# PRACTICE EXAM 22: PHYSICAL SETTING/CHEMISTRY SIMULATION (85 QUESTIONS)

1. Ice floats on liquid water. Which statement best explains why?

A. Ice has more mass than the water beneath it

B. Ice is warmer than the surrounding liquid water

C. Ice traps dissolved air that lifts it to the surface

D. Ice is less dense than liquid water because water expands when it freezes

2. A balloon shrinks when placed in a freezer. Which statement best explains why?

A. The gas particles slow down and the volume decreases at lower temperature

B. The rubber absorbs the cold and contracts on its own

C. The gas inside the balloon turns into a liquid

D. The number of gas particles decreases in the cold

3. Noble gases rarely form compounds. Which statement best explains why?

A. They are too heavy to react with other elements

B. They have full outer electron shells and are chemically stable

C. They exist only as liquids and cannot react

D. They have very high electronegativity values

4. Metals conduct electricity. Which statement best explains why?

A. They contain mobile electrons that move and carry charge

B. They contain trapped ions that vibrate rapidly

C. They are shiny and reflect the electric current

D. They gain electrons easily from the surrounding air

5. Table salt dissolves in water, but oil does not. Which statement best explains why?

A. Salt is lighter than oil

B. Oil is far denser than salt

C. Salt is a gas at room temperature

D. Water is polar and dissolves the ionic salt, while nonpolar oil does not mix

6. A spoonful of sugar dissolves faster in hot tea than in iced tea. Which statement best explains why?

A. Higher temperature increases particle motion and speeds dissolving

B. Hot water has fewer molecules to get in the way

C. Cold water chemically blocks the sugar from dissolving

D. Sugar reacts with heat to form a new substance

7. Atomic radius decreases from left to right across a period. Which statement best explains why?

A. Electrons are added to new shells across a period

B. The atoms lose protons as you move across a period

C. The increasing nuclear charge pulls the electrons in more tightly

D. The atoms gain neutrons that shrink them

8. A piece of sodium reacts violently with water, but gold does not react at all. Which statement best explains why?

A. Gold is lighter than sodium

B. Sodium is a nonmetal and gold is a metal

C. Gold has more valence electrons than sodium

D. Sodium readily loses its single valence electron, while gold is very unreactive

9. Diamond has an extremely high melting point. Which statement best explains why?

A. It is held together by weak ionic forces

B. Its atoms are loosely packed together

C. Its carbon atoms are bonded in a strong covalent network

D. It contains mobile electrons throughout its structure

10. Adding salt to icy roads melts the ice. Which statement best explains why?

A. Salt chemically burns the ice away

B. The dissolved salt lowers the freezing point of the water

C. Salt raises the temperature of the road surface

D. Salt reacts with the ice to release heat

11. A sealed bag of chips expands when carried up a high mountain. Which statement best explains why?

A. The chips release gas at high altitude

B. The lower outside air pressure lets the trapped gas expand

C. The temperature rises sharply at high altitude

D. The bag absorbs moisture from the air and swells

12. Helium balloons rise in air. Which statement best explains why?

A. Helium is heavier than air and sinks downward first

B. Helium reacts with oxygen, which lifts the balloon

C. Helium is less dense than the surrounding air

D. Helium is pushed upward by static electricity

13. A glowing splint relights when placed in a test tube of a certain gas. Which statement best explains why?

A. The gas is hydrogen, which burns the splint

B. The gas is carbon dioxide, which fuels the flame

C. The gas is oxygen, which supports combustion

D. The gas is nitrogen, which reignites embers

14. Group 1 metals become more reactive going down the group. Which statement best explains why?

A. The atoms gain more protons that boost their reactivity

B. The outer electron moves closer to the nucleus

C. The atoms lose their valence electrons less easily

D. The outer electron is farther from the nucleus and lost more easily

15. Heating a reaction mixture speeds up the reaction. Which statement best explains why?

A. Heat removes the activation energy entirely

B. Heat decreases the number of collisions

C. Particles move faster and collide more often with greater energy

D. Heat lowers the concentration of the reactants

16. Two atoms of the same element can have different masses. Which statement best explains why?

A. They are isotopes with different numbers of neutrons

B. They have different numbers of protons

C. They have different numbers of electrons

D. They are bonded to different elements

17. A neutral atom has no overall electric charge. Which statement best explains why?

A. It contains only neutrons

B. It has equal numbers of protons and electrons

C. Its protons cancel out its neutrons

D. It contains no charged particles at all

18. Powdered zinc reacts with acid faster than a single lump of zinc. Which statement best explains why?

A. Powder is chemically more reactive than solid metal

B. The powder contains more zinc atoms overall

C. The powder is at a higher temperature

D. The powder has more surface area exposed to the acid

19. A catalyst speeds up a reaction without being used up. Which statement best explains why?

A. It adds extra energy directly to the reactants

B. It increases the concentration of the reactants

C. It is consumed and then regenerated as a product

D. It provides an alternative pathway with a lower activation energy

20. An exothermic reaction warms its surroundings. Which statement best explains why?

A. It releases energy that had been stored in the chemical bonds

B. It absorbs heat from the surroundings

C. The products contain more energy than the reactants

D. It converts heat directly into new matter

21. Sodium chloride conducts electricity when melted but not when solid. Which statement best explains why?

A. Melting changes the salt into a metal

B. Solid salt contains more ions than molten salt

C. Melting frees the ions so they can move and carry charge

D. The solid salt has no ions at all

22. Hydrogen and oxygen combine to form water, a compound very different from either element. Which statement best explains why?

A. The atoms simply mix together without bonding

B. Chemical bonding creates a new substance with its own properties

C. Water is just a mixture of hydrogen and oxygen gas

D. The elements keep all of their original properties

23. Fluorine is the most reactive halogen. Which statement best explains why?

A. It is the largest halogen atom

B. It has the fewest valence electrons

C. Its outer electrons are far from the nucleus

D. Its small size lets it attract an electron very strongly

24. Steam causes more severe burns than boiling water at the same temperature. Which statement best explains why?

A. Steam is hotter than boiling water

B. Steam contains dissolved acids

C. Steam moves faster than liquid water

D. Steam releases extra energy when it condenses on the skin

25. A precipitate forms when two clear solutions are mixed. Which statement best explains why?

A. An insoluble solid product forms from the combined ions

B. The water evaporates instantly on mixing

C. One solution freezes the other

D. The solutions change color but stay fully dissolved

26. Carbon can form a huge number of different compounds. Which statement best explains why?

A. Carbon is a metal that bonds with everything

B. Carbon forms four covalent bonds and links into chains and rings

C. Carbon has only one valence electron

D. Carbon is the heaviest common nonmetal

27. Increasing the concentration of a reactant speeds up a reaction. Which statement best explains why?

A. More reactant particles are present, so collisions happen more often

B. Higher concentration raises the activation energy

C. The particles move faster at higher concentration

D. Concentration changes the type of product formed

28. An alpha particle is stopped by a sheet of paper, while gamma rays pass through it. Which statement best explains why?

A. Alpha particles travel faster than gamma rays

B. Gamma rays are heavier and push through

C. Alpha particles have no charge and slip through gaps

D. Alpha particles are large and charged, so they are easily blocked

29. The total mass of the products equals the total mass of the reactants in a chemical reaction. Which statement best explains why?

A. New atoms are created during the reaction

B. Some atoms are destroyed and replaced

C. Mass is converted into energy and then back

D. Atoms are only rearranged, so mass is conserved

30. A bottle of soda fizzes more when opened warm than when opened cold. Which statement best explains why?

A. Warm soda contains more sugar

B. Gas is less soluble in warm liquid, so more escapes

C. Cold soda has more dissolved gas to release

D. Warm soda reacts chemically with the air

31. Magnesium forms a +2 ion. Which statement best explains why?

A. It gains two electrons to fill its outer shell

B. It loses its two valence electrons to reach a stable configuration

C. It shares two electrons with another atom

D. It has only two protons in its nucleus

32. A wet towel dries faster on a windy day. Which statement best explains why?

A. Moving air carries away water vapor and speeds evaporation

B. Wind chemically breaks down the water

C. Wind raises the boiling point of the water

D. Wind adds heat that boils the water off

33. Chlorine gas is yellow-green, yet sodium chloride is a white solid. Which statement best explains why?

A. The compound has properties different from its component elements

B. Sodium chloride is actually a mixture of the two elements

C. The chlorine keeps its color inside the salt

D. Sodium turns the chlorine white by heating it

34. A solution with a pH of 1 is a strong acid. Which statement best explains why?

A. It has a very low concentration of hydrogen ions

B. It contains mostly hydroxide ions

C. It has a very high concentration of hydrogen ions

D. It is very close to neutral

35. Boiling water stays at 100 °C even with continued heating until all of it has boiled away. Which statement best explains why?

A. The thermometer stops working at 100 °C

B. The water stops absorbing any heat

C. The added energy goes into changing liquid to gas, not raising the temperature

D. The water cools itself down as it boils

36. A nail rusts faster in moist air than in dry air. Which statement best explains why?

A. Water speeds the chemical reaction that forms rust

B. Dry air contains more oxygen than moist air

C. Water coats the nail and protects it from rust

D. Moisture lowers the iron's melting point

37. Helium and neon are placed in the same group of the periodic table. Which statement best explains why?

A. They have the same atomic mass

B. They have similar full-shell electron arrangements and properties

C. They are both metals

D. They have the same number of protons

38. A strong acid conducts electricity well in water. Which statement best explains why?

A. It ionizes completely, producing many mobile ions

B. It does not dissolve in water

C. It forms only neutral molecules in solution

D. It removes all ions from the water

39. Oxygen exists naturally as $O_2$ rather than as single atoms. Which statement best explains why?

A. Two oxygen atoms share electrons to reach a stable arrangement

B. Oxygen atoms repel each other into pairs

C. $O_2$ is an ionic compound

D. Oxygen is a noble gas

40. A graduated cylinder, not a beaker, is used to measure precise liquid volumes. Which statement best explains why?

A. Beakers cannot hold liquids at all

B. Graduated cylinders are made of stronger glass

C. Beakers change the volume of the liquid inside them

D. The graduated cylinder's narrow markings allow a more accurate reading

41. Down a group of the periodic table, atomic radius increases. Which statement best explains why?

A. Protons are removed going down a group

B. Additional electron shells are added going down a group

C. The nucleus pulls the electrons closer going down a group

D. Electrons are lost going down a group

42. Two substances with the same molecular formula can have different properties. Which statement best explains why?

A. They actually contain different elements

B. They have different numbers of atoms

C. They are isomers with different structural arrangements

D. One is a mixture and the other is a compound

43. A burning candle goes out when covered with a glass jar. Which statement best explains why?

A. The jar adds carbon dioxide that fuels the flame

B. The wax suddenly melts away

C. The jar cools the flame instantly

D. The supply of oxygen is cut off, stopping combustion

44. Ionic compounds tend to have high melting points. Which statement best explains why?

A. They are held together by weak forces

B. Their particles are gases at room temperature

C. Strong electrostatic forces hold the ions in a rigid lattice

D. They share their electrons very loosely

45. A balloon rubbed on hair will stick to a wall. Which statement best explains why?

A. The balloon gains electrons, and its charge attracts the wall

B. The balloon becomes heavier than air

C. The wall melts slightly and grips the balloon

D. The balloon releases a gas that acts as glue

46. Pure water conducts electricity poorly, but saltwater conducts well. Which statement best explains why?

A. Saltwater contains dissolved ions that carry charge

B. Pure water contains more ions than saltwater

C. Salt removes the water's ability to flow

D. Saltwater is essentially a metal

47. The boiling point of water is lower on a mountaintop. Which statement best explains why?

A. The water is purer at high altitude

B. The colder air directly lowers the boiling point

C. The lower air pressure lets the water boil at a lower temperature

D. There is less water vapor in mountain air

48. A radioactive isotope decays to half its amount over each fixed half-life. Which statement best explains why?

A. Decay speeds up as the sample shrinks

B. During each half-life, half of the remaining unstable nuclei decay

C. The sample gains mass during decay

D. Temperature controls the decay rate

49. Bromine is a liquid while chlorine is a gas at room temperature. Which statement best explains why?

A. Bromine has fewer electrons than chlorine

B. Chlorine is much heavier than bromine

C. Bromine's larger atoms have stronger intermolecular attractions

D. Bromine is a metal and chlorine is a nonmetal

50. Acids and bases neutralize each other. Which statement best explains why?

A. They combine to form a stronger acid

B. The acid evaporates on contact with the base

C. Hydrogen ions and hydroxide ions combine to form water

D. The base freezes the acid into a solid

51. A car's metal body is painted to prevent rust. Which statement best explains why?

A. Paint adds extra iron to the surface

B. Paint blocks oxygen and water from reaching the iron

C. Paint chemically converts the iron to gold

D. Paint cools the metal below its melting point

52. Increasing the pressure on a gas decreases its volume. Which statement best explains why?

A. The gas particles disappear under pressure

B. The gas turns into a solid

C. Pressure adds more gas particles to the container

D. The particles are forced closer together into a smaller space

53. A metal spoon left in hot soup becomes hot at the handle. Which statement best explains why?

A. The soup chemically reacts with the metal

B. The handle absorbs steam from the air

C. The hot soup releases electricity into the spoon

D. Metal conducts heat well, transferring energy along the spoon

54. Group 18 elements are colorless, unreactive gases. Which statement best explains why?

A. They each have one valence electron

B. They readily form bonds with most elements

C. They have full outer shells, making them chemically stable

D. They are all metals in gaseous form

55. A reaction in a test tube becomes cold to the touch. Which statement best explains why?

A. The reaction releases heat to the surroundings

B. The reaction absorbs heat from the surroundings

C. The test tube is leaking gas

D. The reaction produces only solids

56. Hydrogen peroxide breaks down faster when manganese dioxide is added. Which statement best explains why?

A. The manganese dioxide is a reactant consumed by the peroxide

B. It raises the temperature of the peroxide

C. It acts as a catalyst, lowering the activation energy

D. It increases the concentration of the peroxide

57. A solution stops dissolving more sugar even though sugar remains at the bottom. Which statement best explains why?

A. The solution is saturated and holds its maximum solute

B. The sugar has chemically changed

C. The water has fully evaporated

D. The sugar has become permanently insoluble

58. A helium atom is very stable and unreactive. Which statement best explains why?

A. It has eight electrons in its outer shell

B. It has no electrons at all

C. It readily shares its electrons with others

D. Its single shell is full with two electrons

59. When wood burns, bonds break and form, releasing heat and light. Which statement best explains why?

A. Burning is a chemical reaction that releases stored chemical energy

B. Wood physically melts into smoke

C. The wood simply changes its shape

D. Heat is created from nothing

60. A copper wire and an iron wire both conduct electricity. Which statement best explains why?

A. Both are metals with mobile electrons

B. Both contain dissolved ions

C. Both are nonmetals

D. Both gain electrons from the surrounding air

61. The Statue of Liberty turned green over time. Which statement best explains why?

A. It was deliberately painted green by design

B. The copper surface melted in the sun

C. Green paint was added to it each year

D. The copper reacted with air and moisture to form a green coating

62. Hot air rises above a flame. Which statement best explains why?

A. Hot air is heavier than cold air

B. Hot air is less dense than cold air and rises

C. The flame physically pushes the air downward

D. Hot air contains far more oxygen

63. A chemical equation must be balanced. Which statement best explains why?

A. To make the formulas look neater

B. To change the substances into entirely new ones

C. Because mass can be created during reactions

D. To satisfy the law of conservation of mass, with equal atoms on each side

64. Lithium, sodium, and potassium all react similarly with water. Which statement best explains why?

A. They are in the same group and each has one valence electron

B. They all have the same atomic mass

C. They are all in the same period

D. They each have a full outer shell

65. An iron nail placed in copper sulfate solution becomes coated with copper. Which statement best explains why?

A. Iron is more reactive and replaces the copper in solution

B. The copper sulfate dissolves the iron away

C. Copper is more reactive than iron

D. The two metals simply mix without reacting

66. Water has a relatively high boiling point for such a small molecule. Which statement best explains why?

A. Water molecules are completely nonpolar

B. Water contains dissolved metal

C. Water molecules strongly repel one another

D. Strong hydrogen bonding between water molecules holds them together

67. A weak acid has a higher pH than a strong acid at the same concentration. Which statement best explains why?

A. The weak acid contains hydroxide ions

B. The weak acid ionizes only partly, releasing fewer hydrogen ions

C. The weak acid is far more concentrated

D. The weak acid does not dissolve in water

68. A scuba diver's air tank holds a large amount of gas in a small volume. Which statement best explains why?

A. The gas is turned into a liquid metal

B. The gas particles shrink in size

C. The number of gas particles is reduced

D. The gas is compressed under high pressure into a small space

69. Neon signs glow when electricity passes through them. Which statement best explains why?

A. Electrons in the neon atoms absorb energy and release it as light

B. The neon gas burns and produces a flame

C. The glass tube melts and glows

D. Neon reacts chemically with the electricity

70. A reaction reaches equilibrium in a sealed flask. Which statement best explains why?

A. The reaction has completely stopped

B. All the reactants have been used up

C. The forward and reverse reactions occur at equal rates

D. The products have all escaped the flask

71. Sodium metal is stored under oil rather than in open air. Which statement best explains why?

A. Oil makes the sodium shinier

B. Sodium reacts quickly with moisture and oxygen in the air

C. Sodium dissolves directly in air

D. Oil adds useful mass to the sodium

72. Two electrons can occupy the first energy level, but the second holds up to eight. Which statement best explains why?

A. The first level is physically larger than the second

B. Energy levels farther from the nucleus can hold more electrons

C. Electrons avoid the first level

D. The nucleus repels electrons in the second level

73. A drop of food coloring spreads through a glass of still water on its own. Which statement best explains why?

A. The water is quietly boiling

B. The coloring is much denser than the water

C. Particles are in constant motion and spread out by diffusion

D. The coloring chemically reacts with the water

74. The combustion of methane produces carbon dioxide and water. Which statement best explains why?

A. The carbon and hydrogen in methane combine with oxygen

B. Methane already contains carbon dioxide

C. The water comes entirely from the surrounding air

D. Methane decomposes without any oxygen

75. A balloon filled with hydrogen explodes near a flame, but one filled with helium does not. Which statement best explains why?

A. Helium is heavier and resists the flame

B. Hydrogen is a noble gas

C. Hydrogen is flammable, while helium is inert

D. Helium reacts more strongly with oxygen

76. The freezing point of water is lowered when antifreeze is added to a car radiator. Which statement best explains why?

A. The antifreeze heats the water

B. The antifreeze removes water from the system

C. The antifreeze raises the boiling point only

D. The dissolved antifreeze particles interfere with ice formation

77. Solid carbon dioxide (dry ice) turns directly into a gas. Which statement best explains why?

A. It melts into a liquid first

B. At normal pressure it sublimes from solid straight to gas

C. It reacts with the air to form gas

D. It freezes the surrounding air into gas

78. A green plant leaf and a piece of coal both contain carbon, yet behave very differently. Which statement best explains why?

A. Coal actually contains no carbon

B. The leaf is made of metal

C. The carbon is arranged in different compounds and structures

D. They contain entirely different elements

79. Electrolytes in sports drinks help conduct electrical signals in the body. Which statement best explains why?

A. They are sugars that simply store energy

B. They are gases dissolved in the drink

C. They are dissolved ions that carry electric charge

D. They are tiny metals suspended in the liquid

80. When an atom loses an electron, it becomes a positive ion. Which statement best explains why?

A. It now has more electrons than protons

B. It now has more protons than electrons

C. It gains an extra neutron

D. Its protons suddenly turn positive

81. A teaspoon of salt makes far more difference to seawater's conductivity than to its color. Which statement best explains why?

A. Salt is itself brightly colored

B. The dissolved ions enable conduction without changing the color

C. Salt removes the color from water

D. Salt causes the water to boil

82. Hydrogen gas burns with a sharp "pop" when a flame is applied. Which statement best explains why?

A. Hydrogen is inert and just makes a noise

B. Hydrogen freezes the flame

C. Hydrogen reacts rapidly with oxygen, producing a small explosion

D. Hydrogen is denser than air and crushes the flame

83. Mixing baking soda and vinegar produces bubbles. Which statement best explains why?

A. The mixture boils from the heat released

B. Carbon dioxide gas is produced by the reaction

C. Trapped air is suddenly released

D. The vinegar evaporates very rapidly

84. An atom's chemical behavior is largely determined by its valence electrons. Which statement best explains why?

A. Valence electrons are located in the nucleus

B. Valence electrons never participate in bonding

C. The nucleus directly controls all bonding

D. The outer electrons are the ones involved in forming bonds

85. Modern airships use helium instead of hydrogen, even though hydrogen is lighter. Which statement best explains why?

A. Hydrogen is actually heavier than helium

B. Helium is much cheaper than hydrogen

C. Hydrogen cannot provide any lift

D. Helium is nonflammable and therefore safer

## Practice Exam 22 — Explained Answer Key

1. D — Water is unusual in expanding as it freezes, so ice is less dense than the liquid. Lower density makes the ice float. This expansion is why ice forms on top of ponds.
2. A — Cooling lowers the kinetic energy of the gas particles, so they strike the walls less forcefully and the volume contracts. This follows Charles's law, where volume and temperature are directly related. The balloon re-inflates when warmed again.
3. B — Noble gases already have complete outer electron shells, so they have no tendency to gain, lose, or share electrons. This stability is why they rarely react. Their full octet makes bonding energetically unfavorable.
4. A — Metals have a "sea" of delocalized electrons that are free to move through the lattice. These mobile electrons carry electric charge. This is the basis of metallic conductivity.
5. D — Water is polar and dissolves ionic substances like salt by surrounding the ions, while nonpolar oil does not interact with water. The rule "like dissolves like" governs solubility. Salt dissolves and oil separates.
6. A — Higher temperature gives water molecules more energy, so they collide with and surround the sugar more rapidly. Faster particle motion speeds the dissolving. The sugar itself is unchanged, so dissolving is physical.
7. C — Across a period, protons are added to the nucleus while electrons fill the same shell, so the stronger nuclear pull draws the electrons inward. This shrinks the atomic radius. Greater nuclear charge means a tighter hold.
8. D — Sodium has a single loosely held valence electron it loses easily, making it highly reactive, while gold is among the least reactive metals. Reactivity depends on how readily electrons are given up. Gold's inertness keeps it from reacting with water.

9. C — Diamond is a covalent network in which every carbon is bonded to four others by strong covalent bonds. Breaking this rigid network requires enormous energy. This gives diamond its very high melting point.
10. B — Dissolved salt interferes with water molecules forming ice, lowering the freezing point. The ice then melts at the colder temperature. This freezing-point depression is a colligative effect.
11. B — At high altitude the outside air pressure is lower, so the gas sealed in the bag pushes outward more than the thinner air pushes in. The bag expands. Pressure and volume are inversely related.
12. C — Helium is less dense than the surrounding air, so the buoyant force lifts the balloon upward. A less dense gas rises through a denser one. This is why helium balloons float.
13. C — Oxygen supports combustion, so it relights a glowing splint. This is the standard laboratory test for oxygen gas. The renewed flame confirms the gas present.
14. D — Going down Group 1, atoms gain shells, so the single valence electron lies farther from the nucleus and is held less tightly. It is therefore lost more easily, increasing reactivity. Larger atoms react more vigorously.
15. C — Raising the temperature increases particle speed, so collisions become more frequent and more energetic. More successful collisions speed the reaction. Heat raises the fraction of collisions that exceed the activation energy.
16. A — Atoms of the same element with different masses are isotopes, differing only in their number of neutrons. The proton count stays the same, so it is the same element. The extra neutrons account for the mass difference.
17. B — An atom is neutral when its positive protons exactly balance its negative electrons. Equal numbers cancel the charge. Gaining or losing electrons would make it an ion.
18. D — Grinding zinc into powder exposes far more surface area to the acid, so more collisions occur at the surface. This speeds the reaction. Smaller pieces react faster than a single lump.
19. D — A catalyst offers a reaction pathway with a lower activation energy, allowing more collisions to succeed. It is not consumed, so it remains available. This is why a small amount has a large effect.
20. A — In an exothermic reaction, the energy stored in the reactant bonds exceeds that in the product bonds, and the difference is released as heat. This warms the surroundings. The products end up at lower energy than the reactants.
21. C — In solid salt the ions are locked in a lattice and cannot move, but melting frees them to flow and carry charge. Mobile ions are required for conduction. This is why only molten or dissolved salt conducts.
22. B — When hydrogen and oxygen bond chemically, they form water, a new compound with properties unlike either gas. Chemical combination creates entirely new characteristics. The product no longer behaves like its elements.
23. D — Fluorine is a small atom whose nucleus strongly attracts an incoming electron, making it eager to gain one. This strong pull makes it the most reactive halogen. Smaller halogens attract electrons more effectively.
24. D — Steam at 100 °C carries the extra latent heat of vaporization, which it releases when it condenses on the skin. This added energy makes the burn worse than the same temperature of liquid water. The phase change delivers a large energy dose.
25. A — When the solutions mix, certain ions combine into a compound that is insoluble, so it falls out as a solid precipitate. The new solid is evidence of a chemical reaction. The ions form a product that water cannot dissolve.

26. B — Carbon has four valence electrons, letting it form four covalent bonds and link into long chains, branches, and rings. This bonding versatility allows an enormous variety of compounds. It is the basis of organic chemistry.
27. A — A higher concentration packs more reactant particles into the same volume, so collisions occur more often. More frequent collisions speed the reaction. The activation energy itself is unchanged.
28. D — Alpha particles are relatively large and carry a +2 charge, so they interact strongly with matter and are stopped by paper. Gamma rays have no charge or mass and penetrate far more. Charge and size determine penetrating power.
29. D — In a chemical reaction atoms are rearranged but neither created nor destroyed, so the total mass is conserved. The same atoms appear in the products as in the reactants. This is the law of conservation of mass.
30. B — Gas is less soluble in warmer liquid, so warm soda holds less dissolved carbon dioxide and releases it more readily. The escaping gas causes the fizz. Cold soda retains more gas in solution.
31. B — Magnesium, in Group 2, loses its two valence electrons to achieve a stable, full-shell configuration, leaving a +2 charge. Losing electrons forms a cation. The +2 ion reflects its two valence electrons.
32. A — Wind continually removes the humid air near the towel, allowing more water molecules to escape into the drier moving air. This speeds evaporation. The water leaves as vapor, a physical change.
33. A — Sodium chloride is a compound with its own properties, which differ from those of the chlorine gas and sodium metal that form it. Chemical combination changes the appearance and behavior. The white solid bears no resemblance to its elements.
34. C — A pH of 1 reflects a very high concentration of hydrogen ions, which marks a strong acid. Lower pH means more hydrogen ions. The strong acid ionizes fully to release them.
35. C — While a liquid boils, the added energy goes into breaking the attractions between molecules to form gas rather than raising the temperature. The temperature holds steady until all the liquid has vaporized. This is the latent heat of vaporization.
36. A — Rusting requires both water and oxygen, so moisture accelerates the chemical reaction that produces rust. Damp conditions speed corrosion. Dry air slows the process because water is scarce.
37. B — Helium and neon share the property of full outer shells and similar unreactive behavior, so they sit in the same group. The periodic table groups elements by electron arrangement. Their shared chemistry, not their mass, places them together.
38. A — A strong acid ionizes completely in water, releasing many ions that are free to carry charge. Abundant mobile ions make the solution conduct well. Complete ionization is the key.
39. A — Two oxygen atoms share electrons to complete their outer shells, forming the stable $O_2$ molecule. Bonding gives each atom a full octet. This is why oxygen is diatomic in nature.
40. D — A graduated cylinder is narrow with fine volume markings, allowing a more precise reading than a wide beaker. Accuracy depends on the resolution of the scale. The narrow column makes small volume differences visible.
41. B — Moving down a group adds electron shells, so the atom's outer edge lies farther from the nucleus. The added shells increase the radius. Each new period adds a principal energy level.
42. C — Substances with the same molecular formula but different structural arrangements are isomers, and their differing structures give them different properties. The atoms are connected differently. Structure, not formula alone, determines behavior.

43. D — Covering the candle cuts off the supply of oxygen needed for combustion, so the flame goes out. Burning cannot continue without oxygen. The trapped flame quickly consumes the remaining oxygen.
44. C — Ionic compounds consist of oppositely charged ions held by strong electrostatic forces in a rigid lattice. Overcoming these forces takes a lot of energy. This is why their melting points are high.
45. A — Rubbing transfers electrons to the balloon, giving it a negative charge that attracts opposite charges in the wall. The static attraction holds it in place. Charge separation creates the cling.
46. A — Saltwater contains dissolved ions that move freely and carry electric charge, while pure water has very few ions. The mobile ions allow conduction. This is why salt makes water conductive.
47. C — At higher altitude the air pressure is lower, so water needs less heat to reach the point where its vapor pressure equals the surrounding pressure. It therefore boils at a lower temperature. Reduced pressure lowers the boiling point.
48. B — During each half-life, half of the remaining unstable nuclei decay, so the amount halves at a constant rate. The fraction decaying stays the same each interval. This gives the steady halving pattern.
49. C — Bromine's larger atoms have stronger intermolecular attractions than chlorine's, so bromine is held together as a liquid while chlorine remains a gas. Stronger attractions raise the boiling point. Atom size drives this difference.
50. C — In neutralization, the acid's hydrogen ions combine with the base's hydroxide ions to form water. This removes the characteristic ions of both. A salt forms from the remaining ions.
51. B — Paint forms a barrier that keeps oxygen and water from reaching the iron, and both are needed for rusting. Without contact, the reaction cannot proceed. The coating protects the metal.
52. D — Increasing the pressure forces the gas particles closer together, reducing the space they occupy. The volume decreases as a result. Pressure and volume are inversely related under Boyle's law.
53. D — Metal is a good conductor of heat, so thermal energy travels along the spoon from the hot soup to the handle. The conduction warms the far end. Mobile electrons help transfer the energy.
54. C — Group 18 elements have full outer electron shells, giving them great chemical stability and little tendency to react. This is why they are inert gases. The complete shell explains their lack of reactivity.
55. B — A reaction that grows cold is endothermic, drawing heat in from its surroundings. The loss of heat from the surroundings makes the tube feel cold. The reaction absorbs energy as it proceeds.
56. C — Manganese dioxide acts as a catalyst, lowering the activation energy for hydrogen peroxide's decomposition without being consumed. The reaction speeds up while the catalyst is recovered. A small amount produces a large effect.
57. A — Once a solution holds all the solute it can at that temperature, it is saturated and dissolves no more, leaving excess sugar undissolved. The solution has reached its solubility limit. Adding heat would let it dissolve more.
58. D — Helium's first and only shell is full with two electrons, giving it a stable configuration. This completeness makes it unreactive. Unlike most elements, helium needs only two electrons for a full shell.
59. A — Burning wood is a chemical reaction in which bonds break and re-form, releasing the energy stored in the wood as heat and light. New substances such as carbon dioxide and water form. The released energy was stored chemically.

60. A — Both copper and iron are metals with delocalized, mobile electrons that carry charge. This shared metallic structure makes both conduct electricity. Mobile electrons are the common factor.
61. D — The copper surface reacted slowly with air and moisture to form a greenish layer of copper compounds. This patina is a chemical change. The color comes from the new compounds, not paint.
62. B — Heating air makes it expand and become less dense than the cooler air around it, so it rises. The denser cool air sinks and pushes it up. This convection lifts the warm air.
63. D — A balanced equation has equal numbers of each atom on both sides, reflecting the law of conservation of mass. Atoms are conserved in a reaction. Balancing ensures none are gained or lost.
64. A — Lithium, sodium, and potassium are all Group 1 metals with one valence electron, so they react with water in the same way. Shared valence structure gives shared chemistry. The single outer electron is readily lost.
65. A — Iron is more reactive than copper, so it displaces copper from the copper sulfate solution and copper deposits on the nail. This is a single-replacement reaction. The more reactive metal takes the place of the less reactive one.
66. D — Water molecules form strong hydrogen bonds with one another, which take extra energy to overcome. This raises the boiling point above what the small molecule's size alone would suggest. Hydrogen bonding holds the molecules together.
67. B — A weak acid ionizes only partly, releasing fewer hydrogen ions than a strong acid at the same concentration. Fewer hydrogen ions means a higher pH. Partial ionization is the key difference.
68. D — Compressing the gas under high pressure forces its particles into a much smaller volume, so a large quantity fits in the tank. The particles themselves are unchanged. High pressure packs them tightly.
69. A — Electricity excites the electrons in the neon atoms, which then release the absorbed energy as visible light. The glow comes from electrons returning to lower energy levels. No burning or chemical change occurs.
70. C — At equilibrium the forward and reverse reactions proceed at equal rates, so the amounts of reactants and products stay constant. The reaction has not stopped; both directions continue. A closed system allows this balance.
71. B — Sodium is so reactive that it quickly reacts with moisture and oxygen in the air, so it is stored under oil to keep air away. The oil prevents contact with air. This protects the reactive metal.
72. B — Energy levels farther from the nucleus can accommodate more electrons, so the second level holds up to eight while the first holds only two. Higher levels have greater capacity. This follows the shell-filling order.
73. C — Particles are in constant random motion, so the food coloring spreads through the still water by diffusion until it is evenly distributed. No stirring is needed. Particle motion drives the mixing.
74. A — In combustion, the carbon and hydrogen in methane combine with oxygen to form carbon dioxide and water. The fuel reacts fully with oxygen. These are the standard products of hydrocarbon combustion.
75. C — Hydrogen is flammable and reacts explosively with oxygen near a flame, while helium is inert and does not burn. This difference in reactivity explains the outcome. Helium's stability makes it safe.
76. D — The dissolved antifreeze particles interfere with water molecules forming ice, lowering the freezing point. This keeps the radiator fluid from freezing in cold weather. It is a colligative effect of the dissolved solute.

77. B — At normal atmospheric pressure, dry ice sublimes, passing directly from solid to gas without melting. Carbon dioxide has no stable liquid phase at this pressure. The solid vaporizes straight into gas.
78. C — Both contain carbon, but it is arranged in different compounds and structures, giving the leaf and the coal very different properties. The element is the same; the arrangement differs. Structure determines behavior.
79. C — Electrolytes are dissolved ions that carry electric charge, which allows them to support the body's electrical signals. Their mobility enables conduction. The dissolved ions are the functional component.
80. B — Losing an electron leaves the atom with more protons than electrons, giving it a net positive charge. The imbalance creates a cation. The proton count now exceeds the electron count.
81. B — The dissolved salt provides ions that make the water conduct electricity, but those ions do not give the water any noticeable color. Conductivity changes sharply while appearance does not. The ions affect charge flow, not color.
82. C — Hydrogen reacts rapidly with oxygen when ignited, producing a small explosion heard as a "pop." This is the standard test for hydrogen gas. The quick reaction releases energy suddenly.
83. B — Baking soda and vinegar react to produce carbon dioxide gas, which forms the bubbles. The gas is a product of the chemical reaction. The fizzing is evidence that a reaction has occurred.
84. D — The valence electrons in the outermost shell are the ones that take part in forming bonds, so they govern an atom's chemical behavior. Inner electrons are not involved in bonding. The outer electrons determine reactivity.
85. D — Helium is nonflammable, so it provides lift without the fire risk of hydrogen, even though hydrogen is lighter. Safety outweighs the small loss of lift. This is why modern airships use helium.