Edexcel International AS/A Level Mathematics

Welcome to Pearson: Module 2

First teaching in 2018, first assessment 2019

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Session Agenda

10:00	Welcome & Introductions, Poll
10.05	Introduction to Assessment Objectives (AOs)
10:25	AOs – the details
10:45	AOs and mark schemes
11.00	Break
11.05	Linking marks with progress through a question
11.40	Support for exam preparation
11:55	Final questions
12.00	Finish

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Poll to get to know the delegates

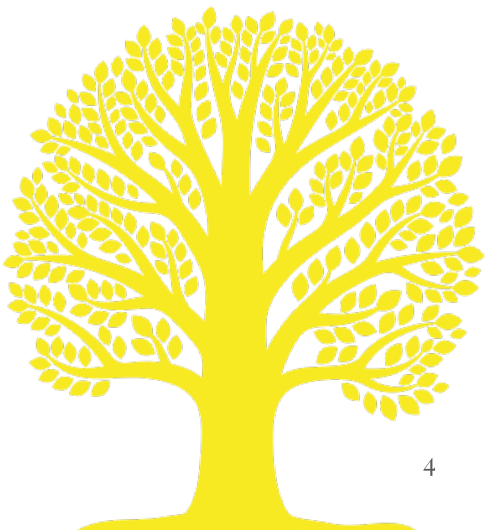
Please complete the online poll.

Results are shared anonymously.

The poll is a little different from the one in module 1.

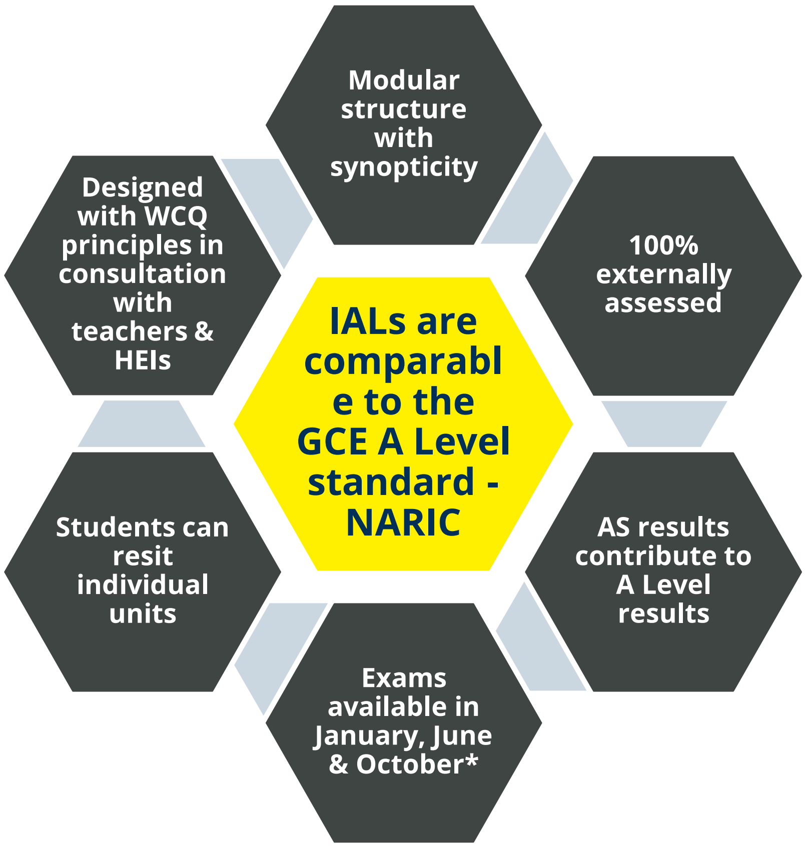
Aims and objectives

- understand the Assessment Objectives for the qualification.
- understand the question types for the qualification
- understand the mark schemes for the qualification
- practise using the mark schemes on exemplar student work
- learn about the support provided by Pearson around assessment and exemplars



IAL Features

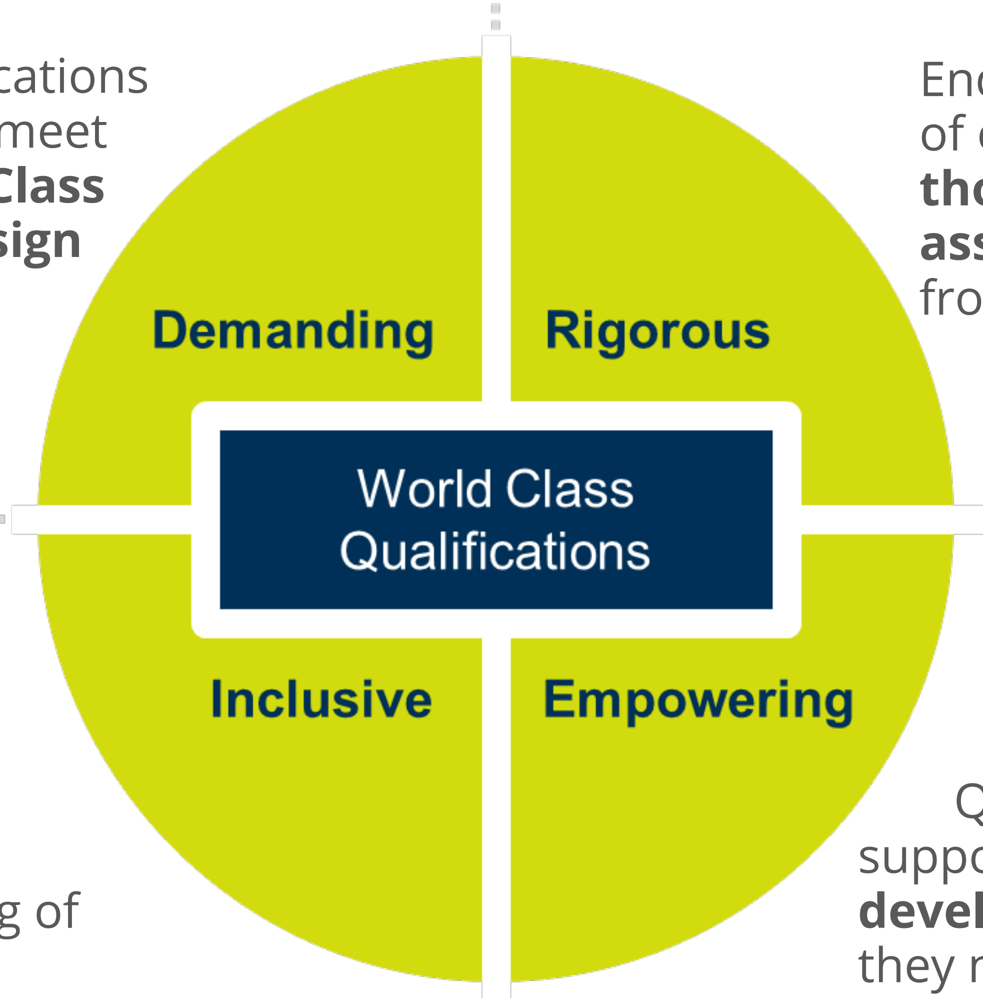
- International A Levels and AS Levels are created for International Students
- Globally recognised.



World-class qualifications

All Edexcel qualifications are developed to meet Pearson's **World Class Qualification design principles**

Endorsement of educational **thought-leaders and assessment experts** from across the globe



Developed using an understanding and benchmarking of **all educational systems**

Qualifications that support young people to **develop the capabilities** they need to **progress** and prosper in their lives

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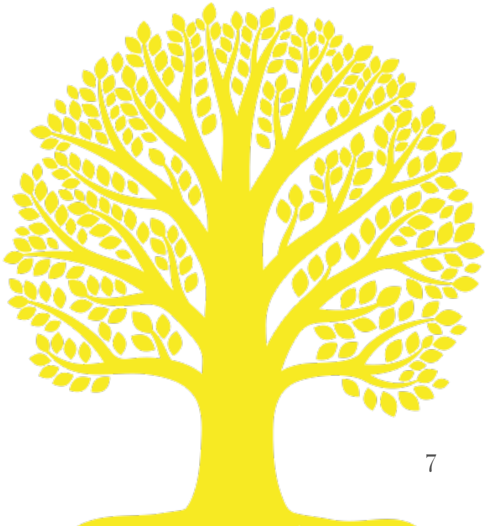
Assessment Objectives

- The Specification is described by the **content** (what is to be learned) and by the **assessment objectives** (what the student has to do to demonstrate learning).
- The content differs for each module of the IAL Mathematics course.
- The assessment objectives (AOs) span each module although the number of marks allocated to each AO differs from module to module.



Assessment Objectives

Content

Facts

Techniques

Relationships

Models

Assessment Objectives

Demonstrate knowledge of facts, techniques and relationships

Demonstrate application of facts, techniques and relationships to solve problems

Demonstrate processes to model real situations and to interpret results of calculations involving models

Assessment Objectives

IAL Mathematics has five AOs:

1. Recall, select and use knowledge of mathematical facts, concepts and techniques………

2. Construct rigorous mathematical arguments and proofs………and the construction of extended arguments for handing substantial problems in unstructured form

3. Recall, select and use knowledge of standard mathematical models to represent situations in the real world….

4. Comprehend translations of common realistic contexts into mathematics….. interpret results

5. Use contemporary calculator technology and other permitted resources …..

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Assessment Objectives

IAL Mathematics has five AOs – examples:

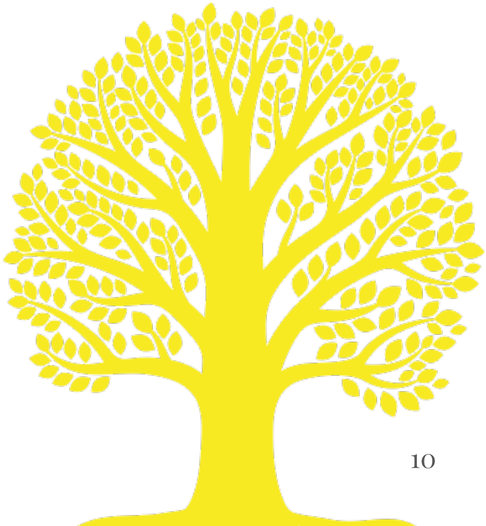
AO1 Given that $y = 4x^2 - \dfrac{3}{\sqrt{x}}$

find $\dfrac{\mathrm{d}y}{\mathrm{d}x}$

This question is fairly standard and is all AO1

AO2 The lengths, in cm, of the two shorter sides of a right -angled triangle are $2 + \sqrt{2}$ and $2 - \sqrt{2}$
Show that the length in cm of the longest side is $2\sqrt{3}$

‘Show’ and ‘prove’ are generally linked to AO2



Assessment Objectives

IAL Mathematics has five AOs – examples:

AO2 also refers to … and the construction of extended arguments for handling substantial problems in unstructured form

9. The equation

$$\frac{3}{x} + 5 = -2x + c$$

where c is a constant, has no real roots.

Find the range of possible values of c.

(7)

Take a few moments to think about the steps a student would have to carry out to complete the question.

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Assessment Objectives

IAL Mathematics has five AOs – examples:

AO3 The population, P millions, of a country is given by

$$P = 5e^{0.4t} + 10e^{-0.8t}$$

where t is the time in years.

Write down the initial population.

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Assessment Objectives

IAL Mathematics has five AOs – examples:

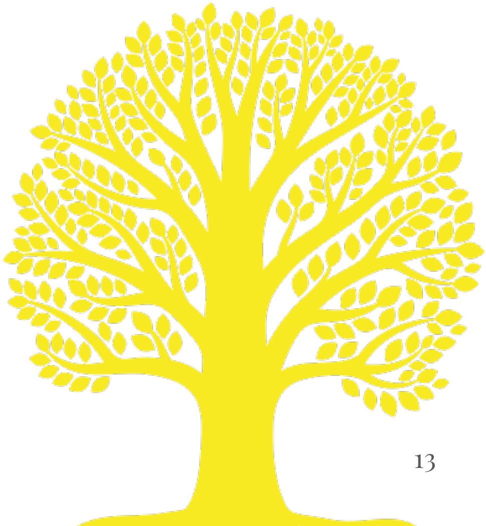
AO4 (a) Show that $\dfrac{\sin(2x+y)+\sin(2x-y)}{4\cos x\cos y} \equiv \sin x$

where $\cos x \cos y \neq 0$

(b) Hence, solve the equation

$$\frac{\sin\left(2x+\frac{\pi}{3}\right)+\sin\left(2x-\frac{\pi}{3}\right)}{2\cos x} \equiv 1$$

for values of x between 0 and 2π



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Assessment Objectives

IAL Mathematics has five AOs – examples:

AO5 $\quad \text{I} = \int_0^1 \mathrm{f}(x)\,\mathrm{d}x$

where $\mathrm{f}(x) = \sqrt{1 + 2x^2}$

Complete the column for $x = 0.75$ giving the value of $\mathrm{f}(x)$ correct to 3 decimal places.

Use the trapezium rule to calculate an estimate for I

x	0	0.25	0.5	0.75	1
$\mathrm{f}(x)$	1	1.061	1.225		1.732

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Assessment Objectives pure units

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

All figures in the above table are expressed as marks out of 75

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Assessment Objectives applied units

	AO1	AO2	AO3	AO4	AO5
M1	20 – 25	20 – 25	15 – 20	6 – 11	4 – 9
M2	20 – 25	20 – 25	10 – 15	7 – 10	5 –10
S1	20 – 25	20 – 25	15 – 20	5 – 10	5 –10
S2	20 – 25	20 – 25	10 – 15	5 – 10	5 –10
D1	20 – 25	20 – 25	15 – 20	5 – 10	5 –10

All figures in the above table are expressed as marks out of 75

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Assessment Objectives

Activity 1

Study the two questions taken from Pure 1 June 2019.
Make a judgement about which AOs should be assigned to each question.
The mark schemes and a summary of the AOs are available to help you.

Complete the online mark sheet.
Marks will be shared anonymously with the meeting.

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Assessment Objectives

Constructing a full paper requires that most of the content is covered and that the sum of the marks allocated to each AO on the paper lies within the allowed totals.

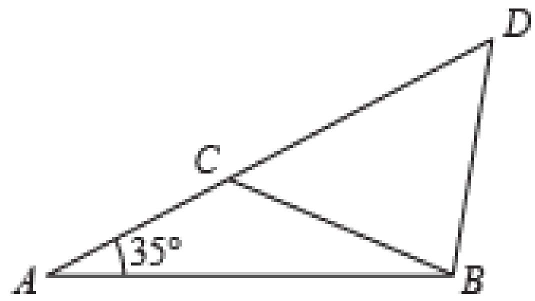
Q	Content	Marks	AO1	AO2	AO3	AO4	AO5
1	4.1, 4.3 Sequences	4					
2	3.1 Circles	7					
3	1.1, 1.3 Proof	4					
4	4.5 Binomial Expansion	7					
5	7.1 Differentiation problem in context	8					
6	2.1, 6.2 Factor Theorem and Trig equation	8					
7	4.2, 4.4 AP and GP problem in context	9					
8	5.2, 5.3 Laws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

This is for a recent Pure 2 paper

Assessment Objectives

However it is possible to vary a question to alter the distribution of AO marks.

7.



Not to scale

Figure 3

Originally all AO4

Figure 3 shows the design for a structure used to support a roof.

The structure consists of four wooden beams, AB, BD, BC and AD.

Given $AB = 6.5$ m, $BC = BD = 4.7$ m and angle $BAC = 35°$

(a) find, to one decimal place, the size of angle ACB,

(3)

(b) find, to the nearest metre, the total length of wood required to make this structure.

(3)

Take a few moments to think how this question could be altered from AO4

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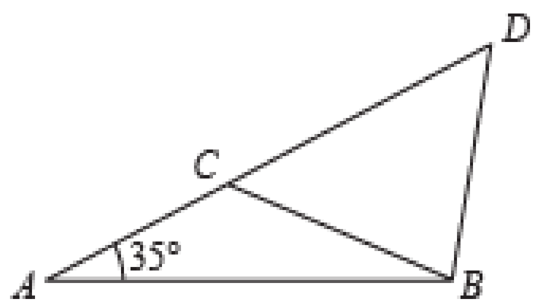
Assessment Objectives

Here is one possible attempt which does not change the underlying mathematical processes very much.

7.



Not to scale

Figure 3

In Figure 3, *ACD* is a straight line.

Given $AB = 6.5\,\text{m}$, $BC = BD = 4.7\,\text{m}$ and angle $BAC = 35°$

(a) find, to one decimal place, the size of angle *ACB.*

(b) find, correct to the nearest metre, the perimeter of triangle *ABD.*

Now a combination of AO1 and AO2

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Assessment Objectives

Producing the finished draft of a paper requires a lot of skill to set the questions so that the AO marks totals agree both across rows and down columns.

The other factor which has to be considered is that of DEMAND – what cognitive skills are required to do each question.

Roughly speaking, the less structure in a question (and the greater number of steps required to complete it) the more demanding it is.

Also important is how familiar the question is likely to be to the student.

Linked to both of the above is the fact the student may have to devise their own strategy – so which techniques to use may not be immediately apparent.

Assessment Objectives

Demand:

This question comes from Mechanics 1 Jan 2019

The same question could be set where only the last part is asked.This usually increases the demand

3.

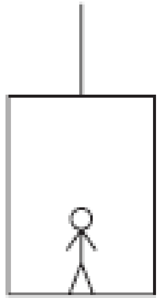

Figure 1

A lift of mass M kg is being raised by a vertical cable attached to the top of the lift. A person of mass m kg stands on the floor inside the lift, as shown in Figure 1. The lift ascends vertically with constant acceleration $1.4\,\text{m}\,\text{s}^{-2}$. The tension in the cable is 2800 N and the person experiences a constant normal reaction of magnitude 560 N from the floor of the lift. The cable is modelled as being light and inextensible, the person is modelled as a particle and air resistance is negligible.

(a) Write down an equation of motion for the person only.

(2)

(b) Write down an equation of motion for the lift only.

(2)

(c) Hence, or otherwise, find

(i) the value of m,

(ii) the value of M.

(3)

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Grade boundaries

Also, for an examination with 5 grades per paper, the demand must be such that each paper is accessible at the low end and challenging enough at the upper end.
The table shows the marks needed in June 2019.
The UMS correspond to grades A to E (80 to 40).

Module	80	70	60	50	40
WMA11 Pure Mathematics 1	58	51	44	38	32
WMA12 Pure Mathematics 2	60	53	46	40	34
WDM11 Decision Mathematics 1	59	53	47	42	37

Total mark for any paper is 75, so a student who got 177 marks or better out of 225 would get a grade A (at AS)

Awarding marks

The purposes of a mark scheme are:

- to enable partial or full success to be rewarded
- to ensure consistency between markers
- to ensure consistency from one exam session to the next

Awarding marks

How partial or full success is rewarded.

Each question is given a number of marks according to the amount of work required to do it.
Marks are allocated according to which AOs the question is testing.

The mark scheme is then constructed so that as the student progresses through the solution of the question, marks are accumulated.

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Awarding marks

How partial or full success is rewarded.

The marks awarded belong to three different types:

- M marks – marks for appropriate methods used in a correct way
- A marks – accurate answers which are conditional on correct method(s) being used
- B marks – unconditional accuracy marks

So the combination M0A1 is NEVER used

Awarding marks

How partial or full success is rewarded.

For M marks there is often guidance for how to reward a student who tries to use a method but not fully correctly.

For example, in integrating a polynomial, the M mark is usually awarded if the power of x is increased by 1.

For example, in solving a quadratic using the formula, sign errors are not penalised for the M mark.

Awarding marks

How partial or full success is rewarded.

In addition:

dM denotes a method mark which is dependent on a previous M mark

“ “ are used to denote where an incorrect answer can be used in a subsequent part and still be awarded marks (known as ‘follow though’). Usually there are conditions attached to following through.

Awarding marks

Students may have access to a sophisticated calculator. Using just this may mean they do not demonstrate ability in an assessment objective.

So Edexcel mathematics exams often have instructions to show full working.

2. Answer this question showing each stage of your working.

(a) Simplify $\dfrac{1}{4 - 2\sqrt{2}}$

giving your answer in the form $a + b\sqrt{2}$ where a and b are rational numbers.

(2)

2.(a)	$\dfrac{1}{4-2\sqrt{2}} = \dfrac{1}{4-2\sqrt{2}} \times \dfrac{4+2\sqrt{2}}{4+2\sqrt{2}}$	M1
	$= \dfrac{4+2\sqrt{2}}{16-8} = \dfrac{1}{2} + \dfrac{1}{4}\sqrt{2}$ oe	A1

This step, or equivalent MUST be shown

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Awarding marks

Activity 2

Suggest some other types of questions where working MUST be shown because of issues over use of a calculator.

Use Chat to write down any types.

Awarding marks

<u>Activity 2</u>

Here is a short (possibly incomplete) list:

Solution of simultaneous equations
Solution of quadratic equations
Solution of cubic equations
Factorisation of cubic polynomials
Definite integrals
Solution of trig equations
Location of turning points

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Awarding marks

Here is question 1 from the November 2019 paper of Pure 2:

1. A curve C has equation $y = 2x^2(x - 5)$

(a) Find, using calculus, the x coordinates of the stationary points of C.

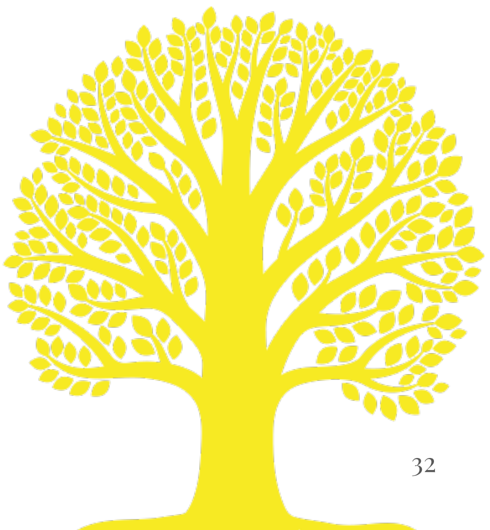
(4)

(b) Hence find the values of x for which y is increasing.

(2)

Just take a moment to think what is the sequence of mathematical processes that a student must use to do part (a).

Use Chat to write down what the very first step should be.



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Awarding marks

Here is question 1 from the November 2019 paper of Pure 2:

1. A curve C has equation $y = 2x^2(x - 5)$

(a) Find, using calculus, the x coordinates of the stationary points of C.

(4)

(b) Hence find the values of x for which y is increasing.

(2)

One way to do part (a) requires the following steps:

Expand the brackets

Differentiate the expanded form

Set the derivative = 0 to get an algebraic equation

Solve the algebraic equation.

The mark scheme must reflect this. There are 4 processes.
There must be an accuracy mark for the final answer

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Awarding marks

Here is question 1 from the November 2019 paper of Pure 2:

1. A curve C has equation $y = 2x^2(x - 5)$

(a) Find, using calculus, the x coordinates of the stationary points of C.

(4)

(b) Hence find the values of x for which y is increasing.

(2)

<u>Activity 3</u>
Decide which processes should be paired to get a mark.
Record your decision on the response sheet.

Decisions will be shared anonymously.

Awarding marks

Here is an excerpt from the mark scheme:

1 (a)	$y = 2x^2(x-5) = 2x^3 - 10x^2$	B1
	$\dfrac{\mathrm{d}y}{\mathrm{d}x} = 6x^2 - 20x$	M1
	Sets $\dfrac{\mathrm{d}y}{\mathrm{d}x} = 0 \Rightarrow 6x^2 - 20x = 0 \Rightarrow x = 0, \dfrac{10}{3}$ oe	dM1 A1
		(4)

The full mark scheme contains a lot more information.

This method mark can only be awarded if the earlier one has been awarded

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Awarding marks

How does it relate to the sequence of processes shown earlier?

1 (a)	$y = 2x^2(x-5) = 2x^3 - 10x^2$	B1
	$\dfrac{dy}{dx} = 6x^2 - 20x$	M1
	Sets $\dfrac{dy}{dx} = 0 \Rightarrow 6x^2 - 20x = 0 \Rightarrow x = 0, \dfrac{10}{3}$ oe	dM1 A1
		(4)

Expand the brackets — B1

Differentiate the expanded form — M1

Set the derivative = 0 to get an algebraic equation
Solve the algebraic equation. — dM1 (both lines needed)

Correct values of *x* — A1

Of course, further explanation is needed for the method marks

Awarding marks

Here is an excerpt from the mark scheme:

1 (a)	$y = 2x^2(x-5) = 2x^3 - 10x^2$	B1
	$\frac{dy}{dx} = 6x^2 - 20x$	M1
	Sets $\frac{dy}{dx} = 0 \Rightarrow 6x^2 - 20x = 0 \Rightarrow x = 0, \frac{10}{3}$ oe	dM1 A1
		(4)

Expand the brackets	B1	Must be correct
Differentiate the expanded form	M1	For reducing at least one power of x by 1
Set the derivative = 0 and solve an algebraic equation	dM1	y' = 0 and solves their quadratic to get at least one root
	A1	

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Awarding marks

Part (b) obviously requires the use of the answers to part (a) and this is reflected in the mark scheme:

One of $x \le "0"$ or $x \ge "\frac{10}{3}"$. Allow for $x < "0"$ or $x > "\frac{10}{3}"$. They must have only achieved a maximum of two x coordinates in (a).	M1
$x \leqslant 0, \quad x \geqslant \frac{10}{3}$	A1

Denotes that the marker must follow through the student's response

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Awarding marks

Activity 4: marking student responses

Please mark the two questions given in Activity 4.
Mark schemes are available on the sheets.

Record your marks on the response sheet which will be shared anonymously.
Any comments/questions put in Chat.

Awarding marks

Activity 4: marking student responses

I hope you found the activity interesting.

Mark schemes are designed to cover most of the likely responses to a question. This explains why they are long and detailed.

Experienced markers will have seen many of the techniques required in previous exams so the task of marking a full paper is not as daunting as it first appears.

Awarding marks

Students lose marks for all sorts of reasons, but there are some common errors which experienced teachers generally know about and teach their classes accordingly.

In the previous activity there were two commonly occurring errors – one for each question.

Spend a moment thinking what they could be.

Awarding marks

Students lose marks for all sorts of reasons, but there are some common errors which experienced teachers generally know about and teach their classes accordingly.
Here is a question from June 2019 Pure 1 which illustrates some of them.

8. The curve C with equation $y = \mathrm{f}(x)$, $x > 0$, passes through the point $P(4, 1)$.

Given that $\mathrm{f}'(x) = 4\sqrt{x} - 2 - \dfrac{8}{3x^2}$

(a) find the equation of the normal to C at P. Write your answer in the form $ax + by + c = 0$, where a, b and c are integers to be found.

(4)

(b) Find $\mathrm{f}(x)$.

(5)

Spend a moment thinking what errors students could make.
There are some in (a) and in (b).
Put any ideas in Chat.

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Awarding marks

The principal examiner's report had these points to make for part (a):

8. The curve C with equation $y = f(x)$, $x > 0$, passes through the point $P(4, 1)$.

Given that $f'(x) = 4\sqrt{x} - 2 - \dfrac{8}{3x^2}$

(a) find the equation of the normal to C at P. Write your answer in the form $ax + by + c = 0$, where a, b and c are integers to be found.

(4)

Misunderstandings seen that caused a loss in marks were:

- Integrating in part (a)
- Differentiating again in part (a) and finding $f''(4)$ as opposed to $f'(4)$
- Finding the equation of the tangent rather than normal in part (a)

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Awarding marks

The principal examiner's report had these points to make for part (b):

8. The curve C with equation $y = \mathrm{f}(x)$, $x > 0$, passes through the point $P(4, 1)$.

Given that $\mathrm{f}'(x) = 4\sqrt{x} - 2 - \dfrac{8}{3x^2}$

(b) Find $\mathrm{f}(x)$.

(5)

- Failing to add a constant in part (b)
- Making a sign slip when integrating $-\dfrac{8}{3x^2}$

Supporting IAL Mathematics

If you are not yet an Edexcel centre, then you can look at some of the support available.

Start with the Specification and the Sample Assessment material (SAMS) at

https://qualifications.pearson.com/en/qualifications/edexcel-international-advanced-levels/mathematics-2018.html

where you can easily access them.

In the same place are copies of recent past papers and further practice papers.

There is additional support if you sign up as an Edexcel centre.

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Supporting IAL Mathematics

…….. Specifically for examinations.

•‘ Maths Emporium - easy access to past papers, mark schemes, grade boundaries and examiner reports

• ResultsPlus - analysis of student performance for your own centre

• Exam Wizard – enables a teacher to produce own worksheets based on exam questions

• easy access to a student’s exam papers

•https://qualifications.pearson.com/en/support/Services/access-to-scripts.html

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ResultsPlus

- Free online results analysis tool for teachers
- Provides a detailed breakdown of student performance in Edexcel exams.
- Identify topics and questions where the student could benefit from further learning
- Use this knowledge to inform teaching strategies and approaches
- Provides a comparison of student performance at regional level.
- Allows centres to view their country’s results compared to the total Edexcel cohort.
- Mock exams results can also be fed into the system to produce an analysis
- Schools can sign up for free ResultsPlus account in just a few quick and easy steps:

https://qualifications.pearson.com/en/support/Services/ResultsPlus.html

examWizard

- Free tool for teachers containing a bank of past paper questions to help create their own bespoke mock exams and tests to focus on particular topic areas as needed

- Use existing mark schemes for accurate marking

- Use existing examiner report for insight

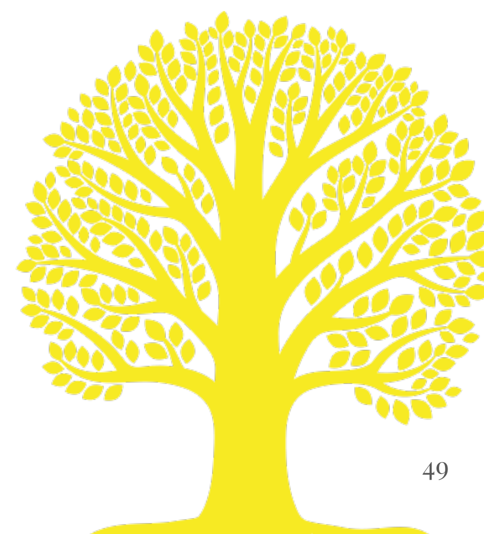
- Use the results to understand where students need more support, informing teaching strategies.

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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Other useful links

1.**Grade Boundaries**

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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ALWAYS LEARNING