edexcel

EDEXCEL INTERNATIONAL GCSE (9-1)

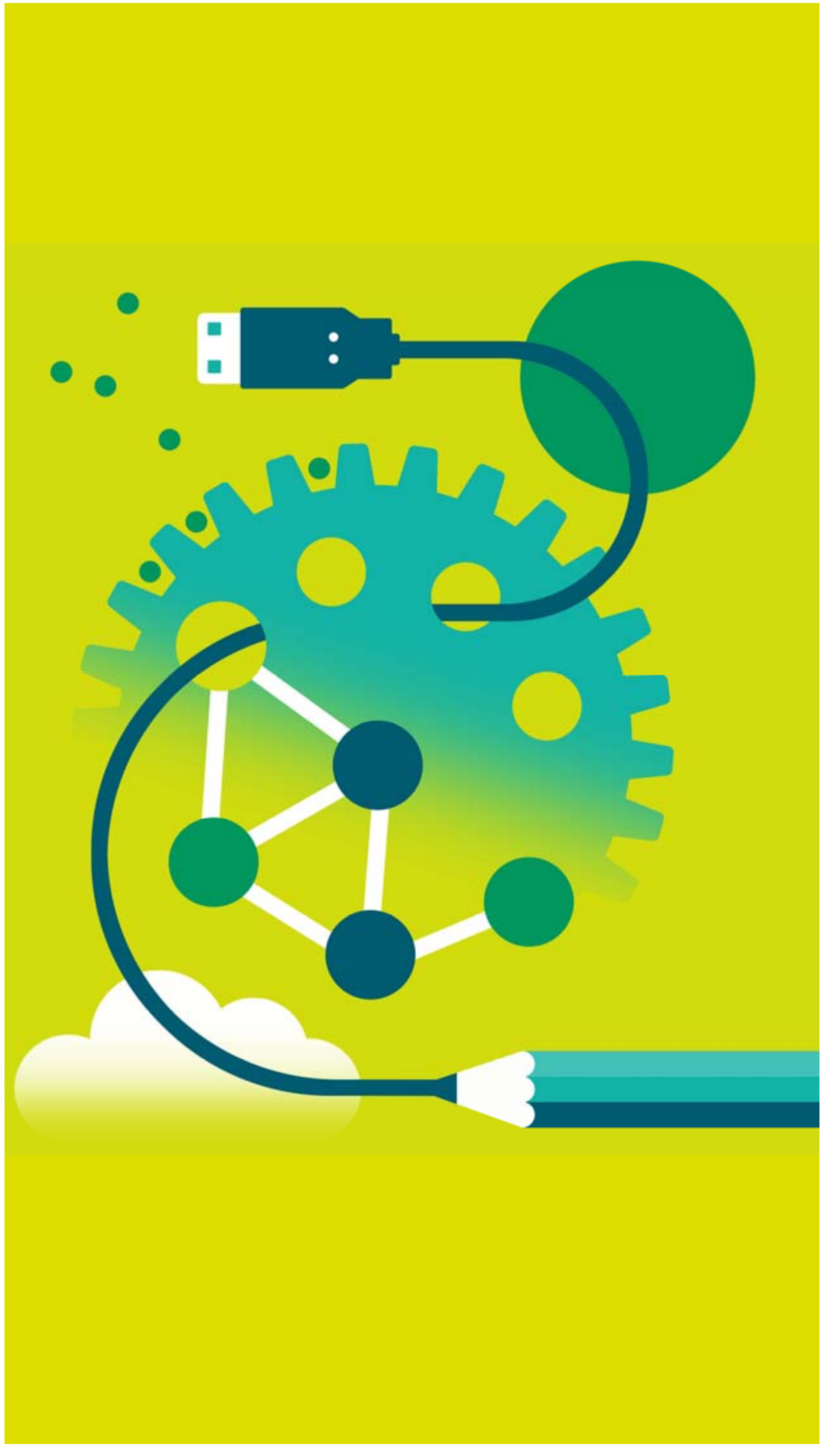
Further Pure Mathematics 4PM1

GETTING READY TO TEACH

Event code: 17IOAM07

First teaching in 2017, first assessment in 2019.

Pearson



edexcel

Your Online Environment

Pearson

Your trainer today:

Please insert name

Aims and Objectives

During the training you will:

- Consider the structure, content and assessment of this qualification through examining each of the papers in detail, and the support to guide you through these changes.
- Consider the key changes from 4PM0
- Learn about the new 9 – 1 scale.
- Explore possible teaching and delivery strategies for the new qualification.

Session Agenda

16:00 Welcome
Overview of the changes to International GCSE Further Pure Mathematics
16:10 Content changes
17:00 Short comfort break
17:50 The new grading scale and resources
18:00 Finish

Assessment Structure

Could you please move everything up please

Introduction to the Assessment

Content

There are minor updates to the present specification rather than large scale changes.

Assessment Objectives / Skills Tested

AO1 – Demonstrate a confident knowledge of the techniques of Pure Mathematics.

AO2 – Apply a knowledge of mathematics to the solutions of problems for which an immediate method is not available.

AO3 – Write clear and accurate mathematical solutions.

Structure of Assessment

Both papers are each 50% of the total International GCSE.

Each paper is assessed through a 2 hour examination set and marked by Pearson and consists of around 11 questions with varying mark allocations per question which will be stated on the paper.

The specification will have approximately 40% of the marks distributed evenly over grades 4 and 5, and approximately 60% of the marks distributed evenly over grades 6, 7, 8 and 9.

edexcel

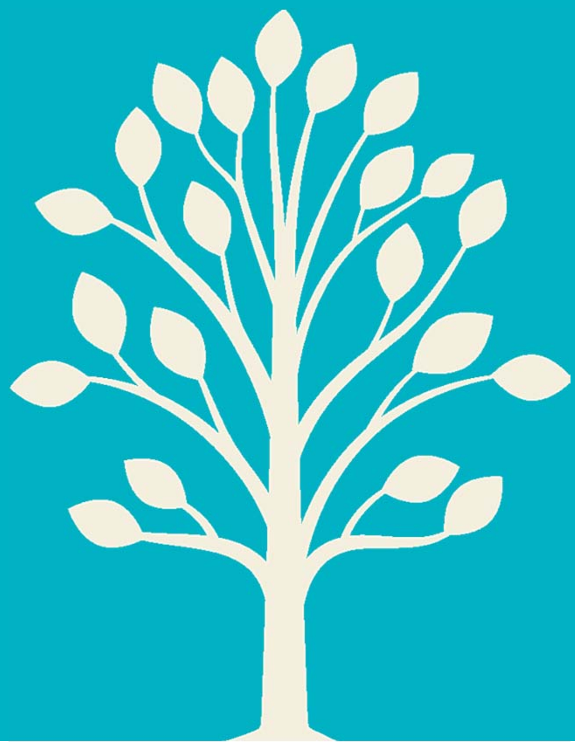
Relationship of assessment objectives to units

Unit Number	Assessment Objectives		
	AO1	**A02**	**A03**
Paper 1	15 – 20%	10 – 15%	17.5 – 25%
Paper 2	15 – 20%	10 – 15%	17.5 – 25%
Total for International GCSE	30 – 40%	20 – 30%	35 – 50%

Pearson

Poll

Getting to know the delegates



Getting to know the delegates

1. How long have you been delivering/teaching this qualification and subject?

   1. I'm new to the delivery. 2. 1 – 2 years 3. More than 2 years

2. Were your students entered for the last examination?

   1. Yes 2. No

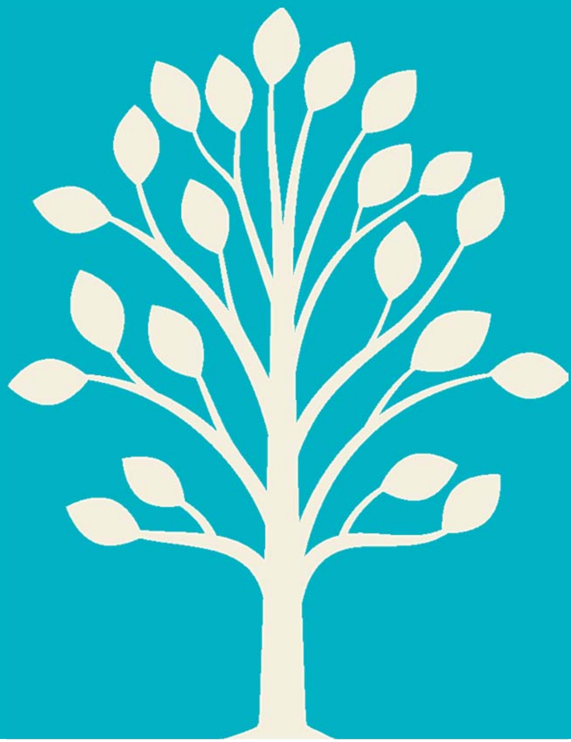
3. What are the key reasons for attending this session?

   Please enter your reasons in the chat panel.

4. What is the single most important thing you hope to take away from the session?

   Please enter your reasons in the chat panel

Information gained from our consultations and the changes we are making



Information gained from our consultations and the changes we are making.

- International GCSE Maths is valued by teachers and learners as an attractive equivalent to GCSE Maths and an alternative preparation for A level

- Centres would welcome some updates, rather than large-scale changes to the specification

- Centres generally would like grades to be on the same scale as for the new GCSE (9 - 1) Maths

edexcel

Following consultations we are making the following changes to the International GCSE in Further Pure Mathematics

- A move from the current A*-G to the new 9 – 4 grading structure to maintain comparability with GCSE 9 – 1 Maths

- Some minor additions to the content assessed to reflect this new 9-4 grading structure

Pearson

but...

- The changes are natural extensions of the current content
- The changes should not involve a large amount of extra teaching time
- Questions requiring the use of problem solving and mathematical reasoning are nothing new to the International GCSE specification – there is just a slight increase in these
- Question types and language used will be very similar to those on the current specification

International centres

The FINAL assessment date for Further Pure Mathematics 4PM0 specification will be January 2019.

The first assessment of International GCSE Further Pure Mathematics will be June 2019

Marking

Types of marks

M – Method mark; is awarded for a correct method.
Note: the method must be complete of the award of this mark.

A – Accuracy mark; is awarded for a correct answer.
Note: If the method mark has not been awarded, for example and incorrect method has been used, the **A** mark is automatically not available, even if the final answer is correct.

B - Independent mark; is awarded for a correct answer seen.

Advice to candidates (1)

- Candidates should **state** formulae before using them.
- In ‘show that’ questions **all necessary steps** must be shown.
- The rubric states clearly that answers without any or sufficient working may not gain full marks.
- Candidates should be encouraged to work neatly. This will not only help the candidate organise their thoughts, but help the examiner to see where marks are awarded.

Advice to candidates (2)

- When answering questions that have more than one part, note that part (a) leads into part (b) which leads into part (c) etc.
- Candidates should submit **ONE** attempt at a question. If there are multiple attempts, candidates should indicate clearly which attempt they wish to be marked by crossing out all other attempts.

Note Carefully: Multiple attempts at a question score no marks.

Content changes

1. Logarithmic functions and indices

A	The functions a^x and $\log_b x$ (where b is a natural number greater than one).
B	Use and properties on indices and logarithms, including change of base.
C	Simple manipulation of surds.
D	Rationalising the denominator. (This has been added to the specification)

1. Logarithmic functions and indices

D Rationalising the denominator

We now expect candidates to be able to rationalise the denominator for expressions such as $\frac{1}{2-\sqrt{3}}$ as well as those with a denominator that is a pure surd. This brings the specification into line with 4MA1 and 4MB1.

SAM Question 8 part (d) Paper 2

(d) Express $\frac{1}{\sqrt{10}-3}$ in the form $a\sqrt{10}+b$, where a and b are integers.

(2)

Marking Activity

Mark the following 3 candidate responses

Show that $\frac{\sqrt{12}-1}{2-\sqrt{3}}$ can be written as $4+3\sqrt{3}$

Show your working clearly. (4)

Mark Scheme

M1 Method to rationalise $\frac{(\sqrt{12}-1)(2+\sqrt{3})}{(2-\sqrt{3})(2+\sqrt{3})}$

M1 correct expansion of brackets $\frac{2\sqrt{12}-2+\sqrt{12}\sqrt{3}-\sqrt{3}}{4-3}$

B1 $\sqrt{12}=2\sqrt{3}$ (may be seen before expansion)

A1 answer from fully correct working with all steps seen

Responses

edexcel

A

that $\frac{\sqrt{12}-1}{2-\sqrt{3}}$ can be written as $4+3\sqrt{3}$

your working clearly.

$\frac{\sqrt{12}-1}{2-\sqrt{3}} = 4+3\sqrt{3}$

$\sqrt{12}-1 = 4+3\sqrt{3} \times (2-\sqrt{3})$

$\sqrt{12}-1 = 8-4\sqrt{3}+6\sqrt{3}-9$

$\sqrt{12} = -1+2\sqrt{3}$

$2\sqrt{3} = -\cancel{1}+\cancel{1}+2\sqrt{3}$

$2\sqrt{3} = 2\sqrt{3}$

Left side = Right side

$\therefore \frac{\sqrt{12}-1}{2-\sqrt{3}}$ can be written as $4+3\sqrt{3}$

$\frac{\sqrt{12}-1}{2-\sqrt{3}}$

$= \frac{2\sqrt{3}-1}{2-\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$

$= \frac{6-1}{2-1} \cdot \frac{5}{1}$

$\frac{\sqrt{4\times 3}-1}{2-\sqrt{3}}$

B

$\frac{\sqrt{12}-1}{2-\sqrt{3}}$

$= \frac{\sqrt{12}-1 \times (2+\sqrt{3})}{2-\sqrt{3} \times (2+\sqrt{3})}$

$= \frac{2\sqrt{12}+\sqrt{36}-2-\sqrt{3}}{2^2-3}$

$\rightarrow \frac{2\sqrt{12}+\sqrt{36}-2+\sqrt{3}}{1}$

$= \cancel{2\sqrt{4\times 3}+\sqrt{n}}$

$= 2\sqrt{4\times 3}+6-2-\sqrt{3}$

$= 4\sqrt{3}-\sqrt{3}+4$

$= \cancel{4}\ 3\sqrt{3}+4$

$= 4+3\sqrt{3}$

C

$\frac{\sqrt{12}-1}{2-\sqrt{3}} = \frac{\sqrt{4\times 3}-1}{2-\sqrt{3}} = \frac{2\sqrt{3}-1}{2-\sqrt{3}} \times 2+\sqrt{3} = \frac{3\sqrt{3}}{4-\sqrt{3}}$

$= \frac{3\sqrt{3}}{\cancel{4}}$

$(2\sqrt{3}-1)(2+\sqrt{3})$

$= 4\sqrt{3}-2+6-\sqrt{3}$

$(2-\sqrt{3})(2+\sqrt{3})$

$= 4-\cancel{2\sqrt{3}}+\cancel{2\sqrt{3}}-\sqrt{3}$

$= 4-\sqrt{3}$

(Total for Question 10 is 4 mark

Pearson

Marking Activity - Poll

Poll

Please insert a poll for delegates to enter their marks for the three responses.

A

M1	
M1	
B1	
A1	

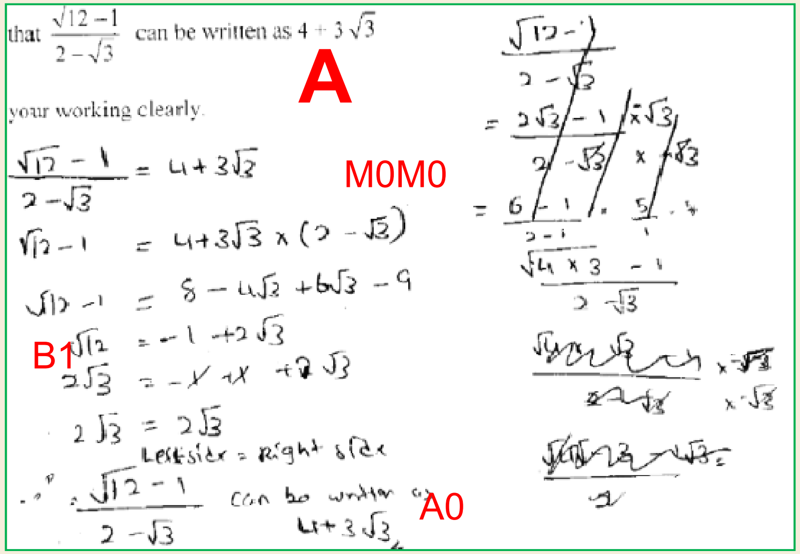
B

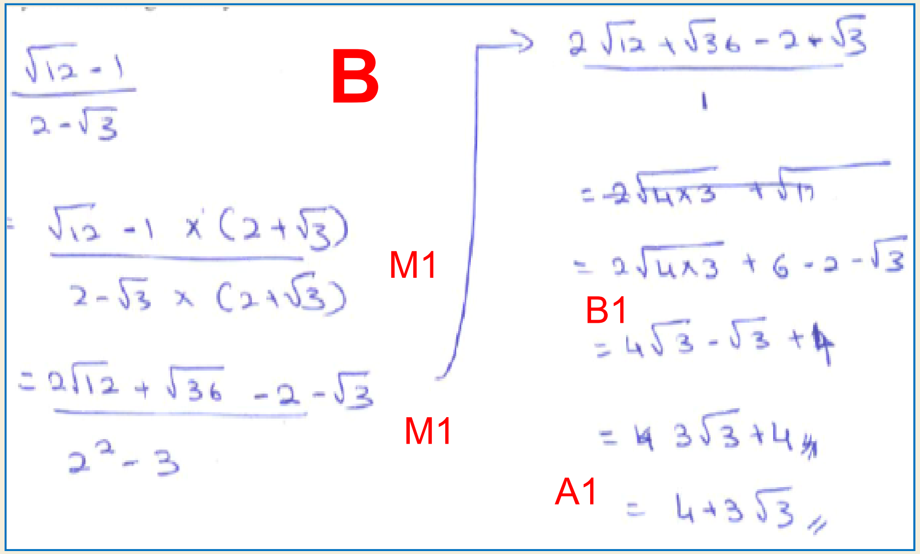
M1	
M1	
B1	
A1	

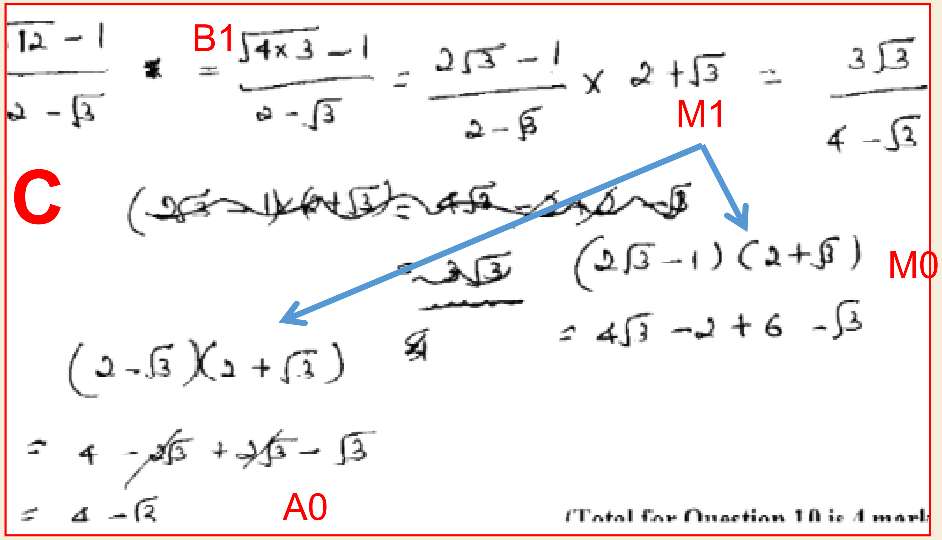
C

M1	
M1	
B1	
A1	

Marking Activity – mark allocation







1. Logarithmic functions and indices

SAM Question 6 Paper 2

6 Solve the equation $\log_2 x + 6\log_x 2 = 7$

Candidates are expected to be able to use the properties of indices and logarithms, including change of base of the logarithm.

This question will develop into a quadratic equation so that specification reference **2A** (manipulation of quadratic equations) will also be tested here.

1. Logarithmic functions and indices

At its very simplest, questions such as could be asked.

Find the value of

$$\log_3 9$$

This part is a 1 mark question as it is expected that candidates are able to 'write down' the correct value.

(Paper 2 June 2015 Q10 (a))

1. Logarithmic functions and indices

This is an example of a 'show' question

(c) 'Show that'

$$2x\log_3 x - 3\log_3 x - 4x\log_9 4 + 6\log_9 4 = \log_3\left(\frac{x}{4}\right)^{(2x-3)}$$

(6)

The instruction 'show that' means that candidates must show EVERY step in their working, and note that there are 6 marks available in this part. This is an indication that a lot of work is required for that many marks. Candidates must demonstrate they understand logarithmic rules.

(Paper 2 June 2015 Q10 (c))

1. Logarithmic functions and indices

The final part of the same question now develops using the word 'hence'. This implies that the previous result is to be used to solve the equation.

(d) Hence solve the equation

$$2x\log_3 x - 3\log_3 x - 4x\log_9 4 + 6\log_9 4 = 0$$

This means, solve the equation $\log_3\left(\frac{x}{4}\right)^{(2x-3)} = 0$

Solution and working are on the next slide.

1. Logarithmic functions and indices

Solving the equation $\log_3\left(\frac{x}{4}\right)^{(2x-3)} = 0$

Use the laws of logs first

Consider **both** possibilities

$$(2x-3)\log_3\left(\frac{x}{4}\right) = 0 \Rightarrow 2x-3 = 0 \text{ or } \log_3\left(\frac{x}{4}\right) = 0$$

$$\Rightarrow x = \frac{3}{2} \text{ or } \frac{x}{4} = 3^0 \Rightarrow x = 4$$

$$\Rightarrow x = \frac{3}{2},\ 4$$

There are two roots !

2. The Quadratic Function

There is no new content in this section.

A	The manipulation of quadratic expressions.
B	The roots of a quadratic equation.
C	Simple examples involving functions of the roots of a quadratic equation.

2. The Quadratic Function

A Manipulation of quadratic expressions

Candidates are expected to be able to recognise applications where quadratic equations require to be solved as part of the problem.

For example; **SAMs Question 4 (a) Paper 1**

A particle P is moving along the x-axis.

At time t seconds ($t \geqslant 0$) the velocity, v m/s, of P is given by $v = 4t^2 - 19t + 12$

(a) Find the values of t for which P is instantaneously at rest.

(2)

2. The Quadratic Function

edexcel

B The roots of a quadratic equation

Candidates should be able to use the discriminant to identify whether the roots are equal, real or not real as in part (c) of this question in the SAMs.

SAMs Question 4 part (c) Paper 2

$$f(x) = 2x^3 + px^2 + qx + 12 \quad p, q \in \mathbb{Z}$$

Given that $(x + 3)$ is a factor of $f(x)$ and that when $f'(x)$ is divided by $(x + 3)$ the remainder is 37

(a) show that $p = 1$ and find the value of q

(6)

(b) hence factorise $f(x)$ completely

(2)

(c) show that the equation $f(x) = 0$ has only one real root.

Pearson

2. The Quadratic Function

Completing the square of a quadratic function

The questions can be simple, or as in the following example, the level of demand has been increased by including a negative coefficient of x^2 in the function.

$$f(x) = 4 + 3x - x^2$$

(a) Write $f(x)$ in the form $P - Q(x+R)^2$

2. The Quadratic Function

Completing the square of a quadratic function

Candidates are also expected to interpret their answer and the questions goes on to ask:

The curve C has equation

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

(b) Find the coordinates of the maximum point of C. (1)

Candidates should look at the marks being awarded to be aware of the amount of work involved. In this case, there is only 1 mark available, so this is a strong hint that the answer can be written down using the result from part (a).

2. The Quadratic Function

edexcel

An example of a candidate's response

In this response, the candidate has not interpreted their answer from (a), but has differentiated (correctly) to find the coordinates.

This is still only worth one mark.

The curve C has equation $y = 4 + 3x - x^2$

(b) Find the coordinates of the maximum point of C.

(b) $\frac{dy}{dx} = 3 - 2x$

put $\frac{dy}{dx} = 0$

so, $3 - 2x = 0$

$\therefore x = \frac{3}{2}$

put $x = \frac{3}{2}$ in $y = 4 + 3(\frac{3}{2}) - (\frac{3}{2})^2$

$= \frac{25}{4}$

Maximum point $= (\frac{3}{2}, \frac{25}{4})$

Pearson

2. The Quadratic Function

C Simple examples involving functions of the roots of a quadratic equation.

Students are expected to understand and use;

the equation $ax^2 + bx + c = 0$ has roots α and β

such that $\alpha + \beta = -\dfrac{b}{a}$ and $\alpha\beta = \dfrac{c}{a}$

The most common source of error in this topic is the inability to expand polynomials correctly and this is pre-requisite in this topic.

2. The Quadratic Function

C Simple examples involving functions of the roots of a quadratic equation.

SAMs Question 9 Paper 1

9 The roots of a quadratic equation are α and β where $\alpha + \beta = -\frac{7}{3}$ and $\alpha\beta = -2$

(a) Find a quadratic equation, with integer coefficients, which has roots α and β

(4)

Given that $\alpha > \beta$ and without solving the equation,

(b) show that $\alpha - \beta = \frac{11}{3}$

(2)

(c) form a quadratic equation, with integer coefficients, which has roots

$$\frac{\alpha + \beta}{\alpha} \text{ and } \frac{\alpha - \beta}{\beta}$$

(7)

2. The Quadratic Function

C Simple examples involving functions of the roots of a quadratic equation.

Two common errors seen

$$f(x) = 196x^2 + 4774x + C$$
$$= 196x^2 + 4774x + 7$$
$$= 28x^2 + 682x + 1$$

This is not an equation!
An equation must = 0

$$\alpha^2 + \beta^2 = (\alpha + \beta)^2 - \alpha\beta$$

An example of careless algebra

3. Identities and Inequalities

There is no new content here

A	Simple algebraic division
B	The factor and remainder theorems
C	Solutions of equations, extended to include the simultaneous solution of one linear and one quadratic in two variables
D	Simple inequalities, linear and quadratic
E	The graphical representation of linear inequalities in two variables

3. Identities and Inequalities

edexcel

SAMs Question 4 Paper 1

4 $$f(x) = 2x^3 + px^2 + qx + 12 \quad p, q \in \mathbb{Z}$$

Given that $(x + 3)$ is a factor of $f(x)$ and that when $f'(x)$ is divided by $(x + 3)$ the remainder is 37

(a) show that $p = 1$ and find the value of q

(6)

(b) hence factorise $f(x)$ completely

(2)

(c) show that the equation $f(x) = 0$ has only one real root.

(2)

This question also brings in specification reference **9A** (differentiation)

Pearson

3. Identities and Inequalities

edexcel

SAMs Question 2 Paper 2

In this question, candidates have to find a simple linear inequality in part (a), a quadratic equality in part (b), and combine the result for part (c).

2 Find the set of values of x for which

(a) $3 + x < 2x - 1$

(1)

(b) $x(x - 1) > 6$

(3)

(c) **both** $3 + x < 2x - 1$ **and** $x(x - 1) > 6$

(1)

Pearson

3. Identities and Inequalities

edexcel

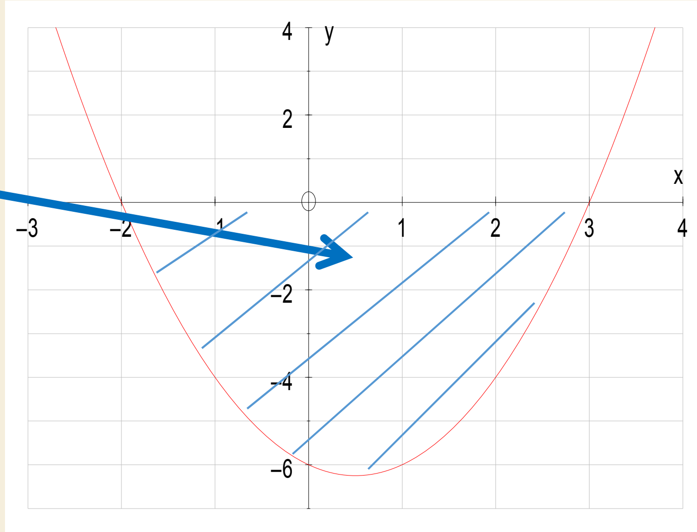
Teaching quadratic inequalities (1)

e.g. $x^2 - x - 6 < 0$

Find critical values: solve $x^2 - x - 6 < 0 \Rightarrow x = 3, x = -2$

Sketch or table?

So $-2 < x < 3$



For $x^2 - x - 6 > 0$

$x < -2$ OR $x > 3$

Do Not Write $3 < x < -2$

Pearson

3. Identities and Inequalities

Teaching quadratic inequalities – (2)

Using a table

	$x < -2$	$-2 < x < 3$	$x > 3$
$(x - 3)$	–	–	+
$(x + 2)$	–	+	+
$(x - 3)(x + 2)$	+	–	+

So for $x^2 - x - 6 > 0$ $x < -2$ OR $x > 3$

Or for $x^2 - x - 6 < 0$ $-2 < x < 3$

Another neat way for quadratic inequalities

	< 0	> 0
$+x^2$	$-2 < x < 3$	$x > 3$ OR $x < -2$
$-x^2$		

So for $x^2 - x - 6 > 0$ $x < -2$ OR $x > 3$

Or for $x^2 - x - 6 < 0$ $-2 < x < 3$

3. Identities and Inequalities

edexcel

SAMs Question 1 Paper 1

Candidates are expected to be able to plot straight lines from the equation of a straight line given in any form, and to identify a region defined by inequalities.

1 (a) On the axes below, sketch the lines with equations $2x + 3y = 8$ and $2y = 4x + 1$

On your sketch, show the coordinates of the points where the lines cross the coordinate axes.

(2)

(b) Show, by shading on your sketch, the region R defined by the inequalities

$$2x + 3y \leqslant 8 \qquad 2y \leqslant 4x + 1 \qquad y \geqslant 0 \qquad x \leqslant 2$$

(2)

Pearson

5. Graphs

edexcel

There is no new content in this section.

A	Graphs of polynomials and rational functions with linear denominators
B	The solution of equations and transcendental functions by graphical methods

Pearson

5. Graphs

SAMs Question 7 Paper 2

The concept of asymptotes parallel to the coordinate axes is expected as in this question.

The curve C with equation

$$y = \frac{ax - 5}{x - b}$$

where a and b are integers, crosses the x-axis at the point $(2.5, 0)$. The asymptote to C which is parallel to the y-axis has equation $x = 1$

(a) (i) Show that $a = 2$

(ii) Find the value of b.

(3)

(b) Find the coordinates of the point where C crosses the y-axis.

(1)

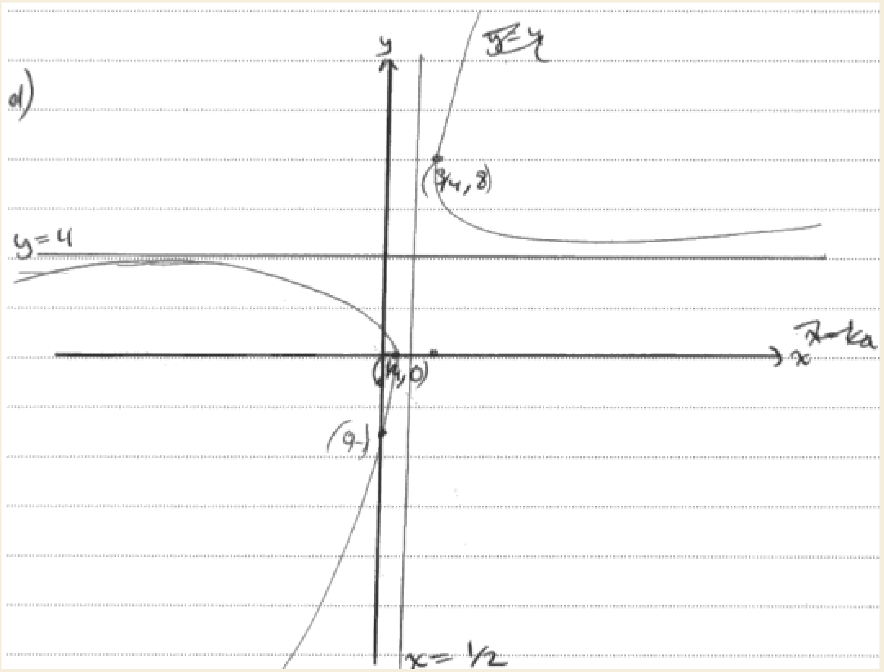
(c) Find the equation of the asymptote to C which is parallel to the x-axis.

(1)

(d) Using the axes below, sketch the curve C showing clearly the asymptotes and the coordinates of the points where C crosses the coordinate axes.

5. Graphs

This is a typical sketch of a student response. (Question 10 (e) Paper 1
Note how poorly the curve endings are drawn.
The asymptote drawn parallel to the *y*-axis is correct and gained B1
There is no asymptote parallel to the *x*-axis, so the line drawn here was ignored as the candidate was already penalised for an incorrect position of the curve.



5. Graphs

SAMs Question 7 Paper 1

This question follows on the next slide.

Part (c) of the question links in to specification reference **1B**

5. Graphs

7 (a) Complete the table of values for

$$y = 2^{\left(\frac{x}{2}+1\right)} + 1$$

giving your answers to 2 decimal places where appropriate.

(2)

x	0	1	2	3	4	5
y	3				9	12.31

(b) On the grid opposite, draw the graph of $y = 2^{\left(\frac{x}{2}+1\right)} + 1$ for $0 \leqslant x \leqslant 5$

(2)

(c) By drawing a suitable straight line on the grid, obtain an estimate, to 1 decimal place, of the root of the equation $\log_2(4x-6)^2 - x = 2$ in the interval $0 \leqslant x \leqslant 5$

(4)

5. Series

There is no new content here, but the formulae for the sum to *n* terms of an Arithmetic series and of a Geometric series will now be given in the formula sheet. The formula for the sum to infinity of a geometric series will also be given. (The formulae for the *n*th terms will **NOT** be given).

A	Use of the Σ notation
B	Arithmetic and Geometric series

Use of the sum to infinity of a convergent series, including the use of $|r| < 1$ is required.

Note: Proofs of the summation formulae are not required – although they are beautiful mathematics and are well worth discussing with students.

5. Series

Arithmetic Series

SAMs Question 8 Paper1

8 The sum S_n of the first n terms of an arithmetic series is given by $S_n = 2n(n + 3)$

(a) Find the first term of the series.

(1)

(b) Find the common difference of the series.

(2)

The nth term of the series is T_n

Given that $6S_{(n-4)} = 7T_{(n+3)}$

(c) find the value of n.

(6)

5. Series

Arithmetic Series

SAMs Question 8 Paper1

8 The sum S_n of the first n terms of an arithmetic series is given by $S_n = 2n(n + 3)$

(a) Find the first term of the series.

(b) Find the common difference of the series.

A common error in a question in this form

The first term is found easily, because $S_n = U_n$

However, $S_2 = U_1 + U_2$ so $U_2 = S_2 - U_1$

5. Series

Geometric Series

SAMs Question 1 Paper 2

1 The nth term of a geometric series is $3e^{(1-2n)}$

Find the sum to infinity of this series.

Give your answer in the form $\frac{ae}{e^b - 1}$ where a and b are integers to be found.

This is an example of an AO2 question.
In order to start it is necessary to find the first term and the common ratio as shown on the next slide, although no indication of this is given in the question.

5. Series

It is always useful to write out a few terms of the sum of a series given in Σ form.

For example;

n	1	2	3	4	5
U_n	$3e^{-1}$	$3e^{-3}$	$3e^{-5}$	$3e^{-7}$	$3e^{-9}$

$$\Rightarrow \text{First term} = 3e^{-1}$$

$$\Rightarrow \text{Common ratio} = \frac{3e^{-3}}{3e^{-1}} = e^{-2}$$

5. Series

The question asks for the sum to infinity in a specific form, so candidates should always look at the given form at every stage to make sure they are working in the correct direction. The solution below is of course only one way this could be simplified.

$$S = \frac{3e^{-1}}{1 - e^{-2}} = \frac{\frac{3}{e}}{1 - \frac{1}{e^2}} = \frac{\frac{3}{e}}{\frac{e^2 - 1}{e^2}} = \frac{3e}{e^2 - 1}$$

6. The Binomial Expansion

There are no changes in this section but the formula for the Binomial expansion of $(1+x)^n$ will now be given in the formula sheet.

A	Use of the binomial series $(1+x)^n$

Questions can be set for the use of the series when:

(i) n is a positive integer

(ii) n is rational and $|x| < 1$

The validity condition for (ii) is expected.

6. The Binomial Expansion

SAMs Question 8 Paper 2

This question is on the next slide.

It includes specification reference **1C** and **1D** in parts (c) and (d)

6. The Binomial Expansion

edexcel

8 (a) Expand $\dfrac{3}{\sqrt{1-2x}}$ in ascending powers of x up to and including the term in x^3 and simplifying each term as far as possible.

(4)

(b) Write down the range of values of x for which this expansion is valid.

(1)

(c) Show that $\dfrac{3}{\sqrt{0.9}} = \sqrt{10}$

(1)

(d) Express $\dfrac{1}{\sqrt{10}-3}$ in the form $a\sqrt{10}+b$, where a and b are integers.

(2)

(e) Hence, using your expansion with a suitable value for x, obtain an approximation to 5 decimal places of $\dfrac{1}{\sqrt{10}-3}$

(3)

Pearson

7. Scalar and vector quantities

edexcel

There are no changes in this section

A	The addition and subtraction of coplanar vectors and the multiplication of a vector by a scalar.
B	Components and resolved parts of a vector
C	Magnitude of a vector
D	Position vector
E	Unit vector
F	Use of vectors to establish simple geometrical properties of geometrical figures.

Pearson

7. Scalar and vector quantities

edexcel

SAMs Question 3 Paper 2

3 O, A and B are fixed points such that

$$\overrightarrow{OA} = 4\mathbf{i} + 3\mathbf{j} \qquad \overrightarrow{OB} = 8\mathbf{i} + p\mathbf{j} \quad \text{and} \quad \left|\overrightarrow{AB}\right| = 2\sqrt{13}$$

(a) Find the possible values of p.

(3)

Given that $p > 0$

(b) find a unit vector parallel to $\overrightarrow{AB}$

(2)

Pearson

7. Scalar and vector quantities

Vector questions always clearly differentiate between the strongest and the weakest candidates.

Many marks in questions in vectors are lost due to two reasons;

1. candidates do not have a consistent approach to directions which are so crucial in this work, and
2. candidates use poor notation.

Questions frequently begin with fairly routine demands.

The next slide gives a typical example.

7. Scalar and vector quantities

Example Question January 2016

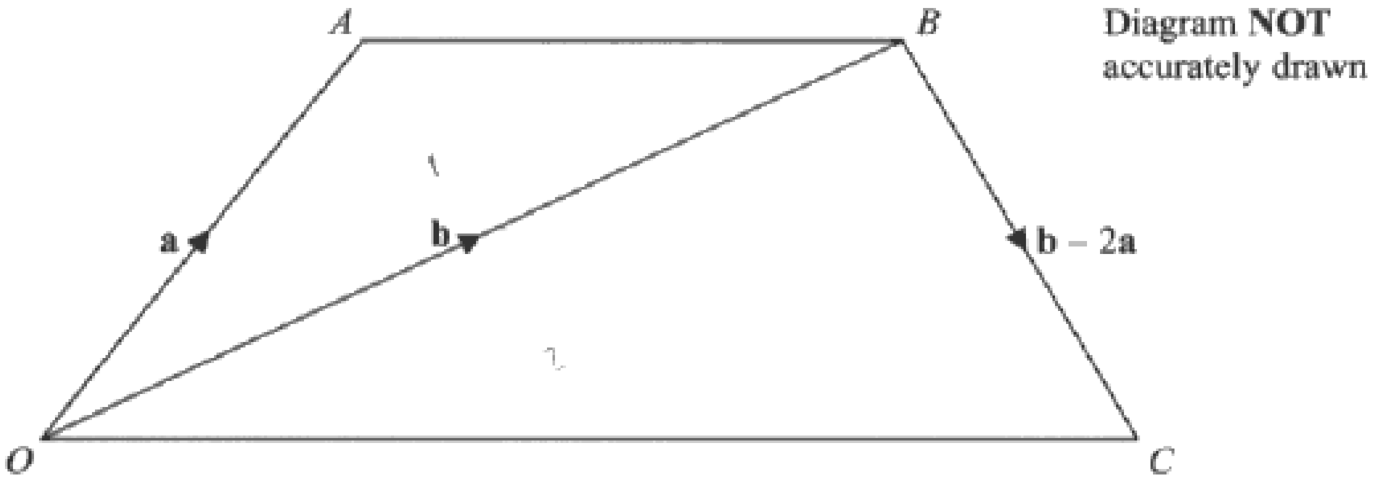


Figure 2

Figure 2 shows a quadrilateral $OABC$

$$\overrightarrow{OA} = \mathbf{a},\ \overrightarrow{OB} = \mathbf{b} \text{ and } \overrightarrow{BC} = \mathbf{b} - 2\mathbf{a}$$

(a) (i) Prove that $\overrightarrow{AB}$ is parallel to $\overrightarrow{OC}$

(ii) Show that $AB : OC = 1 : 2$

7. Scalar and vector quantities

January 2016

It is always advisable to establish correct vector statements **first.**
This will help the candidate **AND** crucially score the Method mark.

$$\overrightarrow{AB} = \overrightarrow{AO} + \overrightarrow{OB} \Rightarrow -\mathbf{a} + \mathbf{b}$$

$$\overrightarrow{OC} = \overrightarrow{OB} + \overrightarrow{BC} \Rightarrow \mathbf{b} + \mathbf{b} - 2\mathbf{a} = 2\left(-\mathbf{a} + \mathbf{b}\right)$$

In a proof, a conclusion is required;

$\overrightarrow{OC} = 2\overrightarrow{AB}$ so same direction,

and the ratio is $\overrightarrow{AB} : \overrightarrow{OC} = 1:2$

7. Scalar and vector quantities

January 2016

The second part of the question increases the level of demand and it continues with;

The point D lies on OB such that $OD : DB = 2 : 3$

(b) Find the ratio of the area of $\triangle ODC$: the area of $\triangle OAB$.

(6)

These parts of vector questions are usually amongst the most challenging in the whole paper, but they need not be so.

The most common error in vector questions involving length or area is to attempt to use vectors instead of lengths.

In this case, the solution is straightforward when areas of triangles are used;

either $\frac{1}{2}ab\sin C$ or half x base x height.

8. Rectangular Cartesian coordinates

There are no changes in this section

A	The distance between two points.
B	The point dividing a line in a given ratio.
C	Gradient of a straight line joining two points.
D	The straight line and its equation.
E	The condition for two lines to be parallel or to be perpendicular

8. Rectangular Cartesian coordinates

SAMs Question 10 Paper 2

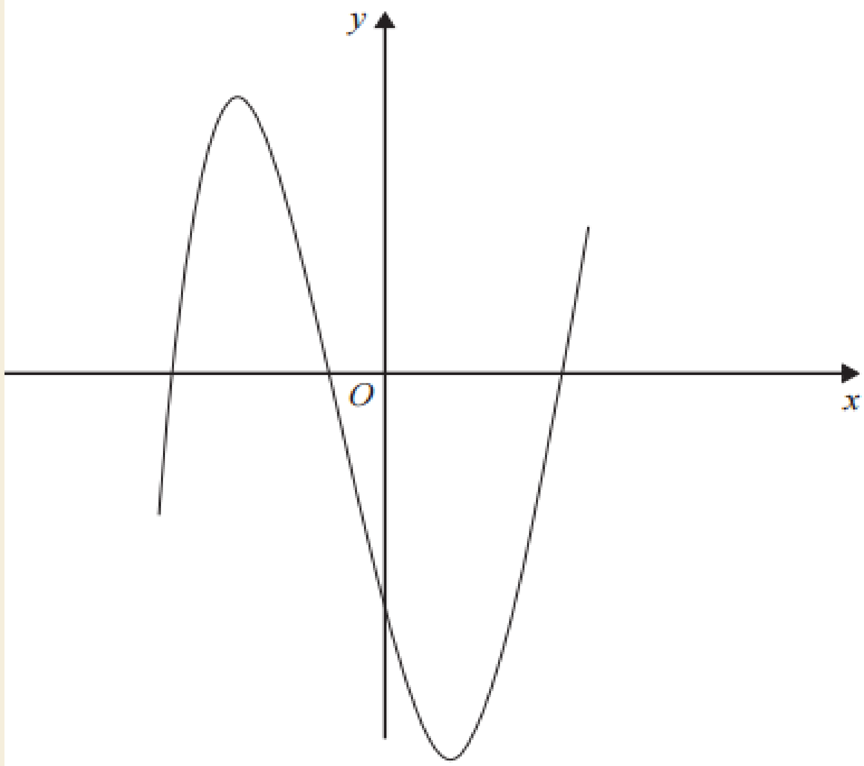


Figure 1

The question follows on the next slide

8. Rectangular Cartesian coordinates

SAMs Question 10 Paper 2

Figure 1 shows the curve M with equation $y = x^3 - 13x - 12$

The point P, with x coordinate -2, lies on M and line l_1 is the tangent to M at the point P.

(a) Find an equation for l_1

(5)

The point Q lies on M and the line l_2 is the tangent to M at the point Q.

Given that l_1 and l_2 are parallel,

(b) find an equation for l_2

(4)

The normal to M at P meets l_2 at the point R.

(c) Find the coordinates of R.

(4)

(d) Find the exact length of the line PR.

(2)

The tangent and normal at P and the tangent and normal at Q form a rectangle.

(e) Find the exact area of this rectangle.

(3)

8. Rectangular Cartesian coordinates

These questions are always generally well attempted.

Key points which candidates would do well to note.

1. Always draw a sketch, or annotate and add the sketch if one is given in the question. A common feature of poor attempts at these questions is the lack of a good careful sketch.
2. Dividing a line in a given ratio – those candidates who attempt to use the formula often make mistakes. Those who use similar triangles nearly always get it right.

8. Rectangular Cartesian coordinates

And finally:

Many candidates do not read questions carefully and find the equation of the normal when the tangent is required, and vice versa.

Please encourage your students to read these questions very carefully to avoid losing marks needlessly.

9. Calculus

There are no changes in this section.

However, the formula for Quotient rule will now be given in the formula sheet.

The formulae for Product and Chain rules will be expected to be known.

9. Calculus

A	Differentiation and integration of sums and multiples of powers of x, $\sin ax$, $\cos ax$ (excluding integration of $1/x$)
B	Differentiation of a product, quotient and simple cases of a function of a function.
C	Applications to simple kinematics and to determination of areas and volumes
D	Stationary points and turning points
E	Maxima and minima
F	The equations of tangents and normals to the curve $y = \mathrm{f}(x)$
G	Applications of calculus to rates of change and connected rates of change

9. Calculus

SAMs Question 6 Paper 1

An example of a question involving specification reference **9A** and **9B**

$$y = e^x\left(x^2 - 3x\right)$$

Show that $y - 2\frac{dy}{dx} + \frac{d^2y}{dx^2} = 2e^x$

Note this is another example of a **show** question. Encourage your students to show every step of working.

9. Calculus

SAMs Question 4 Paper 2 Spec 9C – Applications to kinematics

A particle P is moving along the x-axis.

At time t seconds ($t \geqslant 0$) the velocity, v m/s, of P is given by $v = 4t^2 - 19t + 12$

(a) Find the values of t for which P is instantaneously at rest.

When $t = 0$, the displacement of P from the origin is -4 m.

(b) Find the displacement of P from the origin when $t = 6$

At time t seconds the acceleration of P is a m/s^2.

(c) Find the value of t when $a = 0$

Note: When integrating the velocity to find the displacement, a very common error is to omit $+c$

9. Calculus – Integration

Key point – the constant of integration

•Don't forget to include +*c* in indefinite integrals. This could result in the loss of just a single mark in a question such as.

$$\mathrm{f}(x) = 3x^2 + \frac{5}{x} + 3 \quad \text{find} \int \mathrm{f}(x)\ \mathrm{d}x$$

The level of demand could be increased by asking candidates to find the equation of a curve given also the coordinates of a point on the curve, in which case several marks would be lost by this omission.

9. Calculus

SAMs

Question 11

Paper 1

Part (a) is an example of a question aiming for Grade 9

Diagram **NOT** accurately drawn

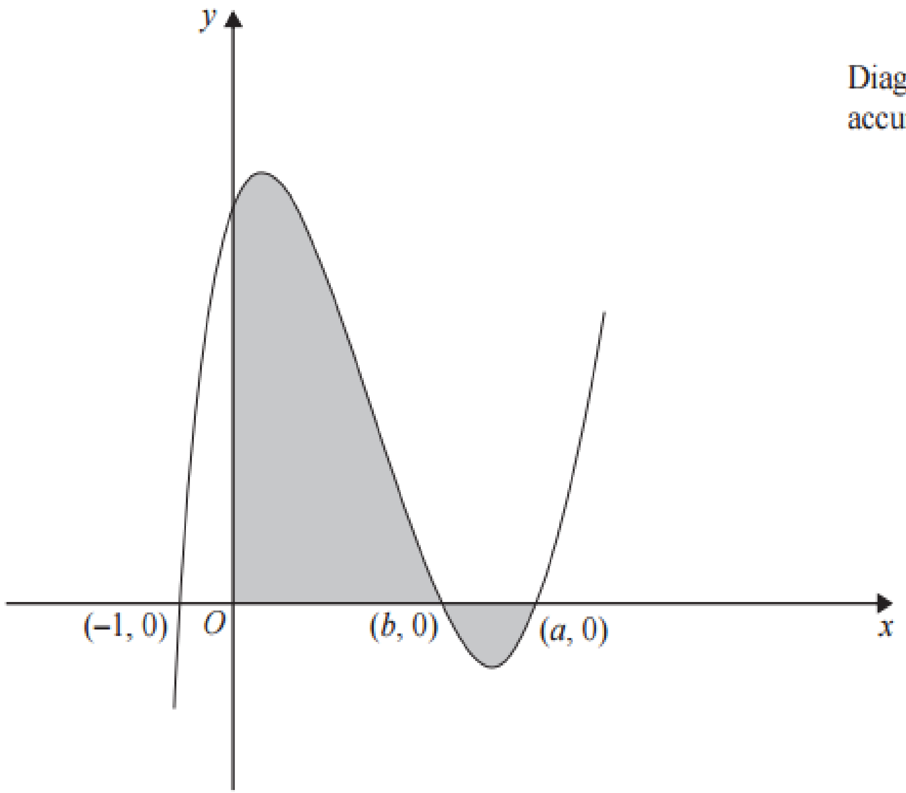


Figure 3

Figure 3 shows a sketch of the curve with equation $y = f(x)$, which passes through the points with coordinates $(-1, 0)$, $(b, 0)$ and $(a, 0)$ where $0 < b < a$.

Given that $f'(x) = 6x^2 - 26x + 12$

(a) find,

(i) the value of a,

(ii) the value of b.

(8)

(b) Use algebraic integration to determine the exact value of the total area of the shaded regions shown in Figure 3.

9. Calculus – Integration

Key point - draw a sketch to find an area or a volume

Some questions include a sketch and some do not as in the following example.

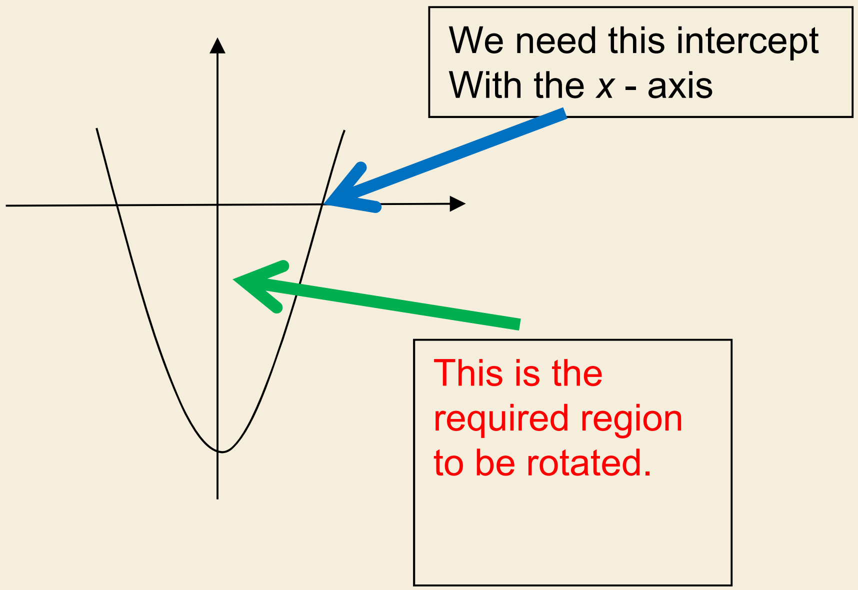
The region enclosed by the curve with equation $y = 4x^2 - 9$, the positive x-axis and the negative y-axis is rotated through 360° about the x-axis.

Use algebraic integration to find, to 3 significant figures, the volume of the solid generated.

9. Calculus – Integration

Key point - draw a sketch to find an area or a volume

The question does not give any limits, so a thumbnail sketch would quickly establish what is required to be found.



9. Calculus – Integration

This question is testing volumes of revolution, so a method mark for increasing the power of a variable by 1 was not available. The method marks were dependent on candidates using the correct formula and method for determining the volume.

Step 1 – find the x intercepts. $4x^2 - 9 = 0 \Rightarrow x = \pm\frac{3}{2}$ M1A1

Step 2 – establish limits of integration (from sketch) 3/2 and 0

Step 3 – set up integration $\text{Vol} = \pi\int_0^{\frac{3}{2}}\left(4x^2 - 9\right)^2 \, dx$ M1

Step 4 – integrate $V = \pi\int_0^{\frac{3}{2}} 16x^4 - 72x^2 + 81 \, dx = \pi\left[\frac{16}{5}x^5 - 24x^3 + 81x\right]$ M1d

Step 5 – evaluate $V = \frac{324\pi}{5} = 203.57\ldots \approx 204 \ (3\text{sf})$ A1 (5)

Both method marks are available even if π is omitted.

9. Calculus

SAMs Question 5 Paper 1

Two numbers x and y are such that $2x + y = 13$

The sum of the squares of $2x$ and y is S.

(a) Show that $S = 8x^2 - 52x + 169$

(3)

Using calculus,

(b) find the value of x for which S is a minimum, justifying that this value of x gives a minimum value for S.

(4)

(c) find the minimum value of S.

(2)

Spec 9E – Maxima and minima may be set in the context of a practical problem. In this case this is set in the context of an algebraic problem

9. Calculus

SAMs Question 11 Paper 2
Spec 9G Application of calculus to connected rates of change

11

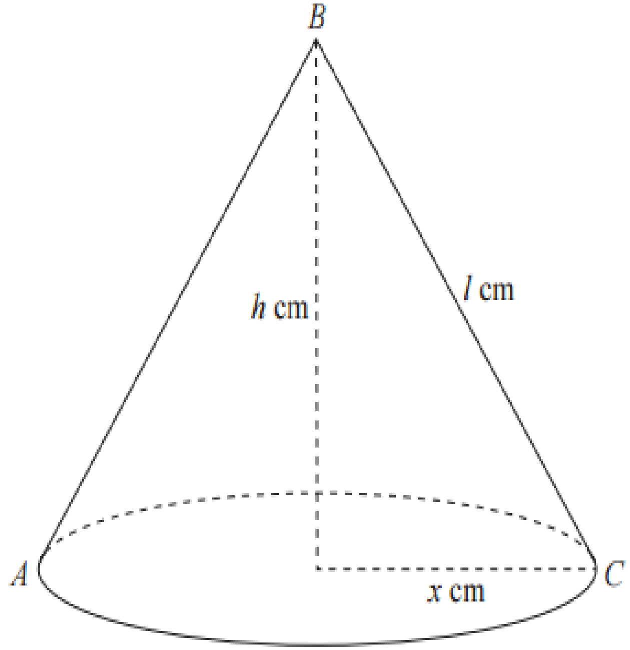


Diagram **NOT** accurately drawn

Figure 2

This is an example of a question aiming for Grade 9

The question follows on the next slide

9. Calculus - differentiation

SAMs Question 11 Paper 2

Figure 2 shows a right circular cone with a base radius of x cm. The slant height of the cone is l cm and the height of the cone is h cm. The vertex of the cone is B and the points A and C, on the base of the cone, are such that AC is a diameter of the base.

The cone is increasing in size in such a way that the size of the angle ABC is constant at 60° and the **total** surface area of the cone is increasing at a constant rate of 10 cm²/s.

Find the exact rate of increase of the volume of the cone when $x = 6$

(11)

The formula for the curved surface area of a cone is given in the formula sheet. This question also includes specification **10C** Trigonometry
The model answer to this question is given in the next two slides.

9. Calculus – connected rates of change

This question is usually not well answered at all, here is a model answer in the next slides together with the allocation of marks.
In this question we have the surface area given in terms of the slant height in the formula sheet.
Note: Common error! All differentiation must be in terms of one variable. Differentiating the volume of a cone with respect to *r* will gain M0 if there is an *h* present in d*V*/d*r* !

$$V = \frac{1}{3}\pi r^2 h$$

$$\frac{dV}{dr} = \frac{2\pi r}{3}$$

This gains no marks!

9. Calculus

SAMs Question 11 Paper 2

A good place to start is to work out the Chain Rule to see what is needed.

$$\frac{dV}{dt} = \frac{dV}{dx} \times \frac{dx}{dS} \times \frac{dS}{dt}$$

This will score the M mark wherever it appears (correctly!)

Let the total surface area of the cone be *S*.

$$\frac{dS}{dt} = 10 \text{ cm/s}^2 \qquad \text{B1}$$

First part – deal with the surface area. Do not forget the base!

$$S = \pi x l + \pi x^2 \quad \text{but} \quad l = \frac{x}{\sin 30} = \frac{x}{0.5} = 2x \qquad \text{B1}$$

so $\quad S = 2\pi x^2 + \pi x^2 = 3\pi x^2 \qquad$ M1A1

and $\quad \dfrac{dS}{dx} = 6\pi x \qquad$ M1

9. Calculus

SAMs Question 11 Paper 2 Model answer continued

Second part – deal with the volume

$h = \dfrac{x}{\tan 30} = \sqrt{3}x$	B1
$V = \dfrac{1}{3}\pi x^2 h = \dfrac{\sqrt{3}}{3}\pi x^3 \Rightarrow \dfrac{\mathrm{d}V}{\mathrm{d}x} = \sqrt{3}\pi x^2$	M1A1

Final part – apply Chain Rule

$\dfrac{\mathrm{d}V}{\mathrm{d}t} = \dfrac{\mathrm{d}V}{\mathrm{d}x} \times \dfrac{\mathrm{d}x}{\mathrm{d}S} \times \dfrac{\mathrm{d}S}{\mathrm{d}t}$	M1
$\Rightarrow \dfrac{dV}{dt} = \sqrt{3}\pi x^2 \times \dfrac{1}{6\pi x} \times 10 = \dfrac{5\sqrt{3}}{3}x = 10\sqrt{3}\ \text{ cm}^3/\text{s}$	M1A1

Don't forget that an EXACT answer is required.

10. Trigonometry

A	Radian measure including use for arc length and area of sector
B	The three basic trigonometrical ratios of angles of any magnitude (in radians or degrees) and their graphs
C	Applications to simple problems in two or three dimensions. (Including angles between a line and a plane and between two planes)
D	Use of sine and cosine formulae
E	The identity $\cos^2 A + \sin^2 A = 1$
F	The use of the basic addition formulae of trigonometry
H	The solution of simple trigonometric equations for a given interval

10. Trigonometry

edexcel

There is no new content here. However, the cosine rule formula will be given in the formula sheet, but sine rule and the area of a triangle $A = \frac{1}{2}ab\sin C$ will be expected to be known.

$\tan A = \frac{\sin A}{\cos A}$ will be given on the formula sheet.

The summation formulae for $\sin(A \pm B)$, $\cos(A \pm B)$ and $\tan(A \pm B)$ will be given in the formula sheet.

There is no new content in **10H**, but we have clarified the specification to explicitly include equations such as;

$$\sin(3x - 30^\circ) = \frac{1}{4} \quad \text{for} \quad -90^\circ \le x \le 90^\circ$$

Pearson

10. Trigonometry

SAMs Question 2 Paper 1

Diagram **NOT** accurately drawn

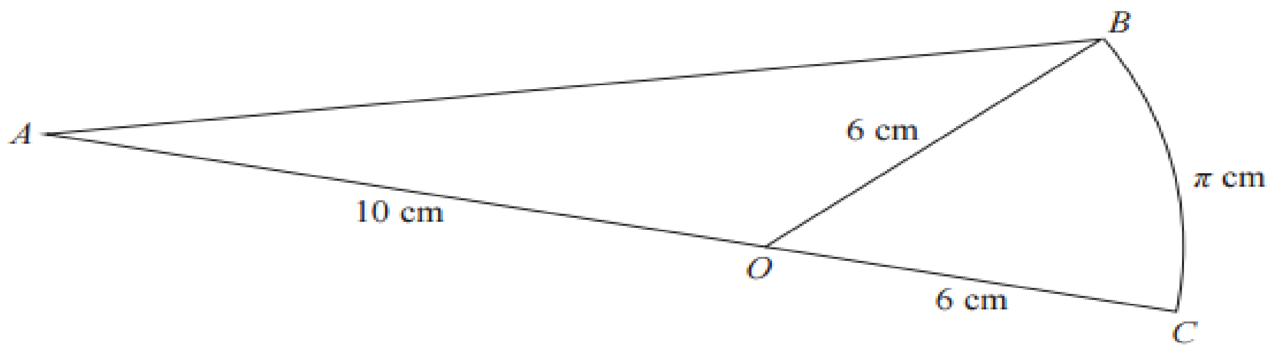


Figure 1

Figure 1 shows a shape ABC in which AOB is a triangle, AOC is a straight line and OBC is a sector of a circle with centre O.

$AO = 10$ cm, $OC = OB = 6$ cm and the length of arc $BC = \pi$ cm.

Find, to 3 significant figures,

(a) the length of AB,

(3)

(b) the area of the shape ABC.

(3)

This question combines Spec **10A** and **10D**

10. Trigonometry

SAMs Question 3 Paper 1

3 Solve, in degrees to 1 decimal place, for $0 \leqslant \theta < 180$

$$2\cos(2\theta + 30)° + \tan(2\theta + 30)° = 0$$

(6)

This question combines specifications **10D, 10E, 10F** and **10H** and also quadratic equations **2A.**

Note that the identity $\tan A = \dfrac{\sin A}{\cos A}$ (which was also a hint to the direction towards the solution) is no longer given in the question. This identity is now found in the formula sheet at the front of the paper.

.

10. Trigonometry

SAMs Question 3 Paper 1

3 Solve, in degrees to 1 decimal place, for $0 \leqslant \theta < 180$

$$2\cos(2\theta + 30)^\circ + \tan(2\theta + 30)^\circ = 0$$

(6)

Please remind your students that it is very important to find **all** the values for what will be $\sin\left(2\theta + 30^\circ\right)$ before subtracting 30° and dividing by 2.

That is;

$$\sin\left(2\theta + 30^\circ\right) = 1.2807..., 0.7807$$

$$2\theta + 30^\circ = 51.331..., 231.331..., 308668...$$

$$\theta = 100.7^\circ, \quad 139.3^\circ$$

10. Trigonometry

SAMs Question 10 Paper 1

Diagram for the question

10

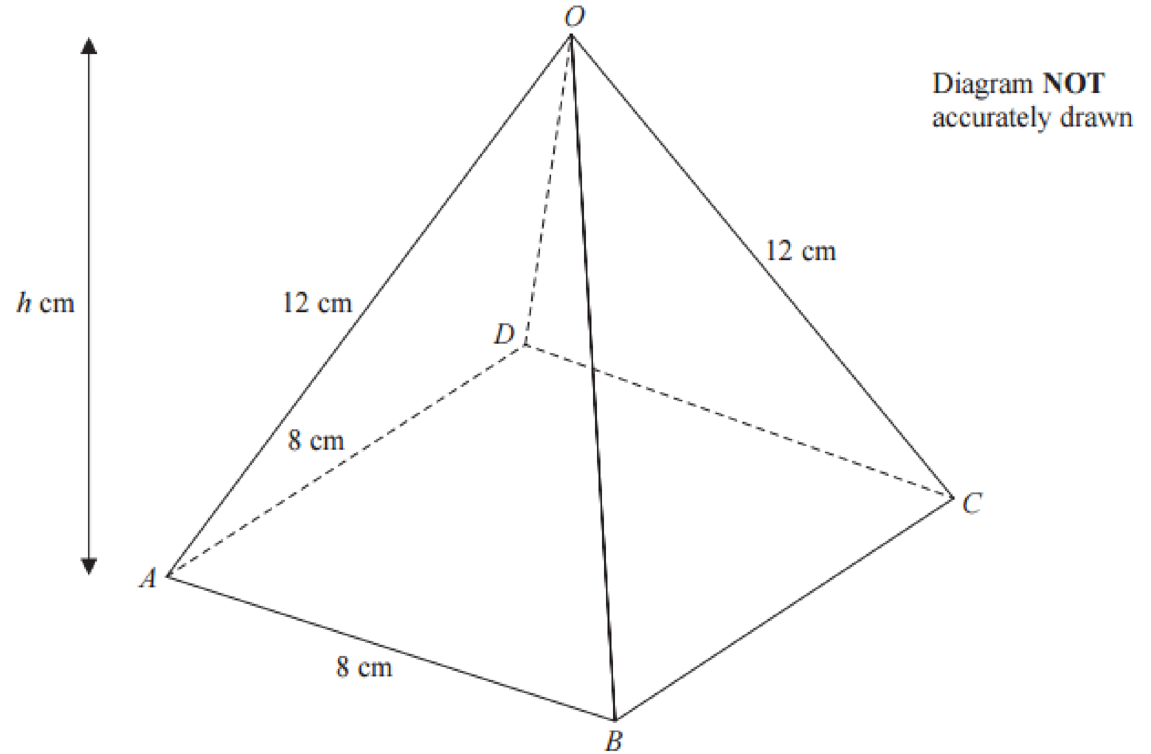


Figure 2

10. Trigonometry

SAMs Question 10 Paper 1 Text of the question

This question is ramped in difficulty and gradually moves from Grade 4 to Grade 9

Figure 2 shows a right pyramid $ABCDO$ with a horizontal square base of side 8 cm. The vertical height of the pyramid is h cm and $OA = OB = OC = OD = 12$ cm.

(a) Find the exact value of h.

(3)

(b) Find, to 1 decimal place, the size of the angle between OA and the plane $ABCD$.

(2)

(c) Find, to 1 decimal place, the size of the angle between the plane AOB and the plane $ABCD$.

(2)

The midpoint of OA is P and Q is the point on BC such that $BQ : QC = 3 : 1$

(d) Show that $PQ = 4\sqrt{5}$ cm.

(4)

Parts (d) and (e) are examples of parts of a question aiming for Grade 9

(e) Find, to 1 decimal place, the size of angle PQA.

(4)

10. Trigonometry

edexcel

SAMs Question 5 Paper 2

5 (a) Show that $\cos(A - B) - \cos(A + B) = 2\sin A \sin B$

(2)

(b) Hence express $2\sin 5x \sin 3x$ in the form $\cos mx - \cos nx$ where m and n are integers, giving the value of m and the value of n,

(1)

(c) (i) Find $\int 4\sin 5\theta \sin 3\theta \, d\theta$

(ii) Hence evaluate $\int_0^{\frac{\pi}{6}} 4\sin 5\theta \sin 3\theta \, d\theta$, giving your answer in the form $\frac{a\sqrt{b}}{c}$ where a, b and c are integers.

(4)

This question tests specification **10G**, **9A** and **1C.**

Part (c) is an example of a question aiming for Grade 9

Pearson

Grade 9 Questions

What does grade 9 look like?

Examples of questions and part questions that are targeting grade 9.

Questions in the SAMs papers are as follows;

Question 10 paper 1 parts (d) and (e)	3D Trigonometry	8 marks
Question 11 paper 1 part (a)	Problem solving/integration	8 marks
Question 5 paper 2 part (c)	Integration of a trig function	4 marks
Question 11 paper 2 whole question	Connected rates of change	11 marks

Total 29 marks, so approximately 15% of the overall specification

Common Issues

Common Issues

1. Incorrect answers without working will lose all marks associated with the question.

Encourage your students to show all working.

2. Please emphasize the importance of reading the demands in the question. If a question requires a simplified answer then that is what the candidate should leave as their final answer.

3. Candidates must read rounding requirements carefully and give their answers to the required degree of accuracy, and round **only** at the end of the question.

The 9 – 1 Grading scale

9-1 grading scale (1)

Awarding

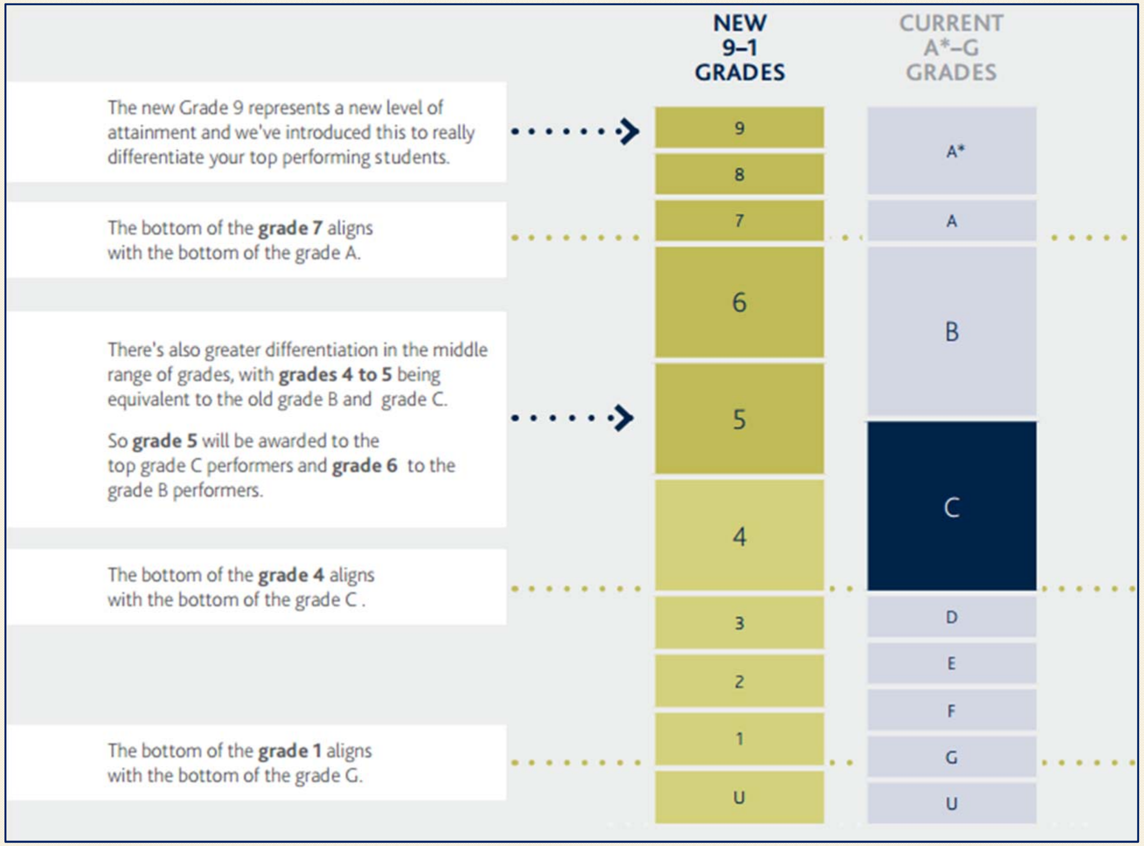
- The grading system is changing but our commitment to awarding grades that accurately reflect learner exam performance remains the same.
- We set new grade boundaries (minimum number of marks needed to achieve each grade) for each assessment of each qualification.

Benefits

- Greater differentiation across levels of attainment e.g. 2 grades where the current C grade is
- Rewards truly outstanding achievement with the grade 9
- Provides more information about student attainment to help progression to A Level
- Same scale for Pearson Edexcel GCSE and International GCSE allows clear comparison with English standards, unlike old A* to G grading

9-1 grading scale (2)

edexcel



4PM1 covers grades 9 – 4. Grade 3 will be awarded as a safety net, but there will be no Grade 3 questions set on the paper.

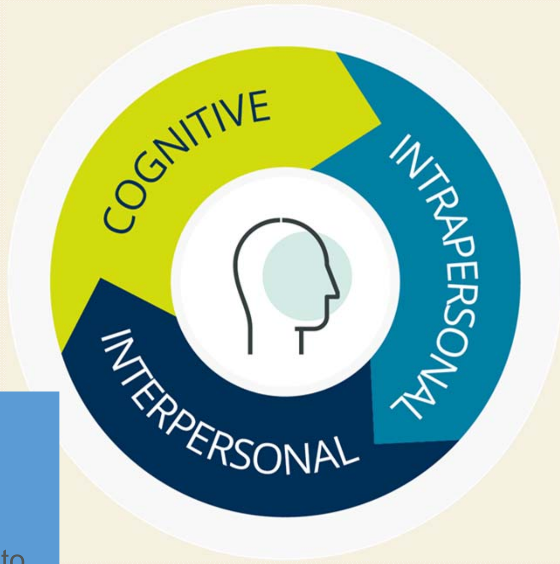
Pearson

World Class Qualifications

- Pearson's World Class Qualification design principles mean all Edexcel qualifications are developed to be **Rigorous**, **Demanding**, **Inclusive** and **Empowering**
- Externally approved by the Expert Panel for World Class Qualifications

Transferable Skills

- Skills frameworks adapted to support design of new Edexcel International GCSEs
- Ensure learners acquire skills needed to access Higher Education and fulfilling careers



Cognitive skills

Core skills brain uses to think, learn and reason – used to carry out any task.

Intrapersonal Skills

Emotional intelligence, ability to know, understand and manage own emotions and learning.

Interpersonal Skills

Life skills used every day to communicate and interact with others, individually and in groups.

Support materials and resources for International GCSE Maths (9 – 1)

edexcel

Resources

We offer a range of free and paid for resources for International GCSEs. These have been designed to support teachers to improve learner outcomes

Pearson

Support overview

Support for all subjects

- Getting Started Guide & Scheme of Work
- Getting Ready to Teach Events
- Subject interpretation of transferable skills
- Subject Advisor
- Results Plus
- Regional Support Manager

Additional support for selected subjects

- Curriculum Matched Publishing
- Exemplar Marked Responses
- Additional SAMs
- Exam Wizard
- Lesson Plans
- Topic booklets

Free support

Getting Started Guide *includes mapping of changes, content and assessment guidance, course planner and resource list*

Editable Scheme of Work *includes activities to support transferable skills development*

Exam Wizard *a free exam preparation tool containing a bank of past Edexcel exam questions*

Results Plus *free online service giving instant and detailed analysis of your students' exam and mock performance*

Edexcel Mathematics Emporium *includes a wealth of past papers and other resources.*

(www.mathsemporium.com)

Regional support manager *access to a regionally based support manager for any query*

Subject Advisor *For any subject related query you have. Sign up to mailing list*

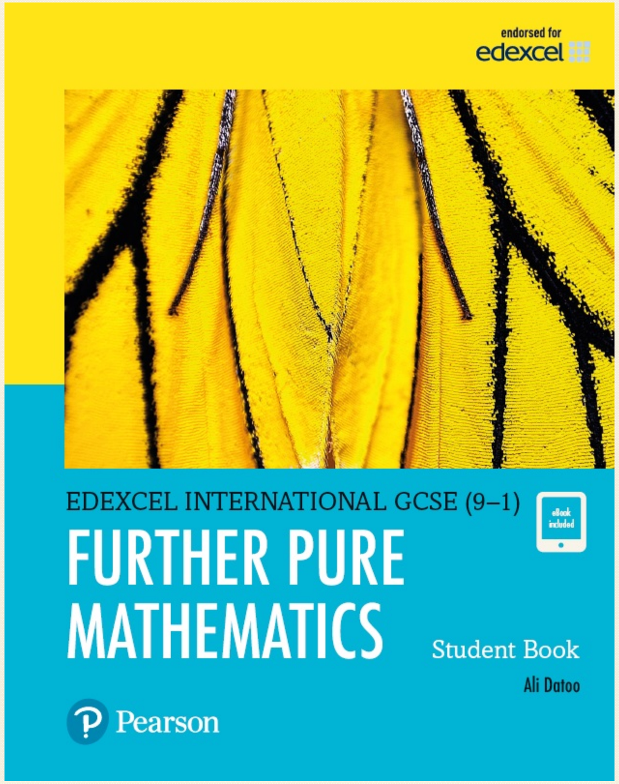
Exemplar *Marked student responses to SAMs questions*

Additional SAMs *An additional set of Sample Assessment Material available as a secure download*

edexcel

Pearson Publishing

The new Further Pure Mathematics textbook



ISBN 9780435188542

Pearson

For your subject specific enquiries

Subject advisor: TeachingMaths@pearson.com

Graham Cumming Mathematics and Statistics

UK: 020 7010 2174
Intl: + 44 (0)20 7010 2174

TeachingMaths@pearson.com

www.mathsemporium.com

Pearson

ALWAYS LEARNING