Measurements in Science and Medicine

This chapter introduces distance, size, mass, volume, density, dosage, and other compound units. Units for each are discussed as well as the metric prefixes and converting from one unit to another using conversion factors. Accuracy and precision are defined and differentiated.

Sample Problem 1.1

73 mm

Sample Problem 1.2

The last one is uncertain, so the 9

Sample Problem 1.3

Balance 3 has the smaller spread of numbers

Sample Problem 1.4

Method 1 as the results are closest to the actual value

Sample Problem 1.5

1 kilowatt = 1000 watts

Sample Problem 1.6

0.245 mL

Sample Problem 1.7

1 centimeter = 10,000 micrometers

Sample Problem 1.8

$$\frac{1\,\text{meter}}{39.37\,\text{inches}} \text{ and } \frac{39.37\,\text{inches}}{1\,\text{meter}}$$

Sample Problem 1.9

$$3774\text{ g} \times \frac{1\,\text{pound}}{453.6\,\text{g}} = 8.320\text{ lb}$$

Sample Problem 1.10

$$11.3\text{ cm} \times \frac{10\,\text{mm}}{1\,\text{cm}} = 113\text{ mm}$$

Sample Problem 1.11

$$17{,}000\text{ L} \times \frac{1\,\text{gallon}}{3.785\,\text{L}} \times \frac{1\,\text{barrel}}{42\,\text{gallons}} = 106.9\text{ barrel}$$ (assuming the number of L is to 5 sig fig)

Sample Problem 1.12

$$\$10.00 \times \frac{1\,\text{gallon}}{\$2.08} = 4.81 \text{ gallons}$$

Sample Problem 1.13

$$10 \text{ mg} \times \frac{5\,\text{mL}}{25\,\text{mg}} = 2 \text{ mL}$$

Sample Problem 1.14

$$62 \text{ kg} \times \frac{1.6\,\text{mg}}{1\,\text{kg}} \times \frac{2\,\text{mL}}{80\,\text{mg}} = 2.48 \text{ mL}$$

Sample Problem 1.15

$$\text{density} = \frac{9.38\,\text{g}}{0.60\,\text{mL}} = 15.6 \text{ g/mL (should be 20 g/mL using 1 sig fig!)}$$

14-carat gold from this density

Sample Problem 1.16

$$23.8 \text{ mL} \times \frac{2.6\,\text{g}}{1\,\text{mL}} = 61.88 \text{ g} = 62 \text{ g}$$

Sample Problem 1.17

a) 53 °F – 32 = 21

b) 21 ÷ 1.8 = 12 °C

Sample Problem 1.18

a) 175 °C × 1.8 = 315

b) 315 + 32 = 347 °F

CORE PROBLEMS

1.1

a) mass

b) volume

c) distance

1.2

a) volume

b) distance

c) mass

1.3

a) L
b) cm
c) mg
d) μL

1.4

a) g
b) mL
c) km
d) cg

1.5

a) meter
b) deciliter
c) kilogram
d) micrometer

1.6

a) liter
b) centimeter
c) microgram
d) milliliter

1.7

a) height
b) mass
c) volume

1.8

a) volume
b) mass
c) depth

1.9

a) kilogram
b) milliliters
c) centimeters

1.10

a) millimeters

b) liters

c) milligrams

1.11

The "cannot possibly be correct ones" are (b), (d), (f)

1.12

The "cannot possibly be correct ones" are (a), (c), (e), (f)

1.13

The 9 in 1.19 mg is uncertain.

1.14

The 4

1.15

a) Balance 1 is more precise

b) Balance 1: $\frac{26.375 + 26.377 + 26.378}{3} = 26.377 \text{ g}$

Balance 2: $\frac{26.389 + 26.381 + 26.385}{3} = 26.385 \text{ g}$

So balance 2 is more accurate.

1.16

a) Tool 1 – the values are closer together (0.03 cm range compared to 0.07)

b) Tool 1 – the values are closer to the actual value

1.17

a) 3 places to the right

b) 2 places to the left

c) 1 places to the right

d) 9 places to the right

1.18

a) 3 places to the left

b) 4 places to the right

c) 4 places to the left

d) 2 places to the right

1.19

a) $27.2\ \text{cm} \times \dfrac{1\ \text{m}}{10^2\ \text{cm}} = 0.272\ \text{m}$

b) $27.2\ \text{cm} \times \dfrac{10\ \text{mm}}{\text{cm}} = 272\ \text{mm}$

c) $27.2\ \text{cm} \times \dfrac{10^4\ \mu\text{m}}{\text{cm}} = 27.2 \times 10^4\ \mu\text{m} = 2.72 \times 10^5\ \mu\text{m}$

1.20

a) 0.12 g

b) 120,000 micrograms

c) 1.2×10^{-4} kilograms

1.21

a) 1 dL = 1/10 L, or 10 dL = 1 L.

b) 1 km = 1000 m or 1 km = 10^3 m

c) 1/1,000,000 g = 1 μg or 1 g = 1,000,000 μg

$1/10^6$ g = 1 μg or 1 g = 10^6 μg

10^{-6} g = 1 μg

d) 10 mm = 1 cm

1.22

a) 1 gram equals 100 centigrams

b) 1 kilometer equals 100,000 centimeters

c) 1 milliliter = 1000 microliters

d) 1 decigrams = 10 centigrams

1.23

a) $\dfrac{1.609\ \text{km}}{1\ \text{mi}}$ or $\dfrac{1\ \text{mi}}{1.609\ \text{km}}$

b) $\dfrac{1\ \text{kg}}{2.205\ \text{pounds}}$ or $\dfrac{2.205\ \text{pounds}}{1\ \text{kg}}$

c) $\dfrac{1\ \text{dL}}{100\ \text{mL}}$ or $\dfrac{100\ \text{mL}}{1\ \text{dL}}$

1.24

a) $\dfrac{1\,\text{cup}}{236.6\,\text{mL}}$ and $\dfrac{236.6\,\text{mL}}{1\,\text{cup}}$

b) $\dfrac{1\,\text{fluid ounce}}{6\,\text{teaspoons}}$ and $\dfrac{6\,\text{teaspoons}}{1\,\text{fluid ounce}}$

c) $\dfrac{1\,\text{kilometer}}{1000\,\text{meters}}$ and $\dfrac{1000\,\text{meters}}{1\,\text{kilometer}}$

1.25

a) The conversion factor says 100 m = 1 cm; should be 1 m = 100 cm

b) The numbers in the conversion factor are correct, but it needs to be flipped so that 100 cm is on the bottom.

1.26

a) The conversion factor says 1000 km = 1 m; should be 1 km = 1000 m

b) The numbers in the conversion factor are correct, but it needs to be flipped so that 1000 m is on the bottom.

1.27

a) $19.7\,\text{fl oz} \times \dfrac{1\,\text{qt}}{32\,\text{fl oz}} = 0.616\,\text{qt}$

b) $4.88\,\text{oz} \times \dfrac{28.35\,\text{g}}{1\,\text{oz}} = 138\,\text{g}$

c) $247\,\text{mL} \times \dfrac{1\,\text{cup}}{236.6\,\text{mL}} = 1.04\,\text{cup}$

d) $1.52\,\text{m} \times \dfrac{39.37\,\text{in}}{1\,\text{m}} = 59.8\,\text{in}$

e) $8.8 \times 10^{-6}\ \text{m} \times \dfrac{39.37\ \text{in}}{1\ \text{m}} = 3.5 \times 10^{-4}\ \text{in}$

1.28

a) $245\ \text{pounds} \times \dfrac{1\,\text{ton}}{2000\,\text{pounds}}$ = 0.1225 tons (0.123 using correct sig figs)

b) $39.6\ \text{cm} \times \dfrac{1\,\text{inch}}{2.54\,\text{cm}}$ = 15.6 inches

c) $2500\ \text{mL} \times \dfrac{1\,\text{quart}}{946\,\text{mL}}$ = 2.6 quarts (or 2.64 or 2.642, depending on interpretation of sig figs!)

d) $41.3 \text{ pounds} \times \dfrac{1\,\text{kilogram}}{2.205\,\text{pounds}} = 18.7 \text{ kilograms}$

e) $5.7 \times 10^{-5} \text{ ounces} \times \dfrac{28.35\,\text{grams}}{1\,\text{ounce}} = 1.6 \times 10^{-3} \text{ grams}$

1.29

He could convert the weight in ounces into pounds (using the relationship between ounces and pounds), then convert the weight in pounds into tons (using the relationship between pounds and tons).

1.30

Convert miles to feet and then feet to inches

1.31

a) $0.235\,\text{km} \times \dfrac{0.621\,\text{mi}}{1\,\text{km}} \times \dfrac{5280\text{ feet}}{1\,\text{mile}} = 771\,\text{ft}$

b) $0.175\,\text{g} \times \dfrac{1\,\text{ounce}}{28.35\,\text{g}} \times \dfrac{437.5\,\text{grains}}{1\,\text{ounce}} = 2.70\,\text{grains}$

c) $25\,\text{teaspoons} \times \dfrac{4.93\,\text{mL}}{1\,\text{teaspoon}} \times \dfrac{1\,\text{fl oz}}{29.57\,\text{mL}} = 4.2\,\text{fl oz}$

d) $5.1 \times 10^{7}\ \text{kg} \times \dfrac{2.205\,\text{pounds}}{1\,\text{kg}} \times \dfrac{1\,\text{ton}}{2000\,\text{pounds}} = 5.6 \times 10^{4}\ \text{tons}$

1.32

a) $82 \text{ furlongs} \times \dfrac{1\,\text{mile}}{8\,\text{furlongs}} \times \dfrac{1.609\,\text{km}}{1\,\text{mile}} = 16 \text{ km}$

b) $313 \text{ fluid drams} \times \dfrac{1\,\text{pint}}{128\,\text{fluid drams}} \times \dfrac{1\,\text{deciliter}}{0.211\,\text{pints}} = 11.6 \text{ deciliters}$

c) $1.25 \text{ quarts} \times \dfrac{946.4\,\text{mL}}{1\,\text{quart}} \times \dfrac{1\,\text{teaspoon}}{4.93\,\text{mL}} = 240.\text{ teaspoons}$

d) $6.27 \times 10^{11} \text{ m} \times \dfrac{1\,\text{mile}}{1609\,\text{m}} \times \dfrac{1\text{ light - year}}{5.88 \times 10^{12}\ \text{miles}} = 6.63 \times 10^{-5} \text{ light-years}$

1.33

$0.125\,\text{L} \times \dfrac{1.057\text{ quart}}{1\,\text{L}} \times \dfrac{8\,\text{quaterns}}{1\,\text{quart}} = 1.06\,\text{quaterns}$

1.34

$16.85 \text{ barrels} \times \dfrac{42\,\text{gallons}}{1\,\text{barrel}} \times \dfrac{4\,\text{quarts}}{1\,\text{gallon}} \times \dfrac{1\,\text{liter}}{1.057\,\text{quarts}} \times \dfrac{1\,\text{kiloliter}}{1000\,\text{liters}} = 2.678 \text{ kiloliters}$

1.35

a) $\frac{1\,\text{pound}}{22\,\text{cents}}$ and $\frac{22\,\text{cents}}{1\,\text{pound}}$

b) $\frac{1\,\text{teaspoon}}{0.8\,\text{mg}}$ and $\frac{0.8\,\text{mg}}{1\,\text{teaspoon}}$

c) $\frac{65\,\text{mL}}{1\,\text{hour}}$ and $\frac{1\,\text{hour}}{65\,\text{mL}}$

d) $\frac{1\,\text{mL}}{11.3\,\text{g}}$ and $\frac{11.3\,\text{g}}{1\,\text{mL}}$

1.36

a) $\frac{1\,\text{gallon}}{\$3.49}$ and $\frac{\$3.49}{1\,\text{gallon}}$

b) $\frac{1\,\text{cup}}{29\,\text{g}}$ and $\frac{29\,\text{g}}{1\,\text{cup}}$

c) $\frac{88\,\text{mg}}{1\,\text{dL}}$ and $\frac{1\,\text{dL}}{88\,\text{mg}}$

d) $\frac{1\,\text{mL}}{0.0012\,\text{g}}$ and $\frac{0.0012\,\text{g}}{1\,\text{mL}}$

1.37

a) $3500\,\text{mg potassium} \times \frac{1\,\text{mL juice}}{2.10\,\text{mg potassium}} = 1700\,\text{mL}$

b) $236.5\,\text{mL juice} \times \frac{2.10\,\text{mg potassium}}{1\,\text{mL juice}} = 497\,\text{mg potassium}$

1.38

a) $1300\ \mu\text{g} \times \frac{1\ \text{mL}}{1.65\ \mu\text{g}} = 790\ \text{mL}$

b) $946\ \text{mL} \times \frac{1\ .65\ \mu\text{g}}{1\ \text{mL}} = 1{,}560\ \mu\text{g}$

1.39

a) $8.2\text{ gallons} \times \dfrac{31\text{ miles}}{1\text{ gallon}} = 250\text{ miles}$

b) $186\text{ miles} \times \dfrac{1\text{ gallon}}{31\text{ miles}} = 6.0\text{ gallons}$

1.40

a) $0.23\text{ pounds} \times \dfrac{4.29\text{ dollars}}{1\text{ pound}} = \$0.99$

b) $\$2.50 \times \dfrac{1\text{ pound}}{4.29\text{ dollars}} = 0.583\text{ pounds}$

1.41

$$0.2\text{ g} \times \frac{1000\text{ mg}}{\text{g}} \times \frac{1\text{ tablet}}{100\text{ mg}} = 2\text{ tablets}$$

1.42

$$15\text{ mg} \times \frac{1\text{ tablet}}{10.\text{ mg}} = 1.5\text{ tablets}$$

1.43

$$300\text{ mg} \times \frac{5\text{ mL}}{200\text{ mg}} = 7.5\text{ mL}$$

1.44

$$100\text{ mg} \times \frac{5\text{ mL}}{250\text{ mg}} = 2\text{ mL}$$

1.45

$$500.\text{ mL} \times \frac{1\text{ hour}}{135\text{ mL}} = 3.70\text{ hours}$$

1.46

$$1.5\text{ mg} \times \frac{1\text{ hour}}{0.35\text{ mg}} = 4.3\text{ hours}$$

1.47

$$3160\text{ g} \times \frac{1\text{ kg}}{1000\text{ g}} \times \frac{25\text{ mg chlor.}}{1\text{ kg}} \times \frac{5.0\text{ mL liquid}}{500.\text{ mg chlor.}} = 0.79\text{ mL liquid}$$

1.48

$$38\text{ kg} \times \frac{40\text{ mg}}{1\text{ kg}} \times \frac{5\text{ mL}}{125\text{ mg}} = 61\text{ mL daily dose}$$

61 ÷ 4 = 15.25 mL each every six hours (20 if using 1 s.f.)

1.49

a) $\frac{7.545\text{ g}}{31.7\text{ mL}} = 0.238\text{ g/mL}$

b) 0.238

1.50

a) density = $\frac{2790\text{ g}}{246\text{ mL}} = 11.3\text{ g/mL}$

b) 11.3

1.51

a) $235\text{ mL} \times \frac{2.8\text{ g}}{1\text{ mL}} = 660\text{ g}$

b) $1600\text{ g} \times \frac{1\text{ mL}}{2.8\text{ g}} = 570\text{ mL}$

1.52

a) $2.18\text{ mL} \times \frac{7.9\text{ g}}{1\text{ mL}} = 17\text{ g}$

b) $51.3\text{ g} \times \frac{1\text{ mL}}{7.9\text{ g}} = 6.5\text{ mL}$

1.53

a) (275 °F – 32) ÷ 1.8 = 135 °C

b) (82.5 °C × 1.8) + 32 =181 °F

c) 82.5 °C + 273 = 356 K

1.54

a) 123 °F – 32 = 91; 91 ÷ 1.8 = 51 °C

b) 56 °C × 1.8 = 100.8 + 32 = 133 °F

c) 56 °C + 273 = 329 K

1.55

0 °C or 32 °F

1.56

100 °C or 212 °F

CONCEPT QUESTIONS

1.57

a) Shipping charges are usually calculated by weight, so this person is probably most interested in the weight or mass of the package. (However shippers usually also have size limits that specify the maximum length in the largest direction, or the maximum sum of length + height + width, so they might also ask for those dimensions as well.)

b) This person is going to be most interested in the width (across the machine), but may also be interested in the distance from front to back (if trying to make sure there will be plenty of room to stand in front of the machine and sort laundry) and the height (if installing a countertop to be level with the top of the machine.) Since the floor will hold the weight of the machine no matter what, the weight isn't important.

c) This person is likely to be interested in, not the volume occupied by the entire machine, but the volume of clothes the machine can wash at one time (the capacity), the volume of water it will use for each load, or the volume of the tub.

d) These people are going to be most interested in the weight, so they know how many people and what equipment will be appropriate for the job. Length, width and height dimensions may also be important – for example, to be sure the machine will fit through a specific doorway or turn on a stairway.

1.58 Mass is the amount of "stuff," volume is the space it occupies. A pillow occupies a larger volume than a brick. A brick has a greater mass than a pillow.

1.59 A unit is a measurement whose size everyone agrees upon, so it can be used as a basis for other measurements. Units are important in health care because we express so many things in terms of numbers—patients' height, weight, age, temperature, heart rate, blood pressure, etc; lab results; dosages of medications; etc. Unless two people are using the same units when they compare or communicate these things, the numbers are meaningless.

1.60 That is because one assumes years for age. However, if a Martian landed and asked a person's age, they would not know whether it was 35 years, months, minutes etc. Imagine that I said I was going to give you money – I was going to give you 20. It would be a pretty significant difference if you were expecting 20 dollars, and I gave you 20 cents.

1.61 The mass of a calculator is closer to a gram than it is to a kilogram or a milligram, so giving the mass in terms of the number of grams is more convenient than using other units. The mass of a calculator would be only a fraction of a kg, and would be tens or hundreds of thousands of milligrams.

1.62 Absolutely in both cases. A lab balance could measure the same amount each time to 3 decimal places – it would be precise. However, if someone had turned the dial so that it read 20 pounds with nothing on, it would not be accurate. A bathroom scale that shows 0 pounds with nothing on can only measure to within a pound. However, it would be more accurate than the badly calibrated balance but not as precise.

1.63 We can't really conclude that Katie's height increased between the two visits, because both measurements have an uncertainty of ±1 in the last digit (in this problem, ± 0.1 cm)—it's possible that her true height at the first measurement was 127.3 (or 127.1) and that her true height at the second measurement was 127.3 (or 127.5). It's possible that she grew by 0.2 cm in four days, or even by as much as 0.4 cm, or not at all. We can't tell for sure from these measurements.

1.64 The "m" in mL stands for 1/1000 of the base unit, so 1 mL = 1/1000 L, which means (through a tiny bit of algebra) that 1000 mL = 1 L.

1.65 A grain. 15 mg is not even one grain.

1.66

a) different

b) different

c) same

d) same

1.67 The wood has a lower density than water while a rock has a higher density than water.

1.68 Dehydration can cause the urine to be more concentrated than usual. Generally, the more concentrated a solution is, the greater its density/specific gravity.

1.69 Because the actual size of a °F is smaller than that of a °C and the 100 to 212 conversion includes an added number 32.

1.70

a) Picture #3: The object will sink.

b) Picture #2: The object will float.

c) Picture #1: The object will stay where it is placed and will neither sink nor float to the top on its own.

SUMMARY AND CHALLENGE PROBLEMS

1.71

a) Models 1 and 2 all give numbers that are very close to each other.

b) Only Model 2 gives numbers that are all close to 100, although the average value from Model 3 is very close to 100.

c) Model 2 is both accurate and precise.

1.72

(77.3 + 79.7 + 78.9)/3 = 78.63333333…

The highest and lowest values are 2.4 mg/dL apart, so there is uncertainty in the first digit to the left of the decimal place. Therefore we round the average to 79 mg/dL.

1.73

a) $327 \text{ g} \times \frac{1 \text{ pound}}{453.6 \text{ g}}$ = 0.721 pounds

b) $18 \text{ inches} \times \frac{2.54 \text{ cm}}{1 \text{ inch}}$ = 46 centimeters

c) $16.2 \text{ fluid ounces} \times \frac{29.57 \text{ mL}}{1 \text{ fluid ounce}}$ = 479 milliliters

d) $96.2 \text{ pounds} \times \frac{1 \text{ kilograms}}{2.205 \text{ pounds}}$ = 43.6 kilograms

e) $423.8 \text{ miles} \times \frac{1.609 \text{ kilometers}}{1 \text{ mile}}$ = 681.9 kilometers

f) $2.75 \text{ cups} \times \frac{2.366 \text{ deciliters}}{1 \text{ cup}}$ = 6.51 deciliters

1.74

a) $618 \text{ rods} \times \frac{1 \text{ mile}}{320 \text{ rods}} \times \frac{1.609 \text{ kilometers}}{1 \text{ mile}}$ = 3.11 km

b) $3.26 \text{ drams} \times \frac{1 \text{ ounce}}{16 \text{ drams}} \times \frac{28.35 \text{ g}}{1 \text{ ounce}}$ = 5.78 g

c) $31.5 \text{ g} \times \frac{1 \text{ ounce}}{28.35 \text{ g}} \times \frac{1 \text{ troy ounce}}{1.097 \text{ ounce}} = 1.01 \text{ troy ounces}$

d) $26.5 \text{ L} \times \frac{1.057 \text{ quart}}{1 \text{ L}} \times \frac{1 \text{ gallon}}{4 \text{ quarts}} \times \frac{1 \text{ British gallon}}{1.201 \text{ gallon}} = 5.83 \text{ British gallons}$

e) $15 \text{ tsp} \times \frac{4.93 \text{ mL}}{1 \text{ tsp}} \times \frac{10 \text{ dL}}{1000 \text{ mL}} = 0.74 \text{ dL}$

f) $5 \text{ cups} \times \frac{2.366 \text{ dL}}{1 \text{ cup}} \times \frac{1 \text{ L}}{10 \text{ dL}} = 1 \text{ L}$

1.75

$9 \text{ ounces} \times \frac{1 \text{ pound}}{16 \text{ ounces}}$ = 0.5625 pounds (*NB*: Sig figs mean 0.6 pounds but keep all for next part)

$26.5625 \text{ pounds} \times \frac{1 \text{ kilograms}}{2.205 \text{ pounds}}$ = 12.046 kilograms but going back to the 1 sig fig given, 10 kg

1.76

$$3.6\times10^{14}\ \text{kg}\times\frac{1\ \text{ton}}{907\ \text{kg}}=4.0\times10^{11}\ \text{tons}$$

1.77

133.2 °F – 32 = 101.2 ÷ 1.8 = 56.2 °C

So, acetone with 56.2 °C has the lower boiling point.

1.78

a) $8.5\ \text{pounds}\times\frac{1.00\ \text{dollar}}{3\ \text{pounds}}=\$2.83$

b) $2.75\ \text{dollars}\times\frac{3\ \text{pounds}}{1.00\ \text{dollar}}=8.25\ \text{pounds}$

1.79

a) $\frac{\$11.28}{4.72\ \text{pounds}}=\$2.39$ per pound

b) $\$5.00\times\frac{4.72\ \text{pounds}}{\$11.28}=2.09$ pounds

c) $2.28\ \text{pounds}\times\frac{\$11.28}{4.72\ \text{pounds}}=\$5.45$

1.80

$100\ \text{mL}\times\frac{1\ \text{min}}{0.75\ \text{mL}}\times\frac{1\ \text{hour}}{60\ \text{min}}=2$ hours to 1 s.f.

1.81

a) $1000\ \text{mg}\times\frac{1\ \text{mL}}{1.25\ \text{mg}}=800\ \text{mL}$

b) $118\ \text{mL}\times\frac{1.25\ \text{mg}}{1\ \text{mL}}=148\ \text{mg}$ (147.5 from calculator)

1.82 $2400\ \text{mg}\times\frac{1\ \text{mL}}{6.27\ \text{mg}}\times\frac{10\ \text{dL}}{1000\ \text{mL}}\times\frac{1\ \text{cup}}{2.366\ \text{dL}}=1.6\ \text{cups}$

1.83 $2\ \text{teaspoons}\times\frac{4.93\ \text{mL}}{1\ \text{teaspoon}}\times\frac{32\ \text{mg}}{1\ \text{mL}}=300\ \text{mg}$ (315.52 from calculator)

1.84

Milk:

$$1\,\text{fl oz} \times \frac{29.57\text{ mL}}{1\text{ fl oz}} \times \frac{1\text{ quart}}{946.4\text{ mL}} \times \frac{1\text{ gallon}}{4\text{ quarts}} \times \frac{3.29\text{ dollars}}{1\text{ gallon}} = 0.026\text{ dollars per fl oz}$$

Wine:

$$1\,\text{fl oz} \times \frac{29.57\text{ mL}}{1\text{ fl oz}} \times \frac{1\text{ L}}{1000\text{ mL}} \times \frac{9.49\text{ dollars}}{0.75\text{ L}} = 0.374\text{ dollars per fl oz}$$

Cola:

$$1\,\text{fl oz} \times \frac{1\text{ can}}{12\text{ fl oz}} \times \frac{5.89\text{ dollars}}{12\text{ cans}} = 0.041\text{ dollars per fl oz)}$$

Water:

$$1\,\text{fl oz} \times \frac{29.57\text{ mL}}{1\text{ fl oz}} \times \frac{1\text{ bottle}}{500\text{ mL}} \times \frac{5.99\text{ dollars}}{24\text{ bottles}} = 0.015\text{ dollars per fl oz}$$

Ranking in order, from lowest to highest cost per fl oz: water < milk < cola < wine

1.85

a) mass of stopper = 102.663 g – 94.095 g = 8.568 g

b) volume of stopper = 39.8 mL – 32.6 mL = 7.2 mL

c) density = $\frac{8.568\text{ g}}{7.2\text{ mL}}$ = 1.2 g/mL

d) 10.313 g × $\frac{7.2\text{ mL}}{8.568\text{ g}}$ = 8.7 mL

1.86

$$\text{Density} = \frac{\text{mass}}{\text{volume}} = \frac{45.718\text{ g}}{5.7\text{ mL}} = 8.0\text{ g/mL}$$

The tableware is probably stainless steel (and certainly cannot be pure silver, aluminum or nickel).

1.87

Specific gravity is the same as density in g/mL

50.0 mL × $\frac{1.002\text{ g}}{1\text{ mL}}$ = 50.1 g is the low end

50.0 mL × $\frac{1.028\text{ g}}{1\text{ mL}}$ = 51.4 g is the high end

1.88

$\text{Density} = \dfrac{\text{mass}}{\text{volume}} = \dfrac{1.593\ \text{g}}{1.50\ \text{mL}} = 1.06\ \text{g/mL (rounded to 3 sf)}$ This person is eligible to donate based on blood density.

1.89 $\dfrac{28.4\ \text{pounds}}{1\ \text{quart}} \times \dfrac{1\ \text{quart}}{946.4\ \ \text{mL}} \times \dfrac{453.6\ \text{g}}{1\ \text{pound}} = 13.6\ \text{g/mL}$

1.90 $22.6\ \text{fl dr} \times \dfrac{1\ \text{fl oz}}{8\ \text{fl dr}} \times \dfrac{29.57\ \text{mL}}{1\ \text{fl oz}} \times \dfrac{0.79\ \text{g}}{1\ \text{mL}} = 66\ \text{g (rounded to 2 sf)}$