1.5: Measurements and Problem-Solving (Exercises)

These are homework exercises to accompany Chapter 1 of the University of Kentucky's LibreText for CHE 103 - Chemistry for Allied Health. Solutions are available below the questions.

Questions

1.1: Measurements Matter

(click here for solutions)

Q1.1.1

Express the following values in scientific notation.

a. 150,000,000
b. 0.000043
c. 332000
d. 0.0293
e. 932
f. 0.1873
g. 78,000
h. 0.0001
i. 4500
j. 0.00290
k. 6281
l. 0.00700

Q1.1.2

Express the following values in decimal notation.

a. 3.8×10^{-3}
b. 9.21×10^{5}
c. 7.91×10^{-2}
d. 2.5×10^{6}
e. 3.42×10^{-8}
f. 5.4×10^{5}
g. 3×10^{-3}
h. 7.34×10^{2}
i. 9.8×10^{-4}
j. 6×10^{7}
k. 4.20×10^{-6}
l. 4.20×10^{6}

Q1.1.3

What SI base unit would be appropriate for each measurement?

a. the length of a room
b. the amount of carbon in a diamond
c. the mass of NaCl in a bottle

Q1.1.4

List the meaning of each abbreviation of the base units.

a. m
b. K
c. kg
d. s

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e. mol

Q1.1.5

What is the the derived unit from the SI base units for the relationship of each pair of quantities?

a. mass and volume
b. distance and time
c. amount of substance and volume
d. area

Q1.1.6

Give the meaning and name of each metrix prefix abbreviation.

a. M
b. m
c. n
d. d

Q1.1.7

Give the abbreviation and meaning of each metrix prefix.

a. kilo
b. centi
c. micro
d. giga

Q1.1.8

Name the prefix with the following numerical meaning.

a. 1/10
b. 1,000,000
c. 1/1,000,000
d. 1/100
e. 1

Q1.1.9

Convert each temperature to the missing one between Celsius and Fahrenheit.

a. 77°F
b. 212°F
c. 37°C
d. 22°C
e. 95°F
f. 15°C
g. 0°F
h. 0°C
i. –10°C
j. –10°F

1.2 Significant Figures

(click here for solutions)

Q1.2.1

Explain the similarities and differences between accuracy and precision.

Q1.2.2

The density of a copper sample was determined by three different students (shown below). Each performed the measurement three times and is reported below (all values in units of g/cm^3). The accepted value for the density of copper is 8.92 g/cm^3.

a. Determine if each student's data is accurate, precise, neither or both.
b. What is the average density based on Justin's data?
c. What is the average density based on Jane's data?

- Jane: 8.94, 8.89, 8.91
- Justin: 8.32, 8.31, 8.34
- Julia: 8.64, 9.71, and 9.10

Q1.2.3

Determine the number of significant figures in each of the following values.

a. 406
b. 3.00
c. 3.20
d. 0.25
e. 0.0689
f. 0.002910
g. 3941
h. 46.250
i. 30.21
j. 0.10300

Q1.2.4

Write each value with three significant figures, use scientific notation if necessary.

a. 34500
b. 24
c. 0.0345
d. 0.012
e. 612.8
f. 98.22
g. 0.14928
h. 300

Q1.2.5

Give three examples of exact numbers.

Q1.2.6

Find the result of each of the following calculations and report the value with the correct number of significant figures.

a. 0.23 + 12.2 =
b. 13 - 1.03 =
c. 0.839 + 0.28925 =
d. 28 + 34.4 =
e. 0.8 + 2.3 =
f. 34.9 - 0.583 =
g. 21 - 0.132 =
h. 0.840 + 0.9334

Q1.2.7

Find the result of each of the following calculations and report the value with the correct number of significant figures.

a. 34 x 0.12 =
b. 68.2 / 0.78 =

c. $3.29 \times 10^4 \times 16.2 =$
d. $0.8449 \times 29.7 =$
e. $5.92 \times 10^3 / 0.628 =$
f. $3.00 \times 2.6 =$
g. $2.50 \times 9.331 =$
h. $3.20 / 12.75 =$

1.3 Scientific Dimensional Analysis

(click here for solutions)

Q1.3.1

What is a conversion factor?

Q1.3.2

What is the conversion factor between each pair of units?

a. feet and inches
b. mL and cm^3
c. kg and g
d. cm and m
e. mm and cm
f. inches and centimeters
g. grams and pounds
h. g and µg (mcg)

Q1.3.3

Complete each of the following conversions.

a. 34 cm to m
b. 3.7 ft to in
c. 345 mg to Mg
d. 5.3 km to mm
e. 4.0 L to mL
f. 3.45×10^3 mm to km
g. 78 cm^3 to mL
h. 0.85 kg to dg
i. 13 pints to gallon
j. 0.35 L to cm^3

Q1.3.4

Complete each of the following conversions.

a. 342 cm^3 to dm^3
b. 2.70 g/cm^3 to kg/L
c. 34 mi/hr to km/min
d. 0.00722 km^2 to m^2
e. 4.9×10^5 mcm^3 to mm^3
f. 80. km/hr to mi/hr

1.4 Percentages

(click here for solutions)

Q1.4.1

Solve each of the following.

a. What percent of 35 is 8.2?

b. What percent of 56 is 12?
c. What percent of 923 is 38?
d. What percent of 342 is 118?

Q1.4.2

Solve each of the following?

a. What is 42% of 94?
b. What is 83% of 239?
c. What is 16% of 45?
d. What is 38% of 872?

Q1.4.3

Solve each of the following?

a. 42 is 34% of what number?
b. 73 is 82% of what number?
c. 13 is 57% of what number?
d. 75 is 25% of what number?
e. 25 is 15% of what number?
f. 98 is 76% of what number?

Q1.4.4

A patient originally weighs 182 pounds and loses 15.0% of their body weight. What is their final weight?

Q1.4.5

A patient's original weight was 135 pounds and they lose 12 pounds. What percent of their body weight did they lose?

Q1.4.6

A patient needs to increase their calcium supplement by 25% a week. If they are currently taking a 300. mg supplement, how much more will they need to take?

Q1.4.7

An infant's birth weight is 7 pounds, 1 ounce. Her discharge weight is 6 pounds, 13 ounces. What percent of her birth weight did she lose?

Q1.4.8

A patient needs a 20.% decrease in their medication dosage from 125 mg. What will his dosage be after the decrease?

Answers

1.1: Measurements Matter

Q1.1.1

a. 1.5×10^{8}
b. 4.3×10^{-5}
c. 3.32×10^{5}
d. 2.93×10^{-2}
e. 9.32×10^{2}
f. 1.873×10^{-1}
g. 7.8×10^{4}
h. 1×10^{-4}
i. 4.5×10^{3}
j. 2.9×10^{-3}
k. 6.281×10^{3}
l. 7×10^{-3}

Q1.1.2

a. 0.0038
b. 921000
c. 0.0791
d. 2500000
e. 0.0000000342
f. 540000
g. 0.003
h. 734
i. 0.00098
j. 60000000
k. 0.00000420
l. 4200000

Q1.1.3

a. meter
b. mole
c. kilogram

Q1.1.4

a. meter
b. Kelvin
c. kilogram
d. second
e. mole

Q1.1.5

a. kg/m^3
b. m/s
c. mol/m^3 is based on SI base units, but mol/L is also acceptable
d. m^2

Q1.1.6

a. Mega, 10^6
b. milli, 10^{-3}
c. nano, 10^{-9}
d. deci, 10^{-1}

Q1.1.7

a. k, 10^3
b. c, 10^{-2}
c. μ (or mc), 10^{-6}
d. G, 10^9

Q1.1.8

a. deci
b. mega
c. micro
d. centi
e. none (base unit)

Q1.1.9

a. 77°F = 25°C
b. 212°F = 100°C

c. 37°C = 98.6°F
d. 22°C = 72°F
e. 95°F = 35°C
f. 15°C = 59°F
g. 0°F = –18°C
h. 0°C = 32°F
i. –10°C = 14°F
j. –10°F = –23°C

1.2 Significant Figures

Q1.2.1

Accuracy is a measure of how close the values are close to the correct value while precision is a measure of how close values are to each other.

Q1.2.2

a.

- Jane: 8.94, 8.89, 8.91 - accurate and precise
- Justin: 8.32, 8.31, 8.34 - precise
- Julia: 8.64, 9.71, and 9.10 - neither accurate nor precise

a. 8.32 g/cm^3
b. 8.91 g/cm^3

Q1.2.3

a. 3
b. 3
c. 3
d. 2
e. 3
f. 4
g. 4
h. 5
i. 4
j. 5

Q1.2.4

a. 3.45×10^4
b. 2.40×10^1
c. 3.45×10^{-2}
d. 1.20×10^{-2}
e. 613 or 6.13×10^2
f. 9.82×10^1
g. 0.149 or 1.49×10^{-1}
h. 300. or 3.00×10^2

Q1.2.5

Answers will vary. 12 eggs, 100 cm = 1 m, 1 inch = 2.54 cm, 4 people

Q1.2.6

a. 0.23 + 12.2 = 12.43 = **12.4**
b. 13 - 1.03 = 11.97 = **12**
c. 0.839 + 0.28925 = 1.12825 = **1.128**
d. 28 + 34.4 = 62.4 = **62**
e. 0.8 + 2.3 = **3.1**

f. 34.9 - 0.583 = 34.317 = **34.3**
g. 21 - 0.132 = 20.868 = **21**
h. 0.840 + 0.9334 = 1.7734 = **1.773**

Q1.2.7

a. 34 x 0.12 = 4.08 = **4.1**
b. 68.2 / 0.78 = 87.4358974 = **87**
c. 3.29 x 10^4 x 16.2 = 5.32980 × 10^5 = 5.33 × 10^5
d. 0.8449 x 29.7 = 25.09353 = **25.1**
e. 5.92 x 10^3 / 0.628 = 9.4267515 × 10^3 = **9.43 × 10^3**
f. 3.00 x 2.6 = **7.8**
g. 2.50 x 9.331 = 23.3275 = **23.3**
h. 3.20 / 12.75 = 0.25098 = **0.251**

1.3 Scientific Dimensional Analysis

Q1.3.1

A conversion factor is a relationship between two units. The value in the numerator has some equivalence to the value in the denominator.

Q1.3.2

a. 1 foot = 12 inches
b. 1 mL = 1 cm^3
c. 1 kg = 1000 g or 1 × 10^{-3} kg = 1 g
d. 100 cm = 1 m or 1 cm = 1 × 10^{-2} m
e. 10 mm = 1 cm
f. 1 inch = 2.54 cm
g. 454 grams = 1 pound
h. 1 g = 1 × 10^6 µg (mcg) or 1 × 10^{-6} g = 1 µg (mcg)

Q1.3.3

a. $34\ cm \times \frac{1\ m}{100\ cm} = 0.34\ m$
b. $3.7\ ft \times \frac{12\ in}{1\ ft} = 44.4\ in = 44\ in$
c. $345\ mg \times \frac{1\ g}{1000\ mg} \times \frac{1\ Mg}{1 \times 10^6\ g} = 3.45 \times 10^{-7}\ Mg$
d. $5.3\ km \times \frac{1000\ m}{1\ km} \times \frac{1000\ mm}{1\ m} = 5.3 \times 10^6\ mm$
e. $4.0\ L \times \frac{1000\ mL}{1\ L} = 4.0 \times 10^3\ mL$
f. $3.45 \times 10^3\ mm \times \frac{1\ m}{1000\ mm} \times \frac{1\ km}{1000\ m} = 3.45 \times 10^{-3}\ km$
g. $78\ cm^3 \times \frac{1\ mL}{cm^3} = 78\ mL$
h. $0.85\ kg \times \frac{1000\ g}{1\ kg} \times \frac{10\ dg}{1\ g} = 8.5 \times 10^3\ dg$
i. $13\ pints \times \frac{1\ quart}{2\ pints} \times \frac{1\ gallon}{4\ quarts} = 1.6\ gallons$
j. $0.35\ L \times \frac{1000\ mL}{1\ L} \times \frac{1\ mL}{1\ cm^3} = 3.5 \times 10^2\ cm^3$

Q1.3.4

a. $342\ cm^3 \times \frac{1\ dm}{10\ cm} \times \frac{1\ dm}{10\ cm} \times \frac{1\ dm}{10\ cm} = 0.342\ dm^3$ **or** $342\ cm^3 \times \left(\frac{1\ dm}{10\ cm}\right)^3 = 342\ cm^3 \times \frac{1^3\ dm^3}{10^3\ cm^3} = 0.342\ dm^3$
b. $\frac{2.70\ g}{cm^3} \times \frac{1\ kg}{1000\ g} \times \frac{1\ cm^3}{1\ mL} \times \frac{1000\ mL}{1\ L} = \frac{2.70\ kg}{L}$
c. $\frac{34\ mi}{hr} \times \frac{5280\ ft}{1\ mi} \times \frac{12\ in}{1\ ft} \times \frac{2.54\ cm}{1\ in} \times \frac{1\ m}{100\ cm} \times \frac{1\ km}{1000\ m} \times \frac{1\ hr}{60\ min} = \frac{0.91\ km}{min}$
d. $0.00722\ km^2 \times \frac{1000\ m}{1\ km} \times \frac{1000\ m}{1\ km} = 7.22 \times 10^3\ m^2$
e. $4.95 \times 10^5\ mcm^3 \times \frac{1\ mm}{1000\ mcm} \times \frac{1\ mm}{1000\ mcm} \times \frac{1\ mm}{1000\ mcm} = 4.95 \times 10^{-4}\ mm^3$
f. $\frac{80.\ km}{hr} \times \frac{1000\ m}{1\ km} \times \frac{100\ cm}{1\ m} \times \frac{1\ in}{2.54\ cm} \times \frac{1\ ft}{12\ in} \times \frac{1\ mi}{5280\ ft} = \frac{50.\ mi}{hr}$

1.4 Percentages

Q1.4.1

a. $\% = \frac{part}{whole} \times 100 = \frac{8.2}{35} \times 100 = 23\%$

b. $\% = \frac{part}{whole} \times 100 = \frac{12}{56} \times 100 = 21\%$

c. $\% = \frac{part}{whole} \times 100 = \frac{38}{923} \times 100 = 4.1\%$

d. $\% = \frac{part}{whole} \times 100 = \frac{118}{342} \times 100 = 34.5\%$

Q1.4.2

a.
$$\% = \frac{part}{whole} \times 100$$
$$42\% = \frac{part}{94} \times 100$$
$$part = 39$$

b.
$$\% = \frac{part}{whole} \times 100$$
$$83\% = \frac{part}{239} \times 100$$
$$part = 198 = 2.0 \times 10^2$$

c.
$$\% = \frac{part}{whole} \times 100$$
$$16\% = \frac{part}{45} \times 100$$
$$part = 7.2$$

d.
$$\% = \frac{part}{whole} \times 100$$
$$38\% = \frac{part}{872} \times 100$$
$$part = 3.3 \times 10^2$$

Q1.4.3

a.
$$\% = \frac{part}{whole} \times 100$$
$$34\% = \frac{42}{whole} \times 100$$
$$whole = 1.2 \times 10^2$$

b.
$$\% = \frac{part}{whole} \times 100$$
$$82\% = \frac{73}{whole} \times 100$$
$$whole = 89$$

c.
$$\% = \frac{part}{whole} \times 100$$
$$57\% = \frac{13}{whole} \times 100$$
$$whole = 23$$

d.
$$\% = \frac{part}{whole} \times 100$$
$$25\% = \frac{75}{whole} \times 100$$
$$whole = 3.0 \times 10^2$$

e.
$$\% = \frac{part}{whole} \times 100$$
$$15\% = \frac{25}{whole} \times 100$$
$$whole = 1.7 \times 10^2$$

f. $\% = \frac{part}{whole} \times 100$

$76\% = \frac{98}{whole} \times 100$

$whole = 129$

Q1.4.4

$\% = \frac{part}{whole} \times 100$

$15.0\% = \frac{part}{182\ pounds} \times 100$

$part = 27.3\ pounds\ lost$

$182\ pounds - 27.3\ pounds = 154.7\ pounds = 155\ pounds$

Q1.4.5

$\% = \frac{part}{whole} \times 100$

$\% = \frac{12\ pounds}{135\ pounds} \times 100$

$\% = 8.9\%\ lost$

Q1.4.6

$\% = \frac{part}{whole} \times 100$

$25\% = \frac{part}{300.\ mg} \times 100$

$part = 75\ mg\ more$

Q1.4.7

Convert both weights to ounces, find the ounces lost, and then find the percent lost.

Birth weight: $(7\ pounds \times 16) + 1\ ounce = 113\ ounces$

Discharge weight: $(6\ pounds \times 16) + 13\ ounces = 109\ ounces$

Weight lost: $113\ ounces - 109\ ounces = 4\ ounces$

Percent lost from original brith weight.

$\% = \frac{part}{whole} \times 100$

$\% = \frac{4\ ounces}{113\ ounces} \times 100$

$\% = 3.5\% = 4\%$

Q1.4.8

$\% = \frac{part}{whole} \times 100$

$20\% = \frac{part}{125\ mg} \times 100$

$part = 25\ mg\ lost$

$125\ mg - 25\ mg = 100.\ mg$

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