



BRITISH LEARNING CENTRE

KEY STAGE 3 · YEAR 8

Mathematics

Year 8

Fourteen Year 8 units matched to the English National Curriculum for Key Stage 3 and Cambridge Lower Secondary Stage 8. Each unit has clear notes, worked examples, skills practice and problem-solving questions with full mark schemes.

Name:

Key knowledge · Practice · Exam-style questions · Mark schemes

How to use this workbook

1

Key knowledge

Read the notes, worked examples and common mistakes.

2

Practice

Build the skill on Sheet A.

3

Exam-style

Answer exam-style questions on Sheet B. Marks are shown in [].

4

Check & reflect

Mark your work with the mark scheme, then colour the tracker.

My progress tracker

Colour each row: **Red** = not yet · **Amber** = nearly · **Green** = secure.

#	Curriculum ref	Topic · I can...	R	A	G
1	Number	Indices and standard form I can use the index laws and write large and small numbers in standard form.			
2	Number, Ratio & proportion	Fractions, decimals and percentages I can calculate with fractions and find percentage changes, including reverse percentages.			
3	Ratio & proportion	Ratio and proportion I can share in a given ratio, compare best buys and solve direct proportion problems.			
4	Algebra	Expanding and factorising I can expand single brackets, simplify expressions and factorise by taking out the highest common factor.			
5	Algebra	Equations and inequalities I can form and solve linear equations, including unknowns on both sides, and solve inequalities.			
6	Algebra	Sequences and the nth term I can find and use the nth term of a linear sequence and recognise other types of sequence.			
7	Algebra, Ratio & proportion	Straight-line and real-life graphs I can draw and use graphs of $y = mx + c$ and interpret real-life graphs.			
8	Geometry & measures	Angles in parallel lines and polygons I can use angle facts for parallel lines and find interior and exterior angles of polygons.			
9	Geometry & measures	Area of trapezia and circles I can find the area of a trapezium and the circumference and area of a circle.			
10	Geometry & measures	Volume and surface area of prisms I can find the volume and surface area of cuboids, prisms and cylinders.			
11	Geometry & measures	Transformations I can reflect, rotate, translate and enlarge shapes and describe transformations fully.			
12	Geometry & measures	Constructions and loci I can construct triangles, bisectors and loci accurately using a ruler and compasses.			
13	Statistics	Scatter graphs and grouped data I can interpret scatter graphs and estimate the mean from a grouped frequency table.			
14	Probability	Probability I can use mutually exclusive events and sample space diagrams to find probabilities.			



CHECK

Starting point check

Starting point check

Name _____ Date _____ Score _____ / 12

Answer as many questions as you can. This check shows what you already know before you begin the book.

1 Work out 2^4 .

2 Find 25% of 360.

3 Simplify the ratio 12 : 18.

4 Expand $4(x + 5)$.

5 Solve $3x + 7 = 22$.

6 Write the next term: 5, 8, 11, 14, ...

7 Find y when $x = 2$ for $y = 3x + 1$.

8 Two angles on a straight line: one is 125° . Find the other.

9 Area of a triangle, base 10 cm, height 7 cm

10 Volume of a cuboid 2 cm $\times$ 3 cm $\times$ 4 cm

11 A fair dice is rolled. Find $P(3)$.

12 Find the mean of 3, 5 and 10.

Indices and standard form

I can... use the index laws and write large and small numbers in standard form.

Curriculum ref: Number

In 5^3 , 5 is the **base** and 3 is the **index** (or power): $5^3 = 5 \times 5 \times 5 = 125$. When the bases are the same, you can multiply or divide powers using the index laws.

Standard form is a short way to write very large or very small numbers: $A \times 10^n$, where $1 \leq A < 10$ and n is an integer. Small numbers (less than 1) have a negative power of 10.

Key words

index (power)

base

index laws

standard form

zero index

Key points

- $a^m \times a^n = a^{m+n}$ $a^m \div a^n = a^{m-n}$ $(a^m)^n = a^{mn}$
- Any number to the power 0 is 1: $a^0 = 1$.
- $72\,000 = 7.2 \times 10^4$ $0.0058 = 5.8 \times 10^{-3}$

Worked example 1

Simplify $5^3 \times 5^4 \div 5^2$. Give your answer as a power of 5.

Multiply: add the indices. $5^{3+4} = 5^7$

Divide: subtract the indices. $5^{7-2} = 5^5$

Worked example 2

Write (a) 650 000 and (b) 0.000 41 in standard form.

(a) 6.5 is between 1 and 10. $6.5 \times 100\,000 = 650\,000$, so 6.5×10^5

(b) 4.1 must be divided by 10 four times to give 0.000 41, so 4.1×10^{-4}

Common mistakes

- Multiplying the indices instead of adding: $2^3 \times 2^4$ is 2^7 , not 2^{12} .
- Thinking 3^2 means 3×2 . It means $3 \times 3 = 9$.

Exam tip: Check a standard form answer by counting: a large number has a positive power; a number less than 1 has a negative power.

Answer each question. Give powers in index form where asked.

1 Work out the value of 3^4 .

2 Work out the value of 2^5 .

3 Write $7 \times 7 \times 7 \times 7 \times 7$ as a power of 7.

4 Write $4^3 \times 4^5$ as a single power.

5 Write $9^7 \div 9^3$ as a single power.

6 Write $(2^3)^4$ as a single power.

7 Work out the value of 6^0 .

8 Simplify $x^4 \times x^6$.

9 Simplify $y^9 \div y^2$.

10 Write $3^5 \times 3^2 \div 3^4$ as a single power.

11 Work out $2^3 \times 5^2$.

12 Simplify $2a^3 \times 5a^4$.

13 Simplify $12b^8 \div 4b^2$.

14 Write 45 000 in standard form.

15 Write 3 200 000 in standard form.

16 Write 0.007 in standard form.

17 Write 0.000 52 in standard form.

18 Write 6.1×10^3 as an ordinary number.

19 Write 2.05×10^5 as an ordinary number.

20 Write 8×10^{-2} as an ordinary number.

21 Which is larger: 4.3×10^5 or 9.8×10^4 ?

22 Find n if $5^n \times 5^2 = 5^9$.

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all questions. Show your working. Marks are shown in [].

- 1 (a) Write $5^6 \times 5^3$ as a single power of 5. [1]

Answer

- (b) Write $(7^2)^5$ as a single power of 7. [1]

Answer

- (c) $2^n \times 2^3 = 2^{10}$. Find the value of n . [1]

Answer $n =$

- (d) Work out the value of $3^8 \div 3^5$. [2]

Answer

- 2 The population of a city is 8 400 000.

- (a) Write 8 400 000 in standard form. [1]

Answer

- (b) The mass of a grain of sand is 0.000 064 g. Write this mass in standard form. [1]

Answer g

- (c) Explain why 0.5×10^5 is **not** written in standard form. [1]

- (d) Write these numbers in order of size, starting with the smallest.
 3.6×10^4 4.1×10^3 2.9×10^5 9.9×10^3 [2]

- 3 Simplify fully.

- (a) $x^5 \times x^4$ [1]

Answer

- (b) $6y^7 \div 2y^3$ [2]

Answer

- (c) $(m^3)^4$ [1]

Answer

- (d) $4p^2 \times 3p^5$ [2]

Answer

4 Amira says, " $2^3 \times 3^2 = 6^5$ ".

(a) Show that Amira is wrong.

[2]

(b) Write 360 as a product of its prime factors. Give your answer in index form.

[2]

Answer

5 You may use a calculator. Light travels 3×10^5 km every second.

(a) How far does light travel in 60 seconds? Give your answer in standard form.

[2]

Answer km

(b) The distance from the Earth to the Sun is about 1.5×10^8 km. How many seconds does light take to travel from the Sun to the Earth?

[2]

Answer s

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Fractions, decimals and percentages

I can... calculate with fractions and find percentage changes, including reverse percentages.

Curriculum ref: Number, Ratio & proportion

To add or subtract fractions, use a common denominator. To divide by a fraction, multiply by its reciprocal (flip it).

A **multiplier** makes percentage questions quick. An increase of 15% means $100\% + 15\% = 115\%$, so multiply by 1.15. A decrease of 15% means 85%, so multiply by 0.85. To find the **original value** (reverse percentage), divide by the multiplier.

Key words

multiplier

percentage change

original value

reverse percentage

mixed number

Key points

- Percentage change = $\text{change} \div \text{original} \times 100$
- New value = $\text{original} \times \text{multiplier}$
- Original value = $\text{new value} \div \text{multiplier}$
- Percentages of percentages: never add or subtract them — use the multiplier.

Worked example 1

The price of a ticket rises from £40 to £46. Find the percentage increase.

$$\text{Change} = 46 - 40 = 6$$

$$6 \div 40 \times 100 = \mathbf{15\%}$$

Worked example 2

After a 20% increase, a price is £96. Find the original price.

$$120\% \text{ of the original} = £96, \text{ so the multiplier is } 1.2$$

$$\text{Original} = 96 \div 1.2 = \mathbf{£80} \quad (\text{Check: } 80 \times 1.2 = 96 \checkmark)$$

Common mistakes

- Dividing by the new value when finding percentage change — always divide by the **original**.
- For a reverse percentage, finding 20% of £96 and subtracting it. This gives £76.80, not £80.
- Writing the multiplier for a 5% increase as 1.5. It is 1.05.

Exam tip: Check a reverse percentage answer by applying the percentage change to it — you should get back to the value in the question.

Answer each question. Give fractions in their simplest form.

1 $\frac{3}{4} + \frac{1}{6}$

2 $\frac{5}{6} - \frac{2}{9}$

3 $\frac{2}{3} \times \frac{9}{10}$ (simplest form)

4 $\frac{4}{5} \div \frac{2}{7}$ (as a mixed number)

5 $1\frac{1}{2} \times 2\frac{2}{3}$

6 Write $\frac{3}{8}$ as a decimal.

7 Write 0.65 as a fraction in its simplest form.

8 Write $\frac{7}{20}$ as a percentage.

9 Write 0.4% as a decimal.

10 Find 15% of 240.

11 Find 35% of 80.

12 Write the multiplier for an increase of 12%.

13 Write the multiplier for a decrease of 30%.

14 Increase 50 by 18%.

15 Decrease 360 by 25%.

16 Increase £85 by 4%.

17 Write 18 as a percentage of 72.

18 Find the percentage change from 50 to 62.

19 Find the percentage change from 80 to 68.

20 After a 10% increase, a price is £77. What was the original price?

21 After a 25% decrease, a value is 48. What was the original value?

22 Write in order, smallest first: $\frac{5}{8}$, 0.6, 61%

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all questions. Show your working. Marks are shown in [].

- 1** Do not use a calculator. Show your working.

(a) Work out $2\frac{3}{4} + 1\frac{5}{6}$. Give your answer as a mixed number.

[2]

Answer

(b) Work out $3\frac{1}{3} \div \frac{5}{6}$.

[2]

Answer

(c) Write $\frac{7}{8}$ as a percentage.

[1]

Answer %

- 2** A laptop costs £650. In a sale, the price is reduced by 18%.

(a) Work out the sale price.

[2]

Answer £

(b) After the sale, the shop increases the sale price by 18%. Ben says the price is now £650 again. Is Ben correct? Show how you decide.

[2]

- 3** The value of a house rose from £240 000 to £261 600. Work out the percentage increase.

[3]

Answer %

- 4** In a sale, all prices are reduced by 35%. The sale price of a coat is £52. Work out the original price of the coat.

[3]

Answer £

- 5 Shop A sells a tablet for £120 with 15% off. Shop B sells the same tablet for £125 with $\frac{1}{5}$ off. Which shop is cheaper, and by how much? [4]

Answer Shop by £

- 6 After a 4% pay rise, Salma earns £27 040 a year.

(a) Work out Salma's salary before the pay rise. [2]

Answer £

(b) How much more does Salma earn each year after the rise? [1]

Answer £

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Ratio and proportion

I can... share in a given ratio, compare best buys and solve direct proportion problems.

Curriculum ref: Ratio & proportion

A ratio compares quantities. Simplify a ratio by dividing every part by the same number. Make sure the units are the same first.

To **share** in a ratio, add the parts, find the value of one part, then multiply. Two quantities are in **direct proportion** when one is always the same multiple of the other: $y = kx$. Use the **unitary method**: find the value of one, then multiply.

Key words

ratio

simplify

share

unit price

direct proportion

unitary method

Key points

- Share £96 in the ratio 5 : 3 → 8 parts, 1 part = £12 → £60 and £36.
- Best buy: compare the price per gram (or grams per penny). The lower price per unit is better value.
- Direct proportion: double one quantity → double the other.

Worked example 1

400 g of coffee costs £2.60. 750 g costs £4.65. Which is the better buy?

400 g: $260 \div 4 = 65\text{p}$ per 100 g; 750 g: $465 \div 7.5 = 62\text{p}$ per 100 g

The **750 g** bag is better value.

Worked example 2

6 pens cost £4.50. Find the cost of 14 pens.

1 pen: $4.50 \div 6 = £0.75$

14 pens: $0.75 \times 14 = \textbf{£10.50}$

Common mistakes

- Dividing by one part of the ratio instead of the total number of parts.
- Simplifying 400 g : 2 kg to 200 : 1 — convert to the same units first ($400 : 2000 = 1 : 5$).

Exam tip: After sharing, add your answers — they should make the original total.

Answer each question. Give ratios in their simplest form.

1 Simplify $18 : 24$

2 Simplify $45 : 60 : 75$

3 Simplify $2.5 : 4$

4 Simplify $400 \text{ g} : 2 \text{ kg}$

5 Write $4 : 5$ in the form $1 : n$.

6 Share 60 in the ratio $2 : 3$.

7 Share 84 in the ratio $3 : 4$.

8 Share £150 in the ratio $1 : 2 : 3$.

9 Boys : girls = $3 : 5$. There are 40 girls. How many boys?

10 Red : blue = $2 : 7$. What fraction of the counters are red?

11 5 apples cost £1.40. Find the cost of 8 apples.

12 3 kg of rice costs £7.20. Find the cost of 5 kg.

13 A recipe for 4 people uses 300 g of flour. How much flour for 10 people?

14 12 litres of fuel cost £17.40. Find the cost of 20 litres.

15 Which is better value: 250 ml for £1.10 or 400 ml for £1.80?

16 £1 = 44 baht. Change £35 into baht.

17 £1 = 44 baht. Change 1100 baht into pounds.

18 y is directly proportional to x . $y = 12$ when $x = 3$. Find y when $x = 7$.

19 A map has scale $1 : 50\,000$. What real distance is 4 cm on the map?

20 A and B share money in the ratio $5 : 2$. A gets £36 more than B. How much money is shared?

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all questions. Show your working. Marks are shown in [].

- 1** Orange paint is made by mixing red paint and yellow paint in the ratio 3 : 5.

(a) How much red paint is needed to make 40 litres of orange paint?

[2]

Answer litres

(b) Ella has 12 litres of red paint and plenty of yellow paint. What is the greatest amount of orange paint she can make?

[2]

Answer litres

- 2** A shop sells cereal in three sizes.

Which size is the best value for money? You must show your working.

[3]

Size	500 g	750 g	1 kg
Price	£2.35	£3.45	£4.70

Answer

- 3** Here are the ingredients for 12 biscuits: 150 g butter, 225 g flour, 90 g sugar.

(a) How much flour is needed for 20 biscuits?

[2]

Answer g

(b) Tom has 400 g of butter, 500 g of flour and 300 g of sugar. What is the greatest number of biscuits he can make?

[3]

Answer

- 4 The cost, C pounds, of a fence is directly proportional to its length, L metres. A 15 m fence costs £247.50.

(a) Write a formula for C in terms of L .

[2]

Answer $C = \dots\dots\dots$

(b) Find the cost of a 32 m fence.

[1]

Answer £ $\dots\dots\dots$

(c) A fence costs £396. How long is it?

[1]

Answer $\dots\dots\dots$ m

- 5 Amy, Ben and Cal share £270 in the ratio 2 : 3 : 4.

(a) How much does Cal get?

[2]

Answer £ $\dots\dots\dots$

(b) Cal gives some money to Amy so that they now have the same amount. How much does Cal give to Amy?

[2]

Answer £ $\dots\dots\dots$

- 6 The angles in a triangle are in the ratio 2 : 3 : 7. Work out the size of the largest angle.

[2]

Answer $\dots\dots\dots^\circ$

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Expanding and factorising

I can... expand single brackets, simplify expressions and factorise by taking out the highest common factor.

Curriculum ref: Algebra

To **expand** a bracket, multiply every term inside by the term outside. Then collect **like terms** (terms with exactly the same letters and powers).

Factorising is the reverse of expanding. Find the highest common factor (HCF) of all the terms — numbers and letters — and write it outside the bracket.

Key words

expression

like terms

expand

factorise

highest common factor

identity

Key points

- $3(2x - 5) = 6x - 15$
- $-2(x - 4) = -2x + 8$ (negative $\times$ negative = positive)
- $x \times x = x^2$, $3a \times 2a = 6a^2$. Check factorising by expanding.

Worked example 1

Expand and simplify $4(x + 3) - 2(x - 1)$.

$$\begin{aligned} &4x + 12 - 2x + 2 \quad (-2 \times -1 = +2) \\ &= 2x + 14 \end{aligned}$$

Worked example 2

Factorise fully $12y^2 + 18y$.

$$\begin{aligned} &\text{HCF of 12 and 18 is 6; both terms contain } y. \text{ HCF} = 6y \\ &12y^2 \div 6y = 2y, \quad 18y \div 6y = 3 \\ &= 6y(2y + 3) \end{aligned}$$

Common mistakes

- Only multiplying the first term: $3(x + 4)$ is not $3x + 4$.
- Sign errors with a negative outside the bracket: $-3(x - 2) = -3x + 6$.

Exam tip: "Factorise fully" means there is more than one common factor to take out — look for numbers **and** letters.

Answer each question.

1 Simplify $5a + 3b - 2a + b$

2 Simplify $4x^2 + 3x - x^2 + 2x$

3 Expand $3(x + 4)$

4 Expand $5(2y - 3)$

5 Expand $-2(a - 6)$

6 Expand $x(x + 7)$

7 Expand $3p(2p - 5)$

8 Expand $4a(3a + 2b)$

9 Expand and simplify $2(x + 5) + 3(x - 1)$

10 Expand and simplify $5(y + 2) - 3(y - 4)$

11 Expand and simplify $x(x + 3) + 2(x - 1)$

12 Factorise $6x + 18$

13 Factorise $10y - 25$

14 Factorise $x^2 + 9x$

15 Factorise fully $8a^2 - 12a$

16 Factorise fully $14pq + 21p$

17 Factorise fully $15m^3 + 5m^2$

18 Fill in the box: $3(2x + \text{ }) = 6x + 21$

19 Fill in the box: $\text{ } (x - 4) = 5x - 20$

20 Find the value of $4(x - 2)$ when $x = 3.5$

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all questions. Show your working. Marks are shown in [].**1** (a) Expand $7(3x - 2)$. [1]

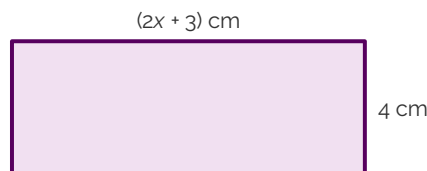
Answer

(b) Expand and simplify $3(2y + 5) - 4(y - 2)$. [2]

Answer

(c) Factorise fully $9a^2 - 15a$. [2]

Answer

2 The diagram shows a rectangle.

Not to scale

(a) Write an expression for the area of the rectangle. Expand the brackets. [2]

Answer cm^2

(b) Write an expression for the perimeter in its simplest form. [2]

Answer cm

(c) The area of the rectangle is 44 cm^2 . Find the value of x . [2]Answer $x = \dots\dots$ **3** Show that $5(x + 2) - 3(x - 4)$ can be written as $2(x + 11)$. [3]

4 Kai factorises $12x^2 + 8x$ and writes $2x(6x + 4)$.

(a) Explain why Kai's answer is not fully factorised.

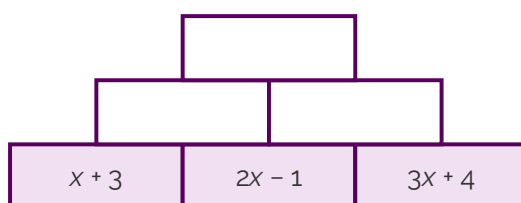
[1]

(b) Factorise $12x^2 + 8x$ fully.

[1]

Answer

5 In this algebra pyramid, the expression in each brick is the sum of the two bricks below it.



(a) Complete the pyramid. Write each expression in its simplest form.

[2]

(b) The top brick is equal to 45. Find the value of x .

[2]

Answer $x =$

6 (a) Expand and simplify $x(x + 5) - 2(x - 3)$.

[2]

Answer

(b) Factorise fully $18x^2y + 24xy^2$.

[2]

Answer

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Equations and inequalities

I can... form and solve linear equations, including unknowns on both sides, and solve inequalities.

Curriculum ref: Algebra

An equation is like a balance: do the same thing to both sides. When the unknown is on **both sides**, first collect the unknown terms on one side (usually the side with more), then the numbers on the other.

An **inequality** is solved in the same way. On a number line, an open circle $\circ$ means the value is not included ($<$ or $>$); a filled circle $\bullet$ means it is included ($\leq$ or $\geq$).

Key words

equation

solve

unknown

inequality

integer

number line

Key points

- To form an equation, write each part in algebra, then set it equal to the total.
- $x > 3$ means x is more than 3; $x \leq 3$ means 3 or less.
- Check a solution by substituting it back into the equation.

Worked example 1

Solve $3(x + 4) = 5x - 2$.

$3x + 12 = 5x - 2 \rightarrow$ subtract $3x$: $12 = 2x - 2 \rightarrow$ add 2: $14 = 2x$

$x = 7$ (Check: $3 \times 11 = 33$ and $35 - 2 = 33$ ✓)

Worked example 2

Solve $2x + 3 < 11$ and show the answer on a number line.



$2x < 8$, so $x < 4$ (open circle at 4, arrow to the left)

Common mistakes

- Moving a term across the equals sign without changing its sign.
- Using a filled circle for $<$ or $>$. Filled circles are only for $\leq$ and $\geq$.

Exam tip: In "show that" questions, write every step clearly — the marks are for the working, not the final line.

Solve each equation or inequality.

1 Solve $x + 9 = 23$

2 Solve $4x = 30$

3 Solve $3x - 5 = 16$

4 Solve $x/4 + 2 = 9$

5 Solve $5x + 3 = 2x + 18$

6 Solve $7x - 4 = 3x + 20$

7 Solve $2x + 15 = 6x - 1$

8 Solve $9 - x = 2x + 3$

9 Solve $4(x - 3) = 20$

10 Solve $3(2x + 1) = 4x + 13$

11 Solve $5(x - 2) = 2(x + 4)$

12 Solve $(2x + 6)/3 = 8$

13 I think of a number, multiply it by 3 and subtract 7. The answer is 20. What is my number? 14 The angles of a triangle are x , $2x$ and $3x$. Find x . 15 Ali is x years old. His mother is 3 times as old. Their ages add up to 52. Find x . 16 List the integers n such that $-2 < n \leq 3$.

17 Solve $3x - 4 > 11$

18 Solve $5x + 2 \leq 3x + 12$

19 Solve $2(x + 3) \geq 14$

20 Find the smallest integer x such that $4x > 18$. Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all questions. Show your working. Marks are shown in [].

- 1** Solve these equations. Show your working.

(a) $6x - 7 = 2x + 9$

[2]

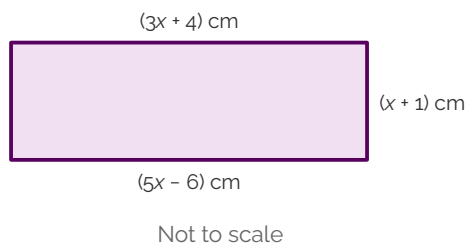
Answer $x = \dots\dots\dots$

(b) $4(2y - 1) = 3(y + 7)$

[3]

Answer $y = \dots\dots\dots$

- 2** The diagram shows a rectangle. All lengths are in centimetres.



- (a)** Write an equation and solve it to find x .

[3]

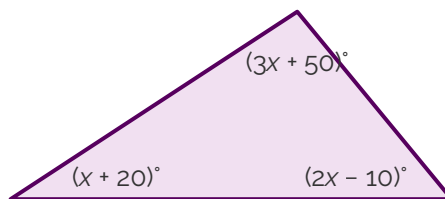
Answer $x = \dots\dots\dots$

- (b)** Work out the perimeter of the rectangle.

[2]

Answer cm

- 3 The diagram shows a triangle.



Not to scale

- (a) Form an equation and solve it to find the value of x . [3]

Answer $x = \dots\dots$

- (b) Is the triangle obtuse-angled? Give a reason. [1]

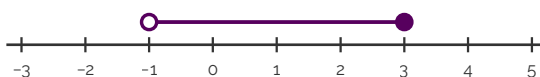
- 4 (a) Solve $4x - 3 < 2x + 9$. [2]

Answer $\dots\dots$

- (b) n is an integer. List all the values of n such that $-3 \leq 2n + 1 < 7$. [3]

Answer $\dots\dots$

- (c) Write down the inequality shown on this number line. [1]



Answer $\dots\dots$

- 5 Sam has $\pounds x$. Tia has $\pounds 15$ more than Sam. Uma has twice as much as Tia. Altogether they have $\pounds 125$.

- (a) Show that $4x + 45 = 125$. [2]

- (b) Work out how much money Uma has. [2]

Answer $\pounds \dots\dots$

- 6 Taxi A charges £3 plus £1.20 per kilometre. Taxi B charges £5 plus £0.95 per kilometre. For what distance do both taxis cost the same?

[3]

Answer km

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Sequences and the n th term

I can... find and use the n th term of a linear sequence and recognise other types of sequence.

Curriculum ref: Algebra

A **term-to-term rule** tells you how to get from one term to the next. A **position-to-term rule** (the n th term) lets you find any term directly from its position n .

In a **linear** sequence the difference between terms is constant. The n th term is $dn + c$, where d is the common difference and c is the “zero term” (the term before the first).

Key words

sequence

term

term-to-term rule

n th term

linear

geometric

Key points

- 5, 9, 13, 17, ... has difference 4; zero term 1; n th term $4n + 1$.
- To test if a number is in a sequence, set the n th term equal to it and solve. A whole-number n means yes.
- Geometric: multiply by the same number each time (2, 6, 18, ...). Square numbers: 1, 4, 9, 16, ...

Worked example 1

Find the n th term of 5, 9, 13, 17, ...

Difference = 4, so the sequence is linked to $4n$: 4, 8, 12, 16

Each term is 1 more than $4n$, so **n th term = $4n + 1$**

Worked example 2

Is 150 a term of the sequence $4n + 1$?

$$4n + 1 = 150 \rightarrow 4n = 149 \rightarrow n = 37.25$$

n is not a whole number, so **150 is not a term**.

Common mistakes

- Writing $n + 4$ instead of $4n + 1$ for 5, 9, 13, ... — the difference goes in front of n .
- Getting the sign wrong for decreasing sequences: 30, 27, 24, ... is $33 - 3n$, not $3n + 27$.

Exam tip: Check your n th term by substituting $n = 1, 2$ and 3 — you should get the first three terms.

Answer each question.

1 Write the next two terms: 7, 11, 15, 19, ...

2 Write the next two terms: 40, 34, 28, 22, ...

3 Write the next two terms: 3, 6, 12, 24, ...

4 Write the term-to-term rule: 2.5, 3, 3.5, 4, ...

5 Write the first three terms of $3n + 2$.

6 Write the first three terms of $20 - 4n$.

7 Find the 10th term of $5n - 3$.

8 Find the 50th term of $2n + 7$.

9 Find the n th term: 3, 5, 7, 9, ...

10 Find the n th term: 4, 10, 16, 22, ...

11 Find the n th term: 11, 20, 29, 38, ...

12 Find the n th term: 1, 6, 11, 16, ...

13 Find the n th term: 30, 27, 24, 21, ...

14 Find the n th term: 2, 1.5, 1, 0.5, ...

15 Is 75 a term of the sequence $4n - 1$?
If so, which term?

16 Is 100 a term of the sequence $3n + 2$?
Explain.

17 Which term of $7n + 4$ is equal to 151?

18 Write the first three terms of $n^2 + 1$.

19 Write the next term: 1, 4, 9, 16, ...

20 Write the next term: 1, 1, 2, 3, 5, 8, ...

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all questions. Show your working. Marks are shown in [].

- 1 Here are some patterns made from matchsticks.



- (a) How many matchsticks are in Pattern 4? [1]

Answer

- (b) Write an expression for the number of matchsticks in Pattern n . [2]

Answer

- (c) How many matchsticks are in Pattern 30? [1]

Answer

- (d) Is there a pattern that uses exactly 200 matchsticks? Show how you decide. [2]

- 2 Here are the first four terms of a sequence: 8, 13, 18, 23, ...

- (a) Find an expression for the n th term. [2]

Answer

- (b) Explain why 302 is not a term of this sequence. [2]

- (c) Find the first term of the sequence that is greater than 500. [2]

Answer

3 The n th term of a sequence is $50 - 3n$.

(a) Write the first three terms.

[1]

Answer

(b) Find the first term in the sequence that is negative.

[2]

Answer

4 Sequence A has n th term $3n + 4$. Sequence B has n th term $5n - 8$.

For one value of n , the two sequences have the same term. Find this term.

[2]

Answer

5 Here is a geometric sequence: 2, 6, 18, 54, ...

(a) Write the term-to-term rule.

[1]

Answer

(b) Work out the 7th term.

[1]

Answer

6 A linear sequence has 4th term 19 and 9th term 44. Find an expression for the n th term. [3]

Answer

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Straight-line and real-life graphs

I can... draw and use graphs of $y = mx + c$ and interpret real-life graphs.

Curriculum ref: Algebra, Ratio & proportion

Every straight line can be written as $y = mx + c$. The number m is the **gradient** (steepness) and c is where the line crosses the y -axis, at $(0, c)$.

Gradient = change in $y \div$ change in x . A positive gradient slopes up from left to right; a negative gradient slopes down. Parallel lines have the same gradient. In real-life graphs, the gradient is a **rate** — on a distance–time graph it is the speed.

Key words

gradient

y -intercept

linear

parallel

coordinates

distance–time graph

Key points

- To draw a line, make a table of values, plot the points and join them with a ruler.
- $y = 3x - 2$: gradient 3, crosses the y -axis at $(0, -2)$.
- Horizontal lines: $y = k$. Vertical lines: $x = k$.
- On a distance–time graph, a horizontal line means the object has stopped.

Worked example

Find the equation of the line through (1, 4) and (3, 10).

Gradient = $(10 - 4) \div (3 - 1) = 6 \div 2 = 3$, so $y = 3x + c$

Substitute (1, 4): $4 = 3 \times 1 + c$, so $c = 1$

$y = 3x + 1$

Common mistakes

- Writing the gradient as change in $x \div$ change in y — it is “up over across”.
- Thinking $y = 5 - 2x$ has gradient 5. The gradient is the number multiplying x : -2 .
- Reading a real-life graph scale wrongly — check what one small square represents.

Exam tip: When converting time for speed, use hours: 20 minutes = $\frac{1}{3}$ hour, 45 minutes = 0.75 hour.

Answer each question.1 Write the gradient of $y = 4x + 7$.2 Write the y-intercept of $y = 4x + 7$.3 Write the gradient of $y = 5 - 2x$.4 Write the y-intercept of $y = 5 - 2x$.5 Write the gradient of $y = x/2 - 3$.

6 Write the equation of the line with gradient 3 and y-intercept (0, -1).

7 Find y when $x = 4$ on the line $y = 2x - 5$.8 Find x when $y = 11$ on the line $y = 3x + 2$.9 Does the point (2, 9) lie on $y = 4x + 1$?

10 Find the gradient of the line through (0, 1) and (2, 7).

11 Find the gradient of the line through (1, 8) and (4, 2).

12 Write the equation of the line parallel to $y = 6x - 1$ through (0, 4).13 Where does $y = 2x - 8$ cross the x-axis?14 Write $2y = 6x + 10$ in the form $y = mx + c$.15 Which line is steeper: $y = 3x + 1$ or $y = 5x - 2$?

16 Find the equation of the line through (1, 5) and (3, 9).

17 Write the equation of the horizontal line through (2, -3).

18 Write the equation of the vertical line through (2, -3).

19 A car travels 150 km in 2.5 hours. Find its average speed.

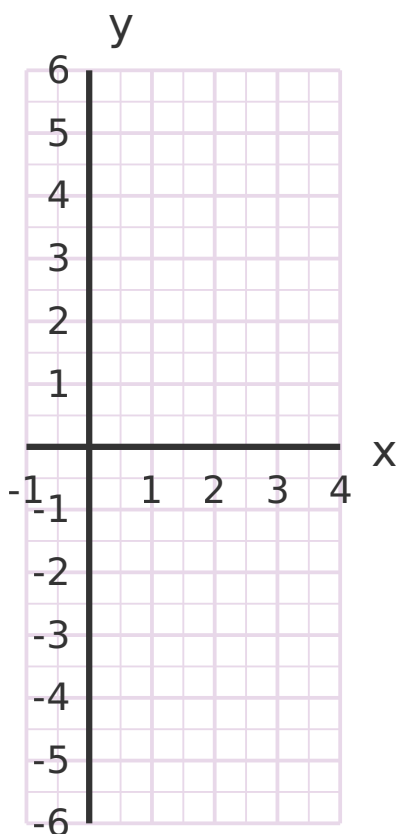
20 On a distance–time graph, what does the gradient show?

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all questions. Show your working. Marks are shown in [].

1

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



(a) Complete the table of values for $y = 2x - 3$. [2]

(b) Draw the graph of $y = 2x - 3$ on the grid. [2]

(c) Use your graph to find the value of x when $y = 2$. [1]

Answer $x = \dots\dots\dots$

- 2 A straight line L passes through the points $(0, -1)$ and $(2, 5)$.

(a) Work out the gradient of L .

[2]

Answer

(b) Write the equation of L .

[1]

Answer $y = \dots\dots\dots$

(c) Write the equation of the line parallel to L that passes through $(0, 4)$.

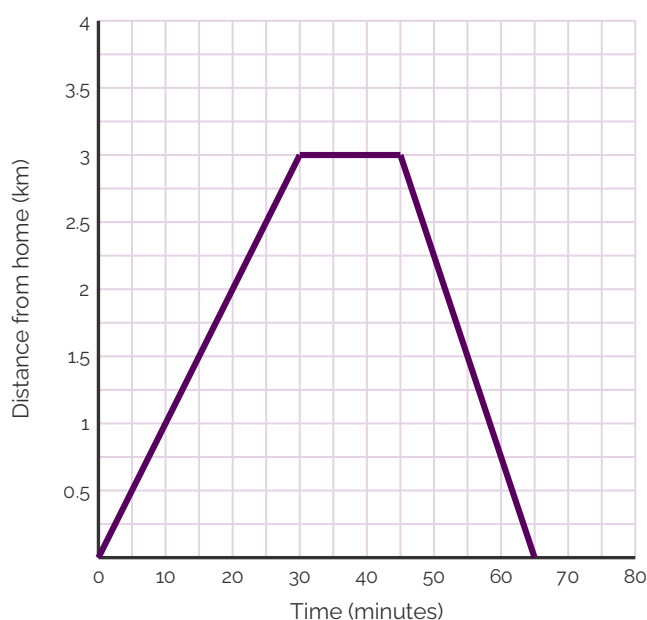
[1]

Answer $y = \dots\dots\dots$

(d) Does the point $(5, 14)$ lie on L ? Show how you decide.

[1]

- 3 Ravi walks from home to a shop, stays there, then walks home. The graph shows his journey.



(a) How many minutes did Ravi spend at the shop?

[1]

Answer minutes

(b) Work out Ravi's speed on the way to the shop, in km/h.

[2]

Answer km/h

(c) Work out Ravi's speed on the way home, in km/h.

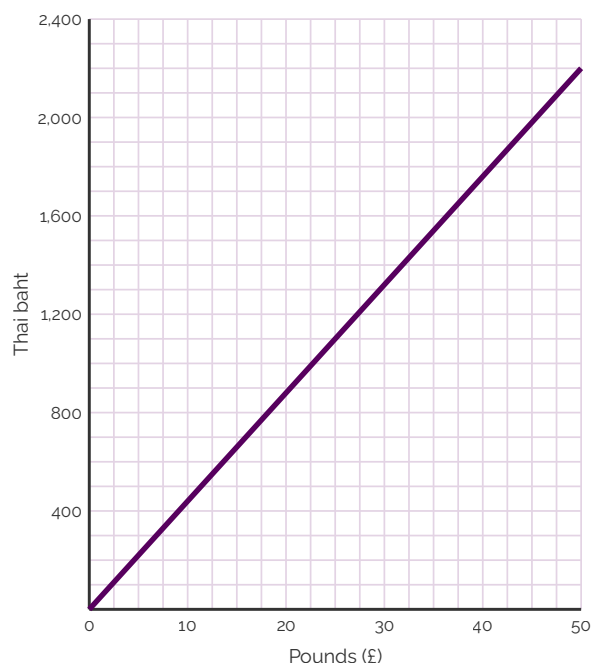
[2]

Answer km/h

(d) How can you tell from the graph which part of the journey was fastest?

[1]

- 4 The conversion graph can be used to change pounds (£) into Thai baht.



- (a) Use the graph to change £30 into baht.

[1]

Answer baht

- (b) Use the graph to change 880 baht into pounds.

[1]

Answer £

- (c) Explain how you could use the graph to change £400 into baht. Give the answer.

[2]

- 5 A plumber uses the formula $C = 25h + 40$ to work out a charge, C pounds, for a job lasting h hours.

- (a) What does the number 40 represent?

[1]

- (b) What does the number 25 represent?

[1]

- (c) Work out the charge for a job lasting $3\frac{1}{2}$ hours.

[1]

Answer £

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Angles in parallel lines and polygons

I can... use angle facts for parallel lines and find interior and exterior angles of polygons.

Curriculum ref: Geometry & measures

When a straight line crosses two **parallel** lines, pairs of angles are related. **Corresponding** angles (F-shape) are equal, **alternate** angles (Z-shape) are equal and **co-interior** angles (C-shape) add up to 180° .

For any polygon, the **exterior** angles add up to 360° . The interior and exterior angle at each vertex add up to 180° .

Key words

alternate

corresponding

co-interior

interior angle

exterior angle

regular polygon

Key points

- Sum of interior angles of an n -sided polygon = $(n - 2) \times 180^\circ$
- Regular polygon: each exterior angle = $360^\circ \div n$
- Number of sides = $360^\circ \div \text{exterior angle}$

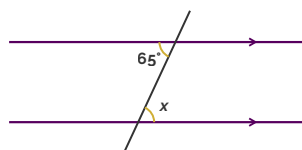
Worked example 1

Find each interior angle of a regular octagon.

Exterior angle = $360^\circ \div 8 = 45^\circ$, so interior angle = $180^\circ - 45^\circ = \mathbf{135^\circ}$

Worked example 2

Find angle x . Give a reason.



x and 65° are alternate angles, so $x = \mathbf{65^\circ}$ (alternate angles are equal).

Common mistakes

- Mixing up alternate and corresponding angles — draw the Z or F shape on the diagram.
- Dividing 360 by the number of sides and calling it the interior angle. $360 \div n$ is the **exterior** angle.

Exam tip: Write the angle fact you use in words. "Because it is parallel" does not score a reason mark.

Answer each question.

1 Find the sum of the interior angles of a pentagon.

2 Find the sum of the interior angles of a hexagon.

3 Find the sum of the interior angles of a decagon (10 sides).

4 Find the size of each exterior angle of a regular hexagon.

5 Find the size of each interior angle of a regular hexagon.

6 Find the size of each interior angle of a regular pentagon.

7 Find each exterior angle of a regular 12-sided polygon.

8 Find each interior angle of a regular 20-sided polygon.

9 A regular polygon has exterior angles of 40° . How many sides does it have?

10 A regular polygon has interior angles of 150° . How many sides does it have?

11 What is the sum of the exterior angles of any polygon?

12 Can a regular polygon have an exterior angle of 50° ? Explain.

13 Corresponding angles on parallel lines are ...

14 Alternate angles on parallel lines are ...

15 Co-interior angles on parallel lines add up to ...

16 Two co-interior angles: one is 115° . Find the other.

17 Three angles of a quadrilateral are 85° , 95° and 110° . Find the fourth.

18 Four angles of a pentagon are 100° , 110° , 120° and 105° . Find the fifth.

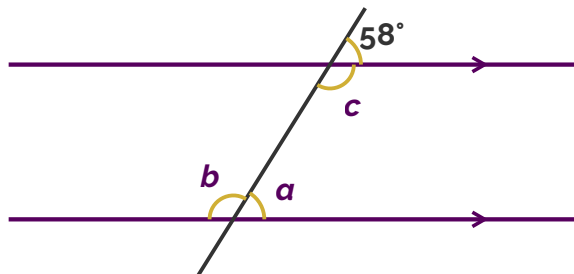
19 An isosceles triangle has a top (apex) angle of 40° . Find each base angle.

20 Two angles of a triangle are 47° and 68° . Find the third.

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all questions. Show your working. Marks are shown in [].

- 1 The diagram shows two parallel lines crossed by a straight line. Give a reason for each answer.



Not to scale

- (a) Find the size of angle a .

[2]

Answer $a = \dots\dots\dots^\circ$ Reason

- (b) Find the size of angle b .

[2]

Answer $b = \dots\dots\dots^\circ$ Reason

- (c) Find the size of angle c .

[2]

Answer $c = \dots\dots\dots^\circ$ Reason

- 2 (a) Work out the size of each interior angle of a regular octagon.

[2]

Answer

- (b) Each interior angle of a regular polygon is 156° . How many sides does the polygon have?

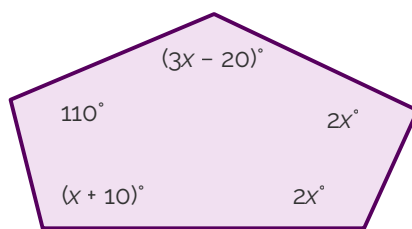
[2]

Answer

- (c) Explain why a regular polygon cannot have interior angles of 100° .

[2]

- 3 The diagram shows a pentagon.



Not to scale

- (a) Find the value of x .

[3]

Answer $x = \dots\dots\dots$

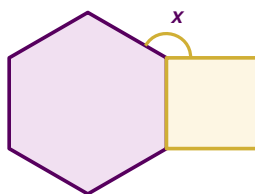
- (b) Find the size of the largest angle.

[1]

Answer $\dots\dots\dots^\circ$

- 4 The diagram shows a regular hexagon and a square that share a side. Work out the size of angle x .

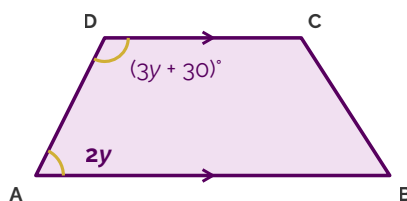
[3]



Answer $x = \dots\dots\dots^\circ$

- 5 ABCD is a trapezium. AB is parallel to DC. Angle DAB = $2y$ and angle ADC = $(3y + 30)^\circ$. Work out the value of y . Give a reason for your working.

[3]



Not to scale

Answer $y = \dots\dots\dots$

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Area of trapezia and circles

I can... find the area of a trapezium and the circumference and area of a circle.

Curriculum ref: Geometry & measures

A **trapezium** has one pair of parallel sides, a and b . Its area is the mean of the parallel sides multiplied by the perpendicular height.

The **radius** r goes from the centre to the edge; the **diameter** $d = 2r$. The perimeter of a circle is its **circumference**. $\pi \approx 3.14159...$; use the π button on your calculator.

Key words

trapezium

radius

diameter

circumference

π (pi)

semicircle

Key points

- Area of a trapezium = $\frac{1}{2}(a + b)h$
- Circumference: $C = \pi d = 2\pi r$
- Area of a circle: $A = \pi r^2$ (square the radius, not the diameter)
- Perimeter of a semicircle = $\frac{1}{2}\pi d + d$
- $1 \text{ m}^2 = 10\,000 \text{ cm}^2$

Worked example 1

Find the area of a trapezium with parallel sides 6 cm and 10 cm and height 5 cm.

$$\frac{1}{2} \times (6 + 10) \times 5 = \frac{1}{2} \times 16 \times 5 = 40 \text{ cm}^2$$

Worked example 2

A circle has radius 4 cm. Find (a) its circumference, (b) its area. Give answers to 1 d.p.

$$(a) C = 2 \times \pi \times 4 = 25.13... = 25.1 \text{ cm}$$

$$(b) A = \pi \times 4^2 = 50.26... = 50.3 \text{ cm}^2$$

Common mistakes

- Using the diameter in $A = \pi r^2$. Halve the diameter first.
- Working out $(\pi \times 4)^2$ instead of $\pi \times 4^2$.
- Forgetting the straight edge when finding the perimeter of a semicircle.

Exam tip: Write down the unrounded calculator value before you round — it can earn method marks.

You may use a calculator. Give answers to 1 decimal place where needed.

1 Area of a rectangle 8 cm by 3.5 cm

2 Area of a triangle, base 9 cm, height 6 cm

3 Area of a parallelogram, base 12 cm, height 5 cm

4 Area of a trapezium, parallel sides 5 cm and 9 cm, height 4 cm

5 Area of a trapezium, parallel sides 7.5 cm and 12.5 cm, height 6 cm

6 A trapezium has area 45 cm^2 and parallel sides 7 cm and 8 cm. Find its height.

7 Circumference of a circle with diameter 10 cm (1 d.p.)

8 Circumference of a circle with radius 6 cm (1 d.p.)

9 Area of a circle with radius 5 cm (1 d.p.)

10 Area of a circle with diameter 12 cm (1 d.p.)

11 Circumference of a circle with radius 3 cm, in terms of π

12 Area of a circle with radius 7 cm, in terms of π

13 Perimeter of a semicircle with diameter 10 cm (1 d.p.)

14 Area of a semicircle with radius 4 cm (1 d.p.)

15 Area of a quarter circle with radius 10 cm (1 d.p.)

16 A circle has circumference 50 cm. Find its diameter (1 d.p.).

17 A circle has area 200 cm^2 . Find its radius (1 d.p.).

18 A wheel has diameter 70 cm. How far does it travel in one turn (1 d.p.)?

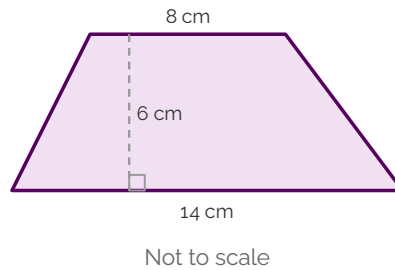
19 Change 3 m^2 into cm^2 .

20 Change $25\,000 \text{ cm}^2$ into m^2 .

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

You may use a calculator. Show your working. Marks are shown in [].

- 1 The diagram shows a trapezium.



- (a) Work out the area of the trapezium.

[2]

Answer cm^2

- (b) Another trapezium has the same area. Its parallel sides are 5 cm and 7 cm. Work out its height.

[2]

Answer cm

- 2 A circular pond has a radius of 3.5 m.

- (a) Work out the area of the pond. Give your answer to 1 decimal place.

[2]

Answer m^2

- (b) A fence is put around the edge of the pond. Fencing costs £12.50 per metre. Work out the cost of the fence.

[3]

Answer £

- 3 The shape is made from a rectangle and a semicircle.



Not to scale

- (a) Work out the area of the shape. Give your answer to 1 decimal place.

[3]

Answer cm²

- (b) Work out the perimeter of the shape. Give your answer to 1 decimal place.

[3]

Answer cm

- 4 A bicycle wheel has a diameter of 64 cm. How many **complete** turns does the wheel make when the bicycle travels 1 km?

[3]

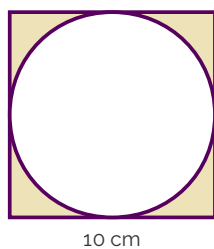
Answer

- 5 A circle has an area of 100 cm². Work out its circumference. Give your answer to 1 decimal place.

[3]

Answer cm

- 6 The diagram shows the largest possible circle drawn inside a square of side 10 cm. Work out the shaded area. Give your answer to 1 decimal place. **[3]**



Answer cm²

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Volume and surface area of prisms

I can... find the volume and surface area of cuboids, prisms and cylinders.

Curriculum ref: Geometry & measures

A **prism** is a 3D shape with the same **cross-section** all the way through. Cuboids, triangular prisms and cylinders all behave like prisms.

Surface area is the total area of all the faces — imagine the net of the shape. Volume is measured in cubic units (cm^3 , m^3); area in square units (cm^2).

Key words

prism

cross-section

volume

surface area

cylinder

net

Key points

- Volume of a prism = area of cross-section $\times$ length
- Cuboid: $V = l \times w \times h$; cylinder: $V = \pi r^2 h$
- Curved surface of a cylinder = $2\pi rh$ (a rectangle when unrolled)
- 1 litre = 1000 cm^3 ; 1 ml = 1 cm^3

Worked example 1

A triangular prism has a triangle with base 6 cm and height 4 cm. It is 10 cm long. Find its volume.

$$\text{Cross-section} = \frac{1}{2} \times 6 \times 4 = 12 \text{ cm}^2$$

$$\text{Volume} = 12 \times 10 = \mathbf{120 \text{ cm}^3}$$

Worked example 2

Find the surface area of a cuboid 5 cm $\times$ 3 cm $\times$ 2 cm.

$$\text{Pairs of faces: } 5 \times 3 = 15, 5 \times 2 = 10, 3 \times 2 = 6$$

$$\text{Surface area} = 2 \times (15 + 10 + 6) = \mathbf{62 \text{ cm}^2}$$

Common mistakes

- Forgetting the $\frac{1}{2}$ when finding the area of a triangular cross-section.
- Only counting three faces of a cuboid — there are six (three pairs).

Exam tip: Sketch the net, or list every face in a table, so you do not miss any faces in surface area questions.

You may use a calculator. Give answers to 1 decimal place where needed.

1 Volume of a cuboid $4\text{ cm} \times 5\text{ cm} \times 6\text{ cm}$

2 Volume of a cube with side 7 cm

3 Surface area of a cube with side 4 cm

4 Surface area of a cuboid $5\text{ cm} \times 3\text{ cm} \times 2\text{ cm}$

5 Surface area of a cuboid $10\text{ cm} \times 4\text{ cm} \times 3\text{ cm}$

6 A prism has cross-section area 15 cm^2 and length 8 cm . Find its volume.

7 Triangular prism: triangle base 6 cm , height 5 cm ; length 12 cm . Find the volume.

8 Volume of a cylinder, radius 3 cm , height 10 cm (1 d.p.)

9 Volume of a cylinder, radius 5 cm , height 4 cm (1 d.p.)

10 Volume of a cylinder, diameter 8 cm , height 15 cm (1 d.p.)

11 Curved surface area of a cylinder, radius 2 cm , height 10 cm (1 d.p.)

12 Cylinder: volume 500 cm^3 , radius 5 cm . Find the height (1 d.p.).

13 Change 2.5 litres into cm^3 .

14 How many cm^3 are in 1 m^3 ?

15 A cuboid has volume 240 cm^3 . Its base is 8 cm by 6 cm . Find its height.

16 A cube has volume 125 cm^3 . Find the length of one side.

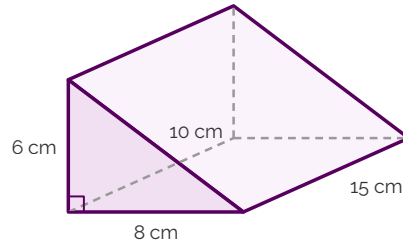
17 Prism: volume 360 cm^3 , length 12 cm . Find the cross-section area.

18 How many litres does a $50\text{ cm} \times 40\text{ cm} \times 30\text{ cm}$ tank hold?

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

You may use a calculator. Show your working. Marks are shown in [].

- 1 The diagram shows a triangular prism. The cross-section is a right-angled triangle.



Not to scale

- (a) Work out the volume of the prism.

[2]

Answer cm^3

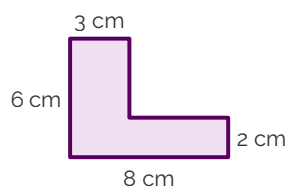
- (b) Work out the total surface area of the prism.

[3]

Answer cm^2

- 2 The diagram shows the L-shaped cross-section of a prism. The prism is 10 cm long. Work out the volume of the prism.

[3]



Not to scale

Answer cm^3

3 A tin of soup is a cylinder with radius 4 cm and height 11 cm.

(a) Work out the volume of the tin. Give your answer to 1 decimal place.

[2]

Answer cm^3

(b) A paper label covers the curved surface of the tin. Work out the area of the label.

[2]

Answer cm^2

4 A fish tank is a cuboid 60 cm long, 30 cm wide and 40 cm tall. It is filled with water to $\frac{3}{4}$ of its height.

(a) How many litres of water are in the tank?

[3]

Answer litres

(b) A stone with volume 900 cm^3 is put into the tank. By how much does the water level rise?

[2]

Answer cm

5 A cube has a total surface area of 150 cm^2 . Work out the volume of the cube.

[3]

Answer cm^3

6 Container A is a cylinder with radius 5 cm and height 12 cm. Container B is a cuboid 9 cm by 9 cm by 12 cm.

Which container holds more? By how much?

[3]

Answer Container by cm^3

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Transformations

I can... reflect, rotate, translate and enlarge shapes and describe transformations fully.

Curriculum ref: Geometry & measures

A **transformation** moves or changes a shape. Reflections, rotations and translations give a **congruent** image (same shape and size). An enlargement changes the size but keeps the shape (similar).

To **describe fully** you must name the transformation and give every detail (see key points). Tracing paper helps with rotations.

Key points

- Reflection: give the equation of the mirror line, e.g. $x = 2$, $y = -1$, $y = x$.
- Rotation: give the angle, the direction (clockwise or anticlockwise) and the centre.
- Translation: give the column vector — top number right (+) or left (-), bottom number up (+) or down (-).
- Enlargement: give the scale factor and the centre. Image distance from centre = scale factor $\times$ object distance.

Key words

reflection

rotation

translation

enlargement

scale factor

centre

Worked example

Write the column vector for a translation 3 squares right and 2 squares down.

$$\begin{bmatrix} 3 \\ -2 \end{bmatrix} \quad \begin{array}{l} 3 \text{ right} \\ 2 \text{ down} \end{array}$$

Right is positive, down is negative:

Common mistakes

- Describing two transformations when the question asks for a **single** transformation.
- Forgetting the centre of rotation or the direction.
- For an enlargement, adding the scale factor instead of multiplying distances from the centre.

Exam tip: Count the marks: "describe fully" a rotation is usually 3 marks — name, angle with direction, centre.

Answer each question. You may sketch a grid to help.

1 Reflect the point (3, 5) in the x-axis.

2 Reflect the point (3, 5) in the y-axis.

3 Reflect the point (2, 7) in the line $x = 4$.

4 Reflect the point (-1, 3) in the line $y = 1$.

5 Reflect the point (4, 1) in the line $y = x$.

6 Translate (2, 3) by 4 squares right and 5 squares down.

7 Translate (-3, 0) by 2 squares left and 6 squares up.

8 Describe the translation that moves (1, 2) to (5, -1).

9 Rotate (3, 1) by 90° clockwise about (0, 0).

10 Rotate (3, 1) by 180° about (0, 0).

11 Rotate (2, 5) by 90° anticlockwise about (0, 0).

12 A rotation of 90° clockwise is the same as a rotation of ... anticlockwise.

13 Enlarge (3, -1) by scale factor 2, centre (0, 0).

14 A side of 4 cm is enlarged by scale factor 3. How long is the image side?

15 A side of 10 cm is enlarged by scale factor $1/2$. How long is the image side?

16 An object side is 7 cm and the image side is 21 cm. Find the scale factor.

17 Which three transformations always give a congruent image?

18 A shape is enlarged by scale factor 3. The area is multiplied by ...

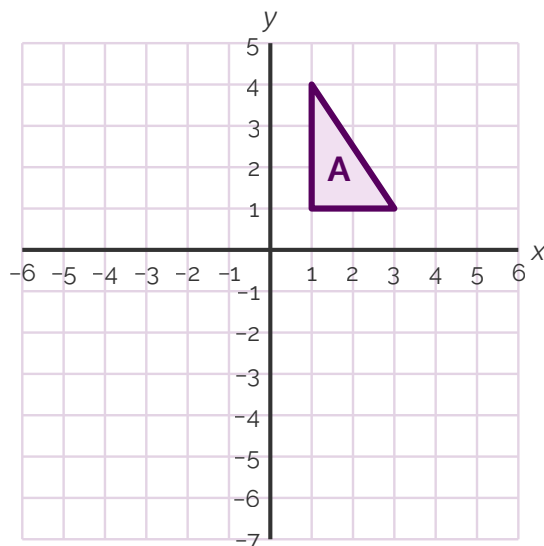
19 How many lines of symmetry does a regular hexagon have?

20 What is the order of rotational symmetry of a square?

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

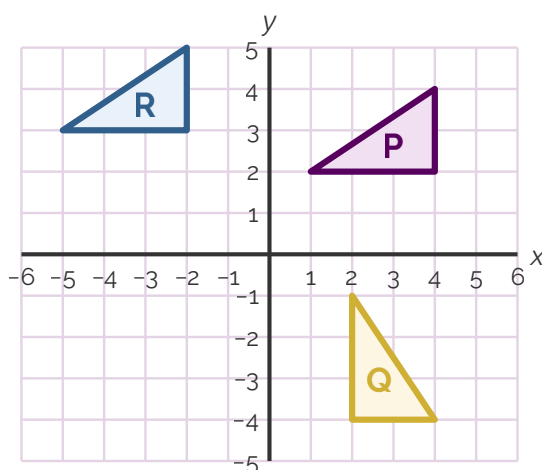
Answer all questions. Draw on the grids. Marks are shown in [].

- 1 Triangle A is drawn on the grid.



- (a) Reflect triangle A in the y-axis. Label the image B. [2]
- (b) Reflect triangle A in the line $y = -1$. Label the image C. [2]
- (c) Describe fully the single transformation that maps triangle B onto triangle C. [3]

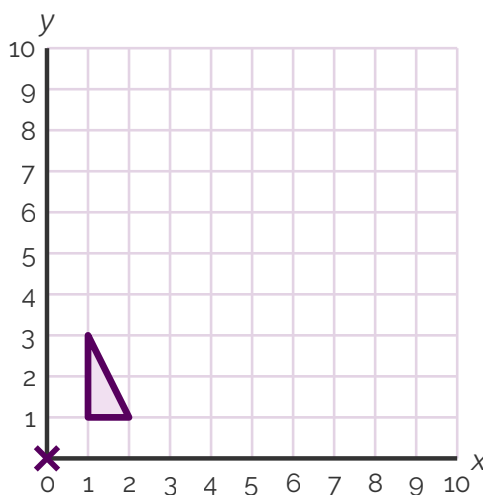
- 2 Shapes P, Q and R are drawn on the grid.



- (a) Describe fully the single transformation that maps shape P onto shape Q. [3]

- (b) Describe fully the single transformation that maps shape P onto shape R. [2]

- 3 A triangle is drawn on the grid. The point $\times$ is at (0, 0).

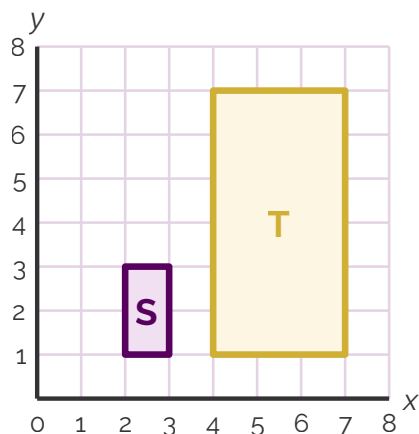


- (a) Enlarge the triangle by scale factor 3, centre (0, 0). [3]

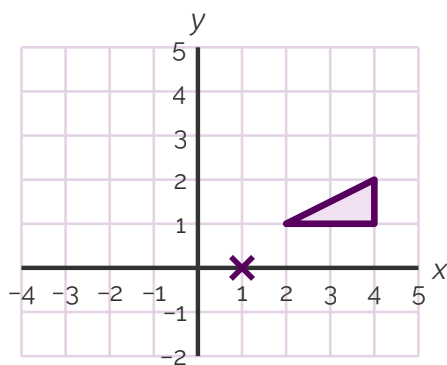
- (b) The area of the original triangle is 1 cm^2 . What is the area of the enlarged triangle? [1]

Answer cm^2

- 4 Describe fully the single transformation that maps shape S onto shape T. [3]



- 5 Rotate the triangle 90° anticlockwise about the point (1, 0), marked x. [2]



Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Constructions and loci

I can... construct triangles, bisectors and loci accurately using a ruler and compasses.

Curriculum ref: Geometry & measures

A **construction** is an accurate drawing made with a ruler and compasses. Always leave your construction arcs — they show your method.

A **locus** is the set of all points that follow a rule. Questions with two rules ask for a **region**: draw each locus, then shade the part that fits both rules.

Key words

construct

compasses

perpendicular bisector

angle bisector

locus (loci)

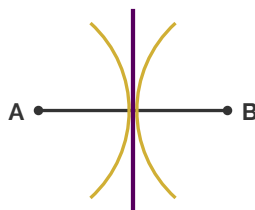
bearing

Key points

- Points a fixed distance from a point → a **circle**.
- Points equidistant from two points → the **perpendicular bisector**.
- Points equidistant from two lines → the **angle bisector**.
- Bearings are measured clockwise from north and have three figures, e.g. 045° .

Worked example

Construct the perpendicular bisector of AB.



Open the compasses to more than half of AB. Draw an arc from A, then the same arc from B. Join the two points where the arcs cross. This line cuts AB in half at 90° .

Common mistakes

- Changing the compass width between the two arcs of a perpendicular bisector.
- Rubbing out construction arcs — you lose the method marks.
- Shading the wrong side of a locus. Test one point in your region against both rules.

Exam tip: Use a sharp pencil and check your compasses do not slip. Accuracy is usually expected within 2 mm and 2° .

Answer each question.

- 1 Describe the locus of points 3 cm from a point P.

- 2 Describe the locus of points equidistant from two points A and B.

- 3 Can a triangle have sides 3 cm, 4 cm and 8 cm?

- 4 Can a triangle have sides 5 cm, 5 cm and 9 cm?

- 5 At what angle does a perpendicular bisector cross its line?

- 6 An angle of 70° is bisected. Find each new angle.

- 7 A(2, 1), B(6, 1). Equation of the perpendicular bisector of AB?

- 8 Find the midpoint of (2, 3) and (8, 7).

- 9 Scale 1 cm to 5 m. What real length is 7 cm?

- 10 Scale 1 : 200. How long is a 15 m wall on the plan?

- 11 Write the three-figure bearing of due east.

- 12 Write the three-figure bearing of south-west.

- 13 The bearing of A from B is 070° . Find the bearing of B from A.

- 14 The bearing of Q from P is 300° . Find the bearing of P from Q.

- 15 Describe the locus of points equidistant from two lines that meet.

- 16 A goat is tied to a post by a 6 m rope. Describe where it can graze.

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

You need a ruler, a protractor, compasses and a sharp pencil. Marks are shown in [].

1 Use a ruler and compasses. Leave in all your construction arcs.

(a) Construct triangle ABC with $AB = 8\text{ cm}$, $AC = 6\text{ cm}$ and $BC = 7\text{ cm}$. Side AB has been drawn for you. **[2]**

A ————— **B**

(b) Measure angle BAC. **[1]**

Answer °

2 The line segment AB is drawn accurately below.

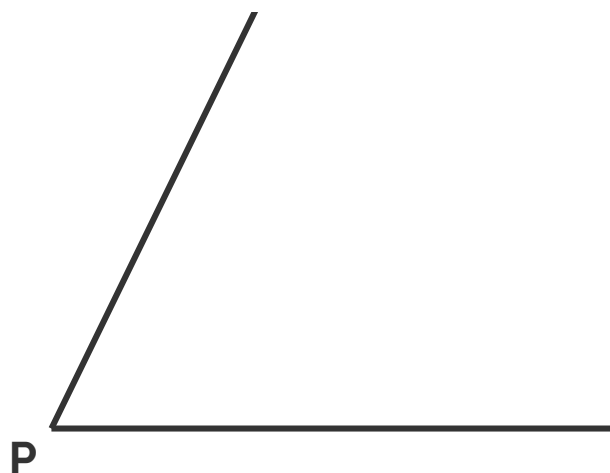
A ● ————— ● **B**

Accurate drawing

(a) Use a ruler and compasses to construct the perpendicular bisector of AB. **[2]**

(b) What is true about every point on the line you have drawn? **[1]**

- 3 The angle at P is drawn accurately below.

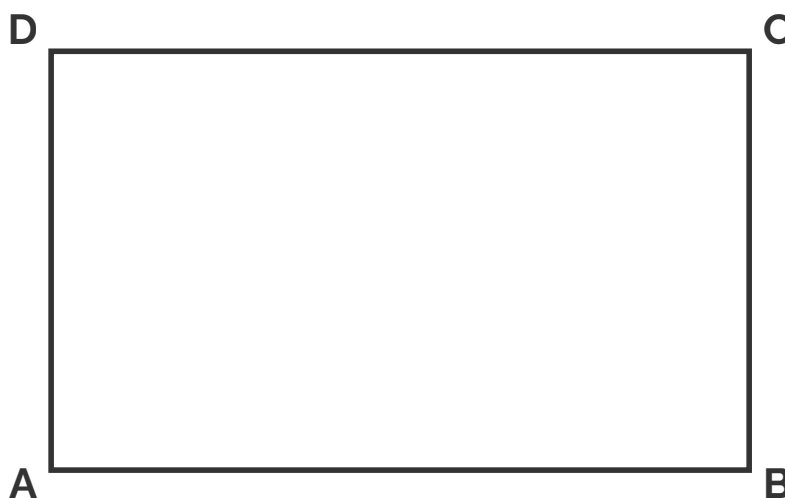


Accurate drawing

- (a) Use a ruler and compasses to construct the bisector of the angle. [2]
(b) Measure one of the two angles you have made. [1]

Answer°

- 4 The diagram shows a plan of a garden ABCD. The scale is 1 cm to 1 m.
A tree is to be planted **less than 4 m from corner A** and **nearer to AB than to AD**. Shade the region where the tree can be planted. [4]



Scale: 1 cm to 1 m

5

(a) Explain why a triangle cannot have sides of 4 cm, 5 cm and 10 cm.

[1]

(b) The bearing of town B from town A is 125° . Work out the bearing of town A from town B.

[2]

Answer $^\circ$

(c) A map has scale 1 : 25 000. Two villages are 6.4 cm apart on the map. How far apart are they in real life? Give your answer in km.

[2]

Answer km

6 Points A and B are 6 cm apart. Shade the region of points that are **closer to A than to B** and **less than 4 cm from B**.

[3]

A
●

B
●

Accurate drawing

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Scatter graphs and grouped data

I can... interpret scatter graphs and estimate the mean from a grouped frequency table.

Curriculum ref: Statistics

A **scatter graph** shows whether two sets of data are related.

Positive correlation: both increase together. **Negative**

correlation: one increases as the other decreases. A **line of best fit** follows the trend, with roughly equal numbers of points on each side.

In a **grouped frequency table** we do not know the exact values, so we use the **midpoint** of each class to estimate the mean.

Key words

correlation

line of best fit

outlier

grouped frequency

midpoint

modal class

Key points

- Estimated mean = $\Sigma(\text{midpoint} \times \text{frequency}) \div \Sigma \text{ frequency}$
- Modal class = the class with the highest frequency.
- Ignore outliers when drawing a line of best fit.
- Estimates inside the data range (interpolation) are more reliable than outside it (extrapolation).

Worked example

Estimate the mean mass from the table.

Mass (m kg)	$10 < m \leq 20$	$20 < m \leq 30$	$30 < m \leq 40$
Frequency	4	10	6

Midpoints: 15, 25, 35. Midpoint $\times$ frequency: $15 \times 4 = 60$, $25 \times 10 = 250$, $35 \times 6 = 210$

Total = 520; frequency total = 20

Estimated mean = $520 \div 20 = \mathbf{26 \text{ kg}}$

Common mistakes

- Dividing by the number of classes instead of the total frequency.
- Using the class width or upper bound instead of the midpoint.
- Forcing the line of best fit through the origin or joining the points dot-to-dot.

Exam tip: Add an extra column to grouped tables for "midpoint $\times$ frequency" — it keeps your working clear.

Answer each question.

1 Height goes up, shoe size goes up.
Type of correlation?

2 Temperature goes up, coat sales go down. Type of correlation?

3 Shoe size and test score: type of correlation?

4 Which average is most affected by an outlier?

5 Is height discrete or continuous?

6 Is number of siblings discrete or continuous?

7 Find the mean of 4, 7, 9, 12, 8.

8 Find the median of 3, 8, 5, 10, 2, 7.

9 Find the mode of 4, 4, 6, 7, 7, 7, 9.

10 Find the range of 12, 5, 19, 8.

11 Five numbers have a mean of 6.4.
Find their total.

12 Find the midpoint of the class $10 < t \leq 20$.

13 Classes A, B, C, D have frequencies 3, 8, 6, 3. Modal class?

14 Same table: which class contains the median?

15 Midpoints 5, 15, 25 have frequencies 2, 5, 3. Estimate the mean.

16 Find the midpoint of the class $0 \leq m < 5$.

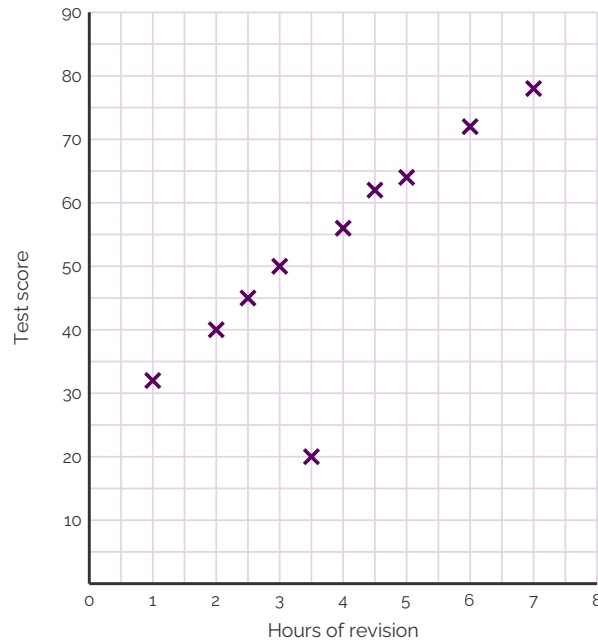
17 What is an outlier?

18 Why is a mean from a grouped table only an estimate?

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all questions. Show your working. Marks are shown in [].

- 1 The scatter graph shows the hours of revision and the test score for 10 students.



- (a) Describe the correlation. [1]
Answer
- (b) One student does not fit the pattern. Write down the coordinates of this point. [1]
Answer (..... ,)
- (c) Draw a line of best fit on the scatter graph. [1]
- (d) Use your line to estimate the score of a student who revised for 5.5 hours. [1]
Answer
- (e) Explain why it may not be sensible to use your line to estimate the score for 12 hours of revision. [1]

- 2 The table shows the times, t minutes, taken by 30 students to finish a puzzle.

Time (t minutes)	$0 < t \leq 10$	$10 < t \leq 20$	$20 < t \leq 30$	$30 < t \leq 40$
Frequency	4	9	12	5

(a) Write down the modal class. [1]

Answer

(b) Write down the class that contains the median. [1]

Answer

(c) Work out an estimate for the mean time. [4]

Answer minutes

(d) Explain why your answer to (c) is only an estimate. [1]

- 3 The table shows the number of goals a team scored in 20 matches. Work out the mean number of goals per match. [3]

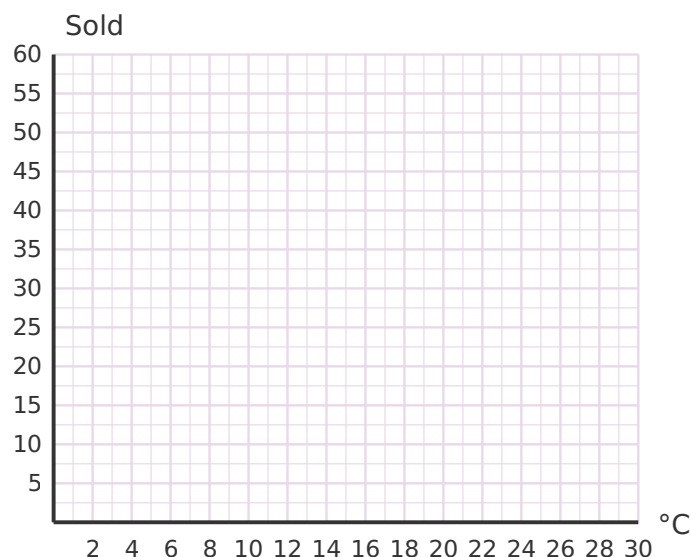
Goals	0	1	2	3	4
Frequency	5	8	4	2	1

Answer

- 4 Class A had a mean score of 64 and a range of 30. Class B had a mean score of 58 and a range of 12. [2]
Compare the scores of the two classes.

- 5 A café records the temperature at midday and the number of hot chocolates sold on 8 days.

Temperature (°C)	4	8	12	15	18	22	25	28
Hot chocolates sold	52	47	41	38	30	26	20	15



- (a) Plot the points on the scatter graph. [2]
- (b) Describe the relationship between the temperature and the number of hot chocolates sold. [1]
-
- (c) Draw a line of best fit. Use it to estimate the number sold when the temperature is 20 °C. [2]

Answer

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Probability

I can... use mutually exclusive events and sample space diagrams to find probabilities.

Curriculum ref: Probability

Probability = number of favourable outcomes ÷ total number of equally likely outcomes. Probabilities are written as fractions, decimals or percentages from 0 (impossible) to 1 (certain).

Events are **mutually exclusive** if they cannot happen at the same time. A **sample space diagram** shows every outcome when two things happen, such as rolling two dice.

Key words

outcome

mutually exclusive

sample space

relative frequency

expected frequency

biased

Key points

- $P(\text{not } A) = 1 - P(A)$
- Mutually exclusive: $P(A \text{ or } B) = P(A) + P(B)$
- The probabilities of all the possible outcomes add up to 1.
- Expected frequency = probability × number of trials
- Relative frequency = frequency ÷ total number of trials

Worked example

Two spinners numbered 1 to 3 are spun and the scores added. Find $P(\text{total} = 4)$.

+	1	2	3
1	2	3	4
2	3	4	5
3	4	5	6

There are 9 equally likely outcomes. A total of 4 appears 3 times.

$$P(\text{total} = 4) = 3/9 = \mathbf{1/3}$$

Common mistakes

- Adding probabilities of events that are not mutually exclusive.
- Forgetting that HT and TH are different outcomes when two coins are thrown.
- Writing probabilities as ratios (1 : 6) or as "1 in 6" in an exam — use $1/6$.

Exam tip: If the probabilities in a table must add up to 1, write that equation first.

Answer each question. Give probabilities as fractions in their simplest form or decimals.

1 A fair dice is rolled. Find $P(6)$.

2 A fair dice is rolled. Find $P(\text{even number})$.

3 A bag has 3 red, 5 blue and 2 green counters. Find $P(\text{blue})$.

4 Same bag: find $P(\text{not green})$.

5 Same bag: find $P(\text{red or green})$.

6 $P(\text{rain}) = 0.35$. Find $P(\text{not rain})$.

7 What does "mutually exclusive" mean?

8 Are "rolling a 2" and "rolling an even number" mutually exclusive?

9 A spinner: $P(\text{red}) = 0.2$, $P(\text{blue}) = 0.45$, the rest is green. Find $P(\text{green})$.

10 A and B are mutually exclusive. $P(A) = 0.3$, $P(B) = 0.25$. Find $P(A \text{ or } B)$.

11 List all the outcomes when two coins are thrown.

12 Two coins are thrown. Find $P(\text{two heads})$.

13 Two dice are rolled. How many possible outcomes are there?

14 Two dice are rolled and the scores added. Find $P(\text{total} = 7)$.

15 Two dice are rolled. Find $P(\text{a double})$.

16 Two dice are rolled and the scores added. Find $P(\text{total} > 10)$.

17 A fair dice is rolled 120 times. How many 4s would you expect?

18 A coin is thrown 50 times and lands on heads 28 times. Find the relative frequency of heads.

19 A card is taken from a normal pack of 52. Find $P(\text{heart})$.

20 A letter is chosen at random from MATHEMATICS. Find $P(M)$.

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all questions. Show your working. Marks are shown in [].

- 1 A spinner can land on red, blue, green or yellow. The table shows some of the probabilities.

Colour	Red	Blue	Green	Yellow
Probability	0.3	0.25	x	$2x$

- (a) The probability of yellow is twice the probability of green. Find the value of x . [2]

Answer $x =$

- (b) Find the probability that the spinner lands on red or blue. [1]

Answer

- (c) The spinner is spun 200 times. How many times would you expect it to land on yellow? [2]

Answer

- 2 Spinner A has the numbers 1, 2, 3. Spinner B has the numbers 1, 2, 3, 4. Both are spun and the two numbers are **multiplied** to give the score.

$\times$	1	2	3	4
1	1			4
2		4		
3			9	

- (a) Complete the sample space diagram. [2]

- (b) Find the probability that the score is 6. [1]

Answer

- (c) Find the probability that the score is an odd number. [1]

Answer

- (d) Find the probability that the score is greater than 6. [1]

Answer

- 3 A bag contains 40 counters. Each counter is red, blue or white. $P(\text{red}) = \frac{1}{4}$ and $P(\text{blue}) = \frac{2}{5}$.

(a) Find the probability that a counter taken at random is white.

[2]

Answer

(b) How many white counters are in the bag?

[1]

Answer

(c) Some extra red counters are added to the bag. Now $P(\text{red}) = \frac{1}{3}$. How many red counters were added?

[3]

Answer

- 4 Leo rolls a dice 60 times. The table shows his results.

Score	1	2	3	4	5	6
Frequency	8	9	11	10	7	15

(a) Find the relative frequency of rolling a 6.

[1]

Answer

(b) Leo says, "The dice is biased towards 6." Comment on Leo's statement.

[2]

- 5 Two fair coins are thrown. Lucy says, "The probability of getting at least one head is $\frac{1}{2}$, because you either get a head or you don't."

Is Lucy correct? Explain your answer.

[2]

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure



CHECK

End-of-book check

End-of-book check

Name _____ Date _____ Score _____ / 12

Answer every question. Compare your score with your Starting point check.

1 Write 0.000 73 in standard form.

2 Simplify $(a^3)^2 \times a$.3 After a 15% decrease, a price is £68.
Find the original price.

4 Share £56 in the ratio 3 : 5.

5 Factorise fully $6x^2 - 9x$.6 Solve $7x - 5 = 3x + 11$.7 Find the n th term: 2, 9, 16, 23, ...8 Find the equation of the line
through (0, 2) and (3, 11).9 Find each interior angle of a
regular decagon.10 Area of a circle with radius 6 cm (1
d.p.)11 Reflect the point (2, -3) in the line y
 $= x$.12 Two dice are rolled and the scores
added. Find $P(\text{total} = 9)$.



End-of-year practice test

Name _____ Date _____ Marks _____ / 50

Time: 60 minutes
Calculator allowed
Total: 50 marks

Answer all questions. Show your working. Give answers to 1 decimal place where appropriate.

1 (a) Write 5.2×10^4 as an ordinary number. [1]

Answer

(b) Write $3^7 \times 3^2 \div 3^4$ as a single power of 3. [1]

Answer

(c) Simplify $2a^4 \times 6a^3$. [2]

Answer

2 (a) The price of a phone rises from £280 to £322. Work out the percentage increase. [2]

Answer %

(b) After a 15% reduction, a TV costs £510. Work out the price before the reduction. [2]

Answer £

3 Mia and Leo share £360 in the ratio 4 : 5. Leo gives $\frac{1}{5}$ of his share to charity. How much does Leo give to charity? [3]

Answer £

4

(a) Expand and simplify $2(3x - 4) - 5(x - 2)$.

[2]

Answer

(b) Factorise fully $10y^2 + 15y$.

[2]

Answer

(c) Solve $5(x + 1) = 2x + 20$.

[3]

Answer $x =$

5

(a) Solve $2x - 5 \leq 9$.

[2]

Answer

(b) n is an integer and $-1 < n \leq 4$. List all the possible values of n .

[1]

Answer

6

Here are the first four terms of a sequence: 6, 10, 14, 18, ...

(a) Find an expression for the n th term.

[2]

Answer

(b) Is 98 a term of the sequence? Show how you decide.

[2]

7

A straight line passes through the points (1, 1) and (4, 10).

(a) Work out the gradient of the line.

[2]

Answer

(b) Find the equation of the line.

[1]

Answer $y =$

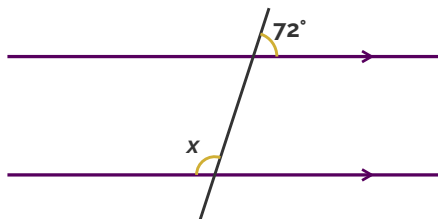
- 8 (a) Each exterior angle of a regular polygon is 24° . How many sides does it have? [1]

Answer

- (b) Write down the size of each interior angle of this polygon. [1]

Answer $^\circ$

- (c) The diagram shows two parallel lines. Find angle x . Give a reason. [2]



Not to scale

Answer $x = \dots\dots\dots^\circ$ Reason

- 9 (a) A circular table top has a diameter of 1.2 m. Work out its area. [2]

Answer m^2

- (b) A trapezium has parallel sides 9 cm and 15 cm and height 8 cm. Work out its area. [2]

Answer cm^2

- 10 A cylinder has radius 6 cm and height 20 cm.

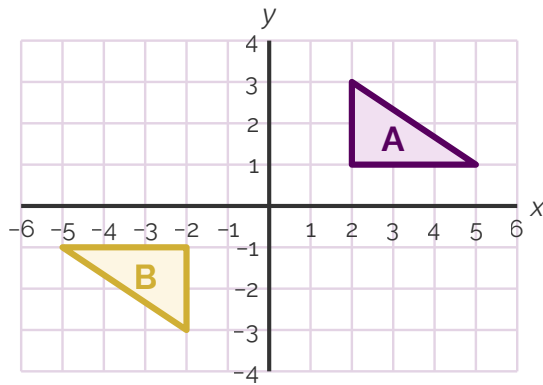
- (a) Work out the volume of the cylinder. [2]

Answer cm^3

- (b) How many litres of water does the cylinder hold? [1]

Answer litres

- 11** Triangles A and B are drawn on the grid.



- (a)** Reflect triangle A in the line $x = 1$. [2]
- (b)** Describe fully the single transformation that maps triangle A onto triangle B. [3]

- 12** The table shows the masses, m kg, of 20 students.

Mass (m kg)	$40 < m \leq 50$	$50 < m \leq 60$	$60 < m \leq 70$	$70 < m \leq 80$
Frequency	6	10	3	1

- (a)** Write down the modal class. [1]
- Answer**
- (b)** Work out an estimate for the mean mass. [3]

Answer kg

- 13** A bag contains red, blue and green counters. A counter is taken at random. $P(\text{red}) = 0.35$ and $P(\text{blue}) = 0.4$.

- (a)** Work out $P(\text{green})$. [1]
- Answer**
- (b)** A counter is taken and replaced 60 times. How many times would you expect a green counter? [1]
- Answer**



FOR TEACHERS & PARENTS

Answers & mark schemes

Mark schemes list the points that earn marks. Accept equivalent answers and follow-through where working is correct. M = method mark, A = accuracy mark, B = independent mark.

Starting point check

- 1 16
- 2 90
- 3 2 : 3
- 4 $4x + 20$
- 5 $x = 5$
- 6 17
- 7 7
- 8 55°
- 9 35 cm^2
- 10 24 cm^3
- 11 $\frac{1}{6}$
- 12 6

Unit 1 · Sheet A — Indices and standard form

- 1 81
- 2 32
- 3 7^5
- 4 4^8
- 5 9^4
- 6 2^{12}
- 7 1
- 8 x^{10}
- 9 y^7
- 10 3^3
- 11 200
- 12 $10a^7$
- 13 $3b^6$
- 14 4.5×10^4
- 15 3.2×10^6
- 16 7×10^{-3}
- 17 5.2×10^{-4}
- 18 6,100
- 19 205,000
- 20 0.08
- 21 4.3×10^5
- 22 $n = 7$

Unit 1 · Sheet B — Indices and standard form

- 1 (a) 5^9 B1 [1] (b) 7^{10} B1 [1] (c) $n = 7$ B1 [1] (d) 3^3 M1; 27 A1 [2]
- 2 (a) 8.4×10^6 B1 [1] (b) 6.4×10^{-5} g B1 [1] (c) 0.5 is not between 1 and 10 (the first number must be $1 \leq A < 10$) B1 [1] (d) 4.1×10^3 , 9.9×10^3 , 3.6×10^4 , 2.9×10^5 B2 (B1 for one pair out of order) [2]
- 3 (a) x^9 B1 [1] (b) $3y^4$ B2 (B1 for 3 or for y^4) [2] (c) m^{12} B1 [1] (d) $12p^7$ B2 (B1 for 12 or for p^7) [2]
- 4 (a) $2^3 \times 3^2 = 8 \times 9 = 72$ M1; $6^5 = 7776$, so not equal (index laws only work when the bases are the same) A1 [2] (b) $2^3 \times 3^2 \times 5$ B2 (B1 for 2, 2, 2, 3, 3, 5 seen) [2]
- 5 (a) $3 \times 10^5 \times 60$ M1; 18×10^7 km A1 [2] (b) $1.5 \times 10^8 \div (3 \times 10^5)$ M1; 500 seconds A1 [2]

Unit 2 · Sheet A — Fractions, decimals and percentages

- 1 $\frac{11}{12}$
- 2 $\frac{11}{18}$
- 3 $\frac{3}{5}$
- 4 $2 \frac{4}{5}$
- 5 4
- 6 0.375
- 7 $\frac{13}{20}$
- 8 35%
- 9 0.004
- 10 36
- 11 28
- 12 1.12
- 13 0.7
- 14 59
- 15 270
- 16 £88.40
- 17 25%
- 18 24% increase
- 19 15% decrease
- 20 £70
- 21 64
- 22 0.6, 61%, $\frac{5}{8}$

Unit 2 · Sheet B — Fractions, decimals and percentages

- 1** (a) $33/12 + 22/12$ or $2 + 1 + 9/12 + 10/12$ M1; $4\frac{7}{12}$ A1 [2] (b) $10/3 \times 6/5$ M1; 4 A1 [2] (c) 87.5% B1 [1]
- 2** (a) 650×0.82 oe M1; £533 A1 [2] (b) 533×1.18 M1; £628.94, so Ben is not correct A1 (18% of a smaller amount is less) [2]
- 3** $261\,600 - 240\,000 = 21\,600$ M1; $21\,600 \div 240\,000 \times 100$ M1; 9% A1 (or $261\,600 \div 240\,000 = 1.09$ M2) [3]
- 4** $100\% - 35\% = 65\%$ M1; $52 \div 0.65$ M1; £80 A1 [3]
- 5** Shop A: 120×0.85 M1 = £102 A1; Shop B: $125 \times 4/5$ M1 = £100; Shop B is cheaper by £2 A1 [4]
- 6** (a) $27\,040 \div 1.04$ M1; £26 000 A1 [2] (b) £1040 B1 ft [1]

Unit 3 · Sheet A — Ratio and proportion

- 1** 3 : 4
- 2** 3 : 4 : 5
- 3** 5 : 8
- 4** 1 : 5
- 5** 1 : 1.25
- 6** 24 and 36
- 7** 36 and 48
- 8** £25, £50, £75
- 9** 24
- 10** 2/9
- 11** £2.24
- 12** £12.00
- 13** 750 g
- 14** £29.00
- 15** 250 ml (44p per 100 ml v 45p)
- 16** 1540 baht
- 17** £25
- 18** 28
- 19** 2 km
- 20** £84

Unit 3 · Sheet B — Ratio and proportion

- 1** (a) $40 \div 8 = 5$ M1; 15 litres A1 [2] (b) $12 \div 3 = 4$ (one part) M1; $4 \times 8 = 32$ litres A1 [2]
- 2** Price per 100 g (or per gram): 47p, 46p, 47p M1 for one correct M1 for all three; 750 g box is best value A1 [3]
- 3** (a) $225 \div 12 \times 20$ oe M1; 375 g A1 [2] (b) Butter 32, flour 26.6..., sugar 40 (or equivalent comparison) M1 M1 for at least two; 26 biscuits (flour runs out first) A1 [3]
- 4** (a) $247.50 \div 15 = 16.5$ M1; $C = 16.5L$ A1 [2] (b) £528 B1 ft [1] (c) 24 m B1 ft [1]
- 5** (a) $270 \div 9 = 30$ M1; £120 A1 [2] (b) Amy has £60; $(120 - 60) \div 2$ M1; £30 A1 [2]
- 6** $180 \div 12 = 15$ M1; 105° A1 [2]

Unit 4 · Sheet A — Expanding and factorising

- 1** $3a + 4b$
- 2** $3x^2 + 5x$
- 3** $3x + 12$
- 4** $10y - 15$
- 5** $-2a + 12$
- 6** $x^2 + 7x$
- 7** $6p^2 - 15p$
- 8** $12a^2 + 8ab$
- 9** $5x + 7$
- 10** $2y + 22$
- 11** $x^2 + 5x - 2$
- 12** $6(x + 3)$
- 13** $5(2y - 5)$
- 14** $x(x + 9)$
- 15** $4a(2a - 3)$
- 16** $7p(2q + 3)$
- 17** $5m^2(3m + 1)$
- 18** 7
- 19** 5
- 20** 6

Unit 4 · Sheet B — Expanding and factorising

- 1** (a) $21x - 14$ B1 [1] (b) $6y + 15 - 4y + 8$ M1; $2y + 23$ A1 [2] (c) $3a(3a - 5)$ B2 (B1 for $3(3a^2 - 5a)$ or $a(9a - 15)$) [2]
- 2** (a) $4(2x + 3)$ M1; $8x + 12$ A1 [2] (b) $2(2x + 3) + 2 \times 4$ M1; $4x + 14$ A1 [2] (c) $8x + 12 = 44$ M1; $x = 4$ A1 [2]
- 3** $5x + 10 - 3x + 12$ M1 (allow one sign error); $2x + 22$ A1; $= 2(x + 11)$ A1 [3]
- 4** (a) $6x + 4$ still has a common factor of 2 B1 [1] (b) $4x(3x + 2)$ B1 [1]
- 5** (a) Middle: $3x + 2$ and $5x + 3$ B1; top: $8x + 5$ B1 ft [2] (b) $8x + 5 = 45$ M1; $x = 5$ A1 ft [2]
- 6** (a) $x^2 + 5x - 2x + 6$ M1; $x^2 + 3x + 6$ A1 [2] (b) $6xy(3x + 4y)$ B2 (B1 for a correct partial factorisation) [2]

Unit 5 · Sheet A — Equations and inequalities

- 1 $x = 14$
- 2 $x = 7.5$
- 3 $x = 7$
- 4 $x = 28$
- 5 $x = 5$
- 6 $x = 6$
- 7 $x = 4$
- 8 $x = 2$
- 9 $x = 8$
- 10 $x = 5$
- 11 $x = 6$
- 12 $x = 9$
- 13 9
- 14 $x = 30^\circ$
- 15 $x = 13$
- 16 -1, 0, 1, 2, 3
- 17 $x > 5$
- 18 $x \leq 5$
- 19 $x \geq 4$
- 20 5

Unit 5 · Sheet B — Equations and inequalities

- 1 (a) $4x = 16$ M1; $x = 4$ A1 [2] (b) $8y - 4 = 3y + 21$ M1; $5y = 25$ M1; $y = 5$ A1 [3]
- 2 (a) $3x + 4 = 5x - 6$ M1; $10 = 2x$ M1; $x = 5$ A1 [3] (b) Length 19 cm and width 6 cm M1 ft; 50 cm A1 ft [2]
- 3 (a) $x + 20 + 2x - 10 + 3x + 50 = 180$ M1; $6x + 60 = 180$ M1; $x = 20$ A1 [3] (b) Yes — the largest angle is $3(20) + 50 = 110^\circ$, which is more than 90° B1 ft [1]
- 4 (a) $2x < 12$ M1; $x < 6$ A1 [2] (b) $-4 \leq 2n < 6$ M1; $-2 \leq n < 3$ M1; -2, -1, 0, 1, 2 A1 [3] (c) $-1 < x \leq 3$ B1 [1]
- 5 (a) $x + (x + 15) + 2(x + 15)$ M1; $= 4x + 45$ A1 [2] (b) $x = 20$ M1; Uma has £70 A1 [2]
- 6 $3 + 1.2d = 5 + 0.95d$ M1; $0.25d = 2$ M1; 8 km A1 [3]

Unit 6 · Sheet A — Sequences and the nth term

- 1 23, 27
- 2 16, 10
- 3 48, 96
- 4 add 0.5
- 5 5, 8, 11
- 6 16, 12, 8
- 7 47
- 8 107
- 9 $2n + 1$
- 10 $6n - 2$
- 11 $9n + 2$
- 12 $5n - 4$
- 13 $33 - 3n$
- 14 $2.5 - 0.5n$
- 15 Yes, the 19th term
- 16 No — $3n = 98$ gives $n = 32.66\dots$, not a whole number
- 17 21st term
- 18 2, 5, 10
- 19 25
- 20 13

Unit 6 · Sheet B — Sequences and the nth term

- 1 (a) 13 B1 [1] (b) $3n + 1$ B2 (B1 for $3n + k$) [2] (c) 91 B1 ft [1] (d) $3n + 1 = 200 \rightarrow 3n = 199$ M1; $n = 66.3\dots$, not a whole number, so no A1 [2]
- 2 (a) $5n + 3$ B2 (B1 for $5n + k$) [2] (b) $5n + 3 = 302 \rightarrow 5n = 299$ M1; not a multiple of 5 / every term ends in 3 or 8 A1 [2] (c) $5n + 3 > 500 \rightarrow n > 99.4$ M1; 503 (the 100th term) A1 [2]
- 3 (a) 47, 44, 41 B1 [1] (b) $50 - 3n < 0 \rightarrow n > 16.6\dots$ or list to 17th term M1; -1 A1 [2]
- 4 $3n + 4 = 5n - 8 \rightarrow n = 6$ M1; 22 A1 [2]
- 5 (a) multiply by 3 B1 [1] (b) 1458 B1 [1]
- 6 $(44 - 19) \div 5$ M1; difference = 5 A1; $5n - 1$ A1 [3]

Unit 7 · Sheet A — Straight-line and real-life graphs

- 1 4
- 2 (0, 7)
- 3 -2
- 4 (0, 5)
- 5 $1\frac{1}{2}$
- 6 $y = 3x - 1$
- 7 3
- 8 3
- 9 Yes ($4 \times 2 + 1 = 9$)
- 10 3
- 11 -2
- 12 $y = 6x + 4$
- 13 (4, 0)
- 14 $y = 3x + 5$
- 15 $y = 5x - 2$
- 16 $y = 2x + 3$
- 17 $y = -3$
- 18 $x = 2$
- 19 60 km/h
- 20 the speed

Unit 7 · Sheet B — Straight-line and real-life graphs

- 1 (a) -5, -1, 1, 5 B2 (B1 for 2 or 3 correct) [2] (b) Straight line from (-1, -5) to (4, 5) B2 ft (B1 for at least 4 points plotted correctly) [2] (c) $x = 2.5$ B1 ft [1]
- 2 (a) $(5 - (-1)) \div (2 - 0)$ M1; 3 A1 [2] (b) $y = 3x - 1$ B1 ft [1] (c) $y = 3x + 4$ B1 ft [1] (d) $3 \times 5 - 1 = 14$, so yes B1 [1]
- 3 (a) 15 minutes B1 [1] (b) 3 km in 30 min ($\frac{1}{2}$ hour) M1; 6 km/h A1 [2] (c) 3 km in 20 min M1; 9 km/h A1 [2] (d) The line is steepest for the journey home B1 [1]
- 4 (a) 1320 baht (accept 1300–1340) B1 [1] (b) £20 (accept 19–21) B1 [1] (c) Read £40 = 1760 and multiply by 10 M1; 17 600 baht (accept 17 400–17 800) A1 [2]
- 5 (a) a fixed (call-out) charge / the cost when $h = 0$ B1 [1] (b) the cost per hour (the gradient) B1 [1] (c) £127.50 B1 [1]

Unit 8 · Sheet A — Angles in parallel lines and polygons

- 1 540°
- 2 720°
- 3 1440°
- 4 60°
- 5 120°
- 6 108°
- 7 30°
- 8 162°
- 9 9
- 10 12
- 11 360°
- 12 No — $360 \div 50 = 7.2$ is not a whole number
- 13 equal
- 14 equal
- 15 180°
- 16 65°
- 17 70°
- 18 105°
- 19 70°
- 20 65°

Unit 8 · Sheet B — Angles in parallel lines and polygons

- 1 (a) 58° B1; corresponding angles are equal B1 [2] (b) 122° B1; angles on a straight line add up to 180° (with a) B1 [2] (c) 122° B1; co-interior angles add up to 180° (with a) oe B1 [2]
- 2 (a) $360 \div 8 = 45$ or $(8 - 2) \times 180 \div 8$ M1; 135° A1 [2] (b) exterior angle $180 - 156 = 24$ M1; $360 \div 24 = 15$ sides A1 [2] (c) exterior angle would be 80° M1; $360 \div 80 = 4.5$ is not a whole number A1 [2]
- 3 (a) sum of angles = 540° B1; $8x + 100 = 540$ M1; $x = 55$ A1 [3] (b) 145° B1 ft [1]
- 4 interior angle of hexagon = 120° B1; $360 - 120 - 90$ M1; 150° A1 [3]
- 5 $2y + 3y + 30 = 180$ M1 (co-interior angles add to 180° B1); $y = 30$ A1 [3]

Unit 9 · Sheet A — Area of trapezia and circles

- 1 28 cm^2
- 2 27 cm^2
- 3 60 cm^2
- 4 28 cm^2
- 5 60 cm^2
- 6 6 cm
- 7 31.4 cm
- 8 37.7 cm
- 9 78.5 cm^2
- 10 113.1 cm^2
- 11 $6\pi \text{ cm}$
- 12 $49\pi \text{ cm}^2$
- 13 25.7 cm
- 14 25.1 cm^2
- 15 78.5 cm^2
- 16 15.9 cm
- 17 8.0 cm
- 18 219.9 cm
- 19 $30\,000 \text{ cm}^2$
- 20 2.5 m^2

Unit 9 · Sheet B — Area of trapezia and circles

- 1 (a) $\frac{1}{2} \times (8 + 14) \times 6$ M1; 66 cm^2 A1 [2] (b) $66 \div 6$ or $\frac{1}{2} \times 12 \times h = 66$ M1; 11 cm A1 ft [2]
- 2 (a) $\pi \times 3.5^2$ M1; 38.5 m^2 A1 [2] (b) $2 \times \pi \times 3.5 (= 21.99\dots)$ M1; $\times 12.50$ M1; £274.89 (accept £274.80 to £275) A1 [3]
- 3 (a) $10 \times 6 = 60$ B1; $\frac{1}{2} \times \pi \times 3^2 (= 14.13\dots)$ M1; 74.1 cm^2 A1 [3] (b) $\frac{1}{2} \times \pi \times 6 (= 9.42\dots)$ M1; $10 + 6 + 10 + 9.42\dots$ M1; 35.4 cm A1 [3]
- 4 $\pi \times 64 = 201.06\dots$ cm M1; $100\,000 \div 201.06\dots (= 497.3\dots)$ M1; 497 A1 [3]
- 5 $r^2 = 100 \div \pi$ M1; $r = 5.64\dots$ A1; 35.4 cm A1 [3]
- 6 $10 \times 10 - \pi \times 5^2$ M1 M1; 21.5 cm^2 A1 [3]

Unit 10 · Sheet A — Volume and surface area of prisms

- 1 120 cm^3
- 2 343 cm^3
- 3 96 cm^2
- 4 62 cm^2
- 5 164 cm^2
- 6 120 cm^3
- 7 180 cm^3
- 8 282.7 cm^3
- 9 314.2 cm^3
- 10 754.0 cm^3
- 11 125.7 cm^2
- 12 6.4 cm
- 13 2500 cm^3
- 14 1 000 000
- 15 5 cm
- 16 5 cm
- 17 30 cm^2
- 18 60 litres

Unit 10 · Sheet B — Volume and surface area of prisms

- 1 (a) $\frac{1}{2} \times 8 \times 6 (= 24) \times 15$ M1; 360 cm^3 A1 [2] (b) $2 \times 24 = 48$ M1; $(6 + 8 + 10) \times 15 = 360$ M1; 408 cm^2 A1 [3]
- 2 split into rectangles, e.g. $8 \times 2 + 3 \times 4$ M1; cross-section = 28 cm^2 A1; 280 cm^3 A1 [3]
- 3 (a) $\pi \times 4^2 \times 11$ M1; 552.9 cm^3 A1 [2] (b) $2 \times \pi \times 4 \times 11$ M1; 276.5 cm^2 A1 [2]
- 4 (a) depth = 30 cm B1; $60 \times 30 \times 30 = 54\,000 \text{ cm}^3$ M1; 54 litres A1 [3] (b) $900 \div (60 \times 30)$ M1; 0.5 cm A1 [2]
- 5 $150 \div 6 = 25$ M1; side = 5 cm A1; 125 cm^3 A1 [3]
- 6 A: $\pi \times 25 \times 12 = 942.5$ M1; B: 972 M1; B holds more by 29.5 cm^3 A1 [3]

Unit 11 · Sheet A — Transformations

- 1 (3, -5)
- 2 (-3, 5)
- 3 (6, 7)
- 4 (-1, -1)
- 5 (1, 4)
- 6 (6, -2)
- 7 (-5, 6)
- 8 4 right, 3 down
- 9 (1, -3)
- 10 (-3, -1)
- 11 (-5, 2)
- 12 270°
- 13 (6, -2)
- 14 12 cm
- 15 5 cm
- 16 3
- 17 reflection, rotation, translation
- 18 9
- 19 6
- 20 4

Unit 11 · Sheet B — Transformations

- 1 (a) Vertices (-1, 1), (-3, 1), (-1, 4) B2 (B1 for a reflection in a different vertical line) [2] (b) Vertices (1, -3), (3, -3), (1, -6) B2 (B1 for a reflection in a different horizontal line) [2] (c) Rotation B1; 180° B1; centre (0, -1) B1 [3]
- 2 (a) Rotation B1; 90° clockwise B1; centre (0, 0) B1 [3] (b) Translation B1; 6 left and 1 up (column vector with top -6, bottom 1) B1 [2]
- 3 (a) Vertices (3, 3), (6, 3), (3, 9) B3 (B2 correct size and orientation, wrong position; B1 two sides enlarged correctly) [3] (b) 9 cm^2 B1 [1]
- 4 Enlargement B1; scale factor 3 B1; centre (1, 1) B1 [3]
- 5 Vertices (0, 1), (0, 3), (-1, 3) B2 (B1 for correct rotation about a different centre, or 90° clockwise about (1, 0)) [2]

Unit 12 · Sheet A — Constructions and loci

- 1 a circle, centre P, radius 3 cm
- 2 the perpendicular bisector of AB
- 3 No ($3 + 4 < 8$)
- 4 Yes ($5 + 5 > 9$)
- 5 90°
- 6 35°
- 7 $x = 4$
- 8 (5, 5)
- 9 35 m
- 10 7.5 cm
- 11 090°
- 12 225°
- 13 250°
- 14 120°
- 15 the bisector of the angle between the lines
- 16 inside (and on) a circle, centre the post, radius 6 m

Unit 12 · Sheet B — Constructions and loci

- 1 (a) Correct triangle within 2 mm B1; construction arcs shown B1 [2] (b) 58° (accept 56° to 60°) B1 [1]
- 2 (a) Two pairs of arcs of equal radius, centres A and B, intersecting M1; correct line drawn through the intersections A1 [2] (b) It is the same distance from A as from B (equidistant) B1 [1]
- 3 (a) Arc centre P cutting both arms, then two equal arcs from those points M1; correct bisector drawn (within 2°) A1 [2] (b) 32° (accept 30° to 34°) B1 [1]
- 4 Arc of radius 4 cm, centre A B1; bisector of angle DAB (45° line) B1; correct region shaded (inside the arc, below the bisector) B2 (B1 ft for one correct locus) [4]
- 5 (a) $4 + 5 = 9$, which is less than 10, so the two short sides cannot meet B1 [1] (b) $125 + 180\text{ M1}$; 305° A1 [2] (c) $6.4 \times 25\,000 = 160\,000\text{ cm M1}$; 1.6 km A1 [2]
- 6 perpendicular bisector of AB B1; circle radius 4 cm centre B B1; correct region (inside circle, on A's side of the bisector) B1 [3]

Unit 13 · Sheet A — Scatter graphs and grouped data

- 1 positive
- 2 negative
- 3 none
- 4 the mean
- 5 continuous
- 6 discrete
- 7 8
- 8 6
- 9 7
- 10 14
- 11 32
- 12 15
- 13 B
- 14 B (10th and 11th values)
- 15 16
- 16 2.5
- 17 a value that does not fit the pattern of the rest of the data
- 18 the exact values are not known — midpoints are used

Unit 13 · Sheet B — Scatter graphs and grouped data

- 1 (a) positive B1 [1] (b) (3.5, 20) B1 [1] (c) Line through the main trend, ignoring the outlier B1 [1] (d) About 68 (accept 64 to 72) B1 ft [1] (e) 12 hours is outside the range of the data (extrapolation); the score cannot go above 100 B1 [1]
- 2 (a) $20 < t \leq 30$ B1 [1] (b) $20 < t \leq 30$ B1 [1] (c) midpoints 5, 15, 25, 35 M1; $20 + 135 + 300 + 175 = 630\text{ M1}$; $630 \div 30\text{ M1}$; 21 minutes A1 [4] (d) the exact times are not known; midpoints were used B1 [1]
- 3 $0 \times 5 + 1 \times 8 + 2 \times 4 + 3 \times 2 + 4 \times 1 = 26\text{ M1}$; $26 \div 20\text{ M1}$; 1.3 A1 [3]
- 4 Class A scored higher on average (higher mean) B1; Class B's scores were more consistent (smaller range) B1 [2]
- 5 (a) All 8 points correct B2 (B1 for 6 or 7 correct) [2] (b) negative correlation — the warmer it is, the fewer hot chocolates are sold B1 [1] (c) Line of best fit B1; about 28 (accept 26 to 32) B1 ft [2]

Unit 14 · Sheet A — Probability

- 1 $1/6$
- 2 $1/2$
- 3 $1/2$
- 4 $4/5$
- 5 $1/2$
- 6 0.65
- 7 the events cannot happen at the same time
- 8 No — 2 is even
- 9 0.35
- 10 0.55
- 11 HH, HT, TH, TT
- 12 $1/4$
- 13 36
- 14 $1/6$
- 15 $1/6$
- 16 $1/12$
- 17 20
- 18 0.56
- 19 $1/4$
- 20 $2/11$

Unit 14 · Sheet B — Probability

- 1 (a) $0.3 + 0.25 + x + 2x = 1$ M1; $x = 0.15$ A1 [2] (b) 0.55 B1 [1] (c) 0.3×200 M1; 60 A1 ft [2]
- 2 (a) Row 1: 1, 2, 3, 4; row 2: 2, 4, 6, 8; row 3: 3, 6, 9, 12 B2 (B1 for at least 8 correct) [2] (b) $2/12 = 1/6$ B1 ft [1] (c) $4/12 = 1/3$ B1 ft [1] (d) $3/12 = 1/4$ B1 ft [1]
- 3 (a) $1 - 1/4 - 2/5$ M1; $7/20$ A1 [2] (b) 14 B1 ft [1] (c) 10 red at the start B1; $(10 + k) \div (40 + k) = 1/3$ or trial M1; 5 A1 [3]
- 4 (a) $15/60 = 1/4$ (0.25) B1 [1] (b) expected about 10 sixes for a fair dice B1; 15 is more, but 60 rolls is not many — he should roll it more times before deciding B1 [2]
- 5 outcomes HH, HT, TH, TT listed M1; P(at least one head) = $3/4$, so Lucy is wrong A1 [2]

End-of-book check

- 1 7.3×10^{-4}
- 2 a^7
- 3 £80
- 4 £21 and £35
- 5 $3x(2x - 3)$
- 6 $x = 4$
- 7 $7n - 5$
- 8 $y = 3x + 2$
- 9 144°
- 10 113.1 cm^2
- 11 $(-3, 2)$
- 12 $1/9$

End-of-year practice test

- 1 (a) 52 000 B1 [1] (b) 3^5 B1 [1] (c) $12a^7$ B2 (B1 for 12 or a^7) [2]
- 2 (a) $42 \div 280 \times 100$ M1; 15% A1 [2] (b) $510 \div 0.85$ M1; £600 A1 [2]
- 3 $360 \div 9 = 40$ M1; Leo gets £200 A1; £40 A1 ft [3]
- 4 (a) $6x - 8 - 5x + 10$ M1; $x + 2$ A1 [2] (b) $5y(2y + 3)$ B2 (B1 for a partial factorisation) [2] (c) $5x + 5 = 2x + 20$ M1; $3x = 15$ M1; $x = 5$ A1 [3]
- 5 (a) $2x \leq 14$ M1; $x \leq 7$ A1 [2] (b) 0, 1, 2, 3, 4 B1 [1]
- 6 (a) $4n + 2$ B2 (B1 for $4n + k$) [2] (b) $4n + 2 = 98$ M1; $n = 24$, so yes, the 24th term A1 [2]
- 7 (a) $(10 - 1) \div (4 - 1)$ M1; 3 A1 [2] (b) $y = 3x - 2$ B1 ft [1]
- 8 (a) 15 B1 [1] (b) 156° B1 ft [1] (c) 108° B1; co-interior angles add up to 180° (or angles on a straight line with the corresponding angle 72°) B1 [2]
- 9 (a) $\pi \times 0.6^2$ M1; 1.13 m^2 (accept 1.1) A1 [2] (b) $\frac{1}{2} \times (9 + 15) \times 8$ M1; 96 cm^2 A1 [2]
- 10 (a) $\pi \times 6^2 \times 20$ M1; 2261.9 cm^3 A1 [2] (b) 2.26 litres B1 ft [1]
- 11 (a) Vertices (0, 1), (-3, 1), (0, 3) B2 (B1 for a reflection in another vertical line) [2] (b) Rotation B1; 180° B1; centre (0, 0) B1 [3]
- 12 (a) $50 < m \leq 60$ B1 [1] (b) midpoints 45, 55, 65, 75 M1; $\Sigma fx = 1090$ M1; 54.5 kg A1 [3]
- 13 (a) 0.25 B1 [1] (b) 15 B1 ft [1]