Pearson

Maths Progress KS3 and Pearson Edexcel GCSE (9–1) Mathematics

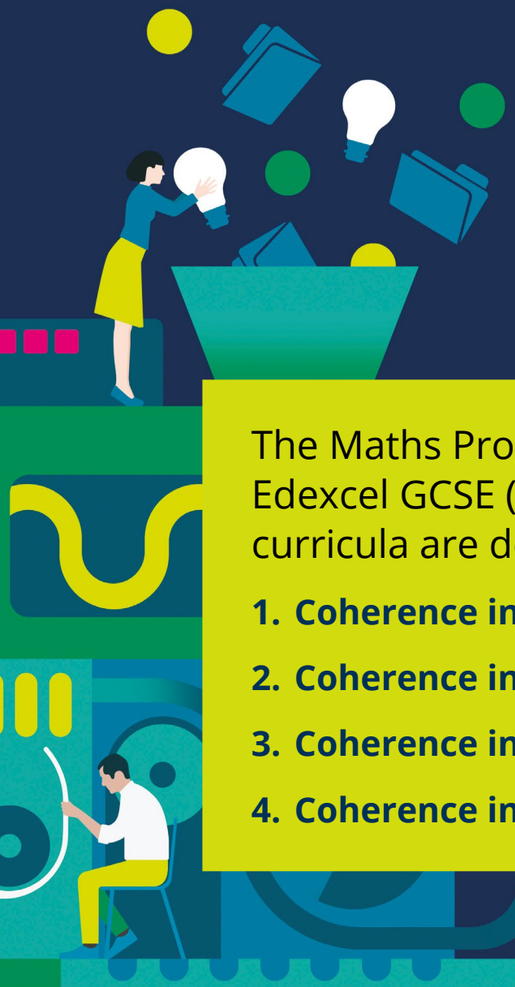
Coherently planned and ambitious curricula, with confidence at the heart

Illustration by Lucy Vigrass

Coherence

"the provider's curriculum is coherently planned and sequenced towards cumulatively sufficient knowledge and skills for future learning and employment"

Ofsted (May 2019) The education inspection framework, p. 9.



The Maths Progress and Pearson Edexcel GCSE (9–1) Mathematics curricula are designed to ensure:

1. **Coherence in position**
2. **Coherence in planning**
3. **Coherence in knowledge**
4. **Coherence in skills**

Illustration by Lucy Vigrass

1. Coherence in position

Students learn maths cumulatively, building on and deepening their understanding of mathematical ideas and concepts that become increasingly complex. A coherent curriculum knows where students are in this progression of mathematics learning and understanding, and builds upon it.

That's why the Maths Progress KS3 curriculum follows on from the KS2 curriculum, acknowledging what students should already know from their primary years, and covering all the knowledge and skills they need as a starting point for GCSE.

In the same way, Pearson Edexcel GCSE (9–1) Mathematics acknowledges what students should already know from KS3. The Foundation GCSE curriculum leads into the Higher curriculum, which in turn provides a starting point for A level.

In Maths Progress and Pearson Edexcel GCSE (9–1) Mathematics:

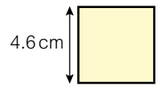
- Units start with prior knowledge checks
- Lessons start with fluency and warm-up questions, based on what students should already know. These are from the start of a lesson on surface area of cuboids:

Warm up

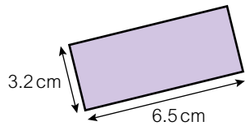
1 **Fluency** What shape are the faces of
a a cube **b** a cuboid?

2 Work out the area of each shape. Round each area to 1 decimal place.

a



b



Always starting a lesson with straightforward questions, on topics students already know, gives them a confidence boost right at the start.

- Cross-curricular links connect to learning in other subjects.

Future skills A scientist collects a sample of leaf mould 20 cm deep from a 0.25 m^2 area in a wood.

a By modelling the sample as a cuboid, calculate the volume of leaf mould she collects.

b In the leaf mould sample, she counts 12 worms.
Estimate the number of worms in the top 20 cm of leaf mould in 2 hectares of the wood.

Future skills The table gives readings P and Q in a science experiment.

P	5	10	14
Q	7.5	15	21

a Write the ratio $P : Q$ in its simplest form.

b Are P and Q in direct proportion? Explain.

c Write a formula for Q in terms of P.

2. Coherence in planning

The meticulous planning that underpins Maths Progress and Pearson Edexcel GCSE (9–1) Mathematics ensures that topics, and concepts within those topics, are taught in a logical sequence.

All the topics in KS3 and KS4 Mathematics were broken down into subtopics, and then small steps within those. These were then ordered to give clear progression through the topic across the whole of KS3 and KS4.

Here is one example, for KS3 algebra:

Topic: Equations

> Subtopic: write and solve linear equations

> Ordered small steps: solve one-step linear equations > write one-step equations > solve two-step linear equations > write two-step equations … and so on

We identified the prior knowledge required for each topic, and connections between different topics:

Prior knowledge

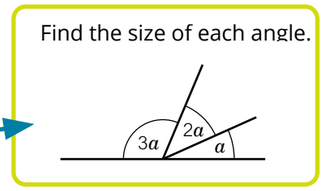
- Read and use algebraic notation
- Write algebraic expressions
- Collect like terms

Write and solve linear equations – progression

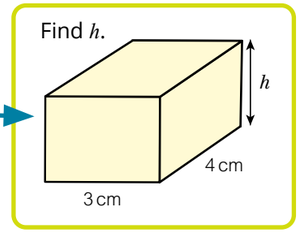
- Solve one-step linear equations
- Write one-step equations
- Solve two-step linear equations
- Write two-step equations

Connections

- Angles:



- Volume of cuboid:



- Linear graphs:

8 **Reasoning** Here is a table of values for the graph of $y = 2x + 3$.

x	1	3	n
y	5	9	15

a Write an equation involving n.

b Solve your equation to find n.

Then we ordered the topics so that all the prior knowledge and connected topics are covered before the lessons on writing and solving equations. This gives students an opportunity to reinforce concepts previously met, and to use them again in new contexts. It also builds confidence by ensuring they always have the necessary prior knowledge to tackle a new topic.

The unit order and contents were reviewed by mathematics teachers. Their feedback helped us fine-tune topic coverage and teaching order.

Students often perceive mathematics as a series of discrete topics and concepts, but research shows that when students recognise the links between two concepts, their understanding of both of them deepens.

- **Maths Progress covers all of the KS3 curriculum.**
- **Pearson Edexcel GCSE (9–1) Mathematics covers all the content of the Pearson Edexcel GCSE examination specifications.**

We have done all this detailed planning, so that you don't have to. You can be confident that Maths Progress and Pearson Edexcel GCSE (9–1) Mathematics cover all the skills and knowledge students need, in a logical progression that teaches for understanding.

The result is a curriculum that is, in Ofsted's words, 'coherently planned and sequenced towards cumulatively sufficient knowledge and skills' and 'does not create unnecessary workload for staff'.

You can 'pick up and use' the Maths Progress and Pearson Edexcel GCSE (9–1) Mathematics resources, or you can adapt them to your own scheme of work using the ActiveLearn planner and the editable 2- and 3-year schemes of work. There is lots of additional support – homework, unit tests, Assessment Builder, and teachers' notes that include common misconceptions and errors for each topic.

All these resources complement each other, allowing you to:

> ***"check learners' understanding systematically, identify misconceptions accurately and provide clear, direct feedback. In doing so, they respond and adapt their teaching as necessary, without unnecessarily elaborate or differentiated approaches"***
>
> Ofsted (May 2019) The education inspection framework, p. 10.

3. Coherence in knowledge

A lot of mathematics skills and knowledge are transferable across topics and concepts. A coherent curriculum revisits and builds on prior teaching and learning and makes clear the connections between concepts.

> ***"over the course of study, teaching is designed to help learners to remember in the long term the content they have been taught and to integrate new knowledge into larger concepts"***
>
> Ofsted (May 2019) The education inspection framework, p. 10.

Maths Progress and Pearson Edexcel GCSE (9–1) Mathematics help students to learn and apply new skills and knowledge through:

▶ Coherence in mathematical ideas

Multiplicative reasoning is a 'big idea' that sits across the mathematics curriculum – the learning of ratio, proportion, percentages, scale factors, similarity, and more, depend on an understanding of how one quantity can be expressed as a multiple of another. Making these connections conscious for students helps them to develop meaningful insights about the relationship between concepts.

Reflect Write a sentence describing how you use multiplication or division in questions about

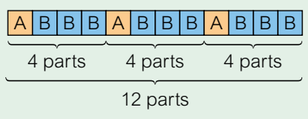
a enlargement **b** compound measures **c** percentage change.

▶ Coherence in mathematical representations

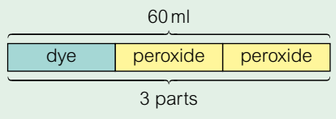
Good representations show the mathematical structure being taught. Using representations consistently, within and across topics, allows students to visualise concepts and builds their understanding. It also gives students strategies of diagrams they can use themselves and builds their confidence in approaching unfamiliar problems.

Bar models

Q13a hint

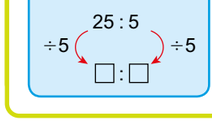


Q14 hint



Arrow diagrams

Q10b hint



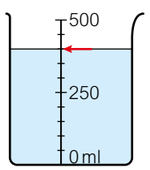
Number lines

(including on speedometers and measuring jugs) - are used to strengthen students' understanding of scales and measures.

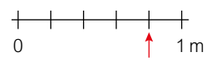
9 Write the measure shown on each scale.

a

b



c



Place value tables

Look at 0.32 in a place value table.

…	H	T	O	•	$\frac{1}{10}$	$\frac{1}{100}$	…
			0	•	3	2	

0.32 is the same as $\frac{32}{100}$

▶ Coherence in questioning

Coherent questions build on prior knowledge, and revisit topics in new contexts.

Fluency and warm up questions – check and practise relevant prior knowledge

Warm up

1 **Fluency** Find the positive and negative square root of

a 9 **b** 49 **c** 100 **d** 144

2 Factorise

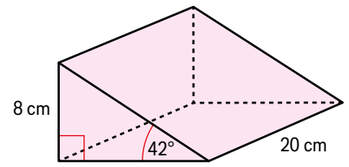
a $x^2+7x+10$ **b** x^2+x-12 **c** x^2-9 **d** $x^2+12x+36$

Warm up for a lesson on solving quadratic equations

Synoptic questions – combining topics

Problem-solving / Reasoning

The diagram shows a triangular prism. Calculate the surface area of the prism.

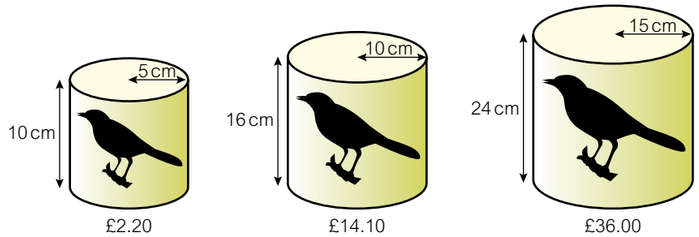


Trigonometry and surface area

Challenge A garden centre sells bird food in cylindrical tubs.

Which tub provides the best value for money?

Which is the worst value?



Volume of cylinder and multiplicative reasoning (best buys)

4. Coherence in skills

Mathematics is all about problem solving and reasoning – being able to solve a problem and explain or show your reasoning are key skills for exam success.

▶ Coherent development of problem-solving strategies

Demonstrating and suggesting strategies in different contexts helps students to build their own problem-solving toolkit to use when they don't immediately know what to do.

Draw a diagram

Exam-style question

18 $A = 2^3 \times 3^4 \times 5^2$ and $B = 2^2 \times 3^6 \times 5$
Write, as a product of its prime factors,
a the HCF of A and B
b the LCM of A and B **(2 marks)**

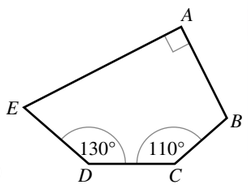
Exam tip

Sometimes it can be useful to draw a picture (e.g. a Venn diagram) to answer exam questions.

Use x for the unknown

Exam-style question

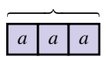
14 $ABCDE$ is a pentagon.
Angle $ABC = 2 \times$ angle AED
Work out the size of angle ABC.
You must show all your working.
(5 marks)



Exam tip

Label angle AED as x. Use what you know about the sum of angles in a pentagon to write and solve an equation.

Use numbers and look for a pattern

2 A film company pays extras an amount per day.
a Work out the total amount paid to an extra who works for
i 2 days at £50 per day
ii 10 days at £35 per day
iii 3 days at £a per day


iv d days at £a per day
b Write a formula for T, the total amount paid, for d days at £a per day.
c Use your formula to work out the total amount paid to an extra who works for 3 days at £25 per day.

> *"teachers present subject matter clearly, promoting appropriate discussion about the subject matter they are teaching"*
>
> Ofsted (May 2019) The education inspection framework, p. 10.

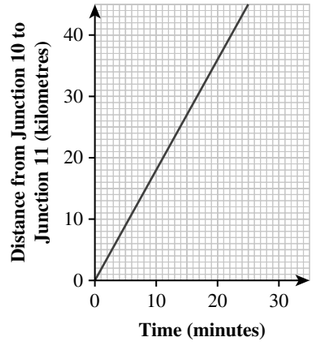
▶ Coherent development of communication skills

Modelling clear ways of setting out working, and giving tips for answers to 'Explain' questions, help build students' mathematical communication skills.

How to show your working

Exam-style question

11 Jon drove from Junction 10 to Junction 11 on a motorway.



Q11 hint

You could plot Carol's journey on the graph to compare the speeds. Or you could work out Jon's speed from the graph.

The travel graph shows Jon's journey. Carol also drove from Junction 10 to Junction 11 on the same motorway. She drove at an average speed of 105 km/h.
Who had the faster average speed, Jon or Carol?
You must explain your answer. **(4 marks)**

Setting out working

Example

Solve $(x+2)^2 = 7$.

$x + 2 = \pm\sqrt{7}$ — Square root both sides. ± means 'plus or minus'.
$x = -2 + \sqrt{7}$ — $+\sqrt{7}$ gives one solution.
or $x = -2 - \sqrt{7}$ — $-\sqrt{7}$ gives the other solution.

Answering 'Explain' questions

Exam-style question

10 The cost of a return ticket for Alice to travel to work by train is £11.15.
Alice works out she will travel to work on 22 days this month.
She does the calculation $20 \times 11 = £220$ to estimate the cost.
Explain why Alice's calculation shows that the cost will be more than £220. **(1 mark)**

Exam tip

Giving the cost does not answer the question. You must write about Alice's calculation compared with the exact number of days and the exact cost of a ticket.

Ambition

"The resources and materials that teachers select – in a way that does not create unnecessary workload for staff – reflect the provider's ambitious intentions for the course of study."

Ofsted (May 2019) The education inspection framework.

The Maths Progress and Pearson Edexcel GCSE (9–1) Mathematics curricula are designed to be challenging, but achievable, with high aspirations for all. They are:

1. **Ambitious for mathematical understanding**
2. **Ambitious to create independent learners**
3. **Ambitious to create mathematical thinkers**
4. **Ambitious for *every* student**

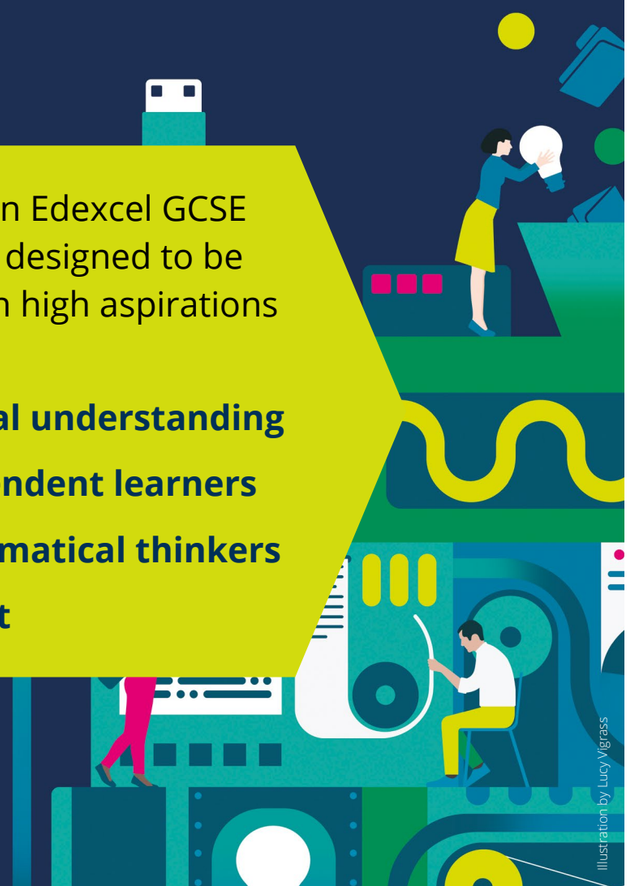


Illustration by Lucy Ygrass

1. Ambitious for mathematical understanding

The Maths Progress and Pearson Edexcel GCSE (9–1) Mathematics curricula are based on an ambition for all students to develop confidence in mathematics and achieve profound conceptual understanding.

This is achieved by:

▶ Addressing misconceptions

Pre-emptive misconceptions are built into the curriculum design, so that alternative understanding, misapplication of rules, and the over- or under-generalisations of ideas can be addressed 'head on'.

5 Draw beads to show the ratios
a blue to yellow 5 : 1 **b** blue to yellow 1 : 5

6 **Reasoning** Is the ratio 5 : 1 the same as the ratio 1 : 5? Explain your answer.

▶ Strengthening through scaffolding

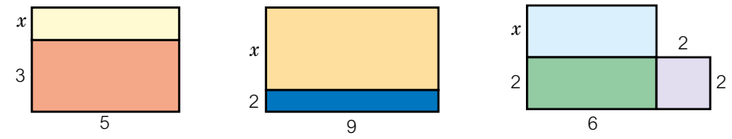
For every concept, the curriculum provides opportunities to scaffold, allowing students (where required) to slowly, but cumulatively, strengthen their understanding.

12 Copy and complete.
a $7 \div \frac{1}{5} = 7 \times \square = \square$
↑ reciprocal of $\frac{1}{5}$

▶ Extending by deepening

For key concepts, the curriculum provides opportunities to deepen understanding, allowing students to explore concepts from different perspectives and acknowledge links they otherwise may never have made.

7 Solve each equation by working out the unknown length.
a $5(x + 3) = 20$ **b** $9(x + 2) = 63$ **c** $6(x + 2) + 4 = 28$



▶ Metacognition

Across the curriculum, students are encouraged to reflect and take active control over the cognitive processes they engage in as they learn mathematics.

4 3 people dig a ditch in 12 hours. How long will it take
a 1 person **b** 5 people?
c **Reflect** What assumption do you have to make to answer parts **a** and **b**?

2. Ambitious to create independent learners

The Maths Progress and Pearson Edexcel GCSE (9–1) Mathematics curricula are designed to encourage students to become confident in taking charge of their own learning.

This is achieved through:

▶ Self-reflection

Across the curriculum, students are encouraged to become increasingly self-aware of their affective responses, identifying how they feel about mathematics – what makes a concept easy or difficult; what makes a method more or less preferable; what makes an answer worth more or fewer marks?

Reflect Which do you find easier, working with expressions or equations? Explain why.

▶ Self-monitoring

There are regular opportunities for students to monitor their understanding and their effort, making decisions for themselves about next steps.

15 **Reflect** How sure are you of your answers? Were you mostly

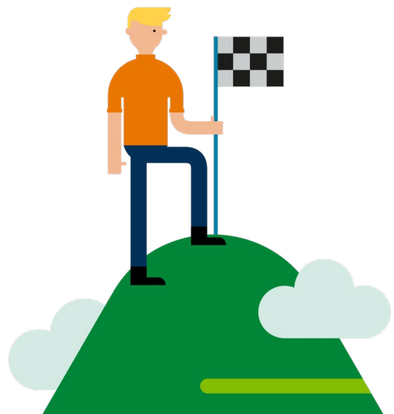
Just guessing ☹ Feeling doubtful 😐 Confident ☺

What next? Use your results to decide whether to strengthen or extend your learning.

Summary of key points

To revise for the test:

- Read each key point, find a question on it in the mastery lesson, and check you can work out the answer.
- If you cannot, try some other questions from the mastery lesson or ask for help.



3. Ambitious to create mathematical thinkers

The Maths Progress and Pearson Edexcel GCSE (9–1) Mathematics curricula are designed to stimulate the mathematical thinking fundamental to being a confident mathematician, by:

▶ Identifying patterns and relationships

Spotting patterns and relationships is a vital mathematical skill.

3 **a** Write each decimal as a fraction in its simplest form and then using powers.

i 0.25

ii 0.125

iii 0.015625

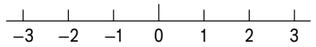
b Use your answer to part **a iii** to write 2^{-5} as a decimal.

Looking for patterns and relationships in fractions, decimals and powers helps deepen understanding of all three concepts.

▶ Working in the abstract

Abstraction is the next step after identifying patterns and relationships. Students are encouraged to move from particular examples to general abstractions, at whatever level their mathematical understanding.

9 On a number line you can see that $-3 < -2$



a Multiply both sides of the inequality by -1. Is the inequality still true?

b **Reflect** Explain what happens to the inequality sign when you multiply both sides of an inequality by -1.

c $-x < -2$. Write an inequality for x.

▶ Encouraging reasoning

Students are given numerous opportunities to reason – by making conjectures, investigating, explaining methods or justifying conclusions.

11 **Problem-solving / Reasoning** An expert predicted that there was a 40% chance that Ferrari would win the next Grand Prix.

If Ferrari win, what could the expert say to justify her prediction?

4. Ambitious for *every* student

The Maths Progress and Pearson Edexcel GCSE (9–1) Mathematics curricula are designed for every student:

> ***"… to be ambitious and to meet their need."***
>
> Ofsted (May 2019) The education inspection framework, p. 9.

Personalised curriculum level

At KS3, the Core books allow for the mastery of key concepts – complemented by Support books for those students that require extra scaffolding, and Depth books for those students that can stretch their understanding a little further.

At GCSE there are Foundation and Higher books, with crossover content clearly labelled.

F H

8 **Problem-solving** There are 237 calories in 100 g of apple pie.
There are 125 calories in 100 g of custard.
Jaya has 80 g of apple pie and 120 g of custard for dessert.
Work out the total number of calories in Jaya's dessert.

Personalised learning path

Every curriculum concept is tested in a Check up assessment. Then, each Check up is mapped to strengthening support, or extension. This allows every student to follow a personalised path that fits with their individual level of understanding.

At GCSE: exam-style questions throughout

Each lesson has exam-style questions similar to past paper questions, at appropriate levels, enabling *all* students to gain confidence in answering exam questions throughout their GCSE mathematics course, and at whatever level they may be working at.

Exam-style question

7 In a sale, the normal price of a hat is reduced by 30%.
The sale price of the hat is £6.30.
Work out the normal price of the hat. **(2 marks)**

Exam-style question

1 Factorise fully $5x^2 - 45$ **(2 marks)**

At GCSE (Higher): a taste of A level

Higher curriculum concepts are mapped to A level concepts, giving Higher students the opportunity to gain a 'taste' of what is required to work at A level standard.

Working towards A level

9 $\overrightarrow{OA} = \begin{pmatrix} k \\ 3k \end{pmatrix}$ where k is a constant.
Given that $|\overrightarrow{OA}| = 4\sqrt{5}$, find the possible values of k.

Apply your knowledge of vectors to the information given, then use other mathematical skills to solve the problem.

Q9 hint

The magnitude, $|\overrightarrow{OP}|$, of a vector $\overrightarrow{OP} = \begin{pmatrix} a \\ b \end{pmatrix}$ is given by $\sqrt{a^2 + b^2}$.

At Pearson, we believe that every KS3 and GCSE Mathematics student deserves to follow a coherently planned and ambitious curriculum, with confidence at the heart.

Developed in partnership with the Maths Progress and Pearson Edexcel GCSE (9–1) Mathematics series editors:

Katherine Pate and
Dr Naomi Norman

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