Edexcel International AS/A Level

Mathematics

Understanding assessment and improving delivery
Module 2 YMA01_20IO7

First teaching in 2018, first assessment 2019

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Aims and Objectives

Delegates will:

- investigate different assessment objectives, considering how questions in these areas have been answered by looking at feedback from previous exam series,

- discuss strategies for teaching to try and make sure students can access questions targeting different assessment objectives,

- review the support Pearson offers for the qualification,

- network, discuss best practice and share ideas with other teachers.
- .

Session Agenda

10:00 Recap and overview

10:10 Solving extended problems and AO2

10:40 AO3, AO4 and AO5

11:00 BREAK

11:05 Teaching issues and support

12 :00 End

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Polls to get to know the delegates.

Review of Assessment Objectives AO1 and AO2

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Problems and examples in this presentation

- Edexcel exam questions undergo a rigorous process before any student sees the examination paper.
  In several slides in this presentation the language and style are not fully that of the exams – indeed there are some problems that would not do at all as exam questions but do have a use as a teaching application.

- The questions themselves are indicative also of the range that students should see in class. They are not intended in any way as a ‘pointer’ to examination questions.
  The Edexcel team have produced material which teachers will be able to use to support their teaching – especially of the new topics.

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Activities in this presentation

There are several activities in this presentation.

Some are as material for delegates to do some mathematics.

In all of the activities delegates are encouraged to consider (with colleagues) such issues as:

Alternative methods of solution
Teaching implications
Demand
How activities/tasks/questions could be adapted.
How well they fit the content
Assigning the Assessment Objective(s)

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AO1 and AO2 in Edexcel International A level

In module 1 we looked in detail at AO1 and how proof underlies part of AO2

Together AO1 and AO2 are allocated about ¾ of the 75 marks on each pure module.

AO1 is…. Recall, select and use their knowledge of mathematical facts, concepts and techniques in a variety of contexts - condensed to DO IT

AO1 and AO2 in Edexcel International A level

AO2 is ….Construct rigorous mathematical arguments and proofs through use of precise statements, logical deduction and inference and by manipulation of mathematical expressions, including the construction of extended arguments for handling substantial problems in unstructured form – condensed to ' SHOW IT'

In module 1 we looked at the statement shown in red.
In particular we looked at 'Proof'.

AO1 and AO2 in Edexcel International A level

The four types of proof we looked at were:

Proof by deduction using algebraic manipulation

Prove that the sum of squares of consecutive even numbers is 4 more than a multiple of 8

Proof by exhaustion

Prove by exhaustion that the equation $2x^2 + y^2 = 10$ has no solutions which are integers

Disproof by counterexample

Disprove the statement ' Any natural number can be expressed as the sum of at most 3 square numbers

Proof by contradiction

Given that a and b are positive, prove by contradiction that $a + b \geq 2\sqrt{(ab)}$

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Looking at AO2 on P1, P2, P3 and P4

Activity 1– Proof

Activity 1 contains 10 proofs based on P1 and P2

Look first at questions 1, 2 , 6 and 9

What knowledge/concepts/techniques are required?

Complete the poll for each of these questions

Use Chat to add any comments you want to make for these or any of the other questions

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Looking at AO2 on P1, P2, P3 and P4

AO2 is ...... the construction of extended arguments for handling substantial problems in unstructured form

Looking at AO2 on P1, P2, P3 and P4

'Extended arguments involving the manipulation of mathematical expressions.'

Stage 1 Read and understand the task/problem/proof

↓

Translation and understanding

Stage 2 Decide on a suitable representation of the problem

Calling upon relevant knowledge

↓ ↑

Planning a strategy

↓

Stage 3 Carry out the mathematical manipulation(s)

↓

Execution and interpretation

Stage 4 Interpret/ give the results as the answer to the task/problem/proof

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Looking at AO2 on P1, P2, P3 and P4

‘Extended arguments involving the manipulation of mathematical expressions.’

Solving extended problems is hard – especially in a limited time!

The difficulty of a problem depends upon several factors!

Use Chat to suggest factors which make a question hard

Looking at AO2 on P1, P2, P3 and P4

‘Extended arguments involving the manipulation of mathematical expressions.’

Factors that affect difficulty include:

The familiarity of the problem to the student

The number of stages the student has to plan to solve the problem

The sophistication/difficulty of the mathematics required to solve the problem

The degree of knowledge of facts, techniques and concepts that are required.

And…………….

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Looking at AO2 on P1, P2, P3 and P4

'Extended arguments involving the manipulation of mathematical expressions.'

…..whether the answer is given or not:

'Show that…' instead of

'Find'

For an argument, supporting reasons do not usually have to be given

We could claim that 'Show that' is easier than 'Find' because it gives the student a definite end point

We could claim that 'Show that' is harder than 'Find' because it could force the student to use a specific method.

'Find' is much more common – for example in the SAMS there are 49 of them (13 'Show that's' and 5 'Proves')

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Scaffolding

Scaffolding is the term used to add structure to a question which will usually require extended mathematics .

$$f(x) = \frac{6 - 5x - 4x^2}{(2 - x)(1 + 2x)} \qquad x > 2$$

Prove that $f(x)$ is a decreasing function.

Just think for a moment about what strategies would students plan to use to answer this question……

The question was eventually scaffolded as………

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Scaffolding

Scaffolding is the term used to add structure to a question which will usually require extended mathematics to answer it.

Gives a start. Makes it clear what is required

$$\frac{6 - 5x - 4x^2}{(2 - x)(1 + 2x)} \equiv A + \frac{B}{(2 - x)} + \frac{C}{(1 + 2x)}$$

(a) Find the values of the constants A, B and C.

$$\mathrm{f}(x) = \frac{6 - 5x - 4x^2}{(2 - x)(1 + 2x)} \qquad x > 2$$

(b)

(c)

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Scaffolding

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$$\frac{6 - 5x - 4x^2}{(2 - x)(1 + 2x)} \equiv A + \frac{B}{(2 - x)} + \frac{C}{(1 + 2x)}$$

(a) Find the values of the constants A, B and C.

$$f(x) = \frac{6 - 5x - 4x^2}{(2 - x)(1 + 2x)} \qquad x > 2$$

(b) Using part (a), find $f'(x)$.

Directs student to use answer already found

(c)

Scaffolding

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Gives a start. Makes it clear what is required

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$$f(x) = \frac{6-5x-4x^2}{(2-x)(1+2x)} \qquad x > 2$$

(b) Using part (a), find $f'(x)$.

Directs student to use answer already found

(c) Prove that $f(x)$ is a decreasing function.

Intends student to use answer already found in (b)

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Scaffolding

As well as making problems more accessible, scaffolding allows specific mathematical techniques to be examined.

A curve has equation

$$y = \ln(1 - \cos 2x), \qquad x \in \mathbb{R},\ 0 < x < \pi$$

find the exact coordinates of the point on the curve where $\dfrac{\mathrm{d}y}{\mathrm{d}x} = 2\sqrt{3}$

No scaffolding.
This Q could be classed as basically all AO2

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Looking at AO2 on P1, P2, P3 and P4

:As well as making problems more accessible, scaffolding allows specific mathematical techniques to be examined.

A curve has equation

$$y = \ln(1 - \cos 2x), \qquad x \in \mathbb{R},\ 0 < x < \pi$$

Show that

(*a*) $\dfrac{\mathrm{d}y}{\mathrm{d}x} = k \cot x$, where k is a constant to be found.

Hence find the exact coordinates of the point on the curve where

(*b*) $\dfrac{\mathrm{d}y}{\mathrm{d}x} = 2\sqrt{3}$

Take a few minutes to work through both parts.
Suggest in Chat what content is being assessed

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Looking at AO2 on P1, P2, P3 and P4

:As well as making problems more accessible, scaffolding allows specific mathematical techniques to be examined.

A curve has equation

$$y = \ln(1 - \cos 2x), \qquad x \in \mathbb{R},\ 0 < x < \pi$$

Show that

(*a*) $\dfrac{dy}{dx} = k \cot x$, where k is a constant to be found.

Tests differentiation and a trig identity

Hence find the exact coordinates of the point on the curve where

(*b*) $\dfrac{dy}{dx} = 2\sqrt{3}$

Tests solution of a trig equation.

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Looking at AO2 on P1, P2, P3 and P4

As well as making problems more accessible, scaffolding allows specific mathematical techniques to be examined.

(ii) (*a*) Use the substitution $x = \sec\theta$ to show that

$$\int_1^2 \sqrt{1-\frac{1}{x^2}}\,\mathrm{d}x = \int_0^{\frac{\pi}{3}} \tan^2\theta\,\mathrm{d}\theta$$

(*b*) Hence find the exact value of

$$\int_1^2 \sqrt{1-\frac{1}{x^2}}\,\mathrm{d}x$$

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Looking at AO2 on P1, P2, P3 and P4

As well as making problems more accessible, scaffolding allows specific mathematical techniques to be examined.

find the exact value of

$$\int_1^2 \sqrt{1-\frac{1}{x^2}}\,\mathrm{d}x$$

No scaffolding – probably beyond a 'simple' substitution

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Looking at AO2 on P1, P2, P3 and P4

As well as making problems more accessible, scaffolding allows specific mathematical techniques to be examined.

find the exact value of

$$\int_1^2 \sqrt{1-\frac{1}{x^2}}\,\mathrm{d}x$$

No scaffolding – probably beyond a 'simple' substitution

$x = \sec\theta$. Write down $\frac{dx}{d\theta}$ in terms of θ

Scaffolding – from the formula book

$y = \sqrt{1 - \frac{1}{x^2}}$

Given that $x = \sec\theta$, write y in terms of θ
Give your answer in its simplest form.

Scaffolding – use of simple trig identities

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Looking at AO2 on P1, P2, P3 and P4

Questions assessing AO2 are almost always assigned AO1 marks also. This is because the processes and knowledge required to solve a complex problem are based on AO1

We can see this by looking at a particular topic from the Specification.

To see how this works we'll look at **parameters**.

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Looking at AO2 on P1, P2, P3 and P4

3.1	Parametric equations of curves and conversion between cartesian and parametric forms.

The scheme of work – on the website – gives some further details

5.1	Differentiation of simple functions defined implicitly or parametrically.	The finding of equations of tangents and normals to curves given parametrically or implicitly is required.

6.1	Evaluation of volume of revolution.	$\pi \int y^2 \, dx$ is required, but *not* $\pi \int x^2 \, dy$. Students should be able to find a volume of revolution, given parametric equations.

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P4 Parameters – how AO1 and AO2 work together (also with AO4)

3.1	Parametric equations of curves and conversion between cartesian and parametric forms.

From a Principal Examiner Report

"………only a minority of students were able to use one of the trigonometric forms of Pythagoras to eliminate *t* and manipulate the resulting equation to obtain an answer in the required form."

A $x = 6\cos 2t$, $y = 2\sin t$

B $x = \tan t$, $y = 2\sin^2 t$

C $x = 1 + \sqrt{3}\tan t$, $y = 5\sec t$

D $x = 3\cos t$, $y = 9\sin 2t$

E $x = 8\cos^3 t$, $y = 6\sin^2 t$

These were taken from recent C34 papers. Many involve use of basic trig identities

P4 Parameters – how AO1 and AO2 work together (also with AO4)

3.1	Parametric equations of curves and conversion between cartesian and parametric forms.

From a Principal Examiner Report
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D $x = 3\cos t$, $y = 9\sin 2t$

E $x = 8\cos^3 t$, $y = 6\sin^2 t$

These were taken from recent C34 papers. Many involve use of $\sin^2 + \cos^2 = 1$ or its equivalent.

As such it's good strategy to isolate the trig functions FIRST

$$\frac{x-1}{\sqrt{3}} = \tan t, \qquad \frac{y}{5} = \sec t$$

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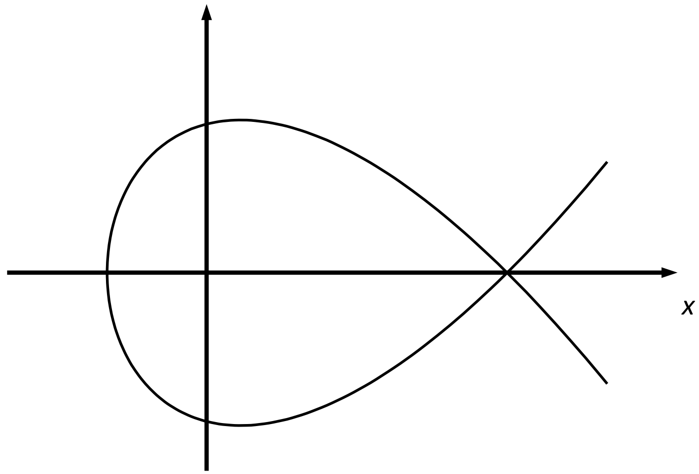
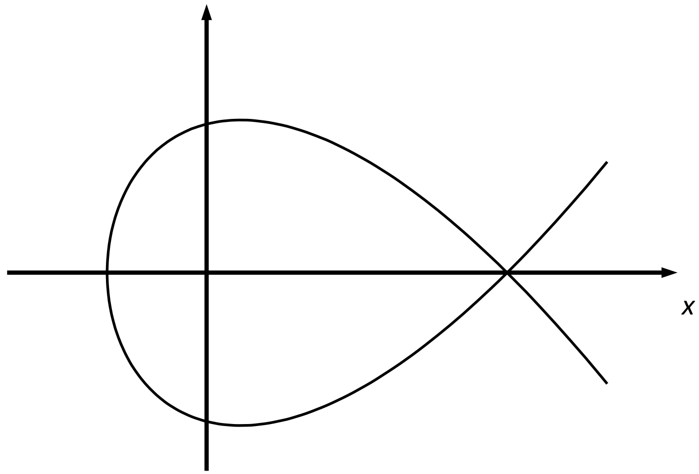
P4 Parameters – how AO1 and AO2 work together (also with AO4)



$x = 2t^2 - 2, \quad y = t(t^2 - 4)$

Find the coordinates of points where
- the curve crosses the axes
- crosses the line $x = 2$

P4 Parameters – how AO1 and AO2 work together (also with AO4)



$x = 2t^2 - 2, \quad y = t(t^2 - 4)$

Find the coordinates of points where
- the curve crosses the axes
- crosses the line $x = 2$

The same point may correspond to more than one value of t
Most graphics package have a slow plot mode that you can demonstrate this to students

P4 Parameters – how AO1 and AO2 work together (also with AO4)

5.1	Differentiation of simple functions defined implicitly or parametrically.	The finding of equations of tangents and normals to curves given parametrically or implicitly is required.

x = 6 cos2t, y = 2sint

Show that y' = λ cosec t, giving the exact value of the constant λ.

x =1 + √3 tan t, y = 5sec t

Show that y'= λ sin t, giving the exact value of the constant λ.

It's almost always easier to use $\dfrac{dy}{dx} = \dfrac{\dot{y}}{\dot{x}}$

This also can involve use of trig identities to achieve a given answer

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P4 Parameters – how AO1 and AO2 work together (also with AO4)

e.g.. Parameters

$x = 8\cos^3 t$, $y = 6\sin^2 t$

Find the equation of the normal to the curve at $t = \pi/3$
Give the equation in the form $ax + by = c$

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P4 Parameters – how AO1 and AO2 work together (also with AO4)

e.g.. Parameters

$x = 8\cos^3 t$, $y = 6\sin^2 t$

Find the equation of the normal to the curve at $t = \pi/3$
Give the equation in the form $ax + by = c$

It's almost always easier to use $\frac{dy}{dx} = \frac{\dot{y}}{\dot{x}}$

It's a good idea to substitute for t in $\frac{dy}{dx}$ as soon as it is found.

Derivatives wrt t are $-24\cos^2 t \sin t$ and $12 \sin t \cos t$ so $\frac{dy}{dx} = -1$

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P4 Parameters – how AO1 and AO2 work together (also with AO4)

6.1	Evaluation of volume of revolution.	$\pi\int y^2\ \mathrm{d}x$ is required, but *not* $\pi\int x^2\ \mathrm{d}y$. Students should be able to find a volume of revolution, given parametric equations.

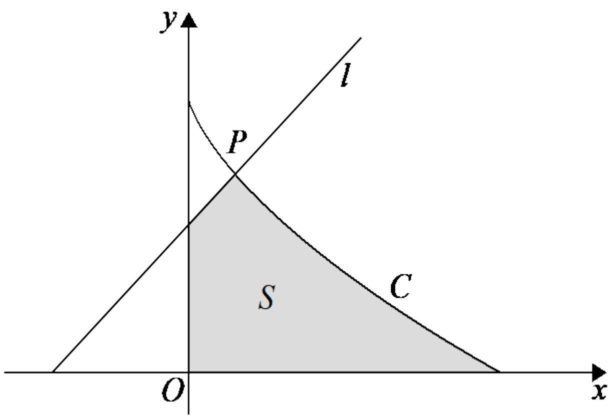

Figure 6

$x = 8\cos^3\theta$, $y = 6\sin^2\theta$,

The line l is the normal to C at P with $t = \pi/3$

(*c*) Show that the area of S is given by

$$4+144\int_0^{\frac{\pi}{3}}(\sin\theta\cos^2\theta-\sin\theta\cos^4\theta)\mathrm{d}\theta$$

(*d*) Hence, by integration, find the exact area of S.

So students have to be able to transform an integral in x to one in θ

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AO3

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AO3 is Recall, select and use their knowledge of standard mathematical models to represent situations in the real world;
recognise and understand given representations involving standard models;
present and interpret results from such models in terms of the original situation, including discussion of the assumptions made and refinement of such models

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Looking at AO3 on P1, P2, P3 and P4

AO3 refers to the use of standard models – this means models that are commonly known or models that are straightforward to understand.

Here is an example from the material in P1

At 12:00 a ship is at a point A 48 km West of a port P.
The ship sails on a bearing of 060^{o} to a point B.
PB = 36 km

Find by calculation, the two possible bearings of B from P.
Give your answers correct to the nearest degree.

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Looking at AO3 on P1, P2, P3 and P4

AO3 refers to the use of standard models – this means models that are commonly known or models that are straightforward to comprehend.

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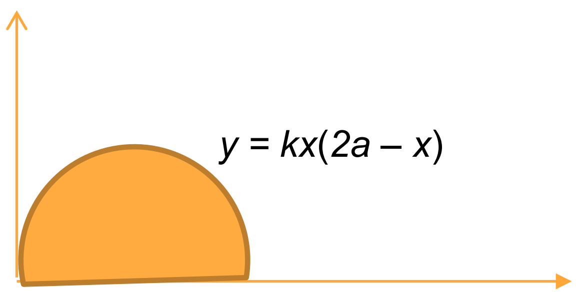

The diagram represents the cross-section of a tunnel.

The width of the cross section is 10 m and the height is 6 m

(a) Find the value of k and the value of a.

(b) Use integration to find the area of the cross-section of the tunnel.

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Looking at AO3 on P1, P2, P3 and P4

AO3 refers to the use of standard models – this means models that are commonly known or models that are straightforward to comprehend.

Common models on P2 require the use of Arithmetic or Geometric series for describing growth and decay.

Key techniques involve:

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Looking at AO3 on P1, P2, P3 and P4

AO3 refers to the use of standard models – this means models that are commonly known or models that are straightforward to comprehend.

Common models on P2 require the use of Arithmetic or Geometric series for describing growth and decay.

Key techniques involve:

finding ‘*n*’ in an Arithmetic series such that the sum to *n* terms exceeds a given value – leads to a quadratic equation (or inequality)

finding ‘*n*’ in a Geometric series such that the sum to *n* terms exceeds a given value – leads to an equation (or inequality) requiring taking logs.

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Looking at AO3 on P1, P2, P3 and P4

Here is an typical example from the material in P3

A rare species of mammal is being studied. The population P, t years after the study started, is modelled by the formula

$$P = \frac{900e^{\frac{1}{4}t}}{3e^{\frac{1}{4}t} - 1}, \qquad t \in \mathbb{R}, \qquad t \geq 0$$

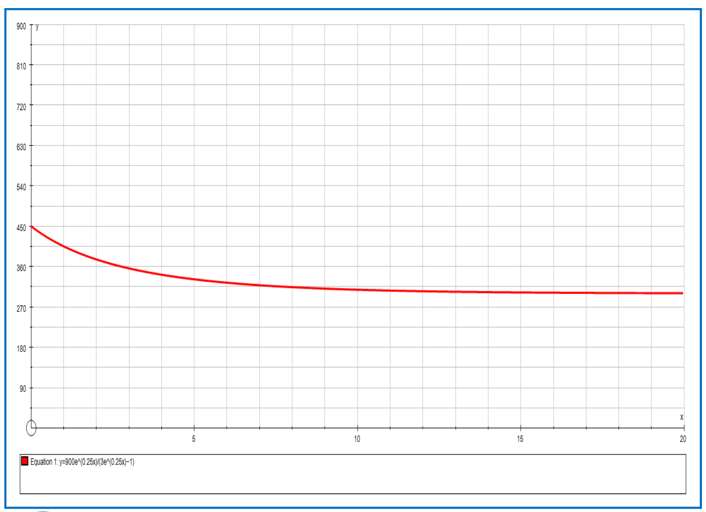
Students should be able to:

Looking at AO3 on P1, P2, P3 and P4

Here is an typical example from the material in P3

A rare species of mammal is being studied. The population P, t years after the study started, is modelled by the formula

$$P = \frac{900e^{\frac{1}{4}t}}{3e^{\frac{1}{4}t} - 1}, \qquad t \in \mathbb{R}, \qquad t \geq 0$$



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Students should be able to:

Work out the population at a given time

Find the rate of change of population at a given time

Find the maximum (or minimum) population and the time at which it occurs

(Not for this particular model, of course)

Looking at AO3 on P1, P2, P3 and P4

Population mathematics in P3

Students need to be able to differentiate expressions of the form $P = \frac{K}{1+Ae^{-\gamma t}}$

Or equivalently $P = \frac{Ke^{\gamma t}}{Ce^{\gamma t}+D}$

A more complex model is $N = \frac{R\mathrm{e}^{pt}}{S+T\mathrm{e}^{qt}}$

Not a case where the product rule for differentiation should be used.

Looking at AO3 on P1, P2, P3 and P4

Here is another example from the material in P3

Students need to be able to use the formula
$y = a \cos \omega t + b \sin \omega t + c$
to describe oscillatory motion.

On P2 this could be set as a single sine or cosine function

This usually requires students set up and to solve equations such as
$5 = 6 \cos \omega t + 3 \sin \omega t + 2$

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Looking at AO3 on P1, P2, P3 and P4

Here is another example from the material in P3

Students need to be able to use the formula
$y = a \cos \acute{\omega} t + b \sin \acute{\omega} t + c$
to describe oscillatory motion.

This usually requires students set up and to solve equations such as
$5 = 6 \cos \acute{\omega} t + 3 \sin \acute{\omega} t + 2$

On P2 this could be set as a single sine or cosine function

So students must be familiar with the $R \cos(\theta + \alpha)$ and $R \sin(\theta + \beta)$ forms.

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Looking at AO3 on P1, P2, P3 and P4

Here is an example from the material in P4

Students need to understand modelling using differential equations.
The key idea is that $\frac{\mathrm{d}A}{\mathrm{d}t}$ represents the rate of change of the quantity A

Overlaps with AO4

Often the form of the rate of change is given

Students do need to be able to write down/derive or interpret a D.E. which shows the rate to change of A to be:

- constant (with interpretation of a negative sign)
- to be proportional to A.

AO4

Looking at AO4 on P1, P2, P3 and P4

AO4 is Comprehend translations of common realistic contexts into mathematics;
use the results of calculations to make predictions, or comment on the context;
and, where appropriate, read critically and comprehend longer mathematical arguments or examples of applications.

Overlaps with AO3

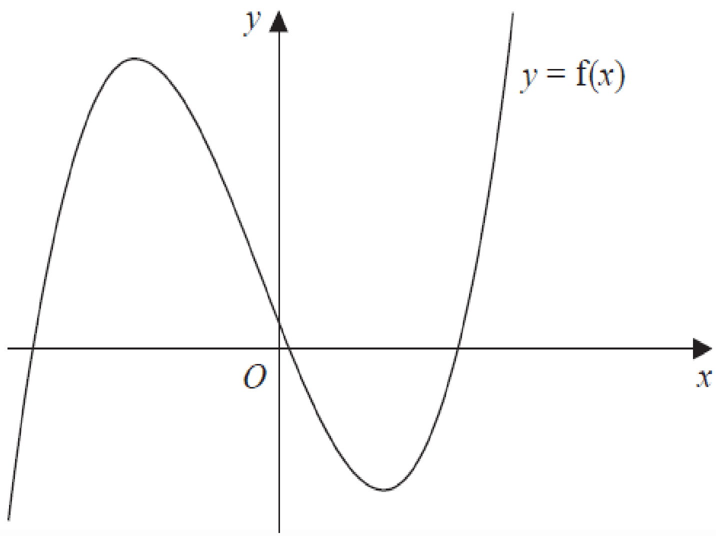
'Hence' is often a key word in AO4

'Deduce' is often a key word in AO4

Looking at AO4 on P1, P2, P3 and P4

Here is an example from the material in P1

4.



….use the results of calculations to make predictions……

$$\mathrm{f}(x) = 2x^3 + \frac{3}{2}x^2 - 18x + 3$$

(a) Find the set of values of x for which $\mathrm{f}(x)$ is decreasing

(b) Hence find the number of roots of the equation $\mathrm{f}(x) = k$ (k constant) according to the values of k

Looking at AO4 on P1, P2, P3 and P4

Here is an example from the material in P3

….use the results of calculations to make predictions……

(a) Prove that $\tan x + \cot x \equiv 2\operatorname{cosec} 2x$ for $x \neq n\pi/2$

(b) Deduce that the equation $\tan x + \cot x = 1$ has no real solutions.

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Looking at AO4 on P1, P2, P3 and P4

Here is an example from the material in P4

'..use the results of calculations to make predictions.'

A curve has equation

$$y = \ln(1 - \cos 2x), \qquad x \in \mathbb{R},\ 0 < x < \pi$$

Show that

(*a*) $\dfrac{dy}{dx} = k \cot x$, where k is a constant to be found.

(4)

Hence find the exact coordinates of the point on the curve where

(*b*) $\dfrac{dy}{dx} = 2\sqrt{3}$

(4)

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Looking at AO4 on P1, P2, P3 and P4

Here is an example from the material in P2

'….read critically'

Solve the equation $2\log_5(2y + 1) - \log_5(2 - y) = 1$

explaining clearly why there is only one real solution

Solve the equation

$$\log_4\left(5x^2 - 11\right) = \log_2\left(3x - 5\right).$$

x real

Looking at AO4 on P1, P2, P3 and P4

Here is an example from the material in P3

'…read critically and comprehend longer mathematical arguments…

Solve $\cos 2x + \sin 2x = \frac{1}{\sqrt{2}}$ for values of x in the interval $0 \le x \le 2\pi$

(1) $\cos 2x + \sin 2x = \sqrt{2}\cos(2x + \frac{\pi}{4})$

(2) So the equation becomes $\cos(2x + \frac{\pi}{4}) = \frac{1}{2}$

(3) A solution of $\cos\theta = \frac{1}{2}$ is $\theta = \frac{\pi}{3}$

(4) So $2x + \frac{\pi}{4} = \frac{\pi}{3}$ and $x = \frac{\pi}{24}$

(5) The second solution is $2\pi - \frac{\pi}{24} = \frac{23\pi}{24}$

In which lines is the mathematical reasoning <u>incorrect</u>?

Activity 2

Activity 2 asks you to work through the 3 previous examples.

What other questions could be set which have the same issues as the log questions?

Use Chat to make any comments and the poll for Question 3

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AO5

AO5 is Use contemporary calculator technology and other permitted resources (such as formulae booklets or statistical tables) accurately and efficiently;
understand when not to use
such technology, and its limitations.
Give answers to appropriate accuracy.

Use contemporary calculator technology…… accurately and efficiently

Which calculators are allowed in Edexcel examinations.?

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

So, some models of graphical calculators are permitted.

Looking at AO5 on P1, P2, P3 and P4

Use contemporary calculator technology…… accurately and efficiently

From the P1 specification

Solution of quadratic equations using the formula
Mensuration and radian measure

*Factorisation of quadratics (and cubics). Some students use their calculator to find the roots of the corresponding equation and then use these to factorise

Graphs:

Quadratic

k/x and k/x^2

sin, cos and tan

Looking at AO5 on P1, P2, P3 and P4

Use contemporary calculator technology…… accurately and efficiently

From the P2 specification

solution of quadratic inequalities (sum of an Arithmetic Series)
solution of inequalities requiring taking logs (sum of a Geometric Series)

values of binomial coefficients

solution of trig equations – degrees and radians

evaluation of expressions after integration
trapezium rule*

*The derivation of the formula is not required knowledge – but should – at least informally – be shown

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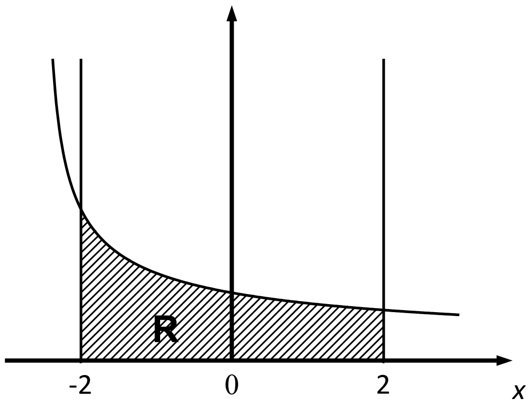
Trapezium rule

8.3 Use of increasing number of trapezia to improve accuracy and an estimate of the error may be required.



The figure shows a sketch of part of the curve C, with equation

$$y = \frac{1}{\sqrt{2x+5}}$$

The finite region **R** shown shaded is bounded by C, the *x*-axis and the lines *x* = ±2

x	-2	-1	0	1	2
$y = \frac{1}{\sqrt{2x+5}}$	1		0.4472		0.3333

(a) Complete the table.

(b) Use the trapezium rule to find an estimate of the area of **R**.

(c) Given that the exact area of **R** is 2, work out an estimate of the error.

In the exam the language is much more precise!

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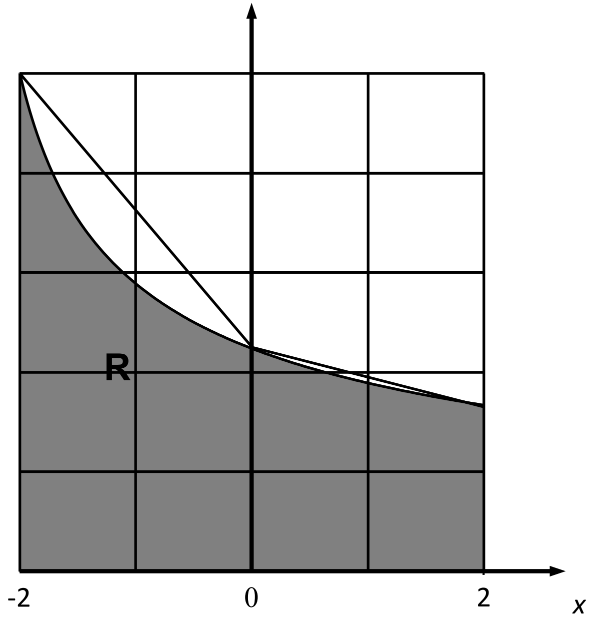
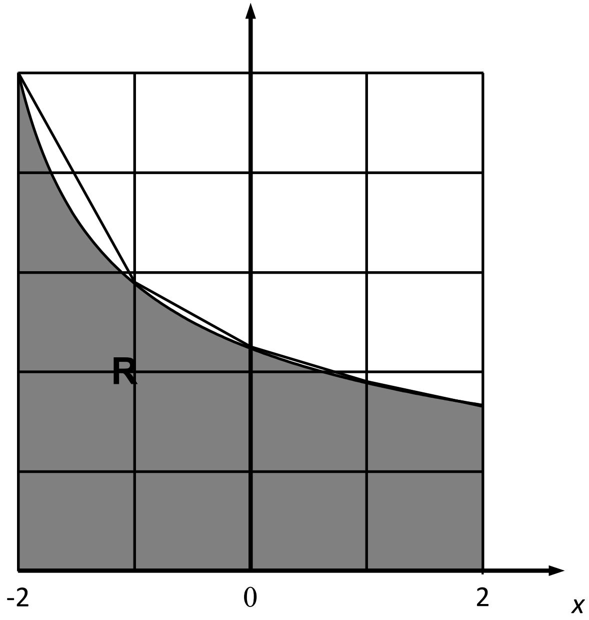
Trapezium rule

8.3 Use of increasing number of trapezia to improve accuracy and an estimate of the error may be required.



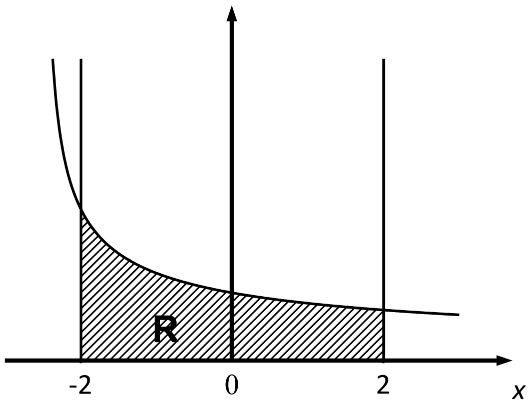


2 trapeziums

4 trapeziums

Trapezium rule

8.3 Use of increasing number of trapezia to improve accuracy and an estimate of the error may be required.



x	y	x	y	x	y
-2	1	-2	1	-2	1
0	0.447214	-1	0.57735	-1.5	0.707107
2	0.333333	0	0.447214	-1	0.57735
	2.227761	1	0.377964	-0.5	0.5
		2	0.333333	0	0.447214
			2.069195	0.5	0.408248
				1	0.377964
				1.5	0.353553
				2	0.333333
					2.019052

In this case doubling the number of strips from 4 to 8 reduces the error from about 3½% to about 2%

If you are faced with the question does doubling the number of strips half the error, how would you answer it?

Geometrically more strips leads to a lower error because ………

However, we must be careful when increasing the number of strips because…..

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Looking at AO5 on P1, P2, P3 and P4

Use contemporary calculator technology…… accurately and efficiently

From the P3 specification

Solution of trig equations

Straight line graphs derived from data of the form $y = ax^n$ or $y = kb^x$

Behaviour of f(t) when t gets large. (exponential type models)

*Location of roots of $f(x) = 0$ by looking for sign changes

*Iteration

Graphs $y = |ax + b|$

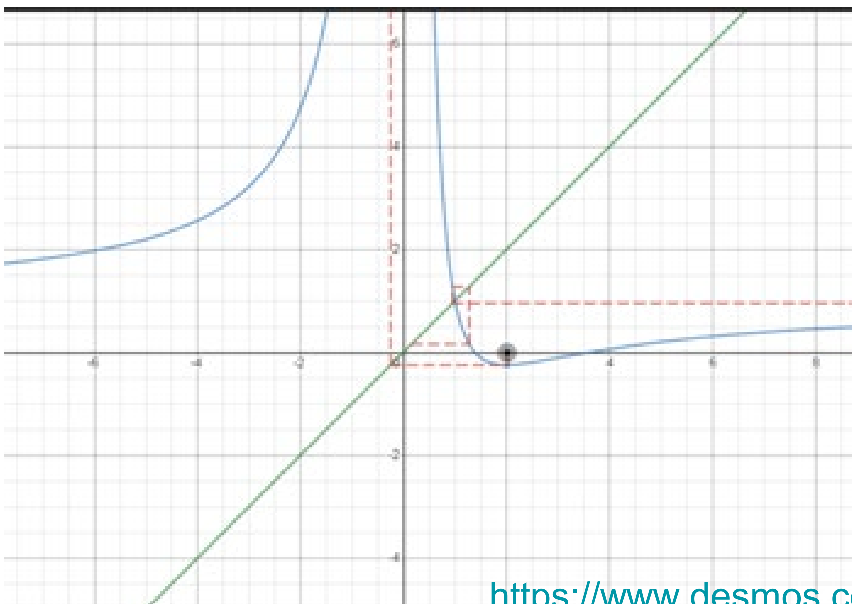
Iteration

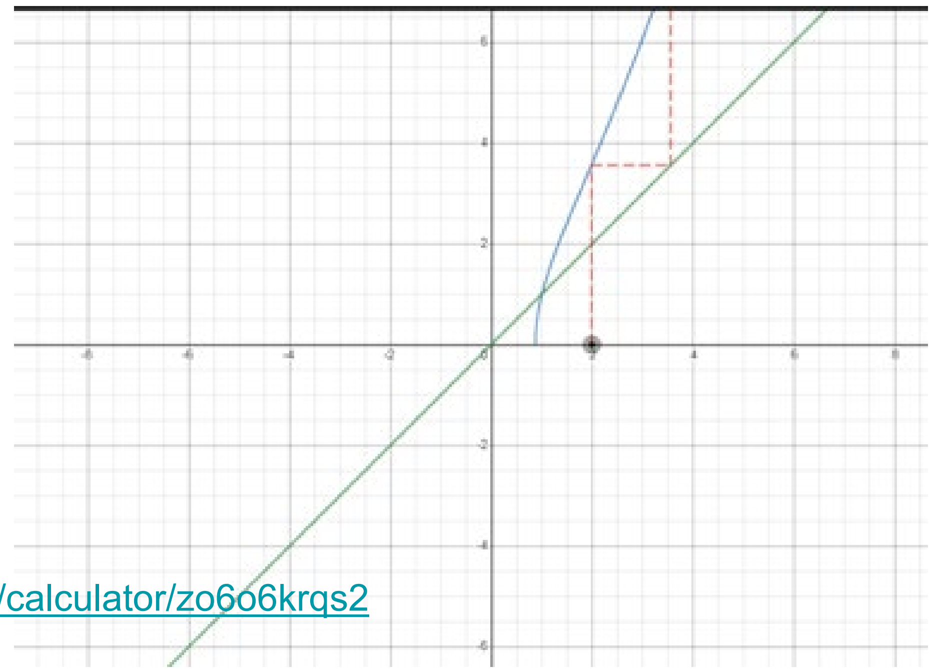
Use contemporary calculator technology…… accurately and efficiently

Students will be given the formula to use
Students should be aware that not all rearrangements of an equation lead to a convergent sequence.

But not be assessed on this

Two different rearrangements of the equation $x^3 - x^2 + 5x = 5$





https://www.desmos.com/calculator/zo6o6krqs2

$$x = \frac{x^2 - 5x + 5}{x^2}$$

$$x = \sqrt{x^3 + 5x - 5}$$

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Looking at AO5 on P1, P2, P3 and P4

Use contemporary calculator technology…… accurately and efficiently

From the P4 specification

Nothing explicit - finding angles between vectors

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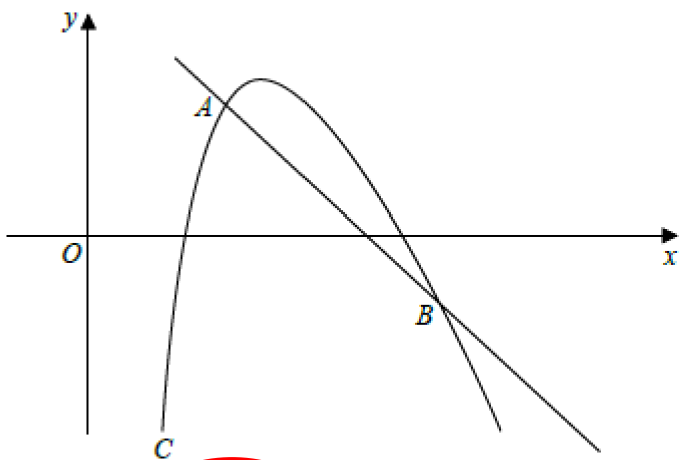
Looking at AO5 on P1, P2, P3 and P4

Use contemporary calculator technology…… accurately and efficiently

Consequences:

Specific wording in questions **to prevent** the use of calculators



(b) Use algebra to find the coordinates of B.

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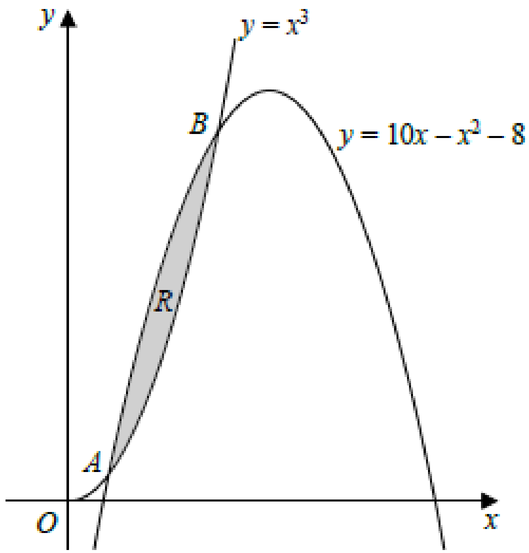
Looking at AO5 on P1, P2, P3 and P4

Use contemporary calculator technology…… accurately and efficiently

Consequences:

Specific wording in questions to prevent the use of calculators

8.



(b) Use algebra to find the coordinates of the point B

(c) Use calculus to find the exact area of R

Looking at AO5 on P1, P2, P3 and P4

Use contemporary calculator technology…… accurately and efficiently

Consequences:

Specific wording in questions to **prevent** the use of calculators

(ii) Use integration to find the exact value of

$$\int_0^{\frac{\pi}{2}} \sin 2x + \sec\frac{1}{3}x\tan\frac{1}{3}x\,dx$$

(b) Use calculus to find the coordinates of A.

(ii) Find $\int_1^2 f(x)\,dx$, giving your answer in the form $a + \ln b$, where a and b are constants.

Find, by integration, the exact value for the area of R.

Give your answer in terms of $\ln 2$

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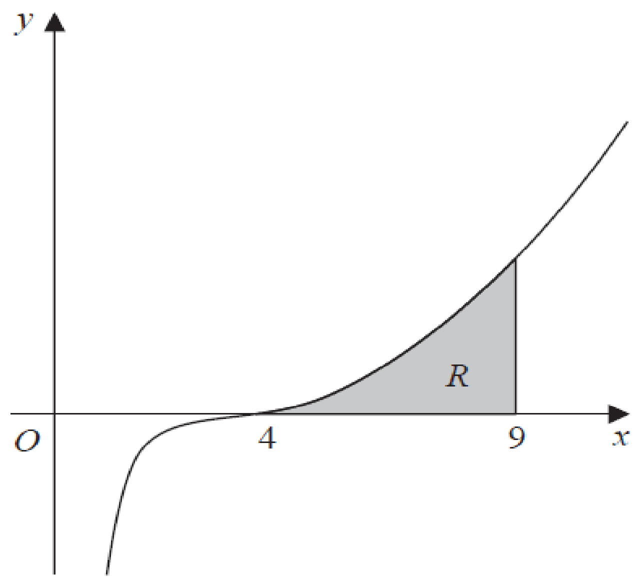
Looking at AO5 on P1, P2, P3 and P4

Use contemporary calculator technology…… accurately and efficiently

Consequences:

Specific wording in questions to **prevent** the use of calculators



Find the exact area of R.

Figure 1

In this question you must show all steps of your working.

Solutions relying on calculator technology are not acceptable.

Looking at AO5 on P1, P2, P3 and P4

…and other permitted resources (such as formulae booklets…)

From the P1 specification

One form of the Cosine Rule

Looking at AO5 on P1, P2, P3 and P4

…and other permitted resources (such as formulae booklets…)

From the P1 specification

One form of the Cosine Rule

Students have to learn the quadratic formula and the sine rule (and possibly the alternative form of the cosine rule)

Looking at AO5 on P1, P2, P3 and P4

…and other permitted resources (such as formulae booklets…)

From the P2 specification

*n*th terms and sums of arithmetic and geometric series

Change of base rule for logs

Binomial series (both forms)

Trapezium rule.

Students have to learn

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Looking at AO5 on P1, P2, P3 and P4

…and other permitted resources (such as formulae booklets…)

From the P2 specification

*n*th terms and sums of arithmetic and geometric series

Change of base rule for logs

Binomial series (both forms)

Trapezium rule.

Students have to learn

Another three laws of logs*
Two trig formulae
Integral form of area under a curve.

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Looking at AO5 on P1, P2, P3 and P4

…and other permitted resources (such as formulae booklets…)

From the P3 specification

Trig identities
e.g.. sin (A + B) = sin A cos B + sin B cos A

Students have to learn

Looking at AO5 on P1, P2, P3 and P4

…and other permitted resources (such as formulae booklets…)

From the P3 specification

Trig identities
e.g. sin (A + B) = sin A cos B + sin B cos A

Students have to learn

Several trig identities

$\cos^2 A + \sin^2 A \equiv 1$

$\sec^2 A \equiv 1 + \tan^2 A$

$\operatorname{cosec}^2 A \equiv 1 + \cot^2 A$

$\sin 2A \equiv 2 \sin A \cos A$

$\cos 2A \equiv \cos^2 A - \sin^2 A$

$\tan 2A \equiv \dfrac{2 \tan A}{1 - \tan^2 A}$

Several formulae for calculus

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Looking at AO5 on P1, P2, P3 and P4

…and other permitted resources (such as formulae booklets…)

From the P4 specification

Students have to learn

Scalar product of 2 column vectors

Looking at AO5 on P1, P2, P3 and P4

…and other permitted resources (such as formulae booklets…)

From the P4 specification

Scalar product of 2 column vectors

Students have to learn

Vector equation of st line
Formula for cosine of the angle between 2 lines – scalar product
Distance between 2 points

Pearson Edexcel

Looking at AO5 on P1, P2, P3 and P4

……give answers to appropriate accuracy.

From the P3 specification

….by looking at the signs of f(a + ε) and f(a – ε)

f(3.18) = 0.01 and f(3.19) = −0.7

Looking at AO5 on P1, P2, P3 and P4

……give answers to appropriate accuracy.

From the P3 specification

….by looking at the signs of f(a + ε) and f(a – ε)

f(3.18) = 0.08 and f(3.19) = −0.21
There is at least one root in the interval (3.18, 3.19)

But there is not enough information to give
the root correct to 2 decimal places.

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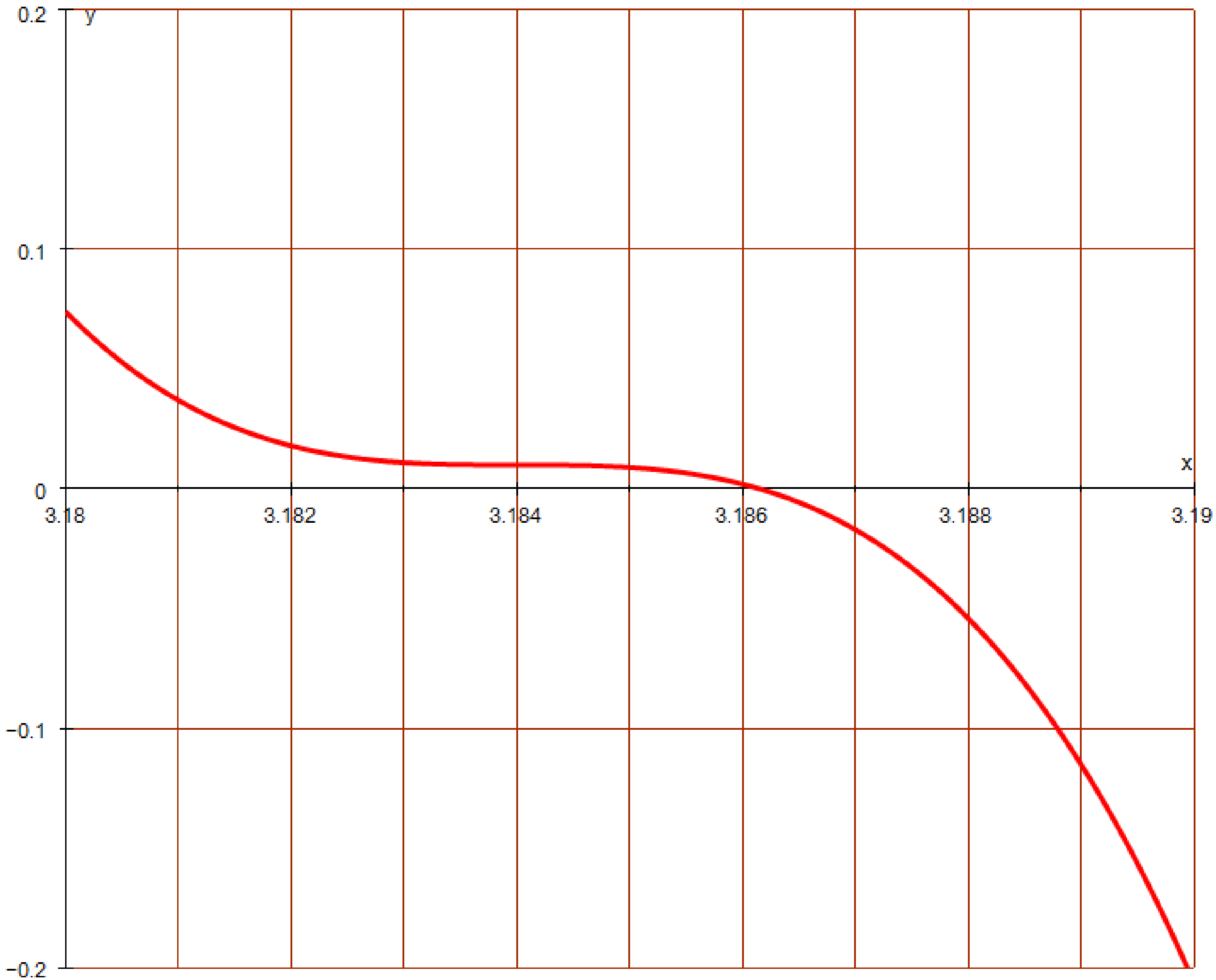
Looking at AO5 on P1, P2, P3 and P4



Looking at AOs on P1, P2, P3 and P4

Activity 83

Use the edited copy of June 2019 paper 2 together with the Mark scheme.

Assign AOs (1 to 5) to the questions where appropriate.

Remember your targets are

	AO1	AO2	AO3	AO4	AO5
P1	30–35	25–30	5–15	5–10	1–5
P2	30–35	25–30	5–15	5–10	1–5
P3	30–35	25–30	5–15	5–10	1–5
P4	30–35	25–30	5–15	5–10	1–5

The official grid

Q	Content	Marks	AO1	AO2	AO3	AO4	AO5
1	4.1, 4.3 Sequences	4	4				
2	3.1 Circles	7	7				
3	1.1, 1.3 Proof	4		4			
4	4.5 Binomial Expansion	7	2	3		2	
5	7.1 Differentiation problem in context	8	1	3	3		1
6	2.1, 6.2 Factor Theorem and Trig equation	8	3	3		1	1
7	4.2, 4.4 AP and GP problem in context	9	2		4		3
8	5.2, 5.3 Laws of logarithms	9	3	6			
9	6.1, 6.2 Trig identity and equation	8	2	3		1	2
10	7.1, 8.1, 8.2 Calculus	11	4	4		3	
		75	**28**	**26**	**7**	**7**	**7**
			25-30	25-30	5-10	5-10	5-10

Resources and Support

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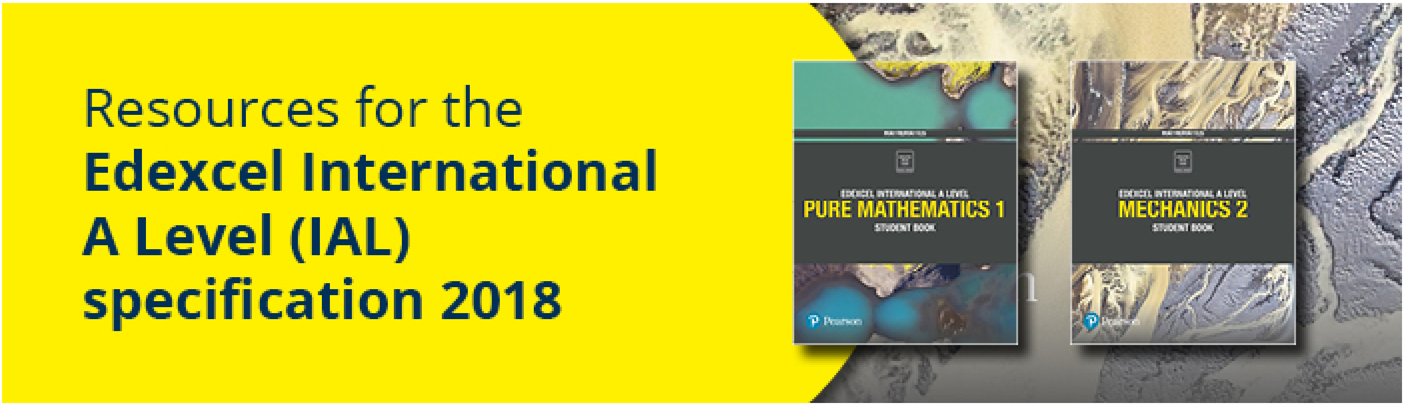

Published resources for each of the 14 Units for International Mathematics

‘Open’ resources on the website

Pearson Edexcel

https://qualifications.pearson.com/en/qualifications/edexcel-international-advanced-levels/mathematics-2018.coursematerials.html#filterQuery=category:Pearson-UK:Category%2FSpecification-and-sample-assessments

ResultsPlus

- Free online results analysis tool for teachers.
- Provides a detailed breakdown of student performance in Pearson Edexcel exams.
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examWizard

- A free tool for teachers which helps you make quick homework assignments, topic tests and mock exams.

- Questions tagged against unit, topic and assessment objective or simply choose a whole past paper.

- Use existing mark schemes for accurate marking.

- Use examiner report for insight.

- Most recent exam content available sooner.

- Use the results to understand where students need more support, informing teaching strategies.

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New Access to Script (ATS) Online Portal

Access to Scripts (ATS) is a free online portal which allows teachers to immediately access electronically marked exam papers

Provides enhanced transparency and

- Offers transparent approach to marking process
- Provides better understanding of marking before requests for enquiries about results are made
- Provides excellent aid for teaching and preparing other cohorts for examinations by helping you to evaluate a student's performance on particular questions in relation to what they have been taught.

Available instantly from results day for all our examination series, for a defined window, you can view and download scripts which have been marked online free of charge from our Self-Service Portal.

For more information on ATS, and the post results windows, visit our post-results pages.

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Contact your dedicated Subject Advisor

Subject Advisor details

Your subject advisor is **Graham Cumming**
Phone: **+44 (0)20 70102174**
Twitter: **@EmporiumMaths**
Email: TeachingMaths@pearson.com

Sign up for monthly newsletters from Graham to stay on top of qualification updates, training, course materials and industry news.

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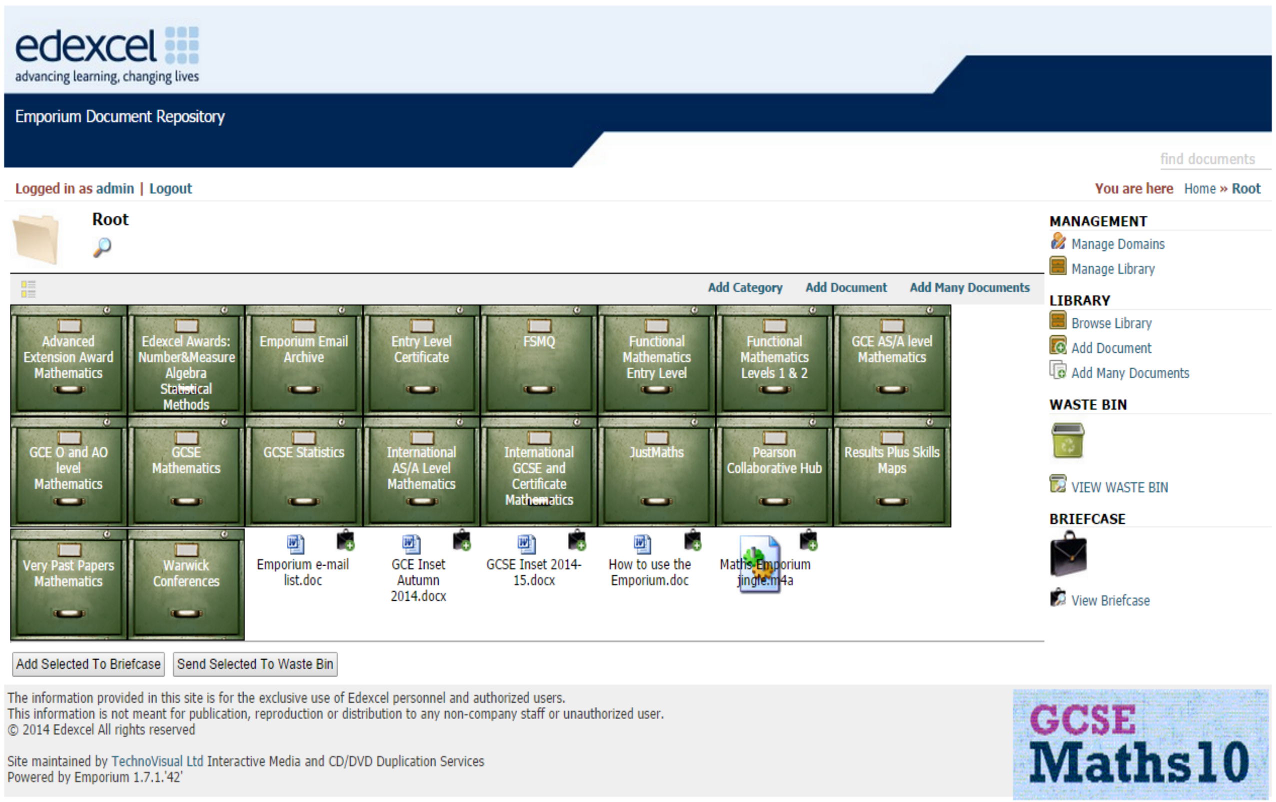
Mathematics Emporium

- Website at www.edexcelmaths.com



- Email updates from mathsemporium@pearson.com

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This page shows the minimum marks needed to achieve a certain grade for all UK and international examinations. Also refer to the examiners report which is available for download with other documents.

2. **Examination Results Statistics**

Results statistics summarise the overall grade outcomes of candidates sitting Pearson Edexcel examinations.

3. **Progress to University**

Here you can find information and guidance about how to progress to universities worldwide with Pearson Edexcel qualifications.

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