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MATHS STUDY MANUAL

At the end of this section, the INSTRUCTOR should be able to:

- Identify the learning activities that can be used to teach the suggested specific content.
- Model and construct low/no cost resources to be used in the teaching of each of the proposed topics. Simulate various learner centered approaches in groups for instructing the desired content.
- Effectively use their ICT in teaching/ learning and making T/L resources.
- Demonstrate gender responsiveness during the lessons.
- Identify misconceptions in the various topics suggested and state how to correct them.
- Effectively use the language of mathematics in lesson preparation and general lesson presentation.
- Design a lesson plan complete with appropriate activities and resources relevant to the specific content.

At the end of this section, the LEARNER should be able to:

- Use math vocabulary correctly in answering questions.
- Correctly use language of mathematics in group discussions and class presentations.
- Demonstrate ability to work with his / her peers in small groups
- Manipulate the various resources availed in class and ask questions about them in learning the various math topics
- Help the instructor in creatively suggesting further resources that can be used to learn various aspects of content already covered in class.
- Freely express any challenges faced in learning any specific area in class to his/ her peers or the instructor.
- Connect math to real life.

RATIONALE

Teaching and learning of math has progressed with a lot of difficulty due to challenges affecting both the instructor and the learner. These include poor communication between the instructors /learners, inadequate teaching and learning resources, inappropriate use of the language of mathematics, general negative attitude in the learning environment among others.

The challenges mentioned give room for rote learning. Learners are made to recall ideas and facts they cannot decipher. There is basically lack of understanding of what is done. Mathematics therefore lacks meaning and the learners struggle in class. The instructors become irreproachable thus instilling fear in the learners. Without formal or direct instruction on specific Math concepts like number facts, algorithms or procedures, learners cannot construct viable solutions to a variety of problems they face.

The basic operations of addition, subtraction, division and multiplication can be defined in terms of intuitive problem solving and symbolic processes. It is therefore important for the instructor to be well equipped to help learners handle the challenges of the classroom environment.

The starting point of all achievement is desire, hence instructors must captivate intrinsic motivation within themselves so as to influence the boys and girls to acquire and model mathematical thinking in their earliest stages of their academic life. Boys and girls are/should be capable of learning when their instructors truly understand their thinking and provide them with opportunities to reason. Learning is highly flexible, therefore the instructor needs to be equipped with varied techniques of teaching and learning that will help develop the learners mind and provide them with a stable foundation for modelling of math concepts.

Introduction

This manuscript has been developed to give instructors an insight on how to model inquiry based approach and help the learners think. It is important that learners understand what they do in class. They need to question the facts presented in order to conceptualize math knowledge concretely. A few topics for grade 5 – 8 levels of the primary curriculum have been suggested. The selected topics are a subset of what the learners are supposed to be exposed to in their primary schooling.

Appropriate teaching and learning resources that can help deliver the subject matter have been outlined. Each content area begins with a guiding question that shall help the learners think along the knowledge they are being exposed to.

The language of mathematics is fundamental and cannot be overemphasised. Appropriate age level specific math vocabulary need to be systematically developed as the language of math develops. Moreover, the language of math takes into consideration symbols and notations alongside their meanings.

Insight on Teaching/Learning Resources

Instructors need to develop teaching and learning materials so that they can effectively disseminate knowledge. An instructor has to think and improvise materials that evoke and capture a learner's attention, however most instructors concentrate on making charts and employ little creativity in designing the teaching/ learning materials. The materials may vary from straws, pebbles, old calendars, days of the week charts, maths games charts, picture books, place value pockets, illustrative charts, flash cards/ pictures, fraction charts and drawings, improvised sack clothes, models of shapes etc.

The instructor should demonstrate good mastery of content and understanding of the environment in which they teach in order to make use of the locally available materials. It has been noted that teaching

and learning resources can be effectively used to introduce maths vocabulary. This forms a strong basis for understanding of concepts and concretization of abstract concepts.

Poor use of teaching /learning resources leads to misconceptions. The materials should be well displayed and appropriately used. Sometimes an instructor may develop good teaching resources but fail to meet the specific learning objectives due to poor presentation.

INTRODUCING

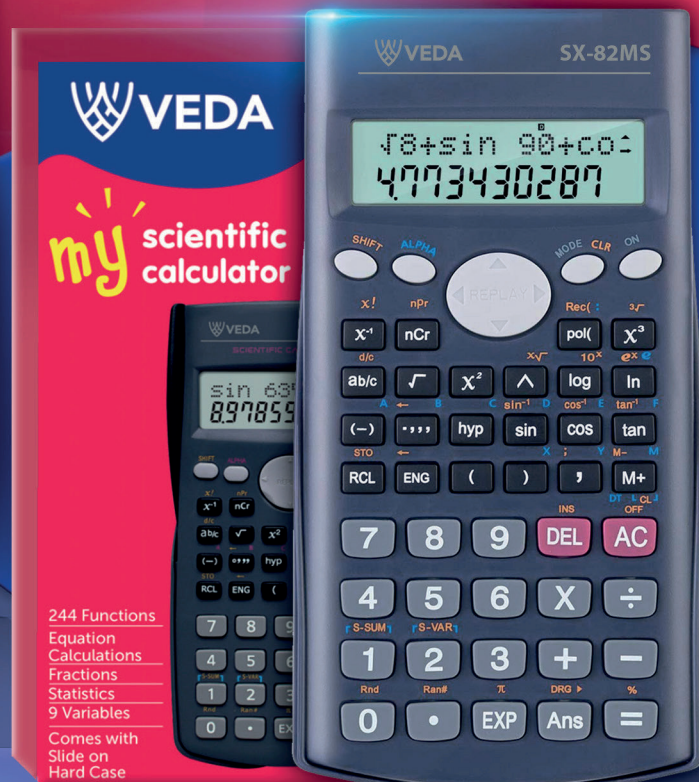
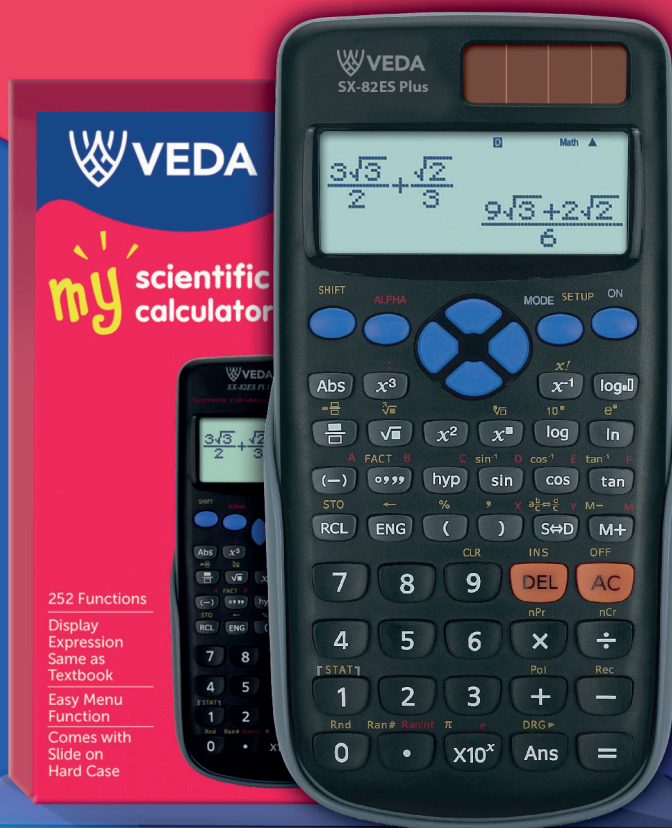
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GUIDING QUESTION 1



**How can
instructors involve
learners in
designing/making
appropriate
teaching/learning
resources within
their context?**

“For many learners, mathematics is seen as a ‘foreign language’; the symbols and expressions provide a formidable barrier to understanding of mathematical concepts,”

(COAG, 2008).

The way in which instructors and textbooks use language and different metaphors in mathematics education determines how learners develop their number sense.

If a problem is largely presented verbally, and later learners asked how they felt when it was done, most of them often talk of feeling frustrated, angry, incompetent, disempowered and tended to switching off. The most challenging thing about math problems is the language used and understanding math vocabulary. There are many terms, constants, symbols, notations and words that learners do not know and understand. Ironically math problems are designed using the language of math that employs such. The instructor therefore needs to ensure that learners can interpret the language of mathematics appropriately during their formative assessment.

Like any other language, mathematics is a special language with nouns, pronouns, verbs etc. Such features of language need to be properly disseminated i.e.

- Nouns could be fixed things, such as numbers, or expressions with numbers: e.g. 14.
- The Verbs could be the equals sign “=”, or inequalities like $<$ or $>$
- Pronouns could be variables like x or y : e.g.

$$5x - 7, xy, \frac{3}{x}$$

They could all be put together into a math Sentence like the one given below;

$$3x + 7 = 22$$

The following key questions need to be answered.

- a. How does the instructor decide what information is relevant for a math problem?
- b. How does the instructor identify a math task to be embedded in a text?
- c. How could math problems be adapted so that learners can think gainfully to find solutions to the task?
- d. And what does a learner’s response to such a task tell about how much mathematics they can do?

These are the kinds of questions that instructors need to think about as they consider how best to support learners in their mathematics lessons.

Meaning of language of mathematics

A systematic way of communicating mathematical ideas.

Mathematics is a language of symbols. It uses symbols instead of words.

There are;

- Symbols for operations: x , $\div$, $+$, $-$,
- And symbols that “stand in” for values: x, y ,
- And many special symbols: $X, >, <, ^\circ C, \%, \pi$
- There are also digits e.g the 10 digits: $0, 1, 2, \dots, 9$

Mathematical language skills include the abilities to read with comprehension, to express mathematical thoughts clearly, to reason logically, and to recognize and employ common patterns of mathematical thought.

SECTION 1

NUMBERS



1.1 Reading and writing numbers in words and symbols

Learning outcome

At the end of the section, the learner should be able to;

- Define different types of numbers; Prime, even, odd, and square numbers.
- Write numbers with three digits or more in words and symbols.
- Distinguish between place value and total value.
- Round off numbers to the nearest ones, tens and thousands.
- Correctly use divisibility tests for numbers 2, 3, 4, 5, 6, 8, 9, 10 and 11.

GUIDING QUESTION 2

**In writing
numbers, what
happens to the
number when the
number of digits
increases from
left to right?**



Write two numbers of your choice to fill up positions IV and V, one of them should have digits to cover the entire table

In the spaces provided write the numbers you have used in the table above in words.

I. 3456 _____

II. 790,771.76 _____

III. 0.047 _____

IV. _____

V. _____

Note

The value of any number depends on the number of digits in the number, the numerical

Activity 1:

Investigating place value of numbers

Complete the table below by placing the digits in the correct positions. The first one has been done for you.

Table 1

S/N	NUMBER	HUNDREDS OF THOUSANDS	TENS OF THOUSANDS	THOUSANDS	HUNDREDS	TENS	ONES	TENTHS	HUNDREDTHS
I	3,456			3	4	5	6		
II	790,771.76								
III	0.047								
IV									
V									

value of the digits and their place values i.e. 9743 is greater than 743 because 9743 has more digits, 563 is greater than 545 because although both have the same digits, 560 is greater than 540. When writing a large number in words, first arrange the digits in the number in groups of three digits from the right to the left i.e. 72,203.

Activity 2:

Investigating the Total value of numbers

Write down what comes to your mind when the word total value of a number is mentioned

Note

To obtain the total value of the number we shall multiply the digit by its corresponding place. For example, the total value of 43134.341 can be obtained as follows.

Table 2

DIGIT		PLACE VALUE		TOTAL VALUE
4	x	100,000	=	400,000
3	x	10,000	=	30,000
1	x	1000	=	1000
3	x	100	=	300
4	x	10	=	40
3	x	0.1 (1/10)	=	0.3
4	x	0.01(1/100)	=	0.04
1	x	0.001(1/1000)	=	0.001

When the total values of the digits are summed up, they give the total value of the number.

For example,

$$400,000 + 30,000 + 1000 + 300 + 40 + 0.3 + 0.04 + 0.001 = 43,134.341$$

Exercise

Work out the total value of all the numbers in table 1.

What is the relationship between total value and place value?

Activity 3:

Rounding of Numbers to the Nearest 10, 100, 1000

Take three minutes to explain to your peer what one needs to do before rounding off a number. Then attempt to round off the following number to the nearest **tens**, **hundreds** and **thousands**.

45678

Note

Procedure for rounding off;

Identify the digit in the place value to be rounded off.

If the digit to the right side is less than 5, the digit in the place value is to remain unchanged and other digits to the right side are replaced with zeros. If the digit to the right is 5 or greater than 5, round off the digit in the place value and replace other digits to right side with zeros.

Worked out example

Round off the number 96532 to the nearest; Tens, Hundreds and Thousands...

The digit to be rounded off is indicated in bold and underlined as shown below.

Tens	Hundreds	Thousands
96532	96532	96532
+ 0	+ 00	+ 000
96430	96500	97000

Activity 3:

Divisibility Tests and types of numbers

Task

What do you understand by the following numbers; prime, odd, even, square? In pairs let each learner tell their friend the meaning.

Write down two examples for each category below:

- Prime
- Odd
- Even
- Square

How can you tell if a number is divisible by 2, 3, 5, 6, 8, 9, 10 and 11?

Compare your answers with your friend

Check your responses against the following known facts;

Note

- A number is divisible by:
- 2, if the last digit is zero or even.
- 3, if the sum of the digit is a multiple of 3.
- 6, if the last digit is 0 or even and the sum of the digit is a multiple of 3 i.e. if it is both divisible by 2 and 3.
- 5, if the last digit is 0 or 5.
- 4, if the last two digits are multiples of 4.
- 8, if the last 3 digits are multiples of 8.
- 9, if the sum of the digit is a multiple of 9.
- 10, if the last digit is zero.
- 11, if the difference between the sums of the alternate digit is 0 or a multiple of 11.

Prime Numbers

A number that has only two divisors, one and itself is called a prime number.

Example 2, 3, 5, 7, 11, 13, 17, 19 etc.

Note; 1 is not a prime number because it has only one divisor.

Prime Factors

A factor is a number that divides another number without a remainder also called a divisor. A factor which is a prime number is called a **prime factor** i.e. **3 and 7 are prime factors of 21** e.g. $3 \times 7 = 21$.
Therefore, 21 is a product of its prime numbers.

Squares and Square Root

Squares of whole numbers: Multiplying a number by itself gives the square of that number. Read as four squared or $4 \times 4 = 16$.

Squares of fractions: multiply the numerator by itself and multiply the denominator by itself i.e.
Means

$$\left(\frac{2}{5}\right)^2 \text{ Means } \frac{2}{5} \times \frac{2}{5} = \frac{4}{5}$$



SECTION 2

MEASUREMENTS

Learning outcome

At the end of this section, the learner should be able to;

- Calculate the area of a rectangle, square, triangle, parallelogram and trapezium.
- Work out the surface area and volume of the cube, cuboid and cylinder.
- Relate various units for volume and capacity

GUIDING QUESTION 1

Is there any relationship between the length, area and volume of a shape? Explain.



Activity 1:

Approximate the measurements for the length and width of your classroom. What can we use to measure the length of the classroom?

Measure the length and width of your desk.

List down objects in your classroom and the general school environment that have the following shapes.

Table 3

S/N	Name of Shape	Examples of objects in the classroom that have such shapes
1	Circle	
2	Rectangle	
3	Square	
4	Parallelogram	
5	Trapezium	

Draw all the shapes listed in table 3 above.

Area of different shapes

Area is the surface covered by a shape like square, triangle, rectangle, parallelogram, circle etc. The formula for calculating area is;

Rectangle $A = L \times W$

Square $A = L \times L$

Triangle $A = \frac{1}{2} \text{Base} \times \text{Height}$

Circle $A = \pi r^2$

Trapezium $A = \frac{1}{2} \text{Height} (a + b)$
where a and b are the parallel sides

Parallelogram $A = B \times H$

$A = \text{Base} \times \text{Perpendicular Height}$

Activity 2:

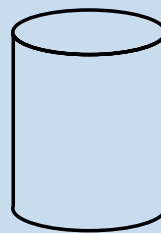
Investigating Surface Area of shapes

Materials required for this activity; Solid shapes of Cubes, cuboid, cylinder, and pyramid made from paper, Pair of scissors.

In your group discuss how the total surface area of the solids can be estimated what will happen to the surface area if the solids were open on one end?

Note

The surface area of a figure is the area of all the faces that make up the concerned figure i.e. cylinder, cubes, cuboids etc. The formulae for calculating surface area is always expressed in square units.



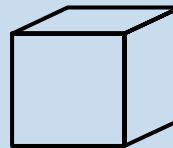
Cylinder

$SA = 2\pi r^2 + 2\pi rh = 2\pi r (r + h)$

If the cylinder is closed and

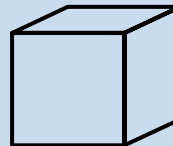
$SA = \pi r^2 + 2\pi rh = \pi r (r + h)$

If the cylinder is open



Cube

$SA = 6 (L \times L) = 6L^2$



Cuboid

$SA = 6 (L \times L) = 6L^2$

Total Surface area is equal to the area of each of the individual faces.

In groups cut out and open all the faces of the shapes provided. Complete the table below.

Shape	Total number of faces	Number of faces that have a rectangular shape	Number of faces that have circular shape	Number of faces that have a triangular shape	Number of faces that have a square shape
Cube					
Cuboid					
Cylinder					
Pyramid					
Cylinder					

In your group discuss how the total surface area of the solids can be estimated

What will happen to the surface area if the solids were open on one end?

Activity 2:

Investigating the volume of shapes

- Explain what you understand by the term volume
- What is the difference between volume and capacity?
- What units are units for volume?
- Discuss how the volume of the shapes in table 4 can be worked out.

Note

Volume

The Volume of an object is the space occupied by the objects measured in cubic units e.g. cm^3 , m^3 etc.

Capacity

It is the amount of liquid contained in a container measured in litres and millilitres. 1000 millilitres equals to 1 litre.

Mass

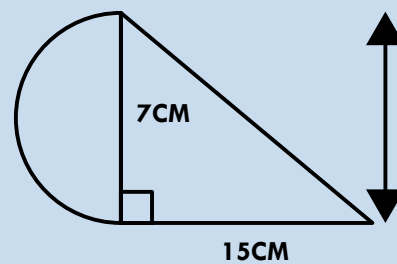
Mass is the quantity of matter in a substance. The unit of measuring mass is grams, kilograms and tonnes.

1000 grams = 1 Kilogram (Kg)

1000 Kilograms = 1 tonne (t)

REVISION QUESTIONS

1. What is the perimeter of a square whose side is 40cm?
2. A rectangular piece of land is 340 long and 200m wide. Find the area of the piece of land in
 - m^2
 - Hectares
 - Acre
3. Calculate the area of the figure below?



4. A rectangular block measures 30cm by 40cm by 50cm. What is the volume in?
 - a. m^3
 - b. Cm^3
 - c. What is the capacity in litres?



SECTION 3

GEOMETRY

Learning outcome

At the end of the session, the learners should be able to;

- Identify different types of angles.
- Justify angle properties of parallel lines.
- Construct basic angles of 30, 45, 60 and 90 degrees.

GUIDING QUESTION 1

**Is geometry
useful in
real life
experiences
of mankind?
Explain**



Activity 3

Investigating different types of angles

- Write down your own understanding of the word angle.
- Using your arm, model different types of angles where possible.
- Identify structures in class and the school that have the different types of angles. Begin with the roof of the classroom.

Complete the table below to summarize your findings

Table 5

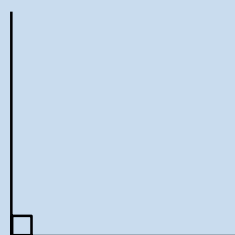
S/N	TYPE OF ANGLE	DESCRIPTION
1	Right angle	
2	Acute angle	
3	Obtuse angle	
4	Reflex angle	
5	Angles on a straight line	
6	Angles at a point	
7	Alternate angles	
8	Allied angles	
9	Corresponding angles	
10	Vertically opposite angles	

Draw diagrams to illustrate the angles suggested in the table above.

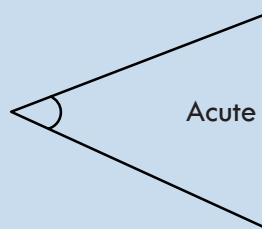
GEOMETRY

Geometry is a branch of Mathematics that deals with construction, measurements, properties and relationships of lines, angles and solids.

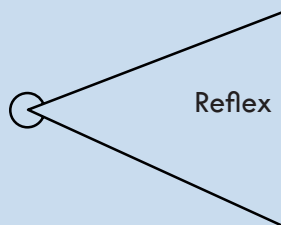
Types of angles



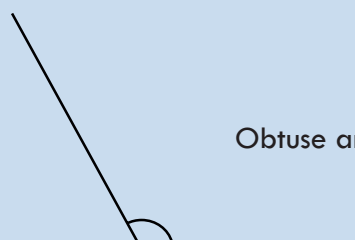
Right angle 90°



Acute angle is less than 90°



Reflex angle is more than 90°



Obtuse angle more than 90°

Properties of angles on parallel lines

- Vertically opposite
- Alternate angles
- Corresponding angles
- Co-interior angles
- Complimentary angles
- Supplementary angles

Activity 4

Construction of various types of angles

Using a ruler and a pair of compasses only, review how the following angles are constructed 30, 45, 60, 90 and 120.

Task

Use a ruler and a pair of compasses, construct a triangle PQR in which $PQ = 6$ cm, and

- Calculate the size of and check your answer with a protractor
- Measure PR and QR to the nearest millimetre
- Hence find the perimeter of triangle PQR in millimetres.

Task

Construct a triangle whose sides are 3.6 cm, 3.0 cm and 4.8 cm. Bisect the smallest angle and measure each part.

Key concepts for review

- To bisect a given angle,
- To draw the perpendicular bisector of a line segment,
- To construct angles of 15° , 30° , 45° , 60° , 90° , etc.
- To construct a triangle given its base, a base angle and the sum of other two sides,
- To construct a triangle given its base, a base angle and the difference of the other two sides,
- To construct a triangle given its perimeter and the two base angles,
- Geometrical construction means using only a ruler and a pair of compasses.

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