FINAL QUESTION PAPER

1. 74. A neutral atom of an element has 20 electrons. How many protons does it have? (a) 10 (b) 20 (c) 30 (d) 40

2. 324. What is the primary driving force for atoms to form chemical bonds? a) To increase their mass b) To achieve a stable electron configuration c) To decrease their atomic number d) To become radioactive

3. 277. A solution that contains more dissolved solute than a saturated solution at the same temperature is called a(n): (a) Unsaturated solution (b) Supersaturated solution (c) Dilute solution (d) Concentrated solution

4. 190. Which of the following compounds requires a Roman numeral in its name? (a) NaCl (b) $AlCl_3$ (c) $MgCl_2$ (d) $FeCl_2$

5. 319. In which state of matter do particles have the most energy and are farthest apart? a) Solid b) Liquid c) Gas d) Plasma

6. 22. In which state of matter do particles possess the least kinetic energy? (a) Solid (b) Liquid (c) Gas (d) Plasma

7. 80. An atom of Oxygen-16 (^{16}O) has 8 protons and 8 neutrons. How many neutrons would an atom of Oxygen-18 (^{18}O) have? a) 8 b) 9 c) 10 d) 11

8. 184. Identify the correct chemical formula for dinitrogen monoxide. (a) NO (b) N_2O (c) NO_2 (d) N_2O_2

9. 168. Which of the following is the correct chemical formula for potassium sulfide? (a) K_2S (b) KS (c) K_2S_3 (d) KS_2

10. 87. How are isotopes of an element represented on the periodic table? a) Each isotope has its own separate box on the periodic table. b) Only the most abundant isotope is shown for each element. c) The periodic table typically lists the average atomic mass, which accounts for the natural abundance of isotopes. d) Isotopes are listed as footnotes at the bottom of the periodic table.

11. 143. An element from Group 1 reacts with an element from Group 17. What type of bond is most likely to form between them? a) Covalent bond b) Metallic bond c) Ionic bond d) Hydrogen bond

12. 102. What is the term for the horizontal rows of the periodic table? (a) Families (b) Groups (c) Series (d) Periods

13. 93. How many periods are there in the modern periodic table? (a) 8 (b) 18 (c) 7 (d) 10

14. 2. What is the approximate mass of a proton? a) 0 amu b) 1 amu c) -1 amu d) +1 amu

15. 290. Consider the energy diagram for a chemical reaction where the energy level of the reactants is higher than the energy level of the products. This diagram represents: a) An endothermic reaction. b) An exothermic reaction. c) A reaction with zero activation energy. d) A reversible reaction at equilibrium.

16. 155. Which of the following compounds contains a double covalent bond? (a) Methane (CH_4) (b) Ammonia (NH_3) (c) Oxygen (O_2) (d) Hydrogen Chloride (HCl)

17. 238. Which statement best describes a precipitation reaction? a) A reaction where a gas is produced. b) A reaction that releases a significant amount of heat. c) A reaction where an insoluble solid forms from two aqueous solutions. d) A reaction that involves the breaking down of a single compound.

18. 144. The strong electrostatic forces between oppositely charged ions in an ionic compound lead to the formation of a rigid, three-dimensional structure. What is this structure called? a) Molecular lattice b) Covalent network c) Crystal lattice d) Amorphous solid

19. 91. What is the primary basis for the arrangement of elements in the modern periodic table? (a) Atomic mass (b) Number of neutrons (c) Atomic number (d) Chemical reactivity

20. 271. Which term best describes a solution that contains a small amount of solute relative to the amount of solvent? (a) Concentrated (b) Dilute (c) Saturated (d) Supersaturated

21. 127. Which of the following compounds is predominantly formed by covalent bonding? (a) MgO (magnesium oxide) (b) NH_3 (ammonia) (c) LiBr (lithium bromide) (d) K_2O (potassium oxide)

22. 263. When an ionic compound like NaCl dissolves in water, the ions become surrounded by water molecules. This process is called: (a) Precipitation (b) Crystallization (c) Hydration (d) Saturation

23. 100. The elements located between Group 2 and Group 13 in periods 4-7 are collectively known as: (a) Alkali metals (b) Alkaline earth metals (c) Transition metals (d) Inner transition metals

24. 109. Which of the following properties is characteristic of elements with strong metallic character? a) High ionization energy b) Tendency to gain electrons c) Low electronegativity d) Formation of acidic oxides

25. 27. The state of matter found in fluorescent lights and neon signs, characterized by super-energetic and super-excited particles, is known as: (a) Liquid (b) Gas (c) Plasma (d) Bose-Einstein Condensate

26. 194. The chemical formula for lead (IV) oxide is: (a) PbO (b) Pb_2O (c) PbO_2 (d) Pb_4O

27. 193. What is the correct name for the compound N_2O_4? (a) Nitrogen tetroxide (b) Dinitrogen tetroxide (c) Dinitrogen oxide (d) Dinitrogen tetraoxygen

28. 220. If a chemical equation shows different numbers of atoms of a specific element on the reactant side compared to the product side, it is: (a) A synthesis reaction. (b) An exothermic reaction. (c) An unbalanced equation. (d) A balanced equation.

29. 242. Avogadro's number represents the number of particles (atoms, molecules, ions, etc.) in one mole of any substance. What is its approximate value? (a) 6.022×10^{22} (b) 6.022×10^{23} (c) 6.022×10^{-23} (d) 1.000×10^{23}

30. 35. The property of a metal that allows it to be hammered or pressed permanently out of shape without breaking or cracking is called: (a) Ductility (b) Brittleness (c) Malleability (d) Conductivity

31. 131. An atom that has gained one or more electrons becomes an ion with a net negative charge, which is called a(n): (a) Cation (b) Anion (c) Isotope (d) Radical

32. 95. Which of the following elements is a metalloid? (a) Calcium (Ca) (b) Oxygen (O) (c) Silicon (Si) (d) Copper (Cu)

33. 10. Write the chemical formula for the compound formed between calcium ions (Ca2+) and phosphate ions (PO4^3-).

34. 16. Which of the following statements accurately describes the characteristics of a solid? (a) Particles are far apart and move randomly. (b) Has a definite volume but no definite shape. (c) Possesses both a definite shape and a definite volume. (d) Can be easily compressed to a smaller volume.

35. 174. An ion X forms a compound with oxygen with the formula X2O. What is the most likely charge on the ion X? (a) +1 (b) +2 (c) -1 (d) -2

36. 3. Which of the following is a physical property of matter? a) Flammability b) Reactivity with acid c) Boiling point d) Ability to rust

37. 112. Non-metallic character generally increases across a period from left to right. This is primarily because: a) The atomic radius increases, making it easier to gain electrons. b) The electronegativity increases, leading to a stronger tendency to gain electrons. c) The ionization energy decreases, making it easier to lose electrons. d) The number of valence electrons decreases, making the atom more stable.

38. 208. The complete combustion of propane (C3H8) produces carbon dioxide and water. What is the sum of the coefficients of the products in the balanced chemical equation? (a) 5 (b) 6 (c) 7 (d) 8

39. 71. Which subatomic particle was the last to be discovered among protons, neutrons, and electrons? (a) Proton (b) Neutron (c) Electron (d) They were discovered simultaneously.

40. 38. The process of burning wood produces ash, smoke, and gases. This is an example of a change involving: (a) Only physical properties (b) Primarily chemical properties (c) Extensive properties only (d) Intensive properties only

41. 243. What is the molar mass of oxygen gas (O2)? (Given atomic mass of O = 16.0 g/mol) (a) 16.0 g/mol (b) 8.0 g/mol (c) 32.0 g/mol (d) 1.0 g/mol

42. 149. What is the correct formula for the ionic compound formed between Aluminum ions (Al3+) and Sulfate ions (SO4 2-)? a) Al2SO4 b) Al(SO4)3 c) Al2(SO4)3 d) Al3(SO4)2

43. 19. Which of the following involves an endothermic change of state? (a) Water vapor turning into liquid water. (b) Liquid water turning into ice. (c) Naphthalene solid turning into naphthalene gas. (d) Molten lead solidifying.

44. 312. Explain why the term "redox reaction" is used for reactions involving both oxidation and reduction.

45. 250. What volume would 0.50 moles of nitrogen gas (N2) occupy at Standard Temperature and Pressure (STP)? (a) 11.2 L (b) 22.4 L (c) 5.6 L (d) 44.8 L

46. 264. An aqueous solution is one in which the solvent is: (a) Alcohol (b) Ether (c) Water (d) Benzene

47. 219. What is the coefficient of H_2O when the equation $Fe_2O_3 + CO \rightarrow Fe + CO_2$ is balanced? (a) 1 (b) 2 (c) 3 (d) There is no H_2O in this reaction.

48. 288. When methane gas (CH_4) burns in oxygen, a significant amount of heat and light are produced. This chemical reaction is an example of: a) An endothermic process. b) An exothermic process. c) A decomposition process. d) A reversible process.

49. 57. Which of the following statements about an anion is true? a) It has more protons than electrons. b) It has a net positive charge. c) It has gained electrons. d) It is formed by losing protons.

50. 308. Which of the following is an example of a redox reaction? (a) $HCl + NaOH \rightarrow NaCl + H_2O$ (b) $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$ (c) $C + O_2 \rightarrow CO_2$ (d) $CaCO_3 \rightarrow CaO + CO_2$ Section: Short Answer / Identification Questions

51. 276. When no more solute can dissolve in a given amount of solvent at a specific temperature, the solution is considered: (a) Dilute (b) Unsaturated (c) Supersaturated (d) Saturated

52. 269. A solution that holds more solute than is normally possible at a given temperature, often formed by carefully cooling a saturated solution, is a: (a) Saturated solution (b) Unsaturated solution (c) Supersaturated solution (d) Dilute solution

53. 227. The reaction $CaCO_3 (s) \rightarrow CaO (s) + CO_2 (g)$ is an example of which type of chemical reaction? a) Combination b) Decomposition c) Single Displacement d) Double Displacement

54. 214. Consider the unbalanced equation: $C_2H_6 + O_2 \rightarrow CO_2 + H_2O$. What is the coefficient for O_2 when the equation is balanced using the smallest whole number integers? (a) 2 (b) 3 (c) 5 (d) 7

55. 114. Arrange the following elements in order of increasing atomic radius: Cl, F, Br, I. a) F < Cl < Br < I b) I < Br < Cl < F c) F < Br < Cl < I d) Cl < F < I < Br

56. 53. Rutherford's gold foil experiment led to the conclusion that: a) Atoms are indivisible. b) The atom is a uniformly positive sphere. c) The atom has a small, dense, positively charged nucleus. d) Electrons revolve in fixed orbits.

57. 5. Elements in the same group of the periodic table typically have the same number of: a) Protons b) Neutrons c) Valence electrons d) Total electrons

58. 146. Ionic compounds generally have very high melting points. This is due to: a) Weak intermolecular forces between molecules. b) Strong covalent bonds within the crystal lattice. c) Strong electrostatic forces between ions in the crystal lattice. d) The presence of delocalised electrons that require a lot of energy to move.

59. 161. How many shared electron pairs are there in a molecule of methane (CH_4)? (a) 1 (b) 2 (c) 3 (d) 4

60. 28. Which of the following correctly orders the states of matter from highest to lowest density for most substances? (a) Gas > Liquid > Solid (b) Solid > Liquid > Gas (c) Liquid > Solid > Gas (d) Solid > Gas > Liquid

61. 84. An atom of hydrogen normally has one proton and zero neutrons. Which of the following represents an isotope of hydrogen containing one proton and two neutrons? a) Protium b) Deuterium c) Tritium d) Helium

62. 294. A catalyst speeds up a chemical reaction by: a) Increasing the activation energy. b) Decreasing the activation energy. c) Changing the overall energy change (enthalpy) of the reaction. d) Increasing the energy of the products.

63. 258. Which of the following is an example of a gas dissolving in a liquid? (a) Sugar dissolving in water. (b) Salt dissolving in water. (c) Carbon dioxide dissolving in soda water. (d) Alcohol dissolving in water.

64. 252. A compound is found to contain 40.0% carbon, 6.7% hydrogen, and 53.3% oxygen by mass. Which of the following could be its empirical formula? (Given atomic masses: C = 12.0, H = 1.0, O = 16.0) (a) CHO (b) CH2O (c) C2H2O (d) C2H3O2

65. 270. Which of the following statements is true regarding a dilute solution compared to a concentrated solution of the same solute and solvent? (a) The dilute solution has a higher solute to solvent ratio. (b) The dilute solution contains more solvent per unit of solute. (c) The concentrated solution contains less solute per unit of solvent. (d) Both solutions have the same amount of solute dissolved.

66. 248. A sample of iron contains 3.011 x 10^23 atoms. How many moles of iron are in this sample? (Given Avogadro's number = 6.022 x 10^23 mol^-1) (a) 0.25 moles (b) 0.50 moles (c) 1.0 moles (d) 2.0 moles

67. 60. A neutral atom always contains: a) An equal number of protons and neutrons. b) An equal number of protons and electrons. c) More protons than electrons. d) Fewer neutrons than protons.

68. 266. A substance that dissolves in water to produce ions and conduct electricity is called an: (a) Non-electrolyte (b) Insulator (c) Electrolyte (d) Precipitate

69. 281. For most solid solutes, as the temperature of the solvent increases, their solubility generally: (a) Decreases (b) Remains unchanged (c) Increases (d) Becomes unpredictable

70. 120. Which of the following statements is true about the periodic trends for noble gases (Group 18)? a) They have high electron affinities and readily form negative ions. b) They have very low ionization energies and easily lose electrons. c) They have extremely high ionization energies and very low electron affinities. d) They show a strong metallic character across the period.

71. 65. Isotopes of the same element differ in the number of which subatomic particle? (a) Protons (b) Electrons (c) Neutrons (d) Ions

72. 228. In the reaction Zn (s) + CuSO4 (aq) -> ZnSO4 (aq) + Cu (s), what type of reaction is occurring? a) Precipitation b) Neutralization c) Single Displacement d) Decomposition

73. 182. The chemical name for the compound with the formula CO2 is: (a) Carbon oxide (b) Carbon dioxide (c) Monocarbon dioxide (d) Carbon (II) oxide

74. 224. For the reaction: Na3PO4 + CaCl2 -> Ca3(PO4)2 + NaCl. After balancing, what is the coefficient for NaCl? (a) 1 (b) 2 (c) 3 (d) 6

75. 204. Which of the following is the balanced chemical equation for the reaction: "Iron metal reacts with oxygen gas to form solid iron(III) oxide"? (a) Fe(s) + O2(g) -> FeO(s) (b) 2Fe(s) + 3O2(g) -> 2Fe2O3(s) (c) 4Fe(s) + 3O2(g) -> 2Fe2O3(s) (d) Fe(s) + O2(g) -> Fe2O3(s)

76. 216. Which of the following statements is true regarding a balanced chemical equation? (a) It shows the exact amount of product formed in an experiment. (b) It indicates the rate at which the reaction proceeds. (c) It ensures

that the number of atoms of each element is equal on both sides. (d) It specifies the physical state of all reactants and products at standard conditions.

77. 164. Which of the following is an example of a giant covalent structure? (a) Carbon dioxide (CO2) (b) Water (H2O) (c) Diamond (C) (d) Sodium chloride (NaCl)

78. 223. Consider the decomposition of potassium chlorate (KClO3) into potassium chloride (KCl) and oxygen gas (O2). What are the coefficients in the balanced equation? (a) KClO3 -> KCl + O2 (b) 2KClO3 -> 2KCl + O2 (c) 2KClO3 -> 2KCl + 3O2 (d) KClO3 -> KCl + 3O2

79. 12. A sample of carbon dioxide (CO2) weighs 44 grams. How many moles of CO2 are present in this sample? (Atomic masses: C = 12 g/mol, O = 16 g/mol)

80. 42. Consider a glass of ice water. As the ice melts, which property of the water remains unchanged? (a) Its physical state (b) Its volume (c) Its chemical composition (d) Its temperature (after all ice has melted)

81. 30. Adding a non-volatile solute to a solvent will generally: (a) Decrease its boiling point. (b) Increase its freezing point. (c) Increase its vapor pressure. (d) Increase its boiling point.

82. 265. Which of the following mixtures is a true solution? (a) Sand in water (b) Milk (c) Saltwater (d) Fog

83. 195. In the compound potassium carbonate, what is the correct formula of the carbonate ion? (a) CO3- (b) CO3(2-) (c) CO2- (d) CO(2-)

84. 314. If a chemical species gains hydrogen atoms during a reaction, is it undergoing oxidation or reduction?

85. 200. What is the correct chemical formula for aluminum sulfate, a compound used in water purification? (a) AlSO4 (b) Al2(SO4)3 (c) Al3(SO4)2 (d) Al(SO4)3

86. 83. Which of the following properties would typically vary the most between isotopes of the same element? a) Reactivity with acids. b) Melting point. c) Number of valence electrons. d) Tendency to form ionic bonds.

87. 55. If an atom has 11 protons and 12 neutrons, what element is it? a) Magnesium (Mg) b) Sodium (Na) c) Neon (Ne) d) Fluorine (F)

88. 289. Photosynthesis, the process by which plants convert carbon dioxide and water into glucose and oxygen, requires energy from sunlight. This reaction is classified as: a) Exothermic. b) Spontaneous. c) Endothermic. d) Neutral.

89. 175. In the chemical formula Fe2(SO4)3, the subscript '3' outside the parenthesis refers to: (a) Three atoms of sulfur. (b) Three molecules of sulfate. (c) Three SO42- ions. (d) Three oxygen atoms.

90. 41. The luster of gold, its ability to be drawn into thin wires, and its resistance to tarnish are all examples of: (a) Chemical properties (b) Extensive properties (c) Intensive chemical properties (d) Physical properties

91. 231. The reaction between an acid and a base, typically forming salt and water, is known as a: a) Redox reaction b) Neutralization reaction c) Synthesis reaction d) Precipitation reaction

92. 244. Calculate the molar mass of calcium carbonate ($CaCO_3$). (Given atomic masses: Ca = 40.1 g/mol, C = 12.0 g/mol, O = 16.0 g/mol) (a) 68.1 g/mol (b) 100.1 g/mol (c) 112.1 g/mol (d) 50.1 g/mol

93. 13. Explain the general trend in ionization energy as you move from left to right across a period in the periodic table.

94. 23. The intermolecular forces of attraction are strongest in which state of matter? (a) Solid (b) Liquid (c) Gas (d) Plasma

95. 142. Why do ionic compounds conduct electricity when molten or dissolved in water, but not when solid? a) In the solid state, electrons are free to move, but not in molten state. b) In the molten or aqueous state, ions become mobile and can carry charge. c) The bonds break down completely in the molten state, releasing electrons. d) Water molecules transfer electrons through the solution.

96. 177. Which of the following chemical formulas is incorrectly written? (a) NaCl (b) $Mg(OH)_2$ (c) Al_2S_3 (d) $CaNO_3$

97. 300. The concept that energy is conserved in a chemical reaction means that: a) The total energy of the reactants must equal the total energy of the products. b) Energy can be created but not destroyed. c) Energy is lost during the reaction in the form of heat. d) Energy is always absorbed, never released.

98. 166. What does the chemical formula H_2O represent? (a) One atom of hydrogen and two atoms of oxygen. (b) Two atoms of hydrogen and one atom of oxygen in a molecule of water. (c) The physical state of water. (d) The chemical reaction of hydrogen and oxygen.

99. 159. Which of the following statements is true regarding the electronegativity difference in a polar covalent bond? (a) There is no difference in electronegativity. (b) The difference in electronegativity is very large. (c) The difference in electronegativity is moderate. (d) Electronegativity is irrelevant for covalent bonds.

100. 134. A very large difference in electronegativity between two bonding atoms typically indicates the formation of what type of bond? (a) Nonpolar covalent bond (b) Polar covalent bond (c) Ionic bond (d) Metallic bond

101. 132. Which group of elements on the periodic table is generally unreactive and already possesses a stable electron configuration, typically not forming chemical bonds under normal conditions? (a) Group 1 (Alkali Metals) (b) Group 17 (Halogens) (c) Group 18 (Noble Gases) (d) Group 2 (Alkaline Earth Metals)

102. 221. Balance the equation: $C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O$. What is the coefficient for O_2? (a) 3 (b) 6 (c) 9 (d) 12

103. 245. How many grams are present in 0.50 moles of water (H_2O)? (Given molar mass of H_2O = 18.0 g/mol) (a) 9.0 g (b) 18.0 g (c) 0.50 g (d) 36.0 g

104. 107. As you move down a group in the periodic table, the ionization energy generally: a) Increases due to an increase in nuclear charge. b) Remains constant because the number of valence electrons is the same. c) Decreases due to increased shielding effect and larger atomic size. d) Increases due to greater effective nuclear charge.

105. 61. Which subatomic particle is found in the nucleus of an atom and carries a positive charge? (a) Electron (b) Neutron (c) Proton (d) Positron

106. 147. A neutral atom of Sulfur (S) gains two electrons to form an ion. What is the charge of this ion? a) +2 b) -1 c) +1 d) -2

107. 226. Which of the following balanced chemical equations represents a combination reaction? a) 2H2O (l) -> 2H2 (g) + O2 (g) b) HCl (aq) + NaOH (aq) -> NaCl (aq) + H2O (l) c) N2 (g) + 3H2 (g) -> 2NH3 (g) d) CuSO4 (aq) + Fe (s) -> FeSO4 (aq) + Cu (s)

108. 302. Reduction is best defined as the process involving the: (a) Gain of oxygen (b) Loss of electrons (c) Gain of hydrogen (d) Gain of electrons

109. 201. Which balanced chemical equation describes the reaction between hydrochloric acid and magnesium metal? (a) HCl(aq) + Mg(s) -> MgCl(aq) + H(g) (b) 2HCl(aq) + Mg(s) -> MgCl2(aq) + H2(g) (c) HCl(aq) + Mg(s) -> MgH(aq) + Cl(g) (d) H2(g) + MgCl2(aq) -> 2HCl(aq) + Mg(s)

110. 197. In a chemical equation, the substances written on the left side of the arrow are called: (a) Products (b) Reactants (c) Catalysts (d) Solutions

111. 49. Isotopes of an element have the same: a) Atomic mass and chemical properties. b) Number of neutrons and electron configuration. c) Atomic number and chemical properties. d) Number of protons and mass number.

112. 110. The shielding effect (or screening effect) refers to the reduction in the effective nuclear charge on an electron due to the presence of inner-shell electrons. How does the shielding effect generally change as you move down a group in the periodic table? a) It decreases because the number of electron shells increases. b) It increases because the number of inner-shell electrons increases. c) It remains constant for all elements in the same group. d) It varies unpredictably depending on the element's reactivity.

113. 176. Which of the following is the correct formula for a compound formed between a Group 13 element (M) and a Group 17 element (X)? (a) MX (b) M2X (c) MX3 (d) M3X

114. 311. In the following reaction, identify the substance that is oxidized and the substance that is reduced: CuO + H2 -> Cu + H2O

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

116. 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) Combination reaction b) Decomposition reaction c) Single displacement reaction d) Double displacement reaction

117. 325. Which of the following compounds is formed by ionic bonding? a) CO2 (Carbon dioxide) b) H2O (Water) c) NaCl (Sodium chloride) d) CH4 (Methane)

118. 163. Covalent compounds typically do not conduct electricity because: (a) They do not contain any atoms. (b) They exist as individual molecules and do not have free moving ions or electrons. (c) They are always solids at room temperature. (d) Their bonds are too strong to break.

119. 205. Balancing a chemical equation primarily ensures that: (a) The total number of molecules on both sides is equal. (b) The total mass of reactants equals the total mass of products. (c) The energy released or absorbed is constant. (d) The reaction occurs at a faster rate.

120. 230. Which of the following is characteristic of a combustion reaction? a) Formation of a precipitate b) Absorption of heat from the surroundings c) Reaction with oxygen, often producing heat and light d) Exchange of ions between two compounds

121. 86. Atom A has 6 protons, 6 neutrons, and 6 electrons. Atom B has 6 protons, 7 neutrons, and 6 electrons. Which statement accurately describes the relationship between Atom A and Atom B? a) They are atoms of different elements. b) They are ions of the same element. c) They are isotopes of the same element. d) They are allotropes of the same element.

122. 90. Which of the following statements about isotopes is generally correct regarding their stability? a) All isotopes of an element are equally stable. b) Stable isotopes have an unstable nucleus and undergo radioactive decay. c) Unstable isotopes are radioactive and decay over time. d) The number of neutrons has no effect on nuclear stability.

123. 259. The solubility of most solid substances in water generally: (a) Decreases as temperature increases. (b) Increases as temperature increases. (c) Remains unaffected by temperature. (d) First decreases, then increases with temperature.

124. 162. Non-polar covalent bonds occur when electrons are shared: (a) Unequally between two different non-metal atoms. (b) Equally between two different non-metal atoms. (c) Equally between two identical non-metal atoms. (d) Unequally between a metal and a non-metal atom.

125. 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

126. 160. Why does water (H_2O) have a higher boiling point than methane (CH_4), even though both are covalent compounds? (a) Water molecules are heavier than methane molecules. (b) Water molecules are linear, while methane molecules are tetrahedral. (c) Water exhibits hydrogen bonding, a stronger intermolecular force. (d) Methane forms ionic bonds, which are weaker.

127. 58. Elements in the same group (column) of the periodic table generally have: a) The same number of electron shells. b) Similar chemical properties. c) The same atomic mass. d) The same number of neutrons.

128. 296. A cold pack used for injuries often contains ammonium nitrate and water. When mixed, the pack becomes cold. This indicates that the reaction between ammonium nitrate and water is: a) Exothermic. b) Combustion. c) Neutralization. d) Endothermic.

129. 165. When naming the covalent compound PCl_3, the correct name is: (a) Phosphorus chloride (b) Phosphorus trichloride (c) Triphosphorus chloride (d) Phosphine trichloride

130. 118. The reactivity of non-metals generally increases with increasing electronegativity. Based on this, which halogen would be the most reactive? a) Iodine (I) b) Bromine (Br) c) Chlorine (Cl) d) Fluorine (F)

131. 64. What determines the chemical identity of an atom, also known as its atomic number? (a) The total number of protons and neutrons (b) The number of electrons (c) The number of protons (d) The total number of subatomic particles

132. 24. When a liquid boils, the energy supplied is primarily used to: (a) Increase the kinetic energy of the particles. (b) Increase the temperature of the liquid. (c) Overcome the intermolecular forces of attraction. (d) Decrease the volume of the liquid.

133. 253. Consider the balanced chemical equation: $2H_2 + O_2 \rightarrow 2H_2O$. If 4 moles of H_2 react completely, how many moles of H_2O will be produced? (a) 1 mole (b) 2 moles (c) 4 moles (d) 8 moles

134. 8. Describe the main difference between ionic bonding and covalent bonding in terms of electron behavior.

135. 29. Which of the following changes represents deposition? (a) Water freezing to form ice. (b) Dry ice changing into carbon dioxide gas. (c) Water vapor forming frost on a cold surface. (d) Liquid mercury evaporating.

136. 43. Which pair correctly classifies the given property? (a) Flammability - Physical property (b) Melting point - Chemical property (c) Conductivity - Physical property (d) Reactivity with oxygen - Physical property

137. 326. What does the subscript '2' in the chemical formula H_2SO_4 represent? a) There are 2 molecules of sulfuric acid. b) There are 2 atoms of hydrogen in one molecule of sulfuric acid. c) The charge of the sulfate ion is -2. d) There are 2 atoms of oxygen in one molecule of sulfuric acid.

138. 104. An element has its outermost electrons in the s subshell and is highly reactive, forming +1 ions. In which group would it be found? (a) Group 1 (b) Group 2 (c) Group 13 (d) Group 17

139. 37. A block of wood floats on water. This phenomenon is related to which physical property of the wood relative to water? (a) Color (b) Hardness (c) Density (d) Brittleness

140. 51. An element has an electron configuration of 2, 8, 3. What is its most likely valency? a) 1 b) 2 c) 3 d) 5

141. 34. Which of the following observations indicates that a chemical change has likely occurred? (a) A change in state from liquid to gas (b) The dissolution of a solid in a liquid (c) The emission of light and heat (d) A change in shape

142. 67. Rutherford's gold foil experiment provided evidence for which key aspect of atomic structure? (a) Electrons orbit the nucleus in specific energy levels. (b) Atoms are indivisible and indestructible. (c) The atom's positive charge and most of its mass are concentrated in a small, dense nucleus. (d) Neutrons are present in the nucleus.

143. 246. How many moles are present in 88.0 grams of carbon dioxide (CO_2)? (Given molar mass of CO_2 = 44.0 g/mol) (a) 0.50 moles (b) 1.0 moles (c) 2.0 moles (d) 4.0 moles

144. 261. According to the "like dissolves like" rule, which substance would most likely dissolve in water (a polar solvent)? (a) Oil (b) Benzene (c) Sodium chloride (d) Iodine

145. 240. Rusting of iron ($Fe + O_2 \rightarrow Fe_2O_3$) is an example of a slow chemical change. From the perspective of reaction types, rusting is best classified as a: a) Decomposition reaction b) Single displacement reaction c) Combustion reaction d) Combination reaction

146. 239. Consider the reaction: $CH_4 (g) + 2O_2 (g) \rightarrow CO_2 (g) + 2H_2O (l)$. This reaction is primarily classified as a: a) Combination reaction b) Decomposition reaction c) Combustion reaction d) Double displacement reaction

147. 257. In a solution, the substance that is present in the smaller amount and gets dissolved is called the: (a) Solvent (b) Solute (c) Mixture (d) Suspension

148. 251. What is the percentage by mass of hydrogen in water (H_2O)? (Given atomic masses: H = 1.0 g/mol, O = 16.0 g/mol) (a) 11.1 % (b) 2.0 % (c) 18.0 % (d) 88.9 %

149. 68. Which of the following statements about subatomic particles is FALSE? (a) Protons and neutrons have approximately the same mass. (b) Electrons are much less massive than protons. (c) All atoms of the same element have the same number of neutrons. (d) The nucleus contains protons and neutrons.

150. 79. Consider the isotopes Carbon-12 (12C) and Carbon-14 (14C). How do these two isotopes differ in their subatomic particles? a) Carbon-14 has two more protons than Carbon-12. b) Carbon-12 has two more neutrons than Carbon-14. c) Carbon-14 has two more neutrons than Carbon-12. d) Carbon-12 has two more electrons than Carbon-14.

151. 198. Which of the following equations correctly represents the decomposition of calcium carbonate upon heating? (a) CaCO3(s) -> Ca(s) + C(s) + O2(g) (b) CaCO3(s) -> CaO(s) + CO2(g) (c) CaO(s) + CO2(g) -> CaCO3(s) (d) Ca(OH)2(aq) + CO2(g) -> CaCO3(s) + H2O(l)

152. 130. When a chemical bond is formed between two atoms, energy is generally: (a) Absorbed from the surroundings (b) Released into the surroundings (c) Neither absorbed nor released (d) Converted into mass

153. 1. Which of the following is an example of a homogeneous mixture? a) Sand and water b) Air c) Oil and vinegar d) Blood

154. 63. The subatomic particle with a negligible mass compared to protons and neutrons, and located in energy levels outside the nucleus, is the: (a) Proton (b) Neutron (c) Electron (d) Nucleon

155. 98. Who is widely credited with creating the first widely accepted version of the periodic table, arranged by atomic mass? (a) John Dalton (b) Ernest Rutherford (c) Dmitri Mendeleev (d) Marie Curie

156. 234. In which type of reaction do two or more reactants combine to form a single, more complex product? a) Decomposition reaction b) Single displacement reaction c) Combination reaction d) Double displacement reaction

157. 330. What is the molar mass of water (H2O)? (Atomic masses: H=1.0 g/mol, O=16.0 g/mol) a) 1.0 g/mol b) 17.0 g/mol c) 18.0 g/mol d) 34.0 g/mol

158. 138. Which of the following noble gas electron configurations would a sodium atom (Na) achieve when it forms an ion? a) Neon b) Argon c) Helium d) Krypton

159. 255. In a reaction where reactant A and reactant B combine to form product C, if reactant A is completely consumed while some of reactant B remains unreacted, then reactant A is known as the: (a) Excess reactant (b) Limiting reactant (c) Product (d) Catalyst

160. 274. If you wish to make a concentrated sugar solution less concentrated, the most direct method would be to: (a) Evaporate some water (b) Add more sugar (c) Add more water (d) Chill the solution

161. 187. What is the name of the compound PCl3? (a) Phosphorus chloride (b) Triphosphorus chloride (c) Phosphorus trichloride (d) Monophosphorus trichloride

162. 279. When an excess amount of solute is added to a solvent and stirred, some solute dissolves, but an undissolved solid remains at the bottom. This resulting solution is likely: (a) Unsaturated (b) Supersaturated (c) Dilute (d) Saturated

163. 77. Isotopes of an element always have a different number of: a) protons b) electrons c) neutrons d) atomic number

164. 88. Which specific isotope is widely used in the technique of "radiocarbon dating" to determine the age of ancient organic materials? a) Uranium-238 b) Carbon-14 c) Iodine-131 d) Cobalt-60

165. 158. What is the chemical formula for carbon dioxide, a common covalent compound? (a) CO (b) C2O (c) CO2 (d) C2O2

166. 172. What is the chemical formula for copper(II) sulfate? (a) CuSO (b) Cu2SO4 (c) CuSO4 (d) Cu(SO4)2

167. 54. The "plum pudding" model of the atom was proposed by: a) John Dalton b) Ernest Rutherford c) J.J. Thomson d) Niels Bohr

168. 4. An atom has 17 protons, 18 neutrons, and 17 electrons. What is its atomic number? a) 17 b) 18 c) 35 d) 34

169. 173. If the molecular formula of a compound is C4H8O4, what is its empirical formula? (a) C2H4O2 (b) CHO (c) CH2O (d) C4H8O4

170. 307. What happens to the substance that is oxidized in a chemical reaction? (a) It gains electrons. (b) It loses electrons. (c) It gains oxygen. (d) Both (b) and (c) are possible depending on the definition used.

171. 196. What does the symbol "(aq)" next to a chemical formula in an equation represent? (a) Solid state (b) Liquid state (c) Gaseous state (d) Aqueous solution

172. 6. Differentiate between an element and a compound, providing one example for each.

173. 207. Which of the following balanced equations represents a redox reaction where copper is oxidized? (a) CuO(s) + H2(g) -> Cu(s) + H2O(l) (b) Cu(s) + 2AgNO3(aq) -> Cu(NO3)2(aq) + 2Ag(s) (c) CuCO3(s) -> CuO(s) + CO2(g) (d) CuCl2(aq) + 2NaOH(aq) -> Cu(OH)2(s) + 2NaCl(aq)

174. 321. Atoms of the same element that have different numbers of neutrons are called: a) Ions b) Allotropes c) Isotopes d) Isomers

175. 45. Iron is widely used in construction due to its strength and ability to be shaped. However, it requires protection from moisture because it readily undergoes: (a) Sublimation (b) Evaporation (c) Oxidation (d) Condensation

176. 317. A substance that cannot be broken down into simpler substances by ordinary chemical means is called a/an: a) Compound b) Mixture c) Element d) Solution

177. 316. Which branch of chemistry primarily focuses on the study of carbon-containing compounds? a) Physical Chemistry b) Organic Chemistry c) Inorganic Chemistry d) Analytical Chemistry

178. 50. What is the electron configuration for a neutral atom of Chlorine (Cl), which has an atomic number of 17? a) 2, 8, 7 b) 2, 7, 8 c) 2, 8, 8, 1 d) 7, 10

179. 59. The chemical properties of an atom are primarily determined by its: a) Number of protons. b) Number of neutrons. c) Number of valence electrons. d) Total mass number.

180. 293. When new chemical bonds are formed in a reaction, energy is typically: a) Absorbed from the surroundings. b) Released into the surroundings. c) Neither absorbed nor released. d) Required to increase the temperature.

181. 36. Which of these is a property that describes how a substance reacts with other substances? (a) Density (b) Boiling point (c) Reactivity (d) Solubility

182. 123. Which type of element typically loses electrons to form positive ions (cations) during chemical bonding? (a) Nonmetals (b) Metalloids (c) Metals (d) Noble gases

183. 297. In an exothermic reaction, the chemical potential energy stored in the products is generally: a) Higher than in the reactants. b) Lower than in the reactants. c) The same as in the reactants. d) Dependent on the state of matter.

184. 94. An element has an atomic number of 17. In which group and period would it most likely be found? (a) Group 17, Period 3 (b) Group 7, Period 3 (c) Group 17, Period 4 (d) Group 3, Period 17

185. 101. An element forms an ion with a charge of -2. To which group is this element most likely to belong? (a) Group 1 (b) Group 2 (c) Group 16 (d) Group 17

186. 96. Elements in Group 18 of the periodic table are characterized by: (a) High reactivity and metallic character (b) Tendency to form many chemical bonds (c) Full outermost electron shells and low reactivity (d) Being liquids at room temperature

187. 222. When aqueous lead(II) nitrate reacts with aqueous potassium iodide to form solid lead(II) iodide and aqueous potassium nitrate, the coefficient for potassium iodide in the balanced equation is: (a) 1 (b) 2 (c) 3 (d) 4

188. 218. In the balanced equation for the combustion of methane ($CH_4 + O_2 \rightarrow CO_2 + H_2O$), what is the sum of all the coefficients? (a) 4 (b) 5 (c) 6 (d) 7

189. 39. Which of the following is NOT considered a chemical property? (a) Corrosiveness (b) Toxicity (c) Viscosity (d) Oxidation state

190. 152. 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

191. 181. What is the correct name for the compound represented by the formula NaCl? (a) Sodium chloride (b) Sodium monochloride (c) Sodium (I) chloride (d) Monosodium monochloride

192. 275. A solution in which more solute can be dissolved at a given temperature is known as a(n): (a) Saturated solution (b) Supersaturated solution (c) Unsaturated solution (d) Concentrated solution

193. 291. Activation energy is best defined as the: a) Total heat released or absorbed in a reaction. b) Energy difference between reactants and products. c) Minimum energy required to initiate a chemical reaction. d) Energy stored within chemical bonds.

194. 268. If you have a highly concentrated solution, it means there is: (a) A large amount of solvent compared to solute. (b) A small amount of solute compared to solvent. (c) A large amount of solute compared to solvent. (d) No solute dissolved in the solvent.

195. 209. In the chemical equation $2KClO_3(s) \xrightarrow{(MnO_2, heat)} 2KCl(s) + 3O_2(g)$, what does MnO_2 represent? (a) A reactant (b) A product (c) A catalyst (d) A solvent

196. 241. Which of the following statements best defines a mole in chemistry? (a) The mass of an atom of an element. (b) The amount of substance that contains as many elementary entities as there are atoms in exactly 12 grams of carbon-12. (c) The volume occupied by 1 gram of a substance at standard temperature and pressure. (d) The number of protons and neutrons in an atom's nucleus.

197. 185. What is the systematic name for the compound Fe_2O_3? (a) Iron oxide (b) Iron (II) oxide (c) Diiron trioxide (d) Iron (III) oxide

198. 40. A clear, colorless liquid turns cloudy and a gas bubbles out when a solid is added to it. This suggests that: (a) A physical change has occurred, such as dissolving (b) A chemical change has occurred, forming new substances (c) The liquid has reached its boiling point (d) The solid has simply changed its state

199. 322. Elements in the same vertical column of the periodic table are known as: a) Periods b) Rows c) Groups d) Blocks

200. 78. What characteristic is identical for all isotopes of a given element? a) atomic mass b) number of neutrons c) chemical properties d) physical properties

201. 313. Provide one common everyday example of an oxidation process.

202. 151. Which statement best describes a covalent bond? (a) It is formed by the transfer of electrons between two atoms. (b) It involves the sharing of electrons between two atoms. (c) It is an electrostatic attraction between oppositely charged ions. (d) It occurs only between a metal and a non-metal.

203. 111. Which of the following elements would typically have the highest first ionization energy? a) Sodium (Na) b) Magnesium (Mg) c) Aluminum (Al) d) Neon (Ne)

204. 7. Define the term "isotope". Explain why isotopes of the same element have identical chemical properties but different physical properties.

205. 211. Which of the following equations correctly represents the Law of Conservation of Mass? (a) $H_2(g) + O_2(g) \rightarrow H_2O(l)$ (b) $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$ (c) $H_2(g) + 2O_2(g) \rightarrow 2H_2O(l)$ (d) $2H(g) + O(g) \rightarrow H_2O(l)$

206. 97. Which of the following describes elements found on the far left side of the periodic table (excluding hydrogen)? (a) Nonmetals that readily gain electrons (b) Highly reactive metals that readily lose electrons (c) Metalloids with intermediate properties (d) Noble gases with stable electron configurations

207. 167. How many atoms in total are present in one formula unit of calcium phosphate, $Ca_3(PO_4)_2$? (a) 9 (b) 13 (c) 17 (d) 19

208. 48. Which subatomic particle is responsible for the unique identity of an element? a) Electron b) Proton c) Neutron d) Photon

209. 191. In the naming of binary covalent compounds, which prefix indicates that there are four atoms of that element in the molecule? (a) Di- (b) Tri- (c) Tetra- (d) Penta-

210. 119. Which periodic trend explains why potassium (K) is more reactive than sodium (Na) as a metal? a) Potassium has a smaller atomic radius than sodium. b) Potassium has a higher ionization energy than sodium. c) Potassium has a lower effective nuclear charge on its valence electron. d) Potassium has a lower electronegativity than sodium.

211. 232. A student adds a piece of shiny grey metal to a blue copper(II) sulfate solution. After some time, the solution becomes colorless and a reddish-brown solid deposits on the metal. What type of reaction has most likely occurred? a) Decomposition b) Double displacement c) Single displacement d) Combination

212. 318. Which of the following describes a chemical change? a) Melting of ice b) Dissolving sugar in water c) Burning of wood d) Evaporation of alcohol

213. 256. Which of the following best describes a solution? (a) A heterogeneous mixture of two or more substances. (b) A homogeneous mixture of two or more substances. (c) A pure substance that can be separated by physical means. (d) A mixture that always appears cloudy.

214. 92. Elements in the same vertical column of the periodic table are known as: (a) Periods (b) Rows (c) Groups (d) Blocks

215. 233. When potassium iodide solution is added to lead(II) nitrate solution, a yellow precipitate forms. This reaction can be classified as a: a) Oxidation-reduction reaction b) Decomposition reaction c) Precipitation reaction d) Combustion reaction

216. 33. When a piece of paper is torn into smaller pieces, what type of change occurs? (a) A chemical change, as the paper's identity is altered (b) A physical change, as the paper's chemical composition remains the same (c) Both a physical and chemical change (d) Neither a physical nor a chemical change

217. 121. Atoms form chemical bonds primarily to: (a) Increase their kinetic energy (b) Achieve a stable electron configuration (c) Become radioactive isotopes (d) Decrease their overall size

218. 105. Which statement accurately compares an element from Group 1 (alkali metals) with an element from Group 17 (halogens) in the same period? (a) Group 1 element is a nonmetal, Group 17 element is a metal. (b) Group 1 element has higher electronegativity than Group 17 element. (c) Group 1 element readily loses one electron, Group 17 element readily gains one electron. (d) Both elements typically form negative ions.

219. 320. An atom of a certain element has 15 protons, 16 neutrons, and 15 electrons. What is the atomic number of this atom? a) 15 b) 16 c) 30 d) 31

220. 82. Isotopes of an element exhibit nearly identical chemical properties because they have the same: a) number of neutrons b) mass number c) electronic configuration d) density

221. 156. In the nitrogen molecule (N_2), what type of covalent bond exists between the two nitrogen atoms? (a) Single bond (b) Double bond (c) Triple bond (d) Ionic bond

222. 81. The notation "Uranium-235" (^{235}U) refers to an isotope of Uranium. What does the number "235" specifically represent for this isotope? a) The number of protons. b) The number of electrons. c) The atomic number. d) The mass number.

223. 113. Electron affinity is the energy change when an electron is added to a neutral atom to form a negative ion. Which group of elements generally exhibits the most negative (most favorable) electron affinity values? a) Group 1 (Alkali Metals) b) Group 2 (Alkaline Earth Metals) c) Group 17 (Halogens) d) Group 18 (Noble Gases)

224. 70. The atomic number of Oxygen is 8. How many protons are in an atom of Oxygen-16? (a) 8 (b) 16 (c) 0 (d) 4

225. 272. A solution that contains a large amount of solute relative to the amount of solvent is described as: (a) Unsaturated (b) Dilute (c) Concentrated (d) Supercooled

226. 85. Element X has two naturally occurring isotopes: X-35 (mass = 34.969 amu) and X-37 (mass = 36.966 amu). If the average atomic mass of element X is 35.453 amu, which statement is true? a) Isotope X-37 is more abundant than X-35. b) Both isotopes are present in equal amounts. c) Isotope X-35 is more abundant than X-37. d) The average atomic mass cannot be determined from this information.

227. 106. Which of the following statements correctly describes the general trend in atomic radius across a period from left to right in the modern periodic table? a) It generally increases due to an increase in the number of electron shells. b) It generally decreases due to an increase in nuclear charge pulling the valence electrons closer. c) It remains relatively constant as the electrons are added to the same principal energy level. d) It decreases for metals and increases for non-metals.

228. 26. A substance is heated at a constant rate. Its temperature rises steadily, then plateaus for some time, and then rises again. The plateau indicates: (a) The substance is undergoing a chemical reaction. (b) The substance is absorbing heat energy to increase its kinetic energy. (c) The substance is undergoing a phase change. (d) The heat source has been removed.

229. 315. Distinguish between an oxidizing agent and a reducing agent.

230. 133. A polyatomic ion is best described as: (a) An atom that can form multiple types of bonds (b) A group of atoms covalently bonded together that carries an overall electric charge (c) A single atom that has gained or lost many electrons (d) An ion that exists only in the solid state

231. 260. A solution that contains the maximum amount of solute that can be dissolved at a given temperature is called a: (a) Unsaturated solution (b) Supersaturated solution (c) Saturated solution (d) Dilute solution

232. 103. Most of the elements in the periodic table are classified as: (a) Nonmetals (b) Metalloids (c) Metals (d) Noble gases

233. 303. In the reaction $2Mg + O_2 \rightarrow 2MgO$, which substance is oxidized? (a) Mg (b) O_2 (c) MgO (d) Both Mg and O_2

234. 215. Balance the following equation: $Al + HCl \rightarrow AlCl_3 + H_2$. The correct coefficients from left to right are: (a) 1, 2, 1, 1 (b) 2, 6, 2, 3 (c) 1, 3, 1, 3 (d) 2, 3, 2, 3

235. 267. What happens to the solubility of gases in liquids as temperature increases? (a) It generally increases. (b) It generally decreases. (c) It remains constant. (d) It first increases, then decreases.

236. 25. Which of the following is NOT an assumption of the kinetic theory of gases? (a) Gas particles are in constant, random motion. (b) The volume occupied by the gas particles themselves is negligible compared to the total volume of the gas. (c) There are strong attractive forces between gas particles. (d) Collisions between gas particles are elastic.

237. 136. What is the fundamental process that occurs during the formation of an ionic bond? a) Sharing of electrons between two atoms. b) Transfer of electrons from one atom to another. c) Overlap of atomic orbitals to

form molecular orbitals. d) Formation of a sea of delocalised electrons.

238. 76. Which statement best defines isotopes? a) Atoms of different elements with the same number of neutrons. b) Atoms of the same element with different numbers of protons. c) Atoms of the same element with different numbers of neutrons. d) Atoms of different elements with the same mass number.

239. 128. According to the octet rule, atoms tend to gain, lose, or share electrons until they are surrounded by how many electrons in their outermost shell? (a) Two (b) Four (c) Six (d) Eight

240. 254. When magnesium reacts with oxygen to form magnesium oxide, the balanced equation is 2Mg(s) + O2(g) -> 2MgO(s). If 48.6 grams of magnesium (Mg) reacts completely, how many moles of MgO are formed? (Given atomic mass of Mg = 24.3 g/mol) (a) 1.0 mole (b) 2.0 moles (c) 0.5 moles (d) 4.0 moles

241. 124. The fundamental characteristic of an ionic bond is the: (a) Equal sharing of electrons between two atoms (b) Transfer of electrons from one atom to another (c) Overlapping of electron clouds between two atoms (d) Formation of a sea of delocalized electrons

242. 66. If a neutral atom gains one electron, it becomes: (a) A cation (b) An anion (c) An isotope (d) A different element

243. 115. What is the main reason that the effective nuclear charge felt by the outermost electrons increases across a period? a) The number of electron shells increases. b) The number of protons in the nucleus increases. c) The shielding effect increases significantly. d) The total number of electrons in the atom increases.

244. 278. Maya adds a small crystal of salt to a solution and observes that the crystal immediately dissolves. This indicates the solution was most likely: (a) Saturated (b) Supersaturated (c) Unsaturated (d) Precipitated

245. 72. According to the modern atomic model, the region where electrons are most likely to be found is called the: (a) Nucleus (b) Neutron cloud (c) Electron cloud (d) Proton shell

246. 14. When sugar dissolves in water, explain what happens at the molecular level to the sugar and water particles.

247. 247. How many molecules are present in 2.0 moles of ammonia (NH3)? (Given Avogadro's number = 6.022 x 10^23 mol^-1) (a) 6.022 x 10^23 molecules (b) 1.204 x 10^24 molecules (c) 3.011 x 10^23 molecules (d) 2.0 molecules

248. 295. Which of the following is a common characteristic of combustion reactions? a) They are typically endothermic. b) They often absorb energy from the surroundings. c) They usually release significant amounts of heat and light. d) They result in a decrease in temperature.

249. 169. The chemical formula for methane is CH4. This indicates that one molecule of methane contains: (a) 1 carbon atom and 4 hydrogen atoms. (b) 4 carbon atoms and 1 hydrogen atom. (c) 1 mole of carbon and 4 moles of hydrogen. (d) Carbon and hydrogen are present in a 1:4 ratio by mass.

250. 126. Which of the following compounds is formed predominantly by ionic bonding? (a) H2O (water) (b) CH4 (methane) (c) CaCl2 (calcium chloride) (d) CO2 (carbon dioxide)

251. 298. Consider the following reaction: A + B -> C + D + Heat. This reaction represents: a) An endothermic process where heat is a reactant. b) An exothermic process where heat is a product. c) A reaction that requires a catalyst to proceed. d) A physical change rather than a chemical one.

252. 73. Dalton's atomic theory proposed that atoms are indivisible particles. Which scientific discovery later contradicted this part of his theory? (a) The Law of Conservation of Mass (b) The discovery of isotopes (c) The discovery of subatomic particles (d) The concept of chemical bonding

253. 44. When a substance undergoes a chemical change, its atoms are: (a) Rearranged to form new substances (b) Destroyed to create energy (c) Created from nothing (d) Separated into individual subatomic particles

254. 262. Which of the following is NOT a factor affecting the rate at which a solid dissolves in a liquid? (a) Temperature of the solvent (b) Stirring the solution (c) Particle size of the solute (d) Pressure on the solution

255. 225. Which term describes the numbers placed in front of chemical formulas to balance an equation? (a) Subscripts (b) Superscripts (c) Coefficients (d) Indices

256. 192. Which of the following name-formula pairs is INCORRECT? (a) Sodium bromide - NaBr (b) Magnesium nitrate - Mg(NO3)2 (c) Zinc (II) chloride - ZnCl2 (d) Sulfur trioxide - SO3

257. 309. Define oxidation in terms of electron transfer.

258. 306. Consider the reaction: Zn + CuSO4 -> ZnSO4 + Cu. Which species is being reduced? (a) Zn (b) Cu (c) SO4(2-) (d) Cu(2+)

259. 327. What is the correct chemical name for the compound FeCl3? a) Iron chloride b) Iron(III) chloride c) Iron trichloride d) Ferric chloride (II)

260. 179. The chemical formula PCl5 represents a compound that is primarily: (a) Ionic, because it contains a metal and a non-metal. (b) Ionic, because of the high electronegativity difference. (c) Covalent, because it contains two non-metals. (d) Covalent, because it forms a network structure.

261. 11. Identify the type of chemical reaction represented by the following equation: Mg (s) + 2HCl (aq) -----> MgCl2 (aq) + H2 (g)

262. 62. An atom of a certain element has 15 protons, 16 neutrons, and 15 electrons. What is its mass number? (a) 15 (b) 16 (c) 30 (d) 31

263. 150. In the formation of potassium chloride (KCl) from potassium (K) and chlorine (Cl) atoms, how are electrons transferred? a) Two electrons are shared between K and Cl. b) One electron is transferred from Cl to K. c) One electron is transferred from K to Cl. d) Electrons are transferred from both K and Cl to form a neutral molecule.

264. 249. What is the mass of 1.204 x 10^24 atoms of helium (He)? (Given atomic mass of He = 4.0 g/mol, Avogadro's number = 6.022 x 10^23 mol^-1) (a) 4.0 g (b) 8.0 g (c) 2.0 g (d) 1.0 g

265. 180. A formula that represents the simplest whole number ratio of atoms in a compound is called its: (a) Molecular formula (b) Structural formula (c) Empirical formula (d) Condensed formula

266. 52. When a neutral atom gains one or more electrons, it becomes a: a) Cation b) Anion c) Isotope d) Molecule

267. 206. When aqueous solutions of silver nitrate and sodium chloride are mixed, a precipitate forms. The balanced net ionic equation for this reaction is: (a) Ag+(aq) + Cl-(aq) -> AgCl(s) (b) Na+(aq) + NO3-(aq) -> NaNO3(s) (c) AgNO3(aq) + NaCl(aq) -> AgCl(s) + NaNO3(aq) (d) Ag+(aq) + Cl-(aq) -> AgCl(aq)

268. 203. In the balanced equation 2Na(s) + Cl2(g) -> 2NaCl(s), how many moles of sodium chloride are produced from 1 mole of chlorine gas? (a) 1 mole (b) 2 moles (c) 3 moles (d) 4 moles

269. 178. If an element 'A' has a valency of 3 and element 'B' has a valency of 2, what is the chemical formula for the compound formed between them? (a) A2B3 (b) A3B2 (c) AB (d) A2B2

270. 129. What type of force holds together the oppositely charged ions in an ionic compound? (a) Gravitational forces (b) Nuclear forces (c) Electrostatic forces (d) Magnetic forces

271. 140. What is the correct chemical formula for the ionic compound formed between Calcium (Ca) and Oxygen (O)? a) CaO2 b) Ca2O c) CaO d) Ca3O2

272. 153. What is the primary reason why atoms form covalent bonds? (a) To achieve a full outermost electron shell, similar to noble gases. (b) To gain a positive charge. (c) To decrease their atomic mass. (d) To become more reactive.

273. 186. Which of the following is the correct chemical formula for copper (II) sulfate? (a) CuS (b) Cu2SO4 (c) CuSO4 (d) Cu(SO4)2

274. 9. Balance the following chemical equation: H2O2 (aq) -----> H2O (l) + O2 (g)

275. 183. What is the correct chemical formula for calcium bromide? (a) CaBr (b) Ca2Br (c) CaBr2 (d) Ca2Br2

276. 20. At a given temperature, the rate of evaporation increases with: (a) Decrease in surface area. (b) Decrease in temperature. (c) Increase in humidity. (d) Increase in wind speed.

277. 210. Consider the incomplete reaction: H2SO4(aq) + X -> FeSO4(aq) + H2O(l). What is the likely identity of substance X? (a) Fe(OH)3 (b) FeO (c) Fe (d) Fe2O3

278. 125. A covalent bond is formed when atoms: (a) Completely transfer valence electrons to another atom (b) Share valence electrons to achieve a stable electron configuration (c) Attract each other through strong magnetic forces (d) Lose all their electrons to become positively charged

279. 137. When a metal atom loses one or more electrons, what type of ion is formed? a) Anion b) Cation c) Isotope d) Molecule

280. 285. Which of the following actions will always result in making a solution more dilute? (a) Adding more solute (b) Increasing the temperature (c) Adding more solvent (d) Removing some solvent

281. 286. Which of the following statements best describes an exothermic reaction? a) A reaction that absorbs heat from its surroundings. b) A reaction that releases heat into its surroundings. c) A reaction that requires light energy to proceed. d) A reaction that forms a precipitate.

282. 329. The reaction 2H2O -> 2H2 + O2 is an example of a: a) Combination reaction b) Decomposition reaction c) Single displacement reaction d) Double displacement reaction

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

284. 189. What is the name of the compound Ba(OH)2? (a) Barium oxide (b) Barium dihydroxide (c) Barium hydroxide (d) Barium (II) hydroxide

285. 154. How many electrons are shared in a single covalent bond? (a) One electron (b) Two electrons (c) Four electrons (d) Six electrons

286. 280. A chemist prepares a solution and then carefully cools it. Upon adding a tiny seed crystal, a large amount of solid rapidly crystallizes out of the solution. This behavior is characteristic of a(n): (a) Saturated solution (b) Unsaturated solution (c) Supersaturated solution (d) Concentrated solution

287. 305. A reducing agent is a substance that: (a) Gets reduced itself (b) Gains electrons (c) Causes another substance to be oxidized (d) Causes another substance to be reduced

288. 15. Distinguish between an exothermic and an endothermic chemical reaction. Give one common example for each.

289. 46. Which statement accurately defines the atomic number of an element? a) The total number of protons and neutrons in the nucleus. b) The number of electrons in the outermost shell. c) The number of protons in the nucleus of an atom. d) The sum of protons, neutrons, and electrons in an atom.

290. 213. What is the primary reason for balancing chemical equations? (a) To ensure the reaction occurs quickly. (b) To satisfy the Law of Conservation of Energy. (c) To satisfy the Law of Conservation of Mass. (d) To determine the heat released or absorbed.

291. 199. When the following equation is balanced, what is the smallest whole number coefficient for O2? C2H6 + O2 -> CO2 + H2O (a) 2 (b) 3 (c) 7 (d) 5

292. 99. An element is located in Period 3, Group 2. How many valence electrons does this element most likely have? (a) 1 (b) 2 (c) 3 (d) 8

293. 32. A substance's tendency to undergo a change that alters its chemical composition is referred to as a: (a) Physical property (b) Chemical property (c) Extensive property (d) Intensive property

294. 328. When the equation __Fe + __O2 -> __Fe2O3 is balanced with the smallest whole number coefficients, what is the coefficient for Fe? a) 1 b) 2 c) 3 d) 4

295. 17. Gases are highly compressible because: (a) Their particles are held together by strong forces. (b) They have a definite volume but no definite shape. (c) The intermolecular spaces between their particles are very large. (d) Their particles are in fixed positions.

296. 108. Electronegativity is a measure of an atom's ability to attract a shared pair of electrons in a chemical bond. Which of the following elements has the highest electronegativity? a) Cesium (Cs) b) Oxygen (O) c) Lithium (Li) d) Nitrogen (N)

297. 310. Define a reducing agent.

298. 170. What is the correct chemical formula for ammonium carbonate? (a) (NH3)2CO3 (b) NH4(CO3)2 (c) (NH4)2CO3 (d) NH4CO3

299. 31. Which of the following is an example of a physical property of matter? (a) The ability of iron to rust (b) The decomposition of water into hydrogen and oxygen (c) The melting point of ice (d) The flammability of gasoline

300. 141. What is the name of the ionic compound with the formula $MgCl_2$? a) Magnesium dichloride b) Magnesium chloride c) Magnesium (II) chloride d) Monomagnesium dichloride

301. 122. Valence electrons are best described as the electrons that are: (a) Located in the innermost electron shell of an atom (b) Responsible for an atom's nuclear stability (c) Found in the outermost electron shell and involved in bonding (d) Transferred during physical changes of matter

302. 217. When solid sodium reacts with liquid water to produce aqueous sodium hydroxide and hydrogen gas, the balanced chemical equation is: (a) $Na(s) + H2O(l) \rightarrow NaOH(aq) + H(g)$ (b) $2Na(s) + 2H2O(l) \rightarrow 2NaOH(aq) + H2(g)$ (c) $Na(s) + 2H2O(l) \rightarrow NaOH(aq) + H2(g)$ (d) $2Na(s) + H2O(l) \rightarrow 2NaOH(aq) + H2(g)$

303. 323. Which of the following elements is generally considered a non-metal? a) Iron (Fe) b) Sodium (Na) c) Sulfur (S) d) Calcium (Ca)

304. 75. What is the approximate relative mass of a neutron compared to a proton? (a) Significantly smaller (b) Significantly larger (c) Approximately equal (d) Exactly double

305. 282. Which statement accurately distinguishes between a "concentrated" solution and a "saturated" solution? (a) A concentrated solution must be saturated, but a saturated solution may not be concentrated. (b) A saturated solution always contains a large amount of solute, making it concentrated. (c) A concentrated solution has a high solute-to-solvent ratio, while a saturated solution has reached its maximum dissolution capacity. (d) A dilute solution can also be saturated, but a concentrated solution cannot be unsaturated.

306. 236. Which type of reaction often requires an input of energy (e.g., heat, light, electricity) to proceed? a) Combination reaction b) Combustion reaction c) Decomposition reaction d) Neutralization reaction

307. 273. To make a dilute solution more concentrated, one could: (a) Add more solvent (b) Add more solute (c) Heat the solution (d) Stir the solution vigorously

308. 301. Which of the following processes describes oxidation? (a) Gain of electrons (b) Loss of oxygen (c) Loss of electrons (d) Gain of hydrogen

309. 212. When the equation $N2 + H2 \rightarrow NH3$ is balanced, the coefficients for $N2$, $H2$, and $NH3$ respectively are: (a) 1, 1, 1 (b) 1, 2, 3 (c) 1, 3, 2 (d) 2, 1, 2

310. 235. The concept of oxidation and reduction, involving the transfer of electrons, is most directly relevant to which of the following reaction types? a) Precipitation reactions b) Neutralization reactions c) Single displacement reactions d) Decomposition reactions that are not thermolysis

311. 237. When chlorine gas is bubbled through an aqueous solution of potassium bromide, bromine liquid and potassium chloride are formed. This is an example of a: a) Combination reaction b) Double displacement reaction c) Single displacement reaction d) Acid-base reaction

312. 157. Which property is characteristic of substances with covalent bonds? (a) High melting and boiling points (b) Good electrical conductivity in molten state (c) Low melting and boiling points (d) Soluble in water only

313. 284. You have a sugar solution. After heating it, you are able to dissolve more sugar than before. This suggests that the original, unheated solution was: (a) Saturated (b) Supersaturated (c) Unsaturated (d) Insoluble

314. 202. The Law of Conservation of Mass dictates that chemical equations must be: (a) Simplified (b) Balanced (c) Reversed (d) Catalyzed

315. 135. Which of the following is a common characteristic property of many ionic compounds? (a) Low melting and boiling points (b) Good electrical conductivity in the solid state (c) Tendency to form soft, malleable solids (d) Form rigid, crystalline solids and are often soluble in water

316. 171. In the expression $2Al_2O_3$, what does the coefficient '2' represent? (a) Two atoms of aluminum. (b) Two molecules of oxygen. (c) Two formula units of aluminum oxide. (d) Two moles of aluminum.

317. 304. An oxidizing agent is a substance that: (a) Gets oxidized itself (b) Loses electrons (c) Causes another substance to be oxidized (d) Causes another substance to be reduced

318. 292. During a chemical reaction, energy is required to break existing bonds. Which of the following statements is true regarding this process? a) Bond breaking is always an exothermic process. b) Bond breaking always releases energy. c) Bond breaking always absorbs energy. d) Bond breaking is unrelated to energy changes.

319. 117. An element with a very large atomic radius and very low ionization energy is most likely to be found in which region of the periodic table? a) Top right b) Bottom left c) Top left d) Bottom right

320. 283. If Solution X is described as "more concentrated" than Solution Y, it implies that Solution X contains: (a) A smaller amount of solute than Solution Y for the same volume of solution. (b) More solvent than Solution Y for the same amount of solute. (c) A larger amount of solute than Solution Y for the same volume of solution. (d) Less solvent than Solution Y for the same amount of solution.

321. 188. The correct chemical formula for aluminum phosphate is: (a) $AlPO_4$ (b) Al_3PO_4 (c) $Al(PO_4)_3$ (d) $Al_2(PO_4)_3$

322. 148. A cation is an ion that has: a) Gained electrons and has a negative charge. b) Lost electrons and has a negative charge. c) Gained electrons and has a positive charge. d) Lost electrons and has a positive charge.

323. 56. An atom of an element X has a mass number of 31 and contains 16 neutrons. How many protons does it have? a) 15 b) 16 c) 31 d) 47

324. 145. Which of the following compounds is primarily ionic? a) CO_2 b) H_2O c) NaCl d) CH_4

325. 116. Consider the elements Li, Be, B, C, N. Which of these elements would have the highest metallic character? a) Li b) Be c) B d) C

326. 287. In an endothermic reaction, the total energy of the products is: a) Less than the total energy of the reactants. b) Equal to the total energy of the reactants. c) Greater than the total energy of the reactants. d) Independent of the total energy of the reactants.

327. 89. An atom of element Z has 17 protons, 18 neutrons, and 17 electrons. What is the mass number of this atom? a) 17 b) 18 c) 34 d) 35

328. 139. Which property is characteristic of most ionic compounds? a) Low melting point b) Poor electrical conductivity in the solid state c) Soft and malleable d) Soluble in non-polar solvents

329. 299. If a reaction has a high activation energy, it means the reaction: a) Will proceed very quickly. b) Will proceed very slowly unless energy is added. c) Will release a large amount of energy. d) Will absorb a large amount of energy.

330. 21. Consider a substance X. When heated, it changes from solid to liquid at 0 degrees Celsius, and from liquid to gas at 100 degrees Celsius. Substance X is most likely: (a) Carbon dioxide (b) Nitrogen (c) Water (d) Methane

ANSWER KEY

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

28. (c)

29. (b)

30. (c)

31. (b)

32. (c)

33. $Ca_3(PO_4)_2$

34. (c)

35. (a)

36. (c)

37. (b)

38. (c)

39. (b)

40. (b)

41. (c)

42. (c)

43. (c)

44. The term "redox reaction" is a combination of "reduction" and "oxidation." It is used because reduction and oxidation always occur simultaneously in a chemical reaction; one substance cannot be oxidized without another being reduced.

45. (a)

46. (c)

47. (d)

48. (b)

49. (c)

50. (c)

51. (d)

52. (c)

53. (b)

54. (d)

55. (a)

56. (c)

57. (c)

58. (c)

59. (d)

60. (b)

61. (c)

62. (b)

63. (c)

64. (b)

65. (b)

66. (b)

67. (b)

68. (c)

69. (c)

70. (c)

71. (c)

72. (c)

73. (b)

74. (d)

75. (c)

76. (c)

77. (c)

78. (c)

79. 1 mole.

80. (c)

81. (d)

82. (c)

83. (b)

84. Reduction

85. (b)

86. (b)

87. (b)

88. (c)

89. (c)

90. (d)

91. (b)

92. (b)

93. Increases, due to increased nuclear charge and smaller atomic radius, making it harder to remove electrons.

94. (a)

95. (b)

96. (d)

97. (a)

98. (b)

99. (c)

100. (c)

101. (c)

102. (b)

103. (a)

104. (c)

105. (c)

106. (d)

107. (c)

108. (d)

109. (b)

110. (b)

111. (c)

112. (b)

113. (c)

114. Oxidized: H_2; Reduced: CuO

115. (c)

116. (d)

117. (c)

118. (b)

119. (b)

120. (c)

121. (c)

122. (c)

123. (b)

124. (c)

125. (c)

126. (c)

127. (b)

128. (d)

129. (b)

130. (d)

131. (c)

132. (c)

133. (c)

134. Ionic bonding: Complete transfer of electrons (metal to non-metal). Covalent bonding: Sharing of electrons (non-metals).

135. (c)

136. (c)

137. (b)

138. (a)

139. (c)

140. (c)

141. (c)

142. (c)

143. (c)

144. (c)

145. (d)

146. (c)

147. (b)

148. (a)

149. (c)

150. (c)

151. (b)

152. (b)

153. (b)

154. (c)

155. (c)

156. (c)

157. (c)

158. (a)

159. (b)

160. (c)

161. (c)

162. (d)

163. (c)

164. (b)

165. (c)

166. (c)

167. (c)

168. (a)

169. (c)

170. (d)

171. (d)

172. Element: Pure substance, one type of atom (e.g., Oxygen). Compound: Two or more elements chemically combined in fixed ratio (e.g., Water).

173. (b)

174. (c)

175. (c)

176. (c)

177. (b)

178. (a)

179. (c)

180. (b)

181. (c)

182. (c)

183. (b)

184. (a)

185. (c)

186. (c)

187. (b)

188. (c)

189. (c)

190. (c)

191. (a)

192. (c)

193. (c)

194. (c)

195. (c)

196. (b)

197. (d)

198. (b)

199. (c)

200. (c)

201. Rusting of iron (or corrosion); Burning of fuel (combustion); Respiration.

202. (b)

203. (d)

204. Isotopes: Same element, same protons, different neutrons. Identical chemical properties (due to electron configuration); different physical properties (due to mass difference). Example: Carbon-12 and Carbon-14.

205. (b)

206. (b)

207. (b)

208. (b)

209. (c)

210. (d)

211. (c)

212. (c)

213. (b)

214. (c)

215. (c)

216. (b)

217. (b)

218. (c)

219. (a)

220. (c)

221. (c)

222. (d)

223. (c)

224. (a)

225. (c)

226. (c)

227. (b)

228. (c)

229. An oxidizing agent is a substance that accepts electrons (or provides oxygen/removes hydrogen) and gets reduced in the process. A reducing agent is a substance that donates electrons (or removes oxygen/provides hydrogen) and gets oxidized in the process.

230. (b)

231. (c)

232. (c)

233. (a)

234. (b)

235. (b)

236. (c)

237. (b)

238. (c)

239. (d)

240. (b)

241. (b)

242. (b)

243. (b)

244. (c)

245. (c)

246. Water molecules surround and separate individual sugar molecules, due to attractions between polar water and polar sugar molecules, breaking intermolecular forces within sugar.

247. (b)

248. (c)

249. (a)

250. (c)

251. (b)

252. (c)

253. (a)

254. (d)

255. (c)

256. (c)

257. Oxidation is the loss of electrons.

258. (d)

259. (b)

260. (c)

261. Single displacement reaction.

262. (d)

263. (c)

264. (b)

265. (c)

266. (b)

267. (a)

268. (b)

269. (a)

270. (c)

271. (c)

272. (a)

273. (c)

274. $2H_2O_2$ (aq) -----> $2H_2O$ (l) + O_2 (g)

275. (c)

276. (d)

277. (b)

278. (b)

279. (b)

280. (c)

281. (b)

282. (b)

283. (d)

284. (c)

285. (b)

286. (c)

287. (c)

288. Exothermic: Releases energy (e.g., combustion). Endothermic: Absorbs energy (e.g., photosynthesis).

289. (c)

290. (c)

291. (c)

292. (b)

293. (b)

294. (d)

295. (c)

296. (b)

297. A reducing agent is a substance that causes another substance to be oxidized, and itself gets oxidized (loses electrons).

298. (c)

299. (c)

300. (b)

301. (c)

302. (b)

303. (c)

304. (c)

305. (c)

306. (c)

307. (b)

308. (c)

309. (c)

310. (c)

311. (c)

312. (c)

313. (a)

314. (b)

315. (d)

316. (c)

317. (d)

318. (c)

319. (b)

320. (c)

321. (a)

322. (d)

323. (a)

324. (c)

325. (a)

326. (c)

327. (d)

328. (b)

329. (b)

330. (c)