

JUNIOR CERTIFICATE

Working with

MATHS
Teacher's Manual **2**

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Introduction

This manual contains the following:

- a list of key learning outcomes for each chapter.
- a list of useful websites for teaching maths.
- answers to all questions in *Working with Maths 2*, including answers with diagrams.

Chapter 1

Working with algebra

KEY LEARNING OUTCOMES

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

- understand the algebraic concepts of a variable, a term and an expression
- 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
- rewrite algebraic fractions as single fractions
- perform long division in algebra
- simplify algebraic fractions with a variable in the denominator.

Chapter 2

Working with factors in algebra

KEY LEARNING OUTCOMES

When they have completed Chapter 2, 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 in which the coefficient of x^2 is greater than 1
- factorise an expression containing the difference of two squares
- factorise an expression fully
- use factors to simplify algebraic fractions.

Chapter 3

Working with numbers

KEY LEARNING OUTCOMES

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

- recognise and distinguish between the number symbols **N**, **Z**, **Q** and **R**
- perform basic and mixed operations with all types of numbers
- distinguish between rational and irrational numbers

- perform basic operations involving surds
- simplify surds
- perform basic operations involving numbers with indices, with and without the use of a calculator
- perform basic operations with numbers written in scientific notation, with and without the use of a calculator.
- substitute into formulae
- solve word problems using simultaneous equations
- solve simple inequalities
- graph the solution of inequalities on number lines
- solve double inequalities
- graph the solution of double inequalities on number lines.

Chapter 4

Working with linear equations and inequalities

KEY LEARNING OUTCOMES

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

- solve linear equations with unknowns on both sides of the equal sign
- solve simple algebraic equations with fractions
- convert algebraic linear equations to word problems and vice versa
- solve simultaneous equations using graphing, elimination and substitution
- solve simultaneous equations containing fractions
- solve square root equations
- solve simple equations with indices
- rearrange equations and formulae

Chapter 5

Working with quadratic equations

KEY LEARNING OUTCOMES

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

- solve quadratic equations of the type $ax^2 + bx + c = 0$
- solve equations with variables in the denominator
- use the quadratic equation formula to solve quadratic equations
- solve connected equations related to a given quadratic equation
- solve word problems using quadratic equations.

Chapter 6

Working with functions and graphs

KEY LEARNING OUTCOMES

When they have completed Chapter 6,

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
- answer questions on linear and quadratic graphs
- solve practical problems using quadratic graphs.

Chapter 7

Working with sets

KEY LEARNING OUTCOMES

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

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

Chapter 8

Working with money

KEY LEARNING OUTCOMES

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

- solve questions on the tax credit system
- calculate annual interest and compound interest on various sums of money
- solve questions on currency exchange
- solve questions on depreciation.

Chapter 9

Working with geometry 1

KEY LEARNING OUTCOMES

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

- apply the geometrical facts and theorems listed in the revision section to questions
- formally prove the following theorems and use them to answer problems:
 - vertically opposite angles are equal in measure
 - the measure of the three angles of a triangle sum to 180°
 - the measure of an exterior angle of a triangle equals the sum of the two interior opposite angles

- if two sides of a triangle are equal in measure, the angles opposite these sides are equal in measure
 - opposite sides and opposite angles of a parallelogram are respectively equal in measure
 - a diagonal bisects the area of a parallelogram
 - the measure of the angle at the centre of a circle is twice the measure of the angle at the circumference, standing on the same arc (students must also be able to apply the three deductions from this theorem)
 - a line through the centre of a circle, perpendicular to a chord, bisects the chord.
- apply the following theorems:
- if a line passes through a point, t , on a circle and is perpendicular to the diameter at t , the line is a tangent to the circle at t
 - any point on the perpendicular bisector of a line segment $[ab]$ is equidistant from a and b and the converse of this theorem
 - any point on the bisector of an angle is equidistant from the half lines forming the angle
- use mathematical instruments to construct the following:
- the perpendicular bisector of a line segment
 - the bisector of an angle
 - dividing a line segment into three equal parts
 - a triangle when given the measure of three sides
 - a triangle when given the measure of two sides and the measure of an included angle
 - a triangle when given the measure of two angles and the measure of a corresponding side
 - a right-angled triangle
 - the circumcircle of a triangle
 - the incircle of a triangle.

Chapter 10

Working with coordinate geometry

KEY LEARNING OUTCOMES

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

- know and apply formulae to find the following:
 - the midpoint of a line segment
 - the length of a line segment
 - the slope of a line
 - the equation of a line
- read the slope of a line from its equation
- graph a line given its equation
- verify if a point is on a line

- find the point of intersection of two lines
- find the equation of lines which are related to a given line, when given sufficient information
- find the image of a point under each of the following:
 - central symmetry in the origin, S_o
 - axial symmetry in the x -axis, S_x
 - axial symmetry in the y -axis, S_y
 - axial symmetry in a line L , S_L
 - a translation.
- apply the following theorem: a line drawn parallel to one side of a triangle divides the other two sides in the same ratio
- move points and shapes under the following transformations:
 - axial symmetry
 - central symmetry
 - translation
 - rotation.

Chapter 11

Working with geometry 2

KEY LEARNING OUTCOMES

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

- formally prove the following theorems and use them to answer problems:
 - if two triangles are equiangular, the lengths of the corresponding sides are in proportion
 - the theorem of Pythagoras: in a right-angled triangle, the square of the length of the side opposite to the right angle is equal to the sum of the squares of the lengths of the other two sides (students must also know the converse of this theorem)

Chapter 12

Working with length, area and volume

KEY LEARNING OUTCOMES

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

- apply formulae to find the area of the following:
 - rectangles
 - parallelograms
 - triangles
 - circles
 - sectors of a circle
- apply formulae to find the volume of the following:
 - cuboids
 - solid cylinders
 - cones
 - spheres
- apply formulae to find the following:

- the total surface area of a cuboid
 - the curved surface area of a cylinder
 - the total surface area of a cylinder
 - the curved surface area of a cone
 - the total surface area of a cone
 - the curved surface area of a sphere
 - the total surface area of a hemisphere
 - the curved surface area of a hemisphere
- solve problems involving a combination of shapes.
- set up a grouped frequency table from a set of data
 - find the mean of a grouped frequency table
 - set up a cumulative frequency table from a grouped frequency table
 - find the median, lower quartile, upper quartile and interquartile range from a cumulative frequency curve.

Chapter 13

Working with statistics

KEY LEARNING OUTCOMES

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

- display data using the following:
 - bar charts
 - pie charts
 - trend graphs
 - histograms
 - cumulative frequency curves (ogives)
- find the mean, mode and median of a set of numbers
- find the mean, mode and median of a frequency table

Chapter 14

Working with trigonometry

KEY LEARNING OUTCOMES

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

- identify the hypotenuse in a right-angled triangle
- identify the adjacent and opposite sides in relation to a specific angle in a right-angled triangle
- apply Pythagoras' theorem to specific questions
- use the sin, cos and tan ratios
- use a calculator to find the sin, cos and tan of angles
- use a calculator to find angles when sin, cos and or tan is given
- identify angles of elevation and depression in applied questions
- change parts of a degree to minutes

- construct angles given specific information
- find the sin, cos and tan of angles between 90° and 360°
- apply the sine rule to find sides and angles in triangles
- apply the formula for the area of a triangle ($\frac{1}{2}abs\sin C$) to various triangles
- use trigonometry to solve practical problems.

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>

This site provides all past examination papers and marking schemes.

The Maths Support Service

<http://www.mathssupport.ie>

This site covers all aspects of Junior and Leaving Certificate maths.

The National Council of Teachers of Mathematics

<http://www.nctm.org>

Other teaching resources sites

<http://www.tsm-resources.com>

<http://www.scoilnet.ie>

<http://www.teachnet.ie>

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

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

<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/vlibrary.html>

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

Chapter 1

Revision exercise 1

1. (a) $-2x - y$ (b) $7s - r - 3$
 (c) $-2p + 5q$ (d) $-8x^2 - x$
 (e) $2y^2 - 6y$ (f) $-5m^3 - m^2$
 (g) $-7x^2 + 4x - 2$ (h) $3y^3 + 2y^2 - 7y$
2. (a) $12x^5$ (b) $15b^5$ (c) $3y^{11}$ (d) $2a^9$
 (e) c^6 (f) $4m^3n^2$ (g) $-9x^3y^3$ (h) $2y^{10}$
3. (a) x^2 (b) $2a$ (c) $\frac{x^2}{3}$ (d) $3b^3a$ (e) $\frac{x^2}{4y}$
 (f) $\frac{3xy}{2}$ (g) -1 (h) $\frac{a}{2}$ (i) $10x^3y^3a^2b^2$
4. (a) $3x + 18$ (b) $-16a + 2$
 (c) $-3x^2 - 6x + 1$ (d) $-x + 7$
 (e) $-6ax + 14a - 3$ (f) $x^2 + 6x + 8$
 (g) $x^2 + 4x - 12$ (h) $-3x^2 - x + 14$
 (i) $81 - x^4$ (j) $x^4 + x^3 + 2x^2 + 4x - 8$
 (k) $2x^3 - 4x^2 - 18x + 8$
 (l) $x^2 + 6x + 9$ (m) $48x^2 - 96x + 48$
 (n) $x^2 + 7x + 19$
5. (a) $\frac{23x+4}{10}$ (b) $\frac{9x+7}{20}$ (c) $\frac{16x-5}{5}$
 (d) $\frac{7x+1}{12}$ (e) $\frac{7x+7}{4}$ (f) $\frac{-2x+35}{9}$
 (g) $\frac{-99p^2+2p+1}{100}$
6. (a) -13 (b) 25 (c) 38 (d) 48 (e) 74
7. (a) 31 (b) $\frac{11}{4}$ (c) $-\frac{47}{2}$ (d) 4 (e) -1

Exercise 1.1

1. (a) $4x$ (b) $(x)(x+3)$ (c) $(x)(x-4)$
 (d) $(5x)(2x+3)$ (e) $(2x)(2x+3)$
 (f) $4x(x+2)$ (g) $(3x)(x+2)$ (h) $2(x+2)$
2. (a) $\frac{3}{2x}$ (b) $\frac{16}{5x}$ (c) $\frac{13}{7x}$

- (d) $\frac{6x+10}{x(x+2)}$ (e) $\frac{13x+3}{(x+3)(4x)}$
 (f) $\frac{17x-18}{(x+6)5x}$ (g) $\frac{3x+6}{(x+4)(x+1)}$
 (h) $\frac{11x+24}{(2x+3)(x+3)}$ (i) $\frac{-2x-2}{x+3}$
 (j) $\frac{-x+6}{(2x+3)(x+3)}$ (k) $\frac{-x-4}{(x+1)(x-2)}$
 (l) $\frac{9x+9}{(x+3)(2x+3)}$
 (m) $\frac{x^2+14x+41}{(x+5)(x+3)(2)}$
 (n) $\frac{6x^2-3x-15}{2(2x-1)(x-3)}$
 (o) $\frac{-2x^2+2x+10}{(x-1)(x+1)}$ (p) $\frac{4}{(x+2)(x+3)}$
 (q) $\frac{-8x^2-27x-13}{(2x+2)(x+3)}$
 (r) $\frac{-6x^2-11x+27}{(3x-5)(3)(x-3)}$
3. (a) $\frac{5}{2x}$ (b) $\frac{x-4}{(x+1)(3x-2)}$
 (c) $\frac{-3x^2+24x-37}{(x-1)(x-3)(4)}$
 (d) $\frac{40x^2-80x+10}{(4x+1)(2x-3)}$
4. $p = 2$
 5. $k = 4$
 6. $r = -4, w = -1$
 7. $b = -3, c = 3$
9. $\frac{-9x+123}{(x-5)(2x+3)}$

Exercise 1.2

1. (a) $x + 1$ (b) $x + 6$ (c) $x + 2$
 (d) $2x + 4$ (e) $3x - 4$ (f) $4x - 3$

- (g) $3x - 2$ (h) $2x + 5$
 2. (a) $x^2 + 3x + 2$ (b) $x^2 + 4x - 5$
 (c) $2x^2 - 3x - 2$ (d) $4x^2 - 2x - 7$
 (e) $5x^2 - 6x + 1$ (f) $2x^2 - 6x - 9$
 (g) $7x^2 - 2x + 1$
 3. (a) $x^2 + 5x + 10$ (b) $x^2 + 8x + 24$
 (c) $2x^2 + 5x + 25$ (d) $2x^2 - 8x + 20$
 (e) $x^2 - x + 5$ (f) $2x^2 + 6x + 13$
 (g) $4x^2 + 2x + 1$ (h) $9y^2 + 6y + 4$
 4. (a) $x^2 - 3$ (b) $x^2 - 4$ (c) $2x^2 - 1$
 (d) $5x^2 - 4$
 5. $b = -8$, $c = -2$ 6. $p = 4$, $q = 16$
 7. $k = -1$

Chapter 1 review

1. (a) 8
 (b) (i) $4x^3 - 10x^2 - 2x + 5$
 (ii) $3x^2y$, 108
 (c) $\frac{7}{(2x-3)(2x+4)}$
 2. (a) $18x + 24$, 30 cm
 (b) (i) $(x+7)$ (ii) $x^2 - 3x - 2$
 (c) (i) $x^2 \quad 3x \quad +2$

$$\begin{array}{|c|c|c|} \hline x & x^3 & 3x^2 & 2x \\ \hline 3 & 3x^2 & 9x & 6 \\ \hline \end{array}$$

Total area = $x^3 + 6x^2 + 11x + 6$

3. (a) 1.2
 (b) (i) $x^2 - 3x - 4$ (ii) $16x - 29$
 (c) $3x^2 - 4x + 2$
 4. (a) $3x^5$

- (b) (i) $\frac{-6x+19}{12}, \frac{4}{3}$ (ii) $-4x - 10$
 (c) $k = 2$
 5. (a) (i) $4x + 8$ (ii) 24 cm
 (b) $4x^2 + 6x - 3$
 (c) $a = -12$, $b = -1$ and $c = 7$

6. (a) $\frac{-3x+15}{x(2x-5)}$ (b) $\frac{5x+9}{x(3x+9)}$
 (c) $\frac{(-x-2)(x+3)}{20}$

Chapter 2

Revision exercise 2

1. $2a(1+2a)$ 2. $(x^2 - 3y)(p - d)$
 3. $(p+1)(p-2b)$ 4. $6b(ab+4)$
 5. $(5x+7)(5x-7)$ 6. $(x+2)(x+4)$
 7. $(x-y)(4-d)$ 8. $3ab(ab+3)$
 9. $(x+9)(x-5)$
 10. $(5+11x)(5-11x)$
 11. $(y+5z)(y-5z)$
 12. $(r-y)(10t+1)$
 13. $4(4x+5y)(4x-5y)$
 14. $(5x+y)(1-y)$
 15. $(a+12b)(a-12b)$
 16. $(x+8)(x-7)$ 17. $(a+d)(p+b)$
 18. $(1+12x)(1-12x)$
 19. $(y-7)(y+5)$ 20. $(-7p)(p+2q)$
 21. $(x+5)(x+4)$
 22. $(q-r)(p+10)$
 23. $(x-8)(x-3)$
 24. $(3y+4xz)(3y-4xz)$
 25. $(p+1)(r-y)$
 26. $(x+10z)(x-10z)$
 27. $(y-1)(y+x)$ 28. $(l-m)(l-n)$
 29. $(y-17)(y+1)$ 30. $p(1-9p)$

Exercise 2.1

1. $(2x+1)(x+2)$ 2. $(2x+7)(x+3)$
 3. $(3x+2)(x+5)$ 4. $(2x+3)(2x+1)$
 5. $(2x+1)(x-3)$ 6. $(4x-1)(x-5)$
 7. $(6x+1)(x-3)$ 8. $(8x+1)(2x-3)$
 9. $(2x-7)(2x-1)$ 10. $(3x-8)(x-2)$
 11. $(4x+9)(2x-1)$ 12. $(x-2)(7x-4)$

13. $(2x - 5)(2x - 3)$ 14. $(4x + 1)(x - 3)$
 15. $(5x + 2)(x - 3)$
 16. $(4x + 1)(2x - 1)$ 17. $(5x + 4)(2x - 3)$
 18. $(5x - 6)(2x + 3)$ 19. $(7x - 3)(x + 2)$
 20. $(3x - 7)(3x + 2)$

Exercise 2.2

1. $4(a - b)(x + z)$ 2. $5(q - 2r)(p + 3)$
 3. $2(5x - 2)(b + c)$
 4. $x(2a - b)(3x + y)$
 5. $p(x - 1)(p + x)$ 6. $3(x + 10)(x + 2)$
 7. $5(x + 4)(x - 3)$ 8. $2(p + 7)(p - 4)$
 9. $6(r - 5)(r + 1)$ 10. $8(2x + 1)(x - 3)$
 11. $q(4p - 1)(p - 5)$ 12. $3(x + y)(x - y)$
 13. $30(p + 2q)(p - 2q)$
 14. $3x(2y + z)(2y - z)$
 15. $10q^2(x + 3y)(x - 3y)$
 16. $2(1 + 2x)(1 - 2x)$
 17. $7y(5x - 2)(x + 1)$
 18. $(-10)(p + 2q)(p - 2q)$
 19. $7(x + 2y)(x - 2y)$
 20. $(x^2 + y^2)(x + y)(x - y)$

Exercise 2.3

1. (a) $(3x - 2)(x + 4)$ (b) $(2x + 1)(x - 3)$
 (c) $(2x + 5)(x - 1)$ (d) $(2 - b)(ac - b)$
 (e) $4(2a + b)(2a - b)$ (f) $(3x + y)(3x - y)$
 2. $\frac{5}{36}$, $(x + y)(x - y)$
 3. (a) $\frac{1}{x + 4}$ (b) $\frac{x + 2}{2}$ (c) $\frac{x - 1}{x + 4}$
 (d) $\frac{a + c}{b}$
 4. $\frac{x + 3}{2}$ 5. $\frac{2}{x}, -1$ 6. $\frac{y - 4}{4}$
 7. $\frac{2(a + b)}{a - 1}, \frac{7}{2}$
 8. (a) 164 (b) 20 120 (c) 328

9. (a) 470 (b) 600 (c) 54 400

Chapter 2 review

1. (a) (i) $a(c - b)$
 (ii) $(3x + 1)(3x - 1)$
 (b) (i) $7(x + 2)(x - 2)$
 (ii) $a(b - 2a)(5b - y)$
 (c) $\frac{x}{x + 2}$
 2. (a) (i) $7x(x - 3)$
 (ii) $(2x - 7)(x - 1)$
 (b) (i) $\frac{2x}{x - 2}$ (ii) 2.4
 (c) 16 and 8
 3. (a) (i) $5x(3 - x)$ (ii) $(2 - k)(l - m)$
 (b) (i) $x(x + 2)(x - 2)$
 (ii) $2(x + 4y)(x - 4y)$
 (c) $3x - 7$
 4. (a) (i) $6b, 6b(2a^2 + 1 - 2b)$
 (ii) $xy, xy(x - y - 3)$
 (b) (i) $2(x + 4)(p + 9)$
 (ii) $4(6y + x)(6y - x)$
 (c) $x(3x + 2)$
 5. (a) (i) $py(x + 2py)$
 (ii) $(7x + 1)(2x - 5)$
 (b) $3x^2 - 4x - 15, (3x + 5)(x - 3)$
 (c) $a = 6, b = -8, c = 2$
 6. (a) (i) $2(x + 5)(x - 5)$
 (ii) $(3x - 8)(2x + 3)$
 (b) $\frac{12a - 24}{a + 1}, -6$
 (c) $4x - 4$

Chapter 3**Revision exercise 3**

1. 23, 29, 31, 37

2. (a) 5 (b) $\frac{1}{4}$ (c) 3 (d) $\frac{4}{3}$ (e) $5\cdot2\dot{4}$

3. 9 4. $\frac{20}{7}$ 5. (a) $\frac{18}{25}$ (b) $\frac{47}{3}$

6. (a) 0.8 (b) 5 (c) 0.3 (d) 0.12
(e) 5000 (f) 20.3

7. 46, 46.334 8. 20, 17.386

9. 2, 1.83 10. 1, 0.88

Exercise 3.1

1. (a) 5 (rational) (b) $\frac{3}{2}$ (rational)

(c) π (irrational) (d) $\sqrt{2}$ (irrational)
(e) $\sqrt{49}$ (rational)

(f) $\sqrt{\frac{1}{4}}$ (rational) (g) $-\sqrt{3}$ (irrational)

(h) $0.\dot{3}$ (rational)

2. (a) $2\sqrt{2}$ (b) $2\sqrt{3}$ (c) $3\sqrt{2}$ (d) $3\sqrt{3}$
(e) $5\sqrt{2}$ (f) $3\sqrt{11}$

3. (a) $3\sqrt{5}$ (b) $5\sqrt{3}$ (c) $3\sqrt{7}$

(d) $2\sqrt{11}$ (e) $6\sqrt{2}$ (f) $2\sqrt{15}$

4. (a) $10\sqrt{2}$ (b) $12\sqrt{22}$ (c) $12\sqrt{3}$

(d) $4\sqrt{5}$ (e) $16\sqrt{2}$ (f) $20\sqrt{2}$

5. (a) $\frac{2\sqrt{2}}{3}$ (b) $\frac{5\sqrt{2}}{7}$ (c) $\frac{3\sqrt{5}}{2}$ (d) $\frac{5\sqrt{2}}{3}$

(e) $\frac{\sqrt{7}}{2}$ (f) $\frac{\sqrt{31}}{5}$

6. (a) $6\sqrt{2}$ (b) $3\sqrt{7}$ (c) $5\sqrt{3}$

(d) $-3\sqrt{5}$

7. (a) $7\sqrt{2}$ (b) $3\sqrt{3}$ (c) $\sqrt{2}$ (d) $10\sqrt{5}$
(e) $-6\sqrt{2}$

8. $1 + \sqrt{2}$ 9. $5\sqrt{5}$ 10. $\frac{3}{4}$

Exercise 3.2

1. (a) 50 (b) -14 (c) $4\sqrt{10}$ (d) $6\sqrt{14}$
(e) $-6\sqrt{10}$

2. (a) 20 (b) -18 (c) $20\sqrt{14}$ (d) -108

3. (a) $\sqrt{10} + \sqrt{22} + \sqrt{15} + \sqrt{33}$
(b) $2\sqrt{15} - 2\sqrt{21} - \sqrt{10} + \sqrt{14}$
(c) $\sqrt{15} - 3\sqrt{5} + \sqrt{10} - \sqrt{30}$

4. (a) 6 (b) $10 + 5\sqrt{6}$

(c) $108 - 20\sqrt{35}$

5. (a) $5 + 2\sqrt{6}$ (b) $7 - 2\sqrt{10}$

(c) $44 - 16\sqrt{6}$ (d) $9 + 4\sqrt{5}$

6. (a) 1 (b) 3 (c) 2

7. (a) $\sqrt{3}$ (b) $\frac{5\sqrt{2}}{2}$ (c) $\frac{\sqrt{2}}{2}$ (d) $\frac{3\sqrt{2}}{2}$

(e) $\frac{3\sqrt{5}}{10}$ (f) $\frac{2\sqrt{7}}{21}$

8. (a) $\frac{\sqrt{2} + \sqrt{10}}{2}$ (b) $\frac{2\sqrt{3} + \sqrt{6}}{3}$

(c) $\frac{\sqrt{6} + 2\sqrt{3}}{6}$ (d) $\frac{4\sqrt{6} + 2\sqrt{30}}{6}$

(e) $1 + \sqrt{15}$

9. $\frac{9 + 5\sqrt{3}}{6}$

10. (a) $\frac{8}{3}$ (b) $\frac{21}{5}$ (c) $\frac{139}{5}$

Exercise 3.3

1. (a) a^5 (b) a^{11} (c) a^3 (d) 1 (e) a^3

(f) a^6 (g) a^8 (h) a^{12}

2. (a) $a^2 b^5$ (b) $b^4 a^8$ (c) $\frac{a^4}{b^6}$ (d) $\frac{a^4}{b^2}$
(e) $b^9 a^2$

3. (a) a^4 (b) a^{12} (c) $\frac{1}{a^8}$ (d) $\frac{b^3}{a^3}$ (e) $\frac{b^6}{a^3}$
(f) $\sqrt[3]{a}$

4. (a) 8 (b) 625 (c) 4 (d) 1 (e) 81

(f) 128 (g) 4 (h) 64

5. (a) 125 (b) 25 (c) 512 (d) 16 (e) 64
 (f) 8 (g) 32
6. (a) $\frac{8}{9}$ (b) $\frac{4}{25}$ (c) $\frac{3}{4}$ (d) $\frac{27}{64}$ (e) $\frac{1}{16}$
7. (a) 2^5 (b) 2^3 (c) 2 (d) 2^3 (e) 2^0
 (f) 2^4 (g) 2^9 (h) 2^7 (i) $2^{-\frac{1}{2}}$
8. (a) 3^3 (b) 3^{-2} (c) 3^1 (d) 3^{-3} (e) 3^0
 (f) 3^0 (g) 3^2
9. (a) 5^2 (b) 5^{-3} (c) 5^1 (d) 5^0 (e) 5^0
 (f) 5^{-1} (g) 5^2
10. (a) 0.5 (b) 1.6 (c) 1.7 (d) 0 (the answer is 0.04) (e) 0.1 (f) 2.9
11. 4^{-3} 12. 8^2 13. 5^{-3} 14. $a^{\frac{19}{6}}$
15. $k = 2$

Exercise 3.4

1. (a) 6×10^4 (b) 2×10^7 (c) 3.5×10^6
 (d) 3.25×10^5 (e) 5.49×10^5
2. (a) 4×10^{-2} (b) 1.4×10^{-3}
 (c) 2.335×10^{-3} (d) 3.6125×10^{-1}
 (e) 5.14×10^{-2} (f) 5.347×10^{-5}
3. (a) 80 000 (b) 820 000 (c) 421.34
 (d) 65 987 (e) 6560.20
4. (a) 0.06 (b) 0.008 32
 (c) 0.000 256 7 (d) 0.000 005 55
 (e) 0.000 070 99
5. (a) 3.05×10^6 (b) 8.72×10^5
 (c) 3.66×10^6 (d) 8.66862×10^5
6. (a) 4.06×10^{-2} (b) 5.371×10^{-3}
 (c) 3.456×10^{-4} (d) 9.812×10^{-4}
7. (a) 1606.96 (b) 109.84 (c) 0.35
8. (a) 2.8×10^{-1} (b) 2.5002×10^{-1}
 (c) 1.548×10^6
9. (a) 1.4 (b) 13.572 (c) 54.644
10. (a) Sun 6.95×10^8 m,
 Earth 6.35×10^6 m

(b) 1.3773×10^6 km

Chapter 3 review

1. (a) 1, 2, 3, 4, 6, 8, 12, 24
 (b) 4^0 (c) 17, 15.96
2. (a) $a = 2$, $b = 3$ (b) 4.72×10^7
 (c) 4, 4.19
3. (a) $\sqrt{7}$ (b) $a^{\frac{19}{6}}$ (c) 1.764×10^{-1}
4. (a) 8, 8.12
 (b) (i) 12 (ii) 60 (iii) $2 \times 5 \times 7 \times 11$
 (c) (i) $\frac{\sqrt{10} + 2\sqrt{2}}{2}, 6$ (ii) $\frac{139}{5}$
5. (a) 3^{-1} (b) 2.37×10^{-1} (c) 3, 3.58
6. (a) (i) 5, 10, 15, 20, 25, 30, 35;
 7, 14, 21, 28, 35, 42 (ii) 35
 (b) $\frac{81}{8}$ (c) $2.5 \times 10^{18} : 1$

Chapter 4

Revision exercise 4

1. (a) 3 (b) -1 (c) 2
2. (a) 14 (b) 3 (c) 6
3. (a) 7 (b) 6 (c) 1
4. (a) $-\frac{5}{7}$ (b) $\frac{10}{7}$ (c) $\frac{19}{2}$
5. (a) 1 (b) -1 (c) -1
6. (a) -8 (b) -5 (c) -3
7. (a) 2 (b) 5 (c) 2
8. (a) 2 (b) 7 (c) 3
9. (a) -12 (b) -17 (c) -44
10. (a) $-\frac{33}{10}$ (b) $-\frac{4}{7}$ (c) $-\frac{5}{3}$
11. (a) $x = 3$, $y = 8$ (b) $x = 1$, $y = 2$
 (c) $x = 5$, $y = 3$
12. (a) $x = 4$, $y = -2$ (b) $x = -1$, $y = 2$
 (c) $x = -3$, $y = 4$

13. (a) $x = 2, y = 2$ (b) $x = 8, y = 1$
 (c) $x = 3, y = -4$

14. (a) $x = \frac{1}{2}, y = 5$ (b) $x = \frac{1}{2}, y = \frac{1}{2}$

(c) $x = \frac{1}{2}, y = -\frac{1}{4}$

15. (a) $x = 3, y = -1$ (b) $x = 4, y = 2$

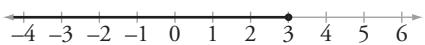
(c) $x = 5, y = -1$

16. $\{0, 1, 2, 3\}$

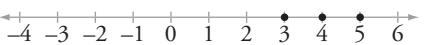
17.



18.



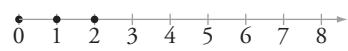
19.



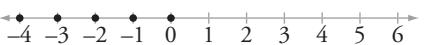
20.



21. $\{0, 1, 2\}$



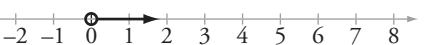
22.



23.



24.



25. $\{2, 1, 0\}$

Exercise 4.1

1. $x = 2, y = 3$ 2. $x = 2, y = -1$

3. $x = 2, y = -6$ 4. $x = -1, y = -3$

5. $x = -1, y = -4$ 6. $x = 2, y = 5$

7. $x = -4, y = -3$ 8. $x = -1, y = -7$

9. $x = 3, y = 3$

Exercise 4.2

1. 36 2. 16 3. 4 4. 1 5. 1 6. 4

7. 11 8. 8 9. $\frac{25}{4}$ 10. 1 11. 9 12. -4

Exercise 4.3

1. 4 2. 2 3. 1 4. 1 5. 5

6. 4 7. -2 8. $\frac{1}{3}$ 9. -3 10. -3

Exercise 4.4

1. $b = \frac{c-a}{2}$ 2. $p = \frac{4r-3t}{5}$

3. $c = \frac{a+4b}{5}$ 4. $b = \frac{3a-c-2}{5}$

5. $r = \frac{3p-q-4}{6}$ 6. $y = \frac{2z-3x}{6}$

7. $b = \frac{5a-2c-6}{20}$ 8. $y = \frac{3x-6z}{4}$

9. $r = \frac{2q-s^2}{4s}$ 10. $q = \frac{s^2-8rs}{4}$

11. $z = \frac{3xy-12}{2y}$ 12. $y = \frac{2z-6x}{xz}, -4$

13. $z = \frac{y^2-x}{3}, 6$ 14. $g = \frac{4\pi^2 l}{T^2}$

15. $q = \frac{p^4+12r}{4}$ 16. $y = \frac{12}{3x-2z}$

17. $b = \frac{3ac}{a-c}$ 18. $z = \frac{6x}{2-xy}, \frac{12}{7}$

20. $p = \sqrt{\frac{qy+q^2}{3}}$ 21. $d = \frac{2S-2na}{n^2-n}$

22. $y = 9 - 16p, 25$

23. $8 - 8a - 9b, 21$

24. $z = (a-2b)^2 - 2(a-b-5), 9$

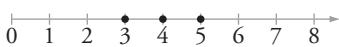
25. (b) $v = \frac{s + \frac{1}{2}at^2}{t}$

Exercise 4.5

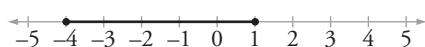
1. $-3 < x \leq 3$ or $\{-3, -2, -1, 0, 1, 2, 3\}$



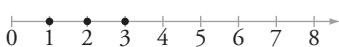
2. $3 \leq x < 6$ or $\{3, 4, 5\}$



3. $-4 \leq x \leq 1$



4. $0 < x < 4$ or $\{1, 2, 3\}$



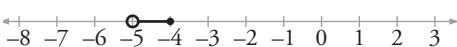
5. $-1 \leq x \leq 6$ or $\{-1, 0, 1, 2, 3, 4, 5, 6\}$



6. $-1 \leq x < 4$ or $\{-1, 0, 1, 2, 3\}$



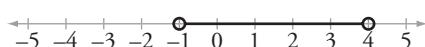
7. $-5 < x \leq -4$



8. $-4 \leq x \leq 1$ or $\{-4, -3, -2, -1, 0, 1\}$



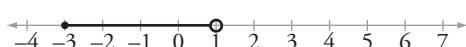
9. $-1 < x < 4$



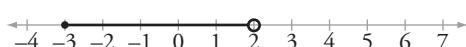
10. $-\frac{1}{2} < x \leq 5$ or $\{0, 1, 2, 3, 4, 5\}$



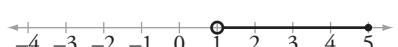
11. $-3 \leq x < 1$



12. $-3 \leq x < 2$



13. $1 < x \leq 5$



14. $x = 3$

15. $\{2, 3, 4, 5, 6, 7\}$

Exercise 4.6

1. (a) $25x$ (b) $30(x+2)$ (c) 2 cent

2. (a) $x-3$ (b) 27

3. (a) $(12-x)$ (b) 2 hours

4. 11 wins 5. 15

6. (a) $\frac{x}{100}$ (b) $\frac{x}{70}$ (c) 140 km

7. (a) $\frac{x}{20}$ (b) $\frac{x+200}{2}$

(c) Week 1: €50, Week 2: €600

8. (a) $\frac{10x}{3}$ (b) $2x$

(c) Lawn: €22, Flower-bed: €33

9. (a) $n+2$ (b) $n=123$, $n+2=125$

10. 12, 13

Exercise 4.7

1. 6, 8 2. 40, 35

3. (a) $5x+3y=390$, $8x+4y=580$

(b) Apple: 45 cent, Pear: 55 cent

4. (a) $4x+3y=430$, $6x+2y=520$

(b) 70 cent, 50 cent

5. (a) $x+y=30$, $20x+50y=720$

(b) $x=26$, $y=4$

6. (a) $x+y=50$, $10x+50y=1700$

(b) $x=20$, $y=30$

7. (a) $x+y=132$, $8x+20y=1200$

(b) 120 cars, 12 buses (c) €780

8. 40 and 30

9. (a) $4x+5y=8.7$, $\frac{1}{2}x+2y=2.6$

(b) Milk: 80 cent, Sugar: €1.10

(c) €15.80

10. (a) $x+y=19$, $\frac{1}{2}x+2y=14$

(b) 16 boys, 3 girls

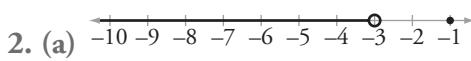
Chapter 4 review

1. (a) $\frac{1}{2}$ (b) (i) $x = \frac{5p+3y}{2}$

(ii) $y = \frac{2x-5p}{3}, -\frac{1}{12}$

(c) (i) $6x + 4y = 700$, $3x + 5y = 515$

(ii) Apple: 80 cent; Pear: 55 cent



(b) $x = \frac{3z}{3-yz}, \frac{3}{2}$

(c) Sharon: 24, Orla: 22

3. (a) $x = 4, y = 0$

(b) (i) $4x + \frac{3x}{4} = 4(x+6)$ (ii) 32

(c) $\{-2, -1, 0, 1\}$

4. (a) 3 (b) (i) $\frac{-7x+19}{12}$ (ii) $\frac{20}{7}$

(c) (i) $x + (x+1) + (x+2) = 213$

(ii) 70, 71, 72

5. (a) $x = 1, y = -1$

(b) $-5b^2 + 10ab + 28a - 14b, 96$

(c) (i) $n + 2$ (ii) 160 and 162

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

(b) (i) $a = \frac{y-3}{3}$ (ii) $z = -y - 3, 2$

(c) (i) $3x + 4y = 47, 4x + 3y = 51$

(ii) Adult: €9, Child: €5

Chapter 5

Revision exercise 5

1. 0, 4 2. 0, -6 3. 6, 2 4. 8, -1 5. 10, 5

6. -3, -2 7. -4, -4 8. -9, -1 9. -8, -4

10. -3, -7 11. 2, 4 12. 6, 2 13. 3, 7

14. 3, 3 15. 3, 8 16. -3, 1 17. 5, -4

18. -5, 3 19. 9, -2 20. 3, -2

Exercise 5.1

1. 0, $-\frac{4}{3}$ 2. 0, $\frac{6}{5}$ 3. -3, 4 4. $\frac{1}{5}, -\frac{1}{2}$

5. $-\frac{1}{2}, -1$ 6. $-\frac{1}{3}, -2$ 7. $-\frac{1}{4}, -4$ 8. $\frac{1}{2}, 1$

9. 3, $\frac{1}{4}$ 10. $-\frac{2}{3}, 2$ 11. $\frac{5}{4}, -3$ 12. $-\frac{4}{7}, 2$

13. $-\frac{8}{3}, 3$ 14. $-\frac{9}{5}, 6$ 15. $-\frac{7}{4}, \frac{8}{3}$

16. $-\frac{5}{2}, \frac{6}{5}$ 17. $-9, \frac{3}{7}$ 18. $-16, \frac{2}{3}$

19. $\frac{3}{5}, -\frac{7}{2}$ 20. 1, -5 21. 0, -2

22. 0, -2 23. 0, 2 24. 0, $-\frac{4}{5}$

25. 0, 4 26. 0, $\frac{10}{3}$ 27. 0, $-\frac{3}{13}$

28. 0, $\frac{3}{2}$ 29. 0, $\frac{12}{7}$ 30. 0, $\frac{2}{7}$

31. $\frac{3}{2}, -\frac{3}{2}$ 32. 2, -2 33. $\frac{10}{3}, -\frac{10}{3}$

34. $\frac{1}{2}, -\frac{1}{2}$ 35. $\frac{5}{7}, -\frac{5}{7}$ 36. 2, -2

37. $\frac{7}{2}, 3$ 38. 2, 2 39. 3, -4 40. $\frac{3}{2}, -\frac{3}{2}$

Exercise 5.2

1. 2, -2 2. 3, -2 3. $\frac{1}{2}, \frac{3}{2}$ 4. 1, -4

5. 2, -2 6. 4, 3 7. $\frac{1}{2}, -1$ 8. 6, 5

9. 3, 3 10. -10, 1 11. $\frac{2}{3}, 0$ 12. $-\frac{2}{3}, 2$

13. $-\frac{1}{2}, -1$ 14. $-\frac{1}{10}, 5$ 15. $-\frac{1}{2}, 2$

16. -5, 3 17. -7, 4 18. -3, 2

19. 2, 1 20. 4, -2

Exercise 5.3

1. $-0.38, -2.62$
2. $-0.44, -4.56$
3. $-0.59, -8.41$
4. $-0.22, -2.28$
5. $0.78, -1.28$
6. $0.46, -1.46$
7. $6.37, 0.63$
8. $1.54, -1.3$
9. $1.29, -1.09$
10. $0.43, -0.77$
11. $1.05, 0.96$
12. $0.34, -1.74$
13. $0.56, -0.36$
14. $2.60, -0.26$
15. $1.47, -1.14$
16. $8.77, 0.23$
17. $3.56, -0.56$
18. $28.54, -0.04$
19. $16.43, -2.43$
20. $3 \pm 2\sqrt{3}$
21. $5 \pm \sqrt{5}$
22. $4 + \sqrt{2}$
23. $-3 + \sqrt{6}$
24. $6 \pm 2\sqrt{10}$
25. $p \pm \sqrt{p^2 - p}$

Exercise 5.4

1. $x = 7, x = -5; t = 8, t = -4$
2. $x = 10, x = 5; y = \frac{25}{4}, y = \frac{15}{4}$
3. $x = \frac{3}{2}, x = -\frac{5}{6}; t = -\frac{3}{4}, t = -\frac{23}{12}$
4. $x = 1, x = -1; y = \frac{3}{2}, y = -\frac{3}{2}, y = 1, y = -1$
5. $x = 6, x = 2; t = -3, t = 2, t = -2, t = 1$
6. $x = -5, x = -4; t = -4, t = -1, t = -2$
7. $x = 1.27, x = -6.27; t = 0.57, t = -1.32$
8. $x = 2.18, x = 0.15; x = 0.24, x = 0.47$
9. $x = 2.65, x = -1.05; t = 0.34, t = -0.34, t = 0.45, t = -0.45$
10. $x = 2.62, x = 0.38; t = 2.38, t = -2.38, t = 1.84, t = -1.84$

11. $x = \pm\sqrt{5}, t = \pm\frac{\sqrt{5}}{5}$

12. $x = \frac{6 \pm 2\sqrt{6}}{6}, t = \frac{-6 \pm 2\sqrt{6}}{6^2}$

13. $x = 2, x = -1$ (not valid); $y = 1$

14. $x = 6, x = 1$ (not valid, as $\sqrt{4} = 2$ not ± 2); $y = 1$

15. $x = 3, x = -1; t = 2, t = -2$

Exercise 5.5

1. 12 or -15
2. (a) $x(x + 10) = 600$ or
 $x^2 + 10x = 600$ (b) 20, -30
3. (a) $6x^2 = 2x + 28$ (b) -2
4. (a) $(2n)^2 + (2n + 2)^2 = 164$
(b) $n = 4$; the two numbers are 8 and 10
5. (a) $(12 - x)$ (b) 10 cm, 2 cm
6. Base = 20 cm; height = 10 cm
7. (a) $x^2 + (x + 3)^2 = 15^2$ (ii) 9 cm
8. (a) $x^2 + 9x + 20 = 30$
(b) 1 cm, perimeter = 22 cm
9. (a) $2x^2 + 6x = 108$ or
 $x^2 + 3x = 54$ (b) 6 cm (c) $108\pi \text{ cm}^3$
10. (a) $x^2 + 40x = 1200$ (b) 20 cm
(c) 4 litres
11. (a) $\frac{3600}{x} = \frac{3600}{x+5} + 500$ (b) 4
12. (a) $\frac{300}{x}$ (b) $\frac{450}{x+1}$
(c) $\frac{300}{x} + \frac{450}{x+1} = 300$ (d) 2 cent
13. (a) $\frac{1000}{x}$ (b) $\frac{1200}{x+5}$
(c) $\frac{1000}{x} - \frac{1200}{x+5} = 20$
(d) $x = 10$; 15 laptops

14. (a) $\frac{20}{x} + \frac{20}{x-3} = 3$ (b) 15 km/h (c) (i) $\frac{2000}{x}$ (ii) $\frac{3000}{x+5}$
 15. (a) $\frac{0.5}{x} + \frac{14}{x+30} = \frac{1}{2}$ (b) 5 km/h (iii) $\frac{2000}{x} = \frac{3000}{x+5} + 100$; 5
 16. (a) $\frac{100}{x}$ (b) $\frac{20}{x-20}$ 4. (a) 3.93, -0.59 (b) 4; 2, -2
 (c) $\frac{100}{x} + \frac{20}{x-20} = \frac{7}{2}$ (d) 40 km/h (c) (i) $(n)^2 + (n+2)^2 = 290$
 17. (a) $\frac{6000}{x}$ (b) $\frac{6000}{x-5} - \frac{6000}{x} = 100$ (ii) $n = 11$; 11 and 13
 (c) $x = 20$ students 5. (a) -3, 2
 18. (a) $\frac{20000}{x}$ (b) $\frac{20000}{x-10}$ (b) (i) 4, -2 (ii) -2, -1, -4 and 1
 (c) $\frac{20000}{x} + 100 = \frac{20000}{x-10}$; 50 rows (c) (i) $\frac{300}{x}$ (ii) $\frac{70}{x+2}$
 19. (a) $\frac{200}{x}$ (b) $\frac{300}{x+2}$ (iii) $\frac{300}{x} + \frac{70}{x+2} = 30$; $x = 12$
 (c) $\frac{200}{x} + 5 = \frac{300}{x+2}$; $x = 10$ or $x = 8$ 6. (a) 0, $\frac{13}{6}$ (b) (i) $\frac{10}{4x^2-25}$ (ii) 3, -3
 20. (a) $\frac{1050}{x}$ (b) $\frac{1050}{x} = \frac{1050}{x+8} + 4$ (c) (i) $\frac{10}{x}$ (ii) $\frac{16}{x-5}$
 (c) 42 stamps (iii) $\frac{10}{x} + \frac{16}{x-5} = \frac{94}{60}$; $x = 20$ km/h

Chapter 6

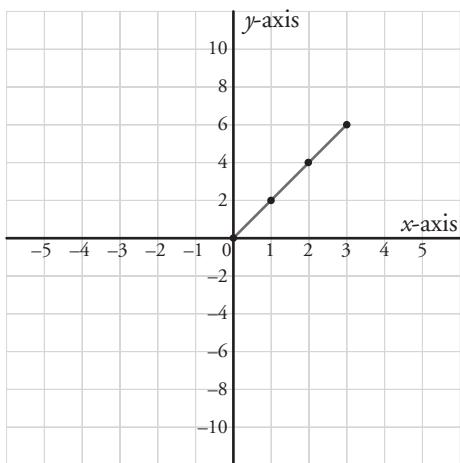
Revision exercise 6

1. (a) 5 (b) 9 (c) 1 (d) -3 (e) 3
2. (a) -6 (b) -5 (c) -2 (d) $-4\frac{1}{4}$ (e) -4
3. (a) -6 (b) -3 (c) -7 (d) $-4\frac{3}{4}$ (e) -3
4. {-5, -3, -1, 1} 5. {16, 7, 2, 1, 4}
6. (a) 0 (b) $-1 < 1$
7. (a) $x = 2$ (b) $\frac{9}{4}$ (c) $x = -3$
8. (a) $x = -14$ (b) $x = -26$ (c) $x = 6$
9. $k = 7$ 10. (a) $b^2 - 4b - 5$
 (b) $(b-1)^2 - 4(b-1) - 5 = b^2 - 6b$;
 $b = \frac{5}{2}$

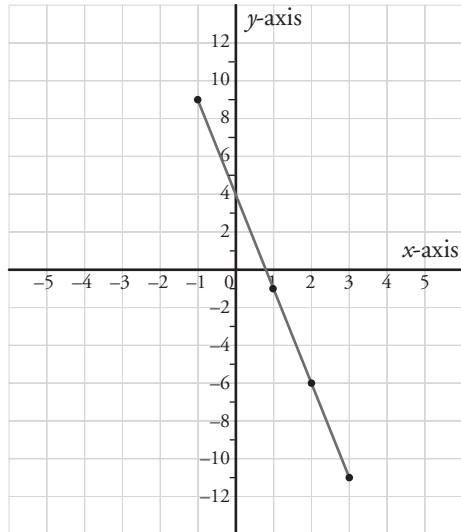
Chapter 5 review

1. (a) $\frac{4}{7}, 2$
 (b) (i) 2.4, -0.9 (ii) 0.5, -0.6
 (c) (i) $24x^2 = 1350$ (ii) $x = 7.5; 75$,
 60 and 45
2. (a) $2 \pm \sqrt{5}$ (b) 6, -1
 (c) (i) $\frac{1200}{x}$ (ii) $\frac{1200}{x+10}$
 (iii) $\frac{1200}{x} = \frac{1200}{x+10} + 10$; $x = 30$
3. (a) 7, 1
 (b) (i) 6.83, -1.83 (ii) 0.15, -0.55

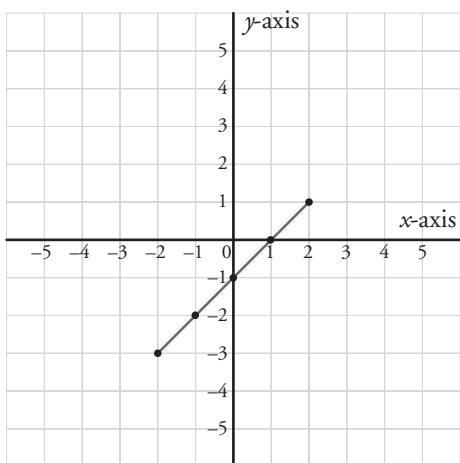
11.



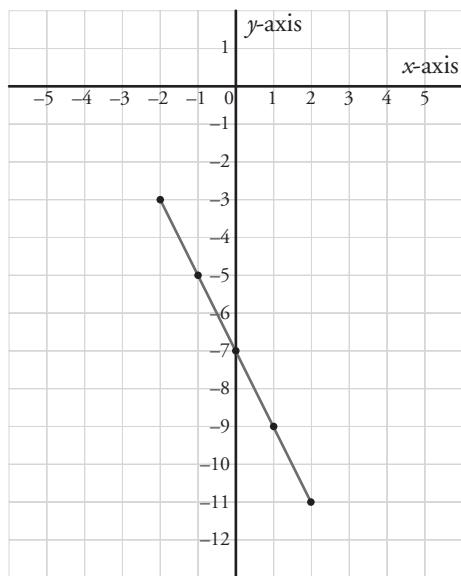
13.



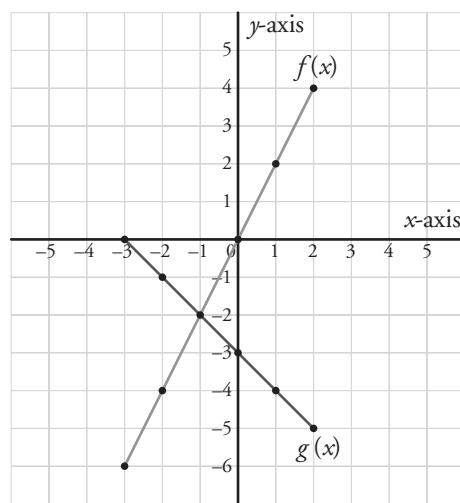
12.



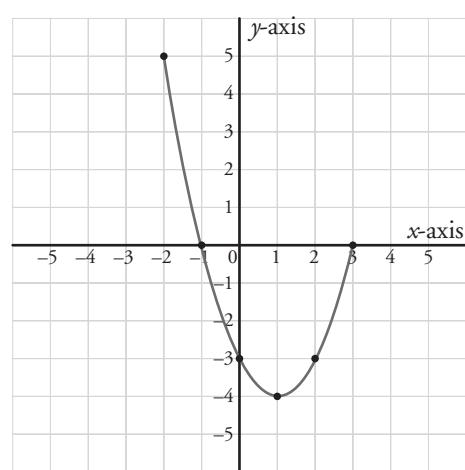
14.



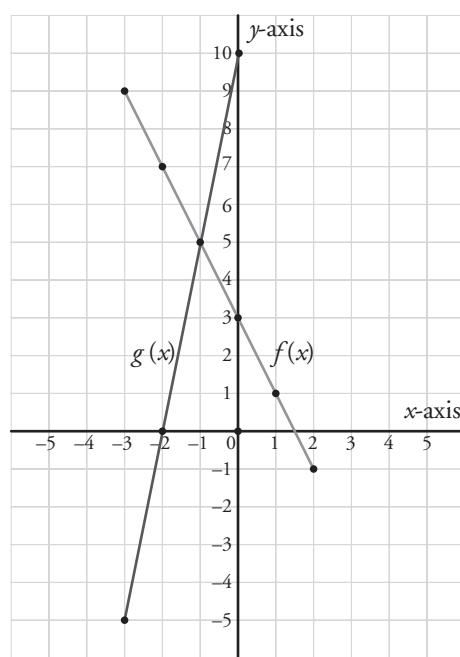
15. Point of intersection $(-1, -2)$



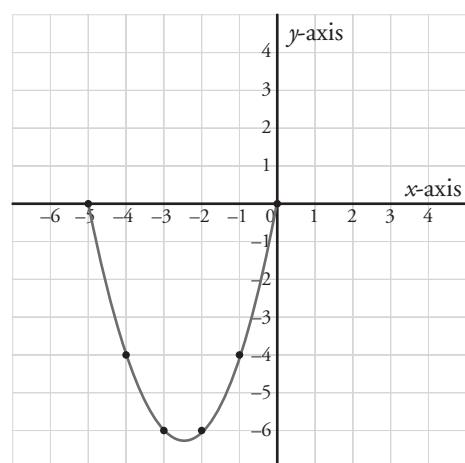
17.



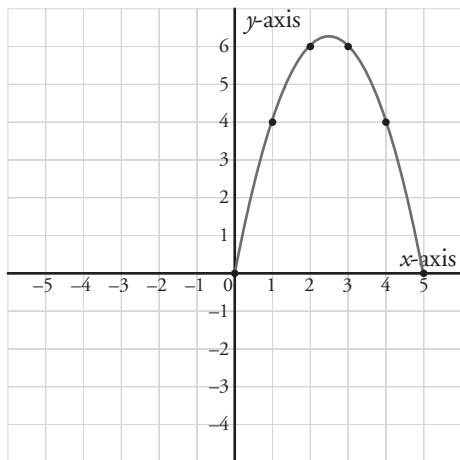
16. Point of intersection $(-1, 5)$



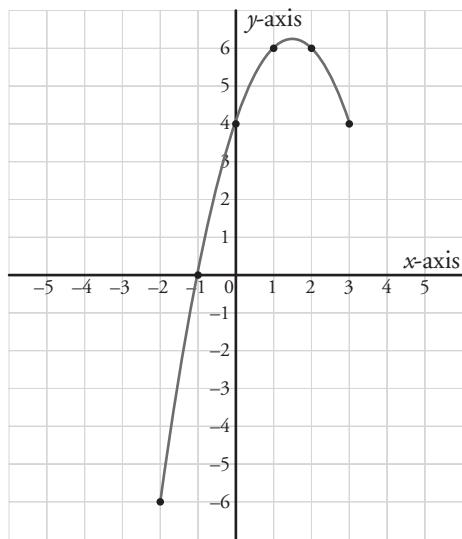
18.



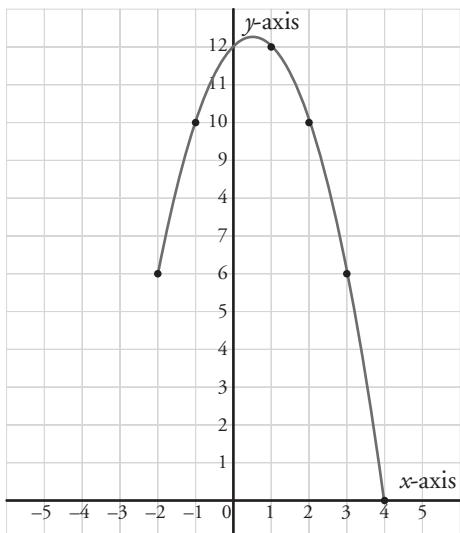
19.



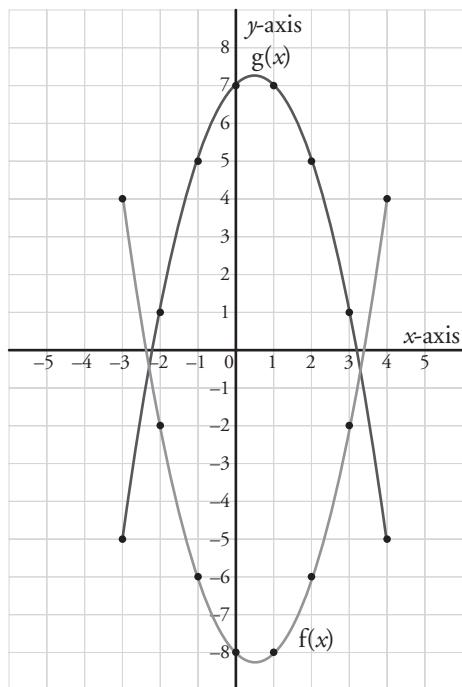
21.



20.

22. x values of intersection:

$$x = -2.3, x = 3.3$$



Exercise 6.1

1. (a) -18 (b) $-11 < -3$

2. $k = -5$

3. (a) (i) $4b - 3$ (ii) $4(b + 1) - 3$
 (b) $4b - 3 < 4b + 1$

4. $-\frac{2}{3}, -\frac{2}{5}$; $k = -2$ 5. $2\sqrt{5}, 2\sqrt{7}$

6. (a) 81, 1 (b) $x = -1$

7. (a) $k^2 - k - 20, 4k^2 - 2k - 20$

(b) $k = 0, k = \frac{1}{3}$

8. (a) $5x + 4, 2x - 2$ (b) $x = -2$

9. (a) 0, 0 (b) 3 (c) $\frac{1}{2}, -\frac{1}{2}$

10. (a) $-7, -2$ (b) $x = 6$ (c) 5, 1

11. (a) 69, 3 (b) $x = 1, x = -1$

12. (a) $p = -2, q = 6$ (b) $x = -1$

13. (a) $t = 2, r = 1$ (b) $x = 26$

14. (a) $b = -2, c = 1$ (b) $x = 1$

(c) $k = 0, k = 3$

15. (a) $a = 5, b = -10$ (b) $x = 1$

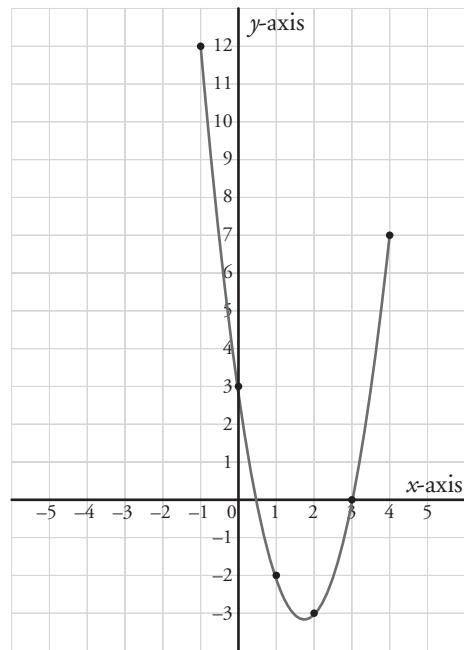
(c) $k = \frac{6}{5}, k = -1$

16. (a) $c = 6, a = -3, b = -5$

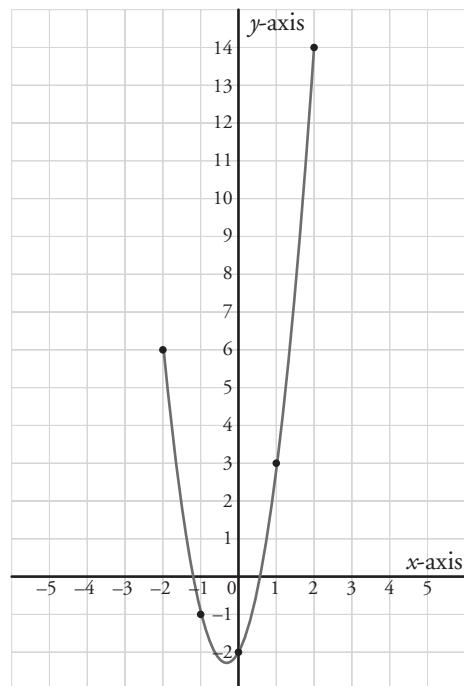
(b) $x = -2, x = \frac{1}{3}$ (c) $k = 2, k = -1$

Exercise 6.2

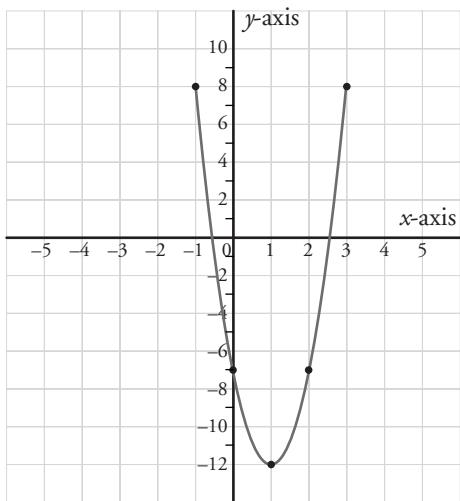
1.



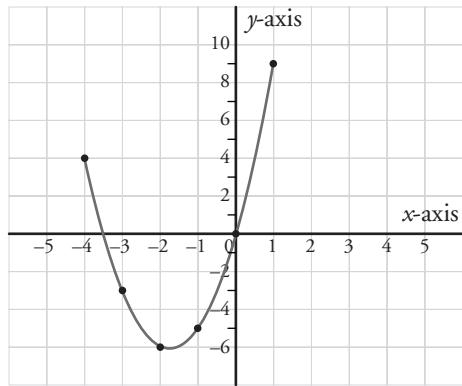
2.



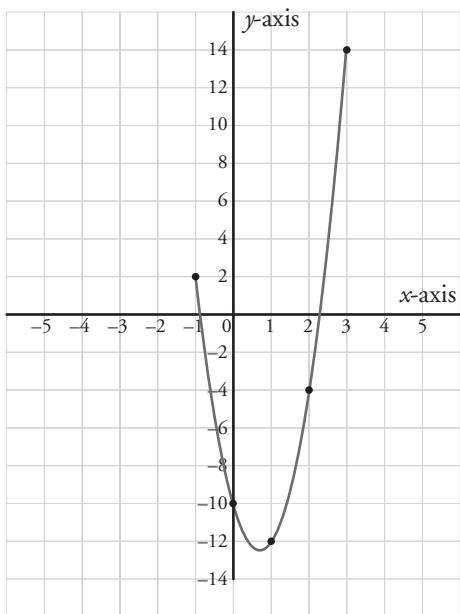
3.



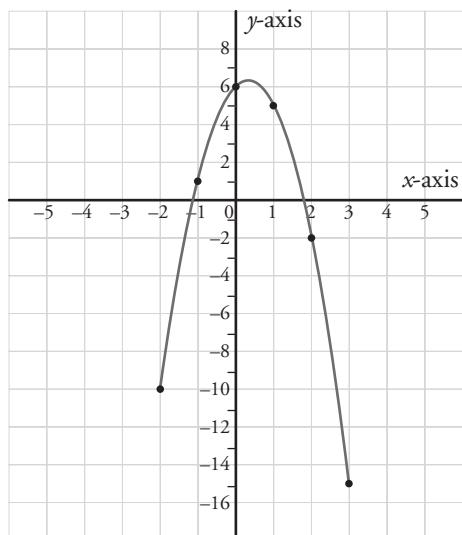
5.



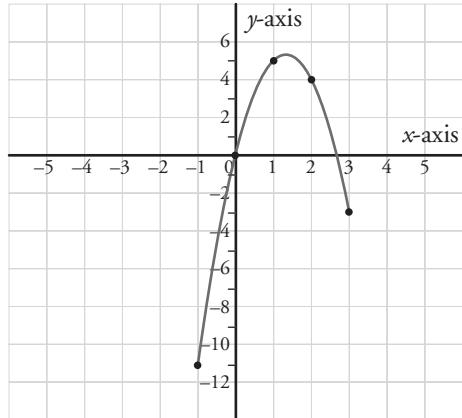
4.



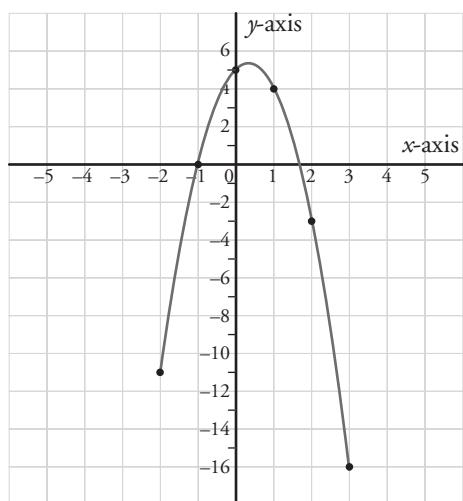
6.



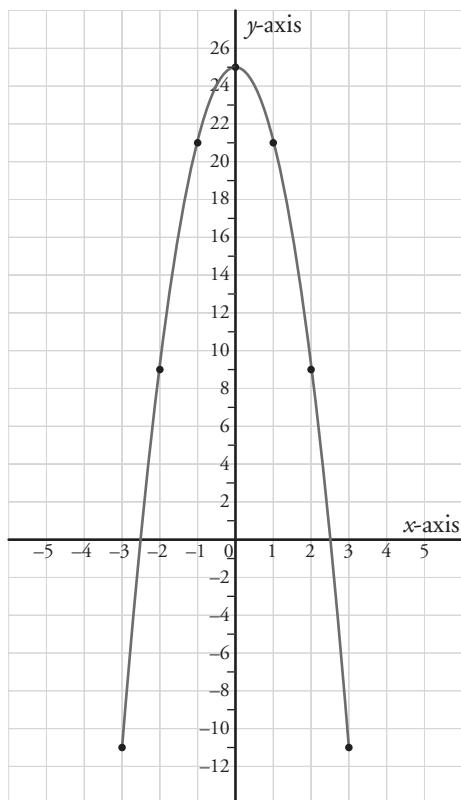
7.



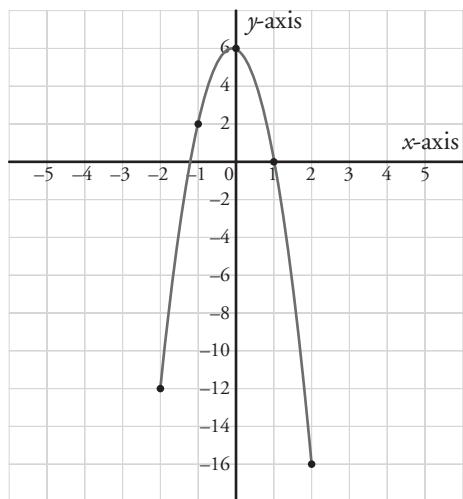
8.



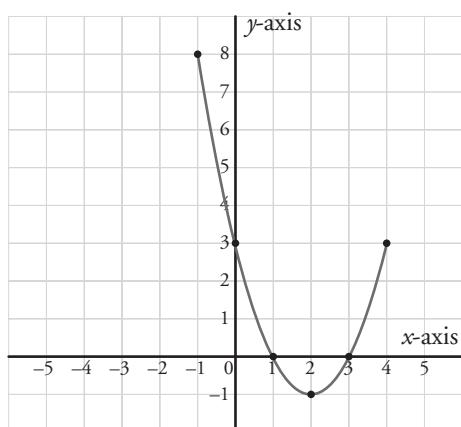
10.



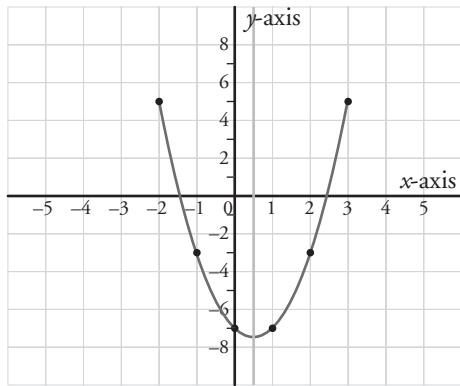
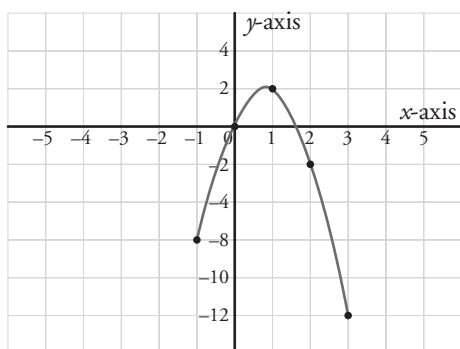
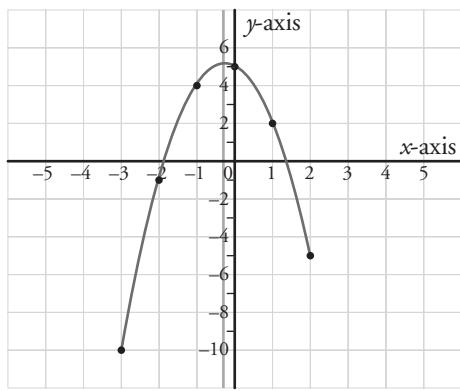
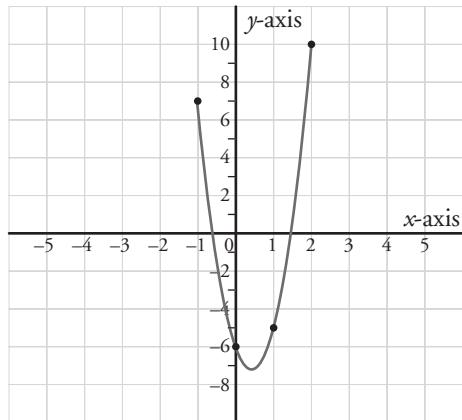
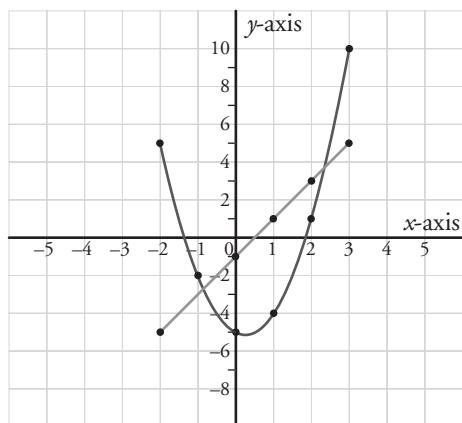
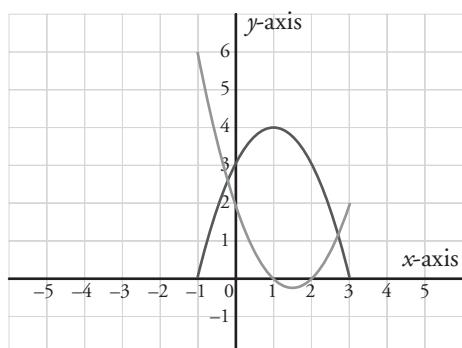
9.

**Exercise 6 .3**

1. (a) $x = 1, x = 3$ (b) $1 \cdot 3$
 (c) -1 (d) $1 < x < 3$



2. (a) $x = -0.6, x = 1.6$

(b) -7.5 (c) $x = 0.5$ 3. (a) $x = 0, x = 1.7$ (b) $-1 \leq x < 0.9$ (c) $0 < x < 1.7$ (d) $-1 \leq x < 0$ and $1.7 < x \leq 3$ 4. (a) $x = -0.3$ (b) $-5 \leq k < 5.2$ (c) $x = -1.8, x = 1.3$ (d) $x = -1.5, x = 1$ 5. (a) -7.4 (b) $k < -7.4$ (c) $x = -0.6, x = 1.45$ (d) $x = -0.35, x = 1.2$ 6. (a) -2 and 2 (b) $-0.85, 2.35$ (c) $-0.85 < x < 2.35$ (d) $x = -1.95, x = 2.25$ 7. (a) 4 (b) $x = -0.2, x = 2.7$ (c) $-0.2 \leq x \leq 2.7$ 8. (a) $x = -0.25, x = 2.25$ (b) -1.2

(c) $x > 0.9$ (d) $2.25 < x \leq 3$

9. (a) $x = -2, x = 4$

(b) Max 9, Min -9

(c) $x < -2, x > 4$ (d) $(1, 9)$

10. (a) $a(-1, 0), b(4, 0), c(0, 4)$

(b) $-1 < x < 4$

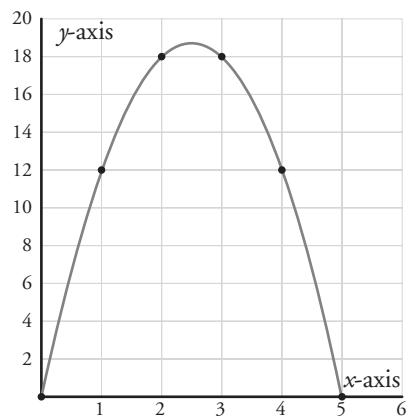
11. (a) $a(2, 0), b(3, 0), c(0, 6)$

(b) $x = 2.5$

12. (a) $a(2, 0), b(3, 0), c(0, 6), p(0, -2)$

(b) $x < 2, x > 4$

4. (a)



(b) 12 m^2 (c) 18.8 m^2

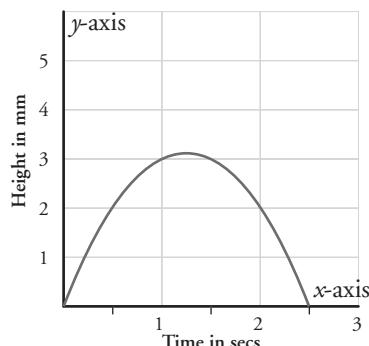
(d) $x = 1.4 \text{ cm}, x = 3.6 \text{ cm}$

5. (a) -9°C (b) -15.2°C

(c) 3:30 am (d) 11 hours

Exercise 6.4

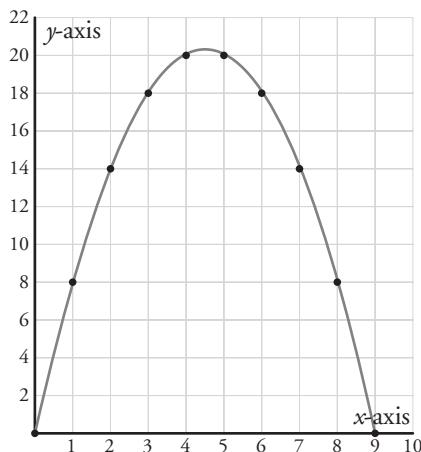
1. (b) 3.1 m (c) 3 m (d) 1.5 sec



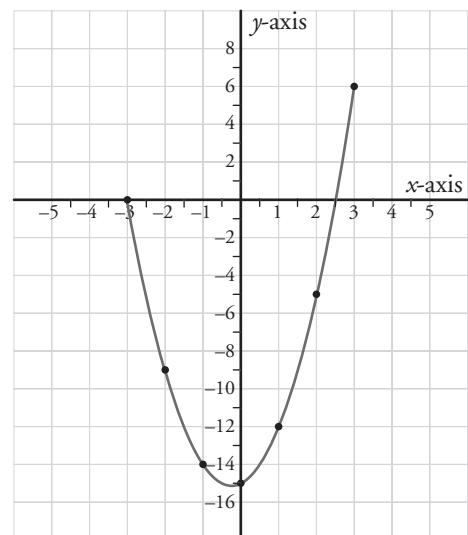
2. (a) 200 m (b) 265 m

(c) 120 m (d) 3.4 sec

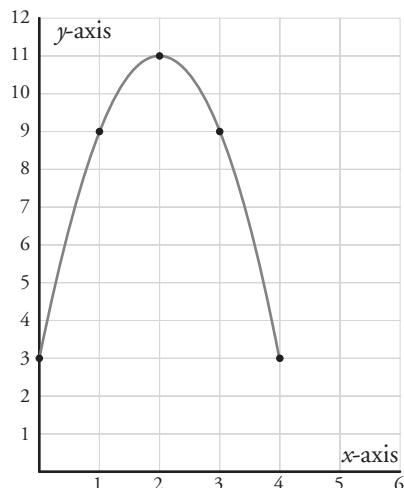
3. (b)



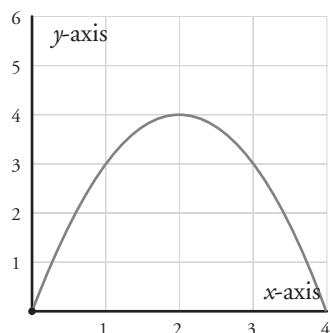
(c) 20 cm^2 (d) 20.25 cm^2



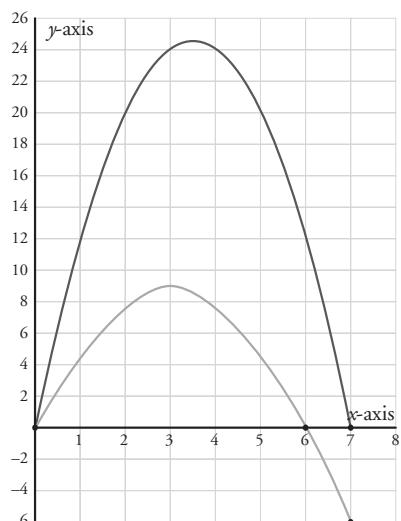
6. (a) 45°C (b) 55°C
 (c) 2 minutes (d) 15°C



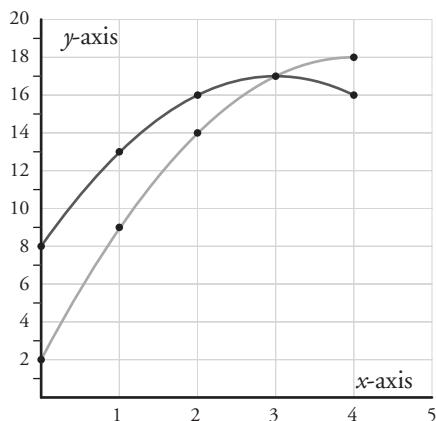
7. (a) 3.7 cm^2 (b) 4 cm^2 (c) 2



8. (a) 6 sec, 7 sec (b) 9 m, 24.5 m
 (c) 16 m

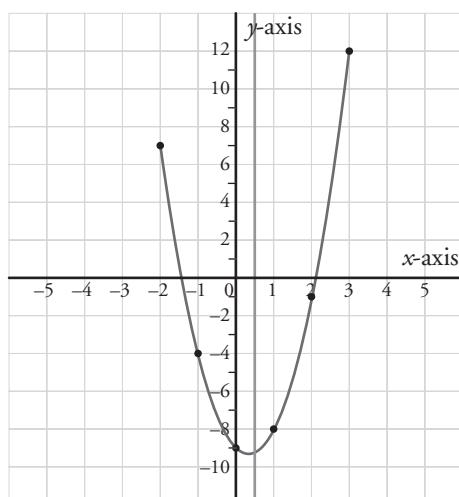


9. (a) Thursday (b) €17, €18 (c) €2



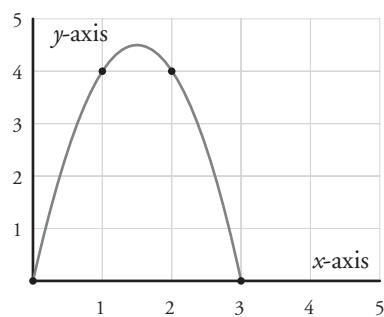
Chapter 6 review

1. (a) (i) -6 (ii) $-18 > -43$
 (b)



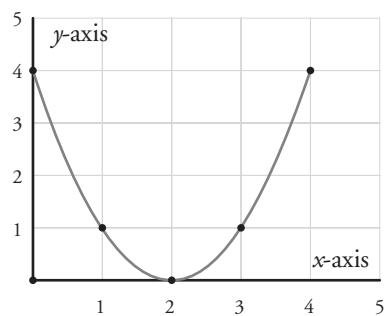
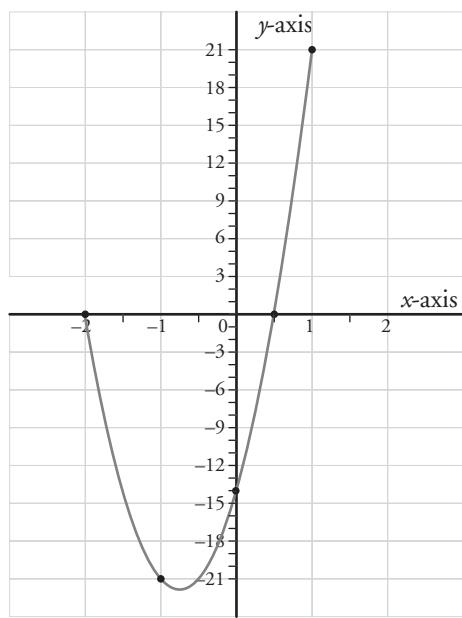
- (c)(i) $-0.8, 1.5$ (ii) 6 (iii) $x = 0.3$
 (iv) $-1.5 < x < 0.3$
 2. (a) $2\sqrt{2}, 4\sqrt{2}$

(b)



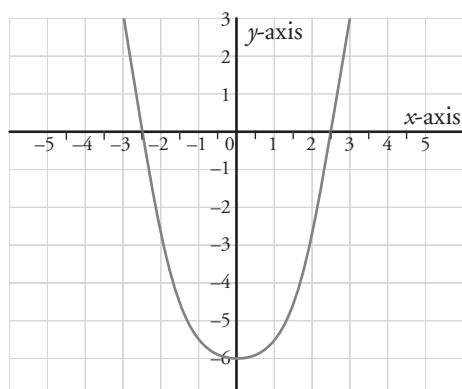
(c) (i) 4.5 m (ii) 4 m (iii) 2.4 sec

3. (b)

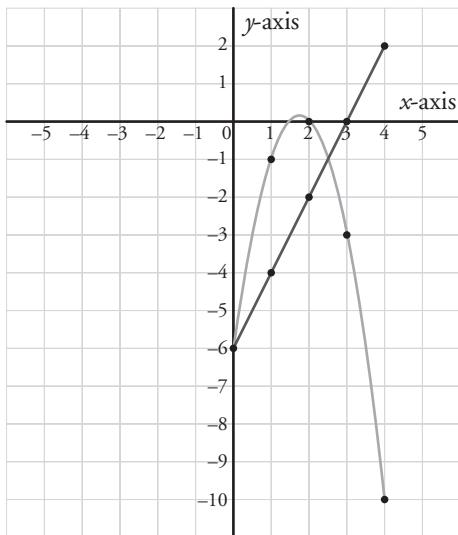
(c) (i) 1 cm^3 (ii) $x = 0.6, x = 3.4$
(iii) Volume = 0, does not exist4. (a) (i) $-1\frac{1}{2}$ (ii) 6(b) (i) $16, \frac{1}{16}$ (ii) $x = \pm\sqrt{3}$ (c) (i) $b = 2, c = -4$ (ii) $x = -2, x = 1$ (iii) $k = -1, k = \frac{1}{2}$ 5. (a) (i) -111 (ii) -1 (b) $x > 0.5$ (c) $a = 4, b = 5$ and $c = 20$, axis of symmetry $x = 4.5$

6. (a)

x	-3	-2	-1	0	1	2	3
y	3	-2	-5	-6	-5	-2	3



- (b) (i) $x = 0, x = 2.5$ (ii) $0 < x < 2.5$



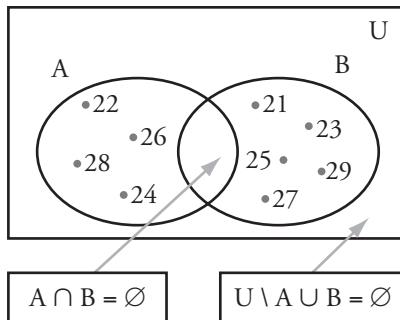
- (c) (i) $a(1, 0)$, $b(8, 0)$, $c(0, 8)$, $p(0, -8)$
(ii) $x = 2, x = 8$

Chapter 7

Revision exercise 7

1. (a) {a, b, c, g, e, f, d} (b) {c, g}
(c) {e, f, d} (d) {a, b}
2. (a) {1, 7, 5, 3, 2, 4, 10, 6, 12}
(b) {2, 4} (c) {7, 1, 5, 3} (d) {6, 10, 12}
3. (a) {2, 8, 1, 0, 11, 3, 7, 5, 4}
(b) {2, 8, 1, 0} (c) {0, 1, 11, 3} (d) {2, 8}
(e) {11, 3} (f) {2, 8, 4, 5, 7}
4. (a) {r, t, x, y, o, q} (b) {m, n, x, y, o, q}
(c) {m, n, r, t, x, y, o, q} (d) {t, r}
(e) {x, y, o, q}
5. (a) {1, 2, 3, 6, 8, 10, 11, 12, 14, 15}
(b) {2, 8} (c) {6, 10, 12, 14}
(d) {1, 3, 11, 15}
6. (a) {b, c, d, a, e, i, o, u}
(b) {b, c, d, i, o, u} (c) {b, c, d}
(d) {i, o, u}

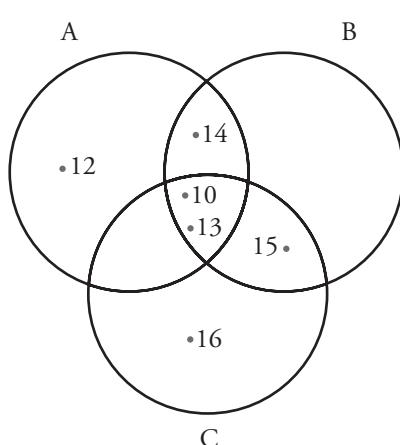
7.



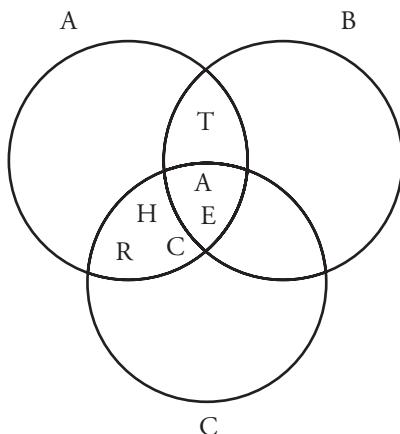
8. (a) {A, O} (b) {A, C} (c) {A, O, C}
(d) {A} (e) {O} (f) {L, S, R, M}
9. (a) {31, 32, 33, 34, 35, 36, 37, 38, 39}
(b) {33, 39, 36, 32}
(c) {31, 34, 35, 37, 38} (d) {33, 39, 32}
10. (a) {11, 13, 17, 19, 21, 22, 23, 24, 25, 29}
(b) {12, 14, 15, 16, 18, 20, 26, 27, 28}
(c) {11, 13, 17, 19, 21, 22, 24, 25, 29}

11. (a) {5, 8, 6, 1} (b) {9} (c) {8}
(d) {2} (e) {5, 8, 2, 11, 9, 6, 1, 3, 7}
(f) {10, 15, 12}
12. (a) {c} (b) \emptyset (c) \emptyset
(d) {a, d, h, c, m, k, e, f}
(e) {a, d, h, e, f} (f) {g, b}

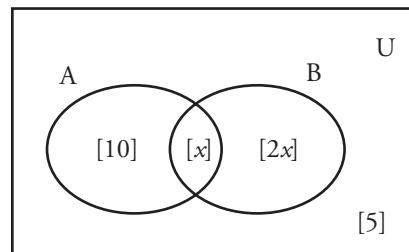
13.



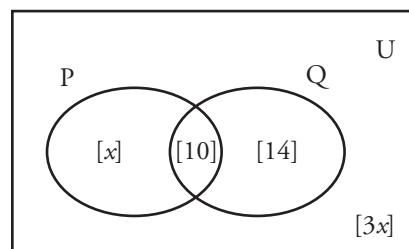
14.



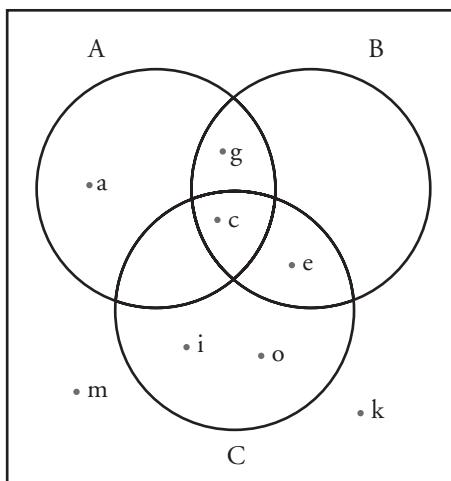
3. #B = 15



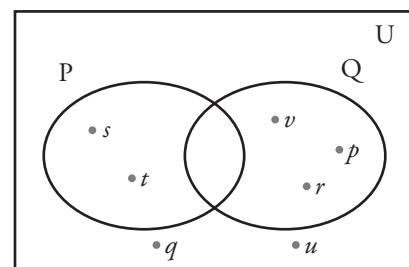
4. #P = 19



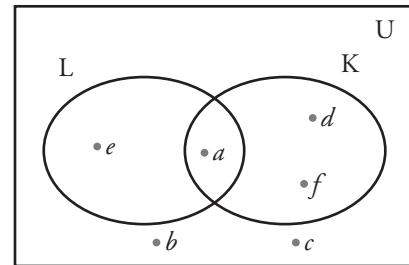
15.



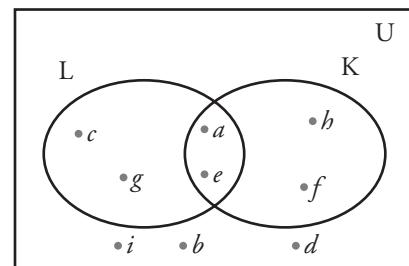
5.



6.



7.



16. (a) {d, f} (b) {a, b, c, o}

17. (a) {-3, -2, -1, 0, 2, 4} (b) {-2}

18. (a) {6, 8, 9} (b) {8} (c) {6, 8}

19. (a) {11, 12, 13, 14, 15, 16, 17, 18, 19} (b) {11, 13, 15, 16, 17, 18, 19}

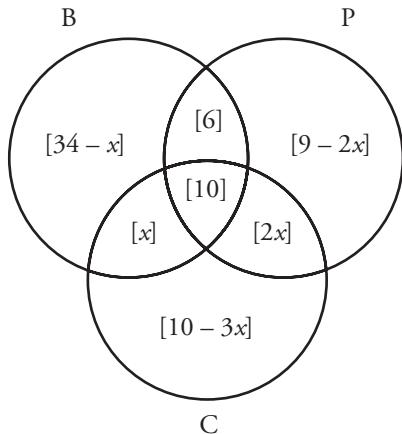
(c) {12, 14} (d) \emptyset 20. $A = \{4, 5, 7\}$, $B = \{5, 7, 8\}$, $C = \{4, 5, 8\}$ **Exercise 7.1**

1. (a) 16 (b) 34

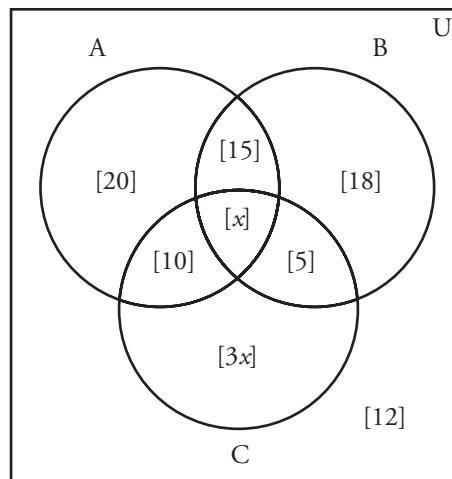
2. (a) 12 (b) 8 (c) 18

8. $x = 7$

9. (a)



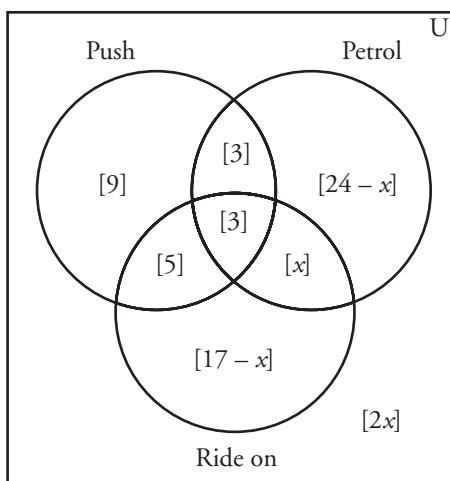
13. $x = 5, \#C \setminus (A \cup B) = 15$



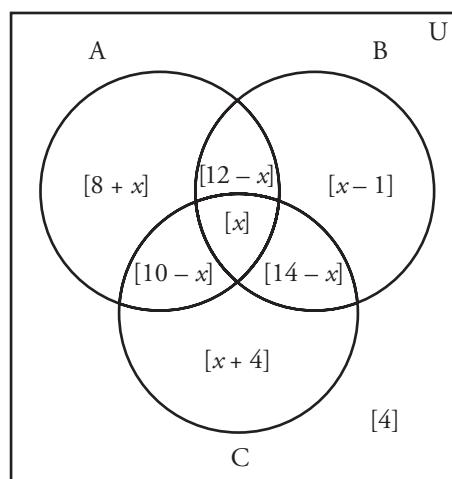
(b) $x = 3$, biology only = 31

10. $x = 6$, credit union only = 39

11. (a)

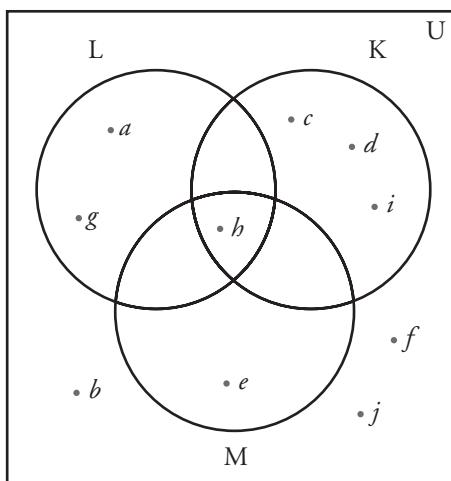


14. $x = 7$



(b) 13 people 12. $x = 3$

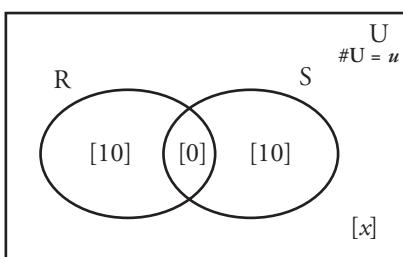
15.



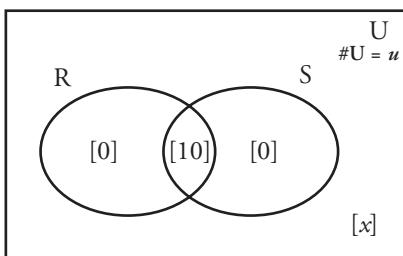
16. (a) Max = 5 (b) Min = 0

17. (a) Max = 10 (b) Min = 3

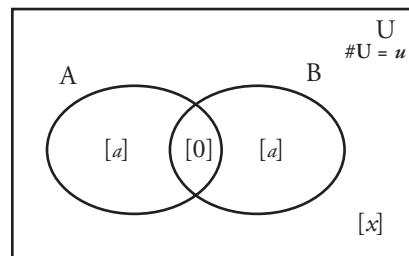
18. (a)

Max: $u = x + 20$

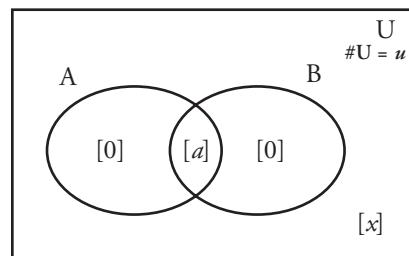
(b)

Min: $u = x + 10$

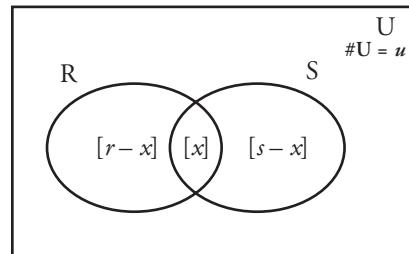
19. (a)

Max: $u = x + 2a$

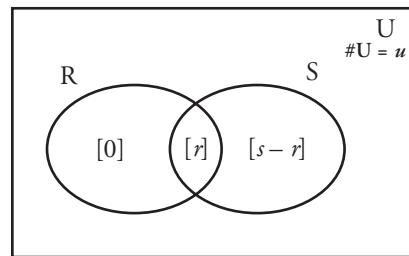
(b)

Min: $u = x + a$

20.

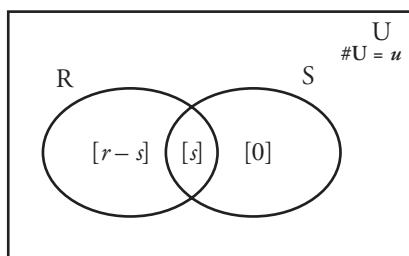
(a) $r - x$ (b) $s - x$ (c) $u - [r + s - x] = [u - r - s + x]$

(d)



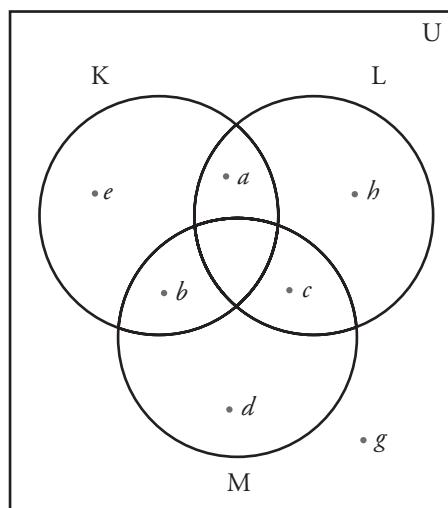
$$\begin{aligned} &\text{If } r < s \\ &\#(\text{R union S})' u - [r + (s - r)] \\ &\quad = u - s \end{aligned}$$

(e)

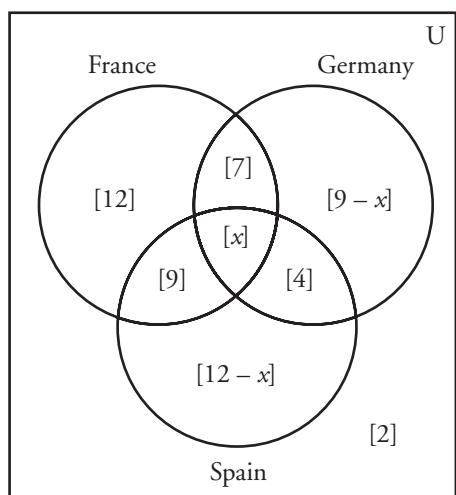


$$\text{If } r > s \\
 \#(R \cup S)' = u - [s + (r - s)] \\
 = u - r$$

(b) (i)

**Chapter 7 review**

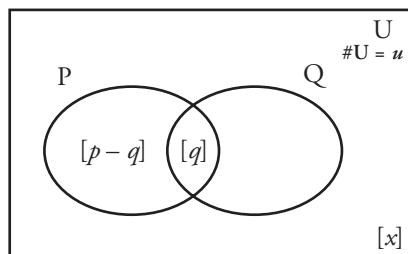
1. (a) {10, 8}, {2, 4}
 (b) (i) {2, 3} (ii) {4, 6, 8, 10, 12}
 (iii) {4, 6, 8, 10, 12, 5, 7, 11} (c) $x = 5$



2. (a) (i) {8} (ii) {4, 6, 7} (iii) {2, 3, 5}

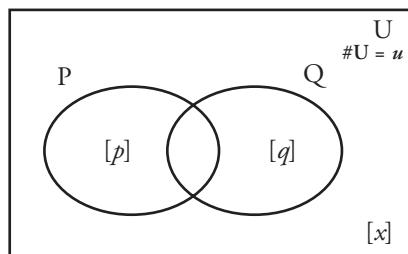
- (ii) $(L \cup M \cup K)' = \{g\}$
 (c) $\#(P \cup Q)' = x$, as $u = p + q + x$, then
 $x = u - q - p$

(i)



$$\text{If } p > q \\
 u = [p - q] + q + x = p + x$$

(ii)



$$\text{If } p > q \\
 u = [p + q] + x = p + q + x$$

3. (a) {-1, 0, 1}, {-1, 0}, {-1, 1}, {0, 1}, {-1}, {0}, {1}, \emptyset

(b) 12 (c) $x = 10$, $\#A \setminus (C \cup B) = 30$

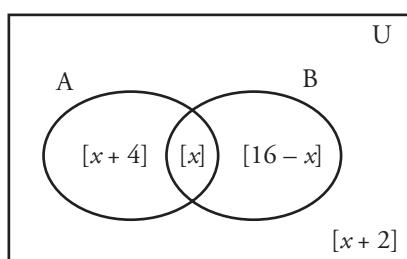
4. (a) {M, I, U, E, R}

(b) (i) 25 (ii) 0

(c) $x = 0$, standard only = 9

5. (a) {2, 4, 6, 10}, {2, 4, 9, 6, 10}

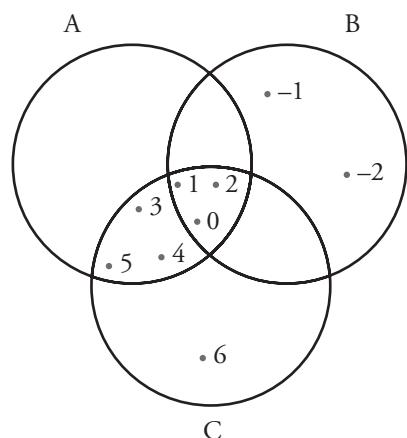
(b) $x = 4$, $\#A = 12$



(c) $x = 3$, Q2 only = $11 - 3 = 8$

6. (a) {53, 59, 61, 67}

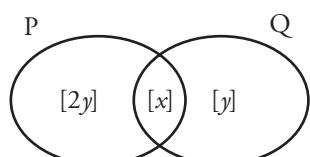
(b) (i)



(ii) $(A \cap C) \setminus B =$

$\{3, 4, 5\}$, $\#C \setminus (A \cup B) = 1$

(c) $x = 6$, $y = 2$



Chapter 8

Revision exercise 8

1. €437.80

2. (a) €675 (b) €535

3. Owen €54 520, Anne €48 450,
Paulo €61 320, Joan €31 010

4. Andrew €46 399,
Jean-Luc €54 693.75,
Therese €50 493.50,
Sandra €61 830

5. €170 6. €3416 7. €75 512 8. €600

9. (a) €51.25 (b) €75.85 (c) €410

(d) €369 (e) €2070.50

10. (a) €61.50 (b) €748.80

(c) €2337.50

11. (a) €33 906.25 (b) €492.10

(c) €6120.80

12. €7098 13. €4151.25

14. €56 243.20 15. €4709.97

16. €2249.52

17. (a) (i) €630 (ii) ¥65 300 (iii) £345

(b) (i) 16 720R (ii) C\$2980

(iii) ¥261 200

(c) (i) US\$4347 (ii) C\$5140.50

(iii) £2380.50

(d) (i) €4761.90 (ii) €6007.94

(iii) €2142.86

(e) (i) €30.63 (ii) €535.99

(iii) €765.70

(f) (i) €3623.19 (ii) €7869.57

(iii) €12 028.99

(g) (i) €717.70 (ii) €1172.25

(iii) €3660.29

(h) ¥3124.40 (i) C\$2159.42

(j) US\$289.43

18. £5 = €7.46 19. 60% 20. €1268.75

Exercise 8.1

1. (a) €705 (b) €147 (c) €522.75
2. (a) €16 030 (b) €43 032.50
3. €20 4. €154 5. €7922 6. €61 425
7. €50 000 8. €29 500 9. €62 400
10. 40% 11. 42%
12. (a) Orla €45 000, John €46 250
(b) €1000
13. (a) €11 100 (b) €43 898
14. (a) €33 900 (b) €50 000
15. (a) €41 000 (b) €750

Exercise 8.2

1. (a) 30% (b) €24 960
2. (a) €31 200 (b) 6%
3. €3000 4. €2500 5. €22 000
6. €40 000 7. €8500 8. €6933.75
9. €84 622
10. (a) 4 (b) €1047.20
11. $x = €10\ 000$
12. (a) €36 000 (b) $x = 10$
13. 8% 14. $x = 6$ 15. $x = 3.5$

Chapter 8 review

1. (a) €506.25 (b) 200%
- (c) (i) €20 700 (ii) €45 900
2. (a) €1562.50 (b) €721.88
(c) €60 000
3. (a) €700 (b) €10 634.38 (c) 5%
4. (a) C\$12 000
(b) (i) €21 300 (ii) €57 931
(c) (i) €73 500 (ii) 8%
5. (a) €3895.68 (b) (i) €731.25
(ii) 4%
(c) €39 500
6. (a) 3.375×10^4 (b) (i) €390
(ii) 12%
(c) €3235

Chapter 9**Exercise 9.1**

1. (a) $x = 125^\circ, y = 80^\circ$
(b) $x = 25^\circ, y = 155^\circ$
(c) $x = 60^\circ, y = 125^\circ$
2. (a) $x = 120^\circ, y = 73^\circ$
(b) $x = 74^\circ, y = 32^\circ$
(c) $x = 30^\circ, y = 150^\circ$
3. (a) 20° (b) 80°
4. (a) 55° (b) 55° (c) 70°
5. (a) 70° (b) 36° (c) 74°
6. (a) 40° (b) 40° (c) 50°
14. $3\text{ cm} < |ad| < 17\text{ cm}$

Exercise 9.2

1. (a) $x = 70^\circ, y = 110^\circ$
(b) $x = 60^\circ, y = 120^\circ$
(c) $x = 125^\circ, y = 55^\circ$
2. (a) 60° (b) 30° (c) 120°
3. (a) 102° (b) 30° (c) 78°
4. (a) 30° (b) 40° (c) 100°
5. (a) 3 cm (b) 4 cm (c) 68° (d) 112°

Exercise 9.3

1. (a) 48° (b) 55° (c) 42°
2. (a) $x = 90^\circ, y = 55^\circ$
(b) $x = 90^\circ, y = 50^\circ$ (c) $x = 90^\circ, y = 45^\circ$
3. (a) $x = 80^\circ, y = 100^\circ$
(b) $x = 100^\circ, y = 90^\circ$
(c) $x = 40^\circ, y = 118^\circ$
4. $x = 82^\circ, y = 98^\circ$
5. (a) 30° , oc and oa are radii
(b) 60° , straight angle
(c) 60° , abc is an equilateral Δ
6. (a) 30° , coa is an isosceles Δ
(b) 60° , as $| \angle bcd | = 90^\circ$
(c) 60° , $| ocl | = | obl |$, radii
7. (a) 60° , theorem

(b) 60° , angle standing on the same arc as $\angle abc$

(c) 120° , opposite angle in a cyclic quadrilateral

8. (a) 65° , theorem

(b) 25° , Δaoc is isosceles

(c) 32.5° , $[(180^\circ - 65^\circ) \div 2] - 25^\circ$

9. (a) 90° (b) 55° (c) 50°

Exercise 9.4

1. 45° as $|am| = |mb|$, theorem $|om| = |mb|$, $\therefore \Delta omb$ is isosceles

2. (a) 120° (b) 60° (c) 30°

3. (a) 114° (b) 33° (c) 33°

4. (a) 16° (b) 16° (c) 74°

Chapter 9 review

1. (a) 30° , 150°

(b) (i) 30° (ii) 8 cm

2. (a) 35° , 55° , 35°

(b) (ii) area = 24 cm^2 ; $|\angle add| = 120^\circ$

(c) (i) 60° (ii) 120°

3. (a) 40° , 140° , 80°

(b) (ii) $|\angle cba| = 65^\circ$, $|\angle ead| = 65^\circ$

4. (a) 65° , 25°

(c) (ii) 22.5 cm^2

5. (a) 48° , 42°

6. (b) (i) 4 cm (ii) 7 cm (iii) 6 cm

(c) $3 \text{ cm} < |xz| < 21 \text{ cm}$

Chapter 10

Revision exercise 10

1. (a) (3, 7) (b) (3, 3)

(c) (8, 3) (d) (5, 4)

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

(c) (-1, -4) (d) (-6, -4)

3. (a) $\left(-2, -\frac{3}{2}\right)$ (b) $\left(-\frac{7}{2}, -2\right)$

(c) $\left(-\frac{7}{2}, -1\right)$ (d) $\left(-3, -\frac{9}{2}\right)$

5. (a) 5 (b) $\sqrt{80}$ (c) $\sqrt{8}$ (d) $\sqrt{72}$

6. (a) $3\sqrt{2}$ (b) $\sqrt{5}$

(c) $2\sqrt{2}$ (d) $\sqrt{34}$

7. (a) $2\sqrt{5}$ (b) $\sqrt{2}$ (c) $\sqrt{5}$ (d) $\sqrt{41}$

8. (a) $\sqrt{34}$ (b) $5\sqrt{2}$

(c) $\sqrt{109}$ (d) $3\sqrt{13}$

9. $|ab| = \sqrt{13}$ and $|bd| = \sqrt{13}$

10. $a(-3, 0)$, $b(-2, 4)$, $c(5, 3)$ and $d(4, -1)$

$|ab| = \sqrt{17}$, $|cd| = \sqrt{17}$, $|ad| = \sqrt{50}$,

$|bc| = \sqrt{50}$

11. $|ab| = \sqrt{32} = 2\sqrt{8}$, $|ad| = \sqrt{8}$

12. (a) 4 (b) 2 (c) 1 (d) $\frac{1}{3}$

13. (a) $\frac{3}{2}$ (b) $\frac{1}{2}$ (c) $\frac{3}{2}$ (d) $\frac{5}{3}$

14. (a) 2 (b) $\frac{7}{5}$ (c) $\frac{9}{5}$ (d) $\frac{4}{7}$

15. (a) $-\frac{1}{4}$ (b) 2 (c) -2 (d) $-\frac{1}{4}$

16. Slopes $[ab] = 1$, $[cd] = 1$,

$[ad] = -\frac{1}{3}$, $[bc] = -\frac{1}{3}$

17. (a) $3x - y - 4 = 0$ (b) $2x - y - 2 = 0$

(c) $2x + y = 0$ (d) $3x + y + 14 = 0$

18. (a) $x - 2y + 5 = 0$

(b) $2x - 3y + 10 = 0$

(c) $x + 3y + 14 = 0$ (d) $5x + 2y + 24 = 0$

19. (a) slope = 1, equation: $x - y - 1 = 0$

(b) slope = 2, equation: $2x - y - 1 = 0$

(c) slope = 5, equation: $5x - y - 15 = 0$

(d) slope = $\frac{1}{2}$, equation: $x - 2y = 0$

20. (a) slope = $\frac{3}{5}$,

equation: $3x - 5y + 1 = 0$

(b) slope = $\frac{3}{8}$, equation: $3x - 8y - 7 = 0$

(c) slope = $\frac{7}{9}$,

equation: $7x - 9y - 13 = 0$

(d) slope = $-\frac{9}{2}$,

equation: $9x + 2y + 50 = 0$

Exercise 10.1

1. Positive: B and D, negative: A and C

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

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

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

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

6. (a) $-\frac{5}{2}$ (b) $-\frac{1}{3}$ (c) $\frac{4}{5}$ (d) 3 (e) $\frac{2}{3}$

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

8. $-\frac{a}{b}$; parallel = $-\frac{a}{b}$, perpendicular = $\frac{b}{a}$

9. (a) Slope of K = 1, Slope of M = -1

(b) $\left(0, -\frac{7}{2}\right)$

10. (a) Slope of K = $\frac{1}{7}$, Slope of M = -7

(b) $\left(0, -\frac{4}{7}\right)$

11. (a) $2x - 5y + k = 0$, any number for k

(b) $5x + 2y + k = 0$, any number for k

12. (a) $6x + y + k = 0$, any number for k

(b) $x - 6y + k = 0$, any number for k

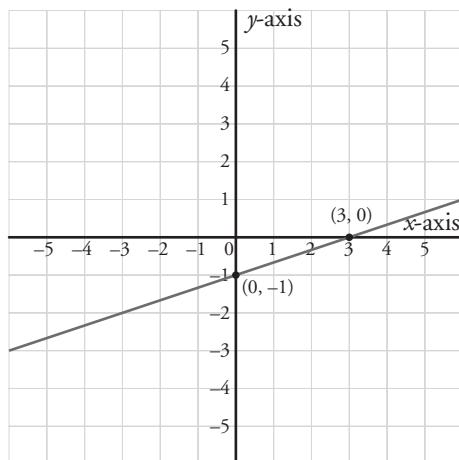
13. -9 14. -4

15. Slope of K = $\frac{t}{4}$, slope of L = $-\frac{4}{t}$;

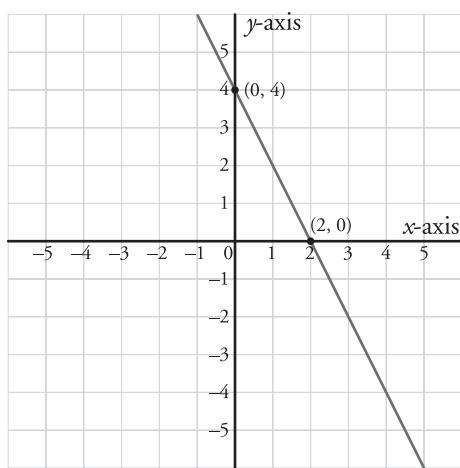
$t = -3$

Exercise 10.2

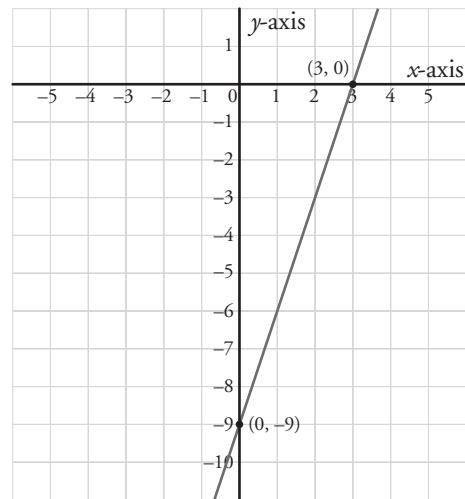
1. (a)



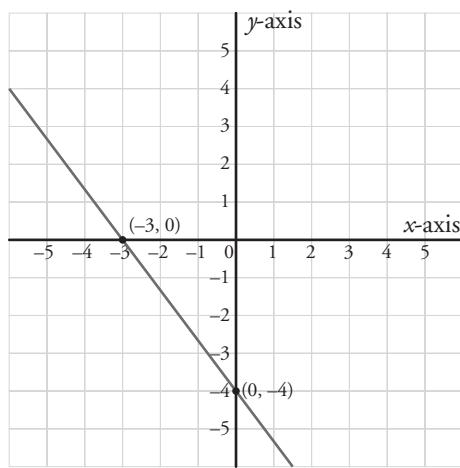
(b)



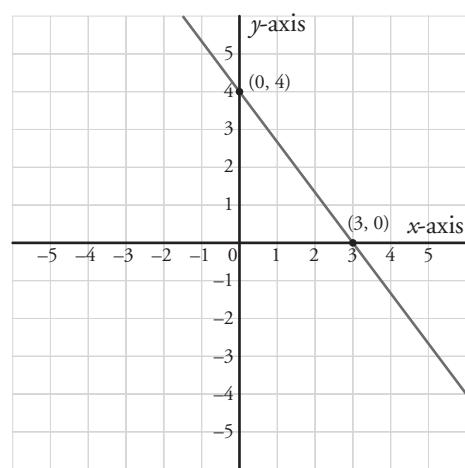
(d)



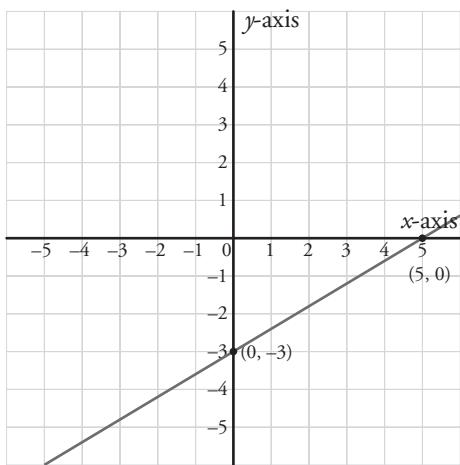
(c)



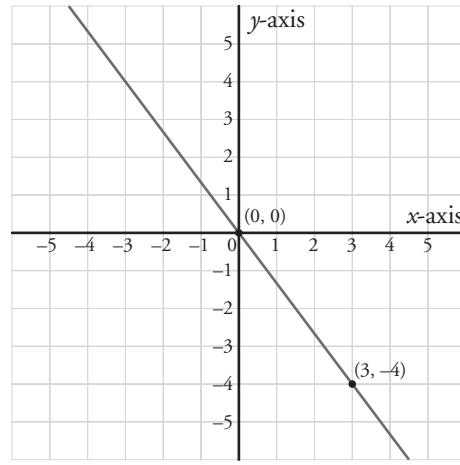
(e)



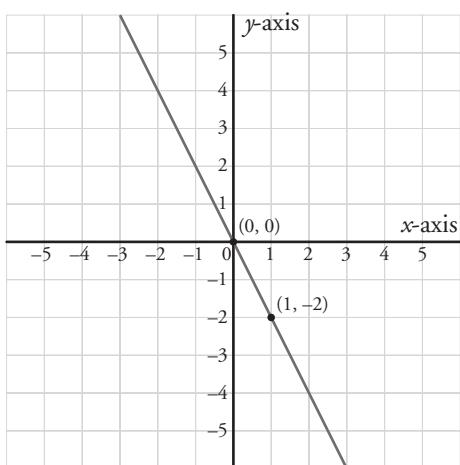
(f)



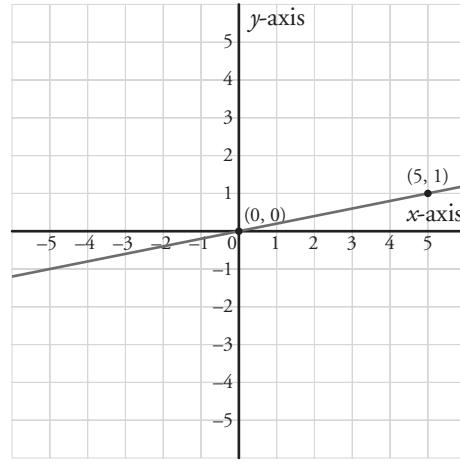
(i)



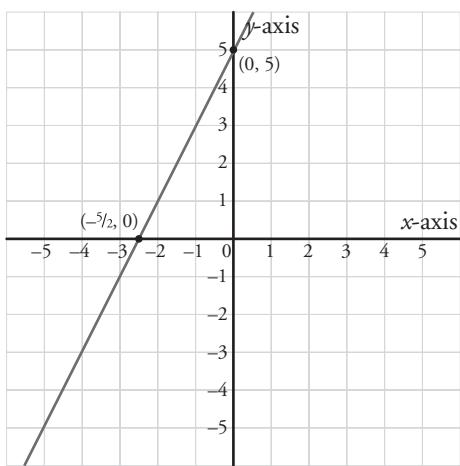
(g)



(j)



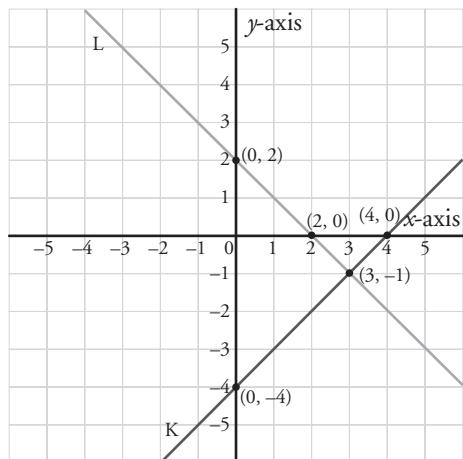
(h)

2. (a) $p(-2, 0)$, $q(0, 7)$

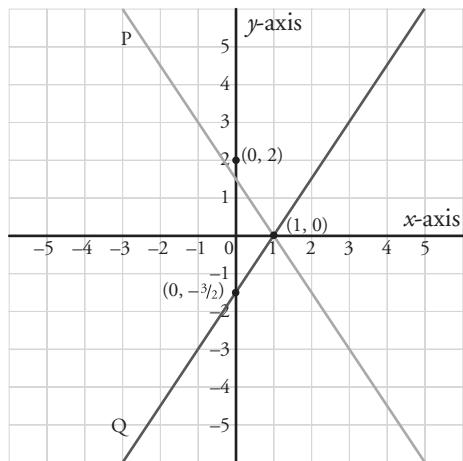
(b) 7 square units

3. (a) $p(-3, 0)$, $q\left(0, 4\frac{1}{2}\right)$ (b) $\frac{27}{4}$ square units4. (a) $(3, -1)$

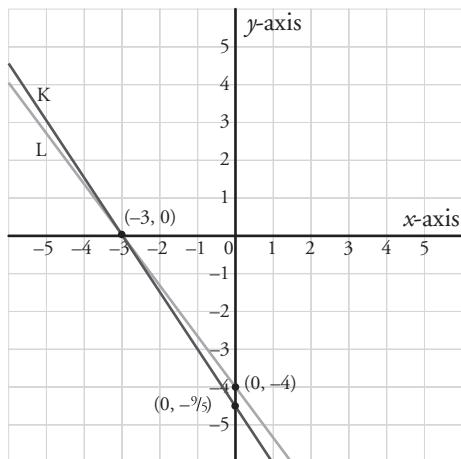
(b)

5. (a) $(1, 0)$

(b)

(d) $1\frac{3}{4}$ square units6. (a) $(-3, 0)$

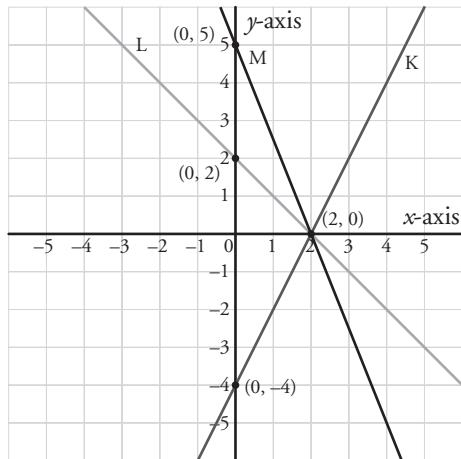
(b)



(d) 6 square units

7. (a) $k = 7, q = 4$ (b) $\frac{49}{6}$ square units8. (a) $c = 11, k = 15$ (b) $|pq| = \frac{7}{4}$ 9. (a) $(2, 0)$

(b)



(d) 9 square units

10. (a) $(6, -2)$ (b) $a = -3, b = 1$

(c) $r\left(\frac{20}{3}, 0\right)$, $q(0, -20)$;

area = $\frac{200}{3}$ square units

Exercise 10.3

1. (a) (2, -3) (b) (-2, -3) (c) (2, 3)
2. (a) (-1, 0) (b) (4, 0) (c) (0, 2)
(d) (0, -5) (e) (5, 5) (f) (-3, 3)
(g) (4, 5)
3. (a) (3, -2) (b) (-3, 2) (c) (1, 4)
(d) (3, 3) (e) (-5, -1) (f) (-5, 4)
(g) (-5, 2)
4. (a) (-1, 5) (b) (2, 3) (c) (2, -4)
(d) (-6, 0) (e) (5, 1) (f) (3, -4)
(g) (2, -2)
5. (a) (-2, 2) (b) (-3, 4) (c) (3, 0)
(d) (-3, 1) (e) (-5, 0)
6. (a) (-3, 0) (b) (1, 2) (c) (-6, -3)
(d) (2, -1) (e) (-7, -2) (f) (-1, 2)
7. (a) (3, 3) (b) (-4, 6) (c) (5, 5)
(d) (-3, 7) (e) (4, 6) (f) (-3, 2)
8. (a) Central symmetry in the origin
(b) Axial symmetry in the y -axis
(c) Axial symmetry in the x -axis
9. (a) $a(5, 1)$, $b(1, -2)$, $c(-2, 1)$
(b) Images: $a'(3, 5)$, $b'(-1, 2)$, $c'(-4, 5)$
10. (a) $q(5, 5)$ (b) Slope = 4
11. (a) $d(0, 5)$ (b) Slopes of ab and
 $cd = \frac{3}{2}$; slopes of ca and $db = 0$
12. (a) $q(0, 3)$ (b) $|ab| = |pq| = \sqrt{34}$
13. (a) $c(2, -3)$
(b) $a(-6, 4)$, $b(-7, -1)$, $c(-4, -3)$,
 $d(-3, 2)$; yes.
Images: $a'(-6, 4)$, $b'(-7, -1)$, $c'(-4, -3)$,
 $d'(-3, 2)$

14. (a) (1, 3) (b) Slope of L = $-\frac{1}{2}$,

slope of K = 2 (d) (5, 11)

15. (a) (1, 1) (b) $t = 4$

(c) Slope of N = $-\frac{2}{3}$, slope of M = $\frac{3}{2}$

(d) (-2, 3)

Exercise 10.4

1. $x - 4y - 3 = 0$ 2. $3x - 4y - 5 = 0$

3. $x + 2y - 6 = 0$ 4. $2x + y - 4 = 0$

5. $2x + 3y + 3 = 0$ 6. $2x + 3y - 5 = 0$

7. $x + 4y - 17 = 0$ 8. $x + 2y - 2 = 0$

9. $7x + y - 11 = 0$

10. (a) (7, -4) (b) $3x + 2y - 13 = 0$

11. (a) (3, 1) (b) $3x - 4y - 5 = 0$

12. (a) $\left(-\frac{1}{2}, -1\right)$ (b) $2x + 2y + 3 = 0$

13. (a) $2x + y - 1 = 0$ (b) (1, -1)

(c) (4, -7)

14. (a) $4x + 3y + 7 = 0$

(b) (-1, -1) (c) (2, -5)

15. (a) $p(-3, 1)$ $q(9, -1)$ (b) (3, 0)

(c) $6x - y - 18 = 0$

Chapter 10 review

1. (a) (i) (-5, 15) (ii) (-7, -3), (-3, 6)

(b) (i) (5, 0), $\left(1\frac{1}{2}, 0\right)$ (ii) (1, -2)

(iii) $2\sqrt{5}$

(c) (ii) $7x - 3y + 27 = 0$ (iii) (4, -1)

2. (a) (i) $-\frac{5}{4}$ (ii) $5x + 4y - 13 = 0$

(b) (i) $m(9, 0)$, $n(0, -9)$

(ii) (-9, 0), (0, 9) (iii) $x - y + 9 = 0$

(c) (i) (3, -2) (ii) $x + 2y + 1 = 0$

(iii) (1, -1)

3. (a) (i) (6, 4) (ii) (6, -10)
 (b) (i) $b = 5$, $t = -2$ (ii) $\left(3\frac{1}{2}, 1\frac{3}{4}\right)$
 (c) (i) Slope = $\frac{1}{2}$ (ii) $k = 0$ (iii) (4, -7)
4. (a) (i) (1, -2) (ii) (-11, -5)
 (b) (i) $p(2, 0)$, $q(0, -8)$ (ii) $r(1, -4)$
 (c) (i) Slope = $\frac{3}{2}$ (ii) $2x + 3y + 11 = 0$
 (iii) (-1, -3) (iv) (2, -5)
5. (a) (i) 3 (ii) $3\sqrt{10}$
 (b) (i) $p(3, 0)$, $q\left(0, -\frac{9}{2}\right)$
 (ii) $\frac{27}{4}$ square units
 (c) (ii) $t(3, 5)$ (iii) $3x - y - 4 = 0$
6. (a) (i) (3, -3) (ii) (3, -5)
 (b) (i) (2, -1) (ii) $3x + y - 5 = 0$
 (c) (i) $p\left(-\frac{c}{m}, 0\right)$, $q(0, c)$
 (ii) $p\left(\frac{-2c}{1-c}, 0\right)$

Chapter 11

Exercise 11.1

1. (a) $2\frac{2}{3}$ cm (b) $12\frac{1}{2}$ cm (c) $3\frac{3}{4}$ cm
2. $1\frac{3}{4}$ cm 3. $7\frac{1}{2}$ cm 4. 16 cm
5. No, as $\frac{|1.4|}{|3.6|} \neq \frac{|1.2|}{|3.4|}$
6. $|cm| = 3$ cm, $|nb| = 8$ cm
8. (a) $\frac{|bn|}{|nc|}$ (b) $\frac{|bn|}{|nc|}$

9. (a) $\frac{|ap|}{|pc|}$ (b) $\frac{|cp|}{|pa|}$
 10. (a) $\frac{|bk|}{|kx|}$ (b) $\frac{|ac|}{|an|}$

Exercise 11.2

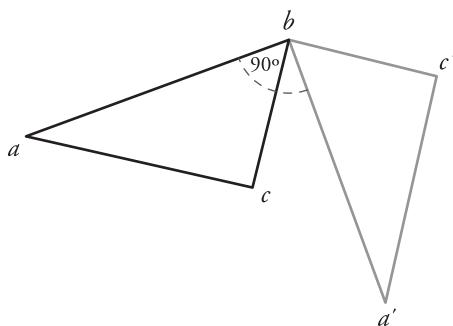
1. (a) 3.5 (b) $1\frac{2}{3}$ (c) $3\frac{3}{4}$
2. (a) Yes (b) Yes (c) No
3. (a) $|\angle pkq| = |\angle mkn|$,
 $|\angle kpq| = |\angle knm|$, $|\angle pqk| = |\angle kmn|$
- (b) $2\frac{2}{3}$
4. (a) Δabc (b) $|\angle dcbl| = |\angle bac|$,
 $|\angle dbcl| = |\angle abcl|$, $|\angle cdbl| = |\angle acbl|$
 (c) 7.5 cm
5. (b) $|cel| = 3\frac{3}{5}$ cm
6. (b) $|acd| = 10$ cm
7. (b) $\frac{|ca|}{|cx|} : \frac{|ab|}{|xy|}$ (c) $7\frac{1}{9}$ cm
8. (b) $\frac{|ap|}{|pd|} : \frac{|ab|}{|cd|}$

Exercise 11.3

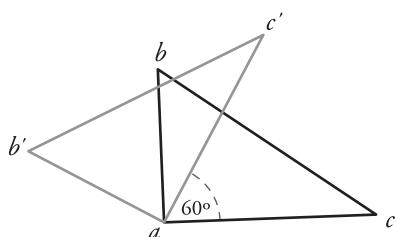
1. (a) 4 (b) 8 (c) 5 (d) $2\sqrt{2}$
 (e) 2 (f) $\sqrt{5}$
2. (a) $x = 10$, $y = \sqrt{19}$
 (b) $x = 4\sqrt{2}$, $y = 2$ (c) $x = 4$, $y = 4\sqrt{3}$
3. (a) $3\sqrt{2}$ cm (b) 18 cm^2 (c) 17 cm
4. (a) $|bcd| = 8$ cm (b) $|bd| = 10$ cm
5. (a) $|bx| = 14$ cm (b) $|ox| = \sqrt{29}$
 (c) Area = $7\sqrt{29}$
6. (a) $2\sqrt{7}$ cm (b) $4\sqrt{2}$ cm
7. (a) 10 cm
8. $5\sqrt{3}$ cm
9. $|dd| = \sqrt{11}$ cm, $|bcd| = \sqrt{22}$ cm

Exercise 11.4

1.



2.



3. A = 90° anticlockwise rotation (270° clockwise rotation), B = 180° anticlockwise rotation (180° clockwise rotation), C = 360° anticlockwise rotation (360° clockwise rotation)

4. A = axial symmetry; B = 180° rotation; C = a translation

5. (a) 180° (b) 270° (c) 360°

6. $ob'a'c'$: 120° anticlockwise or 240° clockwise

$ob''d''c'$: 240° anticlockwise or 120° clockwise

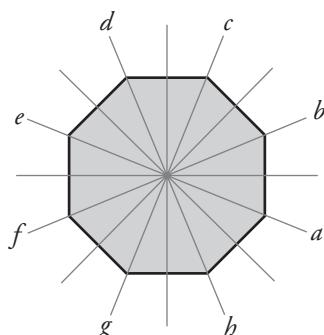
7. (a) Δosb (b) Δoua

(c) Δosb (d) Δbro

8. (a) Δodz (b) Δxoy (c) Δoxb

9. (a) 8

(b)



(c) 90° anticlockwise or 270° clockwise

(d) 225° anticlockwise rotation or 135°

clockwise rotation or a translation \vec{af}

10. (b) (i) 3 (ii) 6

(c) A translation \vec{ac} or \vec{fd}

(d) 60° anticlockwise or 300° clockwise

Chapter 11 review

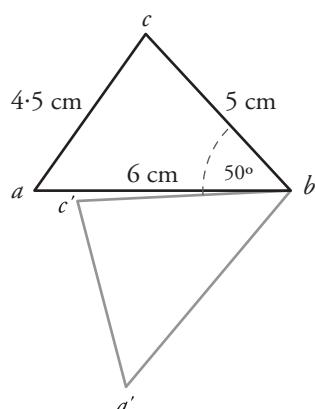
1. (a) 3 (c) (ii) 4.5 cm

2. (a) $4\frac{1}{5}$

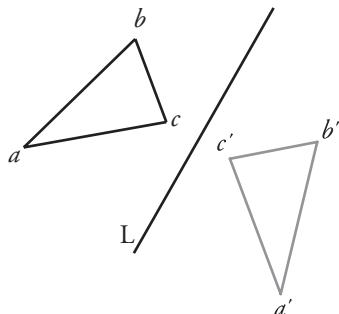
(b) (i) $|\angle prq| = 30^\circ$, $|\angle qpr| = 60^\circ$

(ii) $3\sqrt{3}$

(c) (i) and (ii)



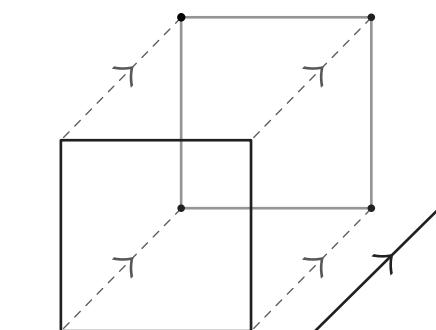
3. (a)



- (b) (i) $|ad| = 5 \text{ cm}$ and $|bd| = 8 \text{ cm}$
(ii) 80°

4. (a) No (b) (i) Δabo (ii) 62.5 cm^2 (iii) Rotation, S_o , 180° rotation5. (a) 270° anticlockwise rotation or
 90° clockwise rotation(b) (i) $4\sqrt{2}$ (ii) $8\sqrt{3}$ (c) (i) 5 (ii) $|\angle doc| = 72^\circ$; $|\angle ocd| = 54^\circ$ (iii) 216° anticlockwise rotation or
 144° clockwise rotation

6. (a)

(c) 11.2 cm

Chapter 12

Revision Exercise 12

1. (a) (i) 14 cm (ii) 34 cm (iii) 18 cm
(b) (i) 10 cm^2 (ii) 50 cm^2 (ii) 14 cm^2
2. (a) (i) 24 cm (ii) 16 cm (iii) 24 cm
(iv) 46 cm (b) (i) 24 cm^2 (ii) 12 cm^2
(iii) 30 cm^2 (iv) 126 cm^2

3. (a) 5 cm (b) $10\pi \text{ cm}$ (b) $25\pi \text{ cm}^2$ 4. (a) (i) 88 cm (ii) 54 cm (iii) $42\frac{2}{3} \text{ cm}$ (iv) 30.5 cm (b) (i) 616 cm^2 (ii) 173.25 cm^2 (iii) $102\frac{2}{3} \text{ cm}^2$ (iv) 57.75 cm^2 5. (a) 192 cm^2 (b) 60 cm^2 (c) 110.25 cm^2 6. 100 cm^2 7. (a) 32 cm (b) $8\sqrt{2} \text{ cm}$ 8. 50 m

9. (a) 25 ares (b) 71 m

10. 93.75 ares

11. (a) 210.375 m^2 (b) 62.5 m 12. 6.6 km 13. 8550 cm^2 14. (a) (i) 125 cm^3 (ii) 420 cm^3 (iii) $40\ 000 \text{ cm}^3$ (40 l)(b) (i) 150 cm^2 (ii) 386 cm^2 (iii) $12\ 400 \text{ cm}^2$ 15. 20 cm 16. (a) $32\pi \text{ cm}^3$ (b) $960\pi \text{ cm}^3$ (c) $708.75\pi \text{ cm}^3$ 17. (a) 270 cm^2 (b) 972 cm^2 (c) 3024 cm^2 18. (a) $36\pi \text{ cm}^3$ (b) $18\ 432\pi \text{ cm}^3$ (c) $12\ 348\pi \text{ mm}^3$ (d) $121.5\pi \text{ cm}^3$ 19. (a) 432 cm^2 (b) 972 cm^2 (c) 2700 cm^2 (d) 6348 mm^2 (e) $750\ 000 \text{ m}^2$ 20. (a) (i) 7 l (ii) 34 l (iii) 493 l (iv) $268\ 117 \text{ l}$ (b) (i) 1810 cm^2 (ii) 5027 cm^2 (iii) $30\ 176 \text{ cm}^2$ (iv) $2\ 010\ 880 \text{ cm}^2$ 21. (a) 20 cm (b) 8 l 22. 20 cm

23. 10.5 cm
 24. (a) 280 l (b) 29%
 25. (a) 91 l (b) 1.31 m²
 26. 3360 cm³
 27. (a) 576 cm³ (b) 288 cm²
 (c) 384 cm² (d) 336 cm²
 28. (a) 2.5 cm (b) 157 cm²
 29. 269 cm³
 30. (a) 562.5π cm³ (b) 10.125 l

Exercise 12.1

1. (a) 4π cm³ (b) 100 cm³
 (c) 8.82π mm³ (d) 21 012.5π cm³
 2. (a) 10 cm (b) 6.5 cm
 (c) $\sqrt{73}$ cm (d) $4\sqrt{2}$ cm
 3. (a) 108 cm² (b) 63.75 cm²
 (c) 3000 cm² (d) 37 500 cm²
 4. (a) 47.12 cm² (b) 204.20 cm²
 (c) 133.20 cm² (d) 6.96 cm²
 5. (a) 2 cm (b) $3\sqrt{6}$ cm (iii) $5\sqrt{6}$ cm
 6. radius = 6 cm, $108\sqrt{2}$ cm²
 7. $b^3 = b^3$
 8. (a) 1 : 8 (b) 1 : 4
 9. (a) (i) 56.55 cm³ (ii) 7068.58 cm³
 (iii) 1176.04 cm³
 (b) (i) 56.55 cm² (ii) 1413.72 cm²
 (iii) 427.65 cm²
 10. (a) 462 cm² (b) 1848 cm²
 (c) 5892.86 cm²
 11. (a) radius = 2.5 cm 12. 56
 13. (a) 125π (b) 98π
 14. 6 cm 15. $\frac{1}{11}$

Exercise 12.2

1. (a) 11 cm (b) 225 cm³ (c) 171 cm²
 2. (a) 9 cm (b) 612π cm³ (c) 8 : 9
 3. (a) $24r^3$ (b) 1.5 cm
 4. (a) 90 cm³ (b) 680 cm³ (c) 555 cm²

5. (a) 2 cm³ (b) 4.75 cm³ (c) 162 cm³
 6. (a) $69 000\pi$ cm³ (b) 29 cm
 7. (a) 25.15 cm (b) 2036 cm³
 8. (a) 18 minutes (b) 374 cm³
 9. (a) 0.25 cm (b) 4 cm
 10. (a) 1800 l
 (b) 800 sec (13 min 20 sec)
 11. $36\sqrt{3}$ cm or 62.35 cm
 12. (a) 5 cm (b) 125 cones
 13. (b) 3 cm

14. (a) 180 candles (b) $66\frac{2}{3}\%$
 15. (a) 99π cm³ (b) 6.5 cm

Chapter 12 review

1. (a) 47.25 cm²
 (b) (i) 2.6 cm (ii) 11.31 cm²
 (c) (i) 1590 cm³ (iii) 4 mm
 2. (a) (i) 972π cm³ (ii) 324π cm²
 (b) (i) 1200 l (ii) 20 cm
 (c) (i) 496π cm³ (ii) 276π cm²
 3. (a) 65.97 cm³
 (b) (i) $\frac{49}{4}\pi$ cm² (ii) 24.99 cm (c) 9
 4. (a) 360 mm
 (b) (i) 800 cm³ (ii) 720 cm² (c) (i) 2 cm
 5. (a) 189 cm² (b) (i) 3 : 25 (ii) 3 : 13
 (c) (i) 36π cm³ (ii) 216π cm³ (iii) $\frac{1}{3}$
 6. (a) 10 cm
 (b) (i) 600 l (ii) 14 minutes
 (c) (i) 500π cm³ (ii) $5\sqrt{3}$ cm

Chapter 13**Revision Exercise 13**

1. (a) 8 (b) 10
 2. (a) 5.25 (b) 7
 3. (a) 3 (b) 6 (c) 11 (c) 6

4. (a) 4.9 (b) 6.25

5. 7 6. $x = 2$ 7. $k = 3.8$ 8. 16

9. (a) Mean = 2, Mode = 1

(b) Mean = 3, Mode = 4

(c) Mean = 13, Mode = 20

10. Mean = 4.2, Mode = 4.5

11. (a) 23 (b) 69 (c) 4 (d) 3

12. Mean = 2

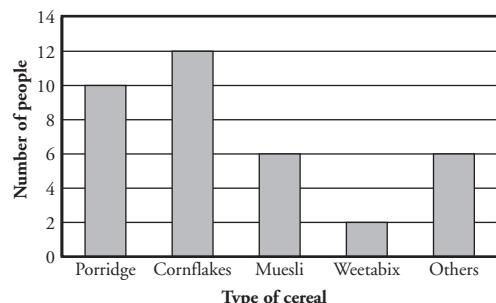
No. of goals	0	1	2	3	4	5
No. of teams	6	3	2	5	2	2

13. Mean = 70.4 °C

Temperature °C	68	69	70	71	72
No. of radiators	3	6	7	5	9

14. 15 15. 46 16. $x = 4$ 17. $x = 7$

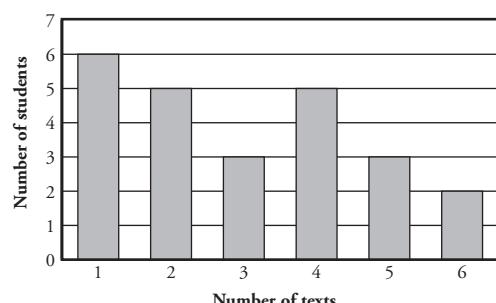
18.



19. (a)

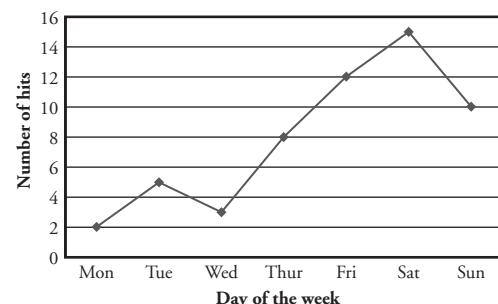
No. of texts	0	1	2	3	4	5
No. of students	6	5	3	5	3	2

(b)

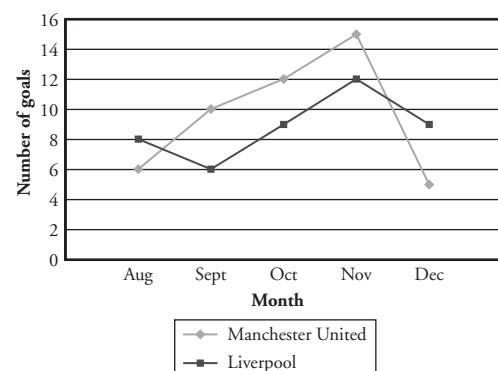


(c) Mean = 2

20.

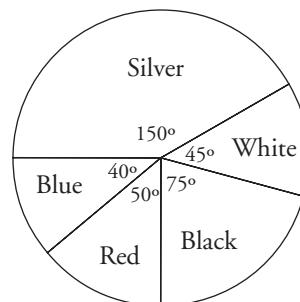


21.

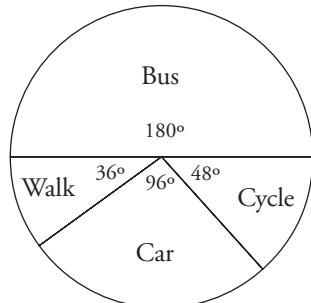


22. (a) 60° (b) 30 (c) 27

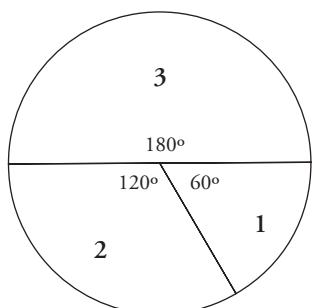
23.



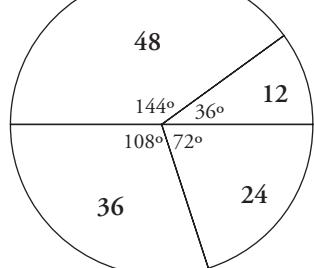
24.



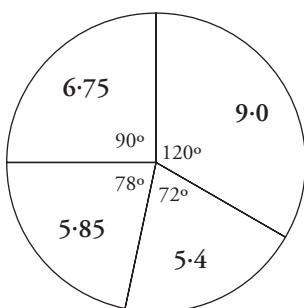
25. (a)



(b)



(c)

**Exercise 13.1**

1. 49 2. 13.5 mm

3. (a) 100 (b) 36 minutes

(c) $24 + 32 + 13 = 69$

4. (a) 20 (b) 25

5. (a)

Rain in mm	0–6	6–12	12–18	18–30	30–35
No. of days	2	3	10	12	3

(b) 18.95 mm

6.

Amount in €	0–10	10–20	20–40	40–60	60–100
No. of customers	1	7	8	13	4

Mean €40

7. $x = 13$ 8. $x = 2$

9. (a) 27

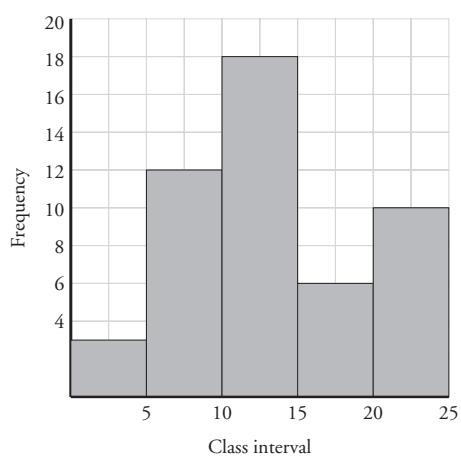
(b) New mean = 27.5, increase = 0.5

10. (a) 19 minutes

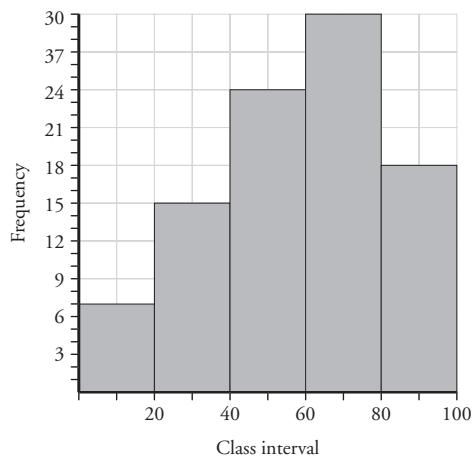
(b) New mean = 19.6 minutes, increase = 0.6 minutes = 36 seconds

Exercise 13.2

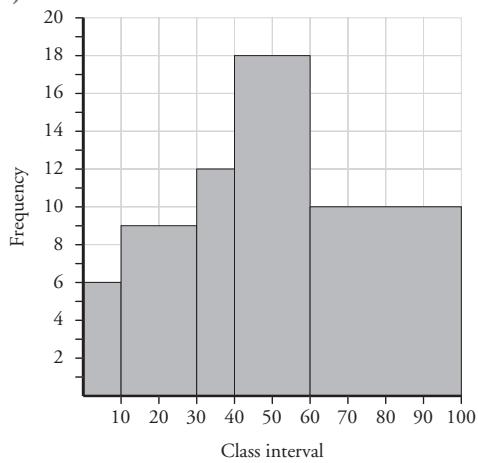
1. (a)



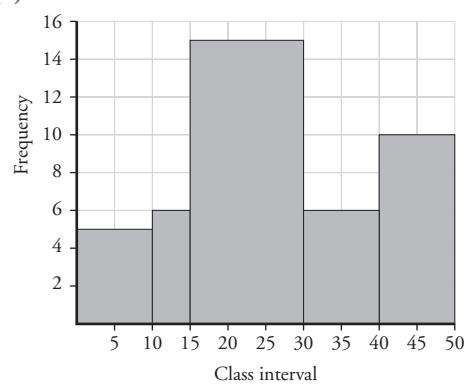
(b)



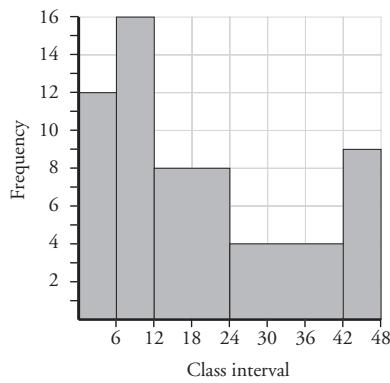
(c)



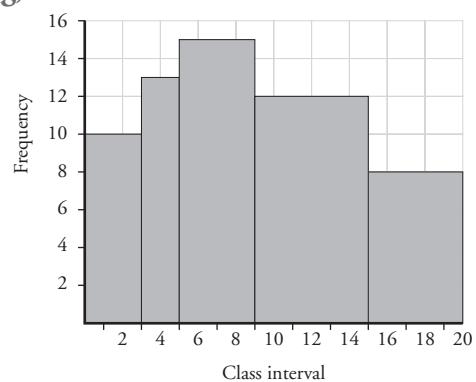
(f)



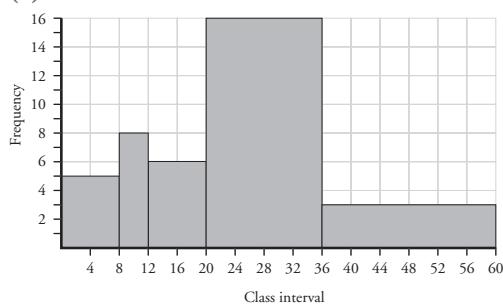
(d)



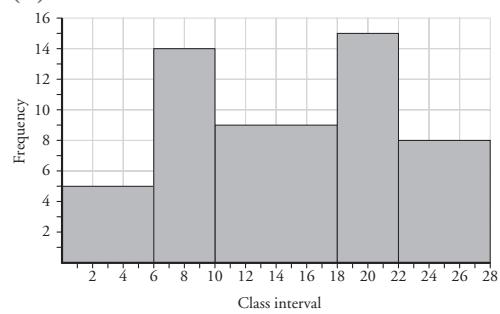
(g)



(e)



(h)



2. (a)

Class interval	0–20	20–40	40–60	60–80	80–100
Frequency	4	8	15	7	2

Median is in the 40–60 class interval.

(b)

Class interval	0–10	10–20	20–40	40–50	50–70
Frequency	8	10	16	12	12

Median is in the 20–40 class interval.

(c)

Class interval	0–4	4–8	8–16	16–24	24–36
Frequency	8	6	24	8	27

Median is in the 8–16 class interval.

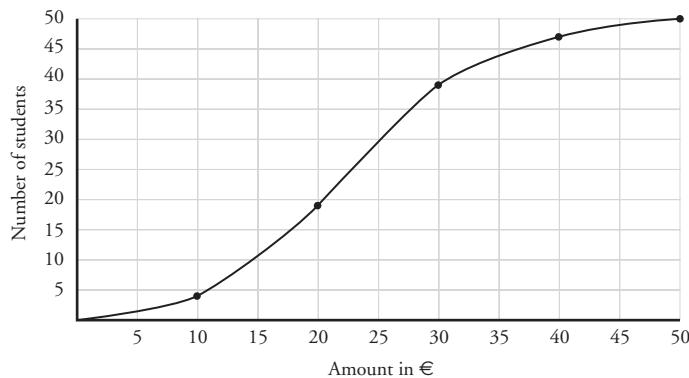
(d)

Class interval	0–5	5–10	10–15	15–25	25–40	40–60
Freq.	20	24	16	36	42	40

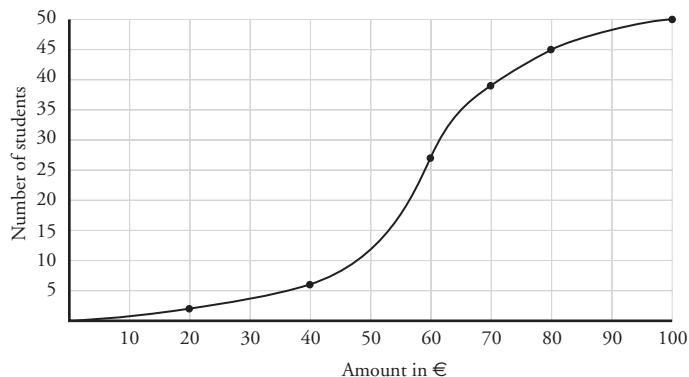
Median is in the 15–25 class interval.

Exercise 13.3

1. (a) €23 (b) €13.7 (c) 25



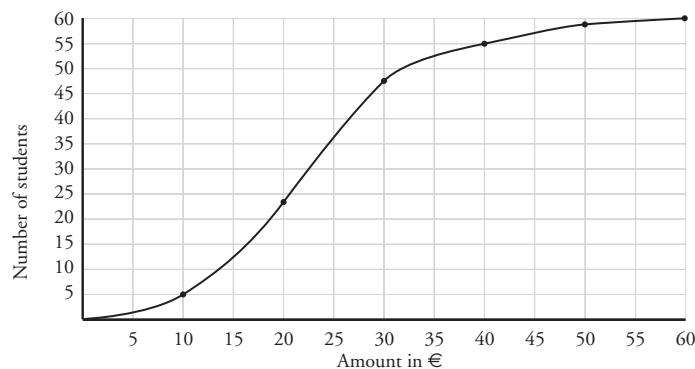
2. (a) 58% (b) 23% (c) 29 students



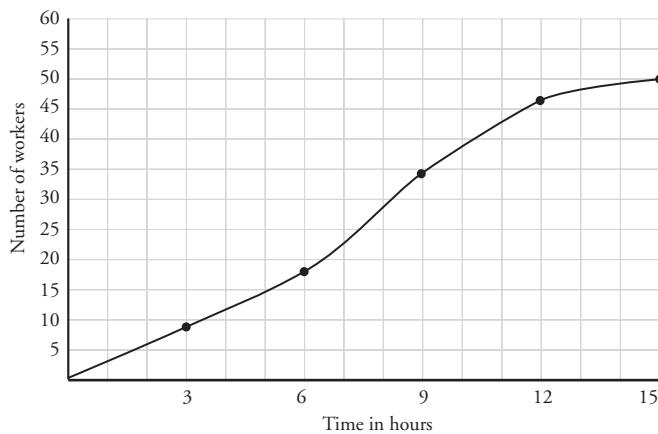
3. (a)

Amount in €	<10	<20	<30	<40	<50	<60
No. of students	5	23	47	55	58	60

(b) (i) 23 (ii) 29, 15.5, 13.5 (iii) 24



4. (a)



(b) 7.2

(c)

Time in hours	0–3	3–6	6–9	9–12	12–15
No. of workers	8	10	16	12	4

(d) Mean = 7 hours

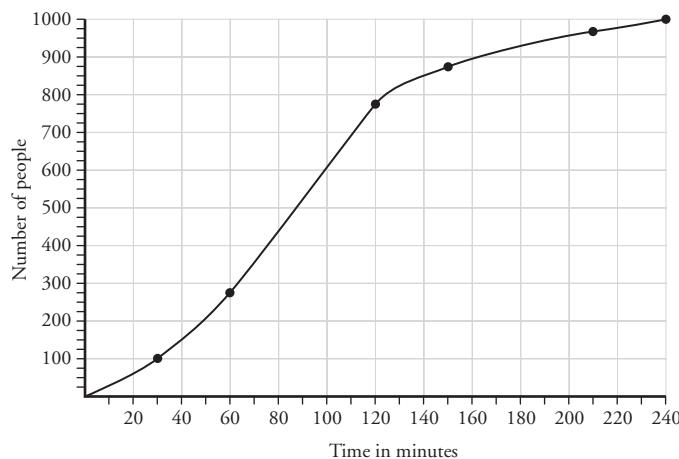
5. (a)

Time in minutes	<30	<60	<120	<150	<210	<240
No. of people	100	270	770	880	965	1000

(b) (i) 88 minutes

(ii) Upper quartile = 118, Lower quartile = 56, interquartile range = 62

(iii) 80 people



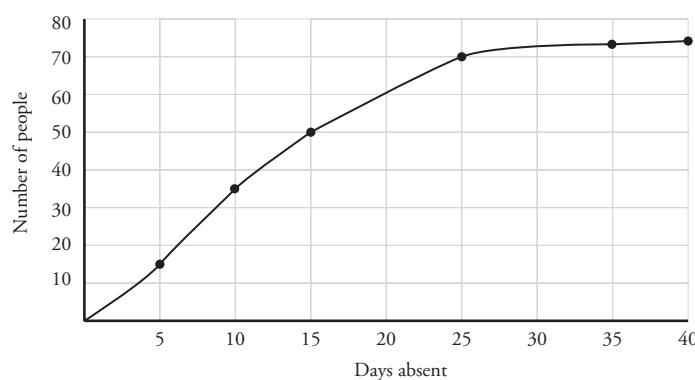
6. (a)

Days absent	<5	<10	<15	<25	<35	<40
No. of students	15	35	55	69	73	74

(b) (i) 10.5 days

(ii) Upper quartile = 15.5, Lower quartile = 7, interquartile range = 8.5

(iii) $72 - 9 = 63$ students



7. (a) (i) 15.5 years (ii) 7.6 (iii) 10

(b)

Age in years	0–5	5–10	10–15	15–20	20–25	25–30
No. of skaters	2	7	23	22	14	2

(c) Mean = 16

8. (a) (i) 160 marks (ii) 6 students

(iii) 120 marks

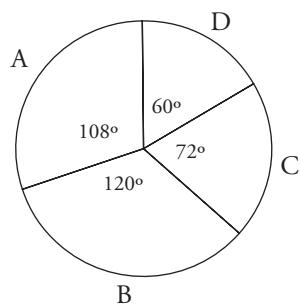
(b)

Mark	0–50	50–100	100–150	150–200	200–250	250–300
No. of students	2	10	30	40	14	4

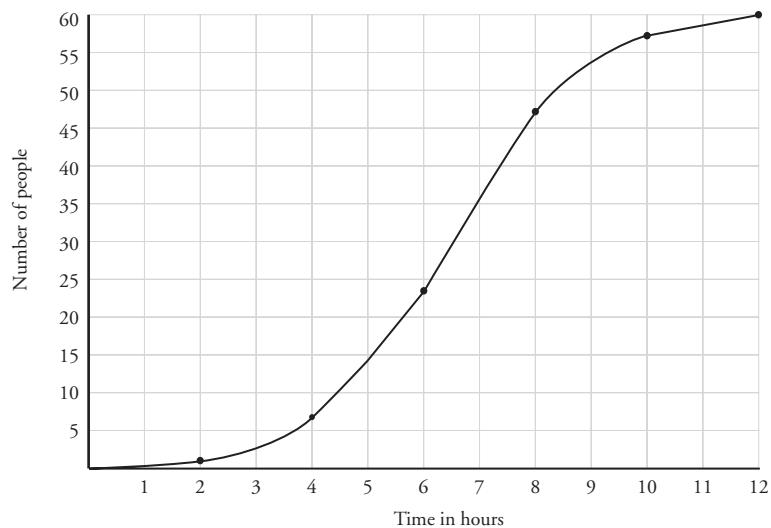
(c) Mean = 158

Chapter 13 review

1. (a)



(b) (i)



(ii) Median = 6.5,

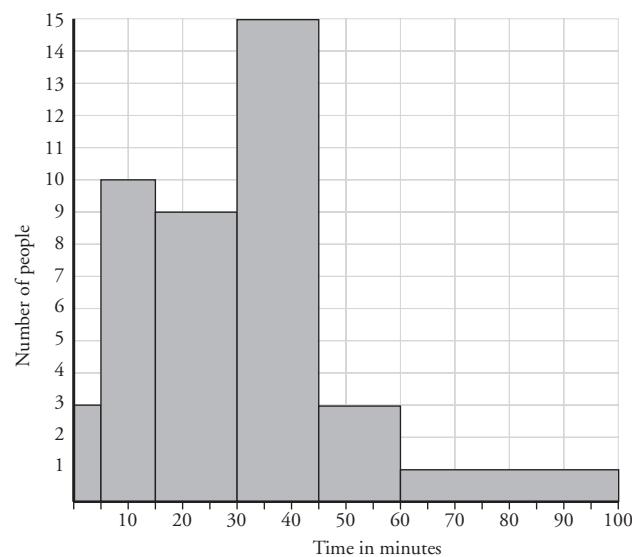
interquartile range = 2.8

(iii) 25 people

(c) $x = 14$

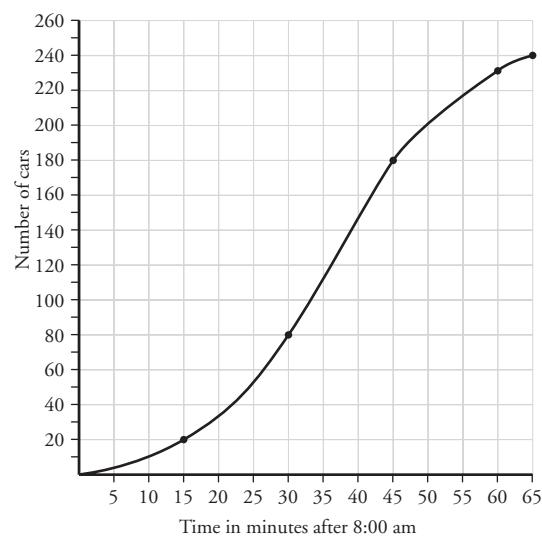
2. (a) 18

(b) (i)



(ii) 30–45 class interval

(c) (i)



(ii) 105 cars

(iii) 8:40 am

3. (a) Mean = 4.7, mode = 5.6

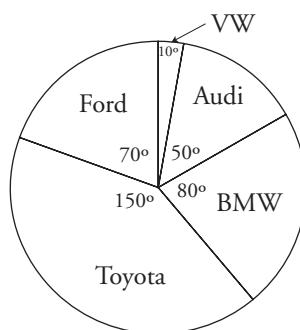
(b) (i) 7 (ii) 6 (iii) 3

(c) (i)

Amount in €	0–10	10–30	30–50	50–70	70–100
No. of people	15	40	30	12	3

(ii) €30.50

4. (a)



(b) (i)

Age	15–25	25–35	35–45	45–60	60–80
No. of people	6	5	6	8	5

(ii) Mean = 43

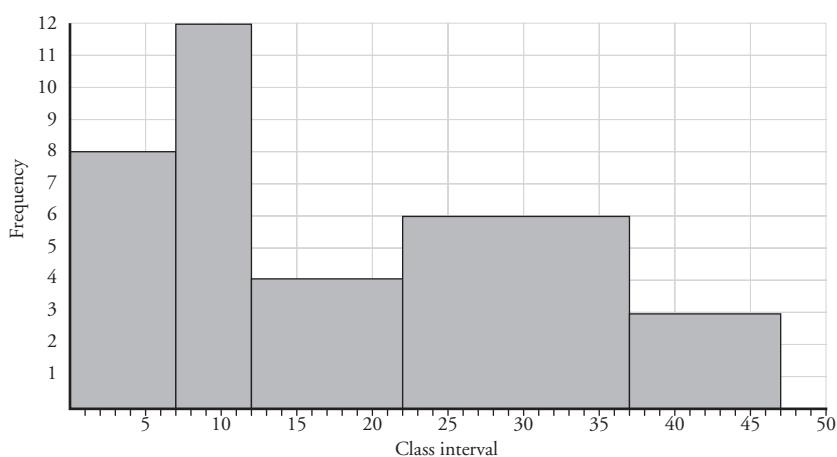
(iii) 35–45 class interval

(c) $x = 5$

5. (a) (i) 120 people (ii) 80 people

(b) (i) 28 (ii) 8.3

(c)



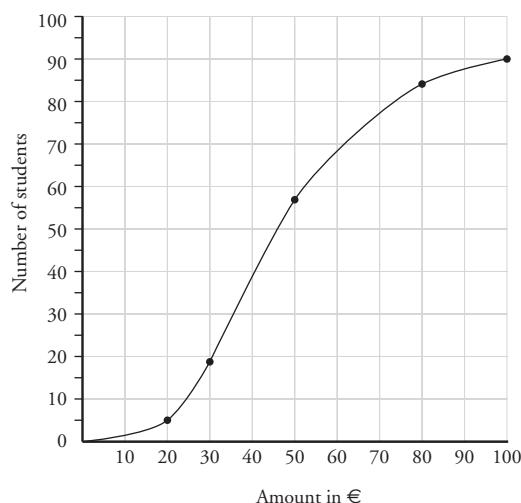
(i) 22–37 (ii) 12–22

6. (a) (i) Mode = 4.5 (ii) Median = 3.8 (iii) Mean = 4

(b) (i)

Wages in €	<20	<30	<50	<80	<100
No. of students	5	19	57	85	90

(ii)



(iii) Median = 43

(c) (i) 10.5

(ii)

Amount in €	0–10	10–20	20–30	30–40	40–60
No. of customers	40	120	300	120	20

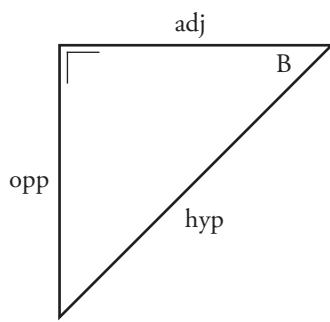
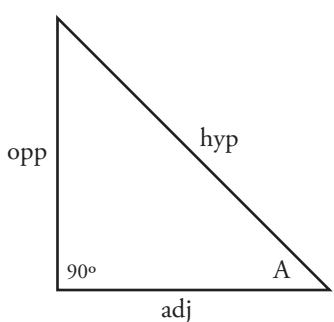
(iii) €24.50

Chapter 14

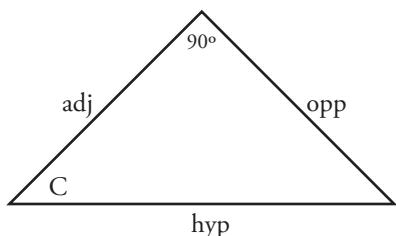
(b)

Revision exercise 14

1. (a)



(c)



2. (a) 10 (b) 3 (c) 2

3. (a) 9.15 (b) 4.62 (c) 10.77

4. (i) $\sin A = \frac{5}{13}$: $\cos A = \frac{12}{13}$:

$\tan A = \frac{5}{12}$

(ii) $\sin A = \frac{6}{10}$ or $\frac{3}{5}$: $\cos A = \frac{8}{10}$ or $\frac{4}{5}$:

$\tan A = \frac{6}{8}$ or $\frac{3}{4}$

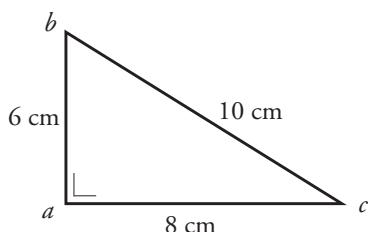
(iii) $\sin A = \frac{\sqrt{2}}{3}$: $\cos A = \frac{\sqrt{7}}{3}$:

$\tan A = \frac{\sqrt{2}}{7}$ or $\frac{\sqrt{14}}{7}$

5. $\cos A = \frac{12}{13}$, $\tan A = \frac{5}{12}$

6. (a) 8 cm

(b)



(c) $\sin \angle acb = \frac{6}{10}$ (d) $\cos \angle acb = \frac{8}{10}$

(e) $\sin \angle abc = \frac{8}{10}$ (f) $\tan \angle abc = \frac{8}{6}$

7. $x = 10$

8. (a) 0.559 (b) 0.788 (c) 1.280

(d) 8.144 (e) 0.914 (f) 0.906

(g) 0.845 (h) 0.968 (i) 0.453

(j) 0.194 (k) 1.866

9. (a) 39° (b) 54° (c) 43° (d) 74°

(e) 24° (f) 76° (g) 41° (h) 61° (i) 74°

10. (a) 2.54 cm (b) 5.67 cm

11. 11.19 cm 12. 16.46 cm

13. 16.88 cm 14. 3.54 cm

15. (a) 7.99 m (b) 12.04 m

16. 14.32 cm

17. (a) 30° (b) 30° 18. (a) 25° (b) 45°

19. 56° 20. 18 m 21. 119 m

22. 470 cm 23. 308 m

24. (a) 868 m (b) 4924 m

Exercise 14.1

1. (a) 0.452 (b) 0.944 (c) 1.136

(d) 3.004 (e) 1.891 (f) 1.451 (g) 1.739

(h) 4.779 (i) 217.524 (j) 4.137

2. (a) $27^\circ 24'$ (b) $52^\circ 18'$ (c) $75^\circ 6'$

(d) $45^\circ 15'$ (e) $89^\circ 31'$ (f) $63^\circ 43'$

3. (a) 25.05° (b) 62.55° (c) 22.12°

(d) 54.58° (e) 78.53° (f) 10.18°

4. (a) 8° (b) 59° (c) 79° (d) 81° (e) 14°

(f) 76° (g) 50° (h) 82° (i) 73° (j) 9°

5. (a) $76^\circ 26'$ (b) $52^\circ 6'$ (c) $72^\circ 29'$

(d) $67^\circ 46'$ (e) $47^\circ 31'$ (f) $78^\circ 59'$

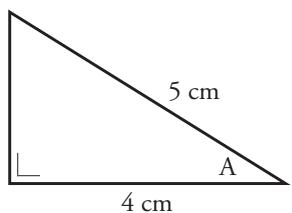
(g) $60^\circ 36'$ (h) $38^\circ 27'$ (i) $79^\circ 12'$

(j) $62^\circ 47'$

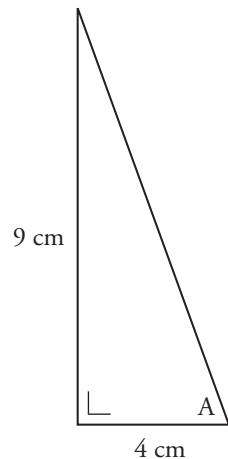
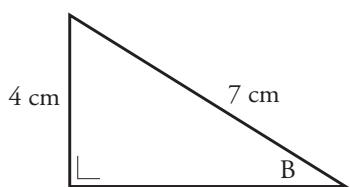
Exercise 14.2

4.

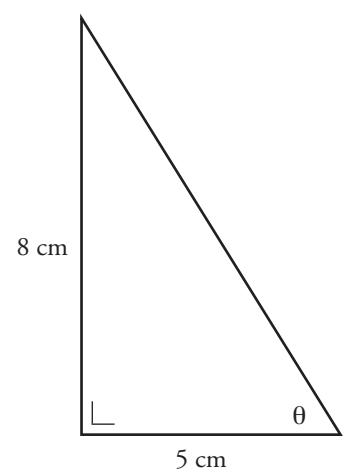
1.



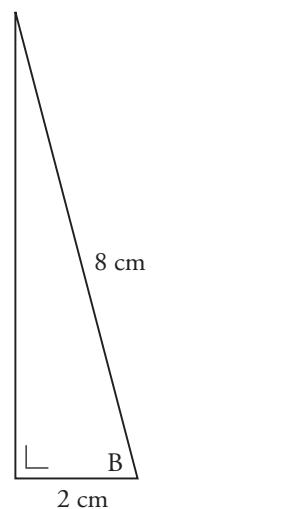
2.



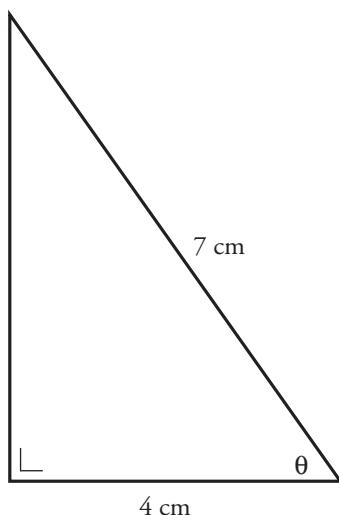
5.



6.



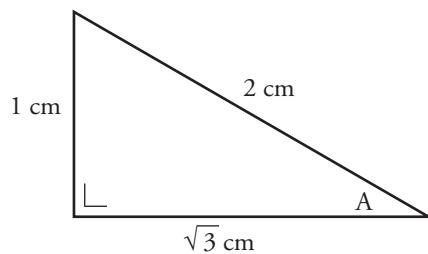
7.



$$(b) \sin\theta = \frac{5}{13} \quad \cos\theta = \frac{12}{13}$$

$$(c) 0.7692 \neq 0.7101$$

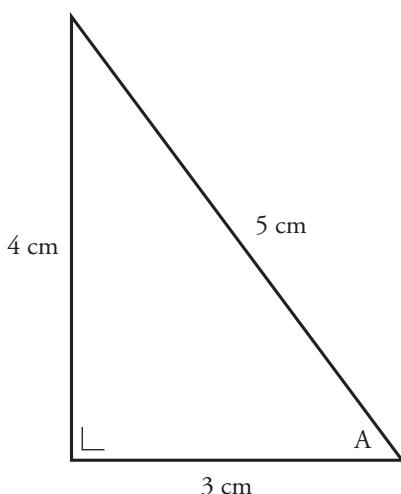
10. (a)



$$(b) \tan A = \frac{1}{\sqrt{3}}$$

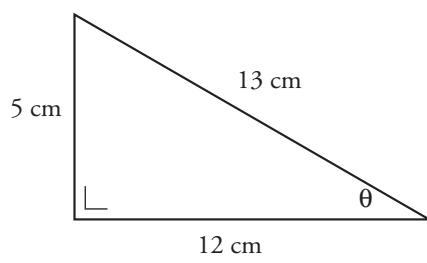
$$(c) 30^\circ; 0.966 \neq 0.433$$

8. (a)



$$(b) \sin A = \frac{4}{5} \quad \cos A = \frac{3}{5}$$

9. (a)

**Exercise 14.3**

1.

A	30°	45°	60°	90°
$\sin A$	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
$\cos A$	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
$\tan A$	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	Undefined

$$2. (a) \frac{3}{2} \quad (b) \frac{\sqrt{3}-1}{2}$$

$$(c) \frac{2\sqrt{3}+3\sqrt{2}}{6} \quad (d) \frac{\sqrt{2}-2}{2}$$

$$3. (a) \frac{2+\sqrt{3}}{2} \quad (b) \frac{1}{4} \quad (c) \frac{1+\sqrt{3}}{2} \quad (d) \frac{1}{12}$$

$$6. (a) -\frac{\sqrt{3}}{2} \quad (b) -\frac{\sqrt{3}}{2} \quad (c) -\frac{1}{\sqrt{3}} \quad (d) \frac{\sqrt{3}}{2}$$

$$(e) 1 \quad (f) -\frac{1}{\sqrt{2}} \quad (g) -\frac{1}{2} \quad (h) \frac{1}{\sqrt{2}}$$

$$7. (a) -1 \quad (b) -2\sqrt{3}$$

- (c) 4 (d) $\frac{2\sqrt{6} - 4\sqrt{3}}{3}$
 8. 60° 9. 270° 10. 120° 11. $150^\circ, 210^\circ$
 12. $150^\circ, 330^\circ$ 13. $90^\circ, 270^\circ$
 14. $0^\circ, 360^\circ$ 15. $45^\circ, 225^\circ$ 16. 150°
 17. (a) $42^\circ, 138^\circ$ (b) $41^\circ, 319^\circ$
 (c) $130^\circ, 310^\circ$
 18. (a) $76^\circ, 284^\circ$ (b) $232^\circ, 308^\circ$
 (c) $109^\circ, 289^\circ$
 19. $-\sqrt{3}$ 20. 1

Exercise 14.4

1. (a) 4.36 (b) 17.44 (c) 6.42
 2. (a) 40° (b) 27°
 3. (a) 14.65 (b) 23.39
 4. 12.94 5. 32°
 6. (a) $\frac{20\sqrt{3}}{3}$ (b) $10\sqrt{2}$
 7. (a) 18.38 cm (b) 49.5° (c) 11.94 cm
 8. (a) 157° (b) 13.3 cm
 9. (a) 7 cm (b) 3 cm
 10. (a) 106° (b) 16 cm

Exercise 14.5

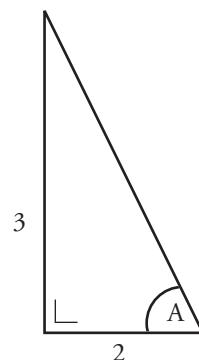
1. (a) 5 cm^2 (b) 7 cm^2
 2. (a) 8.4 cm^2 (b) 37.39 cm^2
 3. (a) 16° (b) 25°
 4. (a) 9 cm (b) 11 cm
 5. (a) 121° (b) 143°
 6. 26 cm^2 7. 34°
 8. (a) $|\angle abd| = 30^\circ$ (b) $|\angle abd| = 150^\circ$
 9. $10\sqrt{3} \text{ cm}^2$ 10. $42\sqrt{2} \text{ cm}^2$

Exercise 14.6

1. 10.83 m 2. 24 km 3. 569 km
 4. 35 km 5. 11 m 6. 69 m 7. 22°
 8. 214 m^2 9. $2\sqrt{3} \text{ cm}$ 10. 15 m

Chapter 14 review

1. (a) $45^\circ, 225^\circ$
 (b) (i) 13.17 cm (ii) 36 cm^2
 (c) (i) $\frac{4}{5}$ (ii) 22.4
 2. (a) $\tan A = \frac{3}{2}$



- (b) $63^\circ 15'$
 (c) (i) 56 m (ii) 28°
 3. (a) $\sin A = \frac{1}{2}$
 (b) 133 km
 (c) (i) $4\sqrt{3} \text{ cm}^2$ (ii) 3.08
 4. (a) (i) $\frac{5}{13}$ (ii) $\frac{12}{13}$
 (b) (i) $26^\circ 34'$ (ii) 1 m
 (c) (i) 30° (ii) 5.1 cm^2
 5. (a) 6
 (b) (i) 14.04° (ii) 12.53°
 (c) 14 m
 6. (a) $-\sqrt{3}$
 (b) (i) 110° (ii) 39 cm^2
 (c) 149 km