Reactivity decreases because ionization energy increases. (d) Reactivity remains constant as they all have one valence electron.

249. 222. When aluminum (Al) reacts with copper(II) chloride (CuCl2) to produce aluminum chloride (AlCl3) and copper (Cu), the balanced equation shows that for every 2 moles of aluminum, how many moles of copper are produced? (a) 1 (b) 2 (c) 3 (d) 4

250. 58. Which of the following physical properties would be most useful for separating a mixture of sand and iron filings? (a) Density (b) Color (c) Magnetism (d) Solubility

251. 139. An atom of sodium (Na) with 1 valence electron is most likely to form a chemical bond by: (a) Gaining seven electrons to achieve a stable octet. (b) Sharing its one electron with another atom. (c) Losing its one valence electron to achieve a stable octet. (d) Accepting a proton to balance its charge.

252. 117. Elements that are considered "transition metals" are found in which part of the periodic table? (a) The far left (Groups 1 and 2) (b) The far right (Groups 17 and 18) (c) The middle section (Groups 3-12) (d) The bottom two rows (Lanthanides and Actinides)

253. 301. Which of the following best describes the process of oxidation in terms of oxygen transfer? a) Removal of oxygen b) Addition of oxygen c) Addition of hydrogen d) Removal of electrons

254. 40. In an element, all atoms present: (a) Must have the same number of neutrons. (b) Have the same atomic number (number of protons). (c) Are always chemically bonded to each other. (d) Can be separated by simple physical means.

255. 273. If you add a tiny crystal of solute to an unknown solution and it dissolves immediately, the original solution was most likely: (a) Saturated (b) Supersaturated (c) Unsaturated (d) Precipitated

256. 168. Which of the following is a general property of most simple covalent compounds? (a) High melting and boiling points (b) Good electrical conductivity in solid state (c) Low melting and boiling points (d) Soluble in all polar and non-polar solvents

257. 181. Which of the following represents a chemical formula? a) 2H b) H_2O c) O + O d) Air

258. 312. In the reaction $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$, which substance is the reducing agent? a) Fe_2O_3 b) CO c) Fe d) CO_2

259. 105. Considering the definition of isotopes, what can be concluded about their position on the Periodic Table? a) Each isotope occupies a separate position on the Periodic Table. b) Isotopes of an element are represented together in the same position on the Periodic Table. c) Only the most abundant isotope of an element is shown on the Periodic Table. d) Isotopes are not represented on the Periodic Table at all.

260. 8. Isotopes of the same element have the same number of protons but different numbers of neutrons. Section: Fill-in-the-Blank Questions

261. 77. What is the approximate relative mass of an electron compared to a proton? a) About 1 times the mass of a proton b) About 1836 times the mass of a proton c) About 1/1836 times the mass of a proton d) Negligible, effectively zero

262. 70. The atomic number of Carbon is 6. How many valence electrons does a neutral Carbon atom have? (a) 2 (b) 4 (c) 6 (d) 8

263. 100. A common application of radioactive isotopes is in: a) Enhancing the strength of materials. b) Sterilizing medical equipment and tracing biological pathways. c) Changing the color of plastics. d) Increasing the boiling point of water.

264. 83. An atom has 17 protons, 18 neutrons, and 17 electrons. What is its mass number? a) 17 b) 18 c) 34 d) 35

265. 287. In an endothermic reaction, which of the following is true regarding the energy of the products and reactants? a) The products have lower energy than the reactants. b) The products have higher energy than the reactants. c) The products and reactants have equal energy. d) The energy change depends solely on the activation energy.

266. 165. How many electrons are transferred when one atom of potassium (K) reacts with one atom of bromine (Br) to form potassium bromide (KBr)? (a) 1 electron is transferred from Br to K. (b) 2 electrons are transferred from K to Br. (c) 1 electron is transferred from K to Br. (d) No electrons are transferred, they are shared.

267. 45. A sample of matter is found to have varying density throughout and different parts can be seen with the naked eye. This sample is most likely a: (a) Pure element (b) Pure compound (c) Homogeneous mixture (d) Heterogeneous mixture

268. 162. Ionic compounds are generally soluble in: (a) Non-polar solvents like hexane. (b) Polar solvents like water. (c) Metallic solvents like mercury. (d) All types of solvents.

269. 67. An atom of an element has an atomic number of 9 and a mass number of 19. How many neutrons does this atom contain? (a) 9 (b) 10 (c) 19 (d) 28

270. 235. A chemical reaction that absorbs heat from its surroundings is classified as: (a) Exothermic (b) Combustion (c) Endothermic (d) Redox

271. 232. Barium carbonate ($BaCO_3$) decomposes upon heating to form barium oxide (BaO) and carbon dioxide (CO_2). This is a: (a) Synthesis reaction (b) Displacement reaction (c) Decomposition reaction (d) Neutralization reaction

272. 160. Which pair of elements would most readily form an ionic bond? (a) Carbon and Oxygen (b) Nitrogen and Hydrogen (c) Sodium and Chlorine (d) Silicon and Fluorine

273. 72. Which element is represented by an atom with 20 protons? (a) Neon (Ne) (b) Calcium (Ca) (c) Argon (Ar) (d) Potassium (K)

274. 42. Which statement accurately differentiates between a mixture and a compound? (a) Mixtures are always heterogeneous, while compounds are always homogeneous. (b) The components of a mixture retain their individual properties, while a compound has new properties. (c) Compounds can be separated by physical means, but mixtures require chemical means. (d) Mixtures have a fixed boiling point, while compounds have a range of boiling points.

275. 9. An atom that gains electrons becomes a negatively charged ion called a(n) _____.

276. 198. The chemical name for $Ca(NO_3)_2$ is: (a) Calcium dinitrate (b) Calcium nitrate (c) Calcium nitrogen trioxide (d) Calcium nitrite

277. 297. Which of the following physical changes involves the absorption of energy? a) Condensation of water vapor b) Freezing of water c) Sublimation of dry ice d) Burning of a candle

278. 212. Consider the unbalanced equation: $H_2 + Cl_2 \rightarrow HCl$. What is the sum of the smallest whole number coefficients after balancing this equation? (a) 3 (b) 4 (c) 2 (d) 5

279. 84. Two atoms are isotopes of the same element if they have the same number of: a) Protons and neutrons b) Protons but different numbers of neutrons c) Neutrons but different numbers of protons d) Electrons and protons

280. 41. When atoms combine to form a compound, they do so: (a) In variable ratios, retaining their individual properties. (b) In fixed ratios by mass, forming new substances with new properties. (c) Through simple mixing, without any chemical change. (d) By losing their electrons completely to become ions.

281. 108. Which of the following groups of elements primarily contains metals? (a) Group 17 (Halogens) (b) Group 18 (Noble Gases) (c) Group 1 (Alkali Metals) (d) Group 14 (Carbon Group)

282. 125. Electronegativity is a measure of an atom's ability to attract shared electrons in a chemical bond. Which of the following statements is true regarding electronegativity trends? (a) It generally decreases across a period and increases down a group. (b) It generally increases across a period and increases down a group. (c) It generally increases across a period and decreases down a group. (d) It generally decreases across a period and decreases down a group.

283. 59. Gold is known to be unreactive with most common acids. This describes gold's: (a) Malleability (b) Ductility (c) Chemical inertness (d) High density

284. 178. What is the maximum number of covalent bonds a single carbon atom can typically form according to the octet rule? (a) 1 (b) 2 (c) 3 (d) 4

285. 68. When an atom loses an electron, it forms a: (a) Cation (b) Anion (c) Isotope (d) Neutral atom

286. 4. The chemical formula for sodium carbonate is Na2CO3. What is the total number of atoms in one formula unit of sodium carbonate? (a) 3 (b) 4 (c) 5 (d) 6

287. 86. An atom becomes a positive ion (cation) when it: a) Gains protons b) Loses electrons c) Gains neutrons d) Loses protons

288. 211. Which law forms the fundamental basis for balancing chemical equations? (a) Law of Multiple Proportions (b) Law of Conservation of Energy (c) Law of Conservation of Mass (d) Law of Definite Proportions

289. 6. A liquid has a definite volume but an indefinite shape.

290. 211. What is the name of the compound Al(OH)3? (a) Aluminum hydroxide (b) Aluminum (III) hydroxide (c) Trialuminum hydroxide (d) Aluminum trihydroxide

291. 152. When a sodium atom (Na) forms an ionic bond, it typically: (a) Gains one electron to become Na-. (b) Loses one electron to become Na+. (c) Gains two electrons to become Na2-. (d) Shares electrons with another atom.

292. 177. A molecule like HCl (hydrogen chloride) has a bond where electrons are shared unequally. This type of bond is called a: (a) Pure covalent bond (b) Non-polar covalent bond (c) Polar covalent bond (d) Ionic bond

293. 129. Non-metallic character is associated with the tendency to gain electrons. What is the general trend for non-metallic character down a group in the periodic table? (a) It increases. (b) It decreases. (c) It remains constant. (d) It first decreases then increases.

294. 3. Which of the following is an example of a homogeneous mixture? (a) Sand and water (b) Oil and vinegar (c) Salt dissolved in water (d) Blood

295. 267. Give one common example of a solid-solid solution.

296. 249. What is the number of molecules in 28 grams of nitrogen gas (N2)? (Atomic mass: N=14) a) 6.022 x 10^23 molecules b) 3.011 x 10^23 molecules c) 1.2044 x 10^24 molecules d) 14 molecules

297. 313. Which of the following statements is INCORRECT? a) Oxidation involves loss of electrons. b) Reduction involves gain of electrons. c) An oxidizing agent is itself reduced. d) A reducing agent is itself reduced.

298. 220. What is the total number of oxygen atoms present on the product side of the unbalanced equation: C6H12O6 + O2 -> CO2 + H2O? (a) 2 (b) 3 (c) 4 (d) 5

299. 106. Which of the following statements best describes the primary basis for the arrangement of elements in the modern periodic table? (a) Increasing atomic mass (b) Increasing number of neutrons (c) Increasing atomic number (d) Increasing number of isotopes

300. 187. The formula for aluminum sulfate is: (Aluminum ion is Al3+, Sulfate ion is SO42-) a) AlSO4 b) Al2(SO4)3 c) Al3SO4 d) Al(SO4)2

301. 243. How many molecules are present in 0.5 moles of carbon dioxide (CO2)? a) 3.011 x 10^23 molecules b) 6.022 x 10^23 molecules c) 1.204 x 10^24 molecules d) 0.5 molecules

302. 121. Which of the following statements correctly describes the trend in atomic radius across a period from left to right in the periodic table? (a) It generally increases due to increasing effective nuclear charge. (b) It generally decreases due to increasing effective nuclear charge. (c) It generally increases due to increasing number of electron shells. (d) It generally decreases due to increasing number of electron shells.

303. 221. If the coefficient of potassium nitrate (KNO3) in the balanced decomposition reaction of potassium nitrate (KNO3 -> KNO2 + O2) is 2, what is the coefficient for oxygen (O2)? (a) 1 (b) 2 (c) 3 (d) 4

304. 256. A solution is best described as: (a) A pure substance (b) A heterogeneous mixture (c) A homogeneous mixture (d) A compound

305. 39. Air is best classified as a/an: (a) Element (b) Compound (c) Homogeneous mixture (d) Heterogeneous mixture

306. 63. An atom has 15 protons, 16 neutrons, and 15 electrons. What is its mass number? (a) 15 (b) 16 (c) 30 (d) 31

307. 291. A chemical reaction feels warm to the touch. This indicates that the reaction: a) Absorbs heat from your hand, making it feel cool. b) Releases heat to your hand, making it feel warm. c) Converts chemical energy into light energy. d) Has a very high activation energy.

308. 286. Which statement best describes an exothermic reaction? a) A reaction that absorbs heat from its surroundings. b) A reaction that releases heat to its surroundings. c) A reaction that requires light energy to proceed. d) A reaction that only occurs at high temperatures.

309. 260. Which of the following is an example of a gas dissolved in a liquid solution? (a) Air (b) Brass (c) Carbonated soft drink (d) Fog

310. 90. An atom of oxygen-18 (18O) differs from an atom of oxygen-16 (16O) primarily in its number of: a) Protons b) Electrons c) Neutrons d) Positrons

311. 15. Identify whether the following reaction involves oxidation and reduction: Zn (s) + CuSO4 (aq) ----------> ZnSO4 (aq) + Cu (s) Justify your answer by explaining what happens to the oxidation state of Zn and Cu.

312. 252. What is the percentage by mass of oxygen in potassium permanganate (KMnO4)? (Atomic masses: K=39, Mn=55, O=16) a) 25.3% b) 31.6% c) 40.5% d) 63.2%

313. 55. Density is a physical property defined as mass per unit volume. How does density help distinguish between different substances? (a) It changes a substance's chemical composition. (b) It indicates a substance's reactivity. (c) It is a unique characteristic for pure substances at constant conditions. (d) It depends on the amount of substance present.

314. 322. Elements in the same group (vertical column) of the periodic table typically have: a) The same number of protons b) Similar chemical properties c) The same atomic mass d) Similar physical states at room temperature

315. 283. If you have 50 mL of a concentrated sulfuric acid solution and you want to make it less hazardous to handle, you should: (a) Add more sulfuric acid to it. (b) Evaporate some water from it. (c) Slowly and carefully add water to it while stirring. (d) Cool the solution to a very low temperature.

316. 85. Which subatomic particle is negatively charged and orbits the nucleus? a) Proton b) Neutron c) Electron d) Positron

317. 115. Which scientist is credited with organizing the first widely accepted periodic table, leaving gaps for undiscovered elements and predicting their properties? (a) John Dalton (b) J.J. Thomson (c) Dmitri Mendeleev (d) Ernest Rutherford

318. 195. What is the chemical formula for ammonium phosphate? (Ammonium ion is NH4+, Phosphate ion is PO43-) a) NH4PO4 b) (NH4)3PO4 c) NH4(PO4)3 d) (NH4)2PO4

319. 28. The energy required to change a unit mass of a substance from liquid to gas at its boiling point without any change in temperature is called: (a) Specific heat capacity (b) Latent heat of fusion (c) Latent heat of vaporization (d) Heat of combustion

320. 197. Choose the correct name for the compound N2O4. (a) Nitrogen oxide (b) Dinitrogen tetroxide (c) Dinitrogen tetraoxide (d) Nitrogen tetroxide

321. 91. What are isotopes? a) Atoms of the same element with different numbers of protons. b) Atoms of different elements with the same number of neutrons. c) Atoms of the same element with different numbers of neutrons. d) Atoms of different elements with the same mass number.

322. 81. An element's identity is uniquely determined by the number of its: a) Neutrons b) Electrons c) Protons d) Valence electrons

323. 218. When magnesium metal reacts with oxygen gas to form solid magnesium oxide, the correctly balanced chemical equation is: (a) Mg + O -> MgO (b) 2Mg + O2 -> 2MgO (c) Mg + O2 -> MgO2 (d) Mg + 2O -> MgO

324. 104. Which of the following is true regarding the physical properties of isotopes? a) Physical properties such as density and boiling point are identical for all isotopes. b) Physical properties can vary slightly due to differences in mass. c) Physical properties are only affected by the number of electrons. d) Physical properties are solely determined by the atomic number.

325. 210. The correct formula for Chromium (III) carbonate is: (a) $CrCO_3$ (b) $Cr_3(CO_3)_2$ (c) $Cr_2(CO_3)_3$ (d) $Cr(CO_3)_3$

326. 50. Which of the following is NOT considered a physical property of matter? (a) Color (b) Density (c) Hardness (d) Corrosiveness

327. 92. Which statement correctly describes isotopes of the same element? a) They have the same mass number but different atomic numbers. b) They have the same number of protons but different numbers of neutrons. c) They have different numbers of protons and different numbers of electrons. d) They have different atomic numbers but the same number of neutrons.

328. 246. How many moles are present in 49 grams of sulfuric acid (H_2SO_4)? (Atomic masses: H=1, S=32, O=16) a) 0.25 mol b) 0.5 mol c) 1 mol d) 2 mol

329. 244. A sample contains 1.8066×10^{24} atoms of helium. How many moles of helium are in the sample? a) 0.3 moles b) 1 mole c) 2 moles d) 3 moles

330. 170. Which pair of elements is most likely to form a covalent bond? (a) Sodium and Chlorine (b) Magnesium and Oxygen (c) Carbon and Oxygen (d) Potassium and Bromine

ANSWER KEY

1. (b)
2. (d)
3. (c)
4. (c)
5. (c)
6. (b)
7. (c)
8. (c)
9. (a)
10. (c)
11. (c)
12. (c)
13. (c)
14. (c)
15. (b)
16. (c)
17. (b)
18. (a)
19. (c)
20. (d)
21. (c)
22. (c)
23. (c)
24. (b)
25. (b)
26. (a)
27. (c)

28. (c)

29. (b)

30. (a)

31. (b)

32. (b)

33. (c)

34. (c)

35. (c)

36. (c)

37. (a)

38. (Explanation)

39. (c)

40. (b)

41. N/A

42. (b)

43. (c)

44. (b)

45. (c)

46. (b)

47. (c)

48. (b)

49. (c)

50. (b)

51. (b)

52. (b)

53. (b)

54. (b)

55. (a)

56. (d)

57. (b)

58. (b)

59. (a)

60. (c)

61. N/A

62. Unit for amount of substance; approx. 6.022 x 10^23 particles.

63. (c)

64. (c)

65. (c)

66. (b)

67. (c)

68. (c)

69. (b)

70. (c)

71. (b)

72. N/A

73. (c)

74. (b)

75. (b)

76. N/A

77. (b)

78. (b)

79. (c)

80. (c)

81. (c)

82. (b)

83. (c)

84. (b)

85. (a)

86. (b)

87. (b)

88. (d)

89. (b)

90. (c)

91. (b)

92. (b)

93. (c)

94. (b)

95. (d)

96. (b)

97. (b)

98. (d)

99. (b)

100. (c)

101. (c)

102. (c)

103. (c)

104. (a)

105. sublimation

106. (b)

107. Ionic: electrons transferred; Covalent: electrons shared.

108. (d)

109. N/A

110. False

111. (c)

112. (a)

113. (b)

114. (d)

115. (b)

116. (c)

117. (c)

118. (c)

119. (b)

120. endothermic

121. (b)

122. N/A

123. (a)

124. (c)

125. (d)

126. (b)

127. (c)

128. (c)

129. (b)

130. (b)

131. N/A

132. (c)

133. (c)

134. (b)

135. (b)

136. (b)

137. (a)

138. (c)

139. (c)

140. (c)

141. (c)

142. (b)

143. (c)

144. (c)

145. (b)

146. (c)

147. (b)

148. (c)

149. (b)

150. (a)

151. (Differentiation)

152. (c)

153. (c)

154. (b)

155. (a)

156. (c)

157. (c)

158. (c)

159. (Definition)

160. (c)

161. (b)

162. N/A

163. N/A

164. (a)

165. (c)

166. (a)

167. (d)

168. N/A

169. (c)

170. (a)

171. (c)

172. (b)

173. (d)

174. (c)

175. (b)

176. (d)

177. (b)

178. (b)

179. (c)

180. (d)

181. (c)

182. (d)

183. (d)

184. (a)

185. (b)

186. (a)

187. (b)

188. (c)

189. (a)

190. (c)

191. (c)

192. (c)

193. (a)

194. (b)

195. (Explanation)

196. (c)

197. (b)

198. (b)

199. N/A

200. (c)

201. (b)

202. N/A

203. (c)

204. (b)

205. (c)

206. (b)

207. (c)

208. (b)

209. (c)

210. (c)

211. (b)

212. N/A

213. (c)

214. (c)

215. (b)

216. (Explanation)

217. (c)

218. (d)

219. (c)

220. (b)

221. (b)

222. (b)

223. (b)

224. (c)

225. (c)

226. (b)

227. (c)

228. $N_2 (g) + 3H_2 (g) \text{----------} > 2NH_3 (g)$

229. (c)

230. (d)

231. (d)

232. (b)

233. (b)

234. (d)

235. (c)

236. (c)

237. (b)

238. (c)

239. (b)

240. (c)

241. (c)

242. (Explanation)

243. (b)

244. (b)

245. (c)

246. (c)

247. (c)

248. (b)

249. (c)

250. (c)

251. (c)

252. (c)

253. (b)

254. (b)

255. (c)

256. (c)

257. (b)

258. (b)

259. (b)

260. True

261. (c)

262. (b)

263. (b)

264. (d)

265. (b)

266. (c)

267. (d)

268. (b)

269. (b)

270. N/A

271. N/A

272. (c)

273. (b)

274. (b)

275. anion

276. (b)

277. (c)

278. (b)

279. (b)

280. (b)

281. (c)

282. (c)

283. (c)

284. (d)

285. (a)

286. (d)

287. (b)

288. (c)

289. True

290. (a)

291. (b)

292. (c)

293. (b)

294. (c)

295. (Example)

296. (a)

297. (d)

298. (b)

299. (c)

300. (b)

301. (a)

302. (b)

303. (a)

304. (c)

305. (c)

306. (d)

307. (b)

308. (b)

309. (c)

310. (c)

311. Yes. Zn is oxidized (0 to +2); Cu is reduced (+2 to 0).

312. (c)

313. (c)

314. (b)

315. (c)

316. (c)

317. (c)

318. (b)

319. (c)

320. (b)

321. (c)

322. (c)

323. (b)

324. (b)

325. (c)

326. (d)

327. (b)

328. (b)

329. (d)

330. (c)