NEW CONCEPT MATHEMATICS

3

for Junior Secondary Schools

Teacher's Guide

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MATHEMATICS 3

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Teacher's Guide

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
Website: 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 Binary numbers system

Objectives

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

1 explain the concept of a binary number system;
2 convert binary numbers to base 10;
3 convert numbers in other bases to binary numbers and vice versa;
4 represent statements in coded form;
5 use binary number system in computer application; and
6 solve problems in quantitative reasoning, using the binary number system.

Conversion of binary numbers to base 10 (Page 7)

Revise how to expand numbers in the powers of their bases, for example,

$52204_{six} = (5 \times 64) + (2 \times 63) + (2 \times 62) + (0 \times 61) + (4 \times 60)$
$= (5 \times 1\ 296) + (2 \times 216) + (2 \times 36) + (0 \times 6) + (4 \times 1)$
$= 6\ 480 + 432 + 72 + 0 + 4$
$= 6\ 988$

Guide the students to discover that this process leads to a method of conversion of numbers from other bases to base 10. Give the students some questions in Exercise 1.1 and guide them to solve those questions. Guide them to solve some questions involving decimal point in Exercise 1.2. Questions 2, 3 and 4 of Exercise 1.2 that involves the operations of addition, powers and roots should be treated by converting each of the numbers to base 10 before the operations are carried out.

For example, to evaluate $(0.110_{two})^2$ and express the answer in base 10, convert 0.110_{two} to base 10 first and then square the result as follows:

$0.110_{two} = 1 \text{ x } 2^{-1} + 1 \text{ x } 2^{-2} + 0 \text{ x} 2^{-3}$

$$= \frac{1}{2} + \frac{1}{4} = \frac{2+1}{4} = \left(\frac{3}{4}\right)_{ten} = 0.75_{ten}$$

$$\therefore (0.110_{two})^2 = \left(\frac{3}{4}\right)^2_{ten} = \left(\frac{9}{16}\right)_{ten} = 0.5625_{ten}$$

Conversion from base 10 and other base to binary (Page 9)

Explain to the students that conversion from base 10 to other bases, including binary, is done by continuous division using the number representing the new base and writing down the reminder each time. For example, to convert 13_{ten} to binary number, the working is set out thus:

$$
\begin{array}{r|l}
2 & 13 \\ \hline
2 & 6 \text{ r } 1 \\ \hline
2 & 3 \text{ r } 0 \\ \hline
2 & 1 \text{ r } 1 \\ \hline
 & 0 \text{ r } 1
\end{array} \uparrow
$$

We then arrange the column of remainders from bottom up to form the new number in base 2.
$\therefore 13_{ten} = 1101_{two}$

Emphasise the fact that there is no direct conversion from other bases, apart from base 10, to binary numbers except in few cases, such as conversion from base four to base two, which should not be introduced to the students at this stage.

For example, to convert 234_{five} to a number in base two, we first convert to base 10 and then to base two.

Note that Method 1 of converting fraction in base ten to binary on page 9 is only applicable to a base ten fraction whose denominator can be written as a power of 2(2, 4, 8, 16, etc). It is advisable to delay the treatment of Method 2 on page 10 till direct division of binary numbers is treated. Guide the students to solve all the problems in Question 1 of Exercise 1.3 (Page 10) and give Questions 2 and 3 as homework.

Application of binary numbers to computers (Page 10)
Guide the students to use Table 1.1 on page 11 to translate words to coded form and coded form to words. Practical application of punch cards or tapes should be demonstrated to the students. Question 2 of Exercise 1.4 can be given to the students as project to be submitted for grading.
Guide the students to pay particular attention to the three types of shapes in the flow chart on page 16 and careful explanation be made concerning each shape.

Quantitative reasoning 1 (Page 17)
Guide the students to study the samples to discover the pattern in the samples. For example, 22, is converted to base 10 to get 12 which is then converted to base 2 to get 1 100.
Give Revision exercise 1 (Page 18) as classwork to be done under your supervision.

Chapter 2 Word problems

Objectives

By the end of this chapter, the students will be able to:
1 interpret and solve word problems involving addition, subtraction and multiplication;
2 interpret and solve word problems that combine sums and differences with products;
3 interpret and solve word problems involving fractions;
4 change numerical statement into words; and
5 solve problems involving equations.

Sum and difference (Pages 19 - 22)

It should be carefully explained that **sum** is the result obtained when two or more quantities are added while **difference** is the result obtained when one quantity is subtracted from another.When the number been subtracted is larger, we get a negative difference while if it is smaller, we get a positive difference. The misconception that sum means addition and difference means subtraction should be carefully addressed by explaining to the students that addition and subtraction are operations or processes which results into sum and difference.

Give the students some of the questions in Exercise 2.1 (Page 20) to solve in order to evaluate their level of understanding while the remaining questions should be given as an assignment.

Product (Page 21)

Just like sum and difference, the product is the quantity obtained when two or more numbers are multiplied. It is suggested that the odd numbered questions in Exercise 2.2 (Page 21) be given to the students to solve under the supervision of the teacher while the even-numbered questions be given as an assignment.

Sums and differences combined with products (Page 22)

Lead the students to solve some of the questions in Exercise 2.3 (Page 22) and give the remaining questions as homework. The more of those questions the students solve, the better is their level of understanding.

Word problems involving fractions (Page 23)

Give and explain the steps to follow when solving word problems involving fractions. Allow the students to participate fully in te interpretation and solving the problems.
Divide the students into four groups or more, depending on the number of the students in the class,

and give them different questions to work from Exercise 2.4 (Page 23) while you act as facilitator.

Changing numerical expressions into words (Page 24)

Guide the students to solve Questions 1 - 10 of Exercise 2.5 (Page 24) and give the others as an assignment.

Problems involving equations (Page 24)

When solving problems involving equations, let the students understand that any letter can be made use of except letters *0* and *i* because o looks like zero (0) while I looks like (1) if it is not dotted. Guide them to work through some selected questions in Exercise 2.6 (Page 25) with detailed explanation on each. Give the other ones as an assignment.
Give Revision exercise 2 and Quantitative reasoning 2 on pages 26 and 27 as a weekend assignment.

Chapter 3 Proportion

Objectives

By the end of this chapter, the students will be able to:
1 solve problems involving direct proportion;
2 solve problems involving indirect proportion;
3 find the reciprocals of numbers;
4 simplify calculations, using reciprocals; and
5 read and interpret graphical representation of direct and indirect proportions.

Direct proportion (Page 28)

Two quantities are said to be in **direct proportion** if they both increase or decrease in the same direction. Give students practical examples like the cost of feeding of a group of students increases with increase in the number of students.

Lead them to draw a graph of direct proportion on pages 29 and 30.

Give them selected questions from Exercise 3.1, page 31, mark and give necessary corrections.

Indirect proportion (Page 33)

If there are two quantities such that an increase in one of them brings about a decrease in the other one, we say that one is indirectly proportional to the other.
Give practical examples like the relationship between the speed and time of a moving car. The higher the speed of the car, the lesser the time it will take the car to cover a given or fixed distance.
Lead the students to draw the graph of indirect proportion on page 34. Give them some questions from Exercise 3.2 (Page 35) and let them do the remaining of the questions as an assignment.

Reciprocals (Page 36)

The reciprocals of any number is actually another name for the multiplicative inverse of the number. Multiplicative inverse is treated in Book 2, Chapter 8.

For example, the reciprocal of -4 is $\frac{1}{-4}$ = -0.25, the reciprocal of a number, x is $\frac{1}{x}$. Guide the students through the process of finding the reciprocals of numbers using the method of the long division. For example, using long division to find the reciprocal of 3.9. The reciprocal of 3.9 =

$$\frac{1}{3.9} = \frac{10}{39}$$

$$\begin{array}{r|r} & 0.2564 \\ \cline{2-2} & 10.0 \\ 39 & 7\,8 \\ \cline{2-2} & 220 \\ & 195 \\ \cline{2-2} & 250 \\ & 234 \\ \cline{2-2} & 160 \\ & 156 \\ \cline{2-2} & 4 \end{array}$$

the reciprocal of 3.9 is 0.2564 to 4 decimal places.

∴ Guide them to complete the table in Question 1, Exercise 3.3 (Page 37).

Lead the students through Example 7 of page 36 fro them to discover that decimal point in the given number and answer move in opposite direction over equal number of places. For example, if the reciprocal of 4.21 is 0.2375 and we required to find the reciprocal of 0.421. It should be observed that the decimal point has moved one place to the left in the number hence, the decimal point in our answer must move one place to the right to become 2.375.

This is particularly useful when dealing with objectives questions in an examination.

Give the students Question 4, Exercise 3.3 as classwork while Question 5 should be given as an assignment.

Reciprocals from the calculator (Page 38)

Divide the students into number of groups, depending on the population, such that each group does not have more than six students. Then go from one group the other and demonstrate to the students how to use calculators to find the reciprocals of numbers using Examples 9 and 10 (Pages 38 and 39). Then give odd numbered questions from Exercise 3.4 as classwork while the even numbered questions be given as an assignment.

Give the Revision exercise 3 on page 41 as a weekend assignment.

Quantitative reasoning 3 (Page 42)

Guide the students through the samples and give the questions as classwork

Chapter 4 Compound interest

Objectives

By the end of this chapter, the students will be able to:
1 solve problems involving sample interest;
2 explain the concept of compound interest and identify the difference between the two;
3 solve problems on compound interest; and
4 apply the knowledge of compound interest to daily life problems.

Simple interest (Page 44)

Revise simple interest by leading the students to work through the examples on pages 44 and 45. Give some selected questions from Exercise 4.1 (Page 45) to the students to solve as classwork while the remaining questions should be given as an assignment.

Compound interest (Page 46)

In compound interest, the interest is usually added to the principal at each time interval (weekly, monthly, half-yearly) to form a new principal upon which another interest is calculated. Although the percentage of interest remain the same, the actual value of interest changes due to the changes in the principal over the time interval.

Most commercial banks in Nigeria add interest monthly, but percentage calculation is done per annum.

For example, if you deposit N100 000 as an initial principal in a bank at an interest rate of 10% per annum, at the end of the first month, the interest will be $\frac{10}{100} \times 100\,000 \times \frac{1}{12}$ = N833.33 and the new principal will be N100 000 + N833.33 upon which the interest is compounded monthly.

Explain clearly the distinction between the process of calculating simple interest and compound interest over a given period of time to the students.

The two methods of calculating the compound interest on page 46 should be treated with the students participating fully.

Give the students selected questions from Exercise 4.2 (Page 47) as classwork while the others should be given as an assignment.

Instalmental repayment (Page 47)

When loans are taken from the bank, for example, instalmental repayments may be made to offset the amount borrowed plus interest.

These instalmental repayments are made at a regular interval of time. It could be monthly or yearly and this will reduce the principal gradually until the loan is paid off.

Work through Example 7 on page 48 with the students with detailed explanation of each step.

Give Questions 1 to 3 from Exercise 4.3 to the students to solve as classwork and let Questions 4 to 6 be done as an assignment.

Give the Reason exercise 4 on page 49 as a weekend assignment.

Chapter 5 Rational and non-rational numbers

Objectives

By the end of the chapter, the students will be able to:
1 define and identify rational numbers;
2 identify non-rational numbers;
3 distinguish between rational and non-rational numbers; and
4 determine practically the approximate value of π (pi).

Rational numbers (Page 50)

If a number can be expressed as a fraction of two integers $\frac{x}{y}$ where $y \neq 0$, then the number is called a **rational number.**

Lead the students to discover that all the integers are rational numbers because they can be expressed as fractions of two integers where the denominator is not zero. For example, 5 is an integer which can be written as $\frac{10}{2}$, $\frac{5}{1}$, $\frac{20}{4}$, $\frac{30}{6}$, $\frac{15}{3}$, etc.

Terminating and recurring decimals are rational numbers because each of them can be expressed as fraction of two integers.

Work through Example 1 of page 51 with detailed explanation to the students.

Give Question 1 and 2 from Exercise 5.1 (Page 51) to the students as classwork, mark and make necessary corrections, then give Questions 3 and 4 as an assignment.

Non-rational numbers (Page 52)

These are numbers which can not be written as fractions of two integers. If expressed as decimal they are neither terminating nor recurring.

Note that $\frac{22}{7}$ is not the exact value of π. While $\frac{22}{7}$ is a rational number, π is a non-rational number. $\frac{22}{7}$ is only an approximate value of π.

Guide the students to work through Exercise 5.2 (Page 52).

Square roots (Page 52-53)

Guide the students to carry out Activity 5.1 on page 52 in order to discover that the exact values of non-rational numbers are difficult to obtain hence, their representation in a special way.

Go through Example 2 and 3 on pages 52 and 53 with the students participating actively and let them carry out Activity 5.2 (Page 53).

Give them some questions from Exercise 5.3 (Page 54) to solve while the other questions should be given as an assignment.

Give the Revision exercise 5 and Quantitative reasoning 5 on page 54 and 55 as weekend assignment.

Chapter 6

Basic operations involving binary numbers

Objectives

By the end of this chapter, students will be able to:
1 add and subtract numbers in base two;
2 multiply and divide numbers in base two; and
3 solve quantitative reasoning problems involving operations on binary numbers.

Addition and subtraction of binary numbers (Page 56)

Lead the students to discover that addition and subtraction operations are done in the same way under binary system as in decimal system.
In binary system, 2 is our 10 so that when we add up column and it comes to 2, we write down 0 and carry 1 to the next column. Also, 3 is our 11, 4 is our 100 and so on.
Whenever we subtract and there is nothing to subtract from, we move 1 from another column to the position we need it and it becomes 10 in the new position. Guide them through the examples on pages 56 and 57 and give them some selected questions from Exercise 6.1 (Page 58) to solve as classwork while the other questions are given as an assignment.

Multiplication and division in base 2 (Page 58)

These operations are carried out in binary as it is done in decimal system.
Lead the students through Examples 3 and 4 on pages 58 and 59
It should be noted that division in binary could be done directly without first converting to base 10. However, it is much easier to convert to base 10 first, perform the division operations and then convert back to base 2.
Give the students at least five carefully selected questions from each of Exercises 6.2 and 6.3 (Pages 59 and 60) so as to evaluate their level of understanding in the class.
Give other questions as an assignment.

Quantitative reasoning 6 (Pages 60 and 61)

Guide the students to discover the rules in the samples.
In the first sample, the two numbers at the top are multiplied together to get the number below:

$$
\begin{array}{r}
111 \\
11 \\
\times \quad 111 \\
\hline
10101 \\
\hline
\end{array}
$$

In the second sample, the two numbers are added to grt the one below:

$$
\begin{array}{r}
1001 \\
+ \quad 111 \\
\hline
10000 \\
\hline
\end{array}
$$

Give the students Questions 1, 3, 5, 7 and 9 under the quantitative reasoning to solve in the class while the remaining ones should be taken as an assignment.
Revision exercise 6 on page 61 should be given as a test.

Chapter 7 Factorisation of simple algebraic expressions

Objectives

By the end of this chapter, the students will be able to:
1 find the HCF of algebraic expressions;
2 factorise algebraic expressions by taking out their common factors;
3 simplify calculations by facotrisation; and
4 factorise algebraic expressions by grouping the terms.

Expansion of algebraic expressions (Page 62)

Revise the expansion of algebraic expression by working through Example 1 and some of the questions in Exercise 7.1 (Page 62) together with the students.

HCF of algebraic expressions (Page 63)

It is advisable to revise the HCF of numbers with the students before proceeding to find HCF in Example 2, page 63.

Note that apart from the method used in finding the HCF in Example 2, we can use the method of factors. For examples, to find the HCF of $9ab$ and $27abc$, we first express each term as a product of their prime factors as follows

$9ab = 3 \times 3 \times a \times b$

$27abc = 3 \times 3 \times a \times b = 9ab$

Give the students some questions from Exercise 7.2 (Page 63) to solve in the class under your supervision.

Factorisation by taking out common factors (Page 64)

Guide the students to learn that factorization id the opposite of expansion.

Take adequate time to work through Examples 3 and 4 on page 64 with the students applying the concept of HCF. For example, to factorise the expression $12x^2y - 18xy^2$, we find the HCF of $12x^2y$ and $-18xy^2$ and use it to divide $12x^2y$ and $-18xy^2$ and put the result in a bracket while the HCF is kept outside the brackets.

$$12x^2y - 18xy^2 = 6xy \quad (2x - 3y)$$

HCF of $12x^2y$ *and* $-18xy^2$ Result of the division

Give Questions 1 - 10 from Exercise 7.3 (Page 64) to the students to solve in the classroom under your supervision. Mark their work and make necessary corrections. Then give Questions 11 - 20 as an assignment.

Simplifying calculations by factorisation (Page 65)

Lead the students to learn that factorization can be used to simplify numerical calculations involving common factors. For example, $\frac{22}{7} \times 24 - \frac{22}{7} \times 10 = \frac{22}{7}(24 - 10) = \frac{22}{7} \times = 44$

Give the students the odd-numbered questions in Exercise 7.4 (Page 65) as classwork while the even-numbered questions should be given as an assignment.

Factorisation by grouping like terms (Page 65)

This method is used for algebraic expressions containing even number of terms from 4. In this technique, terms having common factors are grouped together and the common factor taken out.
For example,

$$mx + ny - nx - my = my - nx + ny$$
$$= m(x - y) - n(x - y) = (x - y)(m - n)$$

Guide the students to learn how to group like terms and take out common factors using Example 6 (Page 65).
Give 10 selected questions from Exercise 7.5 (Page 66) to the students to solve in the classroom under your supervision. Another 10 should be given as an assignment.

Quantitative reasoning 7 (Page 66)

Lead the students to discover their rules in the sample.

In Sample 1, the result in each box is obtained by multiplying the term beside the box and the term above it together.

In Sample 2, the number in the rectangular box below is obtained by adding the two numbers in the triangles and then multiplying the sum by the number between the two triangles.

Group the students and share all the 15 questions within the groups while facilitate.

Revision exercise 7 on page 67 should be given as a weekend assignment.

Chapter 8 Factorisation of quadratic expressions

Objectives

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

1 identify the coefficients of the unknown variables of algebraic expression;
2 factorise quadratic expressions;
3 factorise quadratic expressions involving perfect squares; and
4 evaluate numerical expressions using the different of two squares

Expansion of algebraic expression (Page 68)

The students already know how to expand from the previous class. Revise the expansion of two binomials with the students by guiding the students to work through Example 1 on page 68.

Give the students Questions 31 to 44 in Exercise 8.1 (Page 69) to work through in the classroom while you supervise, mark and make necessary corrections.

Coefficients of terms (Page 69)

Coefficient is another name for **multiplier**. It is what multiplies a letter or group of letters is in an algebraic term. For example, the coefficient of xy in the term $-3xy$ is -3 while the coefficient of x in the term $-3xy$ because it is $-3y$ that multiplies x in the term $-3xy$.

Similarly, the coefficient of x^2 in the term $2px^2$ is $2p$.

Guide the students to understand the concept of coefficient.

Work through Example 2 on page 69 together with the students.

Give them Exercise 8.2 (Page 69) to answer in the classroom under your supervision, correcting them where necessary.

Factorisation of quadratic expression (Page 70)

Guide the students to learn how to identify the general form of a quadratic expression and how to distinguish it from other types of expression which is not quadratic.

Factorisation of quadratic expression is done by breaking the middle term (term in x) into two and then factorise by grouping. For example, to factorise the quadratic expressions $x^2 - 8x = 15$, we proceed as follows:

We break $-8x$ into two by finding two numbers whose product is 15 (constant term) and whose sum is -8 (coefficient of x). They are -3 and -5. Then we break $-8x$ into $-3x$ and $-5x$ and replace $-8x$ in the expression with $-3x$ and $-5x$.

$\therefore x^2 - 8x + 15 = x^2 - 3x - 5x + 15$

$x(x - 3) - 5(x - 3) = (x - 5)$ using factorization by grouping:

Also, to factorise $4x^2 - 11x - 3$, we multiply 4 and -3 together to get -12. Then find two numbers whose product is -12 and whose sum is -11. They are -12 and +1. We then break $-11x$ into $-12x$ and x, and replacing $-11x$ with it to get $4x^2 - 11x - 3 = 4x^2 - 12x + x - 3 = 4x(x - 3) + (x - 3) = (x - 3)(4x + 1)$

Guide the students to work through some of he questions in Exercise 8.3 (Page 71) and give the remaining ones as an assignment.

Perfect squares (Page 71)

Any number which can be written as a square of another number is called a **perfect square**. Similarly, any algebraic expression which can be expressed as a square of another expression is a perfect square. For example, 4 is a perfect square because $4 = 2^2$, also $x^2 + 4x + 4$ is a perfect square because $x^2 + 4x + 4 = (x + 2)^2$.

Guide the students to work through the questions in Example 4 on pages 71 to 72 and give the students 10 questions in Exercise 8. 4(page74) as classwork and give the remaining 10 questions as an assignment.

Difference of two squares (Page 73)

Any expression of the form $A^2 - B^2$ is called a **difference of two squares**. This difference of two squares can be factorised as follows $A^2 - B^2 = (A + B)(A - B)$.

Any algebraic expression which can be written as a difference of two squares can be factorised in this way.

Lead the students to work through Examples 5 and 6 on pages 73 and 74, and give Questions 1 to 10 from Exercise 8.5 (Page 74) to the students to solve as classwork while the remaining questions should be given as an assignment.

Divide the students into groups and share the questions of Exercise 8.6 (Page 74) among the groups to solve while you supervise.

Quantitative reasoning 8 (Page 74)

Guide the students to discover the rules in the sample and then let them complete the questions on their own while you facilitate.

Revision exercise 8 (Page 75) should be given as a weekend assignment.

Chapter 9 Equations involving fractions

Objectives

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

1 solve simple equations with monomial denominators;
2 solve simple equations with binominal denominators; and
3 solve word problems involving equations with fractions.

Solving simple equations involving fractions (Page 76)

Revise this topic with the students by solving some questions in Exercise 9.1 (page 77) as examples.

The students already have the knowledge of solving simple equations involving fractions from Book 2.

Simple equations with monomial denominators (Page 78)

Guide students to learn the steps involved in solving equations with monomial denominators.
See Examples 3 (a) - (d) (Page 78) for detailed explanation and learning.

Give the students some of the questions in Exercise 9.2 (Page 78) as classwork.

Simple equations with binomial denominators (Page 79)

Expressions of the form $\frac{5}{2x-3}$ and $\frac{1}{3x+4}$, are examples of algebraic fractions with binomial denominators.

When solving equations involving algebraic fractions of this type, we clear fractions by multiplying both sides of the given equations by the LCM of their denominators.

See Examples 4 (a) - (c) (Pages 79 and 80) for easy explanations.

Give the students Questions 1 - 5 of Exercise 9.3 (Page 80) as classwork while Questions 10 - 15 should be given as an assignment.

Word problems involving algebraic fractions (Page 80)

Give and explain the following steps to be followed in solving word problems involving fractions:

i) choose a letter to represent the unknown variable;
ii) interprete the statement to form the required equation; and
iii) clear fractions where necessary and then solve the resulting equation.

Guide the students to realize that only correctly interpreted word problems will give the correct answers.

Example

Adamu spends $\frac{3}{5}$ of his monthly allowance on food and $\frac{1}{4}$ on learning materials. If the amount he spent on food and learning materials is ₦300 less than his allowance, how much is his monthly allowance?

Let the monthly allowance be ₦x.

$\therefore \frac{3}{5}x + \frac{1}{4}x + x - 330$

Clear the fractions by multiplying both sides of the equation by 20.

$12x + 5x = 20x - 6\ 600$

$17x - 20x = -6\ 600$

$-3x = -6\ 600$

$x = \frac{-6600}{-3} = 2\ 200$

$\therefore$ the monthly allowance is ₦2 200

Give some questions from Exercise 9.4 (Page 82) to the students as classwork and some as an assignment.

Revision exercise 9 (Page 83) should be given to the students as a periodic test.

Chapter 10 Simultaneous linear equations

Objectives

By the end of this chapter, the students will be able to:
1 explain the meaning of simultaneous equations involving two variables;
2 solve simultaneous linear equations
- graphically;
- by the elimination method;
- using the substitution method; and

3 solve word problems involving simultaneous linear equations.

Simultaneous linear equations (Page 84)

Simultaneous linear equations in two unknown consist of a set of two linear equations involving two letters.

Give practical examples of simultaneous linear equations in a real-life.

There are usually three methods of solving which will be discussed at this level. They are:

a) graphical
b) substitution
c) elimination

Graphical method (Page 85)

Give and explain the steps involved in solving simultaneous linear equations graphically as contained on page 85.

It is suggested that you allow the students to master how to make a table of values for several linear equations in two unknown before teaching how to plot points on the graph from the table of values.

In situation where a graph board is not available, it is suggested that you divide the students into groups of not more than five per group. You then move from one group to the other explaining how to plot points on the graph paper.

Carefully work through Examples 1 (a) - (c) and 2 (a) - (b) on pages 85 to 88 with the students allowed to participate fully.

Give some questions in Exercise 10.1 to the students to solve as classwork while the remaining questions should be done as homework.

Substitution method (Page 88)

Guide the students to learn steps involved in solving simultaneous linear equations in two variables using substitution method.

This method is suitable for a set of equations in which one of the letters can be made the subject in any of the two equations without resulting into fraction.

See Examples 3 (a) - (e) on pages 88 - 90 for easy explanation on the use of the method.

Adequate time and care should be given to explain Example 3(b) page 89 to the students as it involves fraction.

Give Questions 1 - 5 of Exercise 10.2 to the students to solve as classwork while you go round to work and make necessary corrections.

Elimination method (Page 91)

This method involves the elimination of one of the variables. In doing this we either ad the equation or subtract one equation from the other depending on the signs of the terms containing the letter to be eliminated.

The following are the steps involved in using elimination method to solve simultaneous linear equations.

1 Decide on the letter to be eliminated. Any of the letters can be eliminated. But it is advisable to eliminate a letter that will involve the least trouble to eliminate.

2 Make the coefficient of the letter you decide to eliminate in the two equations to be equal.

3 Then subtract or add the equations depending on the signs of the term containing the letter to be eliminated.

For example, solve the equations $2x - 5y = -6$ and $4x - 3y = -12$ simultaneously.

Solution

$2x - 5y = -6$……. (1)

$4x - 3y = -12$…… (2)

It is easier to eliminate x:

Equation (1) x (2): $4x - 10y = -12$…… (3)

Equation (2) - (3): $7y = 0$

$y = 0$

Substitute for y in Equation (1).

$2x - 5(0) = -6$

$2x = -6$

$x = -3$

$\therefore x = -3, y = 0$

Work through Examples 5 and 6 (Pages 91 - 93) together with the students.

Give some questions from Exercise 10.3 (Page 93) to the students to solve and give some as homework.

Word problems involving simultaneous linear equation (Page 93)

Give and explain the steps involved in solving word problems involving simultaneous linear equations on page 93 to the students.

Refer to Examples 7 - 9 (Pages 94 - 95) for detailed explanation on how to solve word problems.

Guide the students to work through Questions 1 - 5 of exercise 10.4 (Page 95) in the classroom and give 6-10 as an assignment.

Give revision exercise 10 on pages 95 and 96 as an assignment for the weekend.

Chapter 11 Substitution and change of subject of formulae

Objectives

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

1 identify formulae by their variables;
2 substitute given values in a formula; and
3 change the subject of a given formula.

Formulae and substitution (Page 97)

A **formula** is an equation containing two or more variables which can be evaluated by substituting the given values(s) to obtain the specific quantity represented by this formula.

For example, $V = \frac{4}{3}\text{p}r^3$ is a formula representing the volume of a sphere. V is called the subject of the formula.

If r = 14 cm and p = $\frac{22}{7}$, then $V = \frac{4}{3} \text{ x } \frac{22}{7} \text{ x } 143 = 11\,498\frac{2}{3}$ cm^3.

Guide the students to work through some questions in Exercise 11.1 (Page 98) and give them same as homework. Give the students some questions in Exercise 11.2 (Page 100) as classwork while you move round to mark and make necessary corrections.

Changing the subject of a formula (Page 101)

To change the subject of a formula is to re-arrange the formula so that one of the letters other than the initial one stands as the subject. For example, in the formula $V = \frac{4}{3}\text{p}r^3$, the subject is V. But if we are required to change the subject to r, then re-arrangement of the formular is necessary for r to stand alone as the subject. That is

$$V = \frac{4}{3}\text{p}r^3$$

$$3V = 4\text{p}r^3$$

$$r^3 = \frac{3V}{4\pi}$$

$$r = \sqrt[3]{\frac{3V}{4\pi}}$$

∴ the subject as been changed from *V* to *r*.

Lead the students to understand that to change the subject of a formula, rearrangement of the formula is necessary. It is advisable to treat the opposite reverse of the basic mathematical operations with the students. For example, the opposite of square root is square and the opposite of addition is subtraction.

Take some selected questions from Exercise 11.3 (Page 101) and work them for the students as examples.

Give them some as classwork as well as an assignment.

Let the students attempt some questions from Exercise 11.4 (Page 104) on their own while you supervise them.

Revision exercise 11 (Page 105) should be given as an assignment for the weekend.

Chapter 12 Similar figures

Objectives

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

1 identify figures and objects that are similar;
2 explain the meaning of similar triangles;
3 apply the conditions for similarity of triangles in solving practical problems;
4 draw the enlargement of any figure given the scale factor; and
5 deduce the scale factor of any given enlargement.

Similar figures (Page 109)

Get models of similar figures and shapes like squares, circles, regular polygons, cubes, cuboids and rectangles.

Present these objects before the students and ask them to identify those ones that are similar.

Lead the students to discover the conditions for similarity. Two figures are similar to each other if they have the same shape or size or one is an enlargement of the other.

Mathematically speaking, two objects of the same shape are said to be similar if the ratios of their corresponding sides are equal.

Give the students objects of the same shape. Ask them to measure their corresponding sides, then find the ratios of the corresponding sides. From their results, they should be able to conclude whether the objects are similar or not.

Similar triangles (Page 111)

Two triangles are said to be similar if they are equiangular i.e. the three angles of one are respectively equal to the three angles of the other.

Lead the students to discover that if two triangles have equal angles, they do not necessarily have equal sides. And that if two triangles have equal angles, their corresponding sides will necessarily be in the same ratio.

Exercise 12.1 (Page 111) should be given to the students as group activities.

Guide the students to work through all the questions from Exercise 12.2 (Page 115).

Enlargement and scale factors (Page 117)

If two shapes are similar, the bigger one can be said to be an enlargement of the other. the ratio of the pairs of corresponding sides gives the scale factor of the enlargement.

Lead the students to understand that to enlarge a particular shape, we need to know tow important things. They are

1 the scale factor that will make the enlargement the right size and

2 the centre of the enlargement

See Activity 12.1 (Page 117), Example 6 and 7 (Page 118 and 119) for detailed explanation and knowledge.

Divide the students into groups and give one question each to the groups from Exercise 12.3 (Pages 119 - 122) while you move round to supervise and correct.

Quantitative reasoning (Page 122)

Give the students the questions in this section as test which should be marked, graded and corrections done.

The Revision exercise 12 (Page 123 and 124) could be given as an assignment for the weekend.

Chapter 13

Areas and volumes of similar shapes

Objectives

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

1 find the areas of similar shapes, using a scale factor;

2 find the volumes of similar shapes, using a scale factor; and

3 solve quantitative reasoning problems on areas and volumes of similar shapes.

Areas of similar plane shapes (Page 125)

If the ratios of corresponding sides of two similar figures is $1:n$, then the ratio of their areas is $1:n^2$. n is called the **linear scale factor**.

Guide the students to realize that this relationship holds only for similar figures and not otherwise. The relationship can also be used to calculate the unknown side or area of the shapes given. Work through Examples 1,2 and 3 on pages 126 and 127 with the students and give them some selected questions from Exercise 13.1 as classwork.

Volumes of similar solid shapes (Page 129)

If the ratios of the corresponding sides of two similar figures is $1:n$, then the ratio of their volumes is $1:n^3$. For example, if two similar buckets have heights of 12 cm and 18 cm respectively and the volume of the larger buckets is $168\frac{3}{4}$ cm^3, the volume of the smaller bucket will be found as follows:

ratio of corresponding heights = 12:18 = 2:3

∴ ratio of their volumes = 23:33 = 8:27

Let the volume of the smaller buckets be x cm^3

$$\therefore 8:27 = x: 168\frac{3}{4}$$

$$\frac{8}{27} = \frac{x}{1683/4}$$

$$\therefore x = \frac{8 \times 1683/4}{27} = 50$$

∴ the volume of the smaller bucket is 50 cm^3

Questions 2, 5 and 10 of Exercise 13.2 and Questions 4 and 6 of Exercise 13.3 should be done fro the students as examples while the remaining questions from the two exercises should be given as a classwork.

Revision exercise 13 (Page 132) is to be given as a weekend assignment.

Quantitative reasoning (Page 132)

Lead the students to discover the rules from the sample. The fraction inside the circle represent the scale factor, the one inside the square represent the area factor while the one inside the triangle is the volume factor.

Give the students the questions under the quantitative reasoning to solve while you supervise, mark and make necessary corrections.

Chapter 14 Tangents of an acute angle

Objectives

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

1 describe the tangent of an acute angle;
2 calculate the tangents of acute angles by measurement;
3 calculate the tangents of acute angles, using the tangent table; and
4 solve practical problems, using tangents of acute angles.

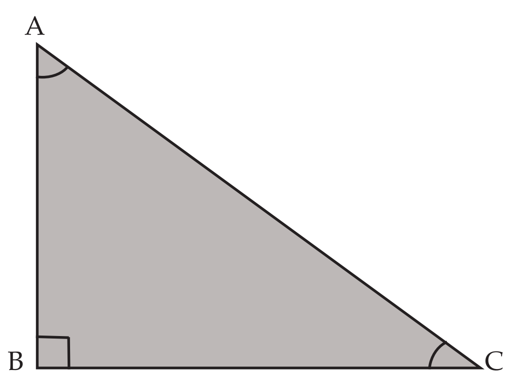
Finding the tangent of an acute angle (Page 134)

An angle less than 90º is called an **acute angle**. The tangent of an acute angle is defined as the ratio of the side opposite to the acute angle and the side adjacent to the acute angle in a right-angled triangle. Introduce this topic to the students by asking them to name the types of triangles they know.

Lead them to understand that only a right-angled triangle is used to define the tangent of an acute angle.

Take adequate care and time to explain the name of the sides of the right-angled triangle: the adjacent. The opposite and the hypotenuse.

The hypotenuse is the longest side of a right-angled triangle and it is opposite the right angle while the opposite and adjacent are named according to the acute angle chosen. There is no fixed position for opposite and the adjacent sides. It all depends on the acute angle of reference in the right-angled triangle.



The tangent of angle *A* from above triangle is

$\dfrac{BC}{AB}$ $\begin{array}{l} \longrightarrow \text{ opposite to angle } A \\ \longrightarrow \text{ opposite to angle } B \end{array}$

But tangent of angle C $\dfrac{BC}{AB}$ $\begin{array}{l} \longrightarrow \text{ now the opposite} \\ \longrightarrow \text{ now the adjacent} \end{array}$

Lead the students to discover that it is only the position of the hypotenuse that is fixed but that of the opposite and adjacent are not fixed and only depend on the acute angle under consideration.

Finding tangent of acute angles by measurement (Page 135)

If a graph board is not available, it is advisable to divide the students into groups of not more than 5 per group. You then go from one group to the other to demonstrate how to find tangents of acute angles by measurement in the students' graph notebooks.

It should be done inside the book of one student in a group while they watch. The other members of the group will then repeat the process in their own notebook until they master it. Similarly things will be done fro other groups.

Give the students some selected questions in Exercise 14.1 (Page 137) especially those ones involving measurements to enable the students practice the concept of finding tangents of acute measurement taught earlier.

Use of the tangent ratio (Page 140)

The tangent ration in a right=angled triangle connect three quantities. They are the given angle, the lengths of the opposite and adjacent sides to the given angle. With any two of these quantities known, the third one can be found using the connection or relationship. The connection is given by

$$\tan q = \frac{oppostie}{adjacent}$$

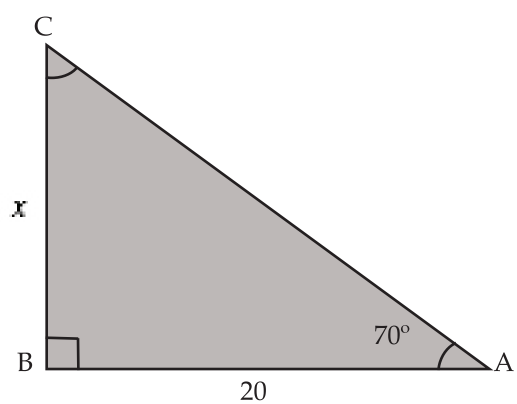
E.g find the value of *x* in the triangle below (Use tan 70° = 2.75)

$$\tan 70^{o} = \frac{BC}{AB}$$

$$= \frac{x}{20}$$

$x = 20 \tan 70^{o} = 20 \times 2.75$

\ /BC/= 55



Give and explain to the students Questions 1, 2 and 10 of Exercise 14.2 (Page 142) and give the remaining questions as classwork and homework.

Use of tangent table (Page 143)

Explain to the students how to use the tangent table to find the tangent of angles and to find the angle whose tangent is given.
You should refer to the explanation on how to use the tangent table on pages 143 - 145.
Ensure that the student spend adequate time to master how to use the tangent table especially to find angle whose tangent is given using Examples 7, 8, 9 and 10 (Pages 144 and 145).

Guide them to answer all questions in Exercise 14.3 (Page 145) on the use of tangent table as way of practicing.

Application of tangents of angles in solving practical problems (Page 146)

Use some carefully selected questions from Exercise 14.4 (Page 147) as examples for the students while the remaining questions should be given as a classwork.

Give Revision exercise 14 (Pages 148 - 149) to the students as an assignment for the weekend.

Chapter 15 Sine and cosine of an acute angle

Objectives

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

1 define the cosine of an acute angle in a right-angled triangle;
2 determine the sine and cosine of acute angles by drawing and measurement;
3 use sine and cosine ratios and calculate the lengths of sides and angles in a right-angled triangle;
4 use sine and cosine tables to calculate the lengths of sides and angles in a right-angles triangle;
5 solve practical problems, using sine and cosine ratios.

Sine and cosine of an acute angle (Page 150)

Just as the tangent of an acute angle in a right-angled triangle is the ratio of the length of opposite side and the length of the adjacent side, there are other two ratios namely: sine and cosine defined with respect to right-angled triangle thus.

$$\sin A = \frac{BC}{AC}$$

$$\cos A = \frac{AB}{AC}$$

Refer to Examples 1, 2, and 3 on pages 151 and 152 for explanation and knowledge and then treat Questions 7, 8, 17 and 20 from Exercise 15.1 (Page 152 and 153) as examples for the students.
Give Questions 14, 15, 16, 18, and 21 as classwork to the students.

Sines and cosines of acute angles by drawing and measurement (Page 154 - 156)

Use the grouping system, similar to what is obtained under the tangent of angles by drawing and measurement, to treat this aspect especially where graph board is not available. Even if graph board is available, the grouping system, described under the tangent of angles by measurement, is still better.

Refer to Examples 4 and 5 on pages 154 - 155 for detailed explanation and knowledge on this aspect.

Give the students all the questions in Exercise 15.2 (Page 156) to practice in the class while you supervise and correct them where necessary.

Use of sine and cosine tables (Page 156)

The use of sine and cosine tables is similar to that of tangent except that under the cosine, the differences are subtracted instead of being added.

Lead the students to discover that sine and cosine of acute angles are complementary. For example, sin 30° = cos 60° = 0.5000

For this reason, the sine of an acute angle increases with increasing angles while the cosine decreases.

Make use of all the questions in Exercise 15.3, 15.4 and 15.5 (Pages 158 - 160) as practice questions for the students to learn and master the use of sine and cosine tables.

Using sine and cosine to solve right-angled triangle problems (Page 160)

In the same way the tangent ratio is used to solve a right-angled triangle, the sine and cosine ratio can also be used to solve a right-angled triangle using the relationships.

sin Ø = $\frac{opposite}{hypotenuse}$ and cos Ø = $\frac{adjacent}{hypotenuse}$

Use Examples 10 and 11 on page 160 to demonstrate to the students how this is done.

Give the students some selected questions in Exercise 15.6 as classwork and another selected questions as an assignment.

Applications of sines and cosines of acute angles to solve word problems (Page 162)

Guide the students to solve some selected questions from Exercise 15.7 (Pages 163 -164) and give them some to do on their own.

Give them Revision exercise 15 (Page 165) as a special weekend assignment.

Chapter 16 Areas of plane shapes

Objectives

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

1. calculate the areas of plane shapes such as rectangles, parallelograms, triangles, trapeziums and circles;
2. calculate the area of plane shapes using trigonometry;
3. calculate the area of rings and sectors of a circle; and
4. relate areas to real-life activities.

Area of plane shapes

Revise the areas of plane shapes with the students by working through some of the questions in Exercise 16.1 (Pages 171 - 173)

Areas of plane shapes, using trigonometry (Page 174)

Guide the students to learn the solutions of Examples 4 and 5, pages 174 and 175 then give some questions in Exercise 16.2 (Pages 175 - 177) to the students as classwork and remaining questions as homework.

Concentric circles and sectors of circle (Page 177)

Take your time to explain the meaning of concentric circle to the students as explained on pages 177 and 178.

Use concrete models to explain this concept. Assist the students to learn the solutions to Examples 7, 8, 9 and 10 on pages 178 and 179.

Give some questions from Exercise 16.3 (Pages 180 - 183) as classwork.

Real life activities involving area (Page 183)

Challenge the students with some questions in Exercise 16.4 (Pages 184 - 186) after guiding them through the solutions to Examples 11 and 12 of pages 183 and 184.

This should be done in the classroom, supervised, marked and corrected.

Quantitative reasoning (Page 196)

Guide the students to learn the rule in the samples which is conversion of units in square measure. For example, 100 mm^2 = 1 cm^2, 100 cm^2 = 1 dm^2 and 100 dm^2 = 1 m^2.

Give them the questions under the quantitative reasoning to work through in the class while you guide them.

Give Revision exercise 16 to the students as a weekend assignment.

Chapter 17 Geometrical constructions

Objectives

By the end of this chapter, the students will be able to:
1 bisect any given line segment;
2 bisect any given angle;
3 construct angles 30º, 45º, 60º and 90º;
4 copy any given angle ; and
5 construct simple plane shapes.

Construction (Page 189)

The students should be able to learn and follow the following rules:
i) Use a hard, sharp-pointed pencil.
ii) Ensure that the edge of the ruler is smooth.
iii) Tighten your pair of compasses, if they are loose.
iv) Do not clean off any construction lines.

Guide them to understand that failure to follow any of the rules above may have a negative effect on their construction work.

It is advisable to divide the students into groups while you go round to show them how to carry out their construction work, making sure that they master a particular one before going to another. It is very importance that you allow the students to have adequate time to practice any particular construction work that you have demonstrated to them how to carry out.

Give them Questions 1- 15 of Exercise 17.1, pages 193 and 194 to do in the classroom while Questions 16 - 21 should be given as an assignment.

Constructions of plane shapes (Page 194)

Using the grouping system, guide them to learn how to carry out the construction work in Examples 1 and 2 on pages 194.

Give them some selected questions in Exercise 17.2 (Pages 195 and 196) to solve in the classroom and move round to render assistance to those students who need it.

Lead them to complete the quantitative reasoning on page 196 and give some questions under the Revision exercise 17 as an assignment.

Chapter 18 Measures of central tendency

Objectives

By the end of this chapter, the students will be able to:
1 explain the meaning of mean, median and mode of a given set of data;
2 calculate the mean of a given set of ungrouped data;
3 find the median and mode of an ungrouped data;
4 determine the range of a given set of an ungrouped data; and
5 state the advantages and disadvantages of each measure of central tendency, the mean, the median and the mode.

Averages (Page 199)

When data are collected, we sometimes seek to find a single number to represent all the values in the data. The single number is called an **average**.

There are different types of averages. The common ones are **mean, median and mode** which are collectively referred to as **measures of central tendency**.

This should be carefully explained to the students.

The mean (Page 199)

It is sometimes known as the arithmetic mean and is the most widely used average.

$$\text{Mean} = \frac{\text{sum of all the values}}{\text{total number of values}}$$

E.g. the mean of 4, 8, 1, 6 and 10 is $\frac{4+8+1+6+10}{5} = \frac{29}{5} = 5.8$

Finding the mean from a frequency table (Page 200)

Ungrouped data may be presented in a frequency table. This is a table showing each value in the data together with the number of times it occurs.

For example, the data 2, 2, 2, 3, 3, 3, 3, 3, 4, 4, 4, 5, 5, 5, 6, 6, 6, 6, 7 and 7 can be presented in a frequency table as shown below:

Score	2	3	4	5	6	7
Frequency	3	5	3	3	4	2

Guide the students to learn that an ungrouped data presented in a frequency table can also be presented in an open form as shown above.

Lead them to solve Questions 2 and 3 in Exercise 18.1 (Page 200 and 201) in the classroom as examples while Questions 4 and 5 should be given as classwork.

The median (Page 201)

This is defined as the middle number (fro odd number of values) or the average of the two middle numbers (for even number of values) when the data is arranged in ascending or descending order of magnitude. For example, the median of the data 2, 3, 1, 4, 5, 2 and 8 is found by first rearranging the data in order of size before picking out the median as follows:

1, 2, 2, 3, 4, 5, 8

The middle number is 3 hence, the median.

Here is another examples: 11, 13, 5, 7, 19 and 17.

First rearrange: 5, 7, 11, 13, 17 and 19. There are two middle numbers 11 and 13, therefore the median is $\frac{1}{2}(11 + 13) = \frac{1}{2}, 24 = 12$

Finding the median from a frequency table (Page 202)

To find the median of an ungrouped data presented in a frequency table, you simply write the data in an open form and find the median in the usual way.

e.g. find the median of the data in the table below:

Score	0	1	2	3	4	5
Frequency	2	1	1	2	3	1

Write the data in the open form:

0, 0, 1, 2, 3, 3, 4, 4, 4, 5

There are two middle numbers 3 and 3.

$\therefore$ the median is $\frac{3+3}{2} = 3$

Lead the students to discover that the median may not necessarily be one of the values in the data just like the mean.

Let the students know that it is very important that they should rearrange the given data, if it is not arranged before finding the median. Although the data presented in a frequency table is usually arranged. Guide them to solve all the questions under Exercise 18.2 (Page 203), some may be given as classwork.

The mode (Page 203)

Mode is the most occurring value in a set of data. In a given set of data, the mode may not exist and if it exist, it may not be unique.

Any data having a single mode is called **unimodal**, with two modes, **bimodal** and with three modes, **trimodal** and so on.

For data presented in a frequency table, the mode is usually the score with highest frequency.

Lead the students to work through Exercise 18.3 (Page 204 and 205) some of which can be done orally by the students.

The range (Page 205)

This is different between the smallest and the highest values in given set of data. Although the range is not one of the averages, but it measures the spread of items in a given set of data.

Allow the students to answer questions under the Exercise 18.4 (Page 205) and correct them where necessary.

Guide the students to learn the advantages and disadvantages of the mean, median and mode as explained on pages 205 and 206.

Give them Revision exercise 18 as an assignment.

Chapter 19 Data presentation

Objectives

By the end of this chapter, the students will be able to:
1 draw single bar charts;
2 draw multiple (side-by-side) bar chart;
3 draw composite (component) bar chart; and
4 construct and interpret pie charts.

Bar charts (Page 209)

This consist of rectangular bars equally spaced along a horizontal axis and whose heights are proportional to the frequency or amount of items being represented.

Explain to the students the steps involved in drawing bar charts from a given data using Examples 1 and 3 on pages 209 and 210 and other relevant questions from Exercise 19.1 (Page 224- 228).

You should also guide them to learn how to interpret and answer questions from drawn bar chart using Examples 2 and 3 on pages 221 and 222 and other relevant questions from exercise 19.1 (Pages 212 - 216).

Give the students some questions from Exercise 19.1 (Page 212 - 216) to solve so as to ascertain their level of understanding.

Pie charts (Page 216)

This is a circular diagram or graph divided into sectors whose angles are proportional to the amount or frequency of the items being represented.

Revise the use of protractor to measure angles with the students.

Lead the students to understand that before constructing a pie chart for a given data, they must first convert the amount or frequency of items in the data to angles of sectors whose sum is

360º. For each item, angle of sector = $\frac{\text{amount}}{\text{total amount}} \times \frac{360^\circ}{1}$

Use the grouping method to demonstrate to them how to construct pie chart as explained in Example 5 (Pages 216 and 217) following carefully the steps given.

Allow the students to practice extensively by giving them different questions from Exercise 19.2 (Pages 218 - 221).

Give them some of the questions under the Revision exercise 19 (Pages 221 - 224) to evaluate their level of understanding.