Prefixes and Conversion of Base Units

Prefix

In science we deal with quantities which are both very large and very small. A short hand form of writing very large and very small numbers is known as a prefix. A few of the prefixes used in the SI system of units are shown in Table 1.3.

Table 1.3. prefixes

Prefix	Symbol	Name	Decimal representation
Mega	M	million	1 000 000
Kilo	k	thousand	1 000
Centi	c	hundredth	0.01
milli	m	thousandth	0.001
micro	**μ**	**millionth**	0.000001

Conversion of base units

It is often necessary to convert between units of measurement. For example, a mass measured in grams may be required to convert into kilogram. To convert from one unit to another within the SI, usually means moving a decimal point. If you can remember what the prefixes mean, you can convert within the SI system relatively easily by simply multiplying or dividing the number by the value of the prefix.

Example 1.2: Convert 6.5 kilogram (kg) to gram (g). Solution: Since k is a prefix representing 1000, so: 6.5 kg = 6.5 × (1000) g = 6500 g

Example 1.3: Convert 200 meters to kilometers. We know that 1 km = 1000m. Then we will ask if 1000m is 1km then what will be 200m in km?

Solution: 1 km = 1000 m
? = 200m $\Longrightarrow$ $200\,m = \frac{1\,km \times 200\,m}{1000\,m} = \frac{200\,km}{1000} = 0.2\,km$

Measuring Physical Quantities

The measurement of a physical quantity is done by using measuring instruments. In this section we will discuss how to measure mass, length, time, and temperature using their appropriate devices.

Measuring the mass of objects

Instruments which are used to measure mass are known as balances. The balance compares the mass of an object with a known mass. Different types of balances are there, see Fig 1.4.


Top pan balance


Table balance


Spring balance


Platform balance


Electronic balance

The SI unit of mass is kilogram (kg). For small mass we use gram (g). To measure the mass of objects less than 1 gram, we can use milligram. To measure the mass of big objects we use quintal and tone.

The relationship between different units of Length.

1 kg = 1000 g.

1 g = 1000 mg

1 quintal = 100 kg

1 tone = 1000 kg

Exercise 1.6: Convert the following measurement: (a) 2.5 kg to gram, (b) 200 gram to milligram.

Measuring Length

Length is a measure of how long an object is. Depending on the size of the length of the object, we are going to use different types of length measuring instrument, see Fig 1.5.

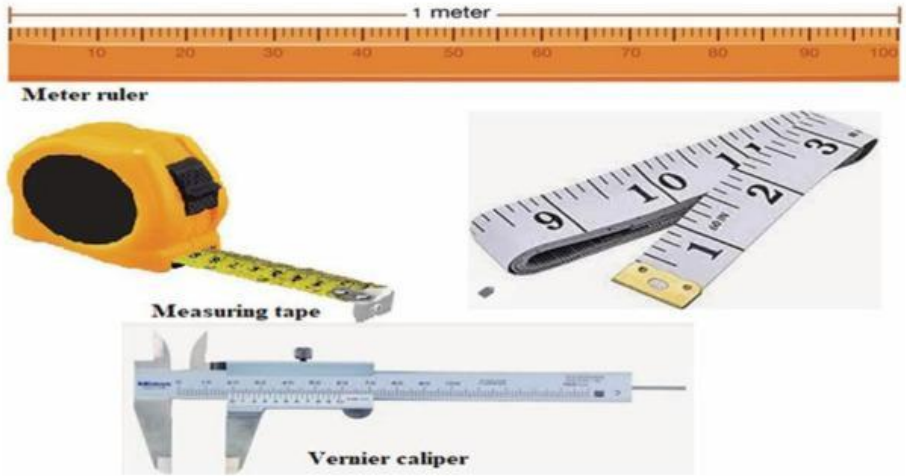


Figure 1.5 Instruments used to Measure Length

The SI unit of length is meter (m). When we want to measure larger lengths, we can use kilometers. If we want to measure small lengths, we can use centimeters or millimeters.

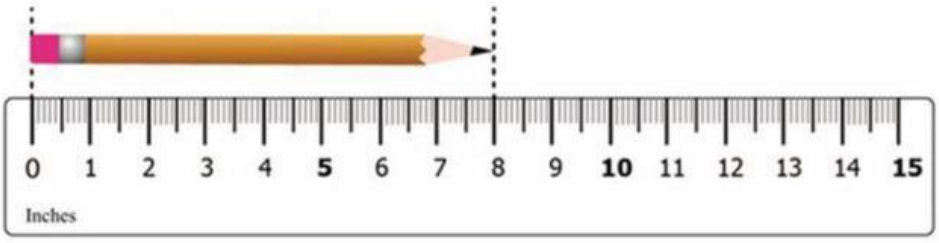
The relationship between different units of Length.

1km = 1000 m

1 m = 100 cm

1cm = 10mm

Note that when we are measuring length using these device do not forget to place the zero mark exactly at one end of the thing you are measuring and read the scale at the other end.



Example 1.5: How many millimeters are there in a meter? Solution: 1m = 100 cm = 100 x 10 mm = 1000 mm

Measuring time

Time is used to quantify the duration of events. Time is measured with a stop watch or clock.



The SI unit of time is second (s). For longer intervals of time we use: day, month , year, decades, century and millennium.

The relationship between different units of time

1 hour = 60 minutes

1 minute = 60 seconds

1 day = 24 hours

1 week = 7 days

1 year = 365 or 366 days

Measuring Temperature

Thermometer is the device used to measure the temperature of an object or place. The SI unit of temperature is Kelvin. Degree Celsius (°C) and degree Fahrenheit (0F) are other units of temperature Thermometers could be analogue or digital, see Figure 1.7

Figure 1.7 Temperature Measuring Devices

In using thermometer, hold the thermometer at the top, do not hold the bulb of a thermometer and do not let the bulb touch the glass.

Accuracy and Precision in Measurement

Accuracy refers to how close a measurement is to its accepted or known value.

Example 1.7: If in a laboratory you obtain a mass measurement of 8.2 kg for a given substance, but the actual or known mass is 10 kg, is your measurement accurate?

Answer: This measurement is not accurate, because your measurement (8.2 kg) is not close to the known value (10kg).

Precision refers to how close two or more measurements are to each other, regardless of whether those measurements are accurate or not.

Example 1.8: In the above example 1.4, if you measure the mass of the given substance five times, and get 3.2 kg, 3.1 kg, 3.25 kg, 3.3 kg and 3.2 kg. Is your measurement precise?

Answer: This measurement is precise, because the values are close to each other but not accurate because it is far from the known value (10 kg). This shows that precision is independent of accuracy. You can be very precise but inaccurate. You can also be accurate but not precise.

Choose the correct answer for the following questions

1. The prefix **kilo-** represents:

a) 10^2 b) 10^3

c) 10^6 d) 10^{-3}

2. The prefix **milli-** represents:

a) 10^{-1} b) 10^{-2} c) 10^{-3} d) 10^{-6}

3. The prefix **centi-** corresponds to:

a) 10^{-1} b) 10^{-2} c) 10^{-3} d) 10^2

4. One **kilometre (km)** is equal to:

a) 100 m b) 1000 m c) 10,000 m d) 100,000 m

5. One **gram (g)** is equal to:

a) 10 mg b) 100 mg c) 1000 mg d) 10,000 mg

6. One **tonne** is equal to:

a) 100 kg b) 500 kg c) 1000 kg d) 10,000 kg

7. One **quintal** is equal to:

a) 50 kg b) 100 kg c) 500 kg d) 1000 kg

8. The SI unit of **mass** is:

a) Gram (g) b) Kilogram (kg)

c) Quintal (q) d) Tonne (t)

9. The SI unit of **length** is:

a) Centimetre (cm) b) Metre (m)

c) Kilometre (km) d) Millimetre (mm)

10. Which instrument is commonly used to measure **mass**?

a) Thermometer b) Balance

c) Stopwatch d) Ruler

11. Which of the following devices is used to measure **time**?

a) Thermometer b) Barometer

c) Stopwatch d) Ruler

12. One **hour** is equal to:

a) 60 seconds b) 600 seconds

c) 3600 seconds d) 24 seconds

13. One **day** is equal to:

a) 12 hours b) 24 hours

c) 60 minutes d) 3600 seconds

14. The SI unit of **time** is:

a) Minute b) Hour c) Second d) Day

15. The SI unit of **temperature** is:

a) Degree Celsius (°C) b) Degree Fahrenheit (°F)

c) Kelvin (K) d) Joule (J)

16. The instrument used to measure **temperature** is:

a) Thermometer b) Stopwatch

c) Balance d) Ruler

17. Which of the following is a precaution when using a thermometer?

a) Hold it at the bulb b) Hold it at the top

c) Place it under sunlight d) Shake it vigorously

18. **Accuracy** in measurement refers to:

a) How close a value is to the true or accepted value

b) How repeatable measurements are

c) The number of decimal places used

d) The sensitivity of the instrument

19. **Precision** in measurement refers to:

    a) How close a measurement is to the correct value

    b) How close repeated measurements are to each other

    c) How accurate the instrument is

    d) The difference between units

20. Which of the following statements is **TRUE**?

    a) A measurement can be precise but not accurate.

    b) A measurement can be accurate but not precise.

    c) A measurement can be both accurate and precise.

    d) All of the above