

PRACTICE EXAM 6: PHYSICAL SETTING/CHEMISTRY SIMULATION (85 QUESTIONS)

1. The electron configuration 2-8-1 represents a neutral atom of which element?

- A. lithium
- B. sodium
- C. potassium
- D. hydrogen

2. In the formula H_2SO_4 , the subscript 4 indicates that the unit contains four atoms of

- A. hydrogen
- B. sulfur
- C. both hydrogen and sulfur
- D. oxygen

3. In the balanced equation $2 \text{KClO}_3 \rightarrow 2 \text{KCl} + 3 \text{O}_2$, the coefficient 3 indicates

- A. three atoms of oxygen
- B. three molecules of oxygen gas
- C. three potassium atoms
- D. three grams of oxygen

4. The notation "carbon-14" indicates that this atom of carbon has a

- A. atomic number of 14
- B. mass number of 14
- C. charge of 14
- D. half-life of 14 years

5. In a nuclear equation, the symbol ${}^4_2\text{He}$ represents

- A. a hydrogen atom
- B. a beta particle
- C. a neutron
- D. an alpha particle

6. In the compound Na_2O , the oxidation number of each sodium atom is

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

7. Using the ions Al^{3+} and O^{2-} , the correct formula for aluminum oxide is

- A. Al_2O_3
- B. AlO
- C. Al_3O_2
- D. Al_2O

8. The ion Na^+ has the same electron configuration as which neutral atom?

- A. sodium
- B. neon
- C. argon
- D. fluorine

9. A neutral atom of aluminum (atomic number 13) has the electron configuration

- A. 2-8-3
- B. 2-8-8
- C. 2-3
- D. 2-8-13

10. When the equation $__ \text{N}_2 + __ \text{H}_2 \rightarrow __ \text{NH}_3$ is balanced with the smallest whole-number coefficients, the coefficient of H_2 is

- A. 1
- B. 2
- C. 4
- D. 3

11. The formula for the compound containing one calcium ion (Ca^{2+}) and the carbonate ion (CO_3^{2-}) is

- A. Ca_2CO_3
- B. $\text{Ca}(\text{CO}_3)_2$
- C. CaCO_3
- D. $\text{Ca}_2(\text{CO}_3)_3$

12. In the equation $\text{Zn} + 2 \text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$, the substances written on the left side of the arrow are the

- A. reactants
- B. products
- C. catalysts
- D. spectator ions only

13. Which electron configuration represents an atom of nitrogen (7 electrons) in an excited state?

- A. 2-4-1
- B. 2-5
- C. 2-8
- D. 2-7

14. Which formula correctly represents a molecule of nitrogen gas as it occurs in nature?

- A. N
- B. N_2
- C. N_3
- D. 2N

15. The compound with the formula MgCl_2 is correctly named

- A. magnesium dichloride
- B. magnesium chloride
- C. manganese chloride
- D. magnesium chlorine

16. The compound with the formula CO is correctly named

- A. carbon monoxide
- B. carbon oxide
- C. carbonate
- D. carbon dioxide

17. In the nitrate ion, NO_3^- , the oxidation number of nitrogen is (each oxygen is -2 ; total charge -1)

- A. -1
- B. $+3$
- C. -5
- D. $+5$

18. The reaction $2 \text{H}_2 + \text{O}_2 \rightarrow 2 \text{H}_2\text{O}$ is best classified as a

- A. decomposition reaction
- B. single replacement reaction
- C. synthesis (combination) reaction
- D. double replacement reaction

19. The reaction $2 \text{H}_2\text{O} \rightarrow 2 \text{H}_2 + \text{O}_2$ is best classified as a

- A. decomposition reaction
- B. synthesis reaction
- C. single replacement reaction
- D. neutralization reaction

20. The formula CaCl_2 tells you that one formula unit contains

- A. one calcium atom and one chlorine atom
- B. two calcium atoms and one chlorine atom
- C. one calcium atom and two chlorine atoms
- D. two calcium atoms and two chlorine atoms

21. The ion O^{2-} contains how many electrons? (oxygen has atomic number 8)

- A. 6 electrons
- B. 8 electrons
- C. 10 electrons
- D. 16 electrons

22. In the nuclear equation in which carbon-14 (atomic number 6) decays to nitrogen-14 (atomic number 7) plus particle X, particle X is represented by

- A. ${}^4_2\text{He}$
- B. ${}^1_0\text{n}$
- C. ${}^1_1\text{H}$
- D. ${}^0_{-1}\text{e}$

23. A structural formula differs from a molecular formula in that a structural formula shows

- A. how the atoms are bonded and arranged
- B. only the total number of each kind of atom
- C. the mass of each atom
- D. the charge carried by each atom

24. The molecular formula C_4H_8 has which empirical formula?

A. C_4H_8

B. C_2H_4

C. CH_2

D. C_8H_{16}

25. In any correctly balanced chemical equation, the number of each type of atom is

A. greater on the product side

B. greater on the reactant side

C. equal on both sides of the arrow

D. always doubled in the products

26. An atom with the electron configuration 2-8-6 is located in

A. Period 2, Group 16

B. Period 3, Group 16

C. Period 3, Group 6

D. Period 6, Group 3

27. For the compound formed from K^+ and SO_4^{2-} to be neutral, its formula must be

A. KSO_4

B. K_2SO_4

C. $K(SO_4)_2$

D. $K_2(SO_4)_2$

28. According to standard naming, HCl dissolved in water is named

- A. hydrochloric acid
- B. chloric acid
- C. hydrogen chloride gas
- D. chlorous acid

29. The half-reaction $\text{Cu}^{2+} + 2\text{e}^{-} \rightarrow \text{Cu}$ represents

- A. oxidation, because electrons are lost
- B. reduction, because electrons are gained
- C. neutralization of an acid
- D. a physical change of state

30. Changing a subscript in a chemical formula is not allowed when balancing an equation because doing so would

- A. change the coefficient of the substance
- B. change the identity of the substance
- C. conserve the mass incorrectly
- D. add energy to the reaction

31. The molecule $\text{C}_6\text{H}_{12}\text{O}_6$ contains a total of how many atoms?

- A. 6 atoms
- B. 12 atoms
- C. 18 atoms
- D. 24 atoms

32. A neutral atom with a completely filled outer energy level and the configuration 2-8 is
- A. neon, a noble gas
 - B. oxygen, a nonmetal
 - C. magnesium, a metal
 - D. sodium, a metal
33. In the diatomic molecule O_2 , the oxidation number of each oxygen atom is
- A. -2
 - B. 0
 - C. +2
 - D. -1
34. In the equation $N_2 + 3 H_2 \rightarrow 2 NH_3$, the ratio of hydrogen molecules to ammonia molecules is
- A. 1 to 2
 - B. 1 to 3
 - C. 2 to 3
 - D. 3 to 2
35. The compound $FeCl_3$ contains iron with a +3 charge and is correctly named
- A. iron chloride
 - B. iron(II) chloride
 - C. iron(III) chloride
 - D. iron trichloride

36. An atom with the electron configuration 2-7 would most likely

- A. lose one electron to form a +1 ion
- B. lose seven electrons to form a +7 ion
- C. gain one electron to form a -1 ion
- D. lose two electrons to form a +2 ion

37. The notation 3 H₂O represents

- A. three molecules of water
- B. one molecule containing three waters
- C. three atoms of water
- D. three moles of hydrogen only

38. When the equation $__ \text{Mg} + __ \text{O}_2 \rightarrow __ \text{MgO}$ is balanced with the smallest whole numbers, the coefficient of MgO is

- A. 1
- B. 3
- C. 4
- D. 2

39. When a magnesium atom (2-8-2) forms an ion, it loses its valence electrons to achieve the configuration

- A. 2-8-2
- B. 2-8
- C. 2-8-8
- D. 2

40. In the symbol $^{23}_{11}\text{Na}$, the subscript 11 represents the

- A. mass number
- B. number of neutrons
- C. atomic number (number of protons)
- D. number of electrons gained

41. The formula NaCl represents a substance held together by ionic bonds and is best described as a

- A. single molecule of sodium chloride
- B. covalent network of bonded atoms
- C. metallic alloy of two elements
- D. formula unit of an ionic compound

42. In the synthesis reaction $2\text{Na} + \text{Cl}_2 \rightarrow ?$, the product is

- A. NaCl_2
- B. 2NaCl
- C. Na_2Cl
- D. $\text{Na} + \text{Cl}$

43. In most compounds, such as HCl and H_2O , the oxidation number of hydrogen is

- A. 0
- B. -2
- C. -1
- D. +1

44. Which pairing correctly shows a molecular formula and its correct empirical formula?

- A. H₂O and HO
- B. CO₂ and CO
- C. N₂ and N
- D. C₂H₆ and CH₃

45. The neutral atom with the electron configuration 2-8-8-2 is which element?

- A. magnesium
- B. calcium
- C. argon
- D. potassium

46. Ammonium chloride is formed from NH₄⁺ and Cl⁻. Its correct formula is

- A. NH₄Cl₂
- B. (NH₄)₂Cl
- C. NH₄Cl
- D. NHCl₄

47. In the equation $2 \text{H}_2 + \text{O}_2 \rightarrow 2 \text{H}_2\text{O}$, the equation can be read as: 2 moles of hydrogen react with

- A. 2 moles of oxygen
- B. 3 moles of oxygen
- C. 4 moles of oxygen
- D. 1 mole of oxygen

48. When a nucleus emits an alpha particle, the atomic number of the new element, compared with the original, is

- A. higher by 2
- B. exactly the same
- C. lower by 2
- D. lower by 4

49. An atom of oxygen has six valence electrons. To achieve a stable octet, an oxygen atom will tend to

- A. lose six electrons
- B. lose two electrons
- C. gain two electrons
- D. gain six electrons

50. Copper can form Cu^+ and Cu^{2+} ions. In the formula CuO , copper has a charge of

- A. +2
- B. +1
- C. -2
- D. 0

51. The equation $\text{H}_2 + \text{Cl}_2 \rightarrow 2 \text{HCl}$ is balanced because each side contains

- A. one hydrogen and one chlorine atom
- B. two hydrogen and one chlorine atom
- C. one hydrogen and two chlorine atoms
- D. two hydrogen and two chlorine atoms

52. The sum of the oxidation numbers of all atoms in a neutral compound must equal

- A. zero
- B. the number of atoms present
- C. the charge of the cation
- D. positive one

53. The element with the configuration 2-8-7 has how many valence electrons?

- A. 7
- B. 2
- C. 8
- D. 17

54. The atom represented by $^{35}_{17}\text{Cl}$ contains how many neutrons?

- A. 17 neutrons
- B. 52 neutrons
- C. 35 neutrons
- D. 18 neutrons

55. In the formula $\text{Ca}(\text{OH})_2$, the total number of oxygen atoms is

- A. 1
- B. 3
- C. 2
- D. 4

56. In a chemical equation, the symbol (aq) written after a formula indicates that the substance is

- A. dissolved in water
- B. in the gaseous phase
- C. a pure solid
- D. at a very high temperature

57. The compound N_2O_4 is correctly named

- A. nitrogen oxide
- B. nitrous oxide
- C. dinitrogen oxide
- D. dinitrogen tetroxide

58. In the sulfate ion, SO_4^{2-} , the oxidation number of sulfur is (each oxygen is -2)

- A. -2
- B. $+2$
- C. $+6$
- D. -6

59. The ions Na^+ , Mg^{2+} , and F^- all contain the same number of electrons. This number is

- A. 8 electrons
- B. 12 electrons
- C. 10 electrons
- D. 11 electrons

60. In the equation $A + B \rightarrow C + \text{heat}$, the heat term written on the product side indicates the reaction is

- A. endothermic
- B. nuclear
- C. a physical change
- D. exothermic

61. The correct chemical formula for potassium oxide, formed from K^+ and O^{2-} , is

- A. KO
- B. K_2O
- C. KO_2
- D. K_2O_2

62. The half-reaction $Mg \rightarrow Mg^{2+} + 2e^-$ represents

- A. oxidation, because two electrons are lost
- B. reduction, because two electrons are gained
- C. neutralization of magnesium
- D. condensation of magnesium gas

63. An atom contains 17 protons. Regardless of its number of neutrons or electrons, this atom must be

- A. chlorine
- B. argon
- C. sulfur
- D. fluorine

64. The molecular formula $C_6H_{12}O_6$ shows that the ratio of carbon to hydrogen to oxygen atoms is

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

65. When uranium-238 (atomic number 92) emits an alpha particle, the resulting nuclide has a mass number of

- A. 238
- B. 240
- C. 236
- D. 234

66. The compound SO_2 is named "sulfur dioxide" using prefixes because it is

- A. an ionic compound of two metals
- B. an acid dissolved in water
- C. a molecular compound of two nonmetals
- D. a metallic alloy

67. A sodium atom in the ground state has the configuration 2-8-1. Which configuration represents the same atom in an excited state?

- A. 2-8-1
- B. 2-7-2
- C. 2-8
- D. 2-8-2

68. In the ionic compound $\text{Al}_2(\text{SO}_4)_3$, the total positive charge contributed by the aluminum ions is

- A. +2
- B. +3
- C. +5
- D. +6

69. When the equation $__ \text{C}_3\text{H}_8 + __ \text{O}_2 \rightarrow __ \text{CO}_2 + __ \text{H}_2\text{O}$ is balanced, the coefficient of O_2 is

- A. 3
- B. 4
- C. 5
- D. 2

70. In the reaction $2 \text{Na} + \text{Cl}_2 \rightarrow 2 \text{NaCl}$, the oxidation number of sodium changes from

- A. +1 to 0
- B. -1 to 0
- C. 0 to +1
- D. 0 to -1

71. The hydrocarbon with the formula CH_4 is named

- A. methane
- B. ethane
- C. methene
- D. ethene

72. The formula Na_2O indicates that sodium and oxygen combine in a ratio of

- A. one sodium to one oxygen
- B. one sodium to two oxygen
- C. three sodium to one oxygen
- D. two sodium to one oxygen

73. The particle emitted during positron decay is represented by the symbol

- A. ${}^0_{-1}\text{e}$
- B. ${}^0_{+1}\text{e}$
- C. ${}^4_2\text{He}$
- D. ${}^1_0\text{n}$

74. Among atoms with the configurations 2-1, 2-8-1, and 2-8-8-1, the one with the most occupied energy levels is

- A. the atom with configuration 2-1
- B. the atom with configuration 2-8-1
- C. the atom with configuration 2-8-8-1
- D. all have the same number of levels

75. The compound Na_2CO_3 is correctly named

- A. sodium carbon oxide
- B. sodium carbonate
- C. disodium carbonate
- D. sodium bicarbonate

76. The reaction $\text{AgNO}_3 + \text{NaCl} \rightarrow \text{AgCl} + \text{NaNO}_3$ is best classified as a

- A. synthesis reaction
- B. double replacement reaction
- C. single replacement reaction
- D. decomposition reaction

77. The oxidation number of the chloride ion, Cl^- , is

- A. +1
- B. 0
- C. -1
- D. +7

78. An atom with the configuration 2-8-8 is chemically stable and unreactive because it has

- A. only one valence electron
- B. a completely filled outer energy level
- C. an excited electron in a high level
- D. an unstable nucleus

79. The gram-formula mass of a compound is found by

- A. adding the atomic masses of all the atoms in the formula
- B. subtracting the smallest atomic mass from the largest
- C. multiplying the number of atoms by Avogadro's number
- D. dividing the molar mass by the number of atoms

80. In a balanced nuclear equation, the symbol ${}^0_{-1}e$ on the product side indicates the emission of a

- A. proton
- B. neutron
- C. alpha particle
- D. beta particle

81. The acid with the formula HNO_3 is named

- A. nitric acid
- B. nitrous acid
- C. hydronitric acid
- D. nitrogen acid

82. In the combustion equation $\text{CH}_4 + 2 \text{O}_2 \rightarrow \text{CO}_2 + 2 \text{H}_2\text{O}$, the substance that reacts with the fuel is

- A. carbon dioxide
- B. water
- C. oxygen
- D. methane only

83. In the compound H_2O , the oxidation number of oxygen is

- A. +2
- B. -2
- C. +1
- D. 0

84. Atoms with only one valence electron, such as those with the configuration 2-8-1, tend to be

- A. very reactive metals that lose one electron
- B. very reactive nonmetals that gain electrons
- C. unreactive noble gases
- D. metalloids that share electrons

85. The chemical formula CO_2 represents a substance in which one atom of carbon is combined with

- A. two atoms of oxygen
- B. one atom of oxygen
- C. two molecules of oxygen
- D. one carbon and one oxygen

Practice Exam 6 – Explained Answer Key

1. B — A configuration of 2-8-1 totals 11 electrons, identifying the element with atomic number 11, sodium. The number of electrons in a neutral atom equals its atomic number. Reading the configuration directly gives the element.
2. D — In H_2SO_4 , the subscript 4 belongs to oxygen, indicating four oxygen atoms. Subscripts apply only to the element they immediately follow. This formula contains two hydrogen, one sulfur, and four oxygen atoms.
3. B — The coefficient 3 before O_2 means three molecules of oxygen gas. Coefficients count whole molecules or formula units, not individual atoms. Each O_2 molecule contains two oxygen atoms.
4. B — In isotope notation, "carbon-14" gives the mass number, 14, the total of protons and neutrons. The atomic number is fixed by the element carbon. Mass number identifies the particular isotope.
5. D — Table O represents ${}^4_2\text{He}$ as an alpha particle, a helium nucleus. Its mass number is 4 and its charge is +2. This notation is used to balance nuclear equations.
6. A — In Na_2O , oxygen is -2 , so the two sodium atoms must total +2, making each sodium +1. The oxidation numbers in a neutral compound sum to zero. Sodium reliably forms a +1 ion.
7. A — Criss-crossing Al^{3+} and O^{2-} gives Al_2O_3 , which balances the charges at +6 and -6 . The magnitude of each ion's charge becomes the other's subscript. This produces a neutral compound.
8. B — Na^+ has 10 electrons, the same configuration as neutral neon. Losing one electron gives sodium a noble-gas electron arrangement. This stable configuration is why sodium forms a +1 ion.

9. A — Aluminum has 13 electrons, arranged as 2-8-3 in the ground state. Lower energy levels fill before higher ones. This configuration shows three valence electrons in the outer level.
10. D — Balancing gives $\text{N}_2 + 3 \text{H}_2 \rightarrow 2 \text{NH}_3$, so the coefficient of H_2 is 3. This provides six hydrogen and two nitrogen atoms on each side. Coefficients are adjusted to conserve mass.
11. C — Calcium (Ca^{2+}) and carbonate (CO_3^{2-}) have equal and opposite charges, so they combine one-to-one as CaCO_3 . The charges balance without needing subscripts. This is the formula for limestone.
12. A — The substances written to the left of the arrow are the reactants, the starting materials. Products appear on the right side. The arrow shows the direction of the reaction.
13. A — Nitrogen has 7 electrons, and 2-4-1 keeps the total at 7 while leaving the second level short and placing an electron in the third level, marking an excited state. The ground state would be 2-5. An excited atom has absorbed energy that promoted an electron.
14. B — Nitrogen occurs naturally as the diatomic molecule N_2 . It is one of the seven diatomic elements. The two atoms share electrons in a covalent bond.
15. B — MgCl_2 is an ionic compound named magnesium chloride, without prefixes. Prefixes are used only for molecular compounds of two nonmetals. The fixed +2 charge of magnesium sets the formula.
16. A — CO is a molecular compound of two nonmetals named carbon monoxide, using the prefix "mono-" for one oxygen. Prefixes indicate the number of each atom. This distinguishes it from carbon dioxide, CO_2 .
17. D — Setting $\text{N} + 3(-2) = -1$ gives $\text{N} = +5$. The oxidation numbers must sum to the ion's overall charge of -1 . Assigning oxygen's known value isolates nitrogen.
18. C — Two substances combining into a single product, $2 \text{H}_2 + \text{O}_2 \rightarrow 2 \text{H}_2\text{O}$, is a synthesis reaction. Synthesis joins simpler substances into a more complex one. The single product is the signature of synthesis.
19. A — A single compound breaking into simpler substances, $2 \text{H}_2\text{O} \rightarrow 2 \text{H}_2 + \text{O}_2$, is a decomposition reaction. Decomposition is the reverse of synthesis. One reactant yielding multiple products is its hallmark.
20. C — CaCl_2 contains one calcium atom and two chlorine atoms, as shown by the subscript 2 on chlorine. The absence of a subscript on calcium means one atom. The formula reflects the charge balance of Ca^{2+} and two Cl^- .
21. C — The O^{2-} ion gains two electrons, so $8 + 2 = 10$ electrons. Gaining electrons gives the ion a negative charge. This produces a stable, neon-like configuration.
22. D — Balancing mass ($14 = 14$) and atomic number ($6 \rightarrow 7$ requires a -1 particle) identifies X as a beta particle, ${}^0_{-1}\text{e}$. A neutron converts to a proton, raising the atomic number by one. The emitted electron carries away the -1 charge.
23. A — A structural formula shows how the atoms are bonded and arranged, beyond just the count given by a molecular formula. It reveals the connectivity of the atoms. This is why isomers have the same molecular formula but different structural formulas.
24. C — Dividing the subscripts of C_4H_8 by four gives the empirical formula CH_2 . The empirical formula is the simplest whole-number ratio. It cannot be reduced any further.
25. C — A balanced equation has an equal number of each type of atom on both sides of the arrow. This reflects the conservation of mass. No atoms are created or destroyed in a reaction.
26. B — A configuration of 2-8-6 has six valence electrons (Group 16) and three occupied levels (Period 3). The period number equals the number of energy levels. The valence count sets the group.

27. B — Two K^+ ions are needed to balance one SO_4^{2-} , giving K_2SO_4 . The total positive and negative charges must be equal. The polyatomic sulfate keeps its formula intact.
28. A — HCl dissolved in water is named hydrochloric acid, following the rules for binary acids. The "hydro-" prefix and "-ic acid" ending apply to acids without oxygen. Table K lists this name.
29. B — The half-reaction $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$ shows electrons gained, which is reduction. Electrons appearing on the reactant side indicate a gain. The copper ion's oxidation number decreases from +2 to 0.
30. B — Changing a subscript changes the identity of the substance, producing a different compound. Only coefficients may be adjusted to balance an equation. Altering subscripts would describe a reaction that does not occur.
31. D — $\text{C}_6\text{H}_{12}\text{O}_6$ contains $6 + 12 + 6 = 24$ atoms. The subscripts are summed across all elements. This is the molecular formula of glucose.
32. A — A configuration of 2-8 totals 10 electrons with a filled outer level, identifying neon, a noble gas. The complete outer level makes it stable and unreactive. Neon is the element with atomic number 10.
33. B — In the diatomic element O_2 , each oxygen atom has an oxidation number of 0. An element in its free, uncombined state always has an oxidation number of zero. This rule starts oxidation-number assignments.
34. D — In $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$, the ratio of hydrogen molecules to ammonia molecules is 3 to 2. Coefficients give the ratio of substances. This ratio is read directly from the balanced equation.
35. C — FeCl_3 contains iron with a +3 charge, named iron(III) chloride using the Stock system. The Roman numeral indicates the metal's charge. This is needed because iron can form more than one ion.
36. C — A 2-7 configuration has seven valence electrons, so the atom gains one electron to complete its octet, forming a -1 ion. Nonmetals with nearly full outer shells gain electrons. This produces a stable noble-gas configuration.
37. A — The notation $3\text{H}_2\text{O}$ represents three molecules of water. The coefficient 3 multiplies the entire molecule. Each molecule contains two hydrogen and one oxygen atom.
38. D — Balancing gives $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$, so the coefficient of MgO is 2. This provides two magnesium and two oxygen atoms on each side. Coefficients balance the equation without changing formulas.
39. B — A magnesium atom (2-8-2) loses its two valence electrons to reach the stable configuration 2-8. Losing the outer electrons gives a noble-gas arrangement. This forms the Mg^{2+} ion.
40. C — In ${}^{23}_{11}\text{Na}$, the subscript 11 is the atomic number, the number of protons. The superscript 23 is the mass number. The atomic number defines the element as sodium.
41. D — NaCl is held together by ionic bonds and exists as a repeating lattice, so it is described as a formula unit, not a molecule. Ionic compounds do not form discrete molecules. The formula gives the simplest ion ratio.
42. B — Combining 2 Na with Cl_2 produces 2 NaCl , balancing the atoms. Sodium forms +1 ions and chlorine -1 ions in a one-to-one ratio. The coefficient 2 balances the two chlorine atoms.
43. D — In most compounds, hydrogen has an oxidation number of +1. This applies in HCl , H_2O , and similar compounds. It is a standard rule used to assign other oxidation numbers.
44. D — C_2H_6 reduces to the empirical formula CH_3 by dividing the subscripts by two. The other pairs are not correctly reduced. The empirical formula gives the simplest atom ratio.
45. B — A configuration of 2-8-8-2 totals 20 electrons, identifying calcium. The number of electrons equals the atomic number in a neutral atom. Calcium has atomic number 20.

46. C — Ammonium (NH_4^+) and chloride (Cl^-) have equal and opposite charges, combining one-to-one as NH_4Cl . The polyatomic ammonium ion keeps its formula. No additional subscripts are needed.
47. D — In $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$, the 2:1 ratio means 2 moles of hydrogen react with 1 mole of oxygen. Coefficients represent mole ratios. This relationship is the basis of stoichiometry.
48. C — Emitting an alpha particle removes two protons, lowering the atomic number by 2. The mass number also drops by 4. The new element is two places lower on the periodic table.
49. C — Oxygen has six valence electrons and gains two to complete a stable octet. Gaining electrons forms a -2 ion. This drive toward a full outer shell governs oxygen's bonding.
50. A — In CuO , oxygen is -2 , so copper must be $+2$ to balance the neutral compound. The oxidation numbers sum to zero. This identifies the copper(II) form.
51. D — $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$ is balanced because each side has two hydrogen and two chlorine atoms. Equal atom counts on both sides confirm a balanced equation. This satisfies conservation of mass.
52. A — The oxidation numbers of all atoms in a neutral compound must sum to zero. This balance is required because the compound has no overall charge. It is the rule used to find an unknown oxidation number.
53. A — A configuration of 2-8-7 has seven electrons in its outermost level, so it has seven valence electrons. Valence electrons are those in the outer level. This count determines the atom's bonding behavior.
54. D — The number of neutrons equals mass number minus atomic number, so $35 - 17 = 18$. The superscript gives the mass number and the subscript the proton count. Subtracting isolates the neutrons.
55. C — In $\text{Ca}(\text{OH})_2$, the subscript 2 outside the parentheses doubles the contents, giving two oxygen atoms. The hydroxide group is counted twice. Distributing the subscript correctly gives the atom count.
56. A — The symbol (aq) means the substance is aqueous, dissolved in water. Other state symbols are (s), (l), and (g). This notation specifies the physical state in an equation.
57. D — N_2O_4 is a molecular compound named dinitrogen tetroxide, using "di-" for two nitrogen and "tetra-" for four oxygen. Prefixes indicate the number of each atom. This naming applies to two nonmetals.
58. C — Setting $S + 4(-2) = -2$ gives $S = +6$. The oxidation numbers must sum to the ion's charge of -2 . Assigning oxygen's known value isolates sulfur.
59. C — Na^+ ($11 - 1$), Mg^{2+} ($12 - 2$), and F^- ($9 + 1$) each have 10 electrons. They are isoelectronic with neon. This shared electron count gives them similar electron arrangements.
60. D — Heat written on the product side means it is released, so the reaction is exothermic. Exothermic reactions give off energy to the surroundings. The products are at a lower energy than the reactants.
61. B — Balancing K^+ with O^{2-} requires two potassium ions, giving K_2O . Two $+1$ charges balance one -2 charge. This produces a neutral compound.
62. A — The half-reaction $\text{Mg} \rightarrow \text{Mg}^{2+} + 2\text{e}^-$ shows two electrons lost, which is oxidation. Electrons on the product side indicate a loss. Magnesium's oxidation number rises from 0 to $+2$.
63. A — An atom with 17 protons must be chlorine, since the proton count defines the element. Neither neutrons nor electrons change an element's identity. The atomic number is the element's fingerprint.
64. D — The subscripts 6, 12, and 6 reduce to a ratio of 1:2:1 for carbon, hydrogen, and oxygen. Dividing each by six gives the simplest ratio. This is the empirical ratio within glucose.

65. D — Emitting an alpha particle removes four mass units, so $238 - 4 = 234$. The mass number decreases by the alpha particle's mass of 4. Conserving mass number identifies the product.
66. C — SO_2 is named with prefixes because it is a molecular compound of two nonmetals. Prefixes such as "di-" indicate the number of atoms. Ionic compounds, by contrast, are named without prefixes.
67. B — A sodium atom has 11 electrons, and 2-7-2 keeps that total while leaving the second level short, marking an excited state. The ground state is 2-8-1. The promoted electron indicates absorbed energy.
68. D — Two aluminum ions, each +3, contribute a total positive charge of +6 in $\text{Al}_2(\text{SO}_4)_3$. This balances the three sulfate ions at -2 each. The charges sum to zero overall.
69. C — Balancing combustion of propane gives $\text{C}_3\text{H}_8 + 5 \text{O}_2 \rightarrow 3 \text{CO}_2 + 4 \text{H}_2\text{O}$, so the coefficient of O_2 is 5. This balances three carbon, eight hydrogen, and ten oxygen atoms. Hydrocarbon combustion produces carbon dioxide and water.
70. C — In $2 \text{Na} + \text{Cl}_2 \rightarrow 2 \text{NaCl}$, sodium's oxidation number changes from 0 (free element) to +1 in the compound. Losing an electron raises its oxidation number. This identifies sodium as oxidized.
71. A — CH_4 is the one-carbon alkane named methane, using the "meth-" prefix and "-ane" ending. It is the simplest hydrocarbon. The prefix sets the carbon count.
72. D — Na_2O shows two sodium atoms for every one oxygen atom, a 2:1 ratio. The subscript 2 on sodium gives the ratio. This balances the +1 sodium ions with the -2 oxide ion.
73. B — A positron is represented by ${}^0_{+1}\text{e}$, a positively charged electron with mass number 0. It is emitted during positron decay. Its +1 charge distinguishes it from a beta particle.
74. C — The configuration 2-8-8-1 has four occupied energy levels, the most of the three listed. Each number represents one energy level. More levels place the atom lower on the periodic table.
75. B — Na_2CO_3 is named sodium carbonate, using the polyatomic carbonate ion. Ionic compounds with polyatomic ions take the ion's name directly. Prefixes are not used for ionic compounds.
76. B — In $\text{AgNO}_3 + \text{NaCl} \rightarrow \text{AgCl} + \text{NaNO}_3$, the ions exchange partners, making it a double replacement reaction. Two compounds swap components. The formation of insoluble AgCl drives the reaction.
77. C — The chloride ion, Cl^- , has an oxidation number of -1 , equal to its charge. A monatomic ion's oxidation number always matches its charge. This rule applies directly to simple ions.
78. B — A 2-8-8 configuration (argon) has a completely filled outer energy level, making the atom stable and unreactive. A full octet provides chemical stability. This is why the noble gases rarely react.
79. A — The gram-formula mass is found by adding the atomic masses of all atoms in the formula. Each element's mass is multiplied by its subscript before summing. This value converts between mass and moles.
80. D — The symbol ${}^0_{-1}\text{e}$ on the product side indicates the emission of a beta particle, a high-speed electron. It carries a -1 charge and no significant mass. Beta emission raises the atomic number by one.
81. A — HNO_3 is named nitric acid, an oxyacid containing the nitrate ion. The "-ic acid" ending corresponds to the "-ate" polyatomic ion. Table K lists this name and formula.
82. C — In the combustion of methane, oxygen is the substance that reacts with the fuel. Combustion requires oxygen to burn the hydrocarbon. The products are carbon dioxide and water.
83. B — In H_2O , oxygen has an oxidation number of -2 , its usual value in compounds. The two hydrogens at +1 each balance it to zero. This standard value applies in most compounds.

84. A — Atoms with one valence electron, such as 2-8-1 (sodium), are very reactive metals that lose that electron to form +1 ions. Losing the single outer electron gives a stable configuration. This makes the alkali metals highly reactive.
85. A — CO_2 shows one carbon atom combined with two oxygen atoms, indicated by the subscript 2. The subscript applies only to oxygen. This is the molecular formula of carbon dioxide.