THE REPUBLIC OF UGANDA
Ministry of Education and Sports

SENIOR TWO
SELF STUDY MATERIALS
SCIENCE PACKAGE

NCDC
NATIONAL CURRICULUM DEVELOPMENT CENTRE

CHEMISTRY

Topic: Structure of the Atom

Learning outcomes

By the end of these lessons, you should be able to:

- **a)** define an atom
- **b)** state the components of an atom
- **c)** draw a structure of an atom
- **d)** define isotopes

Lesson 1: Structure and Components of an Atom

Introduction

An atom is the smallest electrically neutral indivisible particle of an element that takes part in chemical reactions.
An atom consists of an extremely dense region called a ***Nucleus*** which is surrounded by circular paths called ***Energy levels***. The nucleus contains two sub-atomic particles called,

a) **Protons** which are positively charged.

b) **Neutrons** which have no charge.

Energy levels hold the electrons which are negatively charged.

Activity 1

Using the information in the introduction, draw the general structure of an atom.

Activity 2

Study the given table and complete it correctly

Particle	Symbol	Charge	Mass	Position in atom
Proton				
Electron				
Neutron				

Question:

Why are atoms electrically charged yet both protons and electrons are electrically charged?

Lesson 2: Atomic number and Mass number

Introduction

Each element has an atomic number and a mass number. These numbers can be used to calculate the number of each of the sub-atomic particles in the atom of every element.

Atomic number refers to the number of protons in the nucleus of an atom. **Mass number** or **atomic mass** refers to the sum of the protons and neutrons in the nucleus of an atom, i.e *mass number=number of protons+ number of neutrons*

Example

Consider an atom of sodium element $^{23}_{11}Na$

The symbol of sodium atom is Na

The atomic number of sodium atom is 11

The mass number of sodium atom is 23

Sodium atom has 12 neutrons i.e 23-11=12

Activity 1: The given table shows mass numbers and atomic numbers of atoms P, Q and R, where the letters used are not the actual symbols of the elements. Answer the questions that follow.

Atom	Mass number	Atomic number
P	4	2
Q	9	4
R	11	5

a) How many protons are there in P?
b) How many electrons are there in Q?
c) How many neutrons are there in R?

Activity 2:
Atom T contains 11protons and 13neutrons

a) State the i) atomic number of T
ii) number of electrons in T
b) Determine the atomic mass of T

Lesson 3: Electronic *configuration*

Introduction

Electronic configuration is the arrangement of electrons in the energy levels around the nucleus.

The first energy level takes a maximum of two (2) electrons.

The second energy level takes a maximum of eight (8) electrons.

The third energy level takes a maximum of eight (8) electrons.

Example:

The atomic number of Potassium is 19 and the mass number is 39. Potassium has 19 electrons, 19 protons and 20 neutrons. In the electronic configuration of Potassium atom, two electrons go into the first energy level which is then complete; eight electrons go into the second energy level which is then complete; the other eight then occupy the third energy level and the remaining electron goes to the fourth energy level.

The electronic configuration of Potassium atom is 2:8:8:1

Activity 3:

The table given shows the first twenty elements of the Periodic Table arranged in order of their atomic numbers. Study it well and complete it correctly.

Element	Symbol	Atomic number	Electronic configuration
Hydrogen			
Helium			
Lithium			
Beryllium			
Boron			
Carbon			
Nitrogen			
Oxygen			
Fluorine			
Neon			
Sodium			
Magnesium			
Aluminum			
Silicon			
Phosphorus			
Sulphur			
Chlorine			
Argon			
Potassium			
Calcium			

Activity 4:
Draw the electronic structures for each of the first twenty elements of the Periodic Table.

ACTIVITY: ***Making models of atoms***

- Materials needed:
- small size seeds,
- beads,
- small stones,
- glue
- large sheet of Paper e.g a newspaper

Procedure:

Step1:
pick and arrange seeds, beads and stones for the model, where seeds represent electrons; beads represent protons; and stones represent neutrons.

Step 2:

Draw the outline of the structure of Carbon atom on the large sheet of Paper or the newspaper.

Step 3:

Place the seeds, beads and stones in their right positions on the outline of the Carbon atom structure drawn in step 2.

Step *4*:

Display the completed model of the Carbon atom structure. Follow the above procedure and make models for these atoms, Lithium, Oxygen, Neon, Sulphur and Calcium.

LESSON 4: ISOTOPES

Introduction

Isotopes are atoms of the same element having the same number of protons but different numbers of neutrons.

An atom of any element is represented by, ^{A}X where A is the mass number of element X and Z is the atomic number of element X.

Examples of elements that show isotopy are; Chlorine, Hydrogen, Carbon, Potassium and Oxygen.

The Isotopes of Carbon are;

-carbon 12, ^{12}C

-carbon 13, ^{13}C

-carbon 14, ^{14}C

NOTE:
For all the isotopes of any element, Z is constant and A varies because there are different numbers of neutrons in the different isotopes of the element.

Activity 4

a) Define the term Isotopy
b) mention any six (6) uses of isotopes.

Topic: Periodic table

Learning outcomes

By the end of these activities you should be able to:

1. identify groups and periods in the periodic table
2. describe the arrangement of elements in the periodic table

Introduction:

Visit a place where you keep utensils, how is your storage stand organized? Are plates mixed with cups and saucepans?

In a good store, materials are classified and kept according to use, shape, materials or size.

Activity 1.1: Making a kitchen-ware storage order sheet
Materials needed:

- A paper and pen
- Picture of items found in the kitchen

Procedure:

1. The picture below shows how kitchen items were arranged in store shelf, study the pattern in which they are organised.
2. On a sheet of paper, draw a table with boxes similar to those in the picture

3. Identify and write the name of each item in a matching box on paper.

Observations and conclusion:

- Which name can you give to items in each row and column?
- Why is it important to organize items at home?
  Just like you have discovered that the items above were logically organized in patterns and that this is important in your daily life.
  In the world, there are 118 chemical elements. For these elements to be easily studied, they were logically arranged into vertical sections (columns) called **groups** and horizontal sections (rows) called **periods.**
  Elements in periods and groups form the **periodic table** of chemical elements as shown below.

Activity 1.2: Analysing the arrangement of elements in the periodic table
Materials needed:

- The periodic table
- Pen and paper

Procedure:

1. Count and write the number of periods and groups in the periodic table.
2. Study group I and II, how is the atomic number of the elements used determine their arrangement in the groups?
3. Draw the electronic structure of lithium, sodium and potassium. How does their atomic size vary down the group?
4. Write the electronic configuration of sodium, magnesium, aluminium and chlorine. How does atomic number and atomic size vary across the period?

Periodic table of the elements

Alkali metals
Alkaline-earth metals
Transition metals
Other metals
Other nonmetals
Halogens
Noble gases
Rare-earth elements (21, 39, 57–71) and lanthanoid elements (57–71 only)
Actinoid elements

period	I	II	III	IV	V	VI	VII	O
1	1 H							2 He
2	3 Li	4 Be	5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og

lanthanoid series	6	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
actinoid series	7	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

PHYSICS

CHAPTER ONE
Reflection on curved surfaces

Lesson 1: Types of curved mirrors

Competence:
In this lesson, you will be able to:
- Identify the types of curved mirrors
- Explain the features of curved mirrors

Materials you need:
- A spoon
- An orange
- A motorcycle/car side mirror

Introduction

In S1, you learnt about reflection at plane surfaces. Plane mirrors reflect light to our eyes for an image to be formed. In this lesson you will look at different type of mirrors.

Part 1

Look at the shape of a spoon or fold your palm so that it forms a shape of a spoon. What do you notice?
The folded palm of the hand has two surfaces: the inner one and the outer one. If light falls on the inner face and is reflected, you have a concave mirror and if light is reflected on the outer face, then you have a convex mirror. Curved surfaces are shown in Figure 1.

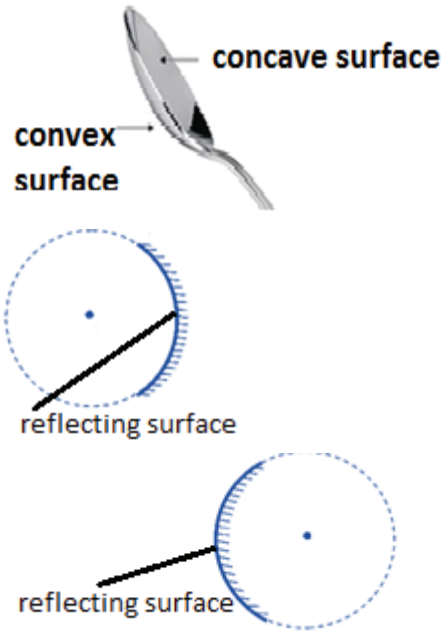


Figure 1: Curved surfaces

Now you are able to identify the two types of curved surfaces. These are the ones that form curved mirrors. So what are the types of curved mirrors?

Project: Try to make models of concave and convex mirrors using an orange.

Part 2: Identifying the features of curved mirrors

You will need a compass, a pencil, a ruler and a piece of paper for this part.
Procedure:
- Draw a circle in the middle of the paper and mark its centre, C.
- Draw a line that passes through the circle through the centre C.
- Mark the point, P at which the line touches the circle. Obtain the mid-point of the line PC and label this point F.
- Now cut off some section of the circle to remain with a part that represents the curved mirrors. Label this curved section M.

In this way you can identify features of the curved mirrors as shown in Figure 1 below:

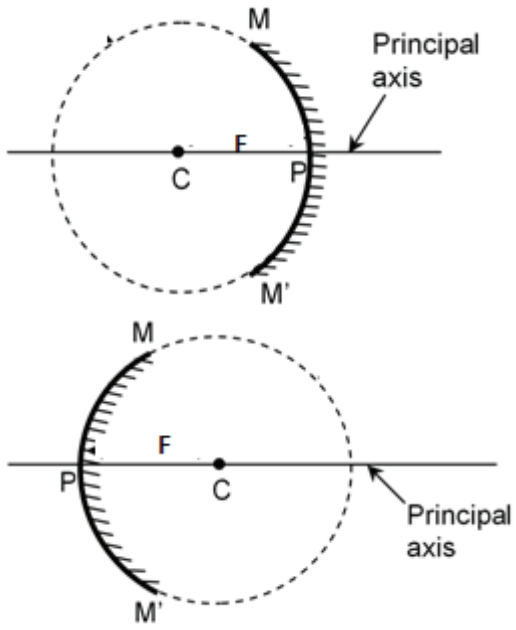


Figure 2: Features of a curved mirror

Now that you have identified the key features of the curved mirrorsas indicated on the figures above, can you explain the meaning of each feature?

Lesson 2: Drawing images in curved mirrors

Competence:
In this lesson you will be able to:
- Draw diagrams to show how curved mirrors form images
- Describe images formed by curved mirrors

Introduction:

In the previous lesson, you saw the different types of curved mirrors and their features. In this lesson you will use the features of the mirrors to show how the curved mirrors form images. You will also describe the nature of images formed by the curved mirrors.

Procedure:
- Draw a curved mirror and the principal axis
- Draw a ray that is parallel to the principal axis that strikes the reflecting surface of the mirror and then show how it is reflected through the point F
- Draw a ray that is incident through the point F and is reflected parallel to the principal axis.
- Now mark the point where the reflected rays meet
- Connect this point to the principal axis, vertically to form the image.

Try to go through this procedure several times until you have clearly understood
Note: If the tip of the image faces upwards, the image is upright (erect) and if the tip faces downwards the image is inverted

Follow up activity: Now that you know the rays to use to draw images formed in curved mirrors, draw diagrams to show how images are formed by curved mirrors when the object is:

- Very near the mirror i.e. between F and P
- Between F and C
- Beyond C

In all these cases, describe the nature of the image.

Lesson 3: Construction of ray diagrams in curved mirrors

In this lesson, you will be able to:
- locate images in curved mirrors using scale drawing
- determine magnification in curved mirrors

Materials you need:
- A graph paper
- A long ruler

Procedure Now that you are able to draw images in curved mirrors, you should go ahead and try to construct images using accurate scale drawing.

In this lesson, a curved mirror will be represented by a vertical line with a cup at the top. This is to avoid the different forms of curving that can be drawn by different people.
Then you will use the rules in lesson 2 to draw an accurate diagram. You will use a graph paper and simple scales e.g 1:2, 1:5 and 1:10

Now try this activity:
An object 2cm high is placed at 10 cm from a concave mirror whose focal length is 8 cm. Using an accurate scale drawing find the height of the image and its distance from the mirror.

After this trial, divide the height of the image to that of the object. What do you obtain? What you obtain is called magnification.

Follow up activity:
An object 10 cm high is placed at 5 cm from a concave mirror whose focal length is 7.5 cm. by construction you need to find the magnification of the image formed.

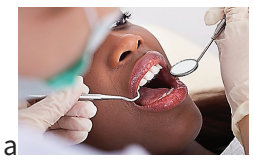
Lesson 4: Applications of curved mirrors

In this lesson ,you will be able to identify the

applications of curved mirrors

In the previous lessons, you have seen how curved mirrors form images. The nature of images formed by curved mirrors determines their applications.

Some of the applications of curved mirrors are indicated in Figure 3 below. Look at each picture carefully.

a  b 

c  d 

Figure 3: Applications of curved mirrors

Can you identify the applications ofcurved mirrors in each case?

Lesson 5: Determination of focal length of a concave mirror

This can only be done in a laboratory setting.

CHAPTER TWO

Turning effects of forces, Centre or gravity

Lesson 1: Explaining the moment of a force

In this lesson, you will be able to:
- Explain the meaning of a moment of a force
- State instances where moments are applied
- State the principle of moments

Materials you need
- A log of wood or stick
- Some sand or soil tied in a cloth or polythene
- A sharp edge

Introduction

Many times when we apply forces to objects, the force causes them to turn or spin about a fixed point (pivot/fulcrum).
Have you ever wondered what happens when children are playing on a seesaw?

Figure 2.1: Children playing on a seesaw

Look at the children in the above figure. What would happen if one of the children left or moved far away from the position where he/she is?

Activity /procedure
- Balance the log of wood on a sharp edge until it is balancing horizontally (Figure 4).
- Put one lump of sand/soil in a sack on one side of the wood using a string and the other on a different side of the sharp edge.
- Adjust the lumps of sand until the two sides balance
- Now slightly move one of the lamps of sand

What do you notice?

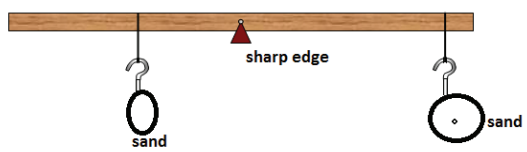


Figure 2.2: A balanced log of wood with loads

For your knowledge

If one of the children left or changes position, the other one would fall over from the other side or be raised upwards; i.e would experience a turning effect. This turning effect is also called moment of a force. It is obtained from: **moment of a force=force x distance of force from the fulcrum**
The direction of the turning (moment) is compared to the movement of the hands of a clock i.e clockwise or anticlockwise

Follow up activity:
Now that you know the meaning of a moment of a force:
1. State the units of moment of a force
2. Identify instances in everyday life where turning effects/moments occur or are applied
3. describe the ways of increasing the turning effect

Lesson 2: The Principle of Moments

In this lesson, you will be able to:
- State the principle of moments
- Apply the principle of moments to determine the mass of objects such as a log of wood

When a body balances, it is said to be in equilibrium. Equilibrium is very essential and is a situation where the resultant force on a body is zero.

Activity 1: To derive the principle of moments

Materials you need
- A sharp edge
- A log of wood or stick
- Ruler
- Two known masses such as a bottle of mineralwater completely filled with water is 500 g while a half filled mineral water bottle is 250 g

Procedure:

1. Balance thelog of wood on a sharp edge as shown in the figure 2.3 and note the balance point.
2. Suspend a mass m_1(bottle completely full of water=500g) at a distanced_1 less than 20 cm from the balance point.
3. Without changing the position of the balance point and the position of m_1 suspend a mass m_2=bottle half filled with water (250 g) the other side of the wood and adjust the mass slowly until the wood balances horizontally (Figure 2.3)
4. Measure the distance $d_2$between m_2 and the balance point

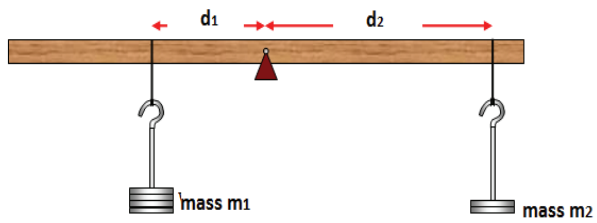


Figure 2.4

5. Record m_1, distance d_1, m_2 and distanced_2 as shown

m_1=…g	distance d_1=…….cm	m_1 x d_1=
m_1 =...g	distance d_2=…….cm	m_2 x d_2=

What do you notice about the values of m_1 x d_1 and m_2 x d_2?
The result verifies the principle of moments which states that:
"When a body is in equilibrium, the sum of clockwise moments about any point is equal to the sum of anti-clockwise moments about the same point''.

Activity 2: To determine the mass, M of a log of wood using the principle of moments

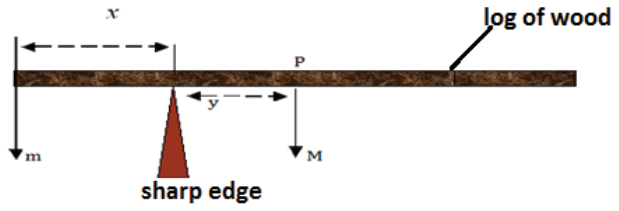


Figure 2.5

What you need:
- A sharp edge
- single mass m=500 g (a small bottle of mineral water completely filled with water)
- Log of wood

Procedure
1. Balance the log of wood on a sharp edge, until it balances horizontally and note the balance point P.
2. Suspend a mass m=500 g at the end of the log of wood as shown in the figure 2.5.
3. Without adding another mass, adjust the log of wood on the sharp edge slowly until it balances horizontally
4. Measure the distance x between the mass m and the sharp edge and the distance *y* between P and the sharp edge
   If **M** is the mass of the log of wood, then it acts at P.
   Using principle of moments, find the value of **M**.

Lesson 3: Centre of gravity

In this lesson, you will be able to:
- Determine the centre of gravity for regular and irregular objects
- Explain the importance of the position of the centre of gravity of objects

Introduction: In the previous lesson, you

balanced a log of wood on a sharp edge until a balance point was obtained. There is only one balance point on each body. This balance point is where all the mass or weight is assumed to be concentrated and is the centre of gravity.

Activity 1: Determination of centre of gravity of regular objects.

Materials you need

- Log of wood
- Sharp edge
- Irregular cardboard from a used box
- String
- Small object like a stone

Procedure

Balance the log of wood on a sharp edge until it balances horizontally
Mark the balance point on the log of wood (Figure 2.6)

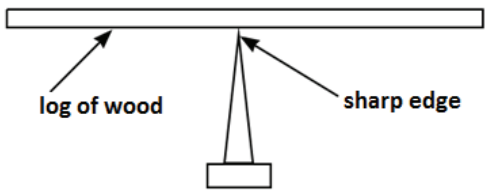


Figure 2.6

What do you say about the balance point of the log of wood?

Activity 2: Determination of centre of gravity of irregular objects

Materials you need:

Procedure (steps):

- Make three holes A, C and B at the edges of an irregular cardboard.
- Hung the cardboard through A so that it swings freely on a nail clumped in a stand.
- Tie the small object like a stone to the nail and trace a line where the string passes (Figure 2.7).
- Hung the cardboard at another hole, C and trace a line where the string passes.
- Locate a point where the two lines intersect.

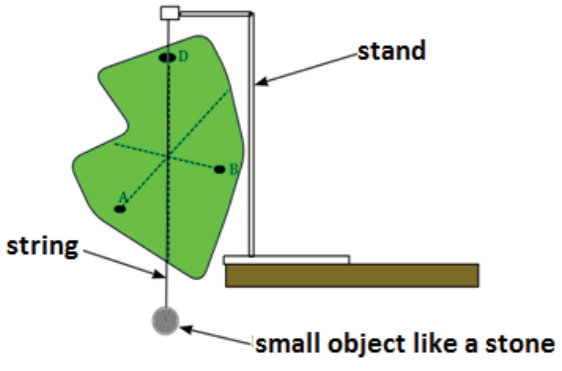


Figure 2.7

What do you say about the point of intersection of the two lines?

Lesson 4: Stability

In this lesson, you will be able to:

- Explain the three types of equilibrium
- Explain how position of centre of gravity affects the stability of objects

Introduction

Have you ever wondered why some bodies when displaced from their positions, the bodies come back to their original positions while others completely fall off to new positions? This is a result of the position of their centre of gravity.

Activity

Materials you will need

- A small ball (you can make one using waste papers, polyethene or banana fibre or grass)
- A short stem of a tree or short section of bamboo stem (each about 5 cm to 10 cm long)
- A small irregular object such as a plastic bottle filled with water

Procedure:

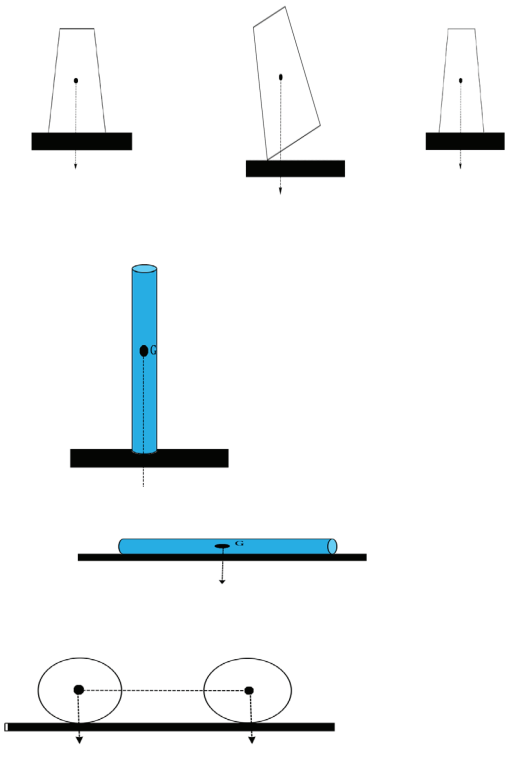
Slightly displace a bottle filled with water to one side and then release it. What do you observe?

Slightly displace a short stem of a tree or the bamboo stem that is standingvertically upwards and release it. What do you observe?

Slightly displace the ball from its position and release it. What do you observe?

In the above three activities, you may have noticed that some of the objects come back to the original position, others acquire new positions and become stable while others may not appear to change positions, though they become stable in new positions.
This results from the change in the position of the centre of gravity.

(a) Now using the diagrams below, can you explain the behaviour in the above three activities in terms of the centre of gravity?



(b) Now using the three situations, can you explain the three types of equilibrium?
(c) How does the idea of centre of gravity affect the construction of cars/ buses/lorries?

In summary, if the body returns to its original position, it is in stable equilibrium. If the body does not return to its original position but acquires a new position in which it settles, then it is in unstable equilibrium. If the body acquires a new position but without change in appearance, then it is in neutral equilibrium.

CHAPTER THREE

Machines

Lesson 1: Meaning of machines

In this lesson, you will be able to:

- Explain what a machine is
- Explain the terminologies related to machines

Materials you need

- A log of wood
- A knife
- Bottle opener

Introduction

Have you ever wondered why you can push two bags of cement using a wheel barrow but it is even difficult to carry one bag of cement without any other device? The wheel barrow simplifies the carrying of the cement. It is a machine. Many more things can be done more easily using these devices called machines. These machines are either simple or many simple machines put together to form complex machines. Can you identify some simple machines and complex machines?

Activity: Terms used in machines

Procedure 1:
Try to lift a heavy object such as a stone from the ground using a log of wood. The object like a stone is the load, L and you apply the effort, E using your hands.

For your knowledge: If the values of L and E are known, the ratio L/E is called mechanical advantage

Now try this: When using a certain machine a force of 250N must be used to raise a load of weight 1000 N. Calculate the mechanical advantage of the machine.

Procedure 2:
Try to measure the distance through which the load is moved and the distance through which the effort moves. What values do you get? Now divide the distance moved by the effort to the distance moved by the load.

For your knowledge: If the value of the effort distance is divided by the load distance, the value obtained is called the velocity ratio

Now try this: What are the units of mechanical advantage and velocity ratio? Try to explain this.

Now try out this example:
When using a certain machine, a force of 250N must be used to raise a 100kg mass through a distance of 1m. If the effort distance is 5m, calculate;

a. Mechanical advantage
b. Velocity ratio
c. Divide the mechanical advantage by the velocity ratio. What do you obtain? Express the answer as a percentage and comment on the answer. Try to ask whether this value can exceed 100 or not and why?

Lesson 2: Levers

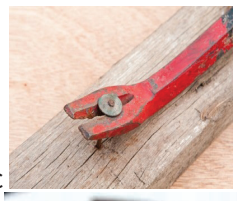
In this lesson, you will be able to:
- Classify the three types of levers
- Explain the reason for the classification

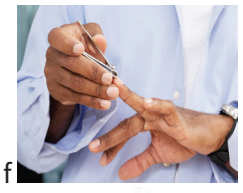
Materials you need
- A log of wood
- A knife
- Bottle opener
- Hammer
- Pair of scissors
- Sea-saw
- Wheel barrow
- Your arm
- A hoe with handle
- Panga
- Nail cutter

Introduction
There are a variety of simple machines in the home which are used to simplify work. However, they are not the same. They are not constructed on the same plan. This brings about three categories of levers.

Now look at the following imagesin Figure 3.1below:

a b

c  d 

e  f 

g  h 

Now from the table, try to explain the reason for the classification of the levers

Lesson 3: Pulleys

In this lesson, you will be able to:
- construct a pulley
- Identify applications of pulleys

Materials you need
- A rope
- A tree/stick
- Two supports/stands whose tops the tree/ stick can easily rotate
- A piece of heavy material such as soil/sand tied in a cloth, or a bucket

Activity 1: To construct a pulley
Procedure
- Support a tree/stick between two supports. Ensure that the tree/stick can easily rotate between the supports/stands
- Tie the rope over the soil
- Run the rope over the tree or stick
- Pull the free end of the rope slowly but continuously

What happens to the soil or bucket?

In the above activity, you have formed a pulley. A common pulley looks like the one shown in Figure 3.2 below.

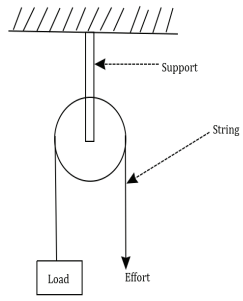


Figure 3.2: A common simple pulley

A pulley is a wheel with a grooved rim in which a rope passes.

Pulleys are also simple machines. The velocity ratio is equal to the number of wheels or pulleys. Look at the pulleys in Figure 3.3below. Try to re-draw each of the pulleys.

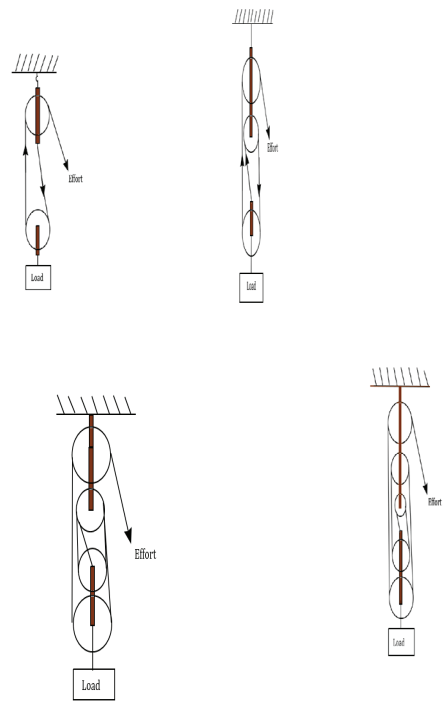


Figure 3.3: Different pulleys

What is the velocity ratio of each of the pulleys? How do you know?

Activity 2
In our ordinary life, pulleys can be applied in a number of ways. Some are indicated in the Figure 3.3 below. Look at each figure carefully.

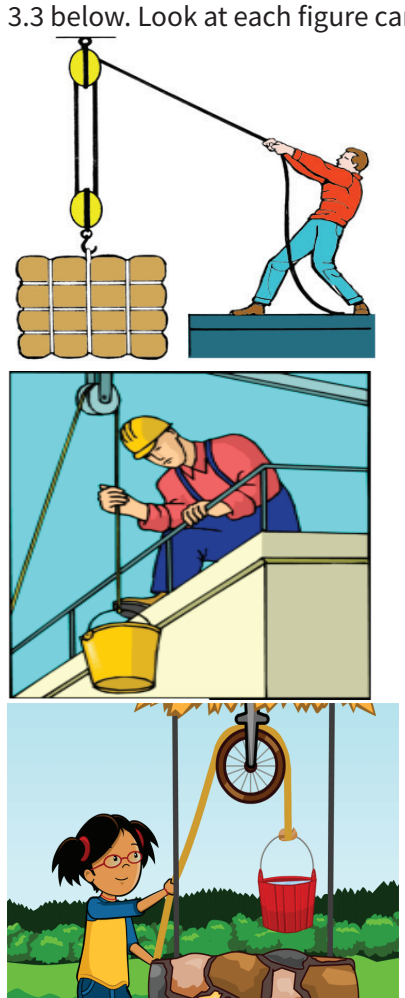


Figure 3.3: Applications of pulleys

(i) Explain what the pulley is being used for in each case
(ii) Identify complex machine systems where pulleys are applied

Lesson 4: Other simple machines

In this lesson, you will be able to:
- Identify other simple machines
- Explain how these other simple machines simplify work

Materials you need
- A wedge (inclined plane)
- Used gear system of a bicycle
- Jack (if available)
- Screw (where possible)

Introduction
In the previous two lessons, you looked at the two types of simple machines, i.e levers and pulleys. In this lesson, you will look at the other different simple machines.

Activity
Look at the images of simple machines shown in Figure 3.4 below:

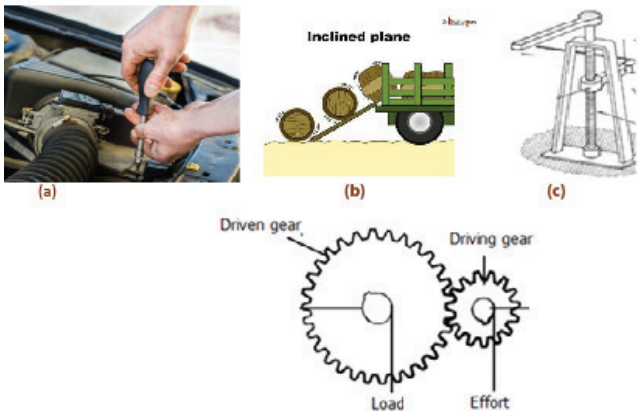


Figure 3.4: Different machines

(a) Where is each of the simple machines applied?
(b) How does each of the simple machines simplify work?

Project work: Now that you have learnt how simple machines work, design a machine that combines many simple machines and can be used to simplify work, for example a crane or excavator. You are allowed to use many components and explain how it works

CHAPTER FOUR

Work, Power and Energy

Lesson 1: Work

In this lesson, you will be able to:
- define work and state its units
- solve numerical problems related to work
- identify instances in everyday life in which work is done and explain why

Materials you need
- A brick or large piece of wood or a jerrycan containing water

Introduction

The word "work" is quite often used in our day to day lives to mean occupation or job.

But in physics, work has a different meaning. When you go to fetch water, you have done work, though it may not be your continuous job.
Look at the children in the Figure4.1 below.


Figure 4.1

Can you say that the children are doing work? Why or why not?
Now assume that the children are playing in the compound. Are they doing work?

Activity:

Procedure:
- Lift the brick or piece of wood or the jerrycan containing water
- Move five large steps while holding this object

Suppose the object you are holding has a mass of 5 kg and the distance covered in the five steps is 5 metres, then;
- convert the mass into weight i.e5x10=50 N
- multiply this weight by the distance covered i.e 50 x 5= 250

What you have obtained in this case is the value of work you have done while carrying the object through that distance.

For your knowledge: Work is done whenever force moves through a distance. Hence work is the product of force and distance in the direction of force. The SI unit of work is the Joule (J)

So human beings and machines do work when they move objects through distances. Do you do work when you move in the compound without carrying any object? Try to explain this.

Now try these problems and express the answer to the appropriate units: (g =10ms^{-1})

1. A body of mass 5kg is lifted through a distance of6m. Calculate the work done.
2. A man lifts a box of mass 3 kg vertically upwards through 2 m. Calculate the work done by the man in lifting the box.
3. Try to identify other instances in everyday life in which work is done.

Lesson 2: Power

In this lesson, you will be able to:
- define power and state its units
- solve numerical problems related to power
- identify instances in everyday life in which power is expended

Materials you need
- A brick or large piece of wood or a jerrycan containing water
- A watch

Introduction

In the previous lesson, you learnt the meaning of work. When a person or machine does a lot of work very quickly, such a person or machine is said to have power. So what does **power** mean in Physics? To understand the meaning of power, you are going to do the following activity.

Activity

Procedure:
- Lift the brick or piece of wood or the jerrycan containing water
- Move five large steps while holding this object. As you move the five steps, count and record the time (in seconds) it takes you to make the five steps (you may use a watch or the counting of figures 1,2,……. for seconds if you have no watch)

Suppose the object you are holding has a mass of 5 kg and the distance covered in the five steps is 5 metres, then;
- convert the mass into weight i.e5x10=50 N
- multiply this weight by the distance covered i.e 50 x 5= 250

What you have obtained in this case is the value of work you have done while carrying the object through that distance.
Now divide this work done by the time you measured i.e

What you have obtained is called power. Can you suggest a definition for power?
For your knowledge: The SI unit of power is the Watt(W).A watt is defined as the power developed when one joule of work is done in one second.

Now try out this problem. Do not forget to express the answer using appropriate units
A machine lifts a load of 2500N through a vertical height of 3m in 1.5s. Find:
(a) The power developed by the machine
(b) Using the same power, how long would it take to lift a body of 6000N through a vertical height of 5m.

Lesson 3: Energy

In this lesson, you will be able to:
- define energy and state its units
- identify the different sources of energy
- categorize energy resources as renewable and non-renewable resources

Materials you need
- pieces of paper or firewood

Introduction

In **lesson 1** you saw the meaning of work. People and machines are able to do work because they have the ability to do the work. This ability is the energy possessed by the person or the machine.

Did you know? The SI unit of energy is joule (J)

The energy of people and machines can be seen in a number of forms such as light, heat and mechanical or physical energy for lifting objects. This energy comes from different sources such as food, fuel and water.

Activity 1:

Procedure
- Burn small pieces of wood or small pieces of paper until they completely burn

(a) What do you observe?
(b) What forms of energy are produced during this activity?
(c) Can you get the wood or paper back or use it again?

From the above activity, you saw that some of the sources of energy are used only once while others can be used several times.

Activity 2:
Look at the images in the Figure 4.2 below





Figure 4.2

(a) Identify the energy source in each case
(b) Which of the energy sources can be used only once?
(c) Which of the energy source can be used several times without being exhausted?

Summary
If an energy resource can be used only once and is exhausted, it is a **non-renewable** resource while one that can be used several times without being exhausted is a **renewable resource**.
Can you identify other renewable and non-renewable energy resources in Uganda, apart from those in Figure 4.2

Lesson 4: Mechanical energy

In this lesson, you will be able to:
- Identify the forms of mechanical energy
- Solve numerical problems related to mechanical energy

Materials you need
- Two small stones

Introduction
In lesson three, you saw that there are different forms of energy. One of the forms of energy is mechanical energy. Mechanical energy enables us to do mechanical work such as moving and carrying objects. In this lesson, you will distinguish between the two types of mechanical energy.

Activity
Procedure
- Place one small stone on the ground or on the table
- Throw the other small stone upwards or drop it from some point towards the ground

Which of the two stones possesses energy?
Explain your answer
Now consider this.
A person sitting at one position and a person running, who of the two possesses energy?
Explain your answer.

In summary, all bodies possess mechanical energy. Bodies at rest possess potential energy due to their position and this energy is given by

Where we have g being the acceleration due to gravity, and h is the height above the ground.
On the other hand, moving bodies possess kinetic energy given by the expression
Where m is the mass of the body and v is the velocity of the body.
Hence all mechanical energy results from masses of bodies

Using the above equations, try out these problems:
1. A stone of mass 8kg is lifted through a height of 2metres.Find the potential energy the stone develops (Take g = $10ms^{-2}$)
2. Find the kinetic energy of a body of mass 2kg moving with a speed of $4ms^{-1}$

Lesson 5: Transformation and conservation of energy

In this lesson, you will be able to:
- Identify energy transformations in life
- State law of conservation of energy
- Describe energy transformations using a pendulum

Materials you need
- A torch
- A small stone
- A string

Introduction:
In lesson 3, you learnt the sources of energy. One of the sources of energy is the dry cell. Can the energy stored in a dry cell do something? Try this activity.

Activity 1
Switch on a torch. What do you observe?
Try to explain this observation.

The energy stored in the dry cells changes into light energy in the torch. The energy stored in the dry cell is chemical energy. Energy is transformed from one form to another. Transformation of energy is very useful to our lives.

Now identify as many instances/devices in everyday life where energy is changed from one form to another. State energy changes that occur.

Activity 2
Procedure
- Hold a small object such as a stone above the ground on a support
- Then release the body and let it fall to the ground (Figure 4.3 below)

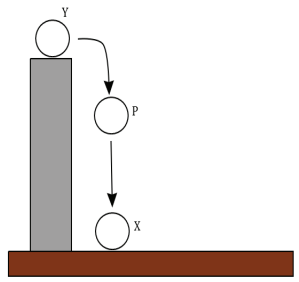


Figure 4.3
Now answer the following questions.
What form of energy does the stone posses when;
(a) It is held above the ground i.e at Y?
(b) It is falling to the ground i.e at P?
(c) It falls and rests to the ground i.e at X?

As you answer these questions, you may discover that same object may have different energy forms. But the total amount of energy is constant. This is summarized in the law of conservation of energy which states that'**energy can neither be created nor destroyed, but only changes from one form to another'**.

You can also explain different energy forms using a pendulum.

Activity 3
Procedure
- Tie a small stone on a string that is about 1 m long
- Suspend the stone from a support
- Set the pendulum into oscillations and observe how it swings (Figure 4.4 below)

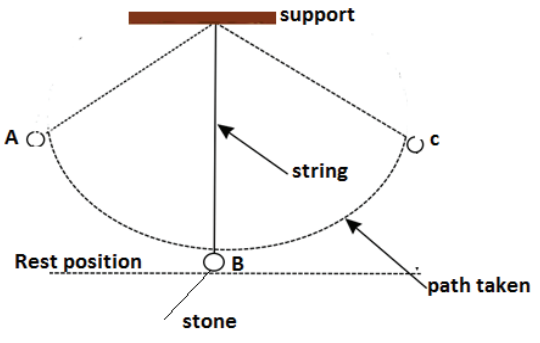
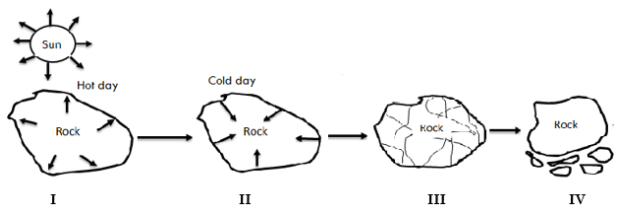


Figure 4.4
From Figure 4.4 above, identify the forms of mechanical energy at positions A, B and C.
Explain your answer.

BIOLOGY

Revision Activity 1

Weathering is the process of soil formation by the breaking down of rocks into small particles. Weathering can be a biological process involving living organisms or a chemical process involving chemicals substances like acids or a physical process involving physical factors of the environment. Weathering is a slow and continuous process.



Study the figure above.

a) What is happening to the rock at Stage I
   Why is it happening?
b) What is happening to the rock at Stage II
   Why is it happening?
c) What is happening to the rock at Stage III
   Why is it happening?
d) What is happening to the rock at Stage IV
e) Do you think this is a physical or chemical or biological process?

Revision activity 2

Soil is grouped basing on the size and nature of the soil particles. Have you ever asked yourself why different types of soils are used for different purposes? In this lesson you will learn how to distinguish clay from loam and sand soil.

Materials you will need:

Soil Sample A, Soil Sample B, Soil Sample C, Water

Activity set up

1. Collect two cups full of soil from the following sites
   I. Soil from the top layer of a well mulched garden/soil near a rubbish pit/soil under leaves in a forest/soil by the roadside where grass is growing **(**Labelled **Soil Sample A)**
   II. Soil from a place where pots or charcoal stoves are made/ from a big anthill **(**Labelled **Soil Sample B)**
   III. Soil from sand pits or mines/ soil that remains by the roadside when slow moving water has drained. **(**Labelled **Soil Sample C)**
2. Place the soils on separate sheets of paper to dry
3. Remove any non-soil material from your samples
4. Keep the soils in separate containers for use in other activities

Caution: wash your hands with soap and water after this activity

Procedure:

Step 1: Take a pinch of soil sample A between your thumb and your forefinger. Press and rub gently. Describe the size of the soil particles. Are they small/ fine (powder-like)/big? Record your description in the table below.

Step 2: Repeat the procedure in step 1 using soil sample B and soil sample C.

Step 3: Take a pinch of soil sample A between your thumb and your forefinger. Pour ONE or TWO drops of water onto the soil between your fingers. Press and rub gently. Describe how the soil feels (texture). Is it smooth/rough/slippery/ gritty? Record your description in the table below.

Step 4: Repeat the procedure in step 3 using soil sample B and soil sample C.

Step 5: Take a handful of soil sample A, add a little water at a time and mix it with the soil. Try and mould the soil into a ball. Throw the ball into the air about 50cm and then catch it. Describe what happens to the ball. Does it remain intact/ it falls apart? Record your observation in the table below.

Step 6 Repeat the procedure in step 5 using soil sample B and soil sample C.

	Soil Sample A	Soil Sample B	Soil Sample C
Size of the soil particles			
Feel (texture) of soil			
Behavior of soil when thrown in air			

Read the characteristics below and use them to identify soil samples A, B and C.

Sand soil; feels gritty when wet, has relatively big particles that do not easily clamp together when wet.

Clay soil; feels smooth and slippery when wet, has very fine particles that strongly clamp together when wet.

Loam soil; feels like an intermediate between gritty and smooth, has small particles that readily clamp together when wet.

Soil Sample A is ……..

Soil Sample B is ……..

Soil Sample C is ……..

Follow-up activity:

Soil in Uganda is used for various economic activities or in making different products. Think about your community and identify the economic activities that use soil or products made from soil. For each activity/product identified, mention the type of soil used and give reasons why that soil type is preferred.

Revision activity 3

Soil drainage is the soil's natural ability to let water pass through it while water retention refers to the amount of water soil can hold. Why do you think it is important to understand these two properties of soil? In this lesson you will compare drainage in two types of soil.

Materials you will need:

4 empty clear plastic bottles (500/600mls) as receivers, cotton wool, dry sand and clay, clock/ watch, water, 4 funnels *(If you cannot fine a ready-made funnel, then use a cutter (knife/razor blade) to cut* ***½*** *of upper portion of the empty clear plastic bottles and use them as funnels and the lower portions as receivers/containers. In this case, you will need a cutter (knife/razor blade)).*

Caution: Wash your hands with soap and water after this activity.

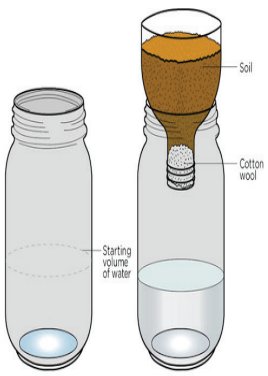
Procedure:

Step 1: Measure an equal volume of each soil sample, for example 30cm^3

Use a piece of cotton wool to plug each funnel

Step 2: Put clay in one funnel and the sand in the other funnel

Step 3: Place the funnels with their contents over the receivers.



Step 4: Pour (at the same time) an equal volume (50cm^3) of water on each of the soil samples. Look at your clock or watch and let the experiment run for 20 minutes

Step 5: Observe and take note of the following:

i. The soil from which water started dripping first.
ii. The volume of water collected after the experiment.

Step 6: Record your findings in a table of your choice.

What explained conclusions can you draw about:

i. Drainage in:
   - Clay soil
   - Sandy soil
ii. Water retention:
   - Clay soil
   - Sandy soil

Follow-up activity

Comment on how the knowledge of drainage and water retention of clay and sand is used in the following areas:

i. Agriculture
ii. Building construction
iii. Craft making

MATHEMATICS

Class: SENIOR TWO

Mathematics

Topic: Numerical Concepts

Lesson 1

Learning outcome

By the end of this lesson, you should be able to know the Rational, Irrational and Real Numbers. You will work out problems involving these numbers and apply them in real life situations.

Materials: You will need grid papers. The grid papers will be used when dealing with Square numbers and Square roots.

Introduction

You have already learnt about some types of numbers like Natural numbers, Whole numbers, Fractions, Decimals, Integers and many others. All these numbers can be expressed in different bases.

In term one of Senior one, you learnt *Bases* where you carried mathematical operations, converted numbers from one base to another and vice versa. **Remember** that Integers have positions on a number line.

Activity 1

Represent the following numbers on the same number line

(a) -3, -1, 1, 2, 5, 10
(b) 0.1, 0.4, 0.5, 0.8
(c) 1/3, 1/2, 1/4, 2/5, 1/7

Rational Numbers

Remember, Integers and decimal numbers can easily be represented on a number line.

In the previous activity, you might have converted fractions to decimals in order to present them on a number line.

When fractions are converted into decimals, **they** are terminating, recurring and others are neither terminating nor recurring.

Note. Terminating and recurring decimals can be expressed in form of **a/b** where **a** and **b** are integers. This means that all integers can be written in form of **a/b**

Activity 2.

Express the following numbers in form of **a/b**

(a) 2, 7, 9, 11, 15, -3, -5

(b) $1\frac{1}{3}, 1\frac{1}{3}, 3\frac{11}{55}$, 2.2, 4.8, 1.02

You have seen that integers, terminating and recurring decimals can be written in form of **a/b** where **a** and **b** are integers.

Numbers which can be expressed in form of **a/b** are called Rational numbers.

Activity3.

Are all Decimal Numbers Rational numbers? With examples, justify your answer.

Irrational Numbers

Activity 4: Using a Calculator, find the square roots of the following numbers

(a) 1 (b) 4 (c) 9 (d) 3 (e) 2 (f) 13

Write the answers for (a)……(f) in form of **a/b** where **a** and **b** are integers

Have you been able to write your answers for (a) …..(f) in form of **a/b**?

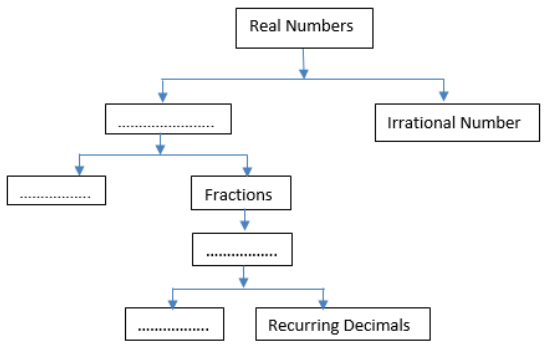
Note: All numbers which cannot be written in form of **a/b** are called irrational numbers

All Irrational numbers have corresponding positions on the Number line

Real Numbers

Remember Rational and Irrational numbers have positions on the Number line

Activity 5: Complete the following chart of Real numbers



Converting Recurring Decimals into Fractions

Activity 6: Convert $\frac{2}{5}, \frac{1}{8}, \frac{3}{505}, \frac{2}{8}, \frac{1}{50}, \frac{3}{50}, \frac{11}{33}$ into decimals.

Note that decimals can be converted into Fractions.

Example: Convert 0.2, 0.5 into fractions

Solutions: $0.2 = \frac{2}{10} \frac{2}{10} = \frac{11}{55}$

$0.5 = \frac{5}{10} \frac{5}{10} = \frac{11}{22}$

Convert $\frac{22}{33}$ into decimal

Answer: $\frac{22}{33} = 0.6666\ldots$.

The answer 0.666… is a non-terminating **but a** recurring decimal

0.666 can be converted to fractions.

The recurring number is 6 and it starts recurring after the tenth position

So, take r to be 0.6666 i.e. r = 0.666 equation (i)

Multiply equation (i) by 10 i.e. 10r = 6.666 equation (ii)

Subtract equation (i) from equation (ii) i.e. 10r – r = 6.666 – 0.666 = 6.0

$9r = 6$

$r = \frac{66}{99} = \frac{22}{33}$

Activity 7

Convert the following recurring decimals into fractions

(a) 0.77…
(b) (b) 0.2424…
(c) (c) 0.01666….
(d) (d) 0.185353…
(e) (e) 4.203203…

Class: Senior Two

Topic: Algebra:

Lesson 1: Use of Symbols, substitution

Learning outcome : By the end of this lesson, you should be able to:

- interpret word problems
- Write a formula using symbols and correct.

Materials:

You will need a note book, pen, paper, razor blade or scissor to help you explore relationships between different shapes and how they can be used to build a formula.

Introduction

In your primary school and S.1, you were introduced to a number of mathematical symbols representing mathematical statements.

Activity 1

1. What are some of the symbols that you regularly interact with?
2. What do these symbols mean**? (MISSING SYMBOLS)**

SYMBOL	MEANING

Look around your homestead and construct a statement. Use the statements drawn from situations in your homestead and represent it using symbols.

Statement	Symbol
Number of boys in my family is **not equal to** the number of girls	≠

Exercise

1. Which of the symbols is not used to show multiplication?
   a. @ b. * c. × d. ( )
2. Which of the following statements is true?
   a. π is a special number
   b. There is only one way to show multiplication symbol
   c. 90^0 is the symbol for representing a right angle in a triangle.
   d. √ is a square root.

Lesson 2:

Learning outcome

By the end of this lesson, you should be able to:

- Write statements in algebraic form using symbols.

An Algebraic expression is formed from variables and constants using different operations.

Expressions are used to write word problems in math terms.

Expressions are like instructions that tell you what you have to do to a number or variable.

Words (statement)	Algebraic Expression
A number b is added to 6	b+6
9 is subtracted from x	x-9
A number t is multiplied by 8	t×8
A number z is divided by 3	z÷3 or $\frac{z}{3}$

Activity

Choose the correct answer for each of the questions

1. The subtraction of 5 times of y from x is

(a) 5x – y

(b) y – 5x

(c) x – 5y

(d) 5y – x

(a) –1 × b

(b) 1 – b – 0

(c) 0 – (–1) × b

(d) – b – 0 – 1

3. The length of a side of square is given as 2x + 3. Which expression represents the perimeter of the square?

(a) 2x + 16

(b) 6x + 9

(c) 8x + 3

(d) 8x + 12

4. A fruit basket contains the same number of mangoes and oranges. If Eric eats 5 mangoes and 1 pear, there will be twice as many oranges as mangoes. How many oranges remain in the basket?

(a) 4
(b) 8
(c) 9
(d) 10
(e) 11

Lesson 3:

Learning outcome

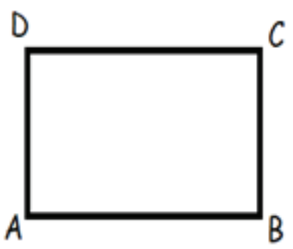
By the end of this lesson, you should be able to express one variable term in terms of another.

Activity 1

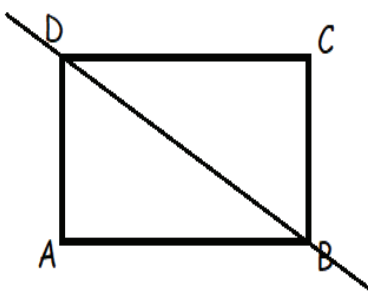
Let us use the area of a square to generate the formula of finding the area of a right-angled triangle.

Hint

Here is a piece of paper in a square shape labelled ABCD



Cut the piece/ fold the paper along diagonal from one end of the vertex to its opposite.



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You will observe there are two equal right-angled triangles formed.

Use the Length, width and the area of the shape ABCD to derive a formula for finding the area of triangle.

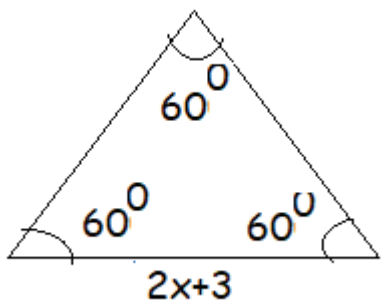
Activity

1. Use the formula you have generated to obtain solutions to the following
a. Base = 4 units, Height = 10units
b. Base =12units, Height= 3units

2. Use the following information to obtain the;
c. Height, when Area= 16square units, Base= 6units
d. Base when Area= 24 square units, Height = 10units
3. Find the values of the following algebraic expressions when a = – 2 and b = 3:
   a. 8a
   b. 5b
   c. a+3b
   d. 4a-2b
   e. $a^2 + 2ab + b^2$
4. Make x the subject in the following algebraic equations
   a. y=x+a
   b. y=2x-a
   c. y=2x+7
   d. ax-y=2y
5. Make x the subject of the formula in each of the following cases**.**
   a) a (x+b) =c
   b) $\frac{x}{a} = 1 + \frac{yx}{ba} = 1 + \frac{y}{b}$
   c) $\frac{x+y}{y} = \frac{y}{a} + \frac{ax+y}{y\ y} = \frac{y}{a} + \frac{a}{y}$

Follow up Activity

1. Find each side of an equilateral triangle given below, if the perimeter of the equilateral triangle is 240 cm.



2. Cut out shapes of two right angled triangles and a rectangle, Join them to form a shape of a trapezium
a. Paste the shape in your exercise book.
b. Draw the shape of the trapezium.
c. Use the right-angled triangles and a rectangle to derive a formula for **the** area of a Trapezium.
d. Write the formula in your notebook.
e. Use the formula to;
   (i) Express the base of the trapezium in terms of the height and Area
   (ii) Express the height of the trapezium in terms of the base and Area

Now, try to reflect on issues discussed above with the following activity.

Activity 1

1. A bicycle bought for 180,000/= was sold for 150,000/=.
   i. What was the cost price?
   ii. What was the selling price?
   iii. Was the bicycle sold at a profit or loss? Give a reason for your answer.

2. Musa bought a radio at 60,000 UGX and sold it to his brother at 55,000 UGX. Calculate the profit or loss made on this item.

3. A box of mineral water has 24 bottles. A shopkeeper bought it from the wholesale shop at 18,000 UGX. He sold each bottle at 1000 UGX. Calculate the profit or loss made by the shopkeeper.

Lesson 2: Percentage loss and profit

Materials: a pen/ pencil and a rough book to try out the exercises.

Topic: Business arithmetic

Lesson 1: Calculating Profit and Loss.

Learning outcomes:

By the end of this lesson, you should be able to:

i. Calculate profit and loss
ii. Express profit and loss as a percentage
iii. Calculate discount and commission
iv. Calculate simple interest.

Materials:

For this lesson, you will need to collect items that are used in a home, those that were bought from a shop. You will need receipts, price tags, a pen/ pencil and a rough book to try out the exercises.

Introduction:

Dear student, you must agree with me that buying and selling is part of any trade. The goods we use at home are bought from shops, markets and supermarkets. People who sell to us also buy from other wholesalers and sell them to us at a higher price. The extra money the goods are sold for is the **profit**. If the goods are sold at a *lower price* than the price at which they were bought, the difference is the **loss**.

The price at which the goods are bought is called the **cost price *(C.P)***

The price at which the goods are sold is called the **selling price (S.P)**

Introduction

In the previous lesson, you were able to calculate the profit or loss made by reselling an item. In this lesson, you will learn to express the profit or loss as a percentage. You can determine the percentage profit or loss using the formulae below;

$$\text{Percentage profit} = \frac{Profit}{Cost\ Price} \times 100$$

$$\text{Percentage loss} = \frac{Loss}{Cost\ Price} \times 100$$

Example 1:

A bicycle bought at 180,000/= was sold for 150,000/=. Calculate the percentage loss.

$$\text{Percentage loss} = \frac{Loss}{Cost\ Price} \times 100$$

$$= \frac{C.P - S.P}{C.P} \times 100$$

$$= \frac{180{,}000 - 150{,}000}{150{,}000} \times 100$$

$$= \frac{30{,}000}{150{,}000} \times 100$$

$$= \frac{\cancel{30{,}000}}{\cancel{150{,}000}} \times 100$$

$$= 20\%$$

The loss on the bicycle is 20%.

Activity 2

1. Mangoes are bought by a fruit shop for 300 shillings each and resold at 500 shillings each.
    a. What is the cost price?
    _____
    b. What is the selling price?
    _____
    c. What is the profit?
    _____
    d. Calculate the percentage profit on the cost price. _____

2. Josephine makes school uniforms. It costs her 30,000/= to make a girl's skirt. She then sells them for 48,000/= each.
    a. What is the cost price?
    _____
    b. What is the selling price?
    _____
    c. What is the profit?
    _____
    d. Calculate the percentage profit._____

3. Ahmed bought a used car for $14 500, spent another $2000 on repairs, before selling it for $19 000. Find:
    a. the total amount Ahmed spent on the car _____
    b. the profit he made
    _____
    c. the percentage profit on the total amount he spent. _____

4. A company selling newspapers spends 15,00/= to produce a copy of the newspaper and sells it at 2,000/=. On a given day, **the** company produced 2000 copies and managed to sell 1000 copies only.
    a. Did the company make a profit or loss on that day?
    b. Calculate the percentage profit/ loss for the day.

5. Copy the table shown below and fill in the missing values.

Item	C.P	S.P	Profit/ Loss	comment	% Profit/ loss
Dress	20000	30000			
Shirt	18000	22000			
Cow	700000	900000			
House	80 million	72 million			
TV	300000	360000			
Smart phone	250000	200000			
Bag of Irish potatoes	100000	120000			
Pair of shoes	45000	40000			

Lesson 3: Discount

Materials: a pen/ pencil and a rough book to try out the exercises.

Introduction

In the areas of competition, shops find ways of encouraging customers to buy. One way of encouraging customers is offering them a discount. This is done by reducing an amount from the usual price of an item. This reduction in price is called **Discount.** It is usually calculated as a percentage of the selling price.

Example: Sarah buys a dress for cash whose marked price is shillings 50,000. A shopkeeper offers 10% discount for cash payments.

a) How much is the discount?
b) How much does she actually pay for the dress?

a) $Discount = \frac{10}{100}\frac{10}{100} \times 50{,}000$
$= 5{,}000 \text{ shillings}$

b) *She pays* $50{,}000 - 5{,}000$
$= 45{,}000 \text{ shillings}$

Activity 3

1. The marked price of a watch is 46,500. The shopkeeper offers an off-season discount of 18% on it. Find its selling price.

2. The price of a sweater was slashed from 9600 shillings to 8160 shillings by a shopkeeper in a rainy season. Find the rate of discount given by him.

3. Find the percentage discount being given on a shirt whose selling price is 54,600 shillings after deducting a discount of 10,400 on its marked price.

Hint. Market Price = (SP) + (discount).

4. After allowing a discount of 8% on a toy, it is sold for $ 216.20. Find the marked price of the toy.

5. A set of kitchen utensils was bought for 52,800 after getting a discount of 12% on its marked price. Find the marked price.

6. A dealer marks his goods at 35% above the cost price and allows a discount of 20% on the marked price. Find his gain or loss per cent.

7. A cell phone was marked at 40% above the cost price and a discount of 30% was given on its marked price. Find the gain or loss percent made by the shopkeeper.

8. A dealer purchased a fan for UGX 10800. After allowing a discount of 25% on its marked price, he gains 25%. Find the marked price of the fan.

Lesson 4: Commission

Materials: You will need a pen/ pencil and a rough book to try out the exercises.

Introduction

Commission is a fee paid for services. It is usually calculated as a percentage of the total cost of the goods. This amount can be paid to salesmen as sales commission. Sales commissions is the amount of money paid to employees or companies that sell goods in stores or by calling on customers. The commission is meant to motivate sales persons to sell more.

For example, if a salesperson receives a 10% commission on their sales, a salesperson sells goods worth 15,000 shillings, they would earn 1,500 shillings in commissions.

So, commission $= \frac{10}{100} \times 15000$

$=$ 1500 shillings

Activity 4

1. A salesman gets a fixed salary of $2000 per month and a commission of 2% on sale. If total sale for the month of April was $30,000, find his total salary for that month?

2. Joan makes a commission of 2% when a house is sold by his company. How much money will Joan make as a commission if her company sells the house for 300,000,000 shillings?

3. Mike makes **a** commission of 10% on each TV set sold at store. Each TV costs $120. How much money will he make as commission if **the** store sells 25 TV sets?

4. John is selling sets of knives and makes a 10% commission on all sales. What would his commission be on the sale of a $3250 set of knives?

5. Sonny works as a furniture salesman and earns a base salary of $350 per week plus 6% commission on sales. What was Sonny's weekly gross salary if his total sales were $3750?

Lesson 5: Simple Interest

Materials: a pen/ pencil and a rough book to try out the exercises.

Introduction

Dear students, do you know that Money is not borrowed for free?

When money is borrowed from the bank, the bank

charges for the use of the money. This charge is called **interest** usually denoted by **(I)**.

Also when money is deposited with the bank, the bank **pays interest to** the owner of the money. The amount borrowed is called the **Principal** usually denoted by **(P).**

The interest is usually calculated as a **Percentage Rate** usually denoted by **(R).** Interest also depends on the length of **Time (T)** that the money is borrowed or invested for. The principal together with the interest is called the **Amount (A)**

Simple interest can be calculated using the formula

$I = P \times R \times TI = P \times R \times T$

For example: Annette deposited 500000 shillings on her fixed account in a financial institution which pays an interest rate of 12% per annum. How much interest will she earn after 2 years?

In this example, the principal is 500,000

The rate is 12% per annum which is the same as $\frac{12}{100}$ per annum.

The time of investment is 2 years.

Using the formula $I = P \times R \times T$|

$$I = 500{,}000 \times \frac{12}{100} \times 2$$

I = 120,000 shillings.

Activity 5

1. If you borrow 675,000 shillings for six years at an interest rate of 10%, how much interest will you pay?
2. If the balance at the end of eight years on an investment of $630 that has been invested at a rate of 9% is $1,083.60, how much was the interest?
3. How much interest is earned on 5,000,000 at 4% for seven years?
4. Jane borrowed 2,250,000 shillings from the bank for eight years at an interest rate of 6%. How much interest will she pay?
5. If you put 624,000 shillings into a savings account that earns 5%, how much money will you have at the end of four years?

Topic: Numerical Concepts

Lesson 1

Learning outcome

By the end of this lesson, you should be able to know the Rational, Irrational and Real Numbers. You will work out problems involving these numbers and apply them in real life situations.

Materials: You will need grid papers. The grid papers will be used when dealing with Square numbers and Square roots.

Introduction

You have already learnt about some types of numbers like Natural numbers, Whole numbers, Fractions, Decimals, Integers and many others. All these numbers can be expressed in different bases.

In term one of Senior one, you learnt *Bases* where you carried mathematical operations, converted numbers from one base to another and vice versa. **Remember** that Integers have positions on a number line.

Activity 1

Represent the following numbers on the same number line

(d) -3, -1, 1, 2, 5, 10
(e) 0.1, 0.4, 0.5, 0.8
(f) 1/3, 1/2, 1/4, 2/5, 1/7

Rational Numbers

Remember, Integers and decimal numbers can easily be represented on a number line.

In the previous activity, you might have converted fractions to decimals in order to present them on a number line.

When fractions are converted into decimals, **they** are terminating, recurring and others are neither terminating nor recurring.

Note. Terminating and recurring decimals can be expressed in form of **a/b** where **a** and **b** are integers. This means that all integers can be written in form of **a/b**

Activity 2.

Express the following numbers in form of **a/b**

(c) 2, 7, 9, 11, 15, -3, -5
(d) $1\frac{1}{3}, 3\frac{1}{5}$, 2.2, 4.8, 1.02

You have seen that integers, terminating and recurring decimals can be written in form of **a/b** where **a** and **b** are integers.

Numbers which can be expressed in form of **a/b** are called Rational numbers.

Activity3.

Are all Decimal Numbers Rational numbers? With examples, justify your answer.

Irrational Numbers

Activity 4: Using a Calculator, find the square roots of the following numbers

(b) 1 (b) 4 (c) 9 (d) 3 (e) 2 (f) 13

Write the answers for (a)……(f) in form of **a/b** where **a** and **b** are integers

Have you been able to write your answers for (a) …..(f) in form of **a/b**?

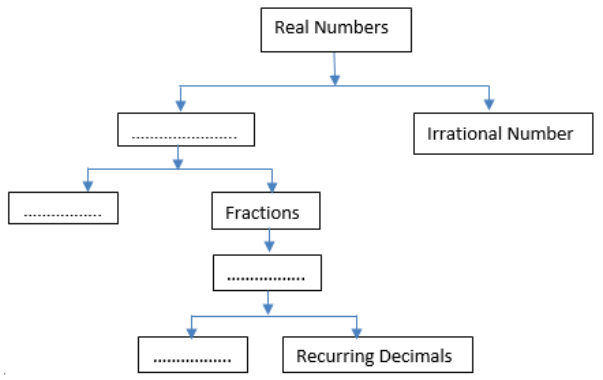
Note: All numbers which cannot be written in form of **a/b** are called irrational numbers

All Irrational numbers have corresponding positions on the Number line

Real Numbers

Remember Rational and Irrational numbers have positions on the Number line.

Activity 5: Complete the following chart of Real numbers



Converting Recurring Decimals into Fractions

Activity 6: Convert $\frac{2}{5}, \frac{1}{8}, \frac{3}{505}, \frac{2}{8}, \frac{1}{50}, \frac{3}{33}, \frac{11}{33}$ into decimals.

Note that decimals can be converted into Fractions.

Example: Convert 0.2, 0.5 into fractions

Solutions: $0.2 = \frac{2}{10} = \frac{1}{5}$

$0.5 = \frac{5}{10} = \frac{1}{2}$

Convert $\frac{2}{3}$ into decimal

Answer: $\frac{2}{3} = 0.6666..$

The answer 0.666… is a non-terminating **but a** recurring decimal

0.666 can be converted to fractions.

The recurring number is 6 and it starts recurring after the tenth position

So, take r to be 0.6666 i.e. r = 0.666 equation (i)

Multiply equation (i) by 10 i.e. 10r = 6.666 equation (ii)

Subtract equation (i) from equation (ii) i.e. 10r – r = 6.666 – 0.666 = 6.0

$$9r = 6$$

$$r = \frac{6}{9} = \frac{2}{3}$$

Activity 7

Convert the following recurring decimals into fractions

(f) 0.77…
(g) (b) 0.2424…
(h) (c) 0.01666….
(i) (d) 0.185353…
(j) (e) 4.203203…

Class: Senior Two

Topic: Algebra:

Lesson 1: Use of Symbols, substitution

Learning outcome : By the end of this lesson, you should be able to:

- interpret word problems
- Write a formula using symbols and correct.

Materials:

You will need a note book, pen, paper, razor blade or scissor to help you explore relationships between different shapes and how they can be used to build a formula.

Introduction

In your primary school and S.1, you were introduced to a number of mathematical symbols representing mathematical statements.

Activity 1

3. What are some of the symbols that you regularly interact with?
4. What do these symbols mean**? (MISSING SYMBOLS)**

SYMBOL	MEANING

Look around your homestead and construct a statement. Use the statements drawn from situations in your homestead and represent it using symbols.

Statement	Symbol
Number of boys in my family is **not equal to** the number of girls	≠

Exercise

3. Which of the symbols is not used to show multiplication?
   b. @ b. * c. × d. ( )
4. Which of the following statements is true?
   e. π is a special number
   f. There is only one way to show multiplication symbol
   g. 90^0 is the symbol for representing a right angle in a triangle.
   h. √ is a square root.

Lesson 2:

Learning outcome

By the end of this lesson, you should be able to:

- Write statements in algebraic form using symbols.

An Algebraic expression is formed from variables and constants using different operations.

Expressions are used to write word problems in math terms.

Expressions are like instructions that tell you what you have to do to a number or variable.

Words (statement)	Algebraic Expression
A number b is added to 6	b+6
9 is subtracted from x	x-9
A number t is multiplied by 8	t×8
A number z is divided by 3	z÷3 or $\frac{zz}{33}$

Activity

Choose the correct answer for each of the questions

2. The subtraction of 5 times of y from x is

(a) 5x – y

(b) y – 5x

(c) x – 5y

(d) 5y – x

(a) –1 × b

(b) 1 – b – 0

(c) 0 – (–1) × b

(d) – b – 0 – 1

3. The length of a side of square is given as 2x + 3. Which expression represents the perimeter of the square?

(a) 2x + 16

(b) 6x + 9

(c) 8x + 3

(d) 8x + 12

4. A fruit basket contains the same number of mangoes and oranges. If Eric eats 5 mangoes and 1 pear, there will be twice as many oranges as mangoes. How many oranges remain in the basket?

(a) 4
(b) 8
(c) 9
(d) 10
(e) 11

Lesson 3:

Learning outcome

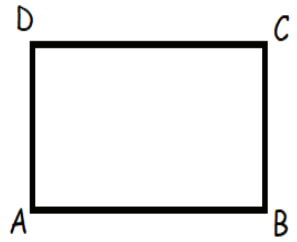
By the end of this lesson, you should be able to express one variable term in terms of another.

Activity 1

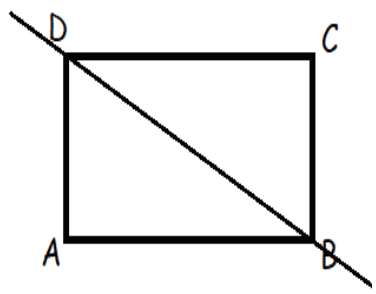
Let us use the area of a square to generate the formula of finding the area of a right-angled triangle.

Hint

Here is a piece of paper in a square shape labelled ABCD



Cut the piece/ fold the paper along diagonal from one end of the vertex to its opposite.



.

You will observe there are two equal right-angled triangles formed.

Use the Length, width and the area of the shape ABCD to derive a formula for finding the area of triangle.

Activity

6. Use the formula you have generated to obtain solutions to the following
   e. Base = 4 units, Height = 10 units
   f. Base =12 units, Height= 3 units

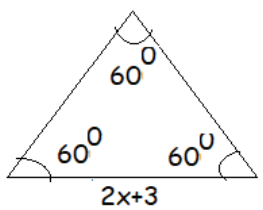
7. Use the following information to obtain the;
   g. Height, when Area= 16 square units, Base= 6 units

h. Base when Area= 24 square units, Height = 10 units

8. Find the values of the following algebraic expressions when a = – 2 and b = 3:
   f. 8a
   g. 5b
   h. a+3b
   i. 4a-2b
   j. $a^2 + 2ab + b^2$
9. Make x the subject in the following algebraic equations
   e. y=x+a
   f. y=2x-a
   g. y=2x+7
   h. ax-y=2y
10. Make x the subject of the formula in each of the following cases**.**
    d) a (x+b) =c
    e) $\frac{x}{a} = 1 + \frac{yx}{ba} = 1 + \frac{y}{b}$
    f) $\frac{x+y}{y} = \frac{y}{a} + \frac{ax+y}{y\ y} = \frac{y}{a} + \frac{a}{y}$

Follow up Activity

1. Find each side of an equilateral triangle given below, if the perimeter of the equilateral triangle is 240 cm.



2. Cut out shapes of two right angled triangles and a rectangle, Join them to form a shape of a trapezium
f. Paste the shape in your exercise book.
g. Draw the shape of the trapezium.
h. Use the right-angled triangles and a rectangle to derive a formula for **the** area of a Trapezium.
i. Write the formula in your notebook.
j. Use the formula to;
   (iii) Express the base of the trapezium in terms of the height and Area
   (iv) Express the height of the trapezium in terms of the base and Area

TOPIC: VECTORS AND TRANSLATIONS.

Lesson 1

Learning Outcome: By the end of this lesson you should be able to describe a translation.

Materials:

- Squared paper
- Sisal/Thread
- Mat/table
- Cup
- Plain paper

Introduction

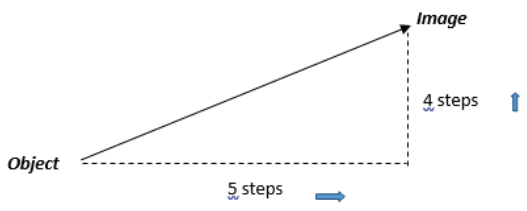
In senior one, you handled how to change the position of a shape by reflection. You are now going to handle translation. Translations is sliding or moving a shape in a straight line. In life, we move objects but the direction should be put into consideration. In reflection, you looked at "object" and "Image". In translation, we have "object" and "image". We describe the translation using specific values. Translations are also shown geometrically using the **X** and **Y** axes on the coordinate plane.

Instructions

I place a book on a table and I move it to another position in a straight line. This is a **translation.** The first position is the "object" position and the second position is the "image" position.

SPECIFIC VALUES

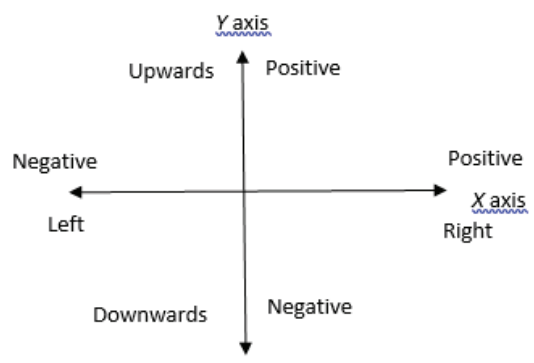
I move from one corner of a room to another. My former position is the "object" position and the new one is the "Image" position. I draw a line to connect the object to the image position. I count the steps from the object position to the right and upwards towards the image position.



The translation is described as 5 steps to the right and 4 steps upwards.

Cartesian plane

On the X and Y axes we represent the X direction (for left and right) and Y direction. (For upwards and downwards)



From the illustration above:

- Right 5 steps is +5 in the x direction.
- Upward 4 steps is +7 in the y direction.

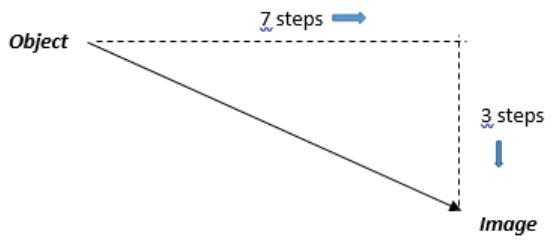
In coordinates, you write the X coordinate first ,then the Y-coordinate ,next like (x,y) with normal brackets but for the translation, it is written with longer brackets with the x-value first on top and the y-value on below.

$\begin{pmatrix} x \\ y \end{pmatrix}$

My translation with 5 steps to the right which is+5 and 4 steps forward which is +4 is written as

$\begin{pmatrix} 5 \\ 4 \end{pmatrix}$

We can also have



7 steps to the right which is +7

3 steps downwards which is -3

ACTIVITY

a) Place a cup on one corner of the mat/ table and then move it to the other corner in a straight line. Connect the two positions with a straight line using a thread or sisal. Use your hands and count the steps to the right and upwards and write the translation as a column vector.
b) Move the cup to any point on the mat/ table and repeat the above steps but count the steps to left and upwards depending on the direction you took.

Write these translations in column vector.

a) 4 steps to the right and 2 steps upwards.
b) 3 steps to the left and 5 steps downwards

Describe these vectors translations using left, right, upwards, downwards.

a) $\begin{pmatrix} -9 \\ 6 \end{pmatrix}\begin{pmatrix} -9 \\ 6 \end{pmatrix}$

b) $\begin{pmatrix} 8 \\ -3 \end{pmatrix}\begin{pmatrix} 8 \\ -3 \end{pmatrix}$

Topic: TRANSLATION

LESSON 2

Lesson Outcome: **By the end of this lesson, you should be able to:**

1. **Represent a translation on axes.**
2. **Show coordinates of the object and image.**
3. **Determine image for a given object and translation, Object for a given image and translation, Translation for given object ad image.**

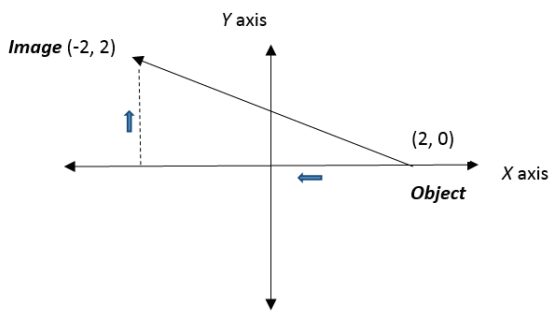
Materials: Graph paper, Ruler, Pencil.

Introduction:

A translation is represented on axes and the image and objects are identified by the coordinates. A line is drawn between the two and this is a vector for the translation. Using a graph paper, the position of the object or **image is** obtained when the vector of the translation is given. Likewise, get the translation vector when coordinates of either object or image are given.

Instruction:

Representation on the axes:

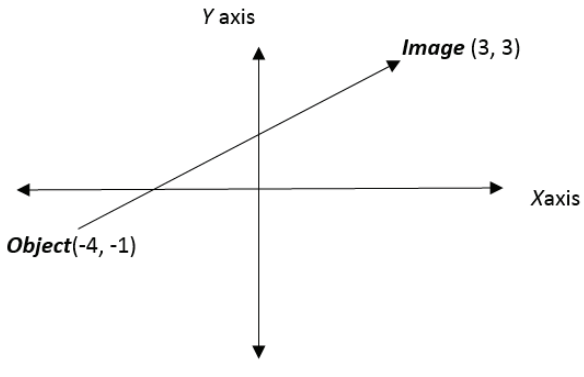


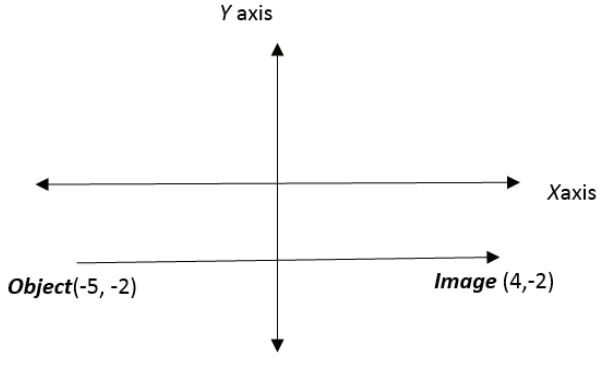
The translation of the object (2, 0) to the image (-2, 2) is then described as four steps to the left, -4 and two steps upward, 2 whose column vector is $\begin{pmatrix}-4\\2\end{pmatrix}$ $\begin{pmatrix}-4\\2\end{pmatrix}$.

ACTIVITY 1

Use your graph paper for this activity. Draw the X and Y axes on the graph paper.

1. Show the following column vectors on the graph axes:
$\begin{pmatrix}3\\5\end{pmatrix};\begin{pmatrix}-4\\9\end{pmatrix};\begin{pmatrix}-2\\-6\end{pmatrix};\begin{pmatrix}8\\-3\end{pmatrix}$.
2. Write the column vectors of the following translations.





3. An object at a point (1,-5) is translated by a vector $\begin{pmatrix}-3\\7\end{pmatrix}\begin{pmatrix}-3\\7\end{pmatrix}$. Write the coordinates of the image.
4. The object at (-3,-2) is translated to a point (-4,-6). What is the column vector of the translation?

LESSON 3: **VECTOR NOTATION**

Learning Outcome.

By the end of this lesson, you should be able to identify:

- A vector using letters and geometrically;
- Equal and opposite vectors.

Materials: Plate, Mat/Table, Squared paper, Ruler.

Introduction

You have drawn translations with arrows and also written them as column vectors. So vectors which represent translations are also represented using letters on lines with arrows on axes. We also have vectors that are equal vectors and opposite vectors.

Instructions

Notations

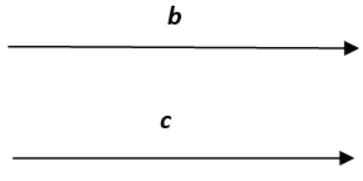
This represents a vector which is written as ***AB*** (bold in text books) or $\underline{AB}$ or $\overrightarrow{AB}\overrightarrow{AB}$ that you write in your exercise books.

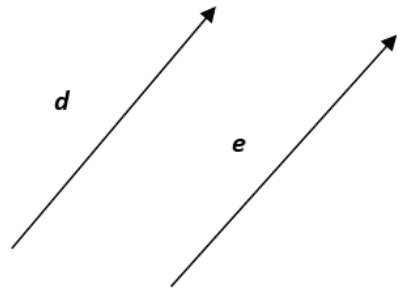
The tail of the vector is at A and the head is at B hence the direction AB. Using translation, A is the object position and B is the image position.

A vector can also be written with only one small letter e.g. $\underline{a}$, $\underline{b}$ or $\underline{c}$ and in text books, they will be bold **a, b** and **c.**

EQUAL VECTOR

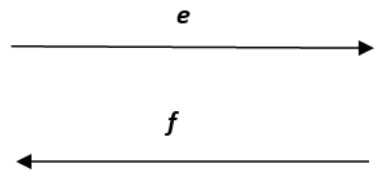
We identified vectors by their length and the direction.





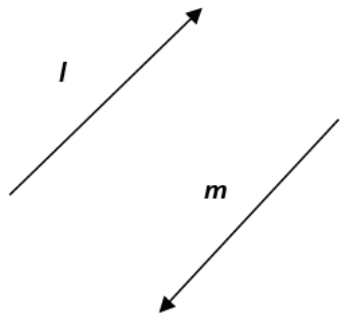
Vectors b and c have the same length and are facing in the same direction then we say the two vectors are equal. Also vectors d and e are equal. Therefore we write **b**=**c** and **d**=**c**

Look at the vectors ***e*** and ***f***. Comment on their length and direction.

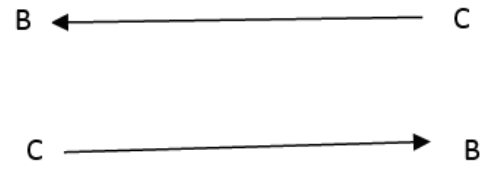


Did you notice that ***e*** and ***f*** have the equal length but facing opposite direction**?** Then we say that they are equal but opposite vectors and we write ***e*** = -***f***.

Write a math statement for vectors ***l*** and ***m***.



We have also seen that when writing vectors, we also use capital letters. For equal and opposite vectors, we write ***BC*** = -***BC*** as shown in the diagram below.



Column Vectors

If$\boldsymbol{AB} = \begin{pmatrix}2\\7\end{pmatrix}\boldsymbol{AB} = \begin{pmatrix}2\\7\end{pmatrix}$, then vectors ***PQ*** and ***RT*** that are equal to ***AB*** are also written as $\boldsymbol{PQ} = \begin{pmatrix}2\\7\end{pmatrix}$ $\boldsymbol{PQ} = \begin{pmatrix}2\\7\end{pmatrix}$ and $\boldsymbol{RT} = \begin{pmatrix}2\\7\end{pmatrix}\boldsymbol{RT} = \begin{pmatrix}2\\7\end{pmatrix}$.

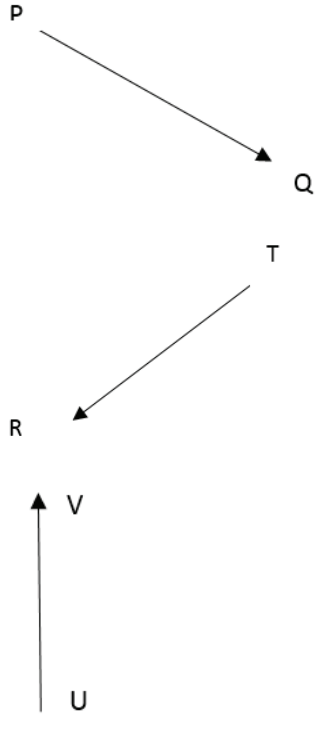
Then vectors ***DE*** and ***FG*** that are equal but opposite to ***AB*** are written as $\boldsymbol{DE} = \begin{pmatrix}-2\\-7\end{pmatrix}\boldsymbol{DE} = \begin{pmatrix}-2\\-7\end{pmatrix}$ and

$\boldsymbol{FG} = \begin{pmatrix}-2\\-7\end{pmatrix} \boldsymbol{FG} = \begin{pmatrix}-2\\-7\end{pmatrix}$ since $\boldsymbol{BA}$=-$\boldsymbol{AB}$=-$\begin{pmatrix}2\\7\end{pmatrix}\begin{pmatrix}2\\7\end{pmatrix}$=$\begin{pmatrix}-2\\-7\end{pmatrix}$ $\begin{pmatrix}-2\\-7\end{pmatrix}$.

ACTIVITY 1

1. Draw the following vectors: ***CD,DC*** using arrows**.**

2. Name the vectors below.



3. Draw on a plain paper

- Two equal vectors and write the vector notation of the vectors
- Two equal and opposite vectors. Write down their vector notations.

4. Place a plate **in** one corner of a mat or table. Slide the cup in a straight line to any position on the mat right down the column vector of the translation. Slide the plate in a straight line back to its original position. Write down the column vector of the translation. What do you observe between the two column vectors**?**

LESSON 4

Topic: Combined vectors

Learning outcomes:

By the end of this lesson you should be able to:

- Write a math statement showing a combination of vectors.
- Represent the combined vectors on a graph paper.
- Write combined vectors using column vectors

Materials

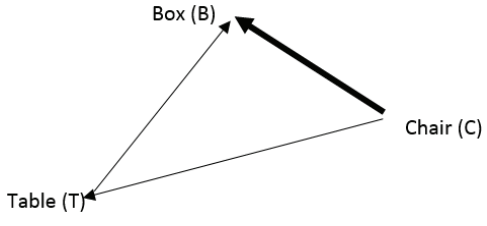
- Charts with letters A, B, C, D, E, F
- Graph paper

Introduction

We combine two or more vectors to form one vector. We also combine translations to obtain one translation. These combinations may be represented using letters, column vectors or graphs.

Instruction:

In my room, there is a table (T), a chair (C) and a box (B) that are not arranged in a straight line as shown in the figure below.



- Am sitting on the chair (C), then I move in a straight line to the table (T).
- From the table (T), I then move to the box (B) in a straight line.

This is a combination of two translations and the result is that I have moved from **the** chair to the box passing the **table.**

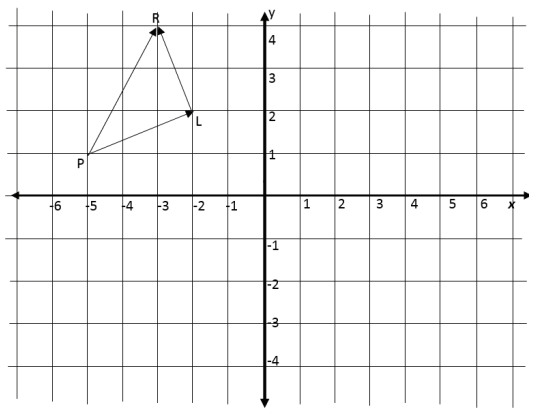
However, I can also move from the chair (C) directly to the box (B) without first going to the table.

Let use the letters to write the vectors of each translation.

- Chair to table is written ***CT***
- Table to box is written ***TB***
- Chair to box is ***CB***

We write the mathematical statement for the combined translations using vectors as $\boldsymbol{CT}+\boldsymbol{TB}=\boldsymbol{CB}$

Graphically:



Combinations of vectors

Mathematical Statement is $\boldsymbol{PL}+\boldsymbol{LR}=\boldsymbol{PR}$

From the graph, the column vectors are

$\boldsymbol{PL} = \begin{pmatrix}3\\1\end{pmatrix}$, $\boldsymbol{LR} = \begin{pmatrix}-1\\2\end{pmatrix}$, $\boldsymbol{PR} = \begin{pmatrix}2\\3\end{pmatrix}$

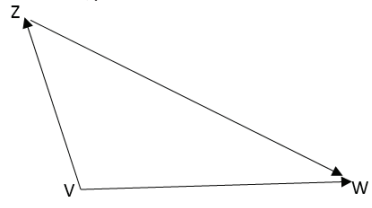
We now substitute the column vectors in the mathematical statement

$\boldsymbol{PL} + \boldsymbol{LR} = \boldsymbol{PR}$

$\begin{pmatrix}3\\1\end{pmatrix} + \begin{pmatrix}-1\\2\end{pmatrix} = \begin{pmatrix}2\\3\end{pmatrix}$

ACTIVITY 2

1. Write a mathematical statement to represent the combined vectors in the diagram below.



2. Identify any three objects inside your house or outside in the compound beginning with different letters. **Place them on papers** with the first letter of each object like Tree put 'T', shirt put 'S' and Hole 'H'
   a) Write different mathematical statements which represent the combined vectors **you have** form out of three objects.
   b) Draw the combinations on a piece of paper.
3. Draw the following column vectors on axes of a squared paper.

$\boldsymbol{EF} = \begin{pmatrix}3\\5\end{pmatrix}$ and $\boldsymbol{FG} = \begin{pmatrix}-2\\1\end{pmatrix}$

   a) Obtain from the graph the column vector of ***EG***
   b) Write the **mathematical** statement from the graph using both letters and column vectors.

Class: Senior Two

Lesson 5

Learning outcomes: By the end of this lesson, you should be able to add vectors and obtain a single vector which represents the other vectors.

Materials: Graph paper.

INTRODUCTION

We earlier in Lesson 4 looked at combined vectors. These are represented as addition of two vectors. A combination of vectors can also be more than two vectors.

INSTRUCTIONS

a) We add vectors by adding the x values and y values then finally obtain the vector.

$\begin{pmatrix}3\\1\end{pmatrix} + \begin{pmatrix}9\\4\end{pmatrix} = \begin{pmatrix}3+9\\1+4\end{pmatrix} = \begin{pmatrix}12\\5\end{pmatrix}$

Or

$\begin{pmatrix}-6\\8\end{pmatrix} + \begin{pmatrix}7\\-3\end{pmatrix} = \begin{pmatrix}-6+7\\8+-3\end{pmatrix} = \begin{pmatrix}1\\5\end{pmatrix}$

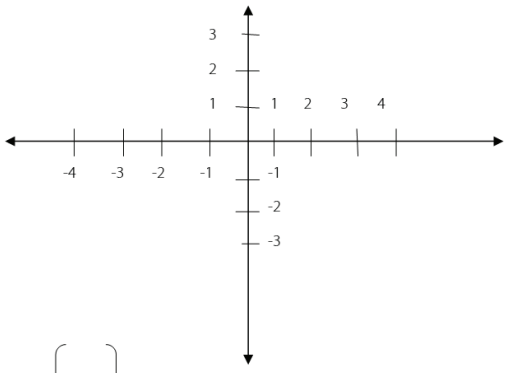
Or

$\begin{pmatrix}-5\\-2\end{pmatrix} + \begin{pmatrix}1\\-1\end{pmatrix} = \begin{pmatrix}-5+1\\-2+-1\end{pmatrix} = \begin{pmatrix}-4\\-3\end{pmatrix}$

a) On axes, draw these vectors and find the

vector that result from the combination.

$$\begin{pmatrix} -1 \\ 3 \end{pmatrix} + \begin{pmatrix} 4 \\ 2 \end{pmatrix}$$



$$= \begin{pmatrix} 3 \\ 5 \end{pmatrix}$$

Do you observe that in the last lesson that combined vectors were added? Check and confirm.

ACTIVITIY 1

1. Draw axes on squared paper and add the following vectors.

a) $\begin{pmatrix} 5 \\ -1 \end{pmatrix} + \begin{pmatrix} 7 \\ 2 \end{pmatrix}$

b) $\begin{pmatrix} -3 \\ 4 \end{pmatrix} + \begin{pmatrix} -2 \\ -8 \end{pmatrix}$

1) Add the following vectors without drawing.

a) $\begin{pmatrix} 2 \\ 11 \end{pmatrix} + \begin{pmatrix} -9 \\ -4 \end{pmatrix}$

b) $\begin{pmatrix} 8 \\ -10 \end{pmatrix} + \begin{pmatrix} -2 \\ 3 \end{pmatrix}$

Topic: Business arithmetic

Lesson 1: Calculating Profit and Loss.

Learning outcomes:

By the end of this lesson, you should be able to:

v. Calculate profit and loss
vi. Express profit and loss as a percentage
vii. Calculate discount and commission
viii. Calculate simple interest.

Materials:

For this lesson, you will need to collect items that are used in a home, those that were bought from a shop. You will need receipts, price tags, a pen/ pencil and a rough book to try out the exercises.

Introduction:

Dear student, you must agree with me that buying and selling is part of any trade. The goods we use at home are bought from shops, markets and supermarkets. People who sell to us also buy from other wholesalers and sell them to us at a higher price. The extra money the goods are sold for is the **profit**. If the goods are sold at a *lower price* than the price at which they were bought, the difference is the **loss**.

The price at which the goods are bought is called the **cost price *(C.P)***

The price at which the goods are sold is called the **selling price (S.P)**

Now, try to reflect on issues discussed above with the following activity.

Activity 1

4. A bicycle bought for 180,000/= was sold for 150,000/=.
   iv. What was the cost price?
   v. What was the selling price?
   vi. Was the bicycle sold at a profit or loss? Give a reason for your answer.

5. Musa bought a radio at 60,000 UGX and sold it to his brother at 55,000 UGX. Calculate the profit or loss made on this item.

6. A box of mineral water has 24 bottles. A shopkeeper bought it from the wholesale shop at 18,000 UGX. He sold each bottle at 1000 UGX. Calculate the profit or loss made by the shopkeeper.

Lesson 2: Percentage loss and profit

Materials: a pen/ pencil and a rough book to try out the exercises.

Introduction

In the previous lesson, you were able to calculate the profit or loss made by reselling an item. In this lesson, you will learn to express the profit or loss as a percentage. You can determine the percentage profit or loss using the formulae below;

$$\text{Percentage profit} = \frac{Profit}{Cost\ Price} \times 100$$

$$\text{Percentage loss} = \frac{Loss}{Cost\ Price} \times 100$$

Example 1:

A bicycle bought at 180,000/= was sold for 150,000/=. Calculate the percentage loss.

$$\text{Percentage loss} = \frac{Loss}{Cost\ Price} \times 100$$

$$= \frac{C.P - S.P}{C.P} \times 100$$

$$= \frac{180{,}000 - 150{,}000}{150{,}000} \times 100$$

$$= \frac{30{,}000}{150{,}000} \times 100$$

$$= \frac{\cancel{30{,}000}}{\cancel{150{,}000}} \times 100$$

$$= 20\%$$

The loss on the bicycle is 20%.

Activity 2

6. Mangoes are bought by a fruit shop for 300 shillings each and resold at 500 shillings each.
   a. What is the cost price? _____
   b. What is the selling price? _____
   c. What is the profit? _____
   d. Calculate the percentage profit on the cost price. _____

$\text{Profit} = S.P - C.P$

$\text{Loss} = C.P - S.P$

7. Josephine makes school uniforms. It costs her 30,000/= to make a girl's skirt. She then sells them for 48,000/= each.
   a. What is the cost price? _____
   b. What is the selling price? _____
   c. What is the profit? _____
   d. Calculate the percentage profit._____ ____

8. Ahmed bought a used car for $14 500, spent another $2000 on repairs, before selling it for $19 000. Find:
   a. the total amount Ahmed spent on the car _____
   b. the profit he made _____
   c. the percentage profit on the total amount he spent. _____

9. A company selling newspapers spends 15,00/= to produce a copy of the newspaper and sells it at 2,000/=. On a given day, **the** company produced 2000 copies and managed to sell 1000 copies only.
   a. Did the company make a profit or loss on that day?
   b. Calculate the percentage profit/ loss for the day.

10. Copy the table shown below and fill in the missing values.

Item	C.P	S.P	Profit/Loss	comment	% Profit/loss
Dress	20000	30000			
Shirt	18000	22000			
Cow	700000	900000			
House	80 million	72 million			
TV	300000	360000			
Smart phone	250000	200000			
Bag of Irish potatoes	100000	120000			
Pair of shoes	45000	40000			

Lesson 3: Discount

Materials: a pen/ pencil and a rough book to try out the exercises.

Introduction

In the areas of competition, shops find ways of encouraging customers to buy. One way of encouraging customers is offering them a discount. This is done by reducing an amount from the usual price of an item. This reduction in price is called **Discount.** It is usually calculated as a percentage of the selling price.

Example: Sarah buys a dress for cash whose marked price is shillings 50,000. A shopkeeper offers 10% discount for cash payments.

c) How much is the discount?
d) How much does she actually pay for the dress?

c) $Discount = \frac{10}{100} x\ 50{,}000$
$= 5{,}000\ shillings$

d) $She\ pays\ \ 50{,}000 - 5{,}000$
$= 45{,}000\ shillings$

Activity 3

1. The marked price of a watch is 46,500. The shopkeeper offers an off-season discount of 18% on it. Find its selling price.

2. The price of a sweater was slashed from 9600 shillings to 8160 shillings by a shopkeeper in a rainy season. Find the rate of discount given by him.

3. Find the percentage discount being given on a shirt whose selling price is 54,600 shillings after deducting a discount of 10,400 on its marked price.

Hint. Market Price = (SP) + (discount).

4. After allowing a discount of 8% on a toy, it is sold for $ 216.20. Find the marked price of the toy.

5. A set of kitchen utensils was bought for 52,800 after getting a discount of 12% on its marked price. Find the marked price.

6. A dealer marks his goods at 35% above the cost price and allows a discount of 20% on the marked price. Find his gain or loss per cent.

7. A cell phone was marked at 40% above the cost price and a discount of 30% was given on its marked price. Find the gain or loss percent made by the shopkeeper.

8. A dealer purchased a fan for UGX 10800. After allowing a discount of 25% on its marked price, he gains 25%. Find the marked price of the fan.

Lesson 4: Commission

Materials: You will need a pen/ pencil and a rough book to try out the exercises.

Introduction

Commission is a fee paid for services. It is usually calculated as a percentage of the total cost of the goods. This amount can be paid to salesmen as sales commission. Sales commissions is the amount of money paid to employees or companies that sell goods in stores or by calling on customers. The commission is meant to motivate sales persons to sell more.

For example, if a salesperson receives a 10% commission on their sales, a salesperson sells goods worth 15,000 shillings, they would earn 1,500 shillings in commissions.

So, commission = $\frac{10}{100}\ \frac{10}{100}$ x 15000

= 1500 shillings

Activity 4

6. A salesman gets a fixed salary of $2000 per month and a commission of 2% on sale. If total sale for the month of April was $30,000, find his total salary for that month?

7. Joan makes a commission of 2% when a house is sold by his company. How much money will Joan make as a commission if her company sells the house for 300,000,000 shillings?

8. Mike makes **a** commission of 10% on each TV set sold at store. Each TV costs $120. How much money will he make as commission if **the** store sells 25 TV sets?

9. John is selling sets of knives and makes a 10% commission on all sales. What would his commission be on the sale of a $3250 set of knives?

10. Sonny works as a furniture salesman and earns a base salary of $350 per week plus 6% commission on sales. What was Sonny's weekly gross salary if his total sales were $3750?

Lesson 5: Simple Interest

Materials: a pen/ pencil and a rough book to try out the exercises.

Introduction

Dear students, do you know that Money is not borrowed for free?

When money is borrowed from the bank, the bank charges for the use of the money. This charge is called **interest** usually denoted by **(I)**.

Also when money is deposited with the bank, the bank **pays interest to** the owner of the money. The amount borrowed is called the **Principal** usually denoted by **(P).**

The interest is usually calculated as a **Percentage Rate** usually denoted by **(R).** Interest also depends on the length of **Time (T)** that the money is borrowed or invested for. The principal together with the interest is called the **Amount (A)**

Simple interest can be calculated using the formula
$I = P \times R \times TI = P \times R \times T$

For example: Annette deposited 500000 shillings on her fixed account in a financial institution which pays an interest rate of 12% per annum. How much interest will she earn after 2 years?

In this example, the principal is 500,000

The rate is 12% per annum which is the same as $\frac{12}{100}$

$\frac{12}{100}$ per annum.

The time of investment is 2 years.

Using the formula $I = P \times R \times TI = P \times R \times T$

$$I = 500{,}000 \times \frac{12}{100} \times 2$$

I = 120,000 shillings.

Activity 5

1. If you borrow 675,000 shillings for six years at an interest rate of 10%, how much interest will you pay?
2. If the balance at the end of eight years on an investment of $630 that has been invested at a rate of 9% is $1,083.60, how much was the interest?
3. How much interest is earned on 5,000,000 at 4% for seven years?
4. Jane borrowed 2,250,000 shillings from the bank for eight years at an interest rate of 6%. How much interest will she pay?
5. If you put 624,000 shillings into a savings account that earns 5%, how much money will you have at the end of four years?

Topic: **Numerical Concepts**

Lesson 1

Learning outcome

By the end of this lesson, you should be able to know the Rational, Irrational and Real Numbers. You will work out problems involving these numbers and apply them in real life situations.

Materials: You will need grid papers. The grid papers will be used when dealing with Square numbers and Square roots.

Introduction

You have already learnt about some types of numbers like Natural numbers, Whole numbers, Fractions, Decimals, Integers and many others. All these numbers can be expressed in different bases.

In term one of Senior one, you learnt *Bases* where you carried mathematical operations, converted numbers from one base to another and vice versa. **Remember** that Integers have positions on a number line.

Activity 1

Represent the following numbers on the same number line

(g) -3, -1, 1, 2, 5, 10
(h) 0.1, 0.4, 0.5, 0.8
(i) 1/3, 1/2, 1/4, 2/5, 1/7

Rational Numbers

Remember, Integers and decimal numbers can easily be represented on a number line.

In the previous activity, you might have converted fractions to decimals in order to present them on a number line.

When fractions are converted into decimals, **they** are terminating, recurring and others are neither terminating nor recurring.

Note. Terminating and recurring decimals can be expressed in form of **a/b** where **a** and **b** are integers. This means that all integers can be written in form of **a/b**

Activity 2.

Express the following numbers in form of **a/b**

(c) 2, 7, 9, 11, 15, -3, -5
(d) $1\frac{1}{3}, 3\frac{1}{5}$, 2.2, 4.8, 1.02

You have seen that integers, terminating and recurring decimals can be written in form of **a/b** where **a** and **b** are integers.

Numbers which can be expressed in form of **a/b** are called Rational numbers.

Activity3.

Are all Decimal Numbers Rational numbers? With examples, justify your answer.

Irrational Numbers

Activity 4: Using a Calculator, find the square roots of the following numbers

(c) 1 (b) 4 (c) 9 (d) 3 (e) 2 (f) 13

Write the answers for (a)……(f) in form of **a/b** where **a** and **b** are integers

Have you been able to write your answers for (a) …..(f) in form of **a/b**?

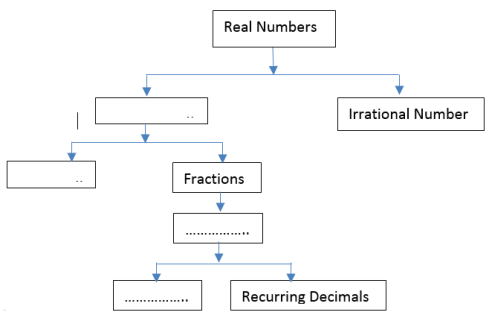
Note: All numbers which cannot be written in form of **a/b** are called irrational numbers

All Irrational numbers have corresponding positions on the Number line

Real Numbers

Remember Rational and Irrational numbers have positions on the Number line.

Activity5: Complete the following chart of Real numbers



Converting Recurring Decimals into Fractions

Activity 6: Convert $\frac{2}{5}, \frac{1}{8}, \frac{3}{50}, \frac{1}{3}$ into decimals.

Note that decimals can be converted into Fractions.

Example: Convert 0.2, 0.5 into fractions

Solutions: $0.2 = \frac{2}{10} = \frac{1}{5}$

$$0.5 = \frac{5}{10} = \frac{1}{2}$$

Convert $\frac{2}{3}$ into decimal

Answer: $\frac{2}{3} = 0.6666\ldots$

The answer 0.666… is a non-terminating **but a** recurring decimal

0.666 can be converted to fractions.

The recurring number is 6 and it starts recurring after the tenth position

So, take r to be 0.6666 i.e. r = 0.666 equation (i)

Multiply equation (i) by 10 i.e. 10r = 6.666 equation (ii)

Subtract equation (i) from equation (ii) i.e. 10r – r = 6.666 – 0.666 = 6.0

9r = 6

$$r = \frac{6}{9} = \frac{2}{3}$$

Activity 7

Convert the following recurring decimals into fractions

(k) 0.77…
(l) (b) 0.2424…
(m) (c) 0.01666….
(n) (d) 0.185353…
(o) (e) 4.203203…

Class: Senior Two

Topic: Algebra:

Lesson 1: Use of Symbols, substitution

Learning outcome : By the end of this lesson, you should be able to:

- interpret word problems
- Write a formula using symbols and correct.

Materials:

You will need a note book, pen, paper, razor blade or scissor to help you explore relationships between different shapes and how they can be used to build a formula.

Introduction

In your primary school and S.1, you were introduced to a number of mathematical symbols representing mathematical statements.

Activity 1

5. What are some of the symbols that you regularly interact with?
6. What do these symbols mean**? (MISSING SYMBOLS)**

SYMBOL	MEANING

Look around your homestead and construct a statement. Use the statements drawn from situations in your homestead and represent it using symbols.

Statement	Symbol
Number of boys in my family is **not equal to** the number of girls	≠

Exercise

5. Which of the symbols is not used to show multiplication?
   c. @ b. * c. × d. ( )
6. Which of the following statements is true?
   i. π is a special number
   j. There is only one way to show multiplication symbol
   k. 90^0 is the symbol for representing a right angle in a triangle.
   l. √ is a square root.

Lesson 2:

Learning outcome

By the end of this lesson, you should be able to:

- Write statements in algebraic form using symbols.

An Algebraic expression is formed from variables and constants using different operations.

Expressions are used to write word problems in math terms.

Expressions are like instructions that tell you what you have to do to a number or variable.

Words (statement)	Algebraic Expression
A number b is added to 6	b+6
9 is subtracted from x	x-9
A number t is multiplied by 8	t×8
A number z is divided by 3	z÷3 or $\frac{zz}{33}$

Activity

Choose the correct answer for each of the questions

3. The subtraction of 5 times of y from x is

(a) 5x – y
(b) y – 5x
(c) x – 5y
(d) 5y – x
(a) –1 × b
(b) 1 – b – 0
(c) 0 – (–1) × b
(d) – b – 0 – 1

3. The length of a side of square is given as 2x + 3. Which expression represents the perimeter of the square?

(a) 2x + 16
(b) 6x + 9
(c) 8x + 3
(d) 8x + 12

4. A fruit basket contains the same number of mangoes and oranges. If Eric eats 5 mangoes and 1 pear, there will be twice as many oranges as mangoes. How many oranges remain in the basket?

(a) 4
(b) 8
(c) 9
(d) 10
(e) 11

Lesson 3:

Learning outcome

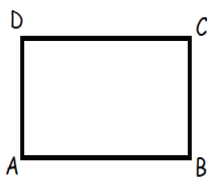
By the end of this lesson, you should be able to express one variable term in terms of another.

Activity 1

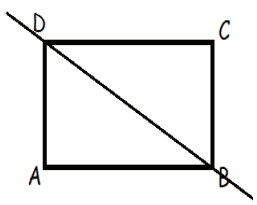
Let us use the area of a square to generate the formula of finding the area of a right-angled triangle.

Hint

Here is a piece of paper in a square shape labelled ABCD



Cut the piece/ fold the paper along diagonal from one end of the vertex to its opposite.



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You will observe there are two equal right-angled triangles formed.

Use the Length, width and the area of the shape ABCD to derive a formula for finding the area of triangle.

Activity

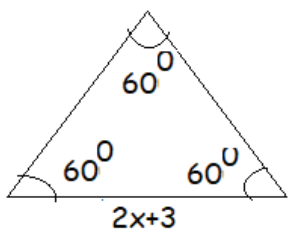
11. Use the formula you have generated to obtain solutions to the following
i. Base = 4 units, Height = 10 units
j. Base =12 units, Height= 3 units

12. Use the following information to obtain the;
k. Height, when Area= 16 square units, Base= 6 units
l. Base when Area= 24 square units, Height = 10 units
13. Find the values of the following algebraic expressions when a = – 2 and b = 3:
    k. 8a
    l. 5b
    m. a+3b
    n. 4a-2b
    o. $a^2 + 2ab + b^2$
14. Make x the subject in the following algebraic equations
    i. y=x+a
    j. y=2x-a
    k. y=2x+7
    l. ax-y=2y
15. Make x the subject of the formula in each of the following cases**.**

g) **a (x+b) =c**
h) $\frac{x}{a} = 1 + \frac{y}{b}$
i) $\frac{x+y}{y} = \frac{y}{a} + \frac{a}{y}$

Follow up Activity

3. Find each side of an equilateral triangle given below, if the perimeter of the equilateral triangle is 240 cm.



4. Cut out shapes of two right angled triangles and a rectangle, Join them to form a shape of a trapezium
k. Paste the shape in your exercise book.
l. Draw the shape of the trapezium.
m. Use the right-angled triangles and a rectangle to derive a formula for **the** area of a Trapezium.
n. Write the formula in your notebook.
o. Use the formula to;
   (v) Express the base of the trapezium in terms of the height and Area
   (vi) Express the height of the trapezium in terms of the base and Area

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