UNITS AND MEASUREMENTS.

Measurement.

Measurement is the comparison of a given physical quantity with a convenient or familiar standard of the same physical quantity. That standard value is called unit.

When we measure length of a table with our forearm (*muzham*), we compare the length of the table with our forearm. And state how many times longer the table than that of the forearm. Now we use ‘length of our forearm’ as the *unit* for measuring length of the table.

We use various units for measuring length. Eg:- centimetre, inch, muzham etc.

But the basic unit of length is metre. Its symbol is 'm'.

Centimetre and millimetre are the smaller units of length.

In metre scale the distance between two successive long lines is 1 cm and the distance between two successive small lines is one millimetre.

$(1/100)^{th}$ part of a metre is one centimetre. That is, 100 cm is equal to 1 m.

Similarly 1000 millimetre is 1 metre.

Kilometre (km), Astronomical unit (AU), Light year (ly) are bigger units of length.

1 km = 1000 m

Astronomical unit is the average distance between the sun and the earth. AU and light year are used to measure distance to planets and stars respectively.

Least count.

The smallest length that can be accurately measured using a measuring device is the least count.

Least count of a metre scale is 1 millimetre.

Indirect methods of measuring length.

1. Suppose you are asked to measure thickness of one sheet of a note book using a scale in your instrument box. Here the direct measurement is impossible. In these situations we follow other convenient methods.

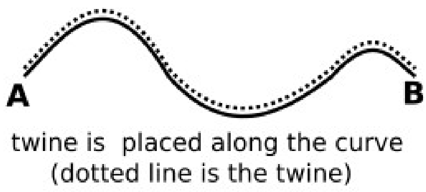
In this case we take the height of a bundle of sheets. Then divide the height with the number of sheets in the bundle. This will be the thickness of one sheet.

Example: Thickness of a bundle of 50 sheets is 6 mm. Find the thickness of one sheet.

Ans. Thickness of one sheet = 6/50 = 0.12 mm

2.Length of a curved line.

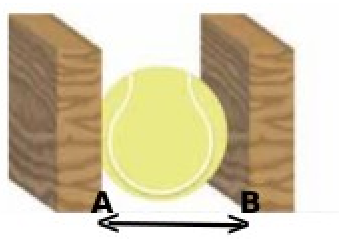
The length of the curve cannot be measured directly using a metre scale. Here we can adopt a technique with a twine. For this place a twine gently along the curve from A to B. . Then measure the straight length of the twine.



3. Radius or diameter of a ball

For finding the diameter of the ball, it is kept in between two wooden blocks as shown.

The distance between the inner sides of the block (AB) is the diameter of the ball.



Mass: Mass of a substance is the measure of the quantity of matter contained in it. The basic unit of mass is kiolgram. Its symbol is kg.
gram (g) and milligram (mg) are the smaller units of mass.
1000 g = 1 kg and 1000 mg = 1 gm
quintal and tonne are the bigger units of mass.
100 kg = 1 quintal.
1000 kg = 1 tonne

Time: Now a days we use watch to ascertain time. In the past, people used to observe length of shadow for this purpose. Sundial is one of the devices they used then. At night they observed the position of certain stars to determine time. But these measurements were not perfect.
Second (s) is the basic unit of time. Minute is another unit of time which is equal to 60 s. Hour is also a unit of time. 60 minutes is equal to one hour.

Solar day: Solar day is the time period from one noon to the next noon.
It is equivalent to 24x60x60 = 86400s

Fundamental quantities and fundamental units.

Quantities which are not related to one another and cannot be expressed using other quantities are called fundamental quantities. Length, mass, time, Electric current, Temperature, amount of substance and luminous intensity are the fundamental quantities. The units of fundamental quantities are fundamental units. The system based on these fundamental units are called SI units.
Fundamental quantities and their units are tabled below.

Quantity	Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Temperature	kelvin	K
Amount of substance	mole	mol
Luminous intensity	candela	cd

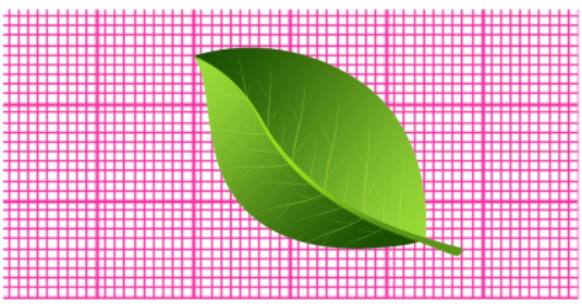
Derived units: Units which are expressed in terms fundamental units are derived units.
Example.1. Unit of Area is m^2 (read as meter square)
That is, unit of area is expressed in terms of the unit of length.
2. Unit of velocity is m/s. It is expressed in terms of fundamental units metre and second.

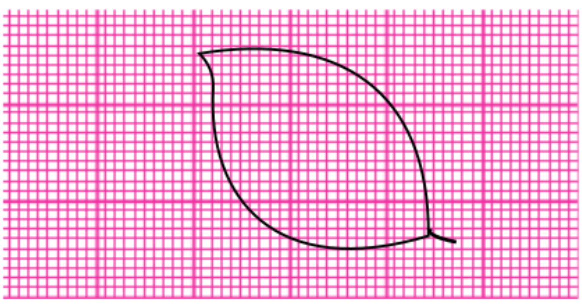
Features of SI units.

*Unified units * Internationally accepted. * Adequate to express all physical quantities.

Area of surfaces having irregular Edges.

Suppose you are given a leaf as shown and asked to find its area.
Place the leaf on a graph paper as shown and trace the outline of the leaf.





In a graph paper, the area of the large square is 1 cm^2 and area of small squares is 1mm^2.
By counting the total number of squares inside the outline, we can find out the area of the leaf.

Volume

The space occupied by a body is known as its volume.
Volume of a rectangular block = length x breadth x height.
The unit of volume is m^3 (cubic metre). It is a derived unit.

Density

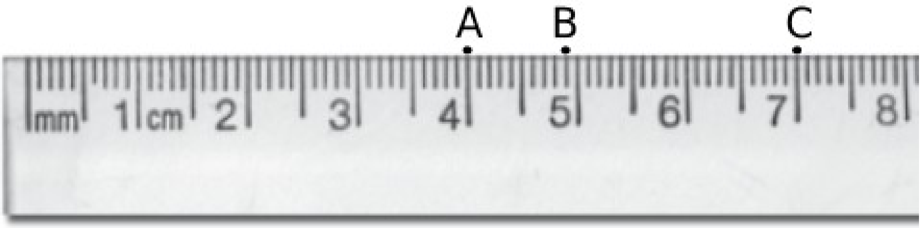
Mass of unit volume of a substance is called its density.
Density = mass/volume
Unit of density is kg/m^3.
For example, density of water is 1000 kg/m^3. It means that the mass of pure water collected in a tank of 1 m length,1m breadth and 1 m height will be 1000kg.
Density of brine (salt water) is greater than that of fresh water.
Similarly kerosene is less denser than water.
If we take equal volume of different substance, the matter contained in the denser substance will be greater.

Rules to be followed in writing units.

1. The symbols of units are normally written in small letters.
Examples. m,s, kg
2. The symbols of units named after persons are written in capital letter.
Example. Unit of force : newton – N, Unit of Pressure: pascal – Pa Unit of voltage: volt - V
3. The names of units never be written in capital letters.
Example: metre (right) Metre (wrong)
kelvin (right) Kelvin (wrong)
newton (right) Newton (wrong)
4. Never use plural forms of units.
Example: 20 metre (right) 20 metres (wrong), 5 cm (right) 5 cms (wrong)
5. Never use full stop or comma after a symbol except at the end of the sentence.
Example: He has 157 cm height. (right) He has 157 cm. height. (wrong)
6. Never use more than one slash (/) in derived units.
Example: m/s^2 (correct) m/s/s (wrong)
7. When derived unit is expressed as the product of other units use a dot or space between them.
Example: N.m (correct) N m (correct) Nm (wrong)
8. Do not mix full name of unit with symbol.
Example: kg/m^3 (correct) kilogram/m^3 (wrong) kg/cubic metre (wrong)
9.There must be a single space between value and unit.
Example: 10 m (correct) 10m (wrong)
: 20 kg (correct) 20kg (wrong)
10. Never use more than one unit to express a physical quantity.
Example: 1.65 m (correct) 165 cm (correct) 1 m 65 cm (wrong) 1 metre 25 centimetre (wrong)

UNITS AND MEASUREMENTS: PRACTICE QUESTIONS& ANSWERS

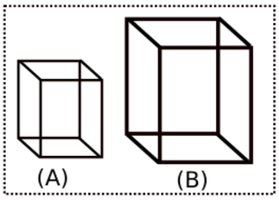
1. What is the basic unit of length? Write down its symbol.
Ans. metre (m)
2. What is least count? Give the least count of metre scale.
Ans. Least count of a device is the smallest measurement that can be accurately measured using the device is called its least count. Least count of metre scale is 1 mm.
3.A portion of a metre scale is given.



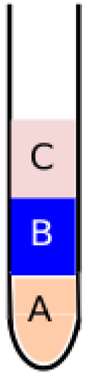
a. Name the physical quantity which is measured using metre scale.
b. What is the distance between two small lines marked in the scale?
c. What is the least count of metre scale?
d. Write down the distance between A and B in millimetrte.
e. Write down the distance between A and C in centimetre?
Ans.a. length.
b. 1 milli metre
c. 1 mm
d. 9 mm
e. 3 cm
4. We use so many units other than metre for measuring distance for various practical purpose.
a. What is known as the average distance from earth to Sun?
b. Define light year. Express one light year in kilometre.
c. Which are the units suitable for measuring distance between stars?
d. 'parsec' is the largest unit of length. How many light year is equivalent to one parsec?
c. The thickness of plastic carry bag is too small. Which is the unit suitable for stating its thickness?
Ans.a. Astronomical unit. b. One light year is the distance travelled by light in one year. It is equal to 9460800000000 km ($9.46x10^{12}$ km)
c. light year and parsec.
d. 3.26 light year.
e. nanometre
5. Common balance is used for measuring mass.
a.What is mass? What is its basic unit?
b. Write down two smaller units of mass. How are they related to the basic unit of mass?
c. How many kilogram is one tonne?
Ans.a. Mass of a substance is the measure of matter contained in it. kilogram is the basic unit of mass.
b. gram and milligram.
1000 g = 1 kg 1000000 mg = 1 kg
c. 1 tonne = 1000 kg
6. See the given figure.

a. Identify the device shown in the figure.
b. What is the basic unit of time?
c. Define one solar day.
d. How many second make a solar day?
Ans.a. Sun dial
b. second
c. One solar day is the time period from one noon to the next noon.
d. One solar day = 24x60x60 = 86400 s
7. SI units are the international system of units based on fundamental units.
a. How many quantities are considered as fundamental quantities?
b. Write down the SI units of each fundamental quantities and their symbols.
c. What are the main features of SI units? (at least three)

Ans.a. There are seven fundamental quantities.
b. length – metre (m) mass – kilogram (kg) time – second (s) Electric current – ampere (A)
Temperature – kelvin (K) Amount of substance – mole (mol) Luminous intensity – candela (cd)
8. Units expressed in terms of basic units are called derived units.
a. Write down a derived unit which is expressed using metre. What is this unit for?
b.What is the unit of density? What are the basic units involved in it?
Ans.a. m^2 : Unit of area
b. kg/m^3 kilogram and metre are used in this derived unit.



9. Two rectangular blocks of equal mass are shown in the figure. Of them which is denser one?
Ans. The block 'A' is denser than that of B.
10. Three immiscible liquids A,B and C are taken in a test tube as shown. Write down the names of the liquids in the ascending order (increasing order) of density.



Ans.C,B,A
11. Why it is said that fire due to petrol, diesel etc cannot be extinguished by adding water?
Ans. As density of petrol and diesel is less than that of water, they float on water and continue their burning.
12. Certain rules are to be followed while writing units. Find out the correct ones from the following pairs and write the related rules.
a. m, M b. Nm, N m c. Newton, newton d. 20 cms, 20 cm
e. 8m, 8 m f. 5 m 20 cm, 5.2 m
Ans. a m : small letters are to be used to write symbols of units.
b. N m: full stop or one space is to be given between the symbols.
c. newton : names of the unit never be written in capital letters.
d. 20 cm : plural forms of symbols are not used.
e. 8 m : space is to be given between value and symbol.
f. 5.2 m : never use more than one units.
13. How many kilometre is 2500 m ? **Ans**. 2.5 km
14. metre, kilometre, millimetre, nanometre and light year are the units of length. Write them in descending order (decreasing order) of its values.
Ans.light year, kilometre, millimetre, nano metre.
15. Express the following in its SI units.
a. 1 minute b. 500 mm c. 2 km d. 250 cm
Ansa.1 minute = 60 s b. 0.5 m c. 2000 m d. 2.5 m
16. Find out the strange one from the following. How is it differ from others?
a.second, minute, parsec, hour b. kg,m,kg/m^3,K c. ampere, kelvin, newton, mol
Ans.a. pasec – It is the unit of distance. Others are the units of time.
b. kg/m^3 - It is a derived unit. Others are fundamental units.
c. newton – It is a derived unit. Others are fundamental units.
17. See the first pair and fill the second accordingly.
a. ampere: A; candela: .... b. second: basic unit; m^3 :..........
c. Distance between planets: Astronomical unit; Distance between stars: ....
d. Electric current: ampere; temperature: ....
Ans. cd b. Derived unit. c. Light year/parsec. d. kelvin