COMPREHENSIVE LESSON NOTEBOOK

GCSE MATHEMATICS

FOUNDATION TIER

UNIT 2 | ALGEBRA

WHAT THIS UNIT TEACHES

Algebra represents structure, relationships and change. This unit develops meaning before method, then builds fluency, graphical understanding, reasoning and contextual problem solving.

AQA Foundation Algebra specification map

Chapter	References	Coverage
1	A1-A3	Algebra language, notation and substitution
2	A4-A6	Simplifying, expanding, factorising and formulae
3	A7-A10	Functions, coordinates and straight-line graphs
4	A11-A14	Quadratic and real-life graphs
5	A17,A21	Linear equations and forming equations
6	A18-A19	Quadratics and simultaneous equations
7	A22	Linear inequalities and solution sets
8	A23-A25	Sequences and nth terms

TIER BOUNDARY

Included: all basic and additional Foundation Algebra content. Excluded: Higher-only transformations, exponential and trigonometric graphs, circle equations, iteration, algebraic proof requirements beyond Foundation, and quadratic nth terms.

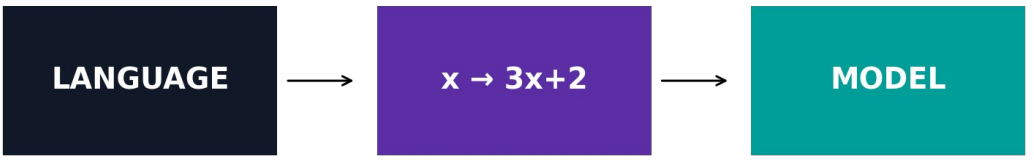
CHAPTER 01 • A1-A3

Algebra language, notation and substitution

What does the method mean, why does it work, and when should it be used?

SPECIFICATION ALIGNMENT

AQA 8300 alignment: 3. The explanations and tasks below address the Foundation-accessible statements and their AO1, AO2 and AO3 applications.



Key vocabulary

Term	Meaning to secure
variable	Define this accurately after studying the chapter.
coefficient	Define this accurately after studying the chapter.
term	Define this accurately after studying the chapter.
expression	Define this accurately after studying the chapter.
equation	Define this accurately after studying the chapter.
formula	Define this accurately after studying the chapter.

Build the idea

Algebra is a precise language

A letter represents a number whose value may vary or may be unknown. In 5x + 3, 5 is the coefficient of x, 5x and 3 are terms, and the expression contains no equals sign.

THINK MATHEMATICALLY

Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

Notation compresses repeated operations

Write 3 × y as 3y, a × a as a^2 and a ÷ b as a/b. The order matters: $3x^2$ means 3 × x × x, not $(3x)^2$.

THINK MATHEMATICALLY

Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

Substitution replaces letters with values

Insert values using brackets, especially for negatives. If $x=-3$, then $x^2=(-3)^2=9$ but $-x^2=-(9)=-9$. Follow BIDMAS after substituting.

THINK MATHEMATICALLY

Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

Worked examples

Evaluate 4a-3 when a=6

QUESTION

Evaluate 4a-3 when a=6

1 **Step 1:** Substitute: 4(6)-3.

2 **Step 2:** Multiply before subtracting: 24-3.

ANSWER

21

Use a scientific formula

QUESTION

Use a scientific formula

1 **Step 1:** For v=u+at, use u=5, a=3, t=4.

2 **Step 2:** v=5+3×4=17.

ANSWER

v=17

Guided check

GUIDED 1

State the coefficient of x in 7x-4.

GUIDED 2

Simplify the notation 3×a×a.

Independent practice

1. State the coefficient of x in 7x-4.

2. Simplify the notation 3×a×a.

3. Evaluate 5p+2 when p=-3.

4. Evaluate $2x^2$ when x=-4.

5. If C=2πr, find C when r=5, using π=3.142.

6. Explain the difference between an expression and an equation.

AO2-AO3 CHALLENGE

Choose one result, justify every step, then create a realistic problem that uses the same algebraic structure.

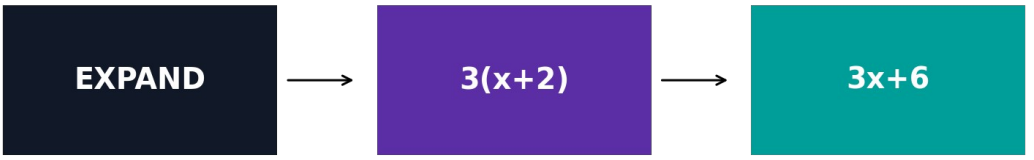
CHAPTER 02 • A4-A6

Simplifying, expanding, factorising and formulae

What does the method mean, why does it work, and when should it be used?

SPECIFICATION ALIGNMENT

AQA 8300 alignment: 6. The explanations and tasks below address the Foundation-accessible statements and their AO1, AO2 and AO3 applications.



Key vocabulary

Term	Meaning to secure
like terms	Define this accurately after studying the chapter.
expand	Define this accurately after studying the chapter.
factorise	Define this accurately after studying the chapter.
common factor	Define this accurately after studying the chapter.
identity	Define this accurately after studying the chapter.
subject	Define this accurately after studying the chapter.

Build the idea

Only like terms can be collected

Terms are like when their letter parts and powers match. $3x+5x=8x$, but $3x+5$ cannot become $8x$ and $x+x^2$ cannot become $2x^3$.

THINK MATHEMATICALLY

Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

Expanding and factorising are inverse processes

Use the distributive law: 4(2x-3)=8x-12. Reverse it by taking out the highest common factor: 12x+18=6(2x+3).

> **THINK MATHEMATICALLY**
>
> Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

Changing the subject isolates one letter

Undo operations in reverse order and apply the same operation to both sides. From y=3x+7, subtract 7 and divide by 3: x=(y-7)/3.

> **THINK MATHEMATICALLY**
>
> Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

An identity is true for every permitted value

The symbol ≡ records equivalence, for example 3(x+2) ≡ 3x+6. An equation is true only for particular solution values.

> **THINK MATHEMATICALLY**
>
> Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

Worked examples

Simplify and expand

> **QUESTION**
>
> Simplify and expand

1 **Step 1:** Collect: 4x+7x-3=11x-3.

2 **Step 2:** Expand: 5(2x-1)=10x-5.

> **ANSWER**
>
> 11x-3; 10x-5

Rearrange a formula

QUESTION

Rearrange a formula

1 **Step 1:** Start with $A=(a+b)h/2$.

2 **Step 2:** Multiply by 2, divide by h, then subtract a.

ANSWER

$b=2A/h-a$

Guided check

GUIDED 1

Simplify $8a-3a+4$.

GUIDED 2

Expand $6(2x-5)$.

Independent practice

1. Simplify $8a-3a+4$.

2. Expand $6(2x-5)$.

3. Factorise $15y+20$.

4. Simplify $3x^2\times4x$.

5. Rearrange $v=u+at$ to make a the subject.

6. Show that $2(3n+4)+n \equiv 7n+8$.

AO2-AO3 CHALLENGE

Choose one result, justify every step, then create a realistic problem that uses the same algebraic structure.

CHAPTER 03 • A7-A10

Functions, coordinates and straight-line graphs

What does the method mean, why does it work, and when should it be used?

SPECIFICATION ALIGNMENT

AQA 8300 alignment: 10. The explanations and tasks below address the Foundation-accessible statements and their AO1, AO2 and AO3 applications.

Key vocabulary

Term	Meaning to secure
input	Define this accurately after studying the chapter.
output	Define this accurately after studying the chapter.
coordinate	Define this accurately after studying the chapter.
gradient	Define this accurately after studying the chapter.
intercept	Define this accurately after studying the chapter.
parallel	Define this accurately after studying the chapter.

Build the idea

A function maps an input to one output

A function machine applies operations in a fixed order. For f(x)=3x-2, f(5)=13. A table of values records inputs and outputs for plotting.

THINK MATHEMATICALLY

Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

Coordinates are ordered pairs

The x-coordinate gives horizontal movement and the y-coordinate vertical movement. Signs determine the quadrant. Never reverse the order.

> **THINK MATHEMATICALLY**
>
> Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

A straight line has constant gradient

In y=mx+c, m is gradient and c is the y-intercept. Gradient = change in y/change in x. Parallel lines have the same gradient.

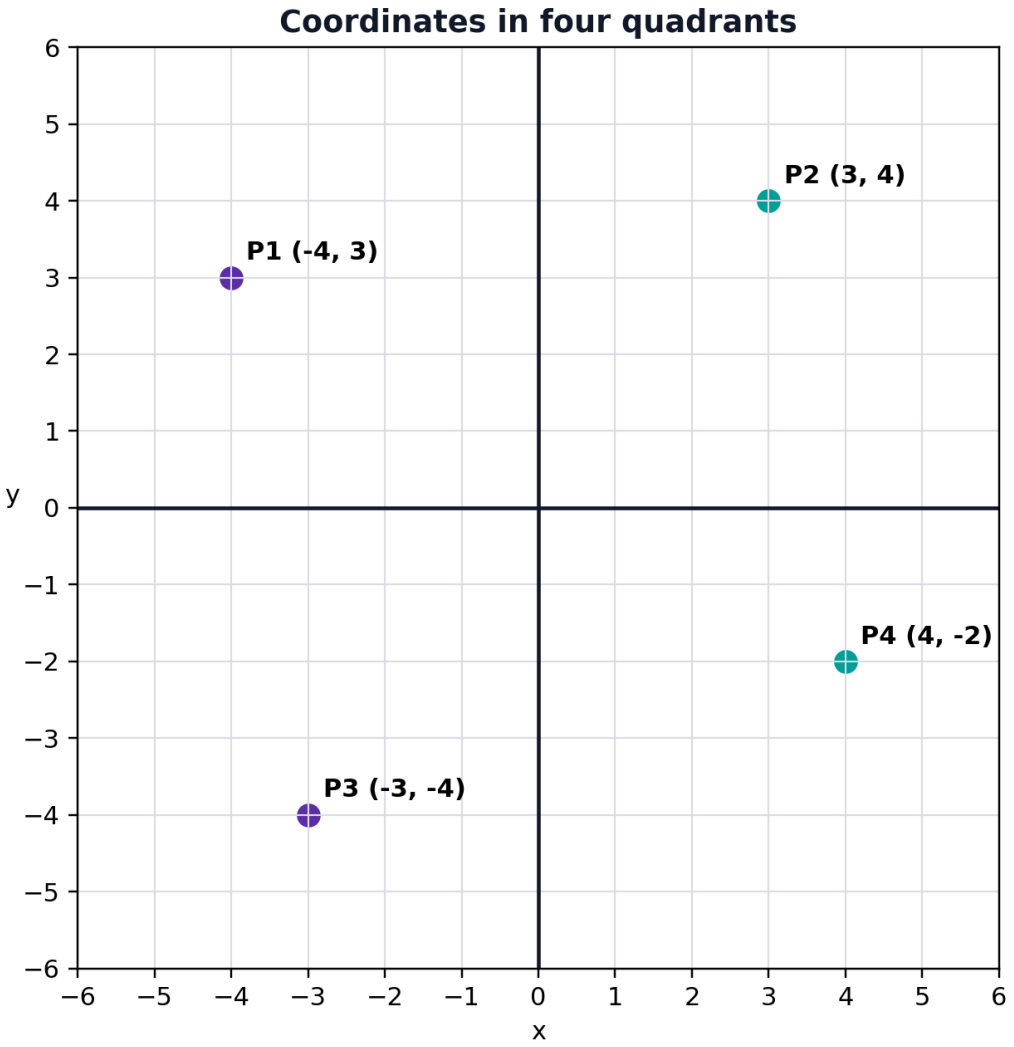
> **THINK MATHEMATICALLY**
>
> Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

A graph is a set of solutions

Every point on y=2x+1 satisfies the equation. Plot accurately using a table or the intercept and gradient, then join with a ruled straight line.

> **THINK MATHEMATICALLY**
>
> Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

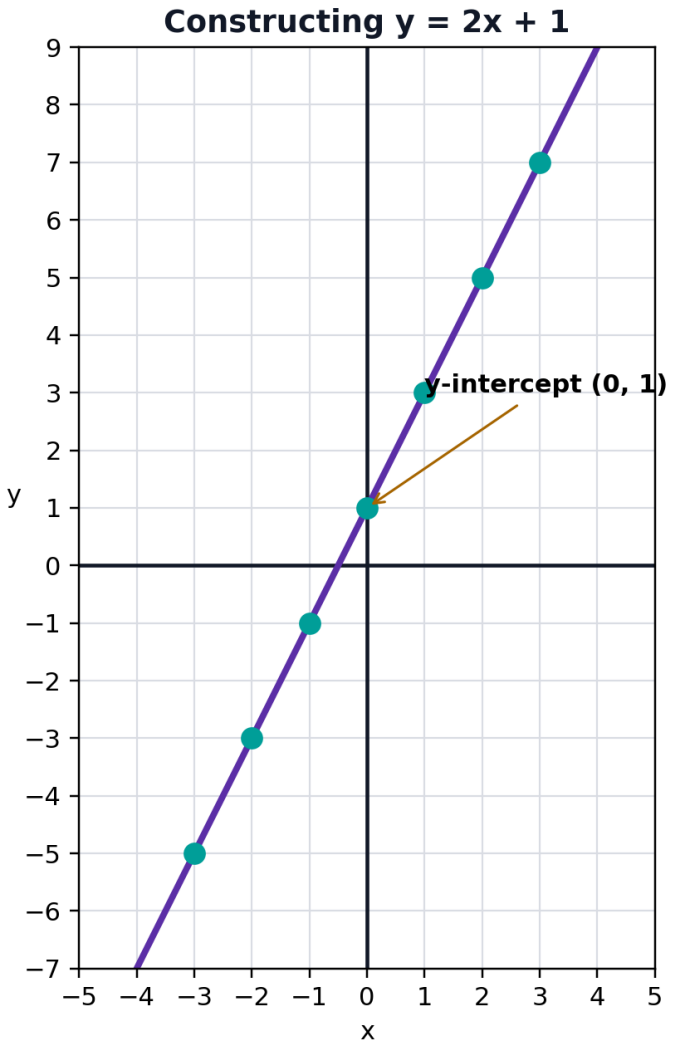
Graph laboratory



Coordinates are read horizontally first, then vertically. The signs of x and y identify the quadrant.

READ - CALCULATE - INTERPRET

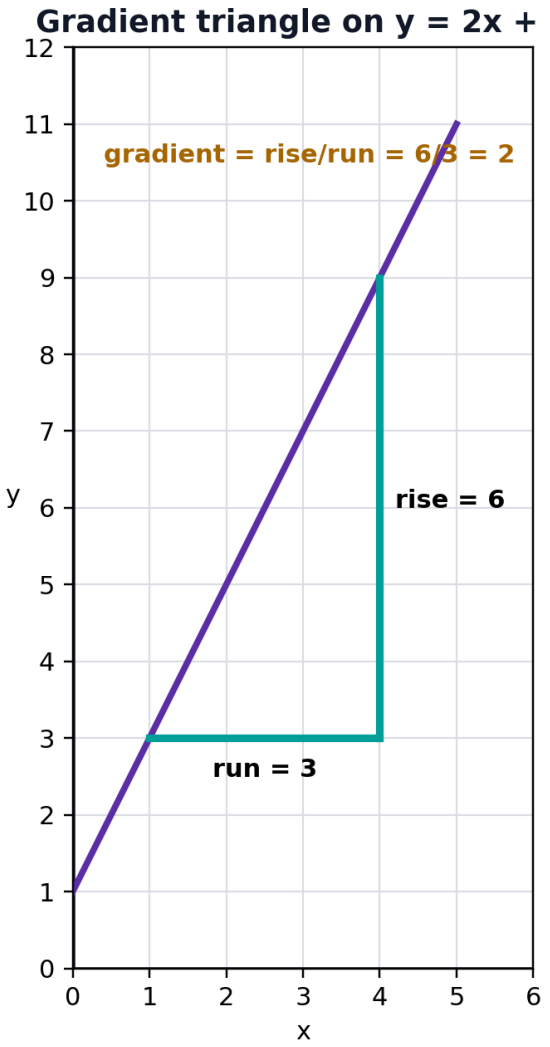
Identify the axes and scale; read or calculate coordinates; describe the mathematical feature; then state what it means in the problem.



For y=2x+1, calculate y for several x-values, plot every ordered pair, check that the points are collinear and join with a ruled line.

READ - CALCULATE - INTERPRET

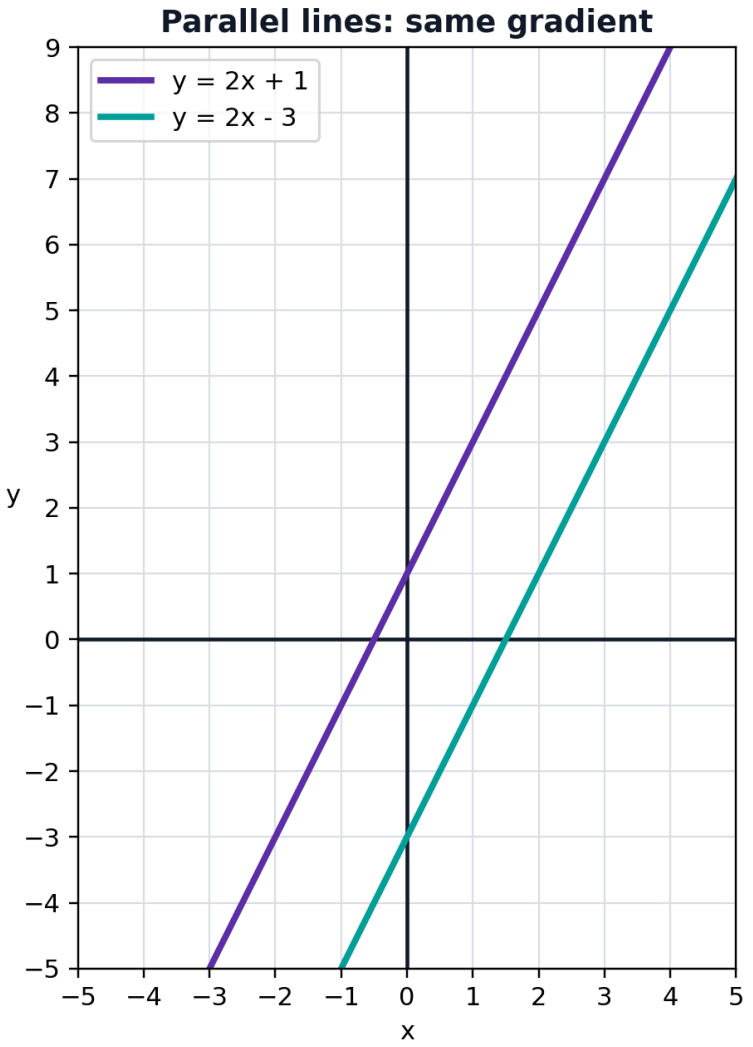
Identify the axes and scale; read or calculate coordinates; describe the mathematical feature; then state what it means in the problem.



Gradient measures vertical change divided by horizontal change. Any correctly drawn triangle on the same straight line gives the same ratio.

READ - CALCULATE - INTERPRET

Identify the axes and scale; read or calculate coordinates; describe the mathematical feature; then state what it means in the problem.



Changing c moves a line vertically. Parallel lines retain the same gradient m but have different intercepts.

READ - CALCULATE - INTERPRET

Identify the axes and scale; read or calculate coordinates; describe the mathematical feature; then state what it means in the problem.

Worked examples

Find a line equation

QUESTION

Find a line equation

1 **Step 1:** Gradient=(11-3)/(5-1)=2.

2 **Step 2:** Use y=2x+c and point (1,3): 3=2+c, so c=1.

ANSWER

y=2x+1

Function output

QUESTION

Function output

1 **Step 1:** For f(x)=4x-7, substitute x=-2.

2 **Step 2:** f(-2)=4(-2)-7=-15.

ANSWER

-15

Guided check

GUIDED 1

State the quadrant containing (-4,3).

GUIDED 2

For f(x)=2x+5, find f(6).

Independent practice

1. State the quadrant containing (-4,3).

2. For f(x)=2x+5, find f(6).

3. Complete y=3x-2 when x=-1,0,2.

4. State gradient and intercept of y=-4x+7.

5. Find the gradient through (2,1) and (6,9).

6. Give an equation parallel to y=5x-3.

AO2-AO3 CHALLENGE

Choose one result, justify every step, then create a realistic problem that uses the same algebraic structure.

CHAPTER 04 • A11-A14

Quadratic and real-life graphs

What does the method mean, why does it work, and when should it be used?

SPECIFICATION ALIGNMENT

AQA 8300 alignment: 14. The explanations and tasks below address the Foundation-accessible statements and their AO1, AO2 and AO3 applications.

Key vocabulary

Term	Meaning to secure
root	Define this accurately after studying the chapter.
intercept	Define this accurately after studying the chapter.
turning point	Define this accurately after studying the chapter.
quadratic	Define this accurately after studying the chapter.
distance-time graph	Define this accurately after studying the chapter.
rate of change	Define this accurately after studying the chapter.

Build the idea

Graph features have meaning

A root is where y=0, a y-intercept is where x=0 and a turning point is a local maximum or minimum. A quadratic is symmetrical about a vertical line through its turning point.

THINK MATHEMATICALLY

Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

Graph shapes signal families

Linear graphs are straight; quadratic graphs are U-shaped or inverted U-shaped. Foundation students also recognise simple cubic S-shapes and reciprocal curves with two branches.

> **THINK MATHEMATICALLY**
>
> Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

Context controls interpretation

On a distance-time graph, gradient represents speed. A horizontal section means stationary. A steeper section means faster movement.

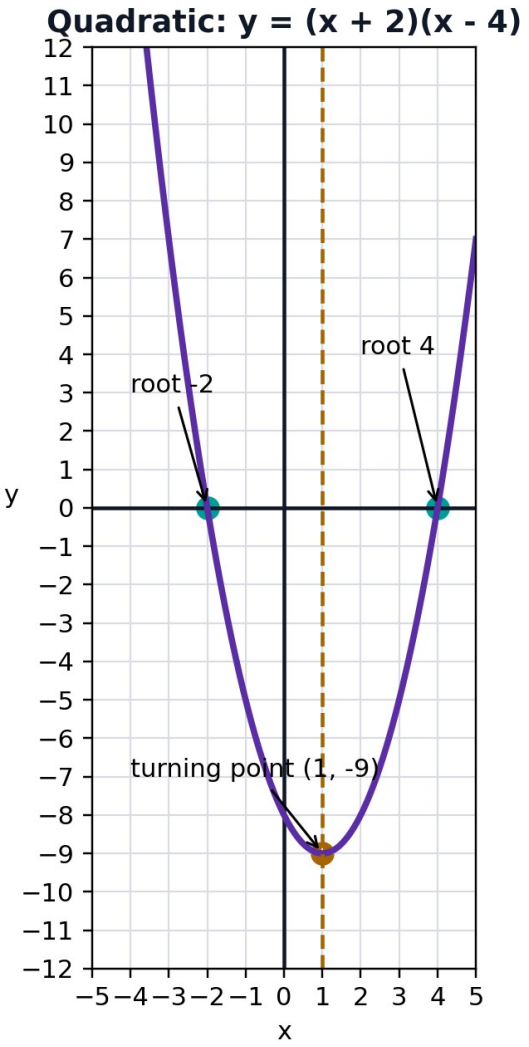
> **THINK MATHEMATICALLY**
>
> Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

Graphs give approximate solutions

To solve f(x)=k graphically, draw y=k and read the x-coordinates of intersections. State that readings are approximate.

> **THINK MATHEMATICALLY**
>
> Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

Graph laboratory



The x-intercepts are roots because y=0 there. The turning point is the minimum, and the dashed vertical line is the axis of symmetry.

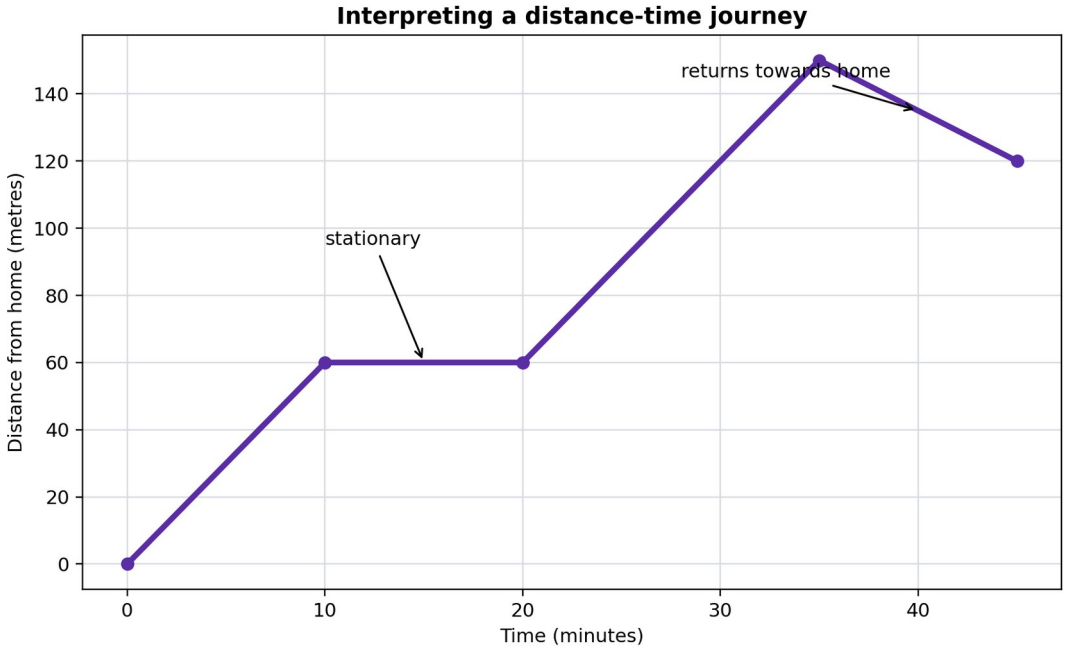
READ - CALCULATE - INTERPRET

Identify the axes and scale; read or calculate coordinates; describe the mathematical feature; then state what it means in the problem.

The reciprocal graph has two branches. It approaches both axes but never reaches them; x=0 is excluded because division by zero is undefined.

READ - CALCULATE - INTERPRET

Identify the axes and scale; read or calculate coordinates; describe the mathematical feature; then state what it means in the problem.



On a distance-time graph, gradient represents speed. A horizontal section means stationary; a downward section means returning towards the starting point.

READ - CALCULATE - INTERPRET

Identify the axes and scale; read or calculate coordinates; describe the mathematical feature; then state what it means in the problem.

Worked examples

Interpret a journey

QUESTION

Interpret a journey

1 **Step 1:** A line rises 120 m in 30 s.

2 **Step 2:** Speed=120/30=4 m/s.

ANSWER

4 m/s

Read quadratic roots

QUESTION

Read quadratic roots

1 **Step 1:** The graph crosses the x-axis at -2 and 5.

2 **Step 2:** At crossings y=0, so these are solutions.

ANSWER

x=-2 and x=5

Guided check

GUIDED 1

Name the shape of $y=x^2$.

GUIDED 2

State the y-intercept of $y=x^2-4$.

Independent practice

1. Name the shape of $y=x^2$.

2. State the y-intercept of $y=x^2-4$.

3. A graph crosses the x-axis at 1 and 6. State its roots.

4. Distance rises 300 m in 50 s. Find speed.

5. What does a horizontal distance-time section mean?

6. Explain how to solve $x^2=7$ using a graph.

AO2-AO3 CHALLENGE

Choose one result, justify every step, then create a realistic problem that uses the same algebraic structure.

CHAPTER 05 • A17,A21

Linear equations and forming equations

What does the method mean, why does it work, and when should it be used?

SPECIFICATION ALIGNMENT

AQA 8300 alignment: 21. The explanations and tasks below address the Foundation-accessible statements and their AO1, AO2 and AO3 applications.

Key vocabulary

Term	Meaning to secure
solution	Define this accurately after studying the chapter.
balance	Define this accurately after studying the chapter.
inverse operation	Define this accurately after studying the chapter.
unknown	Define this accurately after studying the chapter.
form an equation	Define this accurately after studying the chapter.
interpret	Define this accurately after studying the chapter.

Build the idea

An equation is a balance

A valid operation must be applied to both sides. Aim to isolate the unknown while preserving equality.

THINK MATHEMATICALLY

Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

Brackets and variables on both sides require structure

Expand brackets first, collect variable terms on one side and constants on the other, then divide by the coefficient.

> **THINK MATHEMATICALLY**
>
> Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

Context becomes algebra

Define the unknown, translate each statement, solve and interpret. Check whether the solution is sensible and satisfies restrictions such as whole numbers.

> **THINK MATHEMATICALLY**
>
> Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

Worked examples

Unknown on both sides

> **QUESTION**
>
> Unknown on both sides

1 **Step 1:** Solve $5x+7=2x+25$.

2 **Step 2:** Subtract $2x$ and 7: $3x=18$. Divide by 3.

> **ANSWER**
>
> $x=6$

Form an equation

> **QUESTION**
>
> Form an equation

1 **Step 1:** Three consecutive integers total 72: $n+(n+1)+(n+2)=72$.

2 **Step 2:** $3n+3=72$, so $n=23$.

> **ANSWER**
>
> 23,24,25

Guided check

GUIDED 1

Solve 4x+9=37.

GUIDED 2

Solve 7-3x=22.

Independent practice

1. Solve 4x+9=37.

2. Solve 7-3x=22.

3. Solve 5(x-2)=35.

4. Solve 6x+4=3x+25.

5. A rectangle has perimeter 34 cm, length 3 cm more than width. Find dimensions.

6. A number is doubled then 9 is added to give 31. Find it.

AO2-AO3 CHALLENGE

Choose one result, justify every step, then create a realistic problem that uses the same algebraic structure.

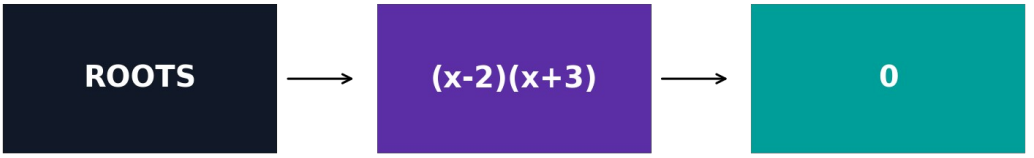
CHAPTER 06 • A18-A19

Quadratics and simultaneous equations

What does the method mean, why does it work, and when should it be used?

SPECIFICATION ALIGNMENT

AQA 8300 alignment: 19. The explanations and tasks below address the Foundation-accessible statements and their AO1, AO2 and AO3 applications.



Key vocabulary

Term	Meaning to secure
quadratic equation	Define this accurately after studying the chapter.
factor pair	Define this accurately after studying the chapter.
zero-product rule	Define this accurately after studying the chapter.
simultaneous	Define this accurately after studying the chapter.
elimination	Define this accurately after studying the chapter.
intersection	Define this accurately after studying the chapter.

Build the idea

A factorised quadratic reveals its roots

If (x+2)(x-5)=0, at least one factor is zero. Therefore x=-2 or x=5. Foundation questions use factorisable quadratics.

THINK MATHEMATICALLY

Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

Rearrange before factorising

Put every term on one side so the other side is zero, then find a factor pair whose product and sum match the quadratic.

> **THINK MATHEMATICALLY**
>
> Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

Simultaneous equations share one solution pair

Elimination adds or subtracts equations to remove one variable. Substitute the first value back to find the second, then check both original equations.

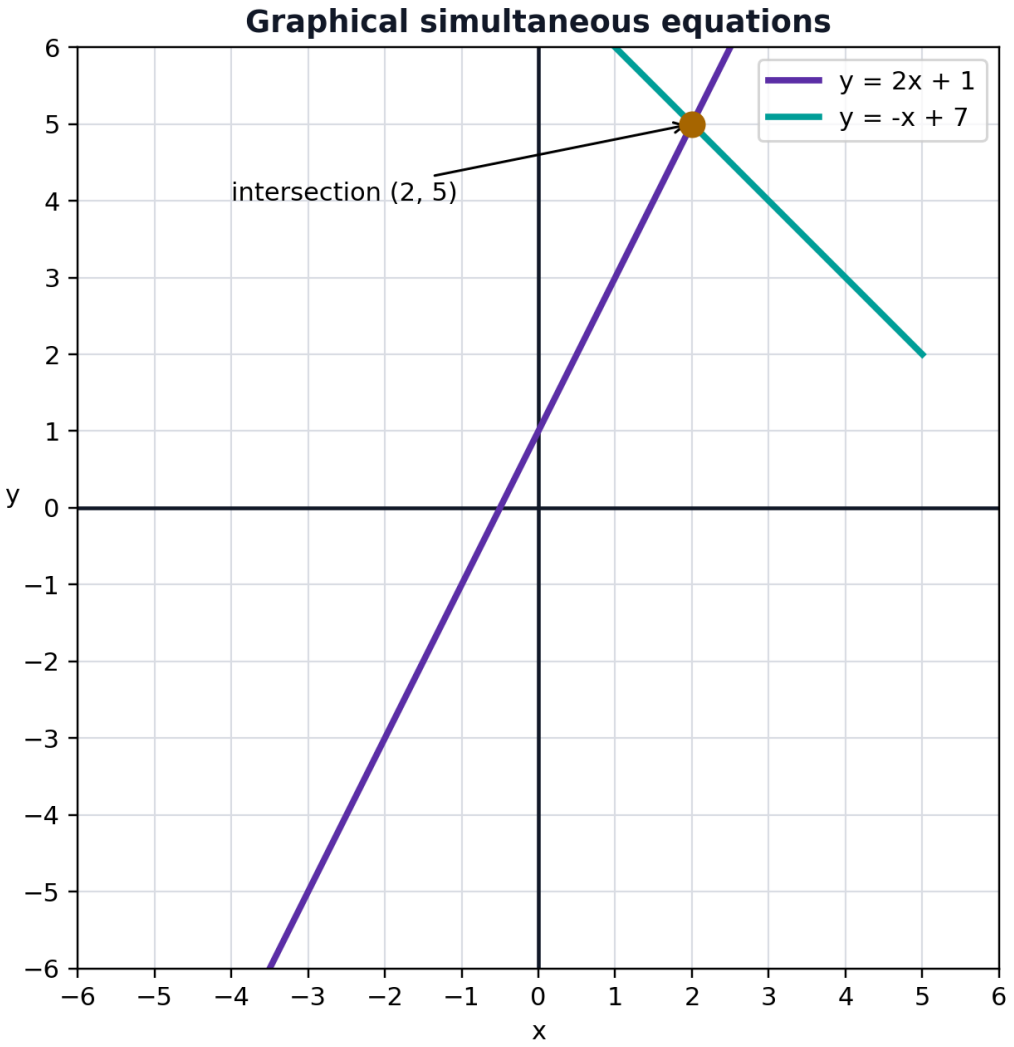
> **THINK MATHEMATICALLY**
>
> Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

Graphical solutions are intersections

The point where two graphs meet satisfies both equations. Graphical readings are approximate unless the intersection is exact.

> **THINK MATHEMATICALLY**
>
> Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

Graph laboratory



The intersection satisfies both equations at once. Reading the coordinates gives the graphical simultaneous solution.

READ - CALCULATE - INTERPRET

Identify the axes and scale; read or calculate coordinates; describe the mathematical feature; then state what it means in the problem.

Worked examples

Solve a quadratic

QUESTION

Solve a quadratic

1 Step 1: $x^2+3x-10=0$.

2 **Step 2:** Factorise: (x+5)(x-2)=0.

ANSWER

x=-5 or x=2

Eliminate a variable

QUESTION

Eliminate a variable

1 **Step 1:** x+y=11 and x-y=3.

2 **Step 2:** Add: 2x=14, x=7. Then y=4.

ANSWER

x=7,y=4

Guided check

GUIDED 1

Solve $x^2+7x+12=0$.

GUIDED 2

Solve $x^2-9=0$.

Independent practice

1. Solve $x^2+7x+12=0$.

2. Solve $x^2-9=0$.

3. Solve $x^2=5x$.

4. Solve x+y=9 and x-y=1.

5. Solve 2x+y=13 and x-y=2.

6. Explain why a quadratic can have two roots.

AO2-AO3 CHALLENGE

Choose one result, justify every step, then create a realistic problem that uses the same algebraic structure.

CHAPTER 07 • A22

Linear inequalities and solution sets

What does the method mean, why does it work, and when should it be used?

SPECIFICATION ALIGNMENT

AQA 8300 alignment: The explanations and tasks below address the Foundation-accessible statements and their AO1, AO2 and AO3 applications.

Key vocabulary

Term	Meaning to secure
inequality	Define this accurately after studying the chapter.
solution set	Define this accurately after studying the chapter.
strict	Define this accurately after studying the chapter.
included boundary	Define this accurately after studying the chapter.
open circle	Define this accurately after studying the chapter.
closed circle	Define this accurately after studying the chapter.

Build the idea

An inequality describes a range

Symbols < and > exclude the boundary; ≤ and ≥ include it. A solution is usually a set of many values, not one number.

THINK MATHEMATICALLY

Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

Solve like an equation—with one exception

Apply the same operation to both sides. When multiplying or dividing by a negative number, reverse the inequality sign because order reverses.

> **THINK MATHEMATICALLY**
>
> Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

Number-line notation communicates inclusion

Use an open circle for a strict boundary and a closed circle for an included boundary. Shade in the direction of valid values.

> **THINK MATHEMATICALLY**
>
> Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

Worked examples

Solve an inequality

> **QUESTION**
>
> Solve an inequality

1 **Step 1:** $3x+5 \leq 20$.

2 **Step 2:** Subtract 5: $3x \leq 15$. Divide by 3.

> **ANSWER**
>
> $x \leq 5$

Negative coefficient

> **QUESTION**
>
> Negative coefficient

1 **Step 1:** $-2x>8$.

2 **Step 2:** Divide by -2 and reverse the sign.

> **ANSWER**
>
> $x<-4$

Guided check

GUIDED 1

Solve $x+7<12$.

GUIDED 2

Solve $4x \geq 20$.

Independent practice

1. Solve $x+7<12$.

2. Solve $4x \geq 20$.

3. Solve $3x-2 \leq 13$.

4. Solve $9-2x>3$.

5. List integer solutions of $-1<x \leq 4$.

6. Describe the number-line representation of $x \geq 2$.

AO2-AO3 CHALLENGE

Choose one result, justify every step, then create a realistic problem that uses the same algebraic structure.

CHAPTER 08 • A23-A25

Sequences and nth terms

What does the method mean, why does it work, and when should it be used?

SPECIFICATION ALIGNMENT

AQA 8300 alignment: 25. The explanations and tasks below address the Foundation-accessible statements and their AO1, AO2 and AO3 applications.

Key vocabulary

Term	Meaning to secure
sequence	Define this accurately after studying the chapter.
term-to-term	Define this accurately after studying the chapter.
position-to-term	Define this accurately after studying the chapter.
arithmetic	Define this accurately after studying the chapter.
common difference	Define this accurately after studying the chapter.
nth term	Define this accurately after studying the chapter.

Build the idea

A sequence follows a rule

A term-to-term rule tells how to get the next term. A position-to-term rule gives any term directly from its position n.

THINK MATHEMATICALLY

Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

Arithmetic sequences have constant difference

For common difference d, begin the nth term with dn. Adjust the constant so n=1 produces the first term.

> **THINK MATHEMATICALLY**
>
> Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

Special sequences should be recognised

Know square, cube and triangular numbers. Fibonacci-type sequences add previous terms; other recursive rules will be stated.

> **THINK MATHEMATICALLY**
>
> Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

An nth term can test membership

Set the nth-term expression equal to the proposed value. If n is a positive integer, the value occurs in the sequence.

> **THINK MATHEMATICALLY**
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> Connect each symbolic step to an operation, graph, balance or pattern. A correct method should be explainable as well as repeatable.

Worked examples

Find an nth term

> **QUESTION**
>
> Find an nth term

1 **Step 1:** Sequence 5,8,11,14 has difference 3, so start 3n.

2 **Step 2:** At n=1, 3n gives 3; add 2 to obtain 5.

> **ANSWER**
>
> 3n+2

Test a term

QUESTION

Test a term

1 **Step 1:** Is 101 in 4n+1? Solve 4n+1=101.

2 **Step 2:** 4n=100, n=25, a positive integer.

ANSWER

Yes, it is the 25th term.

Guided check

GUIDED 1

Write next two terms: 7,12,17,22.

GUIDED 2

Find nth term of 4,7,10,13.

Independent practice

1. Write next two terms: 7,12,17,22.

2. Find nth term of 4,7,10,13.

3. Find nth term of 12,9,6,3.

4. Find the 40th term of 5n-2.

5. Is 80 in the sequence 6n+2?

6. Write the first five square numbers.

AO2-AO3 CHALLENGE

Choose one result, justify every step, then create a realistic problem that uses the same algebraic structure.

Fully explained answers

Chapter 1: Algebra language, notation and substitution

1. 7

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

2. $3a^2$

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

3. -13

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

4. 32

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

5. 31.42

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

6. An expression has no equality sign; an equation states two expressions are equal.

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

Chapter 2: Simplifying, expanding, factorising and formulae

1. 5a+4

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

2. 12x-30

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

3. 5(3y+4)

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

4. $12x^3$

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

5. a=(v-u)/t

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

6. Expanding gives 6n+8+n=7n+8.

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

Chapter 3: Functions, coordinates and straight-line graphs

1. Quadrant II

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

2. 17

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

3. -5,-2,4

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

4. gradient -4; intercept 7

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

5. 2

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

6. Any y=5x+c, for example y=5x+1.

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

Chapter 4: Quadratic and real-life graphs

1. U-shaped parabola

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

2. -4

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

3. 1 and 6

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

4. 6 m/s

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

5. The object is stationary.

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

6. Plot $y=x^2$ and $y=7$; read intersection x-values, approximately ±2.65.

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

Chapter 5: Linear equations and forming equations

1. 7

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

2. -5

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

3. 9

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

4. 7

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

5. width 7 cm, length 10 cm

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

6. 11

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

Chapter 6: Quadratics and simultaneous equations

1. x=-3 or -4

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

2. x=3 or -3

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

3. x=0 or 5

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

4. x=5,y=4

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

5. x=5,y=3

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

6. Its graph may cross the x-axis at two points.

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

Chapter 7: Linear inequalities and solution sets

1. x<5

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

2. x≥5

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

3. x≤5

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

4. x<3

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

5. 0,1,2,3,4

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

6. Closed circle at 2, shaded to the right.

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

Chapter 8: Sequences and nth terms

1. 27,32

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

2. 3n+1

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

3. 15-3n

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

4. 198

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

5. Yes: 6n+2=80 gives n=13.

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

6. 1,4,9,16,25

Check by substituting, reversing the operation, or testing the result against the original graph, equation, inequality or pattern.

Unit 2 mastery record

AQA reference	I can demonstrate…	Secure?
A1-A3	Algebra language, notation and substitution	☐
A4-A6	Simplifying, expanding, factorising and formulae	☐
A7-A10	Functions, coordinates and straight-line graphs	☐
A11-A14	Quadratic and real-life graphs	☐
A17,A21	Linear equations and forming equations	☐
A18-A19	Quadratics and simultaneous equations	☐
A22	Linear inequalities and solution sets	☐
A23-A25	Sequences and nth terms	☐

Official source

AQA GCSE Mathematics (8300), Subject Content 3.2 Algebra: https://www.aqa.org.uk/subjects/mathematics/gcse/mathematics-8300/specification/subject-content/3.2-algebra