LEARNER GUIDE

Unit Standard Title:	**Represent, analyse and calculate shape and motion in 2 and 3 dimensional space in different contexts**
Unit Standard No:	**9016**
Unit Standard Credits:	**4**
NQF Level:	**4**

This outcomes-based learning material was developed by Masifunde Training Centre with funding from INSETA in July 2014. The material is generic in nature and is intended to serve as a minimum standard for the industry.

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Module 1

Measure, estimate and calculate physical quantities

Learning Outcomes
By the end of this module you should be able to plan and control the following :

- Basic instruments to include those readily available such as rulers, measuring tapes, measuring cylinders or jugs, thermometers, spring or kitchen balances, watches and clocks.
- In situations which necessitate it such as in the workplace, the use of more accurate instruments such as vernier callipers, micrometer screws, stop watches and chemical balances.
- Quantities to estimate or measure to include length/distance, area, mass, time, speed acceleration and temperature.
- Distinctions between mass and weight, speed and acceleration.
- The quantities should range from the low or small to the high or large.
- Mass, volume temperature, distance, and speed values are used in practical situations relevant to the young adult or the workplace.
- Calculate heights and distances using Pythagoras` theorem.
- Calculate surface areas and volumes of right prisms (i.e., end faces are polygons and the remaining faces are rectangles) cylinders, cones and spheres from measurements in practical situations relevant to the adult or in the workplace

Assessment Criteria
The following assessment criteria will be used to determine your competency for this specific outcome:

- Scales on the measuring instruments are read correctly
- Quantities are estimated to a tolerance justified in the context of the need
- The appropriate instrument is chosen to measure a particular quantity
- Quantities are measured correctly to within the least step of the instrument
- Appropriate formulae are selected and used
- Calculations are carried out correctly and the least steps of instruments used are taken into account when reporting final values
- Symbols and units are used in accordance with SI conventions and as appropriate to the situation

1.1 Accurate Measurements

Accurate measurement is important and we cannot get accurate measurements by using our eyes only!
In the past some measurements were based on human features and common objects. For example, the yard, a measurement of length first used in England in the fifteenth century, was defined as the distance between the king's nose and the tip of his middle finger when his arm was extended. Thus the length of one yard was different from time to time depending on whom the king was. The length of a person's foot was also used to measure some distances.

Scientists need a standard system of measurement. In 1960 a modern system of units was adopted by international agreement. It is known as the International System of Units, or SI system of units.
In science there are a number of BASE SI units. The base SI units which we will be using are shown in the following table

QUANTITY	NAME OF UNIT	SYMBOL
LENGTH	Metre	m
MASS	Kilogram	kg
TIME	Second	s
TEMPERATURE	Kelvin	ºK

Apart from the base units, the system consists of a whole series of other units which are derived from the base units. We call these units DERIVED SI Units.

QUANTITY	NAME OF UNIT	SYMBOL
AREA	Square Metre	m^2
VOLUME	Cubic Metre	m^3
SPEED	Metre per second	m/s
FORCE	Newton	N

1.2 Measurement of Length

There are many instruments for measuring length. Some measure small distances while others measure long distances. Some instruments measure very accurately while others are not so accurate. When measuring length it is important to choose an **appropriate measuring instrument**.

To measure small lengths such as the size of a page in your file, you could use a **ruler**. You would need a tape measure to measure the floor size of a room to tile or carpet it. You also need to decide on the desired **level of accuracy** needed for the measurement. For example, should it be measured to the nearest cm or do you need it to the nearest millimetre.

The SI unit for length is the metre. Metres can be subdivided in to centimetres and millimetres. **1 m = 100 cm = 1000 mm**
1 cm = 10 mm
1 km = 1000 m

It is very useful to be able to convert from one unit to the other.
The following metric scale can be memorised for quick conversions

km	hm	dam	m	dm	cm	mm

Each unit is **10 x larger** than the unit on its right.
For example, if we wish to convert 3,5 kms to cms
3,5 X 100000 = 350 000

i.e. 3,5 kms = 350 000 cms
If we need to convert 670 centimetres to metres
670 ÷100 = 6,7
i.e. 670 cms = 6,7m

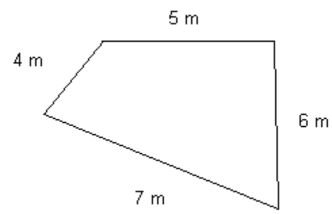
Exercise 1

Complete Exercise 1 in your Learner Work File

1.3 Perimeter

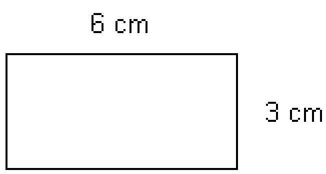
If you wished to fence in your property, you would need to measure the length of the boundaries of your property. This is the **perimeter – the total distance around a closed shape.**

Example 1



The perimeter of this shape is 5m + 6m + 7m + 4m = 22m

Example 2

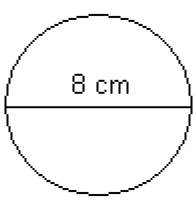


The perimeter of the rectangle is 6cm + 3cm + 6cm + 3cm
= 18cm

Note: **Perimeter of rectangle = 2 L + 2 B** (where L = length , B = breadth)

Example 3

The perimeter of a circle is called its circumference.
Circumference of a circle = πd where d = diameter of circle



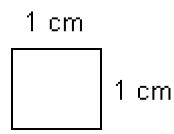
So, for this circle
Circumference = πd
= 3,14 x 8cm
= 25,12cm

1.4 Area

If you wished to carpet a room in your house, you would need to measure the floor area that the carpet will cover. **Area is the amount of surface that a shape covers.**

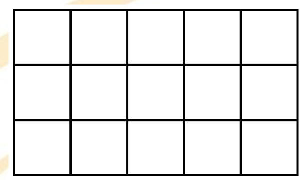
Units for measuring area

We can use squares of various sizes for measuring area. We can use a square with sides measuring 1 cm. This is called one square centimetre (1 cm^2). To find the area of a given shape we therefore find how many cm^2 will cover the shape completely.



Example

Look at the rectangle alongside:
We have 3 X 5 square centimetres which is equal to 15 cm^2
We can therefore calculate the area of the rectangle by multiplying the length (L) by the breadth (B) i.e. L X B = 5 cm X 3 cm



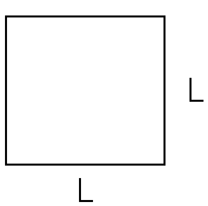
= 15 cm^2

Area of a rectangle = L X B

1.5 Area formulae of 2-dimensional shapes

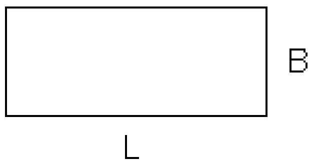
You should already have come across formulae for the areas of various 2 dimensional shapes. Let's look at some of them again:

Square



Area = L X L where L = length of side
= L^2

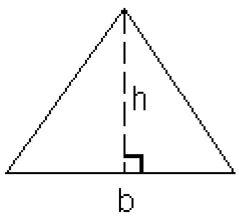
Rectangle



Area = L X B

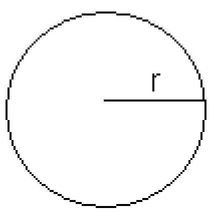
where L = length
B = breadth

Triangle



Area = ½ base X perpendicular height
= ½ bh

Circle



Area = πr^2

where r is the radius of the circle

Activity 2

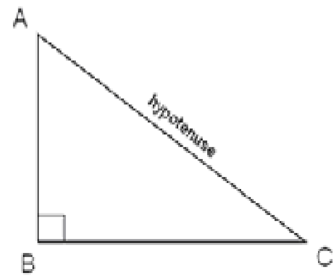
Complete Activity 2 in your Learner Work File.

Exercise 3

Complete Exercise 3 in your Learner Work File

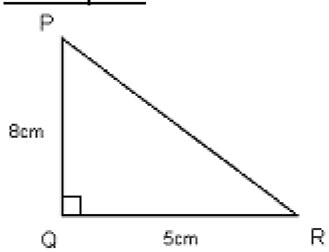
1.6 Theorem of Pythagoras

In a right-angled triangle ABC, the side opposite the right angle, AC, is called the hypotenuse. Pythagoras was a Greek mathematician, who discovered that in a right angled triangle, the square of the hypotenuse will always equal the sum of the squares of the other two sides. i.e. $AC^2 = AB^2 + BC^2$.



This theorem is probably the most well known of all mathematical theorems over the centuries.

Example :



Find the length of side PR of ΔPQR, if PQ = 8cm and QR = 5cm. Give your answer correct to 1 decimal place.

$PR^2 = PQ^2 + QR^2$
$= (8cm)^2 + (5cm)^2$
$= 64cm^2 + 25cm^2$
$= 89cm^2$
PR = 9,4cm

Exercise 4

Complete Exercise 4 in your Learner Work File

1.7 3- Dimensional Shapes

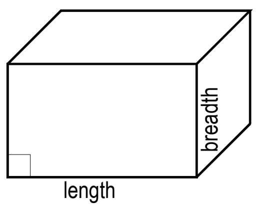
We have calculated measurements of figures which are 2 dimensional. What happens now if we add a third dimension, depth, to these shapes?

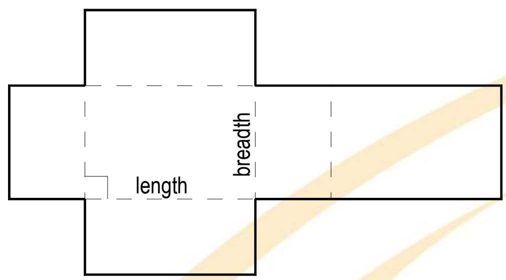
1.8 Nets of 3 dimensional shapes

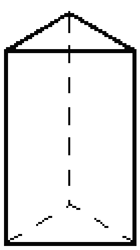
All three dimensional shapes have nets. A net is a flat (2 dimensional) shape that can be folded to form a 3 dimensional shape. You might think of it as a pattern or a plan to make a 3D shape

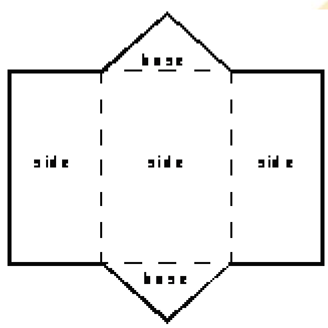
The net of a rectangular prism can vary, but it will always consist of 2 bases (the top and the bottom) and 4 sides. That is, it will always have 6 faces

Similarly, the net of a triangular prism will always consist of 2 bases and 3 sides, as shown below. That is, it will always have 5 faces



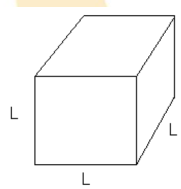






1.9 Surface Area and Volume

Let's look at a cube:



The cube has 6 faces (each 2 dimensional surface is called a face). The area of each face is L^2. The **surface area** of the cube is the total of the <u>areas of all the faces</u> of the cube. I.e. the surfaces that can be seen if we turn the cube around i.e. Surface area of a cube = 6 L^2.

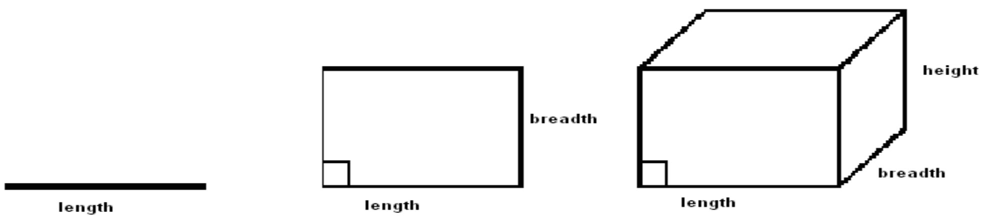
The **volume** of a 3 dimensional shape is the space that it takes up i.e. its capacity. The volume of any regular 3 dimensional figure can be calculated as

Volume = area of base X height

Therefore, volume of cube = L X L X L
= L^3

Note:

- To measure length, we count units of length e.g. mm, cm or km.
- To measure area, we count units of area e.g. cm^2 (square centimetres)
- For volume measurement, we count units of volume e.g. cm^3 (cubic centimetres



Activity 5

Complete Activity 5 in your Learner Work File

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1.10 Capacity

CAPACITY is a measure of the amount of substance that a container can hold

Fizzy cold drinks and milk are supplied in one-litre bottles. Petrol is sold by the litre. An average petrol tank holds between 50 and 60 litres of petrol. When calculating the amount of water in a swimming pool we use kilolitres. Medicine measures are either 5 millilitres or 10 millilitres.

Remember

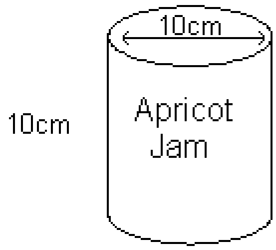
1 litre = 1 000 millilitres
1 kilolitre = 1 000 litres

Note:

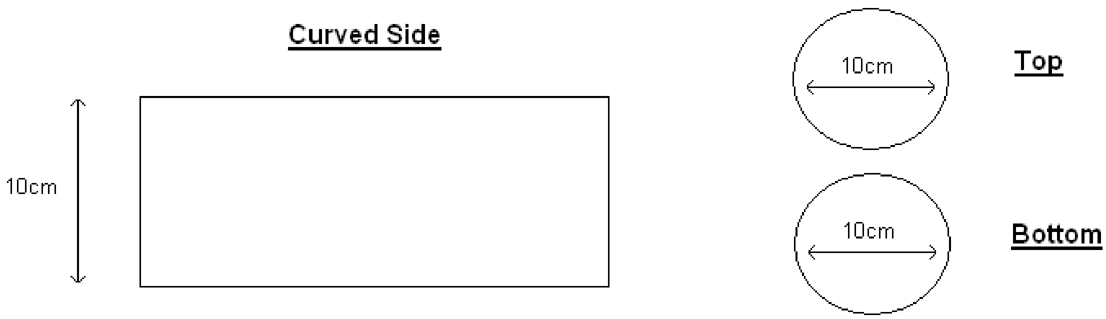
- A container of volume **1 m^3** will hold exactly **1 kilolitre**
- A container of volume **1 cm^3** will hold exactly **1 millilitre**

1.11 The net of a cylinder

Let's investigate what the net of a cylinder will look like.



If we cut this cylindrical metal can into three parts, we would have the top, the bottom and the side.



The top and bottom would be circles, but the side of the can, when opened up, would be a rectangle.

The length of the rectangle will be the circumference of the top (or bottom) circle. The breadth of the rectangle will be the height of the can.
This makes it very easy to calculate the surface area of a cylinder.

Area of top $= \pi r^2$
$= 3{,}14 \times (5cm)^2$
$= 78{,}5cm^2$

Therefore: Area of bottom $= 78{,}5cm^2$

Area of side = L x B
To find the length we need to calculate the circumference of the circle.

Circumference $= \pi$ d
$= 3{,}14 \times 10cm$
$= 31{,}4$ cm

Therefore: Area of side = L x B
$= 31{,}4cm \times 10cm$
$= 314cm^2$

Therefore: Surface area of can $= 78{,}5cm^2 + 78{,}5cm^2 + 314cm^2$
$= 471cm^2$

This is the amount of sheet metal that would be needed to manufacture the jam tin.

1.12 The volume of a cylinder

Remember that the formula for volume is
Volume = area of base X height
A cylinder has a circle for a base, so the base area is πr^2 and therefore
Volume = □ r^2h
For the above example: Volume = $3,14 \times (5cm)^2 \times 10$ cm
= $78,5cm^2 \times 10cm$
= $785cm^3$

Activity 6

Complete Activity 6 in your Learner Work File

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Let's have some further practice with describing and representing 3 dimensional shapes and calculating their volume and surface area.

Exercise 7

Complete Exercise 7 in your Learner Work File

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Assessment 1

Complete Assessment 1 in your Learner Work File

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We have investigated the volume of a cube, a rectangular block, a triangular block and a cylinder. These are all **right prisms** – the shape of the base is the same throughout the height. Therefore for all of them, the formula for their volume is

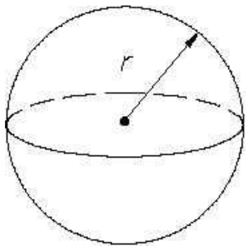
Volume = area of base x height

Will this formula work for a sphere (a ball) or a cone?
No, because the base shape (a circle) changes across the height.

Is a pyramid a right prism? ________
Can we use the formula: Volume = area of base X height to calculate the volume of a pyramid? __________

Let's now investigate how to calculate the volume and surface area of spheres and cones.

1.13 Volume and Surface Area of a Sphere



The volume of a sphere is calculated using the formula: $V = \frac{4}{3}\pi r^3$
The surface area of a sphere is calculated using the following formula: $SA = 4\pi r^2$
The surface area of a sphere is expressed in square units, and the volume of a sphere is expressed in cubic units.

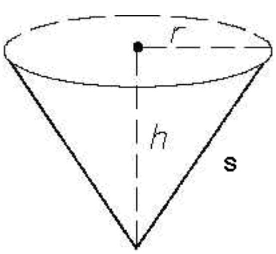
Example: Calculate the volume and surface area of a sphere with r = 5cm.

Solution: **Volume** $= \frac{4}{3}\pi r^3$ **Surface area** $= 4\pi r^2$

$= \frac{4}{3}$ (3,14)(5cm)(5cm)(5cm) = 4(3,14)(5cm)(5cm)

= 523,3 cm^3 = 314 cm^2

1.14 Volume and Surface Area of a Cone



In a right circular cone, the axis (h in the diagram) is perpendicular to the base.
The **volume of a right circular cone** is calculated using the following formula:

$$V = \frac{1}{3}\pi r^2 h$$

Example: Calculate the volume of a cone with a radius of 3,5cm and a perpendicular height of 8cm

Solution: $V = \frac{1}{3}\pi r^2 h$

$= \frac{1}{3}$ (3,14) (3,5cm)(3,5cm)(8cm)

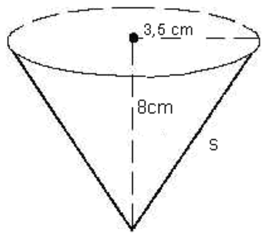
= 102,6 cm^3

The **surface area of a right circular cone** is calculated using the following formula:

$SA = \pi r^2 + \pi rs$ where s is the slant height.

We need to first calculate the slant height, s by using Pythagoras theorem
$s^2 = h^2 + r^2$

Example: Calculate the surface area of a cone with a radius of 3,5cm and a perpendicular height of 8cm



$S^2 = (8cm)^2 + (3,5cm)^2$
$= 64cm^2 + 12,25cm^2$
$= 76,25cm^2$
$S = 8,73cm$

Surface area = $\pi r^2 + \pi rs$
= 3,14 (3,5cm)(3,5cm) + 3,14(3,5cm)(8,73cm)
= $134,4cm^2$

Activity 8

Complete Activity 8 in your Learner Work File

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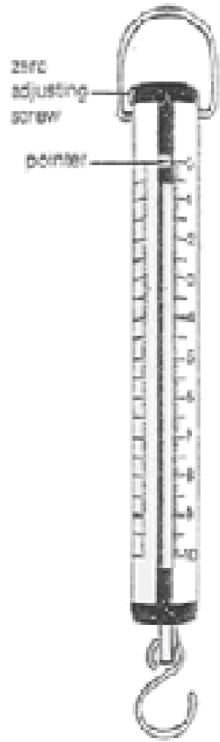
1.15 Mass and Weight

1. Weight

You know that if you drop an object it will always fall down to the ground. The earth will attract the object. When a ball is thrown horizontally it does not continue at the same height above the earth but curves back down towards the earth. The ball changes direction because the earth exerts an attractive force on the ball. In the same way if you throw a ball up into the air it will slow down and come back to earth again.

These examples show us that there is a force which pulls all objects downwards. This downward pulling force is called the force of gravity of the earth. The greater the mass of an object, the greater the force with which the earth attracts it.

The unit in which we measure weight is the NEWTON (N). The unit is named after one of the greatest scientists of all time, Sir Isaac Newton. To measure the weight of an object we use a FORCE METER or SPRING BALANCE which is calibrated (marked) according to Newtons. An example of a force meter is shown in the diagram on the right.



2. Mass

We measure the mass of something when we want to know how heavy it is. The mass of an object is measured in grams (g) or kilograms (kg) using a mass meter or scale.

Activity 9

Complete Activity 9 in your Learner Work File

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3. The Difference between Weight and Mass

The mass of an object never changes. If your mass is 70 kg on the earth, then your mass will be 70 kg on the moon or anywhere else in the universe. The weight of an object changes as the force of gravity on it changes. Your weight on earth is a lot more than your weight on the moon because the gravitational force exerted by the moon is smaller than that exerted by the earth. That is why you would float around on the moon! So your weight can change depending on where you are in the universe. If you were somewhere in outer space, your weight would be zero, because no planet is exerting a force on you. (But you would still have a mass of 70 kg).

4. The Relationship between Mass and Weight

A mass of 100 g has a weight of 1 Newton on earth (or 1kg = 10 Newtons)
So for example, something with a mass of 290g has a weight of 2,9 Newtons.
If your mass is 70kg, your weight will be 700Newtons.

1.16Temperature

We know that a hot object has a high temperature and a cold object has a low temperature. To accurately measure temperature we would need a thermometer. The temperature scale with which you are familiar is the Celsius scale. On this scale, the freezing point is 0ºC and the boiling point of water is 100ºC. (That's why in winter the water in your pipes freezes when the temperature drops to -2ºC for example)

Activity 10

Complete Activity 10 in your Learner Work File

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1.17 Speed

Speed is the rate at which an object moves. It is a measure of the change in distance of an object with respect to time.

Simply put, speed = $\frac{\text{how far an object has travelled}}{\text{how long it takes to get there}}$

i.e. Speed = $\frac{\text{distance}}{\text{time}}$

Example

If a man runs 5 kms in 30 minutes, at what speed is he running?

Speed = distance ÷ time
= 5 ÷ ½ (Remember: 30 minutes = ½ hour)
= 10 km/hour

Speed is measured in km/hr (kilometres per hour) or m/s (metres per second).

1.18 Acceleration

Acceleration is a measure of the change in speed of an object with respect to time. ie. it is the rate at which the speed of an object is changing.

$$\text{Acceleration} = \frac{\text{change in speed}}{\text{Change in time}}$$

Acceleration is measured in km/hr^2 or m/s^2

Example

A stationary car pulls off and reaches a speed of 80 km/hr in $1\frac{1}{2}$ minutes. What is its acceleration?

Change in speed = 80km/hr – 0 km/hr = 80km/hr

Change in time = $1\frac{1}{2}$ minute = $1\frac{1}{2}$ /60 = 0, 025 hrs

$$\text{Acceleration} = \frac{80\ km/hr}{0{,}025\ hr}$$

$$= 3200 km/hr^2$$

1.19 Time

The basic unit of time is the second. As you know there are 60 seconds in a minute and 60 minutes in an hour. We use clocks or watches to measure time. The majority of clocks are analogue. When you tell the time from an analogue clock, you cannot tell whether it is 5.00 in the morning or afternoon. Many watches today are digital. Digital watches have the advantage of removing the uncertainty of whether it is morning or afternoon.

Activity 11

Complete Activity 11 in your Learner Work File

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Module 2

Shape and position of objects in space

Learning Outcomes
By the end of this module you should be able to:

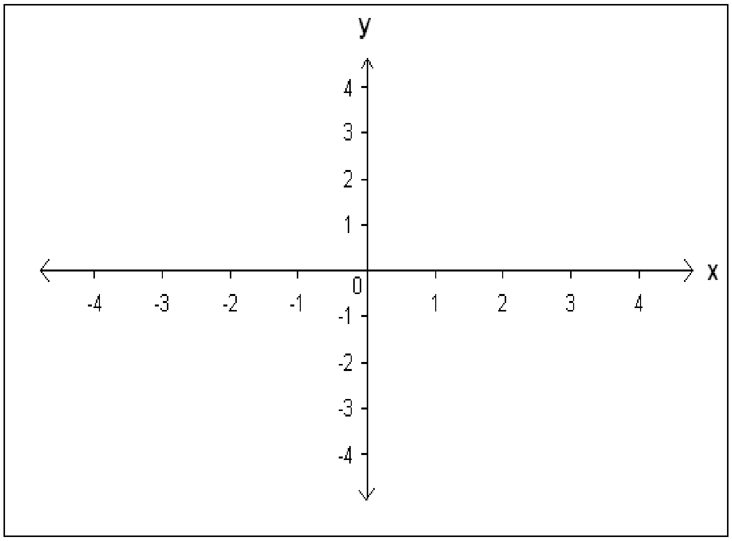
- Apply different contexts such as packaging, arts, building construction, dressmaking.
- Operate simple linkages and mechanisms such as car jacks.
- Represent objects in top, front and side views
- Use rough sketches to interpret, represent and describe situations.
- Use available technology (e.g., isometric paper, drawing instruments, software) to represent objects
- Use and interpret scale drawings of plans (e.g., plans of houses or factories; technical diagrams of simple mechanical household or work related devices,
- Read road maps relevant to the country.
- Read World maps.
- Read International time zones.
- Use of the Cartesian co-ordinate system in determining location and describing relationships in at least two dimensions.

Assessment Criteria
The following assessment criteria will be used to determine your competency for this specific outcome:

- Descriptions are based on a systematic analysis of the shapes and reflect the properties of the shapes accurately, clearly and completely
- Descriptions include quantitative information appropriate to the situation and need
- 3-dimensional objects are represented by top, front and side views
- Different views are correctly assimilated to describe 3-dimensional objects
- Available and appropriate technology is used in producing and analysing representations
- Relations of distance and positions between objects are analysed from different views
- Conjectures as appropriate to the situation, are based on well-planned investigations of geometrical properties
- Representations of the problems are consistent with and appropriate to the problem context. The problems are represented comprehensively and in mathematical terms
- Results are achieved through efficient and correct analysis and manipulation of representations
- Problem-solving methods are presented clearly, logically and in mathematical terms
- Reflections on the chosen problem solving strategy reveal strengths and weaknesses of the strategy
- Alternative strategies to obtain the solution are identified and compared in terms of appropriateness and effectiveness

2.1 The Cartesian Plane

In mathematics, we use a system which pinpoints, with great accuracy, the position of an object in space. This system is called a **Cartesian Plane**.

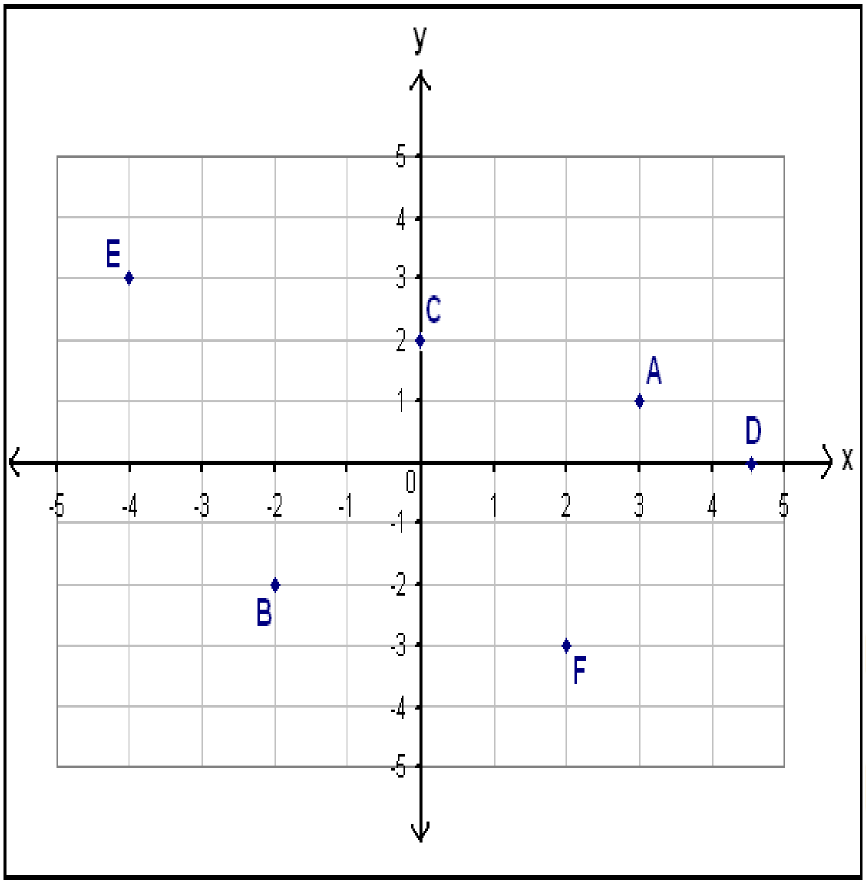


The Cartesian plane was developed by a French mathematician called Rene Descartes. It consists of two number lines at right angles to one another.

Note:

- The number lines are called axes.
- The horizontal axis is always the x-axis and the vertical axis, the y-axis.
- The arrows show that the axes continue in both directions indefinitely.
- The point of intersection of the axes is called the origin and has co-ordinates (0;0).
- All co-ordinates are written in the form (x;y) i.e. the x co-ordinate is written first. They are called ordered pairs for this reason.

Example:



The co-ordinates of the points A to F are as follows:

A (3;1) ; B (-2;-2); C (0;2) ; D (4½;0) ; E (-4;3) ; F (2;-3)

Activity 12

Complete Activity 12 in your Learner Work File

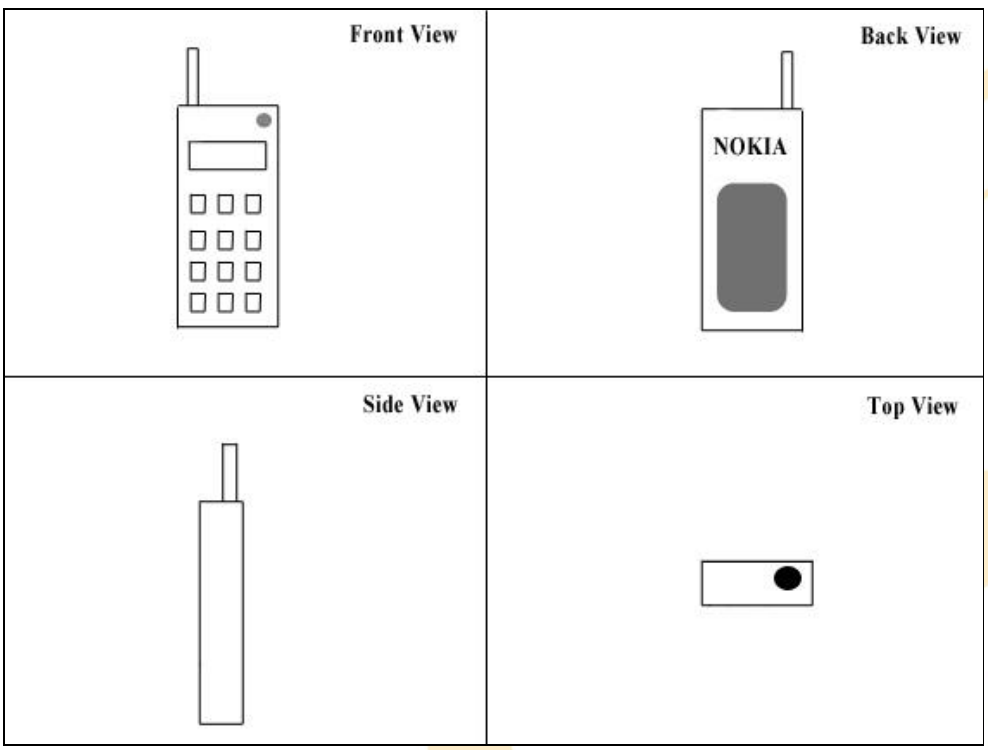
Assessment 2

Complete Assessment 2 in your Learner Work File

2.2 2-Dimensional Drawings from 3-Dimensional Objects

When an architect designs a house, he uses plans to show his ideas to the owners and contractors. Because these plans are drawn on paper, they are in 2 dimensions only and he therefore has to draw the building from different perspectives (i.e. looking at it from the front, from the back, and from the two sides) to give a correct representation of the building. The same is true of any technical drawings which represent mechanical devices. We are going to examine 3 dimensional objects and represent them in 2 dimensions.

Let's consider a cell phone. It is a 3 dimensional object because it has length, breadth and depth. We can represent it in 2 dimensions by observing it from different observational points and drawing the cell phone from each perspective.



Note:

- Each perspective is drawn by viewing the object at eye level, so that you see only one "face" at a time.
- The scale of each perspective remains the same. I.e. the length of the cell phone stays the same whether viewed from the top, bottom or side.

Activity 13

Complete Activity 13 in your Learner Work File

LEARNER
WORK FILE

2.3 Scale Drawing

When an architect or draughtsman draws a plan of a house (or a room in a house), he has to draw it to scale. This means that he must reduce the dimensions, but keep them in exactly the same proportion (they must be drawn an exact number of times smaller than their real size). Obviously, his drawings must be absolutely accurate as the builder will use these plans to construct the house.

To understand scale drawings is a very useful skill that applies to many aspects of life. Apart from building plans, many mechanical devices are represented by scale drawings. All maps are drawn to scale so it is very useful when traveling to be able to read a map and determine distances between towns.

1. Scale

A scale is **the ratio** of the length of something on a plan to its actual length on the ground.
A scale of 1:100 means that one unit of length on the drawing represents 100 units of the same length in reality (1 cm on the plan represents 100 cm in reality).
So if something is 4 cm long on the plan, it is really 4 x 100 cm long in reality
i.e. 400 cm
ie. 4 m long.
A scale of 1:200 000 on a map means that 1 cm on the map represents 200 000 cm on the ground (1 cm = 2 km).

Example: An architect is drawing a scale drawing of a garage measuring 9m x 7m. The scale on his plan is 1:200. What are the dimensions of the garage on plan?
The architect must **reduce** the dimensions by **dividing them by 200**. Let's first convert from metres to centimeters.

So 9m = 900cm	7m = 700cm
900cm ÷ 200 = 4,5cm	700cm ÷ 200 = 3,5cm

The architect will draw the garage with dimensions 4,5cm X 3,5cm.
When the builder looks at the plan, he will **multiply by 200** to **enlarge** the dimensions to their real life size.

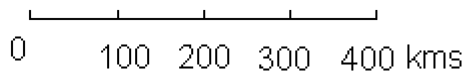
Activity 14

Complete Activity 14 in your Learner Work File

LEARNER
WORK FILE

2.4 Road Maps

Being able to read and interpret a map is an extremely useful skill. All maps are drawn in plan view (they show an area as if it is being seen from above). Maps are always drawn to accurate scale and the scale used is shown on the map to enable you to calculate distances between places. The scale is either represented as a ratio 1:100 (as in scale drawings) or as a line scale like this.



Use the map of KwaZulu-Natal below (p.23) to do Activity 15

Activity 15

Complete Activity 15 in your Learner Work File


KWAZULU-NATAL PROVINCE
CLICKABLE TOWNS
SWAZILAND
MPUMALANGA
FREE STATE
LESOTHO
EASTERN CAPE
INDIAN OCEAN
KWAZULU-NATAL
ZULULAND
BATTLEFIELDS
MIDLANDS
DRAKENSBERG
EAST GRIQUALAND
ELEPHANT COAST
VALLEY OF 1000 HILLS
NDUMO
TEMBE
KOSI BAY
KWANGWANASE
ITALA
PAULPIETERSBURG
MKUZE
SODWANA
SODWANA BAY
PHINDA
HLUHLUWE
HLUHLUWE-UMFOLOZI PARK
GREATER ST.LUCIA WETLAND PARK (WHS)
ST. LUCIA
MTUBATUBA
DUNDEE
ISANDLWANA
RORKES DRIFT
LADYSMITH
COLENSO
ROYAL NATAL
WINTERTON
EMPANGENI
RICHARD'S BAY
ESTCOURT
GREYTOWN
MOOI RIVER
NOTTINGHAM ROAD
CURRY'S POST
MELVILLE
BALGOWAN
HOWICK
SALT ROCK
BALLITO
ZIMBALI
UMHLANGA
DURBAN
DRAKENSBERG PARK
PIETERMARITZBURG
UNDERBERG
DURBAN INTERNATIONAL
AMANZIMTOTI
IXOPO
EASTERN CAPE
MTWALUME
SHELLY BEACH
UVONGO
MARGATE
RAMSGATE
SOUTHBROOM
SAN LAMEER
MUNSTER
PORT EDWARD
N2
N3
N11
SAFARINOW.COM
0 20 40 60
KM

2.5 World Maps

With the help of your facilitator, familiarise yourself with the world map on page 25. Locate the continents and as many countries as you can.

2.6 International Time Zones

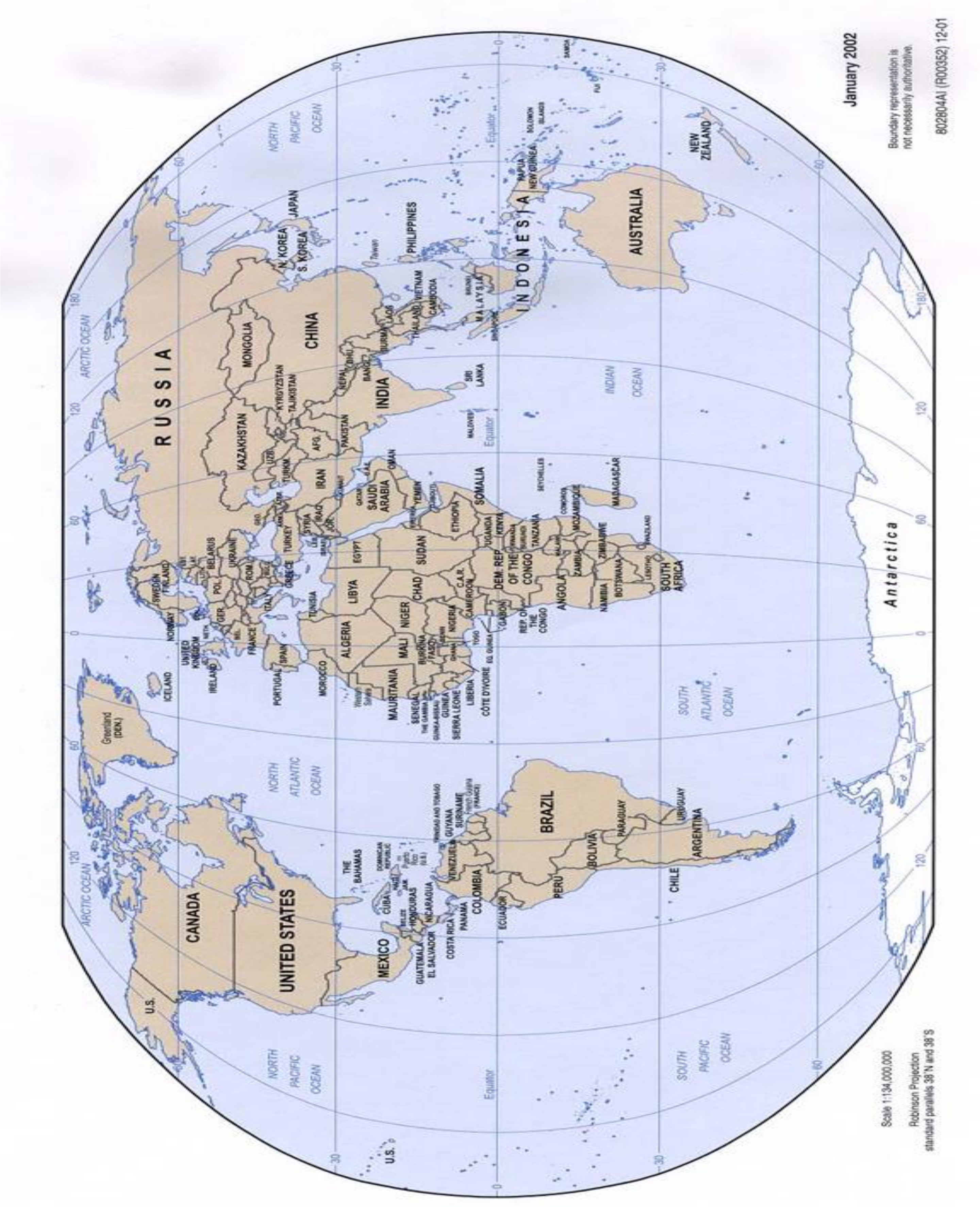
Use the World Map of Time Zones on page 26 to help you to understand international time zones.
The United Kingdom and part of the west coast of Africa lie on the line of longitude called the Greenwich Meridian which is at 0º longitude. (There is a town in England called Greenwich which lies exactly on the 0º line of longitude and which gives this line its name). The Greenwich Meridian is represented on the map as Z. All times in the world are calculated using the time at Greenwich Meridian as a starting point and adding or subtracting hours depending on which time zone they fall into.
So for instance, if it is 13.00 at Z, it is 21.00 at H (13 + 8 hrs) and 8.00 at S (13 – 5hrs)
Some large countries such as the United States of America, fall into more than one time zone, and so operate on different times. Other large countries such as China, also cross multiple time zones, and yet operate on one time for the whole country.

Use the World Map of Time Zones to do the following exercise

Activity 16

Complete Activity 16 in your Learner Work File

LEARNER WORK FILE


January 2002
Boundary representation is not necessarily authoritative.
802804AI (R00352) 12-01
Scale 1:134,000,000
Robinson Projection
standard parallels 38°N and 38°S
RUSSIA
CANADA
UNITED STATES
MEXICO
BRAZIL
CHINA
INDIA
AUSTRALIA
INDONESIA
Antarctica
NORTH PACIFIC OCEAN
NORTH ATLANTIC OCEAN
SOUTH ATLANTIC OCEAN
SOUTH PACIFIC OCEAN
INDIAN OCEAN
ARCTIC OCEAN
Equator
SOUTH AFRICA
ARGENTINA
CHILE
PERU
BOLIVIA
COLOMBIA
KAZAKHSTAN
MONGOLIA
JAPAN
PHILIPPINES
NEW ZEALAND
SAUDI ARABIA
IRAN
EGYPT
LIBYA
ALGERIA
SUDAN
CHAD
NIGER
MALI
MAURITANIA
ETHIOPIA
SOMALIA
KENYA
TANZANIA
ANGOLA
DEM. REP. OF THE CONGO
MADAGASCAR
NAMIBIA
BOTSWANA
ZAMBIA
MOZAMBIQUE
NIGERIA
TURKEY
UKRAINE
GREECE
FRANCE
SPAIN
PORTUGAL
ICELAND
NORWAY
SWEDEN
FINLAND
IRELAND
UNITED KINGDOM
Greenland (DEN.)
U.S.
CUBA
THE BAHAMAS
VENEZUELA
GUYANA
SURINAME
ECUADOR
PARAGUAY
URUGUAY
PAKISTAN
AFG.
MALAYSIA
THAILAND
VIETNAM
CAMBODIA
N. KOREA
S. KOREA
PAPUA NEW GUINEA
SRI LANKA
MOROCCO

WORLD MAP OF TIME ZONES