Solutions to problems in Chapter 1 – Problem-solving, units, significant figures.

1.8 **(a)** Physical change. The helium isn't changed in any way by leaking out of the balloon.

(b) Chemical change in the battery.

(c) Physical change. The orange juice concentrate can be regenerated by evaporation of the water.

(d) Chemical change. Photosynthesis changes water, carbon dioxide, etc., into complex organic matter.

(e) Physical change. The salt can be recovered unchanged by evaporation.

1.11 **(a)** element **(b)** compound **(c)** element **(d)** compound

1.18 $\text{density} = \dfrac{\text{mass}}{\text{volume}}$

Step 1: You are asked to solve for the mass of mercury. Therefore, solve the above equation algebraically for the mass.

$$\textbf{mass} = \text{density} \times \text{volume}$$

Step 2: Calculate the mass of mercury by substituting the known values into the equation.

$$\textbf{mass of Hg} = 13.6\ \frac{\text{g}}{\text{mL}} \times 95.8\ \text{mL} = \mathbf{1.30 \times 10^3\ g}$$

1.19 $$?\ ^\circ\text{C} = (^\circ\text{F} - 32^\circ\text{F}) \times \frac{5^\circ\text{C}}{9^\circ\text{F}}$$

(a) $$?\ ^\circ\text{C} = (95^\circ\text{F} - 32^\circ\text{F}) \times \frac{5^\circ\text{C}}{9^\circ\text{F}} = \mathbf{35^\circ C}$$

(b) $$?\ ^\circ\text{C} = (12^\circ\text{F} - 32^\circ\text{F}) \times \frac{5^\circ\text{C}}{9^\circ\text{F}} = \mathbf{-11^\circ C}$$

(c) $$?\ ^\circ\text{C} = (102^\circ\text{F} - 32^\circ\text{F}) \times \frac{5^\circ\text{C}}{9^\circ\text{F}} = \mathbf{39^\circ C}$$

(d) $$?\ ^\circ\text{C} = (1852^\circ\text{F} - 32^\circ\text{F}) \times \frac{5^\circ\text{C}}{9^\circ\text{F}} = \mathbf{1011^\circ C}$$

1.27 **(a)** four **(b)** two **(c)** five **(d)** two, three, or four

1.25 **(a)** $145.75 + (2.3 \times 10^{-1}) = 145.75 + 0.23 = \mathbf{1.4598 \times 10^{2}}$

(b) $\dfrac{79500}{2.5 \times 10^{2}} = \dfrac{7.95 \times 10^{4}}{2.5 \times 10^{2}} = \mathbf{3.18 \times 10^{2}}$

(c) $(7.0 \times 10^{-3}) - (8.0 \times 10^{-4}) = (7.0 \times 10^{-3}) - (0.80 \times 10^{-3}) = \mathbf{6.2 \times 10^{-3}}$

(d) $(1.0 \times 10^{4}) \times (9.9 \times 10^{6}) = \mathbf{9.9 \times 10^{10}}$

1.30 **(a)** Division

The number of significant figures in the answer is determined by the original number having the smallest number of significant figures.

$$\frac{7.310 \text{ km}}{5.70 \text{ km}} = 1.28\mathbf{3}$$

The 3 (bolded) is a nonsignificant digit because the original number 5.70 only has three significant digits. Therefore, the answer has only three significant digits.

The correct answer rounded off to the correct number of significant figures is:

1.28 (Why are there no units?)

(b) Subtraction

The number of significant figures to the right of the decimal point in the answer is determined by the lowest number of digits to the right of the decimal point in any of the original numbers. Writing both numbers with exponents = −3, we have

$$3.26 \times 10^{-3} \text{ mg} - 0.0788 \times 10^{-3} \text{ mg} = \mathbf{3.18 \times 10^{-3} \text{ mg}}$$

Since 3.26×10^{-3} has only two digits to the right of the decimal point, two digits are carried to the right of the decimal point in the final answer.

(c) Addition

The number of significant figures to the right of the decimal point in the answer is determined by the lowest number of digits to the right of the decimal point in any of the original numbers. Writing both numbers with exponents = +7, we have

$$0.402 \times 10^{7} \text{ dm} + 7.74 \times 10^{7} \text{ dm} = \mathbf{8.14 \times 10^{7} \text{ dm}}$$

Since 7.74×10^{7} has only two digits to the right of the decimal point, two digits are carried to the right of the decimal point in the final answer.

1.31 **(a)** $\textbf{? dm} = 22.6 \text{ m} \times \dfrac{10 \text{ dm}}{1 \text{ m}} = \mathbf{226 \text{ dm}}$

(b) $\textbf{? kg} = 25.4 \text{ mg} \times \dfrac{0.001 \text{ g}}{1 \text{ mg}} \times \dfrac{1 \text{ kg}}{1000 \text{ g}} = \mathbf{2.54 \times 10^{-5} \text{ kg}}$

1.37 **(a)** $6.0 \text{ ft} \times \dfrac{1 \text{ m}}{3.28 \text{ ft}} = \mathbf{1.8 \text{ m}}$

$168 \text{ lb} \times \dfrac{453.6 \text{ g}}{1 \text{ lb}} \times \dfrac{1 \text{ kg}}{1000 \text{ g}} = \mathbf{76.2 \text{ kg}}$

(b) $\dfrac{55 \text{ mi}}{1 \text{ h}} \times \dfrac{1.609 \text{ km}}{1 \text{ mi}} = \mathbf{88 \text{ km/h}}$

(c) $\dfrac{3.0 \times 10^{10} \text{ cm}}{1 \text{ s}} \times \dfrac{1 \text{ in}}{2.54 \text{ cm}} \times \dfrac{1 \text{ ft}}{12 \text{ in}} \times \dfrac{1 \text{ mi}}{5280 \text{ ft}} \times \dfrac{3600 \text{ s}}{1 \text{ hr}} = \mathbf{6.7 \times 10^{8} \text{ mph}}$

(d) $(6.0 \times 10^{3} \text{ g of blood}) \times \dfrac{0.62 \text{ g Pb}}{1 \times 10^{6} \text{ g blood}} = \mathbf{3.7 \times 10^{-3} \text{ g Pb}}$

1.48 The volume of silver is equal to the volume of water it displaces.

$$\text{Volume of silver} = 260.5 \text{ mL} - 242.0 \text{ mL} = 18.5 \text{ mL} = 18.5 \text{ cm}^3$$

$$\textbf{density} = \frac{194.3 \text{ g}}{18.5 \text{ cm}^3} = \mathbf{10.5 \text{ g/cm}^3}$$

1.65 $(40 \times 10^{6} \text{ cars}) \times \dfrac{5000 \text{ mi}}{1 \text{ car}} \times \dfrac{1 \text{ gal gas}}{20 \text{ mi}} \times \dfrac{9.5 \text{ kg } CO_2}{1 \text{ gal gas}} = \mathbf{9.5 \times 10^{10} \text{ kg } CO_2}$