

ch1

Student: _____

- xxWhich one of the following is a "substance" in the sense of the word as used in your textbook?
 - air
 - tap water
 - sea water
 - water
 - toothpaste
- Select the best statement.
 - Physical changes may be reversed by changing the temperature.
 - Physical changes alter the composition of the substances involved.
 - Physical properties are not valid characteristics for identifying a substance.
 - Physical properties are mostly extensive in nature.
 - Physical changes are usually accompanied by chemical changes.
- Select the best statement.
 - Chemical changes provide the only valid basis for identification of a substance.
 - Chemical changes are easily reversed by altering the temperature of the system.
 - Chemical changes always produce substances different from the starting materials.
 - Chemical changes are associated primarily with extensive properties.
 - Chemical changes are accompanied by changes in the total mass of the substances involved.
- Which of the following is a chemical change?
 - boiling of water
 - melting wax
 - broiling a steak on a grill
 - condensing water vapor into rainfall
 - carving a piece of wood
- Water vapor is less dense than ice because
 - molecules in the gas phase are in constant motion.
 - molecules in the gas phase have more potential energy than in solids.
 - molecules in the gas phase have more kinetic energy than in solids.
 - gaseous molecules have less mass.
 - molecules in the gas phase have more space between them than in solids.
- During the swing of a frictionless pendulum, what energy form(s) remain constant?
 - kinetic energy only
 - potential energy only
 - both kinetic energy and potential energy
 - kinetic plus potential energy
 - None of these forms remains constant.
- The most significant contribution to modern science made by alchemists was
 - their fundamental work in the transmutation of the elements.
 - their widespread acceptance of observation and experimentation.
 - their systematic method of naming substances.
 - their understanding of the nature of chemical reactions.
 - their discovery of phlogiston.
- Select the best statement about chemistry before 1800.
 - Alchemy focused on objective experimentation rather than mystical explanations of processes.
 - The phlogiston theory laid a valuable theoretical basis for modern chemistry.
 - Lavoisier's quantitative work on the role of oxygen in combustion was the beginning of modern chemistry.
 - The interpretation of data by alchemists was not biased by their overall view of life.
 - Alchemists failed because they did not develop any practical chemical methods.
- Which of the following activities is not a part of good science?
 - proposing a theory
 - developing a hypothesis
 - making quantitative observations
 - designing experiments
 - indulging in speculation
- A scientist made careful measurements of the pressure and temperature of many different gases. Based on these measurements, he concluded that "the pressure of a fixed amount of gas, measured at constant volume, is directly proportional to its absolute temperature." This statement is best described as a
 - theory.

- B. hypothesis.
- C. law.
- D. experiment.
- E. definition.

11. A dictionary has the following definition for a word: "A tentative explanation that accounts for a set of facts." Which of the following words best fits that definition?

- A. theory
- B. hypothesis
- C. law
- D. experiment
- E. definition

12. A detailed explanation of natural phenomena that is generally accepted and has been extensively tested is called a

- A. theory.
- B. hypothesis.
- C. law.
- D. fact.
- E. postulate.

13. The distance between carbon atoms in ethylene is 134 picometers. Which of the following expresses that distance in meters?

- A. 1.34×10^{-13} m
- B. 1.34×10^{-12} m
- C. 1.34×10^{-10} m
- D. 1.34×10^{-7} m
- E. 1.34×10^{-6} m

14. The average distance from Earth to the Sun is 150 megameters. What is that distance in meters?

- A. 1.5×10^8 m
- B. 1.5×10^6 m
- C. 1.5×10^5 m
- D. 1.5×10^3 m
- E. 1.5×10^{-6} m

15. The mass of a sample is 550 milligrams. Which of the following expresses that mass in kilograms?

- A. 5.5×10^8 kg
- B. 5.5×10^5 kg
- C. 5.5×10^{-4} kg
- D. 5.5×10^{-6} kg
- E. 5.5×10^{-1} kg

16. A dose of medication was prescribed to be 35 microliters. Which of the following expresses that volume in centiliters?

- A. 3.5×10^5 cL
- B. 3.5×10^4 cL
- C. 3.5 cL
- D. 3.5×10^{-4} cL
- E. 3.5×10^{-3} cL

17. Which of the following represents the largest volume?

- A. 10,000 μ L
- B. 1000 pL
- C. 100 mL
- D. 10 nL
- E. 10 cm^3

18. You prepare 1000. mL of tea and transfer it to a 1.00 quart pitcher for storage. Which of the following statements is true?

- A. The pitcher will be filled to 100% of its capacity with no tea spilled.
- B. The pitcher will be filled to about 95% of its capacity.
- C. The pitcher will be filled to about 50% of its capacity.
- D. The pitcher will be completely filled and a small amount of tea will overflow.
- E. The pitcher will be completely filled and most of the tea will overflow.

19. In an average year the American chemical industry produces more than 9.5 million metric tons of sodium carbonate. Over half of this is used in the manufacture of glass while another third is used in the production of detergents and other chemicals. How many pounds of sodium carbonate are produced annually?

- A. 2.1×10^{10} lb
- B. 4.3×10^9 lb
- C. 1.1×10^7 lb
- D. 2.2×10^6 lb
- E. 2.1×10^4 lb

20. A large pizza has a diameter of 15 inches. Express this diameter in centimeters.

- A. 38 cm
- B. 24 cm
- C. 18 cm
- D. 9.3 cm
- E. 5.9 cm

21. The average distance between the Earth and the Moon is 240,000 miles. Express this distance in kilometers.

- A. 6.1×10^5 km
- B. 5.3×10^5 km
- C. 3.9×10^5 km
- D. 1.5×10^5 km
- E. 9.4×10^4 km

22. The area of a 15-inch pizza is 176.7 in^2 . Express this area in square centimeters.

- A. $1140. \text{ cm}^2$
- B. 448.8 cm^2
- C. 96.8 cm^2
- D. 69.57 cm^2
- E. 27.39 cm^2

23. The speed needed to escape the pull of Earth's gravity is 11.3 km/s. What is this speed in mi/h?

- A. 65,500 mi/h
- B. 25,300 mi/h
- C. 18,200 mi/h
- D. 1,090 mi/h
- E. 5.02×10^{-3} mi/h

24. The density of mercury, the only metal to exist as a liquid at room temperature, is 13.6 g/cm^3 . What is that density in pounds per cubic inch?

- A. 849 lb/in^3
- B. 491 lb/in^3
- C. 376 lb/in^3
- D. 0.491 lb/in^3
- E. $1.83 \times 10^{-3} \text{ lb/in}^3$

25. Given that 1 inch = 2.54 cm, 1 cm^3 is equal to

- A. 16.4 in^3
- B. 6.45 in^3
- C. 0.394 in^3
- D. 0.155 in^3
- E. 0.0610 in^3

26. At a pressure of one billionth (10^{-9}) of atmospheric pressure, there are about 2.7×10^{10} molecules in one cubic centimeter of a gas. How many molecules is this per cubic meter?

- A. 2.7×10^{16}
- B. 2.7×10^{14}
- C. 2.7×10^{12}
- D. 2.7×10^8
- E. 2.7×10^4

27. If the price of gold at the morning fixing in London was \$5310 per lb, what would a kilogram of gold have cost in \leq (pounds)? (Assume

an exchange rate of \$1.00 = ≤0.545)

- A. ≤1310
- B. ≤3510
- C. ≤6370
- D. ≤10400
- E. ≤17100

28. Which of the following is not an S.I. base unit?

- A. meter
- B. ampere
- C. second
- D. gram
- E. kelvin

29. The symbol for the S.I. base unit of mass is:

- A. mg
- B. g
- C. kg
- D. metric ton
- E. lb

30. Which of the following abbreviations of the given SI base unit is incorrect?

- A. second: s
- B. kilogram: kg
- C. kelvin: K
- D. mole: m
- E. ampere: A

31. Which of the following abbreviations of the given SI base unit is incorrect?

- A. second: s
- B. kilogram: kg
- C. meter: m
- D. mole: mol
- E. kelvin: k

32. The S.I. prefix mega- (M) means:

- A. 10^{-6}
- B. 10^{-3}
- C. 10^3
- D. 10^6
- E. 10^9

33. The S.I. unit of speed (velocity) is

- A. km/h
- B. km/s
- C. m/h
- D. m/s
- E. None of these choices is correct.

34. The joule is the S.I. unit of energy, and is equal to $1 \text{ kg m}^2 \text{ s}^{-2}$. The erg is another energy unit, equal to $1 \text{ g cm}^2 \text{ s}^{-2}$. Use unit conversion methods to work out how many ergs are there in 1 joule.

- A. 10^{-1} ergs
- B. 10 ergs
- C. 10^2 ergs
- D. 10^5 ergs
- E. 10^7 ergs

35. Which of the following correctly shows how to convert a density of 20.1 g cm^{-3} to units of kg m^{-3} ?

- A. $\frac{20.1 \text{ g}}{1 \text{ cm}^3} \times \frac{1000 \text{ kg}}{1 \text{ g}} \times \frac{1 \text{ cm}^3}{0.01 \text{ m}^3}$
- B. $\frac{20.1 \text{ g}}{1 \text{ cm}^3} \times \frac{1 \text{ kg}}{1000 \text{ g}} \times \frac{1 \text{ cm}^3}{0.01 \text{ m}^3}$
- C. $\frac{20.1 \text{ g}}{1 \text{ cm}^3} \times \frac{1 \text{ kg}}{1000 \text{ g}} \times \frac{0.01 \text{ cm}^3}{1 \text{ m}^3}$
- D. $\frac{20.1 \text{ g}}{1 \text{ cm}^3} \times \frac{1 \text{ kg}}{1000 \text{ g}} \times \frac{(0.01 \text{ cm})^3}{(1 \text{ m})^3}$
- E.

$$\frac{20.1\text{g}}{1\text{cm}^3} \times \frac{1\text{kg}}{1000\text{g}} \times \frac{(1\text{cm})^3}{(0.01\text{m})^3}$$

36. If the density of a certain spherical atomic nucleus is $1.0 \times 10^{14} \text{ g cm}^{-3}$ and its mass is $2.0 \times 10^{-23} \text{ g}$, what is its radius in cm?
- A. $3.6 \times 10^{-13} \text{ cm}$
 B. $2.0 \times 10^{-37} \text{ cm}$
 C. $4.8 \times 10^{-38} \text{ cm}$
 D. $2.2 \times 10^{-19} \text{ cm}$
 E. None of these choices is correct.
37. Which of the following is an extensive property of oxygen?
- A. boiling point
 B. temperature
 C. average kinetic energy of molecules
 D. density
 E. mass
38. A flask has a mass of 78.23 g when empty and 593.63 g when filled with water. When the same flask is filled with concentrated sulfuric acid, H_2SO_4 , its mass is 1026.57 g. What is the density of concentrated sulfuric acid? (Assume water has a density of 1.00 g/cm^3 at the temperature of the measurement.)
- A. 1.992 g/cm^3
 B. 1.840 g/cm^3
 C. 1.729 g/cm^3
 D. 1.598 g/cm^3
 E. 0.543 g/cm^3
39. Talc is a mineral that has low conductivity for heat and electricity and that is not attacked by acid. It is used as talcum powder and face powder. A sample of talc weighs 35.97 g in air and 13.65 g in mineral oil ($d = 1.75 \text{ g/cm}^3$). What is the density of talc?
- A. 4.61 g/cm^3
 B. 2.82 g/cm^3
 C. 2.63 g/cm^3
 D. 2.44 g/cm^3
 E. 1.61 g/cm^3
40. Acetone, which is used as a solvent and as a reactant in the manufacture of Plexiglas \rightarrow , boils at 56.1° C . What is the boiling point in degrees Fahrenheit?
- A. 159° F
 B. 133° F
 C. 101° F
 D. 69.0° F
 E. 43.4° F
41. Isopropyl alcohol, commonly known as rubbing alcohol, boils at 82.4° C . What is the boiling point in kelvins?
- A. 387.6 K
 B. 355.6 K
 C. 323.6 K
 D. 190.8 K
 E. -190.8 K
42. Acetic acid boils at 244.2° F . What is its boiling point in degrees Celsius?
- A. 382.0° C
 B. 167.7° C
 C. 153.4° C
 D. 117.9° C
 E. 103.7° C
43. Which one of the following numbers contains a digit or digits which is/are not significant?
- A. 970.0
 B. 502
 C. .300
 D. .0043
 E. 20.01
44. Select the answer that expresses the result of this calculation with the correct number of significant figures.
- $$\begin{array}{r} 13.602 \times 1.90 \times 3.06 \\ 4.2 \times 1.4097 \end{array}$$

- A. 13.3568
- B. 13.357
- C. 13.36
- D. 13.4
- E. 13

45. Select the answer that expresses the result of this calculation with the correct number of significant figures and with correct units.
 $16.18 \text{ cm} \times 9.6114 \text{ g} \div 1.4783 \text{ cm}^2 =$

- A. 105.2 g/cm^3
- B. 105.2 g/cm^2
- C. 105.2 g/cm
- D. 72.13 g/cm^2
- E. 72.13 g/cm

46. Which measurement is expressed to 4 significant figures?

- A. 0.423 kg
- B. 24.049 cm
- C. 1300 K
- D. 82,306 m
- E. 62.40 g

47. Express 96,342 m using 2 significant figures.

- A. $9.60 \times 10^4 \text{ m}$
- B. $9.6 \times 10^4 \text{ m}$
- C. $9.60 \times 10^{-4} \text{ m}$
- D. $9.6 \times 10^{-4} \text{ m}$
- E. 96,000. m

48. Select the answer with the correct number of decimal places for the following sum:
 $13.914 \text{ cm} + 243.1 \text{ cm} + 12.00460 \text{ cm} =$

- A. 269.01860 cm
- B. 269.0186 cm
- C. 269.019 cm
- D. 269.02 cm
- E. 269.0 cm

49. The appropriate number of significant figures in the result of 15.234×15.208 is:

- A. 2
- B. 3
- C. 4
- D. 5
- E. 6

50. The appropriate number of significant figures in the result of $15.234 - 15.208$ is:

- A. 1
- B. 2
- C. 3
- D. 4
- E. 5

51. The result of $(3.8621 \times 1.5630) - 5.98$ is properly written as:

- A. 0.06
- B. 0.056
- C. 0.0565
- D. 0.05646
- E. 0.056462

52. As chief chemist at Superior Analytical Products (SAP) you must design an experiment to determine the density of an unknown liquid to three (3) significant figures. The density is of the order of 1 g/cm^3 . You have approximately 7 mL of the liquid and only graduated cylinders and balances are available for your use. Which of the following combinations of equipment will allow you to meet but not exceed your goal?

- A. graduated cylinder with $\pm 0.1 \text{ mL}$ uncertainty; balance with $\pm 0.1 \text{ g}$ uncertainty
- B. graduated cylinder with $\pm 0.01 \text{ mL}$ uncertainty; balance with $\pm 0.1 \text{ g}$ uncertainty
- C. graduated cylinder with $\pm 0.01 \text{ mL}$ uncertainty; balance with $\pm 0.01 \text{ g}$ uncertainty
- D. graduated cylinder with $\pm 0.001 \text{ mL}$ uncertainty; balance with $\pm 0.001 \text{ g}$ uncertainty
- E. graduated cylinder with $\pm 0.1 \text{ mL}$ uncertainty; balance with $\pm 0.001 \text{ g}$ uncertainty

53. A student makes several measurements of the density of an unknown mineral sample. She then reports the average value of these measurements. The number of significant figures she uses in her result should be a measure of its

- A. accuracy.
B. precision.
C. systematic error.
D. determinate error.
E. human error.
54. The difference between a student's experimental measurement of the density of sodium chloride and the known density of this compound reflects the _____ of the student's result.
- A. accuracy
B. precision
C. random error
D. systematic error
E. indeterminate error
55. Bud N. Chemist must determine the density of a mineral sample. His four trials yield densities of 4.77 g/cm^3 , 4.67 g/cm^3 , 4.69 g/cm^3 , and 4.81 g/cm^3 . Independent studies found the correct density to be 4.75 g/cm^3 . Which of the following statements represents the best analysis of the data?
- A. Bud's results have much greater accuracy than precision.
B. Bud's results have much greater precision than accuracy.
C. Bud's results have high accuracy and high precision.
D. Bud's results have low accuracy and low precision.
E. Bud's equipment is faulty.
56. As part of an experiment to determine the density of a new plastic developed in her laboratory, Sara Ann Dippity measures the volume of a solid sample. Her four trials yield volumes of 12.37 cm^3 , 12.41 cm^3 , 12.39 cm^3 , and 12.38 cm^3 . Measurements of other scientists in the lab give an average volume of 12.49 cm^3 . Which of the following statements represents the best analysis of the data?
- A. Sara's results have low precision and high accuracy.
B. Sara's results have high precision and high accuracy.
C. Sara's results have greater precision than accuracy.
D. Sara's results have greater accuracy than precision.
E. Sara has been using a faulty instrument to measure the volume.
57. Which of the following correctly expresses 52,030.2 m in scientific notation?
- A. $5.20302 \times 10^4 \text{ m}$
B. $5.20302 \times 10^5 \text{ m}$
C. $5.203 \times 10^4 \text{ m}$
D. $5.20 \times 10^4 \text{ m}$
E. $5.2 \times 10^4 \text{ m}$
58. Which of the following correctly expresses 0.000007913 g in scientific notation?
- A. $7.913 \times 10^6 \text{ g}$
B. $7.913 \times 10^5 \text{ g}$
C. $7.913 \times 10^{-5} \text{ g}$
D. $7.913 \times 10^{-6} \text{ g}$
E. $7.913 \times 10^{-9} \text{ g}$
59. Give an example of a physical property and a chemical property of each of the following:
- oxygen gas
 - octane
 - copper
60. Briefly explain the relationship between hypothesis and experiment in the scientific method.
61. Calculate (to three significant figures) the numerical part of the conversion factors needed to carry out the following unit conversions:
- density in g/cm^3 to kg/m^3
 - speed in mi/h to ft/s
 - area in km^2 to mi^2
 - area in km^2 to cm^2

- e. mass/area of aluminum foil in mg/cm^2 to g/m^2
- f. number of gas molecules per unit volume from $/\text{m}^3$ to $/\text{ft}^3$
- g. number of bacteria per unit area on a microscope slide from $/\text{mm}^2$ to $/\text{in}^2$

62. The S.I. unit of energy is the joule, J. $1 \text{ J} = 1 \text{ kg m}^2/\text{s}^2$. Another energy unit, the erg, was once in widespread use. $1 \text{ erg} = 1 \text{ g cm}^2/\text{s}^2$. Calculate the number of ergs in 1 J, showing all your work.
63. Classify the following properties of hydrogen gas as either intensive or extensive.
- a. the mass of the gas sample
 - b. the average speed of a molecule in the sample
 - c. temperature
 - d. density
 - e. number of molecules present
64. An evacuated 276 mL glass bulb weighs 129.6375 g. Filled with an unknown gas, the bulb weighs 130.0318 g. Calculate the gas density in g/L, and express it with an appropriate number of significant figures.
65. Use the relationship between temperatures in Celsius and Fahrenheit to calculate the temperature at which
- a. the numerical value is the same on both scales.
 - b. the Fahrenheit number is exactly twice the Celsius number.
66. Write the following numbers and results in scientific notation, with appropriate significant figures.
- a. 654
 - b. 1234560
 - c. 0.000000673
 - d. 0.002590
 - e. 200.4
 - f. 260.0
 - g. πr^2 , where $r = 8.7 \text{ cm}$
 - h. $23.24 + 18.6 - 5$
67. Write the following numbers and results in standard notation, with appropriate significant figures.
- a. 7.85×10^{-3}
 - b. 7.85×10^4
 - c. 5.920×10^3
 - d. 7.85×10^{12} , 10^{10}
 - e. 7.00×10^{-5}
 - f. circumference of a circle, $2\pi r$, where $r = 8.7 \text{ cm}$
 - g.
$$\frac{6.626 \times 10^{-34} \times 6.02214 \times 10^{23} \times 2.9979 \times 10^8}{5.23 \times 10^{-6}}$$

68. In each of the sets below, choose the one quantity or number which is exact.

- a. i. the human population
- ii. the distance in light years from the sun to Alpha Centauri, a nearby star
- iii. the winning time for the 100 m dash in the Olympic Games

- b. i. the weight of a particular one cent coin in g
- ii. the boiling point of lead, in °C
- iii. the number of cm in 1 yd

- c. i. the measured value of the speed of light ($2.998... \times 10^8$ m/s)
- ii. π (3.141...)
- iii. the volume of milk in a 1-gallon jug

69. The ripening of fruit, once picked, is an example of physical change.

Difficulty: E

True False

70. An important aim in much chemical work is to use macroscopic measurements in order to gain an understanding of the microscopic world.

Difficulty: M

True False

71. The potential energy of a car moving on a level road does not depend on its speed.

Difficulty: M

True False

72. When a wooden match burns in air, chemical potential energy is converted to kinetic energy.

Difficulty: E

True False

73. When applying the scientific method, it is important to avoid any form of hypothesis.

Difficulty: M

True False

74. When applying the scientific method, a model or theory should be based on experimental data.

Difficulty: E

True False

75. The numerical value of any temperature expressed in Celsius is always different from the numerical value of the same temperature in Fahrenheit.

Difficulty: E

True False

76. The numerical value of any temperature expressed in Celsius is always different from the numerical value of the same temperature in kelvin.

Difficulty: E

True False

77. The number 6.0448, rounded to 3 decimal places, becomes 6.045.

Difficulty: E

True False

78. The number 6.0448, rounded to 2 decimal places, becomes 6.05.

Difficulty: M

True False

79. The weight of a coin measured as 1.96235 g on one balance is definitely more accurate than a weight measurement of 1.95 g on another balance.

Difficulty: M

True False

ch1 KEY

1. (p. 4) xxWhich one of the following is a "substance" in the sense of the word as used in your textbook?

- A. air
- B. tap water
- C. sea water
- D. water**
- E. toothpaste

Silberberg - 001 Chapter... #1

2. (p. 4) Select the best statement.

- A.** Physical changes may be reversed by changing the temperature.
- B. Physical changes alter the composition of the substances involved.
- C. Physical properties are not valid characteristics for identifying a substance.
- D. Physical properties are mostly extensive in nature.
- E. Physical changes are usually accompanied by chemical changes.

Silberberg - 001 Chapter... #2

3. (p. 5) Select the best statement.

- A. Chemical changes provide the only valid basis for identification of a substance.
- B. Chemical changes are easily reversed by altering the temperature of the system.
- C.** Chemical changes always produce substances different from the starting materials.
- D. Chemical changes are associated primarily with extensive properties.
- E. Chemical changes are accompanied by changes in the total mass of the substances involved.

Silberberg - 001 Chapter... #3

4. (p. 5) Which of the following is a chemical change?

- A. boiling of water
- B. melting wax
- C.** broiling a steak on a grill
- D. condensing water vapor into rainfall
- E. carving a piece of wood

Silberberg - 001 Chapter... #4

5. (p. 7) Water vapor is less dense than ice because

- A. molecules in the gas phase are in constant motion.
- B. molecules in the gas phase have more potential energy than in solids.
- C. molecules in the gas phase have more kinetic energy than in solids.
- D. gaseous molecules have less mass.
- E.** molecules in the gas phase have more space between them than in solids.

Silberberg - 001 Chapter... #5

6. (p. 9) During the swing of a frictionless pendulum, what energy form(s) remain constant?

- A. kinetic energy only
- B. potential energy only
- C. both kinetic energy and potential energy
- D.** kinetic plus potential energy
- E. None of these forms remains constant.

Silberberg - 001 Chapter... #6

7. (p. 10) The most significant contribution to modern science made by alchemists was

- A. their fundamental work in the transmutation of the elements.
- B.** their widespread acceptance of observation and experimentation.
- C. their systematic method of naming substances.
- D. their understanding of the nature of chemical reactions.
- E. their discovery of phlogiston.

Silberberg - 001 Chapter... #7

8. (p. 11) Select the best statement about chemistry before 1800.

- A. Alchemy focused on objective experimentation rather than mystical explanations of processes.
- B. The phlogiston theory laid a valuable theoretical basis for modern chemistry.
- C.** Lavoisier's quantitative work on the role of oxygen in combustion was the beginning of modern chemistry.
- D. The interpretation of data by alchemists was not biased by their overall view of life.
- E. Alchemists failed because they did not develop any practical chemical methods.

Silberberg - 001 Chapter... #8

9. (p. 13) Which of the following activities is not a part of good science?

- A. proposing a theory
- B. developing a hypothesis
- C. making quantitative observations
- D. designing experiments

E. indulging in speculation

Silberberg - 001 Chapter... #9

10. (p. 13) A scientist made careful measurements of the pressure and temperature of many different gases. Based on these measurements, he concluded that "the pressure of a fixed amount of gas, measured at constant volume, is directly proportional to its absolute temperature." This statement is best described as a

- A. theory.
- B. hypothesis.
- C.** law.
- D. experiment.
- E. definition.

Silberberg - 001 Chapter... #10

11. (p. 13) A dictionary has the following definition for a word: "A tentative explanation that accounts for a set of facts." Which of the following words best fits that definition?

- A. theory
- B.** hypothesis
- C. law
- D. experiment
- E. definition

Silberberg - 001 Chapter... #11

12. (p. 12) A detailed explanation of natural phenomena that is generally accepted and has been extensively tested is called a

- A.** theory.
- B. hypothesis.
- C. law.
- D. fact.
- E. postulate.

Silberberg - 001 Chapter... #12

13. (p. 19) The distance between carbon atoms in ethylene is 134 picometers. Which of the following expresses that distance in meters?

- A. 1.34×10^{-13} m
- B. 1.34×10^{-12} m
- C.** 1.34×10^{-10} m
- D. 1.34×10^{-7} m
- E. 1.34×10^{-6} m

Silberberg - 001 Chapter... #13

14. (p. 19) The average distance from Earth to the Sun is 150 megameters. What is that distance in meters?

- A.** 1.5×10^8 m
- B. 1.5×10^6 m
- C. 1.5×10^5 m
- D. 1.5×10^3 m
- E. 1.5×10^{-6} m

Silberberg - 001 Chapter... #14

15. (p. 19) The mass of a sample is 550 milligrams. Which of the following expresses that mass in kilograms?

- A. 5.5×10^8 kg
- B. 5.5×10^5 kg
- C.** 5.5×10^{-4} kg
- D. 5.5×10^{-6} kg
- E. 5.5×10^{-1} kg

Silberberg - 001 Chapter... #15

16. (p. 19) A dose of medication was prescribed to be 35 microliters. Which of the following expresses that volume in centiliters?

- A. 3.5×10^5 cL
- B. 3.5×10^4 cL
- C. 3.5 cL
- D. 3.5×10^{-4} cL
- E.** 3.5×10^{-3} cL

Silberberg - 001 Chapter... #16

17. (p. 19) Which of the following represents the largest volume?

- A. 10,000 μL
- B. 1000 pL
- C.** 100 mL
- D. 10 nL
- E. 10 cm^3

Silberberg - 001 Chapter... #17

18. (p. 19) You prepare 1000. mL of tea and transfer it to a 1.00 quart pitcher for storage. Which of the following statements is true?

- A. The pitcher will be filled to 100% of its capacity with no tea spilled.
- B. The pitcher will be filled to about 95% of its capacity.
- C. The pitcher will be filled to about 50% of its capacity.
- D.** The pitcher will be completely filled and a small amount of tea will overflow.
- E. The pitcher will be completely filled and most of the tea will overflow.

Silberberg - 001 Chapter... #18

19. (p. 19) In an average year the American chemical industry produces more than 9.5 million metric tons of sodium carbonate. Over half of this is used in the manufacture of glass while another third is used in the production of detergents and other chemicals. How many pounds of sodium carbonate are produced annually?

- A. 2.1×10^{10} lb
- B. 4.3×10^9 lb
- C. 1.1×10^7 lb
- D.** 2.2×10^6 lb
- E. 2.1×10^4 lb

Silberberg - 001 Chapter... #19

20. (p. 19) A large pizza has a diameter of 15 inches. Express this diameter in centimeters.

- A.** 38 cm
- B. 24 cm
- C. 18 cm
- D. 9.3 cm
- E. 5.9 cm

Silberberg - 001 Chapter... #20

21. (p. 19) The average distance between the Earth and the Moon is 240,000 miles. Express this distance in kilometers.

- A.** 6.1×10^5 km
- B. 5.3×10^5 km
- C. 3.9×10^5 km
- D. 1.5×10^5 km
- E. 9.4×10^4 km

Silberberg - 001 Chapter... #21

22. (p. 19) The area of a 15-inch pizza is 176.7 in^2 . Express this area in square centimeters.

- A. 1140. cm^2
- B. 448.8 cm^2
- C.** 96.8 cm^2
- D. 69.57 cm^2
- E. 27.39 cm^2

Silberberg - 001 Chapter... #22

23. (p. 19) The speed needed to escape the pull of Earth's gravity is 11.3 km/s . What is this speed in mi/h ?

- A.** 65,500 mi/h
- B. 25,300 mi/h
- C. 18,200 mi/h
- D. 1,090 mi/h
- E. 5.02×10^{-3} mi/h

Silberberg - 001 Chapter... #23

24. (p. 19) The density of mercury, the only metal to exist as a liquid at room temperature, is 13.6 g/cm^3 . What is that density in pounds per cubic inch?

- A. 849 lb/in^3

- B. 491 lb/in³
- C. 376 lb/in³
- D.** 0.491 lb/in³
- E. 1.83×10^{-3} lb/in³

Silberberg - 001 Chapter... #24

25. (p. 19) Given that 1 inch = 2.54 cm, 1 cm³ is equal to

- A. 16.4 in³
- B. 6.45 in³
- C. 0.394 in³
- D. 0.155 in³
- E.** 0.0610 in³

Silberberg - 001 Chapter... #25

26. (p. 19) At a pressure of one billionth (10^{-9}) of atmospheric pressure, there are about 2.7×10^{10} molecules in one cubic centimeter of a gas. How many molecules is this per cubic meter?

- A.** 2.7×10^{16}
- B. 2.7×10^{14}
- C. 2.7×10^{12}
- D. 2.7×10^8
- E. 2.7×10^4

Silberberg - 001 Chapter... #26

27. (p. 19) If the price of gold at the morning fixing in London was \$5310 per lb, what would a kilogram of gold have cost in ≤ (pounds)? (Assume an exchange rate of \$1.00 = ≤0.545)

- A. ≤1310
- B. ≤3510
- C.** ≤6370
- D. ≤10400
- E. ≤17100

Silberberg - 001 Chapter... #27

28. (p. 18) Which of the following is not an S.I. base unit?

- A. meter
- B. ampere
- C. second
- D.** gram
- E. kelvin

Silberberg - 001 Chapter... #28

29. (p. 18) The symbol for the S.I. base unit of mass is:

- A. mg
- B. g
- C.** kg
- D. metric ton
- E. lb

Silberberg - 001 Chapter... #29

30. (p. 18) Which of the following abbreviations of the given SI base unit is incorrect?

- A. second: s
- B. kilogram: kg
- C. kelvin: K
- D.** mole: m
- E. ampere: A

Silberberg - 001 Chapter... #30

31. (p. 18) Which of the following abbreviations of the given SI base unit is incorrect?

- A. second: s
- B. kilogram: kg
- C. meter: m
- D. mole: mol
- E.** kelvin: k

Silberberg - 001 Chapter... #31

32. (p. 19) The S.I. prefix mega- (M) means:

- A. 10^{-6}
- B. 10^{-3}
- C. 10^3
- D.** 10^6
- E. 10^9

Silberberg - 001 Chapter... #32

33. (p. 18) The S.I. unit of speed (velocity) is

- A. km/h
- B. km/s
- C. m/h
- D.** m/s
- E. None of these choices is correct.

Silberberg - 001 Chapter... #33

34. (p. 19) The joule is the S.I. unit of energy, and is equal to $1 \text{ kg m}^2 \text{ s}^{-2}$. The erg is another energy unit, equal to $1 \text{ g cm}^2 \text{ s}^{-2}$. Use unit conversion methods to work out how many ergs are there in 1 joule.

- A. 10^{-1} ergs
- B. 10 ergs
- C. 10^2 ergs
- D. 10^5 ergs
- E.** 10^7 ergs

Silberberg - 001 Chapter... #34

35. (p. 19) Which of the following correctly shows how to convert a density of 20.1 g cm^{-3} to units of kg m^{-3} ?

- A. $\frac{20.1 \text{ g}}{1 \text{ cm}^3} \times \frac{1000 \text{ kg}}{1 \text{ g}} \times \frac{1 \text{ cm}^3}{0.01 \text{ m}^3}$
- B. $\frac{20.1 \text{ g}}{1 \text{ cm}^3} \times \frac{1 \text{ kg}}{1000 \text{ g}} \times \frac{1 \text{ cm}^3}{0.01 \text{ m}^3}$
- C. $\frac{20.1 \text{ g}}{1 \text{ cm}^3} \times \frac{1 \text{ kg}}{1000 \text{ g}} \times \frac{0.01 \text{ cm}^3}{1 \text{ m}^3}$
- D. $\frac{20.1 \text{ g}}{1 \text{ cm}^3} \times \frac{1 \text{ kg}}{1000 \text{ g}} \times \frac{(0.01 \text{ cm})^3}{(1 \text{ m})^3}$
- E.** $\frac{20.1 \text{ g}}{1 \text{ cm}^3} \times \frac{1 \text{ kg}}{1000 \text{ g}} \times \frac{(1 \text{ cm})^3}{(0.01 \text{ m})^3}$

Silberberg - 001 Chapter... #35

36. (p. 24) If the density of a certain spherical atomic nucleus is $1.0 \times 10^{14} \text{ g cm}^{-3}$ and its mass is $2.0 \times 10^{-23} \text{ g}$, what is its radius in cm?

- A.** $3.6 \times 10^{-13} \text{ cm}$
- B. $2.0 \times 10^{-37} \text{ cm}$
- C. $4.8 \times 10^{-38} \text{ cm}$
- D. $2.2 \times 10^{-19} \text{ cm}$
- E. None of these choices is correct.

Silberberg - 001 Chapter... #36

37. (p. 22) Which of the following is an extensive property of oxygen?

- A. boiling point
- B. temperature
- C. average kinetic energy of molecules
- D. density
- E.** mass

Silberberg - 001 Chapter... #37

38. (p. 24) A flask has a mass of 78.23 g when empty and 593.63 g when filled with water. When the same flask is filled with concentrated sulfuric acid, H_2SO_4 , its mass is 1026.57 g. What is the density of concentrated sulfuric acid? (Assume water has a density of 1.00 g/cm^3 at the temperature of the measurement.)

- A. 1.992 g/cm^3
- B.** 1.840 g/cm^3
- C. 1.729 g/cm^3
- D.

- 1.598 g/cm³
E. 0.543 g/cm³

Silberberg - 001 Chapter... #38

39. (p. 24) Talc is a mineral that has low conductivity for heat and electricity and that is not attacked by acid. It is used as talcum powder and face powder. A sample of talc weighs 35.97 g in air and 13.65 g in mineral oil ($d = 1.75 \text{ g/cm}^3$). What is the density of talc?

- A. 4.61 g/cm³
B. 2.82 g/cm³
C. 2.63 g/cm³
D. 2.44 g/cm³
E. 1.61 g/cm³

Silberberg - 001 Chapter... #39

40. (p. 26) Acetone, which is used as a solvent and as a reactant in the manufacture of Plexiglas \rightarrow , boils at 56.1° C. What is the boiling point in degrees Fahrenheit?

- A. 159° F
B. 133° F
C. 101° F
D. 69.0° F
E. 43.4° F

Silberberg - 001 Chapter... #40

41. (p. 26) Isopropyl alcohol, commonly known as rubbing alcohol, boils at 82.4° C. What is the boiling point in kelvins?

- A. 387.6 K
B. 355.6 K
C. 323.6 K
D. 190.8 K
E. -190.8 K

Silberberg - 001 Chapter... #41

42. (p. 26) Acetic acid boils at 244.2° F. What is its boiling point in degrees Celsius?

- A. 382.0° C
B. 167.7° C
C. 153.4° C
D. 117.9° C
E. 103.7° C

Silberberg - 001 Chapter... #42

43. (p. 28) Which one of the following numbers contains a digit or digits which is/are not significant?

- A. 970.0
B. 502
C. .300
D. .0043
E. 20.01

Silberberg - 001 Chapter... #43

44. (p. 29) Select the answer that expresses the result of this calculation with the correct number of significant figures.

$$\frac{13.602 \times 1.90 \times 3.06}{4.2 \times 1.4097}$$

- A. 13.3568
B. 13.357
C. 13.36
D. 13.4
E. 13

Silberberg - 001 Chapter... #44

45. (p. 29) Select the answer that expresses the result of this calculation with the correct number of significant figures and with correct units.

$$16.18 \text{ cm} \times 9.6114 \text{ g} \div 1.4783 \text{ cm}^2 =$$

- A. 105.2 g/cm³
B. 105.2 g/cm²
C. 105.2 g/cm
D. 72.13 g/cm²
E. 72.13 g/cm

Silberberg - 001 Chapter... #45

46. (p. 28) Which measurement is expressed to 4 significant figures?

- A. 0.423 kg
- B. 24.049 cm
- C. 1300 K
- D. 82,306 m
- E. 62.40 g**

Silberberg - 001 Chapter... #46

47. (p. 28) Express 96,342 m using 2 significant figures.

- A. 9.60×10^4 m
- B. 9.6×10^4 m**
- C. 9.60×10^{-4} m
- D. 9.6×10^{-4} m
- E. 96,000. m

Silberberg - 001 Chapter... #47

48. (p. 29) Select the answer with the correct number of decimal places for the following sum:

$$13.914 \text{ cm} + 243.1 \text{ cm} + 12.00460 \text{ cm} =$$

- A. 269.01860 cm
- B. 269.0186 cm
- C. 269.019 cm
- D. 269.02 cm
- E. 269.0 cm**

Silberberg - 001 Chapter... #48

49. (p. 29) The appropriate number of significant figures in the result of 15.234×15.208 is:

- A. 2
- B. 3
- C. 4
- D. 5**
- E. 6

Silberberg - 001 Chapter... #49

50. (p. 29) The appropriate number of significant figures in the result of $15.234 - 15.208$ is:

- A. 1
- B. 2**
- C. 3
- D. 4
- E. 5

Silberberg - 001 Chapter... #50

51. (p. 29) The result of $(3.8621 \times 1.5630) - 5.98$ is properly written as:

- A. 0.06**
- B. 0.056
- C. 0.0565
- D. 0.05646
- E. 0.056462

Silberberg - 001 Chapter... #51

52. (p. 29) As chief chemist at Superior Analytical Products (SAP) you must design an experiment to determine the density of an unknown liquid to three (3) significant figures. The density is of the order of 1 g/cm^3 . You have approximately 7 mL of the liquid and only graduated cylinders and balances are available for your use. Which of the following combinations of equipment will allow you to meet but not exceed your goal?

- A. graduated cylinder with ± 0.1 mL uncertainty; balance with ± 0.1 g uncertainty
- B. graduated cylinder with ± 0.01 mL uncertainty; balance with ± 0.1 g uncertainty
- C. graduated cylinder with ± 0.01 mL uncertainty; balance with ± 0.01 g uncertainty**
- D. graduated cylinder with ± 0.001 mL uncertainty; balance with ± 0.001 g uncertainty
- E. graduated cylinder with ± 0.1 mL uncertainty; balance with ± 0.001 g uncertainty

Silberberg - 001 Chapter... #52

53. (p. 31) A student makes several measurements of the density of an unknown mineral sample. She then reports the average value of these measurements. The number of significant figures she uses in her result should be a measure of its

- A. accuracy.
- B. precision.**
- C. systematic error.
- D. determinate error.
- E. human error.

54. (p. 31) The difference between a student's experimental measurement of the density of sodium chloride and the known density of this compound reflects the _____ of the student's result.
- A.** accuracy
 - B. precision
 - C. random error
 - D. systematic error
 - E. indeterminate error

Silberberg - 001 Chapter... #54

55. (p. 31) Bud N. Chemist must determine the density of a mineral sample. His four trials yield densities of 4.77 g/cm^3 , 4.67 g/cm^3 , 4.69 g/cm^3 , and 4.81 g/cm^3 . Independent studies found the correct density to be 4.75 g/cm^3 . Which of the following statements represents the best analysis of the data?
- A.** Bud's results have much greater accuracy than precision.
 - B. Bud's results have much greater precision than accuracy.
 - C. Bud's results have high accuracy and high precision.
 - D. Bud's results have low accuracy and low precision.
 - E. Bud's equipment is faulty.

Silberberg - 001 Chapter... #55

56. (p. 31) As part of an experiment to determine the density of a new plastic developed in her laboratory, Sara Ann Dippity measures the volume of a solid sample. Her four trials yield volumes of 12.37 cm^3 , 12.41 cm^3 , 12.39 cm^3 , and 12.38 cm^3 . Measurements of other scientists in the lab give an average volume of 12.49 cm^3 . Which of the following statements represents the best analysis of the data?
- A. Sara's results have low precision and high accuracy.
 - B. Sara's results have high precision and high accuracy.
 - C.** Sara's results have greater precision than accuracy.
 - D. Sara's results have greater accuracy than precision.
 - E. Sara has been using a faulty instrument to measure the volume.

Silberberg - 001 Chapter... #56

57. (p. 29) Which of the following correctly expresses 52,030.2 m in scientific notation?

- A.** $5.20302 \times 10^4 \text{ m}$
- B. $5.20302 \times 10^5 \text{ m}$
- C. $5.203 \times 10^4 \text{ m}$
- D. $5.20 \times 10^4 \text{ m}$
- E. $5.2 \times 10^4 \text{ m}$

Silberberg - 001 Chapter... #57

58. (p. 29) Which of the following correctly expresses 0.000007913 g in scientific notation?

- A. $7.913 \times 10^6 \text{ g}$
- B. $7.913 \times 10^5 \text{ g}$
- C. $7.913 \times 10^{-5} \text{ g}$
- D.** $7.913 \times 10^{-6} \text{ g}$
- E. $7.913 \times 10^{-9} \text{ g}$

Silberberg - 001 Chapter... #58

59. (p. 4) Give an example of a physical property and a chemical property of each of the following:
- a. oxygen gas
 - b. octane
 - c. copper

Answers could all be the same, but some possibilities are:

- a. boiling point, reaction with sodium
- b. boiling point, reaction with oxygen
- c. electrical conductivity, reaction with nitric acid

Difficulty: E

Silberberg - 001 Chapter... #59

60. (p. 13) Briefly explain the relationship between hypothesis and experiment in the scientific method.

A hypothesis should be capable of leading to a prediction which is testable by experiment. If the experimental result differs from the prediction, the hypothesis should be modified.

Difficulty: H

Silberberg - 001 Chapter... #60

61. (p. 19) Calculate (to three significant figures) the numerical part of the conversion factors needed to carry out the following unit

conversions:

- density in g/cm^3 to kg/m^3
- speed in mi/h to ft/s
- area in km^2 to mi^2
- area in km^2 to cm^2
- mass/area of aluminum foil in mg/cm^2 to g/m^2
- number of gas molecules per unit volume from $/\text{m}^3$ to $/\text{ft}^3$
- number of bacteria per unit area on a microscope slide from $/\text{mm}^2$ to $/\text{in}^2$

- 10^3 (exactly)
 - 1.47
 - 0.386
 - 10^{10} (exactly)
 - 10 (exactly)
 - 0.0283
 - 645
- Difficulty: M

Silberberg - 001 Chapter... #61

62. (p. 19) The S.I. unit of energy is the joule, J. $1 \text{ J} = 1 \text{ kg m}^2/\text{s}^2$. Another energy unit, the erg, was once in widespread use. $1 \text{ erg} = 1 \text{ g cm}^2/\text{s}^2$. Calculate the number of ergs in 1 J, showing all your work.

$$1 \text{ J} = 10^7 \text{ erg}$$

Difficulty: M

Silberberg - 001 Chapter... #62

63. (p. 22) Classify the following properties of hydrogen gas as either intensive or extensive.
- the mass of the gas sample
 - the average speed of a molecule in the sample
 - temperature
 - density
 - number of molecules present

- extensive
 - intensive
 - intensive
 - intensive
 - extensive
- Difficulty: M

Silberberg - 001 Chapter... #63

64. (p. 24) An evacuated 276 mL glass bulb weighs 129.6375 g. Filled with an unknown gas, the bulb weighs 130.0318 g. Calculate the gas density in g/L , and express it with an appropriate number of significant figures.

$$1.43 \text{ g/L}$$

Difficulty: M

Silberberg - 001 Chapter... #64

65. (p. 26) Use the relationship between temperatures in Celsius and Fahrenheit to calculate the temperature at which
- the numerical value is the same on both scales.
 - the Fahrenheit number is exactly twice the Celsius number.

- $40.^\circ \text{F} = -40.^\circ \text{C}$
 - $320.^\circ \text{F} = 160.^\circ \text{C}$
- Difficulty: H

Silberberg - 001 Chapter... #65

66. (p. 29) Write the following numbers and results in scientific notation, with appropriate significant figures.
- 654
 - 1234560
 - 0.000000673
 - 0.002590
 - 200.4
 - 260.0
 - πr^2 , where $r = 8.7 \text{ cm}$
 - $23.24 + 18.6 - 5$

- 6.54×10^2
- 1.23456×10^6
- 6.73×10^{-7}
- 2.590×10^{-3}

- e. 2.004×10^2
 f. 2.600×10^2
 g. $2.4 \times 10^2 \text{ cm}^2$
 h. 3.7×10^1

Difficulty: E

Silberberg - 001 Chapter... #66

67. (p. 29) Write the following numbers and results in standard notation, with appropriate significant figures.

- a. 7.85×10^{-3}
 b. 7.85×10^4
 c. 5.920×10^3
 d. 7.85×10^{12} , 10^{10}
 e. 7.00×10^{-5}
 f. circumference of a circle, $2\pi r$, where $r = 8.7 \text{ cm}$
 g. $\frac{6.626 \times 10^{-34} \times 6.02214 \times 10^{23} \times 2.9979 \times 10^8}{5.23 \times 10^{-6}}$

- a. 0.00785
 b. 78500
 c. 5920.
 d. 785
 e. 0.0000700
 f. 55 cm
 g. 22900

Difficulty: E

Silberberg - 001 Chapter... #67

68. (p. 30) In each of the sets below, choose the one quantity or number which is exact.

- a. i. the human population
 ii. the distance in light years from the sun to Alpha Centauri, a nearby star
 iii. the winning time for the 100 m dash in the Olympic Games

 b. i. the weight of a particular one cent coin in g
 ii. the boiling point of lead, in °C
 iii. the number of cm in 1 yd

 c. i. the measured value of the speed of light ($2.998... \times 10^8 \text{ m/s}$)
 ii. π (3.141...)
 iii. the volume of milk in a 1-gallon jug

- a. i
 b. iii
 c. ii

Difficulty: M

Silberberg - 001 Chapter... #68

69. (p. 4) The ripening of fruit, once picked, is an example of physical change.

Difficulty: E

FALSE

Silberberg - 001 Chapter... #69

70. (p. 8) An important aim in much chemical work is to use macroscopic measurements in order to gain an understanding of the microscopic world.

Difficulty: M

TRUE

Silberberg - 001 Chapter... #70

71. (p. 9) The potential energy of a car moving on a level road does not depend on its speed.

Difficulty: M

TRUE

Silberberg - 001 Chapter... #71

72. (p. 9) When a wooden match burns in air, chemical potential energy is converted to kinetic energy.

Difficulty: E

TRUE

Silberberg - 001 Chapter... #72

73. (p. 13) When applying the scientific method, it is important to avoid any form of hypothesis.

Difficulty: M

FALSE

Silberberg - 001 Chapter... #73

74. (p. 13) When applying the scientific method, a model or theory should be based on experimental data.
Difficulty: E

TRUE

Silberberg - 001 Chapter... #74

75. (p. 25) The numerical value of any temperature expressed in Celsius is always different from the numerical value of the same temperature in Fahrenheit.
Difficulty: E

FALSE

Silberberg - 001 Chapter... #75

76. (p. 25) The numerical value of any temperature expressed in Celsius is always different from the numerical value of the same temperature in kelvin.
Difficulty: E

TRUE

Silberberg - 001 Chapter... #76

77. (p. 29) The number 6.0448, rounded to 3 decimal places, becomes 6.045.
Difficulty: E

TRUE

Silberberg - 001 Chapter... #77

78. (p. 29) The number 6.0448, rounded to 2 decimal places, becomes 6.05.
Difficulty: M

FALSE

Silberberg - 001 Chapter... #78

79. (p. 31) The weight of a coin measured as 1.96235 g on one balance is definitely more accurate than a weight measurement of 1.95 g on another balance.
Difficulty: M

FALSE

Silberberg - 001 Chapter... #79

ch1 Summary

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