PRACTICE EXAM 7: PHYSICAL SETTING/CHEMISTRY SIMULATION (85 QUESTIONS)

1. A student investigates how temperature affects the solubility of a salt by dissolving the salt at five different temperatures and recording how much dissolves. In this experiment, the independent variable is the

A. amount of salt that dissolves

B. temperature of the water

C. type of salt used

D. volume of the beaker

2. In the same experiment, the dependent variable, which is measured as a result, is the

A. temperature of the water

B. type of salt chosen

C. mass of salt that dissolves

D. brand of thermometer used

3. To make the solubility experiment a fair test, the student should keep which of the following constant?

A. the temperature, since that is being changed

B. the amount of salt that dissolves

C. nothing needs to be kept constant

D. the volume of water used in each trial

4. A student records that 20 g of a salt dissolves at 10 °C, 30 g at 20 °C, and 40 g at 30 °C. The data show that as temperature increases, the solubility of this salt

A. decreases steadily

B. increases steadily

C. stays the same

D. increases, then decreases

5. Based on the trend above (20 g at 10 °C, 30 g at 20 °C, 40 g at 30 °C), the student would predict that at 40 °C, the amount dissolving would be about

A. 50 g

B. 40 g

C. 30 g

D. 20 g

6. A student performs each trial of an experiment three times and averages the results. The main reason for repeating trials is to

A. use up the extra chemicals

B. make the experiment take longer

C. improve the reliability of the results

D. change the independent variable

7. During a titration, a student reads the burette from above rather than at eye level. This is best described as a

A. correct experimental procedure

B. source of measurement error

C. chemical reaction error

D. way to improve accuracy

8. A scientist tests whether a catalyst speeds up a reaction by running one reaction with the catalyst and an identical one without it. The reaction without the catalyst serves as the

A. independent variable

B. dependent variable

C. measurement error

D. control for comparison

9. In an experiment, a metal reacts with acid to release gas, and more gas is collected when the acid is more concentrated. The best conclusion is that increasing the acid concentration

A. has no effect on the reaction

B. slows the reaction rate

C. increases the reaction rate

D. changes the identity of the metal

10. Three students measure the density of a sample whose accepted density is 2.70 g/cm³. They report 2.71, 2.69, and 2.70 g/cm³. These results are best described as

A. precise but very inaccurate

B. both accurate and precise

C. neither accurate nor precise

D. accurate but very imprecise

11. A student heats a liquid and records its temperature each minute. The temperature rises steadily, then stays constant for several minutes while the liquid boils. The constant-temperature region indicates that the liquid is

A. cooling down

B. increasing in kinetic energy

C. undergoing a phase change

D. decreasing in mass rapidly

12. A student studies how the surface area of a solid affects reaction rate by using a powder in one trial and a single lump in another. To make this a fair test, the student must keep constant the

A. surface area of the solid

B. shape of the solid sample

C. total mass of the solid used

D. reaction rate that is measured

13. Before beginning an experiment, a student writes, "If the temperature is increased, then the reaction rate will increase." This statement is best described as a

A. hypothesis

B. conclusion

C. measurement

D. controlled variable

14. In five trials measuring boiling point, a student records 100.0, 100.1, 99.9, 100.0, and 85.0 °C. The value of 85.0 °C is best described as

A. an outlier likely caused by error

B. the most accurate measurement

C. the average of the data

D. the controlled variable

15. A student measures the mass of a product in three trials as 4.0 g, 4.2 g, and 3.8 g. The average mass of the product is

A. 4.2 g

B. 3.8 g

C. 12.0 g

D. 4.0 g

16. A student measures reaction time at different temperatures: 60 seconds at 10 °C, 30 seconds at 20 °C, and 15 seconds at 30 °C. These data show that as temperature increases, the reaction time

A. increases

B. stays constant

C. doubles each time

D. decreases, so the reaction speeds up

17. A student wants to determine how the amount of a catalyst affects reaction rate. The quantity the student should measure in each trial is the

A. time required for the reaction to finish

B. mass of the catalyst that is added

C. temperature of the room

D. color of the beaker

18. A student measures the boiling point of water as 102 °C, while the accepted value is 100 °C. The percent error of this measurement is

A. 102%

B. 0.2%

C. 2%

D. 20%

19. A student adds a substance to water and observes no temperature change, no color change, no gas, and no new solid. The best conclusion is that

A. a chemical reaction definitely occurred

B. likely no chemical reaction occurred

C. the water boiled away completely

D. a precipitate must have formed

20. In a properly designed experiment testing one factor, the only variable that should be deliberately changed by the experimenter is the

A. independent variable

B. dependent variable

C. controlled variable

D. measured result

21. A saturated solution is prepared at 80 °C and then slowly cooled to 20 °C, and a student observes solid crystals forming at the bottom. The best explanation is that the solubility of the solute

A. decreased as the temperature dropped

B. increased as the temperature dropped

C. was unaffected by the temperature

D. caused the water to evaporate

22. A student collects gas from a reaction and records the total volume each minute: 5 mL, 9 mL, 12 mL, 14 mL, 15 mL, 15 mL. The data indicate that the reaction

A. never started at all

B. sped up continuously

C. slowed down and then stopped

D. produced gas at a constant rate

23. To fairly test whether salt lowers the freezing point of water, a student should compare the freezing point of saltwater with that of

A. saltwater at a higher temperature

B. a different salt solution

C. boiling water

D. pure water under the same conditions

24. A student needs to measure 25.0 mL of a liquid as precisely as possible for an experiment. The best tool to use is a

A. beaker

B. flask

C. test tube

D. graduated cylinder

25. Two different students perform the same experiment carefully and obtain nearly identical results. This agreement suggests that the results are

A. inaccurate

B. reproducible and reliable

C. caused by random error

D. affected by the independent variable only

26. A student heats a solid and records temperatures: it rises, then holds steady at 50 °C for a while, then rises again. The steady period at 50 °C most likely represents the substance's

A. boiling point

B. melting point

C. final temperature

D. room temperature

27. A student forgets to record the starting temperature in a heat experiment. This omission will most directly affect the calculation of the

A. mass of the substance

B. type of substance

C. color of the substance

D. temperature change, ΔT

28. A student mixes two solutions, and the temperature of the mixture rises from 22 °C to 35 °C. The best conclusion is that the reaction is

A. endothermic, absorbing heat

B. exothermic, releasing heat

C. a physical change only

D. impossible to classify

29. An experiment is considered a "fair test" when the experimenter changes

A. only one variable at a time

B. all of the variables at once

C. no variables at all

D. only the measured outcome

30. A student measures solubility from 10 °C to 30 °C and finds a steady increase. Using this data to predict the solubility at 90 °C would be

A. completely reliable

B. an extrapolation that may be uncertain

C. the dependent variable

D. a controlled variable

31. Averaging the results of several trials helps reduce the effect of

A. the independent variable

B. the chemical formula

C. the boiling point

D. random measurement error

32. A student tests how concentration affects reaction rate, using the same temperature in every trial. Keeping the temperature constant ensures that any change in rate is due to

A. the temperature

B. the concentration being tested

C. the brand of equipment

D. random chance only

33. A student writes, "The solution turned blue." This statement is best classified as

A. an observation

B. a hypothesis

C. an inference

D. a controlled variable

34. A student writes, "The blue color means copper ions are present." This statement is best classified as

A. an observation

B. a measurement

C. a controlled variable

D. an inference

35. When a student graphs experimental data, the independent variable is conventionally placed on the

A. y-axis (vertical)

B. title of the graph

C. x-axis (horizontal)

D. legend of the graph

36. A student finds that a reaction produces gas faster when the solid reactant is powdered than when it is one large piece. The best-supported conclusion is that increasing surface area

A. decreases the reaction rate

B. has no effect on the rate

C. increases the reaction rate

D. changes the products formed

37. A student performs an experiment only once and obtains an unusual result. The best next step is to

A. repeat the experiment several times

B. immediately publish the result

C. change the accepted value

D. discard all of the equipment

38. A student measures the pH of four household liquids: lemon juice (2), water (7), baking soda solution (9), and soap (10). The most acidic of these is

A. water

B. baking soda solution

C. soap

D. lemon juice

39. To check whether a balance is working correctly, a student weighs an object of known mass. The known-mass object serves as a

A. dependent variable

B. random error

C. standard for comparison

D. chemical catalyst

40. A student records the volume of a fixed amount of gas at constant pressure: 100 mL at 200 K, 150 mL at 300 K, and 200 mL at 400 K. These data show that gas volume and temperature are

A. inversely related

B. completely unrelated

C. directly related

D. always equal in value

41. Using the data above (100 mL at 200 K, 150 mL at 300 K, 200 mL at 400 K), the predicted volume at 500 K would be about

A. 250 mL

B. 200 mL

C. 150 mL

D. 100 mL

42. The statement "the gas volume was 250 mL" is an example of

A. a qualitative observation

B. an inference

C. a quantitative measurement

D. a hypothesis

43. The statement "the gas had a sharp odor" is an example of

A. a quantitative measurement

B. a numerical data point

C. a controlled variable

D. a qualitative observation

44. A student wants to show how the temperature of a cooling liquid changes continuously over time. The most appropriate way to display this data is a

A. line graph

B. pie chart

C. single data point

D. word description only

45. A student tests one sample of a metal and concludes that all metals behave that way. This conclusion is flawed because it is based on

A. too many trials

B. too small a sample to generalize

C. an accurate measurement

D. a controlled variable

46. In a titration, a student adds base to acid until the indicator changes color, then records the volume of base used. The color change marks the point at which the acid is

A. beginning to boil

B. forming a precipitate

C. completely neutralized

D. changing into a metal

47. If a student uses a contaminated beaker that adds extra mass to every measurement, the results will be

A. perfectly accurate

B. unaffected by the contamination

C. consistently too high

D. consistently too low

48. A thermometer reads 5 °C in a mixture of ice and water that should read 0 °C. To get correct readings, the student should

A. ignore the error entirely

B. account for the 5 °C offset in all readings

C. use the thermometer only for hot liquids

D. discard all data from the experiment

49. A student keeps everything constant except concentration and finds that higher concentration gives faster reactions. The student can conclude that

A. temperature controls the rate

B. concentration affects the reaction rate

C. nothing can be concluded

D. surface area is the only factor

50. A student plots solubility (grams of solute) on the y-axis against temperature on the x-axis and obtains an upward-sloping curve. This curve indicates that

A. solubility decreases with temperature

B. temperature has no effect

C. the solute must be a gas

D. solubility increases as temperature increases

51. A student records that a reaction produces 2 mL of gas in the first minute, 1 mL in the second, and 0 mL afterward. The reaction is best described as having

A. sped up over time

B. slowed and then gone to completion

C. produced gas at a steady rate

D. never begun at all

52. To determine the mass of gas lost during a reaction in an open container, a student should measure the mass of the contents

A. only at the end

B. only at the beginning

C. before and after the reaction

D. of the empty container alone

53. When comparing the reactivity of two metals with acid, a student should use acid that is the same

A. concentration and temperature for both

B. color for both

C. brand name for both

D. age for both

54. In an experiment to test how light affects plant growth, the amount of light is changed and the height of the plants is measured. The plant height is the

A. independent variable

B. dependent variable

C. controlled variable

D. hypothesis

55. Reading a graduated cylinder at the top of the meniscus instead of the bottom will cause the recorded volume to be

A. exactly correct

B. consistently too low

C. unaffected by the error

D. consistently too high

56. A student gets results of 25.0, 25.1, 24.9, and 31.0 mL in four trials. To improve the reliability of the average, the student should

A. include the 31.0 value without question

B. report only the 31.0 value

C. stop the experiment immediately

D. investigate the 31.0 value as a possible error

57. A student dissolves a salt in water, and the temperature drops from 24 °C to 18 °C. The best conclusion is that dissolving this salt is

A. exothermic, releasing heat

B. a chemical reaction forming a gas

C. endothermic, absorbing heat

D. impossible to determine

58. A scientist draws a best-fit line through scattered data points on a graph. The main purpose of the best-fit line is to

A. connect every single point exactly

B. hide the data from view

C. show the overall trend in the data

D. mark the controlled variables

59. Estimating a value between two measured data points on a graph is called

A. interpolation

B. extrapolation

C. calibration

D. control

60. A student records gas data at constant temperature: 100 kPa at 4.0 L, 200 kPa at 2.0 L, and 400 kPa at 1.0 L. These data show that pressure and volume are

A. directly related

B. completely unrelated

C. inversely related

D. always equal

61. Using the data above (100 kPa at 4.0 L, 200 kPa at 2.0 L, 400 kPa at 1.0 L), at 800 kPa the volume would be about

A. 1.0 L

B. 0.50 L

C. 2.0 L

D. 4.0 L

62. A student changes both the temperature and the concentration at the same time and observes a faster reaction. The problem with this design is that the student cannot tell

A. whether a reaction occurred

B. which variable caused the change

C. the color of the solution

D. the mass of the reactants

63. In testing a new water purifier, a scientist also examines a sample of untreated water. The untreated sample is included to serve as a

A. baseline for comparison

B. source of error

C. dependent variable

D. catalyst for the reaction

64. Before plotting gas data, a student must convert all Celsius temperatures to kelvin. A reading of 0 °C should be plotted as

A. 0 K

B. 100 K

C. 273 K

D. −273 K

65. A student measures a length as 12.34 cm. This measurement contains how many significant figures?

A. 4

B. 3

C. 2

D. 5

66. A student finds that metal X reacts with acid but metal Y does not. The best conclusion is that

A. metal X is more reactive than metal Y

B. metal Y is more reactive than metal X

C. both metals are equally reactive

D. neither metal can react with acid

67. The main advantage of changing only one variable in an experiment is that it allows the experimenter to

A. finish the experiment more quickly

B. identify the cause of any observed effect

C. use less equipment overall

D. avoid taking any measurements

68. A student records the mass of a sample at five different times and finds it stays at 10.0 g throughout. The data indicate that the mass

A. remained constant over time

B. increased steadily

C. decreased steadily

D. doubled each minute

69. A measuring instrument that consistently gives the same reading for the same sample is described as

A. accurate

B. inaccurate

C. reliable (precise)

D. random

70. To test whether a substance acts as a catalyst, the key comparison is between reactions that are identical except for

A. their temperature

B. the presence or absence of the substance

C. the size of the container

D. the time of day

71. A student measures a radioactive sample: 80 g at 0 hours, 40 g at 2 hours, 20 g at 4 hours, and 10 g at 6 hours. These data indicate that the half-life of the sample is

A. 6 hours

B. 4 hours

C. 1 hour

D. 2 hours

72. Using the half-life data above (80 g, 40 g, 20 g, 10 g at 0, 2, 4, 6 hours), the mass remaining at 8 hours would be

A. 10 g

B. 8 g

C. 5 g

D. 0 g

73. After testing five samples of the same compound and getting consistent results, a reasonable conclusion is that

A. the compound behaves consistently under these conditions

B. all compounds behave this exact way

C. the results were due to chance

D. no conclusion is possible

74. A student investigates how the mass of a reactant affects the amount of product formed. The independent variable is the

A. amount of product formed

B. mass of the reactant

C. temperature of the room

D. type of container used

75. In a calorimetry experiment, some heat escapes to the surroundings. This heat loss would cause the calculated heat released to be

A. exactly correct

B. unrelated to the result

C. too high

D. lower than the true value

76. A student records the time for a reaction at three concentrations: 40 s at 1.0 M, 20 s at 2.0 M, and 10 s at 4.0 M. The data show that increasing concentration

A. decreases the reaction time, speeding up the reaction

B. increases the reaction time

C. has no effect on the reaction

D. stops the reaction completely

77. While performing an experiment, a student should record observations

A. only after leaving the laboratory

B. from memory at the end of the week

C. only if the results look correct

D. immediately and accurately as they occur

78. After analyzing all the data, the statement a student makes about whether the hypothesis was supported is called the

A. independent variable

B. controlled variable

C. observation

D. conclusion

79. In a sealed flask, the concentrations of reactants and products become constant and stop changing over time. This observation indicates that the system has reached

A. complete reaction

B. a phase change

C. equilibrium

D. its boiling point

80. Across many experiments, raising the temperature consistently speeds up reactions. The best general conclusion is that reaction rate

A. is unrelated to temperature

B. decreases as temperature rises

C. depends only on the container

D. generally increases as temperature increases

81. A student studies how the temperature of water affects how fast sugar dissolves, timing how long the sugar takes to disappear. The dependent variable is the

A. time it takes the sugar to dissolve

B. temperature of the water

C. amount of sugar used

D. size of the stirring rod

82. A controlled variable in an experiment is one that is

A. kept the same in every trial

B. deliberately changed each trial

C. measured as the final result

D. never written down

83. A student claims that a reaction is exothermic. The observation that best supports this claim is that

A. the mixture changed color

B. the temperature of the mixture increased

C. a gas was produced

D. a solid dissolved completely

84. Two laboratories in different cities perform the same experiment and reach the same conclusion. This strengthens confidence that the conclusion is

A. due to random error

B. caused by faulty equipment

C. unique to one laboratory

D. valid and reproducible

85. The correct general order of steps in a scientific investigation is

A. conclusion, hypothesis, experiment, observation

B. experiment, hypothesis, question, conclusion

C. conclusion, experiment, hypothesis, question

D. question, hypothesis, experiment, conclusion

Practice Exam 7 – Explained Answer Key

1. B — The independent variable is the factor the experimenter deliberately changes, here the temperature of the water. Solubility is being tested against temperature. Changing only this variable allows its effect to be measured.
2. C — The dependent variable is the result that is measured, in this case the mass of salt that dissolves. It responds to changes in the independent variable. This is the outcome the experiment is designed to record.
3. D — A fair test requires keeping all other factors constant, so the volume of water must be held the same each trial. Controlled variables prevent other influences from affecting the result. This isolates the effect of temperature.

4. B — As temperature rises from 10 to 30 °C, the dissolved amount climbs from 20 to 40 g, a steady increase. The data show solubility increasing with temperature. This is the typical behavior of a solid solute.
5. A — The data rise by 10 g for each 10 °C, so at 40 °C the amount would be about 50 g. Extending the linear trend gives the prediction. This is interpolation-style reasoning applied just beyond the data.
6. C — Repeating trials and averaging improves the reliability of the results by reducing the impact of random error. Multiple measurements give a more trustworthy value. Reliability is the main goal of repetition.
7. B — Reading a burette from above instead of at eye level introduces a parallax measurement error. This produces an inaccurate volume reading. Proper technique requires reading at eye level with the meniscus.
8. D — The reaction run without the catalyst is the control, providing a baseline for comparison. Comparing the two reveals the catalyst's effect. A control isolates the variable being tested.
9. C — Collecting more gas with more concentrated acid supports the conclusion that higher concentration increases the reaction rate. More reactant particles produce more frequent collisions. This is consistent with collision theory.
10. B — Values of 2.71, 2.69, and 2.70 are close to one another (precise) and close to the accepted 2.70 (accurate). Both qualities are present. This indicates a well-performed measurement.
11. C — A constant temperature while heating continues indicates a phase change, here boiling. The added energy breaks particle attractions instead of raising temperature. This produces the flat region on a heating curve.
12. C — To fairly test surface area, the total mass of solid must be kept constant between the powder and the lump. Only the surface area should differ. This isolates surface area as the variable.
13. A — An "if-then" prediction made before experimenting is a hypothesis. It proposes a testable relationship between variables. The experiment is then designed to test it.
14. A — The 85.0 °C value, far from the cluster near 100 °C, is an outlier likely caused by error. It does not fit the consistent data. Such anomalies should be investigated rather than averaged in blindly.
15. D — The average is $(4.0 + 4.2 + 3.8) \div 3 = 12.0 \div 3 = 4.0$ g. Summing the trials and dividing by their number gives the mean. Averaging reduces the effect of random variation.
16. D — Reaction time falls from 60 to 15 seconds as temperature rises, so the reaction speeds up as time decreases. Shorter times mean faster reactions. Higher temperature increases reaction rate.
17. A — To study a catalyst's effect on rate, the student should measure the time for the reaction to finish. Reaction time reflects the rate. The amount of catalyst is the independent variable, not the measured result.
18. C — Percent error is $(|102 - 100| \div 100) \times 100 = 2\%$. The difference divided by the accepted value gives the fractional error. A small percent error indicates a fairly accurate measurement.
19. B — With no temperature change, color change, gas, or new solid, there is no evidence of a chemical reaction. The absence of these signs suggests no reaction occurred. New substances would produce observable changes.
20. A — Only the independent variable should be deliberately changed by the experimenter. All other factors are held constant. This design isolates the cause of any observed effect.
21. A — Crystals forming on cooling show that the solute's solubility decreased as the temperature dropped. The solution could no longer hold all the dissolved solute. The excess came out as a solid.

22. C — The shrinking increments (5, 4, 3, 2, 1, 0 mL) followed by no further gas show the reaction slowed and then stopped. The rate decreased as reactants were used up. A constant final volume marks completion.
23. D — A fair comparison requires testing saltwater against pure water under the same conditions, the control. Only the presence of salt should differ. This isolates the salt's effect on freezing point.
24. D — A graduated cylinder gives the most precise volume measurement of the listed tools. Beakers, flasks, and test tubes give only approximate volumes. Precision requires the graduated cylinder.
25. B — When two students independently obtain nearly identical results, the results are reproducible and reliable. Independent agreement strengthens confidence in the data. Reproducibility is a key sign of reliability.
26. B — The first steady temperature region during heating represents the melting point, where solid changes to liquid. Temperature stays constant during this phase change. A later plateau would be the boiling point.
27. D — Without the starting temperature, the temperature change (ΔT) cannot be calculated. ΔT requires both the initial and final readings. This omission directly undermines any heat calculation.
28. B — A temperature rise from 22 to 35 °C shows the reaction released heat, making it exothermic. The released energy warmed the mixture. Exothermic reactions give off heat to the surroundings.
29. A — A fair test changes only one variable at a time. This ensures any observed effect can be attributed to that single factor. Changing several at once would confound the results.
30. B — Predicting solubility at 90 °C from data ending at 30 °C is an extrapolation beyond the measured range, which may be uncertain. Trends can change outside the tested values. Extrapolation carries more risk than interpolation.
31. D — Averaging several trials reduces the effect of random measurement error. Random errors tend to cancel out across repeated measurements. This produces a more reliable mean value.
32. B — Holding temperature constant ensures any change in rate is due to the concentration being tested. Controlling other variables isolates the one under study. This is essential to a valid conclusion.
33. A — "The solution turned blue" is a direct observation, something perceived through the senses. It states what was seen without interpretation. Observations form the raw data of an experiment.
34. D — Stating that the blue color "means copper ions are present" is an inference, an interpretation of an observation. It goes beyond what was directly seen. Inferences explain or interpret observations.
35. C — By convention, the independent variable is plotted on the x-axis (horizontal). The dependent variable goes on the y-axis. This standard layout makes trends easy to read.
36. C — Faster gas production from the powdered reactant supports the conclusion that greater surface area increases reaction rate. More exposed surface allows more collisions. This is a direct application of collision theory.
37. A — An unusual single result should be checked by repeating the experiment several times. Repetition reveals whether the result is reliable or an error. One trial is not enough to draw a firm conclusion.
38. D — Lemon juice, with a pH of 2, is the most acidic of the four liquids. Lower pH values indicate greater acidity. Water is neutral, and the others are basic.
39. C — Weighing an object of known mass provides a standard for comparison to check the balance. The known value reveals whether the instrument reads correctly. This is a calibration check.
40. C — Volume rises with temperature (100 to 200 mL as temperature doubles), showing a direct relationship. As one increases, so does the other. This matches Charles's law behavior.

41. A — Extending the direct trend of +50 mL per 100 K gives about 250 mL at 500 K. The pattern continues linearly. This prediction follows the established relationship.
42. C — "The gas volume was 250 mL" is a quantitative measurement because it reports a number with a unit. Quantitative data are numerical. This contrasts with descriptive, qualitative observations.
43. D — "The gas had a sharp odor" is a qualitative observation describing a property without a number. Qualitative data describe characteristics. It contrasts with numerical measurements.
44. A — A line graph best shows how a continuous quantity, temperature, changes over time. Line graphs display trends in continuous data. This makes the cooling pattern easy to see.
45. B — Concluding that all metals behave like one tested sample is flawed because the sample is too small to generalize. One example cannot represent all metals. Broad conclusions require many samples.
46. C — The indicator's color change marks the point at which the acid has been completely neutralized by the base. At this endpoint, the moles of acid and base are balanced. This allows the unknown concentration to be found.
47. C — A beaker that adds extra mass to every measurement makes the results consistently too high. The error shifts all readings in the same direction. This is a systematic, not random, error.
48. B — A thermometer reading 5 °C in ice water that should read 0 °C has a 5 °C offset that must be accounted for in all readings. Correcting for the known offset restores accuracy. The instrument is still usable once calibrated.
49. B — Holding everything constant except concentration allows the conclusion that concentration affects the reaction rate. The controlled design isolates this variable. The faster reactions at higher concentration support the claim.
50. D — An upward-sloping solubility curve shows that solubility increases as temperature increases. The rising line reflects more solute dissolving at higher temperatures. This is typical for most solid solutes.
51. B — Gas output of 2, then 1, then 0 mL shows the reaction slowed and then went to completion. The decreasing amounts indicate a falling rate. No further gas means the reactants are used up.
52. C — Finding the mass of gas lost requires measuring the contents both before and after the reaction. The difference equals the mass of escaped gas. A single measurement cannot reveal the change.
53. A — Comparing two metals fairly requires using acid of the same concentration and temperature for both. Only the metal should differ. Matching conditions isolates the metals' reactivity.
54. B — Plant height, the measured outcome, is the dependent variable. It responds to the changed amount of light. The dependent variable is what the experiment records.
55. D — Reading at the top of the meniscus instead of the bottom records a volume that is consistently too high. The top of the curve sits above the true level. Correct readings use the bottom of the meniscus.
56. D — The 31.0 mL value, far from the others, should be investigated as a possible error before averaging. Including an outlier without question distorts the mean. Identifying errors improves reliability.
57. C — A temperature drop from 24 to 18 °C shows the dissolving absorbed heat, making it endothermic. The process drew energy from the surroundings. Endothermic changes lower the surrounding temperature.
58. C — A best-fit line shows the overall trend in scattered data without passing through every point. It summarizes the relationship between variables. This reveals the general pattern despite scatter.

59. A — Estimating a value between two measured points is interpolation. It stays within the range of the data. This is generally more reliable than extrapolating beyond the data.
60. C — As pressure rises, volume falls (100 kPa at 4.0 L to 400 kPa at 1.0 L), an inverse relationship. The product of pressure and volume stays constant. This is Boyle's law behavior.
61. B — Since pressure times volume is constant at 400, at 800 kPa the volume is $400 \div 800 = 0.50$ L. The inverse relationship sets the product as fixed. Doubling pressure halves the volume.
62. B — Changing two variables at once means the student cannot tell which one caused the faster reaction. The effects are confounded. A valid test changes only one variable.
63. A — The untreated water sample is a control that provides a baseline for comparison with the purified water. It shows the starting condition. Comparing the two reveals the purifier's effect.
64. C — Converting 0 °C to kelvin gives $0 + 273 = 273$ K. The kelvin scale is required for gas-law graphs. Adding 273 shifts Celsius to kelvin.
65. A — The measurement 12.34 cm has four significant figures, all of them non-zero digits. Each digit carries meaning. The count of significant figures reflects the measurement's precision.
66. A — Because metal X reacts with acid and metal Y does not, X is more reactive than Y. Greater reactivity allows X to displace hydrogen from the acid. This comparison reveals their relative activity.
67. B — Changing only one variable lets the experimenter identify the cause of any observed effect. The single change can be linked directly to the result. This is the core of controlled experimentation.
68. A — A mass that stays at 10.0 g across all measurements indicates the mass remained constant over time. No change occurred. The data show stability rather than a trend.
69. C — An instrument that gives the same reading repeatedly for the same sample is reliable, or precise. Consistency reflects precision. Precision is separate from accuracy, which is closeness to the true value.
70. B — Testing for a catalyst requires comparing reactions identical except for the presence or absence of the substance. This isolates the substance's effect. The control reaction lacks the suspected catalyst.
71. D — The sample halves every 2 hours ($80 \rightarrow 40 \rightarrow 20 \rightarrow 10$ g), so the half-life is 2 hours. Each interval reduces the mass by half. The constant halving time defines the half-life.
72. C — Continuing the pattern, the 10 g at 6 hours halves to 5 g at 8 hours. One more half-life passes between 6 and 8 hours. Each step leaves half the previous mass.
73. A — Consistent results across five samples of the same compound support the conclusion that it behaves consistently under those conditions. The conclusion is limited to that compound and setup. It should not be overgeneralized to all compounds.
74. B — The mass of the reactant, the factor deliberately changed, is the independent variable. The amount of product is the measured result. Changing the reactant mass tests its effect on product formed.
75. D — Heat escaping to the surroundings means the measured heat released will be lower than the true value. Some energy is not captured by the calorimeter. This loss makes calorimetry results underestimate the heat.
76. A — Reaction time drops from 40 to 10 seconds as concentration rises, so higher concentration speeds up the reaction. Less time means a faster rate. More concentrated reactants collide more frequently.
77. D — Observations should be recorded immediately and accurately as they occur. Recording in real time avoids memory errors and bias. Reliable data depend on careful, prompt recording.

78. D — The final statement about whether the hypothesis was supported is the conclusion. It interprets the analyzed data. The conclusion completes the scientific investigation.
79. C — Constant concentrations of reactants and products in a sealed flask indicate the system has reached equilibrium. The forward and reverse rates have become equal. Concentrations stay steady at equilibrium.
80. D — Consistent speeding up with higher temperature supports the general conclusion that reaction rate increases as temperature rises. Repeated results across experiments strengthen the generalization. Higher temperature means more effective collisions.
81. A — The time for the sugar to dissolve, the measured outcome, is the dependent variable. It responds to the changed water temperature. The dependent variable is what the experiment records.
82. A — A controlled variable is kept the same in every trial. Holding it constant prevents it from affecting the results. This isolates the effect of the independent variable.
83. B — An increase in the mixture's temperature best supports the claim that a reaction is exothermic. Released heat raises the temperature. The other observations do not specifically indicate energy release.
84. D — When two laboratories in different cities reach the same conclusion, it is valid and reproducible. Independent confirmation strengthens confidence. Reproducibility across labs is strong evidence.
85. D — The general order of a scientific investigation is question, hypothesis, experiment, conclusion. A question prompts a testable hypothesis, which the experiment tests, leading to a conclusion. This sequence structures the scientific method.