2. Distinguish between the accuracy and precision of a measurement.

Accuracy - Agreement of measured value with true or accepted value for an object.
Precision - Agreement of measured values to each other for an object.

3. Identify the number of significant figures in a measurement.
   a. 0.421
   b. 78.00 m
   c. 320 g

4. Use the rules for significant figures in calculations to correctly round off numbers.
   a. Round off 8630 km to two significant figures.
   b. Round off 0.01025 m to three significant figures.
   c. Round off 0.00543 L to two significant figures.
   d. Round off 7.013 g to three significant figures.
   e. Round off 0.003629 mm to three significant figures.

3. How many significant figures are in the measurement 40.04 cm²?

4. How many significant figures are in the measurement 400.000 cm²?

5. How many significant figures are in the measurement 3.15 cm²?

6. If the measurement in Question 5 were multiplied by another number, what is the maximum number of significant figures the product could have?
7. If the measurement in Question 5 were added to another number, what is the maximum number of significant decimal places the sum could have?

Match the numbers on the left with the correct scientific notation on the right.

a. 0.000 71
   b. 71 000
   c. 71.000
   d. 710.00
   e. 0.710 00

Match the numbers on the left with the correct number of significant figures on the right.

a. 0.000 370
   b. 1.000 37
   c. 100
   d. 0.10
   e. 10.01
   f. 0.001 000 3
USING CONCEPTS

How many significant digits are in each of the following numbers?

a. 1.005 \( \text{g} \)  
    b. 10 000 \( \text{g} \)  
    c. 74 200 \( \text{g} \)  
    d. 0.000 010 \( \text{g} \)

Fill in the blanks.

a. \( 1 \text{ m}^3 = \frac{1 \times 10^6}{1} \text{ cm}^3 \)  
   b. \( 1 \text{ m}^3 = \frac{1 \times 10^3}{1} \text{ liters} \)  
   c. \( 4.13 \text{ mL} = \frac{4.13 \times 10^3}{1} \text{ cm}^3 \)

Fill in the blanks.

a. \( 2 \text{ m} = \frac{2 \times 10^3}{1} \text{ cm} \)  
   b. \( 4.62 \text{ L} = \frac{4.62 \times 10^3}{1} \text{ mL} \)  
   c. \( 0.4 \text{ kg} = \frac{4 \times 10^2}{1} \text{ g} \)

Write the following numbers in scientific notation.

1. 512
2. 35 615
3. 885 326 251
4. 0.000 40
5. 0.010 01

Write the following numbers in standard notation.

6. \( 3.0 \times 10^6 \)
7. \( 1.49 \times 10^{-5} \)
8. \( 5.000 102 \times 10^3 \)
9. \( 4.4 \times 10^{-7} \)
10. \( 9.993 \times 10^{-2} \)

Express the following numbers either in scientific notation or in conventional form.

Standard Scientific Notation:  

a. 93 000 000 \( \text{g} \)  
   b. 0.000 000 070 42 \( \text{g} \)  
   c. 1.00 \( \text{g} \)

d. 6.200 \( \times 10^{-3} \)
e. 3.14 \( \times 10^6 \)
f. \( 1 \times 10^1 \)

Multiply the following. Be sure the correct number of significant digits appears in the answer.

a. \( 2.1 \times 0.4700 = \frac{1 \times 10^{-4}}{} \)  
   b. \( 6000 \times 0.144 = \frac{1 \times 10^2}{10} \)  

Add the following numbers. Be sure the answer contains the correct number of decimal places.

\[
\begin{align*}
40.0 \text{ g} & \quad 0.0067 \text{ cm} \\
0.7631 \text{ g} & \quad 0.1004 \text{ cm} \\
5000.112 \text{ g} & \quad 3 \text{ cm} \\
610.70 \text{ g} & \quad 7.00002 \text{ cm} \\
& \quad 1 \text{ cm}
\end{align*}
\]

Perform the following operations.

a. \( (2.1 \times 10^6)(4.0 \times 10^{-1}) = \frac{4.0 \times 10^4}{8.0 \times 10^2} \)  
   b. \( \frac{1.6 \times 10^{-6}}{8.0 \times 10^{-3}} = \frac{2 \times 10^{-3}}{} \)  

\[
\begin{align*}
c. \quad & \frac{4.0 \times 10^4}{+6 \times 10^3} \\
d. & \frac{8.0 \times 10^{-4}}{-9 \times 10^{-5}}
\end{align*}
\]
CHEMISTRY: SIGNIFICANT FIGURES/SCIENTIFIC NOTATION
CALCULATING WITH SF & SN

1. List the two main causes of error or uncertainty in measurements.
   
   human error / instrument error

2. What general relationship does the number of significant figures found in a measurement have to the accuracy of that measurement?
   
   the greater the # of SF's the greater the accuracy

3. In science, precise measurements are always accurate measurements. TRUE or FALSE. FALSE

(Q:4-8) Indicate the number of SF's in the following measurements:

4. 1200.0023 cm 8
5. 57.00 g
6. 1.0020 L

(Q:9-13) Perform the following calculations and report your answer to the correct number of SF's:

9. 3.24 cm + 9.11 cm + 2 cm = 14 cm
10. 10.89 kg - 4.123 kg = 6.77 kg
11. 11.44 L + 6.043 L - 2.1257 L = 15.31 L
12. 2.20 s x 4.1 s = 9.05 s
13. 6.464 mm ÷ 2.1 mm = 3.1

(Q:14-15) Convert the following numbers into $SN$:

14. 243500000 2.435 x $10^8$
15. 0.00004315 4.315 x $10^{-5}$

(Q:16-17) Convert the following numbers from $SN$ into expanded form:

16. 4.065 x $10^3$
17. 3.002 x $10^{-4}$

(Q:18-20) Perform the following calculations using $SN$:

18. (2.2 x $10^3 m$) x (1.0 x $10^{-4} m$) = 2.2 x $10^3 m^2$
19. 4.44 x $10^5 m$ ÷ 2.0 x $10^2 = 2.2 x 10^3 m$
20. 7.33 x $10^5 + 3.11 x 10^4 - 2.3 x 10^3 = 7.66 x 10^5$
Key: Chap 3 Practice Problems

16. $2.023 \times 10^{-3} \text{mg} = ? \text{kg} = 2.023 \times 10^{-9} \text{kg}$

17. $9.94 \times 10^3 \text{g} = ? \text{kg} = 9.94 \times 10^{-1} \text{kg}$

18. $0.00031 \text{g} = ? \text{mg} = 0.00031 \text{mg}$

19. $1.94 \times 10^{-1} \text{g} = ? \text{dg} = 1.94 \text{dg}$

20. $0.2 \times 10^{4} \text{mg} = ? \text{g} = 0.2 \times 10^{-2} \text{g}$

21. $0.5 \times 10^{3} \text{dm}^3 = ? \text{cm}^3 = 5 \times 10^2 \text{cm}^3$

22. $4 \times 10^{-3} \text{m}^3 = ? \text{cm}^3 = 4 \times 10^3 \text{cm}^3$

23. $1.738 \times 10^3 \text{kg} = ? \text{t} = 1.738 \times 10^{-3} \text{t}$

24. $8.063 \text{m}^3 = ? \text{dm}^3 = 8.063 \times 10^3 \text{dm}^3$

25. $5.94 \times 10^{-3} \text{dm}^3 = ? \text{cm}^3 = 5.94 \times 10^{-2} \text{cm}^3$

26. $1.6 \times 10^{-3} \text{m}^3 = ? \text{cm}^3 = 1.6 \times 10^3 \text{cm}^3$

27. $8.301 \times 10^{-2} \text{cm}^3 = ? \text{mm}^3 = 8.301 \times 10^{-2} \text{mm}^3$

28. $4.261 \times 10^{-3} \text{kg} = ? \text{mg} = 4.261 \times 10^3 \text{mg}$

29. $1.07 \times 0.0283 \times 0.095 \text{m} = 2.13 \times 10^{-3} \text{m}^3 = 2.14 \text{cm}^3$

30. $587 \times 93.5 \times 103.2 \text{mm} = 5.87 \times 10^4 \text{mm}^3 = 5.87 \times 10^2 \text{cm}^3$
A. DISCOVERING CONCEPTS

Circle the letter in front of the best answer to complete each statement.

1. The International System (SI) of measurement is a modern version of the __________ system of measurement.
   a. English  b. Metric

2. __________ depends on the distance between an object and the center of the earth.

3. An object's mass __________ as the object is moved from sea level to the top of a mountain.
   a. increases  b. decreases  c. remains the same

4. The unit used to express our basic standard of time is the __________.
   a. second  b. day  c. month  d. year

5. The unit of __________ is the kelvin (K).
   a. time  b. temperature  c. mass  d. length

6. The temperature of a bucket of boiling water is __________ the temperature of a glass of boiling water.
   a. higher than  b. lower than  c. the same as

7. A bucket of boiling water has __________ heat energy than/as a glass of boiling water.
   a. less  b. more  c. the same

8. The Celsius temperature scale has __________ degrees between the boiling and freezing points of water.
   a. 32  b. 100  c. 180  d. 212

9. The units used to express measurements of speed, area, and volume are called __________ units.
   a. precise  b. derived  c. significant  d. basic

10. The newton (N) is a unit of __________.
    a. mass  b. length  c. weight force  d. volume

11. The standard __________ is defined in terms of the wavelength of a particular color of light.
    a. kilogram  b. second  c. meter  d. degree

12. __________ is expressed as a length per unit time.
    a. Density  b. Area  c. Volume  d. Speed

13. The density of 1 kg of lead is __________ the density of 1 kg of feathers.
    a. more than  b. less than  c. the same as

14. The density of 1 kg of lead is __________ the density of 1 g of lead.
    a. more than  b. less than  c. the same as

15. The mass of 1 kg of lead is __________ the mass of 1 kg of water.
    a. more than  b. less than  c. the same as
B. INTERPRETING CONCEPTS

1. Circle the arrow indicating the direction heat will flow between the objects.

2. Match the prefixes with their equivalents.
   
a. micro (µ)  
   b. kilo (k)  
   c. deka (da)  
   d. deci (d)  
   e. centi (c)  
   f. hecto (h)  
   g. giga (G)  
   h. milli (m)  
   i. nano (n)  

   (1) 1/1 000 000 000 (billionth)  
   (2) 1/1 000 000 (millionth)  
   (3) 1/1 000 (thousandth)  
   (4) 1/100 (hundredth)  
   (5) 1/10 (tenth)  
   (6) 10 (ten)  
   (7) 100 (hundred)  
   (8) 1000 (thousand)  
   (9) 1 000 000 (million)  
   (10) 1 000 000 000 (billion)

3. Fill in the blanks correctly.
   
a. g/cm³ is a unit of **density**.  
b. cm/s is a unit of **speed**.  
c. cm² is a unit of **area**.  
d. m³ is a unit of **volume**.

4. Match the numbers on the left with the correct scientific notation on the right.
   
a. 0.000 71  
b. 71 000  
c. 71.000  
d. 710.00  
e. 0.710 00  

   (1) 7.1000 × 10⁻²  
   (2) 7.1 × 10⁴  
   (3) 7.10000 × 10¹  
   (4) 7.1 × 10⁻⁴  
   (5) 7.1000 × 10⁻¹

5. Match the numbers on the left with the correct number of significant figures on the right.
   
a. 0.000 370 m  
b. 1.000 37 m  
c. 100 m  
d. 0.10 m  
e. 1001 m  
f. 0.001 000 3 m  

   (1) 1  
   (2) 2  
   (3) 3  
   (4) 4  
   (5) 5  
   (6) 6

6. The answer to the following problem should be expressed in units of \( \frac{\text{m}}{\text{yr}} \).

\[ \frac{5 \text{yr}}{60 \text{ s}} \times \frac{60 \text{ min}}{1 \text{ min}} \times \frac{24 \text{ hr}}{1 \text{ day}} \times \frac{365 \text{ days}}{1 \text{ yr}} = \]