KEY

Chapter 3 Review Questions: Dimensional Analysis HONORS ONLY

1. Racing cars at the Indianapolis Motor Speedway routinely travel around the track at an average speed of 0.0963 km/sec. What is this speed in miles/hour? (1km = 0.62 mi)

$$\frac{0.0963\ km}{sec} \times \frac{0.62\ mi}{1\ km} \times \frac{3600\ sec}{1\ hr} = 215\ mi/hr$$

2. The length of a marathon race is approximately 26.2 miles. What is the distance in kilometers? (1 km = 0.62 miles)

$$\frac{26.2\ mi}{1} \times \frac{1\ km}{0.62\ mi} = 42.26\ km$$

3. A tank contains 5,000 L of chlorine gas. Express this volume in cubic centimeters.

$$\frac{5{,}000\ L}{1} \times \frac{1000\ mL}{1\ L} \times \frac{1\ cm^3}{1\ mL} = 5 \times 10^6\ cm^3$$

4. Light travels at a speed of 186,000 miles/second. How many kilometers will it travel in 2 hours? (1km = 0.6 miles)

$$\frac{186{,}000\ mi}{sec} \times \frac{1\ km}{0.62\ mi} \times \frac{3600\ sec}{1\ hr} \times \frac{2\ hr}{1} = 2.16 \times 10^9\ km$$

5. Stephen weighs 59,000 grams and is 5'11." Will he be a likely recruit for the offensive line on the Penn State football team? (1 kg = 2.2 lbs)

$$\frac{59{,}000\ g}{1} \times \frac{1\ kg}{1000\ g} \times \frac{2.2\ lbs}{1\ kg} = 129.8\ lbs$$ NO

6. What is the volume in Liters of a swimming pool that has the dimensions of 10 cm x 25 m x 12.9 mm?

$$\frac{25\ m}{1} \times \frac{100\ cm}{1\ m} = 2{,}500\ cm \qquad \frac{12.9\ mm}{1} \times \frac{1\ cm}{10\ mm} = 1.29\ cm$$

$$V = 10\ cm \times 2500\ cm \times 1.29\ cm = 32{,}250\ cm^3$$

$$\frac{32{,}250\ cm^3}{1} \times \frac{1\ mL}{1\ cm^3} \times \frac{1\ L}{1000\ mL} = 32.25\ L$$

7. A student wants to identify the main component in a commercial liquid cleaner. He finds that 35.8 mL of the cleaner weighs 28.1 g. Of the following possibilities, which is the main component of the cleaner?

Substance	Density, g/cm³
Chloroform	1.483
Diethyl ether	0.714
Isopropyl alcohol	0.785
Toluene	0.867

$$D = \frac{28.1\ g}{35.8\ mL}$$

$$D = 0.785\ g/mL$$

8. For a material to float on the surface of water, the material must have a density of less than that of water (1.0 g/mL) and must not react with the water or dissolve in it. A spherical ball has a radius of 0.5 cm and weighs 2.0 g. Will this ball float or sink when placed in water? (Volume of a sphere = $4/3 \prod r^3$)

$$V = \frac{4}{3}\pi (0.5\ cm)^3 = 0.524\ cm^3$$

$$D = \frac{2.0\ g}{0.524\ cm^3} = 3.82\ g/cm^3$$ SINK

9. Perform the following conversions:
   a. 8.43 cm to millimeters
   b. 2.41×10^2 cm to meters
   c. 1.445×10^5 mm to kilometers
   d. 550 cm³ of water to Liters

$$\frac{8.43\ cm}{1} \times \frac{10\ mm}{1\ cm} = 84.3\ mm \qquad \frac{2.41 \times 10^2\ cm}{1} \times \frac{1\ m}{100\ cm} = 2.41\ m$$

$$\frac{1.445 \times 10^5\ mm}{1} \times \frac{1\ km}{10^6\ mm} = 0.1445\ km \qquad \frac{550\ cm^3}{1} \times \frac{1\ mL}{1\ cm^3} \times \frac{1\ L}{1000\ mL} = 0.55\ L$$

10. If a bee flies at an average speed of 3.4 m/s, what is its average speed in miles/hour? (1 km = 0.62 miles)

$$\frac{3.4\ m}{sec} \times \frac{1\ km}{1000\ m} \times \frac{0.62\ mi}{1\ km} \times \frac{3600\ sec}{1\ hr} = 7.59\ mi/hr$$

11. Mercury is traded by the "flask," a unit that has a mass of 34.5 kg. What is the volume of a "flask" of mercury if the density of mercury is 13.6 g/mL?

$$D = \frac{M}{V} \qquad \frac{34.5\ kg}{1} \times \frac{1000\ g}{1\ kg} = 34{,}500\ g$$

$$V = \frac{M}{D} \qquad V = \frac{34{,}500\ g}{13.6\ g/mL} = 2536.8\ mL$$