Republic of Zambia

Ministry of Education

MATHEMATICS I

TEACHING MODULE

FORM 1: TERM 1

Developed by the Curriculum Development Centre
Lusaka
2025

Vision

Quality, lifelong education for all which is accessible, inclusive and relevant to individual, national and global needs

PREFACE

The **Mathematics I Teaching Module** for Form 1 has been developed to provide guidance to the teacher on how to deliver competence-based lessons which for learners at ordinary secondary school level. The teaching module is aimed at providing quality education that is aligned with the Competence-Based Curriculum and 21st Century Skills. It also aims to facilitate the building of knowledge, skills, values and positive attitudes that are aimed at enabling learners to live and grow into productive and useful members of their communities and the Zambian society.

The guide provided in this teaching module is aimed at facilitating the acquisition of knowledge, competences and values to nurture a learner who is creative, critical and an analytical thinker. The suggested learning activities are designed to offer learners hands-on and minds-on experiences through manipulative tasks. Thus, the learners will develop knowledge, desirable lifelong skills, values and positive attitudes needed for their personal and national development.

It is hoped that the guidance provided in this module will make learning at Form 1 level more meaningful and enjoyable as it is highly activity oriented and allows for a smooth transition into the Constructivist way of learning.

Joel Kamoko, (Mr.)
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ACKNOWLEDGEMENT

This Form 1 Teaching Module incorporates guidance on how to deliver Competence based lessons for learners in Mathematics. The module is a result of the tireless contributions of many key individuals and organisation with a passion for the subject.

Many thanks go to individuals, institutions and organizations that participated in the successful development of this Module. These include teachers, lecturers from colleges and public universities in Zambia, experts from Directorates in the Ministry of Education.

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Lastly I also recognise the commitment and hard work of Staff at the Curriculum Development Centre in ensuring that this syllabus is successful.

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INTRODUCTION

The Form 1 Mathematics Teaching Module has been developed to guide teachers on how to facilitate competence-based lessons at this level. The module aims to provide quality education that is aligned with the competence-based curriculum and 21st Century Skills. It also aims to facilitate the developing of knowledge, skills, values and positive attitudes that are aimed at enabling learners to live and grow into productive and useful members of their communities and the Zambian society.

PURPOSE OF THE MODULE

The purpose of the module is to illustrate teaching and learning activities that:

a) are consistent with teaching and learning in a competence-based curriculum;
b) show processes that allow achievement of 21st Century Skills such as creativity, collaboration, communication and critical thinking;
c) Illustrate what activity-based and learner-centred teaching and learning could look like.

HOW TO USE THE MODULE

This module provides **suggested learning activities and teaching strategies** that enhance learners' mathematical competences. The suggested activities are designed to offer learners hands-on experiences through manipulation of tasks that are interactive and learning through practice. We should bearing in mind that the desired competences and 21st century skills will NOT be achieved by the topics 'covered' but by the manner in which teaching and learning activities are carried out. For example, asking learners to give reasons for their answers, whether or not the answer is right; to plan for solving a problem; to consider alternative ways of solving a problem even if the first method yields a correct answer and to consider which of the methods is

better; to acknowledge that even in Mathematics, more than one correct answer is possible, for example, "What two numbers when added have 5 as the answer?"

Activities in the Module are meant to be incorporated in the teacher's lesson plan. The activities are NOT meant to replace the teacher's lesson plan. The topics and activities in the Module are as specified in the 2023 Mathematics I Form 1to 4 syllabus. There might be terms used in the Module that are not exactly the same as those in the syllabus, but this is in the interest of using language that might be more learner-friendly. Teachers are encouraged to vary the environment when conducting lessons in order to create a good atmosphere for learning and teaching which is learner friendly.

Each topic in the Module begins with a *Hook*. A Hook is an opening statement at the start of the topic that seeks to stimulate learners' curiosity and motivate them to learn. Teachers may create their own hooks that provoke their learners' curiosity and motivation. A hook can be a provocative question, a scenario or something that puts learners into a thinking mood. Let the designed hook incline towards problem-solving scenarios.

TOPIC 1: NUMBERS

INTRODUCTION

Numbers are the foundation of mathematics and play an important role in our daily lives. They are used to quantify, measure, and make comparisons in different aspects of our day-to-day life situations. Understanding numbers helps us make informed decisions, solve problems and understand the world around us. In this topic, we shall explore classification of numbers and combined operations on real numbers.

Key terms

Prime Numbers, Composite Numbers, Integers, Rational Numbers, Irrational Numbers, Real Numbers, Complex Numbers, Factors, Multiples, Prime Factorisation, Combined Operations

General competence(s):

Analytical Thinking, Communication, Problem Solving, Collaboration, Financial Literacy, Digital literacy, Creativity.

Key question: Imagine a world where numbers no longer exist. One day, you wake up to find that all numerical data has vanished from your life. How different would the world be?

Subtopic 1 - Classification of Numbers.

Introduction

Classification of numbers is a fundamental concept in mathematics that helps us understand the different types of numbers and their properties. In this section we shall explore properties of different numbers, factors and multiple and their applications in real life.

Specific competence: Apply classification of numbers in real life situations

Key question:

You are on duty to wash the kitchen utensils you used for lunch. After washing you are to pack them. What would you consider in the packing process? Can you do the same for numbers?

Learning Activity 1: Exploring properties of different types of numbers (*natural, numbers, whole, integers, prime numbers, even numbers, odd numbers, rational, irrational, composite* numbers) using materials (*puzzles, number cards, games*….)

Activity 1.1 Brainstorming

Learners in pairs examine the groups of numbers given to them. Their task is to figure out the properties that numbers in each group share. What do they have in common?

a. {1,2,3,4,5,6,7,…}
b. {0,1,2,3,4,5,…..}
c. {…,-3,-2.-1,0,1,2,3,…)
d. {…-5,-3.-1,1,3,5,7,9,11,13, 15…}
e. {…-4,-2,0,2,4,6,8,10,…}
f. {2,3,5,7,11,13..}

g. {4,6,8,9,10,12,….}

- Next Pairs compare number groups;
  i. (a) and (b)
  ii. (c) and (b)
  iii. (d) and (e)
  iv. (f) and (g)

Content Tips:

From examining members of each group and comparing groups, learners will determine the properties of each group of umbers.

a. Properties: - (*non-negative numbers , starting from 1, they have no fractions or decimal numbers,…..* ***Natural numbers[N])***
b. Properties: - *(non-negative numbers starting from zero, They have no fractions or decimal numbers,…..* ***whole numbers[W]).***
c. Properties: - (*zero, positive and negative numbers, They have no fractions or decimal numbers,…..****Integers****[Z]).*
d. Properties:- (*zero, positive and negative numbers, They have no fractions or decimal numbers, divisible by two ….****.. Even numbers***).
e. Properties:- (*positive and negative numbers, They have no fractions or decimal numbers, not divisible by two ….. **Odd numbers*****).***
f. Properties:- (*zero, positive numbers, They have no fractions or decimal numbers, divisible by one and itself ….. **prime numbers*****).***
g. Property :- (*positive numbers, They have no fractions or decimal numbers, divisible by more than one number….. **Composite numbers*****).***

Activity 1.2

In pairs learners compare the elements in each group

A={1.25, 1.5, $\frac{1}{3}$,$\frac{1}{7}$, $\frac{5}{1}$, $\sqrt{9}$, $\sqrt{16}$…..}

B= {pi(π), $\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$….}

In pairs the learners answer the following questions (learners should use a calculator for conversion)

i. What do you observe about the decimal part for each of the groups?
ii. Can all the members in A and in group B be represented as a fraction (in the form $\frac{a}{b}$ where a and b are integers and b not equal to 0)?
iii. What can you observe about the result of the square roots in A and in B ?

Content Tips:

From the examination of the two groups of numbers of learners will observe the properties of the numbers

- Numbers in A (Decimal part is repeating and for others its terminating, they can be written in the form $\frac{a}{b}$, contains perfect squares … **Rational Numbers**)
- Numbers in B (Decimal part is non repeating and for others its nonterminating, they cannot be written in the form $\frac{a}{b}$, contains non perfect squares …**Irrational Numbers**)

Activity 1.3: Individual Work

Task:

a. Create groups of numbers that have the same properties, from the numbers given in the table.

4	0	5	21	-7
23	12	-3	7	-13
37	8	3	2/5	10
19	4/7	π	$\sqrt{9}$	26
$\sqrt{7}$	-1	14	o.25	35
9	16	$\sqrt{25}$	2.5	43
11	18	1	37	2
-4	19	$\sqrt{2}$	$\sqrt{3}$	6

b. State the properties of the numbers in the each of the groups you have created.

Key considerations

- Ensure that learners are given enough time to analyse the numbers.
- Fill in the gaps of classifications not identified by asking probing questions.
- Check on the learners as they work.

Content Tips:

- Groups of numbers expected are natural, whole numbers, prime numbers, even, odd, integers rational, irrational, composite numbers.

Learning Activity 2: Investigating the factors and multiples of numbers

Activity 2.1 Group work

Materials: Paper, markers Whiteboards, Manila paper, Number cards (20 to 50), Counters (bottle*tops, cubes,* …) brought by learners, Worksheets for recording findings

Instructions:

- Divide the class into small groups.
- pick a number card and show it to the learners
- ask the learners to group their counters into equal sets based on the different ways the given number can be organised
- ask the learners to explain how they came up with the equal groups
- ask follow up questions in case of any missing groups.
- Ask each group to pick a number card and find all possible equal groups and present to the whole class.

Activity 2.2: Individual task.

1. You are planning a party for 18 guests. You want to set up tables where each table has the same number of seats. What are all the possible ways you can arrange the seating?
2. You're creating a playlist of songs, and you want each song to be exactly 4 minutes long. If you have 28 minutes available, how many full songs can you fit into the playlist?
3. A soccer tournament has 24 teams, and you want to create groups with 4 teams per group. How many groups will there be? If instead the organizers decide that there should be 3 teams per group, how many groups will there be in the tournament?
4. A factory operates in 9-hour shifts. If you want to schedule a worker for 72 hours, how many shifts will they work?
5. You are organizing a school event, and you need to divide 30 learners into smaller groups. Each group should have the same number of Learners. How many ways can you divide the Learners into equal-sized groups?
6. You have 48 books, and you want to organize them into stacks with an equal number of books in each stack. What are the different ways you can make equal-sized piles of books?
7. You need to buy markers for a classroom, and each pack contains 8 markers. If you need 64 markers, how many packs do you need to buy? How many packs of 8 markers do you need to buy to get at least 64 markers?

Content Tips:

A factor is a number that goes into another number without leaving a remainder. From the activity, all possible arrangements of equal groups of any number give the factors of the number (1, 2, 4, 5, 10, 20 are factors of 20)

A multiple is a number into which another number goes without leaving a remainder. From the activity, 20 is a multiple of 1, 2, 4, 5, 10, 20

Every number is both a factor and multiple of itself

Learning Activity 3: Investigating ways of finding Highest common factor (HCF) and Lowest common multiple (LCM) (*prime factorisation, listing*…).

 **Activity3.1** : Pair work

Materials Needed:

- Paper and pencil
- A calculator (optional)
- Whiteboard (for demonstration)
- Pre-prepared sets of pairs of numbers for practice (*36 and 60, 24 and 36, 12 and 15...)*

Instructions:

- Give learners cards with pairs of numbers
- Learners (in pairs) will explore different methods to find the Highest common factor (HCF) and Lowest common multiple (LCM)of two numbers.
- Presentation, learners to present to the class the method used to find Highest common factor (HCF) and Lowest common multiple (LCM)
- After presentations learners in the same pairs answer the questions below

- Which method was easiest for you?
- Were any methods quicker or slower? Why do you think that is?
- Can you think of situations where one method might be better than another?
- Which situations in everyday life do you think Highest common factor (HCF) and Lowest common multiple (LCM) can be applied?

Activity 3.2: (Individual task)

1. A teacher has 120 pencils and 150 erasers. If she wants to distribute them into identical packages with the same number of pencils and erasers in each, what is the maximum number of identical packages she can create?
2. The school tuckshop receives deliveries at regular intervals. One supplier delivers every 12 days and the other supplies every 18 days. Both suppliers delivered today, in how many days will the two suppliers deliver on the same day again?
3. Tinta works for state house and is tasked to plan the Presidents movements. He must ensure that the President passes through town when the traffic lights at two intersections are green. The traffic lights at the first intersection changes every 30 seconds and the second intersection every 25 seconds. When will the two traffic lights turn green at the same time?
4. John and James love gardening. John has 60 seeds of okra and James has 72 seeds of maize. They want to make identical seed packets with no seeds left over.
   (a) Determine the greatest number of identical seed packets they can make using all the seeds.
   (b) determine how many seeds of okra and maize will be in each packet.

Content Tips:

Listing method involves

- (a) HCF: listing all the factors of the given numbers and picking the highest of the factors common to the numbers.
  (b)LCM: listing as many multiples of the given number and picking the lowest common multiple.
- Prime factorisation involves expressing a given number as products of its prime factors.
  (a) To find HCF using prime factorisation, express the given numbers as a product of prime factors. Multiply the lowest powers of common prime factor to get the HCF.
  The HCF of 12 and 18

$$12 = 2 \times 2 \times 3 = 2^2 \times 3$$
$$18 = 2 \times 3 \times 3 = 2 \times 3^2$$
$$HCF = 2^1 \times 3^1 = \mathbf{6}$$

  (b) To find LCM using prime factorisation, express the given numbers as a product of prime factors. Multiply the highest powers of all prime factors to get the LCM.
  The HCF of 12 and 20

$$12 = 2 \times 2 \times 3 = 2^2 \times 3$$
$$20 = 2 \times 2 \times 5 = 2^2 \times 5$$
$$LCM = 2^2 \times 3^1 \times 5^1 = \mathbf{30}$$

- HCF is used for finding the **largest equal division** or **shared factor** between things (*dividing resources, scheduling overlapping events*, *and Time Management, Building Projects (Like Fencing),…)*
- LCM is useful when finding **smallest common interval** or **multiple** when events with different cycles need to align or match, (*purchasing items in bulk, coordinating schedules, Finding Common Time Intervals, Planning Work Cycles, Working with Timetables…).*

Learning Activity 4: Creating number patterns (*games, puzzles)*

Activity 4.1 : Project: Design and Present a Math Board Game

Procedure:

Learnersshould**create a board game** that challenges players to use their understanding of number properties, factors, multiples, HCF and LCM.

Presentation:

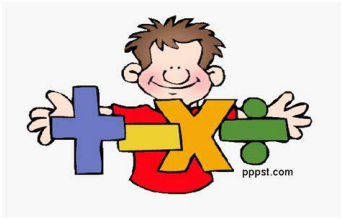
Learners will present their games to the class and explain how the game incorporates the mathematical concepts they've learned. Learners may incorporate technology into their games or during presentations.

Assessment Criteria:

- **Accuracy**: Correctly identifying and explaining properties of numbers, finding factors, and calculating HCF and LCM.
- **Creativity**: Originality and design of the number-based games, puzzles, and patterns.
- **Presentation**: Clear and confident explanation of the final project (board game), with an emphasis on the math concepts involved.

Expected standard: Numbers applied in real life situations consistently.

SUBTOPIC 2 - Combined Operations on Real Numbers



INTRODUCTION

This topic focuses on applying combined operations on real numbers in real life situations. Understanding combined operations is crucial for solving real-world problems (*budgeting, calculating costs…)*

SPECIFIC COMPETENCE: Apply combined operations on real numbers in real life situations

Learning Activity 1: Solving real life situations using combined operations.

Activity1.1: Group work

Place learners in groups and ask them to work out the following questions:

1. A pen costs k15 and a pencil costs k10 less than a pen. Find the total cost of six pens and seven pencils.
2. Two females namedSpiwe and Patience, work a forty-hour week, Spiwe is paid at the rate of k450 per hour and Patience is paid at the rate of k600 per hour. Calculate how much they were paid in one week.

Learners present their work to the whole class

Content Tips

Word problems should be written as mathematical expressions correctly; learners write the problems as mathematical statements (*in question (1) the mathematical statement could be* $6 \times 15 - 7 \times (15 - 10)$)

The correct order of operations should be applied in Combined operations.

P: Parentheses (Brackets) – First, simplify expressions inside parentheses (brackets).

E: Exponents (Powers) – Next, evaluate exponents (like squares, cubes, …).

MD: Multiplication and Division – Perform multiplication and division from left to right.

AS: Addition and Subtraction – Finally, perform addition and subtraction from left to right

When solving word problems, learners should understand the problem, devise a plan, carryout the plan and evaluate the solution.

Activity 1.2 Individual activity

- Learners answer the following questions

1. Jones decides to host a party for 4 of his friends. He needs 5 snack packs at k59 each, 5 drinks at k11.50each , music system at k200 , transport to the venue at k100 one way and k200 for their venue. If they are given a 15% discount on all their expenses, find their total expenditure.
2. A family of 5 is planning to go on a road trip from one city to another. The distance between the two cities is 300 kilometres, their car has a fuel consumption rate of 15 kilometres per litre. Fuel costs k34 per litre. They will spend a night at a lodge in two rooms at k350 per night per room. They will spend k420 on food. Workout thetotal expenditure for this trip.
3. John and Mary are tasked to come up with the cost of some items for a three bedroomed house under construction. They will need 3500 blocks for walls. A bag of cement produces 35 blocks and costs k145. They need 2 loads of quarry dust for the blocks at a cost of k3200 per load. The house will need fifteen iron sheets at k320 each. The house will have its floors tiled using 200 tiles that come in boxes containing 10 tiles each. Each box of tiles is k120. The owner of the house decided to reduce the costs by reducing on the items to be bought to 2800 block, 150 tiles , $1\frac{1}{2}$ loads of quarry dust and 160 tiles. What was the new cost of the items.
4. For extended practice learners should calculate the following:
    a. $15\div3+5\times2-(7+1)$

b. $(6+2)\times5-4\div2$
c. $12-3\times2+(8+4)$
d. $2(3+4)-6$
e. $\frac{12}{(6\div3)}$
f. $8+3\times6\div2-58\ +\ 3$

Expected standard: Combined operations on real numbers applied in everyday life situations correctly.

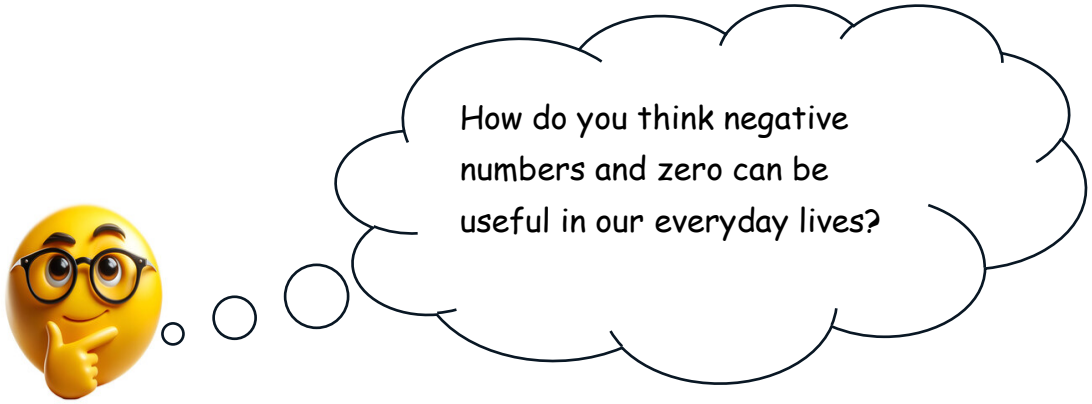
TOPIC2: INTEGERS

Introduction

Integers are the building blocks of mathematics. Mastering integers is key to understanding essential math operations like addition, subtraction, multiplication, and division, which lay the groundwork for tackling more complex concepts. In this topic, we'll dive into how these operations on integers apply to real-world situations and why they matter.

Key Terms: Integers, Four operations (*addition, subtraction, division, multiplication)*

General Competence(s): Critical thinking, Analytical Thinking, Creativity and Innovation, problem solving, digital literacy, collaboration and Communication.



Sub-Topic- The Four Operations on Integers

Introduction

The four basic operations (*addition, subtraction, multiplication, and division*) are crucial when working with integers. In this section we shall explore the relevance of integers to our daily lives. We will explore, how operations on integers can be useful in areas such as calculating temperatures, managing finances, and measuring changes in various contexts.

Specific competence: Use integers in real life.

Learning Activity 1:

Exploring the applications of the four operations (*addition, subtraction, multiplication, division*) on integers in real life situations (*temperatures, bank account balance, share market, index goal, difference…)*

Activity 1.1 Project

- Give the learners the following project.
- Project should be submitted by the end of the topic and presentation shall be the last activity in this topic.

Project Title: "Exploring integers: Real-Life Applications"

Learners will work on a project where they simulate real-life scenarios that involve the use of integers. They will research different situations where integers are used, solve problems related to these situations, and create a visual or written report of their findings.

a. Project themes

- Learners may pick or be assigned a theme as individuals or in groups:
- Learners may also be allowed to create a theme aside from the ones suggested

Temperature Tracking – Explore how temperatures rise and fall over a week or month. (*temperature fluctuations)*.

Banking – Learners simulate a personal bank account.

Sea Level – Examine the concept of altitude with positive and negative values.

Sports – Use a sport like basketball or football to track.

Debt and Credit – Learners create a scenario where someone is managing debt and credit.

b. **Create Visual Representations and write a report**:

Learners may use number line, graphs, tables, charts computer applications to represent their data and calculations. They can also use creative visuals like a thermometer for temperature, a balance scale for banking.

Learners should document their findings and explain how they used integers to solve problems in their scenario.

Include a brief explanation of the mathematical operations used (addition, subtraction, multiplication, or division of integers).

c. Presentation:

Each learner/group will present and explain their real-life scenario, walk through the calculations, and show their visual representation.

Assessment Criteria:

Learners will be awarded marks for

- **Accuracy:** Correct use of addition, subtraction, multiplication, and division of integers.

- **Relevance to real life**: How well the project connects the abstract concept of integers to a practical scenario.
- **Creativity and Clarity of Explanation**: Ability to explain the project and the use of integers clearly and effectively.

Activity 1.2: Exploration

Engage the learners in an activity that will make them explore different ways of performing operations of addition and subtraction *(number line , integer tiles .....).* The following is one such activity that uses number tiles.

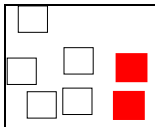
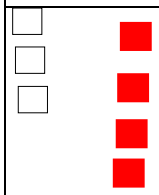
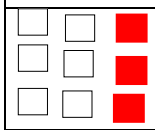
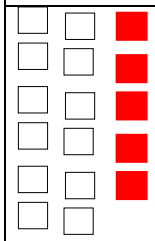
Integer Tiles

Step 1: - Provide learners with number tiles: red tiles represent positive integers while white tiles represent negatives integers.

White (-)

i. Ask the learners what number each of the tiles represent

Integer tiles	Integers
	+1
	-3

	-3
	
	
	

ii. Provide learners with integer tiles and have them explore how to represent the mathematical statements with number tiles.

a. $(+5) + (0) = (+5)$
b. $(+1) + (+4) = (+5)$
c. $(5) + (-4) = (+1)$
d. $(-3) + (-4) = (-7)$
e. $(-7) + (+3) = (-4)$
f. $(-1) + (+4) = (+3)$
g. $(+5) - (+4) = (+1)$
h. $(-2) - (+4) = (-6)$
i. $(+2) - (-4) = (+6)$

j. $(-2) - (-4) = (+2)$

iii. Learners to apply number tiles to solving questions on operations on integers *(addition, subtraction)*

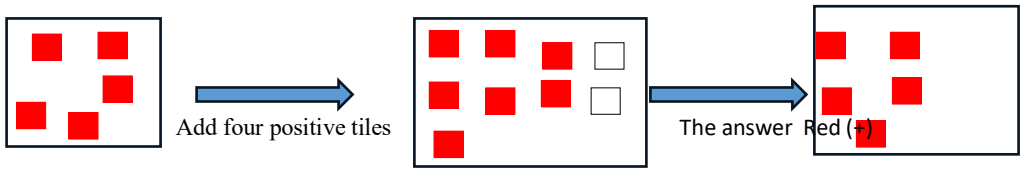
a. $(-2) + (-4) =$
b. $(+2) - (-4) =$
c. $(-2) - (-4) =$
d. $(-2) - (-4) =$

iv. Learners to make conclusions about the integer value of the result after adding:

a. Any number + 0
b. Positive integer + Positive integer
c. Negative integer + Negative integer
d. Positive integer + Negative integer

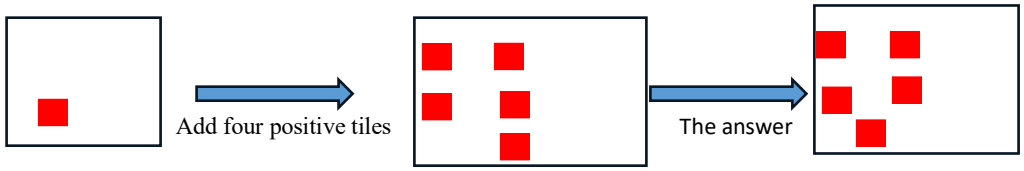
Content Tips:

- If integer tiles are used, they will act as a visual representation of addition and subtracting
  i. $(+5) + (0) = (+5)$

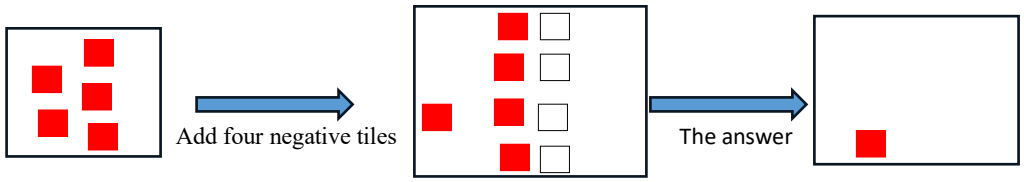


We can add any number of pairs of negative and positive tiles but they will equal zero and still give us the number we started with

ii. $(+1) + (+4) = (+5)$

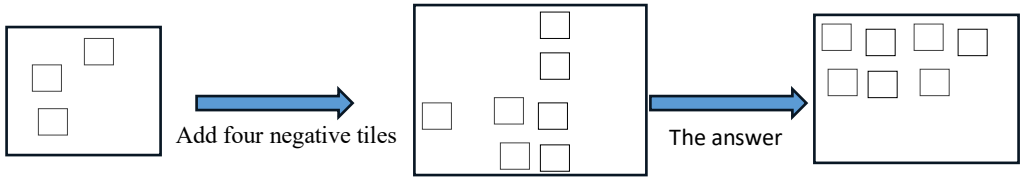


iii. $(+5) + (-4) = (+1)$

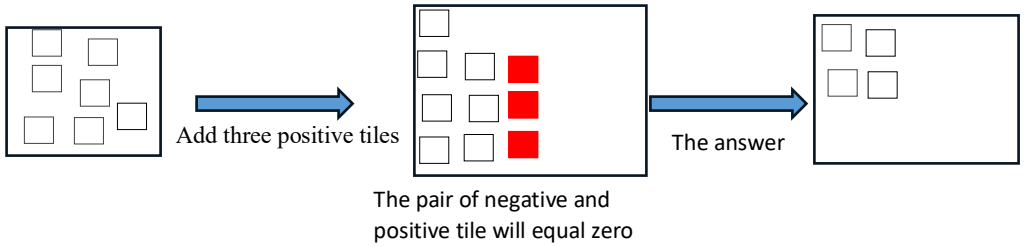


The pair of negative and positive tiles will equal zero

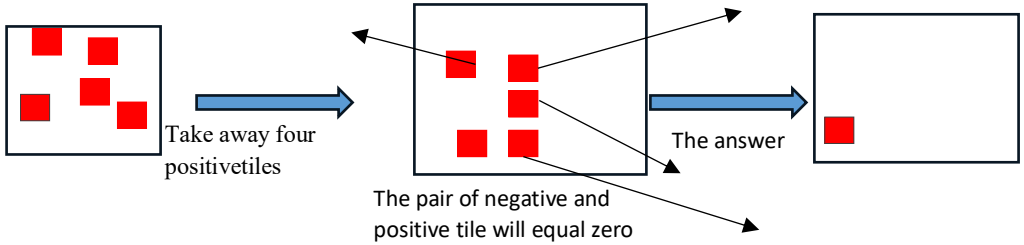
iv. $(-3) + (-4) = (-7)$



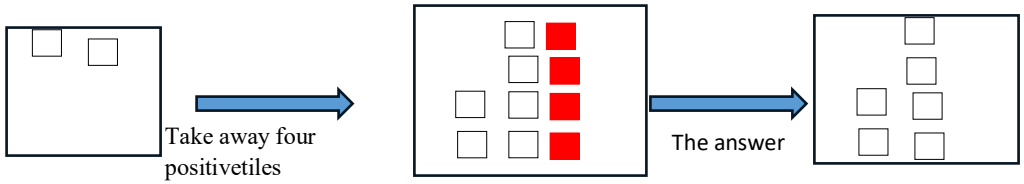
v. $(-7) + (+3) = (-4)$



vi. $(+5) - (+4) = (+1)$

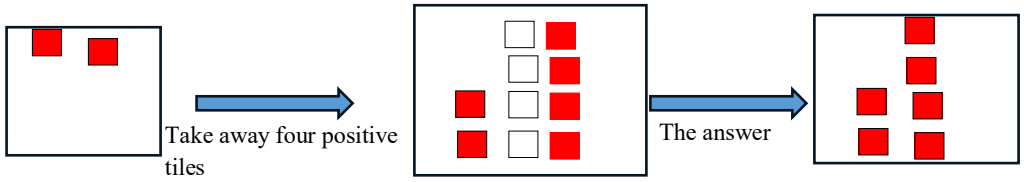


vii. $(-2) - (+4) = (-6)$



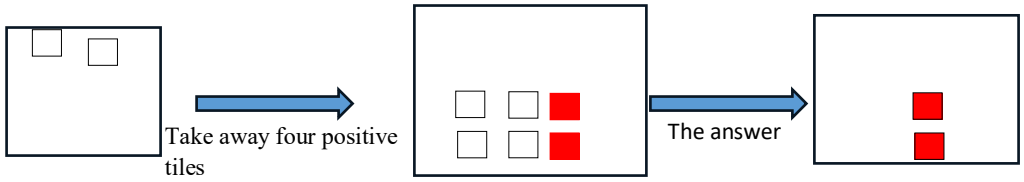
There are not enough positive tiles so we add zeros (four pairs) then take away four positive tiles

viii. $(+2) - (-4) = (+6)$



There are no negative tiles to remove so we add zeros (four pairs) then take away four negative tiles

ix. $(-2) - (-4) = (+2)$



There are not enough negative tiles to remove so we add zeros (two pairs) then take away four negative tiles

- Ensure that the activity selected allows learners to explore and practice the addition and subtraction operation and discover the following generalizations
  a. $(-2) + (-4)$ *can be expressed as* $-2-4$
  b. $(-2) - (-4)$ *can be expressed as* $-2+4$

Positive integer + Positive integer = Positive integer,

$$+5 + (+3) = +8$$
$$5 + 3 = 8$$

Negative integer + Negative integer = Negative integer

$$\mathbf{-4} + (\mathbf{-3}) = -7$$
$$-4 - 3 = -7$$

Positive integer + Negative integer = subtract the numerically smaller number form the numerically bigger number and take the sign of the bigger one

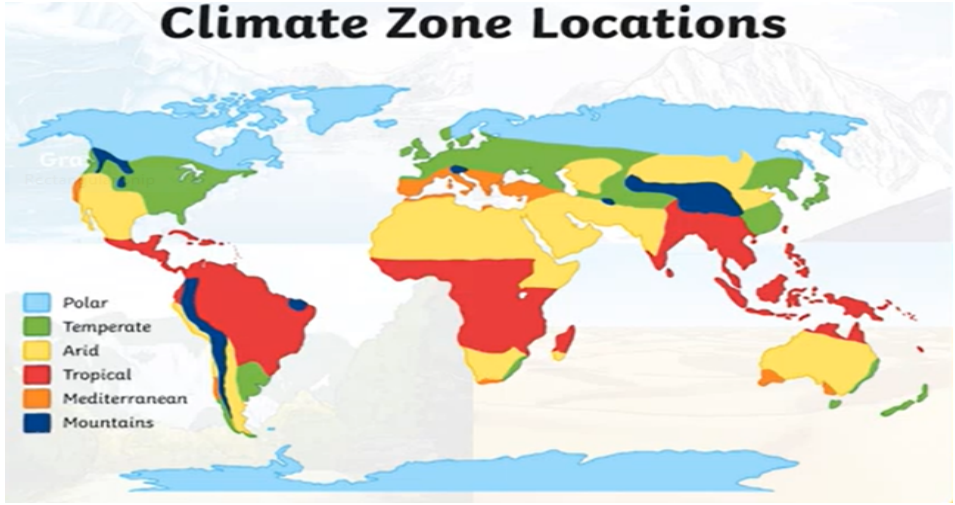
For (Negative < Positive):
$7 + (-4) = 3$ (since 7 is larger, the result is positive)
For (Negative > Positive):
$-6 + 3 = -3$ (since -6 is larger, the result is negative)

Any number + 0 = the number itself

$$8 + 0 = 8$$
$$0 + (-5) = -5$$

Activity 1.3:individual work

1. Jack dreams of becoming a **meteorologist** one day! A meteorologist is someone who studies the atmosphere, weather patterns, and climate. To kickstart his journey, Jack decides to practice by observing different climates around the world. He begins by creating a colorful map that shows various climate zones around the Earth and tabulates average winter temperatures for each of the zones in 2024.



Climate zone	Average Winter Temperature
Arid	8ºC
Polar	-13ºC
Temperate	3ºC
Tropical	26ºC
Mediterranean	10ºC

i. Of the climate Zones shown in the table, which zone has:
   a. Has the highest average winter temperature?
   b. Has the lowest average winter temperature?

ii. Zambia has typically a Tropical Climate Zone, calculate the difference, in degrees Celsius between:
   a. Zambia's Climate Zone and the Polar Zone?
   b. Zambia's climatic Zone and the Mediterranean?
   c. Which climate zone has an average winter temperature that is closest to that of Zambia?

iii. If the average temperature in the polar climatic zone reduced further by 7°C, what would the temperature be?

iv. Given the choice to visit towns in other climatic zones, which would you choose based on the average temperature? Give a reason for your choice. ?

Key Considerations

- Question (**d)** is subjective and will be primarily to enhance learners' spatial awareness.

Content Tip:

- As observed in the activity a negative number is less than a positive number (-13°C is less than 3°C)
- In finding the average winter temperature closest to that of Zambia learners applied subtraction of Integers (26 – (-13)= 39°C, 26-10=16°C,…). The smallest difference is the one whose climatic zone is closest to that of Zambia.

Activity 1.4: Individual work

Scenario: Mobile money Account Transactions

Imagine you have a mobile money account with neither withdraw nor deposit charges. Over the course of a week, you make several deposits and withdrawals. The table below shows the balance changes after each transaction. Positive numbers represent deposits (money added to the account), while negative numbers represent withdrawals (money taken out).

Day	Transaction Description	Balance Change	New Account Balance
Monday	Deposit: K200	+200	+200
Tuesday	Withdrawal: K50	-50	+150

Wednesday	Deposit: K100	+100	
Thursday	Withdrawal: K30	-30	
Friday	Deposit: k150	+150	
Saturday	Withdrawal: K100	-100	
Sunday	Deposit: K50	+50	

i. With a deposit of K100 is made on Wednesday, what is the new balance?
ii. After a withdrawal of K30 on Thursday, how much money is left in the account?
iii. How much will the account balance increase after a K150 deposit is made on Friday?
iv. What will the account balance be after a withdrawal of K100 on Saturday?
v. If you combine all the transactions for the week, what is the total amount of money deposited?
vi. what is the total amount of money withdrawn?
vii. What is the total net change in the account balance for the week (deposit total minus withdrawal total)?
viii.

Content Tip:

This activity will allow learners to practice addition of integers with the same sign and different signs

- for the initial balance of K150 plus a deposit of K100 give us a new balance K250, $(150 + 100 = 250$ *...)*.
- After a withdraw of -30, learners will find how much is left in the account by adding integers with different signs ($-30 + 250 = 220$ *...)*.

Activity 1.5 : Task (pair work)

Learners to be placed in pairs to attempt the task below.

Copy and complete the table below. The first 2 rows have been completed for you.

Multiplication	Repeated addition	Solution
4×3		
$4 \times (-2)$		
$(-2) \times 4$		
2×10		
$2 \times (-4)$		

i. Follow up questions
   a. What do you observe about the sum in each row?
   b. What conclusions can we make based on the results?

ii. Learners to present and explain their work to the class.

Activity 1.6 : Pair work

Learners to work in pairs and take the activity below.

Instructions:

i. In pairs learners should fill in the blank spaces of the arithmetic grid given below. Learners should clearly show all their working.

a)

10	
150	15

Total= 150

b)

5	5	
75	75	15

Total= 150

c)

5	5	
40	40	8
35	35	7

Total= 150

d)

12	-2	
96	-16	8
84		7

Total= 150

e)

12	-2	
-60		-5
240	-40	20

Total= 150

f)

11	-1	
187	-17	17
240		-2

Total= 150

negative integers.

Content Tips:

- When multiplying two integers of the same signs the result should be positive
  $[4 \times 3 = 12\ ,\ \ (-2) \times (-5) = 10\ ]$
- When multiplying two integers of the different signs the result should be negative

$[4 \times (-3) = (-12)\ ,\ \ 2 \times (-5) = (-10)\ ]$

- These conclusions for multiplying integers are the same as those for dividing integers.
- When dividingtwointegers of the same signs the result is positive
  $(\ 4 \div 2 = 2\ ,\ \ (-2) \div (-1) = 2$
- When dividing two integers of the different signs the result is negative

$$4 \div (-2) = (-2\ ),\ \ (-2) \div (1) = (-2)$$

Activity 1.7: Individual task

Learners to answer questions individually

i. Pauline is a tailor, and she enjoys making traditional attires. She decides to make a Siziba (Lozi traditional attire) to be sold during the Kuomboka ceremony. It takes her 2 days to make one attire. How long would it take her to make 8 attires?

ii. Denoting a borrowed amount (debt) with a negative and earned amount (gain) with a positive, if a boy named Mulenga borrowed K5 from you every day for 7 days. How much money would he owe you by the end of the week.

iii. Mr.Emmanuel Chisanga owns a store in town centre. In the past week he made a profit of K60 each day for 5 days, but he loses K20 each day for 2 days. Calculate his total earnings after a week and determine if it is a profit or loss?

iv. Doye wants to be a Pilot when she grows up. She discovers that the higher she goes above ground level the cooler it becomes. She further discovers that the drop in temperature is 7^oC for each kilometer above ground level. If the temperature at ground level is 0^oC find the temperature 10kms above ground level.

v. Chabota has a savings account with ZANACO (Zambia National Commercial Bank) she needs to have a positive average weekly balance for her to get a reward at the end of each week. Below is a table showing her daily balance.

- in the first week of the month of January

Day	Daily Balance
Sunday	K170
Monday	-K100
Tuesday	-K180
Wednesday	-K20
Thursday	-K160
Friday	K80

- in the first week of the month of February .

Day	Daily Balance
Sunday	K500
Monday	-K100

Tuesday	-K50
Wednesday	K300
Thursday	-k100
Friday	K150

a. What was Chabota's average daily balance in the first week of January?
b. What was Chabota's average daily balance in the first week of February?
c. In which of the two months will she get a reward?

Extension work:

Find the value of each of the following

a. $(-10) + (-3)$
b. $(-6) + 2$
c. $(-3) + 4$
d. $(+7) - 3$
e. $(-5) - 8$
f. $9 - (-2)$
g. $10 - (-4)$
h. $(-16) \div (-2)$
i. $(8) \div (-4)$
j. $(-2) \div 1$
k. $(-4) \times 4$
l. $(-6) \times (-3)$

Expected standard: Integers used in real life correctly

TOPIC 3: APPROXIMATIONS AND ESTIMATIONS

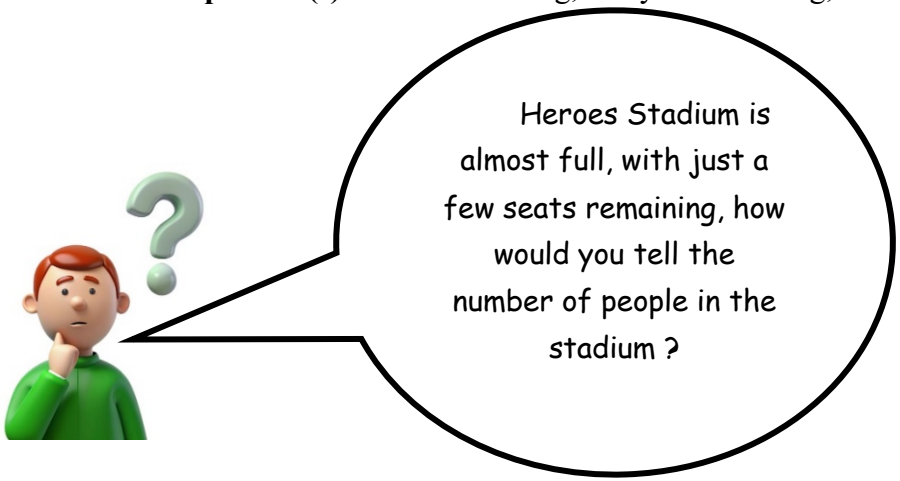
Introduction

Approximations and Estimations are critical skills used in everyday life to simplify complex measurements, ensure precision, and support informed decision-making. This topic introduces learners to the fundamental concepts of approximations and estimations and their application in real-life contexts.

Through a variety of interactive and hands-on activities, this topic connects the principles of approximation and estimations with real-world applications, empowering learners to make sound, data-driven decisions in their everyday lives.

Key Terms: Approximation, Significant Figures, Scientific Notation, Estimation, Relative Error, Absolute Error, Percentage Errors, Tolerance.

General Competence(s): Problem solving, analytical thinking, collaboration, communication, digital literacy and financial literacy.



Sub Topic 1: Approximations

Introduction

This sub-topic introduces learners to the fundamental ideas of approximations and their application in real-life contexts. It will focus on significant figures and scientific notation and how these can be useful to our day to day lives.

Specific Competence: Use approximation to make informed decisions in real life.

Learning Activities: Exploring approximations in real life situations.

Activity 1.1 Measuring

Materials needed: Objects (*books, desks, liquids…)*, measuring instruments (*ruler, measuring tape, measuring cylinder, string…),* pencil, paper.

Procedure:

- Place learners in small groups or pairs.
- Ensure each group/pair has the materials needed.
- Groups/ pairs to measure the objects using two different instruments.
- Groups to round of the measurement to a given degree of accuracy (*10 units, unit, tenth, hundredth …)*
- Groups/pairs to the design a poster giving details of the quantities they have measured.
- Groups/ pairs to explain how they took the measurement.

Presentation: learners present and explain their measurements to the whole class.

Key consideration:

- Ensure that the instruments used by each group have different degrees of accuracy.
- Use locally available materials

Content Tips:

- Approximate values are used when the exact value of something cannot be found, or it is not important that the value be exact for the exercise. Rounding is one way of approximating a value.
- By using different instruments with different degrees of accuracy, the learners will be forced to pick one of the two measurements to be used on their poster based on their reasoning (measuring an apple with a digital scale and with a beam balance that is correct to one decimal place may give, digital scale – 70.24 grams while the beam balance will give 70.3grams)
- The selection of one of the two measures to place on the poster will be an approximation.

Activity 1.2: Individual activity

Answer the following:

1. You are shopping for groceries and the total prices of items in your cart are as follows:
K12.49, K5.75, K8.23, K15.99, and K9.50.

a) Find the total cost by expressing each price to the nearest whole number.

b) Calculate the actual total and compare it to your approximation.

2. You are planning a road trip of 275 kilometers. Your car's fuel consumption is approximately 8 liters per 100 kilometers.

a) By rounding the distance and fuel efficiency values, determine how much fuel you would need for the trip.

b) Compare your approximation to the exact fuel cost.

c) Reflect on the implications of using approximations for fuel planning.

3. You are tiling a rectangular room that measures 6.3 meters by 4.8 meters. Each tile covers an area of 0.36 square meters.

a) Approximate the total number of tiles needed by rounding the room's dimensions and tile area to the nearest unit.

b) Compare this to the exact calculation and explain how approximation can help in planning materials for construction projects.

4. Approximate each of the following by rounding each number to the given accuracy

(a) 7846 X 917 (Hundreds)

(b) 586 X 326 (Tens)

Learning Activity 2: Investigating the significance of figures in measures.

Activity 2.1: Group Assignment

Learner to be given this assignment as part of conclusion to activity 1.1 exploring approximation and the findings presented as part of activity two.

- Ask learners to investigate significant figures in whole numbers and decimal numbers.
  (Which figures are significant, what they used for in everyday life…)
- Presentations to be made as part of the start to this activity.

Content Tips:

- Significant figures are used to express degree of detail (precision) of a measurement.
  - **All non-zero** digits in a number are significant (3727 has 4 significant figures)
  - **Zeros** between non-zero digits are always significant in both whole and decimal numbers (*105 has 3 significant figures, 1.03 has 3 significant figures, 0.00402 has 3 significant figures)*
  - Zeros at **the end of a whole number**are not significant.
  - Zeros **at the end** of a decimal number are significant (3.00 has 3 significant figures)
  - Zeros **before** the first non-zero digit in a decimal are not significant (0.0045 has 2 significant figures)

Activity 2.2 individual work

i. A Weather station in Mongu depends on **Significant figures to determine** the exactness(detail) of a measurement from rain gauges. It has two rain gauges for measuring the amount of rainfall. On the 4th of January the two gauges gave readings as gauge A = 63.5mm and gauge B = 60.40mm.

a. State the number of significant figures in the measurement from : 1) gauge A , 2) gauge B.

b. Which of the two rain gauges is more detailed?

ii. How many significant figures do the following numbers have?

a) 58870
b) 809450
c) 0.00521
d) 0.00850

Learning Activity 3: Expressing measures (*whole and decimal*) to a required number of significant figures.

Activity 3.1: Group work

Put the learners in small groups and let them discuss the following question, their answers should be presented to the class.

1. A pharmaceutical company is producing new medication in capsules, and each capsule must contain exactly **0.07855 grams** of the active ingredient. However, due to the limitations of the measuring instruments used during production, the company decides to round off the exact measure to a specified number of significant figures.

   a) Assist the company to round off 0.07855 g to:

      i. 1 significant figure
      ii. 2 significant figures
      iii. 3 significant figures

b) Will the answers you have found in (a) affect the dosage? Explain your answer

2. A flight agency determines the distance a Plane will travel from Ndola to Addis abba to be 3156 kilometers, but they want to round it to a specific number of significant figures for marketing materials and simplicity in communication.
    i. Round the number to:
        a. 1 significant figure
        b. 2 significant figures
    ii. Which of the two rounded figure in (ii) would be more appropriate, give reasons for your answer,

Content Tips:

- In the group work, rounding off 0.07855g to 2 significant figures gives 0.079g (since 8 is rounded up), to 3 significant figures it is 0.0786g and 4 significant figures is 0.07855g.
- Based on these results on the dosage when the number is rounded off, it either gets bigger or smaller, in this case it may make the drug stronger or weaker.
- In general, when rounding off to a specified number of significant figures
    - Identify the significant figures.
    - Determine the position of the last significant figure (based on how many you need).
    - Check the Digit After the Last Significant Figure. If the digit immediately following the last significant figure is 5 or greater, round the last significant figure up. If the digit following the last significant figure is less than 5, leave the last significant figure unchanged.

- Replace any remaining digits with zeros (if it's a whole number) or remove them (if it's a decimal).

Activity 3.2: Individual task

1. Jane is an engineer working on designing a part that needs to fit exactly into an existing system. She measures the length of the part with a high detail ruler and the measurement comes out as 15. 206. For consistency and simplicity, the company standard requires her to report all measurements with 2 significant figures. What measure would she report?
2. A rectangular iron sheet has got sides 5.302 cm and 7.60 cm. Round off its area correct to 3 significant figures.
3. Give each of the following numbers correct to 3 significant figures.

(a) 47035(b) 3530 (c) 0.6001 (d) 24.0081 (e) 0.001011

Learning Activity 4: Exploring ways of expressing large and small measures

Activity 4.1: Brainstorming

Instruction

- Learners to be placed in groups and answer the following questions.

- Learners to answer these questions without using a calculator.
  1. The distance from Earth to Pluto is five billion kilometers, express this number in centimeters.
  2. A single raindrop is 0.000004 ml. Write the number in liters.
  3. In what forms or ways can the measurements in questions (1) and (2) above be expressed to make the calculations simpler?
- Learners to immediately attempt Activity 5.1

Learning activity 5:Exploring scientific notation *($a \times 10^n$)* using scientific calculators andactivities*(notation maze, scientific notation maze, scientific notation Bingo, scientific notation escape, room activity, card game...)*

Design/ select activities that would allow learners to explore scientific notation. One such activity has been provided:

 **Activity 5.1** brainstorming

- Learners to answer questions in activity 4.1. this time they mustuse Scientific calculator
- The pairs to then answer the follow up question:
  a. Analyze the calculator's representation of the solution to question 1 and 2 from the activity 4.1 explain what each term represents and analyze how you think the number can be converted back with or without a calculator.
- **Pairs / groups to then present their solutions to the class and give reasons.**

 **Content Tips:**

- The representation on the calculator is known as Scientific Notation. It is written as: $\boldsymbol{a \times 10^n}$where.

i. a is a number greater or equal to one and less than 10.

ii. $n$is an integer (positive, negative, or zero).

iii. 10^n scales the number to its actual magnitude.

Steps to follow when expressing in standard form:

a) Large Numbers in Standard Form

i. **Move the decimal point** to the left until you have one nonzero digit to the left of the decimal point. This number becomes a.

ii. **Count the number of places** you moved the decimal point. This becomes the **positive exponent** (n).

iii. **Write the number as: $a \times 10^n$**

b) Smaller numbersin Standard Form

i. Move **the decimal point** to the right until you have one nonzero digit to the left of the decimal point. This number becomes a.

ii. Count the number of places you moved the decimal point. This becomes the negative exponent (n).

iii. Write the number as: $a \times 10^{-n}$

Activity 5.2: Scientific Notation learning by play activities.

Design/ select activities that would allow learners to explore scientific notation. One such activity has been provided:

Game

Materials: Number Cards

Procedure:

- Create 10 cards for each group with very large and very small numbers (*0.00000000007, 23690000000, ...)* and distribute them.
- Call out numbers in standard form, and learners must find the corresponding numbers on their cards.
- The first learner to find it raises the card.
- The learner should read out the number loudly and give reasons for their choice.
- The first one to read the correct one wins a point.

Key considerations:

- The teacher can use more than 10 cards per group to extend the activity.
- Teacher can choose an appropriate environment for the activity *(classroom, playground, computer laboratory, ...)*

Activity 5.2:Individual work

1. Mars is approximately 227, 939, 921 km from Earth. How many buses of length 6m each could be placed end to end to reach Mars from Earth? Give your answer in standard form.

2. A smart phone has 128 GB (gigabytes) of storage. One gigabyte is 1 x 10^9 bytes. How many bytes is 128 GB? Write your answer in scientific notation.
3. If a photo takes up 2.5 x 10^6 bytes. How many photos can the phone store?
4. Write down the following numbers in scientific notation
    a. 3120
    b. 97000000
    c. 0.00056
    d. 0.00000000657
    e. 0.000004
    f. 7560000000

Learning Activity 6: Approximating measures in scientific form to a specified degree of accuracy.

Activity 6.1 Pair work

1. "A spacecraft traveling to Mars covers a distance of 225,623,000 kilometers. Engineers need to plan fuel requirements and communicate efficiently.

a) Express this distance in scientific notation and round it to 2 and 3 significant figures?"
b) If the cost of fuel per litre is K34.67 and the spacecraft consumes 67000litres per km to reach Mars, determine the cost of the fuel required in standard form correct to 2 and 3 significant figures.
c) State which cost is realistic for this distance and explain why.

2. The concentration of a drug in a solution is 0.00000378 grams per milliliter. Write this concentration in scientific notation, rounded to **3 significant figures.**
3. The mass of a dust particle in space is approximately 0.000000000000000000000000015 kilograms. Express this mass in standard form, correct to **1 decimal place.**

Content Tips:

- Approximating numbers in scientific notation to a given degree of accuracy involves rounding the coefficient (the number before the "$\times 10^n$ ") to the desired number of significant figures or decimal places. Here are the key rules and steps:
- Consider the number of significant figures needed
- Round the coefficient '***a'*** to the specified number of significant figures or decimal places using standard rounding rules (*If the digit after the desired precision is 5 or greater, round up. If it is less than 5, round down*).
- If rounding the coefficient changes its magnitude (e.g., from 9.99 to 10.0), adjust the exponent *n* to maintain the correct value. For example: 9.99×10^3 rounded to 2 significant figures becomes 10×10^3, which is rewritten as 1.0×10^4.
- Express the number in scientific notation with the rounded coefficient and adjusted exponent(if applicable) .

Activity 6.2 Individual work

1. The mass of the earth is approximated as being 5,972,000,000,000,000,000,000,000 kilograms.
    a. Express this in scientific Notation correct to
        i. 2 significant figures
        ii. 3significant figures

iii. 4 significant figures

b. If you were tasked with choosing one of the three notations in (a), which one would you choose and why?

2. Zambia's population is approximately 2×10^7 people. If each person uses 50 litres of water daily:
   b. Calculate the total daily water usage in litres, express your answer in scientific notation.
   c. If 1 litre is 1×10^{-3} cubic metres, convert the total daily water usage to cubic metres. Express the solution to a degree of accuracy of your choice. Explain why you have decided to used that degree of accuracy.
3. The thickness of a single strand of human hair is 8×10^{-5} meters. A sheet of paper is 1×10^{-4}, how many times thicker is the paper than the hair? If the diameter of the red blood cell is 7×10^{-6}metres. How many red blood cells fit across the width of the human hair?
4. Write 0.000000000000000789 in scientific notation, correct to 2 decimal places.

Expected standard: Approximations used to make informed decisions in real life appropriately.

Sub-Topic 2: Estimations

Introduction

Estimations are essential in simplifying complex problems, making quick decisions and evaluating the accuracy of measurements. In this sub-topic, you will learn about **relative error**, **absolute error**, **percentage error and tolerance**, which are key tools for assessing how close a measurement is to the true value.

Specific Competence(s): Use estimation to make informed decisions in real life.

Learning Activity 1: Estimating measures and comparing them with actual measurements

Brainstorming: learners discuss the following questions in pairs or groups.

1. Your mother sends you to a grocery shop to buy sugar, soap, toothpaste, lotion and juice. How much money would you need to buy the items?

2. What is the distance from your home to your school?
3. How much time do you take from your home to your school?
4. What is your daily water usage at home?

Presentation: learners present their ideas to the whole class

Content Tip:

- Estimation helps us make an assumption on various aspects of everyday life *(Money to be spent, distance, time taken and water usage c…),* especially in situations where the exact measure is not known.
- For instance, sugar costs K60.99, toothpaste costs K35.44, soap costs K16.23, lotion costs K54.00 and Juice costs K42.49, the total cost of the items which is K209.15 can be estimated as K210.00.

Activity 2.2 : Individual work

1. Judith was enrolled into attend a boarding school at Form 1. She wants to ask her mother for money to buy school stationery, but she hasn't been to the shops in a long time. She remembers that the previous year, a book cost K39.50, a pen was K5.00, and a box of pencils was K40.00. She knows that the prices have definitely gone up, but she has no time to confirm the prices. If she needs 15 books, 5 pens, and 5 boxes of pencils, how much should she ask her mother for?

2. John has been transferred to a new school that is not too far from his current school but is farther from town than his current school. It takes him 10 minutes to get to town and 20 minutes to get to his current school from town. Estimate the time it would take for him to get to his new school, given that he still needs to pass through town.
3. In what situations is estimation useful, and in what situations is it not useful?

Learning activity 2: Interpreting the absolute, relative, percentage errors and tolerance in real life.

Activity 2.1 :Practical activity

Instructions

- The teacher sets a predetermined target like the length of the classroom *(8.4m,9.6m…)* after measuring it and does not tell the learners.
- learners as groups/ pairs to take turns in measuring the length of the classroom and give the measurement found.
- Learners in pairs/group answer the following:
  - **i.** Compare your measurements, with the true value provided (8.4) and find the difference.
  - ii. Find the value that relates the difference to the true measurement as a fraction.
  - iii. What percentage of the true value is the difference found in (i).
  - iv. Given that each of the pairs/groups found different measurements, what do you think was the reason. How can we determine which measurements are acceptable and which ones are not?
  - v. Given that the acceptable range of amendment from the true value is ±0.05m (*teacher to replace tolerance range based on their predetermined target*), determine the highest acceptable value and the lowest acceptable value.
  - vi. Is the measurementyou found as a pair/group acceptable or not?

Content Tips:

- From the practical activity 1, we obtained different measurements against the true value *(8.4m, 9.6m,...)* the difference between the true value and the measured value is called **absolute error.**

  Absolute error = |Measured Value−True value| (*8.4m -8.2m=0.2m,...)* in this case our absolute error is 0.2m.

- Relative error is the ratio of the absolute error of the measurement to the true measurement. (*refer to the different measurements that learners have found).*

  Relative Error = $\frac{\text{Absolute error}}{\text{True value}}$

- Error in measurement may also be expressed as a percent of error. The percent of error is found by multiplying the relative error by 100%

  Percentage Error = $\frac{\text{Absolute error}}{\text{True value}} \times 100\%$

- Tolerance refers to the allowable limit of variation in a measurement, value, or dimension. It defines the range within which a measurement or value is considered acceptable or accurate. One of the ways of expressing Tolerance range is True Value ± Tolerance value (for instance 10 cm ± 0.2 cm), where the true value (10 cm) is the target or ideal measurement. The tolerance range (±0.2 cm) specifies how much the actual measurement can deviate from the true value and still be acceptable.
- Tolerance range =Nominal Value ± Tolerance Value
- Tolerance range can also be expressed using limits, (*lower limit* $\leq l <$ *upper limit where the lower bound = true value – tolerance value , upper bound = true value + tolerance value and l is the true value)*
- When the true value is rounded off, the acceptable error can be found by taking half the smallest unit value (*8.4cm to one decimal place smallest unit value of 0.1 giving a tolerance range of 8.4±0.05 cm)* The smallest unit value of:

  i. 5cm is 1

ii. 5.3 km is 0.1

iii. 10.234litres is 0.001

Activity 2.2 Pair work

1. You are tasked with measuring the length of a piece of wire using a ruler. The true length (measured with a highly accurate tool) is 100 cm, but your ruler is not perfect, and you get a measurement of 98 cm.
   a. what is your
      i. Absolute error
      ii. Relative error
      iii. Percentage error
   b. Given that the tolerance Value is $\pm 0.1cm$, *is you measure within the acceptable range? Give reasons for your answer.*
2. A Milling company called Nyambe millers has put a tolerance value for a bag of mealie meal at $\pm 0.5kg$. Musonda decides to buy a bag of mealie meal from them. As soon as she gets home she measures the bag again. She discovers that the bag is 24.5kg. Mando does the same and finds that his bag is 25.5kg.
      i. Determine the tolerance range in the form $lower\ bounds \leq l < upper\ bound$.
      ii. Are the bags bought by Musonda and Mando within the tolerance range? Give a reason for your answer
3. A furniture designer is tasked with creating a table that is exactly 1.50 meters in height. After building the prototype, the measured height of the table is found to be 1.47 meters.
   i. Determine the absolute error, relative error, and percentage error of the measurement.
   ii. Given that true measurement was rounded to two decimal places, was the error made acceptable or not.
4. If 0.333 is the approximate value of ⅓, find absolute, relative and percentage errors.

5. In a car engine, the diameter of a piston is designed to be 8.0cm with a tolerance of ±0.02cm. The cylinder has a diameter of 8.05cm with a tolerance of ±0.03cm.
   a) What is the acceptable range for the piston diameter?
   b) What is the acceptable range for the cylinder diameter?
   c) Will the piston fit into the cylinder under the worst-case scenario?

Activity 2.3: Individual work

1. John is a carpenter, and he is tasked with building custom doors for state house. Each door needs to fit perfectly in the door frame. His blueprint says the door width should be 90 cm, but the manufacturing process allows for a small difference and hence sets a tolerance of ±0.5 cm for the width of the door. A door whose width is outside the acceptable range is returned to the production cycle for modifications.
   i. What is the acceptable range of the door's width?
   ii. He measures the width of three doors as 89.8 cm,90.6 cm and 90.4cm. Will any of the three be returned to the production Cycle? Give reasons for your answer
2. Dingani is a scientist working in a laboratory and measuring the mass of a small object using a balance scale. The true mass of the object is known to be **50 grams**. He uses a scale and records the mass as 49.5 grams.
   i. What is the absolute error in his measurement?
   ii. Calculate the relative error of his measurement.
   iii. Convert the relative error into percentage error.

iv. If the acceptable tolerance for the measurement was ±0.2 grams, is his measurement within the tolerance? Give reasons for your answer.

Expected Standard– Estimations to make informed decisions in real life used correctly.

2.6 Project: Designing

Instructions:

- Learners to design of their choice*(table, chair, wire car, …)*, learners should be encouraged to use computers to make the designs where possible.
- They will then build a model based on their layout design and set acceptable errors for the model.
- After completing the model learners will then measure the dimensions of the model
- Learners should then compare the model dimensions with the exact dimensions (from the design layout)
- Learners to determine what percentage error is in each of the dimensions on the model.
- Learners to document their process and show clearly calculations of the errors.

Assessment criteria:

- **Creativity:** in creating a design layout and model *(innovation in using cost effective and locally available materials ….)*
- **Accuracy in calculations:**Determiningof errors.

Content Tip:

- The objective of the activity is to increase learners' awareness of how errors arise during manufacturing process as they compare the measurements of the model to those on their design

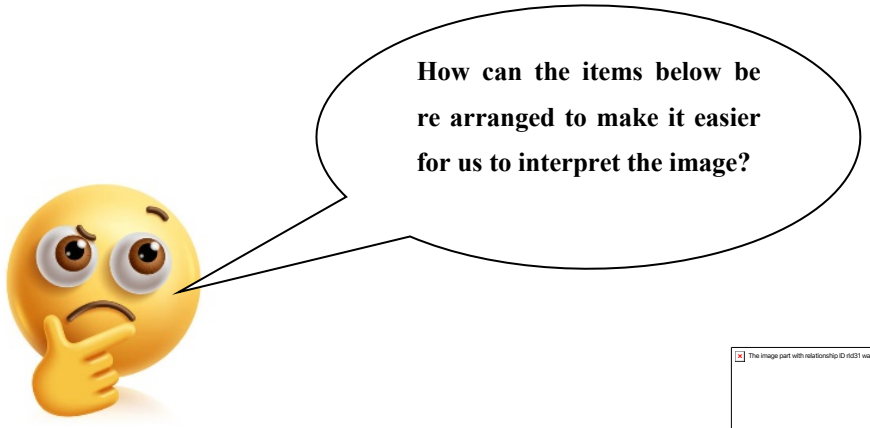
TOPIC 4: SETS

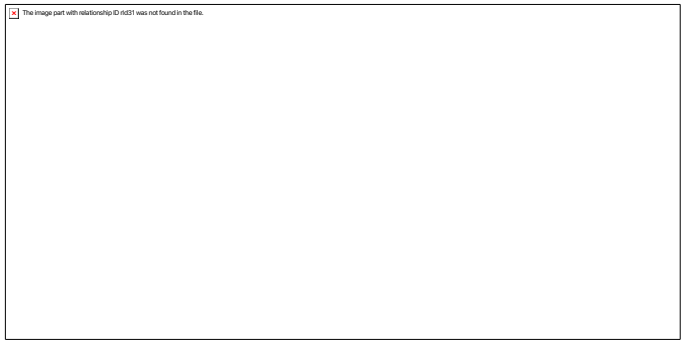
Introduction

In this topic we will discuss Operations on Sets. Knowledge of Sets is of great importance to help us develop a sense of order, organization and logic as we encounter different kinds of information, objects, tools in the environment.

Key Terms: Subset, Complement, Union, Intersection, Notations, Venn Diagram

General Competence(s): Communication, creativity, innovation, collaboration, critical thinking, digital literacy and problem solving.





Sub-Topic: Operations on sets

Introduction: In this sub-topic, we will explore how to create sets, learn different ways to represent sets, and examine combined operations on sets. We will also look at how to represent these combined operations using Venn diagrams. All these aspects shall be explored in real-life contexts

Specific Competence : Apply set operations in real life context**.**

Learning Activity1-Creating sets using information gathered by learners (both numerical and descriptive)

Activity 1.1 Pair work

In pairs learners gather objects/information

Instructions

- Divide learners into small groups and assign each group a specific category to gather information about *(names of villages where they come from, seasons, rivers in Zambia, colors, groups of numbers, unit of sweets, letters of the English alphabet, all the teachers in school, shoe sizes, teachers of mathematics at your school, members of your class, sets of numbers*, *whole numbers less than 10, set of multiples of 10 less than 100,…).*
- Each group must either research online or brainstorm to list items at least 10 items that fit their assigned category.
- Learners to then present their work to the class, using the blackboard, paperboard or power point.
- Learners to explain why they decided to place those items in that category

Content Tips

- From the activity learners will notice that the members in the category are sets with items called elements which are well defined (same characteristics) and distinct (not repeated).For instance, a set of Natural numbers from 1 up to 7 maybe {1,2,3,4,5,6,7}, a group of vowels could be {a, e, i, o, u}, names of the villages maybe named as {Kasese, Mwangu , Fendi,…}
- A set is denoted with a capital letter *(A, B,...)* and elements enclosed using curly brackets or braces {} for instance, V= {a, e, i, o, u}. The order of elements in that group or collection may not be important.

Learning Activity 2: Exploring different forms of set representation (*listing, number line, set builder notation, Venn diagram; difference between elements and number of elements on Venn diagram)*

2.1: Brainstorming

Instructions

- Each group to split thecategory given in activity 1.1 into two subcategories.(*teachers in the school: teachers of English, teachers of history ...)*

- Learners to then explore different ways of representing their set.

- learners to present their work to the class

Content Tips:

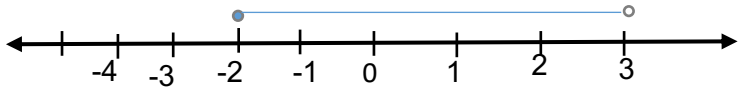
From the activity:

- Roster form or listing set of shoe sizes can be

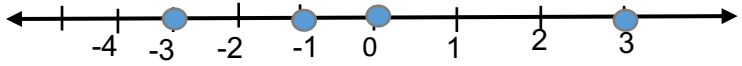
  *(S = {1, 2, 3, 4, ,…}or S= {34,35,36,…}, V= {*Kasese, Mwangu, Fendi,…})

i. Set-builder notation form, since the shoe sizes are recorded using a set of numbers which belong to Natural numbers, thus maybe: {x | x is a Natural number less than 5} or {x| x<5, x∈N}. (Numerical elements)

ii. Number line: *(*{x | x is a Whole number less than 5} or {x| x<5, x∈N}. (Numerical elements)

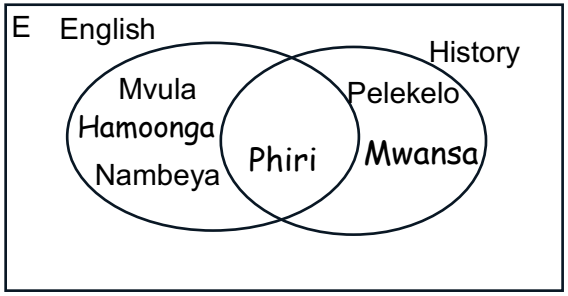


S= {x| -2 ≤ x < 3}



S= {-3, -1, 0, 3}

iii. A Venn diagram will provide visual representation of the universal set aswell as subcategories and their intersection. (descriptive and Numerical)



- Sets without any intersection are disjoint sets

- The learners reflect on their learning through discussions.

Activity 2.2: pair work

- Learners in pairs answer the following question

1. A local running club tracks the distances run by its members over a month. The club wants to analyze the performance of two different groups: beginners and experienced runners. Each group records their running distances in kilometers.

set of Distances Run by Beginners (B):

- B= {5,7,10,12,15}

set of Distances Run by Experienced Runners (Ex):

- Ex = {10,12,15,18,20}

a. Use a Venn diagram to represent this information by showing the
   i. actual elements.
   ii. number of elements

b. The club wants to gain understanding into the performance of its members, identify common distances run, and recognize areas for improvement or further training. Which of the two representations do you think is more useful?

2. A local fitness centre tracks the activities of its members over a month. The centre wants to analyse the participation of three groups of members: Occasional Gym-Goers, Regular Gym-Goers, and Dedicated Gym-Goers. Each group records the number of workout sessions attended in the past month.

Below is the information collected on the number of hours per workout session over 7days for:

- **Occasional Gym-Goers (O)**:

  O={0,1,2,3,4,5,6,7}
- **Regular Gym-Goers (R)**:

  R={3,4,5,6,7,8,9,10}
- **Dedicated Gym-Goers (D)**:
- D= {5,6,7,8,11,12}

Present this information showing clearing the ours overlapping between and among gym- goers on a Venn diagram of :

i. actual set elements

ii. number of elements

Activity 2.3 : Individual Activity

Leaners answer the following questions

1. A local library tracks the number of books read by its members every day for eight days. The library wants to analyse the reading habits of two groups of members: Casual Readers and Avid Readers. Each group records the number of books read in the past month.

- Set of Books Read by Casual Readers (C):
  - C = {0,1,3, 5,6, 8, 10, 12}
- Set of Books Read by Devoted Readers (D):
  - A = {5, 8, 12, 15, 16, 18,20,21}

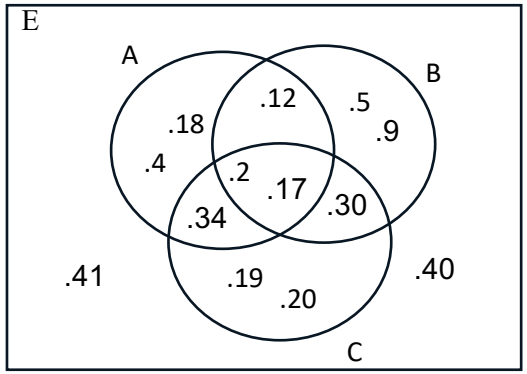
a. the sets of casual and avid readers have been represented in list roster form. Represent both sets on a number line and on a Venn diagram (actual element and number of elements).

b. which of the three representations do you think is more useful to the library.

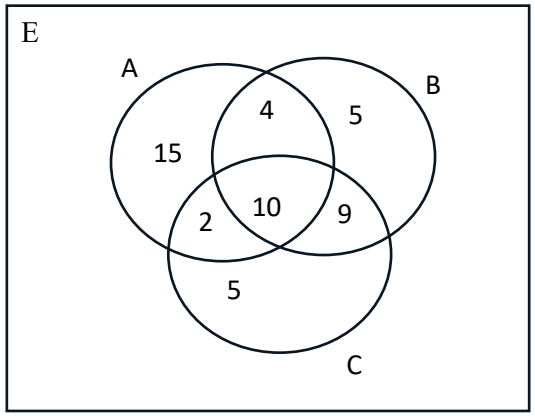
Content Tips:

- Drawing a Venn diagram with

i. actual elements will **show a point** at the beginning of each number.



ii. number of elements will **not show a point** at the beginning of each number.



Learning Activity 3: Exploring and interpreting various, single and combined set operations *(intersection*(∩), *union* (∪) *complement, set difference (-),…)* through games and real-life activities *(event planning, email management, task management, shopping list, scores of an experiment, tests,…)*

Activity 3.1: Pair work

Instructions:

- Place learners in pairs or more.

- Ask each learner to write a list of their hobbies on a piece paper.
- Ask learners to identify common hobbies and list them separately.
- Ask each pair to make one list of their hobbies.
- Ask learners to List hobbies that are on their partner's list but not on your list.
- Pairs to present and explain their Solutions to the class

Activity 3.2:Group work

- This activity should be repeated, with learners placed in groups of 3 each
- Ask each group to make one list of their hobbies.
- Ask learners to identify common hobbies and list them separately. Hobbies that are:
    i. common to all three
    ii. common to any two but not the third.
- Ask learners to list hobbies that are unique to them (not on any of the other two friends lists)
- Pairs to present and explain their Solutions to the class

Content Tips

- The intersection of sets is the set of all elements which are common to the given sets. From the activity above, the list of the common hobbies in each pair is the intersection (∩) set. This is written as A ∩B where A is a set of Ann's hobbies and B is a set of Boyd's hobbies and ∩is the symbol for intersection.
- The union (∪) of sets is the set of all elements which belong to the sets under consideration. From the activity, the list of all the hobbies for a pair is the Union set.

- The complement of a set is the set of elements that are in one set but not in the other set. From the activity above, the list of hobbies that are one partners list and are not part of the other partners list is the compliment. Given a set A its compliment is A^c.
- ***(All the hobbies,… form the universal (E) set).***

Activity 3.3 Individual work

1. A school library categorizes its books into three different categories : Fiction, Biography, and Science. For record keeping purposes the books are assigned numbers.In order to arrange the books in an orderly manner, the Librarian decides to number the books so that he can clearly see the overlap. The books were arranged in categories as follows:

Category: Fiction

Book title	Number given
Harry Potter	1
The Martian	2
I know why the caged bird sings	3
Dune	4
A Journey to the centre of the Earth	6
Paths of glory	10
The Wise Book	12
A brief History of Time	14

Category: Biography

Book title	Number given
I know why the caged bird sings	3
Einstein : his life and Universe	5
Long walk to freedom	7
Paths of glory	10
America Promethius: Robert Oppenheimer	11
An Algerian Childhood : A collection of Autobiographical narratives	13
A brief History of Time	14

Category : Science

Book title	Number given
The Martian	2
Dune	4
Einstein : his life and Universe	5
A Journey to the centre of the Earth	6
The Origin of Species	9
America Promethius: Robert Oppenheimer	11
A brief History of Time	14

A book titled "**Finding location on the Earth"** was given number 15 and placed under Geography category.

a) Illustrate this information on a Venn diagram

i. showing all the elements in each set.

ii. Showing the number of elements in each set.

b) Which of the two illustrations in (a) would you advice John to use. Give reasons for your answer.

2. a library, 50 people were surveyed about their reading habits. 22 read novels, 28 read magazines, and 10 read both novels and magazines. Draw a Venn diagram and answer the following questions:

   a) How many people read only novels?

   b) How many people read only magazines?

   c) How many people read neither?

3. Chanda and Mary wanted to start a career in the music industry. They were not sure of which type of music had more listeners. They decided to do a survey on 60 people about their music listening habits. The survey asked if they listened to KalindulaMusic, Reggae Music, or Hip hop Music. The results were as follows:
   30 people listen to Kalindula Music.
   40 people listen to Reggae Music.
   25 people listen to Hip hop Music.
   15 people listen to both Kalindula and ReggaeMusic.
   10 people listen to both Reggae and Hip hop Music.
   5 people listen to both Kalindulaand Hip hop Music.
   3 people listen to Kalindula, Reggae, and Hip hop Music

   i. With the aid of a Venn diagram or otherwise, answer the following:
   a. How many people listen to only Kalindula Music?

   b. How many people listen to only Reggae Music?

c. How many people listen to only Hip hop Music?

d. How many people listen to both Kalindula and Reggae Music, but not Hip hop Music?

e. How many people listen to none of these three types of music?

f. which music would you advise them to take and why.

Learning Activity 4-Representing combined operations on Venn diagram using tools (*Computers, paperboard, chalkboard,…upto 3 sets).*

Activity 4.1: Pairs / groups

Materials needed : (C*omputers, paperboard, chalkboard,…)*

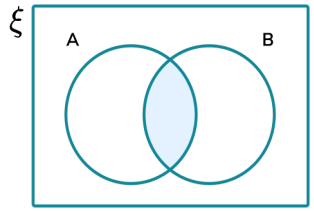
- In pairs/ Groups learners to create various set operations and represent them on a Venn diagram by shading
- Learners to show set operations on a Venn diagram through shading a given operation on a set using as many tools as is locally available (Microsoft word, Paper board, black board…)

Content Tips:

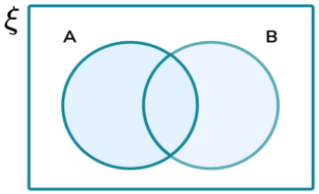
- The sets to be shed should:

i. be created by the learners themselves
ii. include some combined operations
iii. must have operations for upto 3 sets .($A^c \cap (BUC)$)

- Each pair should create presentations that clearly shows the operations by shadings.



$A \cap B$



$A \cup B$

Activity 4.2 : Individual Work

Learners shade the region represented by each of the sets given below using any tools available (*papers, computer applications ,.....)*

a. A^C
b. $A^C \cap B$
c. $A^C \cap (A \cap C)$
d. $A^C \cap (B \cup C)$
e. $\boldsymbol{A \cap B \cap C}$

Expected standard: Set operations as applied in real life context correctly.

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