6. MEASUREMENT

6.1 Introduction

In our daily life we use rough estimates all the time– to decide the quantity of sugar to put in tea, the quantity of salt while cooking, the time taken to reach school, the time for which the new tube of toothpaste will last etc. This rough estimates works well where-ever accurate measurement is not necessary.

But we also see that the tailor measures and marks the cloth before stitching the shirt, pant, kurta etc. The bell in the school is rung after checking the time on the clock. The shopkeeper sells vegetables, fruit, foodgrains etc. after weighing them. The doctor while examining the patient suffering from fever first checks the body temperature by using a thermometer. Why is all this done? Actually to get accurate information measurement is important. Without measuring it would not be possible to find the accurate length, area, volume, weight or temperature. On the basis of estimates the answer may often be inaccurate.

In figure 6.1 we see that the segment CD appears longer than segment AB, but if you measure with a scale you will find that they are of the same length.

Fig. 6.1

In the same way in figure 6.2 the volume of water in the two vessels is the same, but it can appear to be different to our eyes. In other words, to get the correct information it is essential to measure the volume.

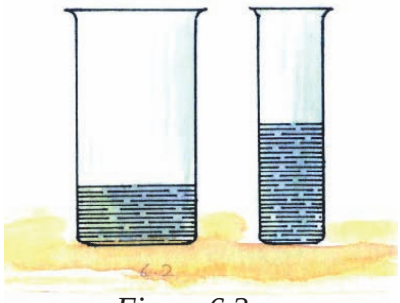


Figure 6.2

Length, area, volume, weight, time, temperature and other measures are known as Physical measures.

In this chapter we will learn some methods to measure the length, volume, weight, time and temperature.

6.2 What does measurement mean

To find out the quantity of an unknown measure we compare it with a known quantity of a similar kind of entity. The known fixed quantity of the measure used for comparison is known as the unit of measurement. In each measurement one part is a numerical value. The second part is its unit of measurment. If we consider a table of 2 metre (2 m) length, in this 2 is the numerical value and metre is the unit of length. Similarly, if any student weighs 35 kilogram then 35 is its numerical value and kilogram is the unit of weight.

ACTIVITY 1

Write down the numerical values and units in the table give below –

TABLE 6.1

S. No.	Physical measure	Measurement	Numerical value	Unit
1	Length	4 metre	----------	-------
2	Weight	50 kilogram	----------	-------
3	Time	5 minute	----------	-------
4	Temperature	100 kelvin	----------	-------

When writing the result of any measurement the numerical value and the unit should be mentioned.

6.3 The need for units of measurement

Many things can be used to compare with as a unit. In earlier times people measured length using different parts of the body like foot, hand-span, arm length, width of four fingers etc. as units. But there are differences in the lengths of these body parts of people hence, these can not be used as units.

ACTIVITY 2

Measure the length of your classroom using your foot steps and write the measure in your notebook. Now you ask your friends to measure the length of the room in the same way and fill it in your notebook.

TABLE 6.2

S. No.	Name of the student	Length of the classroom(number of steps)
1.	----------	----------
2	----------	----------
3	----------	----------
4	----------	----------

Are all measurements the same? If they are not the same then why are they not the same? Your foot-steps and those of your friends may have different lengths. Hence, you would get different values for the length of the classroom. Hence, it is not correct to use parts of the human body as the unit of measurement. Similarly, we cannot use bowls or cups to measure the volume of milk.

For uniformity it is essential to have the same units for a measure. This is the reason that for buying or selling in markets the same units are used. Any unit that is accepted as a standard for measurent by a group of people becomes a standard for that group. Standard units represent a fixed quantity which when measured whenever, wherever and by whomsoever will give the same result.

ANSWER THESE

1. Why can not the length of a hand-span be considered as a standard unit of measurement?
2. Give examples of any three measures used in daily life.
3. While selling rice what measure of quantity is used by the shopkeeper?
4. Which two things need to be specified while measuring any quantity?

Story of the scale – How new, how old

Many years ago people used their hand-span, foot and fist to measure lengths, but there were problems since the lengths of hand-spans, feet or fists of different people varied according to their body sizes. Therefore people developed a fixed length as the standard unit and divided it into smaller parts. Then people started measuring length and distance with it. This was the early version of the scale. People made scales using a fixed length of metal or wood. But it was not specific enough. In some places they took the distance between the nose of the king and the tip of his index finger as one yard. They divided this one yard into three parts and considered each part to be one foot. For long distances, two hundred and twenty yards was considered to be one furlong and eight furlongs as one mile. In this way different standards were formed. Everything was working fine, until countries started to trade with each other. Due to different standards there was great inconvenience in trade and there was also a danger of fights occurring due to this. Hence a country named France came forward. France decided that a fixed length of a bar of special metal will be considered as a metre. The metre was further divided into hundred parts and each part was called a centimetre. One centimetre was divided into 10 equal parts called millimetre and in this way the standard had got a permanent form. Though, even now at different places various measuring units are used, the metre is considered as the international unit for length.

Following systems are used to measure the length, mass and time-

Systems of measurement-

• **C.G.S. System: -** In this system length is measured in centimeter, mass in gram and time in second.

• **F.P.S. System: -** In this System length is measured in foot, mass in pound and time in second.

• **M.K.S. System: -** In this system length is measured in metre, mass in kilogram and time in second.

6.4 International System of units (SI)

In order to bring uniformity all the scientists of the world agreed to use a standard set of units for different measures. This widely accepted system is known as 'International System of units'. In brief it is known as SI system. Under this system the following units have been accepted for measurement of various physical measures –

Table 6.3

S. No.	Measure	Unit	Sign
1.	Length	metre	m
2.	Weight	kilogram	kg
3.	Time	second	s
4.	Temperature	kelvin	K

We commonly use degree celsius as the unit for temperature (°C).

6.5 International units and their symbols

1. The units of measures are written using small English alphabet. For example – metre is denoted by m, kilogram denoted by kg and second by s.
2. The units which have been named after the scientist are written in capital letters. For example – kelvin is denoted by K, degree celsius by ^{0}C.
3. No full stop is used after a unit name, for example metre is denoted as m not "m." But if it appears at the end of the sentence then full stop can be used.
4. The sign is always used in the singular form and not as plural. For example, if the length of any material is 10 metre then we write it as 10 m not 10 ms.
5. While writing in the full form the units are always written in small alphabets example – kelvin, metre, celsius etc

6.6 Division and Multiplication of Units

We know that the metre is the unit of length. The length and breadth of a playground is measured in metres. Similarly, the height of a building can be measured in metres. Suppose you have to measure the length of your book. The length of the book is much less than a metre. It is convenient to write such lengths in smaller units. The smaller measure is said to be a factor of the standard measure. Centimetre is a factor of the metre.

1 metre (m) = 100 centimetre (cm)

1 metre (m) = 10 decimetre (dm)

1 decimetre (dm) = 10 centimetre (cm)

1 centimetre (cm) = 10 millimetre (mm)

Now consider that you have to measure the distance between two countries. It is inconvenient to measure this distance using metres. It will be convenient if we have a measure bigger than the metre. A unit that is bigger than the standard unit is said to be its multiple.

1 kilometre (km) = 1000 metre (m)

kilometre is a multiple of a metre.

In a similar way the weight is measured as gram (g) and milligram (mg). They are factors of kilogram.

1 kilogram (kg) = 1000 gram (g)

1 gram (g) = 1000 milligram (mg)

Heavy materials like wood, coal etc. are weighed in multiples of kilogram like quintal, tonne etc.

1 quintal = 100 kilogram

1 tonne = 10 quintal = 1000 kilogram

Factors and Multiples of the units of length, weight and time

Length

10 millimetre (mm)	= 1 centimetre (cm)
10 centimetre (cm)	= 1 decimetre (dm)
10 decimetre (dm)	= 1 metre (m)
1000 metre (m)	= 1 kilometre (km)

Weight

1000 milligram (mg)	= 1 gram (g)
1000 gram (g)	= 1 kilogram (kg)
100 kilogram (kg)	= 1 quintal
10 quintal	= 1000 kilogram (kg)
	= 1 metric tonne

Time

60 second (s)	= 1 minute (min)
60 minute (min)	= 1 hour (h)
24 hours (h)	= 1 day
365 days	= 1 year
10 years	= 1 decade
10 decades	= 100 years
	= 1 century

ANSWER THESE

1. What is the SI unit for length?
2. What is the SI unit for time
3. kilogram is the SI unit for which measure?
4. How many kilograms are there in one quintal?
5. How many hours are there in one day?
6. How many seconds are there in an hour?

7. What unit of length will you use to show the distance between Raipur and Bilaspur?

8. What unit of length will you use to show the thickness of a two rupee coin?

6.7 Measurement of length

In our daily life we use various devices like measuring tape, metre rod, metre scale etc. for measuring length. To measure the length of a material an appropriate device should be used. For example, to measure the width of the trunk of a tree or measure the chest of a person, measuring tape is the most useful, not the metre scale. To measure the length of a pencil we use metre scale or the scale in the geometry box.

The length of the scale in the geometry box is 15 cm. Each one cm is divided into 10 equal parts. In this way each part is 1/10 cm = 0.1 cm or 1mm. This is the minimum length that can be measured by using this scale. This minimum measure is said to be the least count of the scale. While using a measuring equipment it is necessary to know its least count.

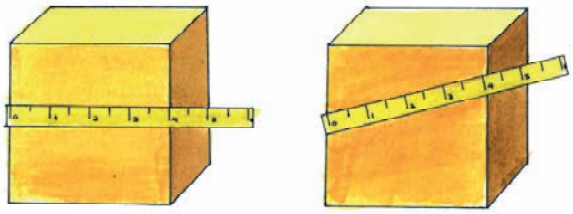
While measuring the length of any line the scale is placed in such a way that any mark of the scale is at the start of the line. The measure on the scale of the other end of the line is noted. The difference between these two numbers is the length of the line. In Figure 6.3, one end of the line AB is at 1.1 cm and the other is at 4 cm. Therefore, the length of AB = 4.0 – 1.1 = 2.9 cm.

Figure 6.3 Measuring the length of a line using a scale.

The following precautions should be taken while measuring with a scale –

1. The scale should be kept very close to the object and parallel to the length being measured.

2. Sometimes the edges of the scale wear away. Also repeated use of a scale may result in scraping or breaking of the scale. Sometimes the zero mark is not clearly visible. In such a situation another convenient mark should be chosen. At one end of the object the 1.0 cm mark can be



(a) Correct *(b) Wrong*

Figure 6.4 The correct position of the scale while measuring a length

placed. In such a case to measure the length of the object the reading at this end is subtracted from the reading at the other end. In Figure 6.5 the first value is 1.0 cm and the second is 5.5 cm, the length of the material is 5.5 – 1.0 = 4.5 cm.

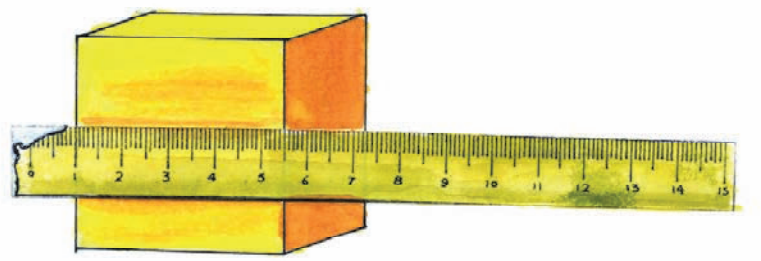


Figure 6.5 The correct position to use when the scale is broken.

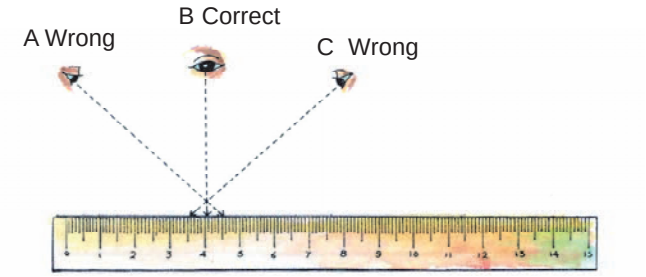


Fig. 6.6 The correct position of the eyes to read the value on the scale

3. The right method to measure with a scale is to keep the eye perpendicular to the point being observed. In the Figure 6.6 the position B of the eye is correct. Position A and C are wrong.

ACTIVITY 3

Let us now see how to measure the length of an arc AB. (Fig. 6.7). For this tie a knot at one end of the thread. Place this on one end of the arc 'A' and press it with the left hand thumb, stretch the thread and place a small portion of it on the line till it seems apparently straight. Press this end with the right hand thumb. Now bring your left hand thumb to take the place of the right hand thumb, again place a small part of some more thread over the remaining portion of the arc till it appears straight. Continue in this way till the thread has covered the entire arc till B. Mark

the point on the thread which reaches B. Measure the distance between the knot and the mark with the help of a metre scale by placing the thread on it. This is the length of the arc AB.

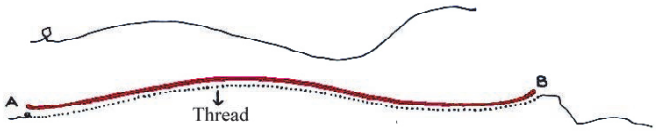


Figure 6.7 Measuring the length of an arc

ANSWER THESE

1. What device will be used to measure the waist of any person?
2. Write two precautions to be taken while measuring with a metre scale.
3. One edge of the scale is broken. The broken edge is marked 1.4 cm. How will you use this scale to measure the length of your pencil?
4. How will you measure the circumference of the circle with the help of a thread?

6.8 Measurement of Volume

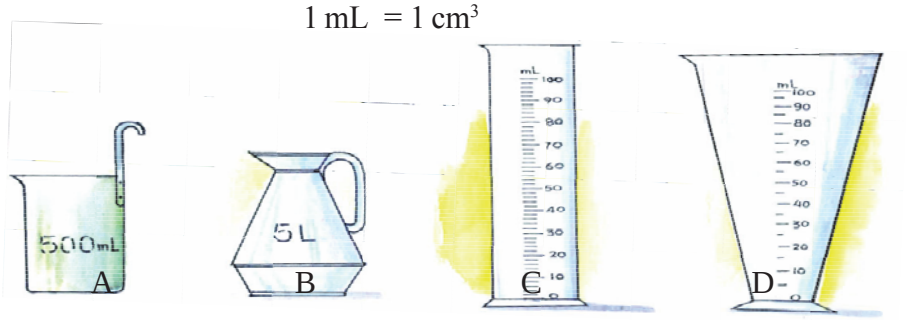
We see chairs, tables and books etc. in our classroom. Apart from the length and breadth these objects either have depth or height or thickness. These objects also occupy a fixed space. The amount of space occupied by a material is known as its volume. The SI unit for volume is cubic metre or metre ^{3}.

Volume of liquids

Liquids like water, milk, oil, diesel, petrol, kerosene are measured by their volume. The volume of liquids is measured in litres (L) . The factor of a litre is millilitre (mL).

1L = 1000 mL

1 mL = 1 cm^3



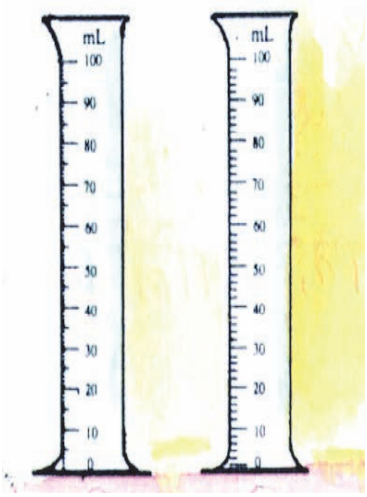
The volume of liquid required to fill a vessel completely is known as its capacity. In reality the capacity of any vessel is its internal volume. Many different types of vessels and apparatus are used to measure the volume of liquids. (Figure 6.8)

The containers shown in figure 6.8 (a) and (b) are used to measure milk, kerosene, oil etc. figure 6.8 c shows a measuring cylinder. This is used in laboratories to measure the volume of liquids. In figure 6.8 d a measuring cup that is used by doctors and by chemists to measure volume of medicines is shown. All these measuring vessels have markings that depict the volume when filled uptil that point, hence we can directly measure volume by using these.

Measurement of the volume of liquids using a measuring cylinder

ACTIVITY 4

The volume of any liquid can be measured easily by using a measuring cylinder. A cylinder has millimetre markings on the outer surface. First find out the volume represented by the smallest division on the cylinder. In the measuring cylinder figure 6.9 (a) there is one division showing two parts between 10 mL and 20 mL Hence one part measures 5 mL (figure 6.9 a). In cylinder b there are 5 parts between 10 mL and 20 mL. Hence the smallest part measures 2mL figure 6.9 (b).



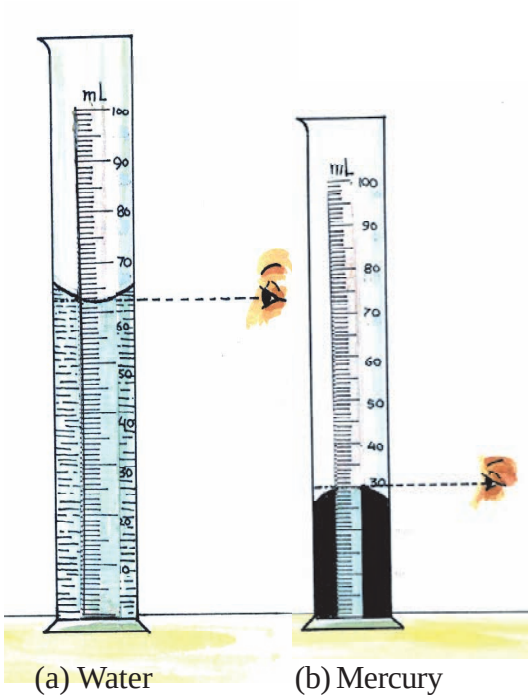
(a) (b)

Figure. 6.9 Measuring cylinder

Place the measuring cylinder on a flat surface like the table, then pour some water into it. You will find that the surface of water is somewhat curved. In the case of water it is pulled downwards from the centre (figure 6.10 a). While noting the level of water the eyes should be at the same level as the lower portion of the curve. This is the volume of the water in the cylinder.

When we take mercury in a measuring cylinder to measure its volume, the upper surface is raised (fig. 6.10 b). In this case keep the eyes level with the upper part of the curve and note the reading.

ACTIVITY 5



(a) Water (b) Mercury

Fig. 6.10 The right position for the eyes while reading a measuring cylinde

Let us now find out how much one litre is. Take a cubical vessel in your laboratory such that each arm measures 10 cm. Take one half litre (500 ml) measuring vessel from a person who sells milk. Use this measuring vessel to completely fill the cubical vessel. You will be required to pour the completely filled measuring vessel twice. From this we say that the cubical vessel contains one litre of water.

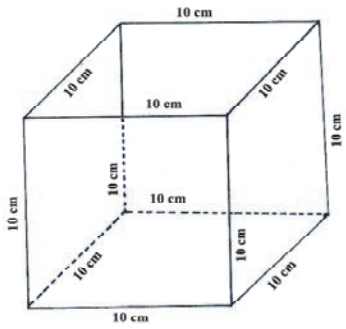


Figure 6.11 Relationship between litre and cubic centimetre

Volume of the one litre vessel = 10 cm × 10 cm × 10 cm

$1\ L = 1000\ cm^3$

$1000\ mL = 1000\ cm^3$

$1\ mL = 1\ cm^3$

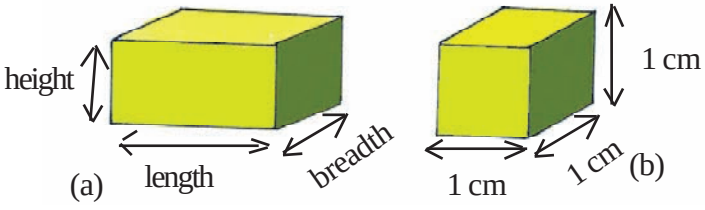


Figure 6.12 A Cuboid and a Cube

The volume of any regular solid cuboid shaped object like the matchbox or a book can be determined using the following formula –

Volume of cuboid = length × breadth × height

If the length, breadth and height of a cuboid are equal then that cuboid is a cube(fig 6.12 b)

Volume of cube = length × length × length = length^3

ACTIVITY 6

Measure the volumes of the objects listed below and write them in the table –

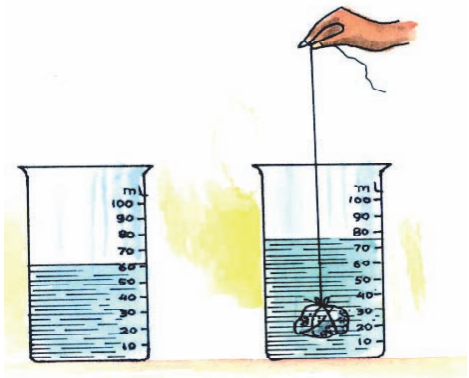
Table 6.4 Measurement of the volume of cuboids

S.No.	Object	Length (a) cm	Breadth (b) cm	Height (c) cm	Volume (a×b×c)cm^3
1	Textbook of Science	---------	---------	---------	---------
2	Geometry box	---------	---------	---------	---------
3	Brick	---------	---------	---------	---------
4	Matchbox	---------	---------	---------	---------

Measuring volumes of irregularly shaped objects

ACTIVITY 7

Take a measuring cylinder. Pour some water into it and note the level of water (Figure 6.13 a). Now take an irregular solid object (piece of stone). Tie it with a thread and very carefully dip it in to the water in the measuring cylinder. What do you see? The level of water rises up. Note the new level of the water. The difference between the two levels is the volume of the stone (figure 6.13 b).



(a) (b)

Figure 6.13 Measuring the volume of irregular shaped objects

ANSWER THESE

1. What do you understand by the volume of any object?
2. What is the SI unit of volume?
3. Which unit is used to represent the volume of liquids?
4. How many cubic centimetres are there in a litre?
5. Give the name of any equipment used in the laboratory to measure volume.

6.9 Measurement of Mass

From our experience we know that two handfuls of sand together are heavier than one handful. This is so because two handfuls of sand have more matter than one handful of sand. Those objects that are heavier also have more mass because the amount of substance in them is more. In this way mass is the measure of the quantity of the substance in any object.

Figure 6.14
Beam balance

In order to measure the mass of an object we compare it with a standard mass. The SI unit of mass is kilogram. A beam-balance is generally used to measure mass (Figure 6.14).

This balance has a metal beam. This beam is balanced on a support at its mid point. The beam can move freely on the support. Two pans are placed at equal distances from the point of support. We keep the object to be weighed on any one pan and the weight measures in the other.

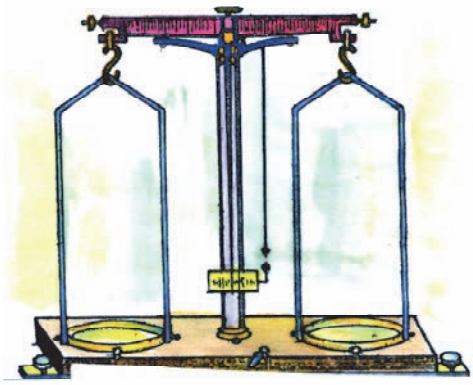


Figure 6.15 Physical balance

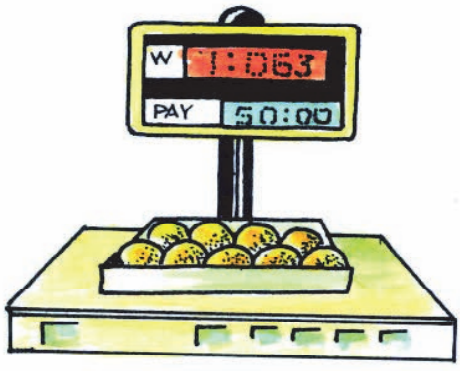


Figure 6.16 Electronic balance

We have seen that the local shopkeepers use a common beam-balance. Do goldsmiths or pharmacists use similar beam-balances? No, as exact measurement of mass cannot be made using a normal beam-balance. To measure mass accurately the use of a physical or a chemical balance is better (figure 6.15). These balances can measure mass accurately up to one tenth of a milligram.

With technological advancement an electronic balance has been made, this can accurately measure upto one part from one lakh divisions of a gram (figure 6.16).

6.10 Measurement of time

In our daily lives it is very important to keep track of time. For example, to travel in a bus or a train, it is important to reach the station on time. Similarly, we have to reach the school on time.

We measure time with the help of clocks, but there was a time when there were no clocks. At that time people used naturally occurring periodic events to know time. One such event was the occurrence of day and night. Nowadays, we have divided our days into smaller intervals. These intervals are hours, minutes and seconds.

Sun dial

In olden days sundial was used to measure time. It had a dial plate. On this plate a triangular metal piece was placed in a perpendicular or upright position. The plate was kept within the south-west direction. The shadow of the triangular piece fell on the dial plate. At different times of the day the shadow of the piece was formed at different parts/ corners of the plate. This helped to determine the time of the day. Such ancient clocks can still be seen at Jantar – Mantar in Delhi and Jaipur. The Jantar-Mantar in Jaipur was built by Maharaj Jaisingh II. The time shown by these dials was more or less correct but these dials could not be used after sunset. (figure 6.17)

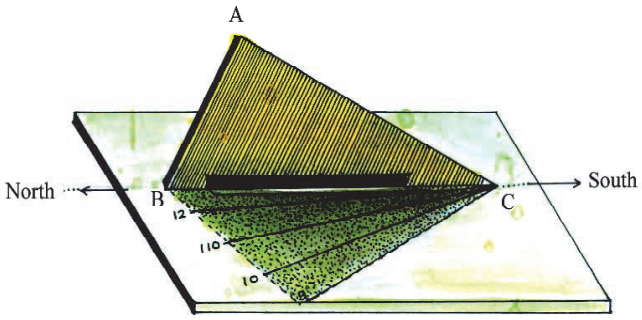


Figure 6.17 Sun dial

Hour glass

In olden days there was another device called an hourglass to measure time. In an hourglass two vessels were joined together through a minute pore. (figure 6.18) The sand

from the upper vessel slowly falls in to the lower vessel in a fixed duration of time. This duration can be used to measure time.

Figure 6.18 Hour glass

Pendulum Clock

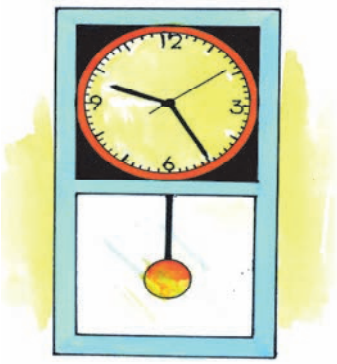


Figure 6.19 Pendulum clock

Modern clocks also use periodic events i.e. events that repeat in a fixed duration of time. The pendulum clock is a good example of this where the periodic event can be seen (Figure 6.19).

Stop clock

Sometimes we need to measure time intervals very accurately, for example the time taken for finishing a 100 metre race or time to complete a swimming race. Such events are timed using a stop clock (figure 6.20). Stop clock can be switched on or off as desired. These clocks are normally used to measure time in a laboratory or in racing competitions.

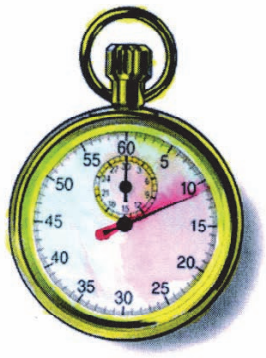


Figure 6.20 Stop clock

Digital Clock

In many clocks nowadays the traditional hour, minute or second hands are not seen. These clocks known as digital clocks which show the time in numeric figures. (figure 6.21)

Figure 6.21 Digital watch

ANSWER THESE

1. What is mass?
2. Which balance is used to measure small weights accurately?
3. Write down the names of two clocks used in olden days.
4. Write the names of two cities where ancient sundial is still present.
5. Which clock is used to measure time in a race?
6. What is the name of the clock that can be switched on and off as desired.

MAHARAJA SAWAI JAISINGH II

Maharaja Jaisingh II was a great Indian astronomer, mathematician and vastu kala expert of his time. He was born in the year 1686. In his youth he had great interest in astronomy. Once he was asked "How far are the stars and moon from here?" He was not able to give an answer. His search of an answer to this question led him to become a famous mathematician and astronomer. He built four Jantar-Mantars (Observatories) in Delhi, Jaipur, Benares and Ujjain.In Sanskrit the meaning of Jantar- Mantar means instruments and formula. Those people who were interested in studying astronomy could visit his observatories. He was keen that this science be popularized. The Maharaja himself designed the three main instruments in Jantar-Mantar – " Samrat instrument, Ram instrument and Jaiprakash". The Samrat instrument is a big sundial which can be used to measure time as well as the distance to the sun. The Ram instrument is used to measure accurately the distances to the stars while Jaiprakash is used to determine the position of astronomical bodies at any given time.

6.11 Measuring temperature

The temperature on a cold day is lower than that on a hot day. What do we understand by the word 'temperature'? The measure of heat in an object or how hot or cold a material is said to be the temperature of the object. The temperature of ice is much less than that of boiling

water. We use a thermometre to measure temperature. Generally we use degree celsius (°C) as a unit for temperature.

The SI unit of temperature is kelvin (K).

The relationship between the celsius and kelvin scale is as below –

$t°C = (273 + t)$ K

For example $40°C = (273 + 40)$ K $= 313$ K.

$100°C = (273 + 100)$ K $= 373$ K.

Ordinary Thermometer

In figure 6.22 we can see an ordinary thermometer.The thermometer has a thick walled glass tube with a uniform thin tube inside. This tube is called the capillary. On one end of this tube a thin walled bulb is present, while the other end is closed. The bulb of the thermometer is filled with mercury. The outer surface of the capillary tube is marked in °C.

An increase in temperature causes the mercury in the bulb to expand and move up in to the capillary to form a bright line. As the temperature increases the length of the line also increases. As the temperature decreases the mercury contracts. Hence, the length of the bright line decreases. In this way the increase or decrease in the bright line represents the increase or decrease in the temperature.

Figure 6.22 Ordinary thermometer

Clinical thermometer

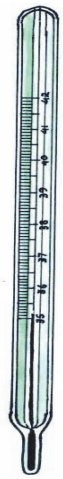


Figure 6.23 Clinical thermometer

Figure 6.24 Maximum - Minimum thermometer

This thermometer is used to measure the temperature of the human body. It is similar to the ordinary thermometer; the only difference is that near the bulb the capillary is curved. This gives an advantage as though this the mercury rises easily with increase in temperature but does not easily flow back into the bulb. Hence it is easy to remove the thermometer from the patients' body and take the reading.

In order to reuse the clinical thermometer it should first be washed and shaken vigorously to bring the mercury that has risen back into the bulb.

A healthy human body has a temperature of 37°C or 98.6°F. Hence a clinical thermometer has markings between 35°C to 42°C.

Maximum-Minimum Thermometer

Figure 6.24 shows a Maximum - Minimum thermometer that can be used to measure the maximum and minimum temperatures of a place.

ACTIVITY 8

Let us take a clinical thermometer and find the temperature of our body. For this take a clinical thermometer and check carefully whether the mercury level is below 35 °C. If it is not so then carefully shake the thermometer once or twice so that the mercury comes to or below 35°C. Now keep the thermometer under your tongue carefully. After approximately one minute remove the thermometer and note the reading. This reading is the current temperature of your body.

ANSWER THESE

1. What is temperature? What is the commonly used unit for this?
2. What is the SI unit for temperature?
3. Which liquid is used in the thermometer?
4. What is the use of a clinical thermometer?
5. What is the temperature of a healthy human body?
6. How is the ordinary thermometer different from the clinical thermometer?

6.12 The Role of the Department of Weights and Measures

In our country the responsibility of safeguarding the standard units is with the New Delhi based National Physical Laboratory. A copy of the standard metre, standard kilogram and standard form of time has been kept here. The metre rod or kilogram weights available in the market are based on these units.

You would have heard of the pip-pip …..sound before the broadcast of news in our Akashwani channel. This signal is indicative of the correct time; this is provided by the National Physical Laboratory, New Delhi.

The Government of India's Department of Weights and Measures ensures that the metre rods, balances, weights etc used in the market are as per the standards.

When you buy cloth, pipe and other materials that are sold as per length, first confirm if the metre rod is proper. In a correct metre rod you find the sign (← →) at both ends as well as the seal of the Department of Weights and Measures, as given in the picture below (figure 6.25)

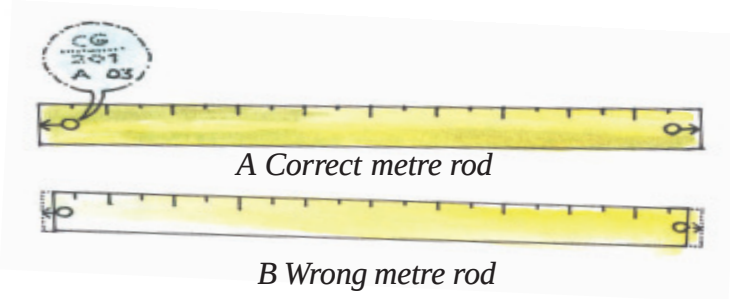


Figure 6.25 Correct and wrong metre rod

Whenever you buy anything by weight you must make sure that the weights and balance being used is correct. At the central point of the beam balance there should be the seal of the Department of Weights and Measures.

Similarly a correct weight will have its value written on it. At the bottom there is a hole which has a little bit of lead filled in it. This is to keep the weight of the measure correct. On this the seal of the Department of Weights and Measures is present. If the seal is not present then the weight may measure higher or lower in quantity.

In India all the shopkeepers should follow the directions of the Department of Weights and Measures and get their metre rods, weights and balances certified every year.

WE HAVE LEARNT

- Our senses cannot estimate measurements of an object accurately.
- Anything that can be measured is a quantity.
- To maintain uniformity it is essential to have a standard unit.
- The meaning of measurement is to compare an unknown quantity with a similar kind of known quantity.
- To measure any quantity two aspects are important – one is the unit and the second its numeric value.
- All scientists in the world use the International System of unit - SI.

- The SI unit of length is metre, of weight is kilogram, of time is second, of volume is cubic metre and of temperature is kelvin.
- The commonly used unit to measure temperature is degree celsius.
- In order to define the measures of quantity conveniently we use the multiples or factors of the unit.
- The device used to measure the length depends on the object to be measured.
- The amount of space occupied by any object is known as its volume.
- The volume of liquid is measured in litres.
- Different apparatus/vessels are used to measure volume.
- The capacity of any vessel is its internal volume.
- The weight of an object is the measure of the amount of matter in it.
- To measure smaller weights physical / chemical balances are used.
- Those events that occur repeatedly after a fixed interval of time are used to measure time.
- To measure smaller time intervals we use stop clocks (laboratory and games).
- The temperature of the object tells how hot or cold it is.
- The capillary of a clinical thermometer is sharply curved and narrow at a point.
- The temperature of a healthy human body is 37°C.
- The Government of India's Weights and Measures Department sees to it that the weights, balances and measuring instruments being used in the market are as per standards.
- In the accurate weights and weighing instruments there is the seal of the Department of Weights and Measures.
- The National Physical Laboratory, New Delhi safeguards the standard units in India.

EXERCISE

1. Choose the right option for every question

1. Measurement is a process to –
   a. change b. calculate
   c. compare d. explain the difference
2. For a measure to be complete it should have a -
   a. numeric value b. unit
   c. unit and numeric value d. none of the above
3. The SI unit of length is -
   a. metre b. centimetre
   c. millimetre d. kilometre
4. The SI unit of temperature is -
   a. kelvin b. celsius
   c. fahrenheit d. none of the above
5. The temperature of a healthy human body is -
   a. 96 °C b. 37.0 K
   c. 40.0 K d. 37.0 °C

2. Fill in the blanks

1. One tonne has _____ kilograms.
2. One kilometre has _____ metres.
3. The clinical thermometer measures temperature between _____ and _____.
4. The goldsmith uses _____balance.
5. The length of the field is measured using_____.

3. Match the following

A	B
Unit of length	second
Unit of mass	cubic metre
Unit of time	kelvin
Unit of temperature	kilogram
Unit of volume	metre

4. Answer the following questions

1. What is a physical quantity? Give three examples.
2. What are the two most important things to mention when writing the result of a measurement?
3. Write the following lengths in descending order-
   kilometre, millimetre, metre, centimetre
4. Place the following masses in ascending order
   Quintal, tonne, milligram, kilogram, gram
5. How is stop clock different from an ordinary clock?
6. In India who has the responsibility to ensure the availability of the correct instruments for measurements?
7. How will you know whether the metre rod used by the cloth trader is correct or not?
8. How will you know whether the weights and balance used to measure weight is correct or not?
9. Draw the picture of an ordinary thermometer.
10. The smallest division of a measuring cylinder is 1.0 ml Water is poured in it such that the water level reaches the 35 mark. When we put a stone into the water now the level reaches the 56 mark. What is the volume of the stone?
11. Each of the following shows a measure. Find out what is wrong with the way they are written and correct them.
    1. The pencil is 15 cm. long.
    2. The temperature of water is 300 k.
    3. The bag has 40 Kg rice.
    4. The volume of water in the drum is 100 l.
    5. Neeraj swims 100 m distance in 10 Sec.

THINGS TO DO

1. Divide the class into groups and ask them to measure the length of the room as well as the black board and discuss the result.

2. Measure the height and weight of any five of your friends and write it on a card. encourage them to fill the card every month.

3. Let us measure the height of the tallest tree that is situated at a distance.

i. First look around and identify the tallest tree around you.

ii. Now ask your friend to stand near the tree.

iii. Move backwards while holding a scale (or rod) vertically upright in your right hand. Hold out your hand in front of you such that the top of the rod is in line with the top of the tree. Place your thumb at the place on the scale where it is in line with the bottom of the tree.

Figure 6.26. Measuring the height of the tree

iv. Now without moving the thumb from its position on the scale, rotate the scale into an horizontal position. Ask your friend to move side ways to a point where the top of the rod appears to be in line with the feet of you friend.

v. In this position measure the distance between the tree and your friend, this is the height of the tree.

Now take a scale, a straight rod or a pencil. With the help of any of these you can measure heights of tall buildings, the height of the water tank and trees around your school.

4. a. The tap valves in homes or on the roads sometimes become loose and water starts flowing from them. Collect the water flowing from such a tap in one minute or one hour and measure it using a measuring vessel. Calculate the volumes for other time periods and fill values as required in the table below –

S. No.	S.No. of tap	Water collected				
		In 1 minute	In 1 hour	In 1 day	In 1 month	In 1 year
1						
2						

b. Discuss the measures to stop this flow with your teachers and write about it to the municipal bodies.

5. Ask your grand parents / uncles / aunts about the units they used in their times to measure weight and length. Discuss about these in the class.