Modelling with algebra

MEI Conference 2026

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Agenda

- A level Maths criteria
- Prior knowledge from GCSE
- Modelling at A level
- Sharing ideas on improving outcomes

Modelling With Algebra: Developing confidence in A level Mathematics modelling from GCSE Maths algebra.

Many of the algebra topics studied at GCSE are fundamental for A level modelling, but these are often where A Level students struggle.

This session will explore algebraic A level Maths Pure content modelling question, while considering how best to develop the algebra knowledge that students should be bringing in from GCSE.

We will examine typical algebra modelling questions, analyse student performance trends and discuss practical strategies to support students in developing the algebraic fluency required for success.

A level Maths criteria

AS and A Level Mathematics content April 2016

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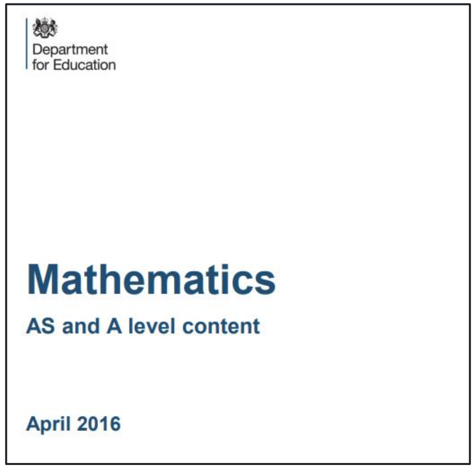
The criteria states that one of the purposes of A level Maths is to show how ‘mathematics can be applied to model situations mathematically using algebra and other representations, to help make sense of data, to understand the physical world and to solve problems in a variety of contexts (note 3)’.


Department for Education

Mathematics

AS and A level content

April 2016

Within the aims and objectives, students must be encouraged to ‘apply mathematics in other fields of study and be aware of the relevance of mathematics to the world of work’. They should use their mathematical knowledge to solve problems both within pure mathematics and in a variety of contexts and communicate the mathematical rationale for these decisions clearly. Students should also represent situations mathematically and understand the relationship between problems in context and mathematical models that may be applied to solve them (note 5).

A level Maths requires students to demonstrate a defined set of **overarching themes**, that must be applied, along with associated mathematical thinking and understanding, across the whole of the detailed content

Prior knowledge from GCSE

GCSE content

Expressions

Ratios

Substitution

Indices and surds

Equations (linear, quadratic and simultaneous)

Lengths, areas and volumes

Trigonometry

Problem solving in abstract and ‘real life’ contexts

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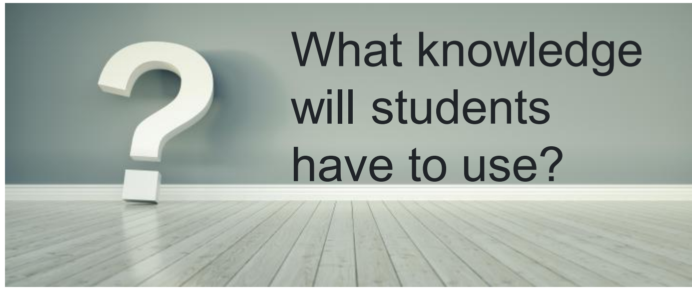
Summer 2025 J560/04 (calculator) Q6

6 The distance of a car race is 420 km.
A car completes the first 210 km at an average speed of 150 km/h.
The same car completes the final 210 km at an average speed of 100 km/h.

Show that the average speed of the car for the whole race is less than 125 km/h. **[5]**

Question	Answer	Mark	Part Marks and Guidance	
6	$\frac{210}{150}$ oe or 1.4	**M1**		implied by 1 [h] 24 [m] or 84 [m]
	$\frac{210}{100}$ oe or 2.1	**M1**		implied by 2 [h] 6 [m] or 126 [m]
	*their*1.4 + *their* 2.1 or 3.5	**M1**		*their* 3.5 could be 3½, 3 [h] 30[m] or 210 [m]
	$\frac{210+210}{their\ 3.5}$ oe or 125 × *their* 3.5 oe or 420 ÷ 125	**M1**		use of $\frac{total\ distance}{total\ time}$ and allow total time=3.30 or in mins
	120 or 420 < 437.5 oe or 3.36 < 3.5 oe	**A1**	**A1** dep. on **M4**	see appendix e.g. 420 is less distance than 437.5 e.g. 3.36 is faster than 3.5



Average speed formula
Substitution
Problem solving in context

Summer 2025 J560/04 (calculator) Q6

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Show that the average speed of the car for the whole race is less than 125 km/h. **[5]**

Average mark of Grade 9 candidates	Average mark of Grade 8 candidates	Average mark of Grade 7 candidates	Average mark of Grade 6 candidates	Average mark of Grade 5 candidates
4.9	4.6	3.8	2.8	2.0

Summer 2025 J560/04 (calculator) Q6

6 The distance of a car race is 420 km.
A car completes the first 210 km at an average speed of 150 km/h.
The same car completes the final 210 km at an average speed of 100 km/h.

Show that the average speed of the car for the whole race is less than 125 km/h. **[5]**

Usually, candidates would either get the entire question fully correct, or they would struggle to gain part marks. The important move was to calculate the time by doing 210 ÷ 150 = 1.4 and so on. There was no requirement to change the decimals to minutes and those who felt compelled to do so often made errors. Those who worked in minutes should have arrived at the calculation 420 ÷ 210, which can be done without a calculator, but the step should still be shown as this is a 'Show that…' question. Another common error was to use the wrong calculation for time, such as 150 ÷ 210.

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210 = 150 km/h

210 = 100 km/h

420 ÷ 125 = 3.36 = 3 hours
21 mins 36 seconds

M1

1 hour = 150 km/h
10 mins = 25 km/h
1 min = 2.5 km/h

1 hour + 20 mins + 4 mins
= 1 hour 24 mins

~~2hours~~

1 hour = 100 km/h
10 mins = ~~16.2 km~~ 16 mins .6̇.

100 × 2 = 200 + 16 mins 40 secs

M1

2 hours + 16 mins 40 secs.

= 2 hours 16 mins 40 secs

3 2 hours + 1 hour = 3 hours

16 + 24 = 40

3 hours 40 mins 40 ses

M1

meaning the average speed was slower that 125 km/h as it took longer to complete the race

Turn over

6 The distance of a car race is 420 km.
A car completes the first 210 km at an average speed of 150 km/h.
The same car completes the final 210 km at an average speed of 100 km/h.

Show that the average speed of the car for the whole race is less than 125 km/h. **[5]**

d / s t

d = 420
s
t

210 ÷ 150 = 1.4 **M1**

210 ÷ 100 = 2.1 **M1**

210 × 150 = 31500

210 × 100 = 21000

~~3.1 − 1.4 = 0.7~~

~~0.7 × 2 = 1.~~

2.1 + 1.4 = 3.5 **M1**

31500 − 21000 = 10500

~~210 + 150~~
~~210 + 100~~

~~(210 + 150 + 210 + 100) / 2 = x~~

$\frac{150 + 100}{2} = x$

$\frac{250}{2} = x$

125 = x

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Summer 2025 J560/04 (calculator) Q16

16 The population of fish, P, in a pond is predicted by the formula

$P = 640 \times 1.025^n$

where n is the number of years after 1st January 2020.

(a) Write down the population of fish on 1st January 2020.

(a) .... **[1]**

(b) Write down the percentage increase per year used in the formula.

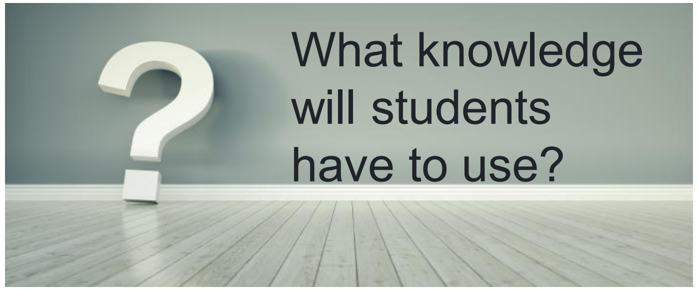
(b) .... % **[1]**

(c) **(i)** Show that the formula predicts that the population of fish will reach 1000 between 1st January 2038 and 1st January 2039. **[3]**

(ii) Give **one** reason why this might not happen.

....

....



Substitution
Indices
Linear equations
Problem solving in contexts

16	**(a)**		640	1		
	(b)		2.5	1		
	(c)	**(i)**	998 to 999 and 1023 to 1024	3	**M2** for one of these correct or **M1** for substitution of any number between 18 and 19 into the formula	e.g. 640×1.025^{18} and 640×1.025^{19} or *their* 998×1.025 If they use other values, one value must be 18 and instead of 19 they can use : $18.08 \leq$ other value ≤ 19 and ignore extras
	(c)	**(ii)**	Any reason suggesting that the rate will not continue	1		see appendix, if more than one statement mark the best unless one is contradictory

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Summer 2025 J560/04 (calculator) Q16

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(a) .... **[1]**

(b) Write down the percentage increase per year used in the formula.

(b) .... % **[1]**

(c) **(i)** Show that the formula predicts that the population of fish will reach 1000 between 1st January 2038 and 1st January 2039. **[3]**

(ii) Give **one** reason why this might not happen.

....

.... **[1]**

	Average mark of Grade 9 candidates	Average mark of Grade 8 candidates	Average mark of Grade 7 candidates	Average mark of Grade 6 candidates	Average mark of Grade 5 candidates
(a)	1.0	0.9	0.8	0.6	0.5
(b)	1.0	1.0	0.9	0.8	0.6
(c)	3.0	2.9	2.9	2.8	2.6
(d)	0.8	0.7	0.6	0.6	0.5

Summer 2025 J560/04 (calculator) Q16

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$$P = 640 \times 1.025^n$$

where n is the number of years after 1st January 2020.

(a) Write down the population of fish on 1st January 2020.

(a) .... **[1]**

Most candidates answered this correctly. A common incorrect answer was 656.

(b) Write down the percentage increase per year used in the formula.

(b) .... % **[1]**

Again, most students gave the correct answer here. The main errors were 1.025 or 25.

(c) **(i)** Show that the formula predicts that the population of fish will reach 1000 between 1st January 2038 and 1st January 2039. **[3]**

This was also answered well. Some candidates additionally used values of n between 18 and 19 instead of just 18 and 19, which was extra work that was not required. A few used 38 and 39 instead of 18 and 19. Some candidates did not state that 1000 lay between their two values, but this was not a requirement.

(ii) Give **one** reason why this might not happen.

....

....

This was answered well. Candidates need to acknowledge that the rate of 2.5 percent may not continue, or to give a reason why it will not, such as a catastrophe. Answers such as 'fish may die' were common and was not sufficient (as fish would die and be replaced by young fish).

16 The population of fish, P, in a pond is predicted by the formula

$P = 640 \times 1.025^n$

where n is the number of years after 1st January 2020.

(a) Write down the population of fish on 1st January 2020.

640 × 1.025 = 625

(a) 625 [1] A0

(b) Write down the percentage increase per year used in the formula.

(b) 2.5 % [1] A1

(c) (i) Show that the formula predicts that the population of fish will reach 1000 between 1st January 2038 and 1st January 2039. [3]

2020 + 18 = ~~2038~~ ~~18~~ 2038

640 × 1.025¹⁸

= 998.1810793

640 × 1.025¹⁹ = 1023.136119

2038 2039

998.2 and 1023.1

1000 between these numbers.

M2A1

(ii) Give **one** reason why this might not happen.

The population of fish may die out ~~that~~ or ~~that~~ be over ~~fish~~ caught or decrease 1 year so it will not increase to 1000. [1]

A1(BOD)

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16 The population of fish, P, in a pond is predicted by the formula

$P = 640 \times 1.025^n$

where n is the number of years after 1st January 2020.

(a) Write down the population of fish on 1st January 2020.

(a) 656 [1] A0

(b) Write down the percentage increase per year used in the formula.

(b) 0.25 % [1] A0

(c) (i) Show that the formula predicts that the population of fish will reach 1000 between 1st January 2038 and 1st January 2039. [3]

2038
− 2020
= 18

640 × 1.025¹⁸ = 998.181...

640 × 1.025¹⁹ = 1023.136119...

M2A1

(ii) Give **one** reason why this might not happen.

Some fish might die. [1]

A0

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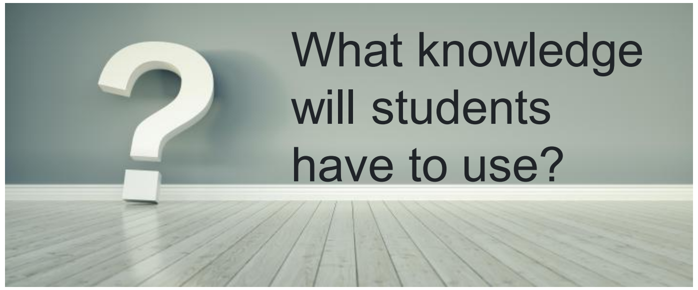
Summer 2025 J560/05 (non-calculator) Q10

10 Heidi is x years old.
Finley is 5 years younger than Heidi.
Zayn is 4 times Finley's age.

Find an expression in terms of x for the **total** age of Heidi, Finley and Zayn.
Write your answer as simply as possible.

.... **[4]**



Setting up linear expressions
Algebraic simplification
Problem solving in context

Question			Answer	Marks	Part marks and guidance	
10			$6x - 25$ final answer	**4**	**B1** for $x - 5$ **B2FT** for $4x - 20$ or 4(*their* $(x - 5)$) correctly expanded or **B1FT** for $4(x - 5)$ or 4(*their* $(x - 5)$)	accept e.g. $1x - 5$ *Their* $x - 5$ must be two term expression with one algebraic term e.g. $5 - x$

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Summer 2025 J560/05 (non-calculator) Q10

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Finley is 5 years younger than Heidi.
Zayn is 4 times Finley's age.

Find an expression in terms of x for the **total** age of Heidi, Finley and Zayn.
Write your answer as simply as possible.

.... **[4]**

Average mark of Grade 9 candidates	Average mark of Grade 8 candidates	Average mark of Grade 7 candidates	Average mark of Grade 6 candidates	Average mark of Grade 5 candidates
3.9	**3.7**	**3.4**	**2.9**	**2.1**

Summer 2025 J560/05 (non-calculator) Q10

10 Heidi is x years old.
Finley is 5 years younger than Heidi.
Zayn is 4 times Finley's age.

Find an expression in terms of x for the **total** age of Heidi, Finley and Zayn.
Write your answer as simply as possible.

.... **[4]**

Almost all candidates attempted this question, with over half scoring full marks and others scoring at least 1 out of the 3 marks available for writing down an expression for Finley as $(x – 5)$. Some did not use a bracket when writing an expression for Zayn's age, e.g. $4x – 5$, and there were also some that gave an incorrect expansion of $4(x – 5)$. In the addition some candidates did not write down an expression for each of Heidi, Finley and Zayn. A few candidates, having obtained $6x – 25$, then went on to treat it as an equation and tried to solve it.

Candidates should note that in questions requiring algebraic simplification, examiners will mark the final answer when considering awarding full marks.

10 Heidi is x years old.
Finley is 5 years younger than Heidi.
Zayn is 4 times Finley's age.

Find an expression in terms of x for the **total** age of Heidi, Finley and Zayn.
Write your answer as simply as possible.

Heidi = x years old

Finley = $x - 5$ B1

Zayn = $4(x-5)$ B1

$2x-5$

.... [4]

10 Heidi is x years old.
Finley is 5 years younger than Heidi.
Zayn is 4 times Finley's age.

Find an expression in terms of x for the **total** age of Heidi, Finley and Zayn.
Write your answer as simply as possible.

$H = x$

$F = x - 5$ B1

$Z = (x-5) \times 4$ B1

$2x - 5 = FH$

$2x-5\ (x-5)\times 4 = FHZ$

$2x - 5 + (x-5)\times 4)$ .... [4]

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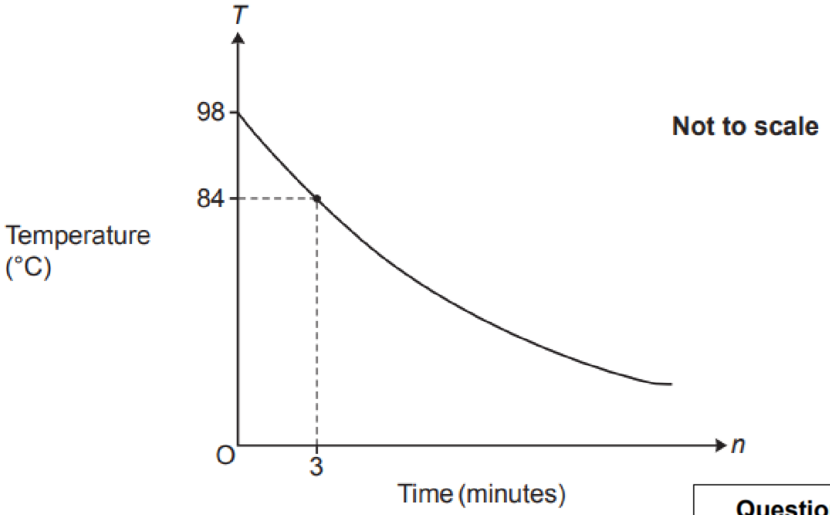
Summer 2025 J560/06 (calculator) Q23

23 A pot of tea is made using boiling water and left to cool.
The temperature, T°C, of the pot of tea after n minutes is given by the formula

$T = ab^n$.

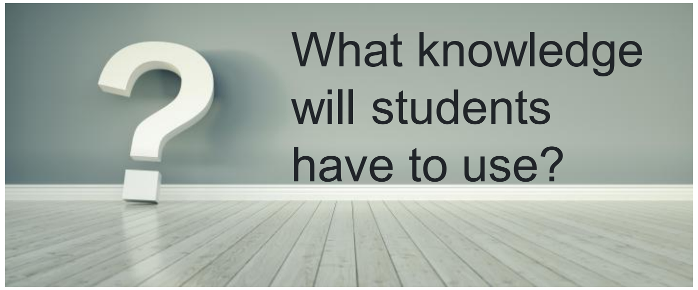
The graph shows some information about the temperature of the pot of tea.



Find the value of a and the value of b.

a = ...

b = ... **[3]**



Exponentials
Indices
Substitution
Problem solving in context

Question			Answer	Marks	Part Marks and Guidance	
23			[a =] 98 [b =] 0.949[9…] or 0.95[0]	**3**	**B1** for [a =] 98 AND **B2** for [b =] 0.949[9…] or 0.95[0] or **M1** for $84 = 98b^3$ or better or $84 = ab^3$	**SC2** if correct answers transposed unless correctly identified in body

Summer 2025 J560/06 (calculator) Q23

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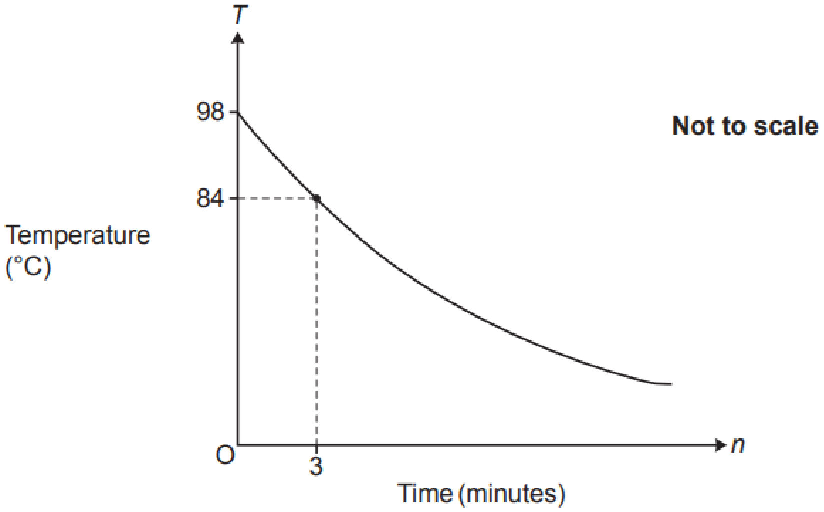

Find the value of a and the value of b.

a = ...

b = ... **[3]**

Average mark of Grade 9 candidates	Average mark of Grade 8 candidates	Average mark of Grade 7 candidates	Average mark of Grade 6 candidates	Average mark of Grade 5 candidates
2.8	2.0	1.1	0.6	0.4

Summer 2025 J560/06 (calculator) Q23

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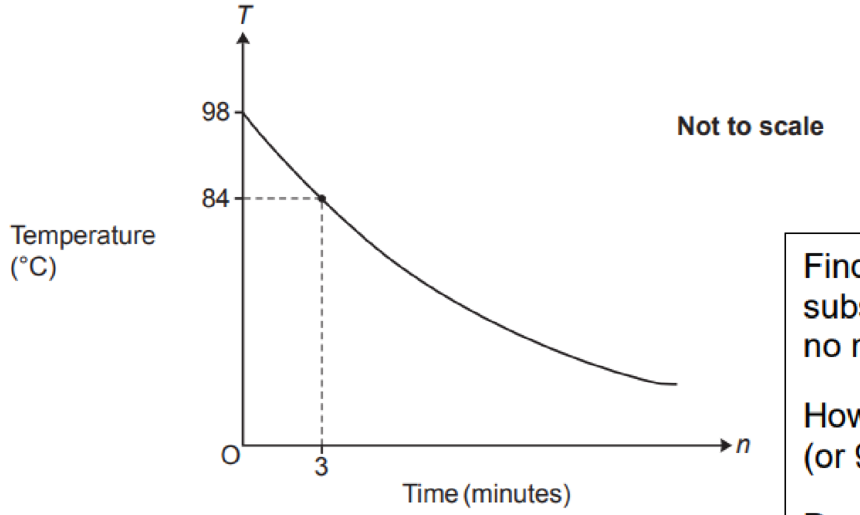

Find the value of a and the value of b.

a = ...

b = ... **[3]**

Finding a = 98 could be done from inspection of the graph, and this picked up B1. Some, however, substituted (0, 98) into the given formula to get $ab^0 = 98$, then were unable to progress further; there was no mark for this as it was an unnecessary step.

However, there was a mark available for the similar substitution of (3, 84) into the formula to get $ab^3 = 84$ (or $98b^3 = 84$), since it is a productive first step to finding b.

Dealing with this cubic equation was a challenge for candidates. A common error was to start by taking the cube root leading to $ab = \sqrt[3]{84} = 4.38$, which then often resulted in $a = 2.19$ and $b = 2.19$.

Other errors were to have 98 ÷ 84 instead of 84 ÷ 98, or to find the square root instead of the cube root.

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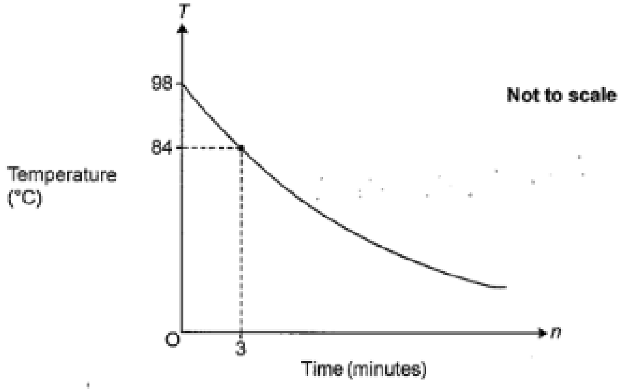


Find the value of a and the value of b.

$ab^0 = 98$

$+$

$ab^3 = 84$ **M1**

$2ab^3 = 182$

$\cancel{ab^3 = 84}$

$2a^2b^3 = 168$

$2a(2b^3)$

$\times 2b^3 = 168$

$b^3 = 14$

$b = 2.410142264$

$a \times b^3 = 84$

$a \times 14 = 84$

$84 \div 14 = 6$

$a = 6$

$a =$ 6

$b =$ 2.410142264 **[3]**

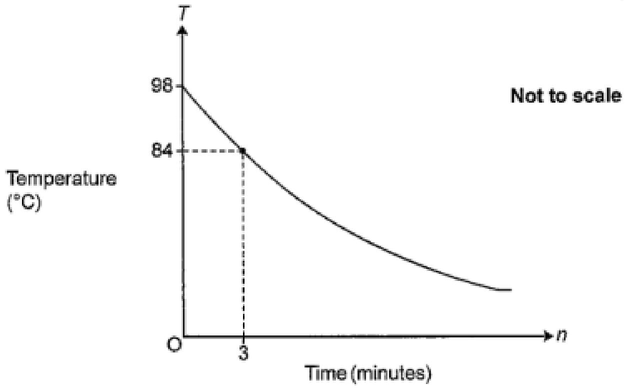
21

23 A pot of tea is made using boiling water and left to cool.
The temperature, T°C, of the pot of tea after n minutes is given by the formula

$T = ab^n$.

$T = a \times b^n$

The graph shows some information about the temperature of the pot of tea.



Find the value of a and the value of b.

$T = a \times b^3$

$84 = a \times b^3$

$84 = ab^3$ **M1**

$98 = ab$

Conclusions from GCSE (9-1) Maths performance

- Many students make mistakes manipulating algebraic expressions.
  - Multiplying out brackets, multiplying negative terms, collecting like terms, etc.

- Students can struggle to link context to algebra.
  - Defining variables, recognising limits, discarding invalid solutions, etc.

- Students would benefit from planning their solution before doing the maths.
  - Sketch a graph, state solution route, identify limiting factors.

- Students have difficulties articulating their thoughts.
  - Encourage peer to peer discussion, use mathematical language and notation.

A Level

Summer AS Maths A H230/02 2025 Q5

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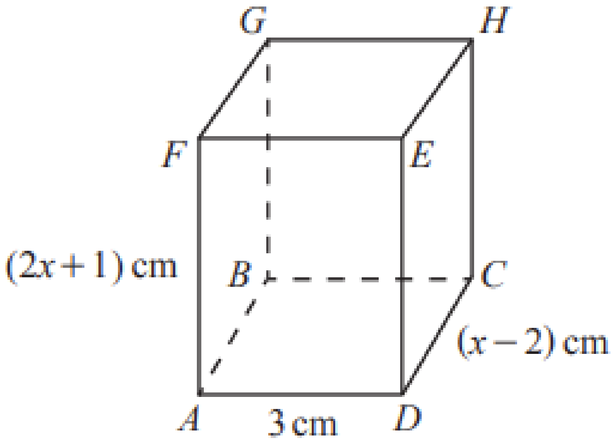
5 In this question you must show detailed reasoning.



The diagram shows the cuboid $ABCDEFGH$ where $AD = 3$ cm, $AF = (2x+1)$ cm and $DC = (x-2)$ cm.

The volume of the cuboid is at most 9 cm^3.

Find the range of possible values of x. Give your answer in interval notation. **[5]**

Summer AS Maths H230/02 2025 Q 5

Assumed knowledge from GCSE

- Formula for volume
- Creating inequalities
- Multiplying out brackets
- Solving quadratics
- Convention of magnitude for lengths

New A level content

- Solving quadratic inequalities
- Interval notation

Overarching themes

- Use set notation for inequalities
- Recognise underlying mathematical structure

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Question			Answer	Marks	AO	Guidance	
5			**DR**				
			$3(x-2)(2x+1) \leqslant 9$	**M1***	**3.1a**	Setting up an inequality or equation with the correct three lengths and 9	Allow any inequality sign or equals
			$2x^2 - 3x - 5 \ (\leqslant 0)$	**M1dep***	**1.1**	Forming a three-term quadratic expression with all terms on the same side	Allow a single sign slip when simplifying
			$(2x-5)(x+1) \ (\leqslant 0)$ $x = \frac{5}{2}, \quad x = -1$	**B1**	**1.1**	Solving their three-term quadratic correctly by factorisation (oe)	If using factorisation then when expanded x^2 term and at least one other term correct for this mark Dependent on both **M** marks
			Either $\lambda \leqslant x \leqslant \frac{5}{2}$ **or** $\lambda \leqslant x$, $x \leqslant \frac{5}{2}$	**A1**	**2.2a**	Dependent on the first two **M** marks – allow strict inequalities for this mark or a mixture of strict and non-strict – can be implied by correct answer	Where $\lambda = -1, 0$ or 2
			$\left(2, \frac{5}{2}\right]$	**A1**	**2.5**	cao	Dependent on both **M** marks
				[5]			

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Very few candidates scored full marks in this question since 'interval notation' did not seem to be well understood, with many candidates giving set notation in the final answer instead. Also many missed the significance of '2'. Many good attempts scored just the first 4 marks, usually with $-1 \leq x \leq 2.5$ getting the fourth mark. This was the second **DR** question on the paper. In this question candidates were expected provide the method used for solving the quadratic equation – as this is a skill required on the Specification, just doing it with the calculator scored B0. The **DR** instruction helps to indicate to candidates when this is required, and it is good practice to include working for all steps in a **DR** question. The other 4 marks were still available. Some candidates did not use the 9cm^3 at all, just giving the volume as a quadratic, simplifying this and then re-factorising and solving to produce $-\frac{1}{2}$ and 2.

5

~~$9 = 3(2x+1)(x-2)$~~

~~$3 = (2x+1)(x-2)$~~ ~~$2x^2 - 4x + x - 2$~~

~~$3 = 2x^2 - 3x - 2$~~

~~$0 = 2x^2 - 3x - 5$~~ ~~$x = \frac{5}{2}$ or -1~~

~~$\{x : -1 \le x \le \frac{5}{2}\}$~~

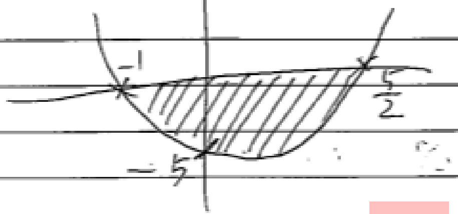
~~$\{x : -1 \le x \le \frac{5}{2}\}$~~

$9 > 3(2x+1)(x-2)$ M1

$3 > 2x^2 - 3x - 2$ M1 A1

$0 > 2x^2 - 3x - 5$ $x = \frac{5}{2}$ or -1

B0



so $\{x : -1 \le x \le \frac{5}{2}\}$ A0

M1M1B0A1A0

Detailed reasoning so need to see a method for solving the quadratic.

Solution has not gone back to the original context. Lengths must be positive so x≥2

5 $(2x+1)(3)(x-2)<9$ M1

$(2x+1)(x-2)$

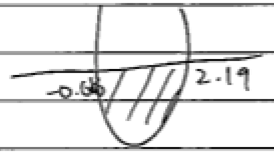
$= 2x^2-4x+x-3 = 2x^2-3x-3$ M0

$3(2x^2-3x-3) = 6x^2-9x-9$

$6x^2-9x-9<9$ B0

$x=\frac{3\pm\sqrt{33}}{4}$ $\quad (x-\frac{3+\sqrt{33}}{4})(x+\frac{3-\sqrt{33}}{4})<9$

$x=-0.686$ $\quad x=\cancel{2.186}\ 2.186 \approx 2.19$ A0



$6(1)^2-9(1)-9<9$ when $x=1$

$-12<9$

$\frac{3-\sqrt{33}}{4}<x<\frac{3+\sqrt{33}}{4}$ A0

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M1M0B0A0A0

Not seen that often, but a mistake multiplying out of brackets made the question much harder.

Unfortunately, the B mark could not be awarded because this candidate has not rearranged fully before using the quadratic formula.

Data Q 5 H230/02 2025

Paper	Total	Mean A	Mean B	Mean C	Mean D	Mean E
H230/02	5	3.9	3.4	3.3	3.0	2.7

Summer Maths A H240/01 2025 Q5

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5 Scientists are comparing h, the average height of a child in cm, with t, the age of the child in years. They suggest the model $h = at + b$ for $t \geqslant 2$, where a and b are constants.

They find that the average height of a 2 year old child is 87 cm and the average height of a 5 year old child is 108 cm.

(a) Find the values of a and b that are consistent with the scientists' findings. **[4]**

(b) **(i)** Sam is 4 years old.

Use the model to predict Sam's height. **[2]**

(ii) Comment on the accuracy of this prediction. **[1]**

(c) Suggest **one** possible limitation of this model when predicting the average height of a 12 year old child. **[1]**

Summer Maths A H240/01 2025 Q5

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Question			Answer	Marks	AO	Guidance	
5	(a)		$2a + b = 87$, $5a + b = 108$	**B1**	**3.3**	State two correct equations soi	
			$3a = 21$	**M1**	**3.1a**	Attempt to solve their two linear simultaneous equations	As far as eliminating one variable **M1** implied by correct final answer, if no method shown
			$a = 7$	**A1**	**1.1**	Obtain correct value for a	
			$14 + b = 87$ $b = 73$	**A1**	**1.1**	Obtain correct value for b	
				[4]			
5	(b)	(i)	$h = 7 \times 4 + 73$	**M1**	**3.4**	Substitute $t = 4$ into their model	
			$= 101$ (cm)	**A1FT**	**1.1**	Condone no units, but **A0** if incorrect eg 101m **FT** their model	Or 1.01 (m)
				[2]			
5	(b)	(ii)	Model only for ‘average’ height so will be variations Sam could be exactly 4 years old or 4 years and 364 days – their height won’t stay the same throughout	**B1**	**3.5a**	Any sensible reason as to why the model for ‘average height’ may, or may not, be accurate in predicting Sam’s height eg height varies a lot between children of the same age eg could depend on different diets and lifestyle eg might be accurate as long as Sam is ‘average’	**B0** for interpolation, including comments about Sam’s height being between 87cm and 108cm
				[1]		**See appendix for exemplars**	
5	(c)		Increase in growth unlikely to continue as a linear model	**B1**	**3.5b**	Any sensible comment eg growth spurt at 12 due to puberty eg people grow quicker when younger	Extrapolation not reliable **B0** for comments about individual variations as question refers to ‘average height’ model
				[1]		**See appendix for exemplars**	

Summer Maths A H240/01 2025 Q5

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This question was exceptionally well answered, with candidates being able to accurately set up and solve two simultaneous equations based on the given model.

Candidates were then able to use their model to predict Sam's height, with lack of units being condoned.

Candidates were expected to suggest a reason as to why this model for average height may not be accurate when predicting the height of an individual. Explanations that gained credit included reference to Sam not necessarily being of average height, with various reasons given, or identifying that having an age of 4 ignores the number of days since their 4th birthday and height will not remain the same until their 5th birthday. The most common error was to focus on interpolation being accurate as opposed to the potential issues with using an 'average' model to predict a single height. As with all of the explanation questions on this paper, the handwriting of some candidates made it difficult to discern their intent.

While the previous question focused on using the given model to predict the height of an individual, this question was expecting candidates to consider why the given linear model may no longer be appropriate. The better explanations identified that increase in average height was unlikely to continue (due to puberty) or that extrapolation from the last recorded data of a 5 year old would be unreliable. Some candidates did not appreciate that it was the general model for average height that could possibly be limited and instead referred to a single child not fitting the model due to circumstances, which was not allowed.

Summer Maths A H240/01 2025 Q5

Assumed knowledge from GCSE

- Substitution
- Solving simultaneous equations

New A level content

- Reviewing validity of model

Overarching themes

- Use of diagrams
- Interpret outcomes of a model
- Evaluate if model is appropriate

5(a) (Ans in extra space at back)

$h = at + b$ for $t \geq 2$ $\quad 87 = 2a + b \quad 108 = 5a + b$

$87 = 2a + b$

$\frac{87}{2} = a + \frac{1}{2}b$

$\left(\frac{87}{2}\right) \div 3 = 14.5$

Seen

$87 = 2a + b$

$\frac{87}{3} = 24$ ~~a = 24 = b if they're equal~~

(I didn't see second line) (check extra space)

5(b)(i) $a = 7 \quad b = 66$

$h = 7 \times 4 + 66 = 94$ cm A0

M1 (or $h = 101$ cm if $b = 73$)

5(b)(ii) It is somewhat accurate as he would be taller than a 2 year old but shorter than a 5 year old, but with b as 66, h is closer to a 2 year old's rather than a 5 year old's, which doesn't make sense, but with $b = 73$, it is closer and seems fairly accurate B0

5(c) Some children will begin having growth spurts at around 12, which makes their heights hard to predict and will cause a large variation of heights B1

EXTRA ANSWER SPACE

If you need extra space use this lined page. You must write the question numbers clearly in the margin.

5a. $87 = 2a + b \quad 108 = 5a + b \quad b = 108 - 5b$ B1

$87 = 2a + (108 - 5b) \quad 3a = 21 \Rightarrow a = 7$ A1

M1 $87 = 2 \times 7 + b \Rightarrow b = 66$

$108 = 5 \times 7 + b \Rightarrow b = 73$ A0

5(a) B1M1A1A0

5(b)(i) M1A0

5(b)(ii) B0

5(c) B1

Unfortunately, this candidate has given two answers for b in Q5(a), which they have then used in Q5(b)(i).

Perhaps a misconception about the number of solutions for linear and quadratic equations.

5(a)	when $t=2$ $h=87$: $87=2a+b$ ① B1 when $t=5$ $h=108$: $108=5a+b$ ② ~~①-②~~ ② - ① : $21=3a$ M1 $a=7$ ③ A1 put ③ into ① : $87=14+b$ $b=73$. A1
5(b)(i)	Sam hight : $h=7t+73$ $t=4$ $h=7\times3+73$ M0 $h=$ ~~85~~ cm 94. A0
5(b)(ii)	~~which is lower than 2 years old.~~ It is normal B0
5(c)	The 12 year old child maybe haven't ~~start~~ ~~grew~~ grow. B0

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5(a) B1M1A1A1

5(b)(i) M0A0

5(b)(ii) B0

5(c) B0

Part (a) answered well.

Silly mistake in part (b)(i), multiplying by 3 even when t=4 correctly stated.

The explanations for part (b)(ii) and (c) are not sufficient for marks.

Data Q5 H240/01 2025

Paper	Total	Mean A*	Mean A	Mean B	Mean C	Mean D	Mean E
H240/01	8	7.1	7.0	6.9	6.8	6.7	6.7

Summer H640/01 2025 Q9

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9 The table below shows information about four of the moons of the planet Jupiter. The semi-major axis is the greatest distance that each moon reaches from the centre of its orbit around Jupiter. The orbital period is the time in Earth days that it takes to orbit the planet.

Moon	**Semi-major axis (km)**	**Orbital period (Earth days)**
Io	421 800	1.7627
Europa	671 100	3.5255
Ganymede	1 070 400	7.1556
Callisto	1 882 700	16.690

A student uses the equation $T = kd^n$ to model the orbital period of Jupiter's moons, where T is the orbital period in Earth days, d is the semi-major axis in km, and k and n are constants.

(a) Show that the equation $T = kd^n$ can be rewritten in the form $\log_{10} T = \log_{10} k + n \log_{10} d$. **[1]**

The student uses graph drawing software to plot $\log_{10} T$ against $\log_{10} d$. They find that the line of best fit for the data has gradient 1.504 and intercepts the $\log_{10} T$ axis at -8.215.

(b) Determine values of k and n that are consistent with this information. **[3]**

The student uses their equation to predict the orbital period for another moon of Jupiter called Thebe which has a semi-major axis of 221 900 km. They look up the value in an online encyclopedia and find it is 0.6761 Earth days.

(c) Comment on the suitability of the student's equation to model the orbital period of Thebe. **[2]**

Summer H640/01 2025 Q9

Question		Answer	Marks	AO	Guidance	
9	(a)	$\log_{10} T = \log_{10} k + \log_{10} d^n$	B1	2.1	Uses laws of logs to split into two terms and then to simplify the second term	This line must be seen
		$\log_{10} T = \log_{10} k + n \log_{10} d$	[1]		**AG**	
9	(b)	Gradient $= 1.504 = n$	B1	3.3	Allow $n = 1.5$ or better seen	
		Intercept $= -8.215 = \log_{10} k$	M1	3.3	soi	
		So $k = 10^{-8.215} [= 6.095 \times 10^{-9}]$	A1	1.1	Allow awrt 6.1×10^{-9}	
			[3]		For using 2 data points from the table SC1 awrt $n = 1.5$, SC1 $5.159 \times 10^{-9} < k < 7.076 \times 10^{-9}$	
9	(c)	For Thebe $d = 221900$				
		Model predicts $T = k \times d^{1.504} = 0.669$	M1	3.4	Uses the model to predict	
		This is close to the given value 0.6761 which suggests that the model is suitable	A1FT	3.5b	Appropriate comment based on similarity of their correct value and the given value. FT their k	Do not accept a comment that implies the model should give an exact match
		Alternative method				
		$-8.215 + 1.504 \log 22190 = -0.174 \ldots$	M1		Uses the model to predict $\log T$	SC1 "Student equation would not be suitable as the data would have to be extrapolated" oe
		This is close to $\log 0.6761 = -0.169989 \ldots$ which suggests that the model is suitable	A1		Appropriate comment based on similarity of their correct values.	
			[2]			

Summer H640/01 2025 Q9

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Most candidates demonstrated confidence in dealing with logs, and in their application to this situation. Most candidates were aware of the need to deal with the multiplication as a first stage, and then the power. A few misinterpreted the model and dealt with the power first.

Candidates generally understood how the gradient and intercept given related to the result in the previous part. Many elected to give the result for k in a power of 10 which was acceptable. A minority used data points from the table to find n and k with varying success but even when successful it did not get full credit as the values given in the question use all the data points not just 2.

Most candidates chose to substitute the semi-major axis into the exponential form of the model and generated a correct result for the orbital period (for their values obtained in the previous part). Some used the model to predict log T. Final marks were often lost because candidates expected the results to be identical, demonstrating that they did not fully understand the concept of modelling.

Some candidates noticed that the data for Thebe sits outside the range of values given for the other moons on the table in the question and so rejected the model for Thebe as it required extrapolation. This is a valid point but does not fully answer the question, as the model is suitable anyway. Special Case B1 was awarded for this where it appeared without any other working.

Summer H640/01 2025 Q9

Assumed knowledge from GCSE

- Algebraic manipulation
- Indices
- Substitution
- Equations of a line

New A level content

- Laws of logarithms
- Reviewing validity of model

Overarching themes

- Use of diagrams
- Interpret outcomes of a model
- Evaluate if model is appropriate

9(a)	$T = kd^n$ $\log_{10} T = \log_{10} kd^n$ B1 $= \log_{10} k + \log_{10} d^n$ $\log_{10} T = \log_{10} k + n\log_{10} d$
9(b)	$n = 1.504$ B1 $\log_{10} T = n \log_{10} d + \log_{10} k$ $\log_{10} k = -8.125$ M1 $y = mx + c$ $k = 10^{-8.125}$ $k = 7.5 \times 10^{-9}$ $n = 1.504$ $k = 7.5 \times 10^{-9}$ A0
9(c)	The model may not be suitable, as the value for $T < 1$. This would give a negative number for the values of $\log_{10} T$, ~~as the~~ so the orbital period model would be incorrect and not suitable. M0 A0

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9(a) B1

9(b) B1M1A0

9(c) M0A0

This candidate has found the correct value for k as a power of ten but then made a mistake converting to a decimal.

In part (c) a calculation would have made the situation more clear.

9(a)	$T = kd^n$ $\log_{10} T = \log_{10} kd^n$ $\log_{10} T = n \log_{10} kd = \log_{10} k + n\log_{10} d$ B0
9(b)	$y = mx + c$ $y = m \quad x \quad c$ $\log_{10} T = n\log_{10} d + \log_{10} k$ $m = n \quad m = 1.504 \quad c = \log_{10} k$ $-8.215 = \log_{10} k$ M1 $n = 1.504$ B1 $\quad k = 6.095\times10^{-9}$ A1
9(c)	$d = 221900 \quad T = 0.6761$ expected $T = kd^n = 6.095\times10^{-9} \times 221900^{1.504} = 0.6693$days M1 therefore the model is fairly suitable as 0.6693 is very close to expected 0.6761. A1

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9(a) B0

9(b) B1M1A1

9(c) M1A1

Unfortunately, an otherwise correct response has dropped a mark through careless notation.

Sharing ideas on improving outcomes

Teaching ideas

Problem Solving

Identify the problem

Represent the given information in a different form (sketch, graph)

Paired work or small groups can help create an environment where problems are discussed.

Oracy – talking through problems, discussing limitations or improvements.

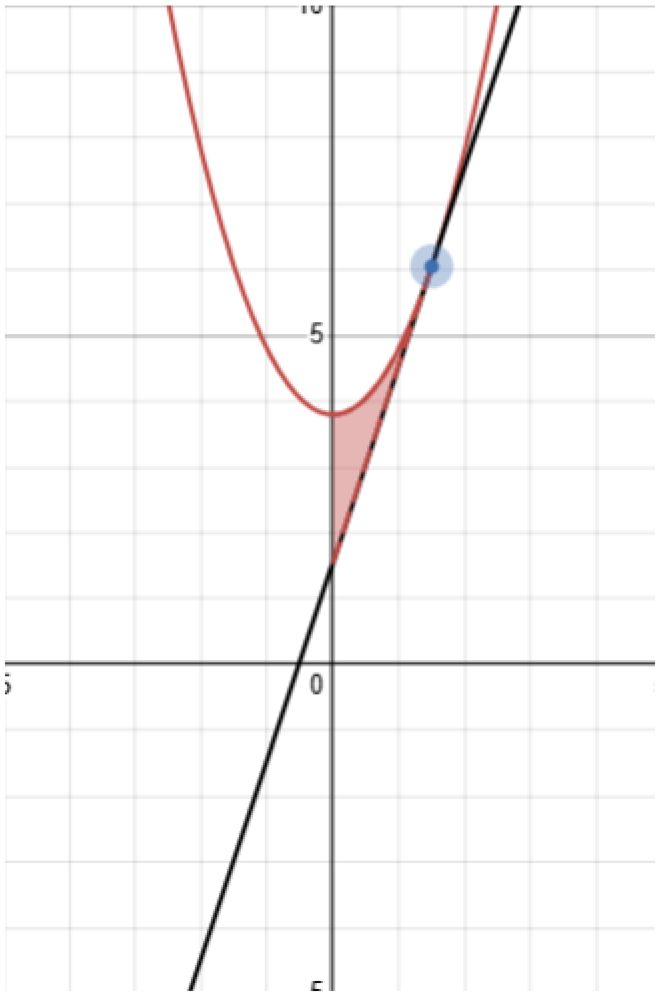
Review alternate approaches and discuss which routes are more efficient as a whole class activity.

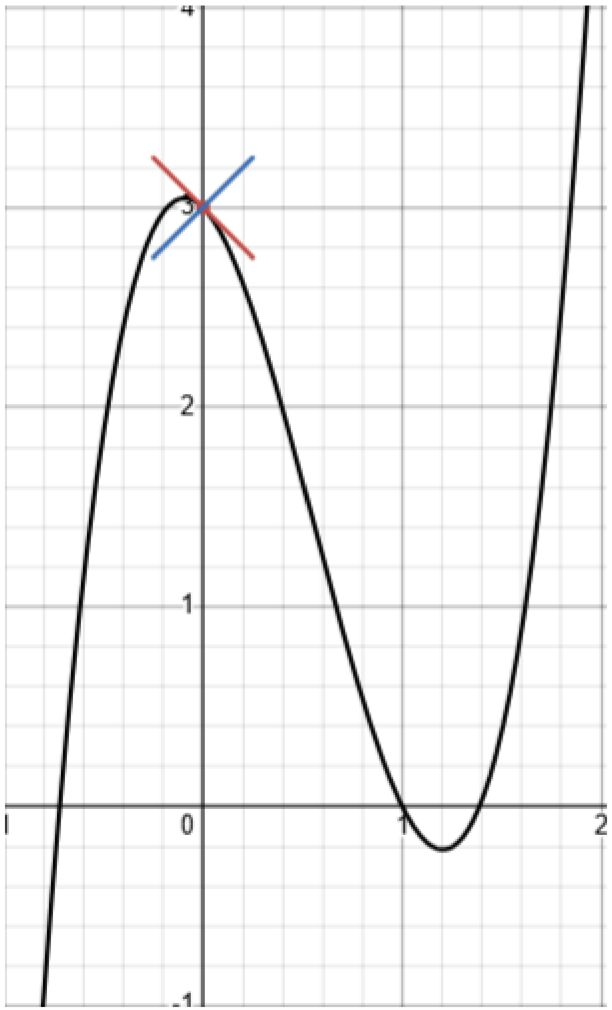
Teaching ideas

Improving algebra confidence

Basic practice exercises, short but regular.

Graphing challenges





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Blogs

Transition from GCSE to A Level Mathematics

16 June 2026

Steven Walker, Maths Subject Advisor

This blog was originally published in 2021. It is republished with updated suggestions to support a smooth transition from GCSE to A Level for your maths students.

Note that some of the resources require a Teach Cambridge login.

1. Transition guides

It can be tempting to assume that all students beginning an AS or A Level Maths course will be confident with the algebra content from the GCSE. However, any gaps or misconceptions in those foundations will impact progression.

Our bridging guide reviews the algebra content from GCSE, and also includes useful trigonometry and graphing material that will help students to progress. These short exercises will give your students some initial practice and can be used to help you identify any areas that might need further support before introducing new concepts.

2. Exam tips and exemplars

Students can use our GCSE higher tier revision checklist to revise topics and develop their exam skills ready for Year 12. Our A Level candidate exam hints (Maths A – H240, Maths B (MEI) – H640) will give them an idea of how they will be examined at the end of the course.

A Level Maths: examiner feedback on modelling with exponentials and logarithms

10 February 2026

Steven Walker, Maths Subject Advisor

Mathematical modelling questions involving population growth, chemical decay, temperature cooling or financial models often require the use of logarithms. Examiner feedback regularly highlights common misconceptions and mistakes seen when candidates are handling the algebra and the graphing needed for solutions.

In this short article I'll review the examiners' feedback and share my ideas to support students.

Algebraic manipulation

Students need to be comfortable with both the laws of indices and the laws of logarithms to be able to switch smoothly between equivalent equations in each format. Examiners regularly see misuse of laws, mixing up addition/subtraction with multiplication/division. Another common source of errors come from mishandling negative exponents. For general support on working with logarithms see my previous blog post on the subject.

Teaching suggestion:

- Practice converting exponential to log form and log to exponential form expressions on the board and ask students to discuss approaches.

Q7 AS Maths A H230/01 2021

[Become-an-examiner-or-moderator/about-assessing]

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Further support

- Sign up to our subject email updates: http://www.ocr.org.uk/signup
- All teachers should have access to Teach Cambridge: https://teachcambridge.org. Don’t have access yet? Use this link.
- Email: maths@ocr.org.uk
- Phone: 01223 553 998
- OCR Blogs: http://www.ocr.org.uk/blog
- Teacher Networks and subject briefings: https://teach.ocr.org.uk/teacher-network-events
- Other PD opportunities: https://www.ocr.org.uk/mathscpd
- Maths Online Research Panel: https://ocrpanel.recollective.com/maths-advisory-group/join?key=Cxp7
- Social Media LinkedIn Bluesky

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Thank you