PRACTICE EXAM 17: PHYSICAL SETTING/CHEMISTRY SIMULATION (85 QUESTIONS)

1. Which element and symbol are correctly matched?

A. Sodium — Na

B. Potassium — P

C. Iron — Ir

D. Gold — Go

2. Which formula and compound name are correctly matched?

A. NaCl — sodium oxide

B. CO_2 — carbon monoxide

C. H_2O — water

D. $CaCO_3$ — calcium chloride

3. Which ion and charge are correctly matched?

A. sodium ion — −1

B. chloride ion — +1

C. calcium ion — +1

D. oxide ion — −2

4. Which subatomic particle and charge are correctly matched?

A. proton — negative

B. electron — positive

C. neutron — no charge

D. proton — no charge

5. Which reaction and type are correctly matched?

A. $2\ H_2O \rightarrow 2\ H_2 + O_2$ — synthesis

B. $2\ Na + Cl_2 \rightarrow 2\ NaCl$ — synthesis

C. $CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$ — decomposition

D. $HCl + NaOH \rightarrow NaCl + H_2O$ — combustion

6. Which phase change and description are correctly matched?

A. melting — gas to liquid

B. freezing — solid to liquid

C. sublimation — gas to solid

D. condensation — gas to liquid

7. Which periodic table group and name are correctly matched?

A. Group 1 — halogens

B. Group 18 — noble gases

C. Group 17 — alkali metals

D. Group 2 — transition metals

8. Which bond and description are correctly matched?

A. ionic bond — sharing of electrons

B. covalent bond — sharing of electrons

C. metallic bond — transfer of electrons to nonmetals

D. ionic bond — sea of mobile electrons

9. Which substance and classification are correctly matched?

A. HCl — base

B. NaOH — acid

C. H_2SO_4 — acid

D. KOH — acid

10. Which pH value and classification are correctly matched?

A. pH 3 — acidic

B. pH 7 — basic

C. pH 10 — acidic

D. pH 1 — neutral

11. Which process and definition are correctly matched?

A. oxidation — gain of electrons

B. reduction — gain of electrons

C. oxidation — gain of protons

D. reduction — loss of electrons

12. Which quantity and unit are correctly matched?

A. temperature — grams

B. molarity — moles per liter

C. density — kelvin

D. pressure — moles

13. Which radiation type and description are correctly matched?

A. alpha particle — high-speed electron

B. beta particle — helium nucleus

C. gamma ray — has a +2 charge

D. alpha particle — helium nucleus

14. Which hydrocarbon and bonding are correctly matched?

A. alkane — single bonds only

B. alkene — triple bond

C. alkyne — single bonds only

D. alkane — double bond

15. Which formula and name are NOT correctly matched?

A. CO_2 — carbon dioxide

B. NaCl — sodium oxide

C. H_2O — water

D. CaO — calcium oxide

16. Which state of matter and property are correctly matched?

A. solid — definite shape and volume

B. liquid — no definite volume

C. gas — definite shape

D. solid — fills its container

17. Which element and classification are correctly matched?

A. oxygen — metal

B. sodium — nonmetal

C. neon — metal

D. silicon — metalloid

18. Which term and definition are correctly matched?

A. isotopes — atoms with different numbers of protons

B. ion — a neutral atom

C. cation — a positively charged ion

D. anion — a positively charged ion

19. Which reaction and its products are correctly matched?

A. acid + base — salt + water

B. synthesis — two simpler products

C. decomposition — a single product

D. combustion — hydrogen + oxygen

20. Which equation symbol and meaning are correctly matched?

A. (s) — gas

B. (g) — solid

C. (l) — aqueous

D. (aq) — dissolved in water

21. Which trend and direction are correctly matched?

A. atomic radius — increases across a period

B. ionization energy — decreases across a period

C. electronegativity — decreases up a group

D. atomic radius — increases down a group

22. Which element and symbol are NOT correctly matched?

A. carbon — C

B. potassium — P

C. hydrogen — H

D. oxygen — O

23. Which measurement and instrument are correctly matched?

A. mass — thermometer

B. temperature — balance

C. heat of reaction — calorimeter

D. volume of liquid — barometer

24. Which element and group name are correctly matched?

A. chlorine — alkali metal

B. argon — halogen

C. calcium — noble gas

D. sodium — alkali metal

25. Which substance and bond type are correctly matched?

A. NaCl — covalent bond

B. O_2 — covalent bond

C. copper metal — ionic bond

D. $MgCl_2$ — metallic bond

26. Which reaction type and energy description are correctly matched?

A. exothermic — releases heat

B. endothermic — releases heat

C. exothermic — absorbs heat

D. endothermic — products lower in energy

27. Which example and classification are correctly matched?

A. saltwater — compound

B. pure water — mixture

C. sand and water — heterogeneous mixture

D. oxygen gas — compound

28. Which quantity and value are correctly matched?

A. molar volume at STP — 11.2 L

B. Avogadro's number — 6.02×10^{23}

C. neutral pH — 14

D. molar volume at STP — 1.0 L

29. Which example and type of change are correctly matched?

A. burning wood — chemical change

B. melting ice — chemical change

C. boiling water — chemical change

D. dissolving sugar — chemical change

30. Which element and property are correctly matched?

A. helium — highly reactive

B. sodium — unreactive

C. fluorine — highly reactive nonmetal

D. neon — a metal

31. Which formula and total number of atoms are correctly matched?

A. H_2O — 3 atoms

B. CO_2 — 2 atoms

C. NaCl — 3 atoms

D. CH_4 — 4 atoms

32. Which term and definition are correctly matched?

A. solute — the dissolving substance

B. solvent — the dissolving substance

C. precipitate — a gas product

D. electrolyte — does not conduct electricity

33. A 100-g sample has a half-life of 2 years. Which elapsed time and remaining mass are correctly matched?

A. 2 years — 50 g

B. 4 years — 50 g

C. 2 years — 25 g

D. 6 years — 50 g

34. Which equation and reaction type are correctly matched?

A. $2\ H_2 + O_2 \rightarrow 2\ H_2O$ — synthesis

B. $CaCO_3 \rightarrow CaO + CO_2$ — synthesis

C. $Zn + 2\ HCl \rightarrow ZnCl_2 + H_2$ — decomposition

D. $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$ — synthesis

35. Which gas law relationship is correctly matched?

A. Boyle's law — volume and temperature directly related

B. Boyle's law — pressure and volume inversely related

C. Charles's law — pressure and volume inversely related

D. Charles's law — volume and temperature inversely related

36. Which particle and location are correctly matched?

A. proton — in the nucleus

B. electron — in the nucleus

C. neutron — outside the nucleus

D. electron — in the nucleus, with the protons

37. Which formula and acid name are correctly matched?

A. HCl — nitric acid

B. H_2SO_4 — hydrochloric acid

C. HNO_3 — nitric acid

D. HNO_3 — sulfuric acid

38. Which property and bonding type are correctly matched?

A. conducts electricity as a solid — metallic

B. conducts electricity as a solid — ionic

C. does not conduct when molten — ionic

D. shares electrons — ionic

39. Which definition and term are correctly matched?

A. energy of motion — potential energy

B. energy to start a reaction — bond energy

C. number of protons — mass number

D. number of protons — atomic number

40. At room temperature, which element and state are correctly matched?

A. oxygen — solid

B. iron — gas

C. mercury — solid

D. nitrogen — gas

41. Which observation and conclusion are correctly matched?

A. temperature rises — exothermic reaction

B. temperature drops — exothermic reaction

C. gas produced — no reaction

D. color change — physical change only

42. Which group and characteristic are correctly matched?

A. Group 1 — forms −1 ions

B. Group 17 — forms +1 ions

C. Group 2 — forms +2 ions

D. Group 18 — highly reactive

43. Which formula and type are correctly matched?

A. $C_6H_{12}O_6$ — empirical formula

B. CH_2O — empirical formula

C. CH_2O — molecular formula of glucose

D. $C_6H_{12}O_6$ — simplest ratio

44. Which solution description and term are correctly matched?

A. can dissolve more solute — saturated

B. holds maximum solute — saturated

C. holds maximum solute — unsaturated

D. holds no solute — concentrated

45. Which element and symbol are correctly matched?

A. lead — Ld

B. silver — Si

C. potassium — K

D. tin — Ti

46. Which nuclear process and description are correctly matched?

A. fission — joining of light nuclei

B. fusion — splitting of a heavy nucleus

C. fission — splitting of a heavy nucleus

D. fusion — gain of electrons

47. Which equation and reaction type are correctly matched?

A. $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$ — single replacement

B. $2\ H_2O \rightarrow 2\ H_2 + O_2$ — synthesis

C. $N_2 + 3\ H_2 \rightarrow 2\ NH_3$ — decomposition

D. $HCl + NaOH \rightarrow NaCl + H_2O$ — combustion

48. Which sample and number of moles are correctly matched? (GFM: $H_2O = 18$, $NaOH = 40$)

A. 36 g of H_2O — 2 moles

B. 18 g of H_2O — 2 moles

C. 40 g of NaOH — 2 moles

D. 36 g of H_2O — 1 mole

49. Which electronegativity difference and bond type are correctly matched?

A. very large difference — nonpolar covalent

B. zero difference — ionic

C. small difference — ionic

D. very large difference — ionic

50. Which action and effect are correctly matched?

A. adding salt to water — raises freezing point

B. adding salt to water — lowers freezing point

C. adding solute — lowers boiling point

D. adding solute — has no effect

51. Which term and definition are correctly matched?

A. catalyst — raises activation energy

B. catalyst — consumed in the reaction

C. catalyst — speeds a reaction without being consumed

D. inhibitor — speeds a reaction

52. Which periodic table feature and definition are correctly matched?

A. group — a horizontal row

B. period — a vertical column

C. group — a vertical column

D. period — a diagonal line

53. Which formula and name are correctly matched?

A. CO — carbon dioxide

B. CO — carbon monoxide

C. CO_2 — carbon monoxide

D. N_2O_4 — nitrogen dioxide

54. Which change and gas effect are correctly matched?

A. increasing pressure at constant T — increases volume

B. increasing temperature at constant P — decreases volume

C. decreasing temperature — increases volume

D. increasing pressure at constant T — decreases volume

55. Which element and natural form are correctly matched?

A. helium — He_2

B. neon — Ne_2

C. argon — Ar_2

D. oxygen — O_2

56. Which statement and property type are correctly matched?

A. "iron rusts in air" — physical property

B. "copper is malleable" — physical property

C. "wood burns" — physical property

D. "silver is shiny" — chemical property

57. For an exothermic reaction, which feature and description are correctly matched?

A. products — higher energy than reactants

B. reaction — absorbs energy overall

C. activated complex — lowest energy point

D. products — lower energy than reactants

58. Which term and description are correctly matched?

A. electrolyte — does not conduct in water

B. nonelectrolyte — conducts strongly

C. solute — the substance doing the dissolving

D. electrolyte — conducts electricity when dissolved

59. Which element and the ion it commonly forms are correctly matched?

A. magnesium — Mg^{2+}

B. chlorine — Cl^{+}

C. sodium — Na^{2+}

D. oxygen — O^{2+}

60. Which process and heat description are correctly matched?

A. hand warmer — absorbs heat

B. instant cold pack — releases heat

C. hand warmer — releases heat

D. ice melting — releases heat

61. Which term and definition are correctly matched?

A. valence electrons — electrons in the nucleus

B. atomic mass — number of protons only

C. neutron — a positively charged particle

D. valence electrons — electrons in the outer shell

62. Which substance and approximate pH are correctly matched?

A. lemon juice — pH 12

B. household ammonia — pH 11

C. pure water — pH 2

D. stomach acid — pH 9

63. Which reaction type and example are correctly matched?

A. neutralization — $CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$

B. neutralization — $HCl + NaOH \rightarrow NaCl + H_2O$

C. combustion — $2\ Na + Cl_2 \rightarrow 2\ NaCl$

D. decomposition — $N_2 + 3\ H_2 \rightarrow 2\ NH_3$

64. Which mixture and best separation method are correctly matched?

A. saltwater — filtration

B. sand and water — distillation

C. alcohol and water — magnet

D. sand and water — filtration

65. For an atom of $^{35}_{17}Cl$, which quantity and value are correctly matched?

A. neutrons — 18

B. protons — 35

C. neutrons — 35

D. protons — 18

66. Which element and family are correctly matched?

A. chlorine — halogen

B. sodium — noble gas

C. helium — alkali metal

D. iron — halogen

67. Which quantity and defining relationship are correctly matched?

A. density — mass × volume

B. molarity — grams per liter

C. density — mass divided by volume

D. molarity — liters per mole

68. Which substance and bond type are correctly matched?

A. sugar dissolved in water — conducts as a strong electrolyte

B. table salt — covalent compound

C. diamond — ionic network

D. sodium chloride — ionic compound

69. Which example and classification are correctly matched?

A. chopping wood — physical change

B. burning wood — physical change

C. rusting iron — physical change

D. cooking an egg — physical change

70. Which property and trend across a period (left to right) are correctly matched?

A. atomic radius — increases

B. metallic character — increases

C. ionization energy — decreases

D. electronegativity — increases

71. Which formula and compound name are correctly matched?

A. $CaCO_3$ — calcium chloride

B. NaOH — sodium chloride

C. $CaCO_3$ — calcium carbonate

D. H_2SO_4 — hydrochloric acid

72. Which particle and relative mass are correctly matched?

A. electron — much smaller than a proton

B. proton — much smaller than an electron

C. neutron — no mass

D. electron — larger than a neutron

73. Which term and definition are NOT correctly matched?

A. melting — solid to liquid

B. freezing — liquid to solid

C. evaporation — gas to solid

D. condensation — gas to liquid

74. Which combustion reaction and products are correctly matched?

A. hydrocarbon combustion — produces only water

B. hydrocarbon combustion — produces hydrogen gas

C. hydrocarbon combustion — produces only carbon dioxide

D. hydrocarbon combustion — produces carbon dioxide and water

75. Which solution and molarity are correctly matched? (moles ÷ liters)

A. 1 mole in 2 liters — 0.5 M

B. 2 moles in 1 liter — 0.5 M

C. 1 mole in 1 liter — 2 M

D. 4 moles in 2 liters — 1 M

76. Which element and symbol are correctly matched?

A. iron — Ir

B. sodium — S

C. nitrogen — Ni

D. calcium — Ca

77. Which group and electron feature are correctly matched?

A. Group 1 — seven valence electrons

B. Group 17 — one valence electron

C. Group 18 — full outer shell

D. Group 2 — three valence electrons

78. Which factor and effect on reaction rate are correctly matched?

A. lowering temperature — speeds up the reaction

B. decreasing concentration — speeds up the reaction

C. increasing surface area — speeds up the reaction

D. adding a catalyst — slows down the reaction

79. Which term and definition are correctly matched?

A. compound — physically combined substances

B. compound — elements chemically combined

C. element — two or more types of atoms

D. mixture — chemically combined substances

80. Which bond and example pair are correctly matched?

A. nonpolar covalent — HCl

B. nonpolar covalent — Cl_2

C. ionic — O_2

D. polar covalent — Cl_2

81. Which term and definition are correctly matched?

A. temperature — total energy of a sample

B. heat — average kinetic energy of particles

C. temperature — average kinetic energy of particles

D. heat — a unit of mass

82. Which emission and its effect on atomic number are correctly matched?

A. alpha emission — increases atomic number by 2

B. beta emission — decreases atomic number by 1

C. alpha emission — no change in atomic number

D. beta emission — increases atomic number by 1

83. Which action and its effect on concentration are correctly matched?

A. adding water — increases concentration

B. removing solvent by evaporation — decreases concentration

C. adding more solute — increases concentration

D. adding water — has no effect

84. In a chemical formula, which part and meaning are correctly matched?

A. coefficient — number of atoms of one element

B. subscript — number of whole molecules

C. subscript — number of atoms of one element

D. coefficient — the color of the compound

85. Which element and characteristic property are correctly matched?

A. neon — highly reactive metal

B. gold — unreactive metal that resists corrosion

C. sodium — unreactive nonmetal

D. chlorine — soft, silvery metal

Practice Exam 17 – Explained Answer Key

1. A — Sodium is correctly represented by the symbol Na. Potassium is K, iron is Fe, and gold is Au. Element symbols come from the element's name or its Latin name.
2. C — The formula H_2O correctly names water. NaCl is sodium chloride, CO_2 is carbon dioxide, and $CaCO_3$ is calcium carbonate. Each formula corresponds to a specific compound.
3. D — The oxide ion correctly carries a −2 charge. Sodium is +1, chloride is −1, and calcium is +2. Group 16 elements gain two electrons to form −2 ions.
4. C — The neutron correctly has no charge. Protons are positive and electrons are negative. The neutral neutron contributes mass but not charge.

5. B — The reaction $2\ Na + Cl_2 \rightarrow 2\ NaCl$ is correctly classified as synthesis, since two substances combine into one product. The water-splitting reaction is decomposition, and the methane reaction is combustion. Synthesis joins simpler substances.
6. D — Condensation is correctly matched as the change from gas to liquid. Melting is solid to liquid, freezing is liquid to solid, and sublimation is solid to gas. Condensation releases energy as the gas cools.
7. B — Group 18 is correctly matched with the noble gases. Group 1 is the alkali metals, Group 17 the halogens, and Group 2 the alkaline earth metals. Noble gases have full outer shells.
8. B — A covalent bond correctly involves the sharing of electrons. Ionic bonds transfer electrons, and metallic bonds feature a sea of mobile electrons. Sharing occurs between nonmetals.
9. C — H_2SO_4 is correctly classified as an acid. HCl is also an acid, while NaOH and KOH are bases. Sulfuric acid produces hydrogen ions in solution.
10. A — A pH of 3 is correctly matched with acidic. A pH of 7 is neutral and pH 10 is basic. Values below 7 indicate acidity.
11. B — Reduction is correctly matched with the gain of electrons. Oxidation is the loss of electrons. Gaining electrons lowers the oxidation number.
12. B — Molarity is correctly matched with moles per liter. Temperature is measured in kelvin, density in mass per volume, and pressure in units like kilopascals. Molarity expresses concentration.
13. D — An alpha particle is correctly matched as a helium nucleus. A beta particle is a high-speed electron, and a gamma ray is energy with no charge. The alpha particle has a +2 charge.
14. A — An alkane is correctly matched with single bonds only. Alkenes have a double bond and alkynes a triple bond. Alkanes are saturated hydrocarbons.
15. B — NaCl paired with "sodium oxide" is the incorrect match, since NaCl is sodium chloride. The other formulas are correctly named. Sodium oxide would be Na_2O.
16. A — A solid is correctly matched with having a definite shape and volume. Its particles are locked in a fixed arrangement. Gases, by contrast, fill their container.
17. D — Silicon is correctly classified as a metalloid. Oxygen is a nonmetal, sodium a metal, and neon a noble gas. Metalloids have properties between metals and nonmetals.
18. C — A cation is correctly defined as a positively charged ion. Isotopes differ in neutrons, not protons, and an anion is negatively charged. A cation forms by losing electrons.
19. A — An acid and base reacting to form salt and water is the correct match. Synthesis gives a single product, and decomposition has a single reactant. This is the neutralization reaction.
20. D — The symbol (aq) correctly means dissolved in water. The symbol (s) is solid, (g) is gas, and (l) is liquid. State symbols specify a substance's physical form.
21. D — Atomic radius increasing down a group is the correct match. Across a period, radius decreases and ionization energy increases. Added shells make atoms larger down a group.
22. B — Potassium paired with the symbol P is the incorrect match, since potassium's symbol is K. The other element symbols are correct. The symbol P stands for phosphorus.
23. C — The heat of a reaction is correctly measured with a calorimeter. Mass uses a balance, temperature a thermometer, and liquid volume a graduated cylinder. The calorimeter captures heat changes.
24. D — Sodium is correctly matched with the alkali metals. Chlorine is a halogen, argon a noble gas, and calcium an alkaline earth metal. Group 1 metals are the alkali metals.
25. B — O_2 is correctly matched with a covalent bond. NaCl and $MgCl_2$ are ionic, and copper has metallic bonding. Two nonmetal atoms share electrons covalently.

26. A — Exothermic is correctly matched with releasing heat. Endothermic reactions absorb heat. Exothermic reactions transfer energy outward to the surroundings.
27. C — Sand and water is correctly classified as a heterogeneous mixture. Saltwater is a homogeneous mixture, pure water is a compound, and oxygen is an element. Heterogeneous mixtures have visibly separate parts.
28. B — Avogadro's number is correctly matched with 6.02×10^{23}. The molar volume at STP is 22.4 L and neutral pH is 7. Avogadro's number is the count of particles in a mole.
29. A — Burning wood is correctly classified as a chemical change, since new substances form. Melting, boiling, and dissolving are physical changes. Combustion produces new products.
30. C — Fluorine is correctly matched as a highly reactive nonmetal. Helium and neon are unreactive noble gases, and sodium is reactive, not unreactive. Fluorine is the most reactive nonmetal.
31. A — H_2O is correctly matched with 3 atoms (two hydrogen, one oxygen). CO_2 has 3, NaCl has 2, and CH_4 has 5. The subscripts are summed for the total.
32. B — The solvent is correctly defined as the dissolving substance. The solute is what gets dissolved, a precipitate is an insoluble solid, and an electrolyte conducts electricity. The solvent is usually the larger amount.
33. A — After one 2-year half-life, a 100-g sample correctly leaves 50 g. Each half-life halves the mass. Two years equals one half-life here.
34. A — The reaction $2\ H_2 + O_2 \rightarrow 2\ H_2O$ is correctly classified as synthesis. The carbonate reaction is decomposition, the zinc reaction is single replacement, and the silver reaction is double replacement. Synthesis combines into one product.
35. B — Boyle's law correctly matches pressure and volume as inversely related. Charles's law relates volume and temperature directly. Boyle's law holds at constant temperature.
36. A — The proton is correctly matched as being in the nucleus. Electrons are outside the nucleus, and neutrons are inside it. Protons and neutrons make up the nucleus.
37. C — HNO_3 is correctly matched with nitric acid. HCl is hydrochloric acid and H_2SO_4 is sulfuric acid. Nitric acid contains the nitrate ion.
38. A — Conducting electricity as a solid is correctly matched with metallic bonding. Ionic solids do not conduct, and they conduct only when molten or dissolved. Metals conduct through mobile electrons.
39. D — The number of protons is correctly matched with the atomic number. Energy of motion is kinetic energy, and activation energy starts a reaction. The atomic number identifies the element.
40. D — Nitrogen is correctly matched with the gas state at room temperature. Oxygen is also a gas, iron is a solid, and mercury is a liquid. Nitrogen exists as N_2 gas.
41. A — A temperature rise is correctly matched with an exothermic reaction. Released heat warms the mixture. Exothermic reactions give off energy.
42. C — Group 2 is correctly matched with forming +2 ions. Group 1 forms +1 ions, Group 17 forms −1 ions, and Group 18 is unreactive. Group 2 metals lose two electrons.
43. B — CH_2O is correctly matched as an empirical formula, the simplest ratio. $C_6H_{12}O_6$ is the molecular formula of glucose, which reduces to CH_2O. The empirical formula gives the lowest whole-number ratio.
44. B — A solution holding the maximum dissolved solute is correctly matched with saturated. An unsaturated solution can dissolve more. A saturated solution is at the solubility limit.
45. C — Potassium is correctly matched with the symbol K. Lead is Pb, silver is Ag, and tin is Sn. The symbol K comes from the Latin name kalium.

46. C — Fission is correctly matched with the splitting of a heavy nucleus. Fusion is the joining of light nuclei. Fission powers nuclear reactors.
47. A — $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$ is correctly classified as single replacement, since iron replaces copper. The water reaction is decomposition, the ammonia reaction is synthesis, and the acid-base reaction is neutralization. One element replaces another.
48. A — 36 g of water is correctly matched with 2 moles, since $36 \div 18 = 2$. The gram-formula mass converts mass to moles. Dividing 36 by 18 gives two moles.
49. D — A very large electronegativity difference is correctly matched with an ionic bond. A zero difference gives nonpolar covalent, and a small difference gives polar covalent. The greater the difference, the more ionic the bond.
50. B — Adding salt to water is correctly matched with lowering the freezing point. The dissolved particles interfere with ice formation. This freezing-point depression is a colligative property.
51. C — A catalyst is correctly defined as speeding a reaction without being consumed. It lowers the activation energy. The catalyst is recovered unchanged.
52. C — A group is correctly matched as a vertical column. A period is a horizontal row. Elements in a group share similar properties.
53. B — CO is correctly matched with carbon monoxide. CO_2 is carbon dioxide and N_2O_4 is dinitrogen tetroxide. The prefix "mono-" indicates one oxygen.
54. D — Increasing pressure at constant temperature is correctly matched with decreasing volume. This follows Boyle's law. Pressure and volume are inversely related.
55. D — Oxygen is correctly matched with its diatomic form, O_2. The noble gases helium, neon, and argon are monatomic. Oxygen exists naturally as O_2.
56. B — "Copper is malleable" is correctly matched with a physical property. Rusting and burning are chemical properties, and shininess is a physical property, not chemical. Malleability is observed without changing the substance.
57. D — In an exothermic reaction, products at lower energy than the reactants is the correct match. The released energy is given off. Lower-energy products are the signature of exothermic reactions.
58. D — An electrolyte is correctly matched with conducting electricity when dissolved. It produces mobile ions. Nonelectrolytes, like sugar, do not conduct.
59. A — Magnesium is correctly matched with the Mg^{2+} ion. Chlorine forms Cl^-, sodium forms Na^+, and oxygen forms O^{2-}. Group 2 metals lose two electrons.
60. C — A hand warmer is correctly matched with releasing heat, an exothermic process. A cold pack absorbs heat. The hand warmer gives off energy to warm your hands.
61. D — Valence electrons are correctly matched with electrons in the outer shell. They determine bonding behavior. The other pairings misstate the particle or quantity.
62. B — Household ammonia is correctly matched with a pH of about 11, making it basic. Lemon juice and stomach acid are acidic, and pure water is neutral. Ammonia is a common base.
63. B — Neutralization is correctly matched with $HCl + NaOH \rightarrow NaCl + H_2O$. The methane reaction is combustion, the sodium reaction is synthesis, and the ammonia reaction is synthesis. An acid and base produce salt and water.
64. D — Sand and water is correctly matched with filtration. Saltwater is separated by evaporation or distillation, and alcohol from water by distillation. Filtration removes insoluble solids.
65. A — For $^{35}_{17}Cl$, the neutrons correctly number 18, since $35 - 17 = 18$. The mass number minus the proton count gives the neutrons. Subtracting isolates the neutrons.
66. A — Chlorine is correctly matched with the halogen family. Sodium is an alkali metal, helium a noble gas, and iron a transition metal. Group 17 elements are the halogens.

67. C — Density is correctly matched with mass divided by volume. Molarity is moles per liter, not grams per liter. Density relates mass to the space it occupies.
68. D — Sodium chloride is correctly matched as an ionic compound. Sugar is a nonelectrolyte, table salt is ionic not covalent, and diamond is a covalent network. NaCl forms from electron transfer.
69. A — Chopping wood is correctly matched with a physical change, since no new substance forms. Burning, rusting, and cooking are chemical changes. Chopping only changes the size and shape.
70. D — Electronegativity increasing across a period is the correct match. Atomic radius decreases, metallic character decreases, and ionization energy increases across a period. Electronegativity rises toward the right.
71. C — $CaCO_3$ is correctly matched with calcium carbonate. NaOH is sodium hydroxide and H_2SO_4 is sulfuric acid. Calcium carbonate is the compound in limestone.
72. A — The electron is correctly matched as being much smaller in mass than a proton. An electron is roughly 1/1836 the mass of a proton. The proton and neutron carry nearly all the atom's mass.
73. C — Evaporation paired with "gas to solid" is the incorrect match, since evaporation is liquid to gas. The other phase changes are correctly defined. Gas to solid is deposition.
74. D — Hydrocarbon combustion is correctly matched with producing carbon dioxide and water. Complete combustion always gives both products. The fuel reacts fully with oxygen.
75. A — 1 mole in 2 liters is correctly matched with 0.5 M, since $1 \div 2 = 0.5$. Molarity is moles divided by liters. Dividing gives 0.5 M.
76. D — Calcium is correctly matched with the symbol Ca. Iron is Fe, sodium is Na, and nitrogen is N. The symbol Ca comes from the element's name.
77. C — Group 18 is correctly matched with a full outer shell. Group 1 has one valence electron, Group 17 has seven, and Group 2 has two. A full shell makes the noble gases stable.
78. C — Increasing surface area is correctly matched with speeding up the reaction. Lowering temperature and decreasing concentration slow reactions, and a catalyst speeds them. More surface area allows more collisions.
79. B — A compound is correctly defined as elements chemically combined. A mixture is physically combined, and an element has one type of atom. Compounds have a fixed composition.
80. B — Nonpolar covalent is correctly matched with Cl_2. HCl is polar covalent, and O_2 is covalent, not ionic. Two identical atoms share electrons equally.
81. C — Temperature is correctly matched with the average kinetic energy of particles. Heat is energy transferred due to a temperature difference. Temperature reflects how fast particles move.
82. D — Beta emission is correctly matched with increasing the atomic number by one. A neutron converts to a proton during beta decay. The emitted electron carries away the -1 charge.
83. C — Adding more solute is correctly matched with increasing the concentration. Adding water dilutes and lowers concentration. More solute in the same volume raises the molarity.
84. C — A subscript is correctly matched with the number of atoms of one element. A coefficient counts whole molecules or formula units. Subscripts apply to the element they follow.
85. B — Gold is correctly matched as an unreactive metal that resists corrosion. Neon is a noble gas, sodium is a reactive metal, and chlorine is a nonmetal. Gold's inertness keeps it from tarnishing.