Qualification Accredited

OCR
Oxford Cambridge and RSA

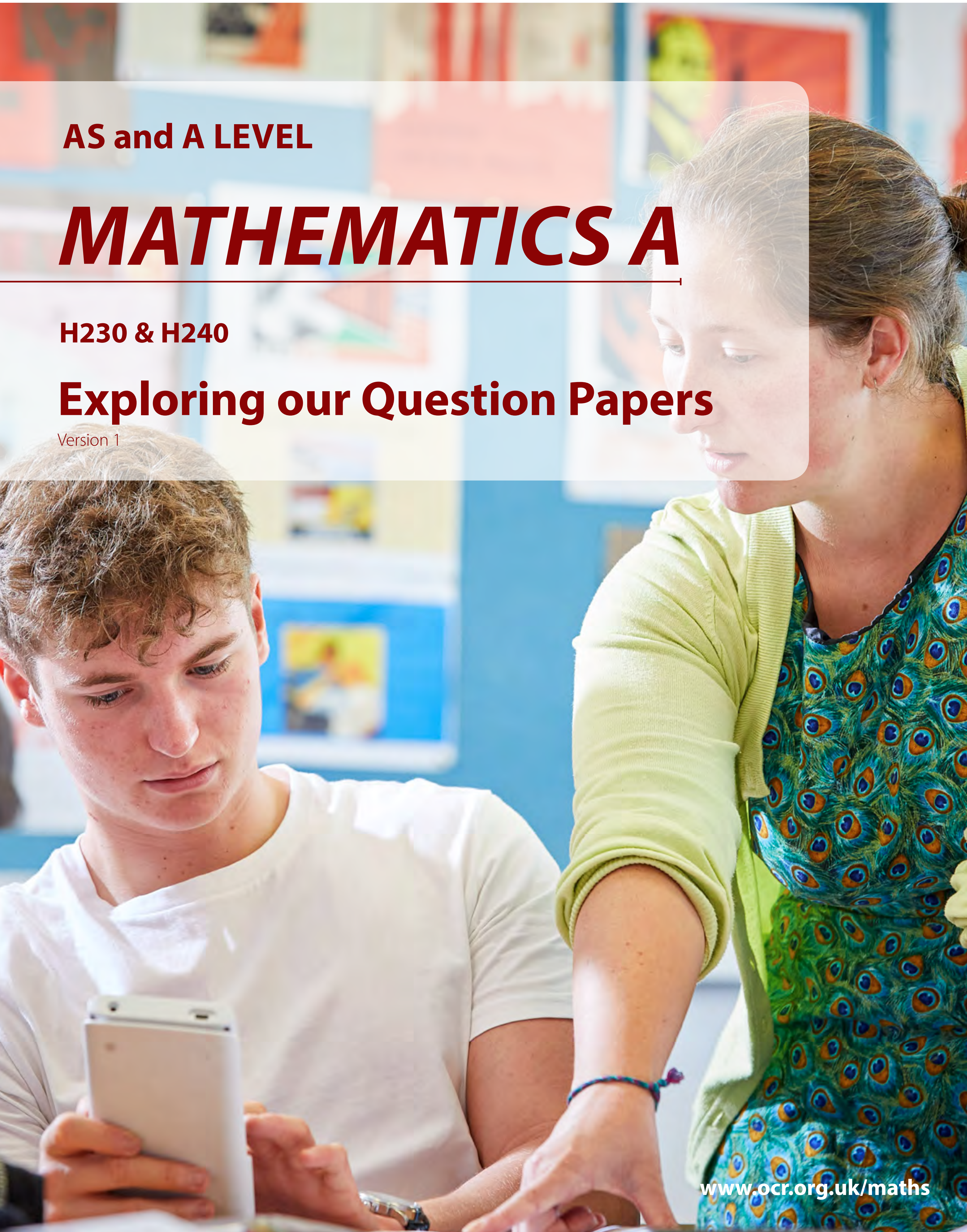
AS and A LEVEL

MATHEMATICS A

H230 & H240

Exploring our Question Papers

Version 1



www.ocr.org.uk/maths

We Like to Show Our Working

We've been listening to teacher feedback about what you loved about our specifications and sample assessment materials in A Level Maths.

To help you prepare your students for the first full A Level examination series in 2019, we wanted to share with you our thinking about what makes our specification so easy to teach, and how we're making some small changes to our question papers to make them even better for your students.

Our Assessments have been designed to give your students the best experience in the exam

We've reviewed our question paper layout, and in order to make it clearer we've increased the size of our typeface and the amount of space around the questions. We're keeping our approach of providing a separate question paper and answer booklet – we think this makes it easier for students to better plan their time in the exam and see the entirety of every multi-part question.

Our papers are structured to help with revision and exam technique

We test Pure Maths, then Mechanics and Statistics separately, so that students can focus on one area of the course at a time when they prepare for each paper.

We use a range of question types that test students fairly

We don't use multiple choice questions which can be misleading, instead we use short answer questions which are clear and accessible. Our questions use authentic real world contexts and mathematical context sparingly, so it doesn't distract students from what they need to do.

Our specification has been re-designed to make it even easier to use.

We use a landscape format that puts the AS and A Level Maths content side by side, so that it's easy to use if you're co-teaching AS, or teaching a two year A Level course.

Use our command words glossary with your students.

It's written in clear and straightforward language so it's easy for them to understand.

You can teach maths in the way that suits you and your students.

The way we assess Pure Maths alongside both the Mechanic and Statistics means you're free to teach the mathematical content in the way you want to, and if you're teaching Further Maths, you can teach it alongside, as a fully combined course, or as two one-year courses.

Find out more about our approach to Maths assessment in this booklet, download our re-designed Sample Assessment Materials, and read about the 2018 exam series in our new Examiner Reports, complete with exemplar student responses. In 2019, when you see our live papers, we hope that you'll agree that these small changes add up to make a big difference.

Accessibility

We have produced this guide to share the story of our assessment approach and explore our question papers with you.

During the development of our qualifications, we talked to a wide range of teachers, students and other stakeholders to influence the structure of our question papers.

Our approach to Accessibility means making sure our Assessments use:

- Clear and appropriate language
- A gradient of difficulty throughout each question paper
- A spacious paper layout
- A clear and larger typeface
- Only one typeface - so that students find the question paper easy to read
- Question papers with separate answer booklets - so that students can better plan their time in the exam and can see all of multiple part questions at once.

We have ensured assessments are structured to help with revision and exam technique:

- Testing pure maths, then mechanics and statistics separately
- Enabling weaker students to focus on one area of the course at a time
- Having a range of question types that test students fairly eg. short answer questions and not MCQs
- Using authentic real world contexts, and only using mathematical context sparingly.

In addition, our specifications are easy to teach from:

- Teaching content is set out in landscape format with AS/Year 1 and Year 2 content laid out next to each other so that you can see how student knowledge should build
- GCSE and A-Level specifications are laid out in the same way to enable seamless progression
- Sections of the Specification are clearly defined such as Command Words and Notation to help you as you plan, prepare and teach.
- Supports separate mechanics and statistics teaching or combined approaches – making it easy to structure a course with a mix of different teachers.

We provide you with:

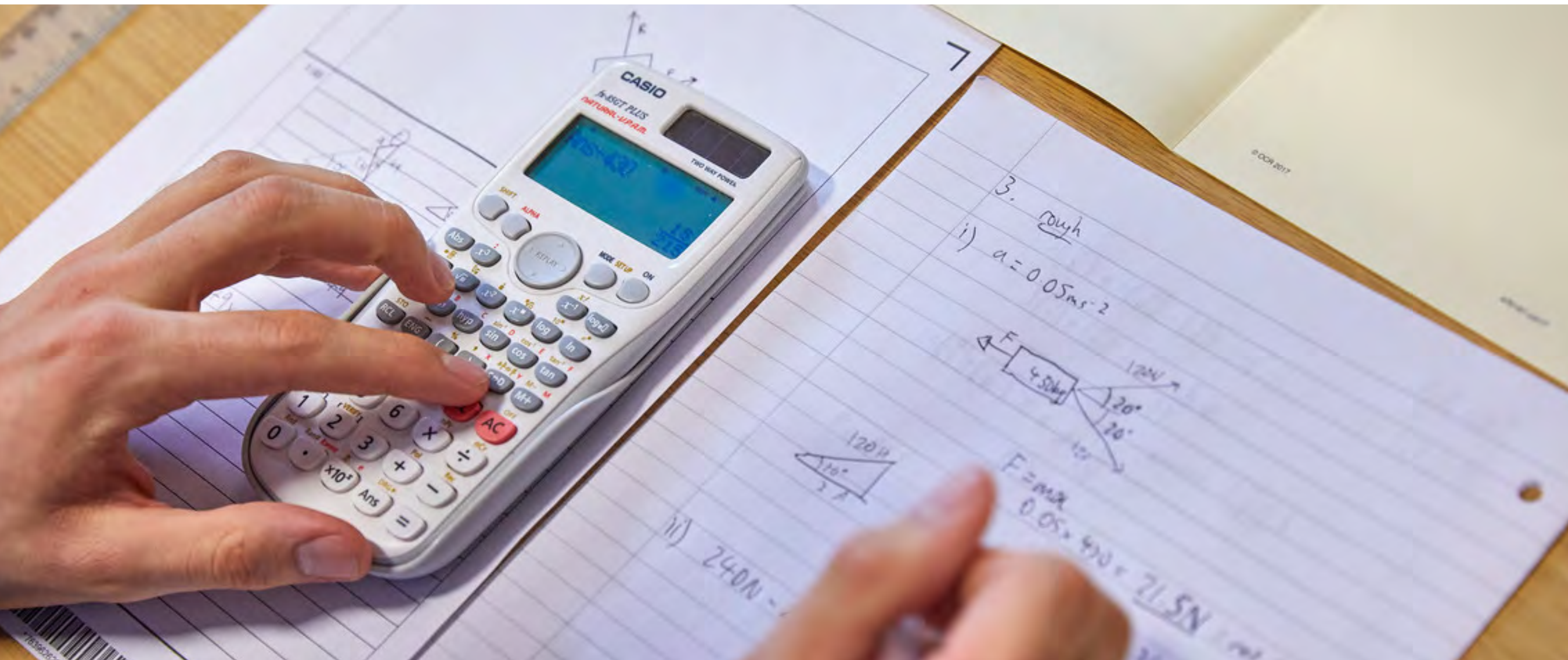
- Practice Papers to use as mock exams
- Exam Builder to create your own mocks and tests
- Baseline check-in tests that give you data all the way through the course
- Planning materials and mapping guides to help you see your route through the course
- Full range of endorsed textbooks from CUP and Hodder
- Full range of teaching and learning resources, including flexible curriculum planners
- CPD courses and webinars to help you get started and learn more
- Network meetings where you can share ideas.

Our Assessment Principles

The principles underpinning our test construction approach for AS/A Level Mathematics are outlined below.

Group	No.	Accessibility Principle	Why?
Look and feel of the paper	1	Tone (assessing good understanding of maths without letting the language of our questions be an obstacle to understanding what is needed) • The use of overly complicated language and grammatical constructions will be avoided. • Contexts and vocabulary will be considered for currency and appropriateness to learners, e.g. glasses not spectacles. • Language used throughout the question will be consistent. For example, usage in the stem matches that throughout the rest of the question and any titles given to any diagrams. • Technical words will be used appropriately to underpin the maths being assessed.	To make it as clear as possible what response is expected.
	2	Text, displayed equations, tables and diagrams will be left aligned. Items in table cells will usually be centred (horizontally and vertically) with 'headers' at the left of rows usually left-aligned. Columns of numerical values will usually be aligned on the decimal point, even when not present.	To align with the principles applied to our modified question papers (left alignment is reported to be easier to understand for a range of visual impairments) and reduce opportunity for errors when processing modified papers.
Assessment approach	3	Command words will be taken from the defined list of command words (with definitions) included in the specification, unless it is inappropriate to do so.	To ensure clarity for centres as to what can be assessed and how all command words will be used.
	4	Negative questions will be kept to a minimum.	Used well, negative questions can be a good way of testing understanding but can also easily lead to confusion. We will only ever use negatives where it is the most appropriate approach.
	5	Where there is a large context provided sentences will be grouped by type of information. Bulleted lists or numbering will be used where it helps indicate multiple demands, methods to be demonstrated or lists of information.	To ensure information is presented in the clearest possible way for candidates.
	6	Italics will only be used in questions where required (for instance denotation of variables in line with standard conventions for the subject). If a specific word requires emphasis, bold font will be used.	Italics can be hard to read if overused.

Group	No.	Accessibility Principle	Why?
	7	We will always ensure that questions indicate where a specific degree of precision is required to gain full credit for a response, e.g. where a calculation requires an answer to a specific number of decimal places/significant figures this will always be clearly stated.	To avoid confusing candidates who may be concerned about the required precision where it is ambiguous.
Images, diagrams, data	8	Images, diagrams and data will only be used where they genuinely support what is required in the question. We will avoid candidates needing to turn pages by aiming to always have images, diagrams and questions on facing pages. • Where necessary, if there is one, or more than one table or graph, they will be referred to as '**Fig. Fig 1** or **Fig. 1.1**', '**Fig 1.2**', '**Table 1** or **Table 1.1**', '**Table 1.2**'. • Where there is an image/diagram/graph or table, the information will be given before we ask the question. We will make it clear what is information and what is the question.	To avoid unnecessary page turning and distracting images for the candidates that do not help them understand what is required in the question.
	9	All tables, graphs, images, diagrams and equations will follow standard mathematical practices.	To avoid establishing bad practices for candidates who progress to Further and Higher Education.
	10	Text will not be wrapped around images/diagrams/ graphs.	To retain clarity.
	11	If candidates are required to do something with an image/diagram/graph, it will be repeated in the Printed Answer Booklet, centred with sufficient space around it for them to do their working.	To avoid candidates struggling to fit in their response.



Command Words

In this question you must show detailed reasoning

When a question includes this instruction, the solution must lead to a conclusion showing a detailed and complete analytical method. There should be sufficient detail to allow the line of argument to be followed. This is not a restriction on a candidate's use of a calculator when tackling the question, e.g. for checking an answer or evaluating a function at a given point, but it is a restriction on what will be accepted as evidence of a complete method.

Example Question

In this question you must show detailed reasoning

Find the coordinates of the stationary point of the curve $y = x\ln x$.

Example Response

At the stationary point $\frac{\mathrm{d}y}{\mathrm{d}x} = 0$

$\frac{\mathrm{d}y}{\mathrm{d}x} = 1.\ln x + x.\frac{1}{x} = \ln x + 1 = 0$

$\Rightarrow \ln x = -1$ so $x = \frac{1}{\mathrm{e}}$

When $x = \frac{1}{\mathrm{e}}$, $y = \frac{1}{\mathrm{e}}\ln\frac{1}{\mathrm{e}} = \frac{1}{\mathrm{e}}\times(-1) = -\frac{1}{\mathrm{e}}$

So the coordinates of the stationary point are $\left(\frac{1}{\mathrm{e}}, -\frac{1}{\mathrm{e}}\right)$

Show that

Candidates must show that the given result is true. It is not sufficient to substitute the given values to verify the result; an explanation must cover the argument.

Example Question

Show that the curve $y = x\ln x$ has a stationary point $\left(\frac{1}{\mathrm{e}}, \ -\frac{1}{\mathrm{e}}\right)$.

Example Response

$\frac{\mathrm{d}y}{\mathrm{d}x} = 1.\ln x + x.\frac{1}{x} = \ln x + 1$

$\frac{\mathrm{d}y}{\mathrm{d}x} = 0$ for stationary point

When $x = \frac{1}{\mathrm{e}} \Rightarrow \frac{\mathrm{d}y}{\mathrm{d}x} = \ln\frac{1}{\mathrm{e}} + 1 = 0$ so stationary

When $x = \frac{1}{\mathrm{e}}$, $y = \frac{1}{\mathrm{e}}\ln\frac{1}{\mathrm{e}} \Rightarrow y = -\frac{1}{\mathrm{e}}$ so $\left(\frac{1}{\mathrm{e}}, -\frac{1}{\mathrm{e}}\right)$ is a stationary point on the curve.

Determine

Candidates must justify any results found, including working where appropriate.

Example Question

Determine the coordinates of the stationary point of the curve $y = x\ln x$.

Example Response

$$\frac{dy}{dx} = 1.\ln x + x.\frac{1}{x} = \ln x + 1$$

$\ln x + 1 = 0 \Rightarrow x = 0.368...$

When $x = 0.368...$, $y = 0.368... \times \ln\frac{1}{0.368...} = -0.368...$

So $(0.368, -0.368)$

Verify

A clear substitution of the given value to justify the statement is required.

Example Question

Verify that the curve $y = x\ln x$ has a stationary point at $x = \frac{1}{e}$.

Example Response

$$\frac{dy}{dx} = \ln x + 1$$

At $x = \frac{1}{e}$, $\frac{dy}{dx} = \ln\frac{1}{e} + 1 = -1 + 1 = 0$ therefore it is a stationary point.

Prove

A formal proof requires a high level of mathematical detail, with candidates clearly defining variables, correct algebraic manipulation and a concise conclusion.

Example Question

Prove that the sum of the squares of any three consecutive positive integers cannot be divided by 3.

Example Response

Let the three consecutive positive integers be $n - 1$, n and $n + 1$

$(n-1)^2 + n^2 + (n+1)^2 = 3n^2 + 2$

This always leaves a remainder of 2 and so cannot be divided by 3.

Hence

When a question uses the word 'hence', it is an indication that the next step should be based on what has gone before. The intention is that learners should start from the indicated statement.

> You are given that $f(x) = 2x^3 - x^2 - 7x + 6$. Show that $(x-1)$ is a factor of $f(x)$.
>
> Hence find the three factors of $f(x)$.

Hence or otherwise

This is used when there are multiple ways of answering a given question. Learners starting from the indicated statement may well gain some information about the solution from doing so, and may already be some way towards the answer. The command phrase is used to direct learners towards using a particular piece of information to start from or to a particular method. It also indicates to learners that valid alternate methods exist which will be given full credit, but that they may be more time-consuming or complex.

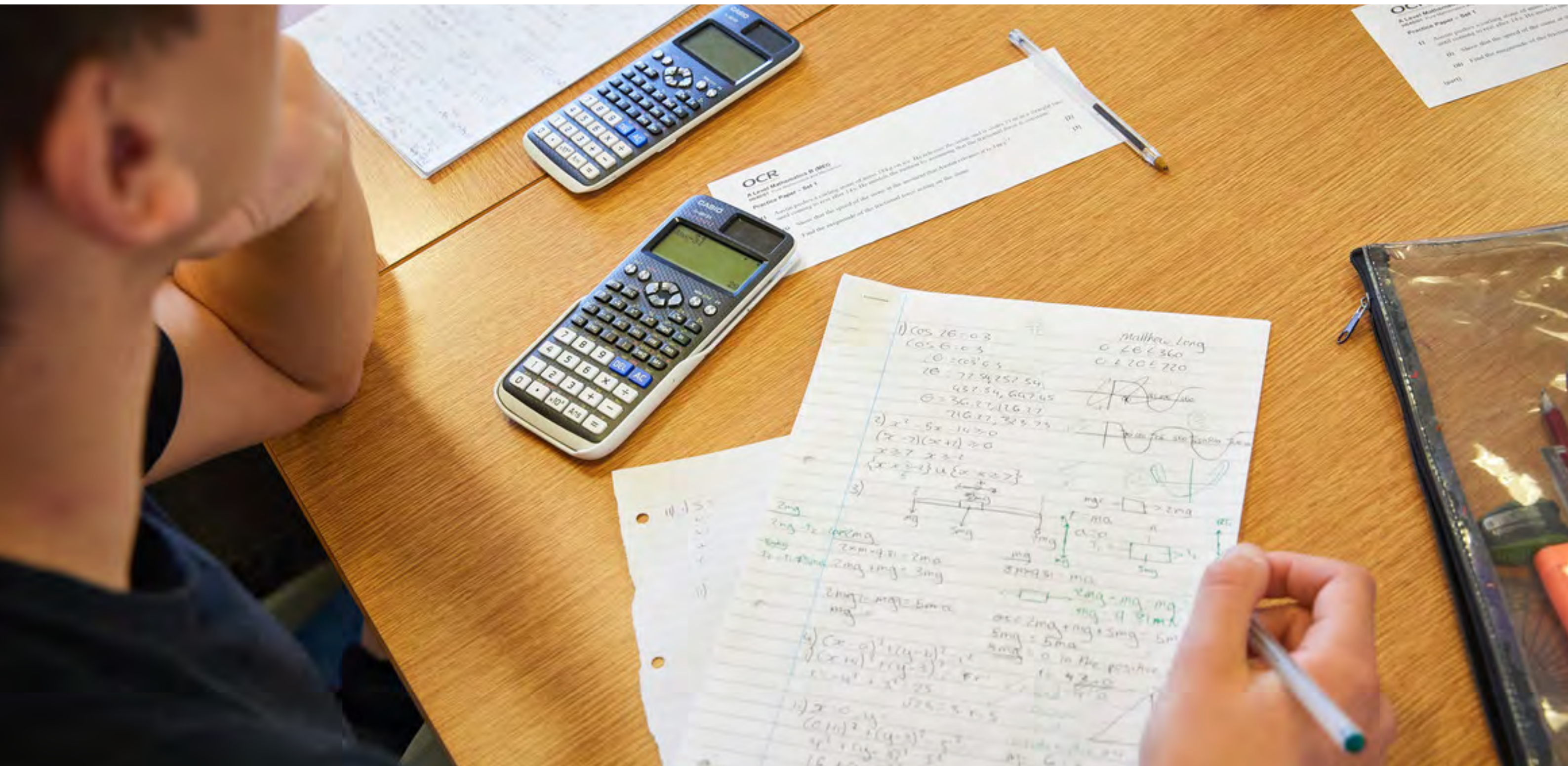
Example:

> Show that $(\cos x + \sin x)^2 = 1 + \sin 2x$ for all x. Hence or otherwise, find the derivative of $(\cos x + \sin x)^2$.

You may use the result

When this phrase is used it indicates a given result that learners would not normally be expected to know, but which may be useful in answering the question.

The phrase should be taken as permissive; use of the given result is not required.



Sketch

Learners should draw a diagram, not necessarily to scale, showing the main features of a curve. These are likely to include at least some of the following.

- Turning points
- Asymptotes
- Intersection with the y-axis
- Intersection with the x-axis
- Behaviour for large x (+ or –)

Any other important features should also be shown.

Plot

Learners should mark points accurately on the graph in their printed answer booklet. They will either have been given the points or have had to calculate them. They may also need to join them with a curve or a straight line, or draw a line of best fit through them.

Draw

Learners should draw to an accuracy appropriate to the problem. They are being asked to make a sensible judgement about this.

Other Command Words

Other command words have their ordinary English meaning.

Examples

Find, State, Write down, Calculate

These command words indicate that neither working nor justification is required, however any working may be rewarded by partial credit as appropriate. A solution could be obtained from the efficient use of a calculator, either graphically or using a numerical method.

<u>Example Question</u>

Find the coordinates of the stationary point of the curve $y = x \ln x$.

<u>Example Response</u>

$(0.368, -0.368)$

Format of our Question Papers

<table>
<tr><th>Content Overview</th><th colspan="2">Assessment Overview</th></tr>
<tr><td>H240/01
Component 01 assesses content from Pure Mathematics</td><td>Paper 1: Pure Mathematics
2 hour written paper
100 marks</td><td>$33^1/_3$%
of total
A Level</td></tr>
<tr><td>H240/02
Component 02 assesses content from Pure Mathematics and Statistics</td><td>Paper 2: Pure Mathematics and Statistics
2 hour written paper
100 marks
Section A Pure
50 marks
Section B Statistics
50 marks</td><td>$33^1/_3$%
of total
A Level</td></tr>
<tr><td>H240/03
Component 03 assesses content from Pure Mathematics and Mechanics</td><td>Paper 3: Pure Mathematics and Mechanics
2 hour written paper
100 marks
Section A Pure
50 marks
Section B Mechanics
50 marks</td><td>$33^1/_3$%
of total
A Level</td></tr>
</table>

OCR's A Level in Mathematics A consists of three components that are externally assessed.

All three components (01–03) contain some synoptic assessment, some extended response questions and some stretch and challenge questions.

Stretch and challenge questions are designed to allow the most able learners the opportunity to demonstrate the full extent of their knowledge and skills.

Stretch and challenge questions will support the awarding of A* grade at A Level, addressing the need for greater differentiation between the most able learners.

The set of assessments in any series will include at least one unstructured problem solving question which addresses multiple areas of the problem solving cycle as set out in the Overarching Themes.

The set of assessments in any series will include at least one extended problem solving question which addresses the first two bullets of assessment objective 3 in combination and at least one extended modelling question which addresses the last three bullets of assessment objective 3 in combination.

Exemplar annotated exam questions

H240/01 Q6

6 Prove by contradiction that there is no greatest even positive integer.

[3]

There is a greater emphasis on formal proof in the reformed content criteria.

Written solutions need to provide a clear argument towards a final conclusion.

6			Assume that there is a greatest even positive integer $N = 2k$	***E1**	**2.1**	Proof must start with an assumption for contradiction	
			$N+2=2k+2=2(k+1)$	**M1**	**2.1**		
			Which is even and $N+2>N$ This contradicts the assumption Therefore there can be no greatest even positive integer	**dep* E1** **[3]**	**2.4**	There must be a statement denying the assumption for the final **E1**	

The mark scheme exemplifies the structure of a proof by contradiction, i.e. a clearly stated starting point, correct algebraic manipulation, and an explicit concluding statement.

H240/01 Q8

8 **(a)** Show that $\frac{2\tan\theta}{1+\tan^2\theta} = \sin 2\theta$. **[3]**

(b) **In this question you must show detailed reasoning.**

Solve $\frac{2\tan\theta}{1+\tan^2\theta} = 3\cos 2\theta$ for $0 \le \theta \le \pi$. **[3]**

Part (a) uses the command phrase "Show that". The answer has been given so candidates are expected to provide a mathematical argument to confirm that the LHS is equivalent to the RHS (or vice versa).

8	**(a)**		$\frac{2\tan\theta}{1+\tan^2\theta} = \frac{2\sin\theta}{\cos\theta} \div \sec^2\theta$	**B1**	**2.1**	Use $1+\tan^2\theta = \sec^2\theta$ and $\tan\theta = \frac{\sin\theta}{\cos\theta}$	
			$= \frac{2\sin\theta\cos^2\theta}{\cos\theta}$	**M1**	**2.1**	Express LHS in terms of $\sin\theta$ and $\cos\theta$	**M0** for attempts to rearrange to solve an equation
			$= 2\sin\theta\cos\theta = \sin 2\theta$	**A1** **[3]**	**2.2a**		

The mark scheme provides a student friendly solution, with guidance for how partial credit would be awarded.

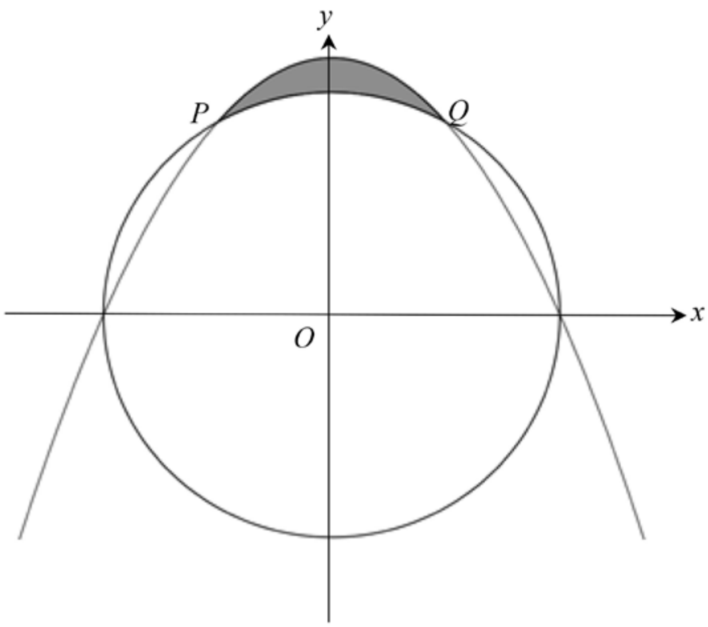
The "Show that" structure of part (a) allowing access to part (b) even if the required identity was not obtained. The bold detailed reasoning statement has been used to indicate that a graphical approach, a numerical method, or trial and improvement solution would not be acceptable (however, checking final answers using a graph or table function should be encouraged).

8	**(b)**		**DR** $\sin 2\theta = 3\cos 2\theta$ so $\tan 2\theta = 3$	**B1**	**2.2a**	Use the result of **(a)** or otherwise achieve an equation in tan only	**OR B1** for squaring both sides and achieving an equation in either sin or cos only
			$\theta = \frac{1}{2}\tan^{-1}3$ oe	**M1**	**2.1**	Use correct order of operations to solve, must be shown	
			0.625, 2.20	**A1**	**1.1**	Both values required. May be given to 3 s.f. or better (0.624523, 2.195319), or both solutions in exact form $\frac{1}{2}\tan^{-1}3, \frac{1}{2}\tan^{-1}3 + \frac{1}{2}\pi$	For answers alone award no marks
				[3]			

The mark scheme makes clear the algebraic manipulation needed for full credit.

H240/02 Q5

5



The circle with centre O and radius 2 meets the parabola $y = \frac{1}{\sqrt{3}}\left(4 - x^2\right)$ at points P and Q, as shown in the diagram.

(a) Verify that the coordinates of Q are $\left(1, \sqrt{3}\right)$. **[3]**

(b) Find the **exact** area of the shaded region enclosed by the arc PQ of the circle and the parabola. **[8]**

Part (a) requires students to clearly demonstrate that the given coordinates are on the circle and the parabola. The graph has been provided since a description alone would give a slight advantage to those candidates with a graphical calculator.

5	**(a)**		$x^2 + y^2 = 4$	**B1**	**1.1**	soi	
			When $x = 1$ $1 + y^2 = 4 \Rightarrow y = \sqrt{3}$	**E1**	**2.1**	AG Check that Q lies on the circle	**OR** **B1** $x^2 + \left(\sqrt{3}\right)^2 = 4 \Rightarrow x =$
			$y = \frac{1}{\sqrt{3}}(4 - 1) \Rightarrow y = \sqrt{3}$	**E1**	**2.1**	AG Check that Q lies on the parabola	**B1** $\sqrt{3} = \frac{1}{\sqrt{3}}\left(4 - x^2\right) \Rightarrow x$
				[3]			

The mark scheme shows clearly the expectation that verify requires the substitution of either x or y into both equations to confirm the value of the other coordinate.

Part (b) states explicitly that an exact area answer is required. The integral required is an integer so, in this case, it is possible to use a calculator to evaluate this definite integral and still have an exact area which is indicated in the mark scheme by "BC".

5	(b)	$\frac{1}{\sqrt{3}}\int_{-1}^{1}\left(4-x^2\right)\mathrm{d}x$	M1	3.1a	Attempt correct integral and limits; may be implied by answer 4.23(39…)	**OR M1** $\frac{1}{\sqrt{3}}\int_{0}^{1}\left(4-x^2\right)\mathrm{d}x = 2.1169\ldots$
		$=\frac{22\sqrt{3}}{9}$	A1	1.1	BC	**A1** $=\frac{11\sqrt{3}}{9}$
		Let N be the point $(1, 0)$ Area $OQN = \frac{\sqrt{3}}{2}$ oe or 0.866 (3 s.f.)	B1	2.1		**OR** **B1** semi-circle: $y=\sqrt{4-x^2}$
		$QON = \tan^{-1}\sqrt{3}$	M1	3.1a	Or $\sin^{-1}\left(\frac{\sqrt{3}}{2}\right)$ or $\cos^{-1}\left(\frac{1}{2}\right)$ or $\frac{1}{3}\pi$ or $60°$	**M1** attempt $\int_{-1}^{1}\sqrt{4-x^2}\,\mathrm{d}x$ by substitution, e.g. $x = 2\sin u$
		$POQ = \frac{1}{3}\pi$ or $60°$	A1	1.1	**M1A1** may be implied by seeing next line	**M1** Use trigonometric identity e.g. $\int_{-\frac{1}{6}\pi}^{\frac{1}{6}\pi} 4\cos^2 u\,\mathrm{d}u = \int_{-\frac{1}{6}\pi}^{\frac{1}{6}\pi} a\cos 2u + b\,\mathrm{d}u$
		Area sector $POQ = \frac{1}{2}\times 2^2\times\frac{1}{3}\pi$ oe $(=\frac{2}{3}\pi$ oe or 2.09 (3 s.f.))	M1	1.1	FT their angle POQ	**A1** $\frac{2}{3}\pi+\sqrt{3}$
		Shaded area $=\frac{22\sqrt{3}}{9}-2\times\frac{\sqrt{3}}{2}-\frac{2}{3}\pi$ oe	M1	3.2a	Correct combination of their areas	**M1** Shaded area $=\frac{22\sqrt{3}}{9}-\frac{2}{3}\pi-\sqrt{3}$ oe
		$=\frac{13\sqrt{3}}{9}-\frac{2}{3}\pi$ oe	A1 [8]	1.1		**A1** $=\frac{13\sqrt{3}}{9}-\frac{2}{3}\pi$ oe

The question does not state detailed reasoning must be seen, so a student that correctly identified the required method and solved each stage on their calculator would be able to gain the majority of marks, but would not be awarded the final accuracy mark if the answer was not given in terms of π and in surd form.

H240/02 Q10

10 In the past, the time spent in minutes, by customers in a certain library had mean 32.5 and standard deviation 8.2.

Following a change of layout in the library, the mean time spent in the library by a random sample of 50 customers is found to be 34.5 minutes.

Assuming that the standard deviation remains at 8.2, test at the 5% significance level whether the mean time spent by customers in the library has changed. **[7]**

As part of the fixed statistics content, students must study binomial (AS and A Level) and normal (A Level only) distribution hypothesis tests. The distributions are not printed in a formulae booklet; they must be accessed using a calculator (Don't worry, students have been doing this for years).

10			$H_0: \mu = 32.5$	**B1**	**1.1**	Must be stated in terms of parameter values	
			$H_1: \mu \neq 32.5$ where μ is mean time spent by all customers	**B1**	**2.5**	**B1B0** for one error, e.g. undefined μ or 1-tail	Use of 34.5 **B0B0**
			$\overline{X}: \text{N}\left(32.5, \frac{8.2^2}{50}\right)$ and $\overline{X} > 34.5$	**M1**	**3.3**	Stated or implied	**OR** **M1** $\dfrac{34.5-32.5}{8.2 \div \sqrt{50}}$ allow without square root
			$\text{P}\left(\overline{X} > 34.5\right) = 0.0423$	**A1**	**3.4**	BC	**A1** $= 1.725$
			Comparison with 0.025	**A1**	**1.1**	Allow comparison with 0.05 if $H_1: \mu > 32.5$	**A1** Comparison with 1.96 (allow comparison with 1.645 if $H_1: \mu > 32.5$)
			Do not reject H_0	**M1**	**1.1**		
			Insufficient evidence that mean time in the library has changed	**A1FT**	**2.2b**	In context, not definite; FT their 0.0423, but not comparison with 0.05	FT their 1.725, but not comparison with 1.645
				[7]			

A full answer requires an explicit statement of the hypotheses, in terms of the parameters, the use of formal statistical notation and a final conclusion in context, which should not be assertive, but only suggestive based on the probability of evidence.

H240/03 Q11

11 In this question the unit vectors **i** and **j** are in the directions east and north respectively.

A particle of mass 0.12 kg is moving so that its position vector **r** metres at time t seconds is given by $\mathbf{r} = 2t^3\mathbf{i} + \left(5t^2 - 4t\right)\mathbf{j}$.

(a) Show that when $t = 0.7$ the bearing on which the particle is moving is approximately $044°$. **[3]**

(b) Find the magnitude of the resultant force acting on the particle at the instant when $t = 0.7$. **[4]**

(c) Determine the times at which the particle is moving on a bearing of $045°$. **[2]**

Mechanics provides a concrete example of techniques studied in pure mathematics.

11	**(a)**		$\mathbf{v} = 6t^2\mathbf{i} + (10t - 4)\mathbf{j}$	**B1**	**1.1**	At least one term reduces in power by 1	
			$\mathbf{v} = 2.94\mathbf{i} + 3\mathbf{j}$ $90\text{-}\tan^{-1}\left(\frac{2.94}{3}\right)$	**M1**	**3.1a**	Substitution of $t = 0.7$, use $\tan^{-1}\left(\frac{y}{x}\right)$ and obtain $90 - 45.578 = 44.4°$ to give a 3 figure bearing	For a complete method to find a bearing
			$= 044°$	**A1**	**1.1**		
				[3]			

Part (a) is a "show that" question, clear evidence that differentiation of the position vector to give an expression for the velocity must be seen.

11	**(b)**		$\mathbf{a} = 12t\mathbf{i} + 10\mathbf{j}$	**M1**	**1.1**	Attempt differentiation of **v**	
			$\mathbf{a} = 8.4\mathbf{i} + 10\mathbf{j}$	**A1**	**1.1**	Substitute $t = 0.7$	
			Use $\mathbf{F} = m\mathbf{a}$ and use Pythagoras	**M1**	**3.3**		
			Obtain 1.57 N	**A1FT**	**3.4**	FT their **a** at $t = 0.7$	
				[4]			

Part (b) does not require any specific working to be shown, but is the answer is incorrect then partial credit may be available for any working shown.

11	**(c)**		$6t^2 = 10t - 4$ $6t^2 - 10t + 4 = 0$ so $t = 1$ or $\frac{2}{3}$ E.g. **i** component always positive so both values are valid	**M1** **E1** **[2]**	**2.2a** **2.3**	Equate **i** and **j** components and solve FT their **v** from part (i) if it leads to a quadratic BC Must include comment on why equating components is sufficient in this case.	

Part (c) includes the command word "Determine"; a method must be seen, but this does not prohibit the use of the quadratic solve function on the calculator. Working that makes clear that the solution is where the i and j components are equal, and then showing that this can be rearranged into the standard quadratic format ax2+bx+c=0 to give two solutions (which could be found using factorising, completing the square, quadratic formula, or By Calculator). The second mark is for confirming that both solutions correspond to a bearing of 045 and not 225.

Meet the Maths team....

Assessment Standards Managers

Will Hornby & Ross Robertson

Will has previously worked as a Senior Assessor for OCR and CIE, as an Associate Lecturer for the Open University and a professional choral singer. Having worked on the development of OCR's reformed GCSE for 2015, he then led the development of OCR's reformed Maths and Further Maths A Level qualifications for 2017. He continues to teach for the Open University.

Ross Previously worked at Cambridge International for 3 years as a Product Manager, managing a portfolio of assessment materials available worldwide including A Level Maths and Further Maths.

Subject Advisors

Steven Walker, Ruth Wroe, Neil Ogden & Caroline Hodgson

Following the redevelopment of GCSE (9-1) and the A Level Maths suite, the subject advisor team support the full range of maths qualifications through quality assurance of resources, leading sessions at network events and conferences, and responding to queries from teachers via telephone and email.

Steven joined OCR during the recent qualification reform period. Having worked on the redevelopment of Entry level, GCSE(9-1), FSMQ and the A Level Maths suite he now focuses mainly on the level 3 qualifications

Ruth worked on the development of OCR's reformed Maths and Further Maths A Level qualifications and is currently responsible for the support and promotion of OCR's Core Maths qualifications.

Neil is currently focused on the development of new Functional Skills maths qualifications and can be seen leading sessions around the country on the full range of OCR maths qualifications.

Caroline has worked in the OCR Maths team for over 15 years and has been involved in the development and implementation of many GCSE Maths qualifications, including a number of pilots, and is currently responsible for the support and promotion of GCSE Maths and Entry Level Maths.

Contact Details

If you are already using OCR specifications, you can contact us at: **www.ocr.org.uk**

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Teacher resources, blogs and support: available from: **www.ocr.org.uk**

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