

# **Teacher's Manual**

**JUNIOR CERTIFICATE**

# **Working with Maths 1**

**Cammie Gallagher**



**FOLENS**

**Editor**

Ciara McNee

**Design and layout**

Bookworks

© 2006 Cammie Gallagher

ISBN 1-84131-796-9

Folens Publishers,  
Hibernian Industrial Estate,  
Greenhills Road,  
Tallaght,  
Dublin 24

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without prior written permission from the Publisher.

The Publisher reserves the right to change, without notice, at any time, the specification of this product, whether by change of materials, colours, bindings, format, text revision or any other characteristic.

## Contents

|   |    |
|---|----|
| Introduction.....   | 1  |
| Websites.....   | 10 |
| <b>Chapter 1</b> Working with natural numbers.....                                    | 11 |
| <b>Chapter 2</b> Working with integers.....   | 12 |
| <b>Chapter 3</b> Working with fractions.....  | 14 |
| <b>Chapter 4</b> Working with decimals.....   | 16 |
| <b>Chapter 5</b> Working with percentages.....  | 18 |
| <b>Chapter 6</b> Working with money.....  | 18 |
| <b>Chapter 7</b> Working with distance, mass, time, speed and ratio.....              | 20 |
| <b>Chapter 8</b> Working with perimeter and area.....                                 | 21 |
| <b>Chapter 9</b> Working with algebra.....  | 22 |
| <b>Chapter 10</b> Working with simple equations.....                                  | 26 |
| <b>Chapter 11</b> Working with factors in algebra.....                                | 27 |
| <b>Chapter 12</b> Working with sets.....  | 29 |
| <b>Chapter 13</b> Working with geometry 1: points, lines and angles.....              | 35 |
| <b>Chapter 14</b> Working with coordinate geometry.....                               | 36 |
| <b>Chapter 15</b> Working with geometry 2: triangles, quadrilaterals and circles..... | 41 |
| <b>Chapter 16</b> Working with statistics.....  | 43 |
| <b>Chapter 17</b> Working with transformation geometry.....                           | 46 |
| <b>Chapter 18</b> Working with simultaneous equations and inequalities.....           | 49 |
| <b>Chapter 19</b> Working with quadratic equations.....                               | 51 |
| <b>Chapter 20</b> Working with functions and graphs.....                              | 51 |
| <b>Chapter 21</b> Working with volume and surface area.....                           | 57 |
| <b>Chapter 22</b> Working with trigonometry.....                                      | 58 |



## Introduction

This manual contains the following:

- answers to all questions in *Working with Maths 1* and the chapter reviews (which are on the Folens website: [www.folens.ie/wwm1](http://www.folens.ie/wwm1))
- a list of key learning outcomes for each chapter
- suggested material to use in conjunction with each chapter to promote active learning in the classroom. These materials are supplied by all educational supply companies. If you have difficulty in identifying and locating any equipment mentioned in this manual, I would suggest typing the name of the equipment into any search engine to help you to locate it
- a list of useful websites for teaching maths.

## Chapter 1 Working with natural numbers

### KEY LEARNING OUTCOMES

When they have completed Chapter 1, students should be able to do the following:

- recognise the symbol for natural numbers, **N**
- arrange natural numbers in ascending and descending order
- recognise the  $>$ ,  $<$ ,  $\geq$  and  $\leq$  symbols
- perform basic operations with natural numbers

- understand and apply the order of operation when working with natural numbers
- understand the meaning and use of prime numbers
- understand the meaning and use of factors, including HCF and LCM
- work with numbers with powers.

### MATERIALS

The following materials can be used when teaching this chapter: a calculator for an overhead projector; number lines; mental maths whiteboards; magic squares; game 24.

## Chapter 2 Working with integers

### KEY LEARNING OUTCOMES

When they have completed Chapter 2, students should be able to do the following:

- recognise the symbol for integers, **Z**
- place integers in order
- perform basic operations with integers
- understand and apply the order of operation when working with integers.

### MATERIALS

The following materials can be used when teaching this chapter: a calculator for an overhead projector; number lines; mental maths whiteboards; game 24.

## Chapter 3

### Working with fractions

#### KEY LEARNING OUTCOMES

When they have completed Chapter 3, students should be able to do the following:

- recognise the symbol for rational numbers,  $\mathbb{Q}$
- identify the parts of a fraction
- perform basic operations with all types of fractions and mixed numbers without the use of a calculator
- recognise equivalent fractions
- understand and apply the order of operation when working with fractions
- apply their knowledge of basic operations with fractions to solve simple word problems.

#### MATERIALS

The following materials can be used when teaching this chapter: a calculator for an overhead projector; a wall chart showing equivalent fractions; a wall chart showing the various words used in problems.

## Chapter 4

### Working with decimals

#### KEY LEARNING OUTCOMES

When they have completed Chapter 4, students should be able to do the following:

- recognise the symbol for real numbers,  $\mathbb{R}$

- perform basic operations with decimal numbers without the use of a calculator
- change a decimal number to a fraction and vice versa
- round numbers
- write numbers correct to a certain number of places
- estimate answers
- perform basic operations with squares, square roots and reciprocals
- perform basic operations with numbers written in scientific notation with and without using a calculator.

#### MATERIALS

The following materials can be used when teaching this chapter: a calculator for an overhead projector; a wall chart showing fractions as decimals.

## Chapter 5

### Working with percentages

#### KEY LEARNING OUTCOMES

When they have completed Chapter 5, students should be able to do the following:

- change percentages into decimals and fractions and vice versa
- find a percentage of a number
- find one number as a percentage of another
- increase or decrease a number by a certain percentage.

**MATERIALS**

The following materials can be used when teaching this chapter: a calculator for an overhead projector; a wall chart showing fractions and decimals as percentages.

## Chapter 6

### Working with money

**KEY LEARNING OUTCOMES**

When they have completed Chapter 6, students should be able to do the following:

- understand the concept of profit and loss
- work with problems on percentage profit and percentage loss
- work with VAT
- understand the layout of common household bills
- understand and work with simple problems on the tax credit system
- calculate annual interest and compound interest on various sums of money
- understand and work with simple questions on currency exchange.

**MATERIALS**

The following materials can be used when teaching this chapter: copies of some common household bills; a video of the tax credit system, which is available from the local tax office; various leaflets from the local tax office

which explain the tax credit system; various leaflets from a local bank or credit union explaining interest rates and currency exchange.

## Chapter 7

### Working with distance, mass, time, speed and ratio

**KEY LEARNING OUTCOMES**

When they have completed Chapter 7, students should be able to do the following:

- convert units of length, mass and time to smaller or larger units of length, mass and time
- convert time on a 12-hour clock to time on a 24-hour clock and vice versa
- understand and work with simple problems involving speed, distance and time
- understand and work with ratios
- understand and work with problems involving direct and inverse proportion.

**MATERIALS**

The following materials can be used when teaching this chapter: rulers; metre sticks; a tape measure; weighing scales; 12-hour and 24-hour clocks.

## Chapter 8

### Working with perimeter and area

#### KEY LEARNING OUTCOMES

When they have completed Chapter 8, students should be able to do the following:

- understand the concept of perimeter and area
- find the perimeter of squares, rectangles, triangles, circles and unusual shapes
- find the area of squares, rectangles, triangles, circles and unusual shapes
- understand the concept of  $\pi$ .

#### MATERIALS

The following materials can be used when teaching this chapter: rulers; metre sticks; a tape measure; an opisometer; a trundle wheel; callipers; mathematical instruments for a blackboard or whiteboard.

## Chapter 9

### Working with algebra

#### KEY LEARNING OUTCOMES

When they have completed Chapter 9, students should be able to do the following:

- understand the algebraic concepts of a variable, a term, an expression, a constant and like and unlike terms
- add, subtract, multiply and divide terms and expressions in algebra
- multiply out brackets containing algebraic expressions

- add simple algebraic expressions with fractions
- replace variables in algebraic expressions with constants.

#### MATERIALS

The following materials can be used when teaching this chapter: algebra tiles; laminated cards showing algebraic expressions.

## Chapter 10

### Working with simple equations

#### KEY LEARNING OUTCOMES

When they have completed Chapter 10, students should be able to do the following:

- solve simple algebraic equations by inspection and balancing
- solve algebraic equations with brackets
- solve algebraic equations with unknowns on both sides of the equal sign
- solve simple algebraic equations containing simple fractions
- verify all solutions to algebraic equations
- convert algebraic equations to word problems and vice versa.

#### MATERIALS

The following materials can be used when teaching this chapter: algebra tiles; an algebra balance; a laminated wall chart showing key words in algebraic problems.

**Chapter 11****Working with factors in algebra****KEY LEARNING OUTCOMES**

When they have completed Chapter 11, students should be able to do the following:

- recognise different types of factors
- factorise by recognising the highest common factor in an algebraic expression
- factorise by grouping like terms in an expression
- factorise a quadratic expression
- factorise an expression containing the difference of two squares.

**MATERIALS**

The following materials can be used when teaching this chapter: algebra tiles.

**Chapter 12****Working with sets****KEY LEARNING OUTCOMES**

When they have completed Chapter 12, students should be able to do the following:

- list the elements of various sets
- understand and apply set operations to two intersecting sets and three intersecting sets
- apply and understand cardinal number problems to two sets and three sets
- identify various regions in a Venn diagram with two sets and three sets.

**MATERIALS**

The following materials can be used when teaching this chapter: set rings; laminated wall charts showing various Venn diagrams; a laminated wall chart showing set symbols.

**Chapter 13****Working with geometry 1****KEY LEARNING OUTCOMES**

When they have completed Chapter 13, students should be able to do the following:

- identify, measure and label line segments on the plane
- identify, estimate the measure of, measure accurately and label different angles
- identify, label and construct parallel and perpendicular lines
- understand and apply the fact that a straight angle is  $180^\circ$
- identify corresponding and alternate angles formed when a line intersects parallel lines
- understand and apply the fact that vertically opposite angles are equal in measure
- construct the perpendicular bisector of a line segment
- construct the bisector of an angle
- divide a line segment into three equal parts.

**MATERIALS**

The following materials can be used when teaching this chapter: geometry

software, such as Geometer's Sketchpad; mathematical instruments for a blackboard or whiteboard; peg boards; angle estimators; a  $360^\circ$  protractor for use on an overhead projector; geostrips; tangrams; scissors for cut-outs.

## Chapter 14

### Working with coordinate geometry

#### KEY LEARNING OUTCOMES

When they have completed Chapter 14, students should be able to do the following:

- identify the coordinates of points
- plot points on a graph
- find the image of a point under  $S_x$ ,  $S_y$  and  $S_o$
- find the image of a point under a translation
- find the midpoint between two given points
- find the distance between two given points
- find the slope of a line segment
- find the equation of a line
- graph a line if given its equation.

#### MATERIALS

The following materials can be used when teaching this chapter: geometry software such as Geometer's Sketchpad; graph paper; a laminated wall chart showing the coordinate geometry formulae.

## Chapter 15

### Working with geometry 2

#### KEY LEARNING OUTCOMES

When they have completed Chapter 15, students should be able to do the following:

- identify different types of triangles
- label and identify angles in a diagram
- understand and apply the fact that the three angles in a triangle add to  $180^\circ$
- understand and apply the fact that the exterior angle in a triangle is equal to the interior opposite angles
- understand and apply the fact that vertically opposite angles are equal in measure
- identify congruent triangles
- understand and apply the fact that angles opposite equal sides in a triangle are equal in measure
- understand and apply the fact that when two sides of a triangle are added together they are greater in length than the third side
- understand and apply the fact that the largest angle in a triangle is always opposite the longest side
- understand and apply the fact that the smallest angle in a triangle is always opposite the shortest side
- understand and apply the fact that the opposite sides and opposite angles in a parallelogram are equal in measure

- understand and apply the fact that the diagonal of a parallelogram bisects the area
- understand and apply the fact that the angle in a semicircle is  $90^\circ$
- understand and apply the fact that the opposite angles in a cyclic quadrilateral add to  $180^\circ$
- construct a triangle when given the measure of three sides
- construct a triangle when given the measure of two sides and the measure of the included angle
- construct a triangle when given the measure of two angles and the measure of a corresponding side
- construct a right-angled triangle.
- find the mode and the mean of a set of numbers
- find the mode and the mean of a set of a frequency table.

#### MATERIALS

The following materials can be used when teaching this chapter: Microsoft Excel; a  $360^\circ$  protractor for use on an overhead projector; wall charts showing bar charts, trend graphs and pie charts.

### Chapter 17 Working with transformation geometry

#### KEY LEARNING OUTCOMES

When they have completed Chapter 17, students should be able to do the following:

- construct the image of points and shapes under axial symmetry in a line
- identify and draw the axis of symmetry of a shape
- construct the image of points and shapes under central symmetry in a point
- identify and label the centre of symmetry of a shape
- construct the image of points and shapes under a given translation.

#### MATERIALS

The following materials can be used when teaching this chapter: geometry software such as Geometer's Sketchpad; mathematical instruments for a blackboard or whiteboard; peg boards; angle estimators; a  $360^\circ$  protractor for use on an overhead projector; geostrips; tangrams; scissors for cut-outs.

### Chapter 16 Working with statistics

#### KEY LEARNING OUTCOMES

When they have completed Chapter 16, students should be able to do the following:

- present data in a frequency table
- draw a trend graph, pie chart and bar chart

angle estimators; a  $360^\circ$  protractor for use on an overhead projector; geostrips; tangrams; mirrors.

## Chapter 18

### Working with simultaneous equations and inequalities

#### KEY LEARNING OUTCOMES

When they have completed Chapter 18, students should be able to do the following:

- solve simultaneous equations using graphing, elimination and substitution
- solve word problems using simultaneous equations
- solve simple inequalities
- graph the solution of inequalities on number lines.

#### MATERIALS

The following materials can be used when teaching this chapter: algebra tiles; number lines.

## Chapter 19

### Working with quadratic equations

#### KEY LEARNING OUTCOMES

When they have completed Chapter 19, students should be able to do the following:

- solve quadratic equations using the zero rule
- solve word problems using quadratic equations.

#### MATERIALS

The following materials can be used when teaching this chapter: algebra tiles.

## Chapter 20

### Working with functions and graphs

#### KEY LEARNING OUTCOMES

When they have completed Chapter 20, students should be able to do the following:

- find the set of couples of a function
- create an input/output table
- draw domain/range arrow diagrams
- graph linear functions and quadratic functions
- use linear and quadratic graphs to find various properties of a function.

#### MATERIALS

The following materials can be used when teaching this chapter: geometry software such as Geometer's Sketchpad and Autograph.

## Chapter 21

### Working with volume and surface area

#### KEY LEARNING OUTCOMES

When they have completed Chapter 21, students should be able to do the following:

- calculate the volume of cuboids, cylinders and spheres
- calculate the surface area of cuboids, cylinders and spheres.

**MATERIALS**

The following materials can be used when teaching this chapter: 3-D models of cuboids, cylinders and spheres; measuring cylinders; callipers; metre sticks; wall charts showing volume and surface area formulae.

**Chapter 22**  
**Working with trigonometry****KEY LEARNING OUTCOMES**

When they have completed Chapter 22, students should be able to do the following:

- identify various sides of a right-angled triangle in relation to a given angle
- understand and apply Pythagoras' theorem

- understand and apply the sin, cos and tan ratios
- use a calculator to find the sin, cos and tan of angles
- find the inverse of sin, cos and tan of numbers
- identify and use angles of elevation and depression
- solve word problems using sin, cos, tan and their inverses.

**MATERIALS**

The following materials can be used when teaching this chapter: cut-outs of Pythagoras' theorem; a clinometer; a trundle wheel; a measuring tape.

## Websites

The following websites can be used to stimulate further interest in all aspects of the Junior Certificate maths course:

**The Examinations Commission** <http://www.examinations.ie/>

All past examination papers and marking schemes are on this site.

**The National Council of Teachers of Mathematics**

<http://www.nctm.org/>

**The Programme for International Student Assessment (PISA)**

<http://www.pisa.oecd.org/>

### Other teaching resources sites

<http://www.scoilnet.ie/>

<http://www.teachnet.ie/>

<http://www.acts.tinet.ie/acts.html>

<http://www.skoool.ie/default.asp>

<http://www.bbc.co.uk/schools/>

<http://www.smilemathematics.co.uk/>

<http://www.math.com/>

<http://www.quickmath.com/>

<http://coolmath.com/>

<http://cut-the-knot.com/>

<http://forum.swarthmore.edu/library/>

<http://dir.yahoo.com/science/mathematics/>

<http://www.mathsnet.net/>

<http://www.links4kids.co.uk/mathscience.htm>

<http://www.aplusmath.com/>

[http://matti.usu.edu/nlvm/nav/frames\\_asid\\_191\\_g\\_3\\_t\\_2.html](http://matti.usu.edu/nlvm/nav/frames_asid_191_g_3_t_2.html)

<http://matti.usu.edu/nlvm/nav/vlibrary.html>

<http://www.math.hmc.edu/>

<http://www.juniorcertmaths.ie>

**Chapter 1 – Exercise 1.1**

1. (a) 06-MO-5673 (b) 06-D-4600

(c) 06-LK-2011

2. 22/6/2000

3. (a) 254 (b) 5360 (c) 250 000

(d) 4 265 025 (e) 24 688

4. (a) Ninety-eight

(b) Two hundred and forty-three

(c) Two thousand and six

(d) Seven thousand, eight hundred and thirty-four

(e) Five million, two hundred and fifty thousand

5. (a) 3, 7, 23, 24, 36, 42

(b) 42, 36, 24, 23, 7, 3

(c) 23 (d) 24

6. (a) 813, 671, 457, 234, 121

(b) 7155, 5762, 5672, 3478, 2534

(c) 9009, 8912, 5678, 5634, 3344

7. (a) 313, 421, 581, 734, 767

(b) 1172, 2278, 5562, 7154, 9534

(c) 21 347, 22 448, 58 678, 69 120, 70

174

8. (a) 70 (b) 900 (c) 500

(d) 60 000 (e) 7

9. (a) 23 578 (b) 87 532

(c) 2357 (d) 875

10. (a) True (b) False (c) True

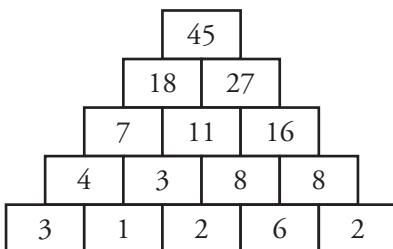
(d) True (e) True (f) True

(h) 58 320 (i) 3 916 800

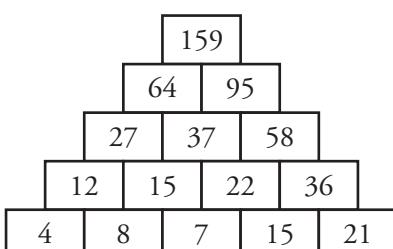
4. (a) 53 (b) 62 (c) 21 (d) 56 (e) 214

(f) 62 (g) 25 (h) 663 (i) 256

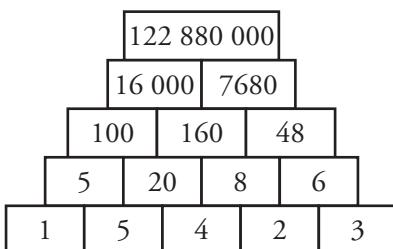
5.



6.



7.



8. (a) 30 (b) 24 (c) 2 (d) 42 (e) 7 (f) 5

9. (a)  $8 \div 2 + 9 = 13$  (b)  $7 - 2 + 9 = 14$ (c)  $12 \times 3 + 9 = 45$  (d)  $7 \times 2 + 9 = 23$ (e)  $7 + 2 + 24 \div 8 = 12$ (f)  $4 \times 4 \times 2 + 8 = 40$ 

10. 22, 55, 66, 88, 25, 26, 28, 52, 56,

58, 62, 65, 68, 82, 85, 86. Sum = 924

**Exercise 1.2**

1. (a) 497 (b) 8849 (c) 688 (d) 4001

(e) 12 872 (f) 3958 (g) 27 182

(h) 22 430 (i) 400 009

2. (a) 31 (b) 25 (c) 598 (d) 9778 (e) 91

(f) 9276 (g) 2164 (h) 1106 (i) 339 901

3. (a) 530 (b) 518 (c) 25 720 (d) 1904

(e) 2952 (f) 100 800 (g) 23 520

**Exercise 1.3**

1. (a) 1, 2, 4, 8 (b) 1, 2, 4, 8, 16

(c) 1, 2, 3, 4, 6, 8, 12, 24

(d) 1, 2, 3, 4, 6, 9, 12, 18, 36

(e) 1, 2, 4, 6, 8, 12, 16, 24, 48

2. (a)  $1 \times 4$ ,  $2 \times 2$  (b)  $1 \times 9$ ,  $3 \times 3$ (c)  $1 \times 15$ ,  $3 \times 5$  (d)  $1 \times 21$ ,  $3 \times 7$ (e)  $1 \times 28$ ,  $2 \times 14$ ,  $4 \times 7$

- 3.** 2, 3, 5, 7, 11, 13, 17, 19  
**4.** 53, 59, 61, 67, 71, 73, 79  
**5. (a)** 2, 3 **(b)** 3, 7 **(c)** 2, 5, 7 **(d)** 3, 11  
**(e)** 2, 7, 13 **(f)** 2, 3, 7, 11  
**6. (a)** 7 **(b)** 15 **(c)** 4 **(d)** 6 **(e)** 12  
**7. (a)** 2, 4, 6, 8, 10 **(b)** 5, 10, 15, 20, 25  
**(c)** 8, 16, 24, 32, 40  
**(d)** 10, 20, 30, 40, 50  
**(e)** 12, 24, 36, 48, 60  
**8.** 21, 28, 35, 42, 49, 63, 70  
**9. (a)** 14 **(b)** 36 **(c)** 21 **(d)** 42 **(e)** 20  
**10. (a)** 30 **(b)** 60 **(c)** 84

### Exercise 1.4

- 1. (a)** 4 **(b)** 25 **(c)** 64 **(d)** 8 **(e)** 27  
**(f)** 125  
**2. (a)** 13 **(b)** 41 **(c)** 36 **(d)** 56 **(e)** 116  
**(f)** 100  
**3. (a)** 9 **(b)** 100 **(c)** 5 **(d)** 8 **(e)** 8 **(f)** 4  
**4. (a)**  $2^2$  **(b)**  $2^4$  **(c)**  $2^5$  **(d)**  $2^6$  **(e)**  $2^0$   
**5. (a)**  $3^2$  **(b)**  $3^3$  **(c)**  $3^4$  **(d)**  $3^0$  **(e)**  $3^2$   
**(f)**  $3^1$   
**6. (a)**  $2^4$  **(b)**  $2^5$  **(c)**  $2^9$  **(d)**  $2^8$  **(e)**  $2^7$   
**7. (a)**  $3^1$  **(b)**  $3^2$  **(c)**  $3^5$  **(d)**  $3^5$  **(e)**  $3^0$   
**8. (a)**  $5^6$  **(b)**  $5^6$  **(c)**  $5^{12}$  **(d)**  $5^{15}$  **(e)**  $5^{20}$   
**9.**  $2^3$  **10.**  $3^3$

### Chapter 1 review

- 1. (a) (i)** 1, 2, 4, 8 **(ii)** 1, 2, 7, 14  
**(iii)** 1, 2, 4, 5, 10, 20  
**(iv)** 1, 2, 3, 4, 6, 9, 12, 18, 36  
**(v)** 1, 2, 3, 4, 6, 8, 12, 16, 24  
**(b) (i)**  $1 \times 6$ ,  $2 \times 3$  **(ii)**  $1 \times 10$ ,  $2 \times 5$   
**(iii)**  $1 \times 18$ ,  $2 \times 9$ ,  $3 \times 6$   
**(iv)**  $1 \times 26$ ,  $2 \times 13$  **(v)**  $1 \times 55$ ,  $5 \times 11$   
**(c) (i)** Prime numbers.  
**(ii)** Because multiples of 4 are also multiples of 2 and they have been

shaded in already.

**(iii)** 1 is not a prime number.

**2. (a)** 11, 13, 17, 23, 29, 31, 37, 41, 43, 47

**(b) (i)** 257 is prime **(ii)** 478 is not prime **(iii)** 3547 is prime **(iv)** 7001 is prime

**(c) (i)** 2 and 3 **(ii)** 5 **(iii)** 2 and 3

**(iv)** 3 and 5 **(v)** 2, 3 and 11

**3. (a)** 2 **(b)** 3 **(c) (i)** 4, 8, 12, 16, 20, 24 **(ii)** 5, 10, 15, 20, 25, 30 **(iii)** 6, 12, 18, 24, 30, 36 **(iv)** 8, 16, 24, 32, 40, 48

**4. (a)** 2 **(b)** 11, 22, 33, 44 / 12, 24, 36, 48. Yes, 11 is prime.

$$(c) 4^2 = 4 \times 4 = 16$$

$$5^2 = 5 \times 5 = 25$$

$$6^2 = 6 \times 6 = 36$$

$$7^2 = 7 \times 7 = 49$$

$$8^2 = 8 \times 8 = 64$$

$$9^2 = 9 \times 9 = 81$$

$$10^2 = 10 \times 10 = 100$$

**5. (a)** 20 **(b)** 7

$$(c) 4^3 = 4 \times 4 \times 4 = 64$$

$$5^3 = 5 \times 5 \times 5 = 125$$

$$6^3 = 6 \times 6 \times 6 = 216$$

$$7^3 = 7 \times 7 \times 7 = 343$$

$$8^3 = 8 \times 8 \times 8 = 512$$

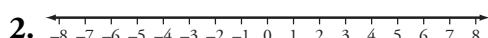
$$9^3 = 9 \times 9 \times 9 = 729$$

$$10^3 = 10 \times 10 \times 10 = 1000$$

**6. (a)**  $10^5$  **(b)** 17 and 71, 19 and 91, 79 and 97, 37 and 73 **(c)**  $10^1$

### Chapter 2 – Exercise 2.1

- 1. (a)** 7 **(b)** 2 **(c)** 7 **(d)** -2 **(e)** 7 **(f)** 10 **(g)** -5



- 3. (a)** 4 **(b)** 8 **(c)** 9

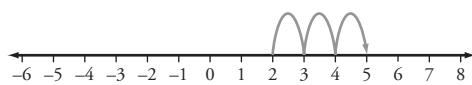
- 4.** (a) 8, 7, 4, -3, -5 (b) 8, 5, -2, -3, -6  
 (c) 7, 3, -2, -3, -7 (d) 7, 4, 0, -4, -7

- 5.** (a)  $-3^{\circ}\text{C}$  (b)  $-8^{\circ}\text{C}$  (c)  $0^{\circ}\text{C}$

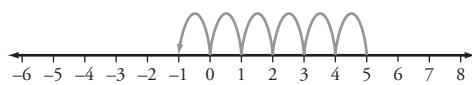
- 6.** (a)  $14 > 5$  (b)  $-2 < 5$  (c)  $7 > -3$   
 (d)  $-10 < -8$  (e)  $-100 > -102$   
 (f)  $76 > -76$

### Exercise 2.2

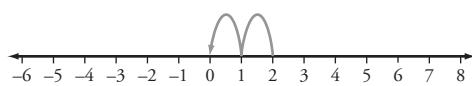
- 1.** (a) 5



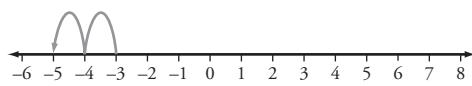
- (b) -1



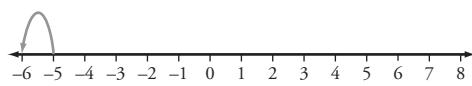
- (c) 0



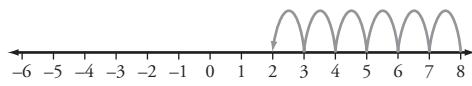
- (d) -5



- (e) -6



- (f) 2



- 2.** (a) 6 (b) 1 (c) 0 (d) -2 (e) -11 (f) -3

3. -€220

| City     | Warmer/Colder     | Temperature          |
|----------|-------------------|----------------------|
| Dublin   |                   | $8^{\circ}\text{C}$  |
| Galway   | 2 degrees colder  | $6^{\circ}\text{C}$  |
| Paris    | 4 degrees warmer  | $12^{\circ}\text{C}$ |
| Moscow   | 12 degrees colder | $-4^{\circ}\text{C}$ |
| New York | 10 degrees colder | $-2^{\circ}\text{C}$ |
| Sydney   | 15 degrees warmer | $23^{\circ}\text{C}$ |
| Cairo    | 10 degrees warmer | $18^{\circ}\text{C}$ |
| Oslo     | 15 degrees colder | $-7^{\circ}\text{C}$ |

- 5.** (a) -11 (b) -13 (c) -32 (d) 2 (e) -49  
 (f) -17

- 6.** (a) 3 (b) 5 (c) 10 (d) -6 (e) -11

- (f) -5 (g) 5 (h) -5

- 7.** (a) 6 (b) -8 (c) 5 (d) -3 (e) 0 (f) 1  
 (g) -17 (h) -9

- 8.** (a) 10 (b) -9 (c) 22 (d) -1

- 9.** (a) Blake D. -3; Browne P. +5; Davin T. -1; Flynn P. +3; Gallagher C. -6; King P.J. +6; Lally D. +4; O'Sullivan P. -8; Reilly J. +7; Tiernan P. -2

- (b) O'Sullivan P. (c) Reilly J.

- (d) 5 players (e) 5 players

### Exercise 2.3

- 1.** (a) -16 (b) 28 (c) -4 (d) -8 (e) 18  
 (f) -40 (g) 6 (h) -30 (i) -24 (j) 6 (k) 5  
 (l) -35

- 2.** (a) -18 (b) 40 (c) 24 (d) -30 (e) 36  
 (f) 32 (g) 40 (h) -12 (i) -14 (j) 24

- 3.** (a) 12 (b) -48 (c) -24 (d) 120

- 4.** (a) 8 (b) 5 (c) 12 (d) 1 (e) 17 (f) 8  
 (g) 1 (h) -10

- 5.** (a) 7 (b) +5 (c) 13 (d) 5

### Exercise 2.4

- 1.** (a) 3 (b) -2 (c) -2 (d) 3 (e) -1 (f) 3  
 (g) -2 (h) -4

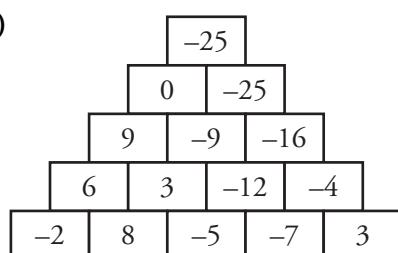
- 2.** (a) 1 (b) 8 (c) 2 (d) 1 (e) -5 (f) -3

- 3.** (a) 6 (b) -6 (c) 2 (d) 3 (e) -6

### Chapter 2 review

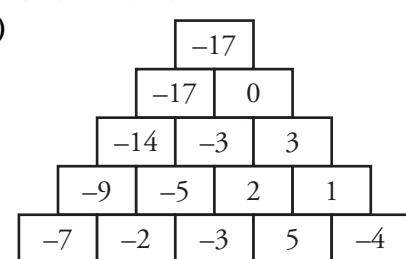
- 1.** (a) (i)  $-9^{\circ}\text{C}$  (ii)  $-4^{\circ}\text{C}$  (iii)  $-4^{\circ}\text{C}$   
 (b) (i) 6 (ii) 16 (iii) -8 (iv) 60 (c) 27

2. (a)



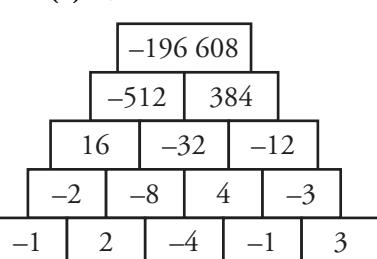
- (b) (i) -21 (ii) 8 (iii) -12 (iv) 8 (v) 36  
 (vi) -15 (vii) 6 (viii) -25 (ix) 10 (x) 18  
 (xi) -40 (xii) 30  
 (c) (i) 3 (ii) -3 (iii) -4 (iv) 4 (v) -1  
 (vi) 3 (vii) -2 (viii) -4

3. (a)



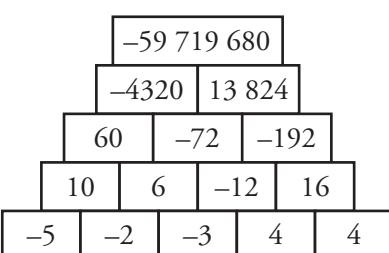
- (b) (i) 3 (ii) -10 (iii) -4 (iv) 2 (v) -7  
 (vi) -6 (vii) -5 (viii) -8 (ix) 0 (x) 20  
 (xi) -48 (xii) -60  
 (c) (i) 32 °C (ii) 7 °C (iii) 39 °C  
 4. (a) (i) -4 (ii) -1 (iii) -8 (iv) -6  
 (v) 14 (vi) 14 (vii) -7 (viii) -7  
 (ix) -44 (x) 85

(b)



- (c) (i) 10 (ii) 5 (iii) 13 (iv) 0  
 5. (a) (i) 18 (ii) 14 (iii) 14 (iv) -2

(b)



- (c) (i) -9 (ii) -24 (iii) 2  
 6. (a) (i) 17 (ii) 5 (iii) 17 (iv) -13  
 (b) (i) 30 (ii) -24 (iii) -48 (iv) 45  
 (c) (i) 2 (ii) -1

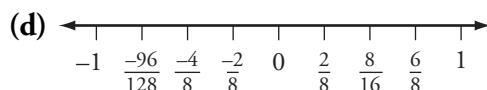
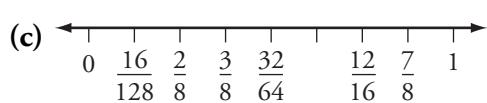
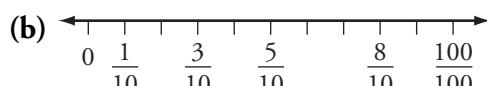
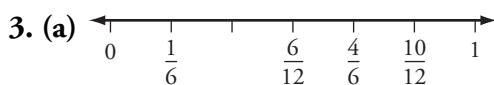
### Chapter 3 – Exercise 3.1

1. (a)  $\frac{1}{2}$  (b)  $\frac{3}{4}$  (c)  $\frac{1}{5}$  (d)  $\frac{7}{30}$  (e)  $\frac{3}{16}$

2. (a)  $\frac{2}{4}$  (b)  $\frac{4}{10}$  (c)  $\frac{3}{4}$  (d)  $\frac{30}{33}$  (e)  $\frac{30}{36}$  (f)  $\frac{18}{15}$

(g)  $\frac{63}{49}$  (h)  $\frac{100}{200} = \frac{10}{20} = \frac{5}{10} = \frac{1}{2}$

(i)  $3\frac{8}{20}$  (j)  $2\frac{3}{6}$  (k)  $\frac{18}{6} = \frac{12}{4} = \frac{6}{2}$



4. (a)  $\frac{2}{12}, \frac{1}{3}, \frac{1}{2}, \frac{4}{6}$  (b)  $\frac{1}{5}, \frac{4}{10}, \frac{1}{2}, \frac{4}{5}$

(c)  $\frac{1}{16}, \frac{2}{12}, \frac{2}{8}, \frac{3}{4}$

5. (a)  $\frac{11}{2}$  (b)  $\frac{11}{4}$  (c)  $\frac{33}{5}$  (d)  $\frac{98}{9}$  (e)  $\frac{137}{11}$

(f)  $\frac{61}{4}$  (g)  $\frac{149}{7}$  (h)  $\frac{502}{5}$  (i)  $-\frac{29}{12}$  (j)  $-\frac{29}{8}$

(k)  $-\frac{45}{7}$

6. (a)  $1\frac{2}{3}$  (b)  $3\frac{3}{4}$  (c)  $8\frac{1}{2}$  (d)  $2\frac{2}{3}$  or  $2\frac{1}{2}$   
 (e)  $2\frac{1}{10}$  (f)  $6\frac{3}{7}$  (g)  $-7\frac{1}{3}$  (h)  $-4\frac{2}{8}$  or  $4\frac{1}{4}$

**Exercise 3.2**

1. (a)  $\frac{7}{6}$  (b)  $\frac{22}{35}$  (c)  $\frac{3}{6}$  or  $\frac{1}{2}$  (d)  $\frac{31}{21}$  (e)  $\frac{27}{20}$   
 (f)  $\frac{43}{72}$  (g)  $\frac{37}{40}$   
 2. (a)  $\frac{1}{6}$  (b)  $\frac{11}{40}$  (c)  $\frac{8}{15}$  (d)  $\frac{32}{99}$  (e)  $\frac{1}{130}$   
 (f)  $\frac{1}{120}$  (g)  $-\frac{19}{36}$

3. (a)  $\frac{11}{12}$  (b)  $-\frac{13}{30}$  (c)  $\frac{5}{6}$  or  $\frac{10}{12}$   
 (d)  $-\frac{50}{42}$  or  $-\frac{25}{21}$  (e)  $-\frac{61}{90}$   
 4. (a)  $\frac{53}{6}$  (b)  $\frac{79}{12}$  (c)  $\frac{11}{15}$  (d)  $-\frac{99}{40}$  (e)  $-\frac{5}{4}$   
 5. (a)  $\frac{115}{12}$  (b)  $\frac{25}{12}$  (c)  $-\frac{107}{20}$  (d)  $-\frac{709}{30}$

6. (a)  $\frac{1}{10}$  (b) 4 (c)  $\frac{21}{20}$  (d)  $-\frac{77}{10}$

**Exercise 3.3**

1. (a)  $\frac{2}{15}$  (b)  $\frac{6}{49}$  (c)  $\frac{5}{24}$  (d)  $\frac{2}{21}$  (e)  $\frac{9}{20}$   
 (f)  $\frac{1}{12}$  (g)  $\frac{1}{12}$   
 2. (a)  $\frac{1}{6}$  (b)  $\frac{1}{20}$  (c)  $\frac{2}{45}$  (d)  $\frac{4}{21}$  (e)  $\frac{6}{65}$   
 (f)  $\frac{4}{5}$  (g)  $\frac{10}{9}$   
 3. (a) 1 (b)  $\frac{35}{2}$  (c)  $\frac{21}{2}$  (d)  $\frac{9}{2}$  (e)  $\frac{93}{4}$   
 4. (a)  $\frac{1}{2}$  (b)  $\frac{14}{3}$  (c)  $\frac{64}{5}$  (d)  $\frac{81}{20}$  (e)  $\frac{231}{8}$   
 5. (a)  $-\frac{1}{6}$  (b)  $\frac{2}{3}$  (c)  $\frac{64}{5}$  (d)  $-\frac{27}{5}$   
 6. (a)  $\frac{1}{8}$  (b)  $\frac{2}{45}$  (c)  $\frac{5}{24}$  (d)  $-\frac{5}{126}$

**Exercise 3.4**

1. (a)  $\frac{3}{8}$  (b)  $\frac{10}{21}$  (c)  $\frac{10}{3}$  (d)  $\frac{21}{10}$  (e)  $\frac{12}{5}$   
 (f)  $\frac{27}{16}$  (g)  $\frac{32}{5}$

2. (a)  $\frac{3}{2}$  (b)  $\frac{6}{15}$  (c) 10 (d)  $\frac{9}{2}$  (e)  $\frac{50}{3}$

- (f)  $\frac{2}{15}$  (g)  $\frac{8}{27}$

3. (a) 12 (b)  $\frac{1}{2}$  (c)  $\frac{8}{23}$  (d)  $\frac{9}{32}$  (e)  $\frac{12}{31}$

4. (a)  $\frac{9}{2}$  (b)  $\frac{21}{8}$  (c)  $\frac{9}{20}$  (d)  $\frac{5}{12}$  (e)  $\frac{14}{33}$

5. (a)  $-\frac{3}{2}$  (b)  $\frac{3}{8}$  (c)  $\frac{9}{20}$  (d)  $-\frac{5}{12}$

6. (a)  $\frac{9}{10}$  (b)  $\frac{2}{15}$  (c)  $\frac{27}{40}$  (d)  $\frac{55}{4}$  (e)  $\frac{8}{15}$

7. (a)  $\frac{7}{12}$  (b)  $\frac{26}{3}$  (c)  $-\frac{52}{35}$  (d)  $-\frac{1}{12}$

**Exercise 3.5**

1.  $4\frac{1}{4}$  cm 2.  $3\frac{1}{4}$  cm 3. €36 4.  $\frac{5}{8}$  5.  $\frac{1}{4}$

6. €1875 7.  $\frac{1}{10}$  8. 6 black, 4 white

9.

| Ingredients | 4 people                      | 3 people            |
|-------------|-------------------------------|---------------------|
| Butter      | $\frac{1}{16}$ kg             | $\frac{3}{64}$ kg   |
| Sugar       | $\frac{1}{20}$ kg             | $\frac{3}{80}$ kg   |
| Milk        | $\frac{1}{2}$ litre           | $\frac{3}{8}$ litre |
| Flour       | $\frac{3}{4}$ kg              | $\frac{9}{16}$ kg   |
| Salt        | $\frac{1}{3}$ tablespoon (ts) | $\frac{1}{4}$ ts    |
| Baking soda | $\frac{1}{4}$ ts              | $\frac{3}{16}$ ts   |

| 2 people            | 1 person            | 10 people            |
|---------------------|---------------------|----------------------|
| $\frac{1}{32}$ kg   | $\frac{1}{64}$ kg   | $\frac{5}{32}$ kg    |
| $\frac{1}{40}$ kg   | $\frac{1}{80}$ kg   | $\frac{1}{8}$ kg     |
| $\frac{1}{4}$ litre | $\frac{1}{8}$ litre | $1\frac{1}{4}$ litre |
| $\frac{3}{8}$ kg    | $\frac{3}{16}$ kg   | $1\frac{7}{8}$ kg    |
| $\frac{1}{6}$ ts    | $\frac{1}{12}$ ts   | $\frac{5}{6}$ ts     |
| $\frac{1}{8}$ ts    | $\frac{1}{16}$ ts   | $\frac{5}{8}$ ts     |

**Chapter 3 review**

1. (a)  $\frac{5}{14}$  (b)(i)  $\frac{3}{5}$  (ii)  $\frac{35}{3}$  (c)(i)  $\frac{5}{18}$  (ii) 18

2. (a)  $\frac{1}{8}$  (b)(i)  $\frac{3}{5}$  (ii)  $-\frac{11}{6}$  (c)(i) 24 cm

- (ii)  $\frac{1}{7}$

3. (a)  $\frac{5}{12}$  (b)(i)  $\frac{1}{3}$  (ii)  $\frac{2}{3}$  (c) €15 625

4. (a)(i)  $\frac{1}{2}$  (ii)  $\frac{1}{4}$  (iii)  $\frac{3}{7}$  (iv)  $\frac{3}{10}$  (v)  $\frac{7}{16}$   
 (b)(i)  $\frac{1}{4}$  (ii) 12 (iii)  $\frac{7}{24}$  (iv)  $\frac{5}{6}$  (c) €840  
 5. (a)  $\frac{3}{5}$  (b)(i)  $\frac{14}{15}$  (ii)  $-\frac{5}{8}$  (c) 45  
 6. (a)  $\frac{1}{7}, \frac{6}{14}, \frac{50}{70}, \frac{30}{35}$  (b)(i)  $\frac{9}{56}$  (ii) -12  
 (c)(i) 6 blue balls (ii)  $\frac{6}{36}$  or  $\frac{1}{12}$

**Chapter 4 – Exercise 4.1**

1. (a) 5 (b) 0.5 (c) 500 (d) 0.005  
 (e) 5000 (f) 0.05  
 2. (a) 0.2 (b) 0.3 (c) 0.5 (d) 0.35  
 (e) 0.045 (f) 0.0034  
 3. (a) 0.4 (b) 0.375 (c) 0.8 (d) 0.625  
 (e) 0.6 (f) 0.12  
 4. (a) 1.2 (b) 1.2 (c) 5.25 (d) 10.8  
 (e) 3.125 (f) 12.0  
 5. (a)  $\frac{1}{5}$  (b)  $\frac{13}{25}$  (c)  $\frac{1}{4}$  (d)  $\frac{9}{25}$  (e)  $\frac{1}{8}$  (f)  $\frac{5}{8}$   
 6. (a)  $2\frac{3}{10}$  (b)  $3\frac{3}{4}$  (c)  $4\frac{53}{200}$  (d)  $19\frac{3}{50}$   
 (e)  $25\frac{1}{200}$  (f)  $21\frac{7}{8}$   
 7. (a) 0.20 (b) 1.8 (c) 0.04 (d) 2.04  
 8. (a) 0.023 21, 0.2321, 2.321, 23.21  
 (b) 0.001 011, 0.1011, 1.011, 10.11  
 (c) 5.023, 5.032, 5.123, 5.124  
 (d) 7.68, 7.86, 8.67, 8.76

**Exercise 4.2**

1. Number      Rounded to the nearest 10  
 5241            5240  
 63 782          63 780  
 534 218        534 220  
 76 349          76 350  
  
 Rounded to the nearest 100  
 5200  
 63 800  
 534 200  
 76 300

**Rounded to the nearest 1000**

5000  
 64 000  
 534 000  
 76 000

2. (a) 3 (b) 6 (c) 82 (d) 102 (e) 99

(f) 60 (g) 1

3. (a) 4.8 (b) 8.6 (c) 72.7 (d) 100.1

(e) 91.0 (f) 59.9 (g) 0.1

4. (a) 7.25 (b) 4.67 (c) 86.85

(d) 192.75 (e) 200.08 (f) 69.90

(g) 0.10

5. (a) 6.275 (b) 19.966 (c) 721.755

(d) 112.376 (e) 12.099 (f) 78.943

(g) 0.8

**Exercise 4.3**

1. (a) 6, 6.06 (b) 14, 13.88 (c) 28, 28.46

(d) 246, 246.24 (e) 20, 19.743

2. (a) 3, 2.66 (b) 0, 0.87 (c) 2, 2.59

(d) 22, 21.49 (e) 6, 6.09

3. (a) -2, -1.74 (b) -7, -6.21

(c) -4, -4.12 (d) 0, -0.19 (e) 0, -0.291

4. (a) 9, 9.49 (b) 11, 11.25

(c) -34, -34.304 (d) -6, -5.4

5. (a) 70, 66.32 (b) 24, 21.43

(c) 28, 32.84 (d) 110, 119.66

(e) 150, 152.12

6. (a) 3, 3.44 (b) 3, 3.29 (c) 12, 9.74

(d) 2, 2.54 (e) 4, 3.98

7. (a) 20, 19.92 (b) 36, 38.57

(c) 88, 79.37 (d) 30, 34.76

8. (a) 5 (b) 4.931 25

9. (a) 6 (b) 5.438 75

10. (a) 2 (b) 1.958

**Exercise 4.4**

1. (a)(i) 4 (ii) 25 (iii) 9 (iv) 144

(v) 400 (vi) 10 000

- (b) (i) 4.41 (ii) 24.01 (iii) 10.3684  
 (iv) 148.84 (v) 388.8784  
 (vi) 9956.0484
- 2.** (a) (i) 2 (ii) 3 (iii) 4 (iv) 5 (v) 5 (vi) 6  
 (b) 2.062 (ii) 2.958 (iii) 4.052  
 (iv) 4.981 (v) 4.822 (vi) 6.351
- 3.** (a) (i)  $\frac{1}{5}$  (ii)  $\frac{1}{8}$  (iii)  $\frac{1}{13}$  (iv)  $\frac{1}{15}$  (v) 19  
 (b) (i) 0.2 (ii) 0.13 (iii) 0.08 (iv) 0.07  
 (v) 19
- 4.** (a) (i)  $\frac{1}{8}$ , 0.125 (ii)  $\frac{1}{5}$ , 0.2  
 (iii)  $\frac{1}{10}$ , 0.1 (iv)  $\frac{1}{100}$ , 0.01  
 (v)  $\frac{1}{50}$ , 0.02 (vi)  $\frac{1}{1000}$ , 0.001  
 (b) (i) 0.123 (ii) 0.207 (iii) 0.104  
 (iv) 0.01 (v) 0.02 (vi) 0.001
- 5.** (a) (i)  $\frac{5}{3}$  (ii)  $\frac{20}{13}$  (iii)  $\frac{2}{7}$  (iv)  $\frac{4}{9}$   
 (v)  $\frac{5}{12}$  (vi)  $\frac{4}{13}$   
 (b) (i) 1.667 (ii) 1.538 (iii) 0.286  
 (iv) 0.444 (v) 0.417 (vi) 0.308
- 6.** (a) (i) 18 (ii) 160 (iii) 4 (iv) 12 100  
 (b) (i) 14.196 (ii) 155.2  
 (iii) 3.24761 (iv) 10 991.925
- 7.** (a) 16 (b) 19.09
- 8.** (a) 12 (b) 13.7
- 9.** (a) 35 (b) 33.48
- 10.** (a) 121 (b) 124.23

### Exercise 4.5

- 1.** (a)  $5.6 \times 10^4$  (b)  $2.1 \times 10^7$   
 (c)  $2.6 \times 10^6$  (d)  $1.25 \times 10^4$   
 (e)  $8.79 \times 10^4$  (f)  $4.44 \times 10^6$
- 2.** (a) 300 000 (b) 9 000 000 (c) 310  
 (d) 45 000 (e) 6120 (f) 1 020 000
- 3.** (a)  $2 \times 10^{-2}$  (b)  $4 \times 10^{-4}$   
 (c)  $3.6 \times 10^{-5}$  (d)  $1.25 \times 10^{-3}$
- (e)  $8.79 \times 10^{-3}$  (f)  $2.22 \times 10^{-6}$
- 4.** (a) 0.0004 (b) 0.008 (c) 0.024  
 (d) 0.000 055 (e) 0.007 12  
 (f) 0.000 1234
- 5.** (i) (a) 650 000 (b)  $6.5 \times 10^5$   
 (ii) (a) 396 000 (b)  $3.96 \times 10^5$   
 (iii) (a) 4 307 600 (b)  $4.3076 \times 10^6$   
 (iv) (a) 22 723 000 (b)  $2.2723 \times 10^7$
- 6.** (a)  $3.5 \times 10^4$  (b)  $5.7063 \times 10^5$   
 (c)  $2.66 \times 10^6$  (d)  $7.08 \times 10^4$
- 7.** (a)  $8 \times 10^7$  (b)  $4.6 \times 10^7$  (c)  $2 \times 10^{11}$   
 (d)  $3.1 \times 10^2$
- 8.** (a)  $5.05 \times 10^{-2}$  (b)  $6.307 \times 10^{-2}$   
 (c)  $-1.3973 \times 10^{-3}$  (d)  $-4.54 \times 10^{-3}$
- 9.** (a)  $6 \times 10^{-6}$  (b)  $9.9 \times 10^{-5}$   
 (c)  $2 \times 10^2$  (d)  $5 \times 10^2$
- 10.** (a) Pluto (b) Mercury
- 11.**  $8.4 \times 10^{-1}$  cm

### Chapter 4 review

- 1.** (a) 5 (b) (i) 3.5 (ii) 3.51  
 (c) (i) 38.5 (ii) 37.924
- 2.** (a) 0.010 123, 0.101 23, 1.0123,  
 10.123, 101.23, 1012
- (b) (i) 5 (ii) 5 (c) (i) 1 (ii) 1.075
- 3.** (a) (i)  $\frac{1}{8}$  (ii)  $\frac{11}{20}$  (iii)  $\frac{17}{20}$   
 (b) (i) 139 000 (ii) 138 500  
 (iii) 138 510  
 (c) (i) 2 (ii) 1.963
- 4.** (a) (i) 4 (ii) 3.437 (b) Tim  
 Montgomery, Dwayne Chambers,  
 Darren Campbell, Maurice Greene,  
 B. O'Regan. No, some would have the  
 same times.  
 (c) (i) 36 (ii) 39.84
- 5.** (b) (i)  $6.12 \times 10^4$  (ii)  $2.65 \times 10^1$   
 (c) (i) 3 (ii) 3.43

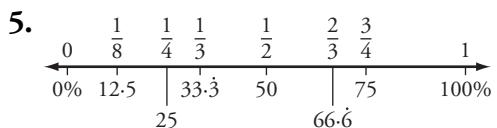
- 6.** (a) (i) 16 (ii) 16.615 (b)  $3.6 \times 10^3$  mm  
 (c) (i) 26 449, 13 649, 12 249, 10 549  
 (ii) 26 351, 13 551, 12 151, 10 451

### Chapter 5 – Exercise 5.1

- 1.** (a)  $\frac{1}{20}$  (b)  $\frac{1}{10}$  (c)  $\frac{1}{4}$  (d)  $\frac{19}{50}$  (e)  $\frac{3}{5}$  (f)  $\frac{3}{4}$   
**2.** (a) 10% (b) 60% (c) 80% (d) 37.5%  
 (e) 30% (f)  $73\frac{1}{3}\%$   
**3.** (a) 50% (b) 40% (c) 4% (d) 91%  
 (e) 80% (f) 34%

**4.** Fraction      Decimal      Percentage

|                  |      |     |
|------------------|------|-----|
| $\frac{3}{10}$   | 0.3  | 30% |
| $\frac{7}{10}$   | 0.7  | 70% |
| $\frac{21}{50}$  | 0.42 | 42% |
| $\frac{7}{100}$  | 0.07 | 7%  |
| $\frac{1}{50}$   | 0.02 | 2%  |
| $\frac{39}{100}$ | 0.39 | 39% |
| $\frac{7}{20}$   | 0.35 | 35% |
| $\frac{3}{50}$   | 0.06 | 6%  |
| $\frac{19}{50}$  | 0.95 | 95% |
| $\frac{13}{50}$  | 0.26 | 26% |



- 6.** 2%, 0.03,  $\frac{1}{30}$ , 5%,  $\frac{3}{10}$ , 0.32 **7.** 95%  
**8.** (a) 50% (b) 25% (c) 50% (d) 30%  
**9.** 55% **10.** Jake 30%; Linda 50%;  
 Conor 20%

### Exercise 5.2

- 1.** (a) 50% (b) 25% (c) 20% (d) 10%

- (e) 5%  
**2.** (a) 80% (b) 25% (c) 20% (d) 2.5%  
 (e) 2%

**3.** James 70%, Peter 88%, Sharon 60%,  
 Una 90%

**4.** mobiles 30%, local  $66.\dot{6}\%$ ,  
 international  $3.\dot{3}\%$

- 5.** (a) 14 (b) 26 (c) 51 (d) 75 (e) 250

- 6.** (a) €10 (b) €6 (c) €253 (d) €564.2  
 (e) €9375

- 7.** (a) €46 875 (b) €2130.68

- 8.** (a) 156.25 (b) 200 (c) 268.75  
 (d) 456.25 (e) 562.5

- 9.** 900 **10.** 92 red; 188 blue

### Exercise 5.3

- 1.** 50% **2.** 25% **3.**  $36.\dot{3}\dot{6}\%$  **4.** 40%

- 5.** 6.24% **6.**  $16.\dot{6}\%$  **7.** 35% **8.** 2%

- 9.** 13% **10.** 3.75%

### Chapter 5 review

- 1.** (a) 3.125%  
 (b) (i) 3.92 (ii) 17.5 (iii) 8750  
 (c) (i) 100 (ii) 120 (iii) €345.60

- 2.** (a)  $\frac{3}{10}$ , 0.3 (b) 250 (c) 32

- 3.** (a) 25%, 2.5% (b) Science 56%;  
 Maths 60%; French 65% (c) 20%;  
 €34.20

- 4.** (a) 25% (b) 19.61 (c) €2.73

- 5.** (a) 0.6% (b) 6%, 28%, 56%, 11%  
 (c) 12%

- 6.** (a) 6.25% (b) 331.25 (c) 0.3 metres

### Chapter 6 – Exercise 6.1

- 1.** TV: (a) €50 (b) 10%;

- Dishwasher:** (a) €30 (b) 5%;

- Home cinema:** (a) €30 (b) 3%

- 2.** **Focus:** (a) €2500 (b) 31.25%;

**Golf:** (a) loss of €3250 (b) 20%;  
**Corolla:** (a) €710 (b) 5%;  
**Punto:** (a) loss of €900 (b) 12.5%  
**3. €3.50:** (a) €0.28 (b) €3.78;  
**€5.60:** (a) €0.56 (b) €6.16;  
**€9.20:** (a) €1.15 (b) €10.35;  
**€12.32:** (a) €1.85 (b) €14.17  
**4. €250:** (a) €12.50 (b) €237.50;  
**€356:** (a) €35.60 (b) €320.40;  
**€120:** (a) €15 (b) €105;  
**€150.25:** (a) €18.03 (b) €133.22  
**5.** €600; €300; €1233; €12 320

### Exercise 6.2

1. €179.20
2. €1400
3. (a) €119 (b) €799
4. €78.65
5. **Car A:** €235.20; **Car B:** €352.80;
- Car C:** €470.40
6. €12 890
7. €110 460
8. (a) 12.5%
- (b) €500
9. €53.50
10. €336

### Exercise 6.3

1. €7.22
2. €36.80
3. **Units:** 463;  
**Domestic charges:** €57.88; €72.66;  
**VAT:** €9.08; **Total:** €81.74
4. **Units:** 560;  
**Domestic charges:** €73.92;  
**Subtotal:** €91.30; **VAT:** €12.33;  
**Total:** €103.63
5. **Mobile calls:** €12.50;  
**National calls:** €12.00;  
**International calls:** €6.00;  
**Total call charges:** €30.50;  
**Subtotal:** €61.49; **VAT:** €12.30;  
**Total:** €73.79
6. **Mobile calls:** €28.35;  
**National calls:** €4.65;

**International calls:** €9.80;  
**Total call charges:** €42.80;  
**Subtotal:** €66.58; **VAT:** €8.32;  
**Total:** €74.90  
**7.** 31 cent **8.** €10.51

### Exercise 6.4

1. **Gross pay:** €310; **Tax @ 22%:** €68.20; **Tax:** €18.20;  
**Take-home pay:** €291.80
2. **40 hours:** €409.60; **3 hours:** €46.08; **Gross pay:** €455.68; **Tax @ 21%:** €95.69; **Tax due:** €30.69;  
**Take-home pay:** €424.99
3. €114.80
4. €461
5. **John:** €24 100; **Alison:** €26 600;  
**Mary:** €37750; **Donal:** €44 460
6. **Pierce:** €59 875.50;  
**Aoife:** €56 342.50;  
**Peadar:** €46 771.50; **Anne:** €65 473.50
7. €982.31
8. €696.16
9. €78 049
10. €400

### Exercise 6.5

1. (i) (a) €10 (b) €210
- (ii) (a) €44 (b) €594
- (iii) (a) €555 (b) €4995
- (iv) (a) €540 (b) €4140
- (v) (a) €3641.40 (b) €23 871.40
2. (a) €30.75 (b) €83.20 (c) €1195.31
- (d) €182.25 (e) €1440.88
3. (a) €3390.63 (b) €422.90 (c) €183.62
4. €2725.38
5. €2152.50
6. €16 232.32
7. €11 910.16
8. €565.15
9. €224.95
10. €2500

### Exercise 6.6

1. (a) US\$496 (b) ¥54 600 (c) £268
2. (a) R8140 (b) C\$1460 (c) ¥136 500

- 3.** (a) US\$317.44 (b) C\$373.76  
(c) £171.52  
**4.** (a) €201.61 (b) €302.42  
(c) €1895.16  
**5.** (a) €21.98 (b) €476.19 (c) €1098.90  
**6.** (a) €3582.09 (b) €5313.43  
(c) €3665.67  
**7.** (a) €614.25 (b) €933.66  
(c) €2518.43  
**8.** ¥1341.52 **9.** C\$1089.55  
**10.** US\$181.68

### Chapter 6 review

- 1.** (a) €103 (b) €174.66 (c) €501  
**2.** (a) \$337.92 (b) €472.88 (c) €558.22  
**3.** (a) €4.94 (b) €25.410 (c) €3234.20  
**4.** (a) €3000 (b) **Units:** 418; **Domestic charges:** €52.25; **Subtotal:** €73.49; **VAT:** €7.35; **Total:** €80.84 (c) €47 884  
**5.** (a) €1236 (b)(i) €630 (ii) €661.50  
(c) €40 268  
**6.** (a) €4.51 (b)(i) €437.50 (ii) 28%  
(c) **Mobile calls:** €14.00; **National calls:** €5.94; **International calls:** €12.00; **Total call charges:** €31.94; **Subtotal:** €62.16; **VAT:** €7.77; **Total:** €69.93

### Chapter 7 – Exercise 7.1

- 1.** (a) 200 cm (b) 23 cm (c) 4 km  
(d) 55 000 m (e) 300 mm **2.** 300 m  
**3.** 272.5 cm **4.** 8.8 km **5.** 50  
**6.** (a) 2 kg (b) 2.45 g (c) 2500 kg  
(d) 2.4 g (d) 30 000 g  
**7.** 5 g and 5000 mg **8.** 2500 g  
**9.** 1.5 kg **10.** 80

### Exercise 7.2

- 1.** (a) 1200 (b) 7200 (c) 86 400

- 2.** (a) 1 hr 20 min (b) 2 hr 5 min  
(c) 5 hr 50 min **3.** 5 hr 40 min  
**4.** 9 hr 45 min **5.** 6 hr 40 min  
**6.** (a) 17:00 (b) 15:30 (c) 07:25  
(d) 00:32 (e) 20:30 (f) 19:55 (g) 18:45  
(h) 23:40  
**7.** (a) 3:15 am (b) 1:32 pm (c) 6:00 pm  
(d) 9:50 pm (e) 7:55 am (f) 2:20 pm  
**8.** (a) 2 hr 33 min, 2 hr 35 min,  
2 hr 29 min (b) 4 min, 10 min, 9 min  
(c) 14:19 (d) 11:59  
**9.** (a) 16:25 (b) 21:25  
**10.** (a)(i) 7 (ii) 1 (b) 10 min, 40 min

### Exercise 7.3

- 1.** 15 km/hr **2.** 88 km/hr  
**3.** 1 hr 12 min **4.** 1 hr 20 min  
**5.** 87.5 km **6.** 4.5 km **7.** 64 km/hr  
**8.** 14:04 **9.** 1.7 km **10.** (a) 350 km  
(b) 5 hr 36 min (c) 62.5 km/hr

### Exercise 7.4

- 1.** (a) 1:3 (b) 1:4 (c) 1:2 (d) 1:4  
(e) 4:2:1 (f) 6:3:1  
**2.** (a) 1:2 (b) 3:5 (c) 5:6 (d) 6:3:2  
(e) 20:2:1  
**3.** (a) 1:20 (b) 1:10 (c) 1:25  
**4.** Sharon gets €120, Orla gets €80  
**5.** 250 cm **6.** €6000, €4000, €2000  
**7.** €6 **8.** 30 g **9.** 3 days **10.** 1 hour

### Chapter 7 review

- 1.** (a) Philip got €300, Sandra got €200  
(b) 1:25  
(c)(i) 2 hr 45 min (ii) 80 km/hr  
(iii) 20:45  
**2.** (a) 1 hr 17 min (b) €2100  
(c)(i) 2.5 hr (ii) 18 (iii) 20 people  
**3.** (a)(i) 5640 m (ii) 45.70 m (b) 2:7

- (c)(i) 1 hr 15 min (ii) 14:30 (iii) €11
- 4.** (a) Seán got €8000, Kate got €4000, Cathal got €2000.  
 (b) 6 apples, 300 g flour, 120 g margarine, 3 eggs, 1.5 litre milk, 150 g sugar.  
 (c)(i) 15 sec  
 (ii) In 1 sec tap A fills  $\frac{1}{30}$  of jug  
 In 1 sec tap B fills  $\frac{1}{50}$  of jug  
 In 1 sec, tap A and tap B fill  $\frac{1}{30} + \frac{1}{50}$  of jug =  $\frac{8}{150}$   
 $\frac{8}{150}$  of jug in 1 sec =  $\frac{1}{150}$  in  $\frac{1}{8}$  sec  
 $\frac{150}{150}$  of jug in  $\frac{1}{8} \times 150 = 18.75$  sec
- 5.** (a) 750 g (b) 36 km/hr  
 (c)(i) 53 min 20 sec (ii) 80 km/hr
- 6.** (a)(i) 20 (ii) 60 (b) 1.6 kg  
 (c)(i) 80 km/hr (ii) 50 min
- Exercise 8.4**
1. (a)  $29 \text{ cm}^2$  (b)  $18 \text{ cm}^2$  (c)  $37 \text{ cm}^2$
  2. (a)  $44 \text{ cm}^2$  (b)  $34 \text{ cm}^2$  (c)  $125 \text{ cm}^2$
  3. (a) 8 cm (b) 6.5 cm (c) 20 cm
  4. (a)  $12 \text{ cm}^2$  (b)  $60 \text{ cm}^2$  (c)  $20 \text{ cm}^2$
  5.  $48 \text{ m}^2$
  6. (a)  $84 \text{ m}^2$  (b)  $50 \text{ m}^2$  (c)  $34 \text{ m}^2$
  7. (a)  $12 \text{ cm}^2$  (b) 1:2
  8. (a) 375 (b) €600 **9.** 70 m
  10. (a) €96 (b) 1920

### Chapter 8 – Exercise 8.1

1. (a) 8 cm (b) 14 cm (c) 4 cm  
 (d) 10 cm (e) 16 cm
2. Get students to measure each of the perimeters using a ruler.
3. (a) 9 cm (b) 16 cm (c) 8 cm
4. (a) 24 cm (b) 30 cm (c) 73 cm
5. (a) 600 cm (b) 700 cm (c) 1200 cm
6. (a) 5 cm (b) 10 cm (c) 7 mm  
 (d) 40 mm (e) 100 m (f) 60 m
7. (a) 60 m (b) 35 m (c) 7910 cm  
 (d) 7850 cm
8. (a) 11 cm (b) 100 cm (c) 120 cm
9. (i) 39 cm (ii) 31 cm **10.** 65 cm

### Exercise 8.3

1. (a) 44 cm (b) 132 cm (c) 352 cm  
 (d) 792 cm
2. (a) 25 cm (b) 94 cm (c) 226 cm  
 (d) 79 cm

- 3.** (a) 5.3 cm (b) 8.8 cm (c) 11.5 cm  
 (d) 15.9 cm
- 4.** 198 m **5.** 118 m **6.** 2842 turns  
 7. 29 mm
- 8.** (a) 36 cm (b) 144 cm (c) 9 cm
- 9.** (a) 42 cm (b) 33 cm (c) 27 cm
- 10.** (a) 44 m (b) 156 m

### Exercise 8.4

1. (a)  $29 \text{ cm}^2$  (b)  $18 \text{ cm}^2$  (c)  $37 \text{ cm}^2$
2. (a)  $44 \text{ cm}^2$  (b)  $34 \text{ cm}^2$  (c)  $125 \text{ cm}^2$
3. (a) 8 cm (b) 6.5 cm (c) 20 cm
4. (a)  $12 \text{ cm}^2$  (b)  $60 \text{ cm}^2$  (c)  $20 \text{ cm}^2$
5.  $48 \text{ m}^2$
6. (a)  $84 \text{ m}^2$  (b)  $50 \text{ m}^2$  (c)  $34 \text{ m}^2$
7. (a)  $12 \text{ cm}^2$  (b) 1:2
8. (a) 375 (b) €600 **9.** 70 m
10. (a) €96 (b) 1920

### Exercise 8.5

1. (a) Estimated: 28; Actual: 28.278
- (b) Estimated: 82; Actual: 78.55
- (c) Estimated: 64; Actual: 63.6255
2. (a)  $154 \text{ cm}^2$  (b)  $1886.5 \text{ cm}^2$   
 (c)  $3850 \text{ cm}^2$  (d)  $15\ 400 \text{ cm}^2$
3. (a)  $314 \text{ cm}^2$  (b)  $962 \text{ cm}^2$   
 (c)  $2003 \text{ cm}^2$  (d)  $61\ 575 \text{ cm}^2$
4. (a) 6 cm (b) 9 cm (c) 9 cm (d) 10 cm
5. 44 cm
6. (a)  $42 \text{ cm}^2$  (b)  $29.96 \text{ cm}^2$   
 (c)  $47.25 \text{ cm}^2$
7. 45 ares
8. (a)  $882 \text{ m}^2$  (b)  $693 \text{ m}^2$  (c)  $189 \text{ m}^2$
9.  $10 \text{ cm}^2$  **10.** 56%

### Chapter 8 review

1. (a) 32 cm  
 (b)(i) 394 m (ii) 7825  $\text{m}^2$   
 (c)(i) 176 cm (ii) 880 m

- 2.** (a) 16 cm  
 (b)(i)  $320 \text{ m}^2$  (ii)  $192 \text{ m}^2$  (iii)  $128 \text{ m}^2$   
 (c)(i) 400 m (ii) 25
- 3.** (a) 88 cm  
 (b)(i) 5 cm (ii)  $40 \text{ cm}^2$  (iii)  $20 \text{ cm}^2$   
 (c)(i)  $100 \text{ cm}^2$  (ii)  $78.5 \text{ cm}^2$  (iii) 21.5%
- 4.** (a)(i) 20 cm (ii)  $21 \text{ cm}^2$   
 (b)(i)  $100\,000 \text{ cm}^2$  (ii) 6250 (iii) 3125  
 (c)  $50\pi \text{ cm}^2$
- 5.** (a)  $85 \text{ cm}^2$   
 (b)(i) 112 cm (ii)  $637 \text{ cm}^2$   
 (c)  $63 \text{ mm}^2$
- 6.** (a) 40 cm  
 (b)(i) 7 cm (ii)  $52.5 \text{ cm}^2$   
 (c)  $6.25\pi \text{ cm}^2$ ,  $4\pi \text{ cm}^2$ ,  $2.25\pi \text{ cm}^2$ , area of  $A = \text{area of } B + \text{area of } C$

### Chapter 9 – Exercise 9.1

1.  $n + 3$  2.  $b - 4$  3.  $3x$  4.  $7y - 6$   
 5.  $6b - 2$  6.  $x^2$  7.  $4(l - 2)$   
 8. Kevin:  $x - 3$ ; Una:  $3x$   
 9.  $x + y$  10.  $(-y + x - 3)^\circ\text{C}$

### Exercise 9.2

1. (a)  $2p$  (b)  $4x$  (c)  $6s$  (d)  $9a$  (e)  $7m$   
 (f)  $3y$  (g)  $8m$  (h)  $6x$  (i) 0 (j)  $-10y$   
 2. (a)  $8x$  (b)  $14a$  (c)  $3y + 3$   
 (d)  $11m + 4$  (e)  $3x$   
 3. (a)  $3x + 3y$  (b)  $5s + 5r$  (c)  $4p + 6q$   
 (d)  $5m - 2n$  (e)  $3x^2 + 4$  (f)  $3y^2 + 5y$   
 (g)  $3k^2 + k - 4p$  (h)  $7m^3 + 2m$   
 (i)  $9x^2 + 3x + 3$   
 (j)  $p^3 + 2p^2 + 2p + 3y^3$   
 (k)  $y^3 + 3y^2 - 5y$

### Exercise 9.3

1. (a)  $x^3$  (b)  $a^4$  (c)  $y^{10}$  (d)  $b^5$  (e)  $a^{m+n}$   
 2. (a)  $3a^3$  (b)  $10x^4$  (c)  $12b^7$   
 (d)  $12y^9$  (e)  $16a^8$

3. (a)  $-3y^4$  (b)  $-21p^3$  (c)  $12m^7$   
 (d)  $-21x^6$  (e)  $16d^4$   
 4. (a)  $x^6$  (b)  $27l^3$  (c)  $18m^2$  (d)  $49x^4$   
 (e)  $27p^9$  (f)  $27y^6$   
 5. (a)  $c^8$  (b)  $-32x^3$  (c)  $18m^2n^2$   
 (d)  $-36x^3y^3$  (e)  $54y^9$  (f)  $-81x^3y^6$

### Exercise 9.4

1. (a)  $x$  (b)  $2a^2$  (c)  $\frac{x^3}{2}$  (d)  $\frac{b^3}{3}$   
 (e)  $\frac{x^2}{4}$  (f)  $\frac{1}{2p^2}$   
 2. (a)  $xy$  (b)  $5x^2y$  (c)  $\frac{b}{2}$  (d)  $\frac{2m^2}{n}$   
 (e)  $\frac{5q}{3p^2}$  (f)  $\frac{x^2y}{4}$   
 3. (a)  $\frac{ab^3}{2}$  (b)  $\frac{x^3}{2}$  (c)  $\frac{2b}{a}$   
 (d)  $2m^2$  (e)  $5xy$   
 4. (a) 1 (b)  $\frac{x^2y}{12}$  (c)  $\frac{2b^2}{a^2}$  (d)  $10y$

### Exercise 9.5

1. (a)  $3x + 12$
- |  |     |    |
|--|-----|----|
|  | $x$ | 4  |
|  | 3   | 12 |
- (b)  $2a - 4$
- |  |     |    |
|--|-----|----|
|  | $a$ | -2 |
|  | 2   | -4 |
- (c)  $-3y + 3$
- |  |     |    |
|--|-----|----|
|  | $y$ | -1 |
|  | -3  | 3  |
2. (a)  $4x + 12$
- |  |     |    |
|--|-----|----|
|  | $x$ | 3  |
|  | 4   | 12 |

(b)  $2m - 6$

|     |    |
|-----|----|
| $m$ | -3 |
| 2   | 2m |

(c)  $6p + 12$

|    |    |
|----|----|
| 2p | 4  |
| 3  | 6p |

(d)  $-4y + 8$

|     |     |
|-----|-----|
| $y$ | -2  |
| -4  | -4y |

(e)  $-3x + 18$

|    |     |
|----|-----|
| -x | 6   |
| 3  | -3x |

(f)  $-8r - 6$

|    |     |
|----|-----|
| 4r | 3   |
| -2 | -8r |

3. (a)  $x^2 + 4x$

|     |       |
|-----|-------|
| $x$ | 4     |
| x   | $x^2$ |

(b)  $2a^2 - 6a$

|     |                 |
|-----|-----------------|
| $a$ | -3              |
| 2a  | 2a <sup>2</sup> |

(c)  $-3y^2 - 6y$

|     |                  |
|-----|------------------|
| $y$ | 2                |
| -3y | -3y <sup>2</sup> |

**4. Diagram method**

(a)  $x^2 + 3x$

|     |       |
|-----|-------|
| $x$ | 3     |
| x   | $x^2$ |

(b)  $2r^2 - 8r$

|     |                 |
|-----|-----------------|
| $r$ | -4              |
| 2r  | 2r <sup>2</sup> |

(c)  $6p^2 + 12p$

|    |                 |
|----|-----------------|
| 2p | 4               |
| 3p | 6p <sup>2</sup> |

(d)  $-2x^2 + 6x$

|     |                  |
|-----|------------------|
| $x$ | -3               |
| -2x | -2x <sup>2</sup> |

(e)  $-3y^2 + 18y$

|    |                  |
|----|------------------|
| -y | 6                |
| 3y | -3y <sup>2</sup> |

(f)  $-8x - 6$

|    |     |
|----|-----|
| 4x | 3   |
| -2 | -8x |

**5. Diagram method**

(a)  $2a^2 + 6a + 2$

|       |                 |    |
|-------|-----------------|----|
| $a^2$ | 3a              | 1  |
| 2     | 2a <sup>2</sup> | 6a |

(b)  $4x^2 + 20x + 8$

|       |                 |     |
|-------|-----------------|-----|
| $x^2$ | 5x              | 2   |
| 4     | 4x <sup>2</sup> | 20x |

(c)  $2p^2 - 6p - 2$

|       |                 |     |
|-------|-----------------|-----|
| $p^2$ | -3p             | -1  |
| 2     | 2p <sup>2</sup> | -6p |

(d)  $-2x^2 + 6x - 2$

|       |                  |    |
|-------|------------------|----|
| $x^2$ | -3x              | 1  |
| -2    | -2x <sup>2</sup> | 6x |

6. (a)  $x^3 + x^2 + x$  (b)  $2a^3 + 4a^2 + 6a$

(c)  $-x^3 + 4x^2 + x$  (d)  $-2b^3 + 6b^2 - 2b$

7. (a)  $4x + 8$  (b)  $11x - 9$

(c)  $7a - 18$  (d)  $2c - 22$

(e)  $x^2 + 3x - 2$  (f)  $-4r^3 - 2r^2 - 2r$

**Exercise 9.6**

1. (a)  $x^2 + 7x + 12$

|       |      |
|-------|------|
| $x$   | 3    |
| $x^2$ | $3x$ |
| 4     | 12   |

(b)  $a^2 + 2a - 8$

|       |      |
|-------|------|
| $a$   | 4    |
| $a^2$ | $4a$ |
| -2    | -8   |

(c)  $y^2 - 4y + 3$

|       |     |
|-------|-----|
| $y$   | -3  |
| $y^2$ | -3y |
| -1    | 3   |

2. (a)  $x^2 + 8x + 15$

**Diagram method**

|       |      |
|-------|------|
| $x$   | 5    |
| $x^2$ | $5x$ |
| 3     | 15   |

$x^2 + 8x + 15$

(b)  $x^2 - 2x - 3$

**Diagram method**

|       |     |
|-------|-----|
| $x$   | 1   |
| $x^2$ | $x$ |
| -3    | -3  |

$x^2 - 2x - 3$

(c)  $2x^2 - 2x - 12$

**Diagram method**

|        |       |
|--------|-------|
| $x$    | -3    |
| $2x^2$ | $-6x$ |
| 4      | -12   |

$2x^2 - 2x - 12$

(d)  $x^2 - 6x + 8$

**Diagram method**

|       |     |
|-------|-----|
| $x$   | -4  |
| $x^2$ | -4x |
| -2    | 8   |

$x^2 - 6x + 8$

(e)  $x^2 + 13x + 42$

**Diagram method**

|       |      |
|-------|------|
| $x$   | 7    |
| $x^2$ | $7x$ |
| 6     | 42   |

$x^2 + 13x + 42$

3. (a)  $x^2 + 6x + 9$

|       |      |
|-------|------|
| $x$   | 3    |
| $x^2$ | $3x$ |
| 3     | 9    |

(b)  $p^2 - 8p + 16$

|       |     |
|-------|-----|
| $p$   | -4  |
| $p^2$ | -4p |
| -4    | 16  |

(c)  $4x^2 + 8x + 4$

|        |      |
|--------|------|
| $2x$   | 2    |
| $4x^2$ | $4x$ |
| 2      | 4    |

4. (a)  $x^2 + 10x + 25$

**Diagram method**

|       |      |
|-------|------|
| $x$   | 5    |
| $x^2$ | $5x$ |
| 5     | 25   |

$x^2 + 10x + 25$

(b)  $a^2 - 2a + 1$

**Diagram method**

|     |        |
|-----|--------|
| $a$ | $-1$   |
| $a$ | $a^2$  |
| -1  | -1 $a$ |

$a^2 - 2a + 1$

(c)  $9c^2 - 6c + 1$

**Diagram method**

|      |        |
|------|--------|
| $3c$ | $-1$   |
| $3c$ | $9c^2$ |
| -1   | -3 $c$ |

$9c^2 - 6c + 1$

(d)  $16x^2 - 32x + 16$

**Diagram method**

|      |         |
|------|---------|
| $4x$ | $4$     |
| $4x$ | $16x^2$ |
| 4    | -16 $x$ |

$16x^2 - 32x + 16$

(e)  $9p^2 + 30p + 25$

**Diagram method**

|      |        |
|------|--------|
| $3p$ | $5$    |
| $3p$ | $9p^2$ |
| 5    | 15 $p$ |

$9p^2 + 30p + 25$

5. (a)  $x^2 - 1$  (b)  $x^2 - 16$

(c)  $a^2 - 36$  (d)  $4x^2 - 16$

6. (a)  $x^3 + x^2 + x + 1$

(b)  $x^3 + 5x^2 + 2x - 8$

(c)  $2a^3 + 5a^2 - 10a - 6$

(d)  $4x^3 - 20x + 8$

### Exercise 9.7

1. (a)  $\frac{7x}{12}$  (b)  $\frac{4a+3}{6}$  (c)  $\frac{9x+1}{20}$

(d)  $\frac{9a+16}{14}$  (e)  $\frac{7x-39}{10}$

2. (a)  $\frac{9a+5}{6}$  (b)  $\frac{27x-17}{10}$

(c)  $\frac{32x+7}{20}$  (d)  $\frac{11x-8}{5}$

3. (a)  $\frac{9a+2}{6}$  (b)  $\frac{x+5}{2}$

(c)  $\frac{30x-29}{10}$  (d)  $\frac{-9x-3}{4}$

4. (a)  $\frac{3x-5}{4}$  (b)  $\frac{-3x-17}{20}$

(c)  $\frac{2x+5}{21}$  (d)  $\frac{x-9}{12}$

5. (a)  $\frac{10x-7}{12}$  (b)  $\frac{6x-9}{4}$

(c)  $\frac{15x+20}{9}$  (d)  $\frac{7x+21}{6}$

6. (a)  $\frac{5a-2}{6}$  (b)  $\frac{4x-31}{10}$

(c)  $\frac{-7x-67}{20}$  (d)  $\frac{13x-64}{10}$

### Exercise 9.8

1. (a) 11 (b) 51 (c) -24 (d) 24 (e) 71

2. (a) 6 (b) 8 (c) 21 (d) 0 (e) 4

3. (a) -14 (b) 24 (c) 52 (d) 112 (e) 161

5. (a)  $\frac{5}{9}$  (b)  $\frac{-1}{3}$  (c)  $\frac{39}{2}$  (d) 1 (e)  $-\frac{1}{12}$

6. 1

### Chapter 9 review

1. (a) 9

(b) (i)  $2x^2 + 7x - 4$  (ii)  $5x^2y, 10$

(c)(i)  $\frac{2x+22}{15}$  (ii)  $\frac{5x+27}{6}$

2. (a)(i) -1 (ii) 13

(b)(i)  $3x - 4$  (ii)  $x^3 - 4x^2 + 3x - 12$

(c)(i)  $mn + 3m$  (ii) €4.90

3. (a) -2

(b)(i)  $x^3 - 3x + 2$

|     | $x^2$  | $x$   | -2    |
|-----|--------|-------|-------|
| $x$ | $x^3$  | $x^2$ | $-2x$ |
| -1  | $-x^2$ | $-x$  | 2     |

(c)(i)  $\frac{-x+21}{12}$  (ii)  $\frac{-a+20}{12}$

4. (a)  $a$

(b)(i)  $\frac{3x+2y}{6}$  (ii)  $15x^2 + 35x - 30$

(c)  $x^2 + 10x$

5. (a) 8 (b)(i)  $x^2 + 7x + 2$  (ii)  $\frac{x+21}{9}$

(c)  $\frac{5}{3}, \frac{1}{6}$

6. (a)  $-x^3 + 5x^2 + 3x + 5$

(b)  $(x+3)(x+2)$

|     | $x$   | 3    |
|-----|-------|------|
| $x$ | $x^2$ | $3x$ |
| 2   | $2x$  | 6    |

(i) 42 (ii) 26 (c)  $\frac{-18x-9}{80}$

### Chapter 10 – Exercise 10.1

1. (a) 4 (b) 2 (c) 8 (d) 13 (e) 10

2. (a) 9 (b) 12 (c) 19 (d) 38 (e) 60

3. (a) 4 (b) 2 (c) 3 (d) 3 (e) 8

4. (a) 8 (b) 45 (c) 24 (d) 40 (e) 200

5. (a) 3 (b) 1 (c) 4 (d) 2 (e) 10

### Exercise 10.2

1. (a) 6 (b) 4 (c) 7 (d) 15 (e) 30

2. (a) 6 (b) 8 (c) 20 (d) 35 (e) 50

3. (a) 5 (b) 6 (c) 4 (d) 3 (e) 9

4. (a) 2 (b) 3 (c) 6 (d) 2 (e) 10 (f) 8

(g) 4 (h) 7 (i) 10 (j) -5

5. (a) 5 (b) 3 (c) 4 (d) 2 (e) 1 (f) 2

(g) 3 (h) 2 (i) -10 (j) -4 (k) 9 (l) -2

(m) 4 (n) 3

### Exercise 10.3

1. (a) 4 (b) 10 (c) 4 (d) 8 (e) 3

2. (a) 2 (b) 2 (c) 2 (d) 2 (e) -4 (f) 4

3. (a) 8 (b) 3 (c) 4 (d) 14 (e) 2 (f) 2

4. (a) 0 (b) 10 (c) 3

5. (a)  $\frac{23}{5}$  (b)  $\frac{17}{7}$  (c)  $\frac{5}{7}$  (d)  $\frac{16}{3}$  (e)  $\frac{73}{7}$

(f)  $\frac{21}{2}$  (g)  $\frac{11}{5}$

### Exercise 10.4

1. (a) 12 (b) 10 (c) 12 (d) 10 (e) 6 (f) 4

2. (a) 1 (b) 2 (c) -4 (d) -35 (e) 5 (f) 2

3. (a) -1 (b) -1 (c) 14 (d) 4 (e) -23 (f) 1

4. (a) 4 (b) 3 (c) 1 (d) 4 (e) -3 (f) 5

### Exercise 10.5

1. 4 2. 5 3. 4 4. (a)  $4x$  (b) 10, 40

5. (a)  $x - 3$  (b) 5, 2 6. (a)  $\text{€}(x - 20)$

(b) €270 7. Peter: 5, Joan: 7

8. (a)  $x + 10$  (b)  $6x + 4(x + 10)$

(c) 30 cent, 40 cent

9. (a)  $3x$  cent (b)  $5(x - 10)$  cent

(c) 12 cent, 2 cent

10. 12 11. (a)  $x + 5$  (b) 13 12. 5 cm

13. (a)  $\text{€}(x - 3)$  (b) €10, €7

14. (a)  $x + 2$  (b) 8, 10

15. (a)  $6x$  (b)  $30^\circ$

**Chapter 10 review**

1. (a) 6 (b) 19 (c) (i)  $x + 4$   
(ii)  $2(x + 4) + 3x = 58$  (iii) 10, 14
2. (a) 4 (b) (i)  $\frac{2x + 19}{15}$  (ii) -5  
(c) (i)  $5x$  (ii)  $5x - 3 + 4x = 33$  (iii) 4
3. (a) 6 (b) -4 (c) (i)  $x + 10$  (ii) 22, 32
4. (a) 3 (b) (i)  $12x$  (ii)  $15^\circ$   
(c) Peter: 21; Paul: 14
5. (a) 4 (b) (i)  $\frac{6x + 13}{20}$  (ii)  $-\frac{1}{2}$   
(c) Cheese: 55 cent; ham: €1.10;  
bread: 45 cent
6. (a) 15 (b) (i)  $\frac{7x + 4}{12}$  (ii) 2 (c) 6

**Chapter 11 – Exercise 11.1**

1. (a) 4 (b) 5 (c)  $y$  (d)  $3b$  (e)  $7x$   
(f)  $2m$  (g) 4 (h)  $y$  (i)  $5y$  (j)  $3ab$   
(k)  $7p$  (l)  $3a$  (m)  $5y$  (n) 7 (o)  $4y$
2. (a)  $b + c$  (b)  $x + 2z$  (c)  $m - 3$  (d)  $c - 1$   
(e)  $q^2 + 1$  (f)  $r + 1$  (g)  $3b + c + 5d$   
(h)  $x - 8 + 16y$
3. (a)  $4b(a + 2)$  (b)  $5y(x + 3z)$   
(c)  $5pq(2r + 1)$  (d)  $ab(3 + b)$   
(e)  $5x(x + 2)$  (f)  $3m(n + 2m)$   
(g)  $6(x - 1)$  (h)  $y(y - 5)$  (i)  $2y(x - 6)$   
(j)  $-3ab(ab - 3)$  (k)  $-7l(l + 7m)$   
(l)  $7rs(r - 7s)$  (m)  $x(x + 1)$  (n)  $y(y - 1)$   
(o)  $x^2(x + 1)$  (p)  $y^2(y - 1)$  (q)  $a^2(a + 1)$   
(r)  $q^2(3p^3 - 1)$  (s)  $3a(2 + b + c)$   
(t)  $5y(y + 5x + 6x^2)$  (u)  $7(x^2 - 4x + 1)$   
(v)  $-4(2y^3 + 6x^2 - xy)$  (w)  $(x + y)(a + b)$   
(x)  $(b + c)(2a - 3d)$  (y)  $(x + y)(3 + x + y)$
4. (a)  $5y(x + 2)$  (b)  $p(p^2 + 1)$   
(c)  $4ab(a + 6b)$  (e)  $3a(3a - b + 5b^2)$

**Exercise 11.2**

1. (a)  $(d + c)(a + b)$  (b)  $(1 + r)(p + q)$   
(c)  $(y - 1)(x + y)$  (d)  $(y - 2)(x^2 - y)$
2. (a)  $(a + d)(c + b)$  (b)  $(x + 2y)(b + a)$   
(c)  $(x + 2y)(p + 3)$  (d)  $(m + 3n)(p + r)$
3. (a)  $(a - b)(x + z)$  (b)  $(p + 3)(q - r)$   
(c)  $(b + c)(5x - 1)$  (d)  $(2a - b)(3x + y)$
4. (a)  $(ax - b)(x + y)$  (b)  $(x - 1)(p + x)$   
(c)  $(3xy - 2)(z + y)$  (d)  $(l - 2m)(2m + x)$
5. (a)  $(x + 3y)(2a - b)$  (b)  $(a + b)(x - 3)$   
(c)  $(6p + 1)(x - y)$  (d)  $(x + 1)(x - y)$
6. (a)  $(c - d)(x - y)$  (b)  $(a - 2)(ax - p)$   
(c)  $(x - y)(4 - d)$  (d)  $(x^2 + y^2)(1 - 2w)$
7. (a)  $(x - 3)(2x - c)$  (b)  $(a + b)(r - 2q)$   
(c)  $(x - 3)(2x - y)$  (d)  $(a + 3b)(2m - d)$
8. (a)  $(5 + b)(a - 5)$  (b)  $(a - b)(4 - c)$   
(c)  $(2y - 1)(x + 7)$  (d)  $(1 + c)(4m - c)$
9. (a)  $(q + r)(p + 3)$  (b)  $(x - 4)(x - 1)$   
(c)  $(a + b)(a + 2)$

| $a$ | $b$   |      |
|-----|-------|------|
| $a$ | $a^2$ | $ab$ |
| 2   | $2a$  | $2b$ |

**Exercise 11.3**

1. (a)  $(x + 4)(x + 1)$  (b)  $(x + 7)(x + 1)$   
(c)  $(x + 2)(x + 2)$  (d)  $(x + 4)(x + 6)$   
(e)  $(x + 10)(x + 2)$  (f)  $(x + 4)(x + 2)$   
(g)  $(x + 4)(x + 3)$  (h)  $(p + 2)(p + 8)$   
(i)  $(a + 4)(a + 5)$
2. (a)  $(x - 7)(x - 1)$  (b)  $(x - 11)(x - 1)$   
(c)  $(y - 3)(y - 7)$  (d)  $(x - 12)(x - 2)$   
(e)  $(t - 8)(t - 2)$  (f)  $(x - 4)(x - 8)$   
(g)  $(x - 5)(x - 8)$  (h)  $(s - 5)(s - 1)$   
(i)  $(x - 3)(x - 2)$
3. (a)  $(x + 4)(x - 1)$  (b)  $(x + 4)(x - 3)$   
(c)  $(x + 4)(x - 2)$  (d)  $(p + 7)(p - 4)$   
(e)  $(x - 2)(x + 14)$  (f)  $(r - 5)(r + 8)$

(g)  $(x + 21)(x - 2)$  (h)  $(x + 16)(x - 2)$

(i)  $(y + 6)(y - 1)$

4. (a)  $(x - 9)(x + 1)$  (b)  $(x + 3)(x - 6)$

(c)  $(x + 2)(x - 9)$  (d)  $(p + 3)(p - 10)$

(e)  $(x - 8)(x + 3)$  (f)  $(r - 5)(r + 1)$

(g)  $(x + 4)(x - 7)$  (h)  $(x + 4)(x - 9)$

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

5. (a)  $(x + 3)(x + 2)$

|     |       |
|-----|-------|
| $x$ | 3     |
| $x$ | $x^2$ |
| 2   | $3x$  |
| 2   | 6     |

(b)  $(x - 3)(x - 4)$

|     |       |
|-----|-------|
| $x$ | -3    |
| $x$ | $x^2$ |
| -4  | -3x   |
| -4  | 12    |

### Exercise 11.4

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

(c)  $(x + 6)(x - 6)$  (d)  $(x + 5y)(x - 5y)$

(e)  $(a + 10b)(a - 10b)$  (f)  $(y + 8z)(y - 8z)$

(g)  $(3x + y)(3x - y)$  (h)  $(2p + 1)(2p - 1)$

(i)  $(7a + 2b)(7a - 2b)$  (j)  $(3 + y)(3 - y)$

(k)  $(8 + 11x)(8 - 11x)$

(l)  $(7 + 2x)(7 - 2x)$

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

(b)  $5(a + b)(a - b)$

(c)  $8(x + 2)(x - 2)$

(d)  $7(x + 2y)(x - 2y)$

(e)  $15(p + 2q)(p - 2q)$

(f)  $3(2y + z)(2y - z)$

(g)  $10(x + 3y)(x - 3y)$

(h)  $-1(2p + 1)(2p - 1)$

(i)  $-1(5a + 3b)(5a - 3b)$

3. (a) 84 (b) 201 (c) 4000 (d) 164 000

(e) 6·8 (f) 20

4. (a)  $(x + 5)(x - 5)$  (b)  $(3x + 4)(3x - 4)$

### Exercise 11.5

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

3.  $(x + 7)(x - 7)$  4.  $3b(a + 8)$

5.  $(a + b)(p - 2r)$  6.  $(x + 10)(x + 1)$

7.  $(7 - d)(x - y)$  8.  $3ab(5 - b)$

9.  $(x + 23)(x - 2)$  10.  $(1 - 11x)(1 + 11x)$

11.  $3(y + z)(y - z)$  12.  $(r - y)(9p + 1)$

13.  $(5x + 6)(5x - 6)$  14.  $(5x - y)(1 + y)$

15.  $(4a + 10b)(4a - 10b)$

16.  $(x + 7)(x - 4)$  17.  $(a + d)(r + b)$

18.  $(3 + 12x)(3 - 12x)$  19.  $(y - 8)(y - 6)$

20.  $-7p(p + 2q)$  21.  $(x + 5)(x + 4)$

22.  $7y(y + 3x + 5x^2)$

23.  $10(p + 2q)(p - 2q)$

24.  $(p + 10)(q - r)$

25.  $7(x + 2y)(x - 2y)$  26.  $(x - 8)(x - 3)$

### Chapter 11 review

1. (a)(i)  $7(a - 2b)$  (ii)  $(x + 5)(x - 5)$

(b)(i)  $5(x + 4)(x - 4)$  (ii)  $x(x - 7)(x + 1)$

(c)  $\frac{x}{x - 2}, 3$

2. (a)(i)  $x(4x - 21)$  (ii)  $(x - 24)(x - 1)$

(b)(i) 640 (ii) 2·4

(c)  $x, x + 5$ ; perimeter = 26

3. (a)(i)  $5y(2x + 1)$  (ii)  $(6a + y)(p + r)$

(b)(i)  $x(x + 7)(x - 7)$

(ii)  $16(2x + y)(2x - y)$

(c)  $b = 14, c = 48$

4. (a)(i) 6 (ii)  $8x^2y$  (b)(i)  $(p + 9)(x + 4)$

(ii)  $(12y + x)(12y - x)$  (c)  $y + p$

5. (a)(i)  $y(px + 2)$  (ii)  $(x + 5)(x + 8)$

(b)  $(x + 2)(x - 3)$  (c)  $(x + 12)(x + 4)$

6. (a)(i)  $-2(1 + 2x)$  (ii)  $(x - 8)(x - 7)$

(b)  $2x(5x - 13)$

(c)  $[(x + 1) + x][(x + 1) - x]$

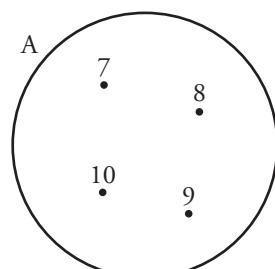
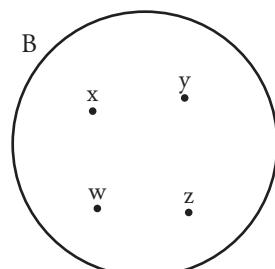
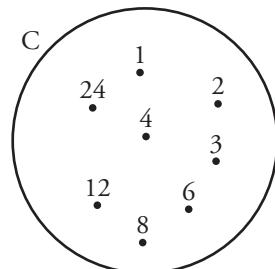
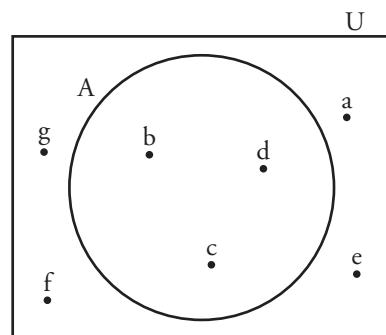
$= (2x + 1)(1)$

$= 2x + 1$

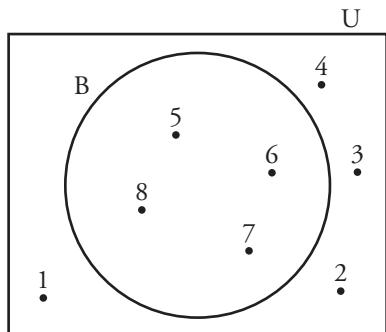
**Chapter 12 – Exercise 12.1**

- 1.** (a) {0, 2, 4, 6, 8} (b) {a, e, i, o, u}  
 (c) {2, 3, 5, 7, 11, 13, 17, 19}  
 (d) {21, 23, 25, 27, 29}  
 (e) {spring, summer, autumn, winter}  
 (f) {3, 6, 9, 12} (g) {2, 3}  
 (h) {-4, -3, -2, -1}
- 2.** (a) { $x / x$  is a day of the week that begins with the letter 'S'}  
 (b) { $x / x$  is a county in Connaught}  
 (c) { $x / x$  is a colour in a rainbow}  
 (d) { $x / x$  is a month of the year that has thirty days}  
 (e) { $x / x$  is a month of the year that has less than thirty-one days}  
 (f) { $x / x$  is one of the first five natural numbers}  
 (g) { $x / x$  is one of the first five multiples of 10}  
 (h) { $x / x$  is a prime number between 20 and 30}
- 3.** (a) True (b) True (c) False (d) True  
 (e) False (f) True (g) True (h) True
- 4.** (a) True (b) False (c) False (d) False  
 (e) True (f) False (g) True (h) False
- 5.** (a) {S, C, H, O, L}  
 (b) {0, 9, 1, 2, 4, 3} (c) {A, B, C, U, S}  
 (d) {U, I, A, O} (e) {6, 4}
- 6.** Null sets (a), (c) and (d)
- 7.** This is not a null set, as there is one element in it: 0.
- 8.** (a) False (b) True (c) True (d) True  
 (e) False (f) True
- 9.** Yes, A = B, as they contain the same elements: {S, H, I, P}
- 9.** Yes

- 10.** A = {p, q, r} B = {p, q}. No, because r is missing in the set B.

**Exercise 12.2****1. (a)****(b)****(c)****2.(a)**

(b)



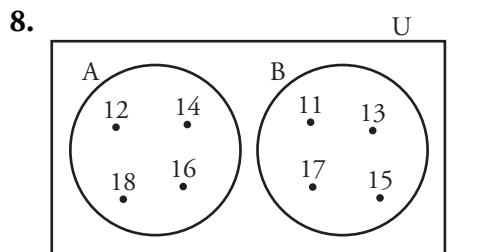
- 3.**  $\subset$  = subset;  $\emptyset$  = null set;  
 $\in$  = is an element of;  
 $\#$  = cardinal number;  
 $U$  = universal set;  
 $\notin$  = is not an element of;  
 $\{ \}$  = null set;  $B'$  = complement of  $B$ ;  
 $\not\subset$  = not a subset.
- 4.** (a) True (b) True (c) True (d) True  
(e) False
- 5.** (a) True (b) False (c) True (d) True  
(e) False (f) True (g) False (h) True
- 6.**  $\{ \}, \{p, q, r\}, \{p\}, \{q\}, \{r\}, \{p, q\}, \{p, r\}, \{q, r\}$
- 7.**  $\{3, 6, 9, 18, 21, 24\}$
- 8.**  $\{ \}, \{0, 5, 10, 15\}, \{0\}, \{5\}, \{10\}, \{15\}, \{0, 5\}, \{0, 10\}, \{0, 15\}, \{5, 10\}, \{5, 15\}, \{10, 15\}, \{0, 5, 10\}, \{0, 5, 15\}, \{0, 10, 15\}, \{5, 10, 15\}$
- 9.** 5
- 10.** Yes, if  $A = B$ .

### Exercise 12.3

- 1.** (a)  $\{s, r, p, x, y\}$  (b)  $\{p\}$   
(c)  $\{x, y\}$  (d)  $\{r, s\}$
- 2.** (a)  $\{7, 3, 5, 4, 6, 10\}$ . (b)  $\{4\}$   
(c)  $\{7, 3, 5\}$  (d)  $\{6, 10\}$

- 3. (a)**  $\{6, 2, 4, 0, 1, 11, 5, 9\}$   
**(b)**  $\{4, 6, 2, 0, 1\}$  (c)  $\{0, 1, 11\}$   
(d)  $\{6, 2, 4\}$  (e)  $\{11\}$  (f)  $\{6, 4, 2, 5, 9\}$
- 4. (a)**  $\{m, n, s, t, r, o, q, x, y\}$   
(b)  $\{m, n, s\}$  (c)  $\{s, t, r\}$  (d)  $\{s\}$  (e)  $\{t, r\}$   
(f)  $\{x, y, o, q\}$

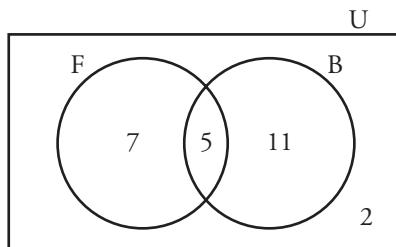
- 5. (a)**  $A \cup B$  (b)  $B \setminus A$  (c)  $(A \cap B)'$   
**6. (a)**  $\{5, 6, 7, 8, 9, 10, 0, 1, 2, 3, 4\}$   
(b)  $\{5, 6\}$  (c)  $\{7, 8, 9, 10\}$   
(d)  $\{0, 1, 2, 3, 4\}$
- 7. (a)**  $\{b, c, d, a, e, i, o, u\}$  (b)  $\{a, e\}$   
(c)  $\{b, c, d\}$  (d)  $\{i, o, u\}$



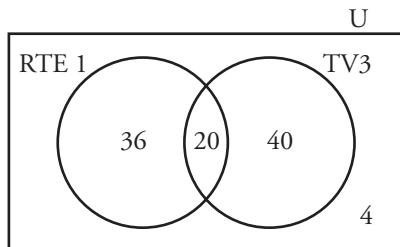
- 9. (a)**  $\{b, c, d, a, e, i, o, u\}$  (b)  $\{a, e\}$   
(c)  $\{i, o, u\}$   
(d)  $\{f, g, h, j, k, l, m, n, p, q, r, s, t, v, w, x, y, z\}$
- 10. (a)**  $\{31, 32, 33, 34, 35, 36, 37, 38, 39\}$  (b)  $\{37, 31, 32, 33, 34\}$   
(c)  $\{35, 36, 38, 37\}$  (d)  $\{37, 34, 33, 32\}$

### Exercise 12.4

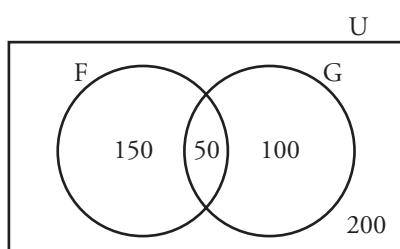
- 1. (a)** 7 (b) 11 (c) 2



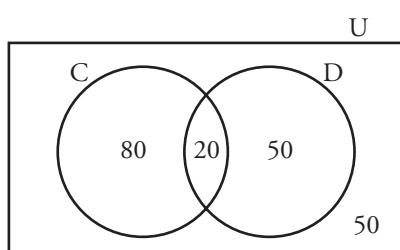
**2. (a) 36 (b) 40 (c) 4**



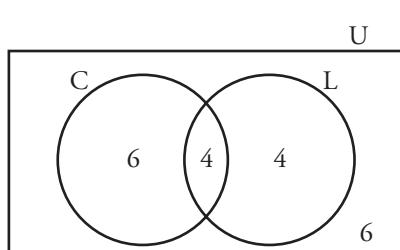
**3. (a) 150 (b) 100**



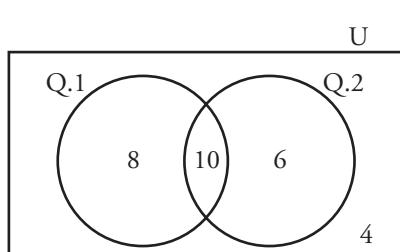
**4. (a) 80 (b) 50**



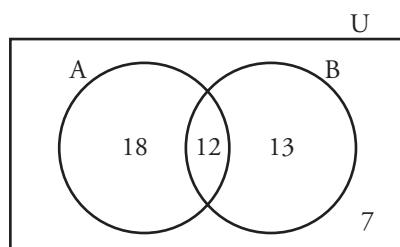
**5. 4**



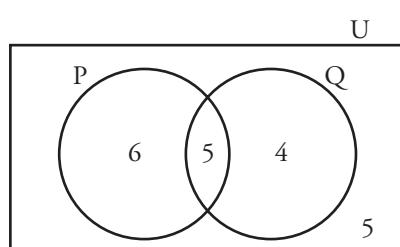
**6. 6**



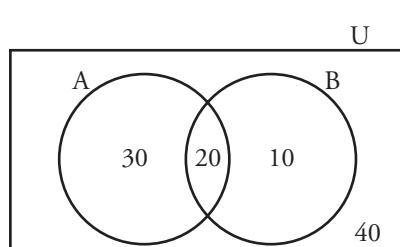
**7. (a) 18 (b) 13 (c) 7**



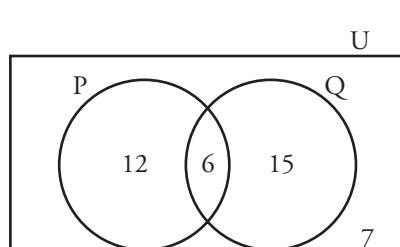
**8. (a) 6 (b) 15 (c) 5**



**9. 20**

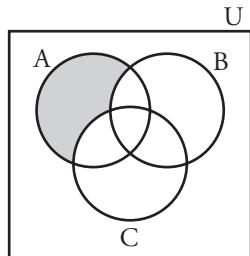


**10. 6**

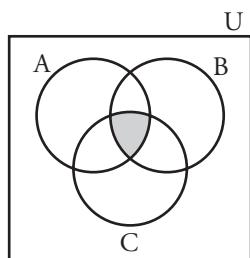


**Exercise 12.5**

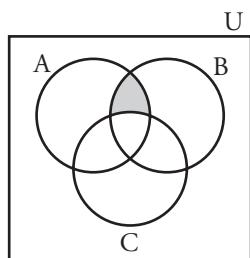
1. (a)



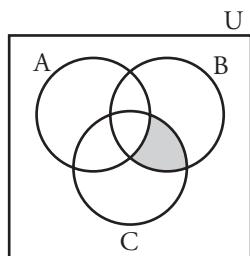
(b)



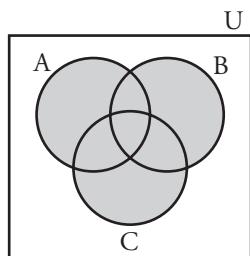
(c)



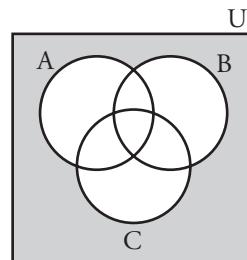
(d)



(e)



(f)

2. Red:  $S \setminus (R \cup T)$ ; Blue:  $R \setminus (T \cup S)$ ;Green:  $T \setminus S$ ; Yellow:  $R \cap S \cap T$ 3. (a)  $(B \cap C) \setminus A$  (b)  $C \setminus (A \cup B)$ 

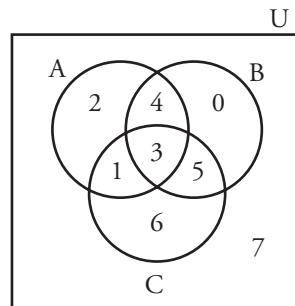
4. (a) {5, 11} (b) {8, 2} (c) {8} (d) {2}

(e) {5, 8, 2, 11, 9, 6, 3} (f) {10}

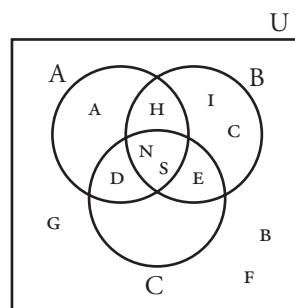
5. (a) {1, 2, 6, 0, 3, 5, 9, 8} (b) {0}

(c) {9} (d) {6} (e) {6, 0, 9} (f) {10, 7}

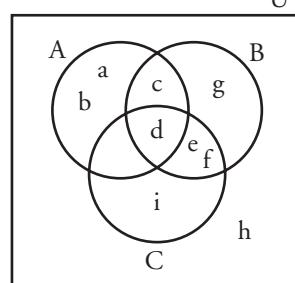
6.



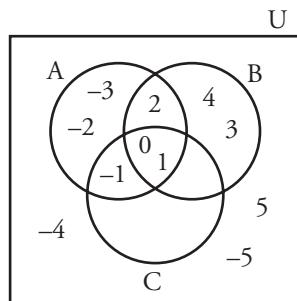
7.



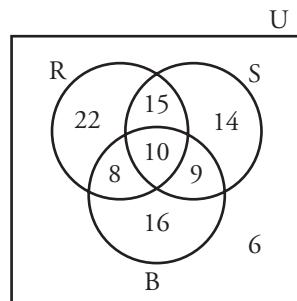
8.



9.

Null sets:  $(B \cap C) \setminus A; C \setminus (A \cup B)$ 

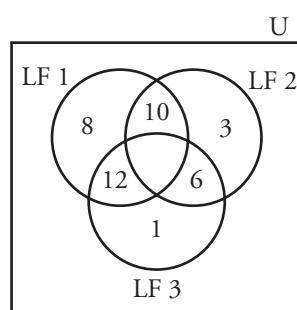
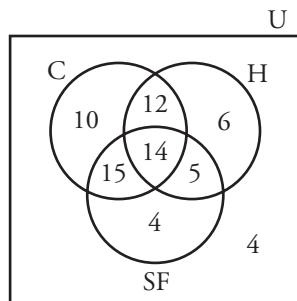
4.



5. 6

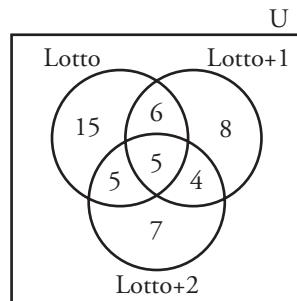
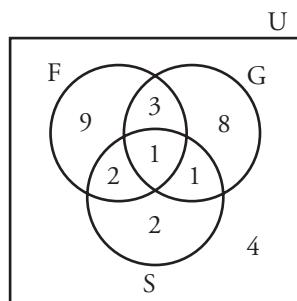
**Exercise 12.6**

1.



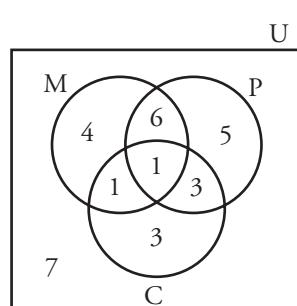
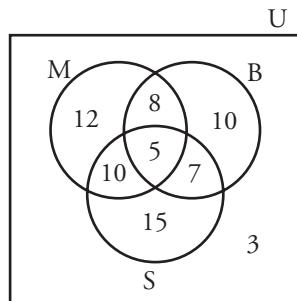
6. 15

2.



7. 7

3.

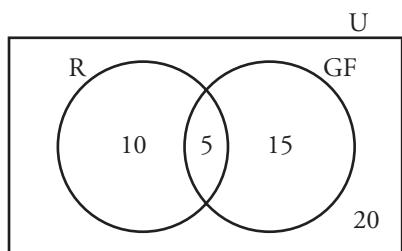


8. 4

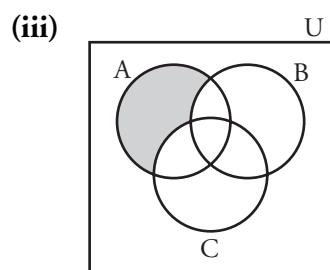
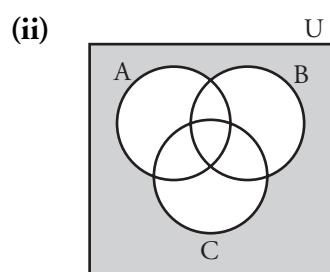
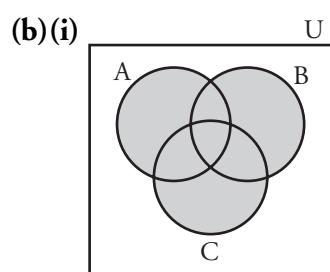
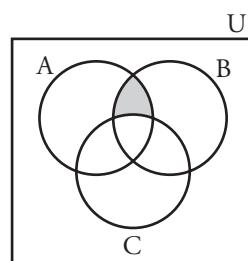
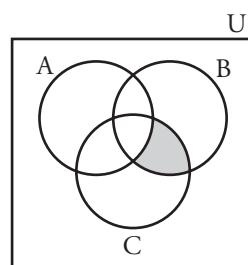
9. 3

**Chapter 12 review**

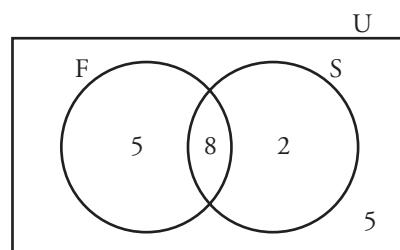
- 1. (a)** {C, O, M, P, L, E, N, T}  
**(b) (i)** {13, 2, 4, 3, 10, 8, 1}  
**(ii)** {12, 10} **(iii)** {3}  
**(iv)** {13, 2, 4, 1, 3, 10}  
**(c)(i)** 10 **(ii)** 15 **(iii)** 20 **(iv)** 25



- 2. (a) (i)** {4, 5, 6, 7, 8, 9, 10}  
**(ii)** {7, 8} **(iii)** {0, 1, 2, 3}

**(iv)****(v)**

- (c) (i)** 8 **(ii)** 5

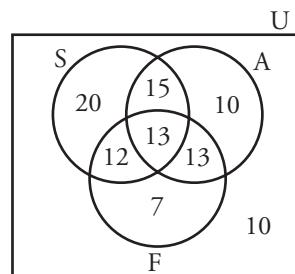


- 3. (a)** {}, {2, 4, 6}, {2}, {4}, {6}, {2, 4},

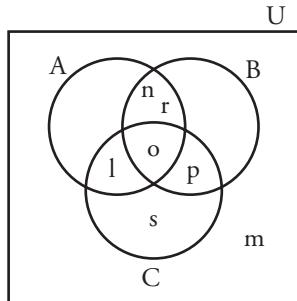
- {2, 6}, {4, 6} **(b) (i)** {0, 1, 2, 3, 4, 5}

- (ii)** {0} **(iii)** {4}

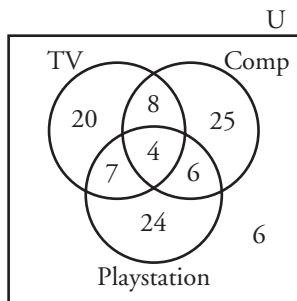
- |                                  |           |
|----------------------------------|-----------|
| <b>(c)</b> Spain only            | 20 people |
| America only                     | 10 people |
| France only                      | 7 people  |
| France and America but not Spain | 13 people |
| Spain and France but not America | 12 people |
| Spain and America but not France | 15 people |
| All three countries              | 13 people |
| None of these countries          | 10 people |



4. (a) {M, I, S, P}  
 (b) (i)  $A \setminus (B \cup C)$ ,  $B \setminus (A \cup C)$   
 (ii) Reason: they are both {m}.



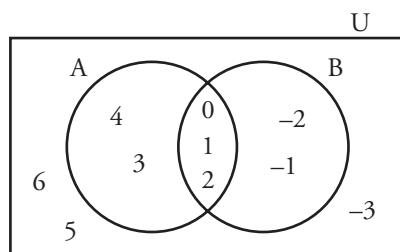
(c) 6



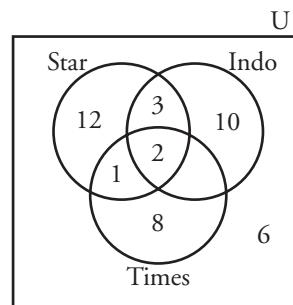
5. (a) Red:  $(B \cap C) \setminus A$ ; Blue:  $A \setminus (B \cup C)$   
 (b) (i) 68 (ii) 15 (iii) 25  
 (c) (i)  $A \cap (B \cap C) = 6$ ;  
 $(A \cap B) \cap C = 6$   
 (ii)  $A \setminus (B \cup C) = \{5, 4\}$ ;  
 $(A \setminus B) \cup C = \{5, 4, 1, 10\}$

6. (a) {23, 29}

(b)



- (c) (i) 10 (ii) 8



### Chapter 13 – Exercise 13.2

1. (a) bac or cab (b) bca or acb  
 (c) qpr or rpq (d) por or rop  
 2. (a) = acute (b) = reflex  
 (c) = obtuse (d) = right angle  
 3. (a)  $40^\circ$  (b)  $40^\circ$  (c)  $110^\circ$  (d)  $90^\circ$   
 5. Sum =  $180^\circ$  6. Sum =  $360^\circ$   
 7. Sum =  $360^\circ$   
 8. (a)  $90^\circ$  (b)  $150^\circ$  (c)  $270^\circ$

### Exercise 13.3

1. (a)  $50^\circ$  (b)  $100^\circ$  (c)  $45^\circ$  (d)  $50^\circ$   
 2. (a)  $260^\circ$  (b)  $88^\circ$  (c)  $75^\circ$  (d)  $40^\circ$   
 3. (a)  $A = 60^\circ$  (b)  $A = 80^\circ$ ;  $B = 100^\circ$   
 (c)  $A = 90^\circ$ ;  $B = 90^\circ$ ;  $C = 90^\circ$   
 (d)  $A = 130^\circ$ ;  $B = 50^\circ$ ;  $C = 50^\circ$   
 4. (a) Corresponding  
 (b) Corresponding  
 (c) Alternate  
 (d) Corresponding  
 5. (a)  $60^\circ$  (b)  $45^\circ$  (c)  $50^\circ$  (d)  $70^\circ$   
 6. (a)  $|\angle abd|$ ,  $|\angle beh|$ ,  $|\angle feg|$   
 (b)  $|\angle abc|$ ,  $|\angle feb|$ ,  $|\angle geh|$   
 (c)  $140^\circ$ , because  $|\angle abd|$  it is a straight angle.  
 7. They are all parallel.  
 8. (a) They are alternate angles.  
 (b)  $45^\circ$ ,  $45^\circ$

**9. (a)**  $60^\circ$ , angles add to  $180^\circ$

**(b)**  $120^\circ$ , straight angle =  $180^\circ$

**10. (a)**  $55^\circ$ , straight angle

**(b)**  $125^\circ$ , corresponding angle

**(c)**  $125^\circ$ , alternate angle

**(d)**  $155^\circ$ , corresponding angle

### Chapter 13 review

**1. (a)**  $x = 135^\circ; y = 45^\circ$

**(b)(i)**  $45^\circ$  **(ii)**  $315^\circ$  **(iii)**  $75^\circ$  **(iv)**  $225^\circ$

**2. (a)**  $135^\circ$

**(b)**  $A = 65^\circ; B = 90^\circ; C = 65^\circ; D = 25^\circ$

**(c)(i)**  $39^\circ$ ; reason:  $|\angle \text{deg}| = 54^\circ$ ,

$$180^\circ - 54^\circ = 39^\circ$$

**(ii)**  $141^\circ$ , straight angle

**3. (a)**  $30^\circ$

**(b)**  $x = 65^\circ; y = 45^\circ; z = 70^\circ$

**4. (a)(i)**  $180^\circ$  **(ii)**  $30^\circ$  **(iii)**  $210^\circ$

**(b)**  $A = 40^\circ; B = 80^\circ; C = 80^\circ$

**5. (a)**  $x = 45^\circ$ , corresponding angle;  
 $y = 45^\circ$ , vertically opposite angle

**(c)**  $57^\circ, 57^\circ$ ,  $abc$  and  $bcd$  are alternate  
 angles

**6. (a)**  $150^\circ$

**(b)(i)**  $60^\circ$  **(ii)**  $120^\circ$  **(iii)**  $120^\circ$  **(iv)**  $60^\circ$

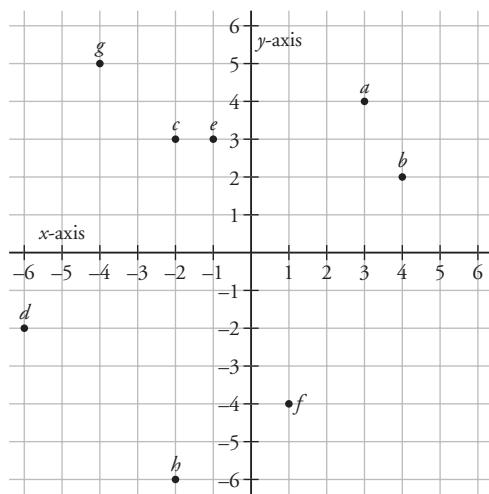
### Chapter 14 – Exercise 14.1

**1.**  $a(4, 3) b(1, 2) c(2, 1) d(-4, 4)$

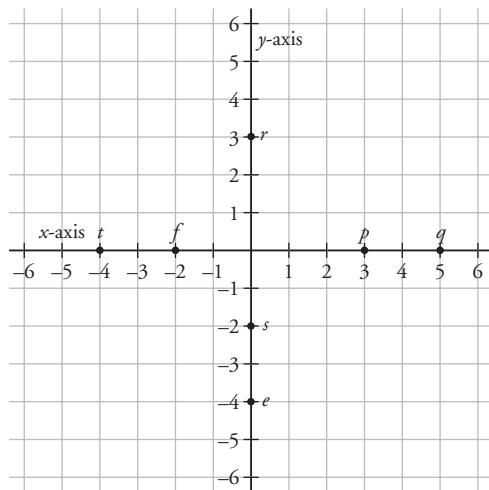
$e(-5, 3) f(-3, 1) g(-2, 1) h(-4, -2)$

$i(-2, -4) p(1, -3) q(3, -3)$

**2.**



**3.**



**4. (a)**  $(4, 2) (2, 4) (0, 2)$ ; first quadrant

**(b)**  $(-3, 2) (-3, 4) (-5, 2) (-5, 4)$ ;

second quadrant

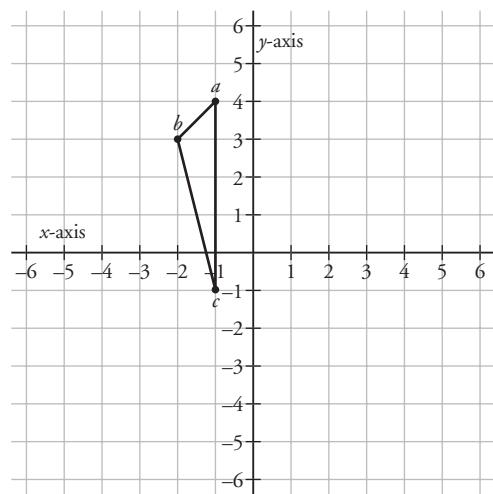
**(c)**  $(-2, -2) (-3, -3) (-4, -2) (-5, -3)$ ;

third quadrant

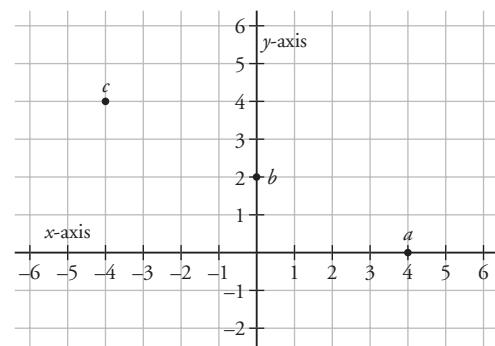
**(d)**  $(3, -2) (3, -4) (3, -3) (4, -3) (2, -3)$ ;

first quadrant

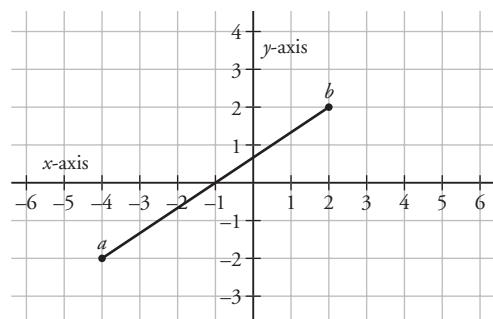
5.



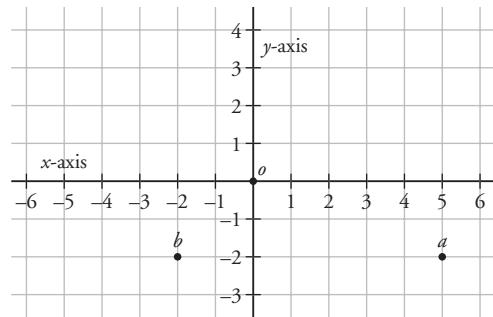
8.



6.



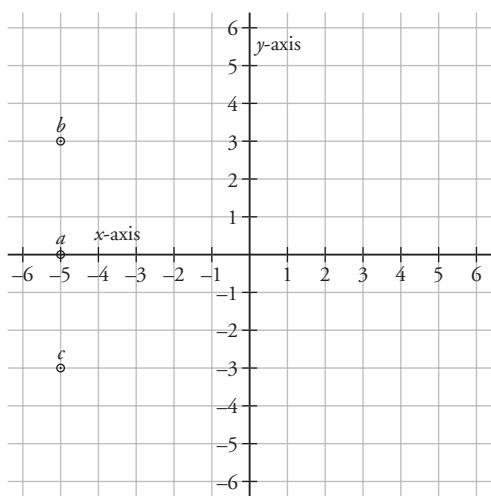
7.

**Exercise 14.2**1. (a)  $(-2, 0)$  (b)  $(3, 0)$  (c)  $(0, 4)$ (d)  $(0, 3)$  (e)  $(-3, -1)$  (f)  $(4, 4)$ (g)  $(-2, 3)$  (h)  $(3, 5)$ 2. (a)  $(2, -1)$  (b)  $(-3, -2)$  (c)  $(0, 4)$ (d)  $(2, 3)$  (e)  $(5, -1)$  (f)  $(-5, 4)$ (f)  $(2, 2)$  (g)  $(-3, 1)$ 3. (a)  $(-3, 5)$  (b)  $(3, 1)$  (c)  $(1, -4)$ (d)  $(-5, 0)$  (e)  $(-5, -1)$  (f)  $(2, -4)$ (g)  $(-3, -2)$  (h)  $(1, -1)$ 4. (a) axial symmetry in the  $x$ -axis

(b) central symmetry in the origin

(c) axial symmetry in the  $y$ -axis5.  $a(-1, -3)$   $b(5, 4)$   $c(3, -2)$ **images:**  $a'(-1, -3)$   $b'(5, 4)$   $c'(5, -4)$ 6. (a)  $(0, -1)$  (b)  $(-1, 2)$  (c)  $(4, -3)$ (d)  $(-2, 1)$  (e)  $(6, -2)$  (f)  $(4, 4)$ (g)  $(6, 3)$  (h)  $(2, 0)$

7.

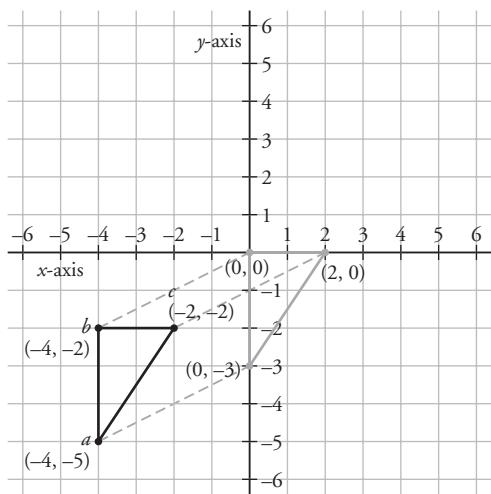


$$a(-5, 0) \rightarrow a'(-5, 0);$$

$$b(-5, 3) \rightarrow b'(-5, -3)$$

$$c(-5, -3) \rightarrow c'(-5, 3)$$

8. (a)



$$\text{(b)} \text{ Area} = \frac{1}{2}(2)3 = 3 \text{ sq. units}$$

$$\text{(c)} \text{ Area} = 3 \text{ sq. units}$$

**(d)** Yes

### Exercise 14.3

1. (a) (3, 4) (b) (2, 2) (c) (5, 3)

(d) (4, 3)

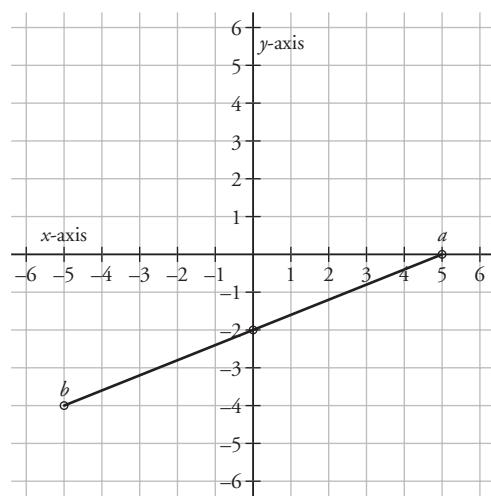
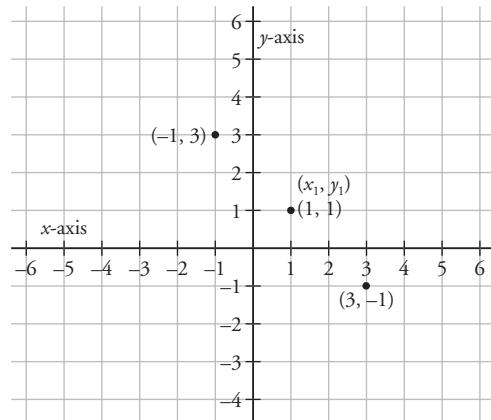
2. (a) (1, 3) (b) (2, 2) (c) (-1, -4)

(d) (-4, -4)

5. (a)  $(2\frac{1}{2}, 2)$  (b)  $(3\frac{1}{2}, 2\frac{1}{2})$  (c)  $(4, 5\frac{1}{2})$

(d)  $(\frac{1}{2}, 4\frac{1}{2})$

6.

7.  $a(-1, 3)$ 

8. (a)  $(-\frac{1}{2}, \frac{1}{2})$  (b)  $(-\frac{1}{2}, -\frac{1}{2})$   
 (c)  $(-\frac{1}{2}, \frac{1}{2})$  (d)  $(-\frac{1}{2}, -\frac{1}{2})$

### Exercise 14.4

1. (a)  $\sqrt{8}$  (b)  $\sqrt{10}$  (c)  $\sqrt{13}$  (d)  $\sqrt{13}$
2. (a)  $\sqrt{41}$  (b)  $\sqrt{113}$  (c)  $\sqrt{73}$  (d) 10
3.  $|oa| = \sqrt{13}; |ob| = \sqrt{13}$
4.  $|bc| = |ad| = \sqrt{29}; |ab| = |dc| = \sqrt{13}$
5.  $|ab| = \sqrt{20}; |ac| = \sqrt{5}$
6.  $|ab| = 5; |bc| = 5$
7. Both distances = 5
8. (a)  $\sqrt{5}$  (b)  $\sqrt{58}$  (c)  $\sqrt{18}$  (d)  $\sqrt{37}$

### Exercise 14.5

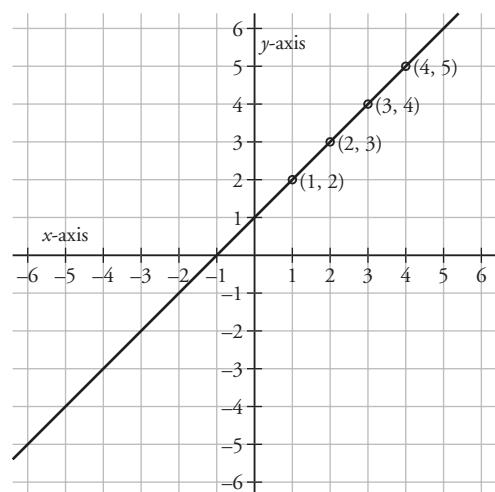
1. (a) 4 (b) 2 (c) 2 (d) 1
2. (a)  $\frac{5}{3}$  (b)  $\frac{5}{7}$  (c) 3 (d)  $\frac{4}{5}$
3. (a)  $\frac{4}{7}$  (b)  $\frac{8}{7}$  (c) 1 (d)  $\frac{3}{5}$
4. Slope of  $bc$  and  $ad = -\frac{2}{5}$ . Slope of  $ab$  and  $dc = \frac{2}{3}$ .
5. (a) 1 (b) 1 (c)  $-\frac{2}{3}$  (d)  $-\frac{2}{3}$
6. Same slope 7. 1 8.  $-\frac{5}{3}$

### Exercise 14.6

1. L:  $y = 2$ , K:  $x = -1$ , P:  $x = 4$ , Q:  $y = -5$
2. x-axis:  $y = 0$ ; y-axis:  $x = 0$
3. (a)  $2x - y = 0$  (b)  $3x - y + 2 = 0$   
 (c)  $x + y - 1 = 0$  (d)  $2x + y + 10 = 0$
4. (a)  $x - 2y + 4 = 0$   
 (b)  $3x - 5y + 17 = 0$   
 (c)  $x + 3y - 10 = 0$   
 (d)  $5x + 2y + 17 = 0$
5. (a)  $1, x - y - 1 = 0$   
 (b)  $2, 2x - y - 3 = 0$   
 (c)  $2, 2x - y - 2 = 0$   
 (d)  $2, 2x - y - 6 = 0$
6. (a)  $-4$  (b)  $4x + y - 10 = 0$
7.  $3x - 8y + 4 = 0$
8. (a)  $p(5, 7)$  (b)  $5x + 4y - 53 = 0$

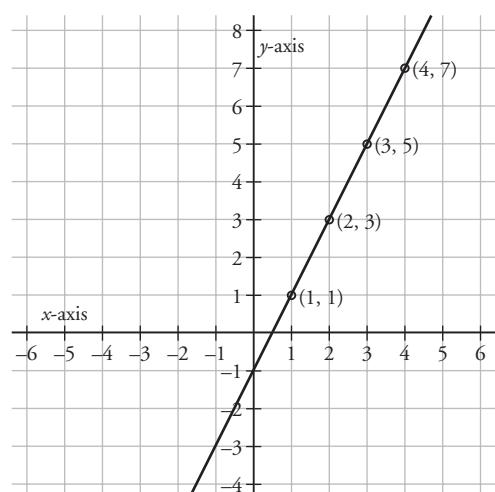
### Exercise 14.7

1.



|   |   |   |   |   |
|---|---|---|---|---|
| x | 1 | 2 | 3 | 4 |
| y | 2 | 3 | 4 | 5 |

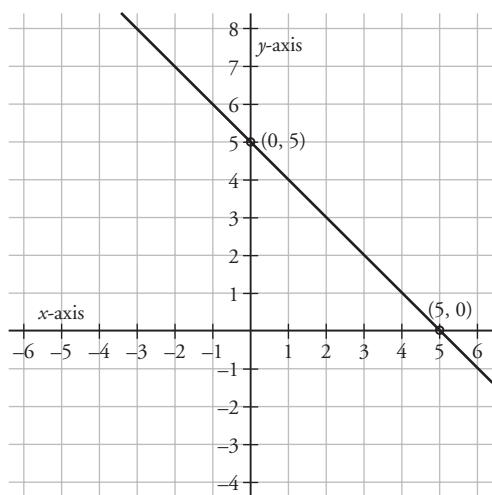
2.



|   |   |   |   |   |
|---|---|---|---|---|
| x | 1 | 2 | 3 | 4 |
| y | 1 | 3 | 5 | 7 |

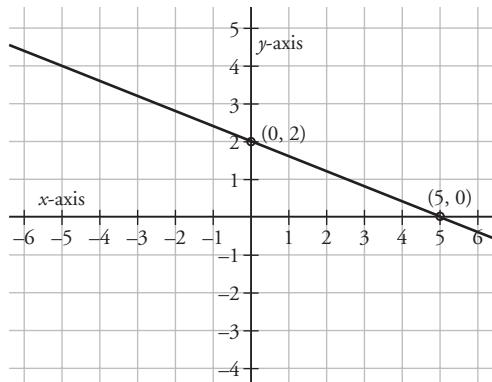
**3. (a)**  $(5, 0), (0, 5)$

**(b)**



**(d)**  $t = 1$

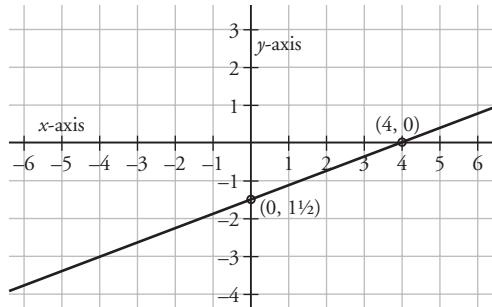
**4. (a)**  $(5, 0), (0, 2)$



**(d)**  $k = -1$

**5. (a)**  $(4, 0), (0, -1\frac{1}{2})$

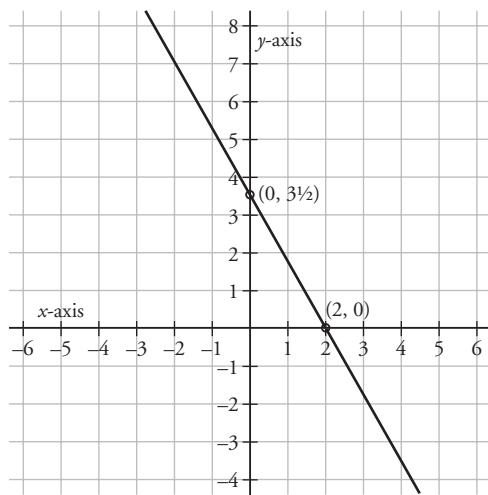
**(b)**



**(d)**  $k = 6$

**6. (a)**  $(2, 0), (0, 3\frac{1}{2})$

**(b)**



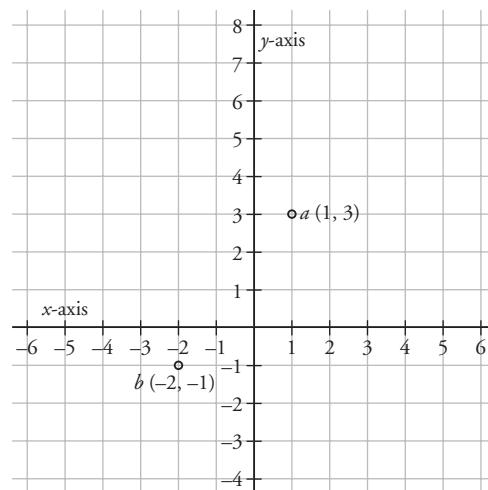
**(d)**  $t = -14$

**7.**  $L$  cuts  $K$  at  $(4, 0)$

**8.**  $P, Q$  and  $R$  cut at  $(4, 1)$

### Chapter 14 review

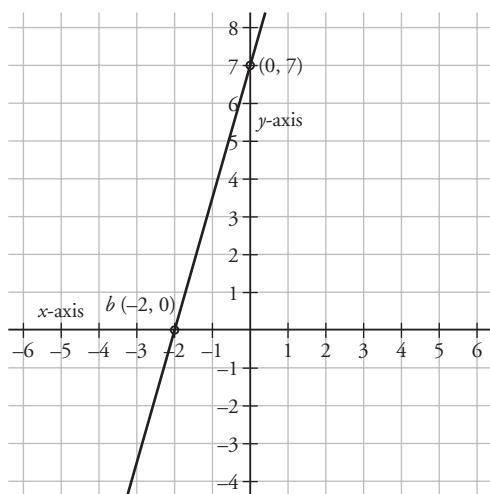
**1. (a)**



**(b)(i)**  $\sqrt{10}$  **(ii)** 3 **(iii)**  $3x - y - 7 = 0$

**(c)(i)**  $a(4, 0)$ ,  $b(0, -4)$  **(iii)**  $k = 6$

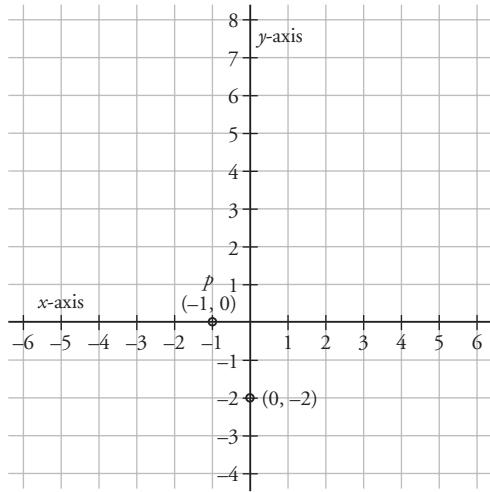
- 2.** (a)  $a(-4, -2)$ ,  $b(3, 3)$   
 (b)(i)  $\sqrt{10}$  (ii)  $\frac{1}{3}$  (iii)  $(-\frac{5}{2}, -\frac{3}{2})$   
 (c)(i)  $t = -1$  (ii)  $3x + y - 1 = 0$
- 3.** (a)(i)  $(-2, -3)$  (ii)  $(-2, 3)$   
 (b)(i)  $\sqrt{13}$  (ii)  $-\frac{2}{3}$   
 (iii)  $2x + 3y + 19 = 0$   
 (c)(i)  $(-2, 0)$  (0, 7)  
 (ii)



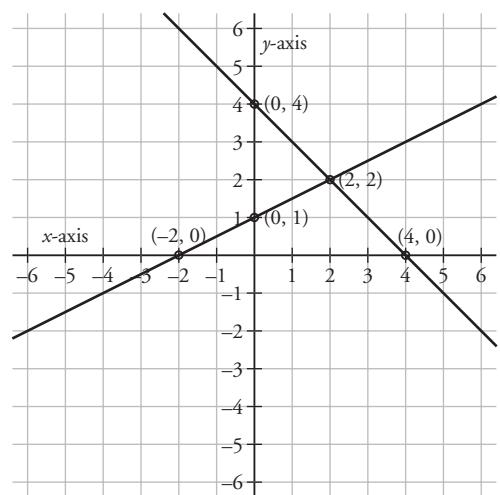
(iii) 7 units<sup>2</sup>

- 4.** (a)(i)  $-2$  (ii)  $\sqrt{180}$   
 (b)(i)  $(4\frac{1}{2}, 0)$  (0, 3) (ii)  $6\frac{3}{4}$  units<sup>2</sup>  
 (c)(i)  $t(4, 5)$  (ii)  $|pq| = 5$  units

**5.** (a)



- (b)(i)**  $(-4, 0)$   $(3, -5)$  **(ii)**  $(4, 0)$   $(-3, -5)$   
 (c)



Lines cut at  $(2, 2)$

- 6.** (a)(i)  $\frac{7}{4}$  (ii)  $7x - 4y + 9 = 0$   
 (b)(i)  $t = -4$ ,  $r = -1$   
 (ii)  $p(-4, 1)$   $q(8, -1)$  (iii)  $-\frac{1}{6}$   
 (iv)  $(2, 1)$  (v)  $2x - y + 3 = 0$

### Chapter 15 – Exercise 15.3

1. (a)  $60^\circ$  (b)  $46^\circ$  2. (a)  $60^\circ$  (b)  $30^\circ$
3. (a)  $70^\circ$  (b)  $110^\circ$  4. (a)  $103^\circ$  (b)  $100^\circ$
5. (a)  $x = 125^\circ$ ;  $y = 55^\circ$   
 (b)  $x = 55^\circ$ ;  $y = 98^\circ$
6. (a)  $x = 45^\circ$ ;  $y = 60^\circ$   
 (b)  $x = 147^\circ$ ;  $y = 72^\circ$
7. (a)  $33^\circ$  (b)  $65^\circ$  8. (a)  $67^\circ$  (b)  $113^\circ$
9. (a)  $10^\circ$  (b)  $10^\circ$  (c)  $136^\circ$
10. (a)  $30^\circ$  (b)  $37^\circ$  (c)  $53^\circ$

### Exercise 15.5

1. (a) SSS = SSS (b) RHS = RHS  
 (c) SAS = SAS
2. 1 and 7, 2 and 3, 4 and 6, 5 and 8.
3.  $abd$  and  $dbc$
4. Any combination of the following triangles:  $abe$ ,  $abc$  and  $adc$ .

5. (a)  $\angle acd$  (b)  $\angle dac$  (c) ASA = ASA  
 6. (a) Yes, they are alternate angles.  
 (b) They are vertically opposite angles.  
 (c) ASA = ASA

### Exercise 15.6

1. (a) Long [ab]; short [cb]  
 (b) Long [xz]; short [xy]  
 2. (a) Large  $\angle abc$ ; small  $\angle acb$   
 (b) Large  $\angle xyz$ ; small  $\angle yxz$   
 3. (a)  $60^\circ$  (b)  $52^\circ$   
 4. (a)  $B = 20^\circ$ ;  $C = 140^\circ$   
 (b)  $B = 50^\circ$ ;  $C = 80^\circ$   
 5. (a)  $A = 60^\circ$ ;  $B = 60^\circ$ ;  $C = 60^\circ$   
 (b)  $A = 60^\circ$ ;  $B = 60^\circ$ ;  $C = 60^\circ$   
 6. (a)  $x = 60^\circ$ ;  $y = 30^\circ$   
 (b)  $x = 60^\circ$ ;  $y = 120^\circ$   
 7. (a)  $x = 45^\circ$ ;  $y = 45^\circ$   
 (b)  $x = 40^\circ$ ;  $y = 100^\circ$   
 8. (a)  $90^\circ$  (b)  $45^\circ$  (c)  $135^\circ$   
 9. (a)  $60^\circ$  (b)  $120^\circ$  (c)  $20^\circ$   
 10. (a)  $70^\circ$  (b)  $70^\circ$  (c)  $70^\circ$

### Exercise 15.9

1. (a)  $A = 100^\circ$ ;  $B = 80^\circ$   
 (b)  $A = 83^\circ$ ;  $B = 97^\circ$   
 (c)  $A = 115^\circ$ ;  $B = 65^\circ$   
 2.  $\triangle pqr$  and  $\triangle oqr$   
 3. (a) [ad] (b) [dc] (c) [xd] (d) [xc]  
 4. (a)  $\triangle bea$  (b)  $\trianglebec$  (c)  $\triangleabc$  (d) [ae]  
 5. There are five triangles and three parallelograms.  
 6. (a) 3 cm (b) 4 cm (c) 5 cm  
 7.  $19^\circ$  8. (a)  $20^\circ$  (b)  $35^\circ$   
 9. (a)  $30^\circ$  (b)  $90^\circ$  (c)  $60^\circ$   
 10. (a) 6 cm (b) 4 cm (c)  $123^\circ$   
 (d)  $21^\circ$  (e)  $36^\circ$

### Exercise 15.12

1. (a)  $A = 90^\circ$ ;  $B = 50^\circ$   
 (b)  $A = 90^\circ$ ;  $B = 55^\circ$   
 (c)  $A = 90^\circ$ ;  $B = 47^\circ$   
 2. (a)  $A = 78^\circ$ ;  $B = 88^\circ$   
 (b)  $A = 93^\circ$ ;  $B = 110^\circ$   
 (c)  $A = 46^\circ$ ;  $B = 129^\circ$   
 3. (a)  $80^\circ$  (b)  $100^\circ$   
 4. (a)  $60^\circ$  (b)  $60^\circ$   
 5. (a)  $30^\circ$  (b)  $30^\circ$   
 6. (a)  $36^\circ$  (b)  $54^\circ$   
 7.  $|\angle cba| = 45^\circ$ ;  $|\angle bac| = 45^\circ$   
 8. (a)  $60^\circ$  (b)  $48^\circ$   
 9. (a)  $90^\circ$  (b)  $65^\circ$  (c)  $115^\circ$   
 10. (a)  $90^\circ$  (b)  $51^\circ$  (c)  $39^\circ$  (d)  $51^\circ$

### Chapter 15 review

1. (a)  $x = 75^\circ$ ;  $y = 30^\circ$   
 (b)(i)  $35^\circ$ ; alternate angles  
 (ii) 6.5 cm; the diagonals of a parallelogram bisect each other  
 (c)(i)  $140^\circ$  (ii)  $20^\circ$   
 2. (a)  $80^\circ$ ; exterior angle equals the interior opposites  
 (b)(i)  $30^\circ$ ; subtract  $(110^\circ + 40^\circ)$  from  $180^\circ$  (ii)  $30^\circ$ ;  $\angle rst = \angle mrs$  as these are alternate angles (iii)  $140^\circ$ ; subtract  $40^\circ$  from  $180^\circ$   
 (c)(i)  $72.5^\circ$ ;  $ayx$  is an isosceles triangle  
 (ii)  $72.5^\circ$ ; corresponding angle to  $\angle ayx$   
 (iii)  $72.5^\circ$ ;  $abc$  is an isosceles triangle  
 3. (a)  $x = 30^\circ$ ; subtract  $115^\circ + 35^\circ$  from  $180^\circ$ .  $y = 115^\circ$ ; opposite angles in a parallelogram are equal

(b)(i) 2.5 cm;  $[oc]$  is a radius, which is half the diameter (ii)  $52.5^\circ$ ; the interior angles in the isosceles triangle  $cob$  equal  $105^\circ$  (iii)  $37.5^\circ$ ; the interior angles in the isosceles triangle  $aoc$  equal  $75^\circ$

4. (a)  $x = 70^\circ$ ; subtract  $20^\circ + 90^\circ$  from  $180^\circ$ .  $y = 20^\circ$ ; the large triangle is isosceles therefore the perpendicular bisects the top angle

(c)(i)  $50^\circ$  (ii)  $20^\circ$

5. (a)  $A = 98^\circ$ ; opposite angles in a cyclic quadrilateral add to  $180^\circ$ .  
 $B = 105^\circ$ ; opposite angles in a cyclic quadrilateral add to  $180^\circ$

(b)(i) 7 cm (ii)  $45^\circ$  (iii)  $100^\circ$

6. (a) Largest  $\angle prq$ ; the largest angle is opposite the longest side. Smallest  $\angle pqr$ , the smallest angle is opposite the shortest side

(b)(i) 6 cm (ii) 8 cm (iii) 10 cm

### Chapter 16 – Exercise 16.1

1. (a) Soccer (b) Hockey

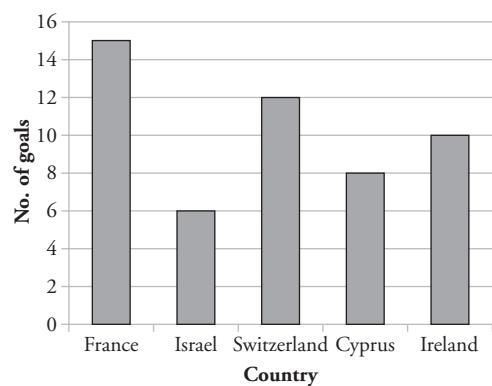
(c) 27% (d) 32

2. (a) 150 (b) 4% (c) 3:1

3. (a) 70 (b) Opel (c)  $5\%$  or  $\frac{1}{14}$

(d) 20%

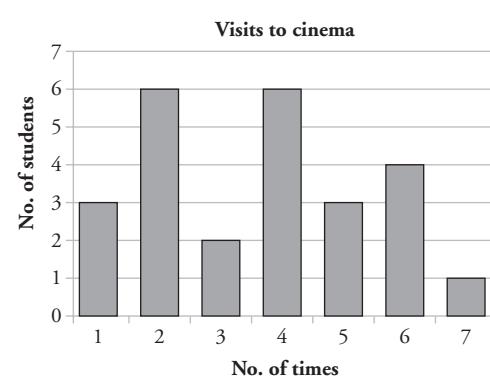
4.



5. (a)

|                    |   |   |   |   |   |   |   |
|--------------------|---|---|---|---|---|---|---|
| Number of times    | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Number of students | 3 | 6 | 2 | 6 | 3 | 4 | 1 |

(b)



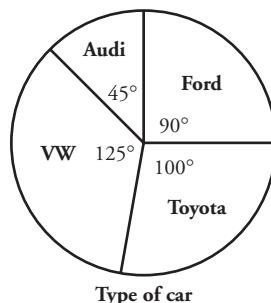
6.

|                    |    |     |     |    |     |    |    |
|--------------------|----|-----|-----|----|-----|----|----|
| Student age        | 12 | 13  | 14  | 15 | 16  | 17 | 18 |
| Number of students | 60 | 110 | 150 | 80 | 120 | 90 | 50 |

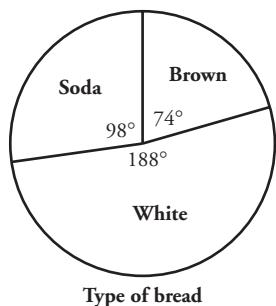
(a) 660 (b) 23% (c)  $\frac{10}{33}$

### Exercise 16.3

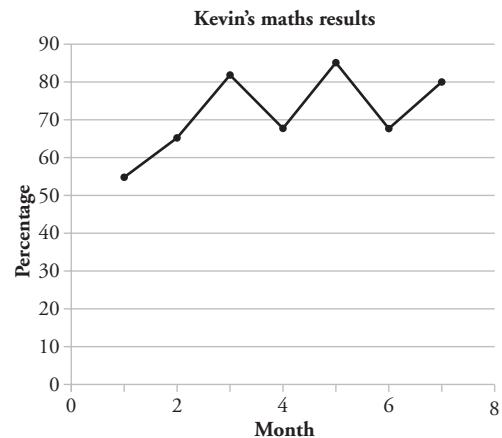
1.



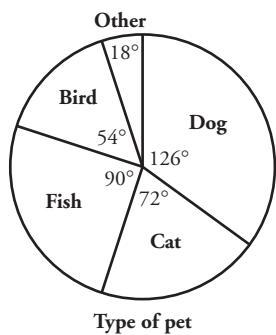
2.



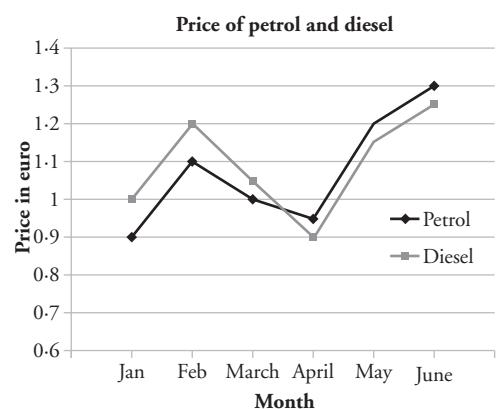
4.



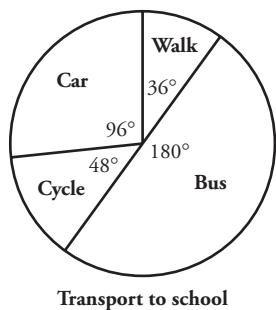
3.



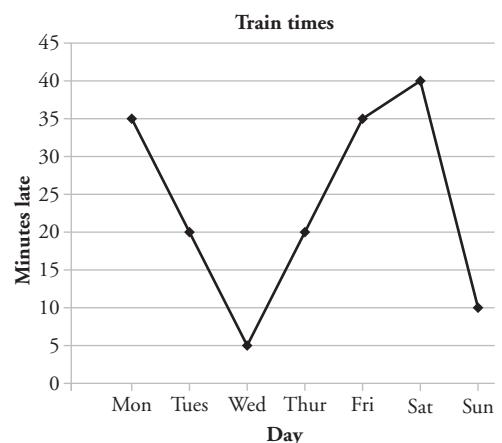
5.



4.



6.



5. (a) 150 (b) 100 (c) 20 (d) 30  
6. (a)  $60^\circ$  (b) 30 (c) 27

### Exercise 16.5

1. (a) 23.5 mm (b) Saturday  
(c) Thursday (d) 32%  
2. (a) 13 m (b) 21.3% (c) April  
(d) Feb and June  
3. (a) £0.8, \$1.40 (b) Week 4  
(c) (i) \$120 (ii) £60 (d) €125

| Day          | Mon | Tues | Wed | Thurs |
|--------------|-----|------|-----|-------|
| Minutes late | 35  | 20   | 5   | 25    |

| Day          | Fri | Sat | Sun |
|--------------|-----|-----|-----|
| Minutes late | 35  | 40  | 10  |

**Exercise 16.7**

1. (a) 7 (b) 7 2. (a) 5 (b) 6  
 3. (a) 4 (b) 13 (c) 7 (d) 7.2  
 4. 8 5. 2.7 6. 50

**Exercise 16.8**

2. Mode = 4.5  
 3. (a) 57 (b) 18 (c) 16 (d) 15  
 4. (a) 30 (b) 2.8 (c) 1.5  
 5. (a) €740 (b) €20 (c) 27%  
 6. (a) 38 (b) 114 (c) 5 (d) 3

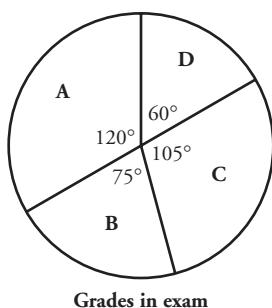
**Chapter 16 review**

1. (a) 2  
 (b)

| Grade              | D | C | B | A |
|--------------------|---|---|---|---|
| Number of students | 4 | 7 | 5 | 8 |

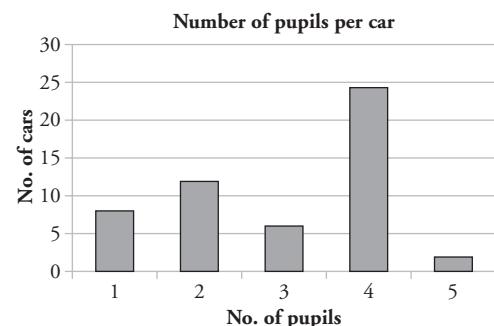
Modal grade = A

(c)

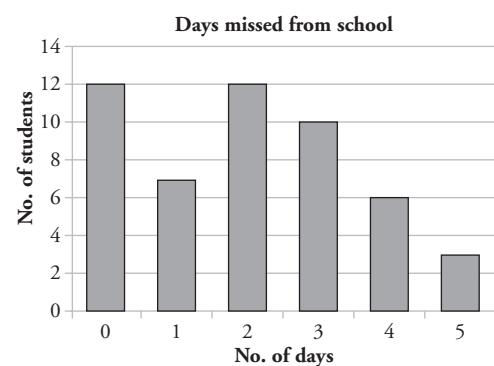


2. (a) 8  
 (b) (i) 156 (ii) 4 (iii) 3

(c)



3. (a) 10  
 (b) (i)



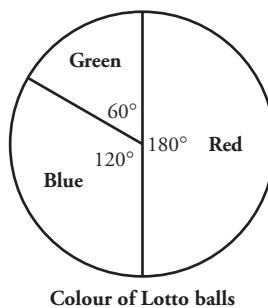
- (ii) 2 (iii) 44%  
 (c) 20  
 4. (a) €114

(b)

| Amount in €      | 4 | 5 | 6  | 7 |
|------------------|---|---|----|---|
| Number of people | 2 | 5 | 10 | 3 |

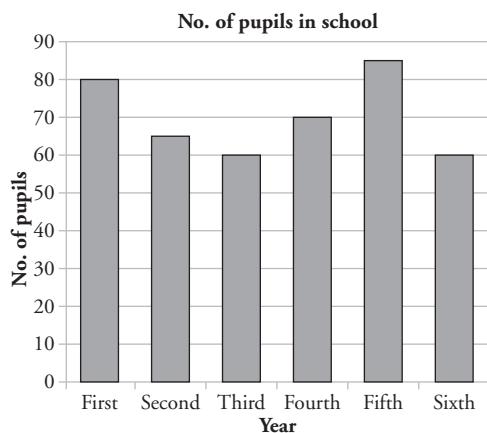
- (i) €5.70 (ii) €6

(c)



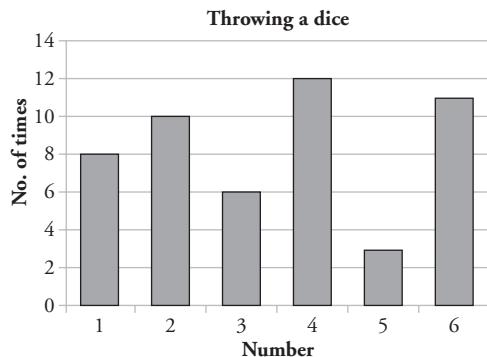
5. (a)(i) 10 (ii) 12.5 (b) 85

(c)



6. (a) 3.5

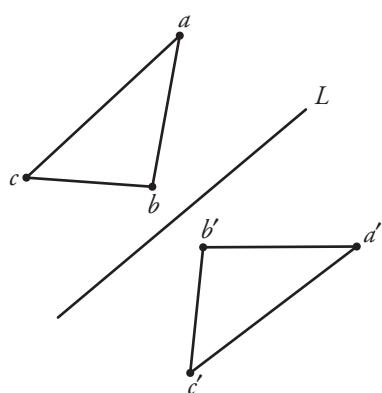
(b) 4



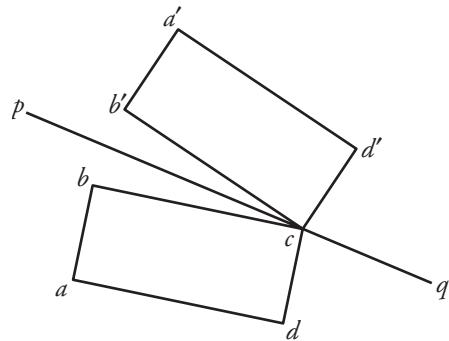
(c)(i) 324 (ii) 144

### Chapter 17 – Exercise 17.2

1.

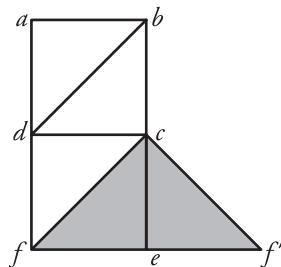


2.

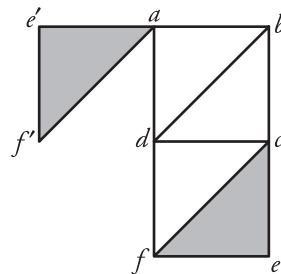


3. (a)(i)  $\triangle dbc$  (ii)  $\triangle fcd$

(b)(i)

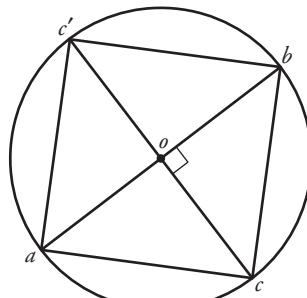


(ii)



4. (a)  $\triangle boc, \triangle oac$

(b)



5. (a)  $b$  (b)  $f(c)$   $o$  (d)  $[ob]$  (e)  $[bc]$

(f)  $\triangle boc$  (g)  $\triangle beo$

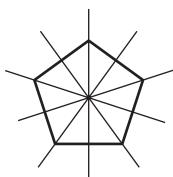
6. Blue

7. (a) 2 (b) 4 (c) 4 (d) 1 (e) 8

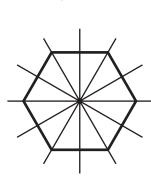
8. (a)



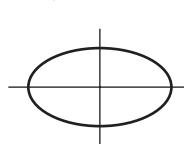
(b)



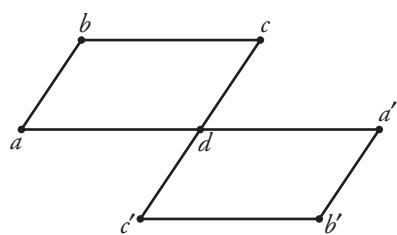
(c)



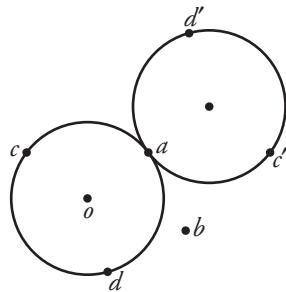
(d)



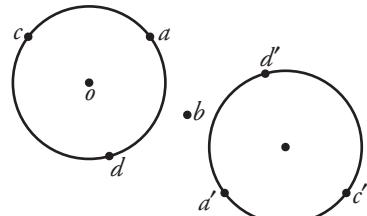
2.



3. (a)



(b)

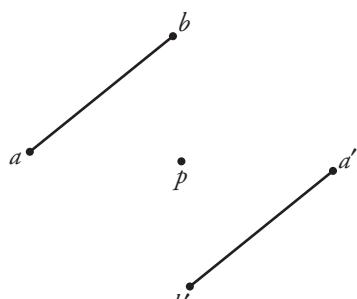
4. (a) d (b) [cb] (c)  $\triangle aob$  (d) cdab5. (a) [ac] (b) [bo] (c)  $\triangle dob$  (d)  $\triangle oac$ 

6. B

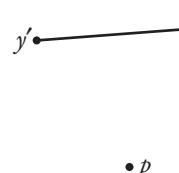
7. (e) as it contains no point through which the shape can be mapped onto itself.

8. (a) [ge] (b) [ec] (c)  $\triangle gfe$  (d)  $\triangle dcg$ (e)  $\triangle ekc$  (f)  $\triangle cda$ **Exercise 17.4**

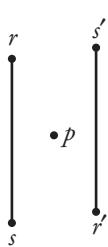
1. (a)



(b)



(c)



2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

12.

13.

14.

15.

16.

17.

18.

19.

20.

21.

22.

23.

24.

25.

26.

27.

28.

29.

30.

31.

32.

33.

34.

35.

36.

37.

38.

39.

40.

41.

42.

43.

44.

45.

46.

47.

48.

49.

50.

51.

52.

53.

54.

55.

56.

57.

58.

59.

60.

61.

62.

63.

64.

65.

66.

67.

68.

69.

70.

71.

72.

73.

74.

75.

76.

77.

78.

79.

80.

81.

82.

83.

84.

85.

86.

87.

88.

89.

90.

91.

92.

93.

94.

95.

96.

97.

98.

99.

100.

101.

102.

103.

104.

105.

106.

107.

108.

109.

110.

111.

112.

113.

114.

115.

116.

117.

118.

119.

120.

121.

122.

123.

124.

125.

126.

127.

128.

129.

130.

131.

132.

133.

134.

135.

136.

137.

138.

139.

140.

141.

142.

143.

144.

145.

146.

147.

148.

149.

150.

151.

152.

153.

154.

155.

156.

157.

158.

159.

160.

161.

162.

163.

164.

165.

166.

167.

168.

169.

170.

171.

172.

173.

174.

175.

176.

177.

178.

179.

180.

181.

182.

183.

184.

185.

186.

187.

188.

189.

190.

191.

192.

193.

194.

195.

196.

197.

198.

199.

200.

201.

202.

203.

204.

205.

206.

207.

208.

209.

210.

211.

212.

213.

214.

215.

216.

217.

218.

219.

220.

221.

222.

223.

224.

225.

226.

227.

228.

229.

230.

231.

232.

233.

234.

235.

236.

237.

238.

239.

240.

241.

242.

243.

244.

245.

246.

247.

248.

249.

250.

251.

252.

253.

254.

255.

256.

257.

258.

259.

260.

261.

262.

263.

264.

265.

266.

267.

268.

269.

270.

271.

272.

273.

274.

275.

276.

277.

278.

279.

280.

281.

282.

283.

284.

285.

286.

287.

288.

289.

290.

291.

292.

293.

294.

295.

296.

297.

298.

299.

300.

301.

302.

303.

304.

305.

306.

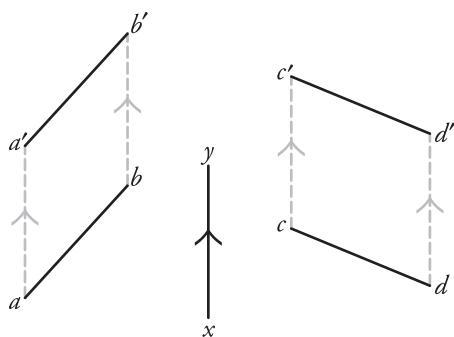
307.

308.

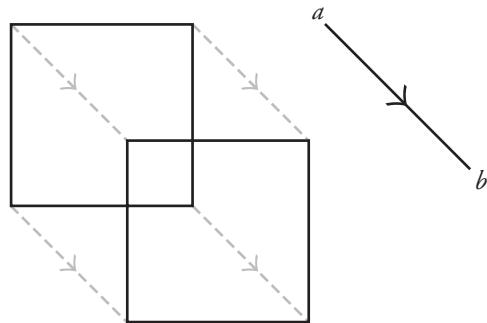
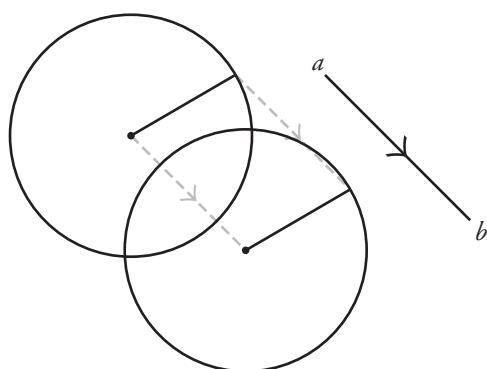
309.

310.

2.

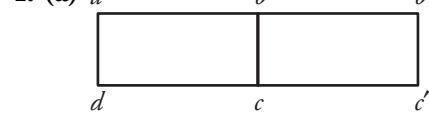


3.

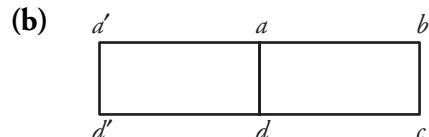


4.

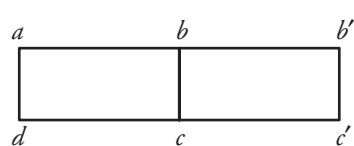
(a)



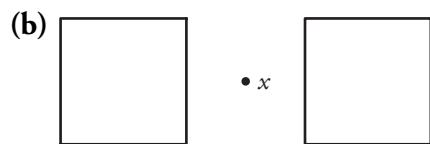
(b)



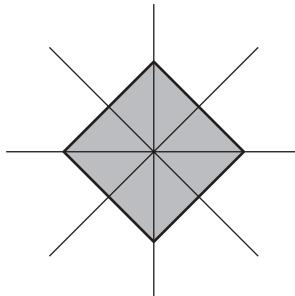
(c)

5. (a)  $\triangle wdz$  (b)  $\triangle ocz$  (c)  $\triangle xoy$ (d)  $\triangle xoy$  (e)  $\triangle xoy$ 6. (a)  $[ef]$  (b)  $[fe]$  (c)  $\triangle gfc$ 7. (a)  $[ed]$  (b)  $[fe]$  (c)  $[af]$ 8.  $\overrightarrow{ab}$  or  $\overrightarrow{bc}$  or  $\overrightarrow{ox}$ 

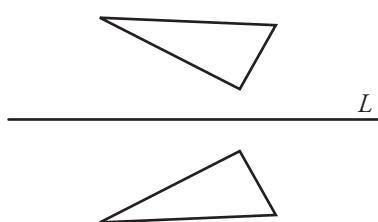
### Chapter 17 review

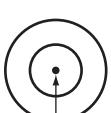
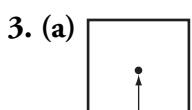
1. (a)  $C, E$ (c)(i)  $\triangle czo$  (ii)  $[ab]$ (iii)  $[bo]$  (iv)  $\triangle coz, \triangle dox, \triangle aox$ 

2. (a) 4



(b)

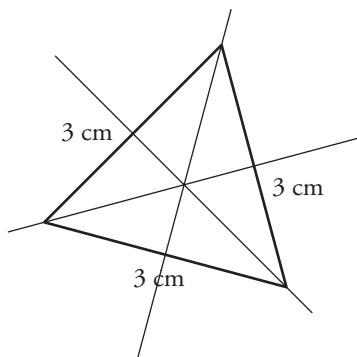
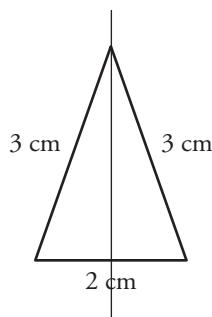
(c)(i) d (ii)  $[ce]$  (iii)  $\triangle gec$ (iv)  $cefg$



3. (a)

(b) *B* (c)(i) [ce] (ii) [ef] (iii) fecd4. (a) *R*

(b)

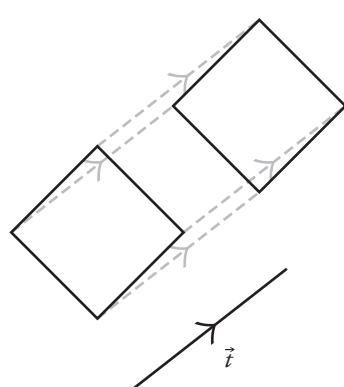


(c)(i) [av] (ii) ravw (iii) [rs], [vt]

(iv) rbtw

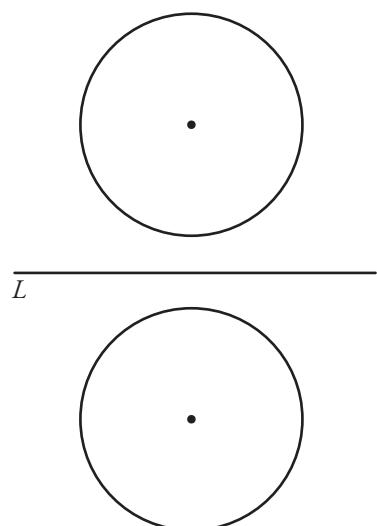
5. (a) *E, R*

(b)

(c)(i) [ac] (ii)  $\triangle cob$  (iii)  $\triangle dga$  (iv)  $\triangle boc$ ,  $\triangle aob$ ,  $\triangle doc$ ,  $\triangle aod$ 

6. (a) 1, no

(b)

(c)(i) [yc] (ii)  $\triangle axz$   
(iii) [ax] (iv)  $xbyz$ ,  $xycz$ ,  $xyza$ ; opposite sides are equal**Chapter 18 – Exercise 18.1**1. (a)  $x = 3, y = 2$  (b)  $x = 4, y = -1$ (c)  $x = 0, y = 1$ 

Answers to 2 and 3 the same as to 1.

4. (a)  $x = 4, y = 2$  (b)  $x = 4, y = 1$ (c)  $x = -4, y = -14$  (d)  $x = -2, y = 1$ 5. (a)  $x = 3, y = 2$  (b)  $x = 7, y = 2$ (c)  $x = 14, y = -4$  (d)  $x = -5, y = 3$ 6. (a)  $x = 2, y = 10$  (b)  $x = 3, y = 2$ (c)  $x = 4, y = 1$  (d)  $x = 4, y = 1$ 7. (a)  $x = -2; y = 0$  (b)  $x = -18; y = -11$ (c)  $x = 5; y = 11$  (d)  $x = -2; y = 1\frac{1}{2}$ 

Answers to 8 the same as to 7.

**Exercise 18.2**1. 20, 15 2. 7, 11 3. (a)  $6x + 5y = 140$ ;  
 $7x + 10y = 180$  (b) €20, €44. Cost per minute: 60 cent;  
one text: 10 cent

**5. Laptops:** 18; **desktops:** 12

**6. June:** 5 days, **July:** 10 days,  
Total: 15 days

**7. Walked:** 60 km; cycled: 40 km

**8. 8 €1s, 7 €2s**

### Exercise 18.3

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

### Exercise 18.4

1. (a)  $x \leq 3$  (b)  $x < 4$  (c)  $x \leq 1$

2. (a)  $x \geq 3$

(b)

(c)  $x > -1$

(c)  $x \leq 2$

3. (a)  $x < 2$

(b)  $x \geq 2$

(c)  $x \leq -1$

4. (a)  $x < 5$  (b)  $x \geq 3$  (c)  $x \leq -2$

5.  $x < 5$

6.  $x \geq -4$

7.  $x \geq 0$

8.  $x \leq -5$

### Chapter 18 review

1. (a)

(b)  $x \leq -5$

(c) 55, 15

2. (a) {0, 1, 2} (b)  $x = 3$ ;  $y = -1$

(c) (i)  $x + y = 36$  (ii)  $2x + 4y = 84$

(iii)  $x = 30$ ;  $y = 6$

3. (a)

(b)  $x = 8$ ,  $y = -3$

(c) Chocolate: 80 cent;

ice cream: 70 cent

4. (a) {4, 3, 2, 1, 0} (b)  $x = 0$ ,  $y = -3$

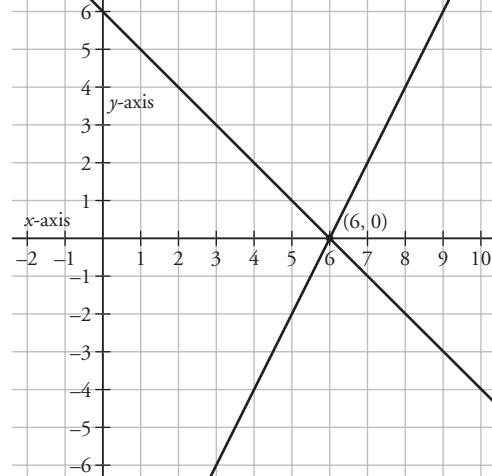
(c) The Star: 150, The Irish

Independent: 100

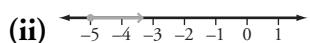
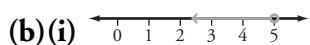
5. (a)

(b)  $x = -1$ ,  $y = -5$

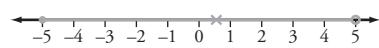
(c) intersect at (6, 0)



6. (a)  $x = 19$ ,  $y = 4$



both inequalities:



(c) 20 students, 5 teachers

### Chapter 19 – Exercise 19.1

1. 0, -4
2. 0, 6
3. -5, -4
4. 7, -1
5. 2, 5
6. -1, -3
7. -2, -5
8. -4, -3
9. -1, -4
10. -4, -3
11. 1, 5
12. 2, 6
13. 7, 3
14. 2, 4
15. 1, 10
16. -2, 1
17. -4, 5
18. 4, -3
19. -2, 7
20. -3, 2

### Exercise 19.2

1. 1, -3
2. -2, -6
3. -5, 1
4. 4, -2
5. 3, -5
6. 7, 3
7. 8, 3
8. 5, 4
9. 2, -1
10. 5, 5
11. 0, 8
12. 0, 2
13. 0, -4
14. 0, 10
15. 0, 5
16. -5, 5
17. -4, 4
18. -7, 7
19. 2, -1
20. -10, 10

### Exercise 19.3

1. 7, -8
2. 10, 15 or -10, -15
3. 3
4. 9, 10
5. 6, 10 or -7, -3
6. (a)  $x^2$ , 5x, x (b)  $x = 4$  (c) 16, 18, 10
7.  $x = 5$ , base = 10 cm, height = 6 cm

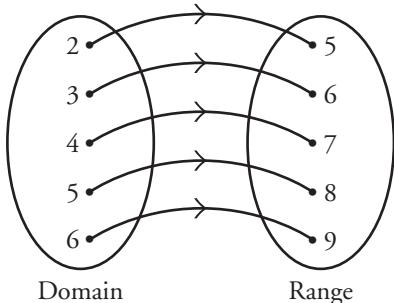
### Chapter 19 review

1. (a) 0, 10 (b)  $x(x - 6)$ , 0, 6  
(c) -7, -2 or 7, 2
  2. (a) 0, -15 (b)  $(x + 2)(x - 6)$ , -2, 6  
(c) -7 or 3
  3. (a) 7, 9 (b) 5 (c) 16, 2
  4. (a) -3, 3 (b)  $x(x - 12)$ , 0, 12  
(c)(i)  $x = 1$  (ii) perimeter = 14 cm
  5. (a) 7, 7 (b)  $(x + 12)(x - 12)$ , -12, 12  
(c)(i)  $x^2$ , 2x, 5x (ii) 10 by 10, 10 by 2,  
10 by 5 (iii) 40, 24, 30
  6. (a) 0, 5 (b) -10, -4 (c) -11, -5
3. (a) (0, 5) (1, 6) (2, 7) (3, 8)  
(b) (0, -3) (1, -2) (2, -1) (3, 0)  
(c) (0, 4) (1, 7) (2, 10) (3, 13)  
(d) (0, 2) (1, 3) (2, 4) (3, 5)  
(e) (0, 5) (1, 6) (2, 9) (3, 14)
4. (a) {1, 2, 3, 12} (b) {4, 5, 6, 15}  
(c) 3 is added to a number.

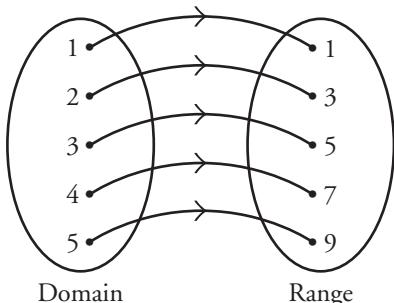
### Chapter 20 – Exercise 20.1

1. (a) D{1, 2, 3, 4, 5} R{2, 3, 4, 5, 6}
- (b) D{1, 2, 3, 4, 5} R{1, 4, 9, 16, 25}
- (c) D{-2, -1, 0, 1, 2} R{2, 3, 4, 5, 6}

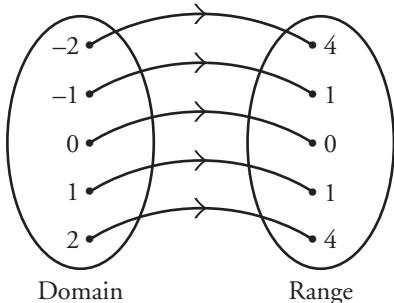
2. (a)



- (b)



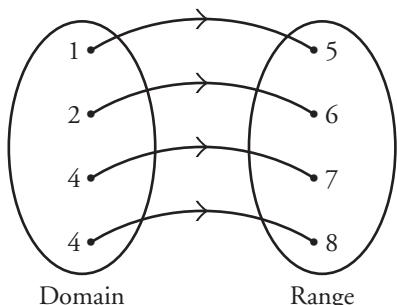
- (c)



5. (a) {4, 9, 16, 25} (b) {2, 3, 4, 5}

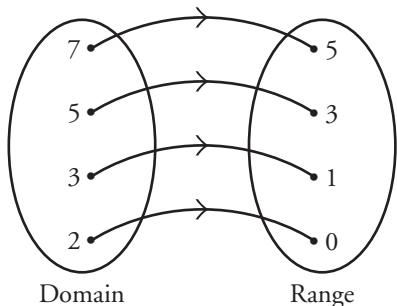
(c) The square root of a number.

6.



{7, 8} 4 is added to a number.

7.



{3, 2} 2 is subtracted from a number.

8. (a) Yes, the domain values are all different.

(b) No, 1 is repeated in the domain.

(c) No, 2 is repeated in the domain.

(d) Yes, the domain values are all different.

(e) No, 20 is repeated in the domain.

### Exercise 20.2

1. (a) 4 (b) 6 (c) 2 (d) 0 (e) 3

2. (a) -3 (b) -1 (c) -3 (d) 9 (e) 3

3. {-5, -3, -1, 1}

4. (a) 15 (b) 5 < 10

5. (a) 6 (b) 9 (c) -12

6. (a) 1 (b) 4 (c) -4

$$7. 12 + 5 = 17$$

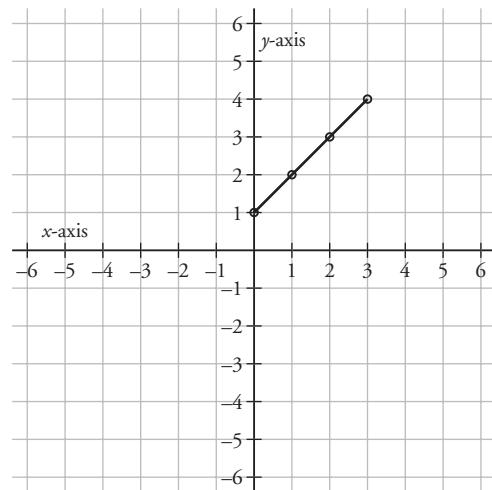
$$8. (a) h^2 - 3h - 2$$

$$(b) (h + 1)^2 - 3(h + 1) - 2$$

### Exercise 20.3

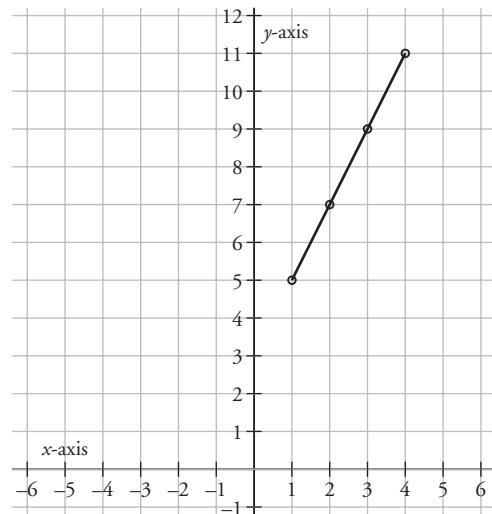
1.

|     |   |   |   |   |
|-----|---|---|---|---|
| $x$ | 0 | 1 | 2 | 3 |
| $y$ | 1 | 2 | 3 | 4 |



2.

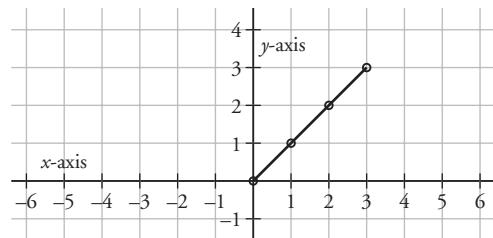
|     |   |   |   |    |
|-----|---|---|---|----|
| $x$ | 1 | 2 | 3 | 4  |
| $y$ | 5 | 7 | 9 | 11 |



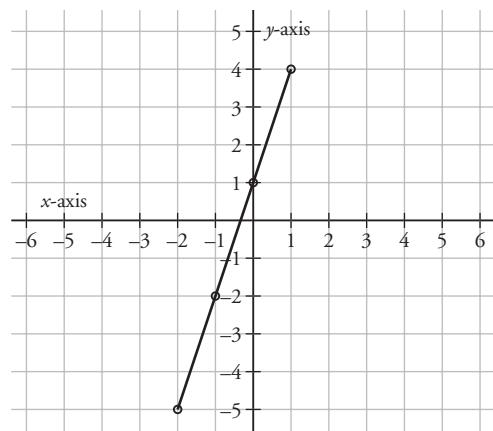
3.

|     |    |   |   |   |
|-----|----|---|---|---|
| $x$ | -1 | 0 | 1 | 2 |
| $y$ | 1  | 3 | 5 | 7 |

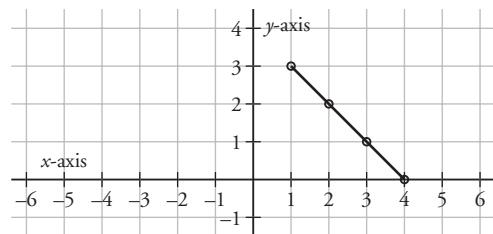
4.



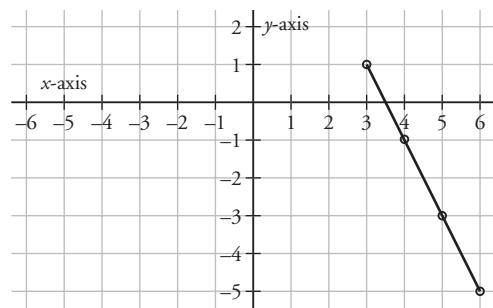
5.



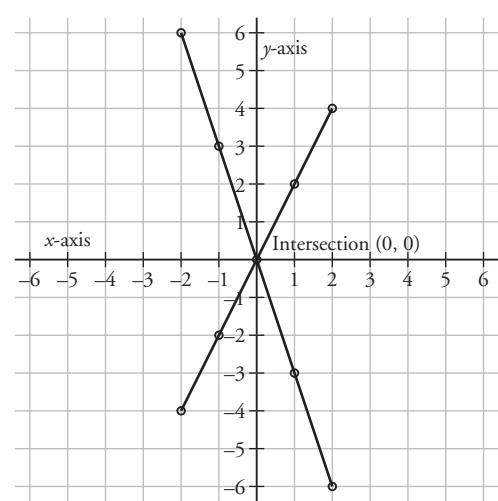
6.



7.



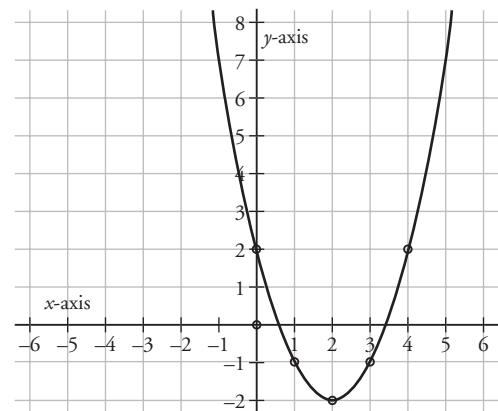
8.



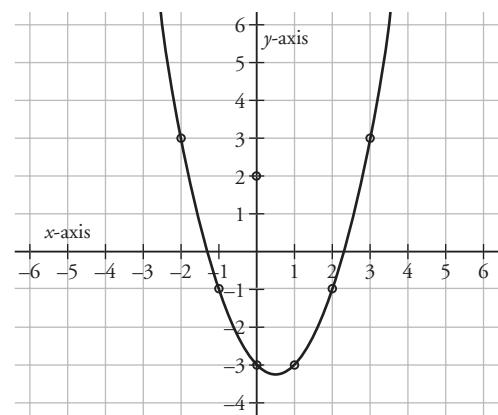
They intersect at (0, 0).

### Exercise 20.4

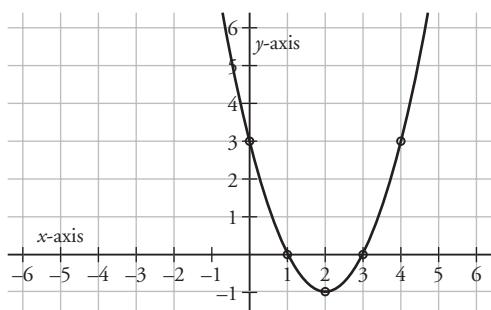
1.



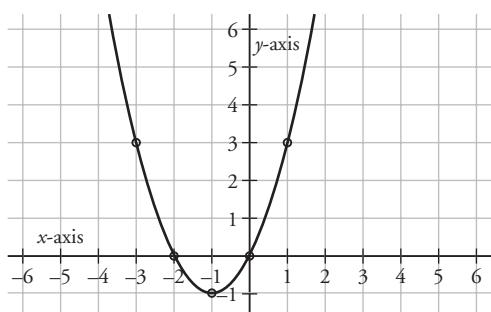
2.



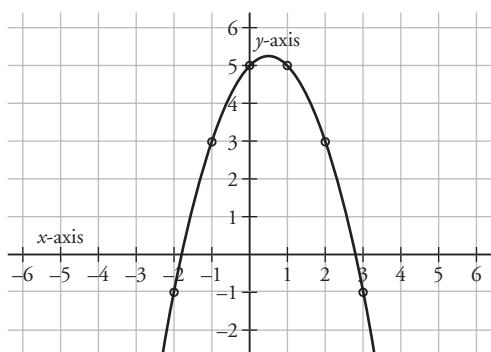
3.



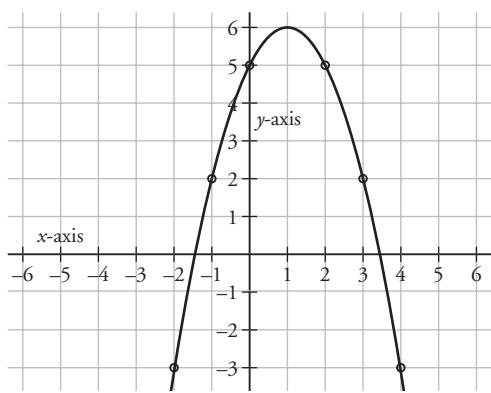
4.



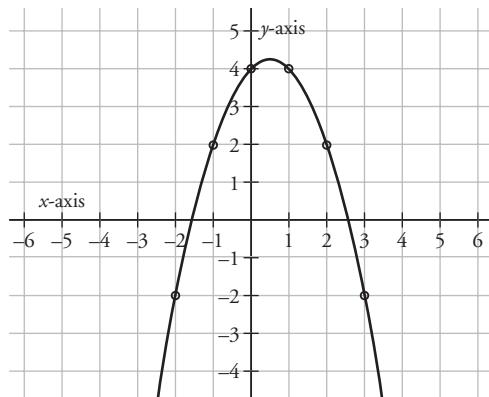
5.



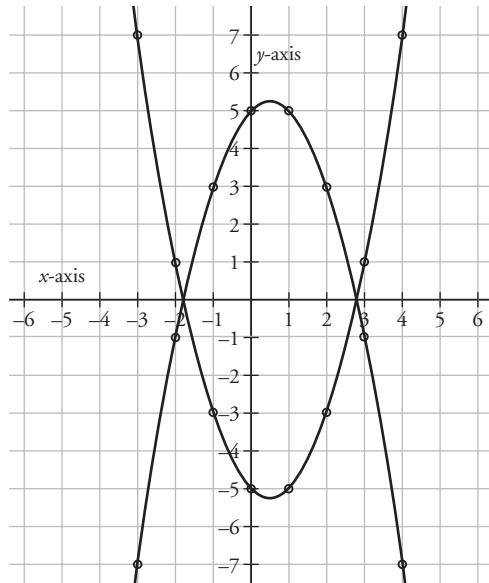
6.



7.



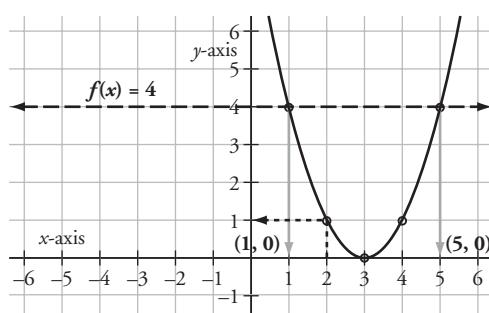
8.



They intersect at  $(-1.8, 0)$  and  $(2.8, 0)$ .

### Exercise 20.5

1.

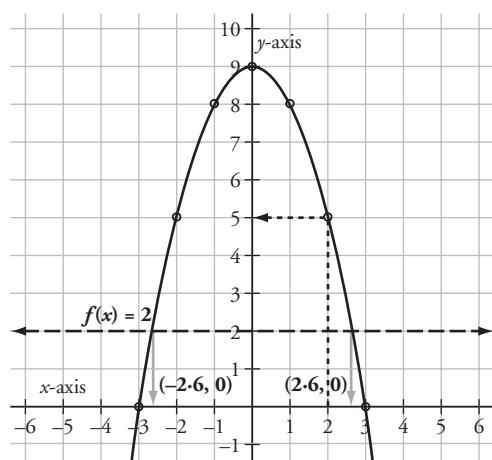


(a)  $x = 1$  and  $x = 5$

(b)  $f(2) = 4$

(c) The minimum value is 3.

2.

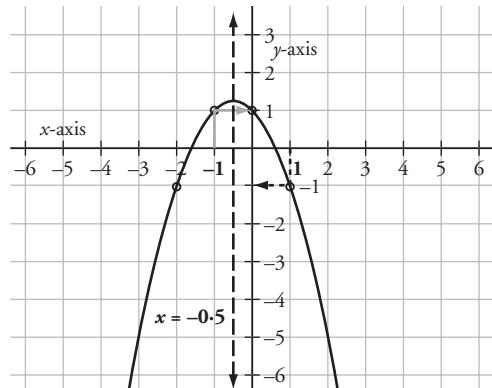


(a)  $x = -2.6$  and  $x = 2.6$

(b)  $f(2) = 4$

(c) The maximum point  $(0, 9)$ .

3.

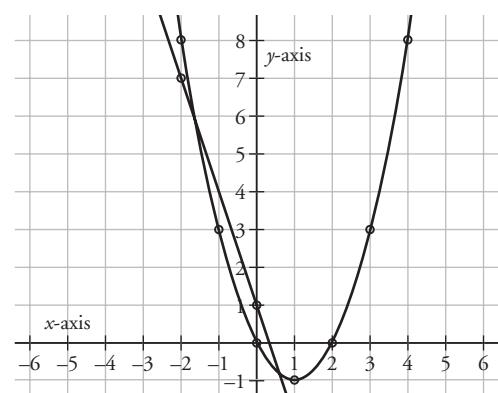


(a) Axis of symmetry:  $x = -0.5$

$$(b) 3f(1) + 2f(-1) = 3(-1) + 2(1) \\ = -3 + 2 = 1$$

(c) The maximum value of  $f(x)$ :  $-0.5$ .

4.



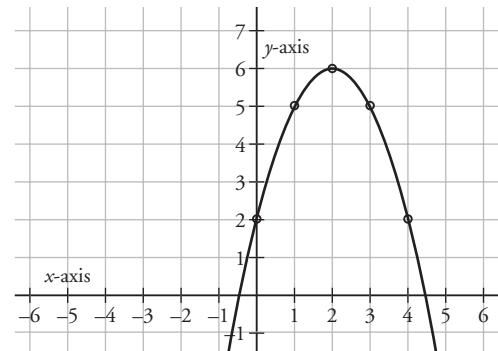
(a)  $-1.6$  and  $0.6$

(b)  $f(2) = 0$ ,  $g(2) = -5$

$$(c) f(0) + g(0) = 0 + 1 = 1$$

5. (a) 4 m (b) 2 m depth (c) 3 sec

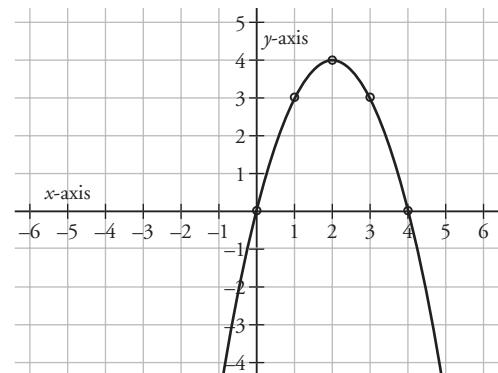
6.



(a)  $50^\circ\text{C}$  (b)  $60^\circ\text{C}$  (c) 2 minutes

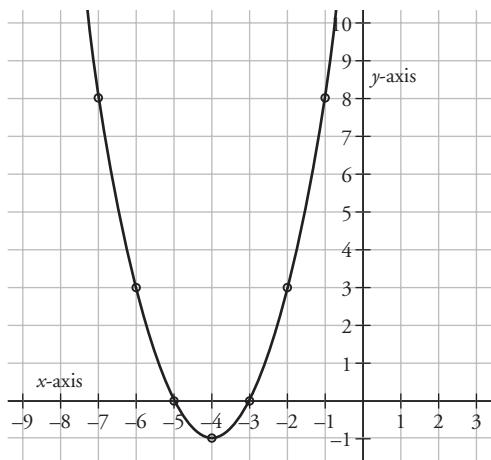
(d)  $20^\circ\text{C}$

7.



(a) 1 sec (b) 4 m/sec

- 8. (a)**  $f(-1) = 8, f(-2) = 3, f(-3) = 0,$   
 $f(-4) = -1, f(-5) = 0, f(-6) = 3,$   
 $f(-7) = 8$



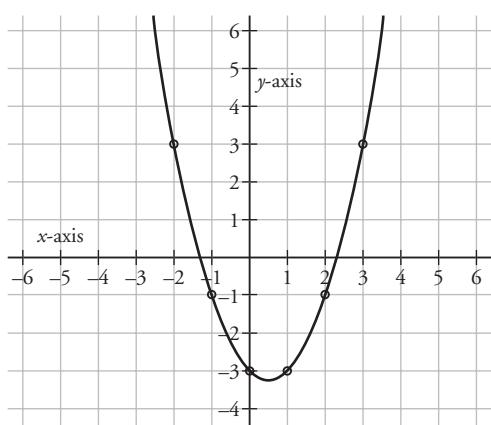
- (i)** 5 **(ii)** 1.8 and 6.4

### Chapter 20 review

- 1. (a)** Domain {1, 2, 3, 4}

Range {2, 4, 6, 8}

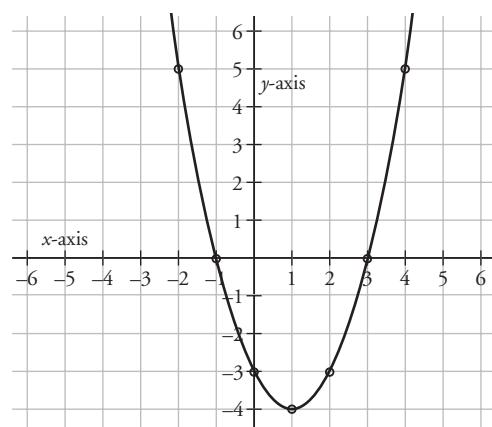
- (b)**



- (c)(i)** 1 **(ii)** -1.4, 2.3 **(iii)** -3.3

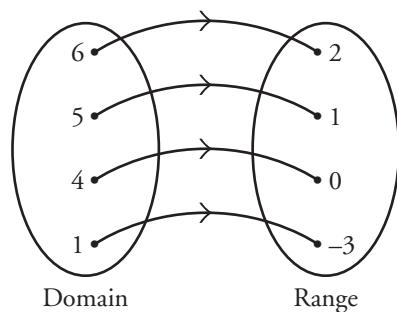
- 2. (a)(i)** 11 **(ii)** -14

- (b)**

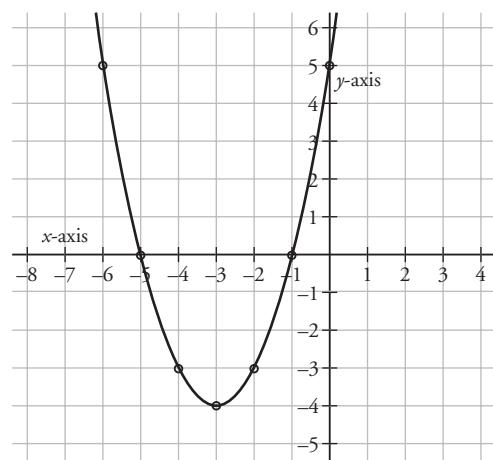


- (c)(i)** 2 **(ii)** -1.5 and 3.5 **(iii)** (1, -4)

- 3. (a)** 4, 1

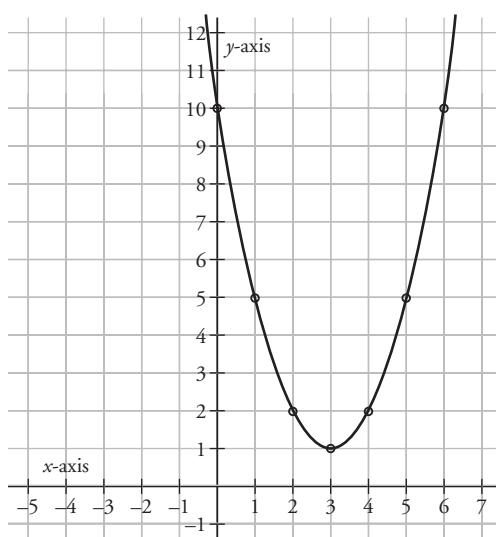


- (b)**



- (c)(i)** -2 **(ii)**  $x = -4$  and  $x = -2$  **(iii)** 0

**4. (a)(i) -4 (ii) 5**

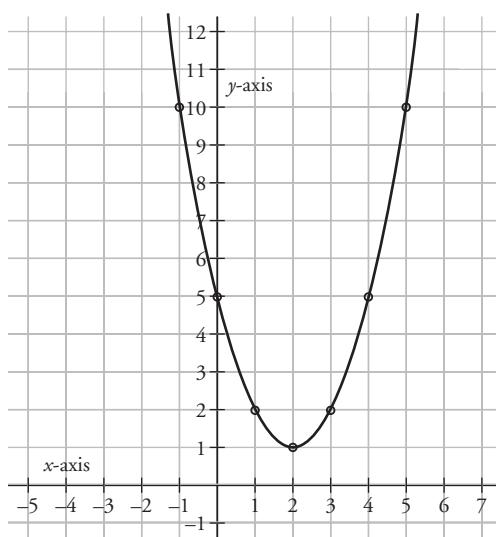


**(b)(i) 3 (ii) 1.3 and 4.7**

**(c)(i) 1 m/s (ii) 2 m/s**

**5. (a)(i) -41 (ii) 15**

**(b)**



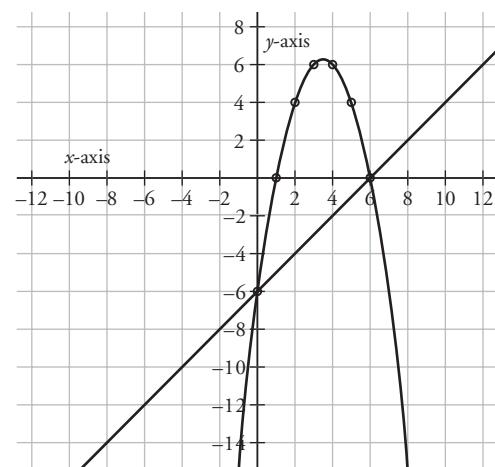
**(c)(i) 12:20, 15:45 (ii) 10 km/h**

**(iii) 20 km/h**

**6. (a)**

|     |    |    |    |    |
|-----|----|----|----|----|
| $x$ | 0  | 1  | 2  | 3  |
| $y$ | -6 | -5 | -4 | -3 |

**(b)  $f: x \rightarrow x - 6$  and  $g: -x^2 + 7x - 6$  in the domain  $0 \leq x \geq -6$ , where  $x \in \mathbf{R}$ .**



**(c)(i) 0, 6 (ii) 6.3**

### Chapter 21 – Exercise 21.1

**1. (a)  $27 \text{ cm}^3$  (b)  $864 \text{ cm}^3$  (c)  $6120 \text{ cm}^3$**

**2. (a)  $150 \text{ cm}^2$  (b)  $344 \text{ cm}^2$  (c)  $132 \text{ cm}^2$**

**3. 5 cm 4. (a) 10 cm (b)  $1000 \text{ cm}^3$**

**5. 600 6. (a) 180 litres (b) 20%**

**7. (a)  $51\,072 \text{ cm}^3$  (b)  $7424 \text{ cm}^2$**

**8. 20 cm**

### Exercise 21.3

**1. (a)  $54\pi \text{ cm}^3$  (b)  $200\pi \text{ cm}^3$**

**(c)  $125\pi \text{ cm}^3$**

**2. (a)  $108 \text{ cm}^2$  (b)  $768 \text{ cm}^2$  (c)  $936 \text{ cm}^2$**

**3. (a)  $423.5 \text{ cm}^3$  (b)  $242 \text{ cm}^2$**

**(c)  $319 \text{ cm}^2$  (d)  $280.5 \text{ cm}^2$**

**4.  $2.625 \text{ cm}$  5.  $14 \text{ cm}$  6.  $3 \text{ mm}$**

**7. (a) 18:1 (b) 6:1 8.  $2688 \text{ cm}^3$**

### Exercise 21.5

**1. (a)  $288\pi \text{ cm}^3$  (b)  $2304\pi \text{ cm}^3$**

- (c)  $18432\pi \text{ mm}^3$  (d)  $36\pi \text{ m}^3$   
**2.** (a)  $48 \text{ cm}^2$  (b)  $768 \text{ cm}^2$  (c)  $3072 \text{ cm}^2$   
(d)  $7500 \text{ mm}^2$  (e)  $691200 \text{ m}^2$   
**3.** (a)(i)  $1437 \text{ cm}^3$  (ii)  $616 \text{ cm}^2$   
(b)(i)  $9204 \text{ cm}^3$  (ii)  $2124 \text{ cm}^2$   
(c)(i)  $195458 \text{ cm}^3$  (ii)  $16288 \text{ cm}^2$   
(d)(i)  $523667 \text{ m}^3$  (ii)  $31420 \text{ m}^2$   
**4.** 2.1 cm **5.** 3.54 cm  
**6.**  $1767.15 \text{ cm}^3$ ,  $10125 \text{ cm}^3$   
**7.** (a)  $108 \text{ cm}^3$  (b)  $486 \text{ cm}^3$   
(c)  $162 \text{ cm}^3$  (d) 3  
**8.** 31.5 cm

### Chapter 21 review

- 1.** (a)  $400 \text{ cm}^3$  (b)(i)  $4851 \text{ cm}^3$   
(ii) 21 cm (iii)  $4410 \text{ cm}^3$   
**2.** (a)  $108000 \text{ cm}^3$  (b)(i) 300 litres  
(ii) 30 cm (c) 6 cm  
**3.** (a)  $250\pi \text{ cm}^3$   
(b)  $445.5 \text{ cm}^3$   
(c)  $387 \text{ cm}^3$   
**4.** (a)  $904 \text{ cm}^3$   
(b)(i)  $288 \text{ cm}^3$  (ii)  $336 \text{ cm}^2$  (c) 4 cm  
**5.** (a)  $151.25 \text{ cm}^2$   
(b) 3 cm  
(c)  $36\pi$ , 10 cm  
**6.** (a) 20 cm  
(b)(i) 3 cm (ii)  $378 \text{ cm}^2$  (c) 2

### Chapter 22 – Exercise 22.3

- 1.** (a) 10 (b) 25 (c) 20  
**2.** (a) 7.81 (b) 9.85 (c) 2.65  
**3.** (a) 4 (b) 8 (c) 5  
**4.** (a) 3.61 (b) 4.82 (c) 2.65

### Exercise 22.4

- 1.** (a)  $\frac{5}{13}, \frac{12}{13}, \frac{5}{12}$  (b)  $\frac{6}{10}, \frac{8}{10}, \frac{6}{8}$   
(c)  $\frac{\sqrt{2}}{\sqrt{7}}, \frac{\sqrt{5}}{\sqrt{7}}, \frac{\sqrt{2}}{\sqrt{5}}$   
**2.**  $\frac{15}{17}, \frac{8}{15}$   
**3.** (b)  $40^\circ$  (c) 13 (d)  $\frac{5}{13}$  (e)  $\frac{12}{13}$   
(f)  $\frac{12}{13}$  (g)  $\frac{12}{5}$   
**4.** (a) 9 (b)  $\frac{9}{41}$  (c)  $\frac{40}{41}$  (d)  $\frac{9}{40}$

### Exercise 22.5

- 1.** (a) 0.407 (b) 0.809 (c) 0.625  
(d) 3.078 (e) 0.999 (f) 0.602  
(g) 1.618 (h) 2.796 (i) 0.405 (j) 0.112  
(k) 0.664 (l) 6.412  
**2.** (a)  $31^\circ$  (b)  $77^\circ$  (c)  $34^\circ$  (d)  $78^\circ$   
(e)  $53^\circ$  (f)  $41^\circ$  (g)  $41^\circ$  (h)  $49^\circ$  (i)  $70^\circ$   
(j)  $15^\circ$  (k)  $79^\circ$  (l)  $53^\circ$  (m)  $69^\circ$  (n)  $62^\circ$

### Exercise 22.6

- 1.** (a) 4 (b) 5 (c) 12  
**2.** 4.935 cm **3.** 15.66 cm **4.** 15.106 cm  
**5.** 12.436 cm  
**6.** (a)  $30^\circ$  (b)  $30^\circ$  (c)  $60^\circ$   
**7.** (a)  $42^\circ$  (b)  $45^\circ$  (c)  $70^\circ$  **8.**  $55^\circ$

**Exercise 22.7**

1. 25 m 2. 257 m 3.  $79^\circ$  4. 842 m

5.  $42^\circ$  6. (a)  $12^\circ$  (b)  $5^\circ$

7. (a) 3.7 m (b) 6.7 m 8. 5 m

**Chapter 22 review**

1. (a) 0.574 (b)(i) 5 (ii)  $\frac{4}{3}, \frac{4}{5}, \frac{3}{5}$  (c) 26 m

2. (a)(i) 7 (ii)  $\frac{24}{7}$  (b)  $43^\circ$

(c)(i) 30 cm (ii) 28 cm

3. (a)(i) 32 (ii)  $\frac{4}{5}$  (b) 11.479 (c) 27 m

4. (a)(i)  $\frac{12}{13}$  (ii)  $\frac{5}{12}$  (b)  $55^\circ$

(c)(i) 125 m (ii) 5 sec (iii) 17 m

5. (b)  $63^\circ$  (c)(i) 5.292 (ii) 12.446  
(iii)  $49^\circ$

6. (a) 6 (b)(i)  $60^\circ$  (ii)  $\frac{1}{2}$  (c) 49 m