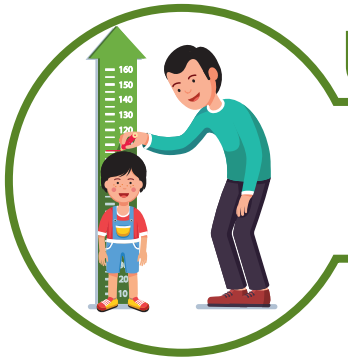

Unit 1 Measurements

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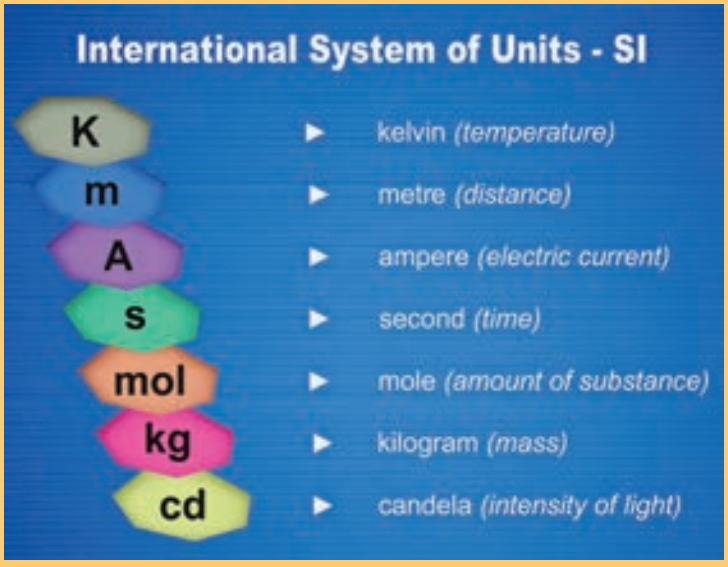
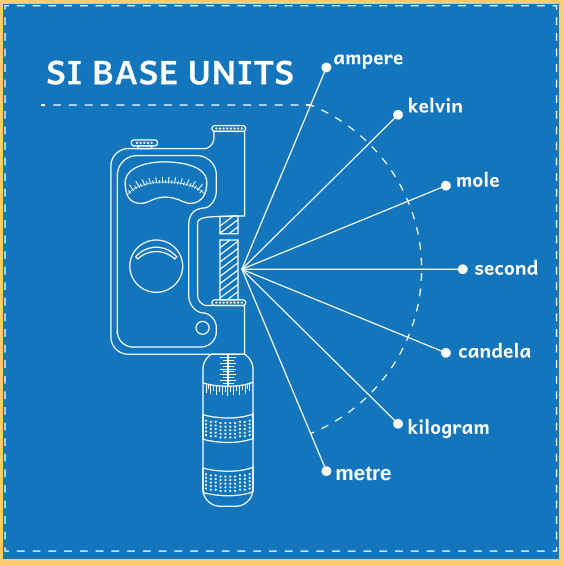




Learning Objectives

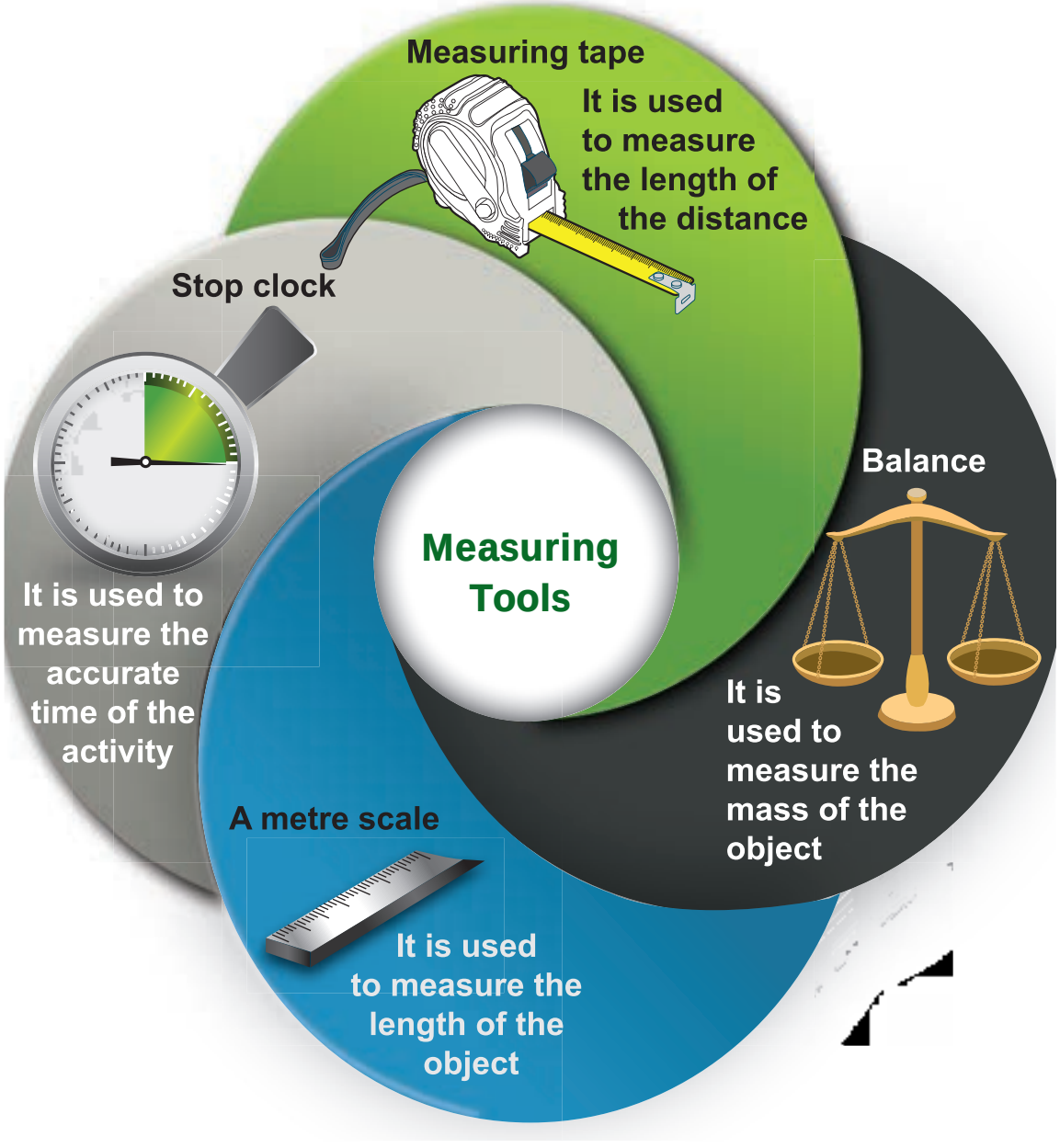
- To understand the need for measurement in daily life.
- To define length, mass and time.
- To evaluate the values of some physical quantities in terms of their units and sub-units.
- To identify zero error and parallax error.
- To construct measuring tools (models).
- To solve problems based on conversion of units.

Introduction

- Your brother asks you what your height is. How will you measure it and tell him?
- Your friends decide to play kabbadi. How will you measure and draw the border lines?
- Your father gives you a bag and asks you to get potatoes. How will you ask the shopkeeper?
- Your mother gets milk from the milkman daily. How much does she get?
- How long will it take to reach your school from your house?
- How does the shopkeeper measure kerosene while selling it?

To do the tasks given above, we need to know about measurement. The comparison of unknown quantities with some known quantities is known as measurement. Measurement of a quantity has two parts: a number and a unit.

To measure the quantities we need measuring tools. What are the measuring tools that you know? Which of those tools you will use to do the tasks listed above and the similar ones?



We hear the terms related to measurement like weight, kilogram, litres, millilitres, kilometre, length, distance etc. In this chapter let's study in detail about length, mass and time and the necessity to measure them.

1.1 Length

What is length? The distance between one point and the other desired point is known as length. It may be the distance between the edges of your book or the corners of the football ground in your school or even from your home to school.

The standard unit of length is 'metre'. It is represented by the letter 'm'. Very small lengths can be measured in millimetre (mm) and centimetre (cm). Larger measures, say height of a building, length of a banner or height of a lamp post are all measured in metre. How to express still longer lengths say, distance between two cities or villages or distance between your school and home? It is expressed in kilometre (km).

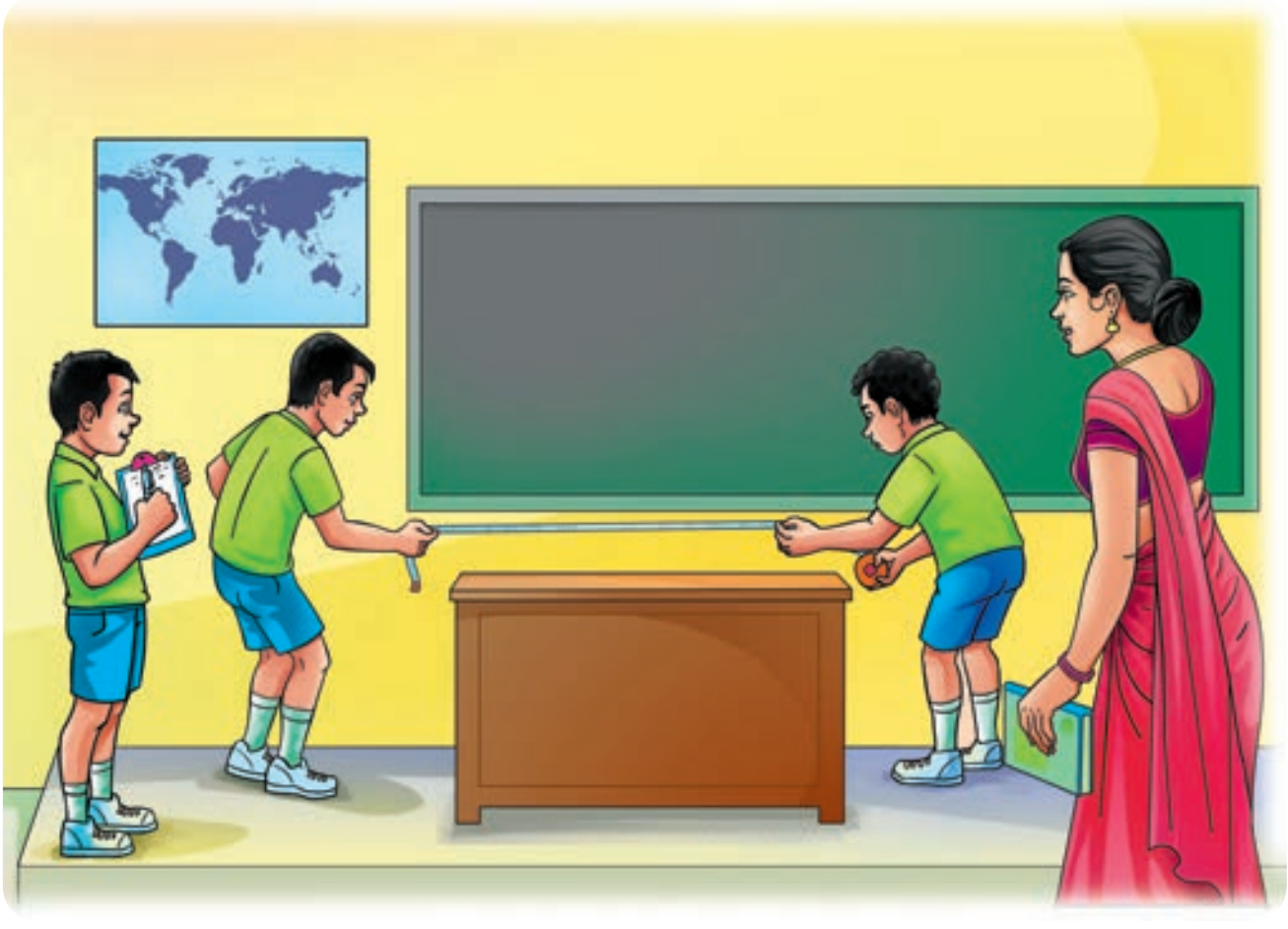
Know the unit of length

1 km (kilometre) = 1000 m (metre)
1 m (metre) = 100 cm (centimetre)
1 cm (centimetre) = 10 mm (millimetre)

Think: Can you express 1 km in cm?

Let us measure the length of your pencil.

1. Take the meter scale
2. Notice the lines with marking 1,2,3,4 ... till 15 (for smaller scales) or 30 (bigger scales). The distance between two numbers (say between 1 and 2) denotes a centimetre (written as 'cm').

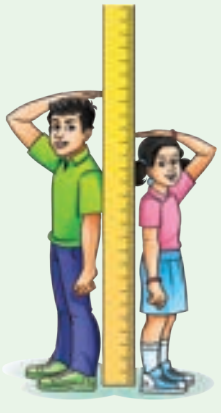


3. Notice, in between 1 and 2 there will be smaller markings. If you count, there will be 9 such lines. The distance between any two consecutive smaller markings within a 'cm' denotes a millimetre (written as 'mm').

Why do we need SI Units?

Activity 1

Form a group of 5 members. Select one person and let others measure her/ his height individually using hand span and cubit. Compare your answers with others. Do you find any difference? Why? Now you all stand in front of a wall and mark your height on the wall. Measure your height with a scale. What differences do you infer?



From the activity 1, you see that your measurement is different from that of your friends. Similarly different measuring units are used in different countries.

For the sake of uniformity, scientists all over the world have adopted a common set of units to express measurements. This system is called as the International System of Units or SI Units.

- SI unit for length is metre
- SI unit for mass is kilogram
- SI unit for time is second
- SI unit for area is m^2
- SI unit for volume is m^3

Prefix

Multiples and sub-multiples of SI units are given as prefixes. Some prefixes are given in the table.

Multiples and Sub-multiples of SI Units

Prefix	Abbreviation	Submultiple / Multiple	For Metre
Deci	d	Submultiple: 1/10	10 decimetre = 1 metre
Centi	c	Submultiple: 1/100	100 centimetre = 1 metre
Milli	m	Submultiple: 1/1000	1000 millimetre = 1 metre
Nano	n	Submultiple: 1/1000000000	1000000000 nano metre = 1 metre
Kilo	k	Multiple: 1000	1000 metre = 1 kilometre

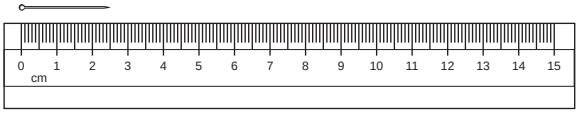
Measure the objects/event given in the table using suitable measuring units and express them with suitable multiple and submultiples.

Picture	Activity	Measuring Unit m/kg/s	Multiple / Submultiple
	Length of tip of pencil.	metre	millimetre
	Length of the pen.		
	Distance between two cities.		
	Mass of dry fruits in table.		
	Mass of ornaments.		
	Time taken to finish 100 m race.		

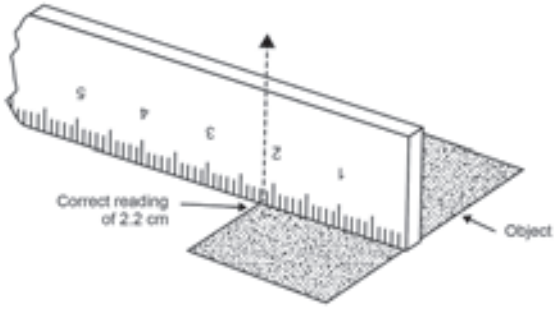
Corrective measures for Measurement

Measurement has to be accurate and the approach has to be correct always. In our day to day life approximation may not have much impact. But it has a large impact in scientific calculations. For example, if the curvature of key (lock and key) is changed even by 1 mm, the lock would not open. So, measurements have to be accurate in scientific calculations. Let us look at some common mistakes that occur while using a scale.

To measure the length of a pin



- The head of the pin has to coincide with '0' of the scale.
- Count the number of centimetre and from there count the number of finer divisions. The count of the division is in 'mm'
- In the above example the length of pin is 2 cm and 6 mm.
- Write the correct submultiple completely.



Note:

- Always keep the object parallel to the scale.
- Start the measurement from '0' of the scale.

Activity 2

Aim: To find the length of a curved line using a string.

Materials needed: A meter scale, a measuring tape, a string and a sketch pen

Method:

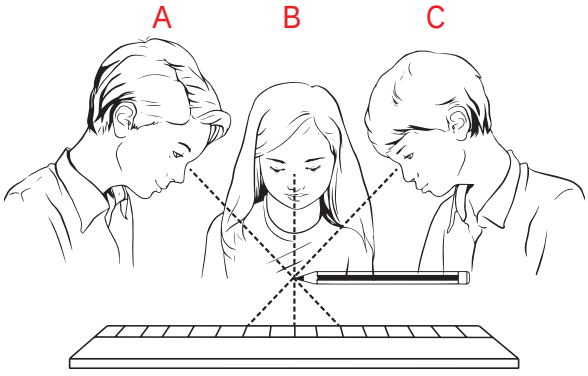
- Draw a curved line AB on a piece of paper
- Place a string along the curved line. Make sure that the string covers every bit of the curved line.
- Mark the points where the curved line begins and ends on the string.
- Now, stretch the string along the length of a meter scale and measure the distance between the two markings of the string and note it.
- This will give you the length of a curved line.

Find the length of a banana.

Parallax Error

Parallax is a displacement or difference in the apparent position of an object viewed along two different lines of sight.

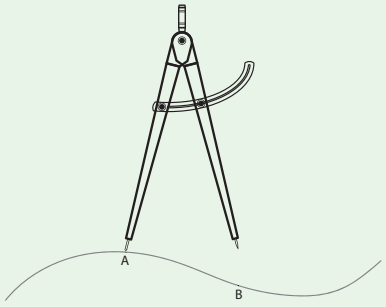
Correct position of the eye is also important for taking measurement. Your eye must be vertically above the point where the measurement has to be



taken. In the above representation, to avoid parallax error, reading from B will be correct. From positions 'A' and 'C', the readings will be different and erroneous.

Activity 3

Aim: Measuring the length of a curved line using a divider.



Draw a curved line AB on a piece of paper.

Separate the legs of the divider by 0.5 cm or 1 cm using a ruler.

Place it on the curved line starting from one end. Mark the position of the other end. Move it along the line again and again cutting the line into number of segments of equal lengths. The remaining parts of the line can be measured using a scale. Count the number of segments.

Therefore, the length of the line = (Number of segments × Length of each segment) + Length of the left over part.

1.2 Mass

Mass is the measure of the amount of matter in an object. The SI unit of mass is kilogram. It is represented by 'kg'. Weight is the gravitational pull experienced by matter. The weight is directly proportional to the mass on the Earth's surface.

Hold a sheet of paper in one hand and a book in other hand. Which hand feels the heaviness? The mass of the book is more than that of a single sheet of paper. Therefore, the pull on the book is more than that is on the paper. Hence, our hand needs more force to hold a book than a piece of paper. The force what we experience is called as 'heaviness'.

On the moon where the gravitational force is less than that is on the earth, the weight will reduce but the mass will remain same. The moon's gravitational pull is one sixth of the earth's pull. Thus objects weigh six times lighter on the Moon than on the Earth.

What is your mass? If you measure it in grams, that would be a huge number. Is it not? So, it is expressed in kilogram. Bigger weights are measured in tonne or metric tonne.

1000 milligram = 1 gram

1000 gram = 1 kilogram

1000 kilogram = 1 tonne

Beam Balance

We use beam balance to measure mass. A beam balance works by comparing the mass of an object to that of known mass (called a standard mass).

Activity 4

Construct your own beam balance using two scrapped coconut shells, strings or twines, thick cardboard as frame and a little sharpened pencil as index needle.

What can you achieve?

1. Find which object is heavier.
2. Find the approximate weight of lighter things like leaves, piece of papers etc.

Electronic Balance

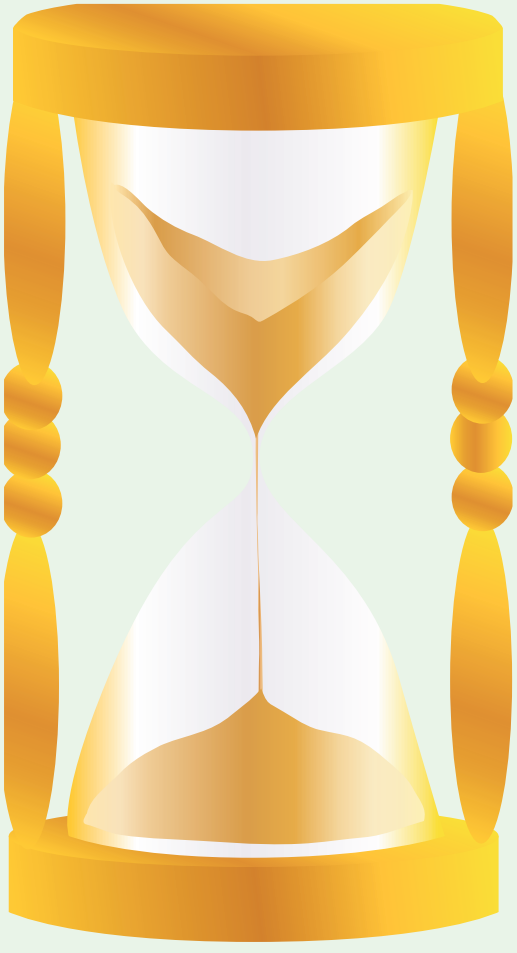
An electronic balance is a device used to find the accurate measurements of weight. It is used very commonly in laboratories for weighing chemicals to ensure a precise measurement of those chemicals for using in various experiments. Electronic balances may also be used to weigh food, other grocery items, as well as jewellery.

1.3 Time

Day changes into night and night in to day. Seasons also change. We know time also changes. How do we measure change of time? Clocks are used to measure time. You know how to read a clock face and note the time. You can also use your pulse to measure the time roughly. Count the number of pulses. That can tell you the time elapsed.

Activity 5 : Ask four or five of your friends to run a race from one end of the school to the other end. Mark the starting point and the ending point. Using your pulse (or counting by counting 1,2,3,.....) count the time taken by each of them to complete the race. Check who is fast?

In the earlier days, people used sand clock and sundial to measure the passage of time during day time. The shadow cast by a stick can be used to estimate time. A vessel having a small hole is filled with sand and it is used as a clock. The sand in the vessel is allowed to come down and it is used to estimate the time.



Sand Clock

These are rough methods for counting passage of time. We can use electronic clock, stopwatch and other instruments to count even smaller durations of time.

Fast Facts

An odometer is a device used for indicating distance travelled by an automobile.

The metric system or standard set of units was created by the French in 1790.

A ruler or scale, used now a days to measure length, was invented by William Bedwell in the 16th century.

A standard metre rod made of an alloy of platinum and iridium is placed at the Bureau of Weights and Measures in Paris. National Physical Laboratory in Delhi has a copy of this metre rod.

One kilogram is equal to the mass of a certain bar of platinum-iridium alloy that has been kept at the International Bureau of Weights and Measures in Sèvres, France since 1889.

Numerical Problems

Look at a meter scale carefully and answer the following.

- How many millimieter divisions are there in a centimeter?
- How many centimeter divisions are there in a meter?

Complete the following.

- 7875 cm = _____ m _____ cm
- 1195 m = _____ km _____ m
- 15 cm 10 mm = _____ mm
- 45 km 33 m = _____ m.

Some open ended questions

- During your school sport day, it is planned to conduct a mini marathon race within the school campus. They decided that the running distance be 2 kilometres. Is it possible to have a school campus with the circumference of 2km? Discuss with your friends, how big the campus should be. Give other options if it is not a big campus.
- Is the distance in the sea also calculated in kilometres? How is it possible to calculate the distance in sea water? Explore!
- We know that the distance between celestial bodies is calculated in terms of light year. Light year is the distance travelled by light in one year. Now without calculator find how many kilometres light would have travelled in a year. Get the speed of light from your teacher.
- We see that the distances between Chennai and Madurai is written as '462' kms. But from which point to which point is this distance calculated?. As we are science students we need to know it with the precision. Is it between the two bus stands? Or between the two railway stations? Discuss and figure it out. Check your answers with your teacher.
- A person needs to drink two litres of water a day. Note down how much water you drink each day? Make a rough calculation and check if you are drinking the required amount of water.

Points to Remember

- The comparison of an unknown quantity with some known quantity is known as measurement.
- All physical quantities have standard units for the sake of uniformity.
- Length, mass and time are some of the fundamental physical quantities.
- The SI units are:

Length	-	metre
Mass	-	kilogram
Time	-	second

- While using a ruler, the accurate measurement can be arrived by avoiding three types of possible errors.
- Electronic balance is an instrument which provides accurate measurement of mass correct upto milligram.

Evaluation

LD78K

I. Choose the correct answer.

1. The height of a tree can be measured by

   a) metre scale c) plastic ruler

   b) metre rod d) measuring tape

2. Conversion of 7 m into cm gives _____

   a) 70 cm c) 700 cm

   b) 7 cm d) 7000 cm

3. Quantity that can be measured is called ____

   a) physical quantity c) unit

   b) measurement d) motion

4. Choose the correct one

   a) km > mm > cm > m

   b) km > mm > m > cm

   c) km > m > cm > mm

   d) km > cm > m > mm

5. While measuring the length of an object using a ruler, the position of your eye should be

   a) left side of the point.

   b) vertically above the point where the measurement is to be taken.

   c) right side of the point

   d) any where according to one's convenience.

II. Fill in the blanks.

1. SI Unit of length is _____.
2. 500 gm = _____ kilogram.
3. The distance between Delhi and Chennai can be measured in _____.
4. 1 m = _____ cm.
5. 5 km = _____ m.

III. State True or False. If false, correct the statement.

1. We can say that mass of an object is 126 kg.
2. Length of one's chest can be measured using metre scale.
3. Ten millimetre makes one centimetre.
4. A hand span is a reliable measure of length.
5. The SI system of units is accepted everywhere in the world.

IV. Complete the analogy.

1. Sugar : Beam balance :: Lime juice :___?
2. Height of a person : cm :: Length of your sharpened pencil lead :___?
3. Milk : Volume :: Vegetables :___?

V. Match the following.

1. Length of the fore arm	a. metre
2. SI unit of length	b. second
3. Nano	c. 10^{3}
4. SI Unit of time	d. 10^{-9}
5. Kilo	e. Cubit

VI. Arrange the following in the increasing order of unit.

1 Metre, 1 centimetre, 1 kilometre, and 1 millimetre.

VII. Answer in a word or two.

1. What is the full form of SI system?
2. Name any one instrument used for measuring mass.
3. Find the odd one out.

   kilogram, millimetre, centimetre, nanometre
4. What is the SI Unit of mass?
5. What are the two parts present in a measurement?

VIII. Find the answer for the following questions within the grid.

1. 10^{-3} is one _____
2. SI Unit of time is _____

3. Cross view of reading a measurement leads to _____

4. _____ is the one what a clock reads.

5. _____ is the amount of substance present in an object.

6. _____ can be taken to get the final reading of the recordings of different students for a single measurement.

7. _____ is a fundamental quantity.

8. _____ shows the distance covered by an automobile

9. A tailor uses _____ to take measurements to stitch the cloth.

10. Liquids are measured with this physical quantity.

IX. Answer briefly.

1. Define measurement.
2. Define mass.
3. The distance between two places is 43.65 km. Convert it into metre and cm.
4. What are the rules to be followed to make accurate measurement with scale?

X. Solve the following.

1. The distance between your school and your house is 2250 m. Express this distance in kilometre.
2. While measuring the length of a sharpened pencil, reading of the scale at one end is 2.0 cm and at the other end is 12.1 cm. What is the length of the pencil?

XI. Answer in detail.

1. Explain two methods that you can use to measure the length of a curved line.

A		P		L								R		K
C		O		E								O		S
M		K		N								R		I
P		R		G								R		T
R	H	E	S	T	E	D	L	L	I	T	R	E	D	A
L		T		H						D		H		P
O		E		O					N			K		E
A		M		S				O				R		V
V		I		E			C					T		O
E		L		K		E						S		S
R		L		I	S				T			K		H
A		I		T				I				V		P
G		M		X			M					N		U
E		Z		D		E	S	K	P	G	I	W	M	F
Z	T	D	K	H			O	D	O	M	E	T	E	R

2. Fill in the following chart.

Property	Definition	Basic Unit	Instrument used for measuring
Length			
Mass			
Volume			
Time			

ICT CORNER

AREA & PERIMETER

Lets play with Area N Perimeter

Steps:

- Access the application by typing **Area N Perimeter** or install with the help of the link given below or the given QR code
- Open the Application and click **START** button.
- You can see the field whose area is to be measured. Drag and put the tiles on field.
- Use the (+) and (-) to find out the area of the given field.
- Click the **CHECK** button to check your answer.
- You can view your whole results by clicking the **RESULT** button.

Step1

Step2

Step3

Step4

URL:

https://play.google.com/store/apps/details?id=com.bodhaguru.AreaNPerimeter

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*Pictures are indicative only