NEW CONCEPT

MATHEMATICS

for Senior Secondary Schools

Teacher's Guide

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A A Arigbabu
M O Salau
A A Salaudeen
O M Salaam
T D Bot
H N Odogwu
M O Obono
R A Jimoh
A E Adebisi
A I Usman

LearnAfrica

Learn Africa Plc
Felix Iwerebon House
52 Oba Akran Avenue
P.M.B. 21036
Ikeja, Lagos State
Telephone: 08093855455, 09137000195
E-mail: learnafrica@learnafricaplc.com
Web: www.learnafricaplc.com

Area offices and branches
Abuja, Abeokuta, Akure, Benin, Calabar, Ibadan, Ilorin,
Jos, Kano, Makurdi, Onitsha, Owerri, Port Harcourt, Zaria,
with representatives throughout Nigeria

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Contents

Chapter 1 Number base system

Objectives

By the end of this chapter, the students will be able to:

1 convert numbers in base 10 to other bases;
2 convert numbers in other bases to base 10;
3 convert decimal fractions in other bases to 10;
4 carry out operations involving addition, subtraction, multiplication and division of numbers in different number bases;
5 solve equations involving number base system; and
6 apply the processes of number base system in computer programming.

Number bases

This chapter deals with counting of digits based on an established pattern; for example, counting of days in a week, counting of seconds in a minute and so on. The examples on Tables 1.2–1.9 of the Pupil's Book should be explained to the students. Examples 1–5 (Pages 19 and 21) should also be explained.

Exercise 1.1 (Pages 21 and 22)

Part of this exercise can be given to students in the class and the remaining questions as assignment.

Conversion of numbers in other bases to base 10 (Page 22)

It is essential that the students should note the following points when converting from other bases to base 10.

1 Expand the given number in the power of its base.
2 Let the expansion be written as a single number.

Guide the students through Example 6 (Pages 22–23).

Exercise 1.2 (Page 23)

Questions 1 – 5 can be given to students as classwork while the remaining questions given to them as assignment.

Conversion of numbers involving fractions from other bases to base 10 (page 23)

This exercise (bicimal numbers) can be done by referring to Example 4 of the Pupil's Book.
It is important for students to know the meaning of bicimals, which are base ten fractions, and their place-values have negative powers of ten. Guide the students through Examples 7 to 9 (Pages 24).

Exercise 1.3 (Page 24)
Part of this exercise should be done in class and others given as assignment.

Conversion of numbers from one base to another, other than base 10 (page 24)
It is essential that the students understand the steps in converting numbers from one base to another, other than base 10. Use Example 10 (pages 24 and 25) to explain further.

Exercise 1.4 (Page 25)
Questions from this exercise can be done in class, let the students solve the questions on their own and go round to check and make corrections where necessary.

Basic operations involving number base system (Page 25)
It is imperative for students to know the basic operations like addition, subtraction, multiplication and division of number base system. Students should know that the digit of the base can not appear in the basic operations. Use Examples 11 to 15 (Pages 25–28) to explain to students in the class.

Exercise 1.5 (Pages 28–29)
This exercise can be done by using Examples 11 to 15 (Pages 25–28) of the Pupil's Book. Part of this exercise can be given as classwork and the rest as assignment.

Equations involving number base system (Page 29)
It is important for the students to have knowledge of solving either simultaneous or quadratic equations to be able to grasp this aspect of number base system.

Exercise 1.6 (Page 30)
Examples 16–19 can be used to solve some of the questions in this exercise. Give them some as classwork and some as assignment.

Application of base number system to computers (Page 30)
Students should be taught how the computer works. The application makes use of the two way coding system of 0 and 1 in storing information.

Exercise 1.7 (Page 32)
Table 1.10 can be used to answer some questions in this exercise.

Chapter 2 Modular arithmetic

Objectives

By the end of this chapter, the students will be able to:

1 recall the process and operation of addition, subtraction, multiplication and division;
2 apply the concept of modular arithmetic in cyclic variables;
3 carry out basic arithmetic operations in various moduli; and
4 apply the concept of modular arithmetic to daily situations.

Puzzle

Students should give other events in nature that are cyclic.

Addition, subtraction, multiplication and division of integers (Page 34)

The operations of addition and subtraction of integers should take care of the following:

1 Place value system should be considered by the students.
2 Decimal points should be in line in each integer.
3 Students should not forget to insert decimal point at the end of the operations.

The operations of multiplication and division of integers should take care of the following:

1 Place-value system should be considered by the students.
2 Number with less digits should be under during multiplication.
3 Division can be carried out using long division method.

Exercise 2.1 (Page 35)

Students can make reference to Examples 1–4 (Page 34) of their textbook to do this exercise.

Circular variables and modular arithmetic (Page 35)

Students should be told of events that occur in a circular manner, e.g. the days of the week, weeks of a month, months of the year, etc.
Guide the students through Examples 5–8 (Page 37).

Exercise 2.2 (Page 37)

The exercise can be done orally in class.

Algebraic processes involving modular arithmetic (Page 37)

Students should be told the steps involved in addition and subtraction of integers in a given modular system, e.g. the sum of two integers in a given modular system is obtained by adding the two integers and then finding the remainder when the sum is divided by the given modulus.

E.g. $8 + 13 \pmod 6$

$8 + 13 = 21$

$21 = 3 \times 6$ rem 3

$= 3 \pmod 6$

$= 3.$

See the students through Examples 9–15 (Pages 38–41) for better explanation.

Simple equations in modular arithmetic (Page 41)

The teacher should show how arithmetic leads to simple equations with given examples.

Use Examples 16 and 17 (Pages 41 and 42) for further explanation.

Exercise 2.3 (Pages 42)

Questions 1 and 2 of this exercise can be done orally while the remaining can be given as classwork and as assignment.

Application of modular arithmetic to real-life situations

Emphasis should be made on application of modular arithmetic to real-life situations. Examples should be given by the teacher and also students. Use Examples 18–23 (Pages 43–45) for further explanations.

Exercise 2.4 (Pages 45 and 46)

Part of this exercise can be done as classwork and the remaining as assignment.

Chapter 3 Indices

Objectives

By the end of this chapter, the students will be able to:

1 express given numbers in standard form;
2 identify and write numbers/letters in index form;
3 apply laws of indices in solving problems; and
4 solve problems, involving indical equations.

Standard form (Page 47)

Students should know the general form of writing numbers in standard form which is $A \times 10^n$ where, A is a number between 0 and 9 and n is an integer. Examples 1to 4 (Pages 47-49) should be taken as reference.

Exercise 3.1 (Page 49)

This exercise can be given to students as classwork and assignment.

Laws of indices (Page 50)

Index means exponent or power; e.g. in t^3 and k^5, 3 and 5 are indices of base form t and k. Emphasis should be put on the laws of indices.

1 $b^x \times b^y = b^{x+y}$

2 $b^x \div b^y = b^{x-y}$

3 $b^0 = 1, b \times 0$

4 $b^{-a} = \frac{1}{b^a}$

Example 5-8 (Pages 50-53) can be used to illustrate the laws above.

Exercise 3.2 (Pages 53 and 54)

This exercise should be taken by students as classwork and assignment.

Zero and negative indices (Page 54)

Students should understand that a number (term) raised to a negative power is equal to the reciprocal of that number raised to the equivalent positive number.. Example 9 should be used to illustrate this law.

Exercise 3.3 (Page 55)
This exercise should be solved in class.

Fractional indices (Page 56)
Students should know that square root is the opposite of square, and it is usually denoted by $\sqrt{\ }$. The square root of a letter y is shortened as $\sqrt{y}$.
Guide the students to go through Example 10 (Page 55) to explain.

Exercise 3.4 (Pages 57 and 58)
Examples 10 (a)–(c) can guide students on how to solve this exercise.

Problems involving indical equations (Page 58)
This involves finding the unknown terms with index power. Use example 11 to explain further.

Exercise 3.5 (Page 59)
All examples will serve as guide in solving this exercise. Give Questions 1-5 as classwork and the rest as assignment.

Exercise 3.6 (Page 60)
Part of this exercise can be solved by students in the class and the rest taken as assignment.

Chapter 4 Logarithms

Objectives

By the end of this chapter, the students will be able to:

1 deduce logarithms from indices and standard form;
2 plot and interpret the graph of y = 10*x*;
3 find the common logarithm and antilogarithms of numbers greater than 1;
4 multiply and divide numbers greater than 1 using the logarithms tables; and
5 find the powers and roots of numbers greater than 1 using the logarithms tables.

Deducing logarithms from indices and standard form (page 61)

Explain the relationship between indices and logarithms.

64 can be express as 8^2,

i.e. $64 = 8^2$

$64 = 4^3$

Similarly, $2^4 = 16$, where 2 is the base and 4 is the power or index. On the other hand, we can write that the log of 16 to base 2 is equal to 4,

denoted by:

$\log_2 16 = 4$

Also, $3^4 = 81$, which means that $\log_3 81 = 4$

Meaning of logarithm

Students should note that the logarithm of a number is the power to which a base must be raised to give an ordinary number. If y is a number and x is the base, then $y = x^n$, where n is the logarithm of y to the base x, written as $\log_x y = n$.

Exercise 4.1 (Pages 62 and 63)

Examples 1 and 2 (Pages 61–62) of the Pupil's Book can be used in solving this exercise.

Logarithms to base 10 (Graph of y= 10^x (Page 63)

Students should note that we can illustrate the relationship between indices and logarithms on a graph of $y = 10^x$, by plotting the values of y and substituting the values of x in $y = 10^x$.

Exercise 4.2 (Pages 64 and 65)
Example 3 (Pages 63 and 64) can be used to solve Questions 1–4.

Use of logarithm tables (Page 65)
How to find the characteristic of a number
Students should know that the characteristic part of a number can be obtained by either;

a) subtracting 1 from the number of digits in the integer part of the number whose logarithms is being sought, or,

b) considering the standard form of the number, the characteristic is the index in the form 9×20^n, i.e. the characteristic is n.

Mantissa (Page 66)
Explain that the mantissa is that part of the logarithm of a number written after the characteristic of that number. It always comes after the decimal point, and is read from the Four-figure tables.

How to find the mantissa of a number
The following steps will guide students in obtaining the fractional part of a logarithm (i.e. the mantissa).

Step I: Consider all the digits (i.e. forgetting the decimal points) as whole numbers.
Step II: Take the first two digits of the number from the left hand column of the table.
Step III: Look for the next digits in the logarithm column.
Step IV: Look for the last digit under the difference column table on the right hand side of the table.
Step V: Add the number in the difference column to that in step (III) to give the logarithm of the given number.

Exercise 4.3 (Page 67)
Examples 4 and 5 (Pages 65–67) can be referred to, while solving this exercise.

Antilogarithm tables (Page 68)
An antilogarithm is the number that has a given logarithm. This is just a reverse process of finding logarithms of numbers, and for this, we can use the natural antilogarithm table. When finding an antilog, look up the fractional part only. Then use the integer to place the decimal point correctly in the final number.

Exercise 4.4 (Page 62)
Examples 6(a)–(d) (Page 68) can be used to solve this exercise. Give Questions 1-3 as classwork and the rest as aaignment.

Application of logarithms (Page 69)
Multiplication and division

When multiplying two numbers, the logarithms are added together before checking on the anti-logarithm. In the case of division of numbers, the logarithms are subtracted before checking on the antilogarithms.

Exercise 4.5 (Page 70)

Examples 7 and 8 will assist in working Exercise 4.5.

Powers and roots of numbers greater than 1 (Page 71)

For a number raised to a power, first find the logarithm of the number, multiply it by the power and find the antilogarithm of the product.

For roots of numbers, first find the logarithms of the numbers, divide by the root and find the antilog of the quotient. Examples 9 and 10 (Page 71) can be used to explain further.

Combined operations (Page 71)

Emphasise the following on combining operations:

1 Working out the brackets.

2 Changing roots to fractional indices.

3 Working out numerator and denominator separately.

4 Setting out the work clearly.

Exercise 4.6 (Page 72)

Example 11 can be used to solve this exercise.

Application of logarithm to capital market (Page 72)

Explain capital market as any market where government or a company (usually a corporation) can raise money (capital) to fund its operations and long term investments. Use Example 12 (Page 73) to explain to the students.

Exercise 4.7 (Page 73)

Give Questions 1-5 as assignment.

Chapter 5 Sets (1)

Objectives

By the end of this chapter, the students will be able to:

1 define sets as a group of objects;
2 state elements contained in a set;
3 describe or represent sets using
   a) statement (word) form;
   b) roster (listing) form;
   c) set builder form (stating rule);
   d) Venn diagrams; and
4 state the types of set with examples.

Definition of set (Page 74)

Define a set as a group of objects that have unique characteristics that differentiate them from another group. A set could also be a well-defined collection of identifiable objects. He should give examples of a set.

Elements of sets

Students should know that members of a set are called **elements**, and each member is separated from the others by a comma.

Set notation

Let the students know that a set is represented by capital letter and the members are in a curly bracket e.g.

$T = (Glo, Airtel, MTN)$

Lead the students through Example 1 (Pages 74 and 75)

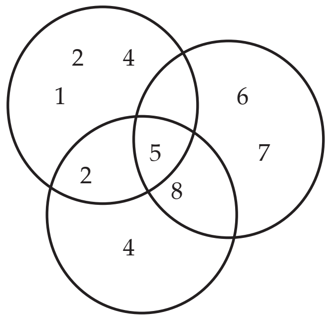
Cardinality of a set (Page 75)

The cardinality of a set is the number of elements in a set. The notation is $n(A)$ for a set.

Description (Representation) of sets (Page75)

Let the students understand that the elements in a set are represented in a pair of curly brackets { } and are usually described in either of the following.

1 Statement form: this is a well-defined description of the elements of the set enclosed in a curly bracket.
2 Roster form: the elements of a set are listed within the curly brackets and separated by commas.
3 Set builder form: representation of a set using variables such as $x, y\ldots$ followed by a colon (:) or /:
4 Venn diagram: this is a pictorial representation of sets with each set represented as a loop. The elements are written inside the loop.



Exercise 5.1 (Pages 76 and 77)

This exercise can be done orally by the students.

Classification of sets (Page 77)

1 Singleton set: this is a set which contains only one element. m= {8}.

2. Equal sets:Two sets are equal if they contain the same elements. The notation for equality is n(A) for a set.

3 Empty set: A set that contains no element is called an **empty set**, a **null set** or a **void set**. Students should know how to represent the null set which is ∅ or { } and not {∅}. This mistaken symbol is commonly used among students.

4 Equivalent sets: two sets *A* and *B* are equivalent if there is one-to-one correspondence between the elements in the two sets e.g.
A = {boy, girl, man}
$B = \{a, b, c\}$
$\therefore\ A = B$

5 Finite and infinite sets: students should know that if all the elements in a set can be listed, then the set is called a **finite set**. If not, it is called an **infinite set**.
E.g. *A* = {Instruments in a mathematical set}
A is a finite set.

6 Subset of a set: this refers to when a set X is said to be a subset of set Y if the element (s) of X are element (s) of Y. It is denoted by C. They can be proper subset or improper subset.

7 Universal set: students should know universal set as the set containing all the elements that can be used to solve the problems under consideration. The symbol for universal set is μ or $\notin$. Use Examples 4–7 (Pages 77–79) to explain the various sets.

8 Complement of a set: this is a set that includes all the elements of the universal set that are not present in the given set. It is denoted by $\bar{A}$ or A^c.

9 Power set: a collection of all the subsets of a set *S* is called the power set. If $A = \{a, b\}$, the subsets of *A* are $\{a\}$, $\{b\}$, $\{a, b\}$ and { }.

Exercise 5.2 (Page 79)

Part of this exercise should be given as classwork and the rest as an assignment.

Chapter 6 Sets (2)

Objectives

By the end of this chapter, the students will be able to:

1 explain by examples
   – intersection;
   – disjoint;
   – union of sets;
2 represent sets using Venn diagrams; and
3 apply Venn diagram in solving set related problems.

Operation on sets (Page 81)

The major operations of sets are union and intersection of sets.

Complement of a set

Let *U* be a universal set, and *A* a subset of *U*, then the complement of *A* written as *A′* or A^c, is the set of all elements in *U* but not in *A*. A′ is read as *A* prime.

Union of sets

The result of the union of two sets *A* and *B* which is like addition with modification is another set *C* which contains all the elements in either *A* or *B*. The symbol for union is $\cup$.

Disjoint sets

Two sets *A* and *B* are disjoint if they have no elements in common. It follows that their intersection is empty.

Intersection of sets

The intersection of two sets *A* and *B* is another set *C* which contains the element common to the two sets. The symbol for intersection is $\cap$.

Exercise 6.1 (Pages 82 and 83)

Examples 1–5 (Pages 81–82) can be used to solve Exercise 6.1 as classwork.

Representing sets using Venn diagrams (Page 83)

Venn diagrams are geometric diagrams that show relationship between sets. They can be used to solve many problems in real-life.

Exercise 6.2 (Pages 84 and 86)

Examples 6–8 can be used to solve this exercise as classwork and assignments.

Application of Venn diagrams to solving problems on sets (Page 86)

Venn diagram is a visual representation of how various sets overlap.
They can be used to solve a variety of real life problems.

Solving problems involving three sets (Page 88)

Explain this using example 10 (Page 88 and 89).

Exercise 6.3 (Pages 89 and 91)

Example 10–11 can be referred to in solving this exercise.

Chapter 7 Change of subject formulae and variation

Objectives

By the end of this chapter, students will be able to:

1 change the subject of any given formulae;
2 solve problems involving change of subject formulae;
3 solve problems involving different types of variations: direct, inverse, joint and partial; and
4 apply variations in the solution of physical and real-life problems.

Change subject of formulae (Page 92)

A formula is an equation in which letters represent quantities. Formula occurs in several physical and daily activities. There are situations that necessitate the re-arrangement of equations. These result in changing the subject of such formulae.

The re-arrangements will involve the arithmetic operations of addition, subtraction, multiplication, division, squares and square roots.

Exercise 7.1 (Page 93)

Examples 1 and 2 (Pages 92 and 93) can serve as guide in solving this exercise.

Exercise 7.2 (Page 94)

Examples 3 and 4 (Page 93) can serve as guide in solving this exercise.

Word problems on change of subject of formulae (Page 94)

This involves harder problems in equations whose subject of formulae must be changed. It may involve the different operations of addition, subtraction, multiplication and division.

Exercise 7.3 (Pages 95–96)

This exercise can be done using Examples 5 and 6 (Pages 94 and 95).

Variation (Page 96)

Variation is relationship between two or more quantities. These relationships are of various types.

Direct variation (Page 96)

Students should know that as a quantity increases and brings about an increase in another quantity, the two quantities are directly proportional to each other. The expression C µ N means that

$\frac{C}{N} = k$, where k is a constant.

$\therefore \; C = kN$

Exercise 7.4 (Page 97)

This exercise can be done using Examples 7 and 8 (Pages 96 and 97) as guide.

Inverse variation (Page 97)

If an increase in a quantity is bringing about a decrease in another quantity, then the two quantities are said to vary inversely with each other. For example, $t \propto \frac{1}{m}$ and $t \propto \frac{1}{s}$.

Exercise 7.5 (Page 99)

This exercise can be done using Examples 9 and 10 (Page 98) of the Pupil's Book as guide.

Joint variation (Page 99)

In joint variation, the relationship is between more than two quantities. Consider the volume of a cylinder, $V = \pi r^2 h$, the volume will be affected by the values of r and h. The volume therefore, jointly varies as the square of the radius of the base r and the height h.

Exercise 7.6 (Page 100)

This exercise can be done using Examples 11–12 (Pages 99–100).

Partial variation (Page 101)

Students should know that in partial variation, the relationship is expressed as a sum of quantities. One of the quantities in the variations is a constant. Problems on partial variation always result in the solution of a pair of simultaneous equations to find the two constants.

Exercise 7.7 (Page 102)

This exercise can be solved by referring students to Examples 13 and 14 (Page 10).

Chapter 8 Quadratic equations

Objectives

By the end of this chapter, the students will be able to:

1 recognise and factorise quadratic expressions;
2 solve quadratic equations of the form $ab = 0$;
3 construct quadratic equations with given roots;
4 draw the graph of quadratic equations;
5 obtain the roots of equations; from quadratic graphs; and
6 solve word problems involving quadratic equations.

Introduction (Page 110)

Students should know that linear and quadratic expressions are algebraic expressions that deal with the general properties of numbers by means of abstract symbols. Any expression in which the highest power of the unknown is one (1), is called a linear expression which is of the form $x + 6$ or $ax + c$, where a and c are constants, and x is the unknown but $a \neq 0$.

Any expression whose highest power of the unknown is two is called a **quadratic expression** which is of the form $ax^2 – bx + c$ where a, b, and c are constants and $a \neq 0$.

Examples of quadratic expressions are (i) $x^2 + 5x$ and (ii) $x^2 + 5x + 10$.

Exercise 8.1 (Page 110)

This can be done orally by the students.

Factorisation of quadratic expressions (Page 111)

Students should know that factorisation of quadratic expressions simply means splitting up a number or algebraic expressions into the parts that form the original number or expression.

Exercise 8.2 (Page 112)

Students can use Examples 1–3 (Pages 111 and 112) of their textbook to solve this exercise as classwork and assignment.

Factorisation of a quadratic expression of the form $ax^2 + bx + c$ (Page 112)

The following steps can be taken while factorising quadratic expressions.

Step 1: Find the factors of the product i.e. factors of ac in $ax^2 + bx + c$, assuming the factors are ux and vr,

The sum of the two factors or numbers must give the middle term which is bx.

Sum: $u + v = bx$

$= (u + v)x = bx$

Step 2: Replace the middle term with those two factors to make the expression four terms: $ax^2 + uv + vx + uv$

Step 3: Group them in twos to find the common factor in the first two terms and the last two terms.

Exercise 8.3 (Page 114)

Examples 4–6 (Pages 113–114) can be referred to while solving this exercise.

Difference of two squares (Page 114)

A quadratic expression of the form $x^2 - v^2$ is usually referred to as **difference of two squares.**

Exercise 8.4 (Pages 114 and 115)

This exercise can be solved using Examples 7–9 (Page 114).

Solutions of quadratic equations (Page 115)

A quadratic expression that equates to zero is called a **quadratic equation**. In general, a quadratic equation is of the form: $ax^2 + bx + c = 0$, where a, b and c are constants, and $a \neq 0$.

If the product of two numbers is zero then one of the numbers is zero or possibly both of them are zero. For example, $ab = 0$

$a \; b = 0$

Either $a = 0$, or $b = 0$ or both.

One of the methods of solving quadratic equations is the factorisation method.

To solve a quadratic equation by factorisation, we factorise the left hand side of the equation and then solve the equation.

Exercise 8.5 (Page 116)

This exercise can be solved as classwork and as assignment by referring to Examples 10(a)–(d) (Pages 115 and 116).

Exercise 8.6 (Page 117)

This can be solved as classwork and as assignment by referring to Examples 11–12 (Pages 116 and 117).

Formation of quadratic equations with given roots (Page 118)

Let α and β represent the roots of a quadratic equation, the equation itself is given in term of x by:

x^2 – (sum of roots) x + product of roots = 0 i.e., $x^2 - (\alpha + \beta)x + \beta = 0$

Exercise 8.7 (Page 119)

This can easily be solved by using the expression above and referring to Examples 13 and 14 (Pages 118 and 119).

Graphs of quadratic equations (Page 119)

This is another method of solving quadratic equations using graphs. The following steps should be considered by students while solving quadratic equations using graphs.

Step 1: Make a table of values for the function which contains the values of x and corresponding values of y.

Step 2: Choose a suitable scale for both x and y axes.

Step 3: Plot the point on the graph.

Exercise 8.8 (Pages 123 and 124)

This exercise can be solved by referring to Examples 15-19 (Pages 119-123).

Word problems leading to quadratic equations (Page 125)

Students should note that mathematical statements can be made, and when interpreted numerically, they lead to quadratic equations. Any of the methods can be used to solve such equations.

Exercise 8.9 (Pages 125 and 126)

This exercise can be solved using Examples 20 and 21 (Page 125) as guide.

Chapter 9 Logical reasoning (1)

Objectives

By the end of this chapter, the students will be able to:

1 define logic;
2 identify simple statements;
3 deduce the truth or falsity of a simple statement; and
4 form the negation of a simple statement.

Logic (Page 127)

Logic is a branch of philosophy that is mainly concerned with the evaluation of arguments based on fundamental laws of scientific reasoning and thinking.

Simple statements (Page 127)

Students should know that a simple statement is a sentence which is true or false but is not both. It is a proposition that is either true or false. This statement may be verbal or writing.

Exercise 9.1 (Page 128)

This can be done orally in class.
See the students through Examples 1 (Page 128).

True and false statements (Page 129)

The truth value of a statement is the truth or falsity of the statement. To determine the truth or falsity of a simple statement, one requires a pre-knowledge and/or definition of the main concepts related to the statement.

Exercise 9.2 (Pages 129 and 130)

This can be done by referring to Examples 2 and 3 (Page 129) of the Students' Book.

Negation of a logical statement (Page 130)

If a statement is denoted by P, then the negation of the proposition is not P, and is also a statement denoted by $\sim P$(*or* P'). So, if the statement P is true, then the statement $\sim P$ is false. Conversely, if P is false, $\sim P$(not P) is true.

Exercise 9.3 (Page 130)
This can be done orally.

Truth tables (Page 131)
The truthfulness or falsity of a statement is called its truth value.

Truth table

P	~P
T	F
F	T

Exercise 9.4 (Pages 131 and 132)
This can be done by referring to Example 6.

Application to real-life situations (Page 132)
Give examples relating to real-life situations. Use Example 7 (page 132) to explain further.

Chapter 10 Logical reasoning (2)

Objectives

By the end of this chapter, the students will be able to:

1 distinguish between simple statements and compound statements;
2 give examples of conjunction, disjunction, implication and bi-implication;
3 list the five logical operations and their symbols;
4 write the truth value of a compound statement involving the logical operators; and
5 translate logical symbols.

Compound statements (Page 134)

Two or more simple statements that contain more than one idea and that can be separated into two or more statements by means of a certain group of words called **connectives** are referred to as **compound statements**.

Connectives (Page 135)

Students should know that the words which combine simple statements to form compound statements are called logical connectives or simple connectives.

Exercise 10.1 (Page 136)

This can be done orally in class.
See the students through Examples 1–3 before doing the above exercise.

Disjunction (Page 136)

This is a compound statement formed by joining two simple statements with *or* for instance,
If P is a statement: *Pastor preaches* and Q is another statement: *Pastor prays*, then $P \Rightarrow Q$ = *Pastor preaches or prays* since he cannot do both at a time.

Exercise 10.2 (Pages 137 and 138)

This can be done by referring to Tables 10.3 and 10.4 (Page 137) of the Students' Book.

Implicative (or conditional) statements (Page 138)

This is when two simple statements are combined by *If…then* such that the first statement implies the second. They are usually denoted by $P \vee Q$. The *If* clause statement (i.e. P) is called the antecedent while the *then* clause (Q) is called **the consequent**.

Exercise 10.3 (Page 140)

This can be done using Examples 4–8 (Pages 138–140).

Tautology (Page 141)

This is a compound statement or proposition whose end result is true despite the values of its sub-statements. The teacher should explain the table below.

Q	$\sim Q$	$Q \vee \sim Q$
T	F	T
F	T	T
T	F	T
F	T	T

Contradiction (Page 142)

This is a situation in which a compound statement results to false despite the validity or otherwise of the substatements. Contradiction is always denoted by F. For instance show that statement $(P \wedge Q) \wedge \sim (P \vee Q)$ is a contradiction.

P	Q	$P \wedge Q$	$P \vee Q$	$\sim P \wedge Q$	$(P \wedge Q) \vee \sim P \vee Q)$
T	T	T	T	F	F
T	F	F	T	F	F
F	F	F	T	F	F
F	F	F	F	T	F

Chapter 11 Basic geometrical constructions

Objectives

By the end of this chapter, the students will be able to:

1 carry out basic geometrical constructions;
2 bisect any given line segments;
3 construct given angles, including special angles;
4 construct equivalent angles; and
5 construct triangles given the required conditions.

Basic geometrical construction (Revision) (Page 142)

All constructions begin with a point. A point occupies a position, but has no magnitude. A point is named by a capital letter: *A*, *P*, *Q*, *R*, etc. A line is the distance between two points.

Parallel lines (Page 143)

Parallel lines lie side by side and can never meet or cross one another. The distance between the lines remains the same, at any point.

Perpendicular lines (Page 144)

A perpendicular line is a line which meets a given line at a right angle. The angle between the lines is 90°.

Perpendicular bisector of a line (Page 145)

A perpendicular bisector is a line which divides a given line into two parts and at right angle with the given line.

Exercise 11.1 (Pages 147 and 148)

This exercise can be done by referring to Examples 1 and 2 (Pages 143 and 144).

Construction of triangles (Page 148)

You are expected to make the students understand the importance of constructing all angles and lengths to scale during this learning process.

Exercise 11.2 (Page 149)

This can be done in class by referring to Examples 3–5 (Pages 148 and 149) of the Students' Book.

Exercise 11.3 (Page 150)

This Exercise 11.3 can be given to students as an assignment.

Chapter 12 Constructions: Quadrilaterals and loci

Objectives

By the end of this chapter, students will be able to:

1 use the basic construction techniques to construct quadrilaterals of different forms;
2 define and describe locus of a point; and
3 construct loci.

Properties of quadrilaterals (Page 151)

The teacher should give the properties of quadrilaterals as follows:

1	Square	–	All four sides are equal in length.
		–	All four angles are right angles.
		–	The diagonals are lines of symmetry.
		–	The diagonals bisect each other at right angles.
2	Rhombus	–	All sides are equal
		–	Opposite angles are equal.
		–	The diagonals are lines of symmetry.
		–	The diagonals bisect each other at right angles.
3	Rectangle	–	Pair of opposite sides are equal.
		–	All angles are right angles.
		–	The diagonals are equal in length.
		–	The diagonals bisect themselves.
		–	The diagonals are lines of symmetry.
4	Parallelogram	–	Opposite sides are equal and parallel.
		–	Opposite angles are equal.
		–	The diagonals bisect each other.
		–	The diagonals bisect the figure into a pair of congruent triangles.
		–	There is no line of symmetry.
5	Kite	–	The pair of adjacent sides are equal.
		–	The main axis is the line of symmetry.
		–	The diagonals intercept at right angles.
		–	The pair of the opposite angles are equal.
6	Trapezium	–	One pair of opposite sides are parallel.

Exercise 12.1 (Page 155)

This can be done by referring to Examples 1–7 (Pages 153–154).

Locus of a point (Page 155)

Students should know that the locus of a point is a path traced out by a point constrained to move in accordance with given conditions. A locus may be a point, a line, a curve, a plane, a surface or a solid.

Types of loci

1 The locus of a point which moves with a constant distance from a fixed point is a circle.

2 The locus of a point which moves with a constant distance from a line is a parallel line.

3 The locus of a point equidistant from two lines intersecting at a point is the angular bisector of the angle between the two lines.

4 The locus of a point equidistant from two points is a perpendicular bisector of the line joining the two points.

Exercise 12.2 (Pages 156 – 158)

This can be solved by referring to Examples 8 and 9 (Page 156).

Chapter 13 Basic geometrical theorems (1): Triangles and polygons

Objectives

By the end of this chapter, the students will be able to:

1 explain this term geometry and the concept of geometric theorem;
2 identify the formalities required when proving any stated theorems;
3 locate angles and state the types;
4 locate line (s) and mention the types of lines;
5 deduce the properties of parallel lines and transversal and their related angles;
6 define and name the different types of triangles;
7 explain the properties of triangles, prove deductively the theorems on triangles and apply both theorems and properties in solving triangles problems;
8 define the word rider and apply the concept to deduce the following:
   a) sum of the interior angles of n-sided polygon;
   b) sum of the exterior angles of n-sided polygon; and
   c) meaning and conditions for congruency of a congruent triangle.

Meaning of geometric theorems (Page 159)

A proof simply means a logical statement, using evidence to establish a fact, a hypothesis or an argument put forward. Geometry is a branch of mathematics that deals within the properties of plane shapes or solid shapes. Geometric theorems are theorems based on the properties of solids and plane shapes, line, angles and polygons.

Angles (Page 159)

Angles are the distances or changes in direction between two lines or surfaces diverging from the same point measured in degrees.

Types of angles (Page 160)

The teacher should explain the difference between the following angles.

1 Acute angle: This is an angle that is less than 90° (right angle).
2 Right angle: This is an angle that is exactly 90° or a quarter of a revolution (360°).
3 Obtuse angle: This is an angle that is greater than 90° (right angles) but less than 180° (2 right angles).
4 Angle on a straight line: This is an angle that is exactly 180°.
5 Reflect angle: This is an angle that is greater than 180° but less than 360°.
6 Angle at a point: This is exactly four right angles (360°).

Elementary theorems (Page 160)

Students should know the following:

1 Vertically opposite angles are equal.
2 Corresponding angles are equal.
3 Alternative angles are equal.
4 The sum of angles of a triangle is 180°.
5 The exterior angle of a triangle is equal to the sum of the opposite interior angles.

Pythagoras' theorem

In a right-angled triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides.

Exercise 13.1 (Pages 162 and 163)

Part of this can be given as classwork and the remaining as assignment. Use Examples 1-4 (pages 161 and 162) to explain further.

Proofs of theorems (Page 163)

Triangles are plane figures bounded by three straight lines.

Classification of triangles (Page 163)

1. Scalene triangle has three unequal sides and angles.
2. Isosceles triangle has two equal sides and base angles.
3. Equilateral triangle has all the sides and angles equal.
4. Right-angled triangle has one angle equal to 90 degrees.

Theorems (Page 163)

The following theorems should be noted by students:

1 The sum of the angles of a triangle is 180°
2 The exterior angle of a triangle is equal to sum of the two interior opposite angles.
3 The base angles of an isosceles triangle are equal.

Exercise 13.2 (Pages 161 and 162)

Examples 5–8 of the Students' Book can be used to solve this exercise.

Riders corollaries (Page 167)

A rider (corollary) is another fact (statement) analysed based on the previous statement. It is an additional remark that follows a statement.

Polygon (Page 168)

Define a polygon as a plane figure with three or more sides, none of which intersects each other.

Classification of polygons (Page 168)

1 Convex polygon: In this type of polygon, each interior angle is less than 180°.

2	Re-entrant polygon:	This is a polygon with one or more of its interior angles reflex i.e. greater than 180°.
3	Equilateral polygon:	This is a polygon in which all its sides are equal.
4	Equiangular polygon:	This is a polygon with all its angles equal.
5	Regular polygon:	This is a polygon in which all its sides and angles are equal.

Proofs of theorems (Page 168)

The following theorems should be noted by students:

1 The sum of the interior angles of any n-sided convex polygon is $(2n–4)$ right angles.

2 The sum of exterior angles of any convex polygon is four right angles.

Congruent triangle (Page 171)

Make the students understand that triangles are congruent when they are equal in all respect; i.e. they have equal sides, angles and one can be super imposed on the other.

Exercise 13.3 (Pages 170 and 171)

Part of this can be given as classwork and the rest as assignment.

Conditions for congruency (Page 171)

Congruents triangles can be described as follows:

1 S S S (Three sides)

2 S A S (Two sides and the included angle)

3 A A S (Two angles and the corresponding sides)

4 R A S (Right angle, hypotenuse and side)

Exercise 13.4 (Pages 173–175)

This exercise can be given as classwork and assignment.

Exercise 13.5 (Pages 175 – 177)

Part of this exercise can be given as classwork and the rest as assignment.

Chapter 14 Basic geometrical theorems (2): Parallelograms and equal intercepts

Objectives

By the end of this chapter, the students will be able to:

1 list properties of quadrilaterals;
2 identify parallelograms and triangles between parallels;
3 prove theorems on parallelograms and triangles between parallels;
4 prove the intercept theorem; and
5 solve problems on riders.

Quadrilaterals (Page 178)

A quadrilateral is a polygon with four sides. Types of quadrilaterals include square, rectangle, parallelogram, rhombus, kite and trapezium.

Elementary theorems (Page 179)

Explain the theorems and see the students through Examples 1–6 (Pages 181–183).

Exercise 14.1 (Pages 183–186)

Part of this exercise can be given as classwork and the remaining questions as assignment.

Other theorems (Page 186)

Explain the remaining theorems and see the students through Examples 7–10 (pages 189 – 191)

Exercise 14.2 (Pages 191–193)

This can be solved by using the theorems stated.

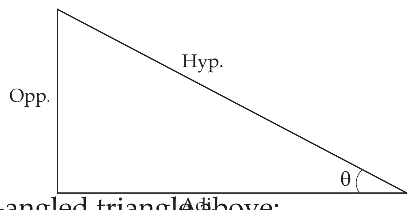
Chapter 15 Trigonometry (1): Trigonometrical ratios

Objectives

By the end of this chapter, students will be able to:

1 solve problems involving the use of sine, cosine and tangent in a right-angled triangle;
2 derive the trigonometric ratio of special angles of 30°, 45°, 60°, 90° etc;
3 find an angle when given its trigonometric ratio; and
3 apply trigonometric ratios in solving right-angled triangle problems.

Sine, cosine and tangent (Page 200)



From the right-angled triangle above:

$\sin\theta = \dfrac{\text{opp. side}}{\text{hyp. side}}$ $\cos\theta = \dfrac{\text{adj. side}}{\text{hyp. side}}$ $\tan\theta = \dfrac{\text{opp. side}}{\text{adj. side}}$

Exercise 15.1 (Pages 201 and 202)

This exercise can be done using Examples 1–2 (Pages 200 and 201) of the Students' Book.

Complementary angles (Page 202)

Two angles are said to be complementary if their sum gives 90°.

Exercise 15.2 (Page 203)

This exercise can be solved by referring to Examples 3–6 (Pages 202 and 203).

Special angles: 45°, 30° and 60° (Pages 203)

Students should be shown the approach to obtain trigonometric ratios of angles without using the trigonometric tables or other calculating aids.

Exercise 15.3 (Pages 206 and 207)

This can be done by referring to Examples 7–9 (Pages 205–206).

Exercise 15.4 (Page 208)

This can be given as classwork and assignment.

Exercise 15.5 and 15.6 (Pages 210 – 212)

Give some questions as classwork and the rest as assignment and test.

Chapter 16 Trigonometry (2): General angles and graphs

Objectives

By the end of this chapter, the students will be able to:

1 derive ratios of general angles in relation to the unit circle;

2 derive ratios of angles between 0° and 360°;

3 draw graphs of sine and cosine functions for angles between 0° and 360°; and

4 apply trigonometric ratios in solving problems.

Introduction (Page 213)

Students should know that general angles are angles between 0° and 360°. The angles in a circle. The Cartesian co-ordinate axes 0*x* and 0*y* divide a circle into four equal parts. The *x*-axis and *y*-axis divide the circle into four equal quadrants.

Exercise 16.1 (Pages 216 and 217)

This can be done using Examples 1 and 2 (Pages 214 and 215).

Trigonometrical ratios of angles between 0º and 360º (Page 217)

1st quadrant: $0° < \theta < 90°$

2nd quadrant: $90° < \theta < 180°$

3rd quadrant: $180° < \theta < 270°$

4th quadrant: $270° < \theta < 360°$

Exercise 16.2 (Page 222)

This can be done by referring to Examples 3 to 7 (Pages 219–221).

Graphs of sine and cosine functions (Page 222)

The following should be noted about sine and cosine curves.

1 All the values of sin θ and cos θ lie between + 1 and –1.

2 The sine and cosine waves have the same shape, but their starting points are different.

3 For any value of sin θ or cos θ, they are two points (angles) between 0° and 360°.

4 The turning points of the waves are quarter turns at 0°, 90°, 180°, 270° and 360°.

5 Sine and cosine curves are continuous in nature.

Exercise 16.3 (Pages 225 and 226)

Examples 8 and 9 (Pages 224 – 225) can be referred to while solving this exercise.

Chapter 17 Plane shapes: Mensuration

Objectives

By the end of this chapter, the students will be able to:

1. give formal definitions of an arc, a sector, and a segment of a circle;
2. compute the length of an arc, the perimeter of a sector, and the segment of a circle; and
3. calculate the areas of a sector and a segment of a circle.

Areas and perimeters of plane shapes (Page 227)

Students should know the areas and perimeters of the following:

a) Circle: Area = πr^2
Circumference = $2\pi r$

b) Square: Area = l^2
Perimeter = $4l$

c) Rectangle: Area = $l \times b$
Perimeter =$2(l + b)$

d) Parallelogram: Area = bh
Perimeter = $2(x + y)$

e) Rhombus: Area = $\frac{1}{2}yz$
Perimeter = $4x$

Where z = smaller diagonal
y = longer diagonal
x = base of the rhombus

f) Triangle: Area = bh
= $ac \sin B$
Perimeter = $(a + b + c)$

g) Trapezium: Area $\frac{1}{2} = (x + y)h$

Theorems

1. Triangles on the same base and between the same parallels are equal in area.
2. Parallelograms on the same base and between the same parallels are equal in area.

Exercise 17.1 (Pages 228 and 229)

This can be done as classwork and as assignment.

Length of an arc of a circle (Page 229)

Length of an Arc = $\frac{\theta}{360°} \times 2\pi r$

Exercise 17.2 (Page 231)

Examples 1–4 can be used as guide for solving this exercise.

Perimeters of section and segments (Page 232)

$$\text{Perimeter of a sector} = r + r + \frac{\theta}{360°} \times 2\pi r$$

$$= 2r + \frac{\theta}{360°} \times 2\pi r$$

Perimeter of a segment = length of a chord + length of an arc

Exercise 17.3 (Page 234)

This can be done using Examples 5–7 (Pages 232 and 233).

Area of sectors and segments of a circle (Page 235)

Area of sector: Area = $\frac{\theta}{360°} \times 2\pi r^2$

Area of segment = area of sector – area of triangle.

$$= \frac{\theta}{360°} \times 2\pi r^2 - \frac{1}{2} r^2 \; Sin\ \theta$$

Exercise 17.4 (Pages 236 and 237)

This can be done using Examples 8–11 (Pages 235 and 236) as guide.

Relationship between the sector of a circle and the surface area of a cone (Page 237)

Identify the relationship between the sector of a circle and the surface area of a cone by demonstrating to the students in class with physical activities.

Exercise 17.5 (Pages 238–239)

This can be done as classwork and as assignment using Example 12 (Page 238).

Chapter 18 Surface area and volume of solid shapes

Objectives

By the end of this chapter, the students will be able to:

find the surface area and volume of:

– prisms (cube, cuboid and cylinder) and pyramid (cone);
– frustum; and
– composite shape.

Surface areas of prisms (Page 240)

Explain the following extensively.

Cube: This is a regular solid figure having six square faces; eight vertices and 12 edges.
Area of the cube of side x unit is given by: Area = $6x^2$.

Cuboid: This is a solid figure of box type having six rectangular faces and eight vertices. In a cuboid, the opposite faces are equal. The total surface area is given by:
$A = 2(xy + yz + xz)$

Cylinder: This is a solid formed by a round face and two flat circular faces.

a) Curved surface area = $2\pi rh$.
b) Curved surface area with one end closed = $2\pi rh + \pi r^2$
c) Curved surface area with two ends closed = $2rh + 2r^2$
r = radius of the cylinder where h = height of the cylinder.

Cone: This is a solid whose base is a circle and whose sides tape up to a point.

a) Curve surface area = πrl
b) Curved surface area including the base = $\pi rl + \pi r^2$

Prism: This is a solid, usually with a uniform cross section (triangular, rectangular or trapezoida).

Exercise 18.1 (Page 244)

This can be done by referring to Examples 1–7 (Pages 241–243).

Volume of solid shapes

Cube: $V = S^3$
Cylinder: $V = \pi r^2 h$
Cuboid: $V = lbh$
Prism: V area of base × perpendicular height × Ah

Pyramid: $V = \frac{1}{3}$ base area × height $\frac{1}{3}bh$

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

Exercise 18.2 (Pages 246 and 247)

This exercise can be done by referring to Examples 8–14 (Pages 245–246)

Surface area and volume of frustum (Page 247)

A frustum is the portion of a cone or pyramid which remains after its upper part has been cut off by a plane parallel to its base.

Surface area of frustum (A) = $\pi RL - \pi r(L - l)$

$= x\,[RL - r(L - l)]$

volume of frustum (v) = $\frac{\pi}{3}[R^2 h - r^2(h - x)]$

Exercise 18.3 (Pages 249–250)

This exercise can be done by referring to Examples 15 and 16 (Pages 248 and 249).

Guide the students through Examples 17 and 18 (Page 257).

Surface areas and volumes of composite shapes (Page 250)

Simple composite shapes can be found every where in our environment such as hammers, bottles, pencils etc.

Exercise 18.4 (Pages 251 and 252)

This can be taken as classwork or as assignment.

Chapter 19 Statistics (1)

Objectives

By the end of this chapter, the students will be able to:

1 collect data and present them in tabular form meaningfully;
2 construct frequency tables;
3 draw line graphs, bar graphs and bar charts;
4 draw histographs with equal and unequal sides; and
5 differentiate between bar charts and histograms.

Data (Page 253)

Explain to students that data represents information that is presented in numerical form or as numbers.

Statistics (Page 253)

This is the study and interpretation of information or data presented in numerical form.

Frequency table (Page 254)

This is a presentation of data in tabular form, it makes it more meaningful and easy to read.

Exercise 19.1 (Pages 255 and 256)

Examples 1–4 (Pages 253–255) can be referred to while solving this exercise.

Graphical representation of data (Page 256)

Line graph

This is one of the ways to represent data graphically. It is drawn after the construction of a frequency table. The lines are drawn on graph paper for accuracy.

Bar chart and bar graph

Bar chart or bar graph consists of rectangular bars of equal width with heights equal or proportional to the frequency of each item.

Exercise 19.2 (Pages 258–260)

Examples 5 – 8 (Pages 256 and 258) can be referred to while solving this exercise.

Histogram (Page 260)

A histogram is a series of rectangular blocks representing the frequency of a distribution. The blocks in a histogram are joined together and the height of each block is proportional to the frequency it represents.

Exercise 19.3 (Page 262)

Examples 9 and 10 (Pages 260 and 261) can be referred to while solving this exercise.

Chapter 20 Statistics (2)

Objectives

By the end of this chapter, the students will be able to:

1 calculate the sectorial components of a pie chart;

2 draw a pie chart correctly;

3 interpret a pie chart; and

4 construct frequency polygon of a given distribution.

Pie chart (Page 264)

A pie chart is a circular graph showing a distribution. The pie chart is divided into sectors that are proportional to the frequency or class frequencies of items in a distribution.

Exercise 20.1 (Pages 266 and 267)

This can be done by referring to Examples 1 and 2 (Pages 264 and 265).

Frequency polygon (Page 267)

Frequency polygon is another graphical representation of a distribution. It is obtained by two ways:

1 by joining the mid-points of the tops of the rectangular bar in a histogram; and

2 by plotting the mid-points of each class intervals.

Exercise 20.2 (Pages 268–270)

This can be done by referring to Examples 3 and 4 (page 268).