Exercise 1.60

(**a**) If an electric car is capable of going 225 km on a single charge, how many charges will it need to travel from Seattle, Washington, to San Diego, California, a distance of 1257 mi, assuming that the trip begins with a full charge? (**b**) If a migrating loon flies at an average speed of 14 m/s, what is its average speed in mi/hr? (**c**) What is the engine piston displacement in liters of an engine whose displacement is listed as 450 $in.^3$? (**d**) In March 1989 the Exxon Valdez ran aground and spilled 240,000 barrels of crude petroleum off the coast of Alaska. One barrel of petroleum is equal to 42 gal. How many liters of petroleum were spilled?

Solution

Part (a)

Use dimensional analysis, starting with the given distance, 1257 mi.

$$1257 \cancel{\text{mi}} \times \frac{5280 \cancel{\text{ft}}}{1 \cancel{\text{mi}}} \times \frac{12 \cancel{\text{in}}}{1 \cancel{\text{ft}}} \times \frac{2.54 \cancel{\text{cm}}}{1 \cancel{\text{in}}} \times \frac{1 \cancel{\text{m}}}{100 \cancel{\text{cm}}} \times \frac{1 \cancel{\text{km}}}{1000 \cancel{\text{m}}} \times \frac{1 \text{ charge}}{225 \cancel{\text{km}}} \approx 8.991 \text{ charges}$$

It will take about 9 charges to go from Seattle to San Diego.

Part (b)

Convert from meters per second to miles per hour using dimensional analysis.

$$14 \frac{\cancel{\text{m}}}{\cancel{\text{s}}} \times \frac{100 \cancel{\text{cm}}}{1 \cancel{\text{m}}} \times \frac{1 \cancel{\text{in}}}{2.54 \cancel{\text{cm}}} \times \frac{1 \cancel{\text{ft}}}{12 \cancel{\text{in}}} \times \frac{1 \text{ mi}}{5280 \cancel{\text{ft}}} \times \frac{60 \cancel{\text{s}}}{1 \cancel{\text{min}}} \times \frac{60 \cancel{\text{min}}}{1 \text{ hr}} \approx 31 \frac{\text{mi}}{\text{hr}}$$

Part (c)

Convert from cubic inches to liters using dimensional analysis.

$$450 \cancel{\text{in}^3} \times \left(\frac{2.54 \cancel{\text{cm}}}{1 \cancel{\text{in}}} \right)^3 \times \frac{1 \cancel{\text{mL}}}{1 \cancel{\text{cm}^3}} \times \frac{1 \text{ L}}{1000 \cancel{\text{mL}}} \approx \begin{cases} 7.4 \text{ L} & \text{if uncertainty in 450 is in tens place} \\ 7.37 \text{ L} & \text{if uncertainty in 450 is in ones place} \end{cases}$$

Part (d)

Convert from barrels to liters using dimensional analysis.

$$240{,}000 \cancel{\text{barrels}} \times \frac{42 \cancel{\text{gal}}}{1 \cancel{\text{barrel}}} \times \frac{3.7854 \text{ L}}{1 \cancel{\text{gal}}} \approx 3.8 \times 10^7 \text{ L}$$

This assumes the uncertainty lies in the ten thousands place: 240,000.