INCREASING ACCESS TO SECONDARY SCHOOL LEVEL EDUCATION THROUGH THE PRODUCTION OF QUALITY LEARNING MATERIALS

JUNIOR SECONDARY LEVEL

PHYSICS

Module 1: Measurement

Partners:
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JUNIOR SECONDARY LEVEL SCIENCE - PHYSICS

MODULE 1 – Measurement

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MODULE 1

MEASUREMENT

INTRODUCTION

In Science we have to make ***observations***. In a number of these, we have to make ***measurements*** too and record them quite systematically. This is done in a tabular form. You will realise that systematic representation of information helps us to make generalisations and see relationships.

In everyday life we are involved in different types of measurements. For instance, we have to measure the:

- length and width of the table top or bed to buy the table cloth or bedsheet respectively
- mass of ingredients in preparing cakes
- volume of water in preparing a baby's milk
- body temperature in case of fever
- time taken for dough to increase in bulk before use.

In this Module we introduce you to various aspects of measurement.

OBJECTIVES

After completing the Module, you should be able to:

- make useful measurements involving mass, length, volume, time, temperature.
- record and present results of elementary experiments in tabular forms
- explain force and give examples of forces
- define pressure and perform simple calculations on pressure.

1.1 ESTIMATING AND MAKING MEASUREMENTS

In the following sub-sections, we are going to make estimates (even roughly!) and then do actual measurements. We'll consider measuring

- Length
- Mass
- Volume
- Temperature
- Time

Length, mass, volume, time and temperature are regarded as the five basic physical quantities we use in Science.

Note: Measurements are also dealt with in Chemistry - Module 1, Unit 1: 1.4.

We'll look at each in turn.

1.1.1 LENGTH

'Length' just means the separation between 2 points.

Length is measured in metres (m). Thus the metre is called the ***base*** unit (or fundamental unit) for length. We shall see later that each of the five physical quantities has a base unit.

You will note that smaller lengths are measured in centimetres (cm).

1 m = 100 cm

If you examine your ruler carefully you will note that there are ten divisions within each centimetre.

Each division represents one millimetre (mm)

1 cm = 10 mm

The kilometre (Km) is a bigger unit of length. For example the separation between 2 villages is expressed in kilometres.

1Km = 1000m

✍ ***Before proceeding further, complete the following activity.***

ACTIVITY 1

What is the fundamental unit of length used in Science?
*Choose **one** from the list below:*

- *Metre*
- *Centimetre*
- *Millimetre*
- *Kilometre*

Answer: ……..

You will find the answer at the end of the Module.

✍ ***Before proceeding further, complete the following activity.***

ACTIVITY 2

For measuring length we can use items from the list below. Consider each and put a tick if correct or a cross if incorrect in the boxes provided.

A metre rule …….. ☐

A half metre rule …….. ☐

A measuring tape…… ☐

A ruler …….. ☐

You will find the answers at the end of the Module.

We can now proceed with an actual investigation.

INVESTIGATION 1: Estimating and measuring height

For each investigation you will require the materials indicated. **You should record your answers in the space provided.**	**Materials needed:** A flat ruler and a measuring tape **Method**: *(a) Estimate your own height* *……* *(Please include the unit)* *(b) Now measure your height. For this, you may stand upright with your back against a wall. Place a ruler horizontally at head level. Get someone to mark on the wall just behind the ruler. Now measure the distance on the wall representing your height. You may use a measuring tape.* *Record the value.* *……..* *(Please include the unit)* *(c) Now compare the answers in (a) and (b).* *Is your estimated height close to the value obtained in (b)?*

At this stage, I suggest you undertake another simple investigation. It concerns the measurement of length of some common items.

INVESTIGATION 2: Measuring specified lengths

For each investigation you will require the materials indicated. **You should record your answers in the space provided.**	**Material:** Measuring tape **Method**: *Make measurements of the following and record each.* *(1) The length of your left hand* *……..* *(2) The length of your pencil* *……..* *(3) The height of a door in the room where you are now* *…….* *(4) For a selected rectangular table* *(a) Its length …….* *(b) Its width …….* *(c) Its height …….*

I am sure you had no difficulty making the measurements of the above items.

1.1.2 MASS OF A SUBSTANCE

Mass of an object is simply the amount of matter present in it. This is a property of an object that does not change. Mass is measured in kilograms (Kg). This is the base unit for mass. Smaller masses can be measured in grammes (g).

1 Kg = 1000g

Mass can be measured by a beam balance or by an electronic balance.

✍ ***Before proceeding further, complete the following activity.***

ACTIVITY 3

(a) How is the mass of a substance defined?
……

(b) State the unit in which mass is expressed correctly.
……

(c) Sketch a single pan (direct reading) balance – like the one used in the kitchen – to measure different masses.

You will find the answers at the end of the Module.

Now it's time for another simple investigation. It concerns the measurement of masses of some common items.

INVESTIGATION 3: Mass of selected items

For each investigation you will require the materials indicated.

Materials:

- Items from school bags
- Single pan (direct reading) balance method.

Method:

Select a variety of items from your school bag.

For each find out the mass and record its value.

You should record your answers in the space provided.

Items	*Mass (grammes)*

I am sure you selected items such as:

- books
- exercise books
- box of mathematical instruments
- eraser
- ink pot

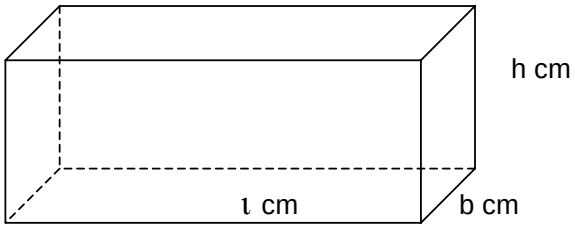
For each, you should have no difficulty measuring and recording its mass.

1.1.3 MEASUREMENT OF VOLUME

The volume of an object just means the space it occupies. Volume is measured in metre cube (m^3) or centimetre cube (cm^3). You will recall

1m = 100 cm
but
$1m^3 = 100 \times 100 \times 100$
$= 1{,}000{,}000\ cm^3$

For an object which has a regular shape, its volume can be calculated from suitable measurements. For example for a rectangular box



Volume = length x breadth x height
$= \iota \times b \times h\ cm^3$

✍ ***Before proceeding further, complete the following activity.***

ACTIVITY 4

a) *A box is 1m long, 0.8m broad and 0.5m high. Calculate its volume.*

……

(b) *A room is 10m long, 8m wide and 4m high. What is the volume of the room?*

……

You will find the answers at the end of the Module.

We can now proceed to another simple investigation. It concerns the measurement of volume of water.

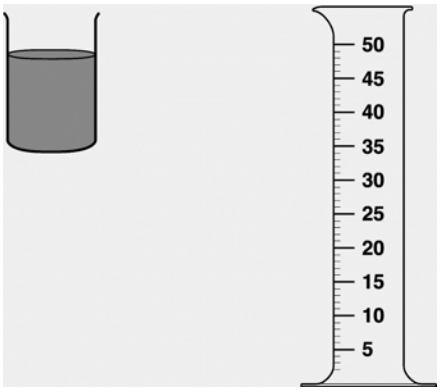
INVESTIGATION 4: To measure the volume of a liquid such as water which is contained in a partly filled glass.

For each investigation you will require the materials indicated.

You should record your answers in the space provided.

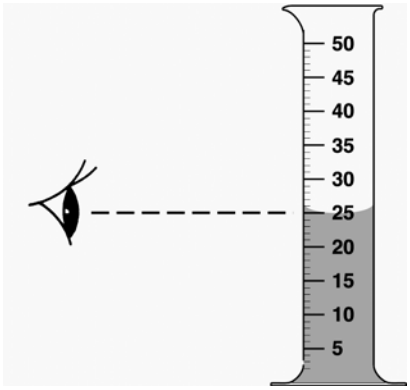
Materials:

- A glass partly filled with water
- A measuring cylinder (50cm^3)



Method

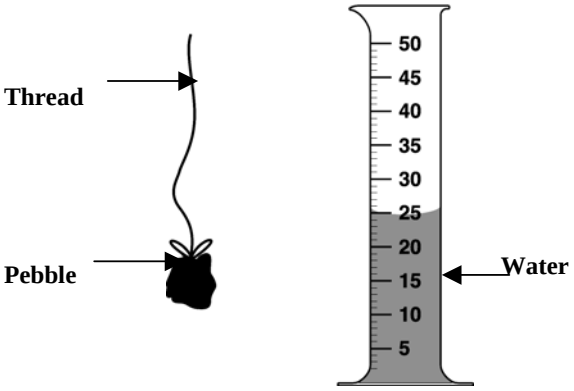
(i) Place the cylinder on the table.
(ii) Pour the entire contents of the glass into the measuring cylinder.
(iii) Position your eye in line with the meniscus (level of the liquid).
(iv) Note the reading and record it.
_____*cm^3*



It's easy to measure correctly the volume of water contained in the glass.

Let's now undertake the following simple investigation. It is about measuring the volume of a small pebble

INVESTIGATION 5: To measure the volume of an irregular solid e.g. a small pebble

For each investigation you will require the materials indicated.	**Materials:** • Small pebble • Piece of thread • Measuring cylinder (50 cm^3) • Water 
You should record your answers in the space provided.	**Method** (a) *Attach a fairly long thread to the pebble as shown above* (b) *Half fill the measuring cylinder with water. Record the initial volume.* *…….. (cm^3)* (c) *Lower the pebble in the cylinder (with the help of the thread) carefully until it is completely submerged. The level of water rises. Record the final volume.* *……. (cm^3)* *Work out the volume of the pebble.* *…….. (cm^3)*

The volume of the pebble is just the difference between the final and initial volumes! Fairly straightforward, isn't it?

1.1.4 MEASUREMENT OF TIME

In common situations, time is read from a clock or a watch. In several cases we have to measure a **time interval** or time taken to do something e.g. anactivity. We need to note the times at which we start and finish the activity. The time taken is determined by difference.

I suggest you undertake the following simple investigation concerning measurement of time.

INVESTIGATION 6 : To measure the time taken for you to walk up the stairs and return to the foot of the stairs

For each investigation you will require the materials indicated.	**Material:** • Stop watch or stop clock. Your brother or sister or anyone can help you, otherwise you can do it yourself **Method**: *Start timing the moment you start to walk up the stairs. Note the time. When you're down, stop timing. Note and record the time interval.*
You should record your answers in the space provided.	Finishing time = Starting time = Time taken =

I am sure you had no difficulty in measuring this time interval. Of course here the time interval depends on how rapidly (or slowly) you go up and then come down.

1.1.5 MEASURING TEMPERATURE

We often hear people talking about temperature. For example, the weather forecast station normally predicts the lowest and highest air temperatures during a 24-hour period. This gives us a measure of how hot or how cold the air is. In fact the temperature of a body refers to its degree of hotness or coldness. It is measured by using a thermometer. Temperature is measured in degree Celsius (^{0}C). However, the base unit for temperature is the kelvin (K). To convert ^{0}C into K we just add 273, for example

$$1^0C = 273 + 1 = 274K$$

✍ ***Before proceeding further, complete the following activity.***

ACTIVITY 5

(a) Name the instrument commonly used for the measurement of temperature.

……

(b) Draw a labelled diagram of the instrument.

You will find the answers at the end of the Module.

At this stage, the following simple investigation will be useful. It is about measurement of temperature

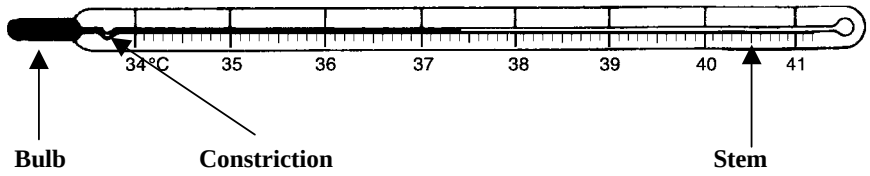
Investigation 7: To measure the temperature of warm water

For each investigation you will require the materials indicated. **You should record your answers in the space provided.**	**Materials:** • A small beaker or glass • A thermometer • Cold water • Hot water **Method**: (i) *Take a small beaker or glass.* *(ii) Partly fill it to about one third its capacity with tap water.* *(iii) Record the temperature* *……* *(iv) Pour an almost equal volume of hot water in the beaker or glass.* *(v) Stir gently with the thermometer.* *Note and record the final temperature*. *……*

I am sure you recorded a final temperature higher than that of tap water.

Measuring the temperature of the human body

The temperature of the human body *(for example, the body temperature of someone)* is measured by a special thermometer. This is called a "clinical thermometer". The following is a simple diagram of a clinical thermometer:



Have a look at the features of this thermometer. What do you note?

- The scale reading is from 34^0C to 41^0C. This is because the temperature of the human body normally lies within this range. For a healthy body, the temperature is 37^0C.

- There is a constriction near the bulb. It prevents the column of mercury from returning back into the bulb when the thermometer is removed from the person's body. This ensures an accurate reading. Also the reading can be taken at leisure.

- The stem is oval in shape. What is the reason for this? It acts as a magnifying glass. This helps readings to be taken more easily!

✍ ***Before proceeding further, complete the following activity.***

ACTIVITY 6

A special thermometer is used to measure the body temperature of a human being.

(a) Give the name of the thermometer.

Answer:
……
……

(b) What are the THREE special features of this thermometer?
1st ……

2nd ……

3rd ……

(c) Briefly describe how this thermometer is used to measure the temperature of a patient.

……

……

……

You will find the answers at the end of the Module.

1.2 MAKING OBSERVATIONS

You will recall that in Science we often make observations and measurements. We have to make accurate observations and record them at times.

Note: **Observations are also dealt with in Chemistry - Module 1, Unit 1: 1.5.**

In everyday life we come across a number of common items.

These include

- flour
- tea

- coffee
- sugar
- salt
- pepper
- sand

Our observations can be in terms of properties like:

- the colour of the item
- the size of particles in it
- the feel (between fingers)
- the shape
- the smell (if any)
- the sound it emits on being shaken

At this stage, I suggest you undertake the following investigation.

It's about very simple observations.

INVESTIGATION 8:

Observe some common solid substances and record their properties in the table below:

Substance	Colour	Size	Feel	Shape	Smell	Sound
Flour						
Tea						
Coffee						
Sugar						
Salt						
Pepper						
Sand						

I hope you found this exercise interesting.

1.3 CLASSIFYING

We can classify (group) substances in a number of ways depending upon their properties. You can refer to properties like colour, smell, shape, feel and size just as we saw earlier.

Another way of classifying them might be in terms of **transparent** substances or **opaque** ones. It is useful to note that transparent objects allow light to pass through while opaque ones do not.

✍ ***Before proceeding further, complete the following activity.***

ACTIVITY 7

(*a) Name a few transparent substances.*

……
……
……

(b) Draw up a list of opaque substances.

……
……
……

You will find the answers at the end of the Module.

Another way to classify substances could be whether they are:

Solids

Liquids

Gases (vapours)

✍ ***Before proceeding further, complete the following activity.***

ACTIVITY 8

(a) Give 5 examples of solids

……
……

(b) Now give 5 examples of liquids

……
……

(c) Finally name 5 gases

……
……

You will find the answers at the end of the Module.

1.4 RECORDING RESULTS

In most of the investigations we have carried out so far, we have been recording the observations and the results.

Whenever measurements are made, they have to be recorded. In many instances, we can record them in tabular forms.

When results are recorded in tabular forms, we can easily interpret them, we can also see the relationships or patterns among the different physical quantities at a glance. This is very important in Science because it helps us to make generalisations. In some cases the relationships are quite straightforward. However, in other cases, they are not.

Note: Recording and Presentation of results are also dealt with in Chemistry - Module 1, Unit 1: 1.6.

We'll consider only simple investigations where results recorded illustrate simple relationships clearly.

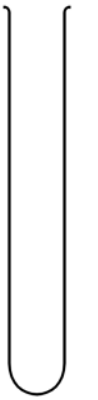
We can now proceed with the following simple investigation.

INVESTIGATION 9: Measuring and recording the height of water in a boiling tube for different volumes of water.

For each investigation you will require the materials indicated.

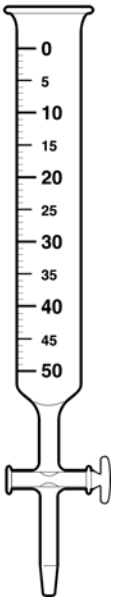
Materials:

- A burette
- A boiling tube
- Water
- A ruler



Boiling Tube

Ruler



Burette

You should record your answers in the space provided.

(a) Fill a burette with water.

(b) From the burette transfer 5cm^3 of water into the boiling tube held vertically. Record the height in the boiling tube.

(c) Add another 5cm^3 and record the height.

(d) Continue until the boiling tube is almost full of water.

(e) Record as in table below.

Volume of water (cm^3) Height of water (cm)	*Height of Water*
5	
10	
15	

I am sure that you recorded increasing values. Do you see any pattern? What simple relationship do you deduce between volume and height? You must have noted that in the later stages the height increases by equal amounts.

1.5 USING CONVERSIONS

You will recall that a physical quantity can be expressed in several units. It is useful to know how one unit can be converted into another. For instance 0.2 Kg is equivalent to 200g.

✍ Before proceeding further, complete the following activity.

ACTIVITY 9

Complete the table of conversions for length.

1 m = 10 decimetre (dm)

1 dm = ... cm

1 cm = ... mm

1 Km = ...m

You will find the answers at the end of the Module.

✍ Before proceeding further, complete the following activity.

ACTIVITY 10

Complete the table for conversions of time

1 week = ... days

1 day = ... hours

1 hour = ... minutes

1 minute = ... seconds

You will find the answers at the end of the Module.

1.6 FORCES

You will recall we mentioned the force of gravity earlier. We shall now consider 'forces' in some more detail. Let's start with a simple definition.

A force can be simply defined as a pull or a push.

A force is measured in Newtons (N). There are various types of forces. For example, the force of gravity is a force which pulls everything towards the centre of the earth. We shall see later in this Module another force called "force of friction" which opposes motion. When a force acts on a body, various effects may be observed.

1.6.1 WEIGHT

If you throw a stone vertically upwards, the stone falls back to the ground. The stone is pulled back by the force of gravity. (We'll learn about forces later in this Module). The force of gravity is a pull (force) that attracts everything towards the centre of the earth.

All objects experience this pull or gravitational force. If an object has a mass of 1 Kg, then it experiences a force of 10 Newtons. The Newton (N) is the unit for force. We'll define the Newton when we look at Newton's laws of motion later in this Module.

The gravitational force per Kg is denoted by 'g'.

The weight of an object is defined as the gravitational force that acts on it. We can calculate the weight of an object as follows:

	Weight	=	Mass x 'g'
	W	=	m x g
where	m	=	mass in Kg
	g	=	gravitational force per Kg
	W	=	Weight in N

We shall use g = 10N/Kg in this Module.

✍ ***Before proceeding further, complete the following activity.***

ACTIVITY 11

Inter conversions between masses and weights

Complete the following:

(a) 1 Kg = ……. g
(b) a mass of 1 Kg has a weight of …….. N
(c) 5 Kg = ……N
(d) 400N = ……Kg

You will find the answers at the end of the Module.

✍ ***Before proceeding further, complete the following activity.***

ACTIVITY 12

A boy of mass 32 Kg runs a distance of half Km in 5 minutes

(a) the weight of the boy. …….
(b) the distance in metres ……..
(c) The time in seconds …….

You will find the answers at the end of the Module.

✍ ***Before proceeding further, complete the following activity.***

ACTIVITY 13

A block weighs 380 N. What is its mass?
……
……
……

You will find the answers at the end of the Module.

1.6.2 EFFECTS OF FORCES

If you pull a piece of elastic band or a spring, the length increases. A force can thus change the shape of a body.

A force tends to produce motion, or tends to stop a moving object.

A force can make a body move faster. In other words a force can increase the velocity of a body.

The velocity of a body means the distance travelled in one second in a given direction. Velocity is measured in metre per second. (m/s)

$$\text{Velocity (in metre per second)} = \frac{\text{distance travelled in a specific direction } \textit{(in metres)}}{\text{Time (in seconds)}}$$

When a force produces an increase in velocity, we say there is an acceleration. It is useful to note that:

$$\text{Acceleration} = \frac{\text{change in velocity}}{\text{Time}}$$

Acceleration is measured in metre per second square (m/s^2).

Thus a force can produce an acceleration.

In fact, Isaac Newton formulated three important laws that illustrate the effects of forces on motion of objects.

Let's look at each one in turn.

1.6.3 NEWTON'S LAWS OF MOTION

Newton's First Law of Motion

Newton's first law states that every object continues in its state of rest or of uniform motion in a straight line unless a force is applied. Thus if your book is at rest on the table, it cannot start moving on its own! It can move if you push it. Similarly if an object is moving in a straight line it will not stop on its own. It will stop if force is applied, for example, if the brakes are applied, in the case of a car moving in a straight line.

Thus if no force is applied on a body

(i) it will remain at rest if it is at rest

(ii) it will continue in its state of uniform motion.

Newton's Second law of Motion

If a force is applied to a body the state of rest or state of uniform motion changes. An acceleration is produced.

The acceleration produced is related to the mass of the body and the force applied by the equation,

Force = Mass x Acceleration

F = ma

F = Force in Newtons (N)

m = Mass in kilogram (Kg)

a = Accelaration in metre per second square (m/s^2)

The relation

F = ma

summarises Newton's Second Law of motion.

Thus if the mass of an object = 1 Kg, and

acceleration = 1 m/s^2

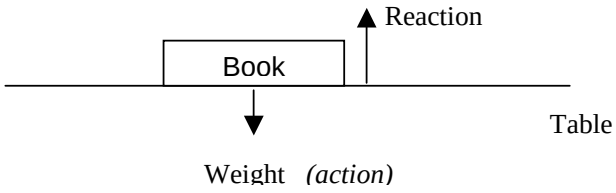
then

Force = 1 x 1 = 1 Newton

We can thus define the Newton as the force which can produce an acceleration of 1 m/s^2 of an object of mass 1 Kg.

Newton's Third Law of Motion

Consider your book lying on a flat table. The weight (W Newtons) of your book acts on the surface of table. The table also exerts a force equal to W Newtons on the book but in the opposite direction. This opposite force is called the **reaction.** The force exerted by the book on the table is called the **action.**



Newton's Third law states that **action and reaction are equal (in magnitude) but opposite (in direction).**

✍ ***Before proceeding further, complete the following activity.***

ACTIVITY 14

*(a) Give a definition for **Force.***

……

……

(b) What is the unit of force?

……

(c) What is meant by the weight of an object?

……

……

You will find the answers at the end of the Module.

✍ ***Before proceeding further, complete the following activity.***

ACTIVITY 15

Make a list of 3 effects of forces. Illustrate each one.

1st

……

……

2nd

……

……

3rd

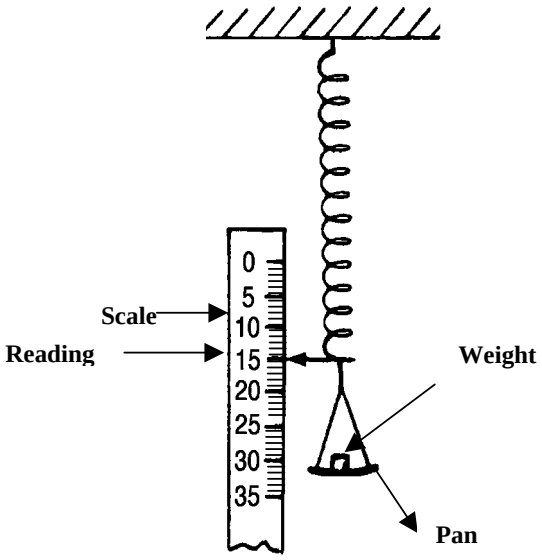
……

……

You will find the answers at the end of the Module.

1.6.4 MEASUREMENT OF FORCES

A force can be measured by a Newton spring balance. One form of this balance is as shown.



The force is due to the weight placed in the pan. Typical results are as follows:

Force (N)	2	4	6	8
Scale reading (N)	2	4	6	8

✍ Before proceeding further, complete the following activity.

ACTIVITY 16

(a) Observe the spring balance carefully and answer the following:

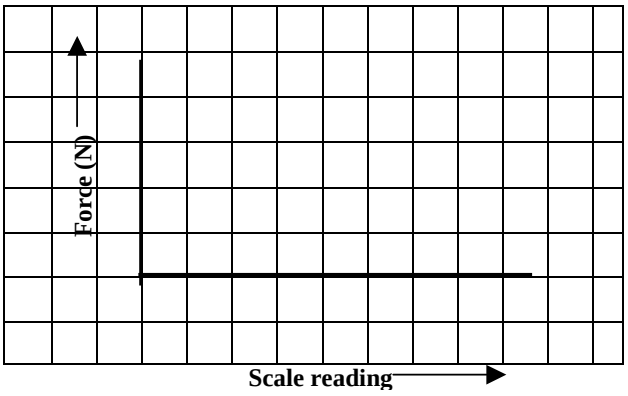
What reading do you expect if no force is applied?

You will recall we mentioned the effect of a force (pull) on a piece of elastic band. Similarly if a force is applied to a spring, the spring becomes longer or it extends. The extension increases as the force increases.

The diagram of a spring balance which can be used to measure a force has been shown on ***page 27.***

Now, if a force of 2 N is applied, the pointer should read ……..

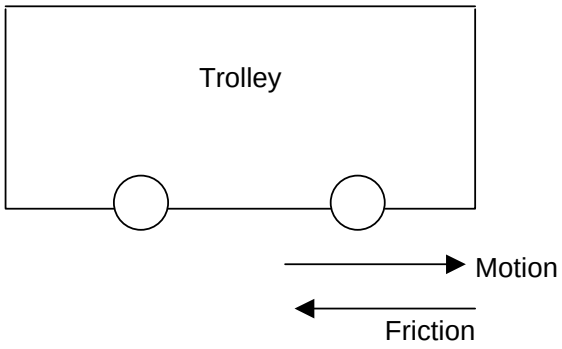
(b) Complete the sketch to show the relationship between force (N) and scale reading (calibrated in N i.e. marked in N)



You will find the answers at the end of the Module.

1.6.5 FORCE OF FRICTION

The force of friction is a force that opposes motion. It always acts in a direction opposite to that of motion. (See diagram below). It shows a trolley with two forces acting. One force is producing motion while the other one is opposing motion.



Friction is often referred to as a 'contact force' between two objects. It slows down motion. Force of friction is more if surfaces are rough. If surfaces are smooth friction is less.

✍ Before proceeding further, complete the following activity.

ACTIVITY 17

*A small block of wood is placed on a table. Both the wood and tabletop have **rough** surfaces. The block of wood is pushed horizontally to the right on the tabletop.*

(a) In which direction does the force of friction act?

……
……
……

(b) Which factors affect friction?

……
……
……

You will find the answers at the end of the Module. .

The effect of the medium

Force of friction often depends on the medium in which motion takes place. Air is an example of a medium. Water is another example.

✍ ***Before proceeding further, complete the following activity.***

ACTIVITY 18

(*a) Name a large object that moves in water, below its surface.*

……

(b) Name a large object that moves in air.

……

*(c) Identify the **medium** in each case above.*

……

*(d) Does the medium in either case **assist** movement or does it **hinder** it?*

……

You will find the answers at the end of the Module.

Friction: its advantages and disadvantages

Now that we know what is friction, it's useful to look at its advantages and disadvantages. Friction is often useful. We can walk without sliding because of friction. You can hold your pencil between your fingers because friction prevents the pencil from sliding down! However sometimes friction can be a problem. For example, friction causes wear and tear of moving parts in machinery and in the movable joints in our body.

✍ ***Before proceeding further, complete the following activity.***

ACTIVITY 19

Consider each statement below. Write down ***True*** *or* ***False*** *after each.*

1 *In a racetrack, friction helps to prevent skidding.* ☐

2 *While we are walking on the pavement, friction between our shoes and the pavement prevents us from walking.* ☐

3. *Blocks of ice have smooth surfaces and negligible friction.* ☐

4. *During the fall of a parachutist (with parachute open) friction in air accelerates the fall.* ☐

5. *In parts of machines which are in contact the force of friction is a nuisance as it interferes with movements of the parts.* ☐

6. *Ball bearings help to decrease friction in specific parts of machines.* ☐

You will find the answers at the end of the Module.

1.7 PRESSURE

Pressure is defined as force acting per unit area. It can be calculated as

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

When force is expressed in N and area in m^2, pressure is expressed in Newtons per Metre Square (N/m^2) or Pascals (Pa). We can write

where P = F/A

F = Force

A = Area

A bigger unit for pressure is the KPa.

1KPa = 1000 Pa

You will note that for the same force, pressure is bigger if area is smaller.

(a) What happens when a heavy person wearing high-heeled shoes stands on soft ground?

(b) What will happen if the same person now wears flat shoes on the same soft ground?

In case (a), the pressure is higher as the area of contact with the ground is smaller.

Atmospheric Pressure

You often hear of atmospheric pressure. It refers to the pressure exerted by the air above us. This is due to the weight of air above us. Atmospheric pressure is measured by a barometer.

✍ ***Before proceeding further, complete the following activity.***

ACTIVITY 20

(i) *Give one mathematical equation to represent the definition of pressure.*
……

(ii) What are the units of

Force? ……
Area? ……

(iii) Now give one unit of pressure.
……

(iv) The unit is also called Pascal. The symbol is
……

(v) In case this unit is too small (for large pressures) we may use the
……
……

You will find the answers at the end of the Module.

✍ ***Before proceeding further, complete the following activity.***

ACTIVITY 21

Delete as required.

*(a) For a given force, when area in contact **decreases**, the pressure (increases/decreases)*

……

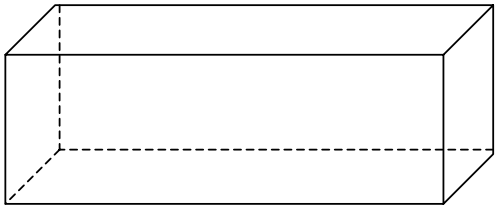
*(b) For a given area of contact, when force **decreases**, the pressure (increases/decreases)*

……

You will find the answers at the end of the Module.

At this stage, I suggest you undertake the following simple investigation.

INVESTIGATION 10: Effect of an area of contact on pressure.

For each investigation you will require the materials indicated. **You should record your answers in the space provided.**	**Materials needed:** • a brick with unequal sides • soft ground **METHOD** *(a) Place the brick with its largest face on the ground. Leave it for a minute or two. Remove it carefully. Note the mark X.*  *(b) Now place the brick with its smallest face on the ground. After a couple of minutes, remove it. Note the mark Y. How do the marks differ?*

I am sure you found out that mark Y is deeper than mark X. This is because the pressure in (b) is greater than that in (a).

✍ ***Before proceeding further, complete the following activity.***

ACTIVITY 22

A brick of mass 40 Kg has sides of 40cm x 20cm x 10cm. Calculate the different pressures it exerts when placed with the different faces flat on the floor. You will find the following steps useful.

(1) Mass = 40 Kg
Force of gravity (weight) …… N

(2) Area of largest face = …….. m^2
Pressure exerted when brick is with largest face on the floor.
……
……
……

(3) Area of medium face = ……. m^2
Pressure exerted in this case.

……
……
……

(4) Area of smallest face = ……m^2
Pressure exerted
……
……
……

What do you conclude?

……
……

You will find the answers at the end of the Module.

POINTS TO REMEMBER

- In this Module we have seen that Science deals with accurate observations, measurements and interpretation of results. This leads to generalisation.
- Measurements often refer to the following basic quantities:
  - Length
  - Mass
  - Volume
  - Time
  - Temperature
- Each quantity is expressed in a specific unit.
- You have also learnt about forces and their characteristics. The force of gravity and the force of friction are common examples of forces. All forces are measured in Newtons. The force acting on unit surface area (that is on one metre square) is called pressure.
- Pressure is measured and expressed in Pa (Pascal)

ANSWERS TO ACTIVITIES

Activity 1

Metre

Activity 2

A metre rule ✓

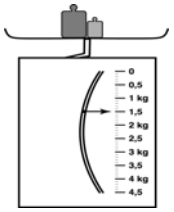
A half metre rule ✓

A measuring tape ✓

A simple ruler ✓

Activity 3

(a) Mass of a substance is the quantity of matter it contains.
(b) Kg
(c)

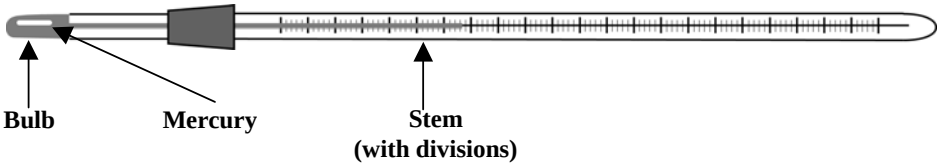


Activity 4

(a) 1 x 0.8 x 0.5 = 0.40 m^3.
(b) 10 x 8 x 4 = 320 m^3.

Activity 5

(a) A thermometer
(b)



Activity 6

(a) The Clinical thermometer.

(b) (i) It has a limited range (34^{o}C – 41^{o}C)
(ii) It has a narrow constriction near the bulb.
(iii) The stem is oval.

(c) A jerk is given to the thermometer so as to transfer all liquid into the bulb. This is placed in the patient's mouth (below the tongue) or below the armpit. It is left for a couple of minutes. It is removed and the reading is noted.

Activity 7

(a) glass
water
air
alcohol

(b) wood
copper
graphite
phosphorus

Activity 8

(a) wood
paper
aluminium
leather
zinc

(b) water
oil
glycerine
alcohol
ink

(c) oxygen
nitrogen
argon
carbon-dioxide
water vapour

Activity 9

1 m = 10 decimetre
1 dm = 10 cm
1 cm = 10 mm
1 Km = 1000 m

Activity 10

1 week = 7 days
1 day = 24 hours
1 hour = 60 minutes
1 minute = 60 seconds

Activity 11

(a) 1 Kg = 1000 g
(b) a mass of 1 Kg has a weight of 10 N.
(c) 5 Kg = 50 N
(d) 400 N = 40 Kg

Activity 12

(a) 320 N
(b) 500 metres
(c) 300 seconds

Activity 13

10 N = 1 Kg
380 N = 38 Kg
Mass = 38 Kg

Activity 14

(a) A force is either a push or a pull.
(b) The Newton.
(c) The force of attraction exerted on the object by the centre of the Earth.

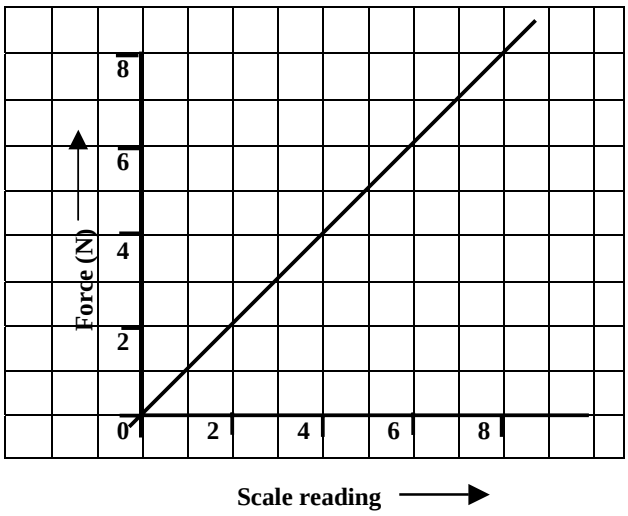
Activity 15

(i) It can produce motion. For instance a chair can be set moving by pushing it.
(ii) It can oppose motion e.g. force of friction.
(iii) It can cause elongation or compression e.g. a spring.

Activity 16

(a) With no force, reading = Zero
2 N

(b)



Activity 17

(a) To the left (in opposite direction to the push).

(b) (i) the surfaces in contact.
(ii) the area in contact.
(iii) the weight.

Activity 18

(a) A submarine
(b) An aeroplane
(c) Water (for submarine)
Air (for aeroplane)
(d) The medium, in each case, hinders movement.

Activity 19

1. TRUE
2. FALSE
3. TRUE
4. FALSE
5. TRUE
6. TRUE

Activity 20

(i) Pressure $= \frac{Force}{Area}$

The unit for Force is the Newton.
The unit for area is the square metre
The unit for pressure is Newton per square metre

(ii) Pa

(iii) Kilopascal (KPa)
1 KPa = 1000 Pa

Activity 21

(a) increases

(b) decreases

Activity 22

(i) 400 N

(ii) 0.4 x 0.2 $= 0.08\ m^2$

Pressure exerted $= \frac{400}{0.08}$

$= \frac{40000}{8}$

= 5000 Pa or 5 KPa

(iii) 0.4 x 0.1
$= 0.04\ m^2$

Pressure exerted $= \frac{400}{0.04}$

$= \frac{40000}{4}$

= 10000 Pa or 10 KPa

(iv) 0.2 x 0.1 $= 0.02\ m^2$

Pressure exerted $= \frac{400}{0.02}$

$= \frac{40000}{2}$

= 20000 Pa or 20 Kpa

Pressure is least when area is greatest.
Pressure is greatest when area is least.