GOVERNMENT OF TAMIL NADU

STANDARD SEVEN

TERM - I

VOLUME - 3

SCIENCE
SOCIAL SCIENCE

A publication under Free Textbook Programme of Government of Tamil Nadu

Department of School Education

Untouchability is Inhuman and a Crime

PREFACE

The Science textbook for standard Seven has been prepared following the guidelines given in the National Curriculum Framework 2005. The book enables the reader to read the text, comprehend and perform the learning experiences with the help of teacher. The Students explore the concepts through activities and by the teacher demonstration. Thus the book is learner centric with simple activities that can be performed by the students under the supervision of teachers.

HOW TO USE THE BOOK?

- ❖ The First term VII Science book has six units.
- ❖ Two units planned for every month including computer science chapter has been introduced.
- ❖ Each unit comprises of simple activities and experiments that can be done by the teacher through demonstration if necessary student's can perform them.
- ❖ Colorful info-graphics and info-bits enhance the visual learning.
- ❖ Glossary has been introduced to learn scientific terms.
- ❖ The "Do you know?" box can be used to enrich the knowledge of general science around the world.
- ❖ ICT Corner and QR code has been introduced in each unit for the first time to enhance digital science skills.

Lets use the QR code in the text books ! How ?

- ❖ Download the QR code scanner from the Google play store/ Apple App Store into your Smart phone.
- ❖ Open the QR code scanner application
- ❖ Once the scanner button in the application is clicked, camera opens and then bring it closer to the QR code in the text book.
- ❖ Once the camera detects the QR code, a URL appears in the screen.
- ❖ Click the URL and go to the content page.

Seed Germination of Monocot Plant

Seed Germination of Dicot Plant

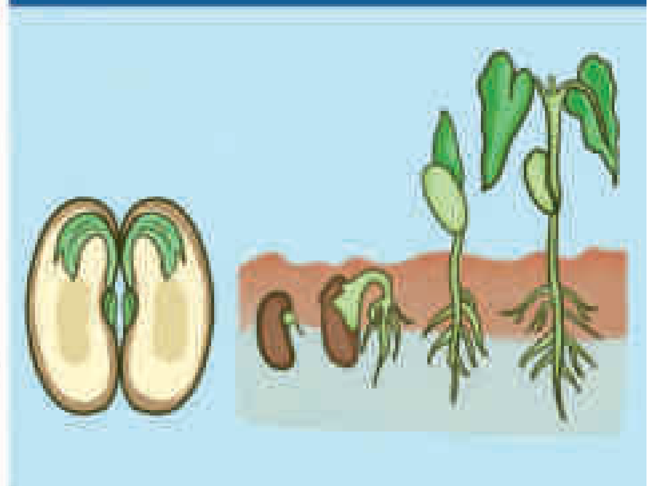


Table of Contents

2WUFUA
E - book

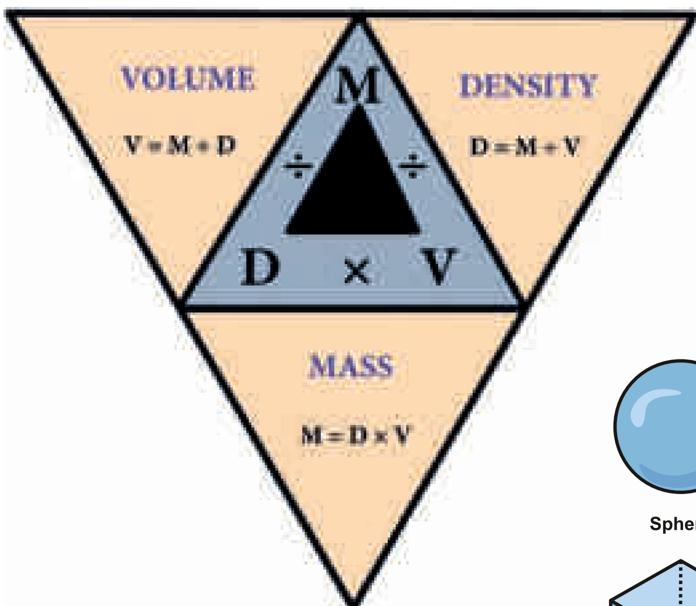
3CDAVL
Assessment

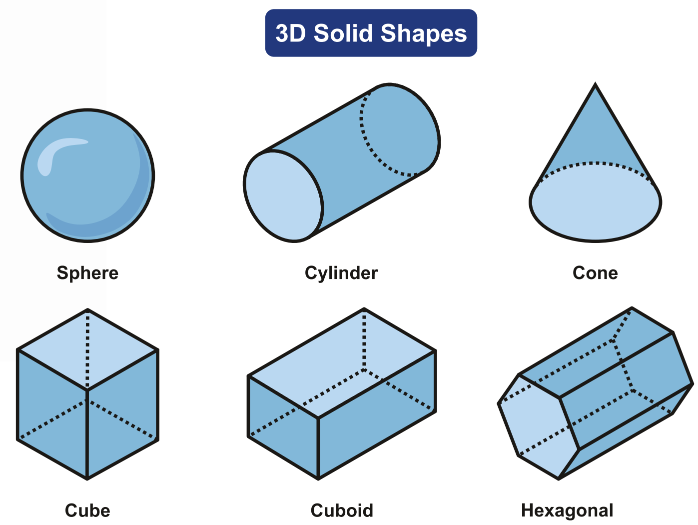
DIGI links

Lets use the QR code in the text books ! How ?
- Download the QR code scanner from the Google PlayStore/ Apple App Store into your smartphone
- Open the QR code scanner application
- Once the scanner button in the application is clicked, camera opens and then bring it closer to the QR code in the text book.
- Once the camera detects the QR code, a url appears in the screen.Click the url and goto the content page.

Unit 1

Measurement





Learning Objectives

After studying this unit, students will be able

- To identify fundamental and derived physical quantities.
- To identify fundamental and derived units.
- To obtain units for certain derived quantities.
- To measure the area and volume of some regular shaped and irregular shaped objects.
- To convert the volume of objects from cubic metre to litre and vice versa.
- To calculate the density of solids and liquids.
- To define Astronomical unit and light year.

Introduction:

How are the various articles and materials shown in the picture measured?

Vegetables	Cloth	Milk	Time
________	________	________	________
Litre	Metre	Second	Kilogram

In day to day life, we measure many things such as the weight of fruits, vegetables, food grains, volume of liquids, temperature of the body, speed of the vehicles etc., Quantites such as mass, weight, distance, temperature, volume are called physical quantities.

A value and a unit are used to express the magnitude of a physical quantity. For example Suresh walks 2 kilometre everyday. In this example '2' is the value and 'kilometre' is the unit used to express the magnitude of distance which is a physical quantity.

1.1 Fundamental and derived quantities:

Generally, physical quantities are classified into two types, namely, (i) Fundamental quantities and (ii) Derived quantities.

Fundamental quantities:

A set of physical quantities which cannot be expressed in terms of any other quantities are known as "Fundamental quantities". Their corresponding units are called "Fundamental units".

There are seven fundamental physical quantities in SI Units (System of International Units).

S.No.	Fundamental quantity	Fundamental unit
1	Length	Metre (m)
2	Mass	Kilogram (kg)
3	Time	Second (s)
4	Temperature	Kelvin (K)
5	Electric current	Ampere (A)
6	Amount of substance	Mole (Mol)
7	Luminous (light) intensity	Candela (cd)

Derived quantities:

All other physical quantities which can be obtained by multiplying, dividing or by mathematically combining the fundamental quantities are known as "derived quantities".

Their corresponding units are called "Derived units". Some of the derived quantities and their units are given in table 1.1.

1.2 Area:

The area is a measure of how much space there is on a flat surface.

The area of the plot of land is derived by multiplying the length and breadth

Area = length × breadth

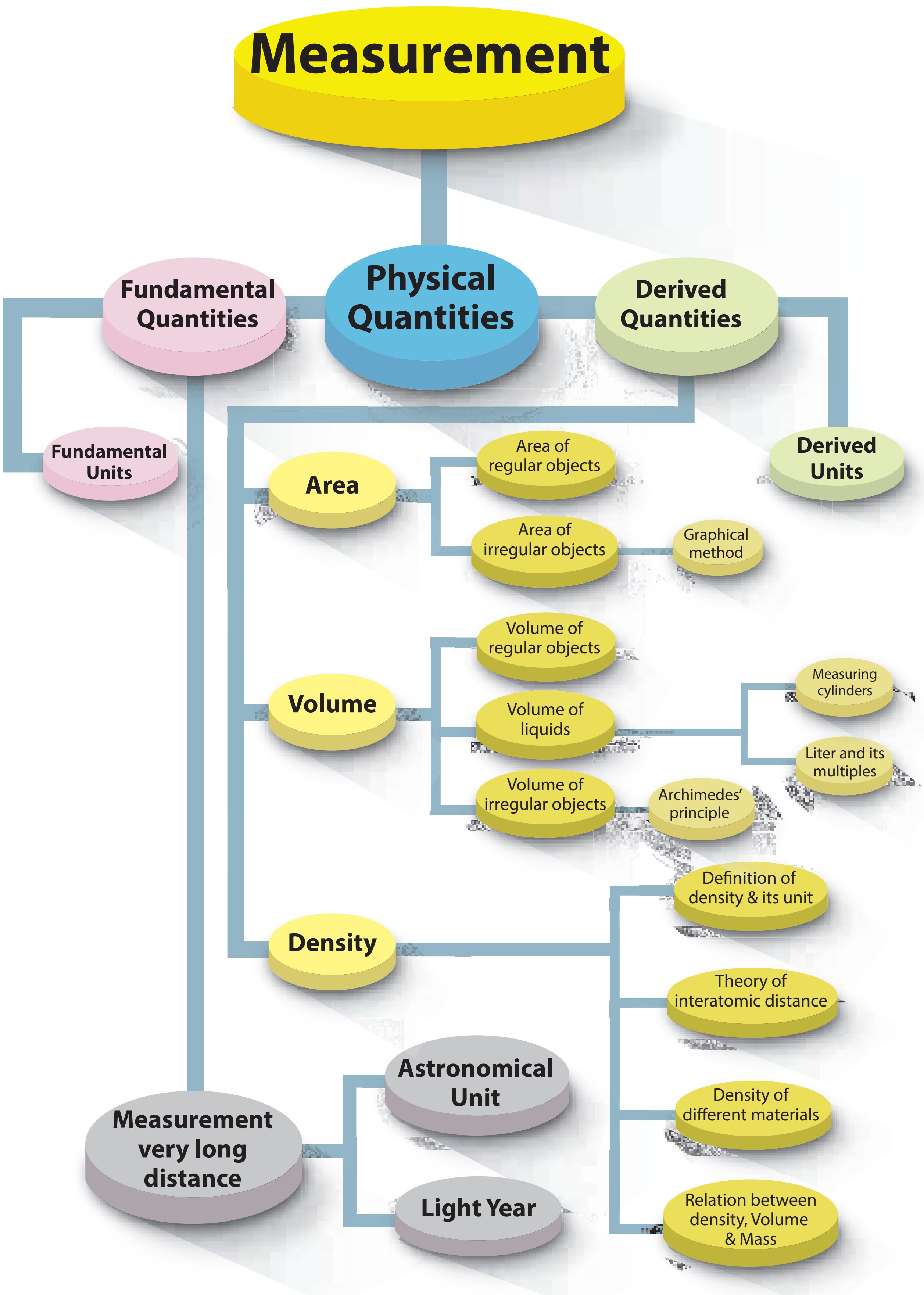
The unit of the area is = metre × metre

= metre^2

= m^2 (Read as square metre)

Table 1.1 Some of the derived quantities and their units in SI System of units

S.No.	Derived quantity	Unit
1	Area = length × breadth	m × m = square metre (or) m^2
2	Volume = length × breadth × height	m × m × m = cubic metre (or) m^3
3	Speed = distance / time	m / s (or) m s^{-1}
4	Electric charge = electric current × time	A × s = As (or) Coulumb (C)
5	Density = mass / volume	Kg / m^3 (or) kg m^{-3}


Measurement
Fundamental Quantities
Physical Quantities
Derived Quantities
Fundamental Units
Derived Units
Area
Area of regular objects
Area of irregular objects
Graphical method
Volume
Volume of regular objects
Volume of liquids
Measuring cylinders
Liter and its multiples
Volume of irregular objects
Archimedes' principle
Density
Definition of density & its unit
Theory of interatomic distance
Density of different materials
Relation between density, Volume & Mass
Measurement very long distance
Astronomical Unit
Light Year

Area is a derived quantity as we obtain are by multiplying twice of the fundamental physical quantity length.

> **DO YOU KNOW?** One square metre is the area enclosed inside a square of side 1 metre.

Problem 1.1

What is the area of a 10 squares each of side of 1 m.

Area of a square = side × side

= 1 m × 1 m

= 1 m^2 or 1 square metre

Area of 10 squares = 1 square metre × 10

= 10 square metre

(Even though the area is given in square metre , the surface need not to be square in shape)

Area of regularly shaped figures

The area of regularly shaped figures can be calculated using the relevant formulae. In the table 1.2, the formulae used to calculate the area of certain regularly shaped figures are given.

Problem 1.2

Find the area of the following regular shaped figures: (Take π = 22/7)

(a) A rectangle whose length is 12 m and breadth is 4 m.

(b) A circle whose radius is 7 m.

(c) A triangle whose base is 6 m and height is 8 m.

Solution:

(a) Area of rectangle = length × breadth

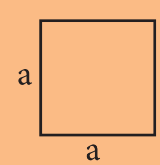
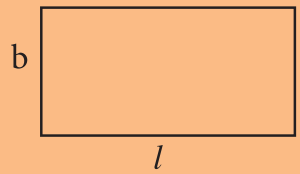
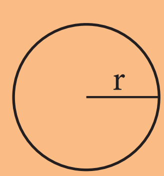
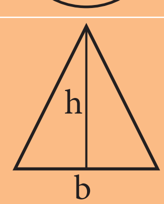
= 12 × 4

= 48 m^2

(b) Area of circle = $\pi \times r^2 = (22/7) \times 7 \times 7$

= 154 m^2

Table 1.2 **Area of some regularly shaped figures**

S.No.	Plane figure	Diagram of figure	Area
1	Square		side × side $a \times a = a^2$
2	Rectangle		length x breadth $l$xb=lb
3	Circle		$\pi \times (\text{radius})^2$ $\pi \times r^2$ πr^2
4	Triangle		(1/2) × base × height 1/2 × b × h

(c) Area of triangle $= (1/2) \times \text{base} \times \text{height}$

$= (1/2) \times 6 \times 8$

$= 24\ m^2$

Area of irregularly shaped figures

In our daily life, we encounter many irregularly shaped figures like leaves, maps, stickers of stars or flowers, peacock feather etc. The area of such irregularly shaped figures cannot be calculated using any formula.

How can we find the area of these irregularly shaped objects?

We can find the area of these figures with the help of a graph sheet.

The following activity shows how to find the area of irregularly shaped plane figures.

The graphical method explained above can be used to find the area of regularly shaped figures also. In the case of square and rectangle, this method gives the area accurately.

1.3 Volume

The amount of space occupied by a three dimensional object is known as its volume.

volume = surface area × height

The SI unit of volume is cubic metre or m^3.

Volume of regularly shaped objects

As in the case of area, the volume of the regularly shaped objects can also be determined using an appropriate formula.

Table 1.3 gives the formulae used to calculate the volume of these regularly shaped objects.

Problem 1.3

Find the volume of (Take $\pi = 22/7$)

i. a cube whose side is 3 cm.

ACTIVITY 1

Take a leaf from any one of trees in your neighbourhood. Place the leaf on a graph sheet and draw the outline of the leaf with a pencil (Figure 1.2). Remove the leaf. You can see the outline of the leaf on the graph sheet.

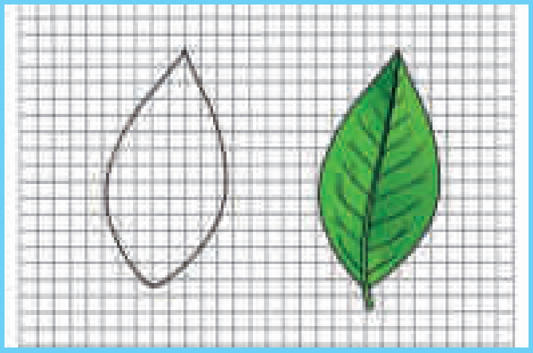


Figure 1.1 Area of an irregularly shaped plane figure

i. Now, count the number of whole squares enclosed within the outline of the leaf. Take it to be M.
ii. Then, count the number of squares that are more than half. Take it as N.
iii. Next, count the number of squares which are half of a whole square. Note it to be P.
iv. Finally, count the number of squares that are less than half. Let it be Q.
v. M = __________; N = __________;
P = __________; Q = __________

Now, the approximate area of the leaf can be calculated using the following formula:

Approximate area of the leaf = M + (3/4) N + (1/2) P + (1/4) Q square cm.

Area of the leaf = _______________.

This formula can be used to calculate the area of any irregularly shaped plane figures.

ACTIVITY 2

Draw the following regularly shaped figures on a graph sheet and find their area by the graphical method. Also, find their area using appropriate formula. Compare the results obtained in two methods by tabulating them.

(a) A rectangle whose length is 12 cm and breadth is 4 cm.
(b) A square whose side is 6 cm.
(c) A circle whose radius is 7 cm.
(d) A triangle whose base is 6 cm and height is 8 cm.

S. No.	Shape	Area using formula	Area using graphical method

ii. a cylinder whose radius is 3 m and height is 7 m.

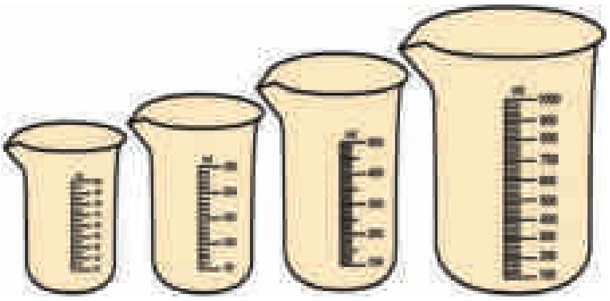
Solution:

(a) Volume of a cube = side × side × side = 3 cm × 3 cm × 3 cm = 27 cubic cm or cm^3.

(b) Volume of a cylinder = $\pi \times r^2 \times$ height = $(22/7) \times 3 \times 3 \times 7 = 198\ m^3$.

Volume of liquids

Liquids also occupy some space and hence they also have volume. But, liquids do not possess any definite shape. So, the volume of a liquid cannot be determined as in the case of solids. When a liquid is poured into a container, it takes the shape and volume of the container. The volume of any liquid is equal to the space that it fills and it can be measured using a measuring cylinder or measuring beaker. The maximum volume of liquid that a container can hold is known as the "capacity of the container". A measuring container is graduated as shown in figure.



Measuring containers

The volume of a liquid is equal to the volume of space it fills in the container. This can be directly observed from the readings marked in the measuring containers. If we notice the measuring cups given in figure carefully, we can observe that the readings are marked in the unit of "ml". This actually represents millilitre. To understand this unit of volume, let us first understand how much a litre means. Litre is the commonly used unit to measure the volume of liquids. we can understand that the unit of volume is cubic cm if the dimensions of the object are given in cm. This cubic cm is commonly known as cc. A volume of 1000 cc is termed as one litre (*l*).

1 litre = 1000 cc or cm^3

1000 ml = 1 litre

DO YOU KNOW?

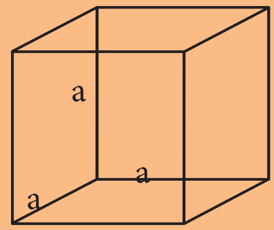
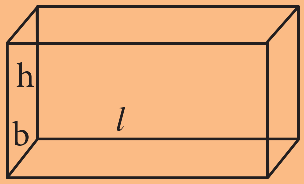
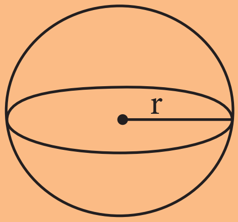
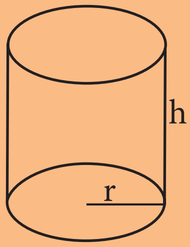
To measure the volume of liquids, some other units are also used. Some of them are gallon, ounce, and quart.

1 gallon = 3785 ml

1 ounce = 30 ml

1 quart = 1 litre

Table 1.3 Volume of regularly shaped objects

S.No.	Objects	Figure	Volume
1	Cube		side × side × side a×a×a a^3
2	Cuboid		length × breadth × height l×b×h $l$bh
3	Sphere		$4/3 \times \pi \times (\text{radius})^3$ $4/3 \times \pi \times r^3$ $4/3\ \pi\ r^3$
4	Cylinder		$\pi \times (\text{radius})^2 \times \text{height}$ $\pi \times r^2 \times h$ $\pi\ r^2h$

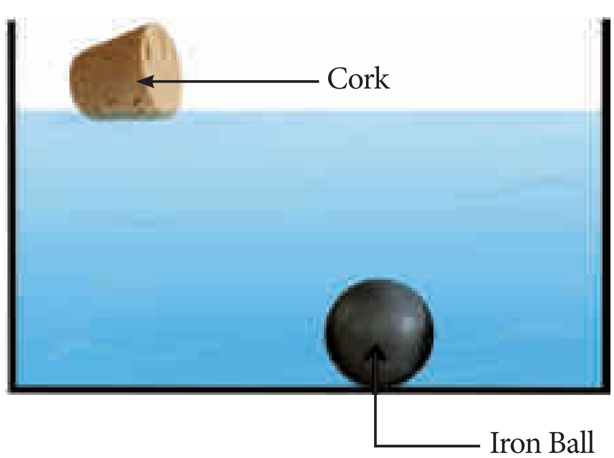
Volume of irregularly shaped objects

As we discussed earlier for the case of area, there are no formulae to determine the volume of irregularly shaped objects. For such cases, their volume can be determined using a measuring cylinder and water.

5VZN19

1.4 Density

Take water in a beaker and drop an iron ball and a cork bowl into the water. What do you observe? The iron ball sinks and the cork floats as shown in figure. Can you explain why? If your answer is "heavy objects sink in water and lighter objects float is water", then, why does a metal coin sink in water whereas a much heavier wooden log floats? These questions can be answered when we understand the concept of density.



Iron ball sinks while cork floats in water

Lighter coin sinks while heavier wooden log floats

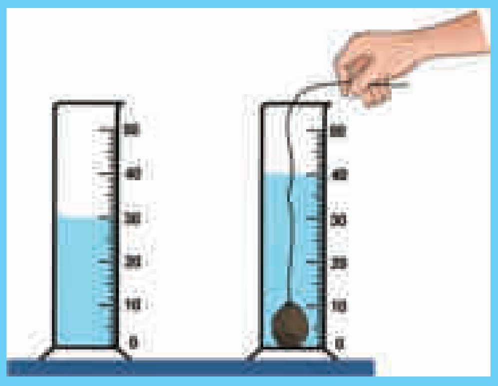
ACTIVITY 3

Take a measuring cylinder and pour some water into it (Do not fill the cylinder completely). Note down the volume of water from the readings of the measuring cylinder. Take it as V_1. Now take a small stone and tie it with a thread. Immerse the stone inside the water by holding the thread. This has to be done such that the stone does not touch the walls of the measuring cylinder (Figure). Now, the level of water has raised. Note down the volume of water and take it to be V_2. The volume of the stone is equal to the raise in the volume of water.

V_1 = ______; V_2 = ____________;

Volume of stone = $V_2 - V_1$

= ______________.



Volume of an irregularly shaped object

From the activity 4, we observe that wooden block occupies more volume than the iron ball of same mass. Also, we observe that wooden block is lighter than the iron block of same size.

The lightness or heaviness of a body is due to density. If more mass is packed into the same volume, it has greater density. so , the iron block will have more mass than the wooden block of the same size. Therefore iron has more density.

Definition of density:

Density of a substance is defined as the mass of the substance contained in unit volume (1 m^3).

If the mass of a substance is "M" whose volume is "V", then, the equation for density is given as

$$Density\ (D) = \frac{mass\ (M)}{volume\ (V)}$$

$$D = \frac{M}{V}$$

ACTIVITY 4

(a) Take an iron block and a wooden block of same mass (say 1kg each). Measure their volume. Which one of them has more volume and occupies more volume?
Ans: ________________

(b) Take an iron block and a wooden block of same size. Weigh them and measure their mass. Which one of them has more mass?
Ans: ________________

Unit of density

SI unit of density is kg/m^3. The CGS unit of density is g/cm^3.

Density of different materials

Different materials have different densities. The materials with higher density are called "denser" and the materials with lower density are called "rarer".

The density of some widely used materials are listed in the following table 1.4.

Table 1.4 Density of some common substances, at room temperature

S.No.	Nature	Materials	Density (kg/m^3)
1	Gas	Air	1.2
2	Liquid	Kerosene	800
3		Water	1,000
4		Mercury	13,600
5	Solid	Wood	770
6		Aluminium	2,700
7		Iron	7,800
8		Copper	8,900
9		Silver	10,500
10		Gold	19,300

Suppose you have one Kg of iron and gold, which of them would have more volume than the other? Give your reason.

Problem 1.4

A solid cylinder of mass 280 kg has a volume of 4 m^3. Find the density of cylinder.

Solution:

$$Density\ of\ cylinder = \frac{mass\ of\ cylinder}{volume\ of\ cylinder}$$

$$= \frac{280}{4} = 70\ kg/m^3$$

Problem 1.5

A box is made up of iron and it has a volume of 125 cm^3. Find its mass. (Density of iron is 7.8 g / cm^3).

Solultion:

Density = Mass / Volume

Hence, Mass = Volume × Density

= 125 × 7.8 = 975 g.

Problem 1.6

A sphere is made from copper whose mass is 3000 kg. If the density of copper is 8900 kg/m^3, find the volume of the sphere.

Solution:

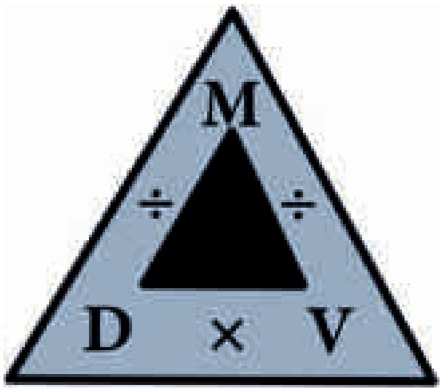
Density = Mass / Volume

Hence, Volume = Mass / Density

= 3000 / 8900 = 30 / 89

= 0.34 m^3

The relationship between Mass, density and volume are represented in the following density triangle:



- Density = Mass/ Volume
- Mass = Density × Volume
- Volume = Mass / Density

Relationship between density, mass and volume

1.5 Measuring distance of celestial bodies

Normally, we use centimeter, metre and kilo metre to express the distances that we measure in our day to day life. But, for space research, astronomers need to measure very long