NEW

Excellence in Mathematics

JUNIOR SECONDARY 3 TEACHER'S GUIDE

CURRENT NERDC Curriculum

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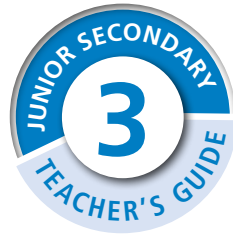
NEW Excellence in Mathematics



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Introduction

The purpose of the curriculum

The main objectives of the curriculum are to prepare the students to:

- acquire the mathematical literacy necessary to function in an information age
- cultivate the understanding and application of mathematical concepts and skills necessary to thrive in the ever-changing technological world
- develop the essential element of problem-solving, communication, reasoning and connection within the study of mathematics
- take advantage of the numerous career opportunities provided by mathematics
- become prepared for further studies in mathematics and other related fields.

The role of the teacher

One of the principal duties of a Mathematics teacher is to prepare and present good lessons to his or her students. The teacher has to:

- be as well informed as possible on the scheme of work of the subject
- know the aims and objective of each topic
- select appropriate content material
- decide on the best methods of presentation such as group work, worksheets, question-answer sessions, debate, etc.
- keep informed about social and environmental issues and other current news in Nigeria and the rest of the world
- through innovative teaching approaches encourage learning that will promote creativity and critical thinking in students.

To be effective in presentation, the teacher must create a written/typed plan for each lesson. This must include aims, objectives, resources, time frames, content for the lesson, activities, homework, assessment, and ideas/additional worksheets to cater for students requiring extension or learning support (remedial).

Prepare each topic in advance. Many teachers go into the classroom inadequately prepared. It is your responsibility as a Mathematics teacher to involve your students actively in the learning process. It is a proven fact that students learn far more by doing than by listening.

Mathematics involves being curious and asking questions. Wherever possible, ask questions to engage the students and to encourage independent thought processes and to develop problem-solving skills. Start your lessons by asking the students to write down answers to questions related to your lesson (approximately five). This will settle them into the lesson.

You can use different types of questions in your lessons:

- diagnostic, enabling you to determine prior knowledge on the topic
- for consolidation of challenging concepts during the lesson
- for stimulation of interest in the subject
- for concluding the lesson. This will assist you to find out whether students have understood the concepts/terminology in the lesson. It will also highlight any areas that they need to revise at home or for you to revisit in the next lesson.

Teachers must ensure that they do not appear to have favourites in the class, so devise a system to ensure that you ask questions fairly, but be careful not to embarrass weak students if they cannot answer questions.

How to use the scheme of work

A scheme of work is defined as the part of the curriculum that a teacher will be required to teach in any particular subject. Its primary function is to provide an outline of the subject matter and its content, and to indicate how much work a student should cover in any particular class. A scheme of work allows teachers to clarify their thinking about a subject, and to plan and develop particular curriculum experiences that they believe may require more time and attention when preparing lessons. The criteria all teachers should bear in mind when planning a scheme of work are continuity in learning and progression of experience. You can add your own notes to the scheme of work provided on pages viii to xii.

The scheme of work is sequential. The sequence of the scheme of work is aligned with the textbook. Do not be tempted to jump around. Rather spend time carefully planning the term to ensure that you adhere to the scheme of work.

Planning for the year

The year is divided into three terms. Each term is divided into 13 weeks. There are 12 topics in Term 1, 4 topics in Term 2 and 3 topics in Term 3. The end of term allows time for revision and an examination. This time frame may vary depending on the planning of your particular school. The worksheets in the *Workbook* give students the opportunity to apply what they have learnt. References in the *Student's Book* indicate the best time to use the worksheets in the Workbook.

Your management of the class will have an enormous influence on your ability to adhere to the time frames. Focus on effective discipline strategies. You will have less discipline issues if you:

- are punctual
- are well-prepared
- follow a plan (write this on the board at the start of the lesson)
- keep your word (don't make empty threats)
- consistently adhere to rules.

A teacher of Mathematics is a professional instructor who facilitates, promotes and influences students to achieve the outcomes of the scheme of work. It is the wish of the authors that the students will, at the end of each course in the series, attain a level of Mathematics proficiency that will equip them for future studies in this field.

Scheme of work

Term 1

Topic	Lesson objectives Students should be able to:	SB pages	WB pages
1. Number systems	• Identify different number systems • Work with binary number systems • Convert binary numbers to other bases • Answer questions and do exercises on conversion of base 10 to binary	1–6	1–6
2. Basic operations in the binary system	• Add and subtract binary numbers using the four basic rules • Multiply and divide binary numbers using the four basic rules • Add and subtract in other bases	7–11	7
3. Application of number systems	• Apply binary number system in computer application • Translate information on punched cards to coded form	12–14	8–9
4. Rational and non-rational numbers	• Identify rational and non-rational numbers	15–22	10–12
5. Word problems	• Factorise simple algebraic expressions • Solve simple word problems in one variables • Solve word problems involving simple quadratic expressions	23–29	13–16
6. Simplify expressions involving brackets and fractions	• Remove brackets from an expression	30–34	17–19
7. Factorisation	• Recap previous knowledge on factors and multiples of algebraic processes • Factorise simple algebraic expressions • Factorise simple quadratic equations using a quadratic equation box	35–63	20–25
8. Changing the subject of a formula	• Change subjects of formulae involving addition and multiplication and roots	64–66	26–29

Topic	Lesson objectives Students should be able to:	SB pages	WB pages
9. Measures of central tendency	• Revise lessons on data collection and sources of data collection • Collect and tabulate data on personal factors such as weight, height, age, shoe size, etc. • Calculate mean, median, mode, and range of the data collected by them	67–80	30–35
10. Representing data	• Present data in bar charts and pie charts	81–94	36–38
11. Simple equations involving fractions	• Solve simple equations involving fractions	95–104	39–43
12. Simultaneous linear equations	• Solve simultaneous linear equations	105–109	44–48
Term 1 Revision exercises		111–121	

Term 2

Topic	Lesson objectives Students should be able to:	SB pages	WB pages
1. Simultaneous linear equations	• Solve simultaneous equations by elimination methods • Solve simultaneous equations by substitution methods • Solve simultaneous equations by graphical methods • Solve graphically simultaneous equations linear equations • Apply the concept and knowledge of simultaneous equations in solving problems	122–129	44–48
2. Direct proportion, inverse proportion and reciprocals	• Illustrate the concept of variation with real-life examples • Demonstrate with illustrative examples the various types of variation • Solve problems on direct and inverse variation	130–149	49–52
3. Simple and compound interest	• Demonstrate understanding of the concept of interest • Solve problems involving simple and compound interest	150–163	53–55

Topic	Lesson objectives Students should be able to:	SB pages	WB pages
4. Trigonometry	• Solve problems on right-angled triangles by the application of trigonometric ratios of angles • Apply the trigonometric ratios to solve problems on angles and sides of right-angled triangles • State the concept of angles of elevation and depression • Illustrate with examples elevation and depression • Use clinometer to demonstrate and estimate or calculate distances • Define or derive the concept of bearing and distances • Take bearing of places: From A to B and vice versa • Name instruments for taking bearing • Do scale drawings of given shapes	164–195	56–68
Term 2 Revision exercises		197–208	

Term 3

Topic	Lesson objectives Students should be able to:	SB pages	WB pages
1. Similar shapes	• Identify similar figures: triangles, rectangles, squares, cubes and cuboids • Identify the presence of similar shapes in the environment • Enlarge figures using scale factors • Calculate lengths, areas and volumes of similar figures • Solve problems on quantitative reasoning involving similar shapes	209–239	69–76

Topic	Lesson objectives Students should be able to:	SB pages	WB pages
2. Area of plane shapes	• Find areas of triangles, parallelograms and trapeziums • Find areas of circles and sectors • Solve problems involving areas • Solve quantitative aptitude problems on areas • By use of meter rule or tape or generalisation of formula find perimeters of plane shapes • Find the circumference of a circle	240–275	77–83
3. Construction	• Construct angle 30°, 45°, 60° and 90° • Construct perpendicular bisectors and lines perpendicular to a point • Use a pair of compasses to copy a given angle • Construct simple shapes: triangles, quadrilaterals • Construct inscribed and circumscribed circles • Solve quantitative reasoning problems on construction	276–297	84–92
Term 3 Revision exercises		299–304	

Numbers and numeration

Topic 1: Number systems

Teaching notes and guidelines

Introduction

Students have already been exposed to numbers in different bases, the binary number system, counting in binary and basic operations in the binary system in Form 2.

We start the topic by revising the base 10 number system and the concept of writing numbers in other bases, such as 5, 7 and 8. Converting from one base to another base is covered, before we move on to discussing the base 2 number system in more detail. Finally, converting from base 10 to base 2 (and vice versa) is covered.

Common difficulties

Students often struggle to grasp the concept of other number bases, in relation to base 10 number systems that they are accustomed to. Make sure students have a clear understanding of the place value system and how to describe a number by its place value. It helps to explain that the base of a number constitute a grouping, for example, the binary system works in groupings of 2s.

Explain to students that, when converting from one base to another, we divide by the powers of the base and collect the remainders. Alternatively, we can use the place value system as explained on page 4 of the *Student's Book*. The base 10 number system is particularly important in the programming of computers, as it helps to write big numbers using the minimum digits.

Preparation

Provide students with grids like the one on page 2 of this *Teacher's Guide* to help them in the conversion from base 10 to base 2. Similar grids can be made for conversions to other bases.

32	16	8	4	2	1
2^5	2^4	2^3	2^2	2^1	2^0

Ask students what number system we normally work in. Write a base 10 number on the board and ask students to expand it in the base 10 number system. Present another number in a different base, such as base 5, and explain what a "base" represents. Then show them what the place values are for base 5. Repeat the process for bases 7 and 8 and so on, until the concept of a base is clear. Practise some conversions between different number bases. Explain that they will now learn about the base 2 number system and how to convert between different number systems.

Answers to exercises

Exercise 1

(SB page 3)

1. **a)** 6 **b)** 10 **c)** 10
d) 8 **e)** 9 **f)** 12
g) 10 **h)** 2 **i)** 7
j) 10 **k)** 3 **l)** 4
m) 7 **n)** 10 **o)** 5

2. **a)** $11_5 = (1 \times 5^1) + (1 \times 5^0)$
b) $211_3 = (2 \times 3^2) + (1 \times 3^1) + (1 \times 3^0)$
c) $3122_4 = (3 \times 4^3) + (1 \times 4^2) + (2 \times 4^1) + (2 \times 4^0)$
d) $51361_7 = (5 \times 7^4) + (1 \times 7^3) + (3 \times 7^2) + (6 \times 7^1) + (1 \times 7^0)$
e) $1111_9 = (1 \times 9^3) + (1 \times 9^2) + (1 \times 9^1) + (1 \times 9^0)$

3. **a)** 5 **b)** 245
c) 5 **d)** 500

4.

6^3	6^2	6^1	6^0
3	2	4	5

5.

7^4	7^3	7^2	7^1	7^0
5	1	3	6	2

Exercise 2

(SB page 3)

1. **a)** 102_8 **b)** 66_8
c) 115_8 **d)** $1\ 412_8$
e) $1\ 747_8$

2. **a)** 150_6 **b)** 130_6
c) 205_6 **d)** $3\ 334_6$
e) $4\ 343_6$

3. **a)** 231_5 **b)** 204_5
c) 302_5 **d)** $11\ 103_5$
e) $12\ 444_5$

4. **a)** 123_7 **b)** 105_7
c) 140_7 **d)** $2\ 161_7$
e) $2\ 625_7$

Exercise 3

(SB page 6)

1. **a)** 7 **b)** 53
c) 97 **d)** 75
e) 24 **f)** 30
g) 14 **h)** 17

2. **a)** 1011000110 **b)** 11101110110
c) 1011010110010 **d)** 11000000010110
e) 11101001011010110 **f)** 10100010101010
g) 10001110010110

3. **a)** $112_9 = 92 = 10010_2$
b) $131_6 = 55 = 110111$
c) $1566_8 = 886 = 1101110110$
d) $22_4 = 10 = 1010$
e) $102_3 = 11 = 1011$
f) 100

4. $10101010 = 170 = 20022_3$

5. **a)** Smallest: 001
Largest: 111
b) 001 = 1
111 = 7

6. $11112 = 31_{10}$
$\therefore$ 11111 – 31 = 11 080

Topic 2: Basic operations in the binary system

Teaching notes and guidelines

Introduction

This section begins with addition and subtraction in the binary system before going on to multiplication and division. It then covers addition and subtraction in other number bases.

Common difficulties

Addition and subtraction in the binary system has been covered in previous years, but students will need to revise the concepts. The most important aspect of performing these operations are remembering the rules as set out on page 7 and 8 of the *Student's Book*. It might be easier for students to first convert the binary numbers to base 10 numbers and doing in the operations. The examples in the *Student's Book* cover both these options.

Preparation

Make charts with the rules for addition, subtraction and multiplying and dividing in binary.

Explain that arithmetic operations can be performed in other number bases just like in the base 10 number system. Present students with an example of addition in binary. Ask how they think they will perform the calculation. Students might come up with different suggestions. Some might suggest converting the binary numbers to base 10. Explain both methods and present them with the rules. Make sure that they understand the rules.

Answers to exercises

Exercise 1

(SB page 8)

1. a) 00100 **b)** 01111
c) 10000 **d)** 110111

e) 11011
f) 11110
g) 10101
h) 100000
i) 110011
j) 10101
k) 0110 or 6
l) 011 or 3

2. a) $x + 111 = 1110$
$\therefore x = 11110 - 111$
$x = 010111$

b) $x + 1110 = 10001$
$x = 10001 - 11110$
$x = -01101$

c) $x - 10 = 101$
$x = 0111$

d) $x + 11 = 1101$
$x = 1101 - 11$
$x = 10000$

3. a) 11101 = 29
1110 = 14
$\therefore$ 29 + 14 = 43

b) 11101 + 1110 = 01 01 011

c) 43

Exercise 2

(SB page 9)

1. a) 11000
b) 111110
c) 100111
d) 110111
e) 100111011
f) 101100101

2. a) 10111
b) 111
c) 1010
d) 11

3. a) 24
b) 30
c) 39
d) 55
e) 315
f) 357

4. a) $23 \times 35 = 805$

b) 23 = 10111
35 = 100011

c) 10111 × 10011
= 110100101, which is 805

Exercise 3 (SB page 10)

Students' own work

Exercise 4 (SB page 11)

1. Students' own work

2. Students' own work

3. Students' own work

4. **a)** 110_3 **b)** 110_3
c) 21_3 **d)** 210_3

5. **a)** 101_4 **b)** 121_4
c) $1\ 100_4$ **d)** $1\ 011_4$

6. **a)** 152_8 **b)** $1\ 354_8$
c) $10\ 023_8$ **d)** $12\ 664_8$

Topic 3: Application of number systems

Teaching notes and guidelines

Introduction

In this topic, we explore some practical applications of the binary number system. This includes the use of punch cards to record data, binary coding to send messages and punch tapes to record data.

The examples include the use of punch cards to record data in a school tuck shop context. The binary alphabet is then presented to show students how it is used for coding messages, before showing how punch tape can be used to record words or data.

Common difficulties

This is a topic that students generally find interesting to study. However, some students may have difficulty reading the coding or the punch tapes.

Preparation

Prepare visual aids showing the different punch tapes and punch cards. A chart with the binary alphabet will also be helpful to students. Contextualise the use of binary code by making other visual aids from research from books, magazines and interesting articles to show how binary code is used in the real world.

Show students the visual aids that were prepared for the lesson and explain that these are all examples of binary code in the real world. Provide some history of the binary system. Work through the examples in the textbook and ask students to come up with their own examples.

Answers to exercises

Exercise 1

(SB page 14)

1. a) 1011001 **b)** 1022001 = 89

c) FRIDAY = 01000110 01010010 01001001
01000100 01000001 01011001

d) By using a rod and counting the cards.

2. MEET AFTER SCHOOL

3. 01001001 01010111 01001001 01001100
01001100 01000010 01000101 01001100
01000001 01010100 01000101

4. BINARY

5. The punch tape shows: 0001
1001
1000
0001

∴ Year of birth is 1981.

6. Students' own work

Topic 4: Rational and non-rational numbers

Teaching notes and guidelines

Introduction

In this topic, the rational number system is revisited and the real number system is expanded to include non-rational numbers.

The topic starts by revising the different number sets that make up rational numbers:

- Natural numbers
- Whole numbers
- Integers
- Rational numbers

An explanation of rational numbers follows as the need to represent fractions as integers. Mixed numbers, proper fractions, improper fractions and recurring decimals are all rational numbers.

Revision of the number systems is followed by converting decimals to fractions and vice versa. Irrational numbers are introduced and its application to the estimation of square roots is discussed. Lastly, the number π is discussed as a significant example of an irrational number.

Common difficulties

Students can have difficulty with understanding the different sets of numbers. It is important to explain that the sets natural, whole and integer numbers are all part of the set called rational numbers. Show students many examples and non-examples of the different numbers and help them to define them in terms of the sets.

Irrational numbers can also be confusing to students, especially when it comes to recurring decimals. Often these are mistaken for irrational numbers, so make sure the definition and the difference between the numbers are clear. It is important for learners to understand these numbers for topics such as Trigonometry.

Preparation

Prepare a chart that shows the number sets such as the one on page 15 of the *Student's Book*.

Make cards with different numbers (for example, 5, $\frac{3}{4}$, π, $-\sqrt{4}$, 1.333… and so on) to use as examples for students to place them in the correct sets. Have circles cut out for students to use for exploring pi. Make a poster with some interesting facts about pi to show students.

Start by showing the chart of the real number system to students. Revise the different sets by asking for examples of the different numbers. Show the number cards to students and ask them to place them in the right set on the diagram. Introduce a few examples of irrational numbers and ask students where they think they fit in. Explain the definition of irrational numbers.

Answers to exercises

Exercise 1 (SB page 16)

1. a) Any natural number starting from 1.
b) Any integer, positive or negative including 0.
c) Any number (positive or negative) written as a fraction ($\frac{a}{b}$), where a and b are integers and $b \neq 0$
d) Irrational numbers such as π, square roots of all natural numbers that are not perfect squares.
e) Any natural number, integers, rational numbers and irrational numbers.

2. a) True **b)** True **c)** True
d) False **e)** True **f)** False

3. **a)** 0; 9 **b)** 9
c) $-9, -4.7, -\frac{2}{5}, 0, \frac{7}{3}, 3.666$ **d)** π
e) $-9; 0; 9$ **f)** -9

Exercise 2

(SB page 17)

1. **a)** 0.4 **b)** 0.416667
c) $0.\dot{2}85714285714\dot{}$ **d)** $0.444\dot{4}$
e) 1.6 **f)** 3.21
g) $0.66\dot{6}$ **h)** $0.5454\dot{5}\dot{4}$
i) 0.65 **j)** 0.099

2. **a)** $0.4 = \frac{4}{10} = \frac{2}{5}$ **b)** $0.52 = \frac{52}{100} = \frac{13}{25}$
c) $0.37 = \frac{37}{100}$ **d)** $3.21 = 3\frac{21}{100}$
e) $0.009 = \frac{9}{1\,000}$ **f)** $3.06 = 3\frac{6}{100} = 3\frac{3}{50}$
g) $11.95 = 11\frac{95}{100} = 11\frac{19}{20}$ **h)** $0.78 = \frac{78}{100} = \frac{39}{50}$
i) $4.44 = 4\frac{44}{100} = 4\frac{11}{25}$ **j)** $0.0063 = \frac{63}{10\,000}$

3. **a)** $0.1212\ldots = \frac{12}{99}$ **b)** $0.555\ldots = \frac{5}{9}$
c) $5.6565\ldots = \frac{560}{99}$ **d)** $0.3\ldots = \frac{1}{3}$
e) $2.181818\ldots = \frac{24}{11}$ **f)** $1.123123\ldots = \frac{374}{333}$

Exercise 3

(SB page 18)

1. $\sqrt[3]{12} \Rightarrow \mathbb{Q}'$
$\frac{22}{7} \Rightarrow \mathbb{Q}'$
$\sqrt{4} \Rightarrow \mathbb{Q}$
$\frac{-17}{2} \Rightarrow \mathbb{Q}'$
$0.5454 \Rightarrow \mathbb{Q}$
$\sqrt{50} \Rightarrow \mathbb{Q}'$
$\frac{\sqrt{25}}{5} \Rightarrow \mathbb{Q}$
$\pi^3 \Rightarrow \mathbb{Q}'$

2. Students' own work

Exercise 4

(SB page 21)

1. **a)** ≈ 7.03 **b)** ≈ 8.6 **c)** ≈ 4.24 **d)** ≈ 3.65

2. Students' own work

Exercise 5 (SB page 22)

The kitchen bin is inaccurate, because $\frac{\text{circumference}}{\text{diameter}} = 2.06$.

Topic 5: Word problems

Teaching notes and guidelines

Introduction

This topic covers word problems and the translation of word problems to mathematical expressions. The topic starts by providing guidelines on how to work with word problems, and provides a list of words and their mathematical translation. The examples in the *Student's Book* cover word problems that involve addition and subtraction and product and quotient problems.

At first, students learn how to 'translate' word problems, before we go on to writing and solving equations for word problems. Lastly, word problems with fractions are covered (numbers only). Fractional equations are covered in Topic 11.

Common difficulties

This is often a particularly challenging section for students. Encourage students to underline key words in the word problem and to break it down into smaller parts. Translation of the parts of the problem often makes it easier for students to grasp. Reading the question out loud or making a drawing is useful techniques to solve word problems.

Preparation

Create flash cards with the mathematical operation and the English word on either side. Use the table on page 23 of the *Student's Book*. These can be used to quiz students. Prepare a chart outlining the different techniques and tips, so students can refer to it. For word problems with fractions, it will be useful to have some visual aids available that represent fractions such as cakes or chocolate slabs.

Start with a simple word problem and ask students to identify the key words. Then ask them to tell the story of the word problem in their own words. Ask what mathematical operations need to be completed. Practise the translations of the problems by using the prepared flash cards. Have students come up with their own word problems before solving those in the *Student's Book*.

Answers to exercises

Exercise 1

(SB page 25)

1. 3 067 stamps

2. 89 years

3. 1 624

4. 34°

5. 754 kg

6. 75 ℓ

7. ₦ 2

8. ₦ 5.25

9. ₦ 90 000

10. 17 km

11. ₦ 52

12. ₦ 6 490

13. 45

14. ₦ 60 500

Exercise 2

(SB page 27)

1. **a)** $2x = 12$

b) $3x + 5 = 12$

c) $x + 2x + x + 1 = 180°$

d) $x + x + 1 + x - 1 = 20$

e) $x + x + 12x + x + 1 = 100$

f) $x + 2x + 3\,000$

g) $x + x + 200 = 700$

h) $30n = 690$

i) $2x + 4 = 5x$

j) $5x - 4 = 3x$

k) $x + 6 = 4x$

l) $2(x - 4) = 40$

m) $10x = x + 60$

2. **a)** 4

b) 3

c) 3

d) 10 cm; 4 cm

e) 19 minutes

f) 20 grapefruit

g) 16 pages

3. **a) – f)** Students' own work

Exercise 3

(SB page 28)

1. $2\frac{1}{2}$ ℓ

2. 60 students

3. ₦ 1 300

4. $\frac{2}{5}$

5. **a)** ₦ 3 250

b) $\frac{7}{20}$

c) $5\frac{1}{7}$ weeks (5 weeks and 1 day)

6. 40

7. $63 \div \frac{9}{7} = 49$

8. $36 \div \frac{6}{7} = 42$

9. $2 \div \frac{1}{4} = 8$

10. $\frac{2}{5}$ will be girls

$\therefore \frac{2}{5} \times 45 = 18$

11. He drank $\frac{3}{5}$

$\therefore \frac{3}{5} \times 500 = 300$

12. $3 \times \frac{1}{4} = \frac{3}{4}$

$\therefore \frac{1}{4}$ of the pizza remains

13. $150 \times \frac{1}{3} = 50$ learnt German

$150 \times \frac{2}{5} = 60$ learnt Italian

$\therefore$ 40 learnt French

14. $(50 - \frac{1}{2}) - 40$

$= 100 - 40 = 60$

15. $(95 \div \frac{1}{5}) + 35$

$= 510$

16. $\frac{1}{4} + \frac{1}{8} = \frac{3}{8}$

$\therefore \frac{2\,000}{\frac{5}{8}}$

$= ₦ 3\,200$

17. $1\frac{1}{6} + \frac{3}{4} + \frac{1}{2}$

$= \frac{29}{12}$ hours

$= 2\frac{5}{12}$

= 2 hours and 25 minutes

So the bell will ring at 12:25.

18. **a)** $2 \times \frac{3}{4} = \frac{6}{4}$ kg of flour

b) $5(\frac{1}{3}) = \frac{5}{3}$ kg nuts

$5(\frac{3}{4}) = \frac{15}{4}$ kg flour

$5(\frac{1}{4}) = \frac{5}{4}$ kg sugar

c) $7(\frac{3}{4}) = \frac{21}{4}$ kg flour

$7(\frac{1}{3}) = \frac{7}{3}$ kg nuts

$7(\frac{1}{4}) = \frac{7}{4}$ kg sugar

$7(3) = 21$ kg butter

Topic 6: Simplify expressions involving brackets and fractions

Teaching notes and guidelines

Introduction

Students are by now familiar with the distributive law and its application to algebraic fractions. Topic 6 starts with revision of removing brackets and then combining like terms. It covers more complicated expressions than those encountered in previous years. Basic operations with fractions are then revised to prepare the student for the final section where brackets and fractions are covered.

Common difficulties

Students often make mistakes with the order of operations when multiplying. For example, in $12 + 2(5a + 4)$ they will often add 12 and 2, instead of removing the bracket first. Reinforce the order of operations and the separation of factors with the students. Sometimes they also make mistakes with signs. For example, in $15 - 7(x - 1)$, the student may multiply by 7, instead of –7, when they remove the bracket.

Removing brackets with fractions also present some difficulty, since students often make mistakes when the fraction is distributed. Once brackets are removed, recognising that an LCM needs to be found in order to simplify further, is often neglected. Remedy this by revising operations with fractions (without algebraic terms).

Preparation

Make a chart that shows the distributive law in different contexts. Include some examples of the difficulties mentioned above to caution students about the potential mistakes.

Write a few examples on the board and remind students that algebraic expressions can be simplified by removing the brackets and then combining like terms. Work through the examples and assist the students who are finding the examples difficult. Do a "spot the mistake" exercise to reinforce awareness of potential problems.

Answers to exercises

Exercise 1

(SB page 31)

1. **a)** $3a - 12b$ **b)** $6xy + x^2$

c) $vs + vu$ **d)** $5ab + ac$

e) $5uv + v^3$ **f)** $6y^3 + 7xy^2$

2. **a)** $10 + 20$ **b)** $13a + 27b$

c) $15y + 23$ **d)** $8y + 20v$

e) $x + 8$ **f)** $7x + 8$

g) $-7x + 22$ **h)** $x - 2y$

i) $-2bx$ **j)** $13a$

k) $-8a - 11b + 11c$ **l)** $-2x^2 - 8x + 5$

m) $-6x - 3y$ **n)** $7x - 5y - 5z$

o) $-5x + 3y$ **p)** $7x - 11y$

q) $12x^2 + 13x + 2$ **r)** $-ab + 4a + 10b$

Exercise 2

(SB page 34)

1. **a)** $2 \times \frac{(x+y)}{3}$

$= \frac{2}{3}x + \frac{2}{3}y$

b) $\frac{2}{3} \times (x+y)$

$= \frac{2}{3}x + \frac{2}{3}y$

c) $3 \times \frac{(x+4)}{7}$

$= \frac{3}{7}x + \frac{12}{7}$

d) $\frac{1}{7} \times 3(x+4)$

$= \frac{3x}{7} + \frac{12}{7}$

e) $\frac{3}{7} \times (x+4)$

$= \frac{3x}{7} + \frac{12}{7}$

f) $\frac{x}{4} + \frac{x}{7}$

$= \frac{11}{28}x$

g) $\frac{2x}{5} + \frac{x}{9}$

$= \frac{23}{45}x$

h) $\frac{2x}{3} - \frac{3x}{4}$

$= \frac{-x}{12}$

i) $\frac{3x}{4} - \left(\frac{x}{5} + \frac{x}{3}\right)$

$= \frac{13}{60}x$

j) $\frac{5x}{-2} + \frac{3x}{7}$

$= \frac{-29}{14}x$

k) $\frac{2x-1}{3} - \frac{x-1}{6}$

$= \frac{2(2x-1)-(x-1)}{6}$

$= \frac{4x-2-x+1}{6}$

$= \frac{3x-1}{6}$

l) $\frac{6x+2}{4} + \frac{3x-2}{3}$

$= \frac{3(6x+2)+4(3x-2)}{12}$

$= \frac{18x+6+12x-8}{12}$

$= \frac{30x-2}{12}$

m) $\frac{4+y}{9}+\frac{3+2y}{2}$

$=\frac{2(4+y)+9(3+2y)}{18}$

$=\frac{8+2y+27+18y}{18}$

$=\frac{35+20y}{18}$

n) $\frac{2b+c}{3}-\frac{5b+3c}{4}$

$=\frac{4(2b+c)-3(5b+3c)}{12}$

$=\frac{8b+4c-15b-9c}{12}$

$=\frac{-7b-5c}{12}$

o) $\frac{y-2x}{2}+\frac{4x+5y}{4}$

$=\frac{2(y-2x)+4x+5y}{4}$

$=\frac{2y-4x+4x+5y}{4}$

$=\frac{7y}{4}$

Topic 7: Factorisation

Teaching notes and guidelines

Introduction

In this expansive section, a number of important concepts are covered. This section is integral in preparing students for future study in algebra.

Factorising using the HCF

- Removing brackets is covered to reinforce the relationship between multiplying and factorising.
- The important concept of factorising used as the distributive property in reverse is explored first through the HCF. Numbers are used to introduce the HCF, and then polynomials are used.
- To familiarise the student with the concept of taking out an HCF, factorising and division and how to write a factorised expression, tables are used first. Examples become more complicated where there are numbers and variables as the HCF, multiple terms and indices.

Factorising a common factor bracket

- Students are first taught to recognise the common factor bracket. The examples then illustrate how to perform the operation. The examples also cover the associative property of addition before proceeding to performing a switch around.

Factorising by grouping

- Sometimes when there is not a common factor, terms in the expression can be grouped in order to factorise it. This section covers various examples of how this is performed.

Difference of squares

- This section starts with a geometrical explanation of the difference of squares. Students are guided through an investigation to become familiar with the concepts.

- The examples cover where there is a difference of squares only, and then look at more complicated examples where an HCF needs to be taken out first.

Factorising trinomials

- Students are reminded of FOIL and how a quadratic is formed. This is to prepare learners for the concept of reversing this process to find the factors of a quadratic.
- This is followed by an in-depth explanation of how a quadratic trinomial is recognised.
- Students are then taught to use a factor box to factorise trinomials. More complicated trinomials where an HCF is taken out first is covered.

Perfect square trinomials

- Here too, a geometrical explanation is given for a perfect square trinomial before the process of factorising this trinomial is explained.

The topic ends with a summary of the different types of factorising, a mixed exercise and word problems involving factorising.

Common difficulties

This is often a difficult topic for students to grasp. It is important to be aware of the difficulties students experience and their progress in this section. The concept of reversing will be hardest to grasp. Do many basic examples to develop students' ability to do this. Make sure the basic concepts are understood before moving on to more complicated examples.

When taking out a common factor where indices are involved, help students by reminding them of the rules of indices. Practise a few division examples with indices to address this. Often when a common factor bracket is present, students do not always recognise this. Keep reminding students that brackets that are the same are considered like terms.

Factorising by grouping can be challenging when the grouping is not always clear. Guide the students on how the factorising is performed. The factorising of a difference of squares in generally reinforced by reminding students how to identify this binomial and what square numbers are. Factorising trinomials will require a lot of practise and guidance. Start with simple examples before moving on to more complex calculations.

Preparation

The following visual aids will be helpful:

- A diagram that shows the relationship between factorising and multiplication.
- A chart the shows all the different types of factorising and the steps to follow to complete them.
- Copies of factor boxes to factorise trinomials to hand out to learners and larger ones to place on the board.
- A chart like the one on page 59 of the *Student's Book*.

Start with a basic introduction to the reverse process of the distributive law, which is called factorising. Numbers can be used first to illustrate before moving on to algebraic terms. Refer back to this basic concept when introducing each new type of factorising.

Answers to exercises

Exercise 1

(SB page 35)

1. $5x$

2. $a^3 - 6a^2 + 11a - 6$

3. $8b^2 - 40b + 48$

4. $-c^2 + 5c$

5. $-2x - 2$

6. $2a^2 + 12a + 16$

7. $x^3 + 17x^2 + 63x - 81$

8. $a^3 + 4ab + 4ab^2 + 2a^2b + 8b^2 + 8b^3$

9. $18a^2 - 39a + 18$

10. $-14a^2 - 27a - 18$

Exercise 2

(SB page 38)

1. x^2 **2.** t^4 **3.** $2x$ **4.** $18x^3$

5. u^2v **6.** xy **7.** $3y^3z^4$ **8.** $15xy^3$

9. $-a^2$ or a^2

Exercise 3

(SB page 41)

1. **a)** a **b)** $2ab$ **c)** a
d) 1 **e)** $3a$ **f)** $3a(1 + 2b)$

2. **a)** $x(x - 5)$ **b)** $m(a - b)$ **c)** $3(3x - 4y)$
d) $y(a - 1)$ **e)** $3(x^2 - 2)$ **f)** $x^2(1 - b)$
g) $3x(2y + 3)$ **h)** $5g(3 + 2hg)$

Exercise 4

(SB page 42)

1. $7x(x + 4)$

2. $3(2y - 9)$

3. $x^2(x + y)$

4. $3ab(a + 4b^2)$

5. $2ab(1 + 2b + 3a)$

6. $x(y + 2t + x)$

7. $6xy(2xy^2 + 3y^2z)$

8. $\frac{1}{3}x(x^2 - 9)$
$= \frac{1}{3}x(x + 3)(x - 3)$

9. $3(x - 3y)$

10. $2x^2(1 + 2xy - 3y^2)$

Exercise 5

(SB page 45)

1. $(k + 1)(3 - k)$

2. $(m - 2)(1 + p)$

3. $(2x - 1)(a + 2b)$

4. $(a - b)(x + y)$

5. $(x - y)(a - b)$

6. $(x^2 - x)(2a + b)$
$= x(x - 1)(2a + b)$

7. $(3p + 1)(2x - 3y)$

8. $(x - 3)(x - 3 + 1)$
$= (x - 3)(x - 2)$

9. $(3x - 2)(x - 3)$

10. $(2x - y)(a - 2b)$

Exercise 6

(SB page 45)

1. $(p - 2q)(a + b)$

2. $(y + z)(a + b)$

3. $(x + y)(2a + b)$

4. $(x - y)(c - d)$

5. $(2a - b)(x - 1)$

6. $(a - b)(a + x)$

7. $(y + z)[x - (y + z)]$

8. $(x - 1)(y - 1)$

9. $(a + b)(x^2 + 4)$

10. $(k - m)(x - z)$

11. $3a(2a + c) + 2b(2a + c)$
$= (3a + 2b)(2a + c)$

12. $-a(-x + y) + b(-x + y)$
$= (-a + b)(-x + y)$

Exercise 7

(SB page 49)

1. **a)** $(x - 3)(x + 3)$

b) $(x - 4)(x + 4)$

c) $(y - a)(y + a)$

d) $(2 - 5b)(2 + 5b)$

e) $2a(5a - 3b)(5a + 3b)$

f) $a(a - b)(a + b)$

g) $(a^2 - 4)(a + 4)$
$= (a - 2)(a + 2)(a + 4)$

h) $(3x - 4y)(3x + 4y)$

i) $\left(x-\frac{y}{2}\right)\left(x+\frac{y}{2}\right)$ **j)** $3(6-x)(6+x)$

k) $[2a-3(a-b)][2a+3(a-b)]$

l) $[2(a-b)-3(c-d)][2(a-b)+3(c-d)]$

m) $(2a)(2b)$

2. a) $(121-120)(121+120)$
$= 1(241)$
$= 241$

b) $(57-56)(57+56)$
$= 1(113)$
$= 113$

c) $(31-29)(31+29)$
$= (2)(60)$
$= 120$

d) $(145-135)(145+35)$
$= (10)(280)$
$= 2\,800$

Exercise 8

(SB page 50)

1. x^2+3x+2 **2.** x^2-2x-3 **3.** x^2+7x-8

4. x^2-4 **5.** $x^2+9x+14$ **6.** x^2-5x+6

7. $x^2-2x-15$ **8.** x^2-25 **9.** $x^2-8x-16$

10. $x^2-2x-24$ **11.** x^2+2x+1 **12.** $x^2+14x+49$

Exercise 9

(SB page 52)

1. a) 1 **b)** x^2 ; 4 ; $4x$

2. a) $(x+3)(x+5)$ **b)** $(x+6)(x+4)$
c) $(x+8)(x+1)$ **d)** $(x+7)(x+2)$
e) $(x+12)(x+8)$ **f)** $(x+4)(x+1)$
g) $(m+3)(m+3)$ **h)** $(b+2)(b+1)$
i) $(n+5)(n+1)$

Exercise 10

(SB page 55)

1. $(x+2)(x+3)$ **2.** $(x-3)(x-5)$

3. $(x-6)(x+1)$ **4.** $(x+7)(x-2)$

5. $(x+5)(x-2)$ **6.** $(x+4)(x-3)$

7. $(x-5)(x+3)$ **8.** $(x-6)(x+3)$

9. $(x+8)(x+2)$ **10.** $(x+5)(x-4)$

11. $(x-9)(x+1)$ **12.** $(x+8)(x+4)$

Exercise 11

(SB page 57)

1. $(x + 4)(x - 2)$

2. $a(x^2 + 5x + 6)$
$= a(x + 1)(x + 5)$

3. $(x + 17)(x + 1)$

4. $x^3 - x^2 - 12x$
$= x(x^2 - x - 12)$
$= x(x - 4)(x - 3)$

5. $(x - 9)(x + 2)$

6. $-x^2 - 2x + 48$
$= -(x^2 + 2x + 48)$
$= x^2 + 2x - 48$

7. $(p - 7)(p + 2)$

8. $4(x^2 - 4x + 3)$
$= 4(x - 3)(x - 1)$

9. $(m - 8)(m - 1)$

10. $(x - 9)(x - 7)$

11. $-2x^2 + 2x + 24$
$= -2(x^2 - x - 12)$
$= -2(x - 4)(x + 3)$

12. $[(a + 3) - 2][(a + 3) - 1]$
$= (a + 1)(a + 2)$

13. $[(x + 1) - 1][(x + 1) + 4]$
$= 2x(x + 5)$

Exercise 12

(SB page 59)

1. **a)** $x^2 + 2x + 1$ **b)** $x^2 - 6x + 9$
c) $x^2 + 8x + 16$ **d)** $x^2 - 10x + 25$
e) $x^2 - 2xy + y^2$ **f)** $9x^2 - 12x + 4$
g) $x^6 + 2x^3 + 1$ **h)** $x^8 - 6x^4 + 9$

2. **a)** $(x - 1)(x - 1)$ **b)** $(x - 3)(x + 3)$
c) $(x - 9)(x - 9)$ **d)** $(x - 6)(x - 6)$
e) $(x - 5)(x - 5)$ **f)** $(x + 12)(x + 12)$

Exercise 13

(SB page 59)

1. **a)** Perfect square trinomial **b)** HCF and perfect square
c) HCF and trinomial **d)** Grouping
e) HCF and trinomial **f)** $(5a^2 - 4b^4)(5a^2 + 4b^4)$

2. **a)** F **b)** C **c)** E
d) A **e)** D **f)** B

Exercise 14

(SB page 61)

1. $3y^7x^3(x - 2y)(x + 2y)$

2. $xy(x - 2y)(x + 2y)$

3. $2x(x + 3)(x - 3)$

4. $(x - 4)(x + 2)$

5. $(m - 2)(m + 2)(m^2 + 4)(m^4 + 16)$

6. $(a - b)(a - b - 1)(a - b + 1)$

7. $2x(x - 2)(2x + 1)$

8. $3(p - 10)(p + 3)$

9. $m(7 - m)(7 + m)(x - y)$

10. $3(x + 3)(2x - 1)$

11. $2(x - 3)(x + 2)$

12. $5(n + 1)(n - 2)$

13. $(x - 2)(g - h)(g + h)(g^2 + h^2)$

14. $x(2x + 3)(a - 2b)$

15. $(a - b)(a + b)(c^2 + d^2)$

16. $(a^2 + 4)(a - 2)(a + 2)$

17. $[2(a - b) + 3(c - d)][2(a - b) - 3(c - d)]$

18. $(4y - 3)(y - 5)$

19. $-(4x + 5)(3x - 2)$

20. $(a - b)(a + b)(c^2 + d^2)$

Exercise 15

(SB page 62)

1. $2x^3 - 2x$
$= 2(x^2 - 1)$
$= 2(x - 1)(x + 1)$
Substitute $x = 5$ $\therefore 2(5)(5 - 1)(5 + 1) = 240$

2. $\pi r_2^2 - \pi r_1^2$; where r_2 = radius of the large circle and r_1 = radius of the small circle $= \pi(r_2^2 - r_1^2)$
$= \pi(r_2 - r_1)(r_2 + r_1)$
$= \pi(6 - 2)(6 + 2)$
$= \pi(4)(8)$
$= 100.53 \text{ cm}^2$

3. $x^2 + 8x + 15$
$= (x + 3)(x + 5)$
They added 3 m in the breadth and 5 m in the length.

4. $x = 15^2 - 12^2$
$= (15 - 12)(15 + 12)$
$= (3)(27) = 8 \text{ cm}^2$

5. $x^2 - 6x - 7$
$= (x - 7)(x + 1)$

6. $9x^4 - 36$
$= 9(x^4 - 4)$
$= 9(x^2 - 2)(x^2 + 2)$
Substitute $x = 3$
$= 9\ (3^2 - 2)(3^2 + 2)$
$= 9(7)(11)$
$= 693$ units^3

7. $V = 98x - 28x^2 + 2x^3$
$= 2x(49 - 14x + x^2)$
$= 2x(x - 7)(x - 7)$

8. $x^2 - 8x + 16$
$= (x - 4)(x - 4)$

9. $(x - 5)(x + 3)$

10. $(3x^2 - 6)(3x^2 + 6)$

$= 693$

11. $2x\ (2x - 9)(x - 10)$

12. $(x - 4)^2$

13. $x = 2$

14. $x = 12$

Topic 8: Changing the subject of the formula

Teaching notes and guidelines

Introduction

This topic is about rearranging formulae where the coefficients and constants are all letters and not numbers. The topic starts by reminding students of what is meant by the subject of a formula, and by giving some general guidelines as to how to rearrange a formula. The examples cover squaring (to remove a square root and how to remove a fraction).

Common difficulties

This is potentially a challenging section for students as numbers are involved and the equations only have variables. Remind the students that in literal equations we follow the same procedure as for equations: move the terms concerned from one side of the equal sign to the other.

Preparation

Make a chart with the guidelines outlined on page 64 of the *Student's Book* to display in the classroom.

Write a simple equation on the board and ask students to solve the equation. This will remind them of the processes to follow in solving the equation. Explain that this can be applied to literal equations too. Introduce a literal equation that they are familiar with, such as the formula for the area of a circle, or the circumference of a circle. Practise rearranging these formulae before moving on to the ones in the examples in the *Student's Book*.

Answers to exercises

Exercise 1

(SB page 66)

1. $x = v - \frac{T}{u}$

2. $c = \frac{(a-b)(a+b)}{4a}$

3. $x = a$

4. $y = \frac{3x}{a+x}$

5. $x = \frac{y(t^2-1)}{(1+t^2)}$

6. $h = \frac{A-2\pi r^2}{2\pi}$

7. $t = \sqrt{\frac{1-p}{p+1}}$

8. $u = \frac{\mathrm{T}(u+w)b}{a}$

9. $\mathrm{U} = \frac{fv}{v-f}$

10. $r = \sqrt{\frac{st}{a} + 1}$

11. $a = \frac{\mathrm{V}^2 - u^2}{2s}$

12. $x = \frac{\mathrm{T}}{x+5}$

13. $m = \frac{14n}{13}$

14. $y = -\frac{20x}{4+6x}$

15. $u = \frac{15}{7.5-2w}$

Topic 9: Measures of central tendency

Teaching notes and guidelines

Introduction

In this topic, the different types of data are revised. This leads up to the process of data collection and recording data in frequency tables. These are concepts that students are already familiar with.

The measures of central tendency, namely the mean, median and mode, are covered for data that are listed. This is followed by an explanation of how to calculate the mean for data presented in frequency distribution tables. Last, the range is covered as a measure of dispersion.

Common difficulties

It is important that students understand the difference between different kinds of data, as it will affect how to interpret and work with it. Often mistakes are made when data is recorded in a frequency table, so encourage students to work accurately.

The most common difficulty among students is that they confuse the mean, mode and median. Assist them in remembering these terms by making a rhyme or an acronym. Calculating the mean from a frequency table is new to them, so ensure that many examples of this are covered.

Preparation

Make a chart that displays all the different terms and their definitions.

Start by presenting students with a scenario where they have to collect and analyse data using the measures of central tendency. Ask students to suggest some examples of qualitative and quantitative data. Discuss organising the data in frequency tables and then go on to find the mean, median and mode. Explain why these measures are important and what they represent.

Answers to exercises

Exercise 1

(SB page 68)

1. **a)** Quantitative, discrete
b) Quantitative, continuous
c) Quantitative, discrete
d) Quantitative, discrete
e) Quantitative, discrete
f) Quantitative, discrete
g) Quantitative, discrete
h) Quantitative, discrete

2. **a)** Qualitative, discrete
b) Quantitative, discrete
c) Quantitative, discrete
d) Quantitative, discrete
e) Quantitative, continuous
f) Quantitative, continuous
g) Quantitative, continuous
h) Quantitative, discrete

Exercise 2

(SB page 70)

1. Students' own work

2. **a)** The group from which data is collected.
b) A small selection from a larger population.
c) The sample drawn is not representative of the population.
d) Every member of the population has an equal chance of being selected.

3. Students' own work

Exercise 3

(SB page 70)

Students' own work

Exercise 4

(SB page 72)

1.

Number of counting sticks	Tally	Frequency (*f*)
9	𝍸	4
10	𝍷	2
12	𝍸	3

Number of counting sticks	Tally	Frequency (f)
15	𝍸	4
20	𝍸	5
25	𝍸	3
30	𝍸	1
35	𝍸	1
40	𝍸	1
		$\sum f = 24$

2. a)

Shoe sizes	Tally	Frequency (f)
20	𝍸	1
25	𝍸	2
27	𝍸	1
28	𝍸	2
30	𝍸	2
36	𝍸	2
38	𝍸	4
39	𝍸	1
40	𝍸	4
41	𝍸	1
42	𝍸	8
43	𝍸	2
		$\sum f = 30$

b) Size 42

3. a) Students' own work

b) The number of families with a certain number of children.

c) 16 **d)** 2 **e)** 100

Exercise 5

(SB page 75)

1. a) 45.7 **b)** 46.625 **c)** 62 **d)** 58.53

e) 62 **f)** 68 **g)** 64.4

2. **a)** 26 and 41 **b)** 27 **c)** 87 **d)** 70
e) 87 **f)** 26 **g)** 99

3. **a)** 41 **b)** 35.5 **c)** 63 **d)** 70
e) 70 **f)** 99 **g)** 58

4. **a)** Mean = 41
Median = 39
Mode = no mode

b) Mean = 10.1
Median = 10
Mode = 9

c) Mean = 64.1
Median = 63
Mode = no mode

d) Mean = $2x + y$
Median = $1\frac{1}{2}x + y$
Mode = $2x - y$

5. **a)** 3 **b)** 3 **c)** 2 and 4

6. **a)**

Nr of people	Frequency
2	7
3	12
4	8
5	5
6	4
7	3
8	1

b) Mean = 4
Median = 4
Mode = 3

7. **a)** 6 **b)** 4 **c)** 10

8. **a)** Mean = 6.1
Mode = 9
Median = 7

b) Mean = 124.7
Mode = 123
Median = 124.5

c) Mean = 4.2
Mode = 2
Median = 3.5

d) Mean = 93.75
Mode = 100
Median = 95

9. **a)** 25 students

b) Mode = 12
Mean = 10.4
Median = 10

c) 10

10.

x	f	fx
1	7	7
2	5	10
3	5	15
4	9	36
5	9	45
6	4	24
7	3	21
8	5	40
9	3	27
	$\sum f = 50$	$\sum fx = 225$

Exercise 6

(SB page 77)

1. a) $\sum fx = 20\,000 \times 6 + 25\,000 \times 12 + 40\,000 \times 15 + 50\,000 \times 9 + 60\,000 \times 5 + 100\,000 \times 2 + 120\,000 \times 1$

$= 2\,090\,000$

$\sum f = 6 + 12 + 15 + 9 + 5 + 2 + 1$

$= 50$

$\therefore$ mean $= \frac{2\,090\,000}{50}$

$= 41\,800$

b) Students' own work

2. a) August

b) 13.25

3. a) Mode = 0

b) Median $= \frac{1}{2}(1 + 1) = 1$

c) $\bar{x} = \frac{\sum fx}{\sum f}$

$= \frac{(28 \times 0) + (21 \times 1) + (6 \times 2) + (3 \times 3) + (1 \times 4) + (1 \times 5)}{60}$

$= \frac{51}{60}$

$= 0.85$

≈ 1

4. a) 39 **b)** 39 **c)** 40

5. a)

Size	Tally	Frequency
10	𝍸 𝍸	10
12	𝍸 𝍸 𝍸 𝍸	20
14	𝍸 𝍸 𝍸	15
16	𝍸 𝍸	10
18	𝍸 |||	8
20	||	2

b) The mode, since it indicates the size that occurs most frequently.

c) **i)** Mean = 13.75
ii) Mode = 12
iii) Median = 14

Exercise 7

(SB page 79)

1. a) Mean = 9.7
Median = 8.5
Mode = 6 and 8
Range = 17 – 5 = 12

b) Mean = 0.91
Median = 0.89
Mode = No mode
Range = 0.11

c) Mean = 4
Mode = 5
Median = 4
Range = 6

2. Mean = 174.18; mode = 176 and 168; median = 173.18; range = 23

3. a) Mean = 16.71; mode = 19; median = 20; range = 22
b) The mean will increase, the median will change

4. a) Mean = 9; mode = 7; median = 7; range = 22
b) **i)** 7 **ii)** 7
iii) 0 **iv)** 21
c) **i)** 7 **ii)** 15

5. Place 1: 2 012
Place 2: 1 423
Place 3: 1 354
Place 4: 1 246
Place 5: 1 009

Topic 10: Representing data

Teaching notes and guidelines

Introduction

Various ways of representing data, namely pictographs, bar graphs, pie charts and line graphs, are covered in this topic.

Common difficulties

Some students will find it difficult to draw pie charts, especially doing the calculations to divide the circle into the correct proportions. Remind students that the proportions represent a number of degrees in the circle, and that these determine the size of the sectors. Remind students to use the correct scale when drawing line graphs and bar graphs. It is important to plot the graphs accurately.

Preparation

Find examples of data representation in the newspaper or from the internet. A chart showing the different ways of representing data can also be useful.

Introduce the topic to students by first showing them data represented as numbers only. Ask them in what ways they think the data can be presented graphically. Show them a graphical representation of the same data and ask a few questions about how it has made reading the data easier. Briefly discuss and provide examples of the four types of data representation.

Answers to exercises

Exercise 1 (SB page 82)

1. Students' own work

2. Students' own work

3. Students' own work

4. Students' own work

Exercise 2 (SB page 84)

1. Students' own work (teacher to provide guidance)

2. Students' own work (teacher to provide guidance)

3. Students' own work (teacher to provide guidance)

4. Students' own work (teacher to provide guidance)

5. **a)** ₦ 700 billion

b) ± ₦ 100 billion more

c) Students' own answers

d) Mean $= \frac{700 + 800 + 400 + 620 + 850 + 780 + 620 + 620 + 780 + 780 + 790}{10}$

$= ₦ 774$ billion

e) Students' own answers

6. There are 32 students.

7. 47% of students scored more than 40%.

8. Students' own work (teachers to provide guidance)

9. Students' own work (teachers to provide guidance)

10. **a)** Orange and purple

b) Yellow

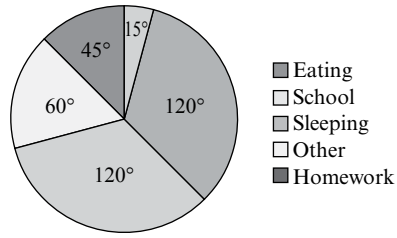
c) 3 packets

d) 600 pencils

Exercise 3

(SB page 90)

1.



2. **a)** $\frac{1}{4} + \frac{1}{8} + \frac{1}{3} = \frac{17}{24}$; so $\frac{7}{24}$ chose jogging

b) $\frac{1}{8} \times 360° = 45°$, ∴ an angle of 45° of the sector represents basketball

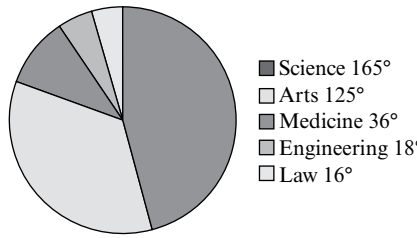
c) $\frac{1}{3}$ represents 32 students, ∴ $\frac{1}{4}$ represents 24 students, ∴ 24 students chose tennis

3. **a)** The Spanish and Dutch have the smallest number of people in the hotel (each represents 45° of the chart)

b) $\frac{1}{6}$ of the people in the hotel are French

c) $\frac{45}{360} \times 288 = 36$, ∴ there are 36 Dutch people in the hotel

4.



5. **a)** $\frac{60}{100} \times 720 = 432$, $\therefore$ 432 students failed

b) $40\% \times 360° = 144°$

$\therefore$ the sector angle for the pass grades is 144°

c) $\frac{10}{100} \times 720 = 72$

$\therefore$ 72 students passed with Grade A

6. Students' own work

7. **a)** **i)** ₦ 104 000 **ii)** ₦ 104 000 **iii)** ₦ 2 000

b) $\frac{1}{8}$

8. Students' own work

Exercise 4

(SB page 92)

1. **a)** Day 5 **b)** 17 °C

c) On day 2 and day 6 **d)** 21 °C

2. Students' own work

3. Students' own work

4. **a)** 2 kg

b) **i)** 5 kg **ii)** 19 kg

c) **i)** 8 months **ii)** 28 months

d) 10 kg

e) 12.8 kg

5. **a)** June 2015

b) Approximately 7 000 cases.

c) October – January 2015

d) Students' own answers

e) The outbreak is contained.

6. **a)** ±52 million people

b) ±6 million

c) Students' own answers

Topic 11: Solving equations involving fractions

Teaching notes and guidelines

Introduction

This topic focuses on equations with fractions. Begin by revising equations to remind the students of the use of multiplicative and additive inverses in solving equations. By now, students should be very familiar with these concepts. The topic then continues by explaining the LCM (lowest common multiple) and how it is used to remove fractions from the denominator. The fractional equations that are covered include:

- Fractional equations with numerical denominators
- Fractional equations with unknown variables in the denominators
- Equations with binomial denominators.

The section ends by looking at word problems that lead to fractional equations.

Common difficulties

Most of the difficulties experienced in this section relates to students' ability to work with fractions. Remind them of the basic operations with fractions. Make it clear that multiplication by the LCM means that the denominators divide into the LCM, in order to remove them.

A common error is that students leave off the denominator, without multiplying by the LCM. Encourage students to work carefully and accurately. Also, remind them that each term in the equation needs to be multiplied by the LCM. That includes whole numbers.

Students sometimes have difficulty when the denominator is a binomial. Make sure they understand that all terms below a division line is considered one term.

Preparation

Create a chart that shows the important concepts of working with fractional equations.

Introduce the topic by looking at a few linear equations and how they are solved using inverse operations. Write an example of a simple fractional equation on the board and ask students how they can eliminate the fractions. Continue to discuss how to solve the equation, reminding students that the basic concepts of solving equations can be applied here.

Answers to exercises

Exercise 1

(SB page 96)

1. **a)** $x = 7$ **b)** $c = 2\frac{1}{2}$ **c)** $a = 4$

d) $b = 7$ **e)** $e = 2\frac{1}{5}$ **f)** $c = 6\frac{3}{4}$

g) $y = 4$

2. **a)** $x = -12$ **b)** $x = 12$ **c)** $x = -2$

d) $x = -\frac{2}{5}$ **e)** $x = -5$ **f)** $x = -2$

g) $x = \frac{5}{12}$ **h)** $x = -8$ **i)** $x = \frac{8}{3}$

j) $x = 2$ **k)** $x = 1$ **l)** $x = \frac{17}{36}$

m) $x = -24$ **n)** $x = 5$ **o)** $x = 9$

p) $x = 9$ **q)** $x = -19$

Exercise 2

(SB page 98)

1. **a)** $x = 120$ **b)** $b = 77$ **c)** $s = 54$

d) $y = 5$ **e)** $a = 22$ **f)** $b = \frac{2}{3}$

g) $c = 8\frac{1}{6}$ **h)** $l = 7\frac{3}{8}$ **i)** $x = 15$

j) $a = 66$

2. **a)** $x = 12$ **b)** $x = \frac{7}{3}$ **c)** $v = \frac{5}{4}$

d) $n = -\frac{1}{5}$ **e)** $a = \frac{99}{2}$ **f)** $x = \frac{25}{16}$

g) $v = \frac{600}{23}$ **h)** $x = 1.5$ **i)** $a = \frac{9}{10}$

j) $x = 4$ **k)** $x = -\frac{7}{2}$ **l)** $v = -\frac{7}{3}$

m) $r = 31.5$ **n)** $v = -\frac{5}{3}$ **o)** $x = \frac{43}{5}$

p) $x = -32$ **q)** $a = -5$

Exercise 3

(SB page 100)

1. $a = \frac{5}{7}$

2. $x = 3$

3. $x = 3$

4. $x = -\frac{1}{2}$

5. No solution

6. No solution

7. $a = \frac{32}{2}$

8. $x = \frac{1}{3}$

Exercise 4

(SB page 101)

1. $x = -8$

2. $x = \frac{-3}{2}$

3. $x = -\frac{6}{7}$

4. $x = 4$ or $x = -1$ (optional)

5. $y = -10$

6. $x = 13$

7. $y = \frac{19}{14}$

8. $t = 10$

Exercise 5

(SB page 103)

1. Let the number be x

$$\frac{1}{2}x + \frac{x-2}{5} = x - 4$$
$$5x + 2x - 4 = 10x - 40$$
$$-3x = 36$$
$$x = -12$$

2. Let the number be x

$$\frac{x-6}{5} = 4$$
$$x - 6 = 20$$
$$x = 26$$

3. Let the number be x

$$\frac{1}{2}x + \frac{1}{3} = x - 8$$
$$3x + 2x = 6x - 48$$
$$-x = -48$$
$$x = 48$$

4.

$$\frac{7+x}{9+x} = \frac{5}{6}$$
$$45 + 5x = 42 + 6x$$
$$-x = -3$$
$$x = 3$$

5. Optional

6. Optional

7.

$$x - 15 = \frac{1}{4}x$$
$$4x - 60 = x$$
$$3x = 60$$
$$x = 20$$

8.

$$\frac{2}{3}x - 35 = \frac{1}{6}x$$
$$4x - 210 = x$$
$$-210 = -3x$$
$$x = 70\ \ell$$

9.

	There	Back
Distance	x	x
Speed	100 km/h	75 km/h
Time	$\frac{x}{100}$	$\frac{x}{75}$

$$7 = \frac{x}{100} + \frac{x}{75}$$
$$2\,100 = 3x + 4x$$
$$2\,100 = 7x$$
$$x = 300 \text{ km}$$

10. Let the time for both pipes = x

In one hour, the first pipe can fill $\frac{1}{8}$ of the tank.

In one hour, the other pipe can fill $\frac{1}{12}$ of the tank.

In one hour, $\frac{1}{x}$ of the tank will be filled.

$\therefore \frac{1}{8} + \frac{1}{12} = \frac{1}{x}$

$6x + 4x = 48$

$10x = 48$

$x = 4.8$

$\therefore$ It will take 4.8 hours.

11. $\frac{1}{3} + \frac{1}{2} = \frac{1}{x}$

$2x + 3x = 6$

$5x = 6$

$x = \frac{6}{5}$

12. $\frac{2}{3}x - 3 = \frac{5}{6}x$

$4x - 18 = 5x$

$-x = 18$

$x = 18$

13. 2 : 3 is 5 parts

$\frac{3}{5} \times 12\,000 = 7\,200$

$\therefore$ The other portion is 4 800.

14. 5 : 7 is 12 parts

$\frac{5}{12} \times 60 = 25$ cm

$\therefore$ The other part will be 35 cm.

15. $x - \frac{x}{2} - \frac{x}{3} - \frac{x}{10} = 200$

$30x - 15x - 10x - 3x = 6\,000$

$2x = 6\,000$

$x = 3\,000$

$\therefore$ She had ₦ 3 000.

16. $x - \frac{x}{2} - \frac{x}{4} - \frac{x}{6} = 3$

$12x - 6x - 3x - 2x = 36$

$x = 36$

$\therefore$ She had 36 beads.

Topic 12: Simultaneous linear equations

Teaching notes and guidelines

Introduction

Simultaneous equations are introduced in this section by revising straight-line graphs. This is key foundational knowledge to solve for two unknown variables graphically. Graphical solutions of simultaneous equations is the focus of the remainder of the topic. First, graphs are drawn by using a table of values. The point of intersection is found for the two equations by accurately drawing the graphs to scale on grid paper.

Common difficulties

At first, students find it difficult to conceptualise what is meant by solving simultaneous equations. Explain that when two equations are paired, and x and y are solved for, the two equations are called simultaneous equations. Explain that the variables are solved for at the same time.

It is important for students to grasp that the graphs of two equations are both straight lines. Explain that where the lines intersect is the solution to the simultaneous equations.

Preparation

Have graph paper available for students to plot their linear functions. As a visual aid, a chart setting out to solve simultaneous equations graphically will be helpful.

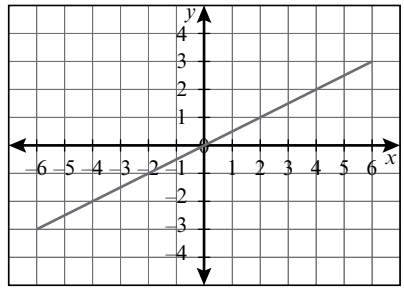
Introduce the topic to students by showing a straight-line equation and revising the basic concepts of drawing straight-line graphs. Then go on to draw two linear equations on the same axes and discuss the point of intersection. Explain simultaneous equations, and how the point of intersection provides the solution for both x and y.

Answers to exercises

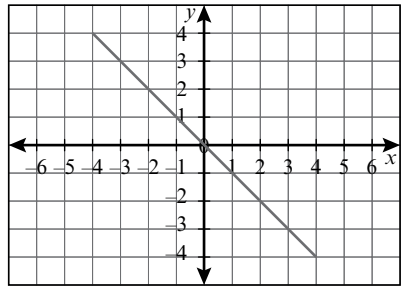
Exercise 1

(SB page 106)

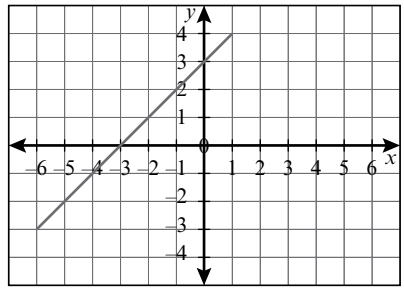
1. $y = \frac{1}{2}x$



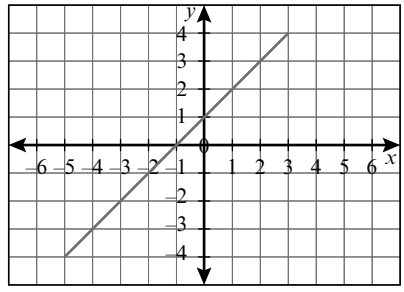
2. $y = -x$



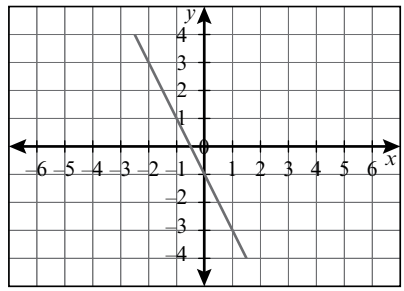
3. $y = x + 3$



4. $y = x + 1$



5. $y = -2x - 1$



Exercise 2

(SB page 107)

1. a) $x + y = 6$

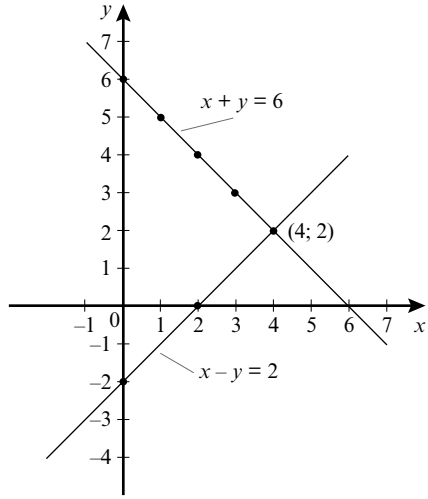
x	–1	0	1	2	3
y	7	6	5	4	3

Test: $4 + 2 = 6$

b) $x - y = 2$

x	–1	0	1	2	5
y	–3	–2	–1	0	3

Test: $4 - 2 = 2$



Solution = (4; 2)

2. **a)** $x + 2y = 7$

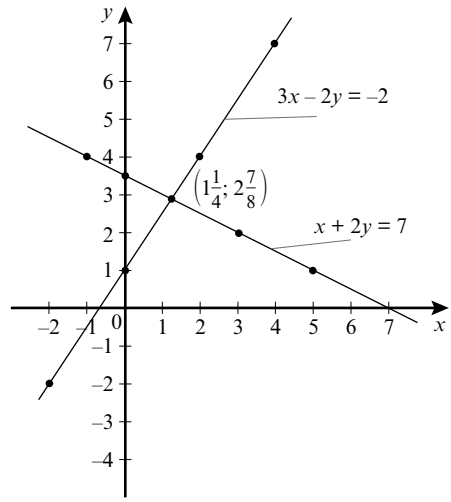
x	–1	1	3	5
y	4	3	2	1

Test: $\frac{5}{4} + (2)(\frac{23}{8}) = 7$

b) $3x - 2y = -2$

x	–2	0	2	4
y	–2	1	4	7

Test: $(3)(\frac{5}{4}) - (2)(\frac{23}{8}) = -2$



Solution = $(1\frac{1}{4}; 2\frac{7}{8})$

3. **a)** $2x + 3y = 5$

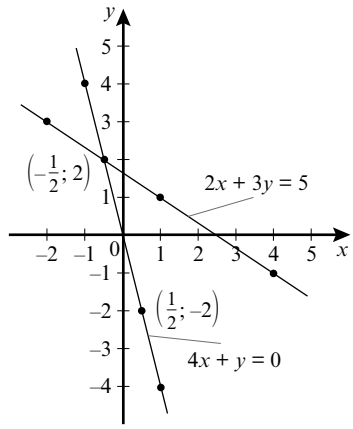
x	–2	1	4
y	3	1	–1

Test: $(2)(-\frac{1}{2}) + (3)(2) = 5$

b) $4x + y = 0$

x	–1	$\frac{1}{2}$	1
y	4	–2	–4

Test: $(4)\left(-\frac{1}{2}\right) + 2 = 0$



Solution = $\left(-\frac{1}{2}; 2\right)$

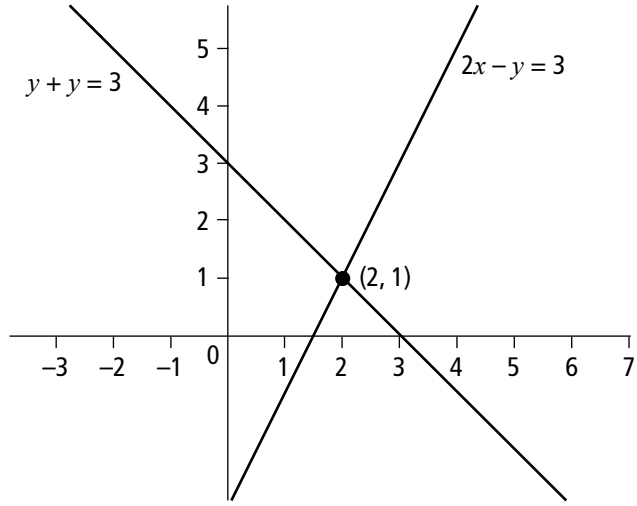
4. a) $2x - y = 3$

x	–1	0	1	2
y	–5	–3	2	1

b) $y + x = 3$

x	–1	0	1	2
y	4	3	2	1

Point of intersection is (2, 1)



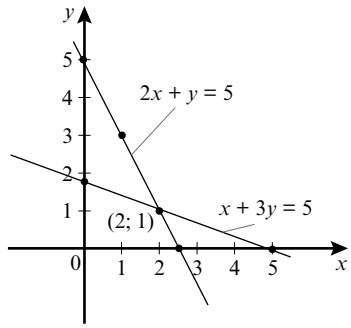
Exercise 3

(SB page 109)

1. Solution = (2; 1)

Test: $2(2) + 1 = 5$

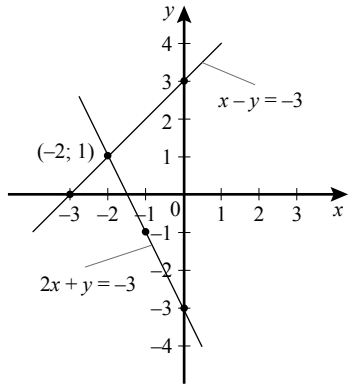
$2 + 3(1) = 5$



2. Solution = (–2; 1)

Test: $–2 – 1 = –3$

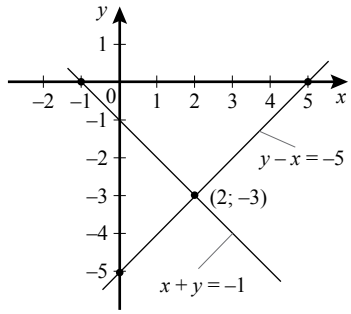
$(2)(–2) + (1) = –3$



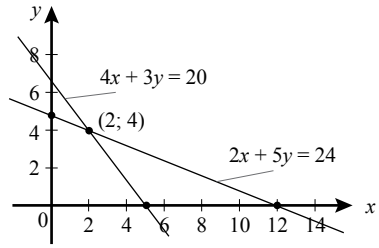
3. Solution = (2; –3)

Test: $–3 – 2 = –5$

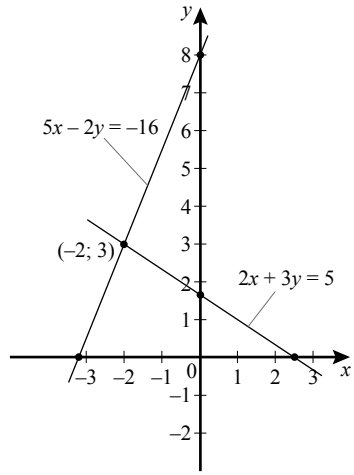
$2 + (–3) = –1$



4. Solution = (2; 4)
Test: (2)(2) + (5)(4) = 24
(4)(2) + (3)(4) = 20



5. Solution = (–2; 3)
Test: (2)(–2) + 3(3) = 5
(5)(–2) – (2)(3) = –16



TERM 1

Revision exercises

(SB page 111)

Binary number system

1. 01100010 **2.** 011001 **3.** 010010

4.
a) 011101 **b)** 01100 **c)** 01100000
d) 010110110 **e)** 011001 **f)** 011100
g) 01000010 **h)** 011110110 **i)** 11000
j) 1011111 **k)** 100111011 **l)** 101100101

5.
a) 29 **b)** 12 **c)** 96
d) 182 **e)** 25 **f)** 28
g) 66 **h)** 246 **i)** 24
j) 95 **k)** 315 **l)** 357

6.
a) 01001110 **b)** 010000101 **c)** 0111110100
d) 011011110 **e)** 010111110011

7.
a) 20, 18, 15, 21, 2, 12, 5
b) trouble

Translate word problems to numerical expressions and equations

1.
a) $(4 \times 8) - 5 = 27$ students

b) $8(1 + 5) + 1 + 1 + 8 = 58$ family members

c) $34 \times 5 \times 4 = 680$ km

d) $[2(5 \times 3) \times 50] + [2(8 \times 3) \times 50]$
$= 1\,500 + 2\,400 =$ ₦ 3 900

e) $(871 + 925 + 52 + 186) - (312 + 16)$
$=$ ₦ 1 706

f) $\frac{159}{3} - 23 = 30$ stamps

2. Let Tutu's age be x:
$x + 3 = 13$
$\therefore x = 10$

3. Let Brazil's energy use be x:
$4x = 12\,000$
$x = 3\,000$ Kilowatt hours

4. $x + 78° = 180°$
$x = 102°$

5. 10 m = 10 000 cm
Let time be x
$x = \frac{10\,000}{40}$
$x = 250$ minutes

6. **a)** $x + 2$
b) **i)** $p \times 25$ **ii)** $25p + 150q$
iii) $25p + 150q + 50r$

7. **a)** 6 **b)** 9

8. **a)** $w - 15$ **b)** girl: 72 kg
boy: 57 kg

9. **a)** $m + 5$ **b)** boy: 40 kg
girl: 45 kg

Word problems with fractions

1. $5\frac{3}{4}, 5.79, 5\frac{4}{5}, 5\frac{7}{8}, 5.9$
The median is $5\frac{4}{5}$

2. $w = 4\frac{5}{7} \div 3\frac{2}{3}$
$= \frac{9}{7}$ m

3. $\frac{77}{12}$ cm

4. –12

5. $1 - \frac{x}{y}$

6. 12

7. $\frac{1}{6}x + 440 = \frac{5}{8}x$
$8x + 21\,220 = 30x$
$21\,120 = 22x$
$x = 960$ in a full tank
$\therefore$ 480 in half a tank

8. $\frac{4}{5} \times 10.5 = 8.4$ kg
$\therefore$ combined weight $= 10.5 + 8.4$
$= 18.9$ kg

Simplify expressions with brackets and fractions

1. **a)** $\frac{5x}{6}$ **b)** $\frac{-5}{14}$ m **c)** $\frac{13m + 5}{14}$ **d)** $13t$

e) $\frac{m-2}{12}$ **f)** $\frac{-9x-9}{2}$ **g)** $\frac{4x + 4}{3}$

2. $\frac{x}{2} - \frac{x-2}{5}$

$= \frac{5x-2(x-2)}{10}$

$= \frac{5x-2+4}{10}$

$= \frac{3x+4}{10}$

Rational and non-rational numbers

1. **a)** 4 **b)** $\frac{0}{4}$

c) $0.\dot{2}$ **d)** $\frac{2}{3}$

e) $\frac{3}{0}$ **f)** Irrational number

2. **a)** $\frac{4}{5}$ **b)** $\frac{19}{20}$ **c)** $\frac{221}{250}$

3. **a)** $x = 0.555\ldots\ldots$

$10x = 5.555\ldots$

$9x = 5$

$x = \frac{5}{9}$

b) $x = 0.8484$

$100x = 84.8484\ldots$

$99x = 84$

$x = \frac{89}{99}$

c) $x = 0.363333$

$100x = 36.3333\ldots..$

$1\,000x = 363.333\ldots.$

$900x = 327$

$x = \frac{327}{900}$

4. **a)** 9.43 **b)** 7.4 **c)** 4.8

5. Students' own work

Factorising

1. **a)** $12x - 15$ **b)** $20x^2 + 3x - 2$

c) $4x^2 - 12x + 9$ **d)** $9x^2 - 4$

e) $6a^2 + 33a + 42$ **f)** $98a^2 - 8b^2$

g) $4m^2 + 4mn + n^2$ **h)** $4x^3 + 10x^2 - 14x + 4$

2. **a)** $x^2 - 12x + 36$ (Sign of last term)

b) $x^2 + 3x - 2$ (Adding like terms)

c) $x^2 - 9x + 20$ (Incorrect multiplication)

d) $x^2 + x - 6$ (Adding like terms)

3. **a)** $49x$ **b)** $4ab$ **c)** 4

d) $6a$ **e)** $7y$ **f)** $2mn$

g) $4x$ **h)** $18a^3b^2$ **j)** $15m$
j) xy **k)** a^3b **l)** b^2

4. **a)** $6(2k + 1)$ **b)** $2(2k + 2)$ **c)** $5(m + 3)$
d) $4(3p - 1)$ **e)** $2(4k + 7)$ **f)** $2(n - 5)$

5. **1.** C **2.** D **3.** E
4. B **5.** A **6.** F

6. **a)** $(x + 4)(x + 3)$ **b)** $(x - 7)(x + 3)$

7. **a)** $(m + 6)(m - 5)$ **b)** $(y - 6)(y - 4)$
c) $(a - 9)(a + 8)$ **d)** $(x - 18)(x + 3)$

8. **a)** $(x + 4)(x + 1)$ **b)** $(m - 5)(m + 3)$
c) $(x - 3)(x + 8)$ **d)** $(x + 1)(x + 2)$

9. **a)** $3ab(3b - 1)$ **b)** $b^2(b^2 - ab + c)$
c) $4x^2y^2(y - 2x)$ **d)** $(2x - 3y)(2x + 3y)$
e) $(m - 15)(m - 2)$ **f)** $(3x - y)(y + 1)$
g) $(p - 9)(p + 2)$ **h)** $4(2x - 3)$
i) $25(2a^2 - b^2)$ **j)** $-3b(a + 4)(a + 4)$
k) $(a + 7)(a - 2)$ **l)** $(a + b)(a - b - 1)$
m) $2(x - 7)(x + 3)$ **n)** $(7a - 8g)(7a + 8g)$
o) $(x + 5)(x + 5)$

10. **a)** D **b)** E **c)** A **d)** B
e) F **f)** G **g)** C

11. **a)** 4 can still be taken out as a common factor
b) $12x^2 - 4x$
$= 4x(3x - 1)$

Word problems involving factorisation

1. **a)** Sum must be –12.
Product must be 20.
b) $x^2 - 12x + 20$
$= (x - 10)(x - 2)$

2. $x^2 + 6x + 5 = (x + 5)(x + 1)$

3. $A = 2\pi r(r + h)$

4. Optional

5. **a)** $A = b(\frac{1}{2}b - 1)$ **b)** $A = 3(\frac{1}{2}(3) - 1)$
$= \frac{3}{2}$

Change the subject of the formula

1. $S = \frac{2\sqrt{x}}{3R}$ **2.** No solution **3.** $x = \frac{1}{8k} + \frac{7}{6}p$

4. $x = \sqrt{\frac{7kh^3}{4gp}}$ **5.** $F = \frac{9}{5}\left(c + \frac{160}{9}\right)$ **6.** $b = \frac{a}{a-1} - 1$

7. $d = \frac{5n-2a}{n-1}$ **8.** $m = \frac{16f^2(m-w)}{n}$ **9.** $r = \sqrt{\frac{3v}{4\pi}}$

10. $h = \frac{2A}{a-b}$

Simple equations involving fractions

1. **a)** $x = \frac{6}{5}$

b) $x = -3$

c) $x = -3$

d) $x = -3$

e) $x = 25$

f) $5(16 - x)$
$= 80x - 40$
$= 8(10x - 5)$
$= 80x - 40$
$\therefore x \in \mathbb{R}$

g) $x = \frac{9}{4}$

h) $x = 3$

i) $x = 5$

j) $x = -\frac{7}{2}$

k) $x = \frac{2}{3}$

l) $x = 4$

m) $x = 5$

n) $x = 13$

Word problems leading to fractional equations

1. $\frac{2}{3}x + \frac{1}{2}x = 35$
$4x + 3x = 210$
$7x = 210$
$x = 30$

2. $\frac{3}{4}x - \frac{1}{3}x = 15$
$9x - 4x = 180$
$5x = 180$
$x = 36$

3. $\frac{2}{5}x - \frac{1}{4}x = 3$
$8x - 5x = 60$
$3x = 60$
$x = 20$

4. $\frac{5}{6}x + \frac{1}{5}x = 31$
$25x + 6x = 930$
$31x = 930$
$x = 30$

5. $\frac{1}{3}x + \frac{1}{2}(x + 1) = 13$
$2x + 3(x + 1) = 78$
$2x + 3x + 3 = 78$
$5x = 75$
$x = 15$

6. $\frac{2}{3}(2x + 30) = x + 30$
$4x + 60 = 3x + 90$
$x = 30$

7.

	Train	Car
Speed	$x + 50$	x
Distance	190	130
Time	190	190
	$x + 50$	$x = 50$

$$\frac{190}{x+50} = \frac{130}{x+50}$$
$$190x = 130x + 6\,500$$
$$60x = 6\,500$$
$$x = 108.33 \text{ km/h}$$

Therefore, the train travels at 158.33 km/h.

Simultaneous equations

1. **a)** $x = -3; y = 4$ **b)** $x = 3.5; y = -1$
c) $a = 2; b = 1$ **d)** $p = 1.2; k = 2.1$
e) $x = 1; y = 0$ **f)** $x = 0.2; y = 2.2$
g) $x = 4; y = 3$

2. $5x + 3 = 3x - 1$
$2x + 3 = -1$
$2x = -4$ (incorrect subtraction)
$x = -2$
$\therefore y = 3(-2) + 1$
$y = -5$

3. **a)** D **b)** C **c)** A **d)** E **e)** B

Word problems leading to simultaneous equations

1. $x + y = 12$
$x - y = 4$
$\therefore x = 4 + y$
$4 + 2y = 12$
$2y = 8$
$y = 4$
$\therefore x = 8$

2. $x - y = 3$
$x + y = 13$
$\therefore x = 13 - y$
$13 - y - y = 3$
$-2y = -10$
$y = 5$
$\therefore x = 8$

3. The digits are 3 and 4.

4. $8x + 8y = 240$
$4x + y = 54$
$y = 54 - 4x$
$8x + 8(54 - 4x) = 240$
$8x + 432 - 32x = 240$
$-24x = -192$
$x = 8$
$y = 22$
$\therefore$ 8 students in a van and 22 in a bus.

5. $3x + 14y = 2\,030$
$11x + 11y = 2\,200$
$x + y = 200$
$3(200 - y) + 14y = 2\,030$
$600 - 3y + 14y = 2\,030$
$11y = 1\,430$
$y =$ ₦ 130
$\therefore x =$ ₦ 70.

6. $2x + y = 75$
$3x + 4y = 135$
$y = 75 - 2x$
$3x + 4(75 - 2x) = 135$
$3x + 300 - 8x = 135$
$-5x = -165$
$x =$ ₦ 33
$\therefore$ A pencil costs ₦ 33 and an eraser costs ₦ 9.

Everyday statistics

1. **a)** 95 **b)** 23 **c)** 37 **d)** 41

2. **a)** 12.5 **b)** 12 **c)** 8

3. Students' own work

4. Students' own work

5. Students' own work

6. **a)** $x = 126°$ **b)** 50 children **c)** 40%

7. **a)** Day 4 **b)** Day 2 **c)** It increased
d) 40 minutes **e)** 60 minutes **f)** On Day 3
g) 20 minutes **h)** 57 minutes

Topic 1: Simultaneous linear equations

Teaching notes and guidelines

Introduction

This section continues from the previous term's work on simultaneous equations. The graphical method of solving simultaneous equations has been covered, with the elimination and substitution methods following in this section. Unit 1 deals with elimination and explains how to eliminate one of the unknowns in the equation. In Unit 2, the process of substitution is explained as changing the subject of one of the two equations in order to substitute it in the second one. The section concludes with more word problems that lead to simultaneous equations.

Common difficulties

Common difficulties experienced in this topic include a failure to recognise which variable to eliminate, and how to go about performing the calculation. Encourage students to write the equations in standard form, and to consider how they can multiply to make the coefficients the same. Ensure that they understand that to eliminate a variable, they need to add or subtract. Add equations of which the signs of the coefficients are different, and subtract if the signs of the coefficients are the same.

Sometimes when substitution is required, the student can overcomplicate the equations by choosing the wrong variable to isolate. Make sure they understand that the variable with a coefficient of 1 is the simplest to isolate.

Preparation

Continue using the same chart that was prepared for the lessons on graphical solutions of simultaneous equations.

Remind students of the previous section on solving simultaneous equations using the graphical method. Explain that two other methods are available, but that the principle remains

the same. Simultaneous equations ultimately involve finding the intersection point of two graphs, but elimination and substitution offers ways of doing it without graphs.

Answers to exercises

Exercise 1

(SB page 123)

1. $2x + y = 5$
$2x - y = 3$
$y = 2$
$\therefore y = 1$
$2x + 1 = 5$
$\therefore x = 2$

2. $3x - y = 7$
$3x + y = 11$
$-2y = -4$
$\therefore y = 2$
$3x - 2 = 7$
$\therefore x = 3$

3. $3x - y = 9$
$4x - y = -14$
$-x = 23$
$\therefore x = -23$
$3(-23) - y = 9$
$\therefore y = -78$

4. $5x + 3y = 23$; $10x + 6y = 46$
$2x + 4y = 12$; $10x + 20y = 60$
$-14y = -14$
$\therefore y = 1$
$5x + 3(1) = 23$
$\therefore x = 4$

5. $x - 2y = -4$; $3x - 6y = -12$
$3x + y = 9$; $3x + y = 9$
$-7y = -21$
$\therefore y = 3$
$x - 2(3) = -4$
$\therefore x = 2$

6. $2x + y = 8$; $-2x - y = -8$
$5x - y = 6$; $5x - y = 6$
$-7x = -14$
$\therefore x = 2$
$2(2) + y = 8$
$\therefore y = 4$

7. $3a + 2b = 13$; $6a + 4b = 26$
$2a + 3b = 12$; $6a + 9b = 36$
$-5b = -10$
$\therefore b = 2$
$3a + 2(2) = 13$
$\therefore a = 3$

8. $4a + 3b = 24$; $12a + 9b = 72$
$3a + 4b = 25$; $12a + 16b = 100$
$-7b = -28$
$\therefore b = 4$

$4a + 3(4) = 24$
$\therefore a = 3$

9. $c = 1$; $d = 1$
10. $p = 2$; $q = 2$
11. $m = 1$; $n = 1$
12. $e = 2$; $f = 2$
13. No solution
14. No solution
15. $r = -2$; $s = 11$
16. $c = -2$; $d = 3$
17. $x = 3$; $y =$ r
18. $a = \frac{3}{4}$; $b = \frac{5}{8}$
19. $e = 2$; $d = -2$
20. $h = 2$; $k = \frac{3}{2}$

21. $y = ax + b$: $6 = a + b$
$10 = 2a + b$
$\therefore 12 = 2a + 2b$
$10 = 2a + b$
$2 = b$
$\therefore b = 2$
$6 = a + 2$
$\therefore a = 4$

22. $y = ax^2 + bx$: $2 = 4a + 2b$
$-1 = a + b$
$\therefore 2 = 4a + 2b$
$-4 = 4a + 4b$
$6 = -2b$
$\therefore b = -3$
$2 = 4a + (2)(-3)$
$\therefore a = 2$

23. $\frac{a+1}{b+1} = 2$; $a - 2b = 1$
$\frac{2a+1}{2b+1} = \frac{1}{3}$; $6a - 2b = -2$
$6a - 2b = -2$
$a - 2b = 1$
$5a = -3$
$\therefore a = \frac{-3}{5}$
$\frac{-3}{5} - 2b = 1$
$\therefore b = \frac{-4}{5}$

24. $2p - q = 5$; $-8p + 4q = -20$

$\frac{p}{4} + \frac{y}{3} = 2$; $\quad 3p + 4q = 24$

$-11p = -44$

$\therefore p = 4$

$2(4) - q = 5$

$\therefore q = 3$

Exercise 2

(SB page 125)

1. $x + y = 10$; $\quad y = 10 - x$

$x - y = 8$; $\quad x - (10 - x) = 8$

$\therefore x = 9$

$y = 10 - 9$

$\therefore y = 1$

2. $2x + y = 5$; $\quad y = 5 - 2x$

$3x - 2y = 4$; $\quad 3x - 2(5 - 2x) = 4$

$\therefore x = 2$

$y = 5 - 2(2)$

$\therefore y = 1$

3. $7x + 2y = 19$; $\quad y = x - 4$

$x - y = 4$; $\quad 7x + 2(x - 4) = 19$

$\therefore x = 3$

$y = 3 - 4$

$\therefore y = -1$

4. $4a + b = 14$; $\quad b = 14 - 4a$

$a + 5b = 13$; $a + 5(14 - 4a) = 13$

$\therefore a = 3$

$b = 14 - 4(3)$

$\therefore b = 2$

5. $3a - b = 5$; $\quad b = 3a - 5$

$2a + 5b = 7$; $2a + 5(3a - 5) = 7$

$\therefore a = \frac{32}{17} = 1.88$

$b = (3)(1.88) - 5$

$\therefore b = 0.64$

6. $x + y = 4$; $y = 4 - x$

$2x + y = 5$; $2x + (4 - x) = 5$

$\therefore x = 1$

$y = 4 - 1$

$\therefore y = 3$

7. $p + 4q = 6$; $p = 6 - 4q$

$8q - p = 3$; $8q - (6 - 4q) = 3$

$\therefore q = \frac{3}{4}$

$p = 6 - (4)\frac{3}{4}$

$\therefore p = 3$

8. $p + 5q = 13$; $p = 13 - 5q$

$2p + 3q = 13$; $2(13 - 5q) + 3q = 13$

$\therefore q = 1.9$

$p = 13 - 5(1.9)$

$\therefore p = 3.5$

9. $2x - y = 5$; $y = 2x - 5$

$\frac{x}{4} + \frac{y}{3} = 2$; $\frac{x}{4} + \frac{2x-5}{3} = 2$

$\therefore x = 4$

$y = (2)(4) - 5$

$\therefore y = 3$

10. $5x - y = 11$; $y = 5x - 11$

$3x + 4y = -5$; $3x + 4(5x - 11) = -5$

$\therefore x = 1.7$

$y = 5(1.7) - 11$

$\therefore y = -2.5$

11. $x = -2$; $t = -1$

12. $m = 1$; $n = \frac{1}{2}$

13. $a = -1$; $b = 3$

14. $a = 5$; $b = -2$

15. $x = -5$; $y = -6$

16. $x = \frac{29}{19}$; $y = -\frac{17}{19}$

17. $m = \frac{4}{5}$; $n = \frac{3}{5}$

18. $x = -1$; $y = -1$

19. $x = 3$; $y = 2$

20. $e = -1$; $b = \frac{1}{2}$

21. $5 = 2m + c$; $c = 5 - 2m$

$13 = 4m + c$; $13 = 4m + (5 - 2m)$

$\therefore m = 4$

$c = 5 - (2)(4)$

$\therefore c = -3$

22. $7 = a + b$; $a = 7 - b$

$13 = 4a + b$; $13 = 4(7 - b) + b$

$\therefore b = -15$

$a = 7 - (-15)$

$\therefore a = 22$

Exercise 3

(SB page 128)

1. $t = 2$ hr

2. large = 18, small = 2

3. $w = 28$, $l = 45$, $d = 53$

4. –34

5. 30° and 60°

6. $x = 1.5$; $y = \frac{7}{2}$

7. $l = 16$, $b = 8$

8. $x = 11$, $y = 9$

9. 8 years old

10. 7 and 35

11. $x = 6$, $y = 36$

12. 54 male and 31 female

13. $\frac{8}{3}$ km

14. $x = 2.28$ km, $y = 64.3$ km

15. $x =$ ₦459, $y =$ ₦240

16. –14

17. 6 and 11

18. $x = 3$, $y = 3$ Area = 150 square units

19. $p = 9$, $q = 4$ Perimeter = 54 m Area = 140.3 m^2

20. 29

Topic 2: Direct proportion, inverse proportion and reciprocals

Teaching notes and guidelines

Introduction

The topic starts by introducing direct proportion definitions and explanations. The exercise that follows guides students through becoming familiar with the relationship $y = kx$. The unitary method is explained as a way to calculate a proportion of a whole quantity by first calculating the value of one part of the whole. The examples and exercises provide various contexts in which the unitary method can be applied.

The topic continues to graphs of direct proportions and the examples and exercises explain the reason why the graph is linear. Again, different contexts are explored to familiarise the students with the concept.

The next section on inverse proportion follows a similar format as the previous one, whereby the relationship $y = \frac{k}{x}$ and the constant of proportionality is introduced. The context of work done by different numbers of students, and the rate at which the work is done, is used as a context to explore inverse proportion. Graphs of inverse proportion are covered next. In the examples, inverse proportion between speed and time is discussed, but then it is shown how speed and $\frac{1}{\text{time}}$ will have a linear graph.

The topic concludes with reciprocals and shows the student how reciprocals can be determined by using a table or a calculator.

Common difficulties

Students often confuse the concepts of direct and inverse proportion and in which situations these occur. Encourage students to use the constant of proportionality to check for the two types of proportion. Problems that involve work rates are also challenging. Setting out one's work as shown on page 128 of the *Student's Book* can be useful to students.

Preparation

Visual aids that show the graphs, formulae and characteristics of the two types of proportion will be helpful. Keep enlarged versions of reciprocal tables available to demonstrate to students how to use them.

Present to students a problem from everyday life that involves first direct proportion and then inverse proportion. Give students a chance to see the relationships between the variables and then go on to provide more formal definitions.

Answers to exercises

Exercise 1

(SB page 132)

1. 3.5 bags

2. 12 wheelbarrows of sand

3. 3 kg flour with 10.5 eggs

4. **a)** ₦ 6 250 **b)** ₦ 62 500 **c)** ₦ 137 500

5. **a)** 61 km **b)** 244 km **c)** 61 km

6. **Pay & Take:** $\frac{320}{25}$ = ₦ 12.8/apple

Shop More: $\frac{256}{16}$ = ₦ 16/apple

∴ **Pay & Take** offers the better deal.

7. **Jimo's** = $\frac{45}{125}$ = ₦ 0.36

Ayoola = $\frac{160}{500}$ = ₦ 0.32

8. One pencil = $\frac{195}{6}$ = ₦ 32.50

11 pencils = 11 × 32.5 = ₦ 357.50

9. **a)** One km = $\frac{250}{320}$ = ₦ 0.78

140 × 0.78 = ₦ 109.2

b) $\frac{950}{0.78}$ = ₦ 1 217.95

10. $\frac{415}{12}$ = ₦ 34.58

20 × 34.58 = ₦ 691.6

Exercise 2

(SB page 133)

1. **a)** Direct **b)** Students' own work

2. **a)** As duration increases, cost increases.
b) ± ₦ 110
c) minutes × 25

3. **a)** $x = 960$, $y = 500$
b) The further travelled, the higher the cost.
c) Students' own work

4. **a)** Direct **b)** $k = 24$

5. Students' own work

6. **a)**

Days worked	1	2	3	4	5
Amount	1 000	2 000	3 000	4 000	5 000

b) He earns ₦ 1 000 per day. **c)** ₦ 8 000

7. **a)** 280 000; 600 000; 840 000; 1 000 000
b) Students' own work
c) Students' own work

Exercise 3

(SB page 136)

1. **a)** Directly **b)** Neither **c)** Inversely

Exercise 4

(SB page 137)

1. **a)** 15 days **b)** 1 bag

2. **a)** 75 days **b)** 7.5 days **c)** 3.75 days

3. **a)** 6 **b)** 6 **c)** 6

4. **a)** 16 days **b)** 1 day 8 hours
c) $\frac{16}{x}$ days **d)** 3 cows

5. 2.92 hours

6. **a)** It will take 12 days
b) 120 days
c) 15 days
d) 6 days

7. **a)** 6 hours **b)** 1 hour

8. 9 workers

9. **a)** 15 **b)** 11 **c)** 3 **d)** $\frac{45}{p}$

Exercise 5

(SB page 140)

1. **a)** Inverse proportion
b) Students' own work

2. **a)** 2, 12, 4.5
b) Students' own work
c) 14.4 m

3. **a)** Inverse
b) 2 days
c) 5 workers

4. **a)** The higher the speed, the shorter the time.
b) Students' own work
c) 20 m
d) 0.005, 0.01, 0.02, 0.04, 0.05
e) Students' own work

5. **a)** The more children, the fewer sweets.
b) Students' own work
c) No. The last sweet is given to the 12th child.

6. **a)** The more passengers, the lower the cost per person.
b) 15, 114.3
c) Students' own work

Exercise 6

(SB page 144)

1. **a)** 8 **b)** 1.39
c) $\frac{1}{37}$ **d)** $\frac{1}{6}$
e) $\frac{5}{2}$ **f)** $\frac{20}{3}$
g) 1.96

2. **a)** $\frac{1}{4}$ **b)** $\frac{1}{25}$
c) $\frac{1}{200}$ **d)** 5
e) 2 **f)** $\frac{1}{6\,250}$

g) 4 **h)** 0.71

i) 0.56 **j)** x

3. Students' own work

Exercise 7

(SB page 145)

1. a) $k = 6\frac{2}{3}$

Area to be carpeted (m^2)	3	5	6	8	9	18
Cost of carpeting (₦)	20	33.33	40	53.33	60	120

b) $k = 5.3$

Distance travelled (km)	100	200	150	169
Cost of petrol (₦)	530	1060	795	895.7

c) $k = 43$

Number of books	10	20	25	60
Cost of books (₦)	430	860	1 075	2 580

d) $k = 100$

Number of cokes	6	18	24	30
Cost of cokes (₦)	600	1 800	2 400	3 000

e) $k = 0.625$

a	8	40	12
b	5	25	7.5

2. a) $z = kx$ **b)** $z = 45$ **c)** $x = 25$

3.

r	1	2	4	$1\frac{1}{2}$
A	4	32	256	$\frac{27}{2}$

4. $y = \frac{243}{4}$

5. a) $V = 42$ **b)** $t = 4$

6.

A	4	9	25	$2\frac{1}{4}$
r	6	9	15	$4\frac{1}{2}$

7. $y = 21$

8. a) 2048 joules **b)** 1 cm

Exercise 8

page 147

1.

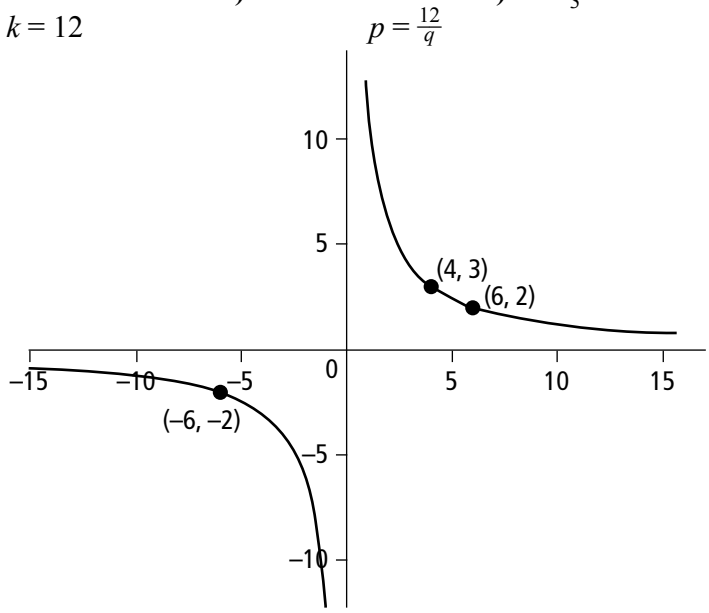
p	8	4	16
q	5	10	2.5

2. $a = 8 \qquad b = 2$

3. **a)** $mn = 10$ **b)** $m = 1$ **c)** $n = \frac{5}{3}$

4. **a)** $k = 12$

b)



5. $y = \frac{5}{4}$ **6.** $S = 2$

7. **a)** $T = 6$ **b)** $x = 16$

8.

x	1	4	256	36
r	12	6	$\frac{3}{4}$	2

Exercise 9

page 149

1. **a)** $H = \frac{52G^2}{625\sqrt{U}}$ **b)** $H = 0.45$ **c)** $G = 104$

2. **a)** $\mathrm{J} = \frac{\mathrm{kB}^2}{\mathrm{V}}$ **b)** $\mathrm{k} = 1\,000$ **c)** $\mathrm{B} = 32$

3. **a)** $Y \propto \frac{G}{\sqrt{I}}$ **b)** $Y = 17.82$

c) $G = 22.73$ **d)** 0.98

4. **a)** $F \propto \frac{H^2}{\sqrt{C}}$ **b)** $F = 1711.63$ **c)** $C = 3751.56$

Topic 3: Simple and compound interest

Teaching notes and guidelines

Introduction

In this topic, the students are introduced to simple and compound interest. The topic starts by illustrating through an example and graphs the difference between the two types of interest. Manual calculations for both investments are performed before moving on to the formulae for simple interest first and then compound interest.

A detailed explanation for the formula for compound interest is provided before the examples show how to apply the formula. This is followed by a discussion of depreciation. The topic concludes by looking at inflation as an application of compound interest to price increases on goods.

Common difficulties

Often students learn the formulae without knowing how they are derived. Make sure students understand the formulae as this will minimise mistakes when they perform calculations. When it comes to simple and compound interest, there are often some misconceptions regarding interest earned and the final value of the investment or loan. Students must familiarise themselves with these calculations and know in which contexts to apply them. Accurate use of calculators also needs to be encouraged.

Preparation

Prepare visual aids that set out the formulae for compound and simple interest, such as posters, notes and charts. Real-life examples of bank brochures or advertisements in the newspaper for loans and investments are also good resources to have.

A good starting point for this topic is to describe scenarios where money is invested or borrowed. Ask students what they know about investing and borrowing money and if any of them

know about interest rates. This can lead to a short discussion of the basic principles of interest. Remember that most of the students will have had little or no experience with banking, so explain the basics well. Continue by working through the example at the start of the topic.

Answers to exercises

Exercise 1

(SB page 152)

1. a)

S1	Year	Initial	Interest	Value at end
	1	6 000	0.09 × 6 000 = 540	6 000 + 540 = 6 540
	2	6 000	0.09 × 6 000 = 540	6 540 + 540 = 7 080
	3	6 000	0.09 × 6 000 = 540	7 080 + 540 = 7 620
C1	1	6 000	0.09 × 6 000 = 540	6 000 + 540 = 6 540
	2	6 540	0.09 × 6 540 = 588.60	6 540 + 588.6 = 7 128.60
	3	7 128.60	0.09 × 7 128.6 = 641.57	7 128.6 + 641.57 = 7 770.17

b) Year 1: No difference
Year 2: 7 128.6 – 7 080 = ₦ 48.60
Year 3: 7 770.17 – 7 620 = ₦ 150.17

c) Compound

d) Students' own work

e) $n \approx 8$

f) 9 231 – 8 700
= ₦ 531.74

2.

1	320 000	0.12 × 320 000 = 38 400	320 000 + 38 400 = ₦ 358 400
2	358 400	0.12 × 358 400 = 43 008	358 400 + 43 008 = ₦ 401 408
3	401 408	0.12 × 401 408 = 48 168.96	401 408 + 48 168.96 = ₦ 449 576.90

3. a) SI after 5 years = ₦ 35 000
CI after 5 years = ₦ 6 733.20

b) SI = ₦ 10 000
CI = ₦ 11 733.20

4. $SI = \frac{PRT}{100}$
$= \frac{20\,000.10.1}{100}$
= ₦ 2 000

5. CI = ₦ 22 000
$\therefore$ ₦ 2 000

6. **a)** SI **b)** CI

Exercise 2

(SB page 154)

1. $SI = \frac{(65\,000)(11.5)(4.5)}{100}$
$= ₦\,33\,637.5$

2. $SI = \frac{(10\,000)(12)(3)}{100}$
$= ₦\,3\,600$
$10\,000 + 3\,600 = ₦\,13\,600$

3. $SI = \frac{(25\,000)(12)(3)}{100}$
$= ₦\,9\,000$

4. $SI = \frac{(45\,000)(6)(7)}{100}$
$= ₦\,18\,900$

5. $SI = \frac{(60\,000)(7.5)(2)}{100}$
$= 9\,000$
$\therefore$ ₦ 69 000

6. **a)** ₦ 86 400
b) ₦ 962 500

7. ₦ 20 320

8. $880 = \frac{(160\,000)(12.8)(T)}{100}$
$T = 0.0429$
$\approx \frac{1}{2}$ month

9. $14\,000 = \frac{(190\,000)(i)(5)}{100}$
$i = 1.47\%$

10. $21\,000 = \frac{(90\,000)(9.5)(T)}{100}$
$T = 2.456$
$\approx$ 2 years 5 months

11. $40\,000 = 15\,000\,(1 + 0.82n)$
$n = 20.325$

$n \approx 20$ years 4 months

12. $2\,900\,000 = 80\,000(1 + i(21))$
$i = 12.5\%$

13. a) ₦ 4 275 **b)** ₦ 13 775

14. 5.48%

15. ₦ 3 791.67

Exercise 3

(SB page 158)

1. ₦ 1 815 835.932

2. ₦ 631 233.48

3. ₦ 63 559.375

4. ₦ 341 967.53

5. ₦ 197 270.89

6. ₦ 1 348 730.88

7. a) ₦ 109 528.78 **b)** ₦ 51 801.16 **c)** ₦ 202 310.01

8. ₦ 74 017.9445 (People's Bank)
₦ 64 640 (Bank for the Future)
∴ People's Bank is the best investment.

9. a) ₦ 548 **b)** ₦ 320

10. a) ₦ 3 075 **b)** ₦ 4 775.40 **c)** ₦ 2 400

11. ₦ 346 420.80

12. ₦ 19 587.96

13. ₦ 175 854.50

14. a) ₦ 884 499.45

b) No, it is not enough. They still require ₦ 15 500.55.

15. ₦ 6 607 240

Exercise 4

(SB page 161)

1. ₦ 1 203 417.95

2. ₦ 772 000, ₦ 617 600, ₦ 494 080, ₦ 395 264, ₦ 316 211.2

3. ₦ 1 827 021.88

4. ₦ 400 562.93

5. ₦ 846 768.63

6. ₦ 41 978.68

7. ₦ 4 050

8. ₦ 35 612.93

9. ₦ 345 600

10. ₦ 286 720

Exercise 5

(SB page 162)

1. ₦ 831.92

2. ₦ 73 771 050.22

3. **a)** First year
b) 973 925.94
c) 2 497 857.73
d) 1 523 931.79

4. ₦ 210 000

5. ₦ 1 356.52

6. **a)** Chicken: –4.75%
Milk: +9.28%
b) ₦ 377.3
c) Rice
d) Politics/imports
e) ₦ 2 405.19

7. ₦ 85 962.50

8. $n \approx 3$ years

9. 95.31%

10. ₦ 7 656

Topic 4: Trigonometry

Teaching notes and guidelines

Introduction

This the first time your students are encountering trigonometry, although they have worked with triangles and Pythagoras' theorem before. The topic is expansive and below is a summary of its layout:

- Revision of right-angled triangles and Pythagoras' theorem
- Introduction to the trigonometric ratios
- Finding the values of trigonometric ratios and their inverses
- The application of trigonometry to finding unknown angles and sides in triangles.
- Solution of triangles
- Problems involving angles of elevation and depression
- Application of trigonometry to solve problems with bearing.

As the principles of trigonometry are based on right-angled triangles, the topic starts by revising the characteristics of these triangles in terms of their sides and angles. Pythagoras' theorem is the next part of the introduction of trigonometry, before the trigonometric ratios are presented.

The trigonometric ratios are introduced through a practical exercise where students will need to draw triangles with the same angle and sides with different lengths. The different ratios of the sides are calculated, so that the students can see that these stay constant across the three triangles. The examples and exercises that follow are aimed at familiarising the students with the three ratios and to practise finding the correct sides in each ratio.

Once students are comfortable with the ratios, using a table or a calculator is demonstrated as ways to find values of trigonometric ratios. The examples deal with important concepts that relate to squaring trigonometric ratios and order of operations. Calculator operations are demonstrated in the examples. Inverses of trigonometric ratios are covered next

and using a table or a calculator is presented. The exercises and examples again deal with various contexts and ways in which angles can be found.

In the next part, it is shown how trigonometry can be used to first find an unknown angle and then to find an unknown side. This is extended into application of trigonometric ratios to everyday practical problems. Solution of triangles follows, where all the unknown sides and angles in a right-angled triangle are found.

Students are then introduced to angles of elevation and depression and how a clinometer can be used to measure these angles. The examples and exercises present various real-life contexts that involve angles of elevation and depression.

The topic concludes with a short revision of bearing. Whereas students have up to now used scale drawings to calculate bearings and distances, they will now learn how to use trigonometry to solve these problems.

Common difficulties

Since this is a new topic for students, care must be taken that the foundational concepts are well developed. Take time to present the trigonometric ratios and provide students with ample time to practise the initial concepts involving the ratios. To help them in remembering the ratios for sine, cosine and tangent, come up with some rhymes and acronyms.

A common misconception is that the ratios are numbers – the words sin, cos and tan are mistaken for numbers and not seen as referring to a ratio of particular sides relating to an angle in a right-angled triangle. Reinforce this often and immediately correct students who misunderstand the concept.

Solving triangles and problems with angles of elevation and depression can be challenging to students, as they often do not know where to start with the problem. Provide them with guidelines and problem-solving strategies in this case.

Preparation

This topic will require some careful preparation to assist students' understanding. Make visual aids of right-angled triangles, Pythagoras' theorem, the trigonometric ratios and problem-solving strategies. If possible, have a computer package available that can demonstrate on a projector how to use the calculator. You will also need to have a clinometer ready made to use in class.

After revising right-angled triangles and Pythagoras' theorem, a good starting point will be to present students with the problem on page 168 of the *Student's Book*. As Pythagoras' theorem cannot be used to solve the problem, a new strategy is required. Give a brief overview of what trigonometry is, as well as its history. The information on pages 164 to 165 of the *Student's Book* is useful or information from the internet can be provided.

Answers to exercises

Exercise 1

(SB page 165)

Triangle	Hypotenuse	Opposite	Adjacent
1	5	3	4
2	13	5	12
3	10	6	8
4	26	10	24
5	20	16	12
6	41	40	9
7	25	24	7
8	s	r	t
9	x	y	z

Exercise 2

(SB page 170)

1. – 3. Students' own work

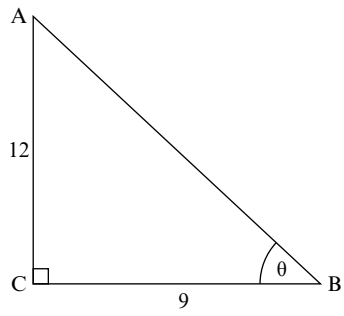
Exercise 3

(SB page 172)

1. a) $\sin A = \frac{BC}{AC}$ **b)** $\cos A = \frac{AB}{AC}$ **c)** $\tan A = \frac{BC}{AB}$

d) $\sin C = \frac{AB}{AC}$ **e)** $\cos C = \frac{BC}{AC}$ **f)** $\tan C = \frac{AB}{BC}$

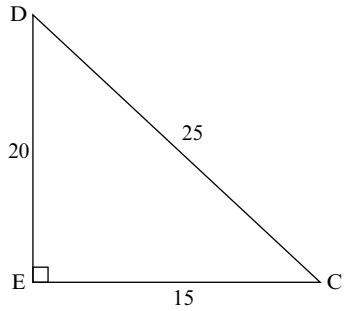
2. a)



b) 15

c) $\sin \theta = \frac{9}{15}$

3.



a) $\tan C = \frac{20}{15}$

b) $\sin D = \frac{15}{25}$

c) $\cos C = \frac{15}{25}$

Exercise 4

(SB page 174)

1.

Angle	0	5.5°	12°	17°	21°	30°	40°
sin	0	0.0958	0.2079	0.2924	0.3584	0.5	0.6428
cos	1	0.9954	0.9781	0.9563	0.9336	0.8660	0.7660
tan	0	0.0963	0.2126	0.3057	0.3839	0.5773	0.8391

Angle	45°	53°	60°	72.7°	78°	84°	90°
sin	0.7071	0.7986	0.8660	0.9548	0.9781	0.9945	1
cos	0.7071	0.6018	0.5	0.2974	0.2079	0.1045	0
tan	1	1.3270	1.732	3.2106	4.7046	9.5144	ud

2. **a)** 2.1445 **b)** 0.6156 **c)** 0.2756 **d)** 1.1504
e) 0.8078 **f)** 0.2349 **g)** 2.5173 **h)** 0.6667

3. **a)** 1 **b)** –0.6241
c) 0

4. **a)** 0.9962 **b)** 1.4396
c) 0.25 **d)** 1
e) 0.0299 **f)** 0.2565

Exercise 5

(SB page 176)

1. **a)** 38.3° **b)** 64.3° **c)** 78.3° **d)** 20.7°
e) 48.2° **f)** 7.1°

2. **a)** 59.5° **b)** 53.1° **c)** 71.3° **d)** 80.1°
e) 41.8° **f)** undefined **g)** 41.4° **h)** 18.1°
i) 40.5° **j)** 18.4° **k)** undefined **l)** 109.9°
m) 26.6° **n)** undefined

Exercise 6

(SB page 177)

1. **a)** 37° **b)** 35° **c)** 63° **d)** 45° **e)** 45°
f) 63.6° **g)** 31° **h)** 24° **i)** 51° **j)** 37°

Exercise 7

(SB page 181)

1. **a)** 5.47

b) 52

c) $\cos 55 = \frac{c}{19}$
$c = 11$

d) $\cos 49 = \frac{d}{33}$
$d = 22$

e) $\cos 17 = \frac{12}{e}$
$e = 12.5$

f) $\cos 22 = \frac{31}{f}$
$f = 33$

g) $\cos 23 = \frac{g}{32}$
$g = 29$

h) $\sin 30 = \frac{h}{20}$
$h = 10$

2. **a)** $\frac{3}{5}$ **b)** $\frac{3}{4}$

3. **a)** $\frac{25}{13}$ **b)** $\frac{1\,728}{125}$

4. **a)** $\sqrt{3.7^2 - 2.4^2} = 2.8$
$\sin x = \frac{2.74}{3.7}$
$x = 40.4°$

b) $\sqrt{56.2^2 - 32.3^2} = 64.8$
$\tan x = \frac{56.2}{32.3}$
$x = 60.1°$

5. **a)** $\sin 60 = \frac{7}{AC}$
$AC = 8.08$

b) $\sin 50 = \frac{7}{BC}$
$BC = 9.14$

c) $\tan 60 = \frac{7}{AX}$ $\tan 50 = \frac{7}{BX}$
$AB = \frac{7}{\tan 60} + \frac{7}{\tan 50}$
$= 9.92$

6. $\tan 40 = \frac{x}{25}$
$x = 20.98$
$y = 29.96$

7. a) $(\frac{5}{10})^2 + (\frac{5\sqrt{3}}{10})^2$

$= \frac{25}{100} + \frac{3}{4}$

$= 1$

b) $(\frac{5\sqrt{3}}{10})^2 + (\frac{5}{10})^2$

$= \frac{25}{100} + \frac{3}{4}$

$= 1$

8. a) 9.06 cm **b)** 8.47 cm

9. 6.53 cm

10. 4.59 cm

Exercise 8

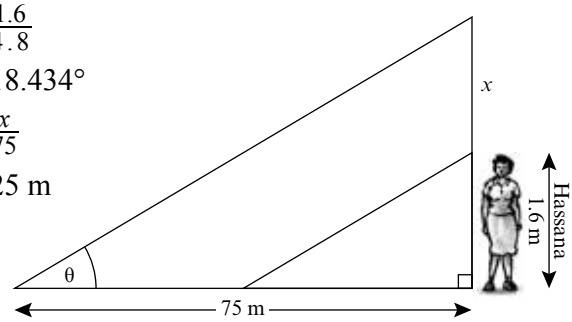
(SB page 184)

1. $\tan \theta = \frac{1.6}{4.8}$

$\theta = 18.434°$

$\tan 18.434 = \frac{x}{75}$

$x = 25$ m

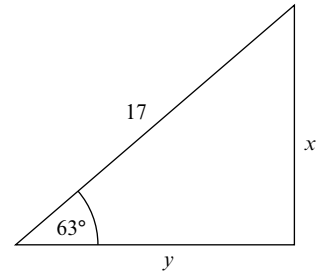


2. a) $\sin 63 = \frac{x}{17}$

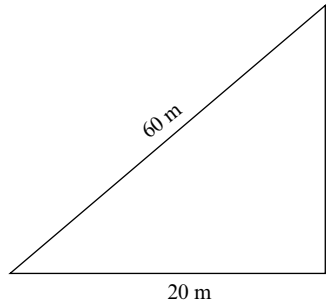
$x = 15.15$ m

b) $\cos 63 = \frac{y}{17}$

$y = 7.72$ m



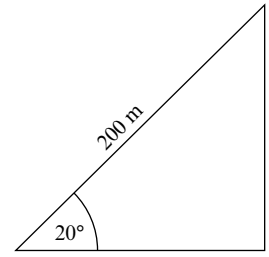
3.



$\sqrt{60^2 - 20^2}$

$= 56.57$ m

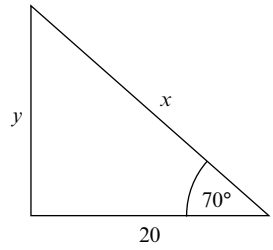
4.



$\cos 20 = \frac{x}{200}$

$x = 187.94$ m

5.

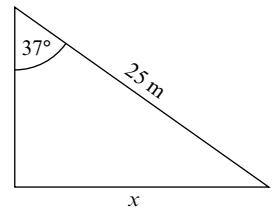


$\cos 70 = \frac{20}{x}$

$x = 58.476$ m

$y = 54.95$ m

6.



$\sin 37 = \frac{x}{25}$

$x = 15$ m

7. **a)** $\tan 38 = \frac{PQ}{104}$

$PQ = 81.25$ m

b) $\cos 38 = \frac{104}{PR}$

$PR = 131.98$ m

c) $\hat{P} = 52°$

Exercise 9

(SB page 186)

1. $\tan 70° = \frac{18}{x}$

$x = \frac{18}{\tan 70°}$

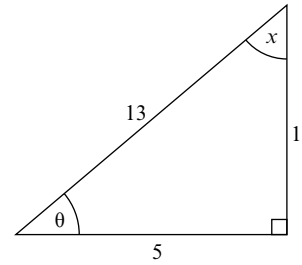
$x = 6.55$ cm

2. $\tan \theta = \frac{12}{5}$

$\theta = 67.4°$

$\cos \alpha = \frac{12}{13}$

$\alpha = 22.6°$



3. **a)** $\tan 45° = \frac{TU}{35}$

$1 = \frac{TU}{35}$

$\therefore TU = 35$ cm

b) $\tan 30° = \frac{35}{SU}$

$0.5774 = \frac{35}{SU}$

$\therefore SU = 60.62 \text{ cm} \approx 61 \text{ cm}$

$\therefore SV = 26$ cm

c) $\tan S\hat{T}U = \frac{61}{35}$

$= 1.7429$

$\therefore S\hat{T}U = 60°$

$\therefore S\hat{T}V = 60° - 45° = 15°$

($\triangle TVU$ is isosceles)

4. **a)** $\tan 50° = \frac{5}{PQ}$

$\therefore PQ = 4.2$ m

b) $\tan 40° = \frac{5}{QR}$

$\therefore QR = 6$ m

$\therefore PR = 10.2$ m

c) $SP^2 = 4.2^2 + 5^2$

$SP = 6.5$ m

5. **a)** $\tan 45° = \frac{AC}{10}$

$\therefore AC = 10$ cm

b) $\sin 30° = \frac{AB}{10}$

$\therefore AB = 5$ cm

6. **a)** $AC^2 = 17^2 - 8^2$

$\therefore AC = 15$ cm

b) $AB = 15 - 5$

$= 10$ cm

c) $BD^2 = 8^2 + 10^2$

$\therefore BD = 12.8$ cm

7. 44 cm

8. 36.8°, 106.2°

9. **a)** $PQ = 8.6$ $PR = 25$

b) $P\hat{Q}R = 54°$

$P\hat{R}Q = 16°$

$Q\hat{P}R = 110°$

c) 101.5 cm^2

10. **a)** 13.856 cm

b) 41.569 cm^2

Exercise 10

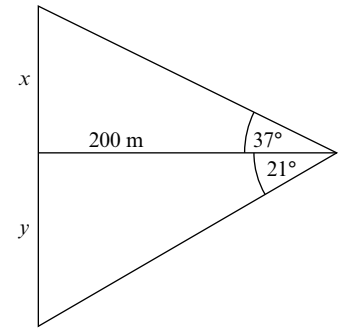
(SB page 190)

1. $\tan 37 = \frac{x}{200}$

$\tan 21 = \frac{y}{200}$

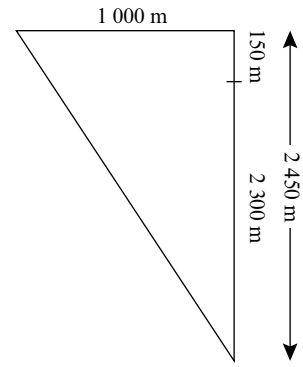
$x + y = 200 \tan 37 + 200 \tan 21$

$= 227.48$



2. $\tan \frac{2\,450}{100} = \theta$

$\theta = 67.8°$



3. **a)** $x = 52°$

height = 441.9 m

$\tan 26 = \frac{x}{250}$

b) $x = 121.9$

4. $\tan 48 = \frac{AB}{x}$ $\tan 29 = \frac{AB}{20-x}$

$x + \tan 48 = (20 - x)\tan 29$

$1.11x = 11.09 - 0.55x$

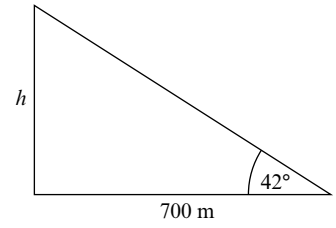
$1.66x = 11.09$

$x = 6.66$

AB = 7.40

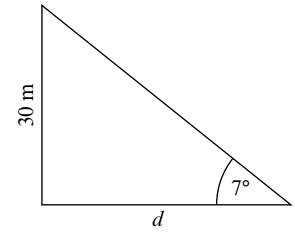
5. $\tan 42 = \frac{h}{700}$

$h = 630.28$



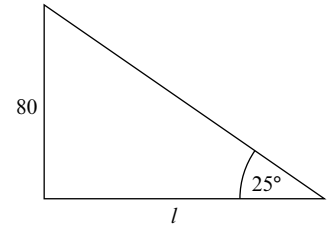
6. $\tan 7 = \frac{30}{d}$

$d = 244.33$ m



7. $\tan 25 = \frac{80}{l}$

$l = 171.56$

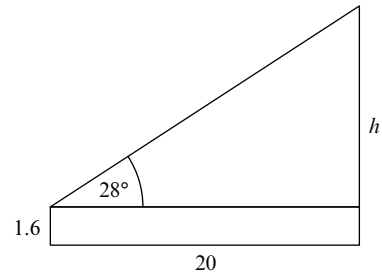


8. $\tan 28 = \frac{h}{20}$

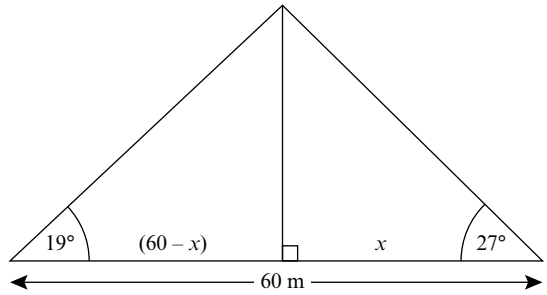
$20 \tan 28 = h$

$h = 10.63$

height = 12.23



9. a)



b) $\tan 19 = \frac{h}{(60-x)}$ $\tan 27 = \frac{h}{x}$

$(60 - x)(\tan 19) = x \tan 27$

$20.66 - 0.344x = 0.51x$

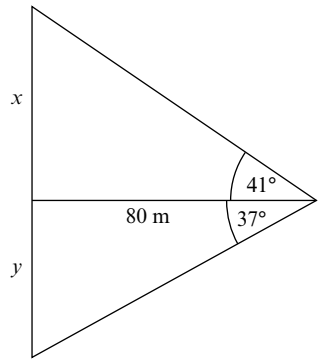
$20.66 = 0.854x$

$x = 24.2$

$24.2 \tan 27 = h$

$h = 12.33$

10.



$\tan 41 = \frac{x}{80}$

$\tan 37 = \frac{y}{80}$

$80 \tan 41 + 80 \tan 37 = 129.8$

Exercise 11

(SB page 195)

1. 210°

2. 296°

3. **a)** 13 km
b) 095°

4. **a)** 038.7°
b) 218.7°

5. **a)** ≈ 16 km
b) 3.5 km
c) 090°

6. **a)** PY = 10 km; 030°
b) PZ = 21.8 km; 066.6°

TERM 2

Revision exercises

(SB page 197)

Simultaneous equations

1. a)
$$\begin{aligned} x + 2y &= -4 \\ 3x - 5y &= -1 \\ -3x + 6y &= -12 \\ \hline -11y &= 11 \\ y &= -11 \\ x - 2 &= -4 \\ x &= -2 \end{aligned}$$

b)
$$\begin{aligned} 4x + 9y &= 5 \\ -5x + 3y &= 8 \\ 4x + 9y &= 5 \\ -15x + 9y &= 24 \\ \hline 19x &= -19 \\ x &= -1 \\ 4(-1) + 9y &= 5 \\ 9y &= 9 \\ y &= 1 \end{aligned}$$

c)
$$\begin{aligned} 9x - 6y &= 12 \\ +4x + 6y &= 14 \\ \hline 13x &= 26 \\ x &= 2 \\ 8 + 6y &= 14 \\ y &= 1 \end{aligned}$$

d)
$$\begin{aligned} x + y &= 3 \\ -3x + 2y &= 1 \\ -2x + 2y &= 6 \\ \hline -5x &= -5 \\ x &= 1 \\ y &= 2 \end{aligned}$$

e)
$$\begin{aligned} -3x + 2 &= 5 \times 5 \\ 4x + 5y &= 1 \times 2 \\ -15x + 10y &= 25 \\ -8x + 10y &= 2 \\ \hline -23x &= 23 \\ x &= -1 \\ 3 + 2y &= 5 \\ y &= 1 \end{aligned}$$

2. a)
$$\begin{aligned} x + y &= 15 \\ y &= 15 - x \\ x - y &= 3 \\ x - (15 - y) &= 3 \\ 2x - 15 &= 3 \\ 2x &= 18 \\ x &= 9 \\ y &= 6 \end{aligned}$$

b)
$$\begin{aligned} x + y &= 0 \\ x - y &= 2 \\ -y - y &= 2 \\ y &= -1 \\ x &= 1 \end{aligned}$$

c)
$$\begin{aligned} 2x - y &= 3 \\ 4x + y &= 3 \\ 2x - (3 - 4x) &= 3 \\ 6x &= 6 \\ y &= -1 \end{aligned}$$

d)
$$\begin{aligned} 2x - 9y &= 9 \\ 5x + 2y &= 27 \\ 5\left(\frac{9 + 9y}{2}\right) &= 27 \\ \frac{45}{2} + \frac{45}{9} + 2y &= 27 \\ \frac{49}{2} &= \frac{9}{2} \\ y &= \frac{9}{49} \\ 2x - 9\left(\frac{9}{49}\right) &= 9 \\ x &= \frac{261}{49} \end{aligned}$$

$$\begin{aligned} 10x - 45y &= 45 \\ -10x + 4y &= 54 \\ \hline -49y &= -9 \end{aligned}$$

e)
$$\begin{aligned} x + 4y &= -4 \\ 3y - 5x &= -1 \\ 3y - 5(-4 - 4y) &= -1 \\ 3y + 20 + 20y &= -1 \\ 23y &= 21 \\ y &= \frac{21}{23} \\ x &= \frac{176}{23} \end{aligned}$$

3. $x = 3$
$y = 2$

4. **a)**

x	–1	0	1	2	3	4
y	–3	–1	1	3	5	7

b)
$$\begin{aligned} 5 - 2x &= 2x - 1 \\ 6 &= 4x \\ \frac{6}{4} &= x \\ y &= 2 \end{aligned}$$

c) $x = \frac{3}{2}$
$y = 2$

5.
$$\begin{aligned} 4x - 8 &= 2x + 3 \\ 2x &= 11 \\ x &= 5.5 \\ y &= 11 + 3 \\ y &= 14 \end{aligned}$$

Word problems leading to simultaneous equations

1. He walked 2 km and ran 3 km.

2.
$$5m + 8r = 9\,100 \times 3$$
$$3m + 10r = 6\,500 \times 5$$
$$15m + 24r = 27\,300$$
$$-15m + 30r = 32\,500$$
$$-6r = -5\,200$$
$$r = 866.67$$
$$5m + 8(8.66.67) = 9\,100$$
$$5m = 2\,166.667$$
$$m = ₦433.3$$

3. 3 km

4.
$$\frac{x}{30} + \frac{y}{60} = 2.5$$
$$2x = y = 150$$
$$y = 150 - 2x$$
$$\frac{x}{15} + \frac{y}{45} = 4\frac{1}{3}$$
$$3x + y = 195$$
$$3x + 150 - 2x = 195$$
$$x = 45 \text{ km}$$
$$\therefore y = 60 \text{ km}$$

5.
$$2L + 2B = 70$$
$$LB = 300$$
$$L = 35 - B$$
$$(35 - B)(B) = 300$$
$$35B - B^2 = 300$$
$$O = B^2 - 35B + 300$$
$$B = 20 \text{ or } B = 15$$

6.
$$x + y = 9$$
$$xy = 20$$
$$x(9 - x) = 20$$
$$x^2 - 9x + 20 = 0$$
$$x = 5 \text{ or } x = 4$$

7.
$$x + y = 21$$
$$\tfrac{1}{2}(x)(y) = 54$$
$$(21 - x) = 108$$
$$x^2 - 21x + 108 = 0$$
$$x = 12 \text{ or } 9$$

Direct and inverse proportion

1. 1 350 **2.** 400 **3.** 2.5 min

4. 12 days **5.** 1 day **6.** 240 hours

7. **a)** ₦ 41.29 **b)** ₦ 39.93

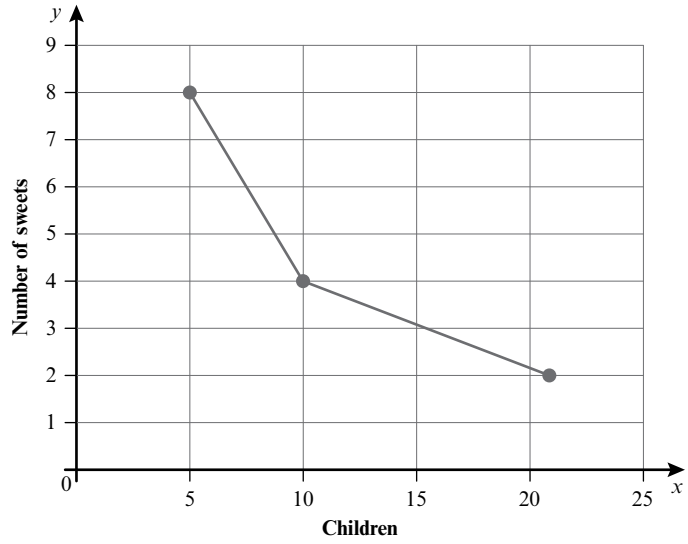
c)

A	₦ 619.35	₦ 825.80	₦ 2 890.30	₦ 4 129	₦ 4 954.80	₦ 7 452
B	₦ 598.88	₦ 797.60	₦ 2 794.77	₦ 3 992.53	₦ 4 791.04	₦ 7 186

d) 41.29 × minutes
39.93 × minutes

8. **a)** Inverse

b)



c) 16 pumps = 2.5 hours

9. **a)** 1 500, 333.33, 250

b) $k = xy$
$k = 5\,000$

c) 100 ℓ

10. a) $k = \frac{\text{water}}{\text{time}}$

$k = \frac{500}{4} = 125$

b) Students' own work

c) 2 500 ℓ

d) 920 min

e) The graph will be less steep.

Variation

1. a) **b)**

2. a) **b)**

3. a) **b)** **c)**

4. a) $m = \frac{10}{n}$ **b)** $m = 10$ **c)** $n = \frac{5}{3}$

5. a) $u = \frac{81}{4v^2}$ **b)** $\frac{9}{4}$ **c)** $v = \pm\frac{3}{4}$

6. $\frac{k}{y} = (x - 4)^2$

7. a) $u^2 = \frac{250}{v}$ **b)** $v = \frac{5}{2}$ **c)** $u = \pm 5$

8. $q = \frac{1}{100}$

9. a) $k = 7$ **b)** $y = 7xz$ **c)** $y = 63$ **d)** $z = 2$

10. a) $k = \frac{1}{3}\pi$ **b)** $V = \frac{1}{3}\pi hr^2$ **c)** 1 047.20 cm^3

Trigonometry

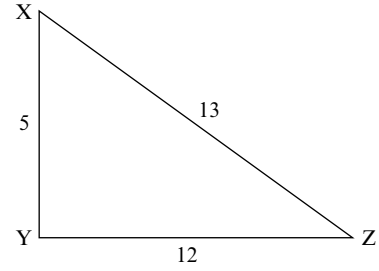
1. a) $\sin Z = \frac{5}{13}$

b) $\cos X = \frac{5}{13}$

c) $\tan Z = \frac{5}{12}$

d) $\sin X = \frac{12}{13}$

e) $\tan X = \frac{12}{5}$



2. a) sin 50 = 0.766 **b)** cos 40 = 0.766

c) undetermined **d)** sin 188 = –0.139

e) cos 123 = –0.545 **f)** tan 240 = $\sqrt{31.732}$

3. a) sin 62 = 0.88

b) cos 28 = 0.88

c) sin(62 + 28) = 1

d) sin 2(62) = 0.083

e) $\cos 28 + \sin 62 = 1.77$

f) $\tan 3(62 + 28) =$ undetermined

g) $\tan(62 - 28) = 0.67$

h) $\sin 2(62) + \cos 2(62) = 0.27$

4. **a)** 35 **b)** 31 **c)** 12

d) 37 **e)** 60 **f)** +60

g) 11.5 **h)** 66 **i)** 57

5. **a)** $\frac{8}{10.63}$ $\theta = 49°$

b) $\cos\theta = \frac{2}{\sqrt{9}}$ $\theta = 68°$

c) $\tan\theta = \frac{\sqrt{7}}{3}$ $\theta = 41.4°$

6. **a)** $\tan 48 = \frac{x}{12}$ **b)** 10.8 **c)** 15

$x = 13.33$

7. **a)** $\sin 62 = \frac{22.6}{x}$

$x = 25.6$

$\tan 62 = \frac{22.6}{x}$

$x = 12$

b) $\tan 51 = \frac{9}{AC}$

$AC = 7.288$

$\sin 51 = \frac{9}{AB}$

$AB = 11.58$

c) $\tan 42 = \frac{4.5}{BC}$

$BC = 5$

$\sin 42 = \frac{4.5}{AB}$

$AB = 6.73$

d) $\cos 53 = \frac{BC}{5}$

$BC = 3$

$\sin 53 = \frac{AC}{5}$

$AC = 3.99$

$= 4$

e) $\tan 28 = \frac{BC}{29.3}$

$BC = 15.58$

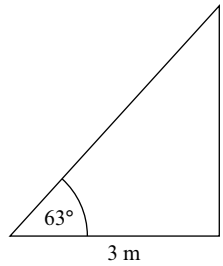
$\cos 28 = \frac{29.3}{AB}$

$AB = 33.2$

f) $\cos 24 = \frac{AC}{14}$

$AC = 12.79$

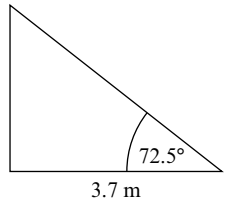
8. a)



$\tan 63 = \frac{\text{wall}}{3}$

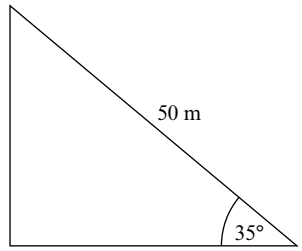
$5.89 = \text{wall}$

b)



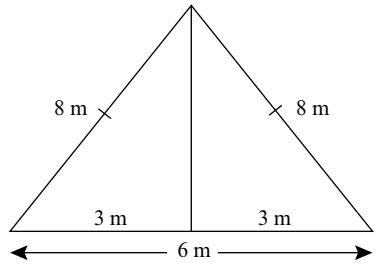
11.73

c)



28.68

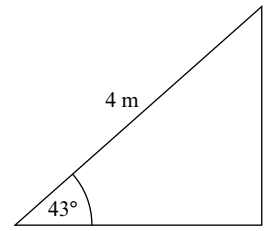
d)



68°/68°/44°

e) $\sin 43 = \frac{x}{4}$

$x = 2.73$



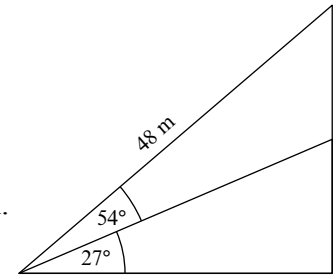
f) Height 1: $\sin 27 = \frac{x}{48}$

$x = 21.79$ m

Height 2: $= \sin 54 = \frac{x}{48}$

$x = 38.83$ m

$\therefore$ Resulting increase is 17 m.

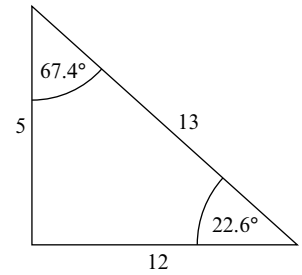


g) $\sin x = \frac{12}{13}$

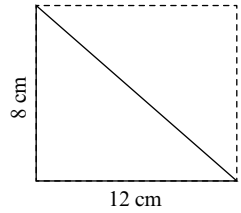
$\therefore x = 67.38°$

$\therefore y = 180 - 90 - 67.38$

$= 22.62°$

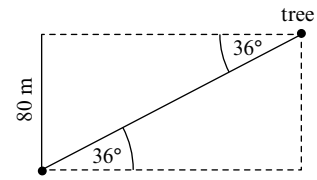


h)



$\theta = 56.3$

i)



$\tan 36 = \frac{80}{x}$

$x = 110$

9. a) 622 km

b) $\tan 20 = \frac{x}{440}$

$x = 140$

10. a) $\cos 34 = \frac{DC}{BC}$

$\cos 34 = \frac{BC}{AC}$

b) $\tan 34 = \frac{BD}{8.3}$

$BD = 5.6$

c) $\sin 56° = \frac{AC}{BC}$

11. a) $\cos 21 = \frac{PQ}{12}$

$PQ = 11.2$

b) $\tan 28 = \frac{KR}{11.2}$

$KR = 5.96$

$\therefore SK = 5.24$

12. $x = 11.4$

$\tan 34 = \frac{11.4}{x}$

$x = 16.9$

$Z = 58°$

13. a) $\tan 42 = \frac{8}{NR}$ **b)** $MR = 11.96$ **c)** $PN = 10.19$

$NR = 8.88$

14. $\tan 40 = \frac{d}{25}$

$d = 20.97$

$d = 15.98$

15. a)–d) $\tan 30 = \frac{y}{50 + x}$

$\tan 40 = \frac{y}{x}$

$x \tan 40 = (50 + x)(\tan 30)$

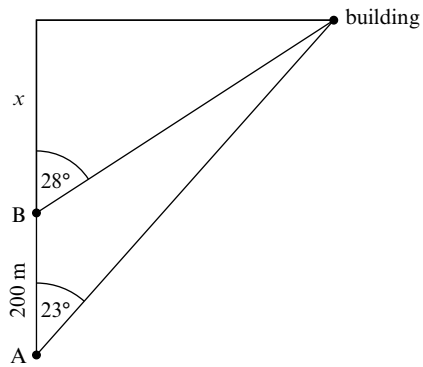
$0.839x = 28.87 + 0.577x$

$0.262x = 28.87$

$x = 110.3$

$y = 92.5$

16. a)



$\tan 23 = \frac{\text{building}}{200 + x}$

$\tan 28 = \frac{\text{building}}{x}$

$x \tan 28 = (200 + x)\tan 23$

$0.532x = 84.89 + 0.424$

$0.107x = 84.89$

$x = 729.63$

b) Distance = 991.7 m **c)** Building = 389 m

17. a) **i)** PR = 117.2 km **ii)** $R\hat{P}Q = 34°$

iii) Bearing = 264°

18. a) i) 36.06 **ii)** 101°

b) i) 35.4 km **ii)** 1 h 46 min

19. a) i) QR = 500 km **ii)** $P\hat{Q}R = 36.8°$

iii) Bearing = 173.14°

b) i) $t = 1.2$ **ii)** 333 km/h

20. BC = 49 km

Simple and compound interest

1.

Years	Simple Interest	Invested Amount	Compound Interest	Invested Amount
0		1 000		1 000.00
1	100	1 100	100	1 100.00
2	100	1 200	110	**1 210**
3	**100**	1 300	121	1 331.00
4	100	**1 400**	**133**	1 464.10
5	100	1 500	146.41	**1 610.51**
6	**100**	1 600	161.05	**1 771.56**
7	100	**1 700**	177.16	1 948.72
8	100	1 800	**194.87**	2 143.59
9	**100**	**1 900**	214.36	**2 357.95**
10	100	**2 000**	**235.79**	2 593.74

2. a) Simple interest increases at a constant rate, but compound interest increases exponentially.

b) 10 years

c) 7.3 years

3. a) $A = P(1 + rt)$

$= x(1 + 0.15 \times 10)$

$= 2.5x$

$A = P(1 + r)t$

$= x(1 + 0.08)^{10}$

$= 2.15x$

$\therefore$ Simple interest is higher.

b) 11.8%

c) Money invested at compound interest earns interest on interest.

4. ₦ 5 750

5. ₦ 2 000

6. ₦ 16 441.04

7. ₦ 17 405

8. ₦ 49 934.73

9. **a)** ₦ 1 891 895.71
b) ₦ 31 531.60

Topic 1: Similar shapes

Teaching notes and guidelines

Introduction

This section starts off with a general exploration of similar shapes, in order to illustrate the general concept of similarity (figures having the same shape, but not the same size). Ratios and proportions are revisited, as procedural competence with these calculations is integral to working with similar shapes.

After these basic concepts are introduced, the topic looks at similar polygons. Simple examples of similar shapes such as squares are used and students are encouraged to draw them. The topic then progresses to working with triangles and covers concepts, such as finding corresponding sides and the conditions for similarity. The exercises provide for ample practise of these concepts.

The topic then proceeds to scale factor and how this is calculated. Once the scale factor is determined, students can go on to solving problems in triangles that involve finding unknown sides. Transformations that include enlargements and reductions follow this section, continuing to applying similarity to area and volume of similar shapes. The topic concludes with practical applications of similar shapes.

Common difficulties

One of the main concepts that students will need to grasp in this section is ratio and proportion of similar shapes. Spend enough time on these concepts to build confidence. Finding corresponding sides could be another challenge, so show students a variety of techniques to do this. This can include the use of colour pencils or matching sides using letters.

When solving problems with unknown sides, students may find it difficult to set up equations that involve the ratio of sides. Go back to examples with numbers and remind them that, when sides are in proportion, the ratio of the corresponding sides is equal.

Preparation

A visual aid that shows real-world examples of similar shapes will be helpful. Also make charts that explain concepts, such as ratio, proportion and so on. Prepare a short investigation that can be used for the introduction where students have to cut out and explore the aspects of similar shapes.

Real-world examples of similar shapes, such as those provided on page 209 and 210 of the *Student's Book* are a good introduction. Explain to students that the same principle can be applied to polygons, but that certain conditions need to be met. Explore these conditions by cutting out shapes, asking students what they notice about shapes of different size (regarding the lengths of the sides and the sizes of the angles).

Answers to exercises

Exercise 1

(SB page 213)

1. **a)** 60°. The triangle is equilateral.

b) Students' construction

2. **a)** $\frac{x}{p} = \frac{q}{y}$ **b)** $\frac{q}{x} = \frac{y}{p}$ **c)** $\frac{p}{y} = \frac{x}{q}$

3. **a)** $\frac{9}{x} = \frac{3}{5}$ $x = 15$

b) $3 : 5 = x : 4$

$= 2 : 4 : 4$

c) $\frac{2}{x} = \frac{y}{8} = \frac{1}{4}$

$x = 8$ and $y = 2$

4. **a)** $\frac{a}{3} = \frac{b}{2}$

$2a = 3b$

$2 : 3$

b) $2a = 5b$

$2 : 5$

c) $a + b = 7(a - b)$

$a + b = 7 - 7b$

$-6a = -8b$

$a = \frac{4}{3}b$

$3 : 4$

Exercise 2 (SB page 214)

Students' own work

Exercise 3 (SB page 215)

1. **a)** $\angle ABC$ corresponds to $\angle DEF$
b) $\angle BCA$ corresponds to $\angle EFD$
c) $\angle CAB$ corresponds to $\angle FDE$

2. $\frac{XY}{KL}, \frac{XZ}{KM}, \frac{YZ}{LM}$

3. **a)** Yes. $\frac{AC}{DE}, \frac{AB}{DF}, \frac{BC}{EF}$
b) Yes. $\frac{AC}{NL}, \frac{AB}{LM}, \frac{BC}{NM}$
c) Yes. $\frac{AB}{HI}, \frac{AC}{HJ}, \frac{BC}{IJ}$
d) Yes. $\frac{UT}{KJ}, \frac{VU}{LK}, \frac{VT}{LJ}$
e) No
f) Yes. $\frac{UW}{FH}, \frac{UV}{FG}, \frac{VW}{HG}$
g) Yes. $\frac{FR}{FE}, \frac{FB}{FD}, \frac{SR}{DE}$
h) Yes. $\frac{ST}{FG}, \frac{TH}{FH}, \frac{SH}{HG}$

4. $\frac{AB}{QR} = \frac{BC}{PQ} = \frac{CA}{PR}$

5. **a)** $\triangle ABZ \,|||\, \triangle YZX$
b) $\frac{XY}{BA} = \frac{ZY}{ZA} = \frac{XZ}{ZB}$
c) $ZA = 5$

Exercise 4 (SB page 218)

1. **a) – c)** Students' own work
d) Infinite

2. **a)** Not similar. The angles are different.
b) Yes, all angles are equal.
c) Yes, all angles and sides are equal.
d) Yes, all angles and sides are equal.
e) Yes, all angles and sides are equal.
f) No, not all angles are equal.
g) No, not all angles are equal and sides are not in proportion.
h) Yes, they have the same sides, with the same lengths and the interior angles are the same.

3. Equal ratio of sides

4. *a* and *d*

5. **a)** 2.5 **b)** 3 **c)** 3

6. **a)** Ratio of sides equal
b) Equiangular
c) Equiangular

7. **a)** $\angle ABD \,|||\, \angle BDC \,|||\, \angle ABC$

b) AD : AB : BD
BD : DC : BC
AB : BC : AC

8. **a)** $\angle ACB \,|||\, \angle CD$

b) Equiangular: $\hat{E} = \hat{G}$, $F = \hat{B}$

9. The angles are equal

Exercise 5

(SB page 222)

1. **a)** 42 cm **b)** 7 : 1

2. **a)** 1 : 5 **b)** 80 cm

3. **a)** 10 cm **b)** 3 : 1
c) 2 : 1 **d)** 6 cm

Exercise 6

(SB page 224)

1. All the triangles are similar.

a) $a = 9$ cm

b) $b = 9$ cm

c) $d = 12$ cm

d) $\frac{50}{70} = \frac{60}{11x + 4}$
$550x - 200 = 4\,200$
$550x = 4\,400$
$x = 8$

e) $\frac{28}{42} = \frac{x}{33}$
$x = 22$

f) $\frac{6}{24} = \frac{12-x}{12}$
$x = 9$

g) $\frac{88}{24} = \frac{5x + 11}{18}$
$66 = 5x + 11$
$x = 11$

h) $\frac{6}{12} = \frac{x}{22}$
$11 = x$

i) $\frac{-4 + 4x}{64} = \frac{27}{72}$
$-4 + 4x = 24$
$x = 7$

2. **a)** $\frac{3}{4.5} = \frac{2}{3}$

b) $x = 5$

c) $y = 3$

3. **a)** $x^2 = 6^2 - 3^2$
$x = \sqrt{15}$

b) $\frac{2}{3} = \frac{x}{6}$
$x = 4$

c) 4 cm

Exercise 7

(SB page 229)

1. A′$(3\frac{1}{2}; 1\frac{1}{2})$, B′$(4\frac{1}{2}; 1\frac{1}{2})$, C′$(3\frac{1}{2}; 4)$

2. **a)** A′(6; 12), B′(4; 6), C′(15; 15)

b) A′(–4; –8), B′(–8; –4), C′(–10; –10)

c) A′(–1; –2), B′(–2; –1), C′$(-2\frac{1}{2}; -2\frac{1}{2})$

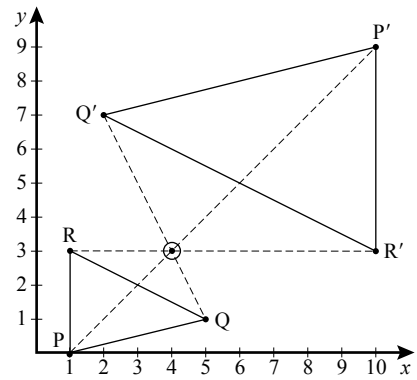
d) A′(0; 4), B′(0; 8), C′(2; 8)

e) A′(14; 13), B′(22; 13), C′(22; 25), D′(14; 25)

f) A′(2; 1), B′(4; 2), C′(3; 3)

g) L′(7; 3), M′(13; 3), N′(13; 9), P′(7; 9)

3. a)–c)



Enlargement, centre (4; 3), scale factor –2

Exercise 8

(SB page 233)

1. **a)** $\frac{2}{3} = \frac{4}{5}$

b) $3 \times 6 = 18$ 8 : 18

$2 \times 4 = 8$ 4 : 9

2. **a)** $\frac{3}{4} : \frac{6}{8}$

b) $3 \times 6 \times 3 = 54$ 54 : 128

$4 \times 4 \times 8 = 128$ 27 : 64

3. **a)** 4 : 10

2 : 5

4 : 25

b) 1 : 2

11 : 4

4. 16 : 9

$4^2 : 4^3$

8 : 6

5. ? : 100

$x = 10^2$

$x = 100$

Base area of A = 25 cm^2

6. 1 : 2

7. **a)** 7 : 14
49 : 16

8. **a)** 3 m 2 : 100
b) 30 m 1 : 50
c) $14 \times 8 = 112$ $1^2 : 2\,500$
$112 \times 2\,500 = 280\,000\ cm^2 = 288\ m^2$

9. **a)** 2 : 3 **b)** 4 : 9

10. 3 : 4
27 : 64 (volume)
0.81 : 1.92

11. **a)** 27 : 125 **b)** 9 : 25

Exercise 9

(SB page 236)

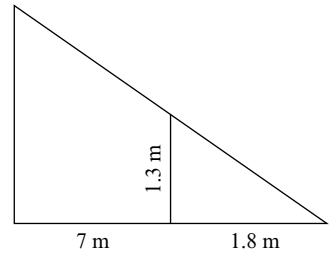
1. 9 m **2.** 3 m **3.** 1 m

4. **a)** $50 \times 35 \times a$ **b)** $1\,750\ m^2$
c) $15\,750\ cm^3$ **d)** 1 : 728 000

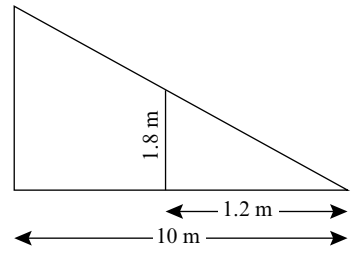
5. 40

6. **a)** yes **b)** 12 cm **c)** 5 cm

7. $\frac{x}{1.3} = \frac{8.8}{1.8}$
$x = 6.36$



8. $x = 15$ m



9. 140 m **10.** P = 627

11. 471 cm **12.** Width = 39.2 m

Topic 2: Area of plane shapes

Teaching notes and guidelines

Introduction

This topic provides practical exploration of area and is focussed on not just providing formulae for areas of shapes, but also an understanding of where these formulae come from. For this reason, the topic starts with a basic explanation of area. Although students would have encountered these concepts in previous years, revision is a good starting point.

The basic formula for area of a rectangle is presented first, because this is the simplest. Thereafter, areas of a number of plane shapes are covered, including triangles, parallelograms and trapeziums. Practical investigations are provided to explored the derivation of these formulae.

After this, perimeter of plane shapes is presented. This includes the calculation of the perimeter of plane shapes such as parallelograms, trapeziums and triangles. The section concludes with the perimeter of irregular shapes.

The next unit deals with all aspects of a circle. This has been kept separate from other shapes, as a circle has its own unique characteristics. The unit starts off with parts of a circle, because it is important for students to be familiar with the terms. The diameter, circumference and area of a circle is then explored in a practical way to show how the formulae are derived. A problem-solving exercise with regards to circles is provided before the unit concludes with area and circumference of circle sectors and arcs. The final part of the section is a mixed exercise on areas of plane shapes.

Common difficulties

Students can experience difficulty with knowing which formula to apply to the various shapes. Compile a short class test to help them memorise the formulae or have a quiz. Students may find it difficult to identify the correct measurement if they have to use the height measurement to calculate the area, for example, in triangles or parallelograms.

Students often find it challenging to work with compound shapes and to calculate the perimeter and area. Provide them with techniques on how to approach these problems. For example,

suggest breaking up the shapes one by one or colouring in the different shapes. Calculating arc lengths and areas of sectors could be problematic for some students. Always refer back to the foundational concepts and use concrete examples.

Preparation

This topic could call for a fair amount of preparation. Ensure that grid paper is available for students to cut out the shapes to perform the investigations. A chart showing the parts of a circle and a summary of all the shapes with their formulae for area and perimeter will be useful.

Start by asking students to explain area in their own words. They can discuss this in pairs. Ask them to think of an example of area in real life. Some students might already know how to calculate the area of a rectangle, so explain to them that the same can be done for other plane shapes. Have them name some other plane shapes.

Answers to exercises

Exercise 1 (SB page 243)

1. 25 cm^2

2. All sides are 9 cm

3. 4

4. Four times bigger

5. Students' own work

6. **a)** 48 cm^2 **b)** 12.5 cm^2
c) 16 cm^2 **d)** 6 300 m^2

7. 144 cm^2

8. 24 m

9. 51.84 cm^2

10. 6 300 m^2

11. **a)** 19 200 m^2

b) 1.92 ha

12. $(15 \times 12) - (6 \times 9)$
$= 126\ cm^2$

Exercise 2 (SB page 248)

1. Students' own work

2. **a)** 7.5 cm^2 **b)** 3 cm^2 **c)** 15.6 cm^2 **d)** 12 cm^2

3. 8 cm

4. 7 cm

5. **a)** 9 m **b)** 234 mm^2

6. 84 square units **7.** 16 cm^2

Exercise 3

(SB page 252)

1. **a)** 76.5 cm^2 **b)** 15 cm^2
c) 43.2 cm^2 **d)** 36 km^2
e) 45.6 cm^2

2. **a)** 32 cm^2 **b)** 36 cm^2
c) 50 cm^2 **d)** 19 200 m^2

3. 6 cm **4.** 18 cm

5. 27 cm^2

Exercise 4

(SB page 254)

1. **a)** 77 cm^2 **b)** 50 cm^2
c) 36 cm^2 **d)** 130 cm^2
e) 51 m^2 **f)** 22.5 m^2
g) 25.2 cm^2 **h)** $A = \frac{1}{2}(7.9 + 2.3) \times 4.6$
$= 23.46\ m^2$

2. **a)** $\sqrt{20}$ **b)** 22.9 cm^2

3. 18 m **4.** 6 cm

Exercise 5

(SB page 259)

1. Students' own work

2. **a)** 3.8 cm **b)** 56 cm

3. 16 cm **4.** 40 cm

5. 34 cm **6.** 15 cm

Exercise 6

(SB page 261)

1. **a)** 94 m **b)** 94 m
c) 72 m **d)** 26 m

2. **a)** 10 m, 94 m **b)** 3 m, 13 m, 112 m
c) 85 cm **d)** 74 cm

Exercise 7

(SB page 262)

1. Students' own work **2.** Students' own work

Exercise 8

(SB page 265)

Radius	Diameter	Circumference
7	14	44
6	12	37.7
17.5	35	110
5.7	11.5	36

Exercise 9

(SB page 267)

1. Students' own work

2. Students' own work

3. **a)** 50.27 cm^2 **b)** 113.1 mm^2 **c)** 63.6 m^2

4. 38.5 m^2

5. 21 cm

6. **a)** 71.46 cm^2 **b)** 257.1 cm^2 **c)** 88.8 cm^2

Exercise 10

(SB page 270)

1. **a)** 616 cm^2 **b)** 25.7 cm^2
c) 19.6 cm^2 **d)** 56.5 cm^2

2. 308 cm^2 **3.** 55.9 cm^2

4. $\frac{\theta}{360°} \times \pi(21) = 22$

$\theta = 120°$

5. **a)** 7.85 cm **b)** 19.6 cm^2

Exercise 11

(SB page 272)

1. **a)** 24 cm^2 **b)** 84 cm^2

2. 14.875 cm **3.** 11.97 cm

4. 113.1 m^2 **5.** $18 + 24 = 42$ m^2

6. 40 m^2 **7.** 12 m^2

8. **a)** 26.2 mm^2 **b)** 510.5 mm^2 **c)** 72%

9. **a)** 60° **b)** 26.2 cm

10. $40 + 39.27 = 79.27$ cm^2 **11.** $25\pi - 50 = 28.5$ cm

Topic 3: Construction

Teaching notes and guidelines

Introduction

Detailed steps are provided for each construction in this section. Topic 3 starts with constructing lines: a perpendicular bisector and a perpendicular to a point on a line. The topic then moves on to angle constructions, which include constructing angles of 30°, 60°, 90° and the sum of angles. Triangle constructions are followed by constructions of an inscribed and circumscribed circle. Finally, the construction of parallelograms and trapeziums are presented.

Common difficulties

Students generally find it challenging to follow steps provided in the question. Always encourage them to make rough drawings first. Accuracy is another pitfall and students have to work carefully with sharp pencils and compasses that work properly. Remind them to make light construction lines, so it is easier to erase when they make a mistake.

Preparation

The most important preparation is ensuring that students have a pencil, eraser and compass available. It is useful to have available a computer package or pictures that show the steps.

Present students with a few geometrical shapes that are shown in the *Student's Book*. Explain to them that these be constructed by following certain steps.

Answers to exercises

Exercise 1

(SB page 277)

1. Students' own work

2. Students' own work

3. Students' own work

4. Students' own work

Exercise 2

(SB page 283)

1. Students' own work

2. **a)** Students' own work **b)** Students' own work
c) Students' own work **d)** Students' own work

3. Students' own work

4. Students' own work

Exercise 3 (SB page 284)

1. **a)** Students' own work
b) Students' own work
c) Students' own work
d) Students' own work
e) Students' own work

2. 180° (straight line)
$70° = 30° + 40°$

Exercise 4 (SB page 285)

1. Students' own work

2. **a)** Isosceles
b) Equilateral
c) Scalene
d) Scalene

Exercise 5 (SB page 289)

1. Students' own work

2. Students' own work

3. Students' own work

4. **a)** Students' own work
b) 180°
c) $7 + 3.5 + 6 = 16.5$ cm

5. Students' own work

6. Students' own work

7. Students' own work

8. Students' own work

9. **a)** Isosceles
b) They are all the same size.

10. Students' own work

11. **a)** Students' own work
b) An altitude

12. a) Students' own work
b) Yes, if it is an isosceles triangle.
c) The median.

Exercise 6

(SB page 292)

1. a) – c) Students' own work
d) Circumscribed

2. a) – c) Students' own work
d) Inscribed

3. Students' own work

4. Students' own work

Exercise 7

(SB page 297)

1. Students' own work

2. Students' own work

3. Students' own work

4. Students' own work

5. Students' own work

6. Students' own work

7. Students' own work

8. Students' own work

9. Students' own work

10. a) Students' own work
b) Students' own work

TERM 3

Revision exercises

(SB page 299)

Similarity

1. 5.6 cm

2. equiangular

3. $\frac{PQ}{DE} = \frac{4}{6}$ (statement (a))

4. 30 + 36 + 60 = 126

5. $\hat{C} = \hat{C}$; $\hat{A} = \hat{E}$; $\hat{D} = \hat{B}$

$\frac{30}{20} = \frac{35}{BC}$

BC = 23.33 mm

$\frac{30}{20} = \frac{CE}{15}$

CE = 22.5 mm

6. $x = 4$

7. $\frac{11}{5} = \frac{x}{6}$

$x = 13.2$

8. 2 : 3

4 : 9

56 : 126 cm

9. 4 : 9

16 : 81

800 : 4 050 cm^2

10. 10 : 18

5 : 9

125 : 729

375 : 2 187 cm^3

11. 30 : 15

2 : 1

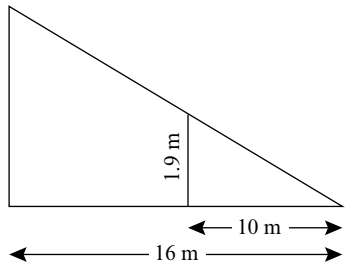
8 : 1

11 200 : 1 400 cm^3

12. 3 cm : 18 000

9 cm

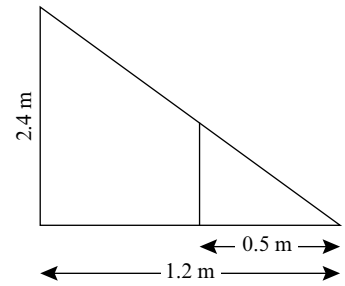
13.



$\frac{8}{5} - 5 = \frac{x}{1.9}$

$x = 3.04$ m

14.



$\frac{12}{5} = \frac{2.4}{x}$

$x = 1$

15. $\frac{x}{4} = \frac{1.8}{2.4}$

$x = 3$ m

Area of plane shapes

1. **a)** $l \times b$

b) $\frac{1}{2}b \times h$

c) $l \times b$

d) πr^2

e) $\frac{1}{2}(a + b)h$

f) πd or $2\pi r$

g) $2l + 2b$

2. **a)** 60 cm^2

b) 28 m^2

c) 24 cm^2

d) 32 cm^2

3. **a)** 25.13 cm

b) 4.77 cm

c) 452.39 mm^2

d) 28.27 cm^2

4. **a)** 10 m^2

b) 5 cm

c) 6 m

5. **a)** All sides are 4 m

b) 16 m

6. **a)** 60 cm^2
b) 34 cm

7. 40 m

8. **a)** 53.94 cm^2

b) **22 m^2**

9. **a)** 32 by 18.3
Area = 124.02 m^2
b) 90.2 m
c) 100.6 m

10. **a)** $101 + 101 + \left(\frac{63}{2}\right)^2 = 399.9$ m
b) $101 + 101 = 204.2 = 406.2$ m

11. **a)** $1\,250 + 2\,700 = 3\,950$ cm^2
b) 23 700 cm^2 = 2.37 m^2 = 3 cans

12. **a)** Concentric
b) 769.69 cm^2

13. $r = 3.5$, A = 38.5 m^2

14. 12 cm

15. $\frac{1}{4} \times \pi \times 14$
= 11 cm

16. Diameter of Mars = 6 752 km
Diameter of Moon = 3 376 km
Radius of Moon = 1 688 km
Area = 26 854 424 km^2

17. **a)** $\frac{160}{360} \times \pi \times 20^2 = 558.5$ m^2
$\frac{160}{360} \times \pi \times 40 = 55.85$ m
b) $\frac{40}{360} \times \pi \times 52 = 8.73$ m^2
$\frac{40}{360} \times \pi \times 10 = 3.49$ m
c) $\frac{85}{360} \times \pi \times 142 = 145.4$ cm^2
$\frac{85}{360} \times \pi \times 28 = 20.8$ cm^2

18. $\text{Area} = \frac{300}{360} \times \pi \times 202 - \frac{300}{360} \times \pi \times 72$

$= \frac{1\,000}{3}\pi - \frac{245}{6}\pi$

$= 918.92 \text{ mm}^2$

Construction

1. Students' own work

2. Students' own work

3. **a)** Students' own work
b) Students' own work
c) Students' own work
d) Both triangles are isosceles.
e) 180°

4. **a)** Students' own work
b) $\hat{C} = 90°$
c) right-angled, scalene
d) – f) Students' own work

5. **a)** Students' own work
b) Students' own work
c) Students' own work

6. Students' own work

7. Students' own work

Answers to Worksheets

Worksheet 1

(WB page 1)

1. **a)** $6 \times 8^6 + 5 \times 8^4 + 4 \times 8^3 + 2 \times 8^2 + 3 \times 8^1 + 1 \times 8^0$

b) $2 \times 4^4 + 2 \times 4^3 + 0 \times 4^2 + 1 \times 4^1 + 1 \times 4^0$

c) $1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$

d) $6 \times 5^3 + 7 \times 5^2 + 0 \times 5^1 + 2 \times 5^0$

e) $5 \times 7^3 + 0 \times 7^2 + 4 \times 7^1 + 3 \times 7^0$

f) $4 \times 3^4 + 5 \times 3^3 + 2 \times 3^2 + 0 \times 3^1 + 1 \times 3^0$

g) $2 \times 10^4 + 3 \times 10^3 + 7 \times 10^2 + 0 \times 10^1 + 8 \times 10^0$

2. **a)**
$5 \times 8 + 7$
$= 57_8$

b)
$51 \times 5 + 1$
$10 \times 5 + 1$
$2 \times 5 + 0$
$= 2\,011_5$

c)
$16 \times 6 + 2$
$2 \times 6 + 4$
$= 242_6$

d)
$37 \times 2 + 1$
$18 \times 2 + 1$
$9 \times 2 + 0$
$4 \times 2 + 1$
$2 \times 2 + 0$
$1 \times 2 + 0$
$= 1001011_2$

3. **a)** 3 **b)** 3
c) 147 **d)** 300

4.
$2 \times 7^3 + 4 \times 7^2 + 6 \times 7^1 + 3 \times 7^0$
$= (2 \times 343) + (4 \times 49) + (6 \times 7) + (3 \times 1)$
$= 686 + 196 + 42 + 3$
$= 927$

5.
$7 \times 5^3 + 9 \times 5^2 + 2 \times 5^1 + 6 \times 5^0$
$= (7 \times 125) + (9 \times 25) + (2 \times 5) + (6 \times 1)$
$= 875 + 225 + 10 + 6$
$= 1\,116$

Worksheet 2

(WB page 4)

1.

Base 10 number	Value in powers of 2	Binary number
6	$1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0$	110
7	$1 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$	111
8	$1 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 0 \times 2^0$	1 000
9	$1 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$	1001
10	$1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 0 \times 2^0$	1 010

2. 4 = 100
6 = 110
2 = 010
So, $462_8 = 100110010_2$

3. **a)**

2	45	R
2	22	1
2	11	0
2	5	1
2	2	1
2	1	0
2	0	1

So, $45_{10} = 101101_2$

b)

2	62	R
2	31	0
2	15	1
2	7	1
2	3	1
2	1	1
2	0	1

So, $62_{10} = 111110_2$

c)

2	23	R
2	11	1
2	5	1
2	2	1
2	1	0
0	1	

So, $23_{10} = 10111_2$

d)

2	59	R
2	29	1
2	14	1
2	7	0
2	3	1
2	1	1
0	1	

So, $59_{10} = 111011_2$

4. **a)** 1101
$= 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$
$= 8 + 4 + 0 + 1$
$= 13$

b) 11011
$= 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$
$= 16 + 8 + 0 + 2 + 1$
$= 27$

c) 11010

$= 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 0 \times 2^0$

$= 16 + 8 + 0 + 2 + 0$

$= 26$

d) 110011

$= 1 \times 2^5 + 1 \times 2^4 + 0 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$

$= 32 + 16 + 0 + 0 + 2 + 1$

$= 51$

Worksheet 3

(WB page 7)

1. **a)**
$$\begin{array}{r} 1001 \\ +\ \ 11 \\ \hline 1100 \end{array}$$

b)
$$\begin{array}{r} 11101 \\ +\ 1000 \\ \hline 100101 \end{array}$$

c)
$$\begin{array}{r} 10010 \\ -\ 1111 \\ \hline 0011 \end{array}$$

d)
$$\begin{array}{r} 11100 \\ -\ 1101 \\ \hline 1111 \end{array}$$

e)
$$\begin{array}{r} 10100 \\ \times\ \ 110 \\ \hline 10100 \\ 101000 \\ \hline 111100 \end{array}$$

f)
$$\begin{array}{r} 1100 \\ \times\ \ 11 \\ \hline 1100 \\ 11000 \\ \hline 100100 \end{array}$$

2. **a)** $(10110_2)^2$

$= (2^8 + 2^7 + 2^6 + 2^5 + 2^2)$

$= 1 \times 2^8 + 1 \times 2^7 + 1 \times 2^6 + 1 \times 2^5 + 0 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 0 \times 2^1$

$= 111100100$

b) $\sqrt{1\,000\,000_2}$

$= 1 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 0 \times 2^0$

$= 1000$

c) $100_2 + (101_2 \times 1\,111_2)$

$= 4 + (5 \times 15)$

$= 79$

$= 2^6 + 2^3 + 2^2 + 2^1 + 2^0$

$= 1001110$

Worksheet 4

(WB page 8)

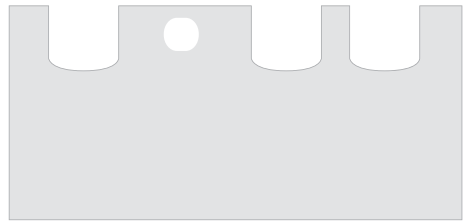
1. **a)** 1010 All and Kosher

b) 0101 Vegetarian and Halaal

c) 1001 All and Halaal

d) 0010 Kosher only

2.



3. No. You cannot eat all the food if you are vegetarian. The choice must be one or the other.

4.

B	0	0	0	1	0
I	0	1	0	0	1
N	0	1	1	1	0
A	0	0	0	0	1
R	1	0	0	1	0
Y	1	1	0	0	1

5. Students' own work

Worksheet 5

(WB page 10)

1. **a)** Rational **b)** Rational
c) Irrational **d)** Rational
e) Irrational **f)** Irrational
g) Irrational **h)** Irrational
i) Rational

2. 2.24

3. 0.17

4. **a)** $\frac{3}{5}$ **b)** $\frac{25}{100} = \frac{1}{4}$
c) $\frac{23}{8}$ **d)** $-\frac{356}{100} = -\frac{89}{25}$

5. $\frac{3\,005}{1\,000}$
$= \frac{601}{200}$

6. 0.42

7. $1.\dot{2}$

8. Let $x = 0.515151\ldots$

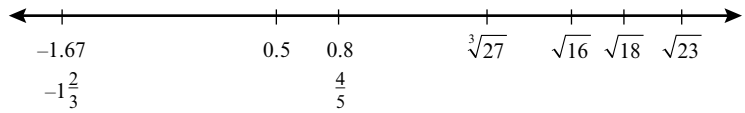
Let $100x = 51.5151\ldots$

$$\begin{aligned} 100x &= 51.5151\ldots \\ -x &= 0.5151 \\ \hline 99x &= 51 \\ x &= \frac{51}{99} \\ x &= \frac{17}{33} \end{aligned}$$

9. $\sqrt{25} = 5$

$\sqrt{36} = 6$

10.



Worksheet 6

(WB page 13)

1. $6x - x = 45$

$5x = 45$

$x = 9$

2. $x + x + 1 + x + 2 = 78$

$3x = 75$

$x = 25$

3. $x + 3 = 7x - 9$

$12 = 6x$

$2 = x$

4. $12 + \frac{1}{4}x = 15$

$48 + x = 60$

$x = 12$

5. $7 - \frac{5x}{2} = 12$

$-\frac{5x}{2} = 5$

$-5x = 10$

$x = -2$

6.

	Abiodun	**Adeleye**
Now:	$x + 32$	x
10 years ago:	$x + 22$	
	$3(x - 10)$	$x - 10$

$3x - 30 = x + 22$

$2x = 52$

$x = 26$

$\therefore$ Abiodun is 58 and Adeleye is 26.

7. 40 km $\rightarrow$ 60 min

$x \rightarrow$ 15 min

$\therefore x = 10$ km

8. Kwento: $3x$ (9)
Maka: x (3)

$\frac{3x}{2} = x + 15$

$3x = 2x + 30$

$x = 30$

$\therefore$ Kwento ate 45 sweets

9. P = 24 cm

$x + 6 + x + 6 + x = 24$

$3x = 12$

$x = 4$

$\therefore$ sides = 4 cm, 10 cm, 10 cm

10. A = $(160 - 10x)$

$\therefore (x - 2)(x - 8) = 160 - 10x$

$x^2 - 10x + 16 = 160 - 10x$

$x^2 = 144$

$x = \pm 12$

$\therefore x = 12$

Worksheet 7

(WB page 16)

1. $\frac{2}{3} = 42$

$\frac{1}{3} = 21$

$\therefore$ 63 students

2. $8 \times \frac{3}{4} = 6$

$\therefore$ 2 doughnuts for Yabani.

3. $3 \times 6 = 18$

4. $8 + \frac{1}{3}x = 14$

$24 + x = 42$

$x = 18$

5. $\left(25 \div \frac{1}{5}\right) + 13$

$= 125 + 13$

$= 138$

Worksheet 8

(WB page 17)

1. $2a + 6b$

2. $k^2m + 3k^3$

3. $-3b + 2b^2$

4. $12 - 2x + 3x^2$

5. $2m - n - m + 2n = m + n$

6. $m^2 + m - 12$

7. $-4\left(p^2 + p + \frac{1}{4}\right)$

$= -4p^2 - 4p - 1$

Worksheet 9

(WB page 18)

1. $\frac{2a+8}{5}$

2. $\frac{a+4}{10}$

3. $\frac{5x+4x}{20}=\frac{9x}{20}$

4. $\frac{6x-5x}{4}=\frac{x}{8}$

5. $-\frac{2x}{3}-\frac{x}{5}+\frac{x}{9}$
$=\frac{-30x-9x+5x}{45}$
$=-\frac{34x}{45}$

6. $\frac{(x+3)}{3}-\frac{(2x-1)}{4}$
$=\frac{4(x+3)}{12}-\frac{3(2x-1)}{12}$
$=\frac{4x+3-6x+3}{12}$
$=\frac{6-2x}{12}$
$=\frac{2(3-x)}{12}$
$=\frac{3-x}{6}$

7. $\frac{(m-2n)}{3}-\frac{(m-2n)}{6}$
$=\frac{2(2m-n)}{6}-\frac{(m-2n)}{6}$
$=\frac{4m-2n-m+2n}{6}$
$=\frac{3m}{6}$
$=\frac{m}{2}$

Worksheet 10

(WB page 20)

1. **a)** 12 **b)** xy **c)** $2abc$ **d)** mn^3 **e)** $\frac{1}{3}p^4q$

2. **a)** $4(a-b)$ **b)** $-(x+y)$

c) $m(m+3)$ **d)** $2xy^2z(xy+3z^2)$

e) $5ab(2bx-3a+a^2y)$ **f)** $\frac{1}{4}pq(1-64p)$

g) $(a-b)(3+a-b)$

h) $(m+3n)(f-g)-(m+3n)(2f-g)$
$=(m+3n)(f-g-2f+g)$
$=(m+3n)(-f)$
$=-f(m+3n)$

i) $(2x+y)(d-2)-d+2$
$=(2x+y)(d-2)-(d-2)$
$=(d-2)(2x+y-1)$

j) $15xy-32+40y-12x$
$=15xy-12x+40y-32$
$=3x(5y-4)+8(5y-4)$
$=(5y-4)(3x+8)$

Worksheet 11

(WB page 22)

1. a) $(a + 2)(a - 2)$

b) $(x + y)(x - y)$

c) $(4m - 3)(4m + 3)$

d) $(x + 3)(x - 1)$

e) $-b^2 + c^2$
$= -(b^2 - c^2)$
$= -(b + c)(b - c)$

f) $(x - 3)(x - 2)$

g) $-x^2 - 6x - 5$
$= -(x^2 + 6x + 5)$
$= -(x + 5)(x + 1)$

h) $12x^2y - 27y^3$
$= 3y(4x^2 - 9y^2)$
$= 3y(2x + 3y)(2x - 3y)$

i) $k^4 - 1$
$= (k^2 + 1)(k^2 - 1)$
$= (k^2 + 1)(k + 1)(k - 1)$

j) $2m^2 - 12m - 54$
$= 2(m^2 - 6m - 27)$
$= 2(m - 9)(m + 3)$

k) $a^2 - 15ab + 100b^2$
$= (a - 20b)(a + 5b)$

l) $\frac{1}{2}a^2 - 2$
$= \frac{1}{2}(a^2 - 4)$
$= \frac{1}{2}(a + 2)(a - 2)$

m) $9a^2 - (a - b)^2$
$= (3a + (a - b))(3a - (a - b))$
$= (4a - b)(2a + b)$

n) $m^2 - \frac{n^2}{25}$
$= \left(m + \frac{n}{5}\right)\left(m - \frac{n}{5}\right)$

o) $48^2 - 47^2$
$= (48 + 47)(48 - 47)$
$= (95)(1)$
$= 95$

p) $-3x^2 - 10xy - 3y^2$
$= -(3x^2 + 10xy + 3y^2)$
$= -(3x + y)(x + 3y)$

q) $(a - 4)^2 + 2(a - 4) - 120$
Let $(a - 4) = x$
$= x^2 + 2x - 120$
$= (x + 12)(x - 10)$
$= (a - 4 + 12)(a - 4 - 10)$
$= (x + 12)(x - 10)$

2. a) $\frac{2x}{3} + \frac{5x}{6}$

$= \frac{4x + 5x}{6}$

$= \frac{9x}{6}$

$= \frac{3x}{2}$

b) $\frac{2}{x}$

c) $\frac{2}{(x+1)} + \frac{4}{x}$

$= \frac{2x + 4(x+1)}{x(x+1)}$

$= \frac{2x + 4 + 4}{x(x+1)}$

$= \frac{6x + 4}{x(x+1)}$

$= \frac{2(3x+2)}{x(x+1)}$

d) $\frac{2}{(x-2)} - \frac{3}{(x-1)}$

$= \frac{2(x-1) - 3(x-2)}{(x-2)(x-1)}$

$= \frac{2x - 2 - 3x + 6}{(x-2)(x-1)}$

$= \frac{4 - x}{(x-2)(x-1)}$

e) $\frac{2}{(x^2 - x - 2)} - \frac{1}{(x^2 - 5x - 6)}$

$= \frac{2}{(x-2)(x+1)} - \frac{1}{(x-6)(x+1)}$

$= \frac{2(x-6) - (x-2)}{(x-2)(x+1)(x-6)}$

$= \frac{2x - 12 - x + 2}{(x-2)(x+1)(x-6)}$

$= \frac{x - 10}{(x-2)(x+1)(x-6)}$

Worksheet 12

(WB page 25)

1. a) $V = 2(x^4 - 16)$

$= 2(x^2 + 4)(x^2 - 4)$

$= 2(x^2 + 4)(x + 2)(x - 2)$

b) $V = 2(44 - 16)$

$= 480 \text{ m}^3$

2. a) $(x - 4)(x + 4)$

b) $(2x - 3)(x - 2)$

c) $A = (2x - 3)(x - 2) - (x - 4)(x + 4)$

d) $A = (2(15) - 3)(15 - 2) - (15 - 4)(15 + 4)$

$= 142 \text{ m}^2$

Worksheet 13

(WB page 26)

1. a) $xy + xb = 4$

$x(y + b) = 4$

$x = \frac{4}{y + b}$

b) $y(x + yx) = 5$

$xy + xy = 5$

$x(y + y) = 5$

$x = \frac{5}{2y}$

c) $P = \frac{(dx - c)}{a}$

$aP = dx - c$

$aP + c = dx$

$\frac{aP + c}{d} = x$

d) $M = wx^2y$

$\frac{M}{wy} = x^2$

$x = \pm\sqrt{\frac{M}{wy}}$

e) $A = \frac{(2x + y)}{x}$

$Ax = 2x + y$

$Ax - 2x = y$

$x(A - 2) = y$

$x = \frac{y}{A - 2}$

f) $4a\sqrt{x} = \frac{1}{b}$

$\sqrt{x} = \frac{1}{4ab}$

$x = \frac{1}{16a^2b^2}$

g) $\frac{(y - x)}{(y + x)} = z$

$y - x = z(y + x)$

$y - x = yz + xz$

$y - yz = x + xz$

$y - yz = x(1 + z)$

$x = \frac{y - yz}{(1 + z)}$

h) $\sqrt{\frac{(a - x)}{x}} = b$

$\frac{a - x}{x} = b^2$

$a - x = b^2x$

$a = b^2x + x$

$a = x(b^2 + 1)$

$x = \frac{a}{(b^2 + 1)}$

2. a) $R = \sqrt{b^2 - 4ac}$

$R^2 = b^2 - 4ac$

$R^2 - b^2 = -4ac$

$\frac{R^2 - b^2}{-4ac} = c$

b) $R = \sqrt{b^2 - 4ac}$

$R^2 = b^2 - 4ac$

$R^2 + 4ac = b^2$

$\pm\sqrt{R^2 + 4ac} = b$

c) $c = \frac{R^2 - b^2}{-4ac}$

$c = \frac{3^2 - (4)^2}{-4(2)}$

$c = \frac{7}{8}$

3. a) $97\,500 = P(1 + 0.06 \times 5)$

$\frac{97\,500}{(1 + 0.06 \times 5)} = P$

$P = ₦\,75\,000$

b) $68\,800 = 40\,000(1 + i \times 8)$

$\frac{43}{25} = 1 + 8i$

$\frac{18}{25} = 8i$

$0.09 = i$

rate = 9%

4. $\sqrt{26} = \sqrt{(5-0)^2 + (y-0)^2}$

$26 = 25 + y^2$

$1 = y^2$

$y = \pm 1$

$\therefore y = 1$

Worksheet 14

(WB page 30)

1. a)

Test result	Tally	Frequency
1	|	1
2		0
3		1
4	||	2
5		0
6		0
7	||||	4
8	𝍸	9
9		4
10	|||	3

b) $(1 \times 1) + (1 \times 3) + (2 \times 4) + (4 \times 7) + (9 \times 8) + (4 \times 9) + (3 \times 10)$

$= 178$

$\therefore \frac{175}{24}$

$= 7.42$

c) Easy test. The mean is 7.42. (Average 74%.)
Mode = 8. (Most students scored 80%.)

d) 8

2. **1.** G **2.** D **3.** F **4.** B
5. C **6.** E **7.** A

Worksheet 15

(WB page 33)

1. **a)** Mean: $\frac{109}{15} = 7.3$
Median: 8
Mode: 6

b) Arrange: 0.53; 0.54; 0.55; 0.56; 0.58; 0.59
Mean: 0.558
Median: 0.555
Mode: No

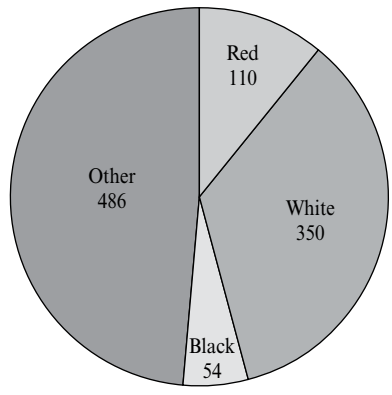
2. **a)** Set A – definite values (counting objects)
b) Quantitative – numerical values.
Qualitative data is described in words; cannot be counted.
c) Set B – can have any value measured to a degree of accuracy (height, weight, and so on).
d) Probably not, as they are in ascending order already.
e) A $\rightarrow$ 25 – 1 = 24
B $\rightarrow$ 0.66 – 0.55 = 0.11
f) Set A. It is 25.
An outlier is a number that does not follow the same trend as the rest of the data.

3. **a)** $62 + 57 + 74 + 60 + 72 + 69 + 96 = \frac{490}{7} = 70\%$
b) $\frac{70\% + x}{2} = 73\%$
$\therefore x = 76\%$

Worksheet 16

(WB page 36)

1. **a)**

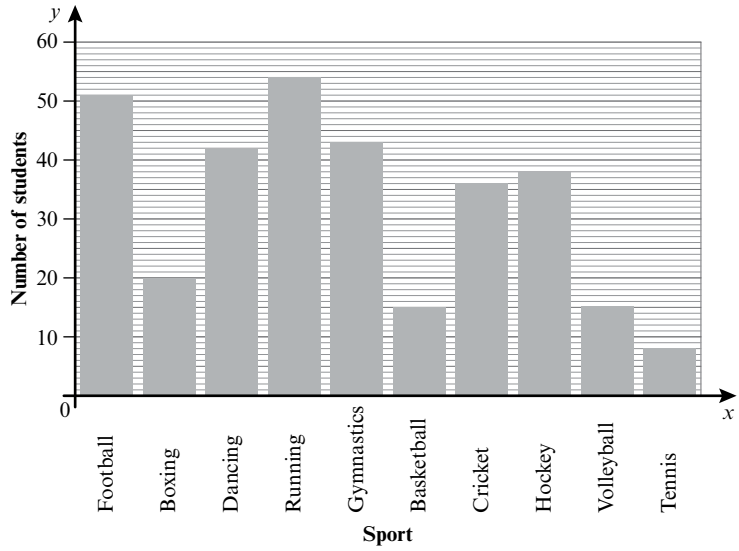


b) $350 + 110 + 54 + 486 = 1\,000$

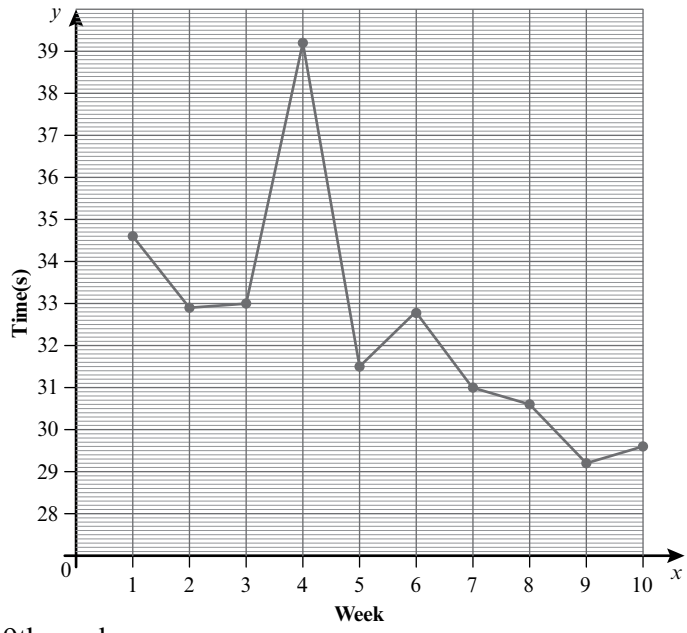
$\frac{350}{1\,000} = \frac{7}{20} \times 100 = 35\%$

c) Good graphical representation – clearly see the number of cars in comparison.

2.



3. a)



b) 9th week

c) 10 seconds

d) Osayuwamen was probably tired.

e) Not exact time. But the times do continue to get better and better (less and less).

Worksheet 17

(WB page 39)

1. $x = 13$

2. $x = -10$

3. $2x + 4 = 4x - 5$

$9 = 2x$

$\frac{9}{2} = x$

4. $3(x + 1) + x = -4(x + 2)$

$3x + 3 + x = -4x - 8$

$4x + 4x = -8 - 3$

$8x = -11$

$x = -\frac{11}{8}$

5. $\frac{x}{3} = \frac{9}{2}$

$2x = 27$

$x = \frac{27}{2}$

6. $\frac{x}{2} + \frac{(x-1)}{4} = 5$

$2x + x - 1 = 20$

$3x = 21$

$x = 7$

7. $\frac{(x+3)}{5} - x - 1 = \frac{(3x-1)}{2}$

$2(x + 3) - 10x - 10 = 5(3x - 1)$

$2x + 6 - 10x - 10 = 15x - 5$

$6 - 10 + 5 = 15x + 10x - 2x$

$1 = 23x$

$x = \frac{1}{23}$

8. $\frac{1}{2}x = \frac{3}{4}x - \frac{2}{5}$

$10x = 15x - 8$

$8 = 5x$

$x = \frac{8}{5}$

9. $\frac{4}{x} = \frac{2}{-3}$

$-12 = 2x$ $\qquad x \neq 0$

$-6 = x$

10. $\frac{3}{x} + \frac{2}{5x} = \frac{-4}{3}$

$45 + 6 = -20x \qquad x \neq 0$

$51 = -20x$

$x = -\frac{51}{20}$

11. $\frac{(x-1)}{2x} = \frac{(x+3)}{4x}$

$4x(x-1) = 2x(x+3) \qquad x \neq 0$

$4x^2 - 4x = 2x^2 + 6x$

$2x^2 - 10x = 0$

$2x(x-5) = 0$

$2x = 0$ or $x = 5$

Since $x \neq 0$, $x = 5$ only.

12. $\frac{1}{(x-2)} + 3 = 0$

$1 + 3(x-2) = 0 \qquad x \neq 2$

$1 + 3x - 6 = 0$

$3x = 6$

$x = 2$

But $x \neq 2$, so no solution.

13. $\frac{2}{(x+1)} = \frac{3}{2x}$

$4x = 3(x+1) \qquad x \neq 0; x = -1$

$4x = 3x + 3$

$x = 3$

14. $\frac{(3x-1)}{(x-1)} = \frac{(6x+1)}{(2x+1)}$

$(3x-1)(2x+1) = (6x+1)(x-1) \qquad x \neq 1; x \neq -\frac{1}{2}$

$6x^2 + 3x - 2x - 1 = 6x^2 - 6x + x - 1$

$x = -5x$

$6x = 0$

$x = 0$

Worksheet 18

(WB page 42)

1. $\frac{5}{12}x - \frac{1}{6}x = 10$

$5x - 2x = 120$

$3x = 120$

$x = 40$

2. $\frac{(x+3)}{8} = 2$

$x + 3 = 16$

$x = 13$

3. $\frac{1}{2}x + \frac{1}{6}x = x - 8$

$3x + x = 6x - 48$

$48 = 2x$

$x = 24$

4. $7 - \frac{5x}{2} = 12$

$14 - 5x = 24$

$-5x = 10$

$x = -2$

5. $x - 600 = \frac{1}{5}x$

$\frac{4}{5}x = 600$

$4x = 3\,000$

$x = 750$ ml

6. $\frac{1}{4}x + \frac{1}{8}x + \frac{1}{3}x = \frac{17}{24}x$

$\therefore$ amount left $= \frac{7}{24}$

$\frac{7}{24} \times 150 =$ ₦43.75

7. $x + x + \frac{3}{4}x = \frac{55}{2}$

$\frac{11}{4}x = \frac{55}{2}$

$11x = \frac{220}{2}$

$x = 10$

$\therefore$ sides = 10; 10 and 7.5 units

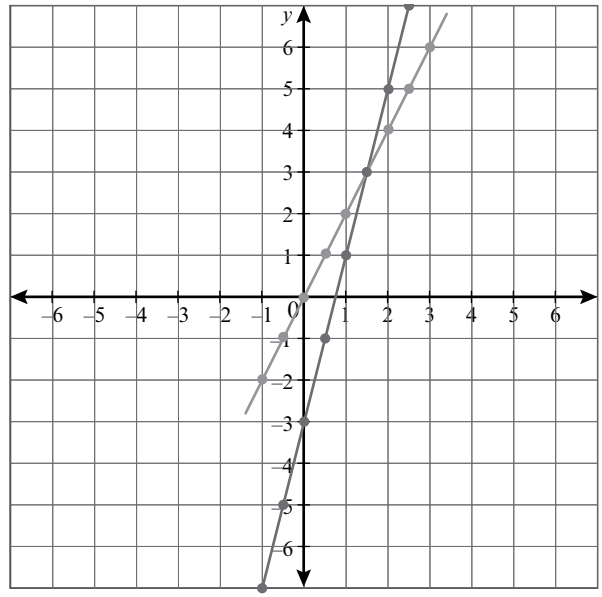
Worksheet 19

(WB page 44)

1.

$\frac{y}{2} = x$									
x	–1	$-\frac{1}{2}$	0	$\frac{1}{2}$	1	$\frac{3}{2}$	2	$\frac{5}{2}$	3
y	–2	–1	0	1	2	3	4	5	6

$4x - y = 3$									
x	–1	$-\frac{1}{2}$	0	$\frac{1}{2}$	1	$\frac{3}{2}$	2	$\frac{5}{2}$	3
y	–7	–5	–3	–1	1	3	5	7	9



2. **a)** $5x + y = 5$

$5(7 + y) + y = 5$

$35 + 5y + y = 5$

$6y = -30$

$y = -5$

$x - y = 7$

$x = 7 + y$

$\therefore x = 7 - 5$

$x = 2$

b) $4x - 2y = 6$ and $\frac{x}{2} + \frac{y}{3} = 4$

$4x - 2y = 6$

$4x - 6 = 2y$

$2x - 3 = y$

$2\left(\frac{30}{7}\right) - 3 = y$

$y = \frac{39}{7}$

$\frac{x}{2} + \frac{y}{3} = 4$

$3x + 2y = 24$

$3x + 2(2x - 3) = 24$

$3x + 4x - 6 = 24$

$7x = 30$

$x = \frac{30}{7}$

c) $4x + 0.2y = 1.8$ and $x - 2y = 3.5$

$4x + 0.2y = 1.8$

$4(2y + 3.5) + 0.2y = 1.8$

$8y + 14 + 0.2y = 1.8$

$8.2y = -12.2$

$y = -\frac{61}{41}$

$x - 2y = 3.5$

$x = 2y + 3.5$

$x = 2\left(-\frac{64}{41}\right) = 3.5$

$x = \frac{43}{82}$

3. **a)** $y = -2x + 10$

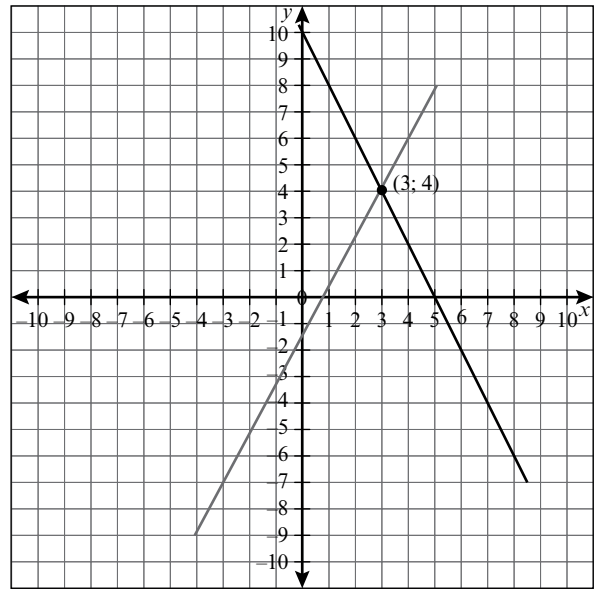
y-intercept: $y = 10$

x-intercept: $x = 5$

$y = \frac{5}{3}x - 1$

y-intercept: $y = -1$

x-intercept: $x = \frac{3}{5}$



b) $y = -6x + 3$

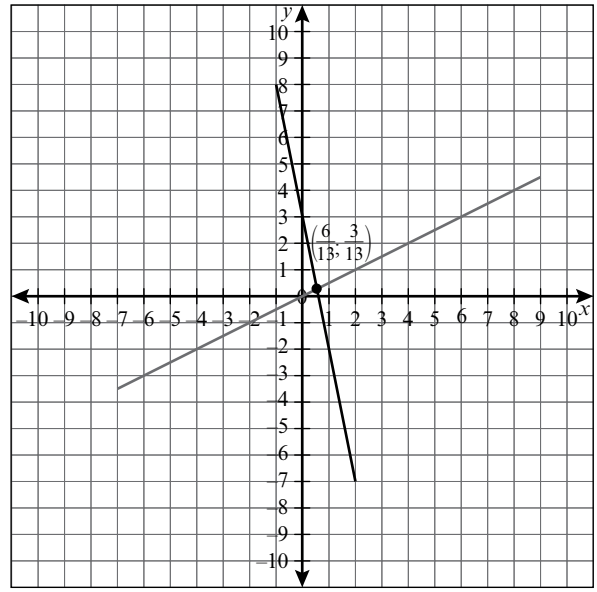
y-intercept: $y = 3$

x-intercept: $x = \frac{1}{2}$

$y = \frac{1}{2}x$

y-intercept: $y = 0$

x-intercept: $x = 0$



Worksheet 20

(WB page 47)

1. $6 = a + b$ $\qquad a = 6 - b$

$10 = 2a + b$

$\therefore\ 10 = 2(6 - b) + b$ $\qquad a = 6 - 2$

$10 = 12 - 2b + b$ $\qquad \therefore\ a = 4$

$-2 = -b$

$2 = b$

2. **a)** xy

$x^2 + xy + y^2 = 12$ $\qquad xy = 4$

$xy = 12 - x^2 - y^2$

$xy = 12 - (x^2 + y^2)$

b) $x^2 + 2xy + y^2$

$= x^2 + y^2 + 2xy$

$= 8 + 2(4)$

$= 16$

c) $(x + y)^2$

$= x^2 + 2xy + y^2$

$= 16$

d) $(x + y)$

$= \sqrt{(x + y)^2}$

$= \sqrt{16}$

$= 4$

3. $x + y = 30$ $\qquad x = 30 - y$

$4\ 500x + 3\ 000y = 105\ 000$

$4\ 500(30 - y) + 3\ 000y = 105\ 000$

$135\ 000 - 4\ 500y + 3\ 000y = 105\ 000$

$30\ 000 = 1\ 500y$

$\therefore\ y = 20$

$\therefore$ long trousers = 10

4. $2x + 3 = 2y + 1$

$2y + 1 + y - 3x$ $\qquad y = -3x - 1$

$2x + 2 = 2(-3x - 1)$

$2x + 2 = -6x - 2$

$8x = -4$

$x = -\frac{1}{2}$

$y = -3\left(-\frac{1}{2}\right) - 1$

$y = \frac{1}{2}$

$\therefore$ sides = 2; 2 and 2 units

Worksheet 21

(WB page 49)

1. **a)**

x	1	2	4	6
y	8	16	32	48

Direct

b)

x	10	4	–4	–12
y	25	10	–10	–30

Direct

c)

x	1	2	4	10
y	20	10	5	2

Inverse

d)

x	45	25	15	5
y	5	9	15	45

Inverse

2. **a)** 198 000 ÷ 7 = ₦ 28 285.71

b) 198 000 ÷ 7 × 12 = ₦ 339 428.57

c) Direct. The more days you stay, the more you pay.

3. $\frac{301}{7} \times 15 =$ ₦ 645

4. **a)** 40 days **b)** 2 days **c)** 4 pigs

5. 80 min × 40 ÷ 16 = 200 km

6. 100 × 140 ÷ 100 = 140 km/h

7. 162 × 3 ÷ 18 = 27 boxes

8. 10 × 6 ÷ 4 = 15 days

9. **a)** 6

b) $0.32 = \frac{32}{100} = \frac{100}{32} = 3\frac{1}{8} = 3.125$

c) $15 = \frac{1}{15}$

d) $0.014 = \frac{14}{1\,000} = \frac{1\,000}{14} = 71\frac{6}{14} = 71\frac{3}{7}$

e) $-\frac{7}{8} = \frac{8}{7}$

Worksheet 22

(WB page 53)

1. SI = 100 450 × 0.12 × 20
= 241 080

2. $70\ 392 = 40\ 800\ (1 + i \times 4)$
$\frac{70\ 392}{40\ 800} = 1 + 4i$
$0.725 = 4i$
$i = 18\ 132$
∴ rate = 18.31%

3. $430\ 000 = 200\ 000\ (1 + 0.115n)$
$\frac{43}{20} = 1 + 0.115n$
$\frac{23}{20} = 0.115n$
∴ $n = 10$

4. $20\ 000 = P(1 + 0.10 \times 6)$
$12\ 500 = P$

5. $A = 15\ 000(1 + 0.09)^3$
$A = 19\ 425.44$

6. $103\ 808 = 50\ 000(1 + i)^7$
$\frac{6\ 488}{3\ 125} = (1 + i)^7$
$0.1099 = i$
∴ rate = 10.99%

7. $A = 30\ 000(1 + 0.065)^4$
$A = 38\ 593.99$
$A = 50\ 000(1 + 0.08 \times 4)$
$A = 66\ 000$
It is better to invest ₦ 50 000 at 8% simple interest for 4 years.

8. **a)** $178.5 = 139.5(1 + i)^{10}$
$= \frac{119}{93} = (1 + i)^{10}$
$0.0249 = i$
∴ rate = 2.5%

b) $A = 178.5(1 + 0.0282)^1$
$A = 183.5$ million (183 500 000)

9. $A = 950\ 000(1 + 0.1219)^{20}$
$A = 9\ 479\ 961.33$

10. $A = 900\,000(-0.11)^5$
$A = 502\,565.35$

11. $21\,995 = P(1 - 0.08)^3$
$28\,246.23 = P$

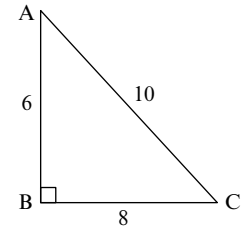
Worksheet 23

(WB page 56)

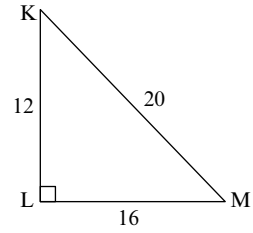
1. **a)** $\sin P = \frac{QR}{QP}$ **b)** $\cos P = \frac{PR}{PQ}$ **c)** $\tan P = \frac{QR}{PR}$

d) $\sin Q = \frac{PR}{PQ}$ **e)** $\cos Q = \frac{QR}{PQ}$ **f)** $\tan Q = \frac{PR}{QR}$

2. $\tan A = \frac{BC}{AB}$
$= \frac{8}{6}$
$= \frac{4}{3}$



3. $\sin K = \frac{LM}{KM}$
$= \frac{16}{20}$
$= \frac{4}{5}$



4. **a)** 0.31 **b)** 0.42 **c)** 0.62 **d)** 1

e) $\frac{1}{8}$ or 0.13 **f)** 0.80 **g)** 5.19 **h)** 0.86

i) 3.46 **j)** 0.88 **k)** –2.56

5. **a)** 0 **b)** 1.37 **c)** 1 **d)** 1.5

e) –2.5 **f)** 2.31 **g)** 0.13

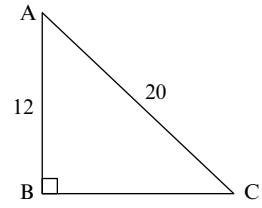
6. **a)** 36.9 **b)** 76.7 **c)** 56.3 **d)** 41.8

e) 12.4 **f)** 66.5 **g)** 36.9

Worksheet 24

(WB page 59)

1. $\cos A = \frac{12}{20}$
$A = 53.13$
$\sin C = \frac{12}{20}$
$C = 36.87$

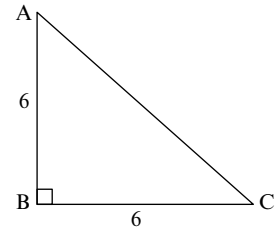


2. $\tan C = \frac{6}{6}$

$C = 45$

$\tan A = \frac{6}{6}$

$A = 45$

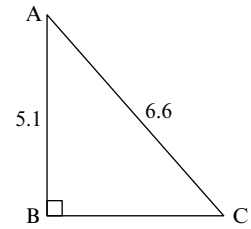


3. $\cos A = \frac{5.1}{6.6}$

$A = 39.4$

$\sin C = \frac{5.1}{6.6}$

$C = 50.6$

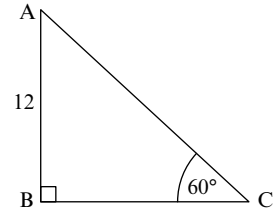


4. $\sin 60 = \frac{12}{AC}$

$AC = 13.86$

$\tan 60 = \frac{12}{BC}$

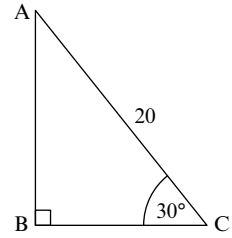
$BC = 6.93$



5. $\sin 30 = \frac{AB}{20}$ $AB = 10$

$\cos 30 = \frac{BC}{20}$

$BC = 17.32$

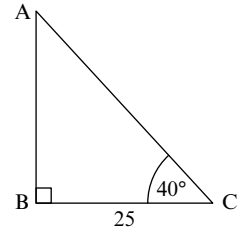


6. $\tan 40 = \frac{AB}{25}$

$AB = 21$

$\cos 40 = \frac{25}{AC}$

$AC = 32.64$



7. **a)** Length of SQ

$\tan 21.8 = \frac{SQ}{5.1}$

$SQ = 2.04$ m

b) Length of PR

$PR^2 = 5.1^2 + 4.34^2$

$PR = 6.7$ m

c) Angle RPS

$\cos P = \frac{5.1}{6.7}$

$= 40.43 - 21.8$

RPS = 18.63

Worksheet 25

(WB page 62)

1. In △KLM:

$M\hat{K}N = 55$

$L\hat{K}N = 35$

$\therefore \hat{L}\ 90$

KM = 20.48

$\sin 55 = \frac{KM}{LM}$

$\sin 55 = \frac{KM}{25}$

In △KMN:

$\sin M = \frac{KN}{KM}$

$\sin 35 = \frac{KN}{20.48}$

KN = 11.75

2. $B\hat{A}C = 35$

In △ABC:

$\tan 35 = \frac{BC}{10}$

BC = 7

$B\hat{A}D = 56$

In △ABD

$\tan 56 = \frac{BD}{10}$

BD = 14.83

$\therefore$ CD = BD – BC = 7.83

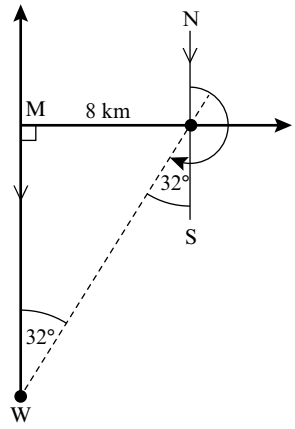
Worksheet 26

(WB page 64)

1. a) 135°

b) 225°

2. a)



b) $180° + 32° = 212°$ ($W\hat{H}S = 32$ (alt angles), NS || MW. NS is a straight line = 180°

c) $\tan 32 = \frac{8}{WM}$

$WM = \frac{8}{\tan 32°}$

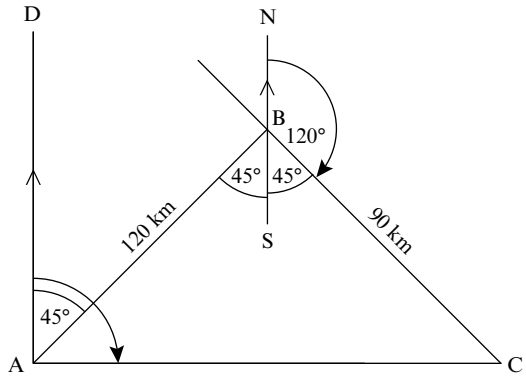
$WM = 12.80$ km

d) $\sin 32 = \frac{8}{WH}$

$WH = \frac{8}{\sin 32°}$

$WH = 15.10$ km

3. a)



b) $A\hat{B}S = 45°$ (alt angles, AD || NS)

$S\hat{B}C = 45°$ (angles on straight line)

$\therefore A\hat{B}C = 90°$

c) $AC^2 = 90^2 + 120^2$

$AC^2 = 22\,500$

$AC = 150$ km

d) $\tan B\hat{A}C$

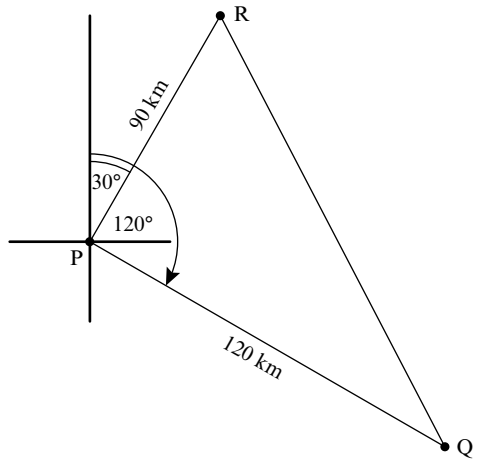
$= \frac{90}{120}$

$= 36.87$

$\therefore$ Bearing $= 45 + 36.87$

$= 81.87°$

4. a)



b) $RQ^2 = 90^2 + 120^2$
$= 22\,500$
$RQ = 150$ km
$\therefore$ Each boat must sail 75 km along RQ to meet at M.

Worksheet 27

(WB page 69)

1. **a)** 2 : 3
b) 8 : 1
c) 15 ml : 1.2 l
15 : 1 200
1 : 80
d) $\frac{3}{4} : \frac{2}{3}$
9 : 8

2. $160 \div 4 \times 13$
$= 520$

3. $160 \div 16 = 10$
110 : 50

4. $210 \times 20\% = 42$
$210 - 42 = 168$

5. $187 \div 11$
85 : 102

6. **a)** $\triangle ABC \,|||\, \triangle DFE$ (sides in proportion)
b) $\triangle GHI \,|||\, \triangle XYW$ (sides in proportion)
c) $\triangle MNO \,|||\, \triangle LNO$ (= corresponding angles)

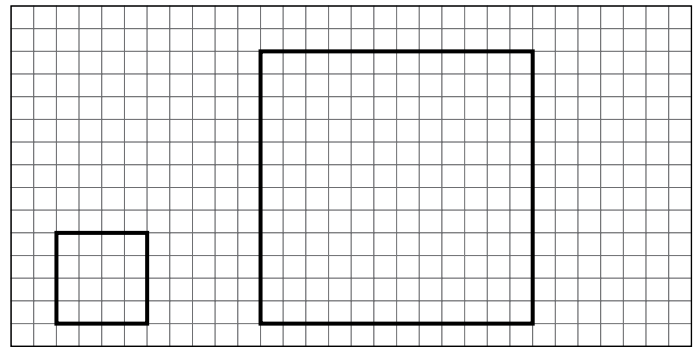
7. **a)** $K\hat{J}L = x$ (isosceles $\triangle JKL$, base angles equal)
b) $\triangle JKL \,|||\, \triangle MNL$ (AAA)

8. $\frac{AK}{AB} = \frac{AL}{AC}$
$\frac{1.5}{4.5} = \frac{AL}{6}$
$AL = 2$
$\therefore LC = 4$
$x = 4$

Worksheet 28

(WB page 72)

1. **a)**



b)

Dimensions	Area
4 × 4	16 blocks
12 × 12	144 blocks

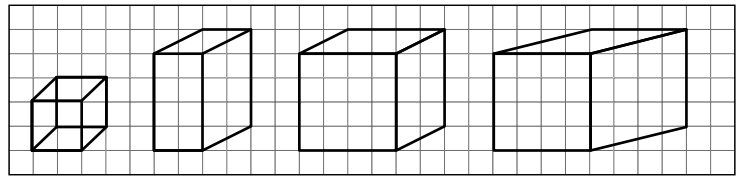
c) Yes. Sides are in proportion. Enlarged by scale factor of 3.

d) $\frac{4}{12} = \frac{1}{3}$. Scale factor = 3

e) $\frac{16}{144} = \frac{1}{9}$

f) Ratio of areas = (scale factor)^2
$(\frac{1}{3})^2 = \frac{1}{9}$

2.



a) – d)

Dimensions	Volume	Surface area
2 × 2 × 2 cm	8 blocks^3	24 blocks^2
2 × 2 × 4 cm	16 blocks^3	2(2)(2) + 2(2)(4) + 2(2)(4) 40 blocks^2
2 × 4 × 4 cm	32 blocks^3	2(2)(4) + 2(4)(4) + 2(2)(4) 64 blocks^2
4 × 4 × 4 cm	64 blocks^3	2(4)(4) + 2(4)(4) + 2(4)(4) 96 blocks ^{2}

e) Volume: Original V × (scale factor)^3
Example: $8 \times 2^3 = 64$

Surface area: Original SA × (scale factor)^2
Example: $24 \times 2^2 = 96$

Worksheet 29

(WB page 75)

1. 1.5 : 4
4.5 : x
$x = 12$

2. 3 : 7.5
x : 5
$x = 2$

3. 15 : 4
28.125 : 7.5
$x = 28\frac{1}{8}$

4. $3 \times 50\,000 = 150\,000$ m^2

5. $27 \times 2^3 = 216$
$\therefore$ scale factor = 2

6. 150 : 200
30 : x
$x = 40$

7. **a)** $V = \pi r^2 h$
$V = 160\pi$ or 502.65 m^3

b) **i)** $V = 160\pi \times \frac{1}{2} = 80\pi$

ii) $V = 160\pi \times 3^2 = 1\,440\pi$

Worksheet 30

(WB page 77)

1. **a)** Area:
$A = l \times b$
$= 12 \times 5$
$= 60\ m^2$

Perimeter:
$P = 2l + 2b$
$= 2(12) + 2(5)$
$= 34$ m

b) Area:
$A = \frac{1}{2}bh$
$= \frac{1}{2}(9)(12)$
$= 54\ cm^2$

Perimeter:
$P = s + s + s$ PR = 15 cm (Pyth)
$= 9 + 12$
$= 36$ cm

c) Area:
$A = \frac{1}{2}bh$
$= \frac{1}{2}(6)(8)$
$= 24\ m^2$

$CB = \sqrt{17}$
$A = \frac{1}{2}bh$
$= \frac{1}{2}(\sqrt{17})(8)$
$= 4\sqrt{17}$

Total area = 40.49 m^2

Perimeter:

$P = 10 + 9\sqrt{17} + 6$

$= 23.8$ m

d) Area:

YZ = 9 m; XY = 12 m; WX = 9 m

$A = l \times b$

$= 12 \times 9$

$= 108$ m^2

Perimeter:

$P = 2l + 2b$

$= 2(12) + 2(9)$

$= 42$ m

e) Area:

$A = \frac{1}{2}(a + b) \times h$ UW = 6 cm

$= \frac{1}{2}(6 + 19) \times 8$

$= 100$ cm^2

Perimeter:

$P = 9 + 13 + 6 + 10 + 6$ TU = 10 (Pyth)

$= 44$ cm

f) Area:

$A = \pi r^2$

$= \pi(7)^2$

$= 49\pi$ or 153.94

Perimeter:

$P = 2\pi r$

$= 2\pi(7)$

$= 14\pi$ or 43.98

Worksheet 31

(WB page 81)

1. a) Part 1: $A = s^2 = 36$ m^2

Part 2: $A = \frac{\pi r^2}{2} = \frac{\pi(3)^2}{2}$

$= \frac{9}{2}\pi$ or 14.14

$\therefore$ white $= 36 - (14.14 \times 2)$

$= 7.72$ m^2

b) Part 1: $A = \frac{1}{2}(a + b) \times h$

$= \frac{1}{2}(8 + 11) \times 8$

$= 76 \text{ cm}^2$

Part 2: $A = \pi r^2$

$= \pi(4)^2$

$= 16\pi$ or 50.27

Area = 25.73 cm^2

c) 60 of 360 $= \frac{1}{6}$

$A = \pi r^2$

$= \pi(10)^2$

$= 100\pi \times \frac{1}{6}$

$= \frac{50}{3}\pi$ or 52.36 cm^2

2. $A = \pi r^2$

$= \pi(5)^2$

$= 25\pi$ or 78.54 cm^2

3. $A = \frac{1}{2}bh$

$60 = \frac{1}{2}b(12)$

$60 = 6b$

$10 = b$

4. $C = \pi d$

$55 = \pi d$

$17.5 = d$

5. $A = \frac{1}{2}(a + b) \times h$

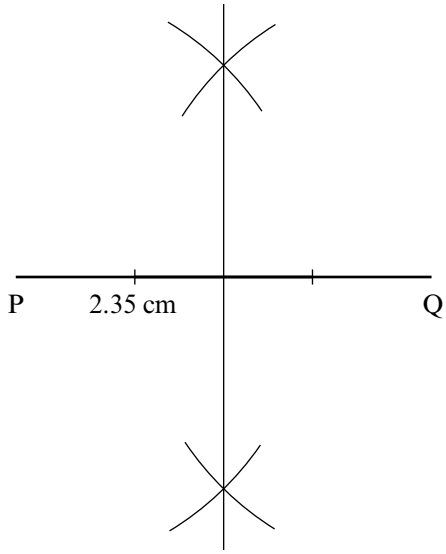
$36 = \frac{1}{2}(5 + 7) \times h$

$6 = h$

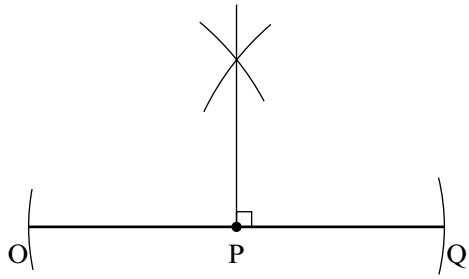
Worksheet 32

(WB page 84)

1.



2.



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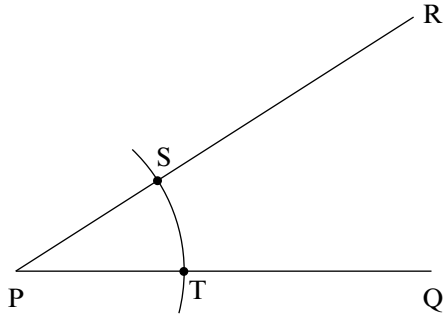
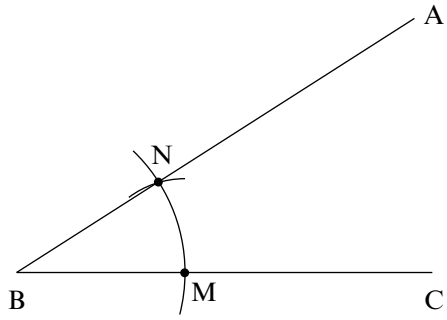
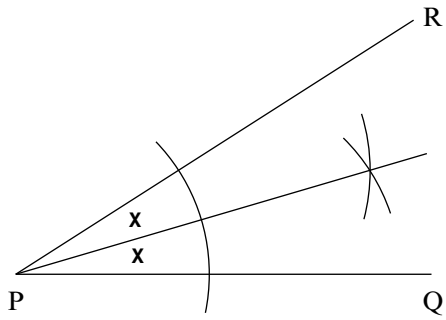
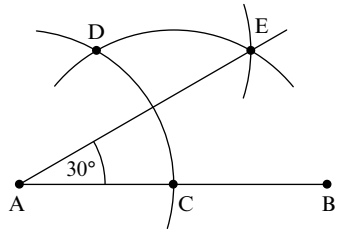


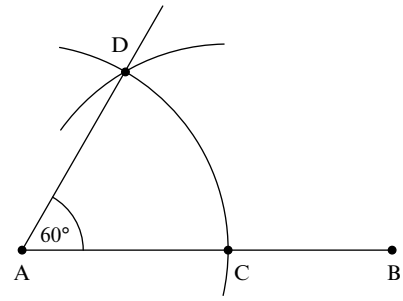


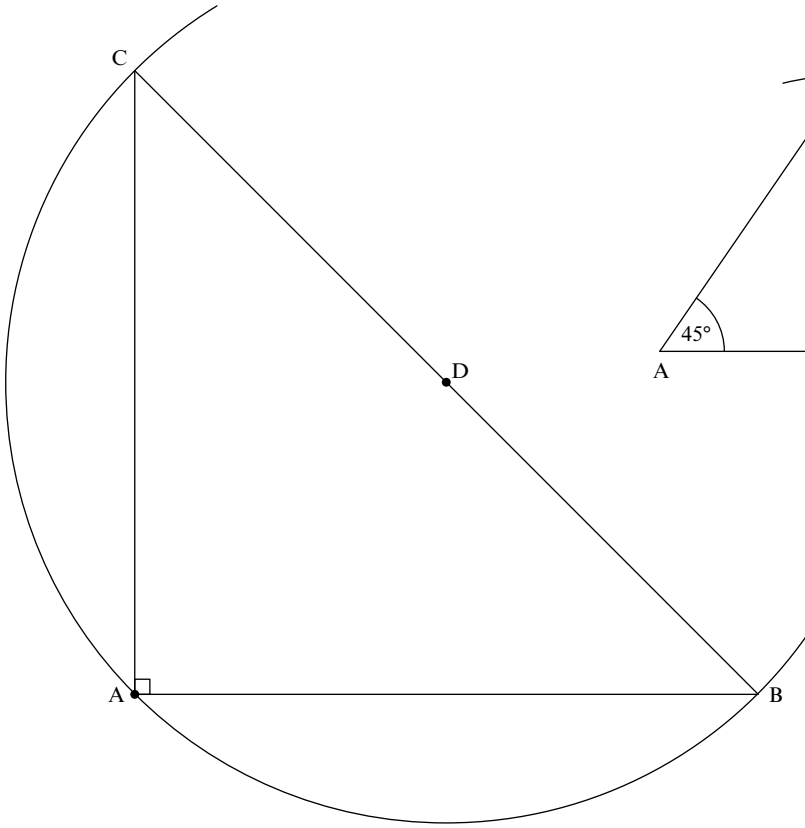
4.

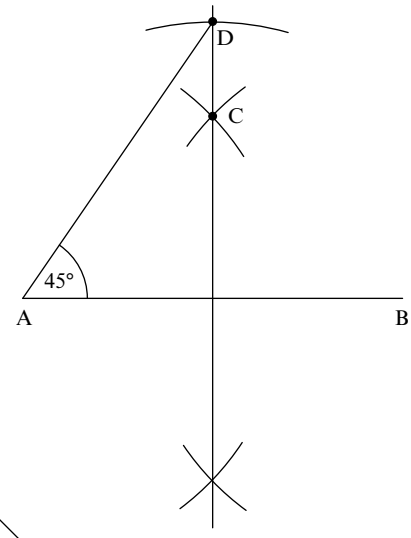


5.







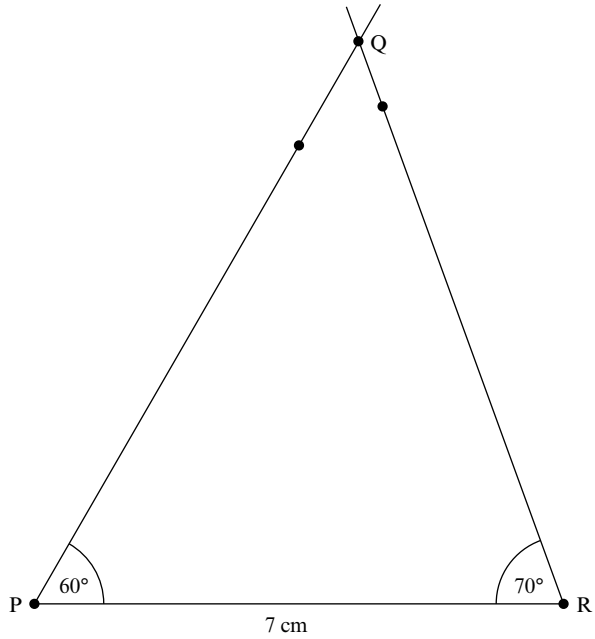


Angles of 105°, 120°, 135° and 150° – Students' own work with teacher guidance.

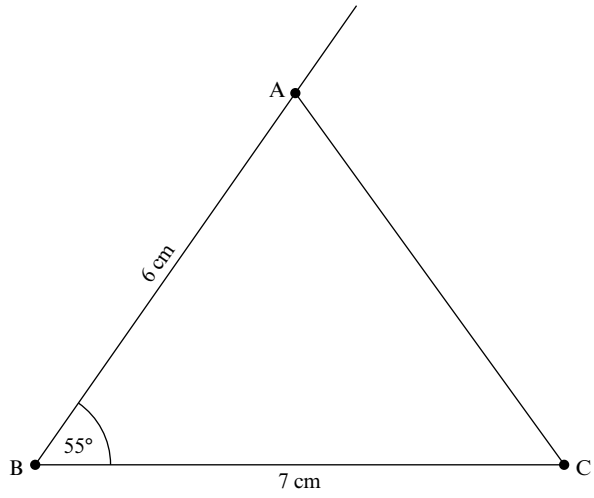
Worksheet 33

(WB page 88)

1.



2.



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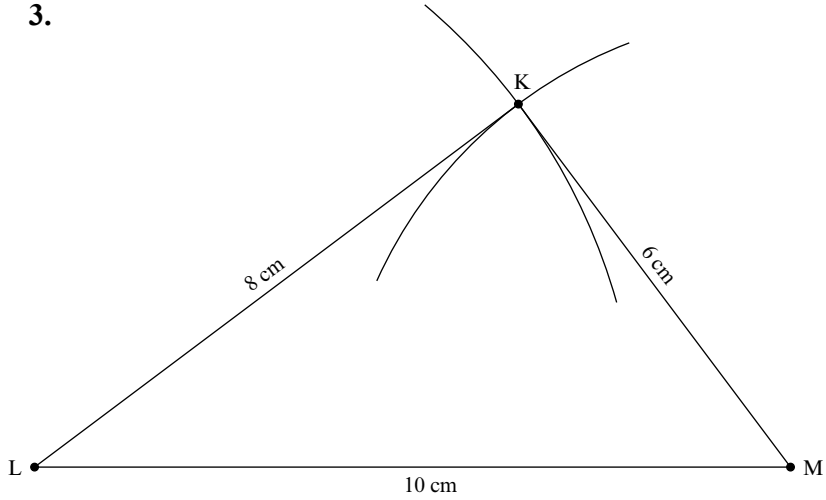
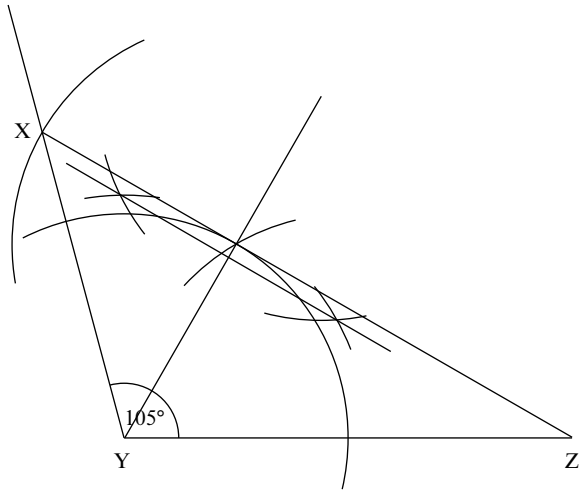


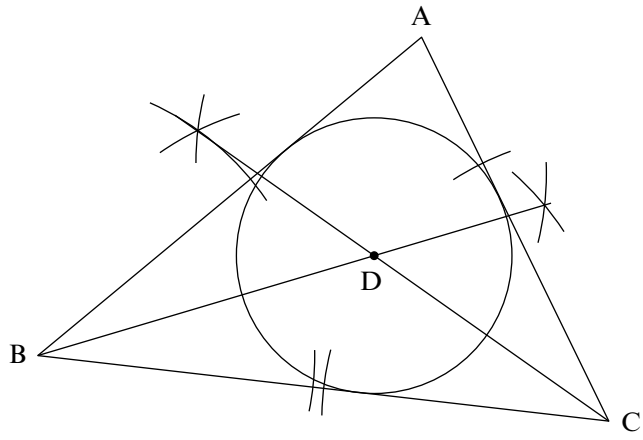
4.



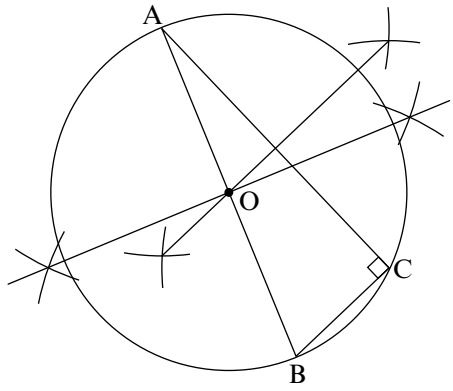
Worksheet 34

(WB page 90)

1.



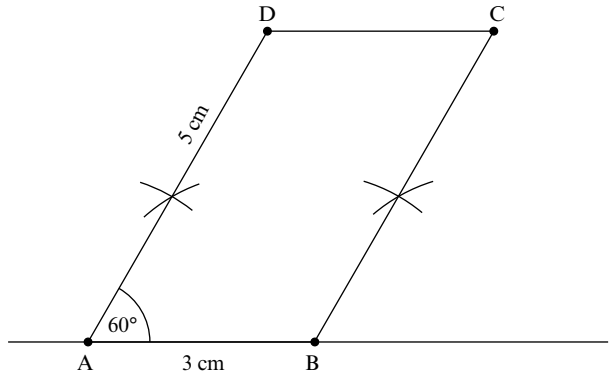
2.



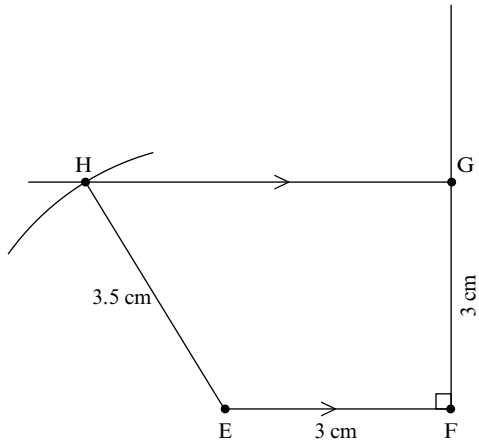
Worksheet 35

(WB page 91)

1.



2.



Memorandum: Exemplar Examination Paper 1 (SB page 306)

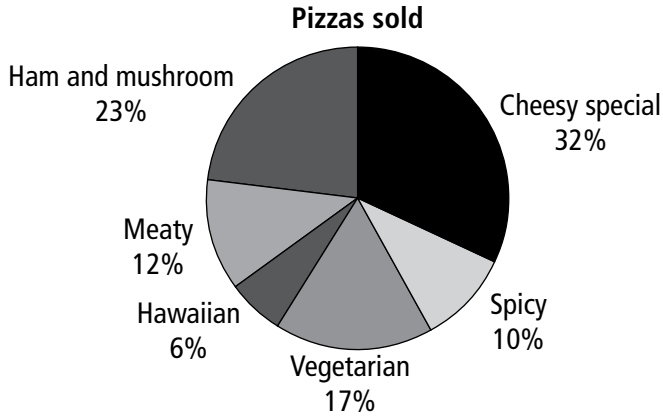
1. A	**2.** C	**3.** B	**4.** A	**5.** D
6. C	**7.** C	**8.** D	**9.** A	**10.** C
11. B	**12.** B	**13.** D	**14.** A	**15.** C
16. A	**17.** D	**18.** C	**19.** B	**20.** A
21. A	**22.** D	**23.** C	**24.** B	**25.** B
26. A	**27.** C	**28.** D	**29.** C	**30.** B
31. A	**32.** A	**33.** C	**34.** B	**35.** D
36. C	**37.** B	**38.** B	**39.** A	**40.** D
41. B	**42.** A	**43.** C	**44.** D	**45.** B
46. C	**47.** B	**48.** C	**49.** A	**50.** A
51. B	**52.** C	**53.** C	**54.** D	**55.** A
56. D	**57.** C	**58.** B	**59.** A	**60.** C

Memorandum: Exemplar Examination Paper 2 (SB page 314)

1. B	**2.** A	**3.** A	**4.** D	**5.** C
6. D	**7.** D	**8.** C	**9.** A	**10.** A
11. B	**12.** D	**13.** C	**14.** B	**15.** A
16. C	**17.** A	**18.** B	**19.** B	**20.** D
21. D	**22.** A	**23.** B	**24.** D	**25.** A
26. C	**27.** B	**28.** C	**29.** B	**30.** A
31. D	**32.** D	**33.** A	**34.** C	**35.** B
36. A	**37.** C	**38.** B	**39.** D	**40.** C
41. C	**42.** D	**43.** A	**44.** A	**45.** A
46. D	**47.** B	**48.** C	**49.** C	**50.** D
51. B	**52.** A	**53.** C	**54.** D	**55.** A
56. B	**57.** B	**58.** A	**59.** C	**60.** D

Memorandum: Exemplar Examination Paper 3 (SB page 320)

1. $x = 24$

2. $x = 7, y = 10$

3.