PRACTICE EXAM 10: PHYSICAL SETTING/CHEMISTRY SIMULATION (85 QUESTIONS)

1. Which statement about protons is correct?

A. Protons have a positive charge and are found in the nucleus.

B. Protons have a negative charge and orbit the nucleus.

C. Protons have no charge and are found in the nucleus.

D. Protons have a positive charge and orbit the nucleus.

2. Which statement about the atomic number is correct?

A. The atomic number equals the number of protons in an atom.

B. The atomic number equals the number of neutrons in an atom.

C. The atomic number equals the total of protons and neutrons.

D. The atomic number equals the number of electron shells.

3. Which statement about isotopes is correct?

A. Isotopes of an element have different numbers of protons.

B. Isotopes of an element have the same number of protons but different numbers of neutrons.

C. Isotopes of an element have different atomic numbers.

D. Isotopes of an element are always radioactive.

4. Which statement about electrons is NOT correct?

A. Electrons have a negative charge.

B. Electrons are located outside the nucleus.

C. Electrons have a mass greater than that of a proton.

D. Electrons occupy energy levels around the nucleus.

5. Which statement about the periodic table is correct?

A. Elements are arranged by decreasing atomic number.

B. The vertical columns are called periods.

C. Elements in the same group have similar chemical properties.

D. The horizontal rows are called groups.

6. Which statement about metals is correct?

A. Metals tend to lose electrons and form positive ions.

B. Metals tend to gain electrons and form negative ions.

C. Metals are generally poor conductors of electricity.

D. Metals are typically brittle and dull.

7. Which statement about noble gases is correct?

A. Noble gases have a stable, full outer electron shell.

B. Noble gases readily form ionic bonds.

C. Noble gases have seven valence electrons.

D. Noble gases are the most reactive elements.

8. Which statement about ionic bonding is NOT correct?

A. Ionic bonds form between metals and nonmetals.

B. Ionic bonds involve the transfer of electrons.

C. Ionic compounds conduct electricity well in the solid state.

D. Ionic compounds tend to have high melting points.

9. Which statement about covalent bonding is correct?

A. Covalent bonds involve the complete transfer of electrons.

B. Covalent bonds form only between metals.

C. Covalent compounds always conduct electricity.

D. Covalent bonds involve the sharing of electrons between nonmetals.

10. Which statement about the mole is correct?

A. One mole of any substance contains 6.02×10^{23} particles.

B. One mole always has a mass of 12 grams.

C. One mole of a gas occupies 1 liter at STP.

D. The mole measures the charge of an ion.

11. Which statement about a balanced equation is NOT correct?

A. The number of each type of atom is equal on both sides.

B. Coefficients are used to balance the equation.

C. Subscripts may be changed to balance the equation.

D. A balanced equation obeys the law of conservation of mass.

12. Which statement about exothermic reactions is correct?

A. Exothermic reactions absorb heat from the surroundings.

B. Exothermic reactions release heat to the surroundings.

C. In exothermic reactions, products have more energy than reactants.

D. Exothermic reactions always feel cold to the touch.

13. Which statement about catalysts is correct?

A. A catalyst increases the activation energy of a reaction.

B. A catalyst is permanently consumed in the reaction.

C. A catalyst changes the amount of product formed at equilibrium.

D. A catalyst speeds up a reaction by lowering the activation energy.

14. Which statement about acids is NOT correct?

A. Acids produce hydrogen ions (H^+) in solution.

B. Acids have a pH less than 7.

C. Acids turn litmus paper from red to blue.

D. Acids react with many metals to produce hydrogen gas.

15. Which statement about bases is correct?

A. Bases produce hydroxide ions (OH^-) in solution.

B. Bases have a pH less than 7.

C. Bases taste sour.

D. Bases turn blue litmus paper red.

16. Which statement about the pH scale is correct?

A. A pH of 7 indicates a strong acid.

B. Higher pH values indicate more acidic solutions.

C. The pH scale only measures temperature.

D. A pH below 7 indicates an acidic solution.

17. Which statement about oxidation is correct?

A. Oxidation is the gain of electrons.

B. Oxidation always involves oxygen gas.

C. Oxidation decreases the oxidation number of an atom.

D. Oxidation is the loss of electrons.

18. Which statement about reduction is correct?

A. Reduction is the loss of electrons.

B. Reduction is the gain of electrons.

C. Reduction increases the oxidation number of an atom.

D. Reduction always releases a gas.

19. Which statement about the three states of matter is NOT correct?

A. Solids have a definite shape and volume.

B. Gases have a definite shape but no definite volume.

C. Liquids have a definite volume but no definite shape.

D. Gases expand to fill their container.

20. Which statement about temperature is correct?

A. Temperature measures the total energy of a sample.

B. Temperature is measured in grams.

C. Temperature measures the average kinetic energy of particles.

D. Temperature has no effect on reaction rate.

21. Which statement about endothermic reactions is correct?

A. Endothermic reactions release energy to the surroundings.

B. Endothermic reactions absorb energy from the surroundings.

C. Endothermic reactions always feel warm.

D. In endothermic reactions, products have less energy than reactants.

22. Which statement about the kinetic molecular theory is NOT correct?

A. Gas particles are in constant, random motion.

B. Gas particles strongly attract one another at all times.

C. Gas collisions are considered elastic.

D. Gas particles are very small compared to the space between them.

23. Which statement about sublimation is correct?

A. Sublimation is the change from liquid to gas.

B. Sublimation is the change from gas to liquid.

C. Sublimation is the change from solid directly to gas.

D. Sublimation is the change from liquid to solid.

24. Which statement about valence electrons is NOT correct?

A. Valence electrons are in the outermost energy level.

B. Valence electrons determine bonding behavior.

C. Valence electrons are located in the nucleus.

D. The group number can indicate the number of valence electrons.

25. Which statement about a physical change is correct?

A. A physical change does not produce a new substance.

B. A physical change always produces a new substance.

C. A physical change cannot be reversed.

D. Melting ice is a chemical change.

26. Which statement about a chemical change is correct?

A. A chemical change never forms new substances.

B. Boiling water is a chemical change.

C. A chemical change only alters the shape of a substance.

D. A chemical change produces one or more new substances.

27. Which statement about electronegativity is correct?

A. Electronegativity decreases from left to right across a period.

B. Electronegativity measures an atom's attraction for shared electrons.

C. Metals generally have high electronegativity.

D. Fluorine has the lowest electronegativity.

28. Which statement about the law of conservation of mass is NOT correct?

A. Mass is neither created nor destroyed in a reaction.

B. The total mass of products is usually less than that of the reactants.

C. The mass of the reactants equals the mass of the products.

D. It explains why chemical equations must be balanced.

29. Which statement about concentration is correct?

A. Molarity is measured in grams per liter.

B. A dilute solution has a large amount of solute.

C. Adding solvent increases the concentration.

D. Molarity is moles of solute per liter of solution.

30. Which statement about solubility is correct?

A. Most solids become less soluble as temperature increases.

B. Most solids become more soluble as temperature increases.

C. Gases become more soluble as temperature increases.

D. Solubility is unaffected by temperature.

31. Which statement about a saturated solution is correct?

A. A saturated solution holds the maximum solute at a given temperature.

B. A saturated solution can always dissolve more solute.

C. A saturated solution contains no solute.

D. A saturated solution is always dilute.

32. Which statement about diatomic elements is NOT correct?

A. Hydrogen exists as H_2.

B. Oxygen exists as O_2.

C. Helium exists as He_2.

D. Nitrogen exists as N_2.

33. Which statement about activation energy is correct?

A. Activation energy is the minimum energy needed to start a reaction.

B. Activation energy is the energy released by a reaction.

C. Activation energy is always zero for fast reactions.

D. Catalysts raise the activation energy.

34. Which statement about gases is correct?

A. Gases cannot be compressed.

B. Gas particles are tightly packed together.

C. Gases have a fixed shape.

D. Gases are highly compressible and fill their container.

35. Which statement about ions is NOT correct?

A. A cation has a positive charge.

B. An anion has a negative charge.

C. A cation forms when an atom gains electrons.

D. An anion forms when an atom gains electrons.

36. Which statement about the nucleus of an atom is correct?

A. The nucleus contains protons and electrons.

B. The nucleus contains protons and neutrons.

C. The nucleus is negatively charged.

D. The nucleus contains most of an atom's volume.

37. Which statement about nuclear reactions is correct?

A. Nuclear reactions involve only the electrons of an atom.

B. Nuclear reactions can change one element into another.

C. Nuclear reactions release far less energy than chemical reactions.

D. Nuclear reactions never involve radiation.

38. Which statement about half-life is NOT correct?

A. Half-life is the time for half a sample to decay.

B. Half-life is constant for a given isotope.

C. Half-life depends on the temperature of the sample.

D. Different isotopes have different half-lives.

39. Which statement about alpha particles is correct?

A. An alpha particle is a high-speed electron.

B. An alpha particle has a charge of −1.

C. An alpha particle has no mass.

D. An alpha particle is a helium nucleus with a +2 charge.

40. Which statement about beta particles is correct?

A. A beta particle is a high-speed electron with a −1 charge.

B. A beta particle is a helium nucleus.

C. A beta particle has a +2 charge.

D. A beta particle has a large mass.

41. Which statement about reaction rate is correct?

A. Increasing temperature always slows a reaction.

B. Increasing surface area increases the reaction rate.

C. Concentration has no effect on reaction rate.

D. Catalysts decrease the reaction rate.

42. Which statement about equilibrium is NOT correct?

A. At equilibrium, the forward and reverse rates are equal.

B. Equilibrium can be reached in a closed system.

C. At equilibrium, concentrations remain constant.

D. At equilibrium, the reaction has completely stopped.

43. Which statement about an electrolyte is correct?

A. An electrolyte is a substance that does not dissolve in water.

B. An electrolyte never conducts electricity.

C. Sugar is a strong electrolyte.

D. An electrolyte conducts electricity when dissolved in water.

44. Which statement about the boiling point is correct?

A. The boiling point increases as external pressure increases.

B. The boiling point decreases as external pressure increases.

C. Adding a solute lowers the boiling point.

D. Boiling point is unrelated to intermolecular forces.

45. Which statement about the freezing point is correct?

A. Adding salt raises the freezing point of water.

B. Pure water freezes at 100 °C.

C. Freezing is an endothermic process.

D. Adding a solute lowers the freezing point of a solvent.

46. Which statement about heat and temperature is NOT correct?

A. Heat flows from a hotter object to a colder one.

B. Temperature measures average kinetic energy.

C. Heat and temperature are the same thing.

D. Heat is a form of energy transfer.

47. Which statement about an exothermic potential energy diagram is correct?

A. The products are at a lower energy than the reactants.

B. The products are at a higher energy than the reactants.

C. Energy is absorbed overall.

D. The reaction stores energy in the products.

48. Which statement about empirical formulas is correct?

A. An empirical formula shows the actual number of atoms in a molecule.

B. An empirical formula is always the same as the molecular formula.

C. $C_6H_{12}O_6$ is an empirical formula.

D. An empirical formula shows the simplest whole-number ratio of atoms.

49. Which statement about a polar molecule is correct?

A. A polar molecule has an uneven distribution of charge.

B. A polar molecule always has nonpolar bonds.

C. CO_2 is a polar molecule.

D. A polar molecule cannot dissolve in water.

50. Which statement about metallic bonding is NOT correct?

A. Metallic bonding involves a "sea" of mobile electrons.

B. Metallic bonding explains electrical conductivity.

C. Metallic bonding involves the transfer of electrons to nonmetals.

D. Metallic bonding explains malleability.

51. Which statement about the pressure and volume of a gas is correct?

A. At constant temperature, pressure and volume are directly related.

B. Increasing volume increases pressure at constant temperature.

C. At constant temperature, pressure and volume are inversely related.

D. Pressure and volume are unrelated.

52. Which statement about STP is correct?

A. STP stands for standard time and pressure.

B. At STP, one mole of gas occupies 11.2 L.

C. STP is defined as 100 °C and 2 atm.

D. At STP, one mole of any gas occupies 22.4 L.

53. Which statement about a synthesis reaction is correct?

A. A synthesis reaction breaks a compound into simpler substances.

B. A synthesis reaction combines substances into a single product.

C. A synthesis reaction always produces a gas.

D. A synthesis reaction has two products.

54. Which statement about a decomposition reaction is correct?

A. A decomposition reaction breaks one substance into simpler ones.

B. A decomposition reaction joins two elements.

C. A decomposition reaction has a single product.

D. A decomposition reaction cannot be reversed.

55. Which statement about double-replacement reactions is NOT correct?

A. Double-replacement reactions involve an exchange of ions.

B. Double-replacement reactions involve only a single element.

C. A precipitate may form in a double-replacement reaction.

D. Two compounds typically react in a double-replacement reaction.

56. Which statement about electron configuration is correct?

A. Electrons fill higher energy levels before lower ones.

B. The first energy level holds up to eight electrons.

C. Electron configuration has no effect on bonding.

D. Electrons fill lower energy levels before higher ones.

57. Which statement about the bright-line spectrum is correct?

A. Each element produces a unique bright-line spectrum.

B. All elements produce identical spectra.

C. Bright lines form when electrons absorb energy and rise to higher levels.

D. The spectrum is unrelated to electron energy levels.

58. Which statement about the gram-formula mass is correct?

A. It is found by subtracting atomic masses.

B. It is the sum of the atomic masses of all atoms in a formula.

C. It is always equal to 100 g/mol.

D. It measures the charge of a compound.

59. Which statement about percent composition is NOT correct?

A. It gives the percent by mass of each element in a compound.

B. The percentages in a compound add up to 100%.

C. It depends on the size of the sample taken.

D. It is calculated using the gram-formula mass.

60. Which statement about a neutralization reaction is correct?

A. It produces an acid and a base.

B. It produces a salt and water.

C. It always produces a gas.

D. It lowers the pH below 1.

61. Which statement about strong and weak acids is correct?

A. A weak acid ionizes completely in water.

B. A strong acid ionizes only slightly.

C. Strong and weak acids ionize to the same extent.

D. A strong acid ionizes completely in water.

62. Which statement about the conservation of energy is NOT correct?

A. Energy cannot be created or destroyed.

B. Energy can be transferred between objects.

C. Energy can change from one form to another.

D. Energy disappears in an exothermic reaction.

63. Which statement about reaction collisions is correct?

A. All collisions between particles result in a reaction.

B. Only collisions with enough energy and proper orientation produce a reaction.

C. Reactions occur without any collisions.

D. Slower particles collide more effectively.

64. Which statement about an alloy is correct?

A. An alloy is a pure element.

B. An alloy is a mixture of a metal with one or more other elements.

C. An alloy is a type of acid.

D. An alloy cannot conduct electricity.

65. Which statement about organic compounds is correct?

A. Organic compounds contain carbon.

B. Organic compounds never contain hydrogen.

C. Organic compounds are always ionic.

D. Carbon dioxide is considered an organic compound.

66. Which statement about hydrocarbons is correct?

A. Hydrocarbons contain oxygen and nitrogen.

B. Hydrocarbons are ionic compounds.

C. Methane is not a hydrocarbon.

D. Hydrocarbons contain only carbon and hydrogen.

67. Which statement about isomers is correct?

A. Isomers have different molecular formulas.

B. Isomers always have identical properties.

C. Isomers contain different numbers of atoms.

D. Isomers have the same molecular formula but different structures.

68. Which statement about saturated hydrocarbons is NOT correct?

A. Saturated hydrocarbons contain only single bonds.

B. Alkanes are saturated hydrocarbons.

C. Saturated hydrocarbons contain at least one double bond.

D. Saturated hydrocarbons have the maximum number of hydrogen atoms.

69. Which statement about a precipitate is correct?

A. A precipitate is a gas released in a reaction.

B. A precipitate is the liquid solvent.

C. A precipitate is an insoluble solid formed in a solution.

D. A precipitate always dissolves immediately.

70. Which statement about the conductivity of solutions is correct?

A. Pure water is an excellent conductor of electricity.

B. Molecular solutions like sugar water conduct strongly.

C. Conductivity decreases as ion concentration increases.

D. Solutions with more dissolved ions conduct electricity better.

71. Which statement about the periodic law is correct?

A. Properties of the elements are a periodic function of their atomic numbers.

B. Elements are arranged by atomic mass only.

C. Properties of the elements do not repeat.

D. The periodic law applies only to metals.

72. Which statement about allotropes is correct?

A. Allotropes are different elements with the same properties.

B. Allotropes are different molecular forms of the same element.

C. Allotropes always have identical structures.

D. Diamond and graphite are different elements.

73. Which statement about the heating curve of water is NOT correct?

A. Temperature stays constant during melting.

B. Temperature rises while ice is melting.

C. Temperature stays constant during boiling.

D. Energy added during a phase change breaks intermolecular forces.

74. Which statement about a homogeneous mixture is correct?

A. A homogeneous mixture has a uniform composition throughout.

B. A homogeneous mixture has visibly separate parts.

C. Sand and water form a homogeneous mixture.

D. A homogeneous mixture is a pure substance.

75. Which statement about a compound is NOT correct?

A. A compound contains two or more elements chemically combined.

B. A compound can be broken down by chemical means.

C. A compound has the same properties as the elements that form it.

D. Water is a compound.

76. Which statement about an element is correct?

A. An element can be broken down into simpler substances by chemical means.

B. An element contains two or more types of atoms.

C. An element is a pure substance made of one type of atom.

D. Water is an element.

77. Which statement about a mixture is correct?

A. A mixture is chemically combined.

B. The components of a mixture can be separated by physical means.

C. A mixture always has a fixed composition.

D. A mixture is a pure substance.

78. Which statement about density is correct?

A. Density is mass multiplied by volume.

B. Density increases when a substance is heated and expands.

C. Density depends on the size of the sample.

D. Density is mass divided by volume.

79. Which statement about phase changes is NOT correct?

A. Melting is the change from solid to liquid.

B. Condensation is the change from gas to liquid.

C. Evaporation is the change from gas to solid.

D. Freezing is the change from liquid to solid.

80. Which statement about a strong base is correct?

A. A strong base has a pH below 7.

B. A strong base produces few hydroxide ions.

C. A strong base does not conduct electricity.

D. A strong base ionizes completely to produce hydroxide ions.

81. Which statement about the octet rule is correct?

A. Atoms tend to gain, lose, or share electrons to achieve eight valence electrons.

B. The octet rule states that atoms always have eight protons.

C. The octet rule applies only to metals.

D. Atoms are most stable with one valence electron.

82. Which statement about a chemical formula is correct?

A. Subscripts indicate the number of atoms of each element.

B. Coefficients are written below the element symbols.

C. A formula shows only the color of a compound.

D. Changing a subscript does not change the substance.

83. Which statement about an aqueous solution is correct?

A. An aqueous solution uses oil as the solvent.

B. An aqueous solution has water as the solvent.

C. An aqueous solution contains no solute.

D. An aqueous solution is always a solid.

84. Which statement about a calorimeter is correct?

A. A calorimeter is used to measure heat changes in a reaction.

B. A calorimeter measures the pH of a solution.

C. A calorimeter measures the volume of a gas.

D. A calorimeter creates energy.

85. Which statement about the reactivity of elements is NOT correct?

A. Alkali metals are highly reactive.

B. Noble gases are generally unreactive.

C. The reactivity of metals decreases down Group 1.

D. Halogens are reactive nonmetals.

Practice Exam 10 – Explained Answer Key

1. A — Protons carry a positive charge and reside in the nucleus. They are one of the two nucleons, alongside neutrons. Their count, the atomic number, defines the element.
2. A — The atomic number equals the number of protons in an atom. This count uniquely identifies the element. It also equals the number of electrons in a neutral atom.
3. B — Isotopes share the same number of protons but differ in their number of neutrons. The proton count keeps them the same element, while differing neutrons change the mass number. This is why isotopes have different masses.
4. C — This statement is not correct: an electron's mass is far smaller than a proton's, not greater. An electron is roughly 1/1836 the mass of a proton. The other statements about charge, location, and energy levels are all true.

5. C — Elements in the same group have similar chemical properties because they share the same number of valence electrons. The columns are groups, and the rows are periods. Shared valence structure drives the similar behavior.
6. A — Metals tend to lose electrons and form positive ions. Their loosely held valence electrons are easily given up. This explains their conductivity and reactivity.
7. A — Noble gases have a stable, full outer electron shell. This complete octet gives them little tendency to react. Their stability explains their general inertness.
8. C — This statement is not correct: ionic compounds do not conduct well as solids because their ions are locked in place. They conduct only when molten or dissolved. The other statements about ionic bonding are accurate.
9. D — Covalent bonds involve the sharing of electrons between nonmetal atoms. Shared pairs hold the atoms together without forming ions. This distinguishes covalent from ionic bonding.
10. A — One mole of any substance contains 6.02×10^{23} particles, Avogadro's number. This constant links the microscopic count to a measurable amount. It is the basis of the mole concept.
11. C — This statement is not correct: subscripts must never be changed to balance an equation, since that alters the substance's identity. Only coefficients may be adjusted. The other statements about balancing are correct.
12. B — Exothermic reactions release heat to the surroundings. The products hold less energy than the reactants, and the difference is given off. This release often warms the surroundings.
13. D — A catalyst speeds up a reaction by lowering the activation energy. With a smaller energy barrier, more collisions succeed. The catalyst is not consumed and does not change the equilibrium amounts.
14. C — This statement is not correct: acids turn blue litmus red, not red to blue. Turning litmus from red to blue is a property of bases. The other statements about acids are true.
15. A — Bases produce hydroxide ions (OH^-) in solution. These ions give bases their characteristic properties. Bases have a pH greater than 7 and feel slippery.
16. D — A pH below 7 indicates an acidic solution. Lower pH values mean greater acidity, reflecting more hydrogen ions. A pH of 7 is neutral, and above 7 is basic.
17. D — Oxidation is the loss of electrons. Losing electrons raises an atom's oxidation number. This is half of every redox reaction.
18. B — Reduction is the gain of electrons. Gaining electrons lowers an atom's oxidation number. Reduction always accompanies oxidation in a redox reaction.
19. B — This statement is not correct: gases have neither a definite shape nor a definite volume. They expand to fill their container completely. The statements about solids and liquids are accurate.
20. C — Temperature measures the average kinetic energy of the particles in a sample. It reflects how fast the particles move, not the total energy. This is why temperature governs reaction rates and phase changes.
21. B — Endothermic reactions absorb energy from the surroundings. The products hold more energy than the reactants, with the difference taken in as heat. This absorption often cools the surroundings.
22. B — This statement is not correct: the kinetic molecular theory assumes gas particles have negligible attraction for one another. They are treated as moving independently. The other assumptions about motion, elastic collisions, and particle size are part of the theory.
23. C — Sublimation is the change directly from solid to gas, without passing through the liquid state. Dry ice subliming is a common example. It bypasses the liquid phase entirely.

24. C — This statement is not correct: valence electrons are in the outermost energy level, not the nucleus. The nucleus contains only protons and neutrons. The other statements about valence electrons are true.
25. A — A physical change does not produce a new substance. Only the form or state changes, while the chemical identity stays the same. Melting and dissolving are examples.
26. D — A chemical change produces one or more new substances. The original substances are transformed into different ones with new properties. This distinguishes it from a physical change.
27. B — Electronegativity measures an atom's attraction for shared electrons in a bond. It increases across a period and up a group. Nonmetals like fluorine have the highest values.
28. B — This statement is not correct: the total mass of products equals, not is less than, the mass of the reactants. Mass is conserved in a chemical reaction. The other statements correctly describe conservation of mass.
29. D — Molarity is moles of solute per liter of solution. This ratio defines the concentration. Adding solvent lowers it by spreading the solute through more volume.
30. B — Most solids become more soluble as temperature increases. Added thermal energy helps the solvent dissolve more solute. Gases, in contrast, become less soluble when heated.
31. A — A saturated solution holds the maximum amount of solute that will dissolve at a given temperature. Any additional solute will not dissolve. It represents the solubility limit.
32. C — This statement is not correct: helium exists as single atoms (He), not as He_2. It is a monatomic noble gas. The diatomic statements for hydrogen, oxygen, and nitrogen are accurate.
33. A — Activation energy is the minimum energy needed to start a reaction. It is the barrier that colliding particles must overcome. Catalysts speed reactions by lowering this barrier.
34. D — Gases are highly compressible and expand to fill their container. The large spaces between particles allow compression. They have neither fixed shape nor fixed volume.
35. C — This statement is not correct: a cation forms when an atom loses electrons, not gains them. Losing negative electrons leaves a net positive charge. Anions, by contrast, form by gaining electrons.
36. B — The nucleus contains protons and neutrons. These nucleons account for nearly all of the atom's mass. The nucleus is positively charged and occupies a tiny fraction of the atom's volume.
37. B — Nuclear reactions can change one element into another by altering the number of protons. This transmutation does not occur in chemical reactions. Such reactions release enormous amounts of energy.
38. C — This statement is not correct: half-life does not depend on temperature or other external conditions. It is a fixed property of each isotope. The other statements about half-life are accurate.
39. D — An alpha particle is a helium nucleus with a +2 charge and a mass number of 4. It consists of two protons and two neutrons. Its emission lowers an atom's atomic number by two.
40. A — A beta particle is a high-speed electron with a -1 charge. It is emitted when a neutron converts to a proton. Beta emission raises the atomic number by one.
41. B — Increasing surface area increases the reaction rate by exposing more particles to collisions. Powdering a solid is a common way to do this. The other choices reverse the true effects.
42. D — This statement is not correct: at equilibrium the reaction has not stopped; the forward and reverse reactions continue at equal rates. Concentrations stay constant because the rates are balanced. The other statements correctly describe equilibrium.
43. D — An electrolyte conducts electricity when dissolved in water because it produces mobile ions. Salts and strong acids are examples. Sugar dissolves without ionizing and is a nonelectrolyte.

44. A — The boiling point increases as the external pressure increases. Higher pressure requires a higher vapor pressure, and thus more heat, to boil. This is why water boils at a lower temperature at high altitude.
45. D — Adding a solute lowers the freezing point of a solvent. The dissolved particles interfere with the formation of the solid structure. This freezing-point depression is a colligative property.
46. C — This statement is not correct: heat and temperature are not the same. Heat is energy transferred between objects, while temperature measures the average kinetic energy of particles. The other statements are accurate.
47. A — In an exothermic potential energy diagram, the products lie at a lower energy than the reactants. The energy difference is released to the surroundings. This downward step is the signature of an exothermic reaction.
48. D — An empirical formula shows the simplest whole-number ratio of atoms in a compound. It may differ from the molecular formula, which gives the actual counts. For example, CH_2O is the empirical formula of glucose.
49. A — A polar molecule has an uneven distribution of charge, creating partial positive and negative ends. This results from polar bonds in an asymmetrical shape. Water is a common polar molecule.
50. C — This statement is not correct: metallic bonding does not involve transferring electrons to nonmetals; that describes ionic bonding. Metallic bonding features a shared "sea" of mobile electrons among metal atoms. The other statements correctly describe metallic bonding.
51. C — At constant temperature, the pressure and volume of a gas are inversely related, as stated by Boyle's law. As one increases, the other decreases. Their product remains constant.
52. D — At STP, one mole of any gas occupies 22.4 liters. This molar volume applies to all gases under standard conditions. It links gas volume directly to amount in moles.
53. B — A synthesis reaction combines two or more substances into a single product. It builds a more complex substance from simpler ones. This is the reverse of decomposition.
54. A — A decomposition reaction breaks one substance into two or more simpler ones. A single reactant yields multiple products. It is the opposite of a synthesis reaction.
55. B — This statement is not correct: double-replacement reactions involve two compounds, not a single element. The ions of the two compounds exchange partners. The other statements correctly describe double replacement.
56. D — Electrons fill lower energy levels before higher ones. This follows the principle of minimum energy. The arrangement determines an atom's chemical behavior.
57. A — Each element produces a unique bright-line spectrum, like a fingerprint. The lines come from electrons emitting specific energies as they drop between levels. This allows elements to be identified by their spectra.
58. B — The gram-formula mass is the sum of the atomic masses of all atoms in a formula. Each element's mass is multiplied by its subscript and totaled. This value converts between mass and moles.
59. C — This statement is not correct: percent composition does not depend on the sample size. It is a fixed property of the compound, based on its formula. The other statements about percent composition are accurate.
60. B — A neutralization reaction between an acid and a base produces a salt and water. The hydrogen and hydroxide ions combine to form water. This reaction moves the solution toward neutral.
61. D — A strong acid ionizes completely in water, releasing all of its hydrogen ions. This complete ionization makes it a strong electrolyte. Weak acids, by contrast, ionize only partially.

62. D — This statement is not correct: energy does not disappear in an exothermic reaction; it is released to the surroundings. Energy is conserved, only changing form or location. The other statements correctly describe conservation of energy.
63. B — Only collisions with enough energy and proper orientation produce a reaction. Not every collision is effective. This is the central idea of collision theory.
64. B — An alloy is a mixture of a metal with one or more other elements. Combining metals can improve properties like strength. Steel and brass are common examples.
65. A — Organic compounds contain carbon, typically bonded to hydrogen. Carbon's ability to form chains and rings gives a vast variety of compounds. This defines organic chemistry.
66. D — Hydrocarbons contain only carbon and hydrogen. Methane and propane are simple examples. The presence of other elements would make them a different class of compound.
67. D — Isomers have the same molecular formula but different structural arrangements. The different structures give them different properties. This is why a single formula can represent more than one substance.
68. C — This statement is not correct: saturated hydrocarbons contain only single bonds, not double bonds. The presence of a double bond would make them unsaturated. The other statements correctly describe saturated hydrocarbons.
69. C — A precipitate is an insoluble solid that forms within a solution during a reaction. It separates out because it cannot stay dissolved. Its formation is a sign that a reaction has occurred.
70. D — Solutions with more dissolved ions conduct electricity better because more charged particles carry the current. Strong electrolytes produce many ions. Pure water and sugar solutions conduct poorly.
71. A — The periodic law states that the properties of the elements are a periodic function of their atomic numbers. Arranging elements by atomic number causes properties to repeat at regular intervals. This is the basis of the periodic table's structure.
72. B — Allotropes are different molecular or structural forms of the same element. Diamond and graphite are allotropes of carbon. They are the same element arranged differently, giving different properties.
73. B — This statement is not correct: temperature stays constant, not rising, while ice is melting. The added energy breaks intermolecular forces rather than raising the temperature. The other statements about the heating curve are accurate.
74. A — A homogeneous mixture has a uniform composition throughout. Its components are evenly distributed and not visibly separate. Saltwater is an example.
75. C — This statement is not correct: a compound does not share the properties of the elements that form it. The chemical combination produces entirely new properties. The other statements about compounds are true.
76. C — An element is a pure substance made of only one type of atom. It cannot be broken into simpler substances by chemical means. This distinguishes elements from compounds and mixtures.
77. B — The components of a mixture can be separated by physical means, such as filtering or evaporation. The substances are not chemically combined. Mixtures also have variable composition.
78. D — Density is mass divided by volume. This ratio is an intensive property independent of sample size. It is used to identify substances and predict whether they float.
79. C — This statement is not correct: evaporation is the change from liquid to gas, not gas to solid. The change from gas to solid is deposition. The other phase-change statements are accurate.

80. D — A strong base ionizes completely in water to produce hydroxide ions. This complete ionization gives a high pH and strong conductivity. It makes the base a strong electrolyte.
81. A — The octet rule states that atoms tend to gain, lose, or share electrons to achieve eight valence electrons. This stable configuration drives bonding. Achieving a full outer shell lowers an atom's energy.
82. A — In a chemical formula, subscripts indicate the number of atoms of each element. Coefficients, placed in front, count whole molecules or formula units. Changing a subscript changes the substance.
83. B — An aqueous solution has water as the solvent. The "aq" symbol marks a substance dissolved in water. Many chemical reactions take place in aqueous solution.
84. A — A calorimeter is used to measure the heat changes in a reaction. It captures the energy absorbed or released. This makes it the key tool in calorimetry experiments.
85. C — This statement is not correct: the reactivity of metals increases, not decreases, down Group 1. Lower alkali metals lose their outer electron more easily. The other statements about reactivity are accurate.