



BRITISH LEARNING CENTRE

KEY STAGE 3 · YEAR 7

Mathematics

Year 7

A complete Year 7 maths course for British international school students, matched to the English National Curriculum (KS3) and Cambridge Lower Secondary Stage 7. Each unit has clear notes, worked examples, skills practice and exam-style problem solving.

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	7Np.01, 7Np.02, NC Number	Place value, ordering and rounding I can use place value to multiply and divide by powers of 10, order decimals, round and estimate.			
2	7Ni.01, 7Ni.02, 7Ni.03	Integers and the order of operations I can calculate with positive and negative integers and use the correct order of operations.			
3	7Ni.04, 7Ni.06, NC Number	Factors, primes, powers and roots I can find factors, multiples, primes, HCF and LCM, and work with powers and roots.			
4	7Nf.01, NC Number	Fractions, decimals and percentages I can convert between fractions, decimals and percentages, and find fractions and percentages of amounts.			
5	7Nf.02, 7Nf.03, NC Number	Calculating with fractions I can add, subtract, multiply and divide fractions and mixed numbers.			
6	7Ae.01, 7Ae.02, 7Ae.03, 7Ae.04	Algebraic expressions and substitution I can write, simplify and expand expressions, and substitute numbers into them.			
7	7Ae.05, 7Ae.06, NC Algebra	Solving simple equations I can form and solve linear equations using inverse operations, including equations with brackets.			
8	7As.01, 7As.02, NC Algebra	Sequences I can continue sequences, use term-to-term rules and find and use the nth term of a linear sequence.			
9	NC Algebra, NC Geometry	Coordinates and straight-line graphs I can use coordinates in four quadrants, find midpoints and draw straight-line graphs.			
10	NC Ratio and proportion	Ratio and proportion I can simplify ratios, share amounts in a ratio and solve direct proportion problems.			
11	NC Geometry and measures	Angles and properties of shapes I can use angle facts to find missing angles and describe the properties of 2D shapes.			
12	NC Geometry and measures	Perimeter, area and 3D shapes I can find perimeters, areas of 2D shapes and volumes of cuboids, and describe 3D shapes.			
13	NC Statistics, 7Ss.01	Collecting data and averages I can collect and represent data, and calculate and compare the mean, median, mode and range.			
14	NC Probability, 7Sp.01	Probability I can use the probability scale, find probabilities of equally likely outcomes and calculate expected frequencies.			



CHECK

Starting point check

Starting point check

Name _____ Date _____ Score _____ / 12

Answer as many questions as you can. Do not use a calculator. This shows what you already know.

1 $4.07 \times 100 =$

2 Round 3.846 to 1 decimal place

3 $-5 + 8 =$

4 $4 + 6 \times 2 =$

5 List all the factors of 20

6 $1/2 + 1/4 =$

7 25% of 80 =

8 Simplify $3a + 4a - a$

9 Solve $x + 9 = 15$

10 Write the next term: 3, 7, 11, 15,

11 Two angles on a straight line. One is 115° . Find the other.

12 Find the mean of 3, 5 and 10

Place value, ordering and rounding

I can... use place value to multiply and divide by powers of 10, order decimals, round and estimate.

Curriculum ref: 7Np.01, 7Np.02, NC Number

Each column in our number system is worth ten times the column to its right. Multiplying by 10, 100 or 1000 moves the digits 1, 2 or 3 places to the left; dividing moves them to the right.

To **round**, look at the digit after the place you want. If it is 5 or more, round up. To **estimate**, round every number to 1 significant figure first.

Key words

place value

decimal place

significant figure

round

estimate

Key points

- $4.6 \times 100 = 460$ $72 \div 1000 = 0.072$
- Compare decimals digit by digit from the left: $0.45 > 0.405$
- Decimal places (d.p.) count digits after the point; significant figures (s.f.) start from the first non-zero digit.
- Keep zeros that hold a place: $12.3049 \rightarrow 12.30$ (2 d.p.)

Worked example 1

Round 0.04718 to (a) 3 d.p. (b) 1 s.f.

(a) The 4th decimal digit is 1, so round down: 0.047

(b) The first significant figure is 4; the next digit is 7, so round up: 0.05

Worked example 2

Estimate 612×4.87

Round to 1 s.f.: $600 \times 5 = 3000$ (exact answer 2980.44)

Common mistakes

- Saying $0.405 > 0.45$ because $405 > 45$.
- Dropping a final zero: 12.30 to 2 d.p. must keep the 0.
- Rounding 48,312 to 1 s.f. as 5 instead of 50,000.

Exam tip: Always write an estimate next to a calculator answer to check it is sensible.

Write each answer in the box.

1 Write the value of the digit 7 in
3.472

2 Write the value of the digit 5 in
152,806

3 $4.6 \times 100 =$

4 $0.38 \times 1,000 =$

5 $72 \div 100 =$

6 $5.4 \div 1,000 =$

7 $\times 10 = 36.5$

8 Write in order, smallest first: 0.6,
0.06, 0.66, 0.606

9 Which is larger, 3.09 or 3.1?

10 Write < or > in the box: 0.45
0.405

11 Round 3847 to the nearest 100

12 Round 65,499 to the nearest 1000

13 Round 7.468 to 1 decimal place

14 Round 12.3049 to 2 decimal places

15 Round 0.0726 to 2 decimal places

16 Round 48,312 to 1 significant figure

17 Round 0.00381 to 1 significant
figure

18 Estimate 39×21 by rounding to 1 s.f.

19 Estimate 6.8×9.2

20 Estimate $412 \div 7.9$

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

Show your working. Do not use a calculator.

- 1** Five runners took part in a 100 m race. Their times, in seconds, are shown.

12.08 12.8 12.18 12.088 12.81

(a) Write the times in order, fastest first.

[2]

(b) Round 12.088 to 1 decimal place.

[1]

Answer s

(c) Work out the difference between the fastest and the slowest time.

[2]

Answer s

- 2** Amira says, " $3.45 \times 100 = 3.4500$ because you add two zeros."

(a) Explain why Amira is wrong.

[1]

(b) Work out 3.45×100

[1]

Answer

(c) Work out $3.45 \div 100$

[1]

Answer

- 3** You are told that $318 \times 49 = 15,582$. Use this fact to write down the answers. Do not use a calculator.

(a) 3180×49

[1]

Answer

(b) 31.8×4.9

[1]

Answer

(c) $15,582 \div 4.9$

[1]

Answer

(d) Without working it out, explain how you know that 0.318×49 is less than 49.

[1]

4 A school buys 48 theatre tickets. Each ticket costs £19.75

(a) Estimate the total cost by rounding each number to 1 significant figure. Show your working. [2]

Answer £.....

(b) Is your estimate bigger or smaller than the exact cost? Explain how you know. [1]

5 A number is rounded to 1 decimal place. The answer is 6.4

(a) Write down the smallest number it could have been. [1]

Answer

(b) Write down a number with 3 decimal places that is bigger than 6.4 but rounds to 6.4 [1]

Answer

6 The population of a city is 1,284,516.

(a) Write down the value of the digit 8. [1]

Answer

(b) Round the population to the nearest thousand. [1]

Answer

(c) Round the population to 1 significant figure. [1]

Answer

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

Integers and the order of operations

I can... calculate with positive and negative integers and use the correct order of operations.

Curriculum ref: 7Ni.01, 7Ni.02, 7Ni.03

Integers are whole numbers, positive, negative or zero. On a number line, numbers get bigger as you move right.

Subtracting a negative is the same as adding: $3 - (-5) = 3 + 5$.

When you multiply or divide, two signs the same give a positive answer; two different signs give a negative answer.

Follow the order of operations: **B**rackets, **I**ndices, **D**ivision and **M**ultiplication (left to right), **A**ddition and **S**ubtraction (left to right).

Key words

integer

negative

product

BIDMAS

brackets

Key points

- $+$ $\times$ $=$ $+$ $-$ $\times$ $=$ $-$ $+$ $\div$ $=$ $+$ $-$ $\div$ $=$ $-$
- Adding a negative = subtracting: $4 + (-11) = 4 - 11 = -7$
- BIDMAS: brackets first, then powers, then $\times$ and $\div$, then $+$ and $-$

Worked example 1

Work out $-3 - (-8)$

Subtracting -8 is the same as adding 8

$$-3 + 8 = 5$$

Worked example 2

Work out $20 - 3 \times (2 + 4)^2 \div 9$

Brackets, then indices: $(2 + 4)^2 = 6^2 = 36$

Then $3 \times 36 \div 9 = 12$, so $20 - 12 = 8$

Common mistakes

- Working left to right: $3 + 4 \times 5$ is 23, not 35.
- Writing $-8 \times -3 = -24$. Two negatives give a positive.

Exam tip: Put negative numbers in brackets when you write calculations, e.g. $5 \times (-2)$.

Work out each answer. Show any working.

1 $-4 + 9 =$

2 $-3 - 6 =$

3 $5 - 12 =$

4 $-7 - (-10) =$

5 $4 + (-11) =$

6 $-6 \times 4 =$

7 $-8 \times (-3) =$

8 $36 \div (-9) =$

9 $-45 \div (-5) =$

10 $-2 \times (-3) \times (-5) =$

11 The temperature is -5°C . It rises by 12 degrees. What is the new temperature? **12** Order from smallest: $-3, 2, -8, 0, -1$

13 $3 + 4 \times 5 =$

14 $(3 + 4) \times 5 =$

15 $20 - 12 \div 4 =$

16 $18 \div (2 + 4) \times 3 =$

17 $2 + 3 \times 4^2 =$

18 $(15 - 3) \div (2 \times 3) =$

19 Add brackets to make this true: $6 + 4 \times 2 - 1 = 19$

20 $- 7 = -3$

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

Show your working. Do not use a calculator.

- 1** The table shows the temperature in five cities at midday one day in January.

City	Oslo	Bangkok	Moscow	London	Toronto
Temperature (°C)	-7	31	-12	4	-9

- (a)** Which city was the coldest? [1]

Answer

- (b)** Work out the difference in temperature between Bangkok and Moscow. [1]

Answer °C

- (c)** At midnight the temperature in Oslo was 6 degrees lower. Work out the temperature at midnight. [1]

Answer °C

- (d)** Which two cities had a difference in temperature of exactly 3 degrees? [1]

Answer and

- 2** Leo says, " $12 - 4 \times 2 = 16$ ".

- (a)** Explain the mistake Leo has made. [1]

- (b)** Work out the correct answer. [1]

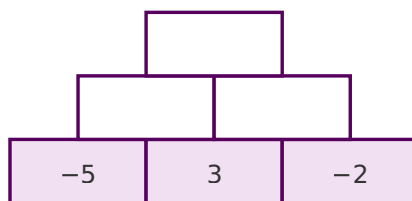
Answer

- (c)** Add two pairs of brackets to make this calculation correct. $12 - 4 \times 2 + 1 = 24$ [1]

- 3** Priya's bank balance is -£35. She pays in £60 and then spends £42. Work out her new balance. [2]

Answer £.....

- 4 In this number pyramid, each block is the **sum** of the two blocks directly below it.



(a) Complete the pyramid. [2]

(b) In a different pyramid, the bottom row is 4, x , -6 and the top block is 0. Find the value of x . [2]

Answer $x = \dots\dots$

- 5 Integers can be positive or negative.

(a) Find two integers that multiply to give -24 and add to give 5 . [2]

Answer $\dots\dots$ and $\dots\dots$

(b) Explain how you know that multiplying three negative numbers always gives a negative answer. [2]

- 6 A lift goes from floor -3 (the lowest car park) up to floor 12 .

(a) The lift starts at floor -3 and goes up 9 floors. Which floor is it on now? [1]

Answer floor $\dots\dots$

(b) Can the lift then go down 11 floors? Explain how you know. [2]

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

Factors, primes, powers and roots

I can... find factors, multiples, primes, HCF and LCM, and work with powers and roots.

Curriculum ref: 7Ni.04, 7Ni.06, NC Number

A **factor** divides exactly into a number. A **multiple** is in a number's times table. A **prime** has exactly two factors: 1 and itself (1 is not prime).

Every whole number greater than 1 can be written as a product of prime factors. Use a factor tree, then write repeated factors as powers. **Squaring** means multiplying a number by itself; the **square root** undoes it. Cubes and cube roots work the same way.

Key words

factor

multiple

prime

HCF

LCM

square root

Key points

- Primes to 30: 2, 3, 5, 7, 11, 13, 17, 19, 23, 29
- HCF = product of the **common** prime factors
- LCM = smallest number in both times tables
- $4^2 = 16$, $\sqrt{16} = 4$; $2^3 = 8$, $\sqrt[3]{8} = 2$

Worked example 1

Write 60 as a product of prime factors.

$$60 = 6 \times 10 = 2 \times 3 \times 2 \times 5$$

$$60 = 2^2 \times 3 \times 5$$

Worked example 2

Find the HCF and LCM of 24 and 36.

$$24 = 2^3 \times 3, \quad 36 = 2^2 \times 3^2$$

$$\text{HCF} = 2^2 \times 3 = 12; \quad \text{LCM} = 2^3 \times 3^2 = 72$$

Common mistakes

- Thinking 2^3 means 2×3 . It means $2 \times 2 \times 2 = 8$.
- Mixing up HCF (small) and LCM (large).

Exam tip: Check a prime factor answer by multiplying it back out.

Write each answer in the box.**1** List all the factors of 18 **2** Write the first five multiples of 7
3 List the prime numbers between 20 and 40 **4** Is 51 a prime number? Give a reason. **5** $7^2 =$ **6** $5^3 =$ **7** $\sqrt{81} =$ **8** $\sqrt[3]{64} =$ **9** $2^5 =$ **10** $10^4 =$ **11** $\sqrt{144} + 2^3 =$ **12** $3^2 \times 2^3 =$ **13** Write 36 as a product of prime factors (index form) **14** Write 84 as a product of prime factors (index form) **15** Write 150 as a product of prime factors (index form) **16** HCF of 12 and 18 **17** HCF of 28 and 42 **18** HCF of 45 and 60 **19** LCM of 4 and 6 **20** LCM of 8 and 12 **21** LCM of 9 and 15 **22** $\sqrt{50}$ lies between which two whole numbers? Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Show your working. Do not use a calculator.

- 1 Bus A leaves the station every 12 minutes. Bus B leaves every 18 minutes. Both buses leave together at 8:00 am. When is the next time they leave together?

(a)**[3]****Answer**

- (b)** Bus C leaves every 15 minutes, also starting at 8:00 am. When do all three buses next leave together?

[2]**Answer**

- 2 **(a)** Write 120 as a product of its prime factors. Give your answer in index form. **[2]**

Answer

- (b)** $84 = 2^2 \times 3 \times 7$. Find the highest common factor (HCF) of 120 and 84. **[2]**

Answer

- 3 Mr Tan has 48 sweets and 60 stickers. He puts them into party bags. Every bag must be the same, and nothing is left over.

- (a)** What is the greatest number of party bags he can make? **[2]**

Answer bags

- (b)** How many sweets and how many stickers are in each bag? **[1]**

Answer sweets, stickers

4 Decide whether each statement is true or false. Explain how you know.

(a) "All prime numbers are odd."

[1]

(b) "Squaring a number always makes it bigger."

[1]

5 (a) Find a number between 50 and 100 that is both a square number and a cube number. [1]

Answer

(b) Work out $\sqrt{3^2 + 4^2}$

[2]

Answer

(c) Show that $2^6 = 8^2$

[1]

6 A square floor tile has an area of 196 cm^2 .

(a) Find the length of one side of the tile.

[1]

Answer cm

(b) Find the perimeter of the tile.

[1]

Answer cm

(c) Write 196 as a product of prime factors in index form.

[1]

Answer

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

Fractions, decimals and percentages

I can... convert between fractions, decimals and percentages, and find fractions and percentages of amounts.

Curriculum ref: 7Nf.01, NC Number

Fractions, decimals and percentages are three ways of writing the same amount. **Per cent** means 'out of 100', so $37\% = 37/100 = 0.37$.

To find a fraction of an amount, divide by the denominator and multiply by the numerator. To find a percentage, build it from 10%, 5% and 1%, or multiply by the decimal.

Key words

equivalent

simplest form

percentage

decimal

mixed number

Key points

- Fraction → decimal: divide the numerator by the denominator
- Decimal → percentage: multiply by 100
- $1/2 = 0.5 = 50\%$ $1/4 = 0.25 = 25\%$ $1/5 = 0.2 = 20\%$ $1/10 = 0.1 = 10\%$

Worked example 1

Write $3/8$ as a decimal and as a percentage.

$$3 \div 8 = 0.375$$

$$0.375 \times 100 = 37.5\%$$

Worked example 2

Find 35% of £60.

$$10\% = £6, \text{ so } 30\% = £18; 5\% = £3$$

$$35\% = £18 + £3 = £21$$

Common mistakes

- Writing 0.08 as 80%. It is 8%.
- Thinking $1/3 = 0.3$. It is 0.333...

Exam tip: To compare a mix of fractions, decimals and percentages, change them all to percentages first.

Write each answer in the box.

1 Simplify $18/24$

2 $3/5 =$ $/20$

3 Write $7/4$ as a mixed number

4 Write $2\frac{2}{3}$ as an improper fraction

5 Write 0.7 as a fraction in its simplest form

6 Write 0.35 as a fraction in its simplest form

7 Write 0.125 as a fraction in its simplest form

8 Write $3/4$ as a decimal

9 Write $1/8$ as a decimal

10 Write $2/5$ as a percentage

11 Write 0.08 as a percentage

12 Write 65% as a decimal

13 Write 45% as a fraction in its simplest form

14 Order, smallest first: 0.3, $1/4$, 28%

15 Which is larger, $2/3$ or 0.65?

16 10% of 340 =

17 25% of 84 =

18 15% of 60 =

19 $1/3$ of 72 =

20 $3/5$ of 45 =

21 Write 12 out of 40 as a percentage

22 Write $7/25$ as a percentage

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

Show your working. Do not use a calculator.

- 1 Three students took different tests. Ana scored $17/20$. Ben scored 82%. Cal scored 0.84 of the marks.

(a) Write Ana's and Cal's scores as percentages. [2]

Answer Ana % Cal %

(b) Who did best? Explain how you know. [1]

- 2 A coat normally costs £80. In a sale, the price is reduced by 35%.

(a) Work out the reduction. [2]

Answer £.....

(b) Work out the sale price. [1]

Answer £.....

- 3 There are 30 students in a class. $2/5$ of them walk to school. 30% of them come by bus. The rest come by car.

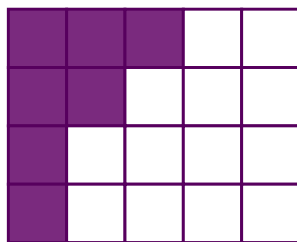
(a) How many students come by car? [3]

Answer

(b) What fraction of the class come by car? Give your answer in its simplest form. [1]

Answer

- 4 The diagram is made of 20 equal squares.



- (a) What percentage of the diagram is shaded? [1]

Answer %

- (b) How many more squares must be shaded so that $\frac{3}{5}$ of the diagram is shaded? [1]

Answer

- 5 Jo says, " $\frac{1}{3}$ is the same as 0.3".

- (a) Is Jo correct? Explain how you know. [1]

- (b) Write these numbers in order, starting with the smallest. 0.3 $\frac{1}{3}$ 0.34 32% [2]

Answer

- 6 Answer these problems about money and amounts.

- (a) Sam has £36. He spends $\frac{1}{4}$ of it on a book. He then spends 40% of the money he has left on food. How much money does Sam have now? [3]

Answer £.....

- (b) A packet of rice normally holds 250 g. A special offer packet holds 20% extra. How much rice is in the special offer packet? [2]

Answer g

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

Calculating with fractions

I can... add, subtract, multiply and divide fractions and mixed numbers.

Curriculum ref: 7Nf.02, 7Nf.03, NC Number

To **add or subtract** fractions, first write them with a common denominator, then add or subtract the numerators. Change mixed numbers to improper fractions first.

To **multiply**, multiply the numerators and multiply the denominators. To **divide**, keep the first fraction, change $\div$ to $\times$, and flip the second fraction.

Key words

numerator

denominator

common denominator

mixed number

reciprocal

Key points

- $a/b + c/d$: use the LCM of b and d as the denominator
- $2\frac{1}{2} = 5/2$ ($2 \times 2 + 1 = 5$)
- Multiply: $2/3 \times 3/4 = 6/12 = 1/2$
- Divide: $3/4 \div 3/8 = 3/4 \times 8/3 = 2$
- Always simplify your answer

Worked example 1

Work out $2/3 + 3/4$

Common denominator 12: $8/12 + 9/12$
 $= 17/12 = 1\frac{5}{12}$

Worked example 2

Work out $1\frac{1}{2} \times 2/3$

$1\frac{1}{2} = 3/2$
 $3/2 \times 2/3 = 6/6 = 1$

Common mistakes

- Adding the denominators: $1/3 + 2/5$ is not $3/8$.
- Multiplying a mixed number in parts: $1\frac{1}{4} \times 2/5$ is not $1 \times 2/5 + 1/4$.
- Flipping the wrong fraction when dividing.

Exam tip: Dividing by a fraction less than 1 gives a bigger answer. Use this to check.

Give each answer as a fraction in its simplest form or as a mixed number.

1 $1/5 + 2/5 =$

2 $1/2 + 1/3 =$

3 $3/4 - 1/6 =$

4 $5/6 - 1/4 =$

5 $2/3 + 4/9 =$

6 $1 1/2 + 2 1/4 =$

7 $3 1/3 - 1 1/2 =$

8 $4 \times 2/7 =$

9 $3/5 \times 10 =$

10 $2/3 \times 3/4 =$

11 $5/8 \times 4/15 =$

12 $1 1/4 \times 2/5 =$

13 $2/5 \div 2 =$

14 $3/4 \div 3 =$

15 $6 \div 1/3 =$

16 $3/5 \div 1/10 =$

17 $5/6 \div 2/3 =$

18 $2 1/2 \div 1/4 =$

19 $1 - 3/8 =$

20 $2/3$ of $3/5 =$

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

Show your working. Do not use a calculator.

- 1 A recipe uses $2\frac{1}{4}$ cups of flour. Mia makes $1\frac{1}{2}$ times the recipe. How many cups of flour does she need? [2]

Answer cups

- 2 A plank of wood is 5 m long. Ali cuts it into pieces that are each $\frac{3}{4}$ m long.

(a) How many whole pieces can he cut? [2]

Answer

(b) How much wood is left over? [1]

Answer m

- 3 Lena travels to her grandmother's house. She goes $\frac{2}{5}$ of the way by train and $\frac{1}{3}$ of the way by bus. She walks the rest.

(a) What fraction of the journey does she walk? [2]

Answer

(b) The whole journey is 30 km. How far does she walk? [2]

Answer km

- 4 Tom writes: $\frac{1}{3} + \frac{2}{5} = \frac{3}{8}$

(a) Explain the mistake Tom has made. [1]

(b) Work out the correct answer. [2]

Answer

5

(a) Show that $1\frac{2}{3} \times 1\frac{4}{5} = 3$

[2]

(b) Without working them out, explain which is bigger: $\frac{2}{3} \div \frac{1}{2}$ or $\frac{2}{3} \times \frac{1}{2}$

[1]

(c) Find the missing fraction. $\frac{3}{4} - \square = \frac{1}{6}$

[2]

Answer

6 A tank holds 12 litres of water when it is full. It is $\frac{5}{8}$ full. Ella pours in another $1\frac{1}{2}$ litres. What fraction of the tank is full now? Give your answer in its simplest form.

[3]

Answer

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

Algebraic expressions and substitution

I can... write, simplify and expand expressions, and substitute numbers into them.

Curriculum ref: 7Ae.01, 7Ae.02, 7Ae.03, 7Ae.04

In algebra, letters stand for numbers. We write $3 \times n$ as $3n$, $n \times n$ as n^2 , and $n \div 2$ as $n/2$.

Like terms have exactly the same letters, so $4x$ and $-7x$ can be collected but $3a$ and $2b$ cannot. To **expand** a bracket, multiply every term inside by the term outside. To **substitute**, replace each letter with its value.

Key words

expression

term

like terms

expand

substitute

formula

Key points

- An **expression** has no equals sign: $3x + 2$
- A **formula** links variables: $A = lw$
- $3(2x - 5) = 6x - 15$
- If $x = -2$: $x^2 = (-2)^2 = 4$

Worked example 1

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

Collect a terms: $5a - 2a = 3a$

Collect b terms: $3b + b = 4b$

Answer: $3a + 4b$

Worked example 2

Find $3a + b^2$ when $a = 4$ and $b = -2$

$$3 \times 4 + (-2)^2 = 12 + 4 = 16$$

Common mistakes

- Writing $3a + 2b = 5ab$.
- Expanding only the first term: $3(x + 2)$ is not $3x + 2$.
- Writing $-3^2 = -9$ when substituting $x = -3$ into x^2 .

Exam tip: Use brackets when you substitute a negative number.

Write each answer in the box.

1 Write an expression for 5 more than n

2 Write an expression for n multiplied by 4

3 Write an expression for x divided by 3

4 Write an expression for y squared, minus 2

5 Simplify $a + a + a$

6 Simplify $4x + 7x$

7 Simplify $9y - 3y + y$

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

9 Simplify $6p - 2q - 4p + 5q$

10 Simplify $3 \times 4m$

11 Simplify $2a \times 5b$

12 Simplify $c \times c$

13 Simplify $12x \div 4$

14 Expand $4(x + 3)$

15 Expand $5(2y - 1)$

16 Expand $-2(a + 6)$

17 Expand and simplify $3(x + 2) + 4x$

18 Expand and simplify $2(3n + 1) + 3(n - 4)$

19 If $a = 5$ and $b = -3$, find $a + b$

20 If $a = 5$ and $b = -3$, find $4a - b$

21 If $a = 5$ and $b = -3$, find ab

22 If $a = 5$ and $b = -3$, find b^2

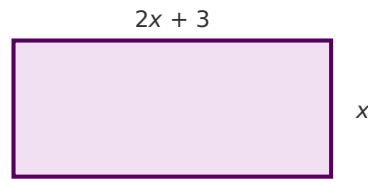
23 If $a = 5$ and $b = -3$, find $2a^2$

24 If $a = 5$ and $b = -3$, find $(a + b) \div 2$

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

Show your working. Do not use a calculator.

- 1 A rectangle has length $(2x + 3)$ cm and width x cm.



Not to scale

- (a) Write an expression for the perimeter. Simplify your answer. [2]

Answer cm

- (b) Find the perimeter when $x = 4$. [1]

Answer cm

- (c) Write an expression for the area. Expand the brackets. [2]

Answer cm^2

- 2 The cost, £ C , of hiring a bike for h hours is given by the formula $C = 8 + 3h$

- (a) Work out the cost of hiring a bike for 5 hours. [2]

Answer £.....

- (b) What does the number 8 represent in the formula? [1]

- (c) Hiring a bike cost £35. For how many hours was it hired? [2]

Answer hours

3 Zara says, " $3a + 2b$ simplifies to $5ab$ ".

(a) Explain why Zara is wrong.

[1]

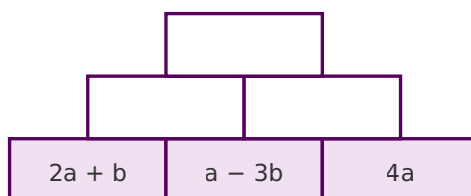
(b) Expand and simplify $4(2x - 1) - 3(x - 2)$

[3]

Answer

4 In this pyramid, each block is the sum of the two blocks below it. Complete the pyramid. Simplify each expression.

[3]



5 A formula is $T = 5 + 2n^2$

(a) Find T when $n = 3$.

[1]

Answer $T = \dots\dots\dots$

(b) Find T when $n = -3$.

[1]

Answer $T = \dots\dots\dots$

(c) Explain why your answers to (a) and (b) are the same.

[1]

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

Solving simple equations

I can... form and solve linear equations using inverse operations, including equations with brackets.

Curriculum ref: 7Ae.05, 7Ae.06, NC Algebra

An **equation** says that two things are equal. Solving it means finding the value of the letter that makes it true.

Think of a balance: whatever you do to one side, you must do to the other. Use **inverse operations** to undo what has been done to the letter, in reverse order. Always check by substituting your answer back in.

Key words

equation

solve

inverse operation

balance

solution

Key points

- Inverse of + is -; inverse of $\times$ is $\div$
- Two-step: undo + or - first, then $\times$ or $\div$
- With brackets: expand first, or divide both sides by the number outside. Answers can be negative or fractions.

Worked example 1

Solve $3x + 7 = 22$

Subtract 7 from both sides: $3x = 15$

Divide both sides by 3: $x = 5$ (check: $3 \times 5 + 7 = 22$ ✓)

Worked example 2

Solve $4(y - 2) = 18$

Expand: $4y - 8 = 18$

Add 8: $4y = 26$

Divide by 4: $y = 13/2$

Common mistakes

- Doing different things to each side.
- Undoing in the wrong order: in $2x + 3 = 17$, subtract 3 before dividing by 2.
- Forgetting to multiply every term when expanding brackets.

Exam tip: Substitute your answer back into the original equation to check it.

Solve each equation. Show your working.

1 Solve $x + 8 = 15$

2 Solve $y - 4 = -1$

3 Solve $5a = 40$

4 Solve $m/3 = 7$

5 Solve $2x + 3 = 17$

6 Solve $4p - 5 = 19$

7 Solve $3n + 10 = 1$

8 Solve $6 - x = 2$

9 Solve $10 = 2k - 4$

10 Solve $x/4 + 3 = 8$

11 Solve $5y - 7 = 18$

12 Solve $3(x + 2) = 21$

13 Solve $2(a - 5) = 6$

14 Solve $4(2b + 1) = 36$

15 Solve $7c + 4 = 25$

16 Solve $2x + 5 = 6$

17 Solve $(x - 1)/3 = 5$

18 Solve $9 - 2y = 1$

19 Solve $8x = 2$

20 Solve $12 = 3(m - 1)$

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

Show your working. Do not use a calculator.

- 1 I think of a number, n . I multiply it by 4 and then subtract 7. The answer is 33.

(a) Write an equation in n .

[1]

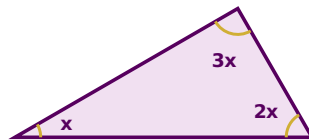
Answer

(b) Solve your equation to find my number.

[2]

Answer $n =$

- 2 The angles of a triangle are x , $2x$ and $3x$.



Not to scale

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

[3]

Answer $x =$ °

(b) Write down the size of the largest angle.

[1]

Answer°

- 3 A rectangle has length $(x + 5)$ cm and width x cm. Its perimeter is 38 cm.

(a) Find the value of x .

[3]

Answer $x =$

(b) Find the area of the rectangle.

[1]

Answer cm^2

4 Ben solves the equation $3x - 4 = 11$. His working is: $3x = 7$, so $x = 7/3$

(a) Explain Ben's mistake.

[1]

(b) Solve the equation correctly.

[1]

Answer $x = \dots\dots$

5 Ali is x years old. His sister is 3 years older than Ali. His mother is 4 times as old as Ali. Their ages add up to 63.

(a) Write an equation and solve it to find Ali's age.

[3]

Answer years

(b) How old is his mother?

[1]

Answer years

6 (a) Is $x = -2$ a solution of the equation $5x + 12 = 2$? Explain how you know.

[2]

(b) Write a different equation, with a bracket in it, that has the solution $x = -2$.

[1]

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

Sequences

I can... continue sequences, use term-to-term rules and find and use the n th term of a linear sequence.

Curriculum ref: 7As.01, 7As.02, NC Algebra

A **sequence** is a list of numbers that follows a rule. The **term-to-term rule** tells you how to get from one term to the next, e.g. 'add 3'.

The **n th term** (position-to-term rule) lets you find any term directly from its position n . In a linear sequence the difference is constant: the difference tells you the number in front of n .

Key words

sequence

term

term-to-term rule

n th term

difference

Key points

- Difference 3 $\rightarrow$ n th term starts $3n$
- Then adjust: first term – difference = the number to add
- Square numbers: n^2 ; triangular numbers: 1, 3, 6, 10, ...
- To test if a number is a term, set the n th term equal to it and solve

Worked example 1

Find the n th term of 5, 8, 11, 14, ...

Difference = 3, so start with $3n$: 3, 6, 9, 12

Each term is 2 more, so the n th term is $3n + 2$

Worked example 2

Is 70 a term of $3n + 2$?

$3n + 2 = 70$, so $3n = 68$

$n = 22 \frac{2}{3}$ is not a whole number, so no

Common mistakes

- Writing $n + 3$ instead of $3n + 2$ for 5, 8, 11, ...
- Forgetting to check the n th term with the first term.
- Saying a decreasing sequence has n th term $3n - \dots$ when the difference is -3 .

Exam tip: Check your n th term by substituting $n = 1$ and $n = 2$.

Write each answer in the box.

1

Next two terms: 4, 9, 14, 19, ,

2

Next two terms: 50, 44, 38, 32,
,

3

Next two terms: -7, -4, -1, 2,
,

4

Next two terms: 3, 6, 12, 24, ,

5

Next two terms: 1, 4, 9, 16, ,

6

Next two terms: 1, 3, 6, 10, ,

7

Next two terms: 1, 1, 2, 3, 5, ,

8

Write the term-to-term rule for 7,
11, 15, 19, ...

9

First term 2. Rule: multiply by 3,
then subtract 1. Write the first four
terms.

10

Write the first three terms of the
sequence with n th term $2n + 5$

11

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

12

Find the 4th term of $n^2 + 1$

13

Find the n th term of 6, 10, 14, 18, ...

14

Find the n th term of 2, 9, 16, 23, ...

15

Find the n th term of 20, 17, 14, 11, ...

16

Find the n th term of 1.5, 2, 2.5, 3, ...

17

Find the 50th term of $4n - 1$

18

Which term of $4n + 1$ is equal to 85?

19

Is 100 a term of $3n + 1$? Give a
reason.

20

Find the missing term: 8, , 20,
26Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Show your working. Do not use a calculator.

- 1 These patterns are made from matchsticks.



Pattern 1



Pattern 2



Pattern 3

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

Answer

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

Answer

- (c) Can a pattern use exactly 50 matchsticks? Explain how you know. [2]

- 2 Here are the first four terms of a sequence. **7, 12, 17, 22, ...**

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

Answer

- (b) Explain why every term in the sequence ends in 2 or 7. [1]

- (c) Find the first term in the sequence that is greater than 200. [2]

Answer

- 3 Sequence P has n th term $3n + 4$. Sequence Q has n th term $54 - 2n$.

For one value of n , the two sequences have the same term. Find this value of n and the term. [3]

Answer $n = \dots\dots$ term =

4

(a) Write down the n th term of the square numbers 1, 4, 9, 16, ...

[1]

Answer

(b) Write down the n th term of 2, 5, 10, 17, ...

[1]

Answer

(c) Find the 20th term of the sequence in part (b).

[1]

Answer

5

A sequence starts with 3. The term-to-term rule is 'multiply by 2, then add 1'.

(a) Write down the next three terms.

[1]

Answer

(b) Kai says, "Every term in this sequence is odd." Explain why Kai is correct.

[1]

6

The n th term of a sequence is $40 - 3n$. Find the first term in the sequence that is negative.

[2]

Answer

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

Coordinates and straight-line graphs

I can... use coordinates in four quadrants, find midpoints and draw straight-line graphs.

Curriculum ref: NC Algebra, NC Geometry

Coordinates (x, y) give a position: go **across** first (x), then **up or down** (y). The axes split the grid into four quadrants, so coordinates can be negative.

Every point on the line $x = 3$ has x -coordinate 3 (a vertical line). Every point on $y = 4$ has y -coordinate 4 (a horizontal line). For a line such as $y = 2x - 1$, make a table of values, plot the points and join them with a ruler.

Key words

coordinates

quadrant

axis

midpoint

equation of a line

Key points

- Midpoint = (average of the x 's, average of the y 's)
- $x = a$ is vertical; $y = b$ is horizontal
- $y = x$ goes through $(0, 0)$, $(1, 1)$, $(2, 2)$, ...
- A point is on a line if its coordinates make the equation true

Worked example 1

Find the midpoint of $(-4, 1)$ and $(2, -5)$.

$$x: (-4 + 2) \div 2 = -1$$

$$y: (1 + (-5)) \div 2 = -2$$

$$\text{Midpoint } (-1, -2)$$

Worked example 2

Complete a table for $y = 2x - 1$, for $x = -1$ to 2 .

$y = -3, -1, 1, 3$. Plot the points and join them with a straight line.

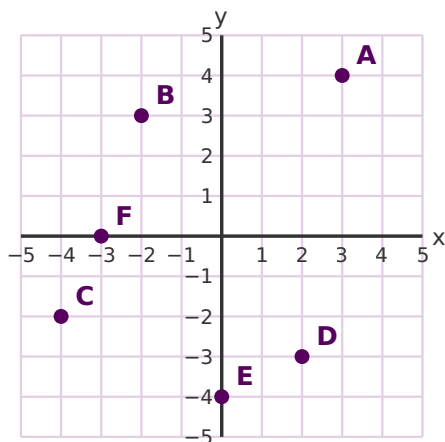
Common mistakes

- Reading y before x : $(3, 4)$ means 3 across, 4 up.
- Thinking $x = 3$ is a horizontal line.

Exam tip: If one plotted point is not in line with the others, recheck that value in the table.

Use the grid for question 1. Write each answer in the box.

- 1 Write down the coordinates of points A, B, C and D.



Answer A (.....) B (.....)
C (.....) D (.....)

- 2 Which point on the grid lies on the x-axis?
- 3 Which point on the grid lies on the y-axis?
- 4 Write down the coordinates of E and F.
- 5 Find the midpoint of (2, 3) and (8, 7)
- 6 Find the midpoint of (-4, 1) and (2, -5)
- 7 Find the midpoint of (1, 6) and (4, 2)
- 8 (1, 1), (4, 1) and (4, 4) are three corners of a square. Find the fourth corner.
- 9 Write the equation of the line through (3, -2) and (3, 5)
- 10 Write the equation of the line through (-1, 4) and (6, 4)
- 11 Does the point (2, 5) lie on the line $y = 2x + 1$?

12 For $y = 3x - 2$, find y when $x = 0$

13 For $y = 3x - 2$, find y when $x = 2$

14 For $y = 3x - 2$, find y when $x = -1$

15 Which line is horizontal: $y = 4$ or $x = 4$?

16 Where do the lines $y = x$ and $x = -3$ cross?

17 On the line $y = x + 7$, find y when $x = 5$

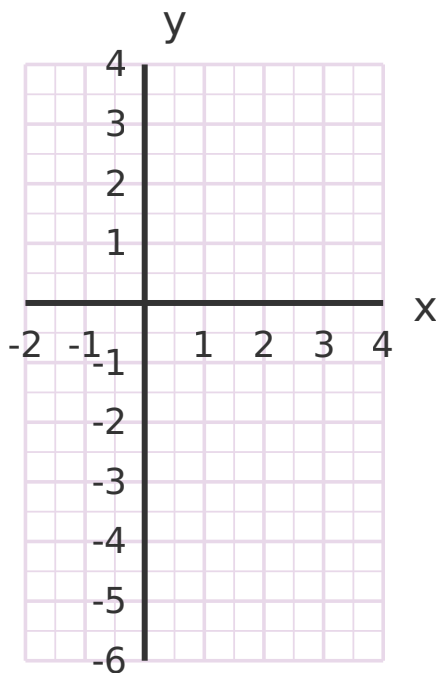
18 On the line $y = 2x$, find x when $y = 10$

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

Show your working. Do not use a calculator.

- 1** This question is about the line $y = 2x - 3$.

x	-1	0	1	2	3
y		-3			3



- (a)** Complete the table of values. [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 $x = \dots\dots$

2 A is the point $(-2, 1)$, B is $(4, 1)$ and C is $(4, -3)$. ABCD is a rectangle.

(a) Write down the coordinates of D.

[1]

Answer (.....,)

(b) Work out the area of the rectangle.

[2]

Answer

(c) Find the midpoint of AC.

[1]

Answer (.....,)

(d) Work out the perimeter of the rectangle.

[1]

Answer

3 The points $(1, 3)$, $(2, 5)$ and $(3, 7)$ lie on a straight line.

(a) Which of these is the equation of the line? $y = x + 2$ $y = 2x + 1$ $y = 3x$

[1]

Answer

(b) Explain how you know.

[1]

(c) Find the y-coordinate of the point on this line where $x = 10$.

[1]

Answer $y =$

4 Does the point $(5, 13)$ lie on the line $y = 3x - 2$? Explain how you know.

[2]

5 The lines $x = 2$, $y = -1$ and $y = x$ make a triangle.

(a) Write down the coordinates of the three corners of the triangle. You may sketch the lines to help you.

[3]

Answer (.....,), (.....,), (.....,)

(b) Work out the area of the triangle.

[2]

Answer

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

Ratio and proportion

I can... simplify ratios, share amounts in a ratio and solve direct proportion problems.

Curriculum ref: NC Ratio and proportion

A **ratio** compares the sizes of two or more quantities. 3 : 2 means 'for every 3 of the first there are 2 of the second'. Simplify a ratio by dividing every part by a common factor; the units must be the same first.

To **share** in a ratio: add the parts, find one part, then multiply. For **direct proportion**, find the value of one item first (the unitary method).

Key words

ratio

simplify

share

proportion

unitary method

Key points

- $12 : 18 = 2 : 3$ (divide by 6)
- Ratio $2 : 3 \rightarrow$ fractions $\frac{2}{5}$ and $\frac{3}{5}$
- Change to the same units: $40 \text{ cm} : 2 \text{ m} = 40 : 200 = 1 : 5$
- Best buy: compare the cost of one item

Worked example 1

Share £45 in the ratio 2 : 3.

$2 + 3 = 5$ parts; one part = $£45 \div 5 = £9$

£18 and £27

Worked example 2

4 pens cost £3.60. How much do 7 pens cost?

1 pen costs $£3.60 \div 4 = £0.90$

7 pens cost $7 \times £0.90 = £6.30$

Common mistakes

- Dividing by one part of the ratio instead of the total number of parts.
- Simplifying without changing to the same units.
- Writing the parts in the wrong order.

Exam tip: Check that the shares add up to the total you started with.

Write each answer in the box.

1 Simplify $6 : 9$

2 Simplify $15 : 25$

3 Simplify $12 : 18 : 24$

4 Write $40 \text{ cm} : 2 \text{ m}$ in its simplest form

5 Write $250 \text{ g} : 1 \text{ kg}$ in its simplest form

6 $3 : 5 = 12 :$

7 Share 30 in the ratio $1 : 2$

8 Share 56 in the ratio $3 : 5$

9 Share 90 in the ratio $2 : 3 : 4$

10 Boys : girls = $2 : 3$. What fraction of the group are girls?

11 Red : blue = $4 : 1$. There are 20 red beads. How many blue beads?

12 $A : B = 3 : 7$. B is 21. Find A.

13 5 apples cost £1.20. How much does 1 apple cost?

14 8 pens cost £2.00. How much do 3 pens cost?

15 A recipe for 4 people uses 200 g of flour. How much flour for 10 people?

16 £1 = 44 baht. Change £15 into baht.

17 £1 = 44 baht. Change 880 baht into pounds.

18 Write $4 : 10$ in the form $1 : n$

19 A map scale is $1 : 50,000$. What real distance does 3 cm show? Give your answer in km.

20 Write $0.5 \text{ m} : 20 \text{ cm}$ in its simplest form

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

Show your working. A calculator is not needed.

- 1 Orange squash is made by mixing concentrate and water in the ratio **1 : 6**.

(a) How much concentrate is needed to make 1.4 litres of squash? Give your answer in ml. [2]

Answer ml

(b) Amy uses 300 ml of concentrate. How much water does she need? [1]

Answer ml

- 2 Ali and Bea share £72 in the ratio 5 : 3.

(a) How much does each person get? [2]

Answer Ali £..... Bea £.....

(b) How much more does Ali get than Bea? [1]

Answer £.....

- 3 Yoghurts are sold in two pack sizes. **Pack A:** 6 yoghurts for £2.40 **Pack B:** 8 yoghurts for £3.04

Which pack is better value? Show how you decide. [3]

Answer Pack

- 4 In a club, the ratio of boys to girls is 2 : 3.

(a) Tom says, "This means $\frac{2}{3}$ of the club are boys." Explain why Tom is wrong. [1]

(b) There are 35 children in the club. How many are boys? [2]

Answer

5 Green paint is made by mixing blue paint and yellow paint in the ratio 3 : 2.

(a) How much blue paint is needed to make 12 litres of green paint?

[2]

Answer litres

(b) Leo has 6 litres of blue paint and 5 litres of yellow paint. What is the greatest amount of green paint he can make? Explain how you know.

[2]

Answer litres

6 Use proportion to answer these questions.

(a) A phone costs £240 in the UK. The same phone costs 10,620 baht in Thailand. The exchange rate is £1 = 45 baht. In which country is the phone cheaper, and by how much in pounds?

[3]

Answer by £.....

(b) A recipe uses 6 eggs to make 15 pancakes. How many eggs are needed to make 25 pancakes?

[2]

Answer eggs

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

Angles and properties of shapes

I can... use angle facts to find missing angles and describe the properties of 2D shapes.

Curriculum ref: NC Geometry and measures

Angles are measured in degrees ($^{\circ}$). Acute angles are less than 90° , obtuse angles are between 90° and 180° , and reflex angles are between 180° and 360° .

Use angle facts to find missing angles and always give a reason. Shapes are named by their properties: equal sides, parallel sides, right angles and lines of symmetry.

Key words

acute

obtuse

reflex

vertically opposite

isosceles

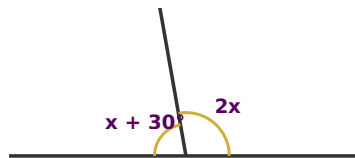
parallel

Key points

- Angles on a straight line add up to 180° ; angles around a point add up to 360°
- Vertically opposite angles are equal
- Angles in a triangle add up to 180° ; in a quadrilateral 360°
- Isosceles triangle: two equal sides and two equal angles

Worked example

Find the value of x . Give a reason.



Not to scale

$$2x + x + 30 = 180 \text{ (angles on a straight line add up to } 180^{\circ}\text{)}$$

$$3x = 150, \text{ so } x = 50^{\circ}$$

Common mistakes

- Using 360° for a triangle or 180° for a quadrilateral.
- Forgetting to give a reason.

Exam tip: Write the angle fact you used next to every step.

Diagrams are not drawn to scale. Write each answer in the box.

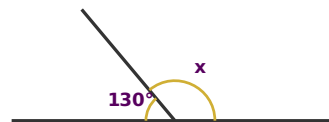
1 What type of angle is 35° ?

2 What type of angle is 120° ?

3 What type of angle is 270° ?

4 What type of angle is 90° ?

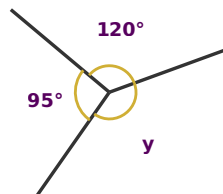
5 Find angle x .



Not to scale

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

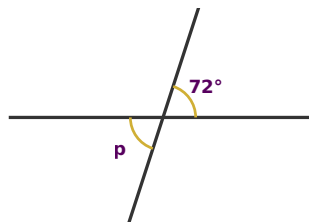
6 Find angle y .



Not to scale

Answer $y = \dots\dots^\circ$

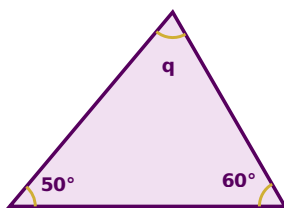
7 Find angle p .



Not to scale

Answer $p = \dots\dots^\circ$

- 8 Find angle q .



Not to scale

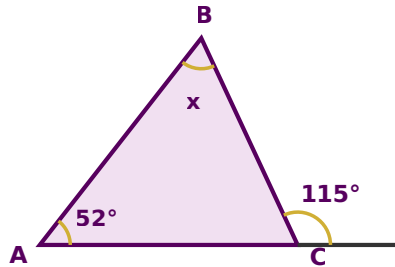
Answer $q = \dots\dots^\circ$

- 9 An isosceles triangle has one angle of 40° between its two equal sides. Find the other two angles.
- 10 A quadrilateral has angles 80° , 95° and 110° . Find the fourth angle.
- 11 A right-angled triangle has an angle of 35° . Find the third angle.
- 12 Two equal angles x and an angle of 80° lie on a straight line. Find x .
- 13 What is the size of each angle in an equilateral triangle?
- 14 How many lines of symmetry does a rectangle have?
- 15 What is the order of rotational symmetry of a square?
- 16 Name a quadrilateral with exactly one pair of parallel sides.
- 17 Name the quadrilateral with four equal sides whose angles are not right angles.
- 18 A triangle has sides 5 cm, 5 cm and 8 cm. What type of triangle is it?

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

Diagrams are not drawn to scale. Show your working and give reasons.

- 1 In triangle ABC, angle BAC = 52° . The side AC is extended. The exterior angle at C is 115° .



Not to scale

- (a) Find the size of angle ACB. Give a reason. [2]

Answer°

- (b) Find the value of x . Give a reason. [2]

Answer $x =$ °

- 2 An isosceles triangle has one angle of 40° . Mia says, "The other two angles must be 70° and 70° ." Explain why Mia might not be correct. Give the angles of a different triangle that fits. [3]

- 3 A quadrilateral has angles x , $2x$, 100° and 110° .

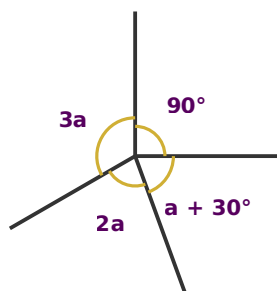
- (a) Find the value of x . [3]

Answer $x =$ °

- (b) Write down the size of the largest angle. [1]

Answer°

- 4 Four angles meet at a point.



Not to scale

- (a) Find the value of a .

[3]

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

- 5 Decide whether each statement is true or false. Explain how you know.

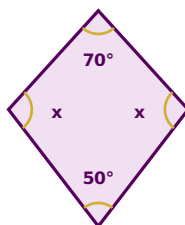
- (a) "Every square is a rhombus."

[1]

- (b) "A triangle can have two obtuse angles."

[1]

- 6 The diagram shows a kite. The kite has one pair of equal angles, marked x .



Not to scale

- (a) Find the value of x .

[3]

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

- (b) Name the quadrilateral that has two pairs of parallel sides, no right angles and sides that are not all equal.

[1]

Answer

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

Perimeter, area and 3D shapes

I can... find perimeters, areas of 2D shapes and volumes of cuboids, and describe 3D shapes.

Curriculum ref: NC Geometry and measures

Perimeter is the distance all the way round a shape (cm, m).

Area is the space inside a 2D shape (cm², m²). **Volume** is the space inside a 3D shape (cm³).

For a triangle, the height must be **perpendicular** (at 90°) to the base. Split compound shapes into rectangles and triangles. 3D shapes have faces, edges and vertices.

Key words

perimeter

area

perpendicular height

volume

face

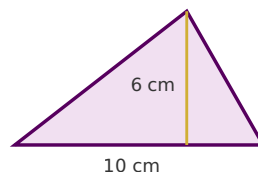
vertex

Key points

- Rectangle: $A = \text{length} \times \text{width}$; triangle: $A = \frac{1}{2} \times \text{base} \times \text{height}$
- Parallelogram: $A = \text{base} \times \text{height}$; trapezium: $A = \frac{1}{2}(a + b)h$
- Cuboid: $V = \text{length} \times \text{width} \times \text{height}$
- 1 m = 100 cm, 1 km = 1000 m

Worked example

Find the area of this triangle.



Not to scale

$$\frac{1}{2} \times 10 \times 6 = 30 \text{ cm}^2$$

Common mistakes

- Using the sloping side instead of the perpendicular height.
- Forgetting $\frac{1}{2}$ in the triangle formula.

Exam tip: Write the formula first, then substitute the numbers.

Write each answer in the box. Include units.

1 Find the perimeter of a rectangle 8 cm by 5 cm

2 Find the area of a rectangle 8 cm by 5 cm

3 Find the area of a square with sides of 7 cm

4 Find the area of a triangle with base 10 cm and height 6 cm

5 Find the area of a triangle with base 7 cm and height 5 cm

6 Find the area of a parallelogram with base 9 cm and height 4 cm

7 A rectangle has area 48 cm^2 and width 6 cm. Find its length.

8 A square has perimeter 36 cm. Find its area.

9 Find the area of a trapezium with parallel sides 6 cm and 10 cm, and height 4 cm

10 $3 \text{ m} = \text{ } \text{cm}$

11 $2.5 \text{ km} = \text{ } \text{m}$

12 $450 \text{ cm} = \text{ } \text{m}$

13 Find the volume of a cuboid 5 cm by 3 cm by 2 cm

14 Find the volume of a cube with edges of 4 cm

15 How many faces does a cube have?

16 How many edges does a cube have?

17 How many vertices does a triangular prism have?

18 How many edges does a triangular prism have?

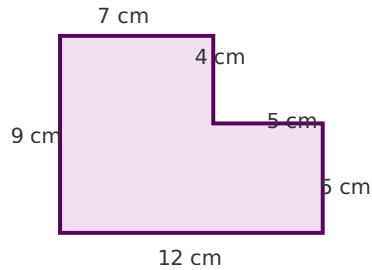
19 How many faces does a square-based pyramid have?

20 Name the 3D shape with one curved face and two flat circular faces.

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

Diagrams are not drawn to scale. Show your working. You may use a calculator.

- 1 The diagram shows a shape made from a rectangle with a corner removed.



Not to scale

- (a) Work out the perimeter of the shape. [2]

Answer cm

- (b) Work out the area of the shape. [3]

Answer cm²

- 2 A rectangular garden is 15 m long and 8 m wide.

- (a) Turf costs £6.50 per square metre. Work out the cost of covering the whole garden with turf. [3]

Answer £.....

- (b) Fence panels are 2 m wide. How many panels are needed to go all the way round the garden? [2]

Answer

3 A rectangle measures 12 cm by 3 cm. A square has the same area as the rectangle.

(a) Find the length of a side of the square.

[2]

Answer cm

(b) Do the two shapes have the same perimeter? Explain how you know.

[2]

4 A box is a cuboid 20 cm long, 10 cm wide and 6 cm high.

(a) Work out the volume of the box.

[2]

Answer cm³

(b) How many cubes with edges of 2 cm will fit exactly inside the box?

[2]

Answer

5 This question is about a pentagonal prism.

(a) Write down the number of faces, vertices and edges.

[2]

Answer F V E

(b) Show that faces + vertices – edges = 2 for this prism.

[1]

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

Collecting data and averages

I can... collect and represent data, and calculate and compare the mean, median, mode and range.

Curriculum ref: NC Statistics, 7Ss.01

Data can be **qualitative** (words, e.g. colours) or **quantitative** (numbers). Quantitative data is **discrete** if it is counted and **continuous** if it is measured. We record data in tally charts and frequency tables, and show it in bar charts, pictograms and pie charts.

An **average** is a typical value. The **range** measures how spread out the data is: a smaller range means more consistent data.

Key words

discrete

continuous

frequency

mean

median

range

Key points

- Mean = total ÷ number of values
- Median = middle value when the data is in order
- Mode = most common value
- Range = largest – smallest
- Pie chart angle = frequency ÷ total × 360°

Worked example

Find the mean, median, mode and range of 4, 7, 2, 7, 10.

Mean = $30 \div 5 = 6$

In order: 2, 4, 7, 7, 10, so median = 7

Mode = 7

Range = $10 - 2 = 8$

Common mistakes

- Finding the median without putting the data in order first.
- Giving the frequency instead of the value for the mode.
- Dividing by the wrong number when finding the mean from a table.

Exam tip: When comparing two sets of data, compare an average AND the range.

Write each answer in the box.

1 Find the mean of 5, 8, 3, 8, 6

2 Find the median of 5, 8, 3, 8, 6

3 Find the mode of 5, 8, 3, 8, 6

4 Find the range of 5, 8, 3, 8, 6

5 Find the mean of 12, 15, 11, 18, 14, 20

6 Find the median of 12, 15, 11, 18, 14, 20

7 Find the range of 12, 15, 11, 18, 14, 20

8 Find the range of these temperatures ($^{\circ}\text{C}$): -4, 2, -1, 3, 0

9 The mean of four numbers is 9. Three of them are 7, 8 and 12. Find the fourth.

10 Five numbers have a mean of 10. What is their total?

11 Is 'number of brothers and sisters' discrete or continuous data?

12 Is 'height of a student' discrete or continuous data?

13 Is 'favourite colour' qualitative or quantitative data?

Use the table to find the number of students and the modal shoe size.

Shoe size	3	4	5	6
Frequency	4	9	6	1

Answer students, mode

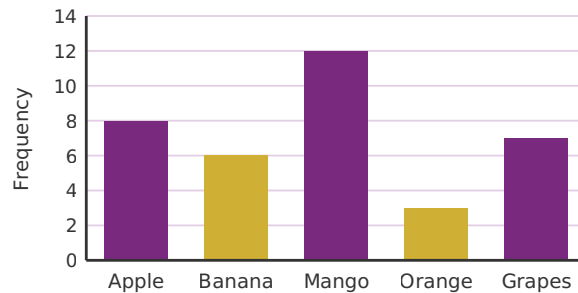
15 Using the shoe size table, find the total of all the shoe sizes.

16 Using the shoe size table, find the mean shoe size.

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

Show your working. You may use a calculator.

- 1 The bar chart shows the favourite fruit of some students.



- (a) How many students are there altogether? [1]

Answer

- (b) What is the mode? [1]

Answer

- (c) What fraction of the students chose mango? Simplify your answer. [1]

Answer

- (d) The results are shown in a pie chart. Work out the angle for mango. [2]

Answer°

- 2 Two basketball teams played five matches. The table shows the points scored by one player from each team.

Team A	12	15	9	18	16
Team B	14	13	15	14	14

- (a) Work out the mean for each player. [2]

Answer A B

- (b) Work out the range for each player. [2]

Answer A B

- (c) Which player is more consistent? Explain how you know. [1]

3 The mean of five numbers is 8. Four of the numbers are 6, 9, 10 and 5.

(a) Find the fifth number.

[2]

Answer

(b) A sixth number is added. The mean of all six numbers is 9. Find the sixth number.

[2]

Answer

4 The table shows the number of goals scored by a football team in each match of a season.

Goals	0	1	2	3	4
Number of matches	4	7	5	3	1

(a) Write down the mode.

[1]

Answer

(b) Find the median.

[1]

Answer

(c) Work out the mean number of goals per match.

[3]

Answer

(d) The team wanted to score a mean of at least 2 goals per match. Did they meet this target? Give a reason.

[1]

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

Probability

I can... use the probability scale, find probabilities of equally likely outcomes and calculate expected frequencies.

Curriculum ref: NC Probability, 7Sp.01

Probability measures how likely something is to happen, on a scale from 0 (impossible) to 1 (certain). We write probabilities as fractions, decimals or percentages.

When all outcomes are **equally likely**, $P(\text{event}) = \text{number of ways it can happen} \div \text{total number of outcomes}$. Use a list or a table (sample space) to find all the outcomes of two events.

Key words

probability

outcome

equally likely

sample space

relative frequency

Key points

- 0 = impossible, $1/2$ = even chance, 1 = certain
- $P(\text{not } A) = 1 - P(A)$
- The probabilities of all the outcomes add up to 1
- Expected number = probability $\times$ number of trials
- Relative frequency = number of successes $\div$ number of trials

Worked example 1

A bag has 3 red, 5 blue and 2 green beads. Find $P(\text{blue})$ and $P(\text{not red})$.

Total = 10, so $P(\text{blue}) = 5/10 = 1/2$

$P(\text{not red}) = 1 - 3/10 = 7/10$

Worked example 2

$P(\text{late}) = 0.1$. How many late days would you expect in 40 days?

$0.1 \times 40 = 4$ days

Common mistakes

- Giving a probability greater than 1.
- Writing probabilities as '1 in 4' or '1 : 4' instead of $1/4$.
- Forgetting outcomes such as (H, T) and (T, H) are different.

Exam tip: Check that the probabilities of all the outcomes add up to 1.

Give probabilities as fractions in their simplest form or as decimals.

1 Describe the probability in words:

The sun will rise tomorrow.

2 Describe the probability in words:

You roll a 7 on a normal six-sided dice.

3 Describe the probability in words: A fair coin lands on heads.

4 A fair dice is rolled. Find $P(\text{a } 4)$

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

6 A fair dice is rolled. Find $P(\text{a number less than } 3)$

7 A fair dice is rolled. Find $P(\text{not a } 6)$

8 A bag has 4 red and 6 yellow counters. Find $P(\text{red})$

9 A bag has 4 red and 6 yellow counters. Find $P(\text{yellow})$

10 A bag has 4 red and 6 yellow counters. Find $P(\text{green})$

11 $P(\text{rain}) = 0.3$. Find $P(\text{not rain})$

12 A letter is chosen at random from MATHEMATICS. Find $P(\text{M})$

13 A letter is chosen at random from MATHEMATICS. Find $P(\text{vowel})$

14 A spinner has 8 equal sections numbered 1 to 8. Find $P(\text{prime number})$

15 A spinner has 8 equal sections numbered 1 to 8. Find $P(\text{multiple of } 3)$

16 Two coins are thrown. How many possible outcomes are there?

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

18 A fair dice is rolled 60 times. How many 3s would you expect?

19 $P(\text{win}) = 0.15$. How many wins would you expect in 200 games?

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

Show your working.

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

Colour	Red	Blue	Green	Yellow
Probability	0.2	0.35		0.15

- (a) Find the probability that the spinner lands on green. [2]

Answer

- (b) Find the probability that the spinner does **not** land on blue. [1]

Answer

- (c) The spinner is spun 80 times. How many times would you expect it to land on red? [2]

Answer

- 2 Spinner A is numbered 1, 2, 3. Spinner B is numbered 1, 2, 3, 4. Both spinners are fair. They are spun and the two numbers are **added**.

A \ B	1	2	3	4
1	2			
2			5	
3				7

- (a) Complete the table of totals. [2]

- (b) Find the probability that the total is 5. [2]

Answer

- (c) Find the probability that the total is greater than 5. [1]

Answer

- 3 A bag contains 5 red counters and some blue counters. A counter is taken at random. The probability it is red is $\frac{1}{3}$. How many blue counters are in the bag? [2]

Answer

4 Kim throws a coin 50 times. It lands on heads 32 times.

(a) Write down the relative frequency of heads as a decimal.

[1]

Answer

(b) Kim says, "The coin must be biased." Is she right? Explain your answer.

[2]

5 A fair coin is thrown and a fair six-sided dice is rolled.

(a) List all the possible outcomes.

[2]

(b) Find the probability of getting a head and an even number.

[1]

Answer

(c) Ravi says, " $P(\text{head and a 6}) = 1/2 + 1/6 = 2/3$." Explain why Ravi is wrong.

[1]

6 Explain why the probability of an event cannot be 1.2.

[1]

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



CHECK

End-of-book check

End-of-book check

Name _____ Date _____ Score _____ / 12

Do not use a calculator. Compare your score with your starting point check.

1 $0.56 \div 10 =$

2 Round 0.04718 to 1 significant figure

3 $-4 \times (-7) =$

4 $(10 - 4) \times 3 + 2^2 =$

5 Find the LCM of 6 and 8

6 $2/3 \times 9/10 =$

7 Write 0.45 as a fraction in its simplest form

8 Expand $3(2x - 4)$

9 Solve $4x - 3 = 21$

10 Find the nth term of 5, 9, 13, 17, ...

11 Share £40 in the ratio 3 : 5

12 Find the area of a triangle with base 8 cm and height 5 cm



End-of-year practice test

Name _____ Date _____ Marks _____ / 50

Time: 60 minutes

Section A (questions 1–6): non-calculator — 23 marks

Section B (questions 7–12): calculator allowed — 27 marks

Total: 50 marks

Answer all questions. Show your working. Diagrams are not drawn to scale.**1 Section A — Non-calculator****(a)** Work out 3.7×100 [1]

Answer

(b) Round 6.0482 to 2 decimal places. [1]

Answer

(c) Work out $-6 - (-9)$ [1]

Answer

2 (a) Work out $7 + 3 \times (8 - 2)^2 \div 4$ [2]

Answer

(b) Work out $2/3 + 1/4$ [2]

Answer

3 (a) Write 18 and 30 as products of prime factors. [2]

Answer 18 = 30 =

(b) Find the highest common factor (HCF) of 18 and 30. [1]

Answer

(c) Find the lowest common multiple (LCM) of 18 and 30. [1]

Answer

4 Solve these equations.

(a) $5x - 8 = 27$

[2]

Answer $x = \dots\dots\dots$

(b) $3(y + 4) = 6$

[2]

Answer $y = \dots\dots\dots$

5 Here are the first four terms of a sequence. 9, 13, 17, 21, ...

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

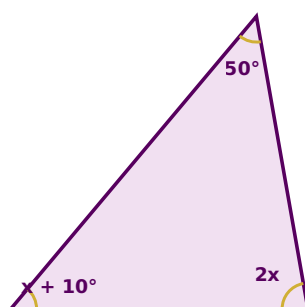
[2]

Answer $\dots\dots\dots$

(b) Is 101 a term in this sequence? Explain how you know.

[2]

6 The diagram shows a triangle.



Not to scale

(a) Find the value of x .

[3]

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

(b) What type of triangle is it? Explain how you know.

[1]

7 Section B — Calculator allowed

(a) A jacket costs £64. In a sale the price is reduced by 15%. Work out the sale price. **[2]**

Answer £.....

(b) Write 18 as a percentage of 75. **[2]**

Answer %

(c) Write $\frac{3}{8}$ as a percentage. **[1]**

Answer %

8 (a) Share £385 in the ratio 3 : 4. **[2]**

Answer £..... and £.....

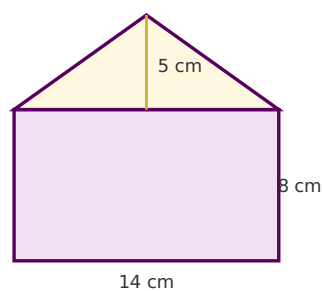
(b) 1.5 kg of cheese costs £6.90. Work out the cost of 4 kg. **[2]**

Answer £.....

(c) The exchange rate is £1 = 44.6 baht. Change £20 into baht. **[1]**

Answer baht

9 The shape is made from a rectangle and a triangle. **[3]**



Not to scale

Answer cm²

10 The masses, in kg, of six parcels are: **2.4 3.1 2.8 3.1 2.6 3.0**

(a) Work out the mean mass. Give your answer to 2 decimal places.

[2]

Answer kg

(b) Find the median mass.

[1]

Answer kg

(c) Find the range.

[1]

Answer kg

11 A bag contains 20 counters. Each counter is red, blue or green. $P(\text{red}) = 0.35$ and $P(\text{blue}) = 0.25$.

(a) Find $P(\text{green})$.

[2]

Answer

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

[1]

Answer

(c) Sam says the probability of blue could be 0.27. Explain why this is not possible for this bag.

[2]

12 This question is about the line **$y = 3x - 4$** .

(a) Find the values of y when $x = 0, 1, 2$ and 3 .

[2]

Answer

(b) Does the point (10, 26) lie on the line? Show how you decide.

[1]

(c) Find the value of x when $y = 11$.

[2]

Answer $x =$



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

- 1 407
- 2 3.8
- 3 3
- 4 16
- 5 1, 2, 4, 5, 10, 20
- 6 $\frac{3}{4}$
- 7 20
- 8 6a
- 9 $x = 6$
- 10 19
- 11 65°
- 12 6

Unit 1 · Sheet A — Place value, ordering and rounding

- 1 7 hundredths (0.07)
- 2 50,000 (5 ten-thousands)
- 3 460
- 4 380
- 5 0.72
- 6 0.0054
- 7 3.65
- 8 0.06, 0.6, 0.606, 0.66
- 9 3.1
- 10 >
- 11 3800
- 12 65,000
- 13 7.5
- 14 12.30
- 15 0.07
- 16 50,000
- 17 0.004
- 18 $40 \times 20 = 800$
- 19 $7 \times 9 = 63$ (accept 70)
- 20 $400 \div 8 = 50$

Unit 1 · Sheet B — Place value, ordering and rounding

- 1 (a) 12.08, 12.088, 12.18, 12.8, 12.81 B2 (B1 for one pair out of order) [2] (b) 12.1 B1 [1] (c) $12.81 - 12.08$ M1; 0.73 s A1 [2]
- 2 (a) Adding zeros after the decimal point does not change the value ($3.4500 = 3.45$); the digits should move two places to the left. B1 [1] (b) 345 B1 [1] (c) 0.0345 B1 [1]
- 3 (a) 155,820 B1 [1] (b) 155.82 B1 [1] (c) 3180 B1 [1] (d) 0.318 is less than 1, so multiplying 49 by it gives less than 49. B1 [1]
- 4 (a) 50×20 M1; £1000 A1 [2] (b) Bigger (overestimate): both numbers were rounded up. B1 (exact cost £948.00) [1]
- 5 (a) 6.35 B1 [1] (b) Any number from 6.401 to 6.449, e.g. 6.42 B1 [1]
- 6 (a) 80,000 B1 [1] (b) 1,285,000 B1 [1] (c) 1,000,000 B1 [1]

Unit 2 · Sheet A — Integers and the order of operations

- 1 5
- 2 -9
- 3 -7
- 4 3
- 5 -7
- 6 -24
- 7 24
- 8 -4
- 9 9
- 10 -30
- 11 7°C
- 12 -8, -3, -1, 0, 2
- 13 23
- 14 35
- 15 17
- 16 9
- 17 50
- 18 2
- 19 $(6 + 4) \times 2 - 1$
- 20 4

Unit 2 · Sheet B — Integers and the order of operations

- 1** (a) Moscow B1 [1] (b) 43 °C B1 [1] (c) -13 °C B1 [1] (d) Moscow and Toronto B1 [1]
2 (a) He subtracted before multiplying; multiplication must be done first. B1 [1] (b) 4 B1 [1] (c) $(12 - 4) \times (2 + 1)$ B1 [1]
3 $-35 + 60 = 25$ M1; $25 - 42 = -17$ A1 [2]
4 (a) Middle row -2, 1 B1; top -1 B1ft [2] (b) Middle row $4 + x$ and $x - 6$, so top = $2x - 2$ M1; $x = 1$ A1 [2]
5 (a) 8 and -3 B2 (B1 for a pair with product -24) [2] (b) The first two negatives multiply to give a positive (B1); positive $\times$ negative = negative (B1). [2]
6 (a) 6 B1 [1] (b) $6 - 11 = -5$ M1; No, because -5 is below the lowest floor (-3) A1 [2]

Unit 3 · Sheet A — Factors, primes, powers and roots

- 1** 1, 2, 3, 6, 9, 18
2 7, 14, 21, 28, 35
3 23, 29, 31, 37
4 No, $51 = 3 \times 17$
5 49
6 125
7 9
8 4
9 32
10 10,000
11 20
12 72
13 $2^2 \times 3^2$
14 $2^2 \times 3 \times 7$
15 $2 \times 3 \times 5^2$
16 6
17 14
18 15
19 12
20 24
21 45
22 7 and 8

Unit 3 · Sheet B — Factors, primes, powers and roots

- 1** (a) Lists multiples of 12 and 18, or uses prime factors M1; LCM = 36 A1; 8:36 am B1ft [3] (b) LCM of 12, 18 and 15 = 180 M1; 11:00 am A1 [2]
2 (a) Correct factor tree or division M1; $2^3 \times 3 \times 5$ A1 [2] (b) Common factors $2^2 \times 3$ M1; 12 A1 [2]
3 (a) Finds HCF of 48 and 60 M1; 12 A1 [2] (b) 4 sweets and 5 stickers B1ft [1]
4 (a) False: 2 is prime and even. B1 [1] (b) False: e.g. $1^2 = 1$ or $0.5^2 = 0.25$ B1 [1]
5 (a) 64 B1 [1] (b) $9 + 16 = 25$ M1; 5 A1 [2] (c) $2^6 = 64$ and $8^2 = 64$ B1 [1]
6 (a) $\sqrt{196} = 14$ cm B1 [1] (b) 56 cm B1ft [1] (c) $2^2 \times 7^2$ B1 [1]

Unit 4 · Sheet A — Fractions, decimals and percentages

- 1** $\frac{3}{4}$
2 12
3 $1\frac{3}{4}$
4 $\frac{8}{3}$
5 $\frac{7}{10}$
6 $\frac{7}{20}$
7 $\frac{1}{8}$
8 0.75
9 0.125
10 40%
11 8%
12 0.65
13 $\frac{9}{20}$
14 $\frac{1}{4}$, 28%, 0.3
15 $\frac{2}{3}$
16 34
17 21
18 9
19 24
20 27
21 30%
22 28%

Unit 4 · Sheet B — Fractions, decimals and percentages

- 1** (a) Ana 85% B1; Cal 84% B1 [2] (b) Ana, because 85% is greater than 84% and 82% B1ft [1]
2 (a) $10\% = 8$ and $5\% = 4$, or 0.35×80 M1; £28 A1 [2] (b) £52 B1ft [1]
3 (a) walk = 12 M1; bus = 9 M1; car = 9 A1 [3] (b) $\frac{3}{10}$ B1ft [1]
4 (a) 35% B1 [1] (b) 5 B1 [1]
5 (a) No: $\frac{1}{3} = 0.333...$ (recurring), which is bigger than 0.3 B1 [1] (b) 0.3, 32%, $\frac{1}{3}$, 0.34 B2 (B1 for converting to a common form) [2]
6 (a) book £9 M1; 40% of £27 = £10.8 M1; £16.2 A1 [3] (b) 20% of 250 = 50 M1; 300 g A1 [2]

Unit 5 · Sheet A — Calculating with fractions

- 1 $\frac{3}{5}$
- 2 $\frac{5}{6}$
- 3 $\frac{7}{12}$
- 4 $\frac{7}{12}$
- 5 $10/9 = 1\frac{1}{9}$
- 6 $15/4 = 3\frac{3}{4}$
- 7 $11/6 = 1\frac{5}{6}$
- 8 $8/7 = 1\frac{1}{7}$
- 9 6
- 10 $\frac{1}{2}$
- 11 $\frac{1}{6}$
- 12 $\frac{1}{2}$
- 13 $\frac{1}{5}$
- 14 $\frac{1}{4}$
- 15 18
- 16 6
- 17 $5/4 = 1\frac{1}{4}$
- 18 10
- 19 $\frac{5}{8}$
- 20 $\frac{2}{5}$

Unit 5 · Sheet B — Calculating with fractions

- 1 $9/4 \times 3/2$ M1; $27/8 = 3\frac{3}{8}$ cups A1 [2]
- 2 (a) $5 \div 3/4 = 20/3 = 6\frac{2}{3}$ M1; 6 pieces A1 [2] (b) $1/2$ m B1ft [1]
- 3 (a) $2/5 + 1/3 = 11/15$ M1; $4/15$ A1 [2] (b) $4/15 \times 30$ M1; 8 km A1ft [2]
- 4 (a) He added the numerators and added the denominators; he needs a common denominator first. B1 [1] (b) $5/15 + 6/15$ M1; $11/15$ A1 [2]
- 5 (a) $5/3 \times 9/5$ M1; $= 45/15 = 3$ A1 (with working shown) [2] (b) $2/3 \div 1/2$, because dividing by $1/2$ doubles the number, but multiplying by $1/2$ halves it. B1 [1] (c) $3/4 - 1/6 = 9/12 - 2/12$ M1; $7/12$ A1 [2]
- 6 $5/8 \times 12 = 15/2$ litres M1; $+ 1\frac{1}{2} = 9$ litres M1; $3/4$ A1 [3]

Unit 6 · Sheet A — Algebraic expressions and substitution

- 1 $n + 5$
- 2 $4n$
- 3 $x/3$
- 4 $y^2 - 2$
- 5 $3a$
- 6 $11x$
- 7 $7y$
- 8 $8a + b$
- 9 $2p + 3q$
- 10 $12m$
- 11 $10ab$
- 12 c^2
- 13 $3x$
- 14 $4x + 12$
- 15 $10y - 5$
- 16 $-2a - 12$
- 17 $7x + 6$
- 18 $9n - 10$
- 19 2
- 20 23
- 21 -15
- 22 9
- 23 50
- 24 1

Unit 6 · Sheet B — Algebraic expressions and substitution

- 1 (a) $2(2x + 3) + 2x$ or $2x + 3 + x + 2x + 3 + x$ M1; $6x + 6$ A1 [2] (b) 30 cm B1ft [1] (c) $x(2x + 3)$ M1; $2x^2 + 3x$ A1 [2]
- 2 (a) $8 + 3 \times 5$ M1; £23 A1 [2] (b) A fixed charge of £8 paid however long you hire the bike. B1 [1] (c) $8 + 3h = 35$ or $(35 - 8) \div 3$ M1; 9 hours A1 [2]
- 3 (a) $3a$ and $2b$ are not like terms, so they cannot be collected. B1 [1] (b) $8x - 4$ M1; $-3x + 6$ M1; $5x + 2$ A1 [3]
- 4 $3a - 2b$ B1; $5a - 3b$ B1; $8a - 5b$ B1ft [3]
- 5 (a) 23 B1 [1] (b) 23 B1 [1] (c) $(-3)^2 = 9 = 3^2$; squaring a negative number gives a positive answer. B1 [1]

Unit 7 · Sheet A — Solving simple equations

- 1 $x = 7$
- 2 $y = 3$
- 3 $a = 8$
- 4 $m = 21$
- 5 $x = 7$
- 6 $p = 6$
- 7 $n = -3$
- 8 $x = 4$
- 9 $k = 7$
- 10 $x = 20$
- 11 $y = 5$
- 12 $x = 5$
- 13 $a = 8$
- 14 $b = 4$
- 15 $c = 3$
- 16 $x = 1/2$
- 17 $x = 16$
- 18 $y = 4$
- 19 $x = 1/4$
- 20 $m = 5$

Unit 7 · Sheet B — Solving simple equations

- 1 (a) $4n - 7 = 33$ B1 [1] (b) $4n = 40$ M1; $n = 10$ A1 [2]
- 2 (a) $x + 2x + 3x = 180$ M1; $6x = 180$ M1; $x = 30^\circ$ A1 [3] (b) 90° B1ft [1]
- 3 (a) $2(x + 5) + 2x = 38$ M1; $4x + 10 = 38$ M1; $x = 7$ A1 [3] (b) $12 \times 7 = 84 \text{ cm}^2$ B1ft [1]
- 4 (a) He subtracted 4 from 11 instead of adding 4 to both sides. B1 [1] (b) $x = 5$ B1 [1]
- 5 (a) $x + x + 3 + 4x = 63$ M1; $6x = 60$ M1; $x = 10$ A1 [3] (b) 40 years B1ft [1]
- 6 (a) $5 \times (-2) + 12$ M1; $= 2$, so yes A1 [2] (b) Any correct equation, e.g. $3(x + 4) = 6$ B1 [1]

Unit 8 · Sheet A — Sequences

- 1 24, 29
- 2 26, 20
- 3 5, 8
- 4 48, 96
- 5 25, 36
- 6 15, 21
- 7 8, 13
- 8 add 4
- 9 2, 5, 14, 41
- 10 7, 9, 11
- 11 47
- 12 17
- 13 $4n + 2$
- 14 $7n - 5$
- 15 $23 - 3n$
- 16 $1/2n + 1$
- 17 199
- 18 the 21st term
- 19 Yes, it is the 33rd term ($3 \times 33 + 1 = 100$)
- 20 14

Unit 8 · Sheet B — Sequences

- 1 (a) 13 B1 [1] (b) $3n$ M1; $3n + 1$ A1 [2] (c) $3n + 1 = 50$ gives $n = 49/3 = 16 \frac{1}{3}$ M1; not a whole number, so no A1 [2]
- 2 (a) $5n$ M1; $5n + 2$ A1 [2] (b) Multiples of 5 end in 0 or 5, and adding 2 gives a last digit of 2 or 7. B1 [1] (c) $5n + 2 > 200$ or tries $n = 40$ M1; 202 A1 [2]
- 3 $3n + 4 = 54 - 2n$ or table of values M1; $n = 10$ A1; term = 34 A1 [3]
- 4 (a) n^2 B1 [1] (b) $n^2 + 1$ B1 [1] (c) 401 B1ft [1]
- 5 (a) 7, 15, 31 B1 [1] (b) Multiplying any whole number by 2 gives an even number; adding 1 makes it odd. B1 [1]
- 6 Tries values or $40 - 3n < 0$ M1; -2 A1 [2]

Unit 9 · Sheet A — Coordinates and straight-line graphs

- 1 A (3, 4), B (-2, 3), C (-4, -2), D (2, -3)
- 2 F
- 3 E
- 4 E (0, -4), F (-3, 0)
- 5 (5, 5)
- 6 (-1, -2)
- 7 (2.5, 4)
- 8 (1, 4)
- 9 $x = 3$
- 10 $y = 4$
- 11 Yes ($2 \times 2 + 1 = 5$)
- 12 -2
- 13 4
- 14 -5
- 15 $y = 4$
- 16 (-3, -3)
- 17 12
- 18 5

Unit 9 · Sheet B — Coordinates and straight-line graphs

- 1** (a) $y = -5, -3, -1, 1, 3$ B2 (B1 for 2 correct) **[2]** (b) 4 or 5 points plotted correctly B1; straight line through them B1ft **[2]** (c) $x = 5/2$ B1ft **[1]**
- 2** (a) $(-2, -3)$ B1 **[1]** (b) length 6, width 4 M1; 24 square units A1 **[2]** (c) $(1, -1)$ B1 **[1]** (d) 20 units B1ft **[1]**
- 3** (a) $y = 2x + 1$ B1 **[1]** (b) All three points fit $y = 2x + 1$ (e.g. $2 \times 3 + 1 = 7$); the others fail for at least one point, e.g. $y = x + 2$ gives 4 when $x = 2$. B1 **[1]** (c) 21 B1ft **[1]**
- 4** $3 \times 5 - 2$ M1; = 13, so yes A1 **[2]**
- 5** (a) $(2, -1)$ B1; $(2, 2)$ B1; $(-1, -1)$ B1 **[3]** (b) $\frac{1}{2} \times 3 \times 3$ M1; 4.5 square units A1ft **[2]**

Unit 10 · Sheet A — Ratio and proportion

- 1** 2 : 3
- 2** 3 : 5
- 3** 2 : 3 : 4
- 4** 1 : 5
- 5** 1 : 4
- 6** 20
- 7** 10, 20
- 8** 21, 35
- 9** 20, 30, 40
- 10** $3/5$
- 11** 5
- 12** 9
- 13** 24p
- 14** 75p
- 15** 500 g
- 16** 660 baht
- 17** £20
- 18** 1 : $5/2$
- 19** $3/2$ km
- 20** 5 : 2

Unit 10 · Sheet B — Ratio and proportion

- 1** (a) $1400 \div 7$ M1; 200 ml A1 **[2]** (b) 1800 ml B1 **[1]**
- 2** (a) $72 \div 8 = 9$ M1; Ali £45, Bea £27 A1 **[2]** (b) £18 B1ft **[1]**
- 3** cost per yoghurt: A 40p M1, B 38p M1; Pack B is better value A1 (or other correct comparison) **[3]**
- 4** (a) There are 5 parts altogether, so $2/5$ are boys ($2/3$ compares boys with girls). B1 **[1]** (b) $35 \div 5 = 7$ M1; 14 A1 **[2]**
- 5** (a) $12 \div 5 \times 3$ M1; 7.2 litres A1 **[2]** (b) 6 litres of blue needs 4 litres of yellow, which he has M1; 10 litres A1 **[2]**
- 6** (a) $\text{£}240 \times 45 = 10,800$ baht, or $10,620 \div 45 = \text{£}236$ M1; difference correctly found M1; Thailand, by £4 A1 **[3]** (b) $6 \div 15 \times 25$ or 3 eggs for 5 pancakes M1; 10 A1 **[2]**

Unit 11 · Sheet A — Angles and properties of shapes

- 1** acute
- 2** obtuse
- 3** reflex
- 4** right angle
- 5** 50°
- 6** 145°
- 7** 72° (vertically opposite)
- 8** 70°
- 9** 70° and 70°
- 10** 75°
- 11** 55°
- 12** 50°
- 13** 60°
- 14** 2
- 15** 4
- 16** trapezium
- 17** rhombus
- 18** isosceles

Unit 11 · Sheet B — Angles and properties of shapes

- 1** (a) 65° B1; angles on a straight line add up to 180° B1 **[2]** (b) $180 - 52 - 65$ M1; $x = 63^\circ$ A1 (angles in a triangle add up to 180°) **[2]**
- 2** The 40° angle could be one of the two equal base angles B1; then the angles are $40^\circ, 40^\circ$ and 100° B1; all angles sum to 180° checked B1 **[3]**
- 3** (a) $x + 2x + 100 + 110 = 360$ M1; $3x = 150$ M1; $x = 50^\circ$ A1 **[3]** (b) 110° B1ft **[1]**
- 4** (a) $3a + 2a + a + 30 + 90 = 360$ M1; $6a = 240$ M1; $a = 40^\circ$ A1 **[3]**
- 5**
- (a) True: a square has four equal sides (with right angles). B1 **[1]**
- (b) False: two obtuse angles add to more than 180° . B1 **[1]**
- 6** (a) $360 - 70 - 50 = 240$ M1; $240 \div 2$ M1; $x = 120^\circ$ A1 **[3]** (b) parallelogram B1 **[1]**

Unit 12 · Sheet A — Perimeter, area and 3D shapes

- 1 26 cm
- 2 40 cm^2
- 3 49 cm^2
- 4 30 cm^2
- 5 17.5 cm^2
- 6 36 cm^2
- 7 8 cm
- 8 81 cm^2
- 9 32 cm^2
- 10 300
- 11 2500
- 12 4.5
- 13 30 cm^3
- 14 64 cm^3
- 15 6
- 16 12
- 17 6
- 18 9
- 19 5
- 20 cylinder

Unit 12 · Sheet B — Perimeter, area and 3D shapes

- 1 (a) $7 + 4 + 5 + 5 + 12 + 9$ M1; 42 cm A1 [2] (b) splits into rectangles or $12 \times 9 - 5 \times 4$ M1; correct areas, e.g. 108 and 20 M1; 88 cm^2 A1 [3]
- 2 (a) $15 \times 8 = 120 \text{ m}^2$ M1; 120×6.50 M1; £780 A1 [3] (b) perimeter 46 m M1; 23 panels A1 [2]
- 3 (a) area = 36 cm^2 M1; 6 cm A1 [2] (b) rectangle 30 cm, square 24 cm M1; No, they are different A1 [2]
- 4 (a) $20 \times 10 \times 6$ M1; 1200 cm^3 A1 [2] (b) $10 \times 5 \times 3$ or $1200 \div 8$ M1; 150 A1 [2]
- 5 (a) faces 7, vertices 10, edges 15 B2 (B1 for two correct) [2] (b) $7 + 10 - 15 = 2$ B1ft [1]

Unit 13 · Sheet A — Collecting data and averages

- 1 6
- 2 6
- 3 8
- 4 5
- 5 15
- 6 14.5
- 7 9
- 8 7°C
- 9 9
- 10 50
- 11 discrete
- 12 continuous
- 13 qualitative
- 14 20 students; mode = 4
- 15 84
- 16 4.2

Unit 13 · Sheet B — Collecting data and averages

- 1 (a) 36 B1 [1] (b) Mango B1 [1] (c) $1/3$ B1 [1] (d) $12/36 \times 360$ or $360 \div 36 = 10^\circ$ per student M1; 120° A1 [2]
- 2 (a) A: 14 B1; B: 14 B1 [2] (b) A: 9 B1; B: 2 B1 [2] (c) Player B: the means are the same but B has a smaller range. B1ft [1]
- 3 (a) $5 \times 8 = 40$ M1; 10 A1 [2] (b) $6 \times 9 = 54$ M1; 14 A1 [2]
- 4 (a) 1 B1 [1] (b) 1 B1 [1] (c) $0 \times 4 + 1 \times 7 + 2 \times 5 + 3 \times 3 + 4 \times 1 = 30$ M1; $\div 20$ M1; 1.5 A1 [3] (d) No, because the mean 1.5 is less than 2 B1ft [1]

Unit 14 · Sheet A — Probability

- 1 certain
- 2 impossible
- 3 even chance
- 4 $1/6$
- 5 $1/2$
- 6 $1/3$
- 7 $5/6$
- 8 $2/5$
- 9 $3/5$
- 10 0
- 11 0.7
- 12 $2/11$
- 13 $4/11$
- 14 $1/2$
- 15 $1/4$
- 16 4
- 17 $1/4$
- 18 10
- 19 30

Unit 14 · Sheet B — Probability

- 1 (a) $1 - (0.2 + 0.35 + 0.15)$ M1; 0.3 A1 [2] (b) 0.65 B1 [1] (c) 0.2×80 M1; 16 A1 [2]
- 2 (a) Row 1: 2, 3, 4, 5; row 2: 3, 4, 5, 6; row 3: 4, 5, 6, 7 B2 (B1 for at least 6 correct) [2] (b) 3 out of 12 M1; $1/4$ A1 [2] (c) $1/4$ B1ft [1]
- 3 total = $5 \times 3 = 15$ M1; 10 blue A1 [2]
- 4 (a) 0.64 B1 [1] (b) Not necessarily: 32 is more than the expected 25 (B1), but 50 throws is a small number of trials; she should throw it many more times (B1). [2]
- 5 (a) H1, H2, H3, H4, H5, H6, T1, T2, T3, T4, T5, T6 B2 (B1 for at least 8 correct with no extras) [2] (b) $1/4$ B1ft [1] (c) Only 1 of the 12 equally likely outcomes is (H, 6), so the probability is $1/12$; adding makes it more likely than getting a 6 alone. B1 [1]
- 6 Probabilities are between 0 and 1 (1 means certain). B1 [1]

End-of-book check

- 1** 0.056
- 2** 0.05
- 3** 28
- 4** 22
- 5** 24
- 6** $\frac{3}{5}$
- 7** $\frac{9}{20}$
- 8** $6x - 12$
- 9** $x = 6$
- 10** $4n + 1$
- 11** £15 and £25
- 12** 20 cm^2

End-of-year practice test

- 1** (a) 370 B1 [1] (b) 6.05 B1 [1] (c) 3 B1 [1]
- 2** (a) $(8 - 2)^2 = 36$ and $3 \times 36 \div 4 = 27$ M1; 34 A1 [2] (b) $8/12 + 3/12$ M1; $11/12$ A1 [2]
- 3** (a) $18 = 2 \times 3^2$ B1; $30 = 2 \times 3 \times 5$ B1 [2] (b) 6 B1 [1] (c) 90 B1 [1]
- 4** (a) $5x = 35$ M1; $x = 7$ A1 [2] (b) $3y + 12 = 6$ or $y + 4 = 2$ M1; $y = -2$ A1 [2]
- 5** (a) $4n$ M1; $4n + 5$ A1 [2] (b) $4n + 5 = 101$ M1; $n = 24$, a whole number, so yes A1 [2]
- 6** (a) $x + 10 + 2x + 50 = 180$ M1; $3x = 120$ M1; $x = 40$ A1 [3] (b) Isosceles: angles are 50° , 80° and 50° , two are equal B1ft [1]
- 7** (a) $0.15 \times 64 = 9.60$ or 0.85×64 M1; £54.40 A1 [2] (b) $18 \div 75 \times 100$ M1; 24% A1 [2] (c) 37.5% B1 [1]
- 8** (a) $385 \div 7 = 55$ M1; £165 and £220 A1 [2] (b) $6.90 \div 1.5 = 4.60$ per kg M1; £18.4 A1 [2] (c) 892 baht B1 [1]
- 9** $14 \times 8 = 112$ M1; $\frac{1}{2} \times 14 \times 5 = 35$ M1; 147 cm^2 A1 [3]
- 10** (a) $17 \div 6$ M1; 2.83 kg A1 [2] (b) 2.9 kg B1 [1] (c) 0.7 kg B1 [1]
- 11** (a) $1 - 0.35 - 0.25$ M1; 0.4 A1 [2] (b) 8 B1ft [1] (c) $0.27 \times 20 = 5.4$ M1; not a whole number of counters A1 [2]
- 12** (a) -4, -1, 2, 5 B2 (B1 for 2 or 3 correct) [2] (b) $3 \times 10 - 4 = 26$, so yes B1 [1] (c) $3x - 4 = 11$ M1; $x = 5$ A1 [2]