PROPERTIES OF MATTER

Matter

Matter is anything that occupies space and has mass. Mass is what matter is made up of. Matter exists in three states commonly known as **solids, liquids** and **gases.**

Characteristics of matter

The different states of matter have different characteristics in regard toshape, volume and mass.

- **Solids** have a definite shape, volume, and mass. Examples of solids are brick, sand, shoe
- **Liquids** unlike solids have no definite shape. They take the shape of the container they occupy. However, have definite volume and mass. Example of liquids are water, milk, petrol.
- **Gases** like liquids have no definite shape. They take the shape of the container they occupy. They have no definite volume and compressed. They however have mass.

Effects of heat on matter

(a) Effects of heat on solids

When solids are heated the following things may take place:

(i) expands or increase in size

(ii) melts or change into liquid

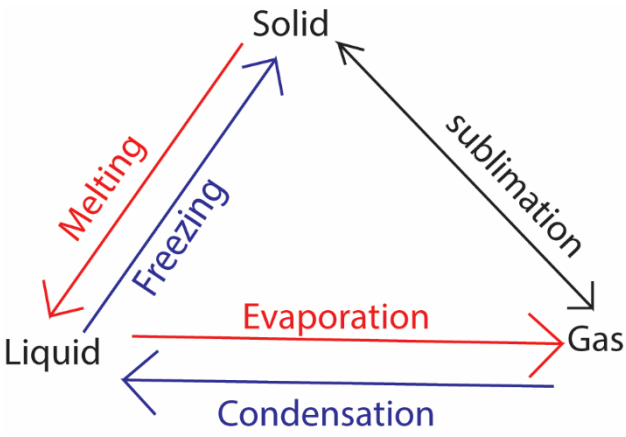
(iii) sublime or changes directly to gas without going through a liquid

on cooling the solid contraction .

Effects of heat on liquids

When the liquid is heated it evaporates into a gas. On cooling the gas **condenses** into a liquid or sublimes into a solid.

Summary of effect of heat no matter

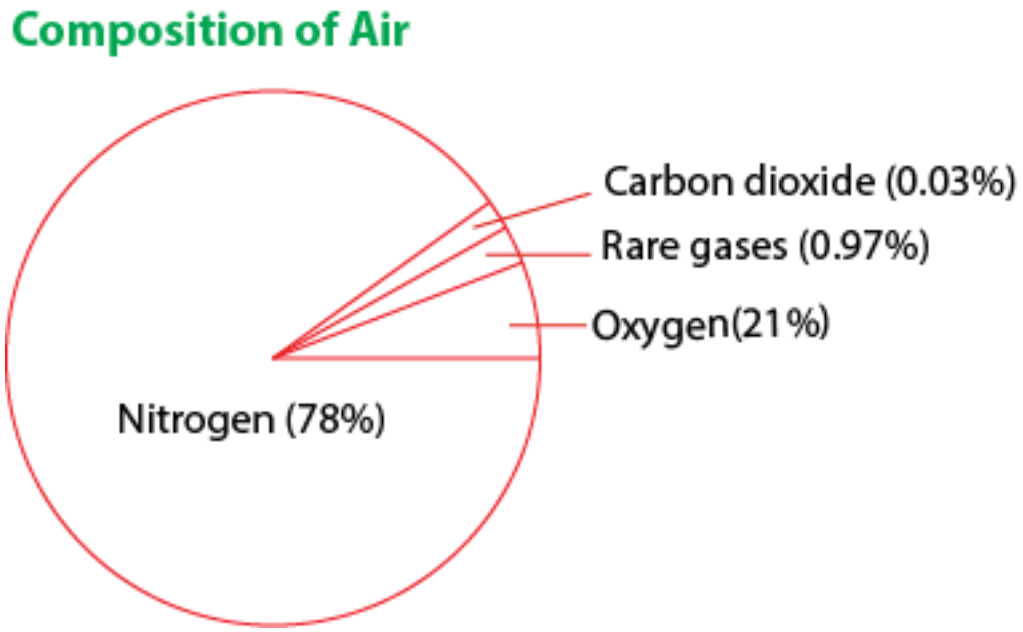


Air

Air is a mixture of gases i.e.

- nitrogen 78%
- oxygen 21%
- inert gases 0.97%
- carbon dioxide 0.03%

- Note that air contains certain varying amounts of water and dust particles.



Component of air	Used for
Oxygen	Breathing, burning, rusting and germination
Carbon dioxide	Photosynthesis (Making plant food), preserving soft drinks, putting out fire (fire extinguishers),
Nitrogen	Used by legumes to fix nitrogen into the soil
Inert gases	Used in electric bulbs or tube

Wind

This is moving air

Effects of moving air (wind)

Wind as negative effects on our surroundings particularly when it is very strong. Some effects of winds are:

- blowing soil away (erosion)
- blowing roofs away
- felling trees

Uses of moving **air (wind)**

We normally make use of wind in many ways. Some uses of wind are:

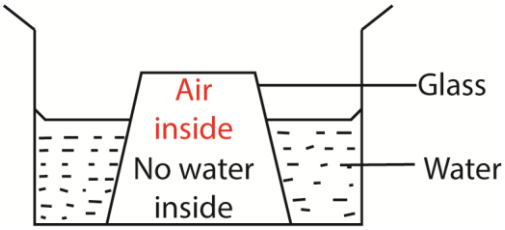
1. **Winnowing** - *this is the process of* separating *chaff from grains by using* the *wind. The grains are tossed in* the air and if the wind is *blowing the* c*haff are blown away by the wind* leaving the grains. One can also blow
away the chaff using the mouth.

2. **Sailing boats and canoes** –some boats and canoes have sail (a large piece of very strong cloth) that they use to catch the wind in order for the boat or canoe to move forward,

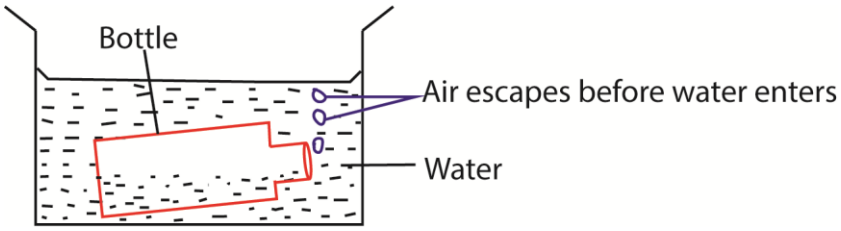
3. ***Turning*** *windmills - a windmill is* a st*ructure that has blades attached* to its roof and is driven by the wind
in or*der to turn and drive a machine* att*ached to it. A wind mill can be* used to generate electricity.

Experiment to show that air occupies space

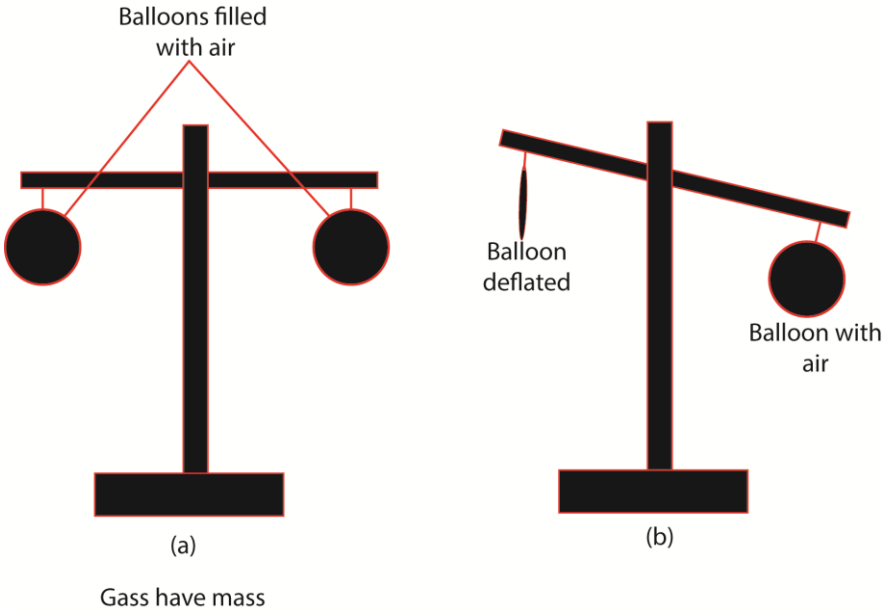
1. When air is blown into a balloon, the balloon expands.
2. When the glass is inverted in a basin of water, the water does not enter the glass because air occupies space in glass



3. Air bubbles out of an empty jerry can or bottle before water enters.



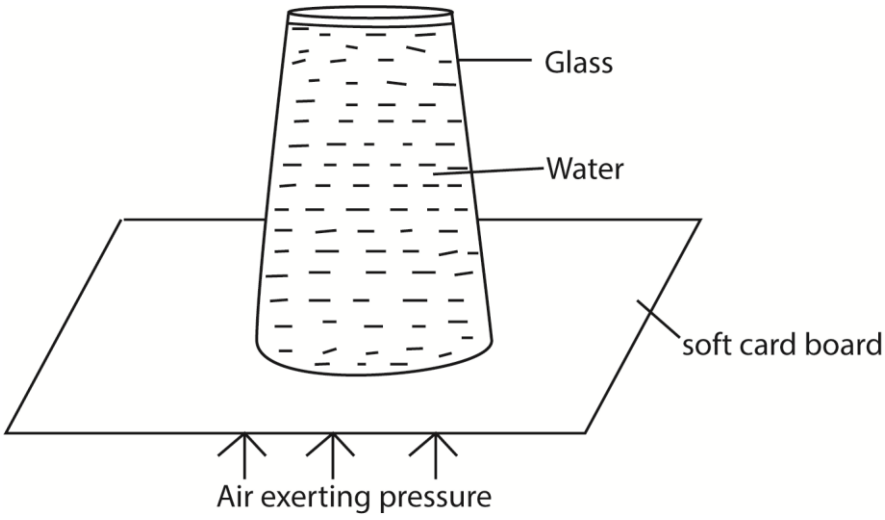
Experiment to show that air has weight.



Gass have mass

A deflated balloon is lighter than a balloon with air

Experiment to show that air exerts pressures



Density of substance

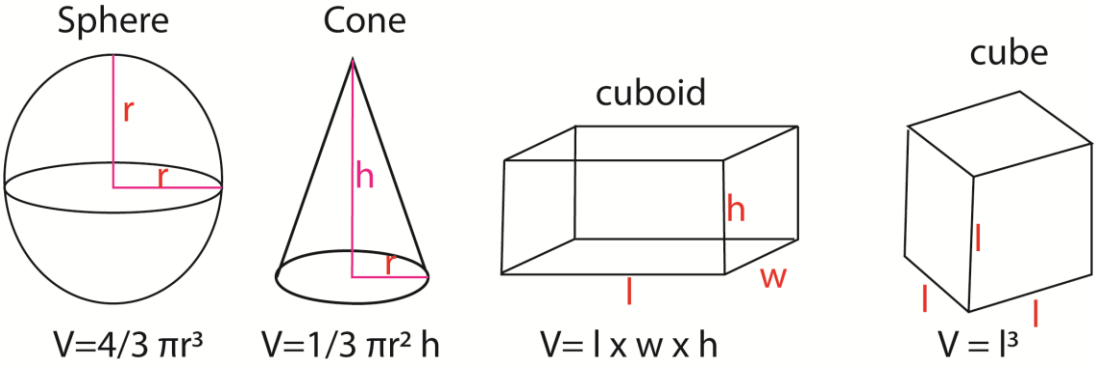
Density is mass of volume

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

Mass is object is determined by weighing balance

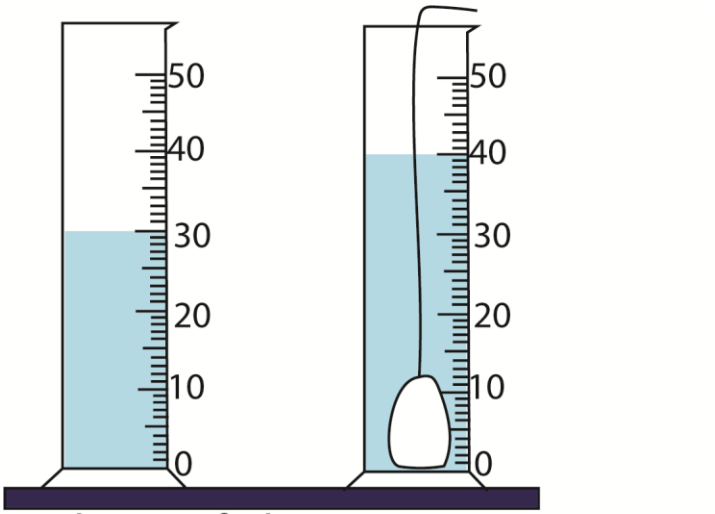
Balances

Volumes of regular objects can be determined from the formulas

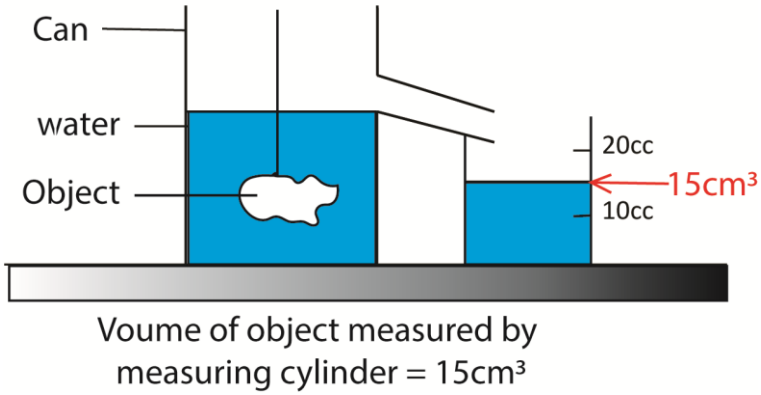


Volumes of irregular objects

(a) Volume using displacement method



(b) Using overflow can



Example

Find the density of acube of side of $2cm^3$ and mass of 10g

Volume = l x w x h = 2 x 2 x 2 = $8cm^3$

Density = mass/volume = 10/8 =$1.25gcm^{-3}$

Note that the density of water = $1gcm^{-3}$ or $1000kg/m^3$

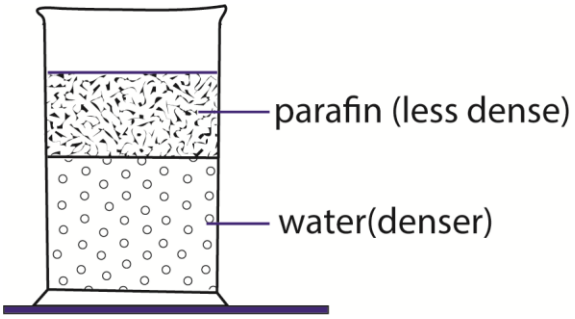
Floating and sinking in a liquid

A substance denser than a liquid sinks while that less dense than a liquid float,

A substance that sinks displaces amount of a liquid equal to its volume.

A substance that float displace amount of a liquid equal to its weight.

For example stones, metals sink in water because it is denser than water while paraffin floats in water because it is lighter than water.

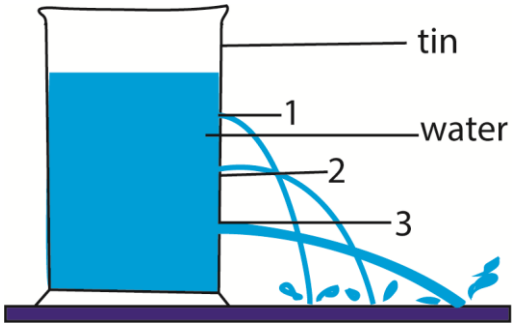


Pressure in liquids

The force that makes the liquid to flow is called pressure. The refusal of the difficult of a liquid to flow is viscosity. Pressure in liquids increase with depth as shown in the diagram below

Pressure increases with depth

The diagram shows that the jet at the bottom of the container (3) has more pressure than all the others. This is because it is the deepest among the others. Therefore the pressure increases with depth.



Mixtures

A mixture is a combination of two are more mixture

Examples

(a) Solid mixture such as maize and bean
(b) Suspension is made of insoluble solid powder in a liquid
(c) Solution is made of a two miscible liquids such a petro and paraffin or a soluble solid in a liquid such as sugar in water. The liquid that dissolves a solid is called a solvent while a solid that dissolves in a liquid is a solute

Methods of separating mixtures

1. **Winnowing** - the wind is used to separate chaff, small sticks, and dry leaves, from grains or seeds by blowing the chaff away. Chaff are usually lighter than the grains.

2. **Sieving** - a sieve is used to separate mixtures of particles of different sizes. For example stones from flour. The larger particles remain on the sieve while the finer ones pass through.

3. **Picking/sorting** - Here the large particles are separated from smaller ones by observing them and using the hands to remove the unwanted ones. For example stones are separated from rice or beans in this way.

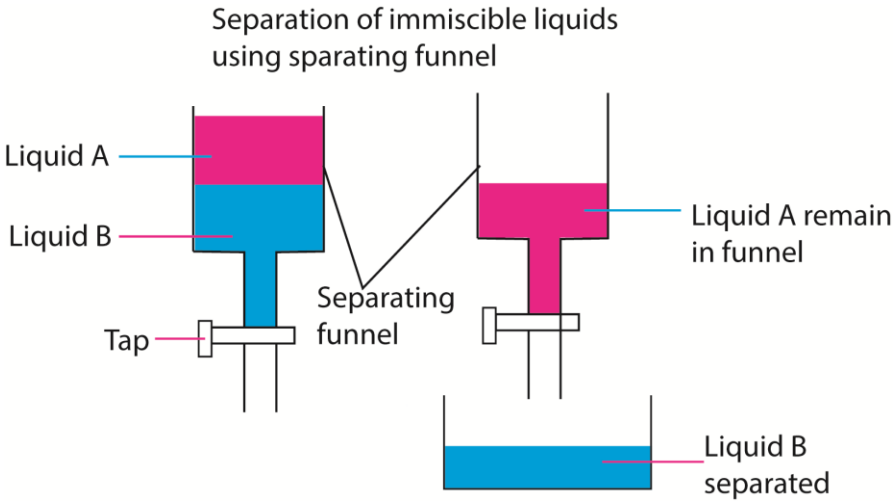
4. **Filtering-** this method is used to separate a liquid from particles that cannot dissolve in it. For example separating sand from water using filter paper or piece of cloth.

5. **Decanting** - this is when a liquid is separated from large particles of solids by pouring the liquid out gently. For example pouring off kerosene that has mixed with tiny ball bearings.

6. **Using a magnet** - a magnet is used to separate magnetic materials that may have mixed up with powder or other non-magnetic materials. For example a magnet is used to separate iron fillings from sugar.

7. **Evaporation**- a solid that has dissolved in a liquid is separated in this way. The liquid is heated until it evaporates and the solid is left behind, For example salt dissolved in water can be recovered by evaporation.

8. **Immiscible** – liquids separated by a separating funnel



Physical and chemical changes

Physical and chemical changes
A physical change: Is one in which no new substance is formed.
Examples of physical change are

(i) Melting of wax
(ii) Melting of ice
(iii) Boling of water
(iv) Expansion of metal
(v) Evaporation
(vi) Sublimation of iodine, ammonium chloride, iron (III) chloride

A chemical change:

Is one in which a new substance is formed.
In many chemical changes, heat and light are given out.
In a chemical change, it is difficult or impossible to change the new substance back to their original composition.

Examples of chemical changes

(i) Burning of candle wax
It requires oxygen to take place

(ii) Rusting

Rusting

When iron is left in damp air for some time it become covered with a brown coat called rust. Chemically rust is hydrated iron III oxide $Fe_2O_3.xH_2O$.

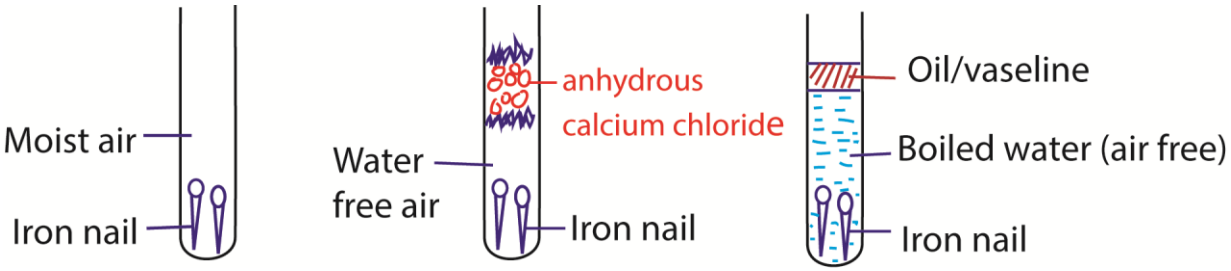
Disadvantage of rusting

1. Weaken objects made of iron
2. Makes objects made of iron look ugly

Conditions necessary for rusting

1. Oxygen not air
2. Water

Experiment to show that oxygen and water is necessary for rusting



The experiment is set up as shown above and left for several days

1. Test tube A contains nails and moist air
2. Test tube B contains nails and dry air because moisture is removed by anhydrous calcium chloride
3. Test tube C contains nail and air free water; boiling removes dissolved air from water while a layer of oil prevents entry of air into water

Observation after several days

1. In test tube a rusting took place because there is both oxygen and water necessary for rusting to take place.
2. In test tube B rusting did not take place because there was not water

3. In test tube C rusting did not take place due to absence of air

Conclusion

Both oxygen and water are necessary for rusting to take place

Method of preventing rusting

1. Keeping iron and steel equipment in air or water free environment, i.e., in the dry places (from water).
2. Oiling (protects equipment from water and oxygen).
3. Painting (protects from both air and water)

4. Tin plating protects iron from both air and water; however, tin-plate is only effective provided the layer of tin remains intact
5. Galvanizing: this is coating iron with zinc. Zinc protects iron because it is passive in air but also it can reduce iron III to ion.
6. **Alloying**

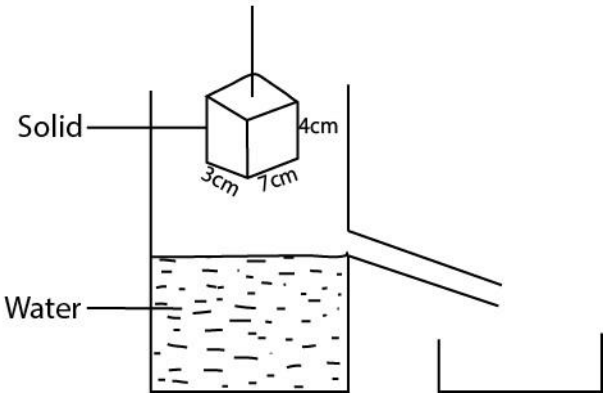
An alloy is a mixture of two or more metals

Examples of alloys

Alloy	Composition	uses
Steel	Iron and carbon	Making cooking utensils, bridges
Bronze	Copper and tin	Ornaments, coins
Brass	Copper and zinc	Coins, ornament
Solder	Tin and lead	Welding

Questions and answers

The diagram below shows an experiment used to find the volume of a regular solid block. Use it to answer questions 1, 2, and 3.



1. What is the volume of the block?

   Volume = L x W x H

   = 3 x 7 x 4

   = 84cm^3.

2. If the solid block is lowered into the overflow can, what volume of water will be displaced?

   The volume equal to volume of the solid = 84cm^3.

3. How would you confirm your answer in question 31 above?

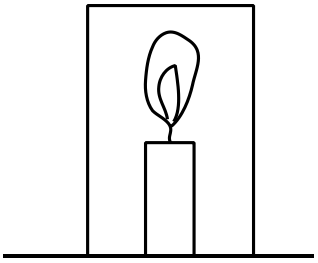
   By measuring the volume of water displaced using a measuring cylinder.

4. (a) What shows that air is matter?

   Air has weight

   Air occupies space

   (b) A candle is lit and placed inside a container and sealed as shown in the diagram below.



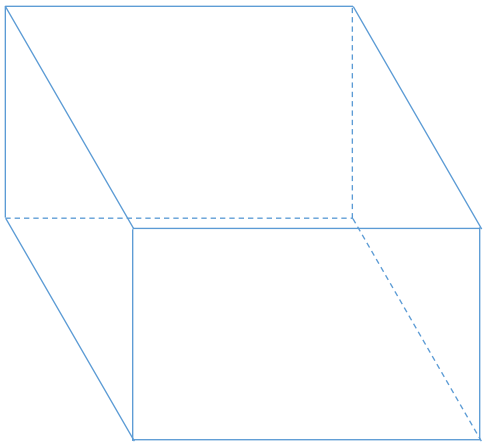
   (i) Why does the candle continue burning for some time inside the sealed container?

   Presence of oxygen in the container

   (ii) Give a reason why the candle light goes off after some time.

   Oxygen is used up

5. The figure below is accurately drawn. What is its volume?



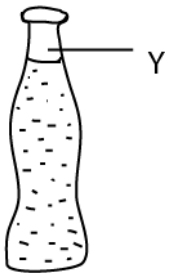
Length = 4.6cm
Width = 3.4cm
Height = 2.8cm

Volume = L x W x H
= 4.6 x 3.4 x 2.8
= 43.792 cm^3

6. In which way is burning similar to rusting?

They both use oxygen

The diagram below is of a sealed soda bottle. Use it to answer questions 6 and 7.



7. Why was the space labelled Y left in the bottle?

To allow for expansion of the liquid and space for carbon dioxide

8. Name the gas that bubbles out when the soda is opened.

Carbon dioxide

9. The driver started at 8.00am from Kampala. He reached Masaka which is 120km at 10.30am. what was his average speed?

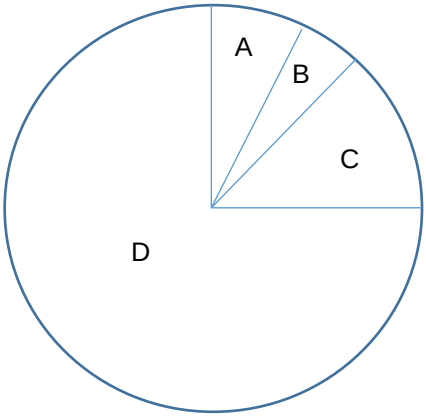
Time taken 10.30 – 8.00 = 2 ½ hours

$$\boldsymbol{speed = \frac{Distance}{time} = \frac{120}{\frac{5}{2}} = \frac{120\ x\ 2}{5} = 48 kmhr^{-1}}$$

10. Calculate the mass of an object whose volume is $15cm^3$ and density is $30g/cm^3$.

Mass = density x volume
= 30 x 15
= 450g

11. The pie chart shows the proportion of air. They are labelled A, B, C, D. use it to answer the questions that follow.



(a) Which letter in the pie chart represents the gas which supports both breathing and burning?

C

(b) What is the use of the gas labelled A?

It is used to put off fire from burning objects

Name the gas labelled

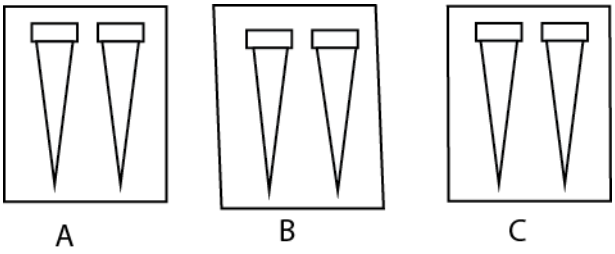
(i) D: **nitrogen**

(ii) A: **Rare gases**

12. State one reason why burning and breathing are similar.

They need oxygen.

13. The diagram below shows two nails under three different conditions



In A – the nails were wrapped in clean wet cloth
In B – the nails were wrapped in clean dry cloth
In C- the nails were smeared with oil and then wrapped in a clean wet cloth.

(a) In which case did the nail rust?

Case A

(b) What is the importance of smearing with oil

To cut off oxygen and water from the nail

(c) Name two conditions necessary for rusting.

Oxygen not air
water

14. The diagram below shows two stages in an experiment. Use it to answer the questions that follow.

(a) Why did the candle flame go off in B?

Oxygen was used up

(b) What happened there after?

Water level rose

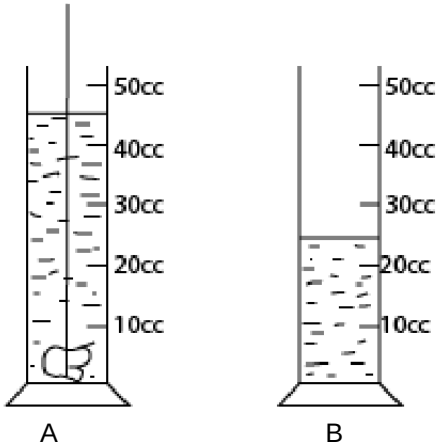
(c) Name the gas inside when the candle flame goes off.

Carbon dioxide

(d) What is the air used for?

Photosynthesis
Respiration

15. Use the diagram below to answer the questions that follow



(a) What is the volume of the stone?

45 -25 = 20cc

(b) Calculate the density of the stone if its mass is 450g.

Density = $\frac{mass}{volume} = \frac{450}{20} = 22.5 g/cc$

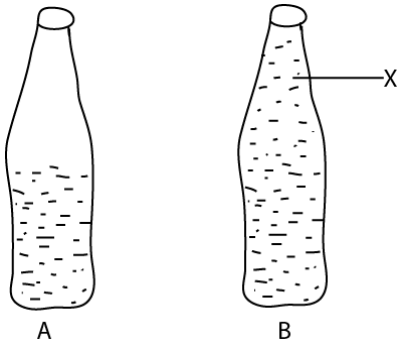
16. Metals are usually painted to prevent them from rusting. How is painting help in stopping metals from rusting?

Painting prevents water and oxygen coming into contact with the metal

17. Give one way in which friction is a disadvantage.

Wear shoes
Lead to production of a lot of noise
Retards motion
Produces unwanted heat

John poured paraffin in the bottle as shown in A below. He added water to fill the bottle as shown in B below. Use the diagram to answer questions 18 and 19.



18. Name the liquid labelled X

Paraffin

19. Give a reason for your answer in question 21 above.

Paraffin is less dense than water

20. Describe an experiment to show that air has weight?

Apparatus
Balance
Empty balloon
Inflated balloon

Procedure
Weight the balloon and a thread
Inflate and tie the balloon with a thread and weigh it again.
Finding
Inflated balloon is heavier than uninflated balloon showing that air has weight.

21. What type of change occurs to an egg which has been left in boiling water or more than ten minutes?

Chemical change

22. (a) What is the mixture of two or more metals

Alloy

(b) Give one example of a common mixture of metals.

Steel, solder, bronze

(c) How does heat move from one point to another in a metal?

By conduction

(d) Apart from painting, give any one method of preventing a metallic object from rusting.

By oiling
By galvanizing
By oiling

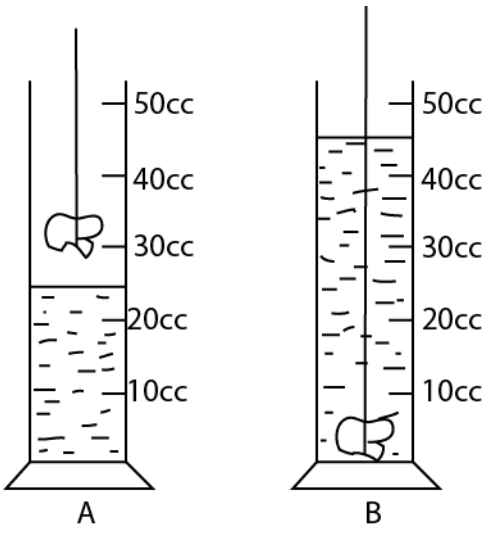
23. Why is carbon dioxide used as a fire extinguisher?

Carbon dioxide does not support burning
Carbon dioxide is denser than air, thus it displaces oxygen form a burning item

24. State one of the characteristics of the objects that float on water.

They are less dense than water

25. The diagram below is a method of measuring an irregular object. Study it and answer questions that follow.



(a) Calculate the volume of the stone.

Volume of stone = volume of water + stone – volume of water without stone

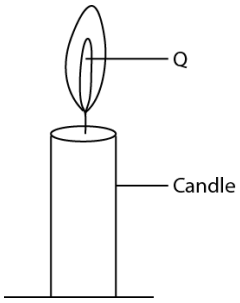
= 45 -25

= 40cm^3

(b) Name the method used to find the volume.

Displacement method

26. The diagram below is of a burning candle. Use it to answer question(a) and (b)



(a) What two forms of energy are given off at Q?

(i) Light

(ii) heat

(b) What gas is supporting the process?

oxygen

(c) What other process in living thing produces the same gas as the candle?

Respiration

Germination

27. The razor blade was left outside for a night in the morning it had rusted. What made a razor blade to rust?

Presence of oxygen and moisture

28. Which method would you use to find the value of an irregular object.

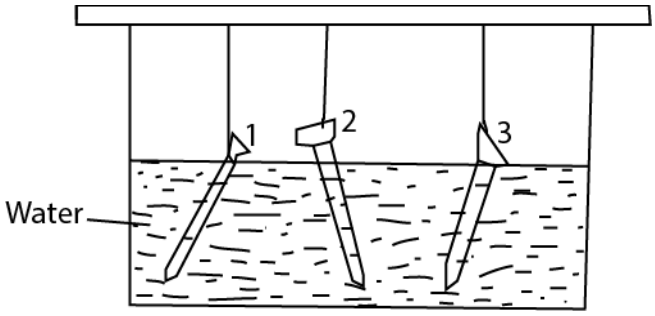
Displacement method

29. Find the density of an object whose mass is 10g and volume is 5cm^3

Density = $\frac{mass}{volume} = \frac{10}{2} = 2gcm^{-3}$ or 2g/cm^3

30. Nails were placed in water as indicated below for one week .us the information to answer to answer the question that follow.

-Nail 1 was painted
-Nail 2 was not painted
-Nail 3 was greased.



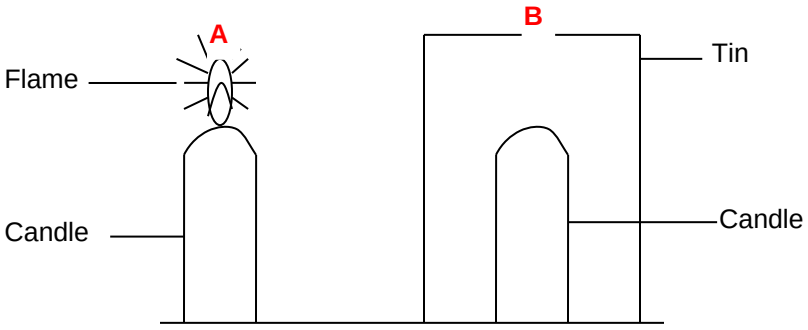
(a) Which of the nails above have changed its colour overnight?
Nail 2
(b) What will grease do in nail 3 above?
Prevents water and air from reaching the nail
(c) Why are metal object painted?
To prevent it from contact with oxygen and water
(d) Which nails will remain unaffected?
Nail 1 and 3

31. Which property of air demonstrated when air is pumped into a ball, and the ball becomes bigger?

Air exert pressure
Air occupy volume

32. **In the diagram below a candle was burning as shown in A then it was covered with a tin as shown in B. after sometimes the candle stopped burning.**

Use the diagram to answer the question below



Why did the candle flame in B go off after sometime?
Because oxygen is used up

33. Air a mixture of gases. Which of the gases forms the greatest percentage of air in the atmosphere?

    Nitrogen

34. Give any one reason why the burning of wood is a chemical change.

    It is irreversible
    A new substance (ash) is formed

35. Which property of air enables one to drink water from a bottle using a straw?

    Air exert pressure

36. How does painting a metal prevent it from rusting?

    Keeps water and oxygen from the metal

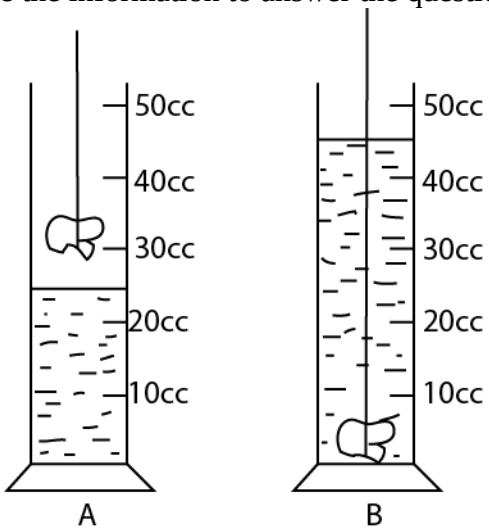
37. What force enables a match-stick to light when it is struck at the side of its box?

    Friction force

38. Why does 1 kg of iron have less volume than 1 kg cotton wool?
    Iron **is denser than cotton wool**

39. The diagram below shows a stone being put into a measuring cylinder A containing water. The level of water rose to that shown in cylinder

Use the information to answer the questions that follow.



(a) Work out the volume of the stone.
Volume of stone = 45-25 = 20cc

(b) If the mass of the stone is 60g, calculate it density.

Density = $\frac{mass}{Volume} = \frac{60}{20} = 3g/cm^3$

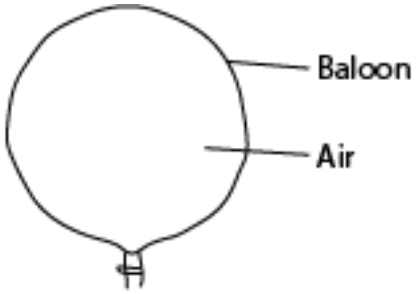
40. Give any one reason why air is considered to be matter

It has weight
It occupies space

50 (a) what is a chemical change?
This is an irreversible change from one form of a substance to another requiring or involving heat and/or light
(b) Give any one example of a chemical change.
Rusting of iron
Burning of firewood
(c) When water change to ice the process is called freezing. Name the process in each of the following changes:
(i) Ice to water **melting**
(ii) Steam to water: **evaporation**

41. Give any one property of air shown in the diagram below

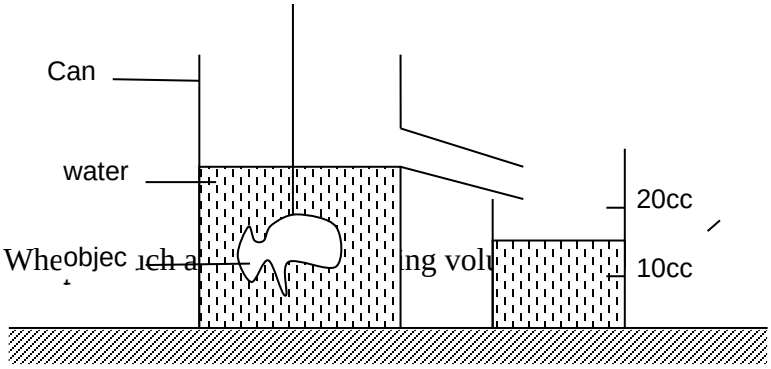
Air occupies space



42. Apart from painting, give any one other way in which metal can be prevented from rusting.

By oiling
Keeping in dry places
Greasing
Galvanizing

43. An experiment was done by a P 7 class as shown in the diagram below***. Use it to answer the question that follow.***



(a) Whe objec ich a ng volu

To find the volume of irregular objects

(b) If the object above has a density of 2 g/cm^3. Find its mass.

Volume = 15cc

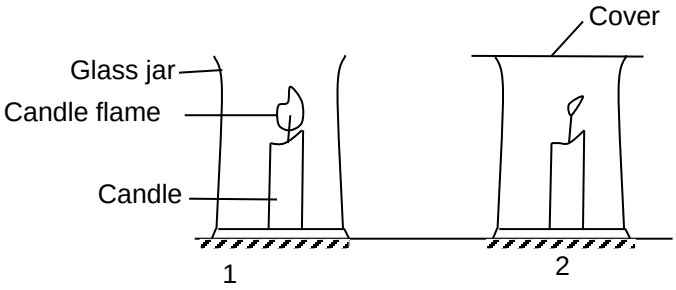
Mass = density x volume

= 2 x 15

= 30g

44. The diagrams numbered 1 and 2 below show an experiment done by a P7 class.

Diagram 1 shows burning candle in an open jar. In diagram 2, the jar was covered as shown.
Use the diagrams to answer the question that follow.



(a) What would happen to the flame in diagram 2 if the cover was removed after a short time?

The candle will burn with a bigger flame

(b) Give a reason for your answer in question (a) above.

The candle burns with a bigger flame due to presence of much oxygen

(c) If the cover had been left on the jar in diagram 2 for a long time what would have happened to the flame?

The flame will go off

(d) Give a reason for your answer in question (c) above.

The flame will go off because oxygen that supports burning is used up

45. The density of sand is 3 grams per cubic centimeter. Its mass is 270 grams. Find its volume.

Density = $\frac{mass}{volume}$ $implies\ that\ volume = \frac{mass}{density} = \frac{270}{3} = 90cm^3$

46. (a) Gives any two example of a physical change

(i) melting of ice

(ii) Evaporation

(iii) Gas to solid

(iv) Melting candle wax

(b) State two characteristics of a chemical change

(i) Heat is given out

(ii) Form new substance

(iii) Are irreversible

(iv) Permanent change

47. In which type of change are the properties of the substance formed permanently different from those of the original one?

Chemical change

48. Which property of air enables you to drink soda using a straw

Air exerts pressure

49. (a) What type of change takes place when an iron tool rusts?

Chemical change

(b) Give two conditions necessary for rusting to take place on an iron tool

(i) **oxygen (not air)**

(ii) water

(c) State any one effect of rusting on iron tools.

- **weakens tools**
- **make tools dull/ugly**
- **make tool blunt**

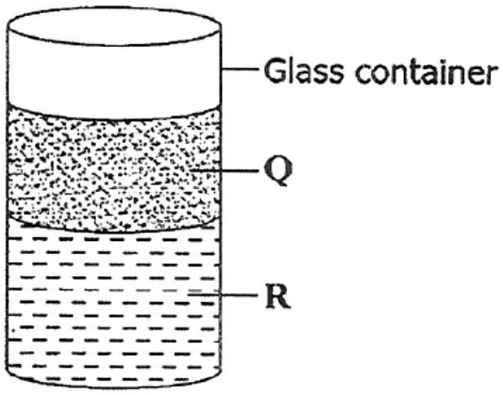
50. Name the gas used in fire extinguisher

Carbon dioxide

51. Why does a nail sink in water?

A nail is denser than water

52. The diagram below shows a glass container into which water and cooking oil were poured. The two liquids settle as shown. Study and use it to answer the questions that follow.



(a) Which of the two liquids is represented by:
Q: **cooking oil**
R: **water**

(b) State any one method that can be used to separate the two liquids
Using a separating funnel

(c) Why has liquid Q settled on top of liquid R?
Q is less dense than R