PRACTICE EXAM 23: PHYSICAL SETTING/CHEMISTRY SIMULATION (85 QUESTIONS)

1. A solid sample of water is heated steadily until it becomes steam. Which sequence shows the correct order of states?

A. liquid → solid → gas

B. solid → liquid → gas

C. gas → liquid → solid

D. solid → gas → liquid

2. Steam is cooled steadily until it becomes ice. Which sequence shows the correct order of states?

A. solid → liquid → gas

B. gas → liquid → solid

C. liquid → gas → solid

D. gas → solid → liquid

3. A substance is heated steadily from a cold solid. Which order shows the phase changes it undergoes?

A. boiling, then melting

B. condensation, then freezing

C. freezing, then melting

D. melting, then boiling

4. To recover both the salt and the sand from a mixture of salt, sand, and water, which order of steps is correct?

A. evaporate the water, then filter out the sand

B. distill first, then add more water

C. filter out the sand, then evaporate the water to recover the salt

D. freeze the mixture, then filter it

5. Which order shows how many electrons fill the first three energy levels of an atom?

A. 8, then 2, then 8

B. 2, then 8, then 8

C. 8, then 8, then 2

D. 2, then 2, then 8

6. Which order of steps correctly builds the formula of an ionic compound?

A. write the formula, then find the ions

B. balance the charges, then identify the ions

C. guess the formula, then check the color

D. identify the ions, balance the charges, then write the formula

7. Which order lists the three states from the most tightly packed particles to the most spread out?

A. gas, liquid, solid

B. liquid, solid, gas

C. gas, solid, liquid

D. solid, liquid, gas

8. Which sequence shows the remaining mass after each successive half-life of an 80-g radioactive sample?

A. 80 g, 60 g, 40 g

B. 80 g, 20 g, 10 g

C. 40 g, 20 g, 10 g

D. 40 g, 30 g, 20 g

9. Which order of stages occurs as a solid is heated until it becomes a gas?

A. melting, solid warming, boiling, liquid warming

B. solid warming, melting, liquid warming, boiling

C. boiling, liquid warming, melting, solid warming

D. liquid warming, boiling, solid warming, melting

10. To dilute a concentrated acid safely, which order of steps is correct?

A. add the water to the acid slowly

B. add the acid to the water slowly

C. mix equal amounts all at once

D. heat the acid first, then add water

11. In distillation, which order of events occurs?

A. the vapor condenses, then the liquid boils

B. the solid melts, then it freezes

C. the liquid freezes, then it boils

D. the liquid boils to vapor, then the vapor condenses back to liquid

12. Which order lists the three states from the lowest particle energy to the highest?

A. gas, liquid, solid

B. liquid, gas, solid

C. gas, solid, liquid

D. solid, liquid, gas

13. Which order of steps correctly balances a chemical equation?

A. change the subscripts, then count the atoms

B. write the correct formulas, count atoms on each side, then adjust the coefficients

C. adjust the coefficients, then write the formulas

D. guess the coefficients, then change the products

14. Which order lists the three subatomic particles from least to greatest mass?

A. proton, neutron, electron

B. neutron, proton, electron

C. proton, electron, neutron

D. electron, proton, neutron

15. A gas is cooled steadily until it becomes a solid. Which order of states occurs?

A. gas → liquid → solid

B. solid → liquid → gas

C. liquid → solid → gas

D. gas → solid → liquid

16. Which order of steps finds the number of moles from a given mass in grams?

A. multiply the grams by the formula mass, then divide by 2

B. add the grams and the formula mass

C. find the gram-formula mass, then divide the given grams by it

D. divide the formula mass by the grams

17. Four solutions have pH values of 1, 5, 9, and 13. Which order lists them from most acidic to most basic?

A. pH 13, pH 9, pH 5, pH 1

B. pH 5, pH 1, pH 9, pH 13

C. pH 1, pH 5, pH 9, pH 13

D. pH 1, pH 9, pH 5, pH 13

18. Which order of events describes how an ionic bond forms between a metal and a nonmetal?

A. the metal loses an electron, the nonmetal gains it, and the ions attract

B. the ions attract, then the metal loses an electron

C. the nonmetal loses an electron, then the metal gains it

D. both atoms share electrons, then separate

19. To measure the volume of an irregular solid by water displacement, which order of steps is correct?

A. record the water level, add the solid, record the new level, then subtract

B. add the solid, subtract, then record the water level

C. record the new level first, then add the solid

D. subtract first, then add the solid

20. Which order of temperature behavior occurs as a solid is heated steadily to a gas?

A. constant, rising, constant, rising

B. rising the entire time

C. rising, constant at melting, rising, constant at boiling

D. constant the entire time

21. Which order lists lithium, sodium, potassium, and rubidium from least to most reactive?

A. lithium, sodium, potassium, rubidium

B. rubidium, potassium, sodium, lithium

C. sodium, lithium, rubidium, potassium

D. potassium, sodium, rubidium, lithium

22. Which order of steps separates iron filings from a mixture of iron filings and sand?

A. pass a magnet over the mixture to remove the iron, leaving the sand

B. dissolve the sand, then filter out the iron

C. evaporate the mixture, then add water

D. boil the mixture, then condense it

23. Which order lists the halogens fluorine, chlorine, bromine, and iodine from most to least reactive?

A. iodine, bromine, chlorine, fluorine

B. chlorine, fluorine, iodine, bromine

C. fluorine, chlorine, bromine, iodine

D. bromine, iodine, fluorine, chlorine

24. Which order of steps correctly makes a saltwater solution?

A. stir first, then add the water

B. add the salt, then remove the water

C. measure the water, add the salt, then stir until it dissolves

D. evaporate the water, then add the salt

25. Which order lists hydrogen, helium, lithium, and beryllium by increasing atomic number?

A. helium, hydrogen, beryllium, lithium

B. lithium, beryllium, hydrogen, helium

C. beryllium, lithium, helium, hydrogen

D. hydrogen, helium, lithium, beryllium

26. Which order of states occurs when a block of dry ice is left out at normal room conditions?

A. solid → liquid → gas

B. solid → liquid only

C. liquid → gas

D. solid → gas, directly

27. Which order shows the electron arrangement of a sodium atom by energy level?

A. 2, 8, 1

B. 1, 8, 2

C. 8, 2, 1

D. 2, 1, 8

28. Which order of steps tests an unknown gas to confirm it is oxygen?

A. observe the relighting, then collect the gas

B. light the splint after observing it

C. insert the splint, then collect the gas

D. collect the gas, insert a glowing splint, and observe it relight

29. Which order lists the three states by increasing particle motion?

A. gas, liquid, solid

B. liquid, gas, solid

C. gas, solid, liquid

D. solid, liquid, gas

30. Which order of steps safely handles a small acid spill in the lab?

A. neutralize it with a base, test the pH, then clean it up

B. clean it up, then neutralize it

C. test the pH only after cleaning up

D. add more acid, then rinse

31. As water vapor is cooled steadily, which order of phase changes occurs?

A. condensation, then freezing

B. freezing, then condensation

C. melting, then boiling

D. boiling, then melting

32. Which order of steps finds an element's percent composition in a compound?

A. multiply by 100 first, then find the masses

B. divide the total mass by the element's mass, then add 100

C. find the element's mass and the total mass, divide, then multiply by 100

D. subtract the masses, then divide by the element

33. Which order lists lithium, beryllium, boron, and carbon by increasing atomic number?

A. carbon, boron, beryllium, lithium

B. beryllium, lithium, carbon, boron

C. boron, carbon, lithium, beryllium

D. lithium, beryllium, boron, carbon

34. Which order of steps describes the experiment in which iron is placed in copper sulfate solution?

A. place iron in the copper sulfate, observe copper coating the iron, then identify the displaced copper

B. observe the coating before adding the iron

C. identify the metal, then add the solution

D. remove the iron first, then add it back

35. Which order of steps distills pure water out of saltwater?

A. condense, collect, boil, let the vapor rise

B. collect the water, then boil it

C. boil the water, let the vapor rise, condense it, then collect the pure water

D. let the vapor rise, boil, collect, condense

36. Which order of steps balances the equation $Na + Cl_2 \rightarrow NaCl$?

A. change Cl_2 to Cl, then balance

B. add a coefficient to NaCl first, then write the reactants

C. write the formulas, count the atoms, then place a 2 before Na and before NaCl

D. guess, then change the subscripts

37. Which order lists the first three electron shells from closest to farthest from the nucleus?

A. third, second, first

B. first, second, third

C. second, first, third

D. third, first, second

38. Which order of events describes how an iron nail rusts?

A. rust forms, then the nail meets oxygen

B. the nail dries, then rust forms instantly

C. the iron is exposed to oxygen and water, reacts, and forms rust over time

D. the nail is painted, then it rusts faster

39. Which order lists the halogens fluorine, chlorine, bromine, and iodine from least to most reactive?

A. fluorine, chlorine, bromine, iodine

B. chlorine, fluorine, bromine, iodine

C. iodine, bromine, chlorine, fluorine

D. bromine, iodine, fluorine, chlorine

40. Which order of steps correctly measures a liquid's volume in a graduated cylinder?

A. read the level first, then pour in the liquid

B. pour in the liquid, lower to eye level, then read the bottom of the meniscus

C. read the top of the meniscus before pouring

D. shake the cylinder, then read it quickly

41. An ice cube melts and then fully evaporates. Which order of states occurs?

A. gas, liquid, solid

B. liquid, solid, gas

C. solid, liquid, gas

D. solid, gas, liquid

42. Which order of steps finds the molarity of a solution?

A. multiply the moles by the liters

B. divide the liters by the moles

C. find the moles of solute, find the liters of solution, then divide moles by liters

D. add the moles and the liters

43. Which order lists lithium, sodium, potassium, and cesium from smallest to largest atomic radius?

A. cesium, potassium, sodium, lithium

B. lithium, sodium, potassium, cesium

C. sodium, lithium, cesium, potassium

D. potassium, sodium, lithium, cesium

44. Which order of events describes alpha decay?

A. the nucleus emits an alpha particle, the atomic number drops by 2, and a new element forms

B. a new element forms before any emission

C. the atomic number rises, then an alpha particle is absorbed

D. an electron is emitted, then the mass rises

45. Which order of events occurs when a saturated solution is cooled and crystals appear?

A. the crystals form, then the solution cools

B. the solubility rises, then the crystals dissolve

C. the solution is heated, then the crystals form

D. the solution cools, the solubility drops, and the excess solute crystallizes out

46. Which order lists the levels of matter from the simplest particle to the most complex?

A. mixture, compound, element, atom

B. compound, mixture, atom, element

C. atom, element, compound, mixture

D. element, atom, mixture, compound

47. Which order shows the correct flow of the word equation for the combustion of methane?

A. carbon dioxide + water → methane + oxygen

B. methane + carbon dioxide → oxygen + water

C. methane + oxygen → carbon dioxide + water

D. oxygen + water → methane + carbon dioxide

48. Which order of steps safely prepares and then tests a dilute acid?

A. test the litmus, then add the acid to water

B. add the acid slowly to the water, stir, then test with litmus

C. add water to the acid, then test it

D. stir the dry acid, then add litmus

49. Which order lists lithium, carbon, fluorine, and neon by increasing ionization energy?

A. neon, fluorine, carbon, lithium

B. lithium, carbon, fluorine, neon

C. fluorine, lithium, neon, carbon

D. carbon, neon, lithium, fluorine

50. Which order of events describes an antacid neutralizing stomach acid?

A. the base meets the acid, they react to form a salt and water, and the pH rises

B. the pH rises before any reaction

C. the salt forms, then the acid is added

D. the acid increases, then only a gas forms

51. Which order of plateaus appears on a heating curve as a solid is heated to a gas?

A. the melting plateau, then the boiling plateau

B. the boiling plateau, then the melting plateau

C. two boiling plateaus only

D. the boiling plateau, then a freezing plateau

52. Which order of steps finds the number of neutrons in an atom?

A. add the mass number and the atomic number

B. find the mass number, find the atomic number, then subtract the atomic number from the mass number

C. divide the mass number by 2

D. subtract the mass number from the number of electrons

53. Which order of events occurs when warm liquid water is cooled until it becomes cold ice?

A. the ice cools, then the water freezes

B. the water boils, then freezes

C. the ice forms before any heat is released

D. the liquid water releases heat, freezes into ice, and the ice cools further

54. Which order of steps describes a flame test on a metal salt?

A. heat the sample in the flame, observe the color, then identify the metal

B. identify the metal, then heat the sample

C. observe the color before heating

D. cool the sample, then observe the flame

55. Which order lists potassium, sodium, copper, and gold from most to least reactive?

A. gold, copper, sodium, potassium

B. copper, gold, potassium, sodium

C. potassium, sodium, copper, gold

D. sodium, potassium, gold, copper

56. Which order of steps correctly filters a sand-and-water mixture?

A. set up the filter paper in the funnel, pour in the mixture, then collect the filtered water

B. collect the water, then pour in the mixture

C. pour in the mixture before setting up the filter

D. evaporate first, then filter

57. Which order lists sodium, silicon, sulfur, and chlorine by increasing electronegativity?

A. chlorine, sulfur, silicon, sodium

B. sodium, silicon, sulfur, chlorine

C. silicon, sodium, chlorine, sulfur

D. sulfur, chlorine, sodium, silicon

58. Which order of events describes a precipitation reaction?

A. a solid settles before the solutions are mixed

B. the ions separate, then the solutions are mixed

C. the solid dissolves, then the solutions combine

D. the two solutions are mixed, the ions combine, and an insoluble solid forms and settles

59. Which order of plateaus appears on a cooling curve as a gas is cooled to a solid?

A. the freezing plateau, then the condensation plateau

B. two melting plateaus

C. the condensation plateau, then the freezing plateau

D. the boiling plateau, then the melting plateau

60. Which order of steps writes the formula of magnesium chloride?

A. write $MgCl_2$, then find the ions

B. balance the charges before finding the ions

C. guess MgCl, then check it

D. find the ions Mg^{2+} and Cl^{-}, balance the charges with two chlorides, then write $MgCl_2$

61. Which order lists the three states from least to most compressible?

A. gas, liquid, solid

B. solid, liquid, gas

C. liquid, solid, gas

D. gas, solid, liquid

62. Which order of steps finds the gram-formula mass of a compound?

A. count each element's atoms, multiply by its atomic mass, then add the products

B. add the atomic masses, then count the atoms

C. divide by the number of elements first

D. multiply all the atomic masses together

63. In a redox reaction, which order shows the flow of electrons?

A. electrons are created, then destroyed

B. reduction loses electrons that oxidation gains

C. oxidation loses electrons, which reduction gains

D. both species gain electrons at the same time

64. Which order of steps tests a solution with litmus paper and reaches a conclusion?

A. identify the acid first, then dip the litmus

B. dip the litmus paper, observe the color change, then identify the solution as acid or base

C. observe the color before dipping

D. rinse the litmus, then identify the color

65. Which order lists the hydrogen isotopes protium, deuterium, and tritium by increasing mass number?

A. tritium, deuterium, protium

B. deuterium, protium, tritium

C. tritium, protium, deuterium

D. protium, deuterium, tritium

66. Which order of events recovers salt by evaporating a salt solution?

A. heat the solution, the water evaporates, and the salt crystals remain

B. the crystals remain before heating

C. add water, then the crystals appear

D. cool the solution, then it evaporates

67. Which order lists the three states from highest to lowest particle energy?

A. solid, liquid, gas

B. liquid, solid, gas

C. solid, gas, liquid

D. gas, liquid, solid

68. Which order of steps classifies the reaction $A + B \rightarrow AB$?

A. name it first, then look at the equation

B. count the products before the reactants

C. identify the reactants and product, see two combine into one, then call it synthesis

D. assume it is decomposition, then check

69. As water evaporates from a lake and later forms clouds, which order of phase changes occurs?

A. condensation, then evaporation

B. freezing, then melting

C. melting, then boiling

D. evaporation, then condensation

70. Which order of steps neutralizes an acid and confirms the result?

A. confirm pH 7 before adding any base

B. add base to the acid until the pH reaches 7, then confirm with an indicator

C. add acid to the base, then remove it

D. heat the acid, then add the indicator only

71. Which order lists Periods 1, 2, and 3 by increasing number of occupied electron shells?

A. Period 3, Period 2, Period 1

B. Period 2, Period 1, Period 3

C. Period 3, Period 1, Period 2

D. Period 1, Period 2, Period 3

72. Which order of steps dissolves a solid and then recovers it by evaporation?

A. dissolve the solid, heat to evaporate the solvent, then recover the solid

B. recover the solid before dissolving it

C. evaporate first, then dissolve

D. cool the solution to recover the solvent

73. Which order lists sodium, magnesium, silicon, and chlorine from largest to smallest atomic radius?

A. chlorine, silicon, magnesium, sodium

B. silicon, sodium, chlorine, magnesium

C. sodium, magnesium, silicon, chlorine

D. magnesium, sodium, chlorine, silicon

74. Which order of events describes beta decay?

A. the atomic number falls before any change

B. a neutron converts to a proton, an electron is emitted, and the atomic number rises by 1

C. an electron is absorbed, then a proton forms

D. a proton becomes a neutron, raising the mass

75. As a candle burns, which order of states does the wax pass through?

A. solid wax melts to liquid, then the liquid vaporizes

B. the vapor forms before the wax melts

C. the liquid freezes, then melts

D. the wax sublimes directly to gas

76. Which order of steps finds the number of particles in a sample from its number of moles?

A. multiply the mass by Avogadro's number directly

B. find the moles, then multiply by Avogadro's number

C. divide Avogadro's number by the moles

D. add the moles and Avogadro's number

77. Which order of events describes the formation of a water molecule?

A. H_2O forms before the atoms meet

B. two hydrogen atoms and one oxygen atom share electrons, forming H_2O

C. the molecule splits, then the atoms bond

D. oxygen loses electrons to hydrogen first

78. Which order of steps reduces the molecular formula $C_6H_{12}O_6$ to its empirical formula?

A. multiply each subscript by 6

B. add the subscripts together

C. leave it unchanged as $C_6H_{12}O_6$

D. divide each subscript by the common factor 6 to get CH_2O

79. Which order of events occurs as warm liquid water is cooled into cold ice?

A. the liquid cools, freezes at 0 °C, and the ice cools further

B. the ice cools before the liquid freezes

C. the water boils, then freezes

D. the ice melts, then refreezes

80. Which order of events describes the synthesis reaction $2\ H_2 + O_2 \rightarrow 2\ H_2O$?

A. water decomposes into hydrogen and oxygen

B. hydrogen and oxygen combine, bonds form, and water is produced

C. water forms before the reactants combine

D. the bonds break, leaving only separate atoms

81. Lemon juice has a pH of 2, pure water 7, soap 9, and bleach 12. Which order lists them by increasing pH?

A. bleach, soap, water, lemon juice

B. lemon juice, water, soap, bleach

C. water, lemon juice, bleach, soap

D. soap, water, bleach, lemon juice

82. Which order of steps separates alcohol from water by distillation, given that alcohol boils first?

A. heat the mixture, the alcohol vaporizes first, the vapor condenses, and the alcohol is collected

B. collect the alcohol before heating

C. the water boils first, then the alcohol

D. condense the mixture, then heat it

83. Which order lists the three states from the most orderly particle arrangement to the least?

A. gas, liquid, solid

B. liquid, gas, solid

C. gas, solid, liquid

D. solid, liquid, gas

84. Which order of steps tests a gas to confirm it is carbon dioxide?

A. bubble the gas through limewater, observe it turn milky, and conclude it is carbon dioxide

B. conclude it is carbon dioxide before testing

C. observe the milkiness before bubbling the gas

D. heat the limewater, then add a splint

85. Which order of events describes what happens to a salt solution as its water slowly evaporates?

A. the solvent leaves, the solution becomes more concentrated, and eventually salt crystals form

B. crystals form before any water leaves

C. the solution becomes more dilute as the water leaves

D. the salt evaporates, leaving pure water behind

Practice Exam 23 — Explained Answer Key

1. B — Heating moves a substance to higher-energy states in the order solid → liquid → gas. Ice melts to water, which boils to steam. Energy is added at each step.
2. B — Cooling moves a substance to lower-energy states in the order gas → liquid → solid. Steam condenses to water, which freezes to ice. Energy is removed at each step.
3. D — On steady heating, a solid first melts to a liquid, then the liquid boils to a gas. Melting precedes boiling because it requires less energy. The order is melting, then boiling.
4. C — Filtering removes the insoluble sand first, then evaporating the remaining solution recovers the dissolved salt. Each step targets one component. This sequence recovers both solids.
5. B — The first energy level holds up to 2 electrons, the second up to 8, and the third up to 8 for the early elements. Filling proceeds outward. The order is 2, then 8, then 8.
6. D — Building an ionic formula means first identifying the ions, then balancing their charges, then writing the formula. The charges must cancel to neutral. This order yields a correct formula.
7. D — Particles are most tightly packed in a solid, looser in a liquid, and most spread out in a gas. Spacing increases with energy. The order is solid, liquid, gas.
8. C — Each half-life halves the mass, so 80 g becomes 40 g, then 20 g, then 10 g. The sequence 40, 20, 10 shows the amounts after the first three half-lives. Each value is half the previous.
9. B — Heating a solid proceeds as solid warming, melting, liquid warming, then boiling. Warming raises temperature between phase changes. This order tracks a heating curve.
10. B — Acid is always added slowly to water, never water to acid, to disperse the heat released safely. Adding acid to water dilutes the heat. This prevents dangerous splattering.

11. D — In distillation, the liquid first boils into vapor, then the vapor condenses back to liquid. Heating drives the vaporization and cooling drives the condensation. The order is boil, then condense.
12. D — Particle energy is lowest in a solid, higher in a liquid, and highest in a gas. Energy rises with each state. The order is solid, liquid, gas.
13. B — Balancing begins by writing the correct formulas, then counting atoms on each side, then adjusting coefficients. Subscripts are never changed. This order conserves atoms.
14. D — The electron has by far the least mass, while the proton and neutron are each about one atomic mass unit, with the proton slightly less. The order from least to greatest is electron, proton, neutron. The nucleons carry nearly all the mass.
15. A — Cooling a gas to a solid passes through gas → liquid → solid. The gas condenses, then the liquid freezes. Energy is removed at each step.
16. C — To find moles from mass, first find the gram-formula mass, then divide the given grams by it. Dividing converts mass to moles. The formula mass is the conversion factor.
17. C — Lower pH is more acidic and higher pH is more basic, so the order from most acidic to most basic is pH 1, 5, 9, 13. The scale increases from acid to base. The values rise in order.
18. A — In ionic bonding, the metal loses an electron, the nonmetal gains it, and the resulting ions attract. The transfer creates oppositely charged ions. Their attraction forms the bond.
19. A — Displacement measurement records the starting water level, adds the solid, records the new level, then subtracts to find the volume. The rise in water equals the solid's volume. Subtraction gives the answer.
20. C — As a solid is heated, the temperature rises, holds constant during melting, rises again, then holds constant during boiling. Phase changes pause the temperature rise. This is the heating-curve pattern.
21. A — Alkali metal reactivity increases down the group, so the order from least to most reactive is lithium, sodium, potassium, rubidium. The outer electron is lost more easily down the group. Reactivity grows with size.
22. A — A magnet attracts the iron filings out of the mixture, leaving the sand behind. Iron is magnetic and sand is not. This single step separates them.
23. C — Halogen reactivity decreases down the group, so the order from most to least reactive is fluorine, chlorine, bromine, iodine. Fluorine attracts an electron most strongly. Reactivity falls with size.
24. C — Making a solution means measuring the water, adding the salt, then stirring until it dissolves. Stirring speeds dissolving. This order produces a uniform solution.
25. D — Atomic number increases in the order hydrogen (1), helium (2), lithium (3), beryllium (4). Each element has one more proton. The order follows the periodic table.
26. D — Dry ice sublimes, passing directly from solid to gas without a liquid stage. Carbon dioxide has no stable liquid phase at normal pressure. The order is solid to gas, directly.
27. A — A sodium atom has 11 electrons arranged as 2 in the first shell, 8 in the second, and 1 in the third. The shells fill from the inside out. The arrangement is 2, 8, 1.
28. D — The oxygen test collects the gas, inserts a glowing splint, and observes it relight. Oxygen supports combustion. The relighting confirms the gas.
29. D — Particle motion increases from solid to liquid to gas. Solid particles vibrate in place while gas particles move freely. The order is solid, liquid, gas.
30. A — An acid spill is first neutralized with a base, then the pH is tested, then it is cleaned up. Neutralizing makes it safe to handle. Testing confirms it is no longer hazardous.

31. A — As water vapor cools, it first condenses to liquid, then freezes to solid. Condensation precedes freezing. The order is condensation, then freezing.
32. C — Percent composition is found by taking the element's mass and the total mass, dividing them, then multiplying by 100. The ratio is converted to a percentage. This gives the element's share.
33. D — Atomic number increases in the order lithium (3), beryllium (4), boron (5), carbon (6). Each has one more proton. The order follows Period 2 left to right.
34. A — The experiment places iron in copper sulfate, observes copper coating the iron, then identifies the displaced copper. Iron is more reactive and replaces the copper. The coating is the displaced metal.
35. C — Distilling water means boiling it, letting the vapor rise, condensing it, then collecting the pure water. Boiling vaporizes the water and cooling recovers it. The salt is left behind.
36. C — Balancing $Na + Cl_2 \rightarrow NaCl$ means writing the formulas, counting the atoms, then placing a 2 before Na and before NaCl. This gives $2\ Na + Cl_2 \rightarrow 2\ NaCl$. The atoms then balance.
37. B — The shells are ordered from closest to farthest as first, second, third. The first shell is nearest the nucleus. Energy increases outward.
38. C — Rusting occurs as iron is exposed to oxygen and water, reacts, and forms rust over time. Both oxygen and water are needed. The slow reaction produces iron oxide.
39. C — Halogen reactivity increases up the group, so from least to most reactive the order is iodine, bromine, chlorine, fluorine. The smaller halogens attract electrons more strongly. Reactivity rises toward the top.
40. B — Measuring volume means pouring in the liquid, lowering to eye level, then reading the bottom of the meniscus. Reading at eye level avoids parallax error. The bottom of the curve is the true reading.
41. C — As ice melts and then evaporates, the states pass through solid, liquid, gas. Melting comes before evaporation. The order tracks added energy.
42. C — Molarity is found by determining the moles of solute, the liters of solution, then dividing moles by liters. The quotient is the concentration. This gives moles per liter.
43. B — Atomic radius increases down the group, so from smallest to largest the order is lithium, sodium, potassium, cesium. Each added shell enlarges the atom. Size grows down the group.
44. A — In alpha decay, the nucleus emits an alpha particle, the atomic number drops by 2, and a new element forms. Losing two protons changes the element. The order follows the emission.
45. D — When a saturated solution is cooled, the solubility drops and the excess solute crystallizes out. Lower temperature holds less dissolved solute. The crystals form as a result.
46. C — From simplest to most complex, the order is atom, element, compound, mixture. An atom is the smallest unit and a mixture the most combined. Complexity increases along the list.
47. C — The combustion of methane flows as methane + oxygen → carbon dioxide + water. Reactants are written first, then products. This is the balanced word equation.
48. B — Preparing a dilute acid means adding the acid slowly to the water, stirring, then testing with litmus. Acid into water disperses the heat safely. Testing confirms the result.
49. B — Ionization energy increases across a period, so from lowest to highest the order is lithium, carbon, fluorine, neon. The nuclear pull tightens across the period. Removing an electron grows harder.
50. A — An antacid works as the base meets the acid, they react to form salt and water, and the pH rises. Neutralization consumes the acid. The rising pH shows the acid being neutralized.
51. A — On a heating curve, the melting plateau appears before the boiling plateau. Melting occurs at a lower temperature than boiling. The order is melting, then boiling.

52. B — Finding neutrons means taking the mass number, the atomic number, then subtracting the atomic number from the mass number. The difference is the neutron count. Subtraction isolates the neutrons.
53. D — Cooling water to ice goes as the liquid releases heat, freezes into ice, then the ice cools further. Heat must leave for freezing to occur. The ice then continues to cool.
54. A — A flame test heats the sample, observes the color produced, then identifies the metal. Different metals give characteristic colors. The color reveals the element.
55. C — Reactivity decreases in the order potassium, sodium, copper, gold from most to least reactive. The alkali metals are far more reactive than copper or gold. Gold is the least reactive.
56. A — Filtering means setting up the filter paper in the funnel, pouring in the mixture, then collecting the filtered water. The paper traps the sand. The water passes through.
57. B — Electronegativity increases across a period, so from lowest to highest the order is sodium, silicon, sulfur, chlorine. The pull on bonding electrons grows rightward. Chlorine is the most electronegative here.
58. D — A precipitation reaction occurs as the two solutions are mixed, the ions combine, and an insoluble solid forms and settles. The new solid is the precipitate. Mixing triggers the reaction.
59. C — On a cooling curve, the condensation plateau appears before the freezing plateau. The gas condenses before the liquid freezes. The order is condensation, then freezing.
60. D — Writing magnesium chloride means finding the ions Mg^{2+} and Cl^{-}, balancing the charges with two chlorides, then writing $MgCl_2$. Two −1 chlorides offset the +2 magnesium. The formula is $MgCl_2$.
61. B — Compressibility increases from solid to liquid to gas, so from least to most the order is solid, liquid, gas. Gas particles have the most space to compress. Solids barely compress.
62. A — Finding the gram-formula mass means counting each element's atoms, multiplying by its atomic mass, then adding the products. The totals are summed. This gives the formula mass.
63. C — In a redox reaction, oxidation loses electrons, which reduction gains. The electrons transfer from one species to the other. The two half-reactions occur together.
64. B — Testing with litmus means dipping the paper, observing the color change, then identifying the solution as acid or base. The color indicates the pH. Red shows acid and blue shows base.
65. D — The hydrogen isotopes increase in mass number as protium (1), deuterium (2), tritium (3). Each gains a neutron. The order follows the neutron count.
66. A — Recovering salt means heating the solution, letting the water evaporate, leaving the salt crystals behind. The dissolved salt cannot evaporate. The crystals remain in the dish.
67. D — Particle energy is highest in a gas and lowest in a solid, so from highest to lowest the order is gas, liquid, solid. Energy decreases as particles slow. The order reverses the heating sequence.
68. C — Classifying $A + B \rightarrow AB$ means identifying the reactants and product, seeing two combine into one, then calling it synthesis. Two substances form a single product. That defines synthesis.
69. D — Water leaving a lake and forming clouds goes as evaporation, then condensation. The liquid becomes vapor, then the vapor becomes droplets. This is part of the water cycle.
70. B — Neutralizing means adding base to the acid until the pH reaches 7, then confirming with an indicator. The base cancels the acid. The indicator verifies neutrality.
71. D — The number of occupied shells increases in the order Period 1 (one shell), Period 2 (two), Period 3 (three). Each new period adds a shell. The order follows the periods.
72. A — Recovering a dissolved solid means dissolving the solid, heating to evaporate the solvent, then recovering the solid. Evaporation removes the solvent. The solid is left behind.

73. C — Atomic radius decreases across a period, so from largest to smallest the order is sodium, magnesium, silicon, chlorine. The growing nuclear charge pulls electrons in. Chlorine is the smallest here.
74. B — In beta decay, a neutron converts to a proton, an electron is emitted, and the atomic number rises by 1. The new proton changes the element. The emitted electron is the beta particle.
75. A — A burning candle's wax first melts to liquid, then the liquid vaporizes. Melting precedes vaporization. The vapor then feeds the flame.
76. B — Finding the number of particles means finding the moles, then multiplying by Avogadro's number. The mole count scales to particles. Avogadro's number is the conversion factor.
77. B — A water molecule forms as two hydrogen atoms and one oxygen atom share electrons, forming H_2O. The sharing creates covalent bonds. The atoms bond into the molecule.
78. D — Reducing $C_6H_{12}O_6$ means dividing each subscript by the common factor 6 to get CH_2O. The empirical formula gives the simplest ratio. Dividing yields CH_2O.
79. A — Cooling warm water to ice goes as the liquid cools, freezes at 0 °C, then the ice cools further. Freezing occurs at the freezing point. The solid keeps cooling afterward.
80. B — The synthesis of water occurs as hydrogen and oxygen combine, bonds form, and water is produced. The reactants join into one product. New bonds create the water.
81. B — By increasing pH, the order is lemon juice (2), water (7), soap (9), bleach (12). Higher pH is more basic. The values rise from acid to base.
82. A — Distilling alcohol from water means heating the mixture, the alcohol vaporizing first, the vapor condensing, then collecting the alcohol. Alcohol's lower boiling point lets it leave first. Condensation recovers it.
83. D — Particle order is greatest in a solid and least in a gas, so from most to least orderly the order is solid, liquid, gas. Solid particles sit in a fixed lattice. Gas particles are random.
84. A — Testing for carbon dioxide means bubbling the gas through limewater, observing it turn milky, then concluding it is carbon dioxide. The milky color is the positive result. This is the standard test.
85. A — As water evaporates, the solvent leaves, the solution becomes more concentrated, and eventually salt crystals form. Less water holds less dissolved salt. The salt crystallizes out.