

Secondary Mathematics

Form 1

Teacher's Guide

Kenya Literature Bureau

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Chapter One

NATURAL NUMBERS

Introduction

The concept of natural numbers, also called counting numbers, is not new to the learner.

This topic aims at reinforcing the learners' knowledge of numbers as it introduces the concept of billing.

Objectives

By the end of the topic, the learner should be able to:

- (i) identify, read and write natural numbers in symbols and words.
- (ii) round off numbers to the nearest tens, hundreds, thousands, millions and billions.
- (iii) classify natural numbers as even, odd and prime.
- (iv) solve word problems involving natural numbers.

Notes and possible approach

Objective (i): Place Value

The place value of digits should be discussed using a place value table to help the learner to read and write natural numbers in symbols and words.

Objective (ii): Rounding Off

With the knowledge of place values, the learner should be guided on how to round off natural numbers.

Objective (iii): Classification of Natural Numbers

By giving a list of numbers, the learner should be guided to identify and classify them as even, odd or prime.

Objective (iv): Operations on Natural Numbers

In this section, the teacher should reinforce the learners' knowledge on basic operations on natural numbers.

Answers

Exercise 1.1

1.
 - (a) Place value of 5 – ten thousands
Total value – 50 000
Place value of 4 – billions
Total value – 4 000 000 000
 - (b) Place value of 3 – hundreds
Total value – 300
Place value of 7 – ten thousands
Total value – 70 000
 - (c) Place value of 8 – tens
Total value – 80
Place value of 8 – ten thousands
Total value of 8 – 80 000
 - (d) Place value of 4 – millions
Total value – 4 000 000
Place value of 9 – ten billions
Total value – 90 000 000 000
2.
 - (a) Seventy four billion, three hundred and seventy nine million, six hundred and fifty two thousand, one hundred and thirty seven.
 - (b) Forty eight million, six hundred and seventy seven thousand, three hundred and ninety five.
 - (c) Three million, four hundred and eighty six thousand, seven hundred and eighty nine.
 - (d) Ninety eight billion, three hundred and seventy four million, eight hundred and three thousand and forty one.
3.
 - (a) 40 600 006
 - (b) 590 700 500
 - (c) 35 000 900 010
 - (d) 80 000 045 000

4.

Number	Hundred billions	Ten billions	Billions	Hundred millions	Ten millions	Millions	Hundred thousands	Ten thousands	Thousands	Hundreds	Tens	Ones
40 600 006				4	0	6	0	0	0	0	0	6
590 700 500			5	9	0	7	0	0	5	0	0	
35 000 900 010		3	5	0	0	9	0	0	0	1	0	
80 000 045 000	8	0	0	0	0	0	4	5	0	0	0	

Exercise 1.2

1.
 - (a) 380
 - (b) 89 400
 - (c) 37 470 000
 - (d) 89 000 000
 - (e) 349 000 000 000
 - (f) 89 000 000 000

2.
 - (a) 38 739 619 → 38 740 000
 - (b) 800 490 → 800 500
 - (c) 292 444 → 292 000
 - (d) 14 850 069 → 15 000 000
 - (e) 348 606 → 348 610
348 600
349 000
 - (f) 38 309 008 002 → 40 000 000 000

3.

93 678 563 → 94 000 000 (to the nearest 1 000 000)
 → 93 680 000 (to the nearest 10 000)

Difference 94 000 000
 - 93 680 000

 320 000

4. 498 382

Exercise 1.3

1. (a) 3 355
(b) 1 019 137
(c) 497 737 202
(d) 1 595 863
3. (a) 5 475
(b) 11 800
(c) 134 244
(d) 231 522
(e) 3 349 888
(f) 4 718 454
5. 275
7. (a) 3 360
(b) 42
(c) 8
(d) 5
2. (a) 379 119 725
(b) 8 003
(c) 406 942
(d) 848 374
(e) 206 404
(f) 395 845
4. (a) 56
(b) 46 rem 16
(c) 56 rem 8
(d) 96 rem 10
(e) 1 180 rem 59
(f) 2 116 rem 7
6. (a) 796
(b) 185
(c) 363
(d) 940
(e) 991
(f) 1 476

Exercise 1.4

1. (a) 11 613
(b) 720 006 kg
3. (a) 1 980 kg
(b) 135 kg
5. (a) 1 284 cartons
(b) 2 568 kg
(c) 12 840 kg
7. (a) Sh. 1 464
(b) Sh. 200
9. (a) 26
2. (a) 1 435
(b) 17 220 packets
4. (a) 820 cabbages
(b) Sh. 21 720
6. (a) 65 litres
(b) Sh. 3 770
8. (a) 8 780
(b) (i) 1 159
(ii) 1 990
(c) 9 611

- (b) 44
(c) Sh. 1 940

Exercise 1.5

1. 52, 54, 56, 58, 60, 62, 64, 66,
68, 70, 72, 74, 76, 78, 80, 82, 84,
86, 88, 90, 92, 94, 96, 98,
2. 11, 13, 15, 17, 19, 21, 23, 25,
27, 29, 31, 33, 35, 37, 39, 41,
43, 45, 47, 49,
3. 49
4. 641, 643, 647
5. Even: 658, 3 960, 6 576
Odd: 347, 851, 3 741, 1 243,
3 965, 6 429, 86 725, 44 001
6. Even: 1 342, 1 344, 1 346, 1 348, 1 350,
1 352, 1 354, 1 356, 1 358, 1 360,
1 362, 1 364, 1 366, 1 368,
Odd: 1 341, 1 343, 1 345, 1 347,
1 349, 1 351, 1 353, 1 355,
1 357, 1 359, 1 361, 1 363,
1 365, 1 367, 1 369

Chapter Two

FACTORS

Introduction

The learner has met problems involving factors and prime factors of whole numbers. In this topic, factors in power form are introduced.

Objectives

By the end of the topic, the learner should be able to:

- (i) express composite numbers in factor form.
- (ii) express numbers as product of prime factors.
- (iii) express factors in power form.

Notes and possible approach

Objective (i): Factors

The teacher should discuss how to find factors of various composite numbers, hence express them in factor form.

Objective (ii): Prime Factors

The teacher should lead the learner to express numbers as products of their prime factors.

Objective (iii): Factors in Power Form

The learner should be guided to express prime factors in power form, e.g,

$$\begin{aligned}2\ 700 &= 2 \times 2 \times 3 \times 3 \times 3 \times 5 \times 5 \\ &= 2^2 \times 3^3 \times 5^2\end{aligned}$$

Answers

Exercise 2.1

1. $2 \times 3 \times 5$
(b) $2^3 \times 5$ (c) 2^6
(d) 3^4 (e) 13^2
2. (a) 2^8 (b) $2 \times 5 \times 43$ (c) $2^3 \times 59$ (d) 2×3^2
3. (a) $2^2 \times 3^2 \times 5^2$ (b) $3 \times 5 \times 7$ (c) $3 \times 7 \times 11$ (d) $5 \times 7 \times 11$
(e) $3^3 \times 7$
4. (a) 3×331 (b) $3 \times 7 \times 17$ (c) $5 \times 11 \times 13$ (d) $5 \times 11 \times 17$
(e) $2 \times 3^2 \times 7 \times 11$
5. (a) $2 \times 7^2 \times 11$ (b) $7^2 \times 11^2$ (c) $11^2 \times 13$ (d) 11×13^2
(e) $11^2 \times 17$

Chapter Three

DIVISIBILITY TEST

Introduction

This topic deals with the divisibility test for 2, 3, 4, 5, 6, 8, 9, 10 and 11, a concept which was introduced in primary mathematics. At this level, large numbers have also been considered.

Objective

By the end of the topic, the learner should be able to test the divisibility of numbers by 2, 3, 4, 5, 6, 8, 9, 10 and 11.

Notes and possible approach

The teacher should discuss each test and give an exercise on it.

Answers

Exercise 3.1

1. (a) 4, 628, 738
(b) 70, 102, 998
(c) 300, 702, 20 020

Exercise 3.2

1. (a) Yes (b) Yes (c) No (d) Yes
2. (a) 681, 24 381, 87 690
(b) 78 426, 942 831
3. (a) Yes
(b) Yes
4. (a) 132, 84, 534
(b) 24, 9 030

Exercise 3.3

1. (a) 100, 324, 640, 832
(b) 1 448, 9 472

2. (a) Yes (b) Yes (c) Yes
3. (a) 132, 416, 600
(b) 256, 496
4. (a) 36, 192 (b) 120, 744, 9 564
5. 1 080, 9216, 12 636

Exercise 3.4

1. (a) 175, 930, 1 050
(b) 95, 535, 800, 4 325
2. (a) 720, 9 430
(b) 820, 57 640, 684 320
3. (a) 74 320, 643 000
(b) 300, 67 420, 931 700
4. (a) 30, 900, 10710
(b) 432 120, 832 710, 92 715
5. 720, 10 320

Exercise 3.5

1. (a) 4 320, 8 730, 93 744
(b) 834, 7 368, 3672, 48 732
2. (a) Yes (b) Yes (c) Yes (d) Yes
3. (a) 390, 5 310, 6 732
(b) 6 822, 7 452, 95 490
4. 390, 5 310, 6 732, 6 822, 7 452, 95 490
5. (a) 53 250, 634 710
(b) 78 300
6. (a) 660, 7 212, 50 520, 42 564
(b) 6 336, 7 260, 30 468, 850 152

7. (a) 210, 450, 510, 900
(b) 750, 630, 1 290

Exercise 3.6

1. (a) 78 104, 634 112, 932 160
(b) 532 168, 432 120, 934 152, 1 034 128
2. (a) 8 112, 93 136, 1 123 136, 2 732 160
(b) 6 104, 93 128, 754 368
3. (a) 73 104, 48 144, 501 144, 754 104
(b) 484 248, 231 672, 2 098 944
4. (a) 1 120, 8 640, 7 320 (b) 640, 3 240, 4 360, 5 160, 5 800
5. (a) Yes (b) No (c) Yes (d) No (e) Yes

Exercise 3.7

1. (a) 405, 5 346, 9 315 (b) 9 792, 7 245, 41 202
2. (a) No (b) Yes (c) No (d) No (e) No
(f) No (g) Yes
3. (a) 4 320, 8 955, 9 540
(b) 38 475, 57 483
4. (a) 875 610, 975 420, 84 735 (b) 2 745, 54 540

Exercise 3.8

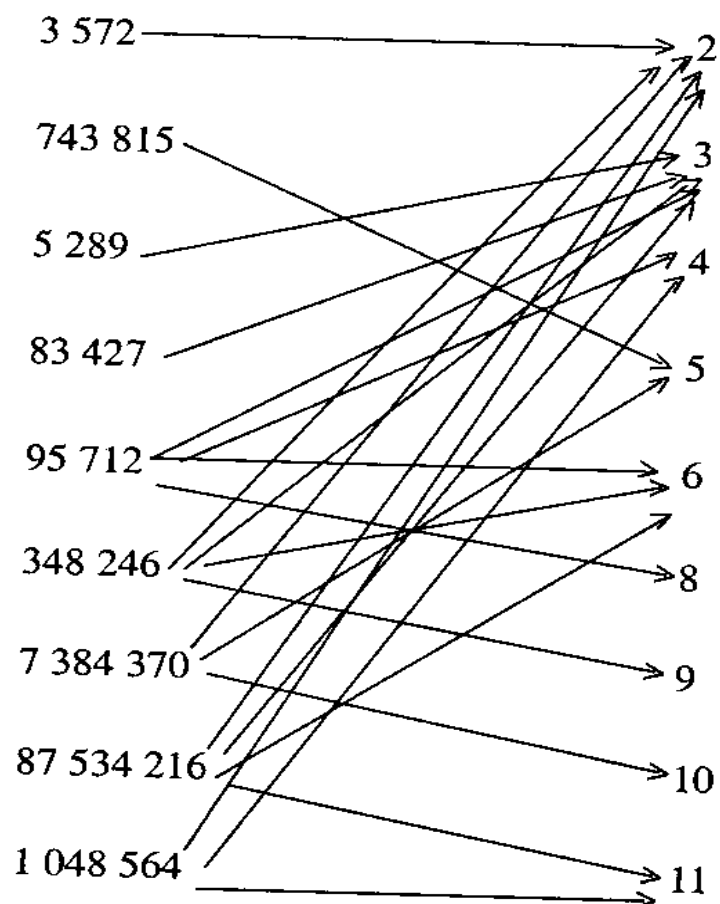
1. (a) 720, 430, 910, 990, 550 (b) 610, 540, 880, 850
2. (a) 640, 980, 1 140, 3 460 (b) 870, 4 350, 5 780, 7 840
3. (a) 270, 510, 720 (b) 4 320, 97 410

Exercise 3.9

1. (a) 2 596, 5 896, 8 151 (b) 4 213, 5 753, 5 016, 53 152
2. (a) 3 520, 4 730, 6 930 (b) 2 530, 5 170, 10 230, 10 780

3. (a) Yes (b) Yes (c) No (d) Yes (e) Yes

4. *Number* *Divisible by*



Chapter Four

GREATEST COMMON DIVISOR (GCD)

Introduction

Prime factorisation, a pre-requisite for this topic, has been covered. This should enable the learner to find GCD/HCF of a set of numbers as covered in the topic.

Objectives

By the end of this topic, the learner should be able to:

- (i) find the GCD/HCF of a set of numbers.
- (ii) apply GCD/HCF to real life situations.

Notes and possible approach

Objective (i): GCD/HCF

The teacher • should probe the learner's understanding of the GCD/HCF.
• should reinforce what had been learnt earlier on GCD/ HCF
• should introduce the factor method in finding GCD/HCF

Objective (ii): Apply GCD/HCF to Real Life situations

The learners should be given word problems on everyday situations where application of the knowledge of GCD/HCF is required.

Answers

Exercise 4.1

- 1. (a) 15 (b) 4 (c) 12 (d) 10 (e) 15 (f) 15
- 2. (a) 21 (b) 15 (c) 14 (d) 20
- 3. 6 litres 4. 18 g 5. 400 cm² 6. 0.024 kg
- 7. 11

LEAST COMMON MULTIPLE

Introduction

In this topic, the three methods of finding L.C.M. are discussed, namely, listing down of multiples, table format and the factor method.

The first two methods have been taught at primary level, whereas the factor method is being introduced to the learner.

Objectives

By the end of the topic, the learner should be able to:

- (i) list multiples of numbers.
- (ii) find the L.C.M. of a set of numbers.
- (iii) apply the knowledge of L.C.M. in real life situations.

Objective (i): Listing down Multiples

The teacher should probe the learner's understanding of the above concept by discussing how to find multiples of a given number.

Exercises should be given to the learner to list down multiples of numbers.

Objective (ii): Finding the LCM

The three methods used in finding the LCM should be discussed. At this level, the term 'power' rather than index should be used.

Objective (iii): Application

Word problems from everyday life situation should be given as suggested in the syllabus, even though the teacher is encouraged to give more problems other than the ones in the pupils' book.

Answers

Exercise 5.1

- 1. $5 \rightarrow 5, 10, 15, 20, 25, 30$
 $6 \rightarrow 6, 12, 18, 24, 30, 36$
 $7 \rightarrow 7, 14, 21, 28, 35, 42$
 $9 \rightarrow 9, 18, 27, 36, 45, 54$

2. (a) $2^4 \times 3^2 \times 5$ (b) $2^6 \times 3^2$ (c) $2^2 \times 3 \times 5^2$
 (d) $2^2 \times 3 \times 7 \times 13$ (e) $2^2 \times 3^2 \times 5^2$ (f) 11×421
3. (a) 36 (b) 330 (c) 420
 (d) 2 100 (e) 3 600 (f) 340
4. (a) 480 (b) 720 (c) 1 470 (d) 1 680
 (e) 210 (f) 3 600
5. 12.30 p.m. 6. 6 hrs 7. 273 8. 6 300 cm
9. 30 kg 10. 200 kg 11. 8.25 a.m. 12. 48
13. 90 or 180 or 450 or 900

Chapter Six

INTEGERS

Introduction

The basic operations on natural numbers have been covered before. In this topic, the learner is introduced to directed numbers, how to operate on them and the order of operations.

Objectives

By the end of the topic, the learner should be able to:

- (i) define and identify integers on a number line.
- (ii) perform the basic operations on integers.
- (iii) work out combined operations on integers in the correct order.
- (iv) apply knowledge of integers to real life situations.

Notes and possible approach

Objective (i): Definition and Identification of Integers

The learner should be guided to define and identify integers.

The number line should be discussed. For example, the learner should know that -5 is less than -3 , -2 is less than 0 , etc.

Objective (ii): Basic Operations on Integers

- Using the number line and other teaching aids such as the ladder, the teacher should discuss how to add, subtract, multiply and divide integers, especially negative numbers. Many exercises should be given to internalise the concept.
- The teacher should put emphasis on subtraction of negative integers.

Objective (iii): Order of Operations

The learner should be guided to perform operations on integers in correct order. Many examples should be used and enough exercises given.

Objective (iv): Real Life Situation Problems

The teacher should discuss problems in real life situations involving integers.

Answers

Exercise 6.1

- | | | | | |
|-----|---------|---------|---------|---------|
| 1. | (a) +5 | (b) +15 | (c) +21 | (d) +17 |
| 2. | (a) +3 | (b) -3 | (c) +1 | (d) -7 |
| 3. | (a) +3 | (b) 0 | (c) -9 | (d) -6 |
| 4. | (a) -7 | (b) -5 | (c) -3 | (d) -12 |
| 5. | (a) +10 | (b) -1 | (c) +10 | (d) -3 |
| 6. | (a) -9 | (b) -8 | (c) +3 | (d) +17 |
| 7. | (a) +9 | (b) -15 | (c) -8 | (d) -10 |
| 8. | (a) +5 | (b) +3 | | |
| 9. | (a) +13 | (b) 0 | (c) -7 | (d) -9 |
| 10. | (a) -4 | (b) -5 | | |
| 11. | (a) -2 | (b) +9 | (c) +4 | (d) +7 |

Exercise 6.2

- | | | | | |
|----|--------|---------|---------|---------|
| 1. | (a) +1 | (b) -3 | (c) +3 | (d) 0 |
| 2. | (a) +9 | (b) +19 | (c) +9 | (d) +15 |
| 3. | (a) -7 | (b) -7 | (c) -12 | (d) -21 |
| 4. | (a) +1 | (b) -1 | (c) -7 | (d) -9 |
| 5. | (a) +5 | (b) +9 | (c) +11 | (d) +3 |
| 6. | (a) +1 | (b) -15 | (c) -9 | (d) -13 |
| 7. | (a) -4 | (b) -20 | (c) -3 | (d) +4 |
| 8. | (a) +3 | (b) -3 | (c) -10 | (d) 0 |

Exercise 6.3

- | | | | | |
|----|---------|---------|---------|---------|
| 1. | (a) 30 | (b) 19 | (c) -25 | (d) -51 |
| 2. | (a) 19 | (b) 61 | (c) 80 | (d) 83 |
| 3. | (a) -21 | (b) -29 | (c) -60 | (d) -88 |
| 4. | (a) 7 | (b) -10 | (c) -7 | (d) 134 |

Exercise 6.4

- | | | | | | |
|----|----------|----------|---|----------|----------|
| 1. | (a) -12 | (b) -28 | 2 | (a) -60 | (b) -110 |
| 3. | (a) -200 | (b) -36 | 4 | (a) -100 | (b) -90 |
| 5. | (a) -80 | (b) -300 | | | |

Exercise 6.5

1. (a) 21 (b) 80 (c) 39 (d) 32
2. (a) 240 (b) 128 (c) 99 (d) 900
3. (a) 112 (b) 80 (c) 210
4. (a) 256 (b) -200
5. (a) -4 (b) 6 (c) 2

Exercise 6.6

1. (a) 5 (b) -2 (c) -7 (d) 14
2. (a) -12 (b) 7 (c) -9 (d) -25
3. (a) -41 (b) -12 (c) 7 (d) -16
4. (a) -17 (b) -35 (c) -48 (d) -30
5. (a) -9 (b) -9 (c) 7
6. (a) -8 (b) 15 (c) 20
7. (a) -62 (b) -7 (c) -60

Exercise 6.7

1. (a) 24 (b) 79 (c) -12 (d) -12
(e) -18 (f) 80 (g) 21 (h) 130
(i) -26 (j) -450
2. (a) 67 (b) -19 (c) -48 (d) -102
(e) 813 (f) -381 (g) 1 208 (h) 2 200
(i) 12 (j) 3 485
3. (a) 4 (b) 12 (c) 3 (d) -3
(e) -11 (f) 42 (g) 24 (h) -75
(i) 500 (j) 1 425 (k) 33 (l) 76
(m) 36 (n) -40 (p) 12 (q) 35
(r) -275 (s) -24 (t) 470 (u) -238
4. (a) -19 (b) 9 (c) -56 (d) 14 (e) 15
(f) 34 (g) 14 (h) -136 (i) -139 (j) 14
(k) 20 (l) -139 (m) 17
(n) 51 (p) 550
5. (a) 6 (b) -2 (c) 12 (d) 36
6. 27°C 7. 12 8. 190 km 9. 56 years 10. 5.2°C

Chapter Seven

FRACTIONS

Introduction

The learner has met fractions, as part of a whole or as a part of a group, including what the denominator and the numerator in a fraction represents. A part from this, he/she has learnt how to carry out the four basic operations on fractions. The knowledge of equivalent fractions should help in the adding and subtracting of fractions.

The learner has also met mixed numbers, i.e., 'whole parts' and parts of a whole. The learner can also express mixed numbers into improper fractions and vice versa.

In this topic, these concepts are reinforced and directed fractions introduced.

Objectives

By the end of the topic the learner should be able to;

- (i) identify proper, improper fractions and mixed numbers.
- (ii) convert mixed numbers to improper fractions and vice versa.
- (iii) compare fractions
- (iv) perform the four basic operations on fractions.
- (v) carry out combined operations on fractions in the correct order.
- (vi) apply the knowledge of fractions to real life situations.

Notes and possible approach

Objective (i): Proper, Improper and Mixed Numbers

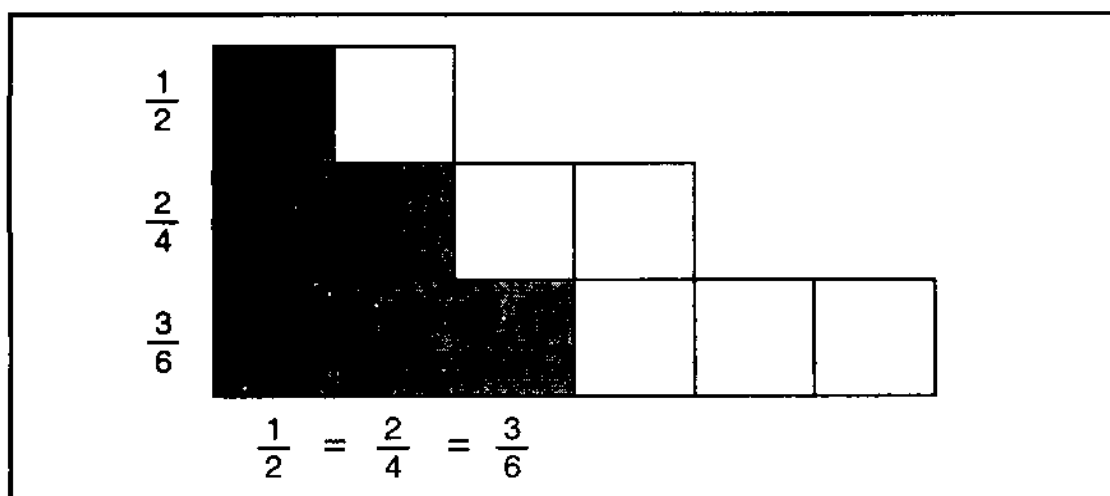
Revise using suitable examples proper, improper fractions and mixed numbers.

Objective (ii): Conversion

- Discuss what the denominator in an improper fraction represents, the 'one whole' giving examples.
- Show how to get the number of 'one whole' in an improper fraction and how to express the left over as a part of 'a whole'.
- Likewise, discuss what the whole part in the mixed numbers is, and what a denominator and a numerator in a fraction represents.

(c) *Objective (iii): Comparing Fractions*

- A quick revision on equivalent fractions, preferably using a chart, should be done as below;



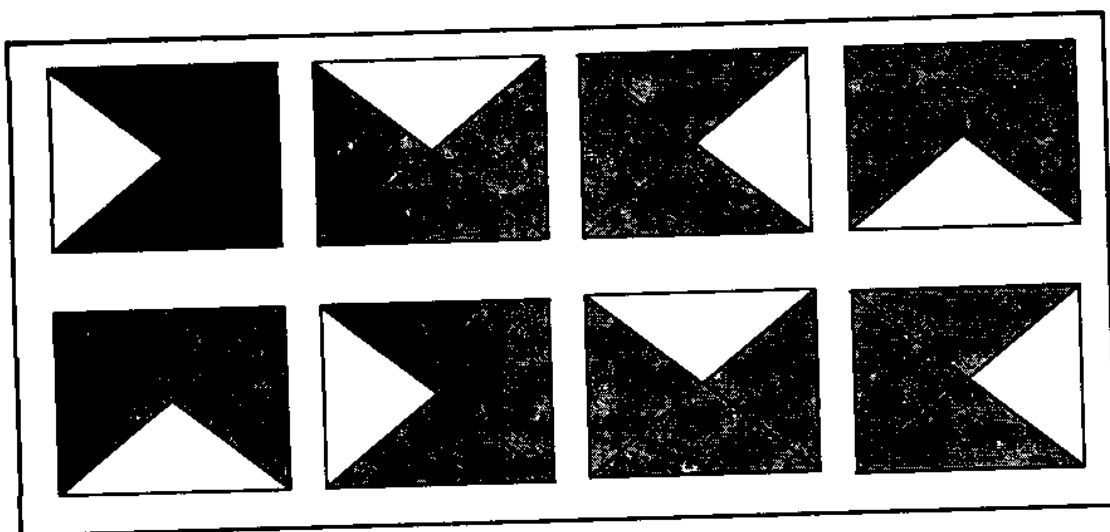
- Use of equivalent fractions in comparing fractions should be discussed. Mention the use of L.C.M. in obtaining equivalent fractions.

Objective (iv): Basic Operations on Fractions

- Use suitable examples to revise addition, subtraction, division and multiplication of fractions.
- The examples should include proper, improper fractions and mixed numbers.
- The four basic operations should also be discussed on directed fractions.

Objective (v): Combined Operations

The learner should be shown how to manipulate fractions involving the use of 'of'. For example, if we say $\frac{3}{4}$ of 8, it could mean the shaded part in the figures below:



This is the same as three quarters multiplied by eight. Once the learner is able to make use of 'of' correctly, give more exercises involving the brackets, the four basic operations and 'of'.

Objective (vi): Besides the question given in the students' book, the teacher is encouraged to give more exercises.

Answers

Exercise 7.1

1. (a) $\frac{2}{3}$ (b) $\frac{1}{7}$ (c) $\frac{3}{5}$ (d) $\frac{7}{10}$ (e) $\frac{6}{7}$ (f) $\frac{3}{100}$

2. (a) Three-quarters (b) Five-seventeenths
 (c) Six-twenty thirds (d) Eleven-thirtieths
 (e) Twenty three fiftieths (f) Thirty seven one hundred and twenty fourths.

3. (a) $\frac{22}{53}$ (b) $\frac{2}{3}$ (c) $\frac{3}{2}$ (d) $\frac{16}{1}$ (e) $\frac{379}{1\ 000}$ (f) $\frac{110}{23}$

4. (a) $2\frac{2}{3}$ (b) $2\frac{1}{7}$ (c) $4\frac{2}{9}$ (d) $26\frac{1}{4}$ (e) $26\frac{2}{13}$ (f) $24\frac{1}{15}$

5. (a) $\frac{20}{7}$ (b) $\frac{23}{12}$ (c) $\frac{91}{10}$ (d) $\frac{11}{2}$ (e) $\frac{27}{4}$ (f) $\frac{93}{13}$

Exercise 7.2

1. (a) 8 (b) 4 (c) 32 (d) 14
 (e) 5 (f) 45 (g) 28 (h) 30, 20
 (i) 21, 14 (j) 6, 15, 1 (k) 24, 12, 3 (l) 32, 52, 8

2. (a) $\frac{2}{3}$ (b) $\frac{25}{78}$ (c) $\frac{17}{26}$ (d) $\frac{1}{5}$

- (e) $\frac{1197}{8}$ (f) $\frac{17}{3}$ (g) $\frac{361}{66}$ (h) $\frac{1}{5}$

- (i) $\frac{4}{3}$ (j) $\frac{3}{4}$ (k) 7 (l) $\frac{13}{10}$

3. (a) $x = 9$ (b) $y = 28$ (c) $x = 15$ (d) $x = 3$
 (e) $t = 7$ (f) $p = \pm 2$

4. (a) $\frac{1}{2}$ (b) $\frac{1}{5}$ (c) $\frac{5}{6}$ (d) $\frac{7}{8}$

- (e) equal (f) $\frac{9}{12}$ (g) $\frac{5}{6}$ (h) $\frac{3}{4}$

- (i) $\frac{2}{3}$ (j) $\frac{4}{6}$ (k) equal (l) $\frac{80}{60}$

5. (a) $\frac{1}{6}, \frac{2}{9}, \frac{5}{12}$ (b) $\frac{7}{12}, \frac{2}{3}, \frac{5}{6}, \frac{7}{8}$ (c) $\frac{1}{6}, \frac{5}{9}, \frac{7}{12}, \frac{3}{4}$ (d) $\frac{5}{12}, \frac{3}{4}, \frac{5}{6}, \frac{7}{8}$

- (e) $\frac{1}{6}, \frac{4}{15}, \frac{2}{5}, \frac{1}{2}, \frac{2}{3}$ (f) $\frac{1}{21}, \frac{1}{15}, \frac{1}{10}$ (g) $\frac{7}{10}, \frac{11}{15}, \frac{11}{14}, \frac{5}{6}, \frac{19}{21}$ (h) $\frac{2}{3}, \frac{3}{4}, \frac{5}{6}, \frac{11}{12}$

6. (a) $\frac{3}{4}, \frac{5}{7}, \frac{1}{2}$ (b) $\frac{11}{3}, \frac{4}{5}, \frac{7}{9}, \frac{2}{3}$ (c) $\frac{7}{8}, \frac{13}{15}, \frac{4}{5}, \frac{2}{3}$ (d) $\frac{3}{2}, \frac{7}{5}, \frac{9}{10}, \frac{11}{15}, \frac{3}{7}$

- (e) $\frac{8}{9}, \frac{2}{3}, \frac{3}{5}, \frac{4}{7}, \frac{1}{2}$ (f) $\frac{9}{10}, \frac{4}{5}, \frac{12}{17}, \frac{11}{16}$ (g) $\frac{8}{9}, \frac{7}{8}, \frac{5}{6}, \frac{3}{4}, \frac{2}{3}$ (h) $\frac{1}{2}, \frac{4}{9}, \frac{2}{5}, \frac{7}{18}$

Exercise 7.3

1. (a) $\frac{28}{9}$ (b) $\frac{61}{14}$ (c) $\frac{123}{13}$

(d) $\frac{26}{17}$ (e) $\frac{22}{9}$ (f) $\frac{57}{10}$

(g) $\frac{91}{8}$ (h) $\frac{89}{6}$ (i) $\frac{62}{3}$

2. (a) $\frac{11}{18}$ (b) $1\frac{13}{66}$ (c) $\frac{95}{153}$ (d) $1\frac{2}{15}$

(e) $\frac{3}{26}$ (f) $2\frac{25}{36}$ (g) $-4\frac{1}{5}$ (h) $1\frac{3}{8}$

(i) $12\frac{5}{8}$ (j) $1\frac{27}{32}$ (k) $-\frac{25}{26}$ (l) $-\frac{19}{24}$

3. (a) $7\frac{11}{18}$ (b) $-\frac{97}{252}$ (c) $3\frac{27}{40}$ (d) $-5\frac{7}{20}$

(e) $2\frac{49}{360}$ (f) $26\frac{1}{10}$ (g) $5\frac{11}{54}$ (h) $1\frac{5}{12}$

4. (a) $\frac{1}{4}$ (b) $-\frac{19}{24}$ (c) $-\frac{223}{225}$ (d) $-\frac{131}{210}$

Exercise 7.4

1. (a) 18 (b) 12 (c) 33 (d) $10\frac{1}{2}$ (e) 44 (f) $20\frac{2}{5}$

2. (a) $\frac{12}{35}$ (b) $\frac{7}{48}$ (c) $\frac{42}{125}$ (d) $\frac{-1}{20}$ (e) $\frac{1}{15}$ (f) $-\frac{2}{7}$

3. (a) $16\frac{11}{12}$ (b) $-55\frac{5}{14}$ (c) $91\frac{2}{3}$ (d) $30\frac{52}{55}$ (e) $15\frac{1}{8}$ (f) 4

4. (a) 6 (b) 18 (c) $1\frac{3}{4}$ (d) $31\frac{1}{9}$ (e) $\frac{9}{20}$ (f) $\frac{1}{3}$

5. (a) $7\frac{7}{8}$ litres 6. $180\frac{4}{5}$ km 7. 25 8. Sh. 340

9. $13\frac{1}{3}$ hectares 10. 9 toys 11. sh. 34 650 12. $59\frac{3}{4}$ kg

13. $163\frac{1}{6}$ kg

14. sh.16071.40

Exercise 7.5

1. (a) $\frac{8}{51}$

(b) $\frac{1}{10}$

(c) $\frac{5}{4}$

(d) $\frac{6}{13}$

(e) $\frac{11}{7}$

(f) $\frac{6}{59}$

(g) $\frac{n}{m}$

(h) $\frac{r}{2k}$

2. (a) $11\frac{2}{3}$

(b) 9

(c) $\frac{1}{22}$

(d) $\frac{1}{16}$

(e) $\frac{3}{5}$

(f) 3

(g) $\frac{2}{5}$

(h) $10\frac{2}{5}$

(i) $65\frac{1}{3}$

(j) $\frac{2}{5}$

(k) $\frac{4}{5}$

(l) $5\frac{10}{13}$

3. (a) $1\frac{1}{5}$

(b) $2\frac{1}{2}$

(c) 1

(d) $\frac{10}{11}$

(e) $\frac{529}{596}$

(f) $9\frac{1}{3}$

(g) $\frac{5}{28}$

(h) $\frac{16}{49}$

(i) $\frac{225}{3808}$

(j) 7

4. 100 books

5. $\frac{1}{6}$

6. $\frac{3}{4}$

7. 112 strides

8. 11 pieces

9. 6 km per litre

Exercise 7.6

1. (a) 7

(b) $\frac{5}{48}$

(c) $-7\frac{8}{15}$

(d) $\frac{7}{25}$

(e) $\frac{7}{11}$

(f) $3\frac{1}{8}$

(g) $8\frac{2}{3}$

(h) $2\frac{29}{55}$

(i) $5\frac{1}{5}$

(j) $\frac{22}{9}$

2. (a) $7\frac{7}{9}$ (b) $1\frac{3}{32}$ (c) 2 (d) $\frac{5}{14}$

(e) $-2\frac{17}{48}$ (f) $-2\frac{1}{20}$ (g) $\frac{45}{53}$ (h) $1\frac{1}{4}$ (i) $1\frac{43}{60}$

(j) $1\frac{19}{40}$ (k) $\frac{17}{20}$ (l) $\frac{1}{3}$

3. $-\frac{1}{6}$ **4.** $9\frac{17}{20}$ **5.** 10 books; sh. 5 **6.** sh. 150

7. $1\frac{1}{3}$ km **8.** sh. 9 000 **9.** 10 litres **10.** 20 and 30

11. 12 000 tiles

12. $\frac{29}{36}$, sh. 409.70 **13.** Sh. 6 800

Chapter Eight

DECIMALS

Introduction

The learner has been taught how to add, subtract, multiply and divide decimal numbers. Also learnt is place values of numbers in the first topic, 'natural numbers'.

This topic addresses different kinds of decimal numbers and operations on them. The concept of standard form is also introduced.

Objectives

By the end of the topic, the learner should be able to:

- (i) convert fractions into decimals and vice versa.
- (ii) identify recurring decimals.
- (iii) convert recurring decimals into fractions.
- (iv) round off a decimal number to the required number of decimal places.
- (v) write numbers in standard form.
- (vi) perform the four basic operations on decimals.
- (vii) carry out operations involving decimals in the correct order.
- (viii) apply the knowledge of decimals to real life situations.

Notes and possible approach

Objective (i): Fractions as Decimals and vice versa

The teacher should use suitable examples to discuss how to convert a fraction into a decimal and vice versa.

The teacher should give examples on:

- how to convert a proper fraction into a decimal number.
- how to convert a mixed fraction into a decimal number.
- how to convert a decimal number into a fraction
- the learner may discuss what a 'zero' before a decimal point represents when converting a proper fraction into a decimal number. Also discuss a 'whole number' before a decimal point when converting an improper fraction into a decimal number.

Objective (ii): Identifying Recurring Decimals

The teacher should give examples of terminating and non-terminating decimals. The learner should be assisted in distinguishing non terminating decimals, recurring decimals and non-recurring decimals. The teacher should then discuss the recurring decimal notation, such as $6.\dot{3} = 6.333\dots$, $6.\dot{3}\dot{4} = 6.3434\dots$, etc.

Objective (iii): Converting Recurring Decimals into Fractions

The learner should be led to convert different types of recurring decimals into fractions systematically.

Objectives (iv): Rounding off Decimal Numbers

Although this is not a new concept, many exercises should be given to the learner to reinforce it. Practicals can be introduced in this section. The learner should be allowed to use different measuring instruments, e.g., ruler and tape measure to measure lengths of objects and round off the answers to different number of decimal places. The teacher should discuss accuracy while avoiding the term 'error'.

Objective (v): Standard Form

The learner should be given many exercises so as to internalise the concept since it has wide applications.

Objective (vi): Basic Operations on Decimals

It is important for the teacher to appreciate that many errors learners make result from the following:

- For addition and subtraction, failure to align decimal places correctly.
- For multiplication, failure to count the total number of decimal places.
- For division, failure to correctly manipulate decimal point in the divisor and /or dividend.

Objective (viii): Order of Operations

The teacher may use examples to discuss the order of operations. Evaluation of problems such as;

$$\frac{0.036 \times 0.0049}{0.07 \times 0.048} \quad \text{and} \quad \frac{0.036 + 0.0049}{0.07 \times 0.048},$$

emphasising where cancellation is possible and where it is not.

Objective (viii): Real Life Problems Involving Decimal Numbers

More real life situation problems may be given in addition to those in the students' book.

Answers

Exercise 8.1

1. (a) 0.8 (b) 0.24 (c) 0.3 (d) 2.7 (e) 0.07
(f) 0.0021 (g) 0.0102 (h) 0.0273 (i) 0.001 (j) 0.015
(k) 0.067 (l) 0.035 (m) 0.0054 (n) 0.01011 (p) 0.037
(q) 0.081 (r) 0.00145 (s) 0.092 (t) 0.036 (u) 0.0221
2. (a) 0.12 (b) 0.03 (c) 1.0123 (d) 26.0101 (e) 1.010101
3. (a) 0.4 (b) 0.34 (c) 2.34 (d) 0.096 (e) 0.0625
(f) 0.000733 (g) 0.216 (h) 0.0025 (i) 7.8
(j) 0.0000045
4. (a) 0.25, 0.75, 2.05 (b) 0.045, 0.45, 0.55
(c) 0.05, 0.25, 0.35, 0.5
5. (a) 0.75, 0.56, 0.53, 0.45 (b) 2.4, 0.24, 0.024, 0.0024
(c) 5.68, 5.6, 0.591, 0.59
6. (a) 0.35 (b) 0.34 (c) 0.375 (d) 0.264 (e) 0.8
(f) 0.365 (g) 0.92 (h) 0.5625 (i) 1.475 (j) 0.1725
(k) 0.016 (l) 0.05
7. (a) 0.5 (b) 0.4 (c) 0.375 (d) 0.3125 (e) 0.4375
(f) $1.\dot{6}$ (g) 0.45 (h) 0.5625 (i) 0.12 (j) 0.14
(k) 0.25 (l) 0.05
8. (a) 2.5 (b) 3.8 (c) 40.375 (d) 58.7
9. (a) $\frac{1}{8}$ (b) $\frac{17}{50}$ (c) $\frac{677}{1000}$ (d) $\frac{199}{4}$
(e) $\frac{267}{40}$

$$(f) \frac{3}{20} \quad (g) \frac{235}{1000} \quad (h) \frac{35}{8} \quad (i) \frac{17}{8} \quad (j) \frac{153}{40}$$

$$(k) \frac{4753}{1000} \quad (l) \frac{169}{20}$$

Exercise 8.2

$$1. \quad (a) \quad 0.\dot{6}\dot{3} \quad (b) \quad 0.8\dot{3} \quad (c) \quad 0.\dot{1}8\dot{5} \quad (d) \quad 6.\dot{2}\dot{7} \quad (e) \quad 0.\dot{7}$$

$$(f) \quad 1.\dot{6} \quad (g) \quad 1.\dot{1}4285\dot{7} \quad (h) \quad 8.\dot{2}\dot{7}$$

$$2. \quad (a) \quad \frac{3}{10} \quad (b) \quad \frac{7}{10} \quad (c) \quad \frac{3}{20} \quad (d) \quad \frac{4}{100}$$

$$(e) \quad \frac{67}{100} \quad (f) \quad 2\frac{5}{6} \quad (g) \quad 4\frac{37}{99} \quad (h) \quad 28\frac{13}{99}$$

$$(i) \quad \frac{215}{999} \quad (j) \quad 1\frac{523}{999}$$

Exercise 8.3

$$1. \quad (a) \quad 0.1, 0.14, 0.140, 0.1398 \quad (b) \quad 0.2, 0.20, 0.203, 0.2035$$

$$(c) \quad 0.0, 0.04, 0.043, 0.0431 \quad (d) \quad 0.0, 0.02, 0.030, 0.0294$$

$$(e) \quad 3.0, 3.00, 3.006, 3.0057 \quad (f) \quad 5.1, 5.10, 5.109, 5.1095$$

$$(g) \quad 7.3, 7.28, 7.280, 7.2803 \quad (h) \quad 9.6, 9.57, 9.568, 9.5678$$

$$(i) \quad 11.6, 11.65, 11.646, 11.6458$$

Exercise 8.4

$$1. \quad (a) \quad 4.0 \times 10^{-1} \quad (b) \quad 3.694 \times 10^2$$

$$(c) \quad 4.82 \times 10^1 \quad (d) \quad 2.89 \times 10^{-2}$$

$$(e) \quad 5.0978 \times 10^2 \quad (f) \quad 6.3274 \times 10^1$$

$$2. \quad (a) \quad 312 \quad (b) \quad 0.901$$

$$(c) \quad 0.00785 \quad (d) \quad 0.493$$

$$(e) \quad 37 \quad (f) \quad 0.0888$$

$$3. \quad \text{Sh. } 1.075 \text{ million}$$

Exercise 8.5

1. (a) 3.38 (b) 9.48
(c) 17.0084 (d) 28.702
(e) 2.081 (f) 10.7581
(g) 22.221 (h) 3.29
(i) 0.1542 (j) 0.105
(k) 92.383481 (l) 93.1458
2. (a) 5.6264 (b) 12.992
(c) 264.353 (d) 50.081
(e) 492.315 (f) 15.62
(g) 475.814 (h) 224.4
(i) 0.1332 (j) 255.774
3. (a) 1.349 (b) 35.357
(c) -0.032 (d) 425.627
(e) -1.2222 (f) 12.8375
(g) -4.7 (h) -53.799
(i) 59.46 (j) 5.798 (k) 5.795 (l) 10.392
(m) 0.0175 (n) 1.613
4. (a) 5.068 (b) 3.229 (c) 2.2593 (d) -2.031
(e) 35.715 (f) 4.721 (g) -0.057 (h) 14.582
(i) -7.521 (j) 218.8
5. (a) 0.733 (b) 26.8 (c) -219.37
(d) 2476.8625 (e) 71.36 (f) 5.32 (g) 3.19
(h) 2.11 (i) 10.51 (j) 50.06
6. 4.7 m 7. 25.5 mm 8. Sh. 651.00
9. 3.8 km 10. 0.4125 11. 0.454 m
12. 8 kg 13. 18.82 km 14. 0.16 l

Exercise 8.6

1. (a) 11.5 (b) 23.4 (c) 5.12 (d) 8.815
(e) 7681.8
2. (a) 163, 1 630, 16 300, 163 000, 1 630 000 16 300 000
(b) 51.6, 516, 5 160, 51 600, 516 000, 5 160 000
(c) 0.532, 5.32, 53.2, 532, 5 320, 53 200

- (d) 6.0241, 60.241, 602.41, 6024.1, 60 241, 602410
 (e) 0.90256, 9.0256, 90.256, 902.56, 9025.6, 90 256
 (f) 7.381, 73.81, 738.1, 7 381, 73 810, 738 100
3. (a) 0.007 (b) 0.02412 (c) 0.002485 (d) 0.441
 (e) 0.4984 (f) 0.259084 (g) 0.000544 (h) 0.123375
 (i) 0.035552 (j) 0.00141102 (k) 0.05085 (l) 0.00181104
4. (a) 16.15 (b) 52.582 (c) 264.48 (d) 456.556
 (e) 514.328 (f) 325.3392 (g) 18.278 (h) 23.54
 (i) 645.327 (j) 26.1371632 (k) 1.082322 (l) 13.66542
5. 28.8 l 6. 126 m 7. Sh. 825.00 8. 165 l
 9. 5481.5742 m² 10. 0.35 g 11. Sh. 337.00 12. Sh. 570.60
 13. 397.75 km 14. Sh. 1160.00

Exercise 8.7

1. (a) 0.85 (b) 3.83 (c) 3.375 (d) 0.000375
 (e) 0.78173 (f) 0.19 (g) 2.5264 (h) 3.365
 (i) 3.5085 (j) 0.0118 (k) 2.0037 (l) 0.019
 (m) 0.45 (n) 0.0026 (p) 9.15005 (q) 17.5
 (r) 8.0058 (s) 30.501 (t) 0.0124 (u) 0.212
 (v) 55.23
2. (a) 0.37, 0.037, 0.0037, 0.00037, 0.000037, 0.0000037
 (b) 0.028, 0.0028, 0.00028, 0.000028, 0.0000028, 0.00000028
 (c) 1.03, 0.103, 0.0103, 0.00103, 0.000103, 0.0000103
 (d) 12.539, 1.2539, 0.12539 0.012539, 0.0012539,
 0.00012539
 (e) 0.1026, 0.01026, 0.001026, 0.0001026, 0.00001026,
 0.000001026
3. (a) 0.974 (b) 12 (c) 2.5 (d) 0.53
 (e) 2.1 (f) 8 (g) 3.4 (h) 0.016
 (i) 0.7 (j) 0.6 (k) 0.8 (l) 3.21
 (m) 2 200 (n) 2 336 (p) 0.0887 (q) 100
 (r) 807.9936 (s) 2790.35
4. 2.8 5. 25 litres 6. 111.257 mm 7. Sh. 0.70 (70 cts)
 8. 31.4 m 9. 12.4 litres 10. 0.096 cm

Exercise 8.8

- | | | | | |
|-----------|------------|------------------|-----------------|-------------------|
| 1. | (a) 0.4 | (b) 0.7 | (c) 3.43 | (d) 7 |
| | (e) 166.67 | (f) - 30.3 | (g) 10.4 | (h) 22.5 |
| | (i) 1 620 | (j) 6 | (k) 32.5 | (l) 0.00058 |
| | (m) 0.006 | (n) 13.0816 | (p) 12.9474 | (q) 0.12712 |
| | (r) 0.0195 | (s) 4.70262 | (t) 0.0018 | |
| 2. | - 1694.444 | 3. 0.0120 | 4. 61.52 | 5. 1.78277 |
| 6. | 31.023 | 7. 0.0248 | | |

Chapter Nine

SQUARES AND SQUARE ROOTS

Introduction

Squares and square roots have been introduced in primary mathematics. In this topic, mathematical tables will be used in finding squares and square roots.

Objectives

By the end of the topic, the learner should be able to:

- (i) find the squares of numbers by multiplication.
- (ii) find squares of numbers from mathematical tables.
- (iii) find square root by factor method.
- (iv) find square roots from mathematical tables.

Notes and possible approach

Objective (i): Squares by Multiplication

The concept of squaring should be revisited and the learner given an exercise including fractions and decimals.

Objectives (ii): Squares from Tables

The learner should be guided in reading squares from tables of squares. Expressing of numbers in standard form should be emphasised.

Objectives (iii): Square Root by Factor Method

Through examples, the learner should be led to realise the connection between finding the square root and squaring. The learner should then be led to find square root of numbers which are perfect squares by factor method.

Objective (iv): Square Root from Tables

- The learner should be guided to obtain square roots from tables.
- The writing of a number in the form, i.e., $A \times 10^n$, where $1 \leq A < 10$ and n is an even integer, should be emphasised.

Answers

Exercise 9.1

1. (a) 36 (b) 81 (c) 121 (d) 529 (e) $\frac{16}{49}$
(f) $\frac{64}{9}$ (g) $\frac{25}{9}$ (h) 3.24 (i) 5.0625 (j) 0.0289
(k) 0.0361 (l) 9.9225

Exercise 9.2

1. (a) 5.290 (b) 16.89 (c) 1.823 (d) 94.67 (e) 7.728
(f) 54.61 (g) 86.86 (h) 15.76 (i) 36.24 (j) 29.05
(k) 64.32 (l) 51.98 (m) 39.44 (n) 22.31 (p) 10.37
(q) 41.45 (r) 4.029 (s) 32.17 (t) 4.044 (u) 68.74
2. (a) 6.250×10^{-2} (b) 1.024×10^{-1} (c) 9.486
(d) 1.600×10^{-3} (e) 6.288×10^{-1} (f) 8.836×10^{-5}
(g) 5.336×10^{-2} (h) 3.755×10^{-1} (i) 8.354×10^{-3}
(j) 9.437×10^{-2} (k) 3.204×10^{-5} (l) 2.256×10^{-5}
(m) 6.129×10^{-5} (n) 4.122×10^{-1} (p) 3.011×10^{-3}
(q) 1.711×10^{-5} (r) 6.790×10^{-5} (s) 1.019×10^{-5}
(t) 2.241×10^{-8} (u) 5.759×10^{-6}
3. (a) 4.562×10^2 (b) 3.849×10^3 (c) 1.681×10^3
(d) 3.249×10^3 (e) 9.467×10^3 (f) 4.629×10^3
(g) 2.396×10^3 (h) 4.917×10^3 (i) 2.639×10^3
(j) 1.006×10^3 (k) 7.955×10^3 (l) 4.995×10^2
(m) 6.785×10^3 (n) 1.851×10^3 (p) 7.843×10^3
(q) 2.936×10^2 (r) 1.580×10^3 (s) 7.861×10^2
(t) 1.0×10^4 (u) 7.987×10^5

Exercise 9.3

1. (a) 9 (b) 13 (c) 14 (d) 25 (e) 20 (f) 12
(g) 16 (h) 19 (i) 18 (j) 30 (k) 26 (l) 29

Exercise 9.4

- | | | | | |
|----|--------|---------|--------|---------|
| 1. | (a) 25 | (b) 24 | (c) 86 | (d) 125 |
| | (e) 57 | (f) 276 | (g) 49 | (h) 66 |
| | (i) 65 | (j) 56 | (k) 72 | (l) 81 |

Exercise 9.5

- | | | | |
|----|-----------|------------|-------------|
| 1. | (a) 6.325 | (b) 2.319 | (c) 0.3821 |
| | (d) 2.478 | (e) 0.2300 | (f) 30.87 |
| | (g) 2.919 | (h) 0.0991 | (i) 2.707 |
| | (j) 830.2 | (k) 25.34 | (t) 0.04418 |
2. (a) 1.644 (b) 2.581 (c) 3.314
3. 5.573 4. 0.6176 5. 18.63 6. 24.80 cm 7. 9 cm
8. 3.059 s
9. 3.090 cm

Chapter Ten

ALGEBRAIC EXPRESSIONS

Introduction

The use of algebraic symbols to represent information and simplification of simple algebraic expressions have been covered at primary level. However, it is necessary to revise what the learner has covered. In this topic, the concept of factorisation and its application is introduced.

Objectives

By the end of the topic, the learner should be able to:

- (i) write statements in algebraic form.
- (ii) simplify algebraic expressions.
- (iii) factorise an algebraic expressions by grouping.
- (iv) remove brackets from algebraic expressions.
- (v) evaluate algebraic expressions by substituting numerical values.

Notes and possible approach

Objective (i): Algebraic Expressions

The teacher should guide the learner in writing statements in algebraic form by representing numbers with letters through examples from real life situations.

Objective (ii): Simplification of Algebraic Expressions

- The learner should be led to identify like and unlike terms and simplify them through addition and subtraction. Emphasis should be laid on terms with the same letters raised to different powers, e.g.
 - (i) a^3 and a^5 are unlike terms.
 - (ii) ab and ba are like terms.
 - (iii) a^2b and ab^2 are unlike terms.
- Simplification of algebraic fractions should be done after the learner has learnt to remove brackets and to factorise.

Objective (iii): Factorisation by Grouping

- The teacher should introduce factorisation as a process of representing algebraic expressions in factor form.
- The learner should be led to factorise algebraic expressions through examples. Emphasis should be laid on factorisation of algebraic expressions involving directed numbers, e.g.,
 $an - ak - mn + mk = a(n - k) - m(n - k) = (n - k)(a - m)$. The teacher should guide the learner to simplify algebraic fractions through factorisation.

Objective (iv): Removal of Brackets

- The learner should be led through the process of removing brackets. Emphasis should be put on the effect on signs as brackets are removed.
- Many exercises should be given to practice on this objective.

Objective (v): Substitution and Evaluation

The learner should be guided on correct substitution and evaluation of algebraic expressions.

Answers

Exercise 10.1

- (a) $2x + 1$ (b) $3x + 6$ (c) $\frac{5x^2}{2}$ (d) st
(e) $7m$ (f) $\frac{24n}{t}$
- $(4x - 7)$ years
- $\frac{x}{3}$ bananas 4. sh. x 5. $3\frac{1}{3}x$
- (a) area of A is ac , area of B is ad , area of C is bd ,
area of D is bc .
(b) The perimeter of A is $2(a + c)$
The perimeter of B is $2(a + d)$
The perimeter of C is $2(b + d)$
The perimeter of D is $2(b + c)$
(c) $ac + ad + bc + bd$

7. (a) $(2x + 10)$ years or $(2x - 10)$ years
 (b) $(2x + 20)$ years or $2x$ years
 (c) $(x + 7)(x - 3)$ or $(x - 3)(x - 13)$

8. $\frac{60 + c + d + e + f}{6}$ 9. $\frac{3}{8}x$

10. (a) $a - b$ (b) $(a - b)(a + b)$

11. $2z - 2y + 3x$ or $2z - x + 2y$ where x , y and z are the first, second and third numbers respectively.

12. $\frac{8(a + b)}{3}$

Exercise 10.2

1. (a) $6a + 2b$ (b) $-13k - 13m$

2. (a) $10t + 7p$ (b) $-3x + 7y$

3. (a) $2a + 2b + 2c$ (b) $0.4r + 0.85$

4. (a) $6a + 2b$ (b) $0.26 + 7c$

5. (a) $-27 - 7d$ (b) $5\frac{1}{2}x - 5y$

6. (a) $6w + 10p$ (b) $\frac{4r - s}{12}$

7. (a) $\frac{20a - 3b}{24}$ (b) $\frac{15k - 8t}{18}$

8. (a) $-\frac{10x + 3y}{15}$ (b) $\frac{2d + p}{8}$

9. (a) $\frac{70a - 9d}{10} + 1$ (b) $\frac{18x - 7y}{12}$

10. (a) $2a^2$ (b) $5m^3$
 (c) ab (d) c^2d

Exercise 10.3

1. (a) $13p^2$ (b) $3y^3 + 4y$
 2. (a) $6x - x^2$ (b) $3W^5 + 9w^5 - 4w$
 3. (a) $4a^2b + ab$ (b) $a^2b + 4ab^2$
 4. (a) $3pqr + 2pq$ (b) $u^3vw + uv^3w + uvw^3$
 5. (a) $5R^4 + 4R^2 - r^2$ (b) $\frac{3}{4}p^2q - \frac{1}{2}q^2p$
 6. (a) $\frac{17}{30}a^3$ (b) $\frac{3}{5}st + \frac{3}{4}t^2s - 5$

Exercise 10.4

1. (a) $7r + 7s$ (b) $30 - 7a$
 2. (a) $y - 2x - 1$ (b) $3x - 4y + 9$
 3. (a) $2pq + pr - rq$ (b) $\frac{x+7}{6}$
 4. (a) $\frac{3}{4}y(y - 25)$ (b) $3\frac{2}{3}w^2 + wm + \frac{1}{3}m$
 5. (a) $x^3 - \frac{3}{2}x^2y + \frac{1}{2}x^2y^2$ (b) $-\frac{x+3}{x}$
 6. (a) $3a + 2y$ (b) $4am^2 + \frac{4}{m} + \frac{1}{2}a^2 + \frac{1}{2}m^3$
 7. (a) $8x + 12y$ (b) $4a^2 + 3ab + 7ac$
 8. (a) $\frac{13x}{2} - 4y$ (b) $x - \frac{y}{2}$
 9. (a) $5p + q - r$ (b) $7y - 4$
 10. (a) $5m + 14p - 4$ (b) $\frac{5T}{3} - \frac{7}{9}ST$

Exercise 10.5

1. (a) $3(p + q + 2r)$ (b) $2(2k + 4r + s)$
 2. (a) $5(a - 2b + 1)$ (b) $7(4 - 3w + 2t)$
 3. (a) $3(2a + 6b + 9c - 4d)$ (b) $8(x + 2y - 4k - 8p)$
 4. (a) $cd(d - c)$ (b) $ab(a^2 + ab - b^2)$
 5. (a) $3a(2 + 6ab - 9c + 4a^2d)$ (b) $2a^2(2b + 12c - 7ad)$

7. (a) $ab(4a^2 + 6a - 9b)$ (b) $2pqr^2(2 + 3p - q)$
 8. (a) $3p^2q^3(2pq^2 - p^2q - 9)$ (b) $x^3y^4(xy^2 + y + 3)$
 9. (a) $p^2q^3(1 + pq)$ (b) $14xy(2x^2 + 5xy - 3y^2)$
 10. $\frac{1}{2}a\left(\frac{9a - 3b^2 + 1}{9}\right)$ (b) $\frac{1}{2}c\left(c + \frac{1}{2} + \frac{3}{2}c^2\right)$
 11. (a) $x(x+3)$ or $x(x-3)$ (b) $a(b+c)$
 12. $(p+q)(r-s) \text{ cm}^2$ (c) $(h+3)(h-3)$ (d) $1-a-2b$
 13. $(6k+2r+2t) \text{ cm}, (2kr+rt-kt) \text{ cm}^2$
 14. $q(100w + 30p) \text{ g}$ or $q\left(w + \frac{3}{100}p\right)$ 15. sh. $\{p - (q+r)\}$
 16. sh. $\frac{3}{4}(p+q)$ 17. $8x \text{ cm}^2$ 18. $4(x+1) \text{ m}^2$
 19. $(x+6)(2y-3) \text{ km}$ 20. $2(x+t+1)$ 21. $(3x-5)(x-5)$
 22. $\pi(R^2 - r^2) \text{ cm}^2$

Exercise 10.6

1. (a) $(x-2)(n+3m)$ (b) $(x+y)(x+2)$
 2. (a) $(n-w)(3-m)$ (b) $(3b+2)(a-c)$
 3. (a) $(x-y)(x+4)$ (b) $(2+k)(ab-m)$
 4. (a) $(x+b)(x+c)$ (b) $(x+y)(r-m)$
 5. (a) $(a+1)(y+3)$ (b) $(f+1)(ef+g)$
 6. $(r^2+p)(a-2)$

Exercise 10.7

1. (a) $30t$ (b) rst (c) $2^2 \times 3^2 \times 5 \times 7$ (d) a^2b^2
 (e) $8a^2b^2$ (f) $2abcp(2b+c)(2c+a)(2a+b)$
 2. (a) $\frac{5x+1}{6}$ (b) $\frac{9a+7b}{6b}$ 3. (a) $\frac{2m+4x-3}{6}$

$$(b) \frac{5a^2 + 3ab}{6(a+b)}$$

$$4. (a) \frac{8p-q}{15} \quad (b) \frac{4a+2b}{2(a+b)}$$

$$5. (a) \frac{2r-5}{12} \quad (b) \frac{2c^2-a^2}{a^2c^2d}$$

$$6. (a) \frac{x-10}{12} \quad (b) \frac{c-d}{c^2d^2} \quad 7. (a) \frac{v^2-u^2+v+u}{uv}$$

$$(b) \frac{bc+a^2c+ab^2c+ab}{a^2b^2c^2}$$

$$8. (a) \frac{2rs+s^2+r^2}{rs} \quad (b) \frac{2}{ab}$$

$$9. (a) \frac{ps+qs-pt+qt}{ts} \quad (b) \frac{b(a+b)(3-b)+4b(1+b)}{(1+b)(a+b)}$$

$$10. (a) \frac{p^2+q^2}{pq} \quad (b) \frac{3+a+b}{4}$$

$$11. (a) \frac{2r^2+2rt+t}{tr} \quad (b) \frac{2(p^2-r^2)}{2-3r}$$

Exercise 10.8

$$1. (a) x \quad (b) a \quad 2. (a) x-y \quad (b) 4a+3b$$

$$3. (a) -2 \quad (b) \frac{x+2y}{2}$$

$$4. (a) \frac{m-y}{m+y} \quad (b) 4y-3$$

$$5. (a) \frac{-1}{a} \quad (b) \frac{x+1}{1-x}$$

Exercise 10.9

$$1. (a) (i) -7 \quad (ii) 8 \quad (iii) -0.013 \\ (b) (i) 2 \quad (ii) 9 \quad (iii) 0 \quad (iv) \frac{-3}{256}$$

2. (a) 26 (b) $3\frac{23}{30}$ (c) $\frac{9}{28}$ (d) 1 (e) $-6\frac{1}{3}$ (f) $-2\frac{3}{10}$

3. (a) 240 (b) 0.32

4. 15

5. (a) 3 (b) 8

6. (a) 4 400 (b) $15\frac{1}{3}$

Mixed Exercise 1

1. (a) $\frac{4b(1+b)-a^2}{ab}$ (b) $a^3b + ab^3 + 4a^2b - 2ab^2$

(c) $\frac{1}{cd}$ (d) $\frac{3a}{4r}$ (e) $\frac{1}{3-a}$ (f) $\frac{34a+15c}{12b}$

(g) $q - 3 - \frac{1}{q}$ or $\frac{q^2 - 3q - 1}{q}$ (h) $\frac{4x - 13y}{60p}$

2. $\frac{2c-b}{2c}$ 3. $\frac{8a+2b}{15}$ 4. $\frac{1}{6}$

5. 23.2 m, 3.4 m

6. (a) (i) 0.875 (ii) 1.125 (iii) $5.\dot{4}2857\dot{1}$ (iv) $\dot{1}.2$

(b) (i) $\frac{3}{8}$ (ii) $\frac{21}{25}$ (iii) $2\frac{2}{5}$ (iv) $\frac{11}{40}$

(c) (i) $\frac{3}{8} = \frac{0.75}{2} = \frac{-15}{40}$ (ii) $\frac{13}{4} = \frac{5.2}{1.6} = \frac{-0.65}{-0.2}$

7. 12.1 cm 8. 26 min 9. $\frac{1}{80}$ 10. 12 800

11.(a) 432 (b) 3

12. 0.99 p

13. $4\frac{1}{8}$

- 14.** (a) 1.28×10^9 (b) 82 944 (c) 6.505 (d) 79.82
- 15.** 0.0917 m
- 16.** Sixty eight billion, seventy five million, seven hundred and thirty thousand shillings.

Chapter Eleven

RATE, RATIO, PROPORTION AND PERCENTAGE

Introduction

The learner has met problems on ratio, rates, percentages and proportion. In this section, the learner will cover the concepts more deeply and solve problems on real life situations.

Objectives

By the end of this topic, the learner should be able to:

- (i) define rates and solve problems involving rates.
- (ii) define ratio and compare two or more quantities using ratios.
- (iii) change a quantity in a given ratio.
- (iv) compare two or more ratios.
- (v) represent and interpret proportional parts.
- (vi) recognise direct and inverse proportions and solve problems involving them.
- (vii) convert fractions and decimals to percentages and vice versa.
- (viii) calculate percentage change in a given quantity.
- (ix) apply rates, ratio, proportion and percentages to real life situations.

Notes and possible approach

Objective (i): Rates

Through examples, the learner should be led to define rates. Problems involving rates should be discussed, followed by enough exercise.

Objective (ii): Ratios

The learner should be led to define ratio by use of examples. Situations where ratios are used to compare different quantities should be given.

An exercise should be given which includes combining of ratios, scale, measurements, application of ratios in consumer problems and simplification of ratios.

During simplification of ratios, it may be necessary to derive a general form which can be used, e.g., $a : b = ak : bk$, where k is a constant

For example,

$$\frac{1}{3} : \frac{2}{7} = \frac{1}{3} \times 21 : \frac{2}{7} \times 21 \\ = 7 : 6$$

Objective (iii): Changing a Quantity in a Given Ratio

Examples on increasing and decreasing a quantity in a given ratio should be discussed, followed by an exercise.

Objective (iv): Comparing Two or More Ratios

- Ratios can be compared just like fractions. The learner should be given two ratios and asked to find out which one is greater. It may be done by writing each ratio as a representative fraction and the fractions compared using equivalent fractions.
- Ratios may also be compared by first expressing them in the form $n : 1$ or $1 : n$

Objective (v): Representing and Interpreting Proportional Parts

- By use of examples, the learner should be led to work out problems on sharing quantities in a given ratio.
- An exercise on use of proportional parts should be given.

Objective (vi): Direct and Inverse Proportion

- The teacher should use relevant examples to discuss inverse and direct proportion. An exercise on direct and inverse proportion should then be given.
- The learner should be guided to apply inverse and direct proportion to solve problems involving compound proportion.

Objective (vii): Fractions and Decimals as Percentages

- The teacher should discuss how to convert fractions to percentages and vice versa. The following generalisation should be established:
 - (i) A fraction is multiplied by 100 to convert it to percentage.
 - (ii) To convert a percentage to a fraction, the percentage is divided by 100.
- The learner should be led to convert decimals to percentage. An exercise involving the following should then be given:
 - (i) Conversion of fractions to percentage.
 - (ii) Conversion of decimals to percentage.

Objective (viii): Percentage Change

A discussion on percentage change should be conducted. The learner will require a lot of practice in this section.

Answers

Exercise 11.1

1. (a) 10 m/s (b) 105 km/h (c) sh. 3.00 per pound
(d) sh. 1.60 per month (e) $\frac{1}{4}$ kg per month (f) sh. 150.00 per tooth
(g) sh. 4 000 per term (h) sh. 115 per hour

2. 840 rolls per day 3. 34.5 km/h

4. 80 words per minute 5. sh. 3 000 per month.

6. 96 km 7. $16\frac{2}{3}$ m/s 8. 1 600 bags

Exercise 11.2

1. (a) 5 : 6 (b) 3 : 4 (c) 1 : 4 (d) 1 : 4
(e) 1 : 6 (f) 3 : 5 (g) 7 : 20 (h) 1 : 3
(i) 1 : 1 250 (j) 4 : 5 (k) 1 : 4 (l) 1 : 4 000
(m) 10 : 3 (n) 20 : 3 (p) 1 : 40 (q) 50 : 1
(r) 3 : 1 (s) 1 : 5 (t) 3 : 5 (u) 4 : 7
2. (a) 2 : 3 (b) 1 : 20 (c) 9 : 1 (d) 18 : 25
(e) 6 : 5 (f) 1 : 45 (g) 24 : 1 (h) 7 : e
3. (a) 6 (b) 7 (c) 25 (d) 33
(e) 18 (f) 210
4. 240 girls 5. 104 kg

Exercise 11.3

1. (a) 30 (b) 18 (c) 625 (d) 160
2. (a) 40 (b) 250 (c) 100 (d) 21
3. sh. 2 100 4. 2.8 5. 5 : 4

Exercise 11.4

- 1.** (a) 2 : 3 (b) 4 : 7 (c) 3 : 5
(d) 10 : 11 (e) 20 : 17 (f) 3 : 2
- 2.** (a) 5 : 6 (b) 5 : 8 (c) 8 : 3 (d) 14 : 4

Exercise 11.5

- 1.** (a) sh. 50, sh. 100 (b) sh. 30, sh. 120
(c) sh. 60, sh. 90 (d) sh. 56.25, sh. 93.75
(e) sh. 75, sh. 75 (f) sh. 70, sh. 80
- 2.** (a) 662.86 ha, 1657.14 ha (b) 580 ha, 1 740 ha
(c) 386.7 ha, 1933.3 ha (d) 331.43ha, 1988.57 ha

- 3.** 144°, 96°, 72°, 48° **4.** sh. 140 000

Exercise 11.6

- 1.** 3 oranges **2.** 1 hour 4.5 minutes **3.** $3\frac{3}{4}$ ha
4. sh. 1 350 **5.** sh. 2 310 **6.** sh. 3 306 **7.** 12 months
8. 12 men **9.** $4\frac{1}{2}$ days **10.** 27 **11.** 20 minutes
- 12.** 30 days
13. 12 days **14.** 121 : 120 **15.** 81, 54, 72 respectively
16. sh. 420 000, sh. 120 000, sh. 80 000 respectively
17. 4 days **18.** $42\frac{2}{3}$ m **19.** 20 lorries **20.** 21 days
21. 6 days

Exercise 11.7

- 1.** (a) 32% (b) 2% (c) 16.7% (d) 88%
(e) 320% (f) 27.5% (g) 42.8% (h) 125%
(i) 273% (j) 2523% (k) 3345% (l) 9892%
- 2.** (a) 50% (b) 20% (c) 42.9% (d) 183.3%
(e) 75% (f) 33.3% (g) 162.5%
- 3.** (a) $\frac{6}{5}$ (b) 2 (c) $\frac{2}{5}$ (d) $\frac{1}{4}$ (e) $\frac{3}{5}$
(f) $\frac{37}{50}$

4. (a) 0.75 (b) 0.23 (c) 1.47 (d) 0.08
 (e) 0.004 (f) 0.0013 (g) 0.0003 (h) 0.00072
 (i) 0.00805

Exercise 11.8

1. sh. 25.00 2. 50% 3. 125% 4. $58\frac{1}{3}\%$
 5. 20% 6. 2 057 7. 0.05% 8. sh. 120 000
 9. sh. 2 000 10. sh. 971.40
 11. (a) (i) $13\frac{1}{3}\%$ (ii) 25.93%
 (b) (i) 2% (ii) 4%
 12. sh. 48 13. 57.58% 14. 52.5%, 27.5%, 20%
 15. sh. 12 000, sh. 24 000 16. 1 398

Chapter Twelve

LENGTH

Introduction

In this topic, the various units of length and how they are related is considered. The concept of significant figures and perimeter of plane figures is also discussed.

Objectives

By the end of the topic, the learner should be able to:

- (i) state the units of length.
- (ii) convert units of length from one form to another.
- (iii) express numbers to required number of significant figures.
- (iv) find the perimeter of a plane figure and circumference of a circle.

Notes and possible approach

Objective (i): Units of Length

- The learner should be introduced to the various units of length such as millimetres, centimetres, metres and kilometres.
- The appropriate choice of units used should be discussed. Practical activities involving the use of measuring devices should be done in and outside the classroom.

Objective (ii): Conversion of Units of Length

The teacher should use appropriate examples to enhance the learner's understanding of conversion from one unit to another.

Objective (iii): Significant Figures

- The learner should be led to understand how to round off numbers to stated significant figures.
- Emphasis should be laid on the position of zero as a significant figure, as explained in the students' book.
- More exercises should be given on rounding off to any stated significant figures.

Objective (iv): Perimeter

- A practical approach is recommended in this section. The learner should be guided on how to measure distances around plane figures such as triangles, squares, rectangles and circles using a string. Thereafter, the formula for perimeter should be derived.
- At this level, the learner should be led to estimate the value of π (π) practically.

Answers

Exercise 12.1

1.

	<i>km</i>	<i>Hm</i>	<i>Dm</i>	<i>m</i>	<i>dm</i>	<i>cm</i>	<i>mm</i>
a	0.25	2.5	25	250	2500	25 000	250 000
b	15	150	1 500	15 000	150 000	1 500 000	15 000 000
c	0.00135	0.0135	0.135	1.35	13.5	135	1 350
d	0.0044	0.044	0.44	4.4	44	440	4 400
e	0.00003	0.0003	0.003	0.03	0.3	3	30
f	1	10	100	1 000	10 000	100 000	1 000 000
g	0.47	4.7	47	470	4 700	47 000	470 000
h	0.00000072	0.0000072	0.000072	0.00072	0.0072	0.072	0.72
i	2.75	27.5	275	2 750	27 500	275 000	2 750 000
j	0.0805	0.805	8.05	80.5	805	8 050	80 500

2. (a) 2 004 m (b) 824 m (c) 17.198 m (d) 2.548 m
(e) 6.3 m (f) 262.1 m (g) 3065.12 m (h) 41.32 m
(i) 21.35 m (j) 162.086 m (k) 1680.365 m (l) 4000.044 m

3. (a) 664.984 m (b) 558.942 m
(c) 349574 m (d) 5105.69 m
(e) 0.58 m (f) 58.27 m
(g) 3.105 m (h) 0.093 m

- (i) 0.34 m (j) 0.679 m
 (k) 33.9932 (l) 3.207 m

4.

	No.	4 s.f.	3 s.f.	2 s.f.	1 s.f.
(a)	125 689	125 700	126 000	130 000	100 000
(b)	3.647	3.647	3.65	3.6	4
(c)	36.0320	36.03	36.0	36	40
(d)	89.545	89.55	89.5	90	90
(e)	3.845	3.845	3.85	3.8	4
(f)	906.24	906.2	906	910	900
(g)	53.2	53.20	53.2	53	50
(h)	0.030024	0.03002	0.0300	0.030	0.03
(j)	736 000	736 000	736 000	740 000	700 000

5.

	No.	3 d.p.	3 s. f.	2 s.f
(a)	4.013	4.013	4.01	4.0
(b)	0.3651	0.348	0.365	0.37
(c)	36.7892	36.789	36.8	37
(d)	0.03475	0.035	0.0348	0.035
(e)	200.01	200.010	200	200
(f)	0.1072	0.107	0.107	0.11
(g)	0.09854	0.099	0.0985	0.099
(h)	341.0032	341.003	341	340
(i)	21.03	21.030	21.0	21

Exercise 12.2

- 1.** (a) 30 cm (b) 32.97 cm
 (c) $(2a + 14)$ cm (d) $(2b + c + 8)$ cm

2.

<i>Length</i>	<i>Breadth</i>	<i>Perimeter</i>
15	8	46
8	4	24
12.5	7.5	40
9	22.5	63
12.5	7.3	39.6

3. (a) 23.2 cm (b) 26.2 cm (c) $(2a + 16)$ cm (d) 16 cm
4. 390 posts 5. 126 cm 6. 600 m 7. 14, 20 and 20 cm
8. 46 m 9. $8b$ cm 10. $(4x - 5)$ cm 11. 30 cm

Exercise 12.3

1.

<i>Radius (r)</i>	<i>Diameter (d)</i>	<i>Circumference</i>
5	10	31.42
7.4	14.8	46.50
7	14	43.99
3.5	7	21.99
2.1	4.2	13.20

2.

<i>Angle subtended by arc at the centre</i>	<i>Circumference (C) in cm ($2\pi r$)</i>	<i>Arc length in cm</i> $\frac{\theta \times 2\pi r}{360}$
30°	48	4
250°	16	11
45°	80	10
90°	60	15
180°	30	15

Angle subtended by arc at the centre	Radius of the circle r (cm)	Length of arc in (cm) 'l'
72°	5	6.284
30°	84.02	44
42°	6	4.4
70°	4.5	5.5
72°	42	52.8

1. (a) 43.42 cm (b) 72 cm (c) 35.2°cm (d) 44.57 cm
 2. (a) 72 cm 6. 31.5 cm 7. 41.9 cm 8. 107.9°
 3. 45° 10. (a) 32 cm (b) 29.3 cm 11. $r = 2.8$ cm
 12. $r = 4.8$ cm 13. 1 833 cm/sec 14. 10.5 cm
 15. 83.8 cm 16. 70 cm 17. Circ. 44 cm, length 5.5 cm
 18. $r = \frac{180x}{p}$ 19. $\frac{6p}{\pi}$

Chapter Thirteen

AREA

Introduction

In this topic, areas of regular plane figures, namely, triangles, rectangles, squares, trapezia, parallelograms and circles are considered. Also included are estimation of areas of irregular plane shapes and surface area of solids.

Though the topic is not very new to the learner, the teacher is encouraged to give many exercises and use a practical approach to enhance understanding.

Objectives

By the end of the topic, the learner should be able to:

- (i) state units of area.
- (ii) convert units of area from one to another.
- (iii) calculate the area of regular plane figures, including circles.
- (iv) estimate the area of irregular plane figures by counting squares
- (v) calculate the surface area of cubes, cuboids and cylinders.

Notes and possible approach

Objective (i): Units of Area

- The learner should be led to understand the concept of area by definition, its units being given.
- The learner to let to derive units of area from units of length as in the students' book.

(b) Objective (ii): Conversion of Units of Area

The learner should be led through conversion of units of length first before using squaring as shown in the text.

$$\begin{aligned}\text{e.g., } 1\text{m}^2 &= 1\text{m} \times 1\text{m} \\ &= 100\text{ cm} \times 100\text{ cm} \\ &= 10\,000\text{ cm}^2\end{aligned}$$

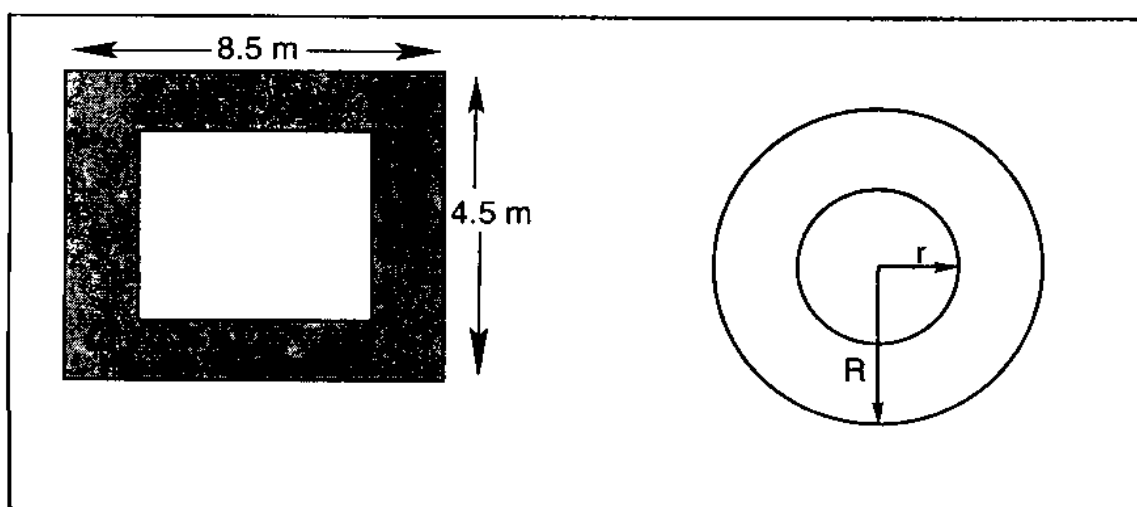
Note:

It should be emphasised that 1 m^2 is not equal to 100 m^3 . Mention should also be made here of equivalents of square metres in area and hectares.

(c) Objective (iii): Area of Regular Plane Figures

The learner should be led to derive the formulae for area of plane figures — squares, rectangles, triangles, parallelograms, trapezia and circles practically.

Borders of common shapes such as a carpet placed in a room or photographs could be included here.



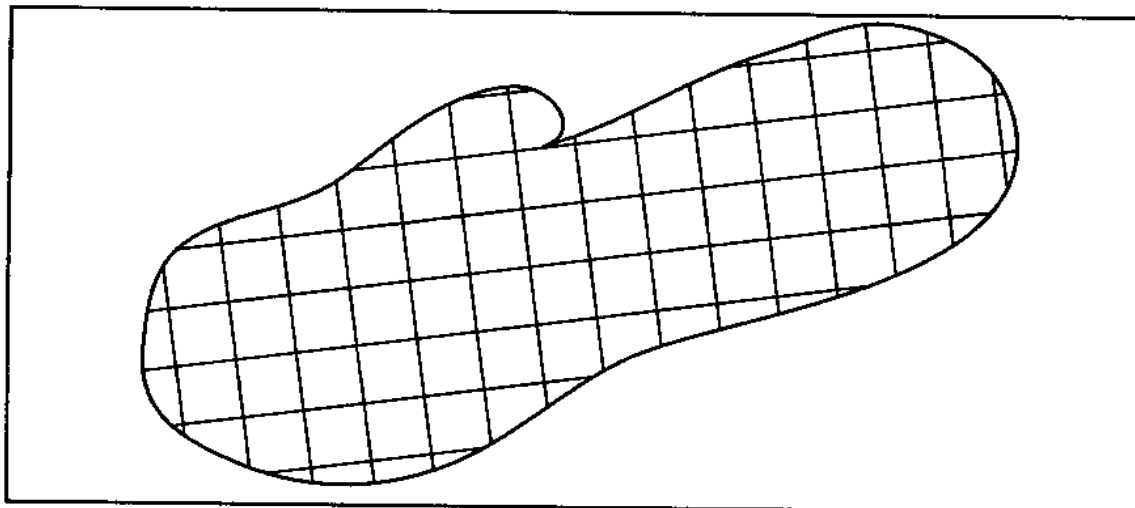
Borders — Consider area of a carpet placed in a room.

— Consider area of a ring.

- The learner should be encouraged to give examples of cases where it would be necessary to calculate the area of a border.

Objective (iv): Area of Irregular Plane Figures

The learner should be given more practice on area estimation using worksheets showing irregular shapes. This is best achieved by using a grid of squares of known areas, such as a graph paper.



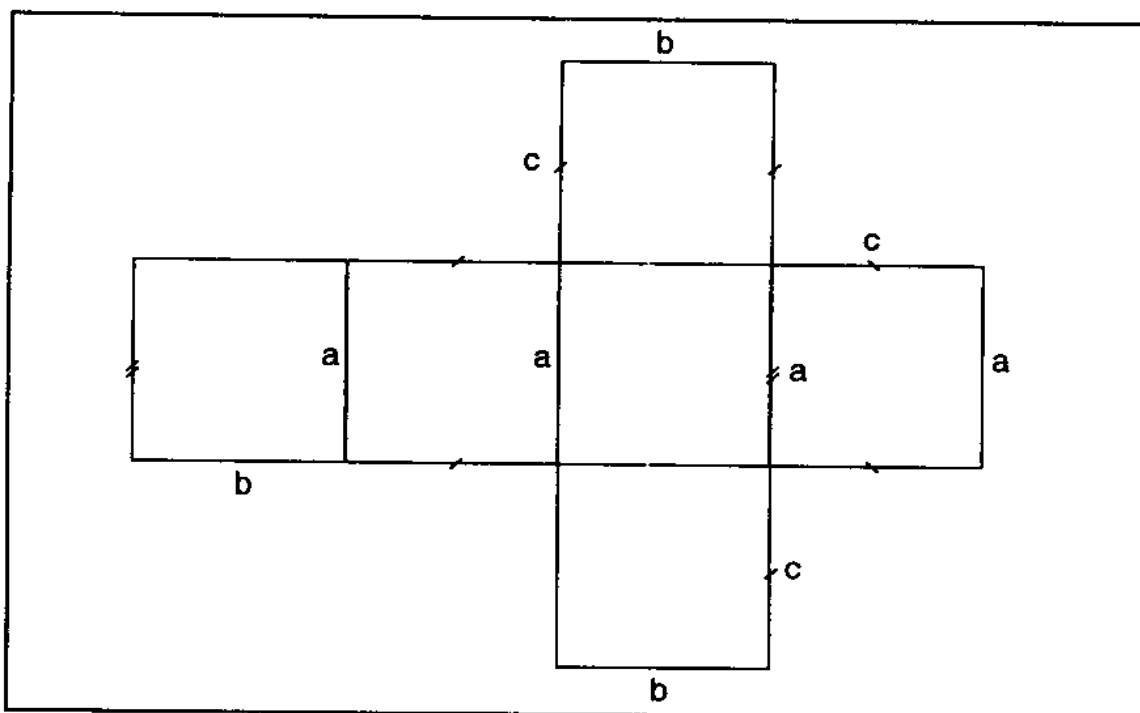
The area of one square is 1 sq unit.

Complete squares are counted and the fractions are added to give full squares. Area is given in terms of unit squares.

Objective (v): Surface Area of Common Solids (Cubes, Cuboids, Cylinders)

The learner should be led to find the surface area of these solids using their nets.

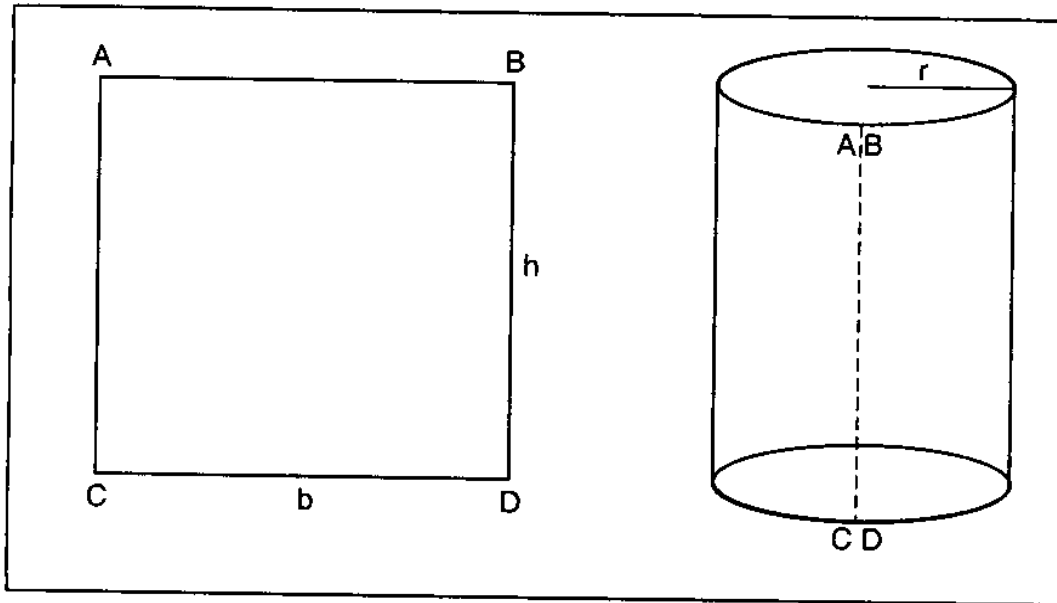
The teacher should prepare the net of a simple regular solid such as a cuboid as shown below and illustrate how it can be folded to form



a cuboid which can be used to calculate its total area.

$$\begin{aligned}\text{Total surface area} &= 2(a \times b) + 2(b \times c) + 2(a \times c) \\ &= 2ab + 2bc + 2ac \\ &= 2(ab + bc + ac)\end{aligned}$$

Another example is that of a cylinder. An exercise book should be used to form a cylinder, as shown below:



$$\text{Area} = bh$$

The figure shows the circumference which is equal to $2\pi r = AB = b$.

Therefore, the surface area of the curved surface $= 2\pi rh$

Where the cylinder is closed at both ends, the total surface area is $2\pi rh + 2\pi r^2$

Answers

Exercise 13.1

1. (a) 20 000 cm² (b) 0.03 m² (c) 4 000 000 m²
 (d) 0.005 km² (e) 0.9 ha (f) 0.02 m²
 (g) 34 000 m² (h) 1.2 ha (i) 680 ares (j) 4 500 m²

2.	cm ²	m ²	km ²
	120 000	12	0.000012
	5 600 000	560	0.00056
	200 000 000	20 000	0.02

Exercise 13.2

1. (a) 30 cm^2 (b) 40 cm^2

2.

<i>Length</i>	<i>Breadth</i>	<i>Area</i>	<i>Perimeter</i>
15	8	120	46
8	4	32	24
18	2	36	40
9	5	45	28
12.5	7.3	91.25	39.6

3. (a) 10.6 cm^2 (b) 30.8 cm^2
 (c) $(12 + 3a) \text{ cm}^2$ (d) $(4 + 2b + 2c) \text{ cm}^2$
4. (a) 110 cm^2 (b) 127 cm^2
5. (a) $20\,000 \text{ m}^2$ (b) 2 ha
6. 292 cm^2 7. 88 cm^2 8. 800 tiles
9. (a) 46 m (b) 126 m^2 10. $3b^2$
11. 27 cm^2
12. $(4x - 5) \text{ m}^2$ 13. 54 m^2 14. 40 m
15. $178\,368 \text{ cm}^2$ 16. 2 cm^2 17. 30 cm^2
18. 40 000 tiles 19. sh. 775 20. 75 000 ha
21. 1462.5 m^2 22. 13 m^2

Exercise 13.3

1. (a) 38.5 cm^2 (b) 0.7546 cm^2 (c) 260.26 cm^2
 (d) 452.4 cm^2 (e) 254.50 cm^2 (f) 18.10 cm^2
 (g) 78.550 cm^2 (h) 530 cm^2 (i) 346.5 cm^2
2. (a) 0.51 cm^2 (b) 1.733 cm^2 (c) 18.44 cm^2 (d) 7.09 cm^2
 (e) 17.35 cm^2 (f) 36.96 cm^2 (g) 36.17 cm^2 (h) 262.7 cm^2
3. (a) 5.43 cm^2 (b) 13.36 cm^2 (c) 10.5 cm^2 (d) 20.335 cm^2
4. 804.4 m^2 5. 3.465 cm^2 6. 616 m^2 7. 124.74 m^2

8. 147.8 m^2 9. 2.92 m^2
10. 6.284 cm^2 (both surfaces) 11. 150.82 cm^2 12. 14.3 cm^2
13. 44.9° 14. 154 cm^2 15. 27.72 cm^2

Exercise 13.4

1. (a) 657812.7 cm^2 (b) 223.8 cm^2
 (c) 388 cm^2 (d) 203 cm^2 (e) 54.88 cm^2 (f) $13\,728 \text{ m}^2$
2. 384 cm^2 3. 13.5 cm^2 4. 1.885 m^2 5. 720 cm^2
6. 48.4 m^2 7. 25138.52 cm^2 8. 447.4 cm^2
9. 1 cm 10. 70 revolutions 11. sh. 5 280
12. $569\,822 \text{ cm}^2$ or 56.98 m^2
13. 44.99 cm^2 14. 181 cm^2 (3 s.f.) 15. 11 m^2 (2 s.f.)
16. 208.5 cm^2 17. $1\,314 \text{ cm}^2$

Exercise 13.5

- 1, 2: Check for accuracy.

Chapter Fourteen

VOLUME AND CAPACITY

Introduction

The learner has done simple problems involving volume and capacity. The teacher should therefore probe the learner's understanding of the same.

Use of the teaching aids such as containers of different size is highly recommended.

Objectives

By the end of the topic, the learner should be able to:

- (i) state units of volume.
- (ii) convert units of volume from one form to another.
- (iii) calculate volume of cubes, cuboids and cylinders.
- (iv) state units of capacity.
- (v) convert units of capacity from one form to another.
- (vi) relate volume to capacity.
- (vii) solve problems on volume and capacity.

Notes and possible approach

Objective (i): Units of Volume

- The learner should be led through the definition of volume and its units.

Objective (ii): Conversion of Units of Volume

- The relationship between the units of length should be re-visited to explain the following:

$$\begin{aligned}1 \text{ m}^3 &= (100 \times 100 \times 100) \text{ cm}^3 \\&= 1\,000\,000 \text{ cm}^3 \\&= 10^6 \text{ cm}^3\end{aligned}$$

or

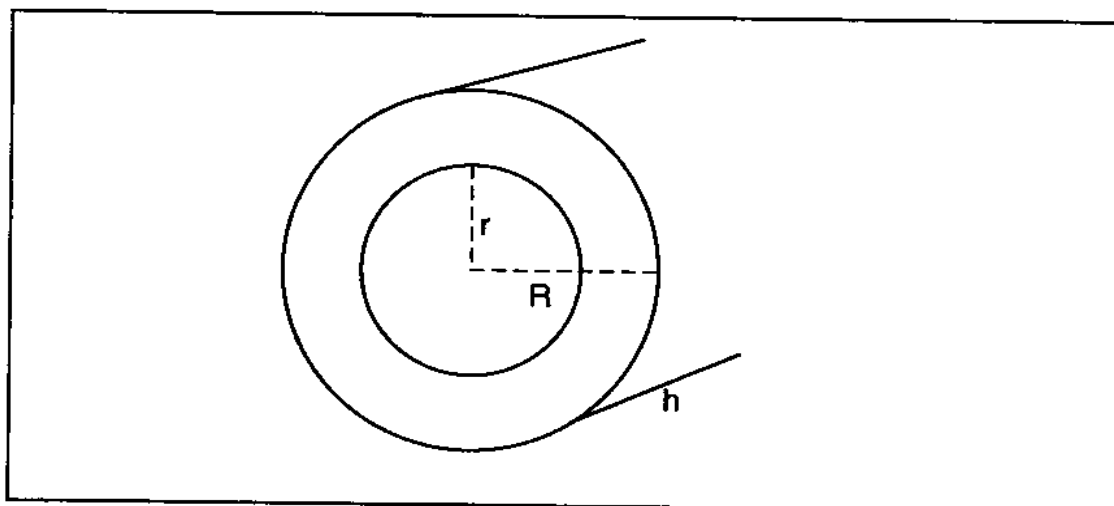
$$\begin{aligned}1 \text{ cm}^3 &= \left(\frac{1}{100} \times \frac{1}{100} \times \frac{1}{100} \right) \text{ m}^3 \\&= (0.01 \times 0.01 \times 0.01) \text{ m}^3 \\&= 0.000001 \text{ m}^3\end{aligned}$$

- The learner should be given more exercises involving mixed units such as cm^3 and m^3 in carrying out conversion.

Objective (iii): Calculating Volume

- In this section the learner should be involved in calculation of volume of cylinders, cubes and cuboids of given dimensions.

A good application of volume is in calculating the volume of materials used to make a pipe. This can be illustrated as below:



$$\begin{aligned}\text{Volumes of the material} &= \text{external volume} - \text{internal volume} \\ &= \pi R^2 h - \pi r^2 h,\end{aligned}$$

where R and r are external and internal radii respectively.

Objective (iv): Units of Capacity

The learner should be guided through the concept of capacity which should be defined as the maximum amount of fluid a container can hold, and its units stated.

Objective (v): Conversion of Units of Capacity

The teacher should guide the learner through the relationship between units of capacity such as millilitres, centilitres, litres and kilolitres.

Objective (vi): Relationship Between Volume and Capacity

The teacher should lead the learners to understand the relationship between volume and capacity by explaining the following:

$$1 \text{ ml} = 1 \text{ cm}^3$$

$$1 \text{ 000 ml} = 1 \text{ 000 cm}^3$$

$$1 \text{ litre} = 1\,000 \text{ cm}^3$$

$$1\,000 \text{ litres} = 1 \text{ m}^3$$

Objective (vii): Applications

The learner to be exposed to real life problems on volume, capacity and their relationship.

Answers

Exercise 14.1

1. (a) $1.05 \times 10^{-4} \text{ m}^3$ (b) $1.97 \times 10^{-5} \text{ m}^3$ (c) $7.5 \times 10^{-7} \text{ m}^3$
 (d) $7.5 \times 10^3 \text{ m}^3$ (e) $2.0 \times 10^5 \text{ m}^3$ (f) $1.0 \times 10^7 \text{ m}^3$

2. 27 cm 3. 21 jarfulls 4. 150 000 cubes

5. 0.4728 m^3 6. 8.19 m^3 7. 200 reams 8. 0.348 m^3

9. 429 cm^3 10. 629.232 cm^3

Exercise 14.2

1. (a) 0.4 l (b) 0.8 l (c) 10 l (d) 0.536 l
 (e) 0.536 l (e) 37 500 l (f) 500 l

2. (a) 0.724 l (b) 1.42 l (c) 1 500 l
 (d) 0.03 l (e) 0.0034 l (f) 170 l

3. 9.8 cm (1d.p.) 4. 3.18 cm 5. 3 m

6. 12 litres 7. 38.25 kilolitres

8. (a) 62 370 litres (b) 12 days

Chapter Fifteen

MASS, WEIGHT AND DENSITY

Introduction

This topic is not entirely new to the learner since mass has been covered at primary school level. The concepts introduced are weight and density. The teacher is advised to emphasise numerical computation concepts involving mass, weight and density.

Objectives

By the end of the topic, the learner should be able to:

- (i) define mass and state its units.
- (ii) convert units of mass from one form to another.
- (iii) define weight and state its units.
- (iv) relate volume, mass and weight.

Notes and possible approach

Objective (i): Mass and Units of Mass

The teacher should probe the learner's understanding of mass.

Objective (ii): Conversion of Units of Mass

Using examples, the teacher should discuss how to convert one unit of mass to another.

Objective (iii): Weight and its Unit

- The learner should be led to the definition of weight through discussion and its unit stated. The distinction between mass and weight should come out clearly.
- Using examples, the teacher should guide the learner to solve problems using the formula;
$$\text{weight (W)} = \text{mass (kg)} \times \text{acceleration due to gravity (N/kg)}$$

Objective (iv): Density

The teacher should define density and state its units. A practical approach is useful in this section.

Using examples, the learner should be led to calculate one variable given the other two variables amongst mass, volume and density.

Answers

Exercise 15.1

1. (a) 2 kg (b) 0.45 kg (c) 0.8 kg (d) 0.0435 kg
(e) 0.03406 kg (f) 0.007889 kg (g) 0.000024072 kg (h) 39 000 kg
(i) 4 000 kg

2. 3 lorries

3. (a) 0.004538 g (b) 4.626 g (c) 4.28 g (d) 32.4 g
(e) 460 g (f) 89 200 g

4. $937\frac{1}{2}$ 5. 0.154 kg

Exercise 15.2

1. (a) 372.4 N (b) 3.9886 N (c) 29 400 N
(d) 5.098 N

2. 56.734694 kg

3. (a) 68.367346 kg (b) 109.38776 N

4. (a) 490 N (b) 81.67 N

Exercise 15.3

1. (a) (i) 0.0013 g/cm³ (ii) 0.25 g/cm³ (iii) 8.9 g/cm³
(iv) 19.3 g/m³ (v) 2.7 g/cm³ (vi) 11.5 g/cm³
(b) (i) 800 kg/m³ (ii) 7 800 kg/m³ (iii) 11 400 kg/m³
(iv) 10 000 kg/m³ (v) 0.45 kg/m³ (vi) 2500 kg/m³
2. 18 480 kg 3. 0.93 g/cm³ (2 d.p.) 4. 62.44 cm³
5. 0.4533 kg/m³ 6. 271.7 kg 7. 0.75 g/cm³
8. 800 kg/m³ 9. 1 599 g 10. 3×10^{-6} m³
11. 5 g/cm³ 12. 6 000 cm³ 13. 280.8 kg
14. 0.831 g/cm³ 15. 0.8462 g/cm³

Chapter Sixteen

TIME

Introduction

The learner has met problems involving time at primary level. This topic serves to reinforce the concept of time.

Objectives

By the end of the topic, the learner should be able to:

- (i) convert units of time from one form to another.
- (ii) relate the 12-hour and the 24-hour systems.
- (iii) read and interpret travel timetables.
- iv) solve problems involving travel timetables.

Objective (i): Units of Time

The learner should be led through different units of time and conversion from one to another.

Objective (ii): The 12 and 24-hour Systems

The teacher should discuss the 12-hour system and the 24-hour system and how they relate to each other. Everyday life situations involving time should be discussed and given.

Objective (iii): Travel Timetables

- The learner should be led to read and interpret travel timetables through examples. The teacher is advised to collect travel timetables from bus companies, airlines and Kenya Railways and display them.
- An exercise on travel timetables should then be given to the learner.

Answers

Exercise 16.1

1. (a) 310 min (b) 248 min (c) 205 min (d) 374 min
 (e) 158 min (f) 504 min
2. (a) 3 480 s (b) 5 640 s (c) 8 160 s (d) 11 105 s
 (e) 15 603 s (f) 26 148 s

3. (a) 336 h (b) 188 (c) 96 h (d) 360 h (e) 192 h
(f) 244 h
4. (a) 1 h 12 min (b) 1 h 48 min
(c) 4 h (d) 12 h
(e) 14 h 2min (f) 10 h 30 min
5. (a) 2 min (b) 4 min 16 s (c) 7 min 17 s
(d) 8 min 24 secs (e) 6 min 12 s (f) 4 min 35 s
6. (a) 2 h 5 min 52 s (b) 2 h 42 min (c) 41min13 s
(d) 25 min 48 s (e) 5 h 2 min 50 s
(f) 9 h 49 s
7. (a) 2 880 min (b) 7 200 min (c) 30 240 min
(d) 50 400 min (e) 23 040 min (f) 34 560 min

Exercise 16.2

1. (a) 0230 h (b) 1850 h (c) 1315 h (d) 0710 h
(e) 1120 h (f) 2030 h (g) 2147 h (h) 2350 h
(i) 0030 h (j) 1619 h (k) 1445 h (l) 0645 h
2. (a) 8.25 a.m. (b) 4.15 p.m. (c) 1.17 p.m.
(d) 12.05 a.m. (e) 2.20 p.m. (f) 2.50 p.m.
(g) 10.30 p.m. (h) 11.40 p.m. (i) 6.11 a.m.
(j) 6.36 p.m. (k) 2.45 a.m. (l) 12.47 p.m.
3. 0600 h (6.00 a.m. the following day) 4. 1140 h

5.

Time of departure	Time of arrival	Time taken
8.15 a.m.	7.15 p.m.	11 h
6.40 p.m.	9.45 a.m.	15 h 5 min
8.30 p.m.	6.15 a.m. next day	9 h 45 min
9.15 a.m.	2.17 pm	5 h 2 min
1222 h	1402 h	1 h 40 min
2235 h	0615 h next day	7 h 40 min

6. 6.20 p.m. 7. (a) 59 min (b) 0914 h

- | | | |
|-------------------------|----------------------|----------------------|
| 8. 6 h 45 min | 9. 3 h 5 min | 10. 9.50 a.m. |
| 11. 8.36 a.m. | 12. 2.32 a.m. | 13. 8.10 a.m. |
| 14. 4:11.21 p.m. | 15. 1613 h | |

Exercise 16.3

- | | | |
|--------------------------|-------------|------------------------|
| 1. (a) 2 h 45 min | (b) 15 min | (c) 2 h 40 min |
| 2. (a) 10.10 a.m. | (b) 20 min | (c) 10 min |
| (d) 11.20 a.m. | (e) 60 km/h | |
| 3. (a) 1 h 30 min | (b) 30 min | (c) 1600 h (d) 40 km/h |
| 4. (a) sh. 60 | (b) sh. 60 | |
| 5. (a) sh. 50 | (b) sh. 50 | |

Chapter Seventeen

LINEAR EQUATIONS

Introduction

The learner has already met the use of algebraic symbols to represent information and in simplification of algebraic expressions. Equations in one unknown have also been examined, though it is necessary to revise what the learner has already covered. This topic should enable the learner gain more insight into the use of letters for numbers, manipulation algebraic expressions formation and solving of linear equations.

Objectives

By the end of this topic, the learner should be able to:

- (i) solve linear equations in one unknown.
- (ii) solve simultaneous linear equations by substitution and elimination.
- (iii) form and solve linear equations in one and two unknowns.

Notes and possible approach

Objective (i): Forming and Solving Linear Equations

The learner should be led through removing of brackets and formation of equations.

Objective (ii): Simultaneous Equations

The teacher should guide the learner through solving of simultaneous equations by substitution and elimination method.

Objective (iii): Formation and Solution of Linear Equations in One and Two Unknowns

The learner should be guided to form and solve linear equations in one and two unknowns.

Answers

Exercise 17.1

1. (a) -20 (b) $-\frac{1}{2}$ 2. (a) $-\frac{46}{7}$ (b) $\frac{1}{3}$
3. (a) $\frac{-15}{8}$ (b) 10 4. (a) 24 (b) $\frac{-21}{6}$
5. (a) -8 (b) -17
6. $\frac{51}{13}$

Exercise 17.2

1. 48 cm by 52 cm 2. sh. 2 700
3. A had sh. 520, B had sh. 500
4. $\angle A = 100^\circ$, $\angle B = \angle C = 40^\circ$
5. $-7, -6, -5, -4$
6. 5, 7, 9
7. Daughter gets sh. 27 000, wife gets sh. 33 000, son gets sh. 66 000
8. 100°C , -40°C 9. 2 years 10. 43.74 cm^2
11. (a) sh. 300 (b) sh. 100

Exercise 17.3

1. (a) $m = 6, n = 2$ (b) $m = \frac{24}{7}, n = \frac{1}{7}$ 2. (a) $x = -\frac{3}{10}, y = \frac{21}{10}$
(b) $r = -6, s = -7$ 3. (a) $p = 0, q = -3$ (b) $r = 2.5, s = -0.5$
4. (a) $p = \frac{5}{3}, r = \frac{8}{3}$ (b) $u = 12, v = 13$ 5. (a) $m = 3, n = 2$
(b) $p = \frac{1}{3}, q = \frac{1}{11}$ 6. (a) $x = \frac{40}{17}, y = \frac{-9}{34}$ (b) $x = 18, y = 1$
7. (a) $u = 2.5, v = -5$ (b) $x = \frac{164}{31}, y = \frac{12}{31}$ 8. (a) $u = 11, v = 3$
(b) $x = 5, y = -5$
9. 135, 66

10. Cost of handkerchief is sh. 25.00.
Price of a pair of socks is sh. 80.00
11. Type **B** contains 6, type **A** contains 7
12. Koki earns sh. 4 800, Kirui sh. 6 000

Exercise 17.4

1. (a) $x = \frac{10-3y}{2}$ (b) $q = \frac{p-14}{6}$ 2. (a) $b = \frac{195-5a}{6}$
(b) $r = s - 10$ 3. (a) $x = \frac{80}{19}$, $y = \frac{3}{19}$ (b) $q = -\frac{47}{19}$, $p = -\frac{16}{19}$
4. $a = 225$, $b = -195$ (b) $r = -18.95$, $s = -8.95$ 5. (a) $x = 4$, $y = 3$
(b) $x = 3.5$ 6. $x = -0.5$, $y = -0.5$ (b) $x = 1$, $y = 1$
7. (a) $x = -1$, $y = -2$ (b) $x = 1$, $y = 2$
8. $u = 4$, $v = 8$

Exercise 17.5

1. (a) $x = 2$, $y = 2$ (b) $x = 2.5$, $y = 2.5$ 2. (a) $x = 5$, $y = 5$
(b) $p = \frac{36}{11}$, $q = \frac{4}{11}$ 3. (a) $x = 2$, $y = 1$ (b) $x = 0.5$, $y = 0.25$
4. (a) $x = \frac{7}{15}$, $y = \frac{2}{75}$ (b) $x = 0.5$, $y = 0.3$ 5. (a) $x = \frac{71}{416}$, $y = \frac{3}{26}$
(a) $x = 5$, $y = 1$ 6. $x = 6.72$, $y = 2.56$
7. Volleyball = 10, tennis = 4
8. (a) sh. 10 (b) sh. 15
9. Each book costs sh. 25, each pen sh. 8.
10. 1 bag of salt weighs 90 kg, 1 bag of beans 70 kg
11. (a) sh. 50 (b) sh. 60
12. 160 km

Chapter Eighteen

COMMERCIAL ARITHMETIC

Introduction

The money used in any country is referred to as currency. Currencies in various countries are identified with certain names. Here in Kenya, the currency used is the Kenya shilling, which the learner is familiar with. In South Africa, it is the Rand, in Britain the Pound Sterling, United States of America the Dollar and in Japan it is the Yen.

It is very important to point out to the learner that while it is possible to purchase locally produced goods in Kenya currency, it is not equally possible to purchase a school bus in Japan using the Kenya currency unless the currency is converted into Japanese currency, i.e., the Yen.

Before embarking on exercises involving currency conversion, the learner must be fully made aware of the international usefulness of other world currencies. One approach to this is to display an assortment of imported objects made from various countries, for example, empty bottles, stapler, bicycle, watches, cameras, medicines, etc.

Apart from buying imported commodities, the learner must be made aware of the other uses of other world currencies, such as paying for travel from one country to another and education in foreign countries.

In addition to currency, other areas covered in this topic include profit and loss, discount and commission, that the learner has met in at primary level.

Objectives

By the end of the topic, the learner should be able to:

- (i) state the currencies of different countries.
- (ii) convert currency from one form into another, given the exchange rates.
- (iii) calculate profit and loss and express them as percentages.
- (iv) calculate discount and commission and express them as percentages.

Objective (i): Currency

A table such as the one shown below should be availed to the learner.

<i>Country</i>	<i>Currency</i>	<i>Symbol</i>
Kenya	Shilling	Ksh
Uganda	Shilling	Ush
Tanzania	Shilling	Tsh
U.S.A.	US Dollar	\$
U.K	Sterling Pound	£
Canada	Canadian Dollar	\$
European countries	Euro	€
Japan	Japanese Yen	¥
India	Indian Rupee	Re or Rs
Australia	Aus Dollar	Aus \$

A class discussion with help of newspaper cuttings should yield additional list of currencies.

Objective (ii): Currency Exchange Rates

- The learner should be referred to the currency exchange rate in the students' book. The teacher may however emphasise that these rates vary from time to time, illustrating this with the latest newspapers.
- It should be emphasised that in exchange transactions, it is the bank which buys currency from or sells to the client.
For the exercises in the students' book, accuracy in long division and multiplication must be emphasised and rounding off discouraged unless otherwise stated.

Objective (iii): Profit and Loss

- The learner should be provided with a clear definition of profit and loss.
- Percentage profit and percentage loss should then be discussed examples.

Percentage profit should be defined as;

$$\text{Percentage profit} = \frac{\text{profit}}{\text{cost price}} \times 100$$

Percentage loss should be defined as;

$$\text{Percentage loss} = \frac{\text{loss}}{\text{cost price}} \times 100$$

Objective (iv): Discount and Commission

- The teacher should discuss discount and percentage discount followed and then give an exercise.
- The teacher should then discuss commission and related problems.

Answers

Exercise 18.1

1. 28.75%
2. sh. 24
3. 36 rubbers; sh. 1.00
4. 20 pens
5. second day sh. 100, third day sh. 400
6. sh. 9 000
7. sh. 3 995
8. sh. 400.50
9. (a) sh. $\frac{(xn + ym)}{100}$ (b) $(xn + ym)$ cts (c) sh. $\left[p - \frac{xn + ym}{100}\right]$
10. sh. 9
11. sh. 9.50
12. sh. 101 400
13. sh. 6 905
14. sh. 133 700
15. 120 000

Exercise 18.2

1. (a) Ksh. 30252.80 (b) Ksh. 17474.55
(c) 276.20 (d) \$562.65
(e) £ Sterling 387.90 (f) Ksh. 628 011
(g) Ksh. 407749.15 (h) Yen 7156.20
(i) US\$ 7390.15 (j) £ Sterling 321.15
(k) Ksh. 10 674 (l) Can \$ 95.85
(m) Ksh. 4181.60
2. Ksh. 573 897 981.70
3. Ksh. 36711.30
4. Ksh. 39237.20
5. Ksh. 377311.70
6. Ksh. 443012.20
7. Ksh. 880350.80
8. (a) Ksh. 1102972.95 (b) Ksh. 1 101 339

Exercise 18.3

- | | |
|--------------|--------------|
| 1. 10.77 % | 2. 19.05% |
| 3. 11.11% | 4. 80% |
| 5. sh. 1 350 | 6. sh. 20.25 |

Exercise 18.4

- | | | |
|---------------|------------------|------------------|
| 1. (a) 4% | 2. (a) sh. 285 | (b) sh. 256.50 |
| 3. sh. 14 400 | 4. sh. 30 030 | |
| 5. 5% | 6. (a) sh. 373.2 | (b) sh. 5 516.80 |
| | (c) sh. 5 890 | (d) 6.3% |
| 7. sh. 600 | 8. 7% | |

Exercise 18.5

- | | | |
|------------------------|---------------|----------------|
| 1. sh. 600 | 2. sh. 26 500 | 3. Ksh. 12 550 |
| 4. sh. 175 | 5. 3% | 6. sh. 18 000 |
| 7. sh. 612.50, sh. 625 | | |

Mixed Exercise 2

1. (a) $x = \frac{1}{3}, y = \frac{3}{2}$ (b) $x = \frac{1}{32}, y = \frac{29}{32}$
- (c) $x = \frac{55}{17}, y = \frac{763}{272}$ (d) $x = 1.5, y = 1.2$
2. Length = 20 cm, width = 16 cm; 40 : 9
3. $\frac{(x+2)(y-5)}{3}$ or $\frac{xy-5x+2y-10}{3}$
4. (a) 9 : 10 : 6 (b) 12 : 3 : 2
5. 4 : 17
6. $\frac{ta}{s}$ 7. (a) 16:25 (b) 64 :125 8. 32.25%
9. sh. 280
10. sh. 348 11. 50% 12. (a) $x = 1, y = 8$ (b) $x = 1.5$
- (c) $x = 6 \frac{12}{19}$ (d) 0.4215 13. 12 cm 14. sh. 6 750
15. £ 1364.40 16. K£44607253.10

CO-ORDINATES AND GRAPHS

Introduction

The learner has been exposed to graph interpretation. However, it is desirable to revise the basics of the graph work. This topic should enable the learner to plot, draw, read and interpret graph using appropriate skills.

Objectives

By the end of this topic, the learner should be able to:

- (i) locate and plot points on the cartesian plane.
- (ii) choose and use appropriate scale for a given data.
- (iii) make a table of values for a given linear relation and use these values to draw a linear graph.
- (iv) solve simultaneous linear equations graphically.
- (v) draw, read and interpret graphs.

Objective (i): Cartesian Plane

- Given that the learner has already studied integers, the extension of the x-y axes to include negative numbers should be discussed. Locating and plotting points should be examined. It should be noted that the learner who plots a point will by implication have located it.
- In this topic, emphasis should be on the use of ordered parts of the cartesian co-ordinates. It is important that the learner should be able to distinguish between (a, b) and (b, a).
- The exercise of plotting points might be made more interesting by choosing sets of points such that some simple geometrical figures such as a polygon are drawn by joining the points.

Objectives (ii): Use of Appropriate Scale

The term appropriate here should refer to:

- (i) regularity of the scale.
- (ii) viability of the scale.

It is necessary to emphasise to the learner that graphs make sense only when the scales are regular.

- Viability means not too small or too big a scale. In other words, the learner should be trained to use as much of a graph space as possible.
- Choosing a scale which squeezes a graph to a corner of a page is likely to create difficulties in reading the graph. Similarly, choosing

a scale such the graph spills a page shows lack of control over the data. It is recommended that many varied examples of tabulated data be used in giving the learner practice in choosing appropriate scale.

Objective (iii): Table of Values for a given Linear Relationship and a Linear Graph

- In drawing a straight line in the cartesian plane, there are two possible ways. One is that a set of collinear points is given, probably in the form of a table. The learner is expected to plot the points and draw a straight line through them. The second method is by using a linear algebraic relation. The learner is expected to tabulate a table of points from the relation before plotting them and then draw a straight line through them.
- The learner will need practice in making tables for linear relations. Through practice, the learner should realise that for linear relations, two points are sufficient to draw a line. The third point can be used for checking.

Objective (iv): Solving Simultaneous Equations using Graphs

The learner has already solved simultaneous linear equations using substitution and elimination methods. Here, the graphs of linear equations are used to solve simultaneous linear equation whereby the point of intersection of the two graphs give the values of the two unknowns.

Objective (v): Interpretation of Graphs

The learner should be guided on how to draw, read and interpret linear and non-linear graphs from given table of values.

Answers

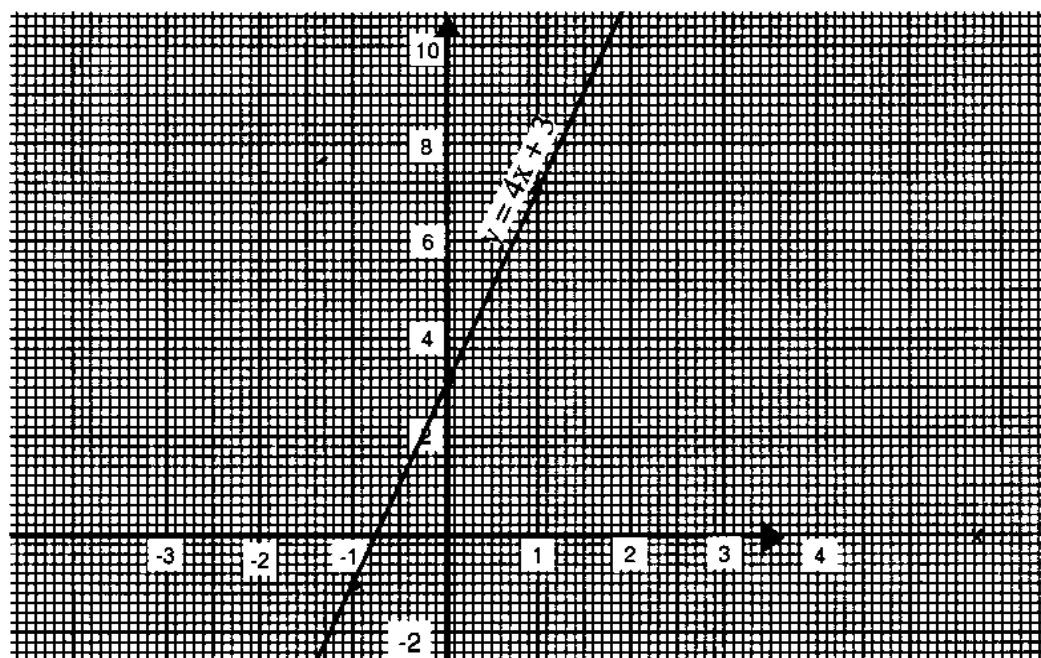
Exercise 19.1

- third
 - second
 - on the x-axis
 - first
 - third
 - second
 - fourth
 - second
- (0, 6)
 - (2, 3)
- 21 sq. units
- D (-4, -1) or (-2, -3)
- (1, 1)
 - (-2, -8)
 - (3, -3)
 - (-7, -3)
 - (-5, -7)
 - 8 units
 - 0 unit
 - 6 units
- B (-3, -3); E (1, 4)
- $x = -4$, $y = -3$ or $x = -2$, $y = 5$
- 2.125 square units

Exercise 19.2

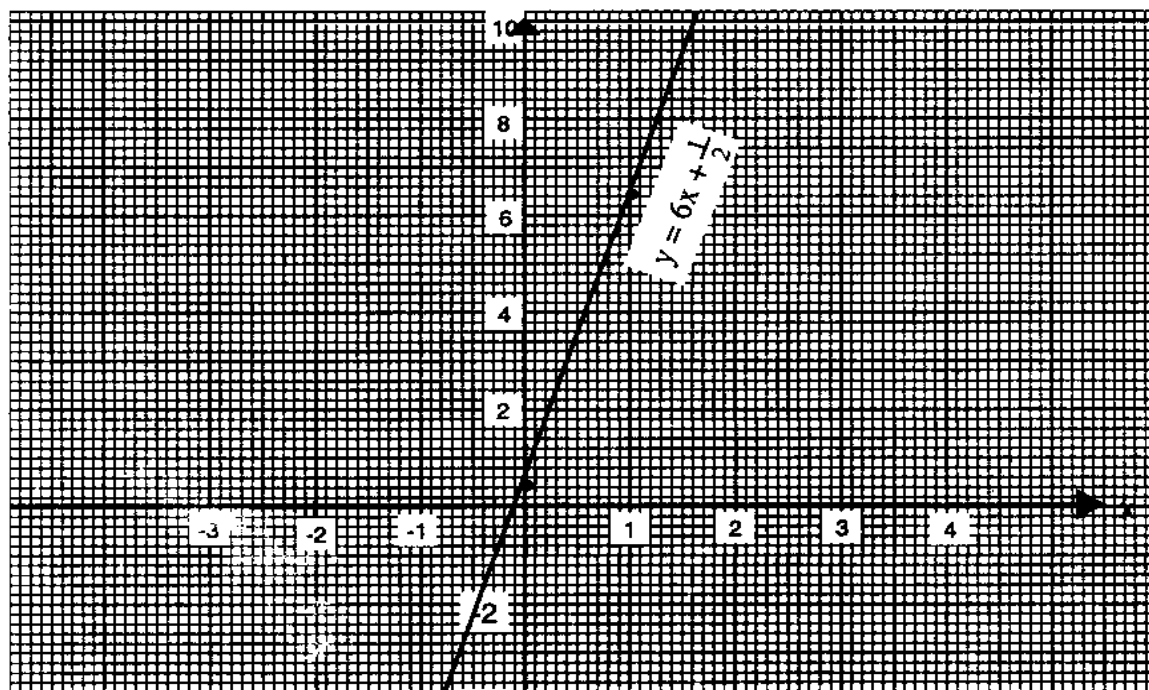
1 (a)

x	-2	-1	0	1	2	3
y	-5	-1	3	7	11	15



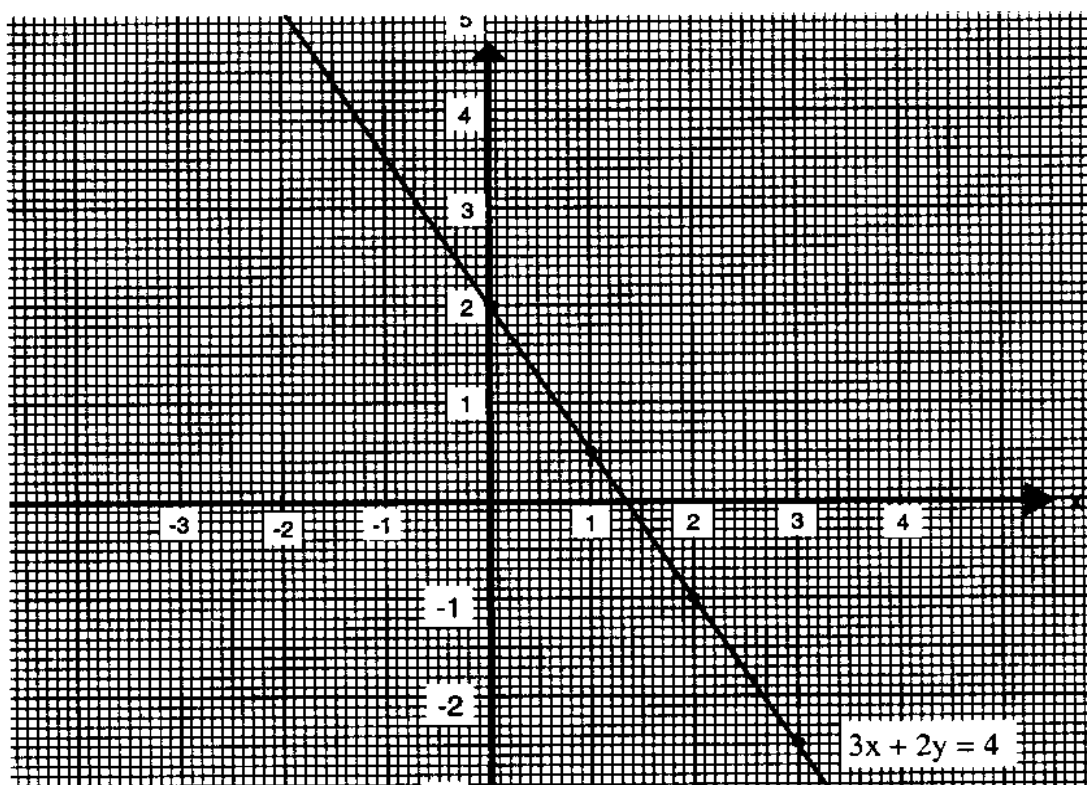
(b)

x	-1	0	1	2	3
y	5.5	0.5	6.5	12.5	18.5

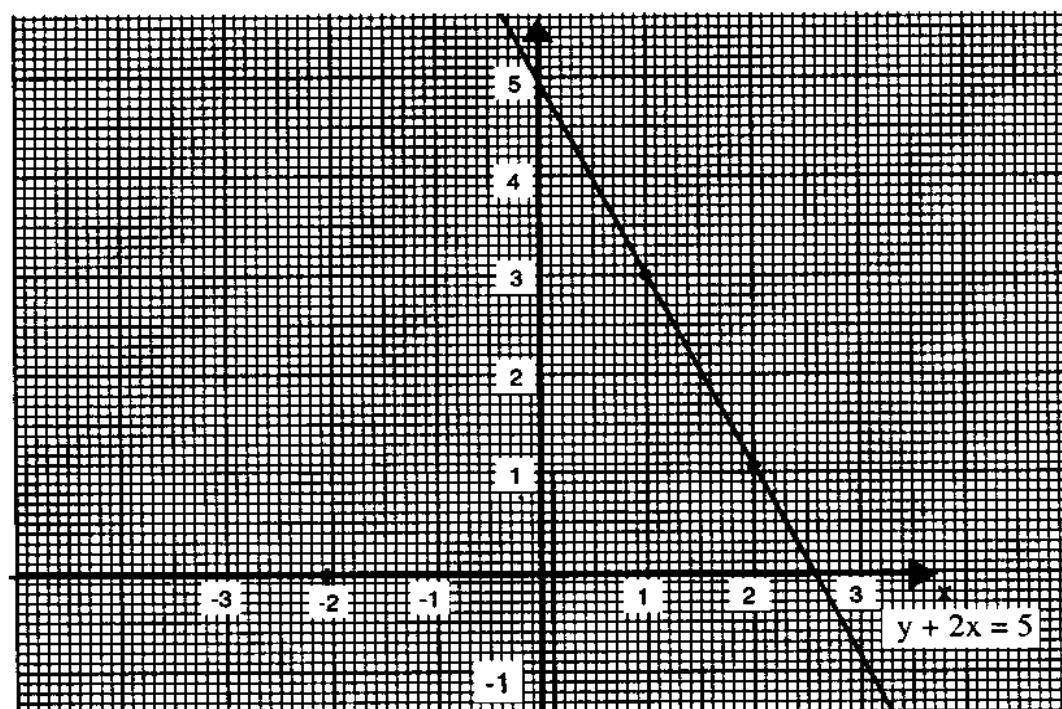


(c)

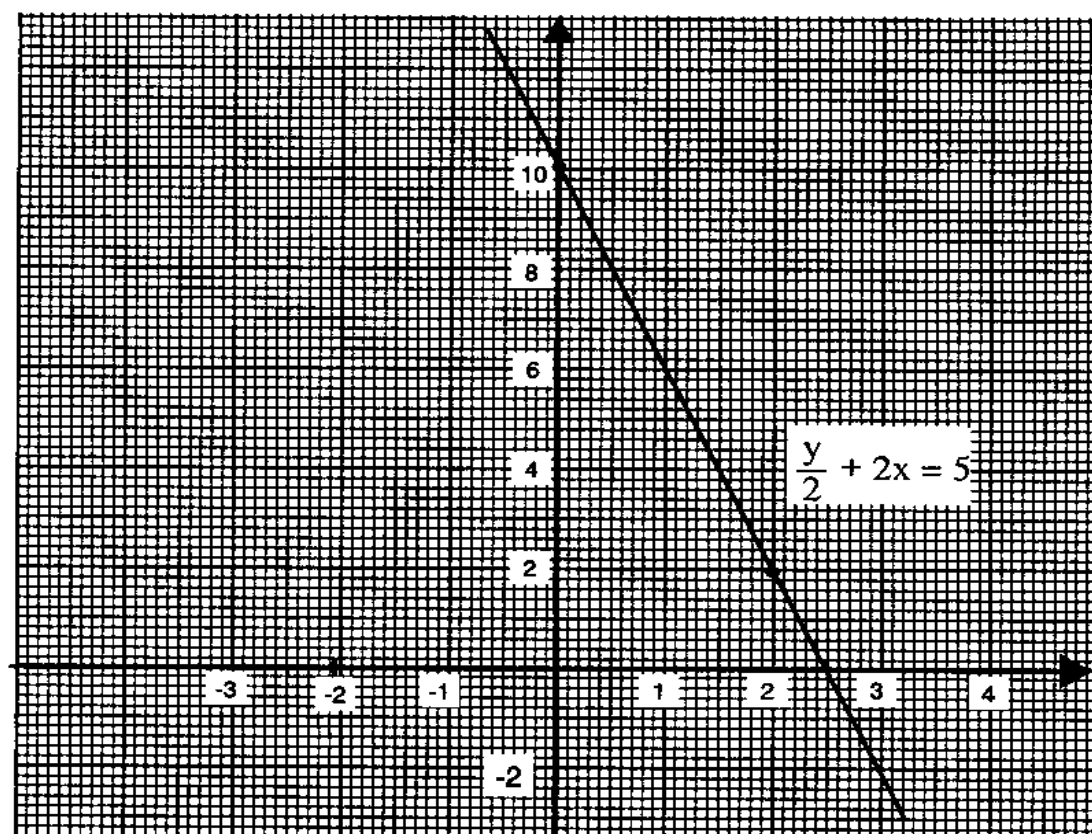
x	-1	0	1	2	3	4
y	3.5	2	0.5	-1	-2.5	-4



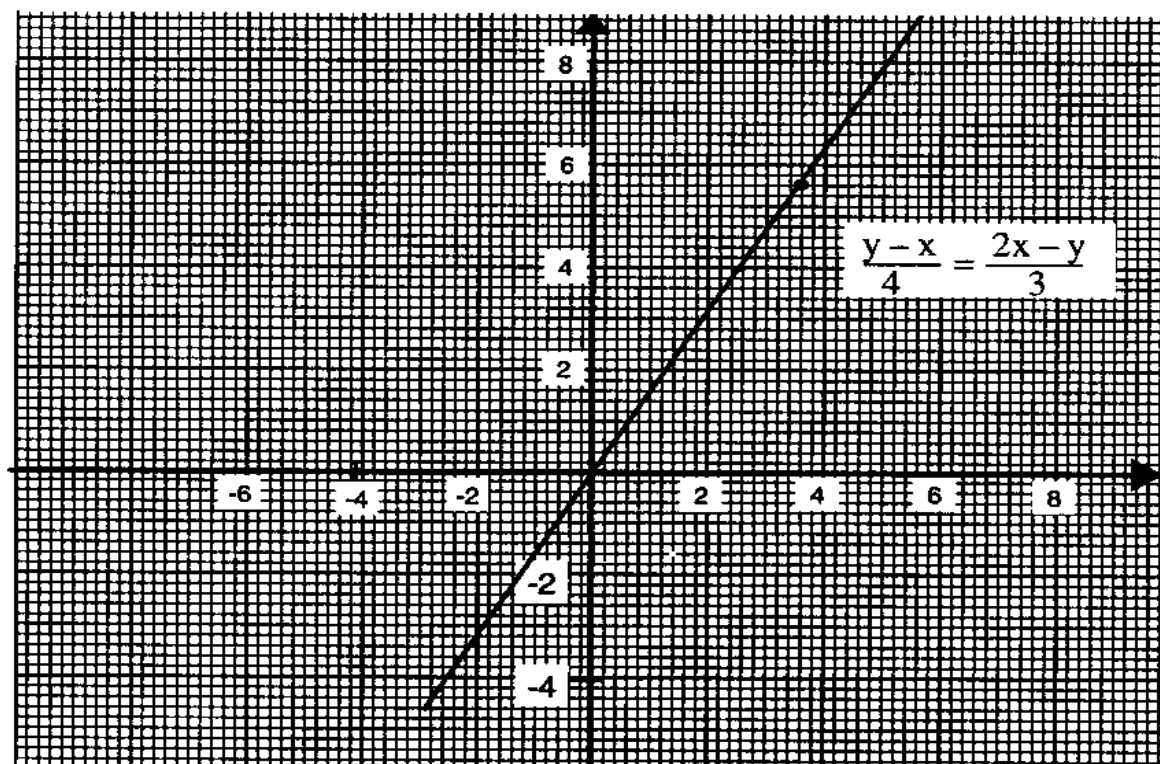
2(a)



(b)

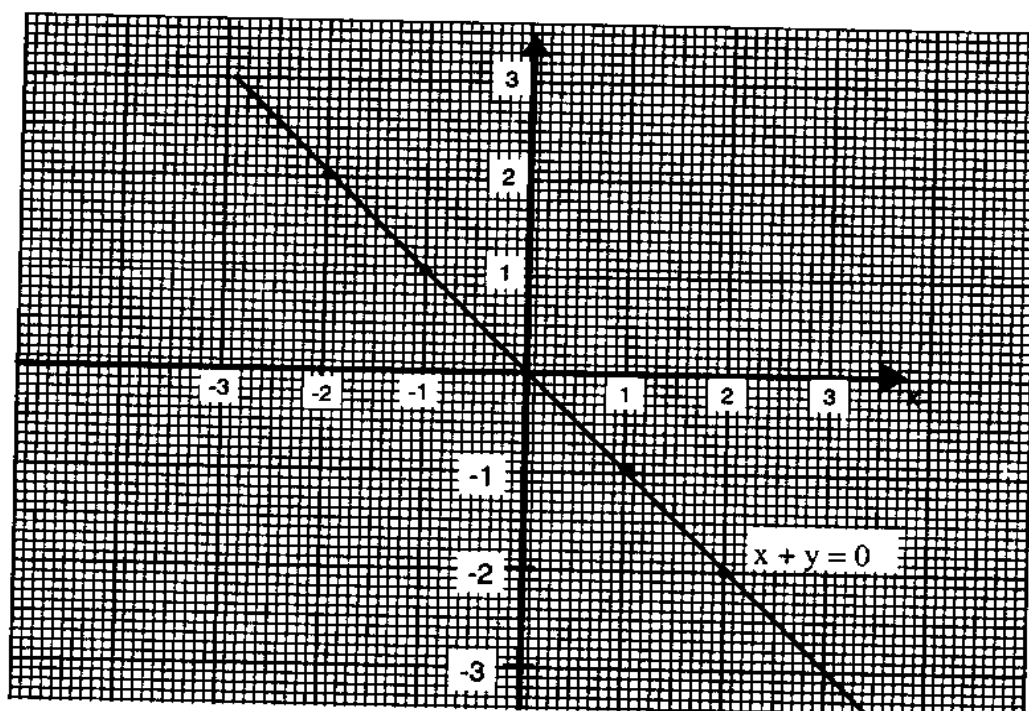


(c)

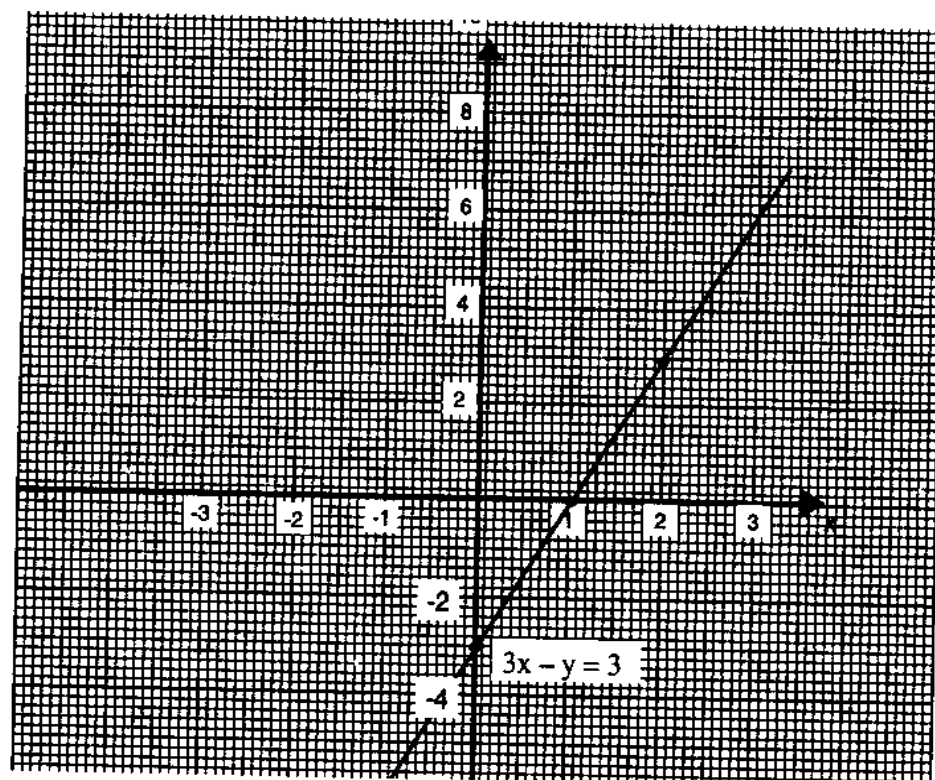


Exercise 19.3

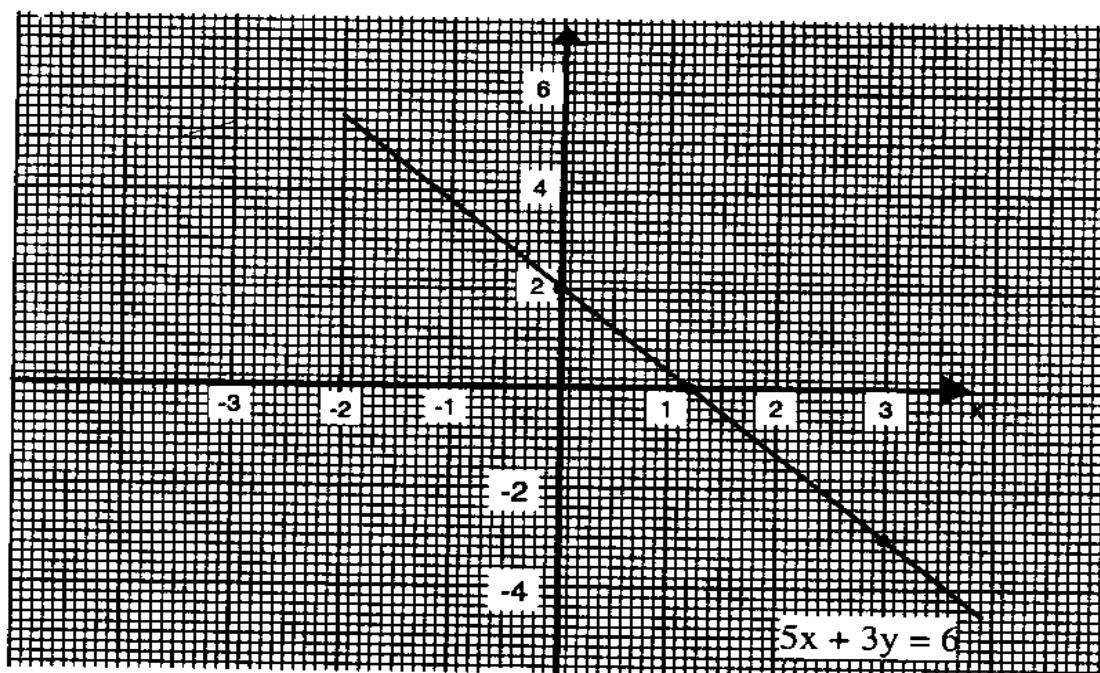
1. (a)



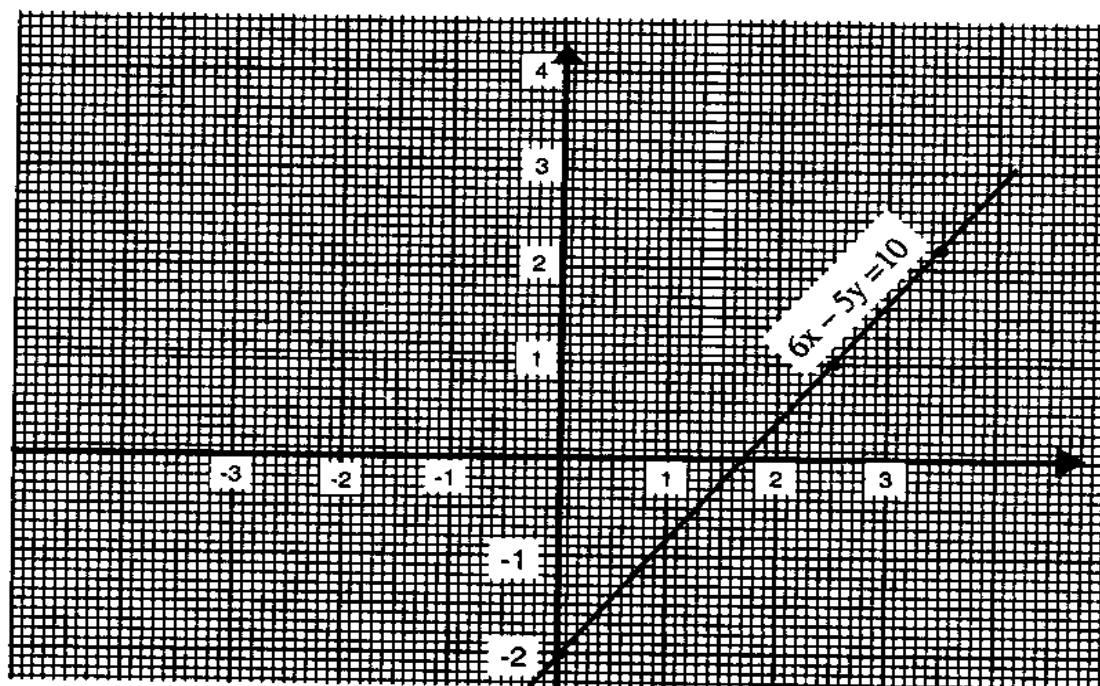
(b)



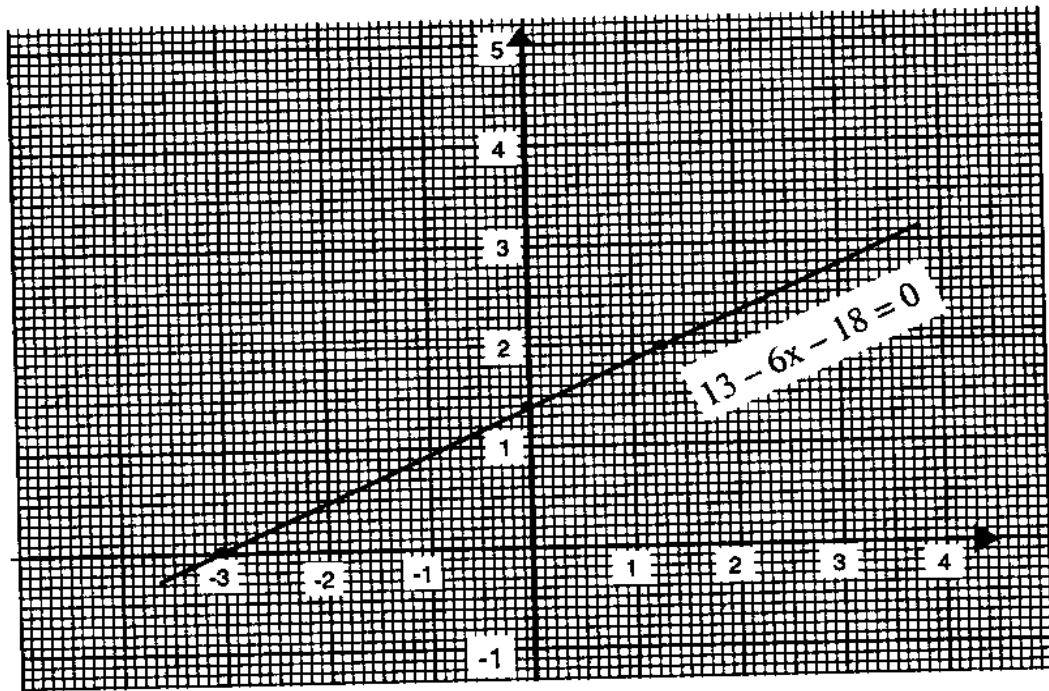
(c)



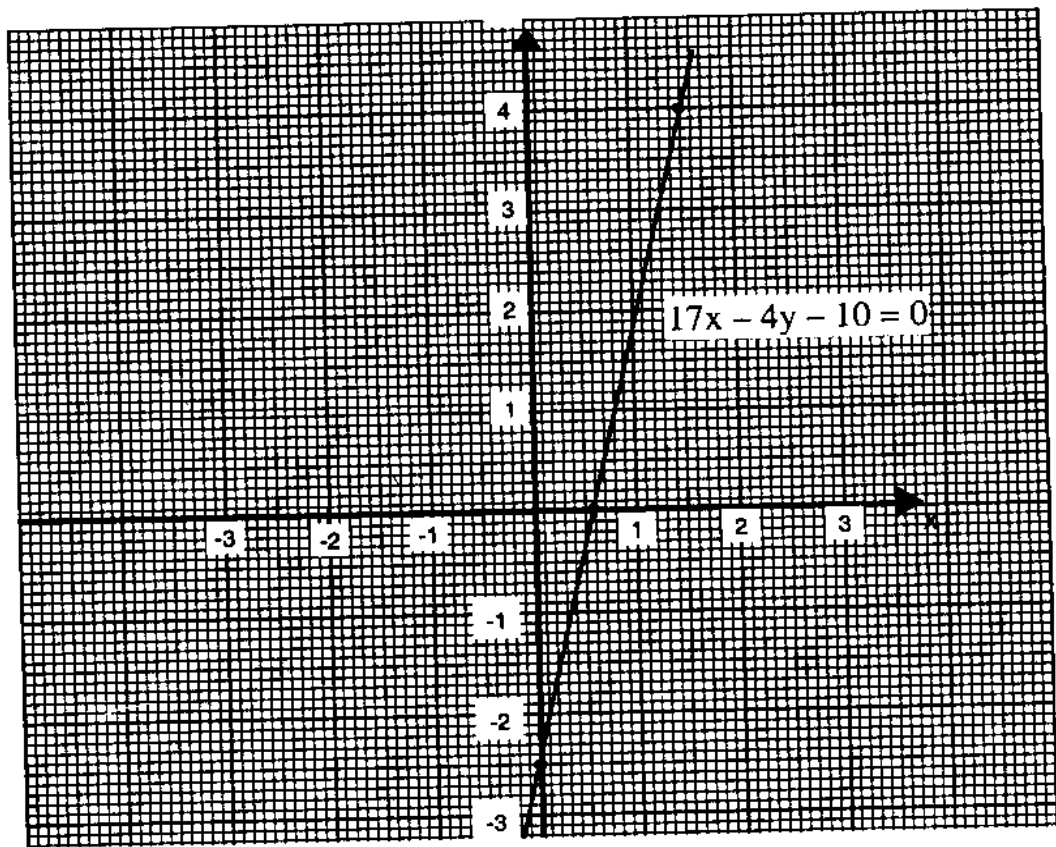
(d)



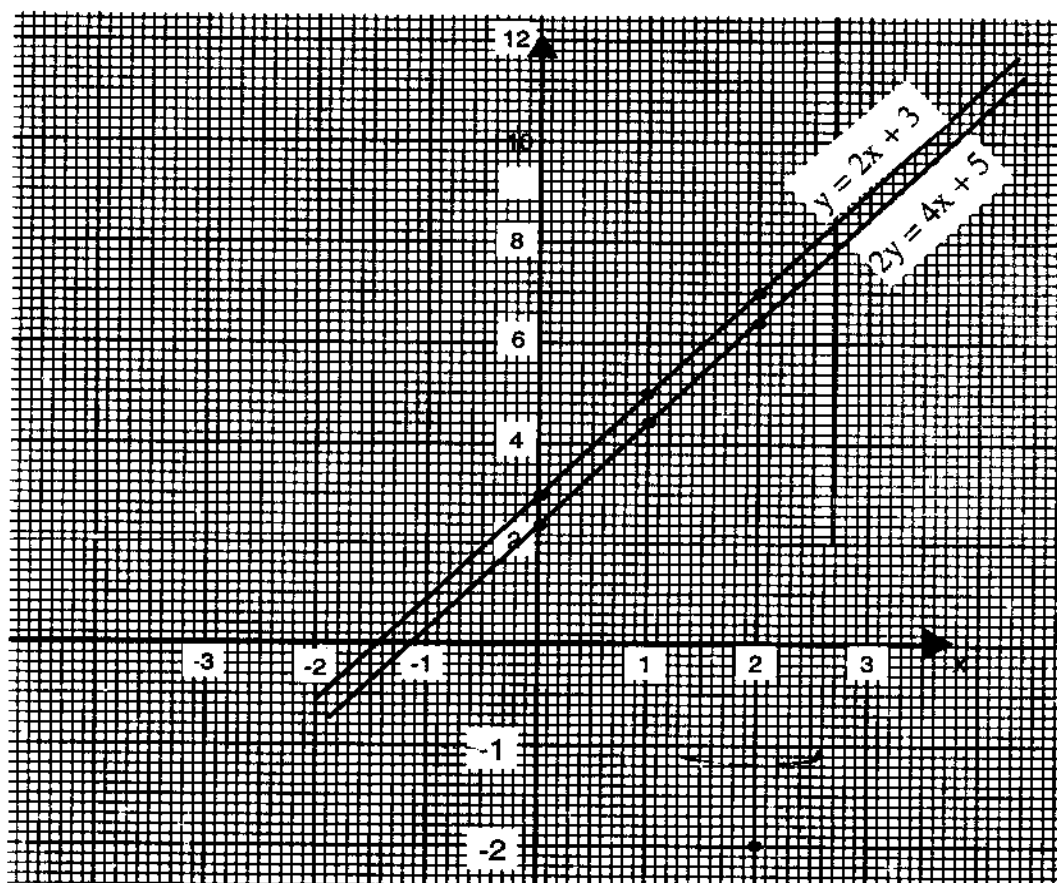
(e)



(f)

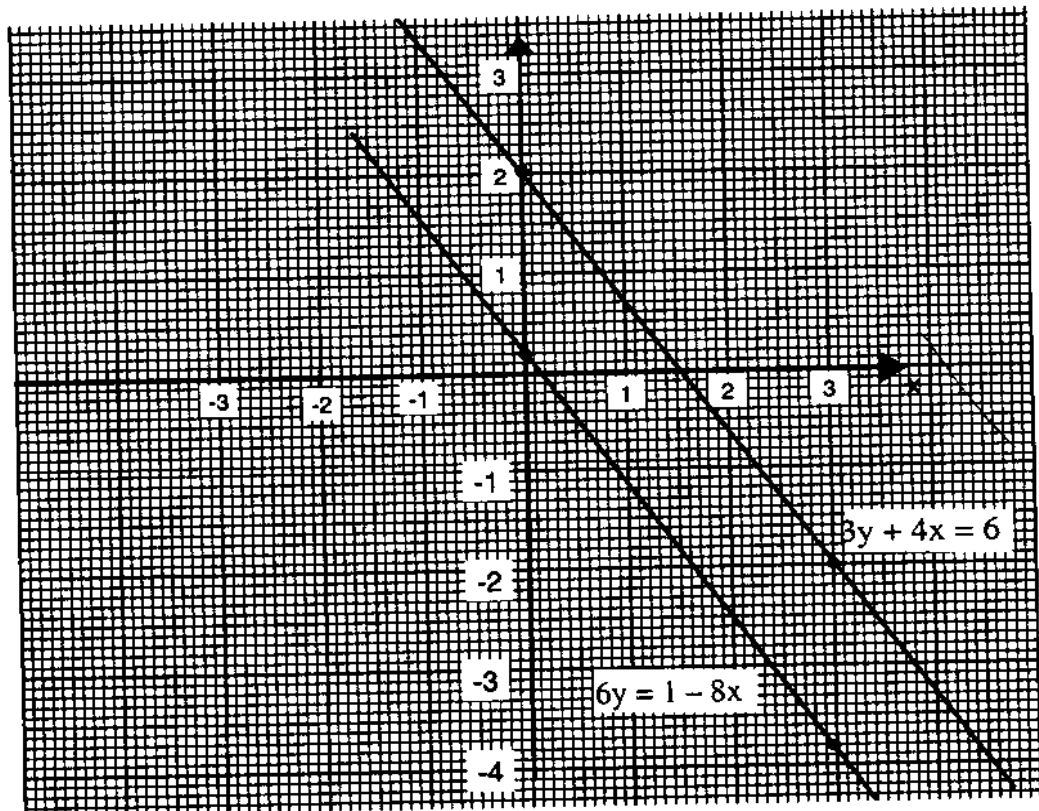


2. (a) $y = 2x + 3$; $m = 2$, $c = 3$ (b) $y = \frac{4}{3}x - \frac{8}{3}$; $m = -\frac{4}{3}$, $c = -\frac{8}{3}$
- (c) $y = -\frac{x}{10} + \frac{7}{2}$; $m = -\frac{1}{10}$, $c = \frac{7}{2}$ (d) $y = \frac{19}{7}x$; $m = \frac{19}{7}$, $c = 0$
- (e) $y = 4$; $m = 0$, $c = 4$ (f) $y = -3x - 4$; $m = -3$, $c = -4$
3. (a) (i) $y = 2x + 3$; $y = 2x + \frac{5}{2}$
- (ii)



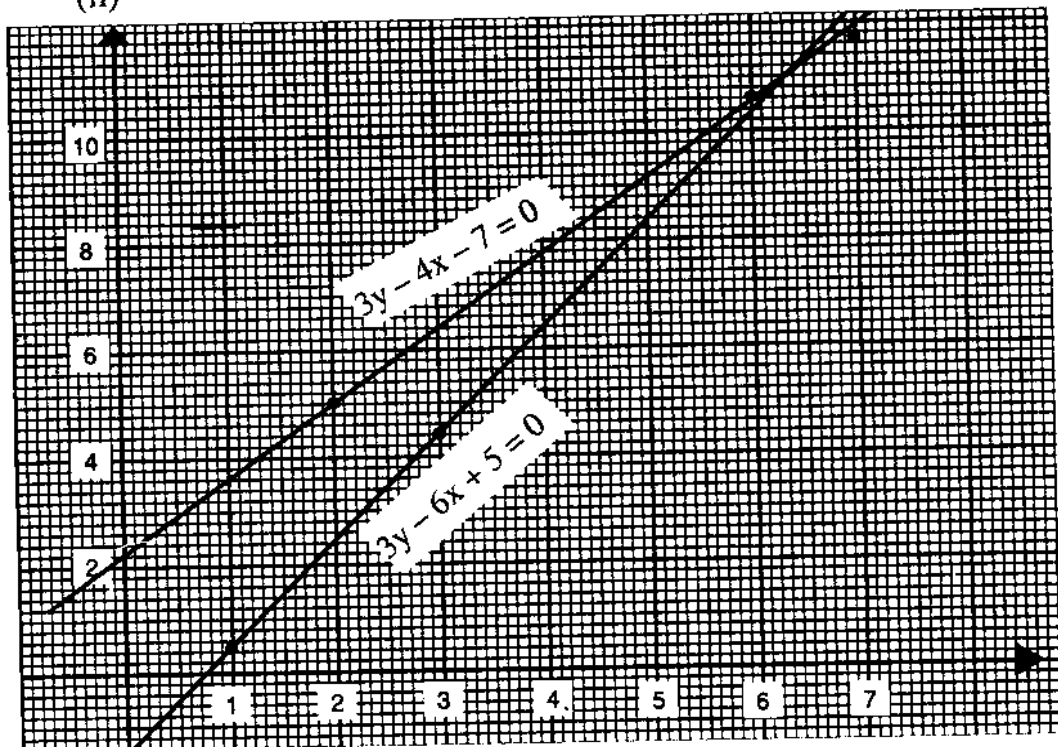
- (b) (i) $y = -\frac{4}{3}x + 2$; $y = -\frac{4}{3}x + \frac{1}{6}$

(ii)

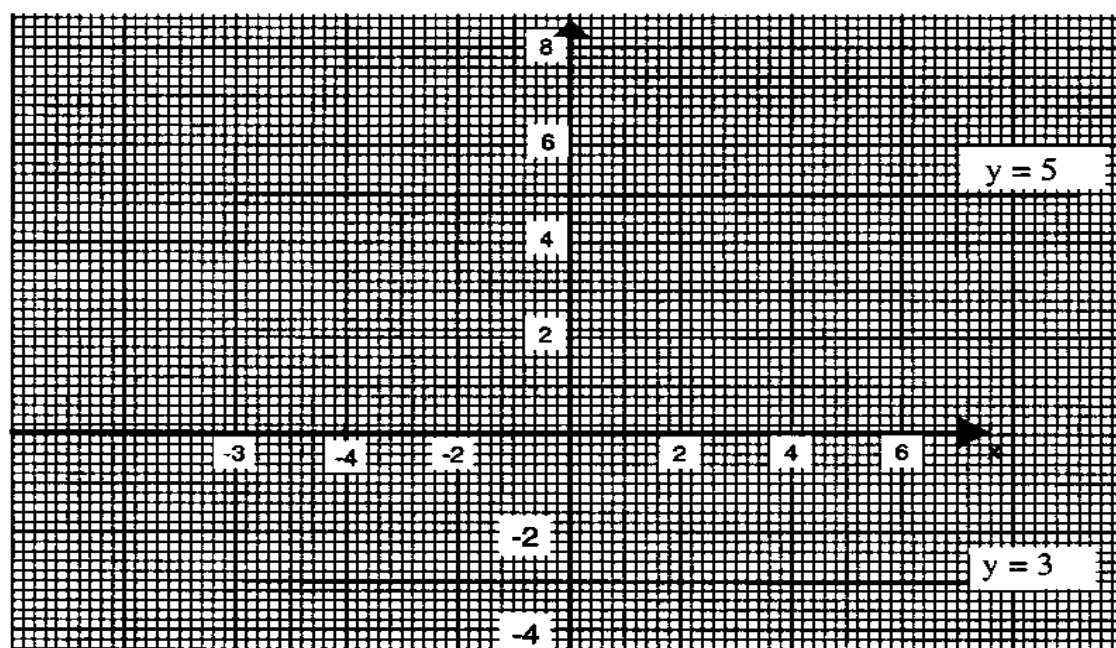


(c) (i) $y = 2x - \frac{5}{3}$, $y = \frac{4}{3}x + \frac{7}{3}$

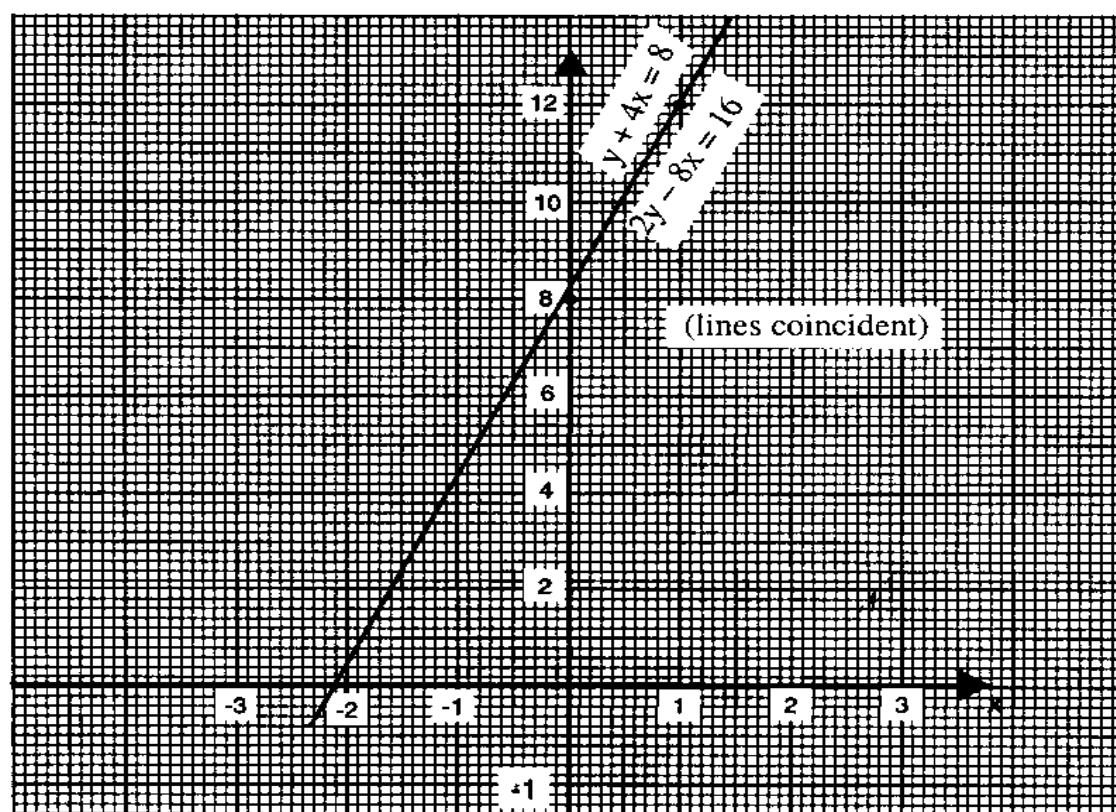
(ii)



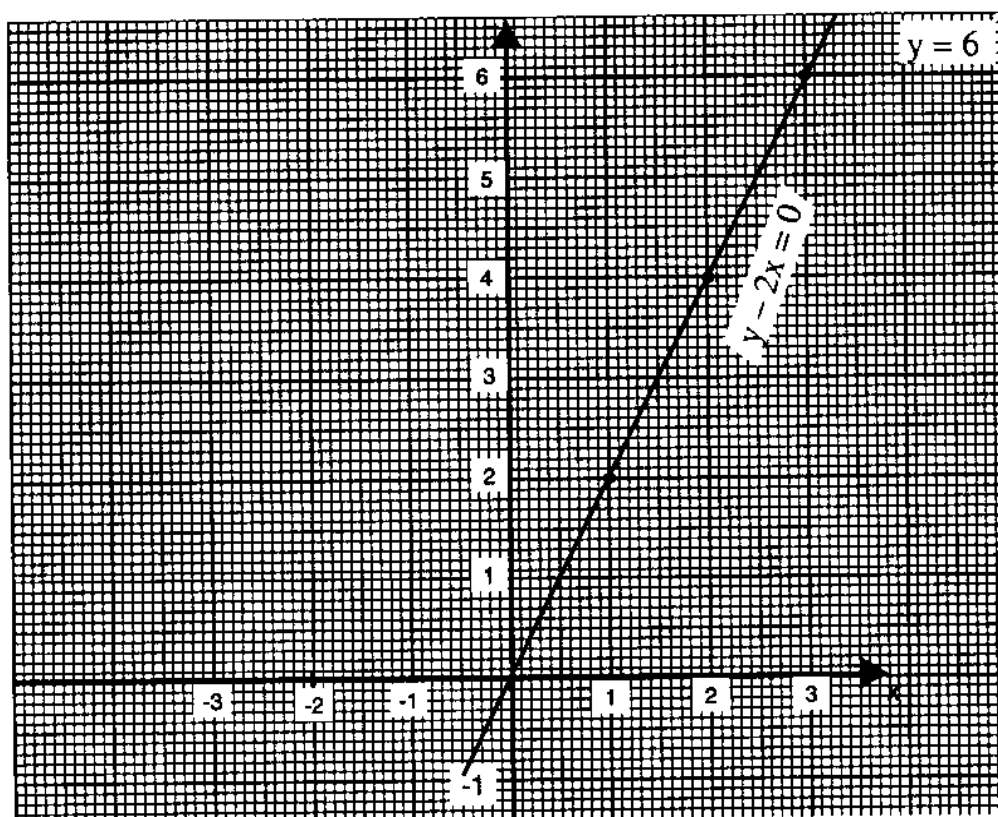
- (d) (i) $y = 5$; $y = -3$
(ii)



- (e) (i) $y = 4x + 8$; $y = 4x + 8$
(ii)



- (f) (i) $y = 6$; $y = 2x$
(ii)



Exercise 19.4

1. (a) $x = \frac{5}{8}$, $y = \frac{7}{8}$ (b) $x = 2$, $y = 1$
2. (a) $x = 4$, $y = 5$ (b) $x = 2$, $y = -3$
3. (a) $x = -1$, $y = -3$ (b) $x = -1$, $y = 1$
4. (a) $x = 0.5$, $y = 0.5$ (b) $x = -1\frac{6}{11}$, $y = -1\frac{2}{11}$
5. (a) $x = 1\frac{1}{2}$, $y = 4$ (b) $x = 1\frac{1}{2}$, $y = 1$
6. (a) $x = -\frac{1}{4}$, $y = -\frac{3}{4}$ (b) $x = \frac{2}{3}$, $y = 0$
7. (a) $x = 0.8$, $y = 0.5$ (b) $x = \frac{2}{3}$, $y = -\frac{1}{9}$

8. $x = 0, y = -4$

Exercise 19.5

1. (a) (i) sh. 82 (ii) sh. 100, (iii) sh. 176 (b) (i) 1 (ii) 48 (iii) 58
(c) sh. 70
2. (a) (i) -18°C (ii) -7°C (iii) 37°C (iv) -5°C
(b) (i) 77°F (ii) 39°F (iii) 98°F (iv) 86°F
3. (b) (i) 1.70 l (ii) 2.00 l, 210 l (iii) $97^{\circ}\text{C}, 46^{\circ}\text{C}$
4. (b) sh. 40 000 (c) sh. 17 500 (d) sh. 67 500
5. (d) (i) 0.58 s, 1.02 s, 1.44 s
(ii) 0.21, 0.46, 0.83
(iii) 0.25, 0.58, 0.81

Exercise 19.6

1. (a) 1 cm represents 4 days (b) (i) 250 insects
1 cm represents 200 insects (ii) 920 insects
(c) (i) 12.4 days
(ii) 7.6 days
2. (a) 9.6 (b) 7.3 (c) 0 (d) ± 3.7 (e) ± 2.9
(f) 8.4
3. (a) (i) 51 years (ii) 30 years (iii) 15 years
(b) (i) 53 years (ii) 40 years (iii) 39 years
(c) $1\frac{1}{2}$ years
4. (a) (i) 2.9 m^2 (ii) 3.6 m^2 (iii) 5 m^2
(b) Butcher A
(c) 35 kg
5. (a) (i) 6 900 (ii) 10 600 (iii) 14 600
(b) (i) 1972
(ii) 1982
6. (a) 20 m (b) 2 s (c) (i) 4 s (ii) 4.7 s
(d) 1 s and 3 s
0.6 s and 3.4 s
0.2 s and 3.7 s
0.1 s and 3.9 s

Chapter Twenty

ANGLES AND PLANE FIGURES

Introduction

In this topic, the learner is exposed to different types of angles, namely, acute, obtuse, reflex and right angles. Other angles covered are angles on a straight line, angles at a point and those on a transversal. Further to this, angle properties of polygons are considered.

The topic is not entirely new but a lot of exercises are required for deeper understanding.

Objectives

By the end of the topic the learner should be able to:

- (i) name and identify types of angles.
- (ii) solve problems involving angles on straight line and at a point.
- (iii) solve problems involving angles on a transversal.
- (iv) state angle properties of polygons and solve related problems.

Objective (i): Naming and identifying different types of angles

- Different types of angles should be discussed with the learner. These include acute, obtuse, right, reflex, complementary and supplementary angles.
- The teacher should emphasise that only two angles can be complementary or supplementary.

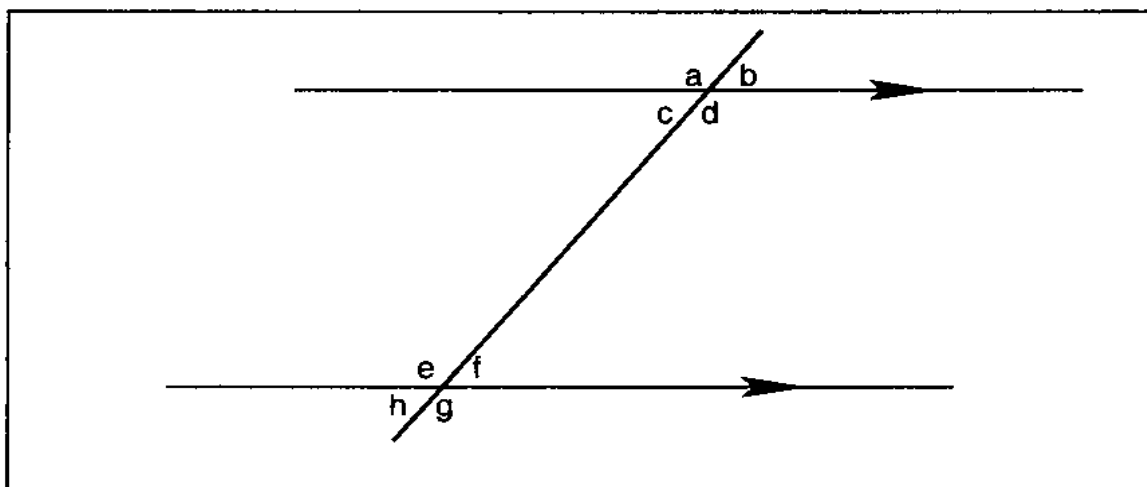
Objective (ii): Solving Problems Involving Angles on a Straight Line and at a Point

The learner should be led through a discussion to identify vertically opposite angles and adjacent angles, as well as to note that the sum of angles at a point is 360° while that on angles on a straight line is 180° .

Objective (iii): Solving Problems Involving Angles on a Transversal

The learner should be led to identify corresponding angles, alternate angles and allied angles.

A diagram of a transversal, as indicated below, is necessary.



Angles b and f, c and g, a and e, b and h are corresponding angles.

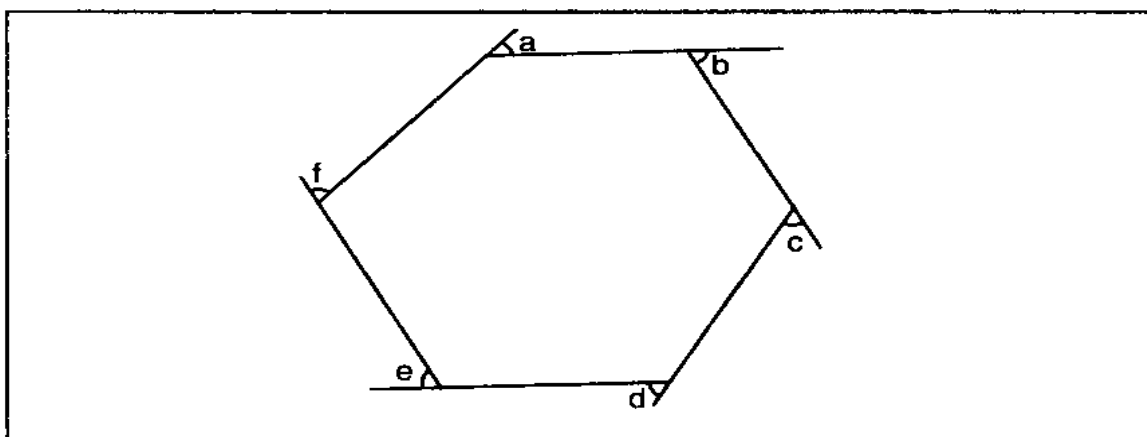
Angles c and f, d and e are allied angles and add up to 180° .

Angles c and e, d and f are alternate angles.

Angles a and c, b and d, f and h, and e and g are vertically opposite angles.

Objective (iv): Stating Angle Properties of Polygons

- Emphasis should be laid on triangles and quadrilaterals of all types, as in the students' book.
- The learner should be led through the table given in the text in order to derive the formula for the sum of interior angles of a polygon that is n sided; $(2n - 4)$ right angles.
- The learner should be guided to the conclusion that the sum of exterior angles of any polygon is 360° .



Hence, in the above figure, $a + b + c + d + e + f = 360^\circ$.

Answers

Exercise 20.1

1. (a) $\angle QOR, \angle POQ, \angle MOP$ and $\angle MOS$
(b) $\angle POR, \angle MOQ$ and $\angle POS$
(c) $\angle ROS$
(d) $\angle s QOR$ and $POQ, \angle s POQ$ and $MOP, \angle s MOP$ and MOS
(e) These can only be shown on the diagram.
2. (a) $\angle OAB, \angle OBA, \angle OBC, \angle OCB, \angle OCD, \angle ODA, \angle OAD$
(b) $\angle AOB, \angle BOC, \angle COD, \angle DOA, \angle ABC, \angle BCD, \angle CDA, \angle DAB$
(c) None.
(d) $\angle s ABC$ and $BCD, \angle s BCD$ and $CDA, \angle s CDA$ and DAB
 $\angle s DAB$ and $ABC, \angle s AOB$ and $BOC, \angle s BOC$ and COD
 $\angle s COD$ and $DOA, \angle s DOA$ and AOB
(e) $\angle s OAB$ and $OAD, \angle s ODA$ and $ODC, \angle s OCD$ and $OCB,$
 $\angle s OBC$ and $OBA, \angle s BAC$ and $BCA, \angle s CBD$ and CDB
 $\angle s DAC$ and $DCA, \angle s ADB$ and DBA
(f) $\angle AB$ and $\angle DC, \angle AD$ and $\angle BC$
3. (a) (i) 33° (ii) 52° (iii) 33.5°
(iv) 1° (v) 90° (vi) 11.4°

(b) (i) 123° (ii) 90° (iii) 41°
(iv) 135° (v) 60° (vi) 0°
4. (a) $\angle AOB = 18^\circ, \angle BOC = 38^\circ, \angle COD = 72^\circ$
 $\angle DOE = 62^\circ, \angle EOF = 52^\circ$
(b) $\angle AOF = 118^\circ$
(c) Acute: $\angle AOB, \angle BOC, \angle COD, \angle DOE, \angle EOF$
Obtuse: $\angle AOF$
(d) $\angle AOF$ and $\angle DOE,$
(e) $\angle AOB = 342^\circ, \angle AOC = 304^\circ, \angle FOC = 186^\circ$
(f) $\angle AOB$ and $\angle COD, \angle BOC$ and $\angle EOF$

Exercise 20.2

1. (a) $w = 33^\circ$ (b) $x = 30^\circ$ (c) $y = 36^\circ$
(d) $\beta = 50^\circ,$ (v) $r = 110^\circ$

2. $a = 30^\circ, b = 90^\circ, c = 60^\circ$
3. $q = 150^\circ$
4. (a) $p = 20^\circ$ (b) $x = 85^\circ, y = 20^\circ, z = 75^\circ$
5. $s = 81^\circ, t = 99^\circ$ 6. $a = 135^\circ, b = 90^\circ$
7. $p = 30^\circ, q = 60^\circ, r = 90^\circ, s = 180^\circ$
8. $a = 24^\circ, b = 48^\circ, c = 72^\circ, d = 96^\circ, e = 120^\circ$
9. $y = 21^\circ$ 10. $x = 48^\circ$ 11. $x = 35^\circ$
12. $\angle BOC = 234^\circ$
13. $\frac{3x}{2} + 6 + \frac{5x}{2} + 2x - 10 + x + y = 360^\circ$
 $7x - 4 + y = 360$
 $y = 364 - 7x; y = 7(52 - x)$
14. $x = 90^\circ, 3y = 90^\circ, z = 45^\circ$
15. $x = 38.87^\circ$

Exercise 20.3

1. $h = 105^\circ, i = 75^\circ, j = 75^\circ, k = 75^\circ$
 $l = 105^\circ, m = 105^\circ, n = 75^\circ$
2. $a = 150^\circ, b = 30^\circ, c = 150^\circ, d = 30^\circ$
 $e = 150^\circ, f = 30^\circ, g = 150^\circ$
3. $x = 265^\circ, y = 85^\circ$
4. $a = 150^\circ, b = 125^\circ, c = 55^\circ$
5. $x = 140^\circ, y = 40^\circ, z = 40^\circ$
6. $a = 50^\circ, b = 63^\circ, c = 67^\circ$
7. $a = 38^\circ, b = 68^\circ, c = 68^\circ$
8. $x = 54^\circ, y = 57^\circ, z = 54^\circ$
9. $a = 53^\circ, b = 67^\circ, x = 60^\circ, y = 53^\circ$
10. $x = 40^\circ, y = 30^\circ, z = 110^\circ$
11. $a = 40^\circ, b = 104^\circ, c = 76^\circ$
12. $a = 70^\circ, b = 70^\circ, m = 40^\circ, n = 110^\circ$
 $w = 70^\circ, x = 70^\circ, z = 70^\circ$
13. $4x + 2x + 2y = 180$ (angle sum of a triangle)
 $6x + 2y = 180$
 $\therefore 3x + y = 90$

Exercise 20.4

1. (a) Scalene (b) Right-angled (c) Isosceles
(d) Equilateral
(e) Scalene (f) Isosceles (g) Right-angled isosceles
2. 87° 3. Each angle is 60° ; Equilateral
4. (a) $a = 40^\circ$, $b = 140^\circ$ (b) $x = 117^\circ$, $y = 133^\circ$
(c) $b = 86^\circ$ (d) $q = 120^\circ$ (e) $r = 108.5^\circ$
(f) $l = 112^\circ$,
 $m = 130^\circ$, $n = 118^\circ$.
5. Right-angled
7. (a) $x = 34.5^\circ$, $3x = 103.5^\circ$, $y = 138^\circ$
(b) $x = 42^\circ$, $y = 48^\circ$ (c) $3x = 69^\circ$, $5x = 115^\circ$, $y = 65^\circ$
(d) $x = 36^\circ$, $3x = 108^\circ$
9. $\angle MSL = 1(r - t)$ 10. $\angle FJK = 130^\circ$
11. (Q is not shown in the triangle).
In PQR, $\angle P = y$ (given), $\angle Q = z$ (given), $\angle R = 180^\circ - 2x$
(Supp. adjacent angles)
 $\angle P + \angle Q + \angle R = y + z + (180^\circ - 2x)$
But the sum of angles in $\Delta = 180^\circ$
 $y + z + 180^\circ - 2x = 180^\circ$
 $\therefore y + z - 2x + 180^\circ = 2 \text{ right angles.}$
12. Let the perpendicular from A meet BC at F.
In ΔAFB , $y + \angle ABD + y = 90^\circ$.
 $2y + \angle ABD = 90^\circ \dots\dots\dots(i)$
In ΔAFC , $2y + x = 90^\circ \dots\dots\dots(ii)$

Comparing (i) and (ii), $\angle ABD = x$
13. $\angle ACE = 105^\circ$
14. $\angle XZY = 90^\circ$; Right-angled
15. $\angle LPM = 96^\circ$
16. In ΔBCD , $\angle BCD = 90^\circ$ (given)
 $\angle CDB = 30^\circ$ (given)
 $\therefore \angle BDC = 60^\circ$
In ΔBCX , $\angle CBX = 30^\circ$ (proved)
 $\angle BXC = 90^\circ$ (given)
 $\therefore \angle BCX = 60^\circ$

$\angle BAC = \angle BCX = 60^\circ$ (AB = BC, given)
 Therefore, $\angle ABC = 60^\circ$ (angle sum of a triangle)
 Hence, $\triangle ABC$ is equilateral.

17. In $\triangle PQX$,

$$\angle Q = 20^\circ \text{ (given } \angle PQX = \frac{1}{2} \angle RSX)$$

$$\angle X = 40^\circ \text{ (angle s sum of a triangle)}$$

In $\triangle RXS$,

$$\angle X = 40^\circ \text{ (vert. opp. angles)}$$

$$\angle S = 40^\circ \text{ (given)}$$

$\therefore \triangle RXS$ is isosceles

18. $\angle OQP = \angle OPQ = 40^\circ$ (isosceles triangle)

$$\angle OQR = \angle ORQ = 40^\circ \text{ (isosceles)}$$

$$\angle POR = 160^\circ \text{ (}\angle\text{s at a point)}$$

$$\therefore \angle OPR = \angle ORP = 10^\circ \text{ (isosceles triangle); and } \angle PQR = 40^\circ$$

$$\therefore \angle QRP = \angle QPR = 50^\circ$$

Thus, $\triangle PQR$ is isosceles.

Exercise 20.5

1. (a) $x = 85^\circ$ (b) $x = 50^\circ$ (c) $x = 100^\circ$

2. $36^\circ, 54^\circ, 126^\circ$ and 144°

3. $\angle PQR = 70^\circ$ 4. (a) 248° (b) 53° (c) 40°

5. $\angle QRS = 90^\circ$ 6. $\angle LPM = 103^\circ$ 7. $\angle DBC = 48^\circ$

8. $\angle BCE = 120^\circ$ 9. $\angle PSQ = 26^\circ$

10. (a) $\angle ABD = 64^\circ$ (b) $\angle ACD = 64^\circ$

12. $\angle PTQ = 115^\circ$

13. (a) $\angle MQO = 22\frac{1}{2}^\circ$, $\angle QMO = 22\frac{1}{2}^\circ$, $\angle MOQ = 135^\circ$

(b) $\angle PLO = \angle LPO = 22\frac{1}{2}^\circ$

But these are base angles of triangle POL.

$\therefore \triangle POL$ is isosceles.

Thus, $PO = OL$

14. 98°

15. The opposite angles are equal.

16. $\angle CAB = \angle BCA = 32^\circ$ (base C, $AB = BC$ (given))

$\angle ABC = 116^\circ$ ($\angle$ s sum of a Δ)

$\angle ACD = \angle CAB = 32^\circ$ (alternate angles, $AB \parallel DCE$, given).

Similarly;

$\angle CAD = \angle ACB = 32^\circ$ and $\angle ADC = 116^\circ$

$\therefore \angle A = 64^\circ, \angle B = 116^\circ, \angle C = 64^\circ, \angle D = 116^\circ$.

The figure is a rhombus.

Properties:

(i) Diagonals bisect the angles.

(ii) Opposite angles are equal.

(iii) Diagonals bisect each other at 90° .

$\angle HDG = 150^\circ$

17. Given $\angle ADO = x, \angle DAO = y$

$\angle DAO = \angle DCO = y$ (base angles of isosceles triangle)

$\angle ADO = \angle ABO = x$ (base angle of isosceles triangle).

$\angle ABO = \angle CDO = x$ (alternate angles $AB \parallel DC$ angles given)

In ΔAOD ,

$x + y = a$ (opposite interior angles = opposite exterior angle)

In ΔCOD ,

$x + y = b$ (opposite interior = opp. ext. angle).

$a = b$

But $a + b = 180^\circ$ (supp. adjacent angles on a straight line).

$\therefore a = b = 90^\circ$.

Exercise 20.6

1. (a) $x = 124^\circ$ (b) $x = 25^\circ$

2. (a) Equilateral triangle (b) Square (c) Hexagon

3. (a) 12 (b) 10 (c) 8 (d) 6 (e) 5 (f) 4

4. 6, 1080° ; 360°

$$\begin{aligned}\text{Sum of interior angles} &= 1\,080^\circ - 360^\circ \\ &= 720^\circ \\ &= 8 \text{ right angles}\end{aligned}$$

$$\begin{aligned}5. \text{ Sum of all the angles} &= 5 \times 180^\circ \\ &= 900^\circ\end{aligned}$$

$$\text{Sum of the 4 angles at } x = 180^\circ$$

$$\begin{aligned}\text{Sum of the angles at the vertices of the hexagon} &= 900^\circ - 180^\circ \\ &= 720^\circ \\ &= 8 \text{ right angles.}\end{aligned}$$

$$\begin{aligned}7. \text{ Sum of exterior and interior angles} &= 5 \times 180^\circ \\ &= 900^\circ\end{aligned}$$

$$\text{Sum of int. } \angle\text{s of a pentagon} = 540^\circ \text{ (refer to Q. 5)}$$

$$\begin{aligned}\text{Sum of the ext. angles} &= 900^\circ - 540^\circ \\ &= 360^\circ \\ &= 4 \text{ right angles}\end{aligned}$$

$$9. \quad (a) \ 1\,080^\circ \quad (b) \ 1\,440^\circ$$

$$10. \quad (a) \ 11 \quad (b) \ 13$$

$$11. \quad \text{Hexagon}$$

$$12. \quad (a) \ 30^\circ \quad (b) \ 25.7 \quad (c) \ 18^\circ$$

Note:

This is only true if the polygons are all regular.

GEOMETRICAL CONSTRUCTIONS

Introduction

With the knowledge of angles and plane figures which have just been covered, the learner is expected to carry out constructions using geometrical instruments. Mention of all geometrical instruments and their use, with emphasis on straight edge and a pair of compasses will be necessary.

Objectives

By the end of the topic, the learner should be able to:

- (i) construct perpendicular lines using either a ruler and pair of compasses only, or a set-square and a ruler.
- (ii) use a ruler and pair of compasses only to bisect angles and construct angles whose values are multiples of $7\frac{1}{2}^{\circ}$.
- (iii) construct parallel lines using either a ruler and pair of compasses, only or using a set-square and a ruler.
- (iv) construct regular and irregular polygons.

Objective (i): Perpendicular Lines

- Using a ruler and pair of compasses only, the teacher should demonstrate how to construct a perpendicular to a given line, a perpendicular bisector of a line, a perpendicular to a line from a given point and a perpendicular to a line through a given point on the line, which should be followed by a lot of practice.
- Through discussion, the learner should be guided on the use of a set-square to draw perpendicular lines.

Objective (ii): Angle Bisector and Construction of Angles

- The learner should be guided through the steps followed in bisecting given angles using a pair of compasses and a ruler.
- The learner should be led to construct angles of 60° and 90° using a ruler and pair of compasses only.
- The learner should be guided by bisecting angles such as 60° , 90° , etc., and their supplements so as to obtain angles whose values are

multiples of $7\frac{1}{2}^\circ$, e.g., 30° , 150° , 120° , $221^\circ 82\frac{1}{2}$, $67\frac{1}{2}^\circ$, etc.

Objective (iii): Parallel Lines

- Specific examples should be given to demonstrate how to construct a straight line through a given point, parallel to a given line using a ruler and a pair compasses only. The learner should be guided to construct a line parallel to another line at a given distance.
- A brief discussion on constructing parallel lines using transfer of angle method should be held. Set-square and a ruler should be used to demonstrate how parallel lines are drawn. The concept of parallel lines must be extended in drawing of proportional division of lines, i.e., dividing a line into any given number of equal parts.

Objective (iv): Construction of Polygons

- A review of the exterior and interior angle properties of polygons is necessary. The learner should be guided to construct regular polygons such as an equilateral triangle, a square, pentagon, hexagon, etc. Where possible, the learner should be encouraged to use a ruler and a pair of compasses only.
- Specific examples on constructing irregular polygons should be given. This should include, triangles, quadrilaterals, pentagon, hexagon etc.
- The following points should be made clear to the learner during construction:
 - (i) Make a neat sketch of the required figure.
 - (ii) Mark on your sketch the given measurements.
- A lot of practice should be done on use of a ruler and a pair of compasses only in constructing irregular figures, e.g., constructing an isosceles triangle whose base angles are 30° .

Answers

Exercise 21.1

2. $PM = RM = 6.8$ cm 3. $XZ = 9.9$ cm, $\angle XZY = 19^\circ$
4. $AC = 8.9$ cm, $BD = 8.8$ cm 5. $SQ = 10$ cm
6. Height = 4.8, area = 17.52 cm²

Exercise 21.2

1. $BN = 4.9 \text{ cm}$, $AN = 18.5 \text{ cm}$ 2. 4.8 cm
3. $\angle MWN = 19^\circ$, $MN = 1.7 \text{ cm}$
4. $PS = 5.4 \text{ cm}$, $\angle PSR + \angle PQR = 180^\circ$
5. 7.9 cm 6. $PQ = RS = 9.2 \text{ cm}$
7. $\angle MLP = 115^\circ$ 8. 1.6 cm for each interval
11. $MN \parallel ZX$

Exercise 21.3

1. $\angle ABC = 89^\circ$, $\angle BAC = 32^\circ$, $\angle ACB = 59^\circ$
2. $\angle LMN = 133^\circ$
3. $\angle XYZ = 90^\circ$; Right-angled triangle
4. $\angle ABC = 80^\circ$, $\angle BAC = 148^\circ$, $\angle ACB = 24^\circ$
5. $\angle DFG = 119^\circ$, $DG = 9.3 \text{ cm}$; Isosceles triangle
6. $RS = 5.8 \text{ cm}$, $\angle SRP = 50^\circ$ 7. $\angle STU = 120^\circ$
8. $AC = 5.3 \text{ cm}$, $\angle ACB = 44^\circ$ 9. $PR = 7.4 \text{ cm}$
10. $\angle PRQ = 53^\circ$, $PR = 5 \text{ cm}$ 11. $LN = 9.6 \text{ cm}$, $\angle LMN = 124^\circ$
12. $SR = 6.5 \text{ cm}$, $\angle TRS = 87^\circ$ 13. $JL = 3 \text{ cm}$, $KJ = 5.8 \text{ cm}$
14. $PR = 5.8 \text{ cm}$, $PR = 8.5 \text{ cm}$
15. (i) $AD = 4.7 \text{ cm}$, $BC = 3.7 \text{ cm}$
(ii) $\angle BAD = 77^\circ$, $\angle ABC = 107^\circ$
16. $\angle PQB = 90^\circ$
17. 39° , 141°

Exercise 21.4

2. $\angle BCD = \angle AED = 105^\circ$
 $CE = AC = 3.7 \text{ cm}$
3. Rhombus, 23 cm^2
4. (i) $AD = BE = 12 \text{ cm}$
(ii) $\angle ADC = \angle BAD = 45^\circ$
(iii) Trapezium, 119.5 cm^2
5. $EA = 2.8 \text{ cm}$, or 9 cm , $ED = 3.6 \text{ cm}$ or 8.1 , $\angle AED = 85^\circ$ or 34°
6. $\angle PTS = 115^\circ$, $\angle TSR = 67^\circ$, $TR = 8.3 \text{ cm}$, $PS = 11.8 \text{ cm}$
7. $\angle BCD = \angle ABC = \angle CDE = 120^\circ$; Hexagon
8. $\angle BNC = \angle BKC = 90^\circ$, Equilateral
9. 42 cm^2 10. 10.85 cm , 5.6 cm 11. $\angle XYZ = 98^\circ$
12. $\angle PQR = 52^\circ$ 13. 7.9 cm 14. $PQ = RS = 9.2 \text{ cm}$
15. $\angle MLP = 115^\circ$ 16. 42 cm ; 3.5 cm

Chapter Twenty Two

SCALE DRAWING

Introduction

The learner has met scale drawing at primary level. In this topic, the concept of scale is reinforced and bearings introduced and used to locate points. Angles of elevation and depression are discussed, as well as simple surveying techniques.

Accuracy in measurements and computation should be emphasised.

Scale drawing is applied in architecture, navigation, surveying and mountaineering, among others.

Objectives

By the end of the topic, the learner should be able to:

- (i) interpret a given scale.
- (ii) choose and use an appropriate scale.
- (iii) state the bearing of a point from another and locate points by using bearings and distance.
- (iv) determine angles of elevation and depression.
- (v) solve problems involving bearing, elevation and scale drawing.
- (vi) apply scale drawing in simple surveying.

Objective (i): Interpreting Scale

The learner should be familiarised with different types of scales, the ratio, representation fraction (R.F.), statement and linear scale. Interpretation of scale must be emphasised.

Objective (ii): Choice of Scale and Drawing to Scale

- The teacher should guide the learner in choosing and using appropriate scale. Once the scale is chosen, a rough sketch containing all measurements must be made before embarking on the actual drawing.
- The learner should be engaged in practical work such as taking measurements of a football pitch using a tape measure, and then drawing the pitch to scale.

- Examples of applications of scale drawing should be given. These could include drawing of buildings plans in architecture and drawing of maps by a cartographer.

Objective (iii): Bearings and Locating Points

- The learner should be introduced to bearing as a method of giving direction. The two types of bearing should be discussed (compass bearing and true bearing).
- Conversion of true bearing to compass bearing and vice versa should be among the exercises to be given.

Objective (iv): Determining Angles of Elevation and Depression

- Through discussion, the learner should be introduced to angles of elevation and depression. The heights of different objects should be got by scale drawing.
- The learner should be given exposure to carrying out practicals such as making clinometers and measuring angles of elevation and depression. Accuracy should be emphasised.

Objective (v): Problem Solving

The teacher should give examples followed by a lot of exercises to enable the learner to internalise the concepts of bearing, elevation and scale drawing.

Objective vi: Surveying

- Only simple surveying techniques should be covered, namely, the triangulation method, the use of compass bearings and distances.
- Practical activities suggested in the students' book should be carried out.

Answers

Exercise 22.1

1. (a) $\frac{1}{400000}$ (b) 14.8 km (c) 10.7 cm

2. (a) 1cm represents 0.5 km
 (b) 6.35 km
 (c) 16.6 cm

Exercise 22.2

2. (a) (i) 1 cm represents 20 m

(ii) $\frac{1}{2000}$

(b) 2 cm

3. 390 m

Exercise 22.3

1. 29.5° 2. 194° 3. 252° 4. (a) $AC = BC = 23$ km (b) 280°

5. 268° , 300 km 6. (a) 540 m (b) 570 m (c) 068°

7. (a) 866 km (b) 262° 8. (a) 145° (b) 105 m (c) 102°

9. (a) 132 km (b) 312°

10. (a) 246° (b) 190 km 11. (a) 313° (b) 49 km

12. (a) 065° (b) 6 km (c) 4.2 km

13. (a) 112°

(b) 131°

(c) (i) 4.1 km (ii) 3.2 km (iii) 3.1 km

Exercise 22.4

1. 11 m 2. 72 m; 48° , they are equal 3. 57 m

4. 13 m 5. 31 m 6. 37.5 m 7. 11 m or 111 m 8. 38 m

9. Height is 4.5 m, horizontal distance is 2.3 m

10. 332 m 11. 3 km or 0.85 km 12. 44 m, 94 m

Exercise 22.5

1. (a) 286° (b) 052° ; 97 m

Exercise 22.6

1. 7.92 ha 2. (a) 8.5 ha

3. (a) 10.125 ha (b) 4.53 ha

Chapter Twenty Three

COMMON SOLIDS

Introduction

Although the learner has met geometrical shapes of solid objects, the teacher should probe learner's understanding of the concepts involving solids.

In this topic, a practical approach should be used in construction of nets and models before working out problems involving distances on solid objects and surface areas.

Objectives

By the end of the topic, the learner should be able to:

- (i) identify and sketch common solids.
- (ii) sketch and accurately draw nets of solids.
- (iii) make models of solids from nets
- (iv) calculate surface area of solids from nets.
- (v) find the distance between two points on a solid.

Objective (i): Identifying and Sketching Solids

- Common solids should be brought to the classroom and the learner assisted in identifying and sketching them.
- The learner should be led to establish the relationship between the number of faces, edges and vertices of each solid.

Objective (ii): Nets of Solids

The learner should be led to sketch and accurately draw nets of solids. Different types of nets of different solids should be drawn.

Objective (iii): Models of Solids

From the previous section, the learner has been introduced to sketching of solids and their nets. In this section, the learner will be introduced to the making of finer models of the solid objects referred to previously.

Models from cardboards

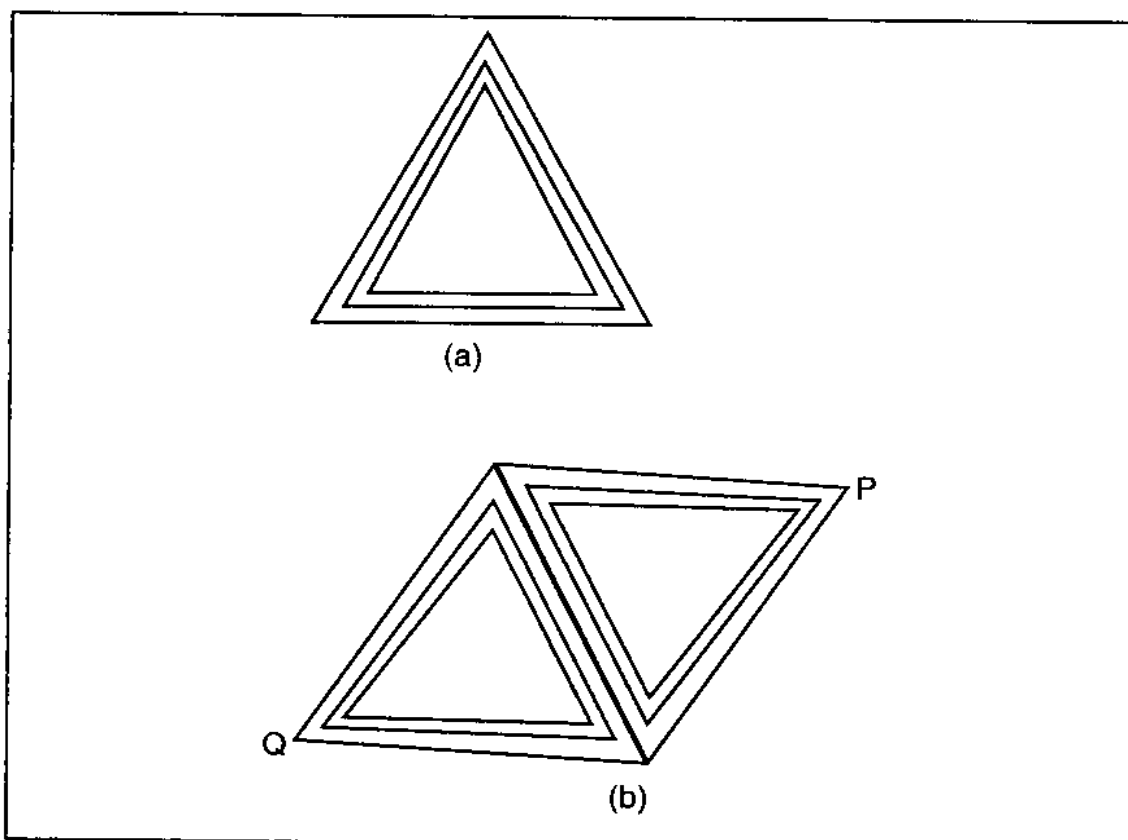
These should be made from manilla paper, starting with the simplest model of a cube. The learner should be guided while drawing the nets of

the cube to avoid excessive use of paper. Where a sealing tape is available, flaps on the nets, are not essential, but where glue is to be used, the flaps to the nets are a necessity in order to help in holding the model together.

For the drawings of nets for the models of the articles like cuboids, pyramids, prisms, cylinders and tetrahedron, refer to the suggested texts.

Models made from drinking straws

The skeleton model of the cube the tetrahedron and the square pyramid can easily be constructed. The learner should be guided in making a regular tetrahedron and device own methods of constructing the other two.



The learner should be led through the following steps:

- Take six straws of equal lengths. (For the sake of economy, half the original length is sufficient).

- Form a firm triangular framework as in the figure (a) above.
- Form a rhombic structure by attaching two more straws as in figure (b) above.
- Finally complete the tetrahedron by joining the opposite corners P and Q in figure (b) with the sixth straw.

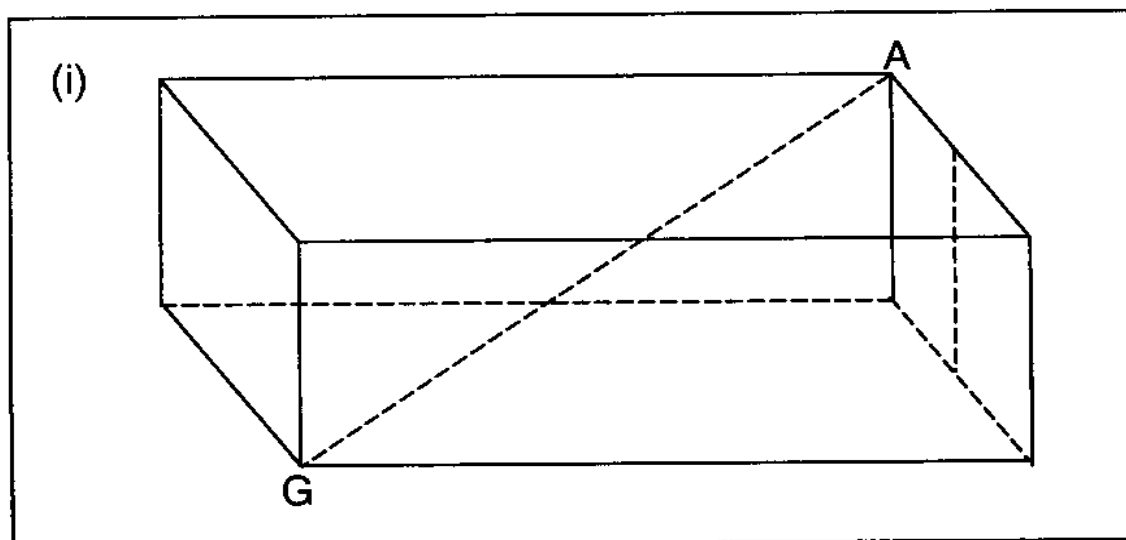
Objective (iv): Surface Area of solids

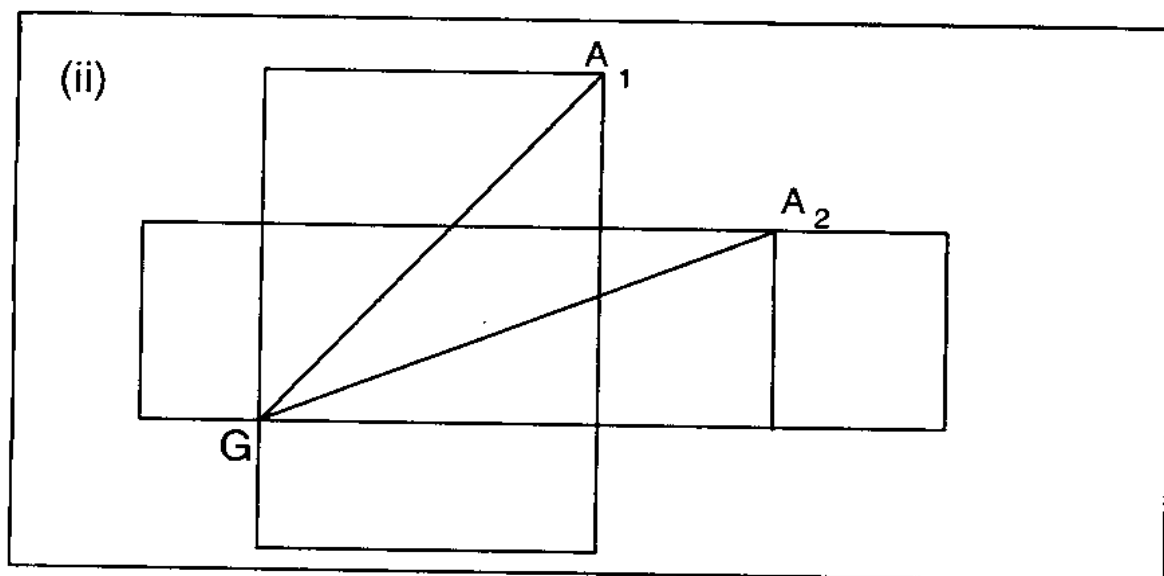
Surface area of a solid can be determined by finding the total area of its faces. The learner may at times forget to include some of the hidden faces of a solid. Therefore, it is helpful to sketch the net of the solid and use it to determine the surface area of the solid.

Objective (v): Determination of Distances Between Specified Points on Solids using Nets

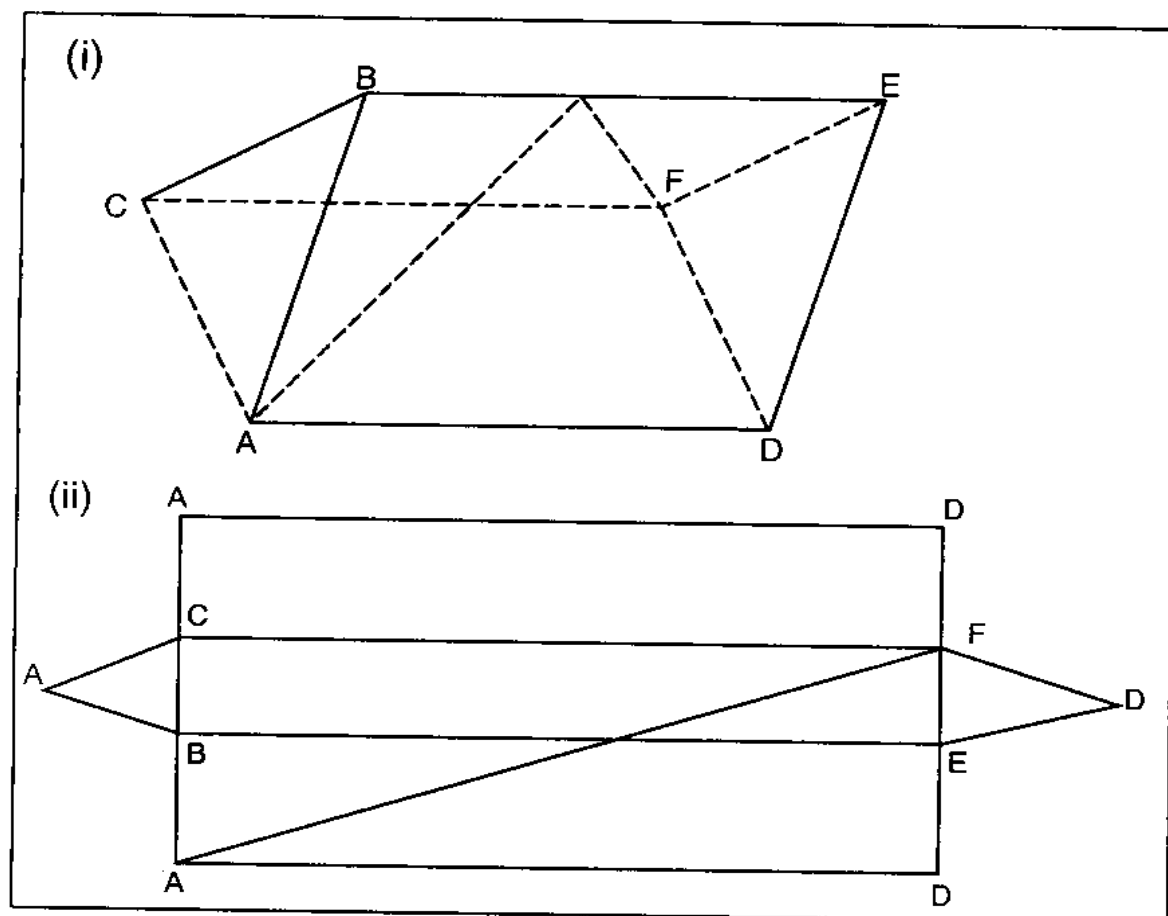
One of the approaches to this topic is to start from the models of cubes, cuboids, prisms, cylinders, tetrahedron and pyramids. The learner may take any one of the selected models and mark the points on it followed by cutting the model to form an appropriate net. The following example should illustrate the procedure:

Example 1





Example 2



AF on the net represents the shortest distance over edge BE on the solid prism.

In all the subsequent exercises on determining distances, the following procedure should be adopted:

- (i) Sketch the object and the path to be followed from one point to another.
- (ii) Decide the edges to be opened so as to draw an appropriate net.
- (iii) Sketch the net and label it correctly.
- (iv) Draw a line representing the distance.
- (v) Determine the line by either calculation or scale drawing.

Answers

Exercise 23.1

1. (a) 6 faces, 12 edges and 8 vertices.
(b) 5 faces, 9 edges, 6 vertices.
(c) 2 faces, 1 edge, 1 vertex.
2. Sphere, cylinder and so on.
3. Sphere; infinite.

Exercise 23.3

1. Use a model to find the edges; 29.2 cm^2
2. Use a model to find the edges; 37.9 cm^2

Exercise 23.4

1. (i) 384 cm^2 2. (ii) 432 cm^2 3. (ii) $100\sqrt{3}$ or 173.2 cm^2
4. (iii) $1\,188 \text{ cm}^2$ 5. (ii) 460.96 cm^2 6. (ii) 240 cm^2
7. 240 cm^2 8. 422.5 cm^2

Mixed Exercise 3

1. Draw the lines passing through:
(i) $(4, 0)$ and $(1, 2)$ (ii) $(0, -4)$ and $(2, 0)$
(iii) $(4, 0)$ and $(0, -4)$ (iv) $(2, 0)$ and $(0, 10)$
2. (a) 68° ; $x = 68^\circ$; $b = 112^\circ$; $c = 68^\circ$
3. $23^\circ, 46^\circ$ 4. 0.092 cm 5. $76 \text{ litres per min.}$
6. $7\,017 \text{ cm}^2$ 7. $18\,393 \text{ g}; 2163.8 \text{ cm}^2$
8. Square base should be of side 4 cm . Ans 52.66 cm^2 .
9. (a) $x = \frac{69}{19}$; $y = \frac{20}{19}$ (b) $x = 7$; $y = 8$

- (c) $x = 2$; $y = -1$ (d) $x = -2$; $y = 5$
10. (a) 286° (b) 17.7 km
11. 988
12. (a) $37 : 286$ (b) 42 cm^3 (42 ml)
13. 1.33, 3.20, 4.17, 6.125, 7.11, 9.09
(i) 1.79, 6.62 (ii) 3.79, 6.87
14. 30°
15. (a) 5 (b) 90° and 108°
16. (a) $30^\circ, 120^\circ, 150^\circ$ (b) $34.8^\circ, 68.8^\circ, 76.4^\circ$
(c) $100^\circ, 180^\circ, 100^\circ, 80^\circ$ (d) $64^\circ, 96^\circ, 64^\circ, 32^\circ$
17. 200° 18. (a) 69° $b = 27^\circ$, $c = 42^\circ$, $d = 84^\circ$
19. $72^\circ, 72^\circ$ 36°
20. (a) 35° , (b) 55°
21. 2.9 cm 22. $CB = 16 \text{ cm}$; $CD = 14 \text{ cm}$; 7 cm^2
23. (a) $(10, -10)$
(b) $S(2, 2)$; $T(1, -1)$
24. Two positions for P; for both $\angle APC = 30^\circ$, $\angle AOC = 60^\circ$ and $OP = 4 \text{ cm}$
25. (a) 7017.16 (b) (i) 10.08 cm^2 (ii) 6.16 cm^3

Revision Exercise 1

1. (a) $2^3 \times 3 \times 5$ (b) $2^2 \times 3^2 \times 5^2 \times 7$ 2. $\frac{2}{5}$, sh. 600.00
3. (a) $\frac{4x-9}{6}$ (b) $\frac{r^2-p^2}{p}$ 4. (a) sh. 3.00 (b) 100%
5. 25 days 6. 135° , Octagon 7. (a) $4\,136 \text{ cm}^2$ (b) $24\,640 \text{ cm}^3$
8. sh. 20.00; sh. 12.00 9. (a) 7.2 km (b) 272°

Revision Exercise 2

1. (a) $1\frac{5}{8}$ (b) $\frac{6}{7}$ 2. (a) -3 (b) 40
3. (a) 32 (b) 8 ; $p + r$ is a factor of $p^2 - r^2$
4. (a) 3.8 (b) 10.21 (c) 5.2
5. (a) $x = -7, y = 4$ (b) $s = \frac{15}{7}, t = \frac{5}{7}$
6. $9, 1\ 260^\circ$ 7. (a) 0.84 gcm^{-3} (b) 55 cm^3
8. $6.1\text{ cm}, 3.9\text{ cm}, 12\text{ cm}$ 9. (a) 36 m (b) 32 m
10. 161 m^3 ; **Hint:** the upper part of the cross-section is a semicircle.

Revision Exercise 3

1. 1.74 2. (a) $(3x-y)(p+q)$ (b) $(a+1)(a-4p)$
3. (a) 420 l (b) 3 l 4. $480\ 00\text{ l}$
5. sh. $380\ 000$ 6. (i) 69° (ii) 21 cm^3
7. (a) $x = 6, y = 4$ (b) $x = 1, y = 5$

Revision Exercise 4

1. (a) $\frac{7}{12}$ (b) $5\frac{3}{11}$ 2. (i) $\frac{5y-4x}{6}$ (iii) $\frac{-2}{(x+1)(x-1)}$
3. 10 4. 3 5. 0.792 m^3 6. sh. 400 ; $16\frac{2}{3}\%$
7. $x = 7, y = 5$

Revision Exercise 5

1. sh. 32 2. (a) $2, 3$ (b) $4, 3$
3. (a) $90^\circ, 36.9^\circ, 53.1^\circ$ (b) $r = 3.7\text{ cm}; 43\text{ cm}^3$
4. 9.4%
5. (a) Ksh. $210\ 000$ (b) 66639.05
6. (a) 36° (b) 1.386 cm^2 7. $10\text{ cows}, 20\text{ hens}$
8. (b) (i) sh. 50.00 (ii) Sh. $120.00, \text{sh. } 132.00, \text{sh. } 155.00$
(iii) $32\text{ km}, 36\text{ km } 56\text{ km}$
9. 2.5275 ha 10. (i) 368 cm^2 (ii) 368 m^2 (iii) sh. 9200.00