

Chapter 1--Introduction to Chemistry

Student: _____

1. Which of the following studies is not considered to be "Chemistry?"

- A. Studying the interactions between energy and matter.
- B. Classifying elements into metallic, nonmetallic or semimetallic.
- C. Studying the interactions between matter and other matter
- D. Removing harmful impurities from a synthetic drug.
- E. Separating the light spectrum into its component colors.

2. Which does *not* represent a scientific investigation?

- A. Weighing the results of an experiment to obtain quantitative data.
- B. Weighing lab reports on a chemical balance to determine the grade.
- C. Graphing the mass of a product as a function of the mass of the starting material.
- D. Determining the temperature at which the maximal amount of product is obtained.
- E. Trying different conditions if an initial experiment fails.

3. Which of the following is correctly classified as a hypothesis?

- A. "The sun will rise in the East today."
- B. "Global warming is a result of the increased carbon dioxide concentration in the atmosphere."
- C. "Our team is better than theirs."
- D. "Cookies will turn brown when baked."
- E. "My book is better than yours."

4. All of the following are properties of Magnesium. Which would be considered a *chemical* property of magnesium?

- I. Magnesium burns in air to produce a white substance known as magnesium oxide.
- II. Magnesium dissolves in acidic water to produce hydrogen gas.
- III. The density of magnesium is 1.738 g/mL.

- A. I
- B. II
- C. III
- D. I and II
- E. all of these

5. The following are properties of sodium metal. Which would be considered a *chemical property* of sodium metal?

- A. Sodium is a silvery-white metal
- B. Sodium has a melting point of 98 °C
- C. Sodium has a density equal to 0.968 g/mL.
- D. Sodium reacts with water violently to produce hydrogen gas.
- E. Sodium metal is drawn into a magnetic field.

6. All of the following are properties of carbon dioxide, CO₂. Which of the following is a *chemical property* of this substance?

- A. It reacts with water to form carbonic acid.
- B. It is a colorless gas at room temperature and 1 atm pressure.
- C. It is a solid below -78 °C.
- D. Its density as a solid equals 1.35 g/mL.
- E. None of these is a chemical property.

7. Of the three properties listed below, which ones are intensive properties?

- I. mass
- II. density
- III. color

- A. I and II
- B. II and III
- C. II only
- D. I only
- E. I, II, and III

8. "A 33 g sample of red liquid at its freezing point of 260 K had a density of 0.926 g/mL." Which of the properties given in the previous statement is extensive?

- A. 33 g
- B. red
- C. freezing point
- D. 260 K
- E. 0.926 g/mL

9. Which of the following is not a physical change?

- A. ice melting
- B. dry ice subliming
- C. a light-bulb glowing
- D. beef cooking
- E. distilling alcohol

10. Which of the following is not a chemical change?

- A. developing a film
- B. refrigerating milk
- C. eating beef
- D. extinguishing a fire
- E. frying an egg

11. Which of the following is considered a *chemical change*?

- A. Beef is browned by heating in a skillet.
- B. A blackberry changes colors from red to black.
- C. Addition of hydrogen peroxide to an open cut produces a white liquid and fizzing.
- D. a and b
- E. all of these.

12. Which of the following would be considered a *chemical change*?

- I. Frost forms on the window
- II. A Silver fork tarnishes
- III. Toasting a slice of bread.

- A. I only
- B. I and II
- C. I and III
- D. II and III
- E. All of these

13. Which of the following would be considered a *physical change*?

- A. gasoline burning
- B. salt dissolving in water
- C. food spoiling
- D. iron rusting
- E. a battery discharging

14. Which of the following processes is considered a *chemical change*?

- I. Corrosion of aluminum metal
- II. Digesting a candy bar.
- III. Melting of ice.

- A. I only
- B. II only
- C. III only
- D. I and II
- E. All of these

15. Which of the following represents a *chemical change*?

- A. Cutting a string into two pieces.
- B. Melting candle wax.
- C. Evaporation of water from a lake.
- D. Rusting of an iron nail.
- E. Peeling an apple.

16. Which form of substances listed below cannot be separated into simpler substances by chemical or physical means?

- A. an element
- B. a compound
- C. a heterogeneous mixture
- D. a homogeneous mixture
- E. All substances can be separated into simpler substances.

17. Identify the matter that is correctly classified as a mixture.

- A. ethyl alcohol
- B. carbon dioxide
- C. water
- D. tin
- E. air

18. Which of the following is a heterogeneous mixture?

- A. salt water
- B. salt
- C. milk
- D. sand
- E. water

19. How can "oil and vinegar" be classified? (Two phases are present.)

- A. pure substance
- B. element
- C. compound
- D. homogeneous mixture
- E. heterogeneous mixture

20. A glass of tea with a uniform composition throughout would be an example of a(n) ____.

- A. pure substance
- B. element
- C. compound
- D. homogeneous mixture
- E. heterogeneous mixture

21. Which of the following is an example of a *homogeneous mixture*?

- I. Water and dissolved salt
- II. Water and sand
- III. Carbonated water (soda) and ice

- A. I only
- B. II only
- C. III only
- D. I and II
- E. All of these

22. Which of the following best describes a *compound*?

- A. A compound is a *mixture* that can be separated into its constituent elements using *physical methods*.
- B. A compound is a *mixture* that can be separated into its constituent elements using *chemical methods*.
- C. A compound is a *pure substance* that can be separated into its constituent elements using *physical methods*.
- D. A compound is a *pure substance* that can be separated into its constituent elements using *chemical methods*.

23. Which of the following best describes a *mixture*?

- A. It's *composition* can vary but its *properties* remain constant.
- B. It's *composition* and *properties* can vary.
- C. It's *composition* remains constant but its *properties* varies.
- D. It's *composition* and *properties* remains constant.

24. Which of the following best describes an element?

- A. An element is a *mixture* that can be separated into simpler substances using *physical methods*.
- B. An element is a *mixture* that can be separated into simpler substances using *chemical methods*.
- C. An element is a *pure substance* that can be separated into simpler substances using *physical methods*.
- D. An element is a *pure substance* that can be separated into simpler substances using *chemical methods*.
- E. An element is a pure substance that cannot be separated into simpler substances using ordinary physical or chemical methods.

25. Which is properly classified as a compound?

- A. salt water
- B. salt
- C. wine
- D. bread
- E. copper

26. Which of the following is not an element?

- A. niobium
- B. thallium
- C. silicon
- D. sodium
- E. ammonium

27. The elements Carbon, Lead, and Magnesium are designated by what chemical symbols respectively?

- A. C, L, M
- B. Ca, Le, Ma
- C. C, Pb, Mn
- D. C, Pb, Mg
- E. Ca, Pb, Mn

28. What is the chemical symbol for the element *tin*?

- A. T
- B. Sn
- C. Ti
- D. Tn
- E. St

29. Which of the following matched pairs of elemental names and chemical symbols is properly labeled?

- I. Magnesium, Mg
- II. Mercury, M
- III. Silver, Si
- IV. Sodium, S
- V. Oxygen, O

- A. I only
- B. II and III
- C. I and V
- D. I, IV and V
- E. All are properly labeled

30. Which of the following matched pairs of elemental names and chemical symbols is properly labeled?

- I. Calcium, C
- II. Plutonium, Pt
- III. Silicon, Si
- IV. Iron, I
- V. Nitrogen, N

- A. I, IV and V
- B. II, III and V
- C. I, III, IV and V
- D. III and V
- E. All are properly labeled

31. The definition "stable pure substance that cannot be separated into simpler substances by chemical means" would best fit which term listed below?

- A. element
- B. compound
- C. atom
- D. molecule
- E. xanon

32. A compound is:

- A. a pure substance that can be decomposed chemically.
- B. a characteristic that describes a substance.
- C. a pure substance that cannot be decomposed chemically.
- D. a combination of atoms.
- E. none of these.

33. A precise measurement

- A. is known to two or more significant figures.
- B. is known to two or more decimal places.
- C. is repeatable.
- D. is close to the correct answer
- E. is beyond the scope of a first-year chemistry student.

34. An accurate measurement

- A. is known to two or more significant figures.
- B. is known to two or more decimal places.
- C. is repeatable.
- D. is close to the correct answer
- E. is beyond the scope of a first year chemistry student.

35. Which of the following volume measurements is the *least precise* measurement?

- A. 1.0 mL
- B. 2.018 mL
- C. 2.02 mL
- D. 2.022 mL
- E. 3 mL

36. Three students measured the density of pure water in the laboratory. Their results are as follows:

Student 1:	Density = 1.20 g/mL
Student 2:	Density = 1.21 g/mL
Student 3:	Density = 1.19 g/mL

The actual density of water at 25 °C equals 0.997 g/mL. What do the results of these three experiments demonstrate when compared to the true density of water?

- A. High accuracy and high precision
- B. High accuracy and low precision
- C. Low accuracy and high precision
- D. Low accuracy and low precision
- E. None of these

37. Three students measured the freezing temperature of water in the laboratory. Their results are as follows:

Student 1:	freezing temperature = 2.86 °C
Student 2:	freezing temperature = -4.52 °C
Student 3:	freezing temperature = 3.21 °C

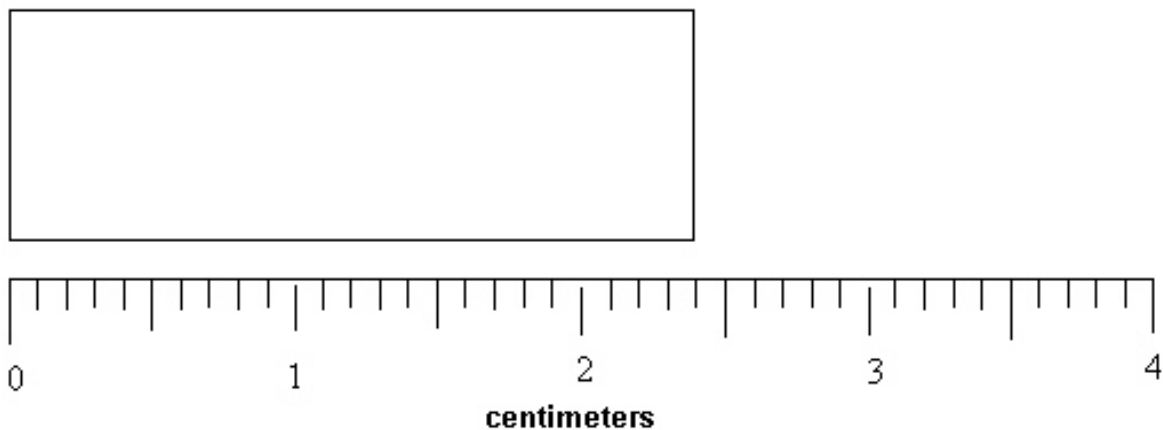
The actual freezing temperature of water equals $0.00\text{ }^{\circ}\text{C}$. The results of these three students when compared to the true freezing temperature of water demonstrates:

- A. High accuracy and high precision
- B. High accuracy and low precision
- C. Low accuracy and high precision
- D. low accuracy and low precision
- E. None of these

38. Which of the following measurements is considered a combination of one of the seven base units from which all other measurements can be made?

- A. mass
- B. volume
- C. amount
- D. temperature
- E. time

39. What length in *millimeters* can be reported for the rectangle below? (Note that the ruler measures in centimeters.)

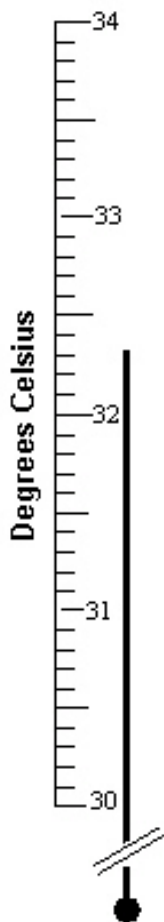


- A. 24 mm
- B. 24.0 mm
- C. 2.4 mm
- D. 2.40 mm
- E. 240 mm

40. In the reported measurement of 24.0 mm, what digit is *uncertain*?

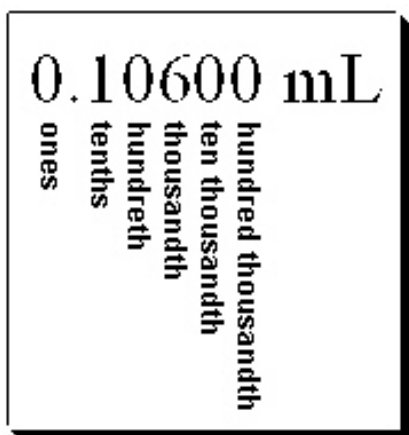
- A. tens place
- B. in the ones place
- C. in the tenths place
- D. in the hundredths place
- E. All places are reported with certainty.

41. What is the temperature given by the thermometer below written with the proper number of significant digits?



- A. 32.3 °C
- B. 32.30 °C
- C. 32 °C
- D. 32.300 °C
- E. 30 °C

42. What digit(s) is(are) considered the digit of *uncertainty* in the following measurement?



- A. thousandths place
- B. ones, hundredths, ten thousandths and hundred thousandths places
- C. ten thousandths place
- D. hundred thousandths place
- E. millionth place

43. How many significant digits are there in 0.0050 mL?

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

44. Choose the *best* answer to the following math problem (*with the proper number of significant digits and rounded correctly*).

$$(12.3432 - 8.84) \cdot 22.48 = ??$$

- A. 78.751936
- B. 78.75
- C. 78.76
- D. 78.8
- E. 78.752

45. Two students combined two different volumes of water. The first student measured 25.4 mL of water using a 100.0 mL graduated cylinder and the second student measured 0.15 mL of water using a 50.00 mL burette. What total volume should be reported after taking into account significant digits and the convention used for rounding?

- A. 25 mL
- B. 25.5 mL
- C. 25.55 mL
- D. 25.6 mL
- E. 26 mL

46. Which measurements below have four significant digits?

	Measurement
I.	0.023 mL
II.	2300 mL
III.	1700. mL
IV.	0.004050 mL

- A. all of these have four significant digits
- B. I, II and III
- C. II, III, and IV
- D. I and II
- E. III and IV

47. Three problems are worked below. Choose the answer that properly describes the correct use of significant digits

I.

$$\begin{array}{r} 0.34 \\ +14.2 \\ \hline 14.5 \end{array}$$

II.

$$\begin{array}{r} 14.3 \\ ' 2.0 \\ \hline 28.6 \end{array}$$

III.

$$\begin{array}{r} 14.21 \\ ' 134 \\ \hline 1.90 \times 10^3 \end{array}$$

- A. I and II are correct, III is incorrect
- B. I and III are correct, II is incorrect
- C. II and III are correct, I is incorrect
- D. all three are correct
- E. none of these

48. Properly expressed, the answer to the mathematical manipulation $(0.243 \times 4.2) + 21 =$ is:

- A. 22
- B. 22.0
- C. 2.2×10^2
- D. 22.02
- E. 2.202×10^2

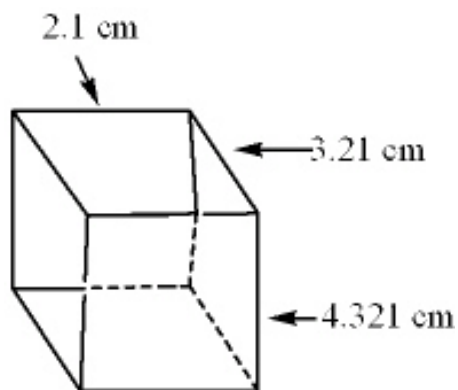
49. The correct answer for $(1.22 \times 10^3) \times 0.013$ is:

- A. 15.8
- B. 158
- C. 16
- D. 15.86
- E. 93846

50. What is the density of mercury when reported to the proper number of significant digits and in scientific notation if a sample is found to have a mass of 524.5 g and occupies a volume of 38.72 mL?

- A. 7.38×10^{-2} g/mL
- B. 7.382×10^{-2} g/mL
- C. 1.35×10^1 g/mL
- D. 1.354×10^1 g/mL
- E. 1.355×10^1 g/mL

51. The dimensions of the following cube were measured. What would be the volume of this cube expressed to the proper number of significant digits? (Volume = $l \times w \times d$)



- A. 29.127861 cm³
- B. 29.13 cm³
- C. 29.1 cm³
- D. 29. cm³
- E. 30 cm³

52. The number 486,000 is equal to:

- A. 4.86×10^2
- B. 4.86×10^{-4}
- C. 4.86×10^3
- D. 4.86×10^4
- E. 4.86×10^5

53. The number 0.00042 is equal to:

- A. 4.2×10^4
- B. 4.2×10^{-4}
- C. 4.2×10^3
- D. 4.2×10^{-3}
- E. 4.2×10^{-2}

54. How would the measurement, 5125 m, be rounded off to three significant digits and expressed in *scientific notation*?

- A. 5.12×10^{-3} m
- B. 5.13×10^{-3} m
- C. 5.130×10^{-3} m
- D. 5.12×10^3 m
- E. 5.13×10^4 m

55. Which is an abbreviation for an SI base unit?

- A. J
- B. kg
- C. Nt
- D. °C
- E. L

56. Which metric prefix(es) listed below is(are) correctly assigned the proper power of ten?

- I. giga: 10^9
- II. micro: 10^6
- III. nano: 10^{-12}

- A. I only
- B. II only
- C. III only
- D. I and II
- E. II and III

57. Which metric prefix(es) listed below is(are) *correctly* assigned the proper power of ten?

- I. deci: 10^1
- II. nano: 10^{-6}
- III. mega: 10^6

- A. I only
- B. II only
- C. III only
- D. I and II
- E. All of these

58. Which metric prefix listed below has a power of 10^{-12} associated with it?

- A. centi
- B. micro
- C. milli
- D. kilo
- E. pico

59. What prefix is used to indicate a base unit multiplied by 10^{-1} ?

- A. deca
- B. centi
- C. milli
- D. deci
- E. micro

60. What prefix is used to indicate a base unit multiplied by 10^{-6} ?

- A. kilo
- B. mega
- C. micro
- D. centi
- E. deca

61. How many nanometers are present in 4.5 cm?

- A. 4.5×10^{-9} nm
- B. 4.5×10^{-7} nm
- C. 4.5×10^6 nm
- D. 4.5×10^7 nm
- E. 4.5×10^{11} nm

62. How many micrometers, μm , are present in 0.575 mm?

- A. 5.75×10^{-10} mm
- B. 5.75×10^{-4} mm
- C. 5.75×10^1 mm
- D. 5.75×10^2 mm
- E. 5.75×10^8 mm

63. Analysis shows the presence of 203 mg of cholesterol in a sample of blood. How many *grams* of cholesterol are present in this blood sample?
- A. 2.03×10^{-6} g
 - B. 2.03×10^{-4} g
 - C. 2.03×10^2 g
 - D. 2.03×10^6 g
 - E. 2.03×10^8 g
64. The diameter of a US Quarter is approximately 2.35 cm. What is the diameter of a quarter expressed in *km* and *scientific notation*?
- A. 2.35×10^{-5} km
 - B. 2.35×10^5 km
 - C. 2.35×10^{-2} km
 - D. 23.5×10^{-4} km
 - E. 2.35 km
65. Express a mass of 0.0220 kg in grams.
- A. 22.0 g
 - B. 2.20×10^{-5} g
 - C. 2.20×10^{-3} g
 - D. 4.84×10^{-2} g
 - E. 0.0100 g
66. Express 15 inches in cm.
- A. 2.5 cm
 - B. 5.9 cm
 - C. 38 cm
 - D. 38.1 cm
 - E. 38.10 cm
67. An object measures 1.92 meters in length. What is this object's length in feet? (1 inch = 2.54 cm)
- A. 9.07×10^{-2} ft
 - B. 5.85×10^{-1} ft
 - C. 6.30 ft
 - D. 4.06×10^1 ft
 - E. 9.07×10^2 ft

68. The smallest bone in the human body, which is in the ear, has a mass of 0.0030 grams. What is this mass in pounds? (1 pound = 454 grams)

- A. 6.6×10^{-6} pounds
- B. 3.0×10^{-3} pounds
- C. 0.73 pounds
- D. 1.4 pounds
- E. 1.5×10^5 pounds

69. How many gallons are present in 43.7 Liters? (1 gallon = 4 quarts and 1 quart = 0.946 L)

- A. 10.3 gallons
- B. 11.5 gallons
- C. 46.2 gallons
- D. 165 gallons
- E. 185 gallons

70. A person weighs 83.2 kg. What is this person's weight in pounds? (1.00 pound = 454 grams)

- A. 0.183 pounds
- B. 5.46 pounds
- C. 37.8 pounds
- D. 183 pounds
- E. 3.78×10^7 pounds

71. The atomic radius of a beryllium atom is 111 pm. Express this distance in inches.

- A. 2.67×10^{-8} inch
- B. 4.37×10^{-9} inch
- C. 2.42×10^{-13} inch
- D. 4.37×10^{-13} inch
- E. 43.7 inch

72. In a new measuring system created by your instructor, 2.16 geb = 1.02 red. How many geb is 7.4 red?

- A. 3.5 geb
- B. 3.49 geb
- C. 15.7 geb
- D. 16 geb
- E. 1.57 geb

73. The speed of light in a vacuum is 2.998×10^8 m/s. What is this speed given in cm/min?

- A. 1.799×10^{13} cm/min
- B. 1.799×10^{12} cm/min
- C. 4.997×10^8 cm/min
- D. 1.799×10^8 cm/min
- E. 4.997×10^4 cm/min

74. The speed limit is 70 miles per hour on some stretches of the interstate. What is this same speed in meters per second, (m/s)? (1 mile = 1.60 km)

- A. 1.9 m/s
- B. 31 m/s
- C. 1.6×10^2 m/s
- D. 1.1×10^5 m/s
- E. 1.1×10^2 m/s

75. The speed limit on the interstate in Virginia is 65 miles per hour. What is this speed in kilometers per second? (1 km = 0.621 miles, 1 hour = 60 minutes and 1 minute = 60 seconds)

- A. 0.029 km/sec
- B. 34. km/sec
- C. 40. km/sec
- D. 55. km/sec
- E. 1.0×10^2 km/sec

76. A car travels 28.0 miles per gallon of gasoline. How many kilometers per liter will it go? (1 mile = 1.6093 km and 1 gallon = 3.7854 L)

- A. 5.86×10^{-3} km/L
- B. 4.60 km/L
- C. 11.9 km/L
- D. 65.9 km/L
- E. 170 km/L

77. What is the speed of an automobile given in miles per second (miles/sec) that is traveling 80. kilometer per hour (km/hour)? (1 km = 0.621 miles; 1 hour = 60 min; 1 min = 60 sec)

- A. 1.4×10^{-2} miles/s
- B. 3.6×10^{-2} miles/s
- C. 50 miles/s
- D. 1.3×10^2 miles/s
- E. 1.8×10^5 miles/s

78. The area of a telescope lens is 5773 mm^2 . What is this area given in square feet, ft^2 ? (1 inch = 2.54 cm)

- A. $6.214 \times 10^{-2} \text{ ft}^2$
- B. 8.948 ft^2
- C. $1.894 \times 10^1 \text{ ft}^2$
- D. $1.288 \times 10^3 \text{ ft}^2$
- E. $5.363 \times 10^4 \text{ ft}^2$

79. The area of a US quarter is approximately $4.5 \times 10^2 \text{ mm}^2$. What is the area of a US quarter in square inches, (in^2)? (1 in = 2.54 cm)

- A. $7.0 \times 10^{-1} \text{ in}^2$
- B. $1.8 \times 10^1 \text{ in}^2$
- C. $2.9 \times 10^5 \text{ in}^2$
- D. $1.8 \times 10^{-1} \text{ in}^2$
- E. $1.1 \times 10^4 \text{ in}^2$

80. A carpenter must lay a floor that covers 1500 ft^2 . What is this area in cm^2 ? (1 foot = 12 inches and 1 inch = 2.54 cm)

- A. 1.6 cm^2
- B. 49 cm^2
- C. $3.2 \times 10^2 \text{ cm}^2$
- D. $4.6 \times 10^4 \text{ cm}^2$
- E. $1.4 \times 10^6 \text{ cm}^2$

81. Convert 38°F to the Celsius scale.

- A. 3.3°C
- B. 8.2°C
- C. -40°C
- D. 4.5°C
- E. 311°C

82. Convert 26°C to kelvins.

- A. 288 K
- B. 321 K
- C. 204 K
- D. 299 K
- E. 53.3 K

83. A heat stroke normally occurs at 106 °F. What temperature is this when converted to the Kelvin scale?

- A. -232 K
- B. -50.2 K
- C. 223 K
- D. 314 K
- E. 496 K

84. A comfortable temperature for bath water is 95 °F. What temperature is this on the Kelvin scale?

- A. -238 K
- B. 35 K
- C. 171 K
- D. 308 K
- E. 476 K

85. The temperature of liquid nitrogen is 77 K. What is this temperature on the Fahrenheit scale?

- A. -196 °F
- B. -321 °F
- C. 350 °F
- D. 662 °F
- E. -385 °F

86. Liquid Helium boils at 4 K. What temperature is this in degrees Fahrenheit?

- A. -452 °F
- B. -269 °F
- C. -167 °F
- D. 136 °F
- E. 531 °F

87. The temperature that pure iron melts is 2795 °F. What is this temperature on the Kelvin scale?

- A. 1262 K
- B. 1535 K
- C. 1808 K
- D. 1843 K
- E. 4790 K

88. What is the mass of 25.0 mL of an oil if its density is 0.843 g/mL?

- A. 29.7 g
- B. 21.1 g
- C. 15.2 g
- D. 38.4 g
- E. 211 g

89. What is the volume of 25.0 g of an oil if its density is 0.843 g/mL?

- A. 29.7 mL
- B. 21.1 mL
- C. 15.2 mL
- D. 38.4 mL
- E. 211 mL

90. What volume of gold has a mass of 25.0 grams? (Density of gold = 19.30 g/mL)

- A. 2.07×10^{-3} mL
- B. 0.772 mL
- C. 1.30 mL
- D. 25.0 mL
- E. 482 mL

91. What mass of platinum occupies a volume of 75.00 cm³? (Density of platinum = 21.45 g/cm³)

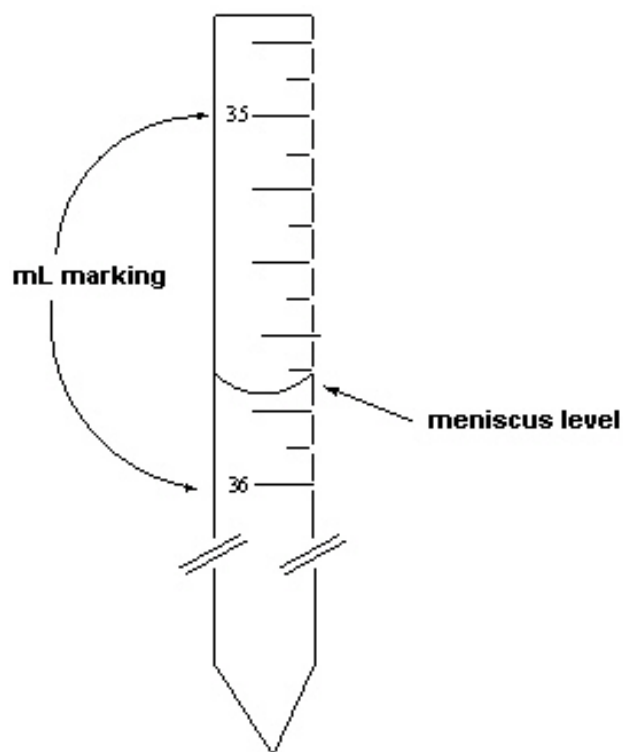
- A. 0.2860 g
- B. 3.497 g
- C. 21.45 g
- D. 75.00 g
- E. 1609 g

92. What is the volume of a 100.0 gram bar of silver metal? (Density of Silver = 10.40 g/mL)

- A. 9.615×10^{-4} mL
- B. 1.040×10^{-1} mL
- C. 9.615 mL
- D. 1.040×10^3 mL
- E. 100.0 mL

93. **Exhibit 1-1**

Consider the following figure that is a "blow-up" view of a region of a 50 mL burette to answer the following question(s).



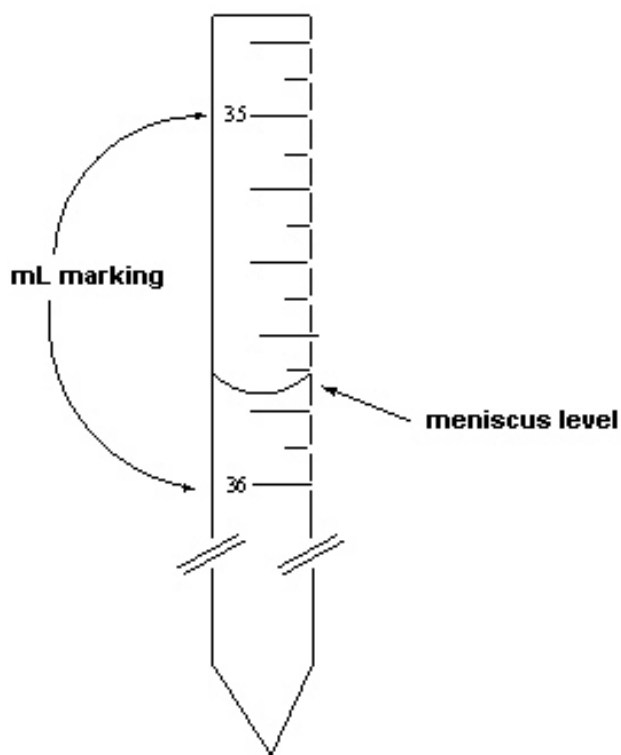
The density of ethanol was measured in two steps. The first step involved measuring its volume using a burette. The mass of this volume was then measured.

Refer to Exhibit 1-1. Look carefully at the figure above of the burette. Read the burette *at the bottom of the meniscus* as accurately as possible to the proper number of significant digits. What volume should be recorded for the volume *delivered* from this burette assuming the liquid level started at the top as zero milliliters?

- A. 36.25 mL
- B. 36.2 mL
- C. 35. mL
- D. 35.7 mL
- E. 35.75 mL

94. **Exhibit 1-1**

Consider the following figure that is a "blow-up" view of a region of a 50 mL burette to answer the following question(s).



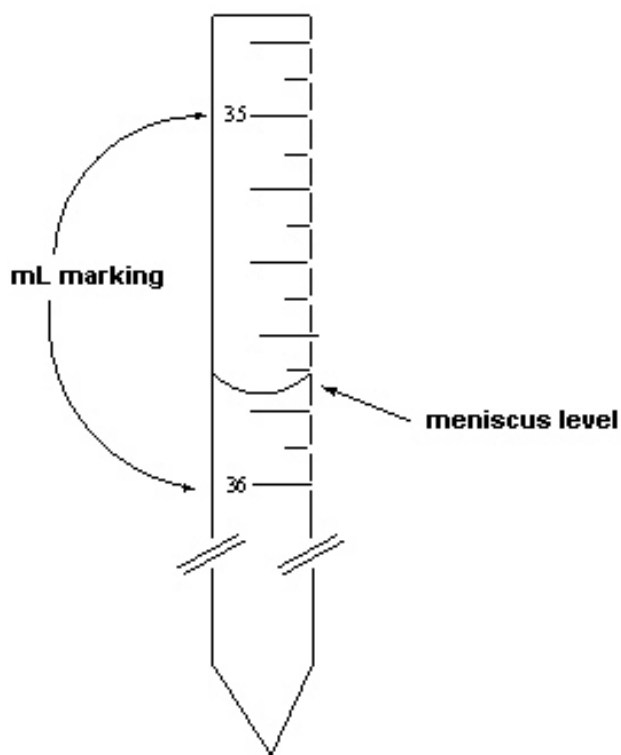
The density of ethanol was measured in two steps. The first step involved measuring its volume using a burette. The mass of this volume was then measured.

Refer to Exhibit 1-1. In the reported measurement above for the volume of the ethanol displaced from the burette (given in milliliters), what digit is the *digit of uncertainty*?

- A. the hundredths place (0.01)
- B. the tenths place (0.1)
- C. the ones place (1)
- D. the tens place (10)
- E. All digits are reported with certainty.

95. Exhibit 1-1

Consider the following figure that is a "blow-up" view of a region of a 50 mL burette to answer the following question(s).



The density of ethanol was measured in two steps. The first step involved measuring its volume using a burette. The mass of this volume was then measured.

Refer to Exhibit 1-1. If the mass of the ethanol delivered was 28.217 grams, what is the density of this liquid reported to the correct number of significant digits?

- A. 0.7893 g/mL
- B. 0.81 g/mL
- C. 0.790 g/mL
- D. 1.267 g/mL
- E. 0.7784 g/mL

Chapter 1--Introduction to Chemistry **Key**

1. Which of the following studies is not considered to be "Chemistry?"

- A. Studying the interactions between energy and matter.
- B. Classifying elements into metallic, nonmetallic or semimetallic.
- C. Studying the interactions between matter and other matter
- D. Removing harmful impurities from a synthetic drug.
- E.** Separating the light spectrum into its component colors.

2. Which does *not* represent a scientific investigation?

- A. Weighing the results of an experiment to obtain quantitative data.
- B.** Weighing lab reports on a chemical balance to determine the grade.
- C. Graphing the mass of a product as a function of the mass of the starting material.
- D. Determining the temperature at which the maximal amount of product is obtained.
- E. Trying different conditions if an initial experiment fails.

3. Which of the following is correctly classified as a hypothesis?

- A. "The sun will rise in the East today."
- B.** "Global warming is a result of the increased carbon dioxide concentration in the atmosphere."
- C. "Our team is better than theirs."
- D. "Cookies will turn brown when baked."
- E. "My book is better than yours."

4. All of the following are properties of Magnesium. Which would be considered a *chemical* property of magnesium?

- I. Magnesium burns in air to produce a white substance known as magnesium oxide.
- II. Magnesium dissolves in acidic water to produce hydrogen gas.
- III. The density of magnesium is 1.738 g/mL.

- A. I
- B. II
- C. III
- D.** I and II
- E. all of these

5. The following are properties of sodium metal. Which would be considered a *chemical property* of sodium metal?

- A. Sodium is a silvery-white metal
- B. Sodium has a melting point of 98 °C
- C. Sodium has a density equal to 0.968 g/mL.
- D.** Sodium reacts with water violently to produce hydrogen gas.
- E. Sodium metal is drawn into a magnetic field.

6. All of the following are properties of carbon dioxide, CO₂. Which of the following is a *chemical property* of this substance?

- A.** It reacts with water to form carbonic acid.
- B. It is a colorless gas at room temperature and 1 atm pressure.
- C. It is a solid below -78 °C.
- D. Its density as a solid equals 1.35 g/mL.
- E. None of these is a chemical property.

7. Of the three properties listed below, which ones are intensive properties?

- I. mass
- II. density
- III. color

- A. I and II
- B.** II and III
- C. II only
- D. I only
- E. I, II, and III

8. "A 33 g sample of red liquid at its freezing point of 260 K had a density of 0.926 g/mL." Which of the properties given in the previous statement is extensive?

- A.** 33 g
- B. red
- C. freezing point
- D. 260 K
- E. 0.926 g/mL

9. Which of the following is not a physical change?

- A. ice melting
- B. dry ice subliming
- C. a light-bulb glowing
- D. beef cooking**
- E. distilling alcohol

10. Which of the following is not a chemical change?

- A. developing a film
- B. refrigerating milk**
- C. eating beef
- D. extinguishing a fire
- E. frying an egg

11. Which of the following is considered a *chemical change*?

- A. Beef is browned by heating in a skillet.
- B. A blackberry changes colors from red to black.
- C. Addition of hydrogen peroxide to an open cut produces a white liquid and fizzing.
- D. a and b
- E. all of these.**

12. Which of the following would be considered a *chemical change*?

- I. Frost forms on the window
- II. A Silver fork tarnishes
- III. Toasting a slice of bread.

- A. I only
- B. I and II
- C. I and III
- D. II and III**
- E. All of these

13. Which of the following would be considered a *physical change*?

- A. gasoline burning
- B. salt dissolving in water**
- C. food spoiling
- D. iron rusting
- E. a battery discharging

14. Which of the following processes is considered a *chemical change*?

- I. Corrosion of aluminum metal
- II. Digesting a candy bar.
- III. Melting of ice.

- A. I only
- B. II only
- C. III only
- D.** I and II
- E. All of these

15. Which of the following represents a *chemical change*?

- A. Cutting a string into two pieces.
- B. Melting candle wax.
- C. Evaporation of water from a lake.
- D.** Rusting of an iron nail.
- E. Peeling an apple.

16. Which form of substances listed below cannot be separated into simpler substances by chemical or physical means?

- A.** an element
- B. a compound
- C. a heterogeneous mixture
- D. a homogeneous mixture
- E. All substances can be separated into simpler substances.

17. Identify the matter that is correctly classified as a mixture.

- A. ethyl alcohol
- B. carbon dioxide
- C. water
- D. tin
- E.** air

18. Which of the following is a heterogeneous mixture?

- A. salt water
- B. salt
- C. milk
- D.** sand
- E. water

19. How can "oil and vinegar" be classified? (Two phases are present.)

- A. pure substance
- B. element
- C. compound
- D. homogeneous mixture
- E. heterogeneous mixture**

20. A glass of tea with a uniform composition throughout would be an example of a(n) ____.

- A. pure substance
- B. element
- C. compound
- D. homogeneous mixture**
- E. heterogeneous mixture

21. Which of the following is an example of a *homogeneous mixture*?

- I. Water and dissolved salt
- II. Water and sand
- III. Carbonated water (soda) and ice

- A. I only**
- B. II only
- C. III only
- D. I and II
- E. All of these

22. Which of the following best describes a *compound*?

- A. A compound is a *mixture* that can be separated into its constituent elements using *physical methods*.
- B. A compound is a *mixture* that can be separated into its constituent elements using *chemical methods*.
- C. A compound is a *pure substance* that can be separated into its constituent elements using *physical methods*.
- D. A compound is a *pure substance* that can be separated into its constituent elements using *chemical methods*.**

23. Which of the following best describes a *mixture*?

- A. It's *composition* can vary but its *properties* remain constant.
- B. It's *composition* and *properties* can vary.**
- C. It's *composition* remains constant but its *properties* varies.
- D. It's *composition* and *properties* remains constant.

24. Which of the following best describes an element?

- A. An element is a *mixture* that can be separated into simpler substances using *physical methods*.
- B. An element is a *mixture* that can be separated into simpler substances using *chemical methods*.
- C. An element is a *pure substance* that can be separated into simpler substances using *physical methods*.
- D. An element is a *pure substance* that can be separated into simpler substances using *chemical methods*.
- E.** An element is a pure substance that cannot be separated into simpler substances using ordinary physical or chemical methods.

25. Which is properly classified as a compound?

- A. salt water
- B.** salt
- C. wine
- D. bread
- E. copper

26. Which of the following is not an element?

- A. niobium
- B. thallium
- C. silicon
- D. sodium
- E.** ammonium

27. The elements Carbon, Lead, and Magnesium are designated by what chemical symbols respectively?

- A. C, L, M
- B. Ca, Le, Ma
- C. C, Pb, Mn
- D.** C, Pb, Mg
- E. Ca, Pb, Mn

28. What is the chemical symbol for the element *tin*?

- A. T
- B.** Sn
- C. Ti
- D. Tn
- E. St

29. Which of the following matched pairs of elemental names and chemical symbols is properly labeled?

- I. Magnesium, Mg
- II. Mercury, M
- III. Silver, Si
- IV. Sodium, S
- V. Oxygen, O

- A. I only
- B. II and III
- C. I and V**
- D. I, IV and V
- E. All are properly labeled

30. Which of the following matched pairs of elemental names and chemical symbols is properly labeled?

- I. Calcium, C
- II. Plutonium, Pt
- III. Silicon, Si
- IV. Iron, I
- V. Nitrogen, N

- A. I, IV and V
- B. II, III and V
- C. I, III, IV and V
- D. III and V**
- E. All are properly labeled

31. The definition "stable pure substance that cannot be separated into simpler substances by chemical means" would best fit which term listed below?

- A. element**
- B. compound
- C. atom
- D. molecule
- E. xanon

32. A compound is:

- A. a pure substance that can be decomposed chemically.**
- B. a characteristic that describes a substance.
- C. a pure substance that cannot be decomposed chemically.
- D. a combination of atoms.
- E. none of these.

33. A precise measurement

- A. is known to two or more significant figures.
- B. is known to two or more decimal places.
- C. is repeatable.**
- D. is close to the correct answer
- E. is beyond the scope of a first-year chemistry student.

34. An accurate measurement

- A. is known to two or more significant figures.
- B. is known to two or more decimal places.
- C. is repeatable.
- D. is close to the correct answer**
- E. is beyond the scope of a first year chemistry student.

35. Which of the following volume measurements is the *least precise* measurement?

- A. 1.0 mL
- B. 2.018 mL
- C. 2.02 mL
- D. 2.022 mL
- E. 3 mL**

36. Three students measured the density of pure water in the laboratory. Their results are as follows:

Student 1:	Density = 1.20 g/mL
Student 2:	Density = 1.21 g/mL
Student 3:	Density = 1.19 g/mL

The actual density of water at 25 °C equals 0.997 g/mL. What do the results of these three experiments demonstrate when compared to the true density of water?

- A. High accuracy and high precision
- B. High accuracy and low precision
- C. Low accuracy and high precision**
- D. Low accuracy and low precision
- E. None of these

37. Three students measured the freezing temperature of water in the laboratory. Their results are as follows:

Student 1:	freezing temperature = 2.86 °C
Student 2:	freezing temperature = -4.52 °C
Student 3:	freezing temperature = 3.21 °C

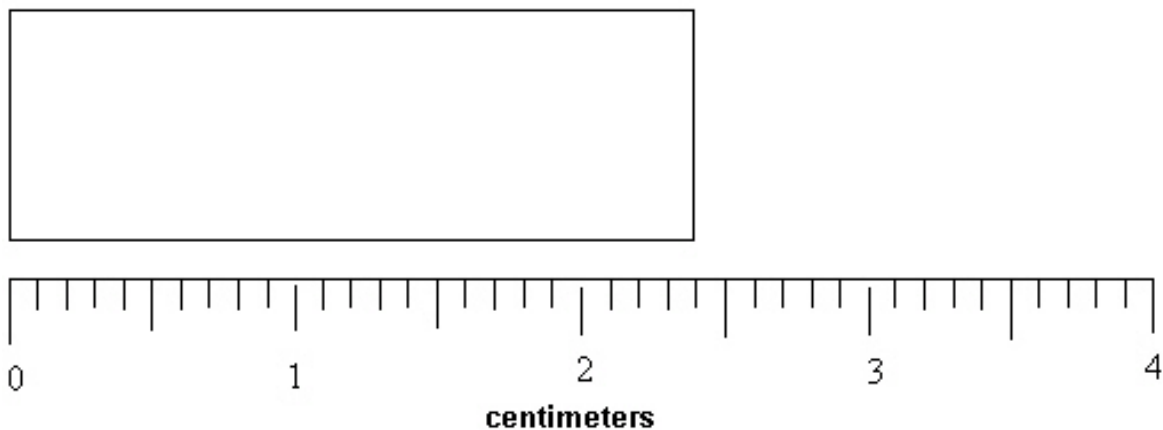
The actual freezing temperature of water equals $0.00\text{ }^{\circ}\text{C}$. The results of these three students when compared to the true freezing temperature of water demonstrates:

- A. High accuracy and high precision
- B. High accuracy and low precision
- C. Low accuracy and high precision
- D. low accuracy and low precision**
- E. None of these

38. Which of the following measurements is considered a combination of one of the seven base units from which all other measurements can be made?

- A. mass
- B. volume**
- C. amount
- D. temperature
- E. time

39. What length in *millimeters* can be reported for the rectangle below? (Note that the ruler measures in centimeters.)

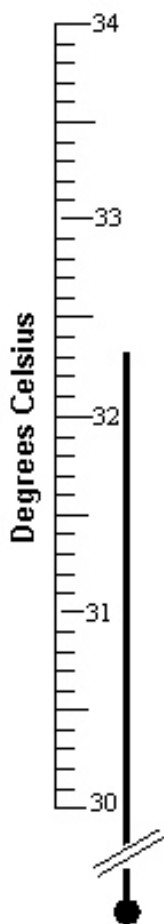


- A. 24 mm
- B. 24.0 mm**
- C. 2.4 mm
- D. 2.40 mm
- E. 240 mm

40. In the reported measurement of 24.0 mm, what digit is *uncertain*?

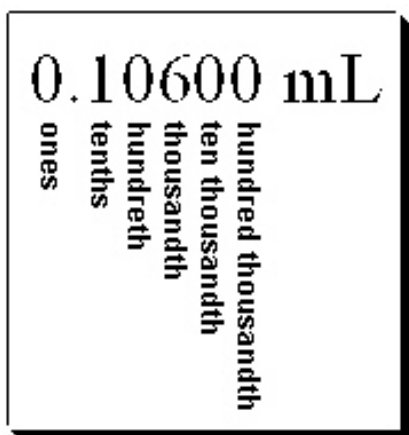
- A. tens place
- B. in the ones place
- C. in the tenths place**
- D. in the hundredths place
- E. All places are reported with certainty.

41. What is the temperature given by the thermometer below written with the proper number of significant digits?



- A. 32.3 °C
- B. 32.30 °C**
- C. 32 °C
- D. 32.300 °C
- E. 30 °C

42. What digit(s) is(are) considered the digit of *uncertainty* in the following measurement?



- A. thousandths place
- B. ones, hundredths, ten thousandths and hundred thousandths places
- C. ten thousandths place
- D.** hundred thousandths place
- E. millionth place

43. How many significant digits are there in 0.0050 mL?

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

44. Choose the *best* answer to the following math problem (*with the proper number of significant digits and rounded correctly*).

$$(12.3432 - 8.84) \cdot 22.48 = ??$$

- A. 78.751936
- B. 78.75
- C. 78.76
- D.** 78.8
- E. 78.752

45. Two students combined two different volumes of water. The first student measured 25.4 mL of water using a 100.0 mL graduated cylinder and the second student measured 0.15 mL of water using a 50.00 mL burette. What total volume should be reported after taking into account significant digits and the convention used for rounding?

- A. 25 mL
- B. 25.5 mL
- C. 25.55 mL
- D.** 25.6 mL
- E. 26 mL

46. Which measurements below have four significant digits?

	Measurement
I.	0.023 mL
II.	2300 mL
III.	1700. mL
IV.	0.004050 mL

- A. all of these have four significant digits
- B. I, II and III
- C. II, III, and IV
- D. I and II
- E.** III and IV

47. Three problems are worked below. Choose the answer that properly describes the correct use of significant digits

I.

$$\begin{array}{r} 0.34 \\ +14.2 \\ \hline 14.5 \end{array}$$

II.

$$\begin{array}{r} 14.3 \\ ' 2.0 \\ \hline 28.6 \end{array}$$

III.

$$\begin{array}{r} 14.21 \\ ' 134 \\ \hline 1.90 \times 10^3 \end{array}$$

- A. I and II are correct, III is incorrect
- B.** I and III are correct, II is incorrect
- C. II and III are correct, I is incorrect
- D. all three are correct
- E. none of these

48. Properly expressed, the answer to the mathematical manipulation $(0.243 \times 4.2) + 21 =$ is:

- A.** 22
- B. 22.0
- C. 2.2×10^2
- D. 22.02
- E. 2.202×10^2

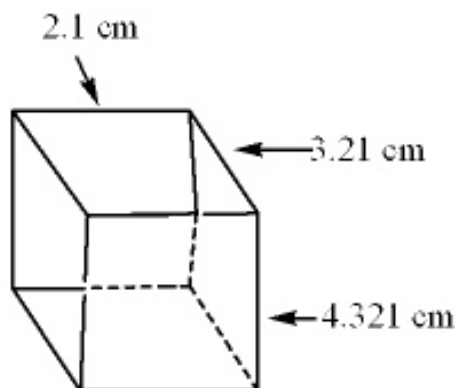
49. The correct answer for $(1.22 \times 10^3) \times 0.013$ is:

- A. 15.8
- B. 158
- C. 16**
- D. 15.86
- E. 93846

50. What is the density of mercury when reported to the proper number of significant digits and in scientific notation if a sample is found to have a mass of 524.5 g and occupies a volume of 38.72 mL?

- A. 7.38×10^{-2} g/mL
- B. 7.382×10^{-2} g/mL
- C. 1.35×10^1 g/mL
- D. 1.354×10^1 g/mL
- E. 1.355×10^1 g/mL**

51. The dimensions of the following cube were measured. What would be the volume of this cube expressed to the proper number of significant digits? (Volume = $l \times w \times d$)



- A. 29.127861 cm³
- B. 29.13 cm³
- C. 29.1 cm³
- D. 29. cm³**
- E. 30 cm³

52. The number 486,000 is equal to:

- A. 4.86×10^2
- B. 4.86×10^{-4}
- C. 4.86×10^3
- D. 4.86×10^4
- E. 4.86×10^5**

53. The number 0.00042 is equal to:

- A. 4.2×10^4
- B. 4.2×10^{-4}**
- C. 4.2×10^3
- D. 4.2×10^{-3}
- E. 4.2×10^{-2}

54. How would the measurement, 5125 m, be rounded off to three significant digits and expressed in *scientific notation*?

- A. 5.12×10^{-3} m
- B. 5.13×10^{-3} m
- C. 5.130×10^{-3} m
- D. 5.12×10^3 m**
- E. 5.13×10^4 m

55. Which is an abbreviation for an SI base unit?

- A. J
- B. kg**
- C. Nt
- D. °C
- E. L

56. Which metric prefix(es) listed below is(are) correctly assigned the proper power of ten?

- I. giga: 10^9
- II. micro: 10^6
- III. nano: 10^{-12}

- A. I only**
- B. II only
- C. III only
- D. I and II
- E. II and III

57. Which metric prefix(es) listed below is(are) *correctly* assigned the proper power of ten?

- I. deci: 10^1
- II. nano: 10^{-6}
- III. mega: 10^6

- A. I only
- B. II only
- C. III only**
- D. I and II
- E. All of these

58. Which metric prefix listed below has a power of 10^{-12} associated with it?

- A. centi
- B. micro
- C. milli
- D. kilo
- E. pico**

59. What prefix is used to indicate a base unit multiplied by 10^{-1} ?

- A. deca
- B. centi
- C. milli
- D. deci**
- E. micro

60. What prefix is used to indicate a base unit multiplied by 10^{-6} ?

- A. kilo
- B. mega
- C. micro**
- D. centi
- E. deca

61. How many nanometers are present in 4.5 cm?

- A. 4.5×10^{-9} nm
- B. 4.5×10^{-7} nm
- C. 4.5×10^6 nm
- D. 4.5×10^7 nm**
- E. 4.5×10^{11} nm

62. How many micrometers, μm , are present in 0.575 mm?

- A. 5.75×10^{-10} μm
- B. 5.75×10^{-4} μm
- C. 5.75×10^1 μm
- D. 5.75×10^2 μm**
- E. 5.75×10^8 μm

63. Analysis shows the presence of 203 mg of cholesterol in a sample of blood. How many *grams* of cholesterol are present in this blood sample?

- A. 2.03×10^{-6} g
- B. 2.03×10^{-4} g**
- C. 2.03×10^2 g
- D. 2.03×10^6 g
- E. 2.03×10^8 g

64. The diameter of a US Quarter is approximately 2.35 cm. What is the diameter of a quarter expressed in *km* and *scientific notation*?

- A. 2.35×10^{-5} km**
- B. 2.35×10^5 km
- C. 2.35×10^{-2} km
- D. 23.5×10^{-4} km
- E. 2.35 km

65. Express a mass of 0.0220 kg in grams.

- A. 22.0 g**
- B. 2.20×10^{-5} g
- C. 2.20×10^{-3} g
- D. 4.84×10^{-2} g
- E. 0.0100 g

66. Express 15 inches in cm.

- A. 2.5 cm
- B. 5.9 cm
- C. 38 cm**
- D. 38.1 cm
- E. 38.10 cm

67. An object measures 1.92 meters in length. What is this object's length in feet? (1 inch = 2.54 cm)

- A. 9.07×10^{-2} ft
- B. 5.85×10^{-1} ft
- C. 6.30 ft**
- D. 4.06×10^1 ft
- E. 9.07×10^2 ft

68. The smallest bone in the human body, which is in the ear, has a mass of 0.0030 grams. What is this mass in pounds? (1 pound = 454 grams)

- A.** 6.6×10^{-6} pounds
- B. 3.0×10^{-3} pounds
- C. 0.73 pounds
- D. 1.4 pounds
- E. 1.5×10^5 pounds

69. How many gallons are present in 43.7 Liters? (1 gallon = 4 quarts and 1 quart = 0.946 L)

- A. 10.3 gallons
- B.** 11.5 gallons
- C. 46.2 gallons
- D. 165 gallons
- E. 185 gallons

70. A person weighs 83.2 kg. What is this person's weight in pounds? (1.00 pound = 454 grams)

- A. 0.183 pounds
- B. 5.46 pounds
- C. 37.8 pounds
- D.** 183 pounds
- E. 3.78×10^7 pounds

71. The atomic radius of a beryllium atom is 111 pm. Express this distance in inches.

- A. 2.67×10^{-8} inch
- B.** 4.37×10^{-9} inch
- C. 2.42×10^{-13} inch
- D. 4.37×10^{-13} inch
- E. 43.7 inch

72. In a new measuring system created by your instructor, 2.16 geb = 1.02 red. How many geb is 7.4 red?

- A. 3.5 geb
- B. 3.49 geb
- C. 15.7 geb
- D.** 16 geb
- E. 1.57 geb

73. The speed of light in a vacuum is 2.998×10^8 m/s. What is this speed given in cm/min?

- A. 1.799×10^{13} cm/min
- B. 1.799×10^{12} cm/min**
- C. 4.997×10^8 cm/min
- D. 1.799×10^8 cm/min
- E. 4.997×10^4 cm/min

74. The speed limit is 70 miles per hour on some stretches of the interstate. What is this same speed in meters per second, (m/s)? (1 mile = 1.60 km)

- A. 1.9 m/s
- B. 31 m/s**
- C. 1.6×10^2 m/s
- D. 1.1×10^5 m/s
- E. 1.1×10^2 m/s

75. The speed limit on the interstate in Virginia is 65 miles per hour. What is this speed in kilometers per second? (1 km = 0.621 miles, 1 hour = 60 minutes and 1 minute = 60 seconds)

- A. 0.029 km/sec**
- B. 34. km/sec
- C. 40. km/sec
- D. 55. km/sec
- E. 1.0×10^2 km/sec

76. A car travels 28.0 miles per gallon of gasoline. How many kilometers per liter will it go? (1 mile = 1.6093 km and 1 gallon = 3.7854 L)

- A. 5.86×10^{-3} km/L
- B. 4.60 km/L
- C. 11.9 km/L**
- D. 65.9 km/L
- E. 170 km/L

77. What is the speed of an automobile given in miles per second (miles/sec) that is traveling 80. kilometer per hour (km/hour)? (1 km = 0.621 miles; 1 hour = 60 min; 1 min = 60 sec)

- A. 1.4×10^{-2} miles/s**
- B. 3.6×10^{-2} miles/s
- C. 50 miles/s
- D. 1.3×10^2 miles/s
- E. 1.8×10^5 miles/s

78. The area of a telescope lens is 5773 mm^2 . What is this area given in square feet, ft^2 ? (1 inch = 2.54 cm)

- A.** $6.214 \times 10^{-2} \text{ ft}^2$
- B. 8.948 ft^2
- C. $1.894 \times 10^1 \text{ ft}^2$
- D. $1.288 \times 10^3 \text{ ft}^2$
- E. $5.363 \times 10^4 \text{ ft}^2$

79. The area of a US quarter is approximately $4.5 \times 10^2 \text{ mm}^2$. What is the area of a US quarter in square inches, (in^2)? (1 in = 2.54 cm)

- A.** $7.0 \times 10^{-1} \text{ in}^2$
- B. $1.8 \times 10^1 \text{ in}^2$
- C. $2.9 \times 10^5 \text{ in}^2$
- D. $1.8 \times 10^{-1} \text{ in}^2$
- E. $1.1 \times 10^4 \text{ in}^2$

80. A carpenter must lay a floor that covers 1500 ft^2 . What is this area in cm^2 ? (1 foot = 12 inches and 1 inch = 2.54 cm)

- A. 1.6 cm^2
- B. 49 cm^2
- C. $3.2 \times 10^2 \text{ cm}^2$
- D. $4.6 \times 10^4 \text{ cm}^2$
- E.** $1.4 \times 10^6 \text{ cm}^2$

81. Convert 38°F to the Celsius scale.

- A.** 3.3°C
- B. 8.2°C
- C. -40°C
- D. 4.5°C
- E. 311°C

82. Convert 26°C to kelvins.

- A. 288 K
- B. 321 K
- C. 204 K
- D.** 299 K
- E. 53.3 K

83. A heat stroke normally occurs at 106 °F. What temperature is this when converted to the Kelvin scale?

- A. -232 K
- B. -50.2 K
- C. 223 K
- D.** 314 K
- E. 496 K

84. A comfortable temperature for bath water is 95 °F. What temperature is this on the Kelvin scale?

- A. -238 K
- B. 35 K
- C. 171 K
- D.** 308 K
- E. 476 K

85. The temperature of liquid nitrogen is 77 K. What is this temperature on the Fahrenheit scale?

- A. -196 °F
- B.** -321 °F
- C. 350 °F
- D. 662 °F
- E. -385 °F

86. Liquid Helium boils at 4 K. What temperature is this in degrees Fahrenheit?

- A.** -452 °F
- B. -269 °F
- C. -167 °F
- D. 136 °F
- E. 531 °F

87. The temperature that pure iron melts is 2795 °F. What is this temperature on the Kelvin scale?

- A. 1262 K
- B. 1535 K
- C.** 1808 K
- D. 1843 K
- E. 4790 K

88. What is the mass of 25.0 mL of an oil if its density is 0.843 g/mL?

- A. 29.7 g
- B. 21.1 g**
- C. 15.2 g
- D. 38.4 g
- E. 211 g

89. What is the volume of 25.0 g of an oil if its density is 0.843 g/mL?

- A. 29.7 mL**
- B. 21.1 mL
- C. 15.2 mL
- D. 38.4 mL
- E. 211 mL

90. What volume of gold has a mass of 25.0 grams? (Density of gold = 19.30 g/mL)

- A. 2.07×10^{-3} mL
- B. 0.772 mL
- C. 1.30 mL**
- D. 25.0 mL
- E. 482 mL

91. What mass of platinum occupies a volume of 75.00 cm³? (Density of platinum = 21.45 g/cm³)

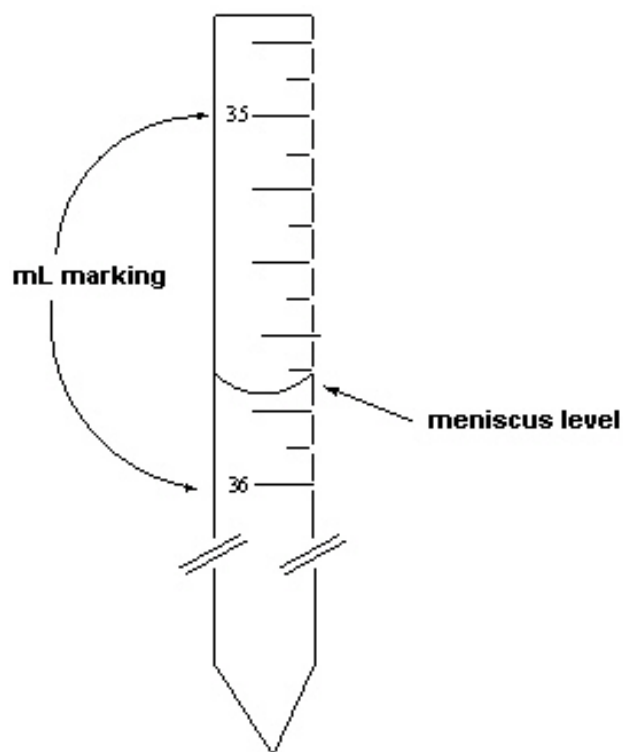
- A. 0.2860 g
- B. 3.497 g
- C. 21.45 g
- D. 75.00 g
- E. 1609 g**

92. What is the volume of a 100.0 gram bar of silver metal? (Density of Silver = 10.40 g/mL)

- A. 9.615×10^{-4} mL
- B. 1.040×10^{-1} mL
- C. 9.615 mL**
- D. 1.040×10^3 mL
- E. 100.0 mL

93. **Exhibit 1-1**

Consider the following figure that is a "blow-up" view of a region of a 50 mL burette to answer the following question(s).



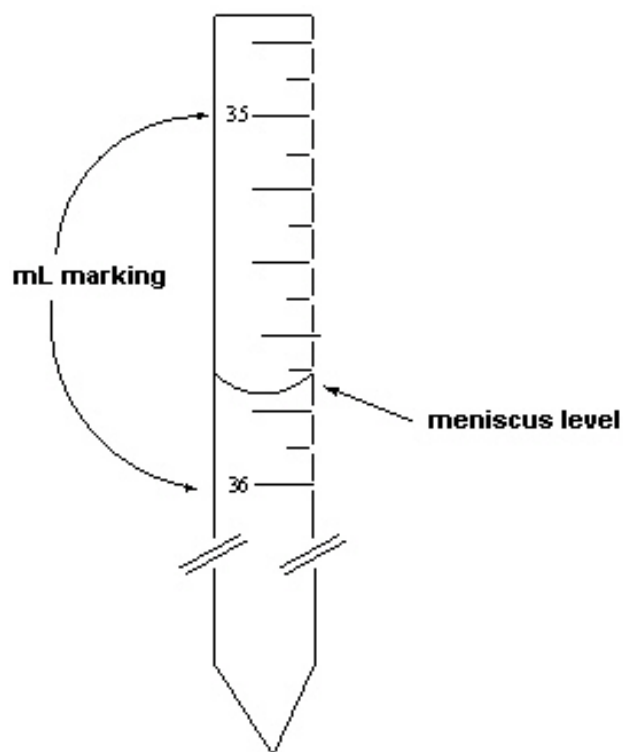
The density of ethanol was measured in two steps. The first step involved measuring its volume using a burette. The mass of this volume was then measured.

Refer to Exhibit 1-1. Look carefully at the figure above of the burette. Read the burette *at the bottom of the meniscus* as accurately as possible to the proper number of significant digits. What volume should be recorded for the volume *delivered* from this burette assuming the liquid level started at the top as zero milliliters?

- A. 36.25 mL
- B. 36.2 mL
- C. 35. mL
- D. 35.7 mL
- E.** 35.75 mL

94. **Exhibit 1-1**

Consider the following figure that is a "blow-up" view of a region of a 50 mL burette to answer the following question(s).



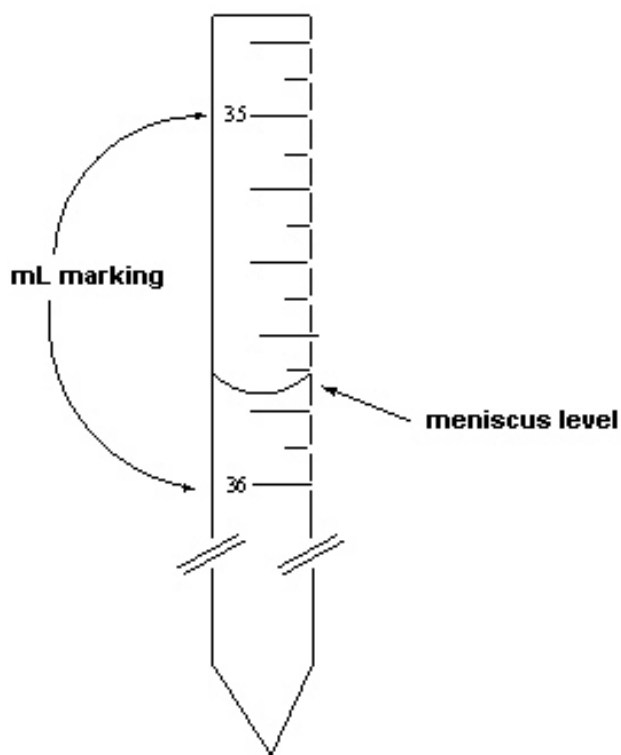
The density of ethanol was measured in two steps. The first step involved measuring its volume using a burette. The mass of this volume was then measured.

Refer to Exhibit 1-1. In the reported measurement above for the volume of the ethanol displaced from the burette (given in milliliters), what digit is the *digit of uncertainty*?

- A. the hundredths place (0.01)
- B. the tenths place (0.1)
- C. the ones place (1)
- D. the tens place (10)
- E. All digits are reported with certainty.

95. **Exhibit 1-1**

Consider the following figure that is a "blow-up" view of a region of a 50 mL burette to answer the following question(s).



The density of ethanol was measured in two steps. The first step involved measuring its volume using a burette. The mass of this volume was then measured.

Refer to Exhibit 1-1. If the mass of the ethanol delivered was 28.217 grams, what is the density of this liquid reported to the correct number of significant digits?

- A. 0.7893 g/mL
- B. 0.81 g/mL
- C. 0.790 g/mL
- D. 1.267 g/mL
- E. 0.7784 g/mL