

CHAPTER 1

Problem 1.1

Amoxicillin is a commonly prescribed antibiotic. A child is given a dose of amoxicillin in the amount of 375 mg. Express this in dose in g using the scientific notation.

- (A). $3.75 \times 10^3 \text{ g}$
- (B). $3.75 \times 10^2 \text{ g}$
- (C). $3.75 \times 10^1 \text{ g}$
- *(D). $3.75 \times 10^{-1} \text{ g}$
- (E). $3.75 \times 10^{-3} \text{ g}$

Solution

This problem uses the conversion factor $\frac{1 \text{ g}}{1000 \text{ mg}}$

$$\text{Mass in g} = 375 \text{ mg} \times \frac{1 \text{ g}}{1000 \text{ mg}} = 3.75 \times 10^{-1} \text{ g}$$

Problem 1.2

What is the SI unit for density?

- (A). g/cm^3
- (B). g/L
- (C). kg/cm^3
- *(D). kg/m^3
- (E). kg^{L}

Solution

This SI unit for mass is kg. The SI unit for distance is m; hence, the SI unit for volume is m^3 . The SI units for density (mass/volume) are thus kg/m^3 .

Problem 1.3

Vitamin E is an antioxidant, i.e., it helps to slow down processes that damage cells. A patient was given a dose of Vitamin E in the amount of 0.0150 g. What is the number of significant figures in this measurement?

- (A). 1
- (B). 2
- *(C). 3
- (D). 4
- (E). 5

Solution

The numbers in bold font in 0.0**150** are all **significant**. The 0 before 1 is a “placeholder”.

Problem 1.4

The following measurements were made by a student. **How many** of these measurements have 2 significant figures?

Volume of water: 10.0 mL

Mass of sodium chloride: 0.078 g

Number of carbon atoms in a molecular model: 12

Length of a side in a cubic block of aluminum: 1.2 cm

- (A). 0
- (B). 1
- *(C). 2
- (D). 3
- (E). 4

Solution

Volume of water: 10.0 mL

There are 3 sf

Mass of sodium chloride: 0.078 g

There are 2 sf

Number of carbon atoms in a molecular model 12

There are unlimited sf in counting

Length of a block of aluminum: 1.2 cm

There are 2sf

Thus, two of the measurements have 2 sf.

Problem 1.5

(Fill in the blank would work well!)

Students are advised to maintain social distancing at 6.00 feet in classrooms to reduce the risk of infection from COVID-19. This distance is _____ m. **Caution: Use exactly 3 digits** in your answer.

Solution

This problem uses the conversion factors

$$\frac{12 \text{ inch}}{1 \text{ ft}}$$

$$\frac{2.54 \text{ cm}}{1 \text{ inch}}$$

$$\frac{1 \text{ m}}{100 \text{ cm}}$$

$$\text{Distance in m} = 6.00 \text{ ft} \times \frac{12 \text{ inch}}{1 \text{ ft}} \times \frac{2.54 \text{ cm}}{1 \text{ inch}} \times \frac{1 \text{ m}}{100 \text{ cm}} = 1.83 \text{ m} \quad (3 \text{ sf})$$

Problem 1.6

Report the calculation of area of the following rectangle to the appropriate number of significant figures.

Length = 65.6 cm

Width = 5.2 cm

(A). $3.4112 \times 10^2 \text{ cm}^2$

(B). $3.411 \times 10^2 \text{ cm}^2$

(C). $3.41 \times 10^2 \text{ cm}^2$

*(D). $3.4 \times 10^2 \text{ cm}^2$

(E). $3 \times 10^2 \text{ cm}^2$

Solution

When we multiply or divide numbers, we round the result to the same number of digits as the number with the least number of significant figures. In this instance, the number of significant figures is 3 for the length, and 2 for the width. Hence, the answer is reported to 2 significant figures.

Problem 1.7

Report the following addition:

$$12.500 + 1.2$$

- (A). 14
- *(B). 13.7
- (C). 13.70
- (D). 13.700

Solution

When we add or subtract numbers, we round the result to the same number of decimal places as the number with the least number of decimal places, in this instance 1 decimal place.

Problem 1.8

On average, the density of human blood is 1.06 g/cm^3 . What is the value of density of human blood, when reported in SI units?

- (A). $1.06 \times 10^6 \text{ kg/m}^3$
- *(B). $1.06 \times 10^3 \text{ kg/m}^3$
- (C). $1.06 \times 10^0 \text{ kg/m}^3$
- (D). $1.06 \times 10^{-3} \text{ kg/m}^3$
- (E). $1.06 \times 10^{-6} \text{ kg/m}^3$

Solution

This problem uses the conversion factors

$$\frac{1 \text{ kg}}{1000 \text{ g}}$$

$$\frac{100 \text{ cm}}{1 \text{ m}}$$

$$\text{Density in } \frac{\text{kg}}{\text{m}^3} = 1.06 \frac{\text{g}}{\text{cm}^3} \times \frac{1 \text{ kg}}{1000 \text{ g}} \times \left(\frac{100 \text{ cm}}{1 \text{ m}} \right)^3 = 1.06 \times 10^3 \frac{\text{kg}}{\text{m}^3} \quad (3 \text{ sf})$$

Problem 1.9

(Fill in the blank would work well!)

An artificial lake has an area of 12.0 square miles. A boat spilled gasoline in this lake such that the thickness of oil in the entire lake is 112 nm. Calculate the volume of gasoline (in gallons) that was spilled. Assume a uniform thickness.

Useful conversions

$$1 \text{ gallon} = 3.7854 \text{ L}$$

$$1 \text{ L} = 1000 \text{ mL}$$

$$1 \text{ mL} = 1 \text{ cm}^3$$

$$1 \text{ mile} = 1.6093 \text{ km}$$

Solution

Volume = Area x thickness

It is easiest to convert all dimensions to m, and then use the conversion factors

$$\frac{1000 \text{ L}}{1 \text{ m}^3} \qquad \frac{1 \text{ gallon}}{3.7854 \text{ L}}$$

$$\text{Volume(gallons)} = 12.0 \text{ mile}^2 \times \left(\frac{1.6093 \text{ km}}{1 \text{ mile}} \right)^2 \times \left(\frac{1000 \text{ m}}{1 \text{ km}} \right)^2 \times (112 \times 10^{-9} \text{ m}) \times \left(\frac{1000 \text{ L}}{1 \text{ m}^3} \right) \times \left(\frac{1 \text{ gallon}}{3.7854 \text{ L}} \right)$$

$$= 9.20 \times 10^2 \text{ gallon (3sf)}$$

Problem 1.10

(Fill in the blank would work well!)

The walls in a room are 1256 square feet in area, and 1.00 gallon of paint covers 15.0 square yards.

How many gallons of paint are needed for painting the room?

Useful information

1 yard = 3 feet exactly

Solution

A useful conversion factor is:

$$\frac{1 \text{ yard}^2}{9 \text{ ft}^2}$$

$$\text{Volume in gallons} = 1256 \text{ ft}^2 \times \frac{1 \text{ yard}^2}{9 \text{ ft}^2} \times \frac{1 \text{ gallon}}{15.0 \text{ yard}^2} = 9.30 \text{ gallon (3 sf)}$$