Measurements in Science and Medicine

This chapter introduces distance, size, mass, volume, density, dosage, and other compound units. Units for each are discussed as well as the metric prefixes and converting from one unit to another using conversion factors. Accuracy and precision are defined and differentiated.

Sample Problem 1.1

73 mm

Sample Problem 1.2

The last one is uncertain, so the 9

Sample Problem 1.3

Balance 3 has the smaller spread of numbers

Sample Problem 1.4

Method 1 as the results are closest to the actual value

Sample Problem 1.5

1 kilowatt = 1000 watts

Sample Problem 1.6

0.245 mL

Sample Problem 1.7

1 centimeter = 10,000 micrometers

Sample Problem 1.8

$$\frac{1\,\text{meter}}{39.37\,\text{inches}} \text{ and } \frac{39.37\,\text{inches}}{1\,\text{meter}}$$

Sample Problem 1.9

$$3774\ \text{g} \times \frac{1\,\text{pound}}{453.6\,\text{g}} = 8.320\ \text{lb}$$

Sample Problem 1.10

$$11.3\ \text{cm} \times \frac{10\,\text{mm}}{1\,\text{cm}} = 113\ \text{mm}$$

Sample Problem 1.11

$$17{,}000\ \text{L} \times \frac{1\,\text{gallon}}{3.785\,\text{L}} \times \frac{1\,\text{barrel}}{42\,\text{gallons}} = 106.9\ \text{barrel (assuming the number of L is to 5 sig fig)}$$

Sample Problem 1.12

$$\$10.00 \times \frac{1\,\text{gallon}}{\$2.08} = 4.81 \text{ gallons}$$

Sample Problem 1.13

$$10 \text{ mg} \times \frac{5\,\text{mL}}{25\,\text{mg}} = 2 \text{ mL}$$

Sample Problem 1.14

$$62 \text{ kg} \times \frac{1.6\,\text{mg}}{1\,\text{kg}} \times \frac{2\,\text{mL}}{80\,\text{mg}} = 2.48 \text{ mL}$$

Sample Problem 1.15

$$\text{density} = \frac{9.38\,\text{g}}{0.60\,\text{mL}} = 15.6 \text{ g/mL (should be 20 g/mL using 1 sig fig!)}$$

14-carat gold from this density

Sample Problem 1.16

$$23.8 \text{ mL} \times \frac{2.6\,\text{g}}{1\,\text{mL}} = 61.88 \text{ g} = 62 \text{ g}$$

Sample Problem 1.17

a) 53 °F – 32 = 21

b) 21 ÷ 1.8 = 12 °C

Sample Problem 1.18

a) 175 °C × 1.8 = 315

b) 315 + 32 = 347 °F

CORE PROBLEMS

1.1

a) mass

b) volume

c) distance

1.2

a) volume

b) distance

c) mass

1.3

a) L
b) cm
c) mg
d) μL

1.4

a) g
b) mL
c) km
d) cg

1.5

a) meter
b) deciliter
c) kilogram
d) micrometer

1.6

a) liter
b) centimeter
c) microgram
d) milliliter

1.7

a) height
b) mass
c) volume

1.8

a) volume
b) mass
c) depth

1.9

a) kilogram
b) milliliters
c) centimeters

1.10

a) millimeters

b) liters

c) milligrams

1.11

The “cannot possibly be correct ones” are (b), (d), (f)

1.12

The “cannot possibly be correct ones” are (a), (c), (e), (f)

1.13

The 9 in 1.19 mg is uncertain.

1.14

The 4

1.15

a) Balance 1 is more precise

b) Balance 1: $\frac{26.375 + 26.377 + 26.378}{3} = 26.377\ \text{g}$

Balance 2: $\frac{26.389 + 26.381 + 26.385}{3} = 26.385\ \text{g}$

So balance 2 is more accurate.

1.16

a) Tool 1 – the values are closer together (0.03 cm range compared to 0.07)

b) Tool 1 – the values are closer to the actual value

1.17

a) 3 places to the right

b) 2 places to the left

c) 1 places to the right

d) 9 places to the right

1.18

a) 3 places to the left

b) 4 places to the right

c) 4 places to the left

d) 2 places to the right

1.19

a) $27.2\ \text{cm} \times \dfrac{1\ \text{m}}{10^2\ \text{cm}} = 0.272\ \text{m}$

b) $27.2\ \text{cm} \times \dfrac{10\ \text{mm}}{\text{cm}} = 272\ \text{mm}$

c) $27.2\ \text{cm} \times \dfrac{10^4\ \mu\text{m}}{\text{cm}} = 27.2 \times 10^4\ \mu\text{m} = 2.72 \times 10^5\ \mu\text{m}$

1.20

a) 0.12 g

b) 120,000 micrograms

c) 1.2×10^{-4} kilograms

1.21

a) 1 dL = 1/10 L, or 10 dL = 1 L.

b) 1 km = 1000 m or 1 km = 10^3 m

c) 1/1,000,000 g = 1 μg or 1 g = 1,000,000 μg

1/10^6 g = 1 μg or 1 g = 10^6 μg

10^{-6} g = 1 μg

d) 10 mm = 1 cm

1.22

a) 1 gram equals 100 centigrams

b) 1 kilometer equals 100,000 centimeters

c) 1 milliliter = 1000 microliters

d) 1 decigrams = 10 centigrams

1.23

a) $\dfrac{1.609\ \text{km}}{1\ \text{mi}}$ or $\dfrac{1\ \text{mi}}{1.609\ \text{km}}$

b) $\dfrac{1\ \text{kg}}{2.205\ \text{pounds}}$ or $\dfrac{2.205\ \text{pounds}}{1\ \text{kg}}$

c) $\dfrac{1\ \text{dL}}{100\ \text{mL}}$ or $\dfrac{100\ \text{mL}}{1\ \text{dL}}$