1.4 Answer Key

Warm Up: p 45

Metric Quantity		**Imperial Quantity**	
A kilogram of butter	X	A pound of butter	
A 5-kilometre hiking trail		A 5-mile mountain bike trail	X
One litre of milk	X	One quart of milk	
A 12-centimetre ruler		A 12-inch ruler	X
A 15-gram piece of chocolate		A 15-ounce chocolate bar	X
A temperature of 22 ^{o}C	X	A temperature of 22 ^{o}F	

Practice Problems – One and Two Step Metric Conversions p 49

1) $16\ s \times \frac{1\ ks}{10^3\ s} =$ **1.6×10^{-2} ks**

2) $75\ 000\ mL \times \frac{10^{-3}\ L}{1\ mL} =$ **75 L**

3) $457\ ks \times \frac{10^3\ s}{1\ ks} \times \frac{1\ ms}{10^{-3}\ s} =$ **4.57×10^8 ms**

4) $5.6 \bullet 10^{-4}\ Mm \times \frac{10^6\ m}{1\ Mm} \times \frac{1\ dm}{10^{-1}\ m} =$ **5600 dm**

Practice Problems – Derived Unit Conversions p 50

1) $\frac{2.67\ g}{1\ mL} \times \frac{1\ kg}{10^3\ g} \times \frac{1\ mL}{10^{-3}\ L} =$ **2.67 kg/L**
(Note: $\frac{1}{10^3} \times \frac{1}{10^{-3}} = 1$; therefore, numerical value does not change)

2) $\frac{8.9994 \bullet 10^{-4}\ mg}{1\ mL} \times \frac{10^{-3}\ g}{1\ mg} \times \frac{1\ kg}{10^3\ g} \times \frac{1\ mL}{10^{-3}\ L} =$ **8.9994×10^{-7} kg/L**

3) $\frac{35 mi}{1\ h} \times \frac{5280\ ft}{1\ mi} \times \frac{12\ in}{1\ ft} \times \frac{2.54\ cm}{1\ in} \times \frac{10^{-2}\ m}{1\ cm} \times \frac{1\ h}{60\ min} \times \frac{1\ min}{60\ s} =$ **16 m/s**

Practice Problems – Use of Rate and Density as Conversion Factors p 51

1) $2.5\ L\ Hg \times \frac{1\ mL}{10^{-3}\ L} \times \frac{13.6\ g}{1\ mL} =$ **34 000 g Hg**

2) $16.5\ kg\ Pb \times \frac{10^3\ g}{1\ kg} \times \frac{1\ cm^3}{11.2\ g} \times \frac{1\ mL}{1\ cm^3} \times \frac{10^{-3}\ L}{1\ mL} =$ **1.47 L Pb**

3) $8.29\ min \times \frac{60\ s}{1 min} \times \frac{3.0 \bullet 10^{10}\ cm}{1\ s} \times \frac{10^{-2}\ m}{1\ cm} \times \frac{1\ km}{10^3\ m} =$ **1.5×10^8 km**

Practice Problems – Use of Conversion Factors Containing Exponents p 52

1) $4.3\ dm^3 \times \frac{(10^{-1}\ m)^3}{(1\ dm)^3} \times \frac{(1\ cm)^3}{(10^{-2}\ m)^3} = \mathbf{4300\ cm^3}$

2) $\frac{14.7\ lb}{1\ in^2} \times \frac{454\ g}{1\ lb} \times \frac{(1\ in)^2}{(2.54\ cm)^2} = \mathbf{1030\ g/cm^2}$

3) $\frac{8.2\ kg}{1\ m^3} \times \frac{10^3\ g}{1\ kg} \times \frac{1\ lb}{454\ g} \times \frac{(10^{-2}\ m)^3}{(1\ cm)^3} \times \frac{(2.54\ cm)^3}{(1\ in)^3} \times \frac{(12\ in)^3}{(1\ ft)^3} = \mathbf{0.51\ lb/ft^3}$

Practice Problems – Conversion Between Units of Temperature p 54

1) $(28.4\ °C \times \frac{1.8\ °F}{1\ °C}) + 32\ °F = \mathbf{83.1\ °F}$

2) $(-319\ °F - 32\ °F) \times \frac{1\ °C}{1.8\ °F} = \mathbf{-195\ °C}$

3) $(0\ K - 273\ K) \times \frac{1\ °C}{1\ K} = \mathbf{-273\ °C}$

$(-273\ °C \times \frac{1.8\ °F}{1\ °C}) + 32\ °F = \mathbf{-459\ °F}$

1.4 Review Questions p 56

1)

Measurement	Given Unit	Calculation	Required Unit
Grain of salt's mass	415 ug	$415\ ug \times \frac{10^{-6}\ g}{1\ ug} = \mathbf{4.15 \times 10^{-4}\ g}$	g
Earth to the Moon's distance	384.4 Mm	$384.4\ Mm \times \frac{10^6\ m}{1\ Mm} = \mathbf{3.844 \times 10^8\ m}$	m
Mass of a nickel	3.976 g	$3.976\ g \times \frac{1\ ug}{10^{-6}\ g} = \mathbf{3.976 \times 10^6\ ug}$	ug
Volumetric pipette length	4.5 dm	$4.5\ dm \times \frac{10^{-1}\ m}{1\ dm} = \mathbf{0.45\ m}$	m
Smoke particle's mass	$1.05 \cdot 10^{-12}$ g	$1.05 \cdot 10^{-12}\ g \times \frac{1\ ng}{10^{-9}\ g} = \mathbf{1.05 \times 10^{-3}\ ng}$	ng
Distance from UBC to SFU	24.99 km	$24.99\ km \times \frac{10^3\ m}{1\ km} = \mathbf{24\ 990\ m}$	m

2)

Measurement	Given Unit	Calculation	Required Unit
Energy to heat a grande latte to 65°C	83.60 kJ	$83.60\ \text{kJ} \times \frac{10^3\ \text{J}}{1\ \text{kJ}} \times \frac{1\ \text{MJ}}{10^6\ \text{J}} = \mathbf{0.08360\ MJ}$	MJ
Mass of a college chemistry text	2.54 kg	$2.54\ \text{kg} \times \frac{10^3\ \text{g}}{1\ \text{kg}} \times \frac{1\ \text{cg}}{10^{-2}\ \text{g}} = \mathbf{2.54 \times 10^5\ cg}$	cg
Average light bulb wattage	600.0 dW	$600.0\ \text{dW} \times \frac{10^{-1}\ \text{W}}{1\ \text{dW}} \times \frac{1\ \text{nW}}{10^{-9}\ \text{W}} = \mathbf{6.000 \times 10^{10}\ nW}$	nW
Volume of a can of soda	355 mL	$355\ \text{mL} \times \frac{10^{-3}\ \text{L}}{1\ \text{mL}} \times \frac{1\ \text{cL}}{10^{-2}\ \text{L}} = \mathbf{35.5\ cL}$	cL
Average time to send one text message	185 das	$185\ \text{das} \times \frac{10^1\ \text{s}}{1\ \text{das}} \times \frac{1\ \text{ms}}{10^{-3}\ \text{s}} = \mathbf{1.85 \times 10^6\ ms}$	ms
Distance from Prince George to Trail	987 km	$987\ \text{km} \times \frac{10^3\ \text{m}}{1\ \text{km}} \times \frac{1\ \text{dm}}{10^{-1}\ \text{m}} = \mathbf{9.87 \times 10^6\ dm}$	dm

3)

$$\frac{14.25\ \text{km}}{1\ \text{L}} \times \frac{10^3\ \text{m}}{1\ \text{km}} \times \frac{1\ \text{cm}}{10^{-2}\ \text{m}} \times \frac{1\ \text{in}}{2.54\ \text{cm}} \times \frac{1\ \text{ft}}{12\ \text{in}} \times \frac{1\ \text{mi}}{5280\ \text{ft}} \times \frac{4.546\ \text{L}}{1\ \text{gal}} = \mathbf{40.25\ mi/gal}$$

4) $\frac{110\ \text{km}}{1\ \text{h}} \times \frac{10^3\ \text{m}}{1\ \text{km}} \times \frac{1\ \text{h}}{60\ \text{min}} \times \frac{1\ \text{min}}{60\ \text{s}} = \mathbf{31\ m/s}$

5) $\frac{16.7\ \text{g}}{1\ \text{mL}} \times \frac{1\ \text{kg}}{10^3\ \text{g}} \times \frac{2.21\ \text{lb}}{1.00\ \text{kg}} \times \frac{1\ \text{mL}}{10^{-3}\ \text{L}} = \mathbf{36.9\ lb/L}$

6) $\frac{5.47 \cdot 10^2\ \text{kWh}}{1\ \text{year}} \times \frac{1\ \text{year}}{365\ \text{days}} \times \frac{1\ \text{GJ}}{277.8\ \text{kWh}} = \mathbf{0.00539\ GJ/day}$

7) $\frac{22.68\ \text{kg}}{1\ \text{dm}^3} \times \frac{10^3\ \text{g}}{1\ \text{kg}} \times \frac{(1\ \text{dm})^3}{(10^{-1}\ \text{m})^3} \times \frac{(10^{-2}\ \text{m})^3}{(1\ \text{cm})^3} = \mathbf{22.68\ g/cm^3}$

8) $1.00\ \text{L} \times \frac{1\ \text{mL}}{10^{-3}\ \text{L}} \times \frac{13.6\ \text{g}}{1\ \text{mL}} \times \frac{1\ \text{kg}}{10^3\ \text{g}} = \mathbf{13.6\ kg}$

9) $120\ \text{dL} \times \frac{10^{-1}\ \text{L}}{1\ \text{dL}} \times \frac{14.25\ \text{km}}{1\ \text{L}} \times \frac{10^3\ \text{m}}{1\ \text{km}} = \mathbf{170\ 000\ m}$

10) $6.00\ \text{g} \times \frac{1\ \text{cm}^3}{10.5\ \text{g}} \times \frac{1\ \text{mL}}{1\ \text{cm}^3} = \mathbf{0.571\ mL}$

11) $2.3\ \text{kg} \times \frac{10^3\ \text{g}}{1\ \text{kg}} \times \frac{1\ \text{lb}}{454\ \text{g}} \times \frac{1\ \text{gal}}{8.34\ \text{lb}} \times \frac{4.546\ \text{L}}{1\ \text{gal}} \times \frac{1\ \text{mL}}{10^{-3}\ \text{L}} = \mathbf{2\ 800\ mL}$

12) 4 Pitt Bulls $\times \frac{3 \text{ Collies}}{1 \text{ Pitt Bull}} \times \frac{5 \text{ Poodles}}{2 \text{ Collies}} \times \frac{7 \text{ Dobermans}}{3 \text{ Poodles}} \times \frac{9 \text{ German}}{1 \text{ Doberman}} =$

630 German sheep dogs

13) 2 Calico $\times \frac{5 \text{ Siamese}}{1 \text{ Calico}} \times \frac{7 \text{ Persians}}{2 \text{ Siamese}} \times \frac{8 \text{ Tabbies}}{3 \text{ Persians}} \times \frac{6 \text{ Heinz}}{1 \text{ Tabby}} =$ **560** Heinz Fifty-Sevens

14) $325 \text{ in}^3 \times \frac{(2.54 \text{ cm})^3}{(1 \text{ in})^3} \times \frac{(10^{-2} \text{ m})^3}{(1 \text{ cm})^3} \times \frac{(1 \text{ dm})^3}{(10^{-1} \text{ m})^3} \times \frac{1 \text{ L}}{1 \text{ dm}^3} =$ **5.33 L**

15) $\frac{14.7 \text{ lb}}{1 \text{ in}^2} \times \frac{454 \text{ g}}{1.00 \text{ lb}} \times \frac{1 \text{ kg}}{10^3 \text{ g}} \times \frac{(1 \text{ in})^2}{(2.54 \text{ cm})^2} =$ **1.03 kg/cm^2**

16) $\frac{400. \text{ ft}^2}{1 \text{ gal}} \times \frac{(12 \text{ in})^2}{(1 \text{ ft})^2} \times \frac{(2.54 \text{ cm})^2}{(1 \text{ in})^2} \times \frac{(10^{-2} \text{ m})^2}{(1 \text{ cm})^2} \times \frac{1 \text{ gal}}{4.546 \text{ L}} =$ **8.17 m^2/L**

17) $(451 \text{ °F} - 32 \text{ °F}) \times \frac{1 \text{ °C}}{1.8 \text{ °F}} =$ **233 °C**

18) $((1.9 \text{ K} - 273 \text{ K}) \times \frac{1 \text{ °C}}{1 \text{ K}} \times \frac{1.8 \text{ °F}}{1 \text{ °C}}) + 32 \text{ °F} =$ **-456.0 °F**

19) $(-89 \text{ °C} \times \frac{1.8 \text{ °F}}{1 \text{ °C}}) + 32 \text{ °F} =$ **-128 °F**

20) $(9.0 \text{ °C} \times \frac{1.8 \text{ °F}}{1 \text{ °C}}) + 32 \text{ °F} =$ **48.2 °F**