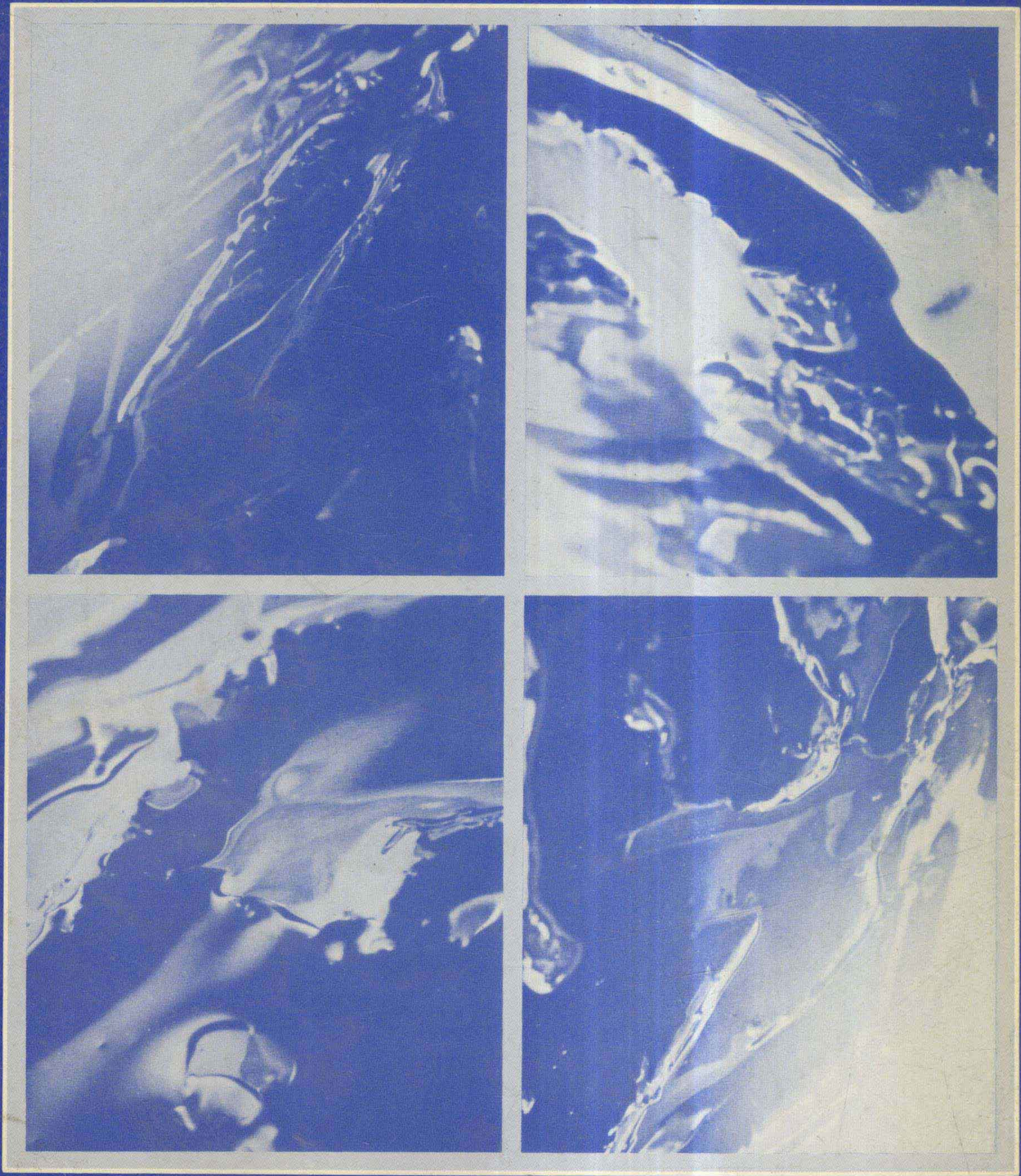
Second Edition

Solutions Manual to accompany

FUNDAMENTALS OF CHEMISTRY

Brady/Holum

Prepared by Ernest R. Birnbaum



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New York

JOHN WILEY & SONS

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PREFACE

This Solutions Manual has been prepared as a supplement to the Second Edition of Fundamentals of Chemistry by James E. Brady and John R. Holum. It provides explicit solutions for all of the in-chapter numerical practice exercises, for all of the end-of-chapter numerical review exercises, and for all of the "Integration of Concepts" numerical problems.

An effort has been made throughout this manual to employ the same problem-solving methods and techniques presented in the text. If your answer in a calculation is close to, but not exactly the answer given here, the difference (especially if the calculation involved the evaluation of a logarithmic expression) might simply be the result of having rounded off numbers at a different point in the calculation than was done in the preparation of these answers.

All of the solutions in this Manual have been independently double checked. Nevertheless, "Murphy's Laws" will undoubtedly prevail, and some errors will have been made. I would certainly be grateful to anyone who brings such errors to my attention.

I wish to thank Dr. John DeKorte of Northern Arizona University for helpful suggestions that increased the clarity of a number of the solutions. I also wish to express my appreciation to Mrs. June Brady for invaluable assistance in the production of this Manual.

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CONTENTS*

*Chapters 19, 20, 21, 22, and 24 do not contain numerical exercises. Also, there are no Numerical Practice Exercises for Chapters 5 and 10.

CHAPTER 1

INTRODUCTION

Solutions to Numerical Practice Exercises

1. (a) Volume = Length x Width x Height = m x m x m = $\underline{m^3}$

   (b) Speed = $\dfrac{\text{distance traveled}}{\text{time}} = \underline{\dfrac{m}{s}}$

3. °C = 5/9 (°F - 32)
   °C = 5/9 (86 °F - 32) = 30 °C
   °F = 9/5 (°C) + 32
   °F = 9/5 (-17.8 °C) + 32 = -0.0400 °F

4. °C = 5/9 (°F - 32)
   °C = 5/9 (90 °F - 32) = 32.2 or round off to 32 °C
   °C = 5/9 (85 °F - 32) = 29.4 or round off to 29 °C

5. K = °C + 273 or °C = K - 273
   For 300 K, °C = 300 - 273 = 27
   For 315 K, °C = 315 - 273 = 42
   So there is a (42 - 27) or 15 °C temperature increase

6. (a) 4.8 x 392 = 1881.6 or round off to 1900 so as to have two significant figures
   (b) 7.255 ÷ 81.334 = 0.08920
   (c) 0.2983 + 1.52 = 1.82
   (d) 14.5403 - 0.022 = 14.518

7. (a) $64.25 \text{ in.} \times \dfrac{1 \text{ ft}}{12 \text{ in.}} \times \dfrac{1 \text{ yd}}{3 \text{ ft}} = \underline{1.785 \text{ yd}}$

   (b) $64.25 \text{ in.} \times \dfrac{1 \text{ ft}}{12 \text{ in.}} \times \dfrac{1 \text{ mi}}{5280 \text{ ft}} = \underline{0.001014 \text{ mi}}$

8. (a) $23{,}000 = \underline{2.3 \times 10^{4}}$

(b) $21{,}700{,}000 = \underline{2.17 \times 10^{7}}$

(c) $0.0015 = \underline{1.5 \times 10^{-3}}$

(d) $0.000027 = \underline{2.7 \times 10^{-5}}$

9. (a) $2.7 \times 10^{3} = \underline{2700}$

(b) $3.5 \times 10^{28} = \underline{35{,}000{,}000{,}000{,}000{,}000{,}000{,}000{,}000{,}000}$

(c) $2 \times 10^{-12} = \underline{0.000000000002}$

10. (a) $3.00 \text{ yd} \times \frac{36 \text{ in.}}{1 \text{ yd}} = \underline{108 \text{ in.}}$

(b) $1.25 \text{ km} \times \frac{1000 \text{ m}}{1 \text{ km}} \times \frac{100 \text{ cm}}{1 \text{ m}} = \underline{1.25 \times 10^{5} \text{ cm}}$

(c) $3.27 \text{ mm} \times \frac{1 \text{ cm}}{10 \text{ mm}} \times \frac{1 \text{ in.}}{2.540 \text{ cm}} \times \frac{1 \text{ ft}}{12 \text{ in.}} = \underline{0.0107 \text{ ft}}$

(d) $\frac{20.2 \text{ mi}}{1 \text{ gal}} \times \frac{1 \text{ gal}}{4 \text{ qts}} \times \frac{1.057 \text{ qts}}{1 \text{ L}} \times \frac{1 \text{ km}}{0.6215 \text{ mi}} = 8.59 \text{ km/L}$

and the reciprocal of this result gives the requested units, $\underline{0.116 \text{ L/km}}$

11. $t_F = \frac{9}{5} t_C + 32$; $t_F = \frac{9 \text{ °F}}{5 \text{ °C}} t_C + 32 \text{ °F}$

Substituting 30 °C for t_C gives

$$t_F = \frac{9 \text{ °F}}{5 \text{ °C}} (30 \text{ °C}) + 32 \text{ °F} = 54 \text{ °F} + 32 \text{ °F} = \underline{86 \text{ °F}}$$

12. density = mass/volume $= \frac{3.92 \text{ g}}{1.45 \text{ mL}} = \underline{2.70 \text{ g/mL}}$

13. $2.86 \text{ g silver} \times \frac{1 \text{ cm}^3}{10.5 \text{ g silver}} = \underline{0.272 \text{ cm}^3}$

$16.3 \text{ cm}^3 \text{ silver} \times \frac{10.5 \text{ g silver}}{1 \text{ cm}^3 \text{ silver}} = \underline{171 \text{ g silver}}$

14. $\text{sp. gr.} = \frac{d_{substance}}{d_{H_2O}} = \frac{2.70 \text{ g/mL}}{1.00 \text{ g/mL}} = \underline{2.70}$

$$\frac{2.70\ g}{1.00\ mL} \times \frac{1.00\ lb}{453.6\ g} \times \frac{1.00\ mL}{1.00\ cm^3} \times \left(\frac{2.54\ cm}{1.00\ in.}\right)^3 \times \left(\frac{12.0\ in.}{1.00\ ft}\right)^3 = \underline{169\ lb/ft^3}$$

15. $$\text{sp. gr.} = \text{a unitless number} = \frac{d_{ethylacetate}}{d_{H_2O}} = 0.902$$

If we substitute 1.00 g/mL for d_{H_2O}, then $d_{ethylacetate}$ must have these same units. Hence

$$d_{ethylacetate} = (\text{sp. gr.}_{ethylacetate}) \times d_{H_2O} = (0.902) \times (1.00\ g/mL) = \underline{0.902\ g/mL}$$

Similarly, substituting 8.34 lb/gal for d_{H_2O},

$$d_{ethylacetate} = (0.902) \times (8.34\ lb/gal) = \underline{7.52\ lb/gal}$$

16. (a) 1-Ni and 2-Cl
(b) 1-Fe; 1-S; and 4-O
(c) 3-Ca; 2-P; and 8-O
(d) 1-Cu; 1-S; 9-O; 10-H

18. 1-Mg; 4-H; 2-O; and 2-Cl

$$Mg(OH)_2(s) + 2HCl(aq) \longrightarrow MgCl_2(aq) + 2H_2O(\ell)$$

Solutions to Numerical Review Exercises

1.18 (a) $1\ cm \times \frac{1\ m}{100\ cm} = \underline{0.01\ m}$

(b) $1\ km \times \frac{1000\ m}{1\ km} = \underline{1000\ m}$

(c) $1\ m \times \frac{1\ pm}{10^{-12}\ m} = \underline{1 \times 10^{12}\ pm}$

(d) $1\ dm \times \frac{1\ m}{10\ dm} = \underline{0.1\ m}$

(e) $1\ g \times \frac{1\ kg}{1000\ g} = \underline{1 \times 10^{-3}\ kg}$

(f) $1\ mg \times \frac{1\ g}{1000\ mg} = \underline{1 \times 10^{-3}\ g}$

1.19 (a) $1\ nm \times \frac{10^{-9}\ m}{1\ nm} = \underline{10^{-9}\ m}$

(b) $1\ \mu g \times \frac{10^{-6}\ g}{1\ \mu g} = \underline{10^{-6}\ g}$

(c) $1\ kg \times \frac{1000\ g}{1\ kg} = \underline{1000\ g}$

(d) $1\ Mg \times \frac{10^6\ g}{1\ Mg} = \underline{10^6\ g}$

(e) $1\ mg \times \frac{1\ g}{1000\ mg} = \underline{10^{-3}\ g}$

(f) $1\ dg \times \frac{1\ g}{10\ dg} = \underline{0.1\ g}$

1.20 The given relationship, 1 yd = 2 ft, is not a true equality, and hence will not produce a proper conversion factor relating yards to feet. The correct relationship to use is 1 yd = 3 ft.

Similarly, 1 cm = 1000 m, is not a true equality and will not produce a proper conversion factor relating cm to m. The correct relationship to use is 1 cm = 0.01 m.

1.21 $\underline{250\ \text{s} \times \frac{1\ \text{hr}}{3600\ \text{s}}}$; $\underline{3.84\ \text{hr} \times \frac{3600\ \text{s}}{1\ \text{hr}}}$

1.22 (a) $10.0\ \text{cm} \times \frac{1\ \text{m}}{100\ \text{cm}} \times \frac{1\ \text{km}}{1000\ \text{m}} = \underline{1 \times 10^{-4}\ \text{km}}$

(b) $5.3\ \text{g} \times \frac{1\ \text{mg}}{10^{-3}\ \text{g}} = \underline{5.3 \times 10^{3}\ \text{mg}}$

(c) $5.3\ \text{mg} \times \frac{10^{-3}\ \text{g}}{1\ \text{mg}} \times \frac{1\ \text{kg}}{1000\ \text{g}} = \underline{5.3 \times 10^{-6}\ \text{kg}}$

(d) $37.5\ \text{mL} \times \frac{10^{-3}\ \text{L}}{1\ \text{mL}} = \underline{3.75 \times 10^{-2}\ \text{L}}$

(e) $0.125\ \text{L} \times \frac{1\ \text{mL}}{10^{-3}\ \text{L}} = \underline{125\ \text{mL}}$

(f) $342\ \text{nm} \times \frac{10^{-9}\ \text{m}}{1\ \text{nm}} \times \frac{1\ \text{mm}}{10^{-3}\ \text{m}} = \underline{3.42 \times 10^{-4}\ \text{mm}}$

1.23 (a) $1.83\ \text{nm} \times \frac{10^{-9}\ \text{m}}{1\ \text{nm}} \times \frac{100\ \text{cm}}{1\ \text{m}} = \underline{1.83 \times 10^{-7}\ \text{cm}}$

(b) $3.55\ \text{g} \times \frac{1\ \text{mg}}{10^{-3}\ \text{g}} = \underline{3.55 \times 10^{3}\ \text{mg}}$

(c) $8.44\ \text{km} \times \frac{1000\ \text{m}}{1\ \text{km}} \times \frac{100\ \text{cm}}{1\ \text{m}} = \underline{8.44 \times 10^{5}\ \text{cm}}$

(d) $33\ \text{m} \times \frac{1000\ \text{mm}}{1\ \text{m}} = \underline{3.3 \times 10^{4}\ \text{mm}}$

(e) $0.55\ \text{dm} \times \frac{0.1\ \text{m}}{1\ \text{dm}} \times \frac{1\ \text{km}}{1000\ \text{m}} = \underline{5.5 \times 10^{-5}\ \text{km}}$

(f) $53.8\ \text{kg} \times \frac{1000\ \text{g}}{1\ \text{kg}} \times \frac{1\ \text{mg}}{10^{-3}\ \text{g}} = \underline{5.38 \times 10^{7}\ \text{mg}}$

1.24 (a) $36 \text{ in.} \times \frac{2.540 \text{ cm}}{1 \text{ in.}}$ = 91.44 which rounds off for two significant figures to <u>91 cm</u>

(b) $5.0 \text{ lb} \times \frac{1 \text{ kg}}{2.205 \text{ lb}}$ = 2.268 which rounds off for two significant figures to <u>2.3 kg</u>

(c) $3.0 \text{ qt} \times \frac{946.4 \text{ mL}}{1 \text{ qt}}$ = 2839.2 which rounds off for two significant figures to $\underline{2.8 \times 10^3 \text{ mL}}$

(d) $8 \text{ oz} \times \frac{29.6 \text{ mL}}{1 \text{ oz}}$ = 236.8 which (assuming "1 cup" to be an exact number) rounds off for three significant figures to <u>237 mL</u>

(e) $55 \frac{\text{mi}}{\text{hr}} \times \frac{1.609 \text{ km}}{1 \text{ mi}}$ = 88.495 which for two significant figures rounds off to <u>88 km/hr</u>

(f) $50.0 \text{ mi} \times \frac{1.609 \text{ km}}{1 \text{ mi}}$ = 80.45 which for three significant figures rounds off to <u>80.5 km</u>

1.25 (a) $250 \text{ mL} \times \frac{1 \text{ qt}}{946.4 \text{ mL}}$ = 0.2642 which for two significant figures rounds off to <u>0.26 qt</u>

(b) $2.0 \text{ ft} \times \frac{1 \text{ yd}}{3 \text{ ft}} \times \frac{0.9144 \text{ m}}{1 \text{ yd}}$ = 0.6096 which for two significant figures rounds off to <u>0.61 m</u>

(c) $1.33 \text{ kg} \times \frac{2.205 \text{ lb}}{1 \text{ kg}}$ = 2.93265 which for three significant figures rounds off to <u>2.93 lb</u>

(d) $1.75 \text{ L} \times \frac{1000 \text{ mL}}{1 \text{ L}} \times \frac{1 \text{ fluid oz}}{29.6 \text{ mL}}$ = <u>59.1 fluid oz</u>

(e) $75 \frac{\text{km}}{\text{hr}} \times \frac{0.6215 \text{ mi}}{1 \text{ km}}$ = 46.6125 which for two significant figures rounds off to <u>47 mi/hr</u>

(f) $80.0 \text{ km} \times \frac{0.6215 \text{ mi}}{1 \text{ km}}$ = 49.72 which for three significant figures rounds off to <u>49.7 mi</u>

1.26 $12 \text{ fluid oz} \times \frac{29.6 \text{ mL}}{1 \text{ fluid oz}}$ = 355.2 which for two significant figures rounds off to $\underline{3.6 \times 10^2 \text{ mL}}$

1.27 $2 \text{ L} \times \frac{1000 \text{ mL}}{1 \text{ L}} \times \frac{1 \text{ fluid oz}}{29.6 \text{ mL}}$ = 67.57 which for one significant figure rounds off to $\underline{7 \times 10^1 \text{ fluid oz}}$

1.28 $1000 \text{ kg} \times \frac{2.205 \text{ lb}}{1 \text{ kg}} = 2205 \text{ lb}$ which for one significant figure rounds off to $\underline{2 \times 10^3 \text{ lb}}$

1.29 $2240 \text{ lb} \times \frac{1 \text{ kg}}{2.205 \text{ lb}} \times \frac{1 \text{ metric ton}}{1000 \text{ kg}} = \underline{1.016 \text{ metric ton}}$

1.30 5 ft and 8 in. = $[5 \text{ ft} \times \frac{12 \text{ in.}}{1 \text{ ft}} + 8 \text{ in.}] = 68$ in., and $68 \text{ in.} \times \frac{2.54 \text{ cm}}{1 \text{ in.}} =$ 173 which for two significant figures rounds off to $\underline{1.7 \times 10^2 \text{ cm}}$

1.31 $74.3 \text{ kg} \times \frac{2.205 \text{ lb}}{1 \text{ kg}} = \underline{164 \text{ lb}}$

1.32 (a) $8.0 \text{ yd}^2 \times \frac{0.9144 \text{ m}}{1 \text{ yd}} \times \frac{0.9144 \text{ m}}{1 \text{ yd}} = 6.689$, or rounding off to two significant figures, $\underline{6.7 \text{ m}^2}$

(b) $3.4 \text{ in.}^2 \times \frac{2.540 \text{ cm}}{1 \text{ in.}} \times \frac{2.540 \text{ cm}}{1 \text{ in.}} = 21.94$, or rounding off to two significant figures, $\underline{22 \text{ cm}^2}$

(c) $1.5 \text{ ft}^3 \times \left(\frac{12 \text{ in.}}{1 \text{ ft}}\right)^3 \times \left(\frac{1 \text{ m}}{39.37 \text{ in.}}\right)^3 \times \left(\frac{1 \text{ dm}}{0.1 \text{ m}}\right)^3 \times \frac{1 \text{ L}}{1 \text{ dm}^3} = 42.48$ or rounding off to two significant figures, $\underline{42 \text{ L}}$

1.33 (a) $85 \text{ cm}^2 \times \frac{1 \text{ in.}}{2.540 \text{ cm}} \times \frac{1 \text{ in.}}{2.540 \text{ cm}} = 13.18$ or rounding off to two significant figures, $\underline{13 \text{ in.}^2}$

(b) $3.3 \text{ m}^3 \times \left(\frac{39.37 \text{ in.}}{1 \text{ m}}\right)^3 \times \left(\frac{1 \text{ ft}}{12 \text{ in.}}\right)^3 = 116.5$ or rounding off to two significant figures, $\underline{12 \times 10^1 \text{ ft}^3}$

(c) $144 \text{ in.}^2 \times \frac{1 \text{ m}}{39.37 \text{ in.}} \times \frac{1 \text{ m}}{39.37 \text{ in.}} = 0.09290$, or rounding off to three significant figures, $\underline{9.29 \times 10^{-2} \text{ m}^2}$

1.34 $\left(\frac{124 \text{ francs spent}}{\text{on cabbage}}\right) \times \left(\frac{1 \text{ head cabbage}}{31 \text{ francs spent on cabbage}}\right) \times \left(\frac{3 \text{ cans potatoes}}{1 \text{ head cabbage}}\right) \times \left(\frac{17 \text{ francs spent on potatoes}}{1 \text{ can potatoes}}\right) = \underline{204 \text{ francs}}$ spent on potatoes

1.35 $\frac{2155 \text{ ft}}{1 \text{ s}} \times \frac{1 \text{ s}}{1 \text{ min}} \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{1 \text{ yd}}{3 \text{ ft}} \times \frac{0.9144 \text{ m}}{1 \text{ yd}} \times \frac{1 \text{ km}}{1000 \text{ m}} = \underline{2365 \text{ km/hr}}$

1.36 $1 \text{ yr} \times \frac{365 \text{ days}}{1 \text{ yr}} \times \frac{24 \text{ hr}}{1 \text{ day}} \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{60 \text{ s}}{1 \text{ min}} \times \frac{3.0 \times 10^8 \text{ m}}{1 \text{ s}} \times \frac{1 \text{ km}}{1 \times 10^3 \text{ m}}$

$\times \frac{0.6215 \text{ mi}}{1 \text{ km}} = \underline{5.9 \times 10^{12} \text{ mi}}$

1.37 $\frac{55 \text{ mi}}{1 \text{ hr}} \times \frac{1 \text{ km}}{0.6215 \text{ mi}} = 88.496$ or rounding off to two significant figures, $\underline{88 \text{ km/hr}}$

1.38 Each revolution moves the point a distance of 1 circumference, $\pi d = 12\pi$ inches.

So $\frac{33.3 \text{ revs}}{1 \text{ min}} \times \frac{12(3.142) \text{ in.}}{1 \text{ rev}} \times \frac{1 \text{ ft}}{12 \text{ in.}} \times \frac{1 \text{ mi}}{5280 \text{ ft}} \times \frac{60 \text{ min}}{1 \text{ hr}} = 1.19$ or

rounding off to two significant figures, $\underline{1.2 \text{ mi/hr}}$

1.39 The original question must traverse 239,000 mi from the earth to the moon. The reply must traverse 239,000 mi from the moon back to the earth. Thus the minimum return-communication time will be that required for radio waves to travel 478,000 mi.

$4.78 \times 10^5 \text{ mi} \times \frac{1 \text{ km}}{0.6215 \text{ mi}} \times \frac{1000 \text{ m}}{1 \text{ km}} \times \frac{1 \text{ s}}{3.0 \times 10^8 \text{ m}} = \underline{2.6 \text{ seconds}}$

1.41 (a) $°F = \frac{9}{5}(°C) + 32 = \frac{9}{5}(24) + 32 = \underline{75\ °F}$ (rounded off to two sig. figures from 75.2)

(b) $°F = \frac{9}{5}(°C) + 32 = \frac{9}{5}(10) + 32 = \underline{50\ °F}$

(c) $°C = \frac{5}{9}(°F - 32) = \frac{5}{9}(41 - 32) = \underline{5\ °C}$

(d) $°C = \frac{5}{9}(°F - 32) = \frac{5}{9}(50 - 32) = \underline{10\ °C}$

(e) $K = °C + 273 = 30 + 273 = \underline{303 \text{ K}}$

(f) $K = °C + 273 = (-10) + 273 = \underline{263 \text{ K}}$

1.42 (a) $°C = \frac{5}{9}(°F - 32) = \frac{5}{9}(85 - 32) = \underline{29\ °C}$ (rounded off to two sig. fig. from 29.4)

(b) $°C = \frac{5}{9}(°F - 32) = \frac{5}{9}[(-5) - 32] = \underline{-2 \times 10^1\ °C}$ (rounded off to one sig. fig. from -20.6)

(c) $°F = \frac{9}{5}(°C) + 32 = \frac{9}{5}(-40) + 32 = \underline{-40\ °F}$

(d) $°C = K - 273 = 215 - 273 = \underline{-58\ °C}$

(e) $°C = K - 273 = 315 - 273 = \underline{42\ °C}$

(f) $K = °C + 273 = 25 + 273 = \underline{298\ K}$

1.43 $°F = \frac{9}{5}(°C) + 32 = \frac{9}{5}(37.13) + 32 = \underline{98.83\ °F}$

1.44 $°C = \frac{5}{9}(°F - 32) = \frac{5}{9}[(-96-32)] = \underline{-71\ °C}$

1.45 $K = °C + 273$; hence $°C = K - 273$

$°C_{4K} = 4 - 273 = \underline{-269\ °C}$

$°F = \frac{9}{5}(°C) + 32$

$°F_{4K} = \frac{9}{5}(-269\ °C) + 32 = \underline{-452\ °F}$

1.46 $°C = K - 273 = 5800 - 273 = \underline{5527\ °C}$

1.49 Four sig. fig. The number 4.165 has four sig. fig. The values in the given conversion factor are exact, and hence may be expressed to any number of sig. fig. we wish. When this factor is multiplied by 4.165, the result must thus be rounded off to the number of sig. fig. in 4.165.

1.50 (a) 2.75 cm = 3
(b) 39.24 mm = 4
(c) 12.0 g = 3
(d) 0.0021 kg = 2
(e) 0.0006080 m = 4
(f) 0.002 mL = 1

1.51 (a) 0.240 g = 3
(b) 11.303 m = 5
(c) 0.0008 kg = 1
(d) 615.0 mg = 4
(e) 1.00005 L = 6
(f) 3.505 mm = 4

1.52 (a) $0.022 \times 315 = 6.93 = \underline{6.9}$
(b) $83.25 - 0.1075 = 83.1425 = \underline{83.14}$
(c) $(84.4 \times 0.02)/(31.22 \times 9.8) = 0.0055171 = \underline{0.006}$
(d) $(33.4 + 112.7 + 0.002)/(6.488) = 22.518804 = \underline{22.5}$
(e) $(315.44 - 208.1) \times 8.8175 = 946.47045 = \underline{946.5}$

1.53 (a) $3.58/1.739 = 2.0587 = \underline{2.06}$
(b) $4.02 + 0.001 = 4.021 = \underline{4.02}$
(c) $(22.4 \times 8.3)/(1.142 \times 0.002) = 81401.051 = \underline{8 \times 10^4}$
(d) $(1.345 + 0.022)/(13.36 \times 8.4115) = 0.0121643 = \underline{0.01216}$
(e) $(74.335 - 74.332)/(4.75 \times 1.114) = 0.0005669 = \underline{6 \times 10^{-4}}$

1.54 (a) $245 = \underline{2.45 \times 10^2}$
(b) $31{,}000 = \underline{3.10 \times 10^4}$
(c) $0.00287 = \underline{2.87 \times 10^{-3}}$
(d) $45{,}000{,}000 = \underline{4.50 \times 10^7}$
(e) $0.0000000400 = \underline{4.00 \times 10^{-8}}$
(f) $324{,}000 = \underline{3.24 \times 10^5}$

1.55 (a) $3389 = \underline{3.389 \times 10^3}$
(b) $0.000025 = \underline{2.5 \times 10^{-5}}$
(c) $81{,}300{,}000 = \underline{8.13 \times 10^7}$
(d) $0.0225 = \underline{2.25 \times 10^{-2}}$
(e) $2.33 = \underline{2.33 \times 10^0}$
(f) $18{,}300 = \underline{1.83 \times 10^4}$

1.56 (a) $2.1 \times 10^3 = \underline{2100}$
(b) $3.35 \times 10^{-4} = \underline{0.000335}$
(c) $3.8 \times 10^6 = \underline{3{,}800{,}000}$
(d) $4.6 \times 10^{-10} = \underline{0.00000000046}$
(e) $34.6 \times 10^{-2} = \underline{0.346}$
(f) $8.5 \times 10^4 = \underline{85{,}000}$

1.57 (a) $4.27 \times 10^{-4} = \underline{0.000427}$
(b) $7.11 \times 10^7 = \underline{71{,}100{,}000}$
(c) $33.5 \times 10^{-6} = \underline{0.0000335}$
(d) $2.85 \times 10^{-3} = \underline{0.00285}$
(e) $5.0000 \times 10^4 = \underline{50{,}000}$
(f) $17.2 \times 10^5 = \underline{1{,}720{,}000}$

1.58 (a) $\underline{2.0 \times 10^4}$
(b) $\underline{8.0 \times 10^7}$
(c) $\underline{1.0 \times 10^3}$
(d) $\underline{2.4 \times 10^5}$
(e) $\underline{2.0 \times 10^{18}}$

1.59 (a) $\underline{4.0 \times 10^{-2}}$
(b) $\underline{2.0 \times 10^5}$
(c) $\underline{5.0 \times 10^{39}}$
(d) $\underline{1.1 \times 10^5}$
(e) $\underline{2.55 \times 10^{-2}}$ (rounded off from 2.553×10^{-2})

1.67 (a) We first need to convert 25 gallons to mL since the density given has g/mL units.

$$25 \text{ gallons} \times \frac{3.786 \text{ L}}{1 \text{ gallon}} \times \frac{1000 \text{ mL}}{1 \text{ L}} = 9.47 \times 10^4 \text{ mL},$$ keeping at this intermediate point, one more than the two significant figures implied by the number "25."

So mass = $(0.65 \frac{g}{mL} \times (9.47 \times 10^4 \text{ mL}) = 6.16 \times 10^4$ g again keeping one more than the two significant figures implied by the number "0.65." Since the answer is required in kg, we finally must convert 6.16×10^4 g to kg.

$$6.16 \times 10^4 \text{ g} \times \frac{1 \text{ kg}}{1000 \text{ g}} = 61.6 \text{ kg}$$ which we now round off to 62 kg

(b) We convert the 62 kg from Part (a) into pounds.

$$62 \text{ kg} \times \frac{2.205 \text{ lb}}{1 \text{ kg}} = 1.37 \times 10^2$$ or rounding off to two significant figures, 1.4×10^2 lb

1.68 $$\text{density} = \frac{\text{mass}}{\text{volume}} = \frac{25.3 \text{ g}}{31.7 \text{ mL}} = 0.798 \text{ g/mL}$$

1.69 $$10.0 \text{ g acetone} \times \frac{1 \text{ mL}}{0.791 \text{ g acetone}} = 12.6 \text{ mL}$$

1.70 Since the apparatus is "full" with water, the volume of the apparatus will be the same as the volume of the water. Hence:

$$21.335 \text{ g } H_2O \times \frac{1 \text{ mL}}{0.99704 \text{ g } H_2O} = 21.398 \text{ mL}$$

1.71 $$\text{density} = \frac{\text{mass}}{\text{volume}} = \frac{(62.00 - 27.35) \text{ g}}{(18.3 - 15.0) \text{ mL}} = 11 \text{ g/mL}$$ (rounded off from 10.5)

1.72 $$\text{density} = \frac{\text{mass}}{\text{volume}} \quad ; \quad \text{volume} = \frac{\text{mass}}{\text{density}}$$

(a) $$\text{volume pycnometer} = \frac{\text{mass water it contained}}{\text{density of water}} = \frac{(36.842 - 27.314) \text{ g}}{0.99704 \text{ g/mL}} =$$

9.556 mL

(b) $$\text{density chloroform} = \frac{\text{mass chloroform in pycnometer}}{\text{volume of pycnometer}} = \frac{(41.428 - 27.314)\ \text{g}}{9.556\ \text{mL}} = \underline{1.477\ \text{g/mL}}$$

1.73 $$\text{sp. gr. ethyl ether} = \frac{\text{density ethyl ether}}{\text{density water}}$$ (where both density values are expressed in the same units)

$$= \frac{0.715\ \text{g/mL}}{1.00\ \text{g/mL}} = \underline{0.715}$$

1.74 $$\text{sp. gr. propylene glycol} = \frac{\text{density propylene glycol}}{\text{density water}}$$ (where both density values are expressed in the same units)

$$= \frac{8.65\ \text{lb/gal}}{8.34\ \text{lb/gal}} = \underline{1.04}$$

1.75 $$\text{sp. gr. trichloroethylene} = 1.47 = \frac{\text{density trichloroethylene in g/mL at 20 °C}}{\text{density water in g/mL at 20 °C}}$$

From which, density trichloroethylene in g/mL units at 20 °C

$$= 1.47\ (0.998203\ \text{g/mL})$$

$$= \underline{1.47\ \text{g/mL}}\ \text{(rounded off from 1.46736)}$$

1.76 $$\text{sp. gr. gold} = 19.3 = \frac{\text{density gold in lb/ft}^3}{\text{density water in lb/ft}^3}$$

From which, density gold in lb/ft^3

$$= 19.3\ (62.4\ \text{lb/ft}^3) = 1.20 \times 10^3\ \text{lb/ft}^3$$

And $$1\ \text{ft}^3\ \text{gold} \times \frac{1.20 \times 10^3\ \text{lb gold}}{1\ \text{ft}^3\ \text{gold}} = \underline{1.20 \times 10^3\ \text{lb gold}}$$

1.81 (a) 1; (b) 2; (c) 8; (d) 4; (e) 8; (f) 10

1.82 (a) Na = 3; P = 1; O = 4
(b) Ca = 1; H = 4; P = 2; O = 8
(c) C = 4; H = 10
(d) Fe = 3; As = 2; O = 8
(e) Cu = 1; N = 2; O = 6
(f) Mg = 1; S = 1; O = 11; H = 14

1.83 Ca = 3 Mg = 5 Si = 8 O = 24 H = 2

1.89 (a) 6; (b) 3; (c) 27

1.90 (a) 16; (b) 36; (c) 50