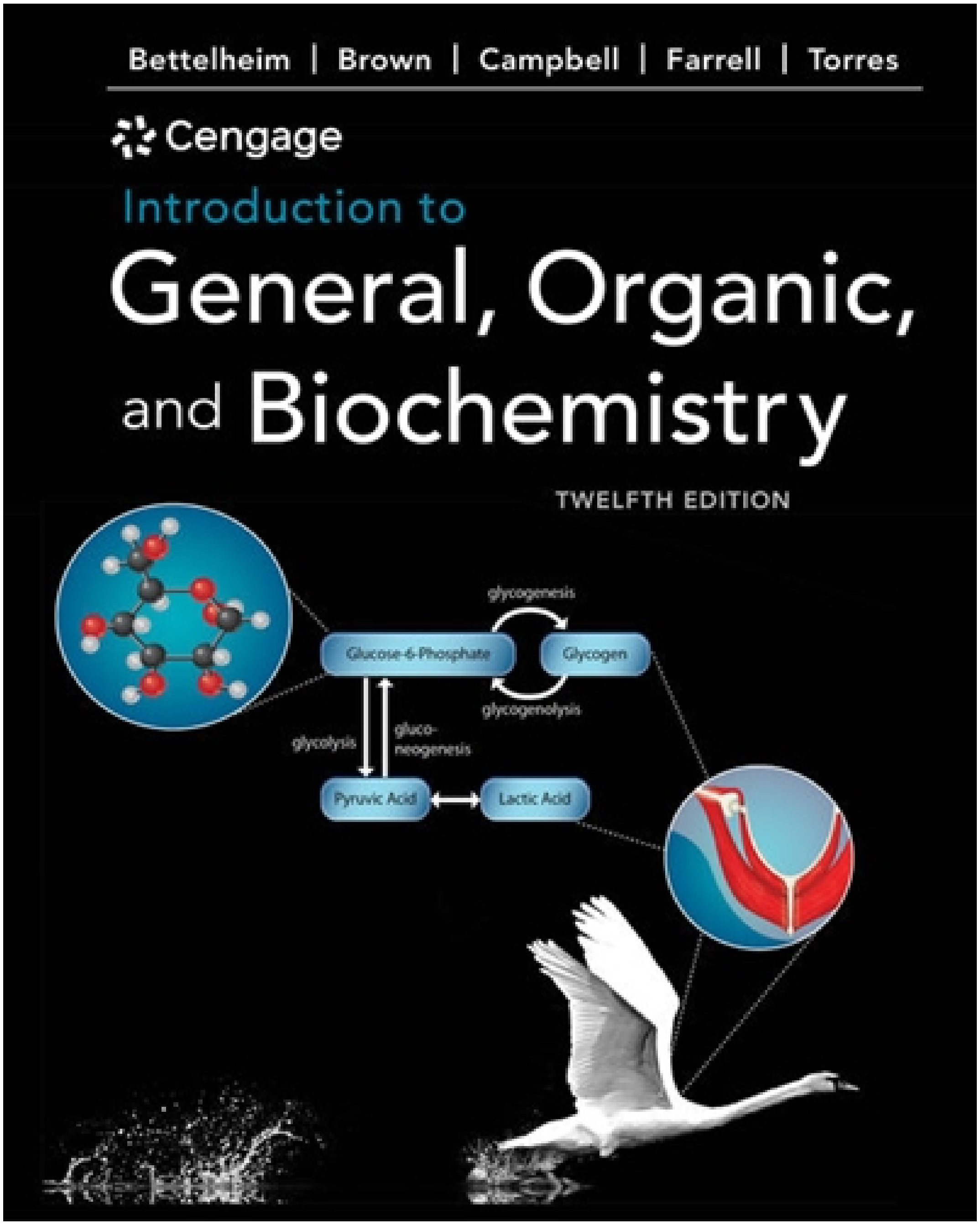
Solutions for Introduction to General Organic and Biochemistry 12th Edition by Bettelheim



Solutions

Chapter 1: Matter, Energy, and Measurement

QC 1.1 Multiplication: (a) 4.69×10^{5} (b) 2.8×10^{-15}
Division: (a) 1.94×10^{18} (b) 1.37×10^{5}

QC 1.2 (a) $^{o}F = \frac{9}{5}\,^{o}C + 32 = \frac{9}{5}\,64.0^{o}C + 32 = 147^{o}F$

(b) $^{o}C = \frac{5}{9}\,(^{o}F - 32) = \frac{5}{9}\,(47^{o}F - 32) = 8.3^{o}C$

QC 1.3 $8.55\ \cancel{mi}\left(\frac{1.609\ km}{1\ \cancel{mi}}\right) = 13.8\ km$

QC 1.4 $\frac{332\ \cancel{m}}{\cancel{s}}\left(\frac{1\ \cancel{km}}{1000\ \cancel{m}}\right)\left(\frac{1\ mi}{1.609\ \cancel{km}}\right)\left(\frac{60\ \cancel{s}}{1\ \cancel{min}}\right)\left(\frac{60\ \cancel{min}}{1\ hr}\right) = 743\ mi/hr$

QC 1.5
$$\frac{50.\ \cancel{mL}\,sol}{\cancel{hr}}\left(\frac{1.5\ \cancel{g\ antibiotic}}{1000.\ \cancel{mL\ sol}}\right)\left(\frac{1000\ mg\ antibiotic}{1\ \cancel{g\ antibiotic}}\right)\left(\frac{1\ \cancel{hr}}{60\ min}\right) = 1.3\ mg\ antibiotic/min$$

QC 1.6 Mass of Ti = $17.3\ \cancel{mL}\left(\frac{4.54\ g\ Ti}{1\ \cancel{mL}}\right) = 78.5\ g\ Ti$

QC 1.7 $d = m/V = \frac{56.8\ g}{23.4\ mL} = 2.43\ g/mL$

QC 1.8 The specific gravity of a substance is the density of this substance divided by the density of water, which is 1.000 g/mL.

Specific gravity = $1.016 = \frac{d}{1.000\ g/mL}$

d = 1.016 g/mL

1.2 A major reason for the increase of the average life expectancy of humans in the last 80 years has been great progresses in medical science. Diseases that were once fatal have either been eradicated or cures developed. The causes and cures for many major diseases are now better understood and treatments more effective.

1.4 (a) Chemical change: burning gasoline is converted to carbon dioxide and water.
(b) Physical change: ice forming from liquid water is still H_2O, just a different state of matter.
(c) Physical change: boiling oil is still oil, just a different state of matter.
(d) Physical change: melting lead remains lead, just a different state of matter.
(e) Chemical change: elemental Fe has been converted to rust, Fe_2O_3.
(f) Chemical change: nitrogen and hydrogen converted ammonia, NH_3, involves a change in chemical composition.
(g) Chemical change: the chemical components in food are converted to energy, carbon dioxide, and water thus changing chemical composition.

1.6 (a) 403,000 (b) 3,200 (c) 0.0000713 (d) 0.000000000555

1.8 (a) 2.10×10^{13} (b) 1.07×10^{4} (c) 2.93×10^{-12} (d) 8.4×10^{1} (e) 1.36×10^{-26}

1.10 (a) 7.74×10^{3} (b) 8.808×10^{-2} (c) 1.3022×10^{2}

1.12 3.25×10^{-10}

1.14 (a) 3 (b) 2 (c) 1 (d) 4 (e) 5

1.16 (a) 2.5×10^{4} (b) 4.1 (c) 15.5

1.18 (a) 10963.1 (b) 244 (c) 172.34

1.20 (a) 1 kg = 1000 g (b) 1 mg = 0.001 g

1.22 (a) 100 cm (b) 230 mL (c) 75 kg (d) 15 mL
(e) 50 mg (f) 100 mm (g) 8 g

1.24 Temperature conversions: $^{o}C = \frac{5}{9}(^{o}F - 32)$ and $K = 273 + {}^{o}C$

(a) $\frac{5}{9}(320^{o}F - 32) = \underline{160^{o}C}$ and $273 + 160^{o}C = \underline{433\ K}$

(b) $\frac{5}{9}(212^{o}F - 32) = \underline{100^{o}C}$ and $273 + 100^{o}C = \underline{373\ K}$

(c) $\frac{5}{9}(0^{o}F - 32) = \underline{-18^{o}C}$ and $273 + (-18)^{o}C = \underline{255\ K}$

(d) $\frac{5}{9}(-250^{o}F - 32) = \underline{-157^{o}C}$ and $273 + (-157)^{o}C = \underline{116\ K}$

1.26 Unit conversions:

(a) $42.6\ \text{kg}\left(\frac{2.205\ \text{lb}}{1\ \text{kg}}\right) = 93.9\ \text{lb}$

(b) $1.62\ \text{lb}\left(\frac{453.6\ \text{g}}{1\ \text{lb}}\right) = 735\ \text{g}$

(c) $34\ \text{in}\left(\frac{2.54\ \text{cm}}{1\ \text{in}}\right) = 86\ \text{cm}$

(d) $37.2\ \text{km}\left(\frac{1\ \text{mi}}{1.609\ \text{km}}\right) = 23.1\ \text{mi}$

(e) $2.73\ \text{gal}\left(\frac{3.785\ \text{L}}{1\ \text{gal}}\right) = 10.3\ \text{L}$

(f) $62\ \text{g}\left(\frac{1\ \text{oz}}{28.35\ \text{g}}\right) = 2.2\ \text{oz}$

(g) $33.61\ \text{qt}\left(\frac{1\ \text{L}}{1.057\ \text{qt}}\right) = 31.80\ \text{L}$

(h) $43.7\ \text{L}\left(\frac{1\ \text{gal}}{3.785\ \text{L}}\right) = 11.5\ \text{gal}$

(i) $1.1\ \text{mi}\left(\frac{1.609\ \text{km}}{1\ \text{mi}}\right) = 1.8\ \text{km}$

(j) $34.9\ \text{mL}\left(\frac{1\ \text{fl oz}}{29.57\ \text{mL}}\right) = 1.18\ \text{fl oz}$

1.28 First, convert one of the bottle's units to the other.

$9.5\ \text{fl. oz.}\left(\frac{29.57\ \text{mL}}{1\ \text{fl. oz.}}\right)\left(\frac{1\ \text{cc}}{1\ \text{mL}}\right) = 2.8 \times 10^{2}\ \text{cc}$, which is less than 300. cc bottle

1.30 The key here is to first convert speed from mph to kph. Yes, you would reach Ottawa within an hour.

$\text{Speed} = \frac{75\ \text{mi}}{1\ \text{hr}}\left(\frac{1.609\ \text{km}}{1\ \text{mi}}\right) = 120\ \text{kph}$

$\text{Time to reach Ottawa} = 80\ \text{km}\left(\frac{1\ \text{hr}}{120\ \text{km}}\right) = 0.7\ \text{hr}$ (rounded to one significant figure)

1.32 $\text{Car efficiency} = \left(\frac{25.00\ \text{mi}}{\text{gal}}\right)\left(\frac{1.609\ \text{km}}{1\ \text{mi}}\right)\left(\frac{1\ \text{gal}}{3.785\ \text{L}}\right) = 10.63\ \text{km/L}$

1.34 $186\ \text{lb}\left(\frac{1\ \text{kg}}{2.205\ \text{lb}}\right)\left(\frac{2.0\ \text{mg drug}}{1\ \text{kg}}\right)\left(\frac{1\ \text{cc IV sol}}{10.\ \text{mg drug}}\right)\left(\frac{1\ \text{mL IV sol}}{1\ \text{cc IV sol}}\right) = 17\ \text{mL IV sol}$

1.36 $36\ \text{lb child}\left(\frac{1\ \text{kg}}{2.205\ \text{lb}}\right)\left(\frac{20.\ \text{mg Velosef/day}}{1\ \text{kg}}\right) = 3.3 \times 10^{2}\ \text{mg/day}$

$36\ \text{lb child}\left(\frac{1\ \text{kg}}{2.205\ \text{lb}}\right)\left(\frac{20.\ \text{mg Velosef /day}}{1\ \text{kg}}\right)\left(\frac{1\ \text{mL sol}}{208\ \text{mg Velosf}}\right) = 1.6\ \text{mL}\ \frac{\text{sol}}{\text{day}}$

1.38 $750\ \text{mg lidocaine}\left(\frac{150\ \text{mL IV sol}}{500.\ \text{mg lidocaine}}\right)\left(\frac{1\ \text{min}}{5\ \text{mL IV sol}}\right) = 5 \times 10^1\ \text{min}$

The answer is rounded to one significant figure because both 1 min and 5 mL only contain one significant figure.

1.40 Vol of pantoprazole IV = $40.\ \text{mg PAN}\left(\frac{1\ \text{mL IV sol}}{0.4\ \text{mg PAN}}\right) = 1 \times 10^2\ \text{mL PAN IV solution}$

Vol of $MgSO_4$ IV = $5\ \text{g } MgSO_4\left(\frac{1\ \text{mL IV sol}}{0.02\ \text{g } MgSO_4}\right) = 3 \times 10^2\ \text{mL } MgSO_4\ \text{IV solution}$

Combined volumes of IV solutions = 4×10^2 mL (rounded to one significant figure)

1.42 At low temperatures, most substances exist as solids.

1.44 $d_{\text{rock sample}} = \text{mass/volume} = \left(\frac{1.075\ \text{kg}}{334.5\ \text{mL}}\right)\left(\frac{1000\ \text{g}}{1\ \text{kg}}\right) = 3.214\ \text{g/mL}$

1.46 Volume of Ti = $163\ \text{g Ti}\left(\frac{1\ \text{mL Ti}}{4.54\ \text{g Ti}}\right) = 35.9\ \text{mL Ti}$

1.48 Answer rounded to two significant figures:

$\text{Mass}_{\text{methanol}} = 280\ \text{mL methanol}\left(\frac{0.791\ \text{g methanol}}{1\ \text{mL methanol}}\right) = 2.2 \times 10^2\ \text{g methanol}$

1.50 (a) The densities of O_2 and CO_2 can be calculated as follows:

$$d_{O2} = \left(\frac{10.00\ \text{g } O_2}{6702\ \text{mL } O_2}\right)\left(\frac{1000\ \text{mL } O_2}{1\ \text{L } O_2}\right) = 1.492\ \text{g/L}$$

$$d_{CO2} = \left(\frac{10.00\ \text{g } CO_2}{5058\ \text{mL } CO_2}\right)\left(\frac{1000\ \text{mL } CO_2}{1\ \text{L } CO_2}\right) = 1.977\ \text{g/L}$$

(b) Carbon dioxide (a gas that does not support combustion) being denser than oxygen will sink to the level of the fire and temporarily displace the oxygen. By cutting off the supply of oxygen (a fuel for the fire), the fire will be extinguished.

1.52 Matter-energy can neither be created nor destroyed (law of conservation of energy), solar panels work by converting light energy into electrical energy.

1.54 Assuming that the 180 lb man is measured to three significant figures:

$$\text{Drug dose}_{135\text{lb}} = 135 \text{ lb man}\left(\frac{445 \text{ mg drug}}{180 \text{ lb man}}\right) = 334 \text{ mg drug}$$

1.56 (a) Volume (b) Volume (c) Mass (d) Density
(e) Temperature (f) Velocity

1.58 V_{room} = length x height x width = (5.3 m)(2.0 m)(4.2 m) = 45 m^3

$$m_{air} = d_{air}V_{air} = \left(\frac{1.25 \times 10^{-3} \text{ g}}{\text{cm}^3}\right)(45 \text{ m}^3)\left(\frac{100 \text{ cm}}{1 \text{ m}}\right)^3\left(\frac{1 \text{ kg}}{1000 \text{ g}}\right) = 56 \text{ kg air}$$

1.60 KE = 1/2(mv^2)

$$m = 127 \text{ lb}\left(\frac{453.6 \text{ g}}{1 \text{ lb}}\right) = 5.76 \times 10^4 \text{ g}$$

$$v = \left(\frac{14.7 \text{ mi}}{\text{hr}}\right)\left(\frac{1.609 \text{ km}}{1 \text{ mi}}\right)\left(\frac{1000 \text{ m}}{1 \text{ km}}\right)\left(\frac{100 \text{ cm}}{1 \text{ m}}\right)\left(\frac{1 \text{ hr}}{60 \text{ min}}\right)\left(\frac{1 \text{ min}}{60 \text{ sec}}\right) = 657 \text{ cm/s}$$

$$KE = 1/2(5.76 \times 10^4 \text{ g})(657 \text{ cm/s})^2 = 1.24 \times 10^{10} \text{ g}\cdot\text{cm}^2\cdot\text{s}^{-2} = \underline{1.24 \times 10^{10} \text{ ergs}}$$

1.62 Convert dollars/L into dollars/gal, then compare:

$$\text{Gasoline price}_{\text{Montreal}} = \frac{\$1.22}{\text{L}}\left(\frac{3.785 \text{ L}}{\text{gal}}\right) = \$4.62/\text{gal}$$

Gasoline is less expensive in Potsdam ($3.93/gal) than in Montreal ($4.62/gal).

1.64 $\left(\frac{75 \text{ mL}}{1 \text{ hr}}\right)\left(\frac{10. \text{ gtts}}{1 \text{ mL}}\right)\left(\frac{1 \text{ hr}}{60 \text{ min}}\right)$ = 13 gtts/min flow rate

1.66

$$\text{dose} = 14 \text{ lb cat}\left(\frac{2.5 \text{ mg}}{1 \text{ lb cat}}\right) = 35 \text{ mg per 12 hours}$$

$$\text{total drug to be delivered} = 7 \text{ days}\left(\frac{24 \text{ hr}}{\text{day}}\right)\left(\frac{1 \text{ dose}}{12 \text{ hr}}\right)\left(\frac{35 \text{ mg}}{\text{dose}}\right) = 4.9 \times 10^2 \text{ mg}$$

1.68 $51.4\ \text{lbs}\left(\dfrac{1\ \text{kg}}{2.205\ \text{lbs}}\right)\left(\dfrac{1.3\ \text{mg drug}}{1\ \text{kg}}\right)\left(\dfrac{1\ \text{mL stock}}{15\ \text{mg drug}}\right) = 2.02\ \text{mL of stock solution}$

1.70 Convert each quantity into a common unit (grams): (a) is the largest and (d) is the smallest.

(a) 41 g

(b) $3 \times 10^3\ \text{mg}\left(\dfrac{1\ \text{g}}{1000\ \text{mg}}\right) = 3\ \text{g}$

(c) $8.2 \times 10^6\ \mu\text{g}\left(\dfrac{1\ \text{g}}{10^6\ \mu\text{g}}\right) = 8.2\ \text{g}$

(d) $4.1310 \times 10^{-8}\ \text{kg}\left(\dfrac{1000\ \text{g}}{1\ \text{kg}}\right) = 4.1310 \times 10^{-5}\ \text{g}$

1.72 Travel time $= 1490.\ \text{mi}\left(\dfrac{1.609\ \text{km}}{1\ \text{mi}}\right)\left(\dfrac{1\ \text{hr}}{220.\ \text{km}}\right) = 10.9\ \text{hr}$

1.74 1.00 mL of butter = 0.860 g and 1.00 mL of sand = 2.28 g

(a) $d_{\text{mixture}} = \dfrac{3.14\ \text{g mixture}}{2.00\ \text{mL}} = 1.57\ \text{g/mL}$

(b) First calculate the volumes of sand and butter, which totals 1.60 mL

$$V_{\text{sand}} = 1.00\ \text{g sand}\left(\dfrac{1.00\ \text{mL sand}}{2.28\ \text{g sand}}\right) = 0.439\ \text{mL}$$

$$V_{\text{butter}} = 1.00\ \text{g butter}\left(\dfrac{1.00\ \text{mL butter}}{0.860\ \text{g butter}}\right) = 1.16\ \text{mL}$$

$$d_{\text{mixture}} = \dfrac{2.00\ \text{g}}{1.60\ \text{mL}} = 1.25\ \text{g/mL}$$

1.76 $60.\ \text{mg meperidine}\left(\dfrac{1\ \text{mL sol}}{75\ \text{mg meperidine}}\right) = 0.8\ \text{mL solution injected}$

1.78 Aspirin tablets that contain 325 mg of aspirin contain more aspirin than 81 mg tablets. The 325 mg dose of aspirin is usually taken for pain, while the 81 mg daily dose of aspirin is usually taken to help prevent heart attacks.

1.80 First, it is important to know exactly what the treatment involves and the mechanism of action. Also, did the study compare the treatment group with a control group consisting of ear infection patients that didn't receive the treatment? Finally, did the scientist test the treatment for safety?

1.82 The folk medicine will be extracted and separated into pure materials. Each pure material will be tested for biological activity. The pure materials that are identified as biologically active will have their chemical structures determined, and often, a chemical synthesis developed for mass production.

1.84 $$\text{flow rate} = \left(\frac{1\ \cancel{\text{L sol}}}{12\ \cancel{\text{hr}}}\right)\left(\frac{1000\ \cancel{\text{mL}}}{1\ \cancel{\text{L sol}}}\right)\left(\frac{1\ \cancel{\text{hr}}}{60\ \text{min}}\right)\left(\frac{15\ \text{gtts}}{\cancel{\text{mL}}}\right) = 21\ \text{gtts/min}$$

1.86 (a) Dose (in milligrams) of Tylenol calculated to two significant figures:

$$\text{Dose} = 42\ \cancel{\text{lb child}}\left(\frac{1\ \cancel{\text{kg child}}}{2.205\ \cancel{\text{lb child}}}\right)\left(\frac{15\ \text{mg Tylenol}}{1\ \cancel{\text{kg child}}}\right) = 2.9 \times 10^{2}\ \text{mg Tylenol}$$

(b) Dose in milliliters of Tylenol solution calculated to two significant figures:

$$\text{Dose} = 42\ \cancel{\text{lb child}}\left(\frac{1\ \cancel{\text{kg child}}}{2.205\ \cancel{\text{lb child}}}\right)\left(\frac{15\ \cancel{\text{mg Tyl}}}{1\ \cancel{\text{kg child}}}\right)\left(\frac{5.0\ \text{mL sol}}{160\ \cancel{\text{mg Tyl}}}\right) = 8.9\ \text{mL sol}$$