Chapter A: Units, Measurements and Uncertainty

Section A.1: Rules for Rounding Numbers

Rule 1: In a series of calculations, carry the extra digits to the final result, then, round off. DO NOT round off in the middle of a series of calculations.

Rule 2: If the digit to be removed is less than 5, the preceding digit stays the same.

Example: Round off the number 1.23.
The number 2 is the preceding number. $3 < 5$. Hence, the number 1.23 rounds off to 1.2

Rule 3: If the digit to be removed is greater than 5 or equal to 5 and followed by nonzero digits, the preceding digit is increased by one.

Example 1: Round off the number 1.27
The number 2 is the preceding number. $7 > 5$. Hence, the number 1.27 rounds to 1.3.

Example 2: Round off the number 4.157 to the tenth place.
The preceding number is 1 followed by 57. Hence, the number 4.157 rounds up to 4.2.

Rule 4: If the digit to be removed is equal to 5 and not followed by any nonzero digits, the preceding digit is increased by one if it is odd, and unchanged if it is even.

Example 1: Round off the number 4.75
The number 7 is the preceding number. 7 is odd. Hence, the number 4.75 rounds to 4.8.

Example 2: Round off the number 6.45
The number 4 is the preceding number. 4 is even. Hence, the number 6.45 rounds to 6.4.

Example 3: Round off the number 4.0150 to the hundredth place
The preceding number is 1. 1 is followed by a 50. 1 is odd. Hence, we round up to 4.02.

In this section, practice the Interactive Problems.

Section A.2: Rules for Counting Significant Figures

“Significant figures” refers to the number of digits for the value of a measured or calculated quantity.

Rules for Counting Significant Figures

Rule 1: All numbers 1-9 are significant, or, non-zero integers are significant.

Examples:
1) 235 has three significant figures
2) 132.24 has five significant figures
3) 25 has two significant figures

In this section, practice the Interactive Problems.

Rule 2: Leading zeros are not significant or zeros that precede non-zero integers are not significant.

Examples:
1) 0.00235 has three significant figures
2) 0.001223 has four significant figures

In this section, practice the Interactive Problems.

Rule 3: Captive zeros are significant or zeros between non-zero integers are significant.

Examples:
1) 1005 has four significant figures
2) 15.067 has five significant figures

In this section, practice the Interactive Problems.

Rule 4: Trailing zeros are significant if the number contains a decimal point or zeros at the right end of a number are significant if it contains a decimal point.

Example 1:
1) 1000 has one significant figure.

Example 2:
1) 157.00 has five significant figures.

In this section, practice the Interactive Problems.

Section A.3: Significant Figures in Multiplication

Multiplication Rule: The number of significant figures in the result is the same as the least number of significant figures used in the calculation.

> **Example: 5.65 x 1.3 = ?**
> 5.65 has 3 significant figures. 1.3 has 2 significant figures. Hence, the answer should be in two significant figures. Your calculator reads 7.345. In the number 7.345, 3 is the preceding number. 4 < 5. Therefore, the correct answer is 7.3.

In this section, practice the Interactive Problems.

Section A.4: Significant Figures in Division

Division Rule: The number of significant figures in the result is the same as the least number of significant figures used in the calculation.

> **Example: 7.231 / 1.23 = ?**
>
> The number 7.231 has 4 significant figures. The number 1.23 has three significant figures. Hence, the answer should be in three significant figures. Your calculator reads 5.878861789. In this number, 7 is the preceding number. The number 8 is > 5. Therefore, the correct answer is 5.88

In this section, practice the Interactive Problems.

Section A.5: Significant Figures in Addition

Addition Rule: The number of decimal places in the result is the same as the least number of decimal places used in the calculation.

> **Example: What is the result of 12.33 + 2.1 + 3.087?**
>
> 12.33 has two decimal places.
> 2.1 has one decimal place.
> 3.087 has three decimal places.
>
> The sum of these three numbers should be expressed in one decimal place. Your calculator reads 17.517. The preceding number is 5. 1 < 5. Therefore, the correct answer is 17.5.

In this section, practice the Interactive Problems.

Section A.6: Significant Figures in Subtraction

Subtraction Rule: The number of decimal places in the result is the same as the least number of decimal places used in the calculation.

Example: What is the result of 12.33 – 2.101?

12.33 has two decimal places.
2.101 has three decimal places.

The difference of these two numbers should be expressed in two decimal places. Your calculator reads 10.229. The number 2 is the preceding number. 9 > 5. therefore, the correct answer is 10.23.

In this section, practice the Interactive Problems.

Section A.7: Accuracy and Precision

Precision is the closeness of results in a set of data. The set of data can be viewed as a subset of a population. Precision is determined by replicating a measurement.

Accuracy is the closeness of results of a set to the true value. True value is an accepted value. Accuracy measures the agreement between a result and its true value.

Section A.8: Mean

Once data is given, we calculate the AVERAGE or the MEAN. Consider a set of N data given by the values, X_1, X_2, X_3, …, X_N.

$\bar{x}$ is the symbol for expressing the average, or the mean.

Mathematically, $$\bar{x} = \frac{\sum_{i=1}^{N} X_i}{N}$$

$\sum$ = Summation sign (or adding all the numbers)

X_i, i = 1 to N represents the set of data.

Example: A student named "Scattergun Jones" runs replicates of a sample and these are the results: 58.90, 58.43, 59.15 and 59.33, respectively. What is the mean of these results?

Arrange these results in a tabulated form.
1. 58.90
2. 58.43
3. 59.15
4. 59.33

i = 1 to N or i = 1 to 4

This is simple. Using any calculator we can add the four numbers and divide by 4.

$$\frac{58.90 + 58.43 + 59.15 + 59.33}{4} = 58.95$$

In this section, practice the Interactive Problems.

Section A.9: Standard Deviation

Standard Deviation (S) is a statistical term to measure the precision of the data set.

For example: A number given as 4.5 ± 0.2. 0.2 represents the standard deviation. This result simply tells us that the true value is between 4.3 and 4.7.

Remember, the smaller the standard deviation, the more precise the data.

The mathematical equation used to calculate standard deviation is:

$$S = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \bar{x})^2}{N - 1}}$$

Example: Calculate the standard deviation for the following data set: 9.961, 10.004, 10.002, 9.973, 9.986

The mean ($\bar{x}$) value of the data is 9.985.

$$\sum_{i=1}^{N}(x_i - \bar{x})^2 = (9.961 - 9.985)^2 + (10.004 - 9.985)^2 + (10.002 - 9.985)^2$$

$$+ (9.973 - 9.985)^2 + (9.986 - 9.985)^2$$

$$= (-0.024)^2 + (0.019)^2 + (0.017)^2 + (-0.012)^2 + (0.001)^2$$

$= \ (5.76 \times 10^{-4}) \ + \ (3.61 \times 10^{-4}) \ + \ (2.89 \times 10^{-4}) \ + \ (1.44 \times 10^{-4}) \ + \ (1.00 \times 10^{-6})$

$= \ 0.001371$

Hence, $\sum_{i=1}^{N} (x_i - \bar{x})^2 = 0.001371$

N – 1 = 5 – 1 = 4

$$S = \sqrt{\frac{0.001371}{4}}$$

Hence, S = 0.0185

Once the Standard Deviation (S) is calculated, we relate the data as follows:

$$9.985 \pm 0.0185$$

0.0185 refers to the precision of the data set.
9.985 refers to the accuracy of the data set.
Hence, the true value is between 9.967 and 10.004.

In this section, practice the Interactive Problems.

Section A.10: Introduction to the Metric System

The measurement of physical quantities is accomplished by comparing those quantities to a set of standard units. In the natural sciences, the preferred set of standard units is the International System of Units (SI), which is based on the metric system. A set of base units is defined, from which all other units are derived. There are seven base units, also called fundamental quantities.

Length is measured in **meters** (abbreviated m). The standard meter was originally defined to be one ten-millionth of the distance from the North Pole to the Equator, measured along the meridian of longitude passing through Paris, France. The modern definition of a meter is the distance traveled by light in vacuum during a time interval of 1/299,792,458 of a second. The standard meter, made of platinum-iridium alloy, is kept at the U.S. Bureau of Standards in Washington, D.C.

Mass is measured in **kilograms**, kg. The standard kilogram is a platinum-iridium cylinder kept at the U.S. Bureau of Standards in Washington, D.C. Note: In the metric system, the simplest mass unit is the gram, g. The SI base unit of mass is the kilogram, which is equal to 1000 grams.

Time is measured in **seconds**, s. The second was originally defined to be 1/86,400 of a mean solar day. The modern definition of the second is based on the cesium-beam atomic clock. Specifically, the second is defined to be exactly 9,192,631,770 periods of a specified microwave radiation from cesium-133 atoms.

Electric charge is measured in **coulombs**, C.

Temperature is measured in **kelvin**, K.

Amount of substance is measured in **moles**, mol.

Luminous intensity is measured in **candela**, cd. Luminous intensity is not typically used in freshmen chemistry.

These units are the base units for SI. Other metric units are related to these by multiplying by powers of 10. These powers of 10 are identified by a set of prefixes, the most common of which are the following:

Prefix	**Abbreviation**	**Multiplier**
pico	p	10^{-12}
nano	n	10^{-9}
micro	μ	10^{-6}
milli	m	10^{-3}
centi	c	10^{-2}
deci	d	10^{-1}
deca	da	10
hecto	h	10^{2}
kilo	k	10^{3}
mega	M	10^{6}
giga	G	10^{9}
tera	T	10^{12}

Examples: 1 millimeter (mm) = 10^{-3} meter (m)
1 kilogram (kg) = 10^{3} grams (g)

In this section, practice the Interactive Problems.

Section A.11: Metric Mass Conversions

The simplest metric unit of mass is the gram, g. Other commonly used units are

1 kilogram (kg) = 10^3 g = 1000 g
1 milligram (mg) = 10^{-3} g = 0.001 g
1 microgram (μg) = 10^{-6} g = 0.000001 g

Example 1: Convert 25 g to kg

$$25 \text{ g} = 25 \text{ g} \times \frac{1 \text{ kg}}{1000 \text{ g}}$$
$$= 0.25 \text{ kg}$$

Example 2: Convert 9.0 mg to g

$$9.0 \text{ mg} = 9.0 \text{ mg} \times \frac{10^{-3} \text{ g}}{1 \text{ mg}}$$
$$= 9.0 \times 10^{-3} \text{ g}$$
$$= 0.009 \text{ g}$$

Example 3: Convert 14 μg to mg

$$14 \ \mu\text{g} = 14 \ \mu\text{g} \times \frac{10^{-6} \text{ g}}{1 \ \mu\text{g}} \times \frac{1 \text{ mg}}{10^{-3} \text{ g}} = 14 \times \frac{10^{-6}}{10^{-3}} \text{ mg}$$
$$= 14 \times 10^{-6 - (-3)} \text{ mg}$$
$$= 14 \times 10^{-6+3} \text{ mg}$$
$$= 14 \times 10^{-3} \text{ mg}$$
$$= 1.4 \times 10^{-2} \text{ mg}$$
$$= 0.014 \text{ mg}$$

In this section, practice the Interactive Problems.

Section A.12: Metric - British Mass Conversions

The British unit of mass is called the slug. The more familiar British unit, the pound (lb) is actually a unit of weight. Approximate weight of 1 slug on earth = 32.1 lb

1 slug = 14.59 kg

Example 1: Convert 4.10 slugs to kilograms

$$4.10 \text{ slug} = 4.10 \text{ slug} \times \frac{14.59 \text{ kg}}{1 \text{ slug}} = 59.8 \text{ kg}$$

Example 2: Find the weight of 1.00 kilogram in pounds.

$$1.00 \text{ kg} = 1.00 \text{ kg} \times \frac{1 \text{ slug}}{14.59 \text{ kg}} \times \frac{32.1 \text{ lb}}{1 \text{ slug}} = 2.20 \text{ lb}$$

Example 3: Convert 3.35 g to slug

$$3.35 \text{ g} = 3.35 \text{ g} \times \frac{1 \text{ kg}}{1000 \text{ g}} \times \frac{1 \text{ slug}}{14.59 \text{ kg}} = 0.000230 \text{ slug}$$

In this section, practice the Interactive Problems.

Section A.13: Metric Length Conversions

The simplest metric unit of length is the meter, m. Other commonly used units are

$$1 \text{ kilometer (km)} = 10^3 \text{ m} = 1000 \text{ m}$$
$$1 \text{ centimeter (cm)} = 10^{-2} \text{ m} = 0.01 \text{ m}$$
$$1 \text{ millimeter (mm)} = 10^{-3} \text{ m} = 0.001 \text{ m}$$

Example 1: Convert 115 m to km

$$115 \text{ m} = 115 \text{ m} \times \frac{1 \text{ km}}{1000 \text{ m}} = 0.115 \text{ km}$$

Example 2: Convert 1.4 cm to m

$$1.4 \text{ cm} = 1.4 \text{ cm} \times \frac{10^{-2} \text{ m}}{1 \text{ cm}} = 1.4 \times 10^{-2} \text{ m} = 0.014 \text{ m}$$

Example 3: Convert 3.0 mm to cm

$$3.0 \text{ mm} = 3.0 \text{ mm} \times \frac{10^{-3} \text{ m}}{1 \text{ mm}} \times \frac{1 \text{ cm}}{10^{-2} \text{ m}} = 3.0 \times \frac{10^{-3}}{10^{-2}} \text{ cm}$$

$$= 3.0 \times 10^{-3 - (-2)} \text{ cm}$$
$$= 3.0 \times 10^{-3 + 2} \text{ cm}$$
$$= 3.0 \times 10^{-1} \text{ cm}$$
$$= 0.30 \text{ cm}$$

In this section, practice the Interactive Problems.

Section A.14: Metric - British Length Conversions

Common British units of lengths are the inch (in), the foot (ft), and the mile (mi).

1 ft = 12 in　　　　1 mi = 5280 ft

The conversions factors from in to cm and ft to m are

1 in = 2.54 cm　　　　1 ft = 0.3048 m

Example 1: Convert 4.32 cm to inches

$$4.32 \text{ cm} = 4.32 \text{ cm} \times \frac{1 \text{ in}}{2.54 \text{ cm}} = 1.70 \text{ in}$$

Example 2: Convert 3.00 ft to mm

$$3.00 \text{ ft} = 3.00 \text{ ft} \times \frac{0.3048 \text{ m}}{1 \text{ ft}} \times \frac{1 \text{ mm}}{0.001 \text{ m}} = 914 \text{ mm}$$

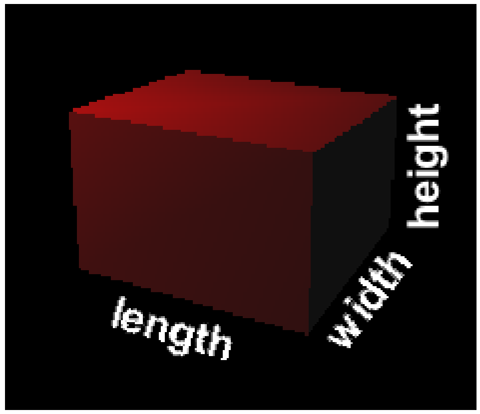
Example 3: Convert 6122 m to miles

$$6122 \text{ m} = 6122 \text{ m} \times \frac{1 \text{ ft}}{0.3048 \text{ m}} \times \frac{1 \text{ mi}}{5280 \text{ ft}} = 3.804 \text{ mi}$$

In this section, practice the Interactive Problems.

Section A.15: Metric Volume Conversions

Volume calculations apply to solids, liquids or gases. The simplest solid is a rectangular solid. Its volume is given by:



If the length, width and height are measured in meters, then V has unit m^3.

$$V = \text{Length} \times \text{Width} \times \text{Height}$$
$$m^3 = m \times m \times m$$

Similarly, if the length, width and height of the rectangular solid are measured in cm or mm, the unit of volume will be cm^3 or mm^3, respectively.

Note that: $1\ cm^3 = 1^3\ cm^3 = (1\ cm)^3 = (10^{-2}\ m)^3 = (10^{-2})^3\ m^3 = 10^{-6}\ m^3$

$$1\ cm^3 = 10^{-6}\ m^3 \qquad\qquad 1\ mm^3 = 10^{-9}\ m^3$$

For liquids and gases, volume is generally measured in liters (L).

Another common unit is the milliliter (mL).

$$1\ mL = 10^{-3}\ L = 0.001\ L$$
$$1\ L = 10^3\ mL = 1000\ mL$$

These two sets of units are connected by the fact that:

$$1\ mL = 1\ cm^3$$

Thus, $1\ L = 10^3\ mL = 10^3\ cm^3 = 10^3 \times 10^{-6}\ m^3 = 10^{3-6}\ m^3 = 10^{-3}\ m^3$

$$1\ L = 10^{-3}\ m^3 = 0.001\ m^3$$

Example 1: Convert 45.3 L to m^3.

$$45.3\ L = 45.3\ L \times \frac{0.001\ m^3}{1\ L} = 0.0453\ L$$

Example 2: Convert 2.0 m^3 to cm^3.

$$2.0\ m^3 = 2.0\ m^3 \times \frac{1\ cm^3}{10^{-6}\ m^3} = 2.0 \times 10^6\ cm^3$$

Example 3: Convert 5.1 mm^3 to mL.

$$5.1\ mm^3 = 5.1\ mm^3 \times \frac{10^{-9}\ m^3}{1\ mm^3} \times \frac{1\ cm^3}{10^{-6}\ m^3} = 5.1 \times \frac{10^{-9}}{10^{-6}}\ cm^3$$

$$= 5.1 \times 10^{-9-(-6)}\ cm^3$$

$$= 5.1 \times 10^{-9+6}\ cm^3$$

$$= 5.1 \times 10^{-3}\ cm^3$$

$$= 5.1 \times 10^{-3}\ mL$$

In this section, practice the Interactive Problems.

Section A.16: Metric - British Volume Conversions

In the British system, the units of volume that are of interest here are the cubic foot (ft^3) and the cubic inch (in^3).

Using the relationships:

$$1\ in = 2.54\ cm$$

$$1\ ft = 0.3048\ m$$

We obtain:

$$1\ in^3 = (1\ in)^3$$

Note: This is only the case with 1 in^3 because cubing 1 is equal to 1.

$$2\ in^3 \neq (2\ in)^3$$

$$1\ in^3 = (1\ in)^3 = (2.54\ cm)^3$$

$$= 2.54^3\ cm^3$$

$$= 16.4\ cm^3$$

Example 1: 45 mL = _______ in^3 ?

$$45\ \text{mL} = 45\ \text{mL} \times \frac{1\ \text{in}^3}{16.4\ \text{mL}} = 2.7\ \text{in}^3$$

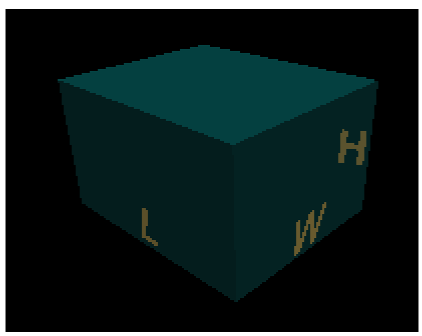
Example 2: **12.1 ft^3 = _______ m^3 ?**

$$12.1\ \text{ft}^3 = 12.1\ \text{ft}^3 \times \frac{0.02832\ \text{m}^3}{1\ \text{ft}^3} = 0.343\ \text{m}^3$$

In this section, practice the Interactive Problems.

Section A.17: Volume of a Rectangular Solid

We have already seen that the volume of a rectangular solid is given by



V = L W H

Example: **Find the volume of a rectangular solid with dimensions: 5.1 cm x 7.0 cm x 3.2 cm.**

L = 5.1 cm   W = 7.9 cm   H = 3.2 cm

$$V = LWH = 5.1 \times 7.9 \times 3.2\ \text{cm}^3 = 130\ \text{cm}^3$$

In this section, practice the Interactive Problems.

Section A.18: Volume of a Sphere

The volume of a sphere with radius *r* is given by

$$V = \frac{4}{3} \pi r^3$$

In practical problems, it is generally the diameter of the sphere (rather than the radius) that is given, since the diameter is more easily measured.

$$r = \frac{\text{diameter}}{2}$$

Example: Find the volume of a spherical ball bearing with a diameter of 19.1 mm.

$$r = \frac{\text{diameter}}{2} = \frac{19.1 \text{ mm}}{2} = 9.55 \text{ mm}$$

$$V = \frac{4}{3}\pi r^3 = 4 \times \pi \times \frac{(9.55 \text{ mm})^3}{3} = 3650 \text{ mm}^3$$

In this section, practice the Interactive Problems.

Section A.19: Volume of a Right Circular Cylinder

The volume of a right circular cylinder with radius r and height h is given by

$$V = \pi r^2 h$$

In practical problems, it is generally the diameter of the cylinder (rather than the radius) that is given, since the diameter is more easily measured.

$$r = \frac{\text{diameter}}{2}$$

Example: A cylindrical can soft drink has diameter 6.35 cm and height 15.24 cm. Find its volume in milliliters.

$$r = \frac{\text{diameter}}{2} = \frac{6.35 \text{ cm}}{2} = 3.175 \text{ cm}$$

$$V = \pi r^2 h = \pi \times (3.175 \text{ cm})^2 \times (15.24 \text{ cm}) = 483 \text{ cm}^3 = 483 \text{ mL}$$

In this section, practice the Interactive Problems.

Section A.20: Volume of a Right Circular Cone

The volume of a right circular cone with base radius *r* and height *h* is given by

$$V = \frac{1}{3}\pi r^2 h$$

In practical problems, it is generally the base diameter of the cone (rather than the radius) that is given, since the diameter is more easily measured.

$$r = \frac{\text{diameter}}{2}$$

Example: Find the volume of an ice cream cone with base diameter 2.0 in and height 5.5 in.

$$r = \frac{\text{diameter}}{2} = \frac{2.0\ \text{in}}{2} = 1.0\ \text{in}$$

$$V = \frac{1}{3}\pi r^2 h = \pi \times (1.0\ \text{in})^2 \times (\frac{5.5\ \text{in}}{3}) = 5.8\ \text{in}^3$$

In this section, practice the Interactive Problems.

Section A.21: Density

The density of a substance is defined by:

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

A unit of density is a unit of mass divided by a unit of volume. Most often, this is either g/cm^3 or kg/m^3.

Example: One liter of a given liquid has a mass of 745 g. Find its density in g/cm^3 and kg/m^3.

$$1\ \text{L} = 1000\ \text{mL} = 1000\ \text{cm}^3$$

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}} = \frac{745\ \text{g}}{1000\ \text{cm}^3} = 0.745\ \text{g/cm}^3$$

Converting this to kg/m^3 we get:

$$\text{Density} = 0.745\ \frac{\text{g}}{\text{cm}^3} \times \frac{1\ \text{kg}}{10^3\ \text{g}} \times \frac{1\ \text{cm}^3}{10^{-6}\ \text{m}^3} = 745\ \text{kg/m}^3$$

In this section, practice the Interactive Problems.

Section A.22: Density of Regular-shape Objects

When calculating the density of regular shaped objects, the formulas for the volumes of these objects are used.

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

Example 1: A spherical, helium-filled balloon has a diameter of 24.0 cm. The mass of the helium in the balloon is 1.30 g. Find the density of this sample of helium.

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}} = \frac{\text{Mass}}{\frac{4}{3}\pi r^3}$$

$$\text{Density} = \frac{1.30\ \text{g}}{\frac{4}{3}\pi (12.0\ \text{cm})^3} = 1.80 \times 10^{-4}\ \text{g}/\text{cm}^3$$

Example 2: A cylindrical rain barrel 1.2 m high and 0.65 m in diameter is filled with water. If the water has a mass of 398 kg, find its density.

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}} = \frac{\text{Mass}}{\pi r^2 h}$$

$$r = \frac{\text{diameter}}{2} = \frac{0.65\ \text{m}}{2} = 0.325\ \text{m}$$

$$\text{Density} = \frac{398\ \text{kg}}{\pi \times (0.325\ \text{m})^2 \times 1.2\ \text{m}} = 1000\ \text{kg}/\text{m}^3$$

In this section, practice the Interactive Problems.

Section A.23: Specific Gravity

The specific gravity of a substance is defined as the ratio of its density to the density of water.

$$\text{specific gravity of a substance} = \frac{\text{density of substance}}{\text{density of water}}$$

Because specific gravity is the ratio of two quantities measured in the same units, it is a pure number, without units or dimensions. Specific gravity of liquids is measured with a hydrometer. Since the density of a substance is temperature dependent, so is specific gravity. It is normal to specify the specific gravity at a particular temperature. At 20°C, the density of water is 0.998 g/cm^3 or 998 kg/m^3.

Example: Gasoline has a density of 680. kg/m^3 at 20°C. Find its specific gravity at this temperature.

$$\text{specific gravity of gasoline} = \frac{\text{density of gasoline}}{\text{density of water}} = \frac{680.\ \text{kg}/\text{m}^3}{998\ \text{kg}/\text{m}^3} = 0.681$$

In this section, practice the Interactive Problems.

Section A.24: Temperature Conversions

The three most commonly used temperature scales are Fahrenheit (°F), Celsius (also called Centigrade) (°C), and Kelvin (K). Let us denote the temperature in these three scales by T_F (Fahrenheit), T_C (Celsius), and T_K (Kelvin), respectively. The three scales are related by the following formulas:

$$T_F = 1.8\,T_C + 32 \qquad\qquad T_K = T_C + 273.15$$

Example 1: Convert 17°C to Fahrenheit and Kelvin.

$$T_F = 1.8\,T_C + 32 = 1.8 \times 17 + 32 = 62^\circ\text{F}$$
$$T_K = T_C + 273.15 = 17 + 273.15 = 290\ \text{K}$$

Note: Since the temperature is 17°C, we simply add 273 to convert to K. However, if the temperature is 17.22°C, then add 273.15 to convert to K.

Example 2: Convert 350 K to Celsius.

Solve the equation for T_C: $$T_K = T_C + 273.15$$

$$T_K - 273.15 = T_C$$

$$T_C = T_K - 273.15 = 350 - 273.15 = 77°C$$

Example 3: Convert -22°F to Celsius.

Solve the equation for T_C: $$T_F = 1.8\,T_C + 32$$

$$\frac{T_F - 32}{1.8} = T_C$$

$$T_C = \frac{T_F - 32}{1.8} = \frac{-22 - 32}{1.8} \; -30°C$$

In this section, practice the Interactive Problems.

Table of Contents Next Chapter