

CHEMISTRY

Chemistry and Measurements

(Lecture PPTs)

Chapter 2 Chemistry and Measurements

Registered nurses work to promote patient health and to prevent and treat disease.



2.1 Units of Measurement

There are many measurements in everyday life.



Learning Goal Write the names and abbreviations for the metric or SI units used in measurements of volume, length, mass, temperature, and time.

Units of Measurement

Scientists use the **metric system** of measurement and have adopted a modification of the metric system called the **International System of Units** as a worldwide standard.

The **International System of Units (SI)** is an official system of measurement used throughout the world for units of length, volume, mass, temperature, and time.

Units of Measurement, Metric and SI

TABLE 2.1 Units of Measurement and Their Abbreviations

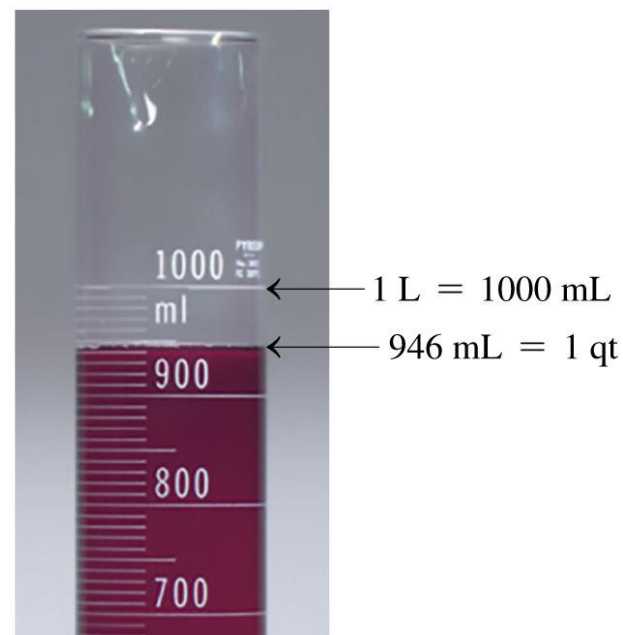
Measurement	Metric	SI
Volume	liter (L)	cubic meter (m ³)
Length	meter (m)	meter (m)
Mass	gram (g)	kilogram (kg)
Temperature	degree Celsius (°C)	kelvin (K)
Time	second (s)	second (s)

Volume

Volume, the space occupied by a substance,

- is measured using units of m^3 in the SI system.
- is commonly measured in liters (L) and milliliters (mL) by chemists.

Graduated cylinders are used to measure small volumes.



Volume

Useful relationships between units of volume include:

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

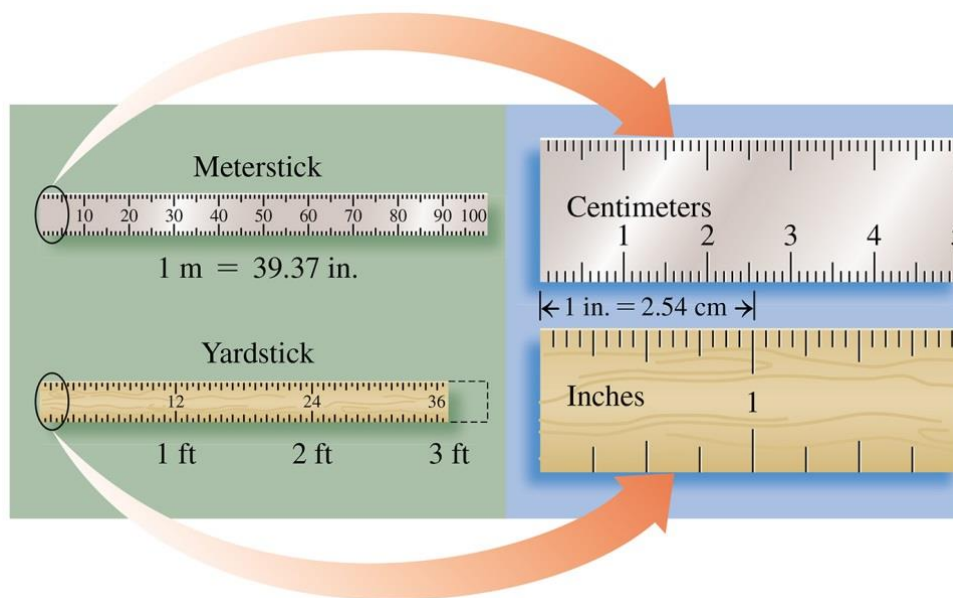
$$1 \text{ L} = 1.06 \text{ qt}$$

$$946 \text{ mL} = 1 \text{ qt}$$

Length

Length is measured in

- units of meters (m) in both the metric and SI systems.
- units of centimeters (cm) by chemists.



Length

Useful relationships between units of length include:

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

$$1 \text{ m} = 39.4 \text{ in.}$$

$$1 \text{ m} = 1.09 \text{ yd}$$

$$2.54 \text{ cm} = 1 \text{ in.}$$

Mass

The mass of an object, a measure of the quantity of material it contains,

- is measured on an electronic balance.
- has the SI unit of kilogram (kg).
- is often measured by chemists in grams (g).



Mass

Useful relationships between units of mass include:

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

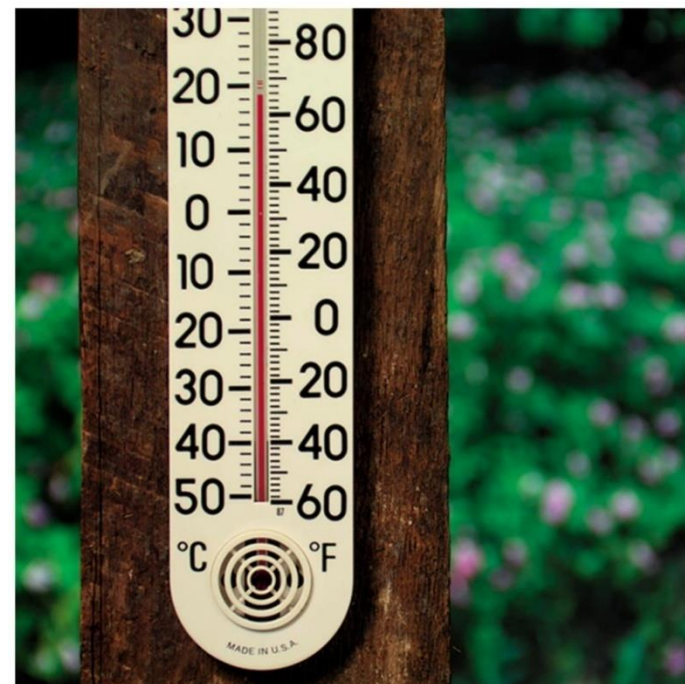
$$1 \text{ kg} = 2.20 \text{ lb}$$

$$454 \text{ g} = 1 \text{ lb}$$

Temperature

Temperature, a measure of how hot or cold an object feels,

- is measured on the **Celsius** ($^{\circ}\text{C}$) scale.
- is measured on the **Kelvin** (**K**) scale in the SI system.
- water freezes at $0\text{ }^{\circ}\text{C}$ ($32\text{ }^{\circ}\text{F}$) and boils at $100\text{ }^{\circ}\text{C}$ ($212\text{ }^{\circ}\text{F}$).
- the Kelvin scale for temperature begins at the lowest possible temperature, 0 K .



Time

Time is based on an atomic clock and is measured in units of seconds (s) in both the metric and SI systems.

A stopwatch is used to measure the time of a race.



Learning Check

For each of the following, indicate whether the unit describes (1) length, (2) mass, or (3) volume.

- A.** A bag of onions has a mass of 2.6 kg.
- B.** A person is 1.7 m tall.
- C.** A medication contains 0.50 g of aspirin.
- D.** A bottle contains 1.5 L of water.

Learning Check

Identify the SI unit for each of the following:

- A. volume
- B. mass
- C. length
- D. temperature

Learning Check

Identify the measurement given in an SI unit.

A. John's height is _____.

(1) 1.5 yd

(2) 6 ft

(3) 1.9 m

B. The mass of a lemon is _____.

(1) 12 oz

(2) 0.145 kg

(3) 0.31 lb

C. The temperature is _____.

(1) 255 K

(2) 85 °C

(3) 45 °F

Measured Numbers

The number of baseballs is counted, which means 2 is an exact number.



Learning Goal Identify a number as measured or exact; determine the number of significant figures in a measured number.

Measured Numbers

A measuring tool

- is used to determine a quantity such as the length or the mass of an object.
- provides numbers for a measurement called **measured numbers**.



Reporting Length

To report the length of an object,

- observe the numerical values of the marked lines at the end of the object.
- estimate the last digit by visually dividing the space between the smallest marked lines.

This estimated number is the final digit that is reported for a measured number.

Reporting Length: 4.5 cm

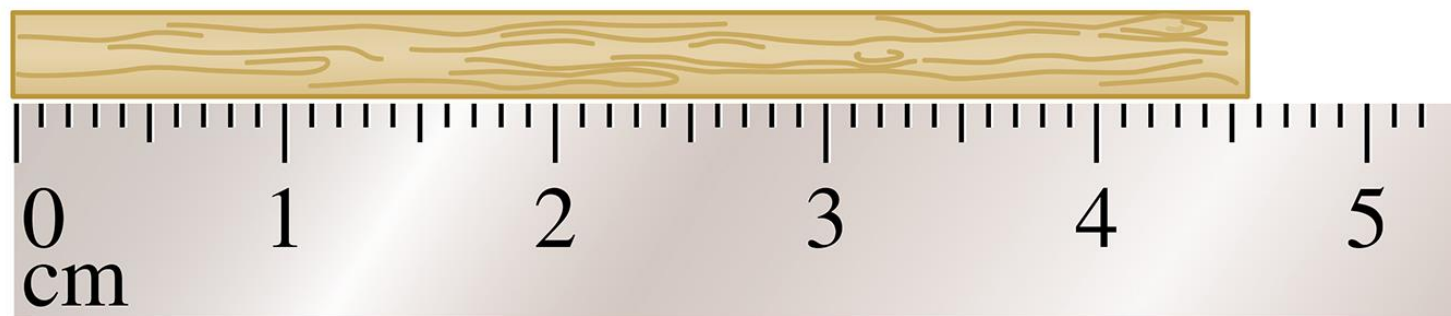
- The end of the object is between the 4-cm and 5-cm marks.
- Estimate that the end is halfway between the 4-cm and 5-cm marks and report the value as 4.5 cm.



(a)

Reporting Length: 4.55 cm

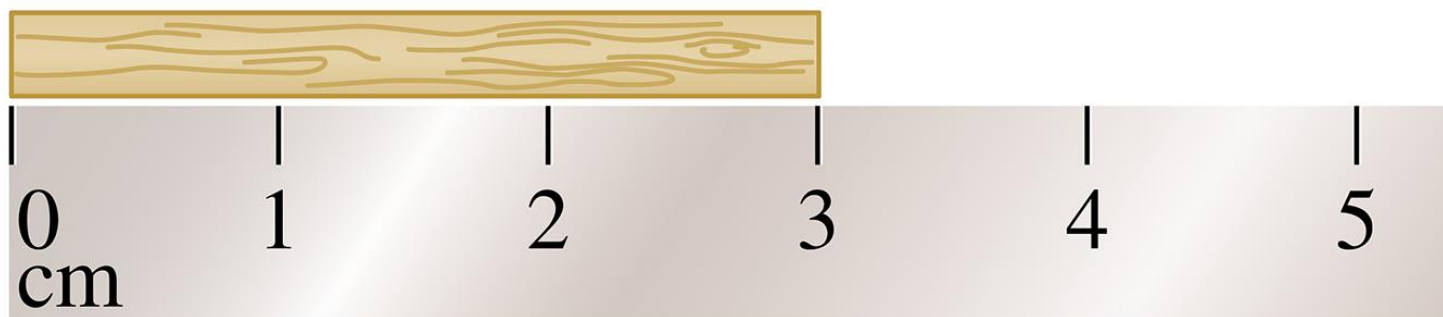
- This metric ruler is marked at every 0.1 cm.
- You can now estimate that the length is halfway between the 4.5-cm and 4.6-cm marks and report the value as 4.55 cm.



(b)

Reporting Length: 3.0 cm

- The end of the object lines up with the 3-cm mark.
- Because the divisions are marked in units of 1 cm, the estimated digit appears in the tenths place (0.1 cm).



(c)

Learning Check

. |⁸..... | |⁹..... | |¹⁰.. cm

What is the length of the red line?

- (1) 9.2 cm
- (2) 9.4 cm
- (3) 9.20 cm