Qualification Accredited

OCR
Oxford Cambridge and RSA

Examiners' report

A LEVEL

MATHEMATICS A

OCR Level 3 Advanced GCE in Mathematics A

H240

For first teaching in 2017

H240/02 Summer 2025 series

Version 1

ocr.org.uk/maths

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate responses is also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from Teach Cambridge.

Paper 2 series overview

Candidate performance on this paper was substantially better than in 2023 and 2024. While overall performance was balanced between Section A (Pure) and Section B (Statistics), as in previous years many candidates appeared to 'prefer' one section or the other.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• worked carefully and precisely, showing all steps of their working to support their answers • demonstrated full working (especially where instructed under a 'detailed reasoning' or 'determine' command), including for steps such as solving a quadratic equation • made good use of their calculator to obtain values and verify their answers, but did not over-rely (and still showed analytical working when required) • provided clear, rigorous arguments in 'show that' questions (where the answer is given) that show a clear, logical flow to the required result.	• attempted to 'skip' steps or write down answers only, when the question has required a full method (e.g. under a 'detailed reasoning' instruction) • did not work to a sufficient degree of accuracy – for instance, rounding prematurely or giving their final answer to less than the 3 significant figures required in the rubric • showed insufficient rigour in proof questions (noting that 'working backwards' from the given answer is often an acceptable starting point) – e.g. by omitting steps in their argument.

Section A overview

The Pure section (Questions 1 – 8) of this paper addressed a balanced range of points from the specification. Candidate performance was generally very strong, with most candidates able to access the majority of questions, although many candidates found the numerical methods (Question 3) challenging and only around a quarter of the cohort obtained a fully correct integration by parts (Question 8) in the final section A question.

Question 1

1 **In this question you must show detailed reasoning.**

Solve the inequality $x^2 + 3x \leqslant 10$. **[3]**

Most candidates answered this part correctly. The '**In this question you must show detailed reasoning**' (DR) instruction here meant that candidates needed to show a fully complete method, with each step clearly evidenced. In this case this meant that the method shown to find the critical values (i.e. to solve the implied quadratic equation) needed to be seen – this was usually by factorising, but of course other methods such as using the formula were acceptable. Candidates who wrote down solutions unsupported by working could not score any marks.

Most candidates went on to write down the correct (closed) interval, although some candidates gave the complement (M1A1A0) or gave the interval as two parts – which could not score the final mark unless some indication of the intersection (e.g. 'and') was seen.

There were several questions on this paper where candidates needed to solve a quadratic as part of the solution. Candidates should be reminded that, where a question has the instruction 'determine' or 'show detailed reasoning' they should show their working in full in order to demonstrate understanding. This means that candidates should always be advised (in these questions) to show the method used to solve a quadratic equation. This does not (and, in general, the DR instruction is not) restrict candidates' use of a calculator to check or verify these solutions, but it does mean that – as was the case here – mark schemes will require candidates to show these steps of working.

Candidates who included a sketch (and appeared to have used this to help determine the correct interval to use) were much less likely to write down the wrong interval.

OCR support

OCR's subject advisors have written a detailed blog post setting out more detail on what is typically required when the instruction '**In this question you must show detailed reasoning**' is given.

Question 2 (a)

2 In this question you must show detailed reasoning.

Solve the following equations.

(a) $(x^2 - 5)^{\frac{3}{2}} = 8$ **[3]**

Many candidates answered this part well, scoring 3/3 marks. The whole of Q2 was also DR, meaning that candidates needed to show a fully complete method to obtain the two required values of x. The most common error seen was candidates omitting the -3 value (usually scoring M1A1A0 if correct working seen first). Most candidates handled the power in a single step. A small number of candidates gave implausible working (e.g. multiplying up to a polynomial of degree 6) before writing down the correct answers. Alternative methods that are equivalent and within the instruction in the question will always be credited, but candidates should be advised not to write down over-complex working before simply applying the 'solve' function from their calculator – the method needs to demonstrate how the solution was obtained.

Question 2 (b)

(b) $e^{3y} = 2$ **[2]**

This part was very well answered. Most candidates showed at least the required step of working and wrote down the correct, exact answer (although the decimal equivalent could also be credited). A few candidates appeared unsure as to whether they were taking $\log_{10}$ or ln – which was sometimes recovered but often led to an incorrect answer.

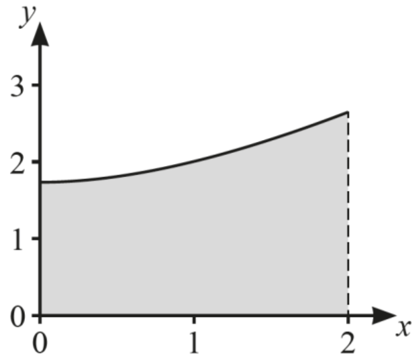
Question 2 (c)

(c) $x^4 - 3x^2 - 4 = 0$ **[4]**

Most candidates scored at least 3 marks in this part. Most correctly identified the form of the given equation as an 'embedded' quadratic and either made an appropriate substitution (e.g. $u = x^2$) or solved directly as a quadratic in x^2. As this question was DR, candidates needed to show their method in full, including the 'intermediate' values before the final answers. A small number of candidates used the invalid notation $x = x^2$ which, although sometimes recovered, typically led to candidates writing down an apparent additional solution $x = 4$ which meant that they could not score full marks. Candidates should be reminded to show every step of their working when the question includes the DR instruction.

Question 3 (a) (i)

3 The diagram shows part of the curve with equation $y = \sqrt{x^2 + 3}$, between $x = 0$ and $x = 2$.



(a) **(i)** Use the trapezium rule, with intervals of 0.5, to determine an approximation to the area of the shaded region. **[3]**

Most candidates answered this question well, obtaining the correct answer of 4.14. A small number used 4 or 6 ordinates instead of the required 5 (as the strip width was given in the question as 0.5). The question included the instruction 'use the trapezium rule' as well as the command word 'determine' so candidates needed to demonstrate how they had used the required technique to obtain their answer – by writing down the trapezium rule formula with the correct y-values substituted in.

Question 3 (a) (ii)

(ii) Use rectangles with the same intervals as in part **(i)** to determine lower and upper bounds for the exact area of the shaded region. **[2]**

Most candidates gave the two required values here, although a number of candidates omitted this part.

Question 3 (b)

(b) Write an expression for the exact area of the shaded region in terms of a limit, involving x and intervals of width δx. **[2]**

Very few candidates scored both marks here for a correct expression. Many incorrect attempts were seen (including candidates writing down the integral expression).

Question 4 (a)

4 **(a)** Prove that $(\cos\theta + \sin\theta)^2 \equiv 1 + \sin 2\theta$. **[2]**

This question asked candidates to complete two, related, trigonometric proofs. This part, the first, was more straightforward and most candidates scored both marks. Some candidates did not fully complete their proof (i.e. not fully simplifying to the RHS form given having started with the LHS of the given identity) or made errors, e.g. writing $1 + 2\sin 2\theta$.

In both parts, many candidates offered working that did not constitute a clear, logical argument. The scheme allowed candidates to score marks where, to some extent, these steps had been shown in an illogical order, but candidates should be reminded that a question with the instruction 'prove' or 'show that' requires a clear, convincing argument that demonstrates the given result without any skipped steps or 'fudges'.

It is best practice, when proving an identity, to start from one side and work sequentially to demonstrate the other. Candidates may of course choose to work on 'bits' of an expression separately – for instance, when simplifying terms or 'testing out' some thinking – this is not at all discouraged but candidates should make sure that, if they choose to 'split up' the identity and work on part of it, that it is clear that they have done so and clear when they bring everything back together. This might be as simple as using arrows to indicate this.

An increasing number of candidates choose to write down the given identity in its entirety and manipulate both sides until an 'obvious' result (e.g. 1=1) is reached. This is permitted (although not encouraged) and the mark scheme will generally follow 'down' one side and then 'up' the other. However, candidates who worked this way were (in both parts) more likely to omit an important step or make an error which meant their proof was not complete.

Question 4 (b)

(b) Hence or otherwise prove that $\sec 2\theta + \tan 2\theta \equiv \dfrac{\cos\theta + \sin\theta}{\cos\theta - \sin\theta}$. **[4]**

This part was also well answered by most candidates, with many scoring at least 3 of the 4 marks available. Most candidates started well, noticing that they needed to use an identity to write $\tan 2\theta$ in terms of $\sin 2\theta$ and $\cos 2\theta$ or to turn the statements in 2θ into expressions in θ only.

As noted above, some proofs were insufficiently rigorous. The scheme documents several different approaches (although others were seen and credited if correct and complete). The most common omission was not showing how (in the main method on the scheme) line 3 leads to the RHS of the given identity by factorising the denominator as a difference of two squares.

The question included the instruction 'hence or otherwise' – most candidates identified that the identity from part (a) would be helpful although some candidates inadvertently proved this again as part of their work in this part.

Question 5

5 In this question you must show detailed reasoning.

A circle has diameter PQ where P is $(-5, 1)$ and Q is $(5, 1)$. The line $x + 2y = 12$ meets the circle at A and B.

Find the exact length AB. **[8]**

This problem-solving question was well answered by most candidates, with many fully correct responses seen. Candidates first needed to deduce the centre and radius of the circle from the given information to score B1 (which was generally done well, although some candidates wrote down 10 and misinterpreted this as the radius rather than the diameter). The next step was to write down a cartesian equation for the circle for M1 (the most common error here was forgetting to square the radius), and solve this simultaneously with the line equation by substitution for x or y. Most candidates proceeded well to obtain a quadratic in x or y and solve this to find the coordinates of the two points of intersection, although quite a few incorrectly factorised the quadratic.

Most candidates who obtained two points correctly used coordinate geometry to calculate the distance between them.

Most candidates heeded the DR instruction and showed an appropriate amount of working in this question.

The alternative method shown in the scheme was only occasionally seen.

Exemplar 1

midpoint $= \left(\frac{-5+5}{2}, \frac{1+1}{2}\right)$

$= \left(\frac{0}{2}, \frac{2}{2}\right) = (0, 1)$ = centre

radius^2 $= (5-0)^2 + (1-1)^2$

$= 5^2$

radius = 5

circle : $x^2 + (y-1)^2 = 25$

$x = 12 - 2y$ $\quad (12-2y)^2 + (y-1)^2 = 25$

$144 - 48y + 4y^2 + y^2 - 2y + 1 = 25$

$5y^2 + 50y + 145 = 25$

$5y^2 + 50y + 120 = 0$

$y^2 + 10y + 24 = 0$

$(y+4)(y+6) = 0$ $\quad y = -4, -6$

$y = -4$
$x = 12 - 2y$
$x = 12 - 2(4)$
$x = 20$
$(20, -4)$

$y = -6$
$x = 12 - 2y$
$x = 12 - 2(-6)$
$= 24$
$(24, -6)$

$\sqrt{(20-24)^2 + (-4 - -6)^2}$

$= \sqrt{(-4)^2 + (2)^2}$

$= \sqrt{16 + 4} = \sqrt{20} = 2\sqrt{5}$

This candidate has identified the correct parameters for the circle and setup the equation correctly, substituting appropriately to reduce to a 3-term quadratic in *y* only (scoring B1M1M1M1). However, they obtain a quadratic with a sign error (the scheme allowed 'one error in the terms' for the method mark) so do not find the correct coordinates of the points of intersection (A0A0). They go on to compute the distance between these (M1) but do not obtain the correct final answer because of their earlier error (A0). This is a good example of a candidate who has shown their method in full (as required by DR) and scores the majority of the marks in this question despite making an error.

Question 6 (a) (i)

6 A curve has equation $y = 3x^4 - 4x^3 - 6x^2 + 12x$.

(a) **(i)** Find $\frac{dy}{dx}$. **[2]**

Almost all candidates answered this part correctly. A few candidates, perhaps misreading the question, went on to start to solve $\frac{dy}{dx} = 0$ which was not required in this part.

Question 6 (a) (ii)

(ii) Use your answer to part **(a)(i)** to find the x-coordinates of the stationary points on the curve. **[2]**

As in part (i), most candidates answered this part correctly. The question asked candidates to 'find' so the scheme did not require candidates to show working – which typically involved using the factor theorem to deduce one or both of the roots. Some candidates solved by inspection (or using their calculator) – this was also acceptable in this context. Some candidates went on to find the corresponding y-values, which were not needed here.

Question 6 (b)

(b) Show that there is exactly **one** point on the curve which is a point of inflection but not a stationary point. **[3]**

Around half of candidates scored all 3 marks here, for differentiating again and solving $\frac{d^2y}{dx^2} = 0$ to find the x-coordinates of the two points of inflection. The final mark was for using these values, compared to the points found in (a)(ii) to deduce that there is one point of inflection that is not a stationary point. The question made a specific request, but some candidates misinterpreted this and instead substituted in their values from part (a)(ii) – without setting =0 – in an attempt to classify the stationary points. This was not sufficient in this context as it does not show the required fact.

Question 7 (a) (i)

7 An arithmetic progression has first term a and common difference d, where a and d are non-zero. The first, third and fourth terms of the arithmetic progression are consecutive terms of a geometric progression with common ratio r.

(a) **(i)** Show that $r = \frac{a+2d}{a}$. **[1]**

Most candidates answered this part well, demonstrating understanding of the two sequences described in the question to deduce the given fact. Some candidates did not score the mark because they did not approach this as a 'proof' – although the result is straightforward to deduce, candidates still needed to demonstrate their understanding of the setup before writing down the expression given in the question. When an answer is given, candidates should be reminded to make sure that they provide a logical argument that shows how that answer is reached.

Question 7 (a) (ii)

(ii) Find d in terms of a. **[2]**

This part was much less well answered than (a) (i), with some candidates appearing unsure about how to translate the given information into a mathematical expression. As shown on the scheme, several different approaches were possible – with the key requirement being to write down an equation in *a* and *d* only. Most candidates identified that this meant using the expression for *r* from part (a) (i) to eliminate *r* but were often unable to make further progress. A common incorrect answer was $d = -a$. The question specifically requested '*d* in terms of *a*' which meant that $a = -4d$ was not sufficient for the final mark.

Question 7 (b)

(b) Find the common ratio of the geometric progression. **[2]**

Relatively few candidates scored both marks in this part. Some candidates identified (as shown in the main method on the scheme) that they could find the value of *r* by combining their answers to (a) (i) and (a) (ii), but many others attempted more complex working – often resulting in a quadratic in *r*. It was possible to solve this and deduce the required answer, but candidates rarely did so successfully. Some candidates (following incorrect or incomplete working in (a) (ii)) started this part by improving on their answer to (a) (ii) but did not appear to recognise that they had done so. Here, and in part (a) (ii), some candidates kept returning to the trivial equation used in part (a) (i) i.e. $ar = a + 2d$ without recognising that they needed to use further information from the question to deduce another equation.

Question 8

8 In this question you must show detailed reasoning.

Use integration by parts to find the exact value of $\int_0^{\frac{1}{2}} \ln(3-2x)\,dx$. **[5]**

Many candidates scored at least 3 marks in this question, and some very good answers were seen, although a significant number of candidates made no progress beyond the initial setup (typically scoring M1 only). The question specified the use of integration by parts, so answers which did not use this technique anywhere could not score full marks (see the third alternative method in the scheme). Most candidates applied 'by parts' directly to the given integral and then proceeded via either partial fractions or substitution on the resulting second integral as shown in the first two methods on the scheme. A few candidates made an error in setting up their 'by parts' (resulting in an inconsistent statement). Some candidates, perhaps in trying to solve the resulting integral, went backwards by attempting 'by parts' again and undoing their initial setup – which normally resulted in no further progress being made.

The second alternative method was quite often seen, with candidates starting by applying a substitution (which is a logical way to approach the given integral). Candidates still needed to demonstrate the use of 'by parts' in their working in order to be eligible for full marks– as shown in the scheme.

In all methods, sign errors were very common – often meaning that the method marks were scored but one or both of the accuracy marks were not.

For candidates who used a substitution, some did not 'translate' the limits at the point of applying the substitution. This was often recovered (especially for candidates who reversed the substitution later) and some candidates even chose to work in a mixture of variables (i.e. keeping the first term of the 'by parts' in x and substituting within the second integral to, e.g. u). The scheme was deliberately flexible to accommodate this, but candidates should be reminded that, when using a substitution on a definite integral, it is important that the limits are adjusted at the point the substitution is made so that the integral remains correct throughout. This is particularly important when working under a DR instruction – which means there is greater emphasis on fully correct working leading to the answer.

In a few cases (whether from substitution or sign errors) candidates inadvertently recovered to the correct final answer, but the final mark could not be awarded for answers that arose from incorrect working.

Exemplar 2

$$\int_0^{\frac{1}{2}} \ln(3-2x)\ dx$$

let $u = \ln(3-2x)$ $\qquad \frac{du}{dx} = \frac{-2}{3-2x}$

let $\frac{dv}{dx} = 1$

$v = x$

$$= \boxed{x\ln(3-2x)} - \int x \cdot \frac{-2}{3-2x}$$

$$= \int \frac{-2x}{3-2x}\ dx \qquad \text{let } u = 3-2x \qquad u+3$$

$$\frac{du}{dx} = -2$$

$$= \int \frac{1}{2}\,\frac{u-3}{u}\ du \qquad \frac{du}{-2} = dx$$

$$= -\frac{1}{2}\int \frac{u}{u} - \frac{3}{u}$$

$$= -\frac{1}{2}\int 1 - \frac{3}{u} \quad = -\frac{1}{2}\left(u - 3\ln|u|\right) = -\frac{u}{2} + \frac{3}{2}\ln u$$

$$= -\frac{(3-2x)}{2} + \frac{3}{2}\ln|3-2x|$$

$$\int_0^{\frac{1}{2}} \ln(3-2x)\,dx = \left[x\ln(3-2x) + \frac{3-2x}{2} - \frac{3}{2}\ln|3-2x|\right]_0^{\frac{1}{2}}$$

$$= \frac{1}{2}\ln 2 + \frac{2}{2} - \frac{3}{2}\ln 2 = \left(1 - \ln 2\right) - \left(\frac{3}{2} - \frac{3}{2}\ln 3\right)$$

$$\frac{3}{2} - \frac{3}{2}\ln 3 \qquad = 1 - \ln 2 - \frac{3}{2} + \frac{3}{2}\ln 3$$

$$= -\frac{1}{2} - \ln 2 + \frac{3}{2}\ln 3$$

$$\approx$$

This is an excellent example of a fully correct solution to this question. This candidate correctly sets up the integration by parts and proceeds to use a substitution to evaluate the 'new' integral (as shown in the first alternative method on the scheme). They do this correctly and revert to the original form in *x* before applying the appropriate limits correctly, leading to the correct final answer, 5/5.

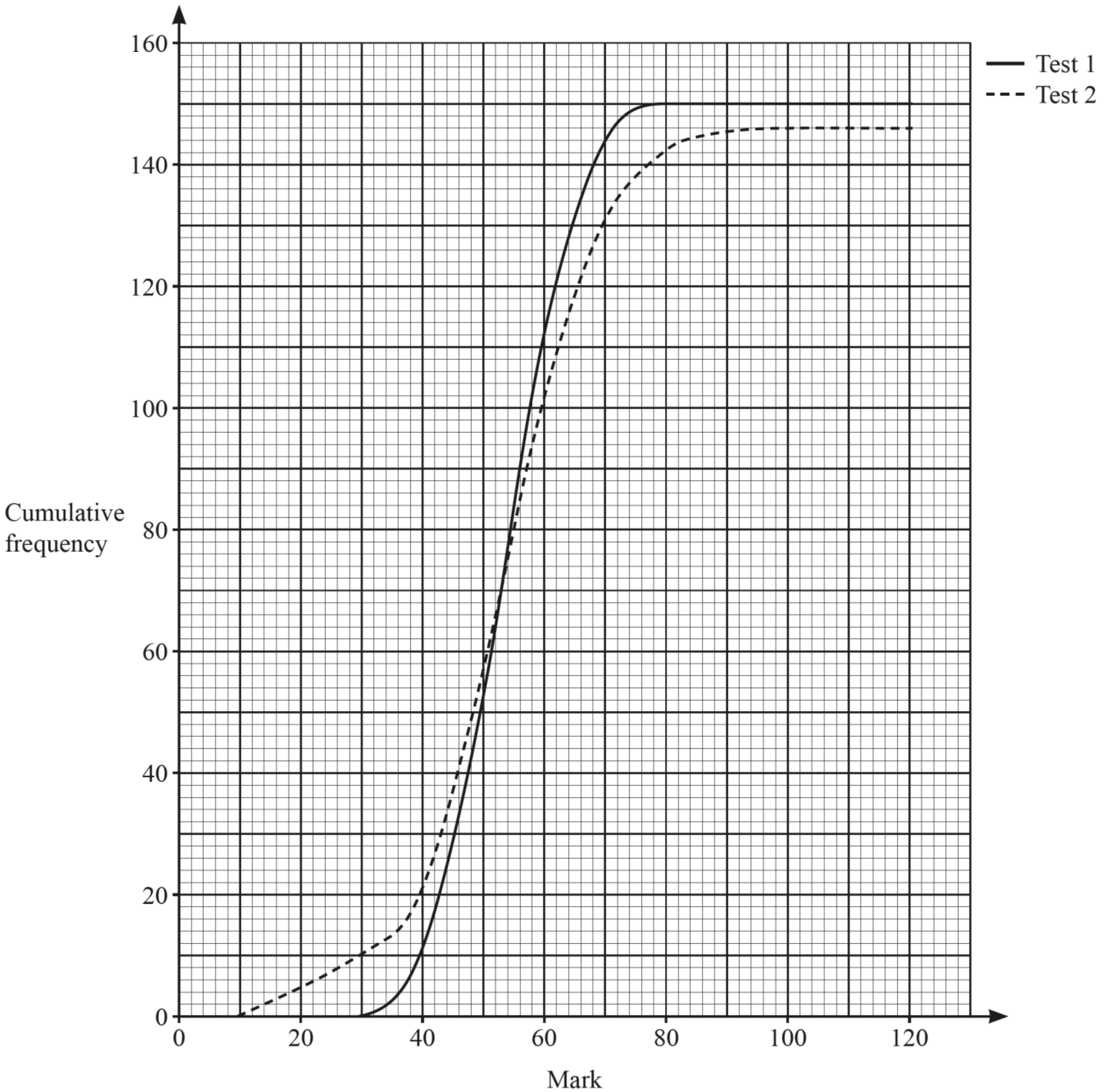
Section B overview

Throughout the statistics section (Questions 9 – 15), candidates who demonstrated their understanding by giving mathematically correct explanations in the context of the question scored the highest marks. Candidate attainment in this section was a little higher than in 2023 and 2024. Question 13 assumed familiarity with the pre-release Large Data Set. Questions on probability (Questions 12 and 15) were the most challenging for many candidates.

Candidates should be reminded that the rubric on the front of the question paper applies to the entire paper, especially in terms of the degree of accuracy required (3sf, unless the question specifies otherwise). While some statistics mark schemes will occasionally condone an answer that is correct to 2sf or an 'adjacent' answer (which is normally included to account for minor variations between calculators, provided that this value is clearly from the same method) this is **not** a general exception to the rubric. Candidates should work as accurately as possible and make sure that their final answer is given to (and correct to) 3 significant figures.

Question 9 (a)

9 Some students in a year-group took two tests, Test 1 and Test 2. The maximum mark in each test was 120.
The students' marks are illustrated in the cumulative frequency diagram. The diagram is reproduced in the Printed Answer Booklet.



(a) All the students in the year-group took Test 1, but some students missed Test 2.

State the number of students who missed Test 2. **[1]**

Almost all candidates answered this part correctly.

Question 9 (b)

(b) Find an estimate of the number of students whose marks for Test 1 were in the range 45 to 65 inclusive. **[2]**

Most candidates scored both marks here for a correct answer in the required range (which considered likely errors in reading the cumulative frequency graph). Some candidates made an error in subtracting their values or misread the graph (leading to values significantly outside the ranges given in the scheme).

Question 9 (c)

(c) The final parts of the graphs are horizontal.

For Test 1, explain what this means about the results. **[1]**

Here, candidates needed to demonstrate their understanding of both the context and the cumulative frequency diagram in their explanation. Most candidates gave an acceptable explanation (along the lines of the examples in the scheme) and read off an appropriate value. A few candidates misinterpreted the context (or the diagram) and gave answers which were not correct and could not be credited.

Question 9 (d)

(d) It is required that the number of students obtaining grade A* should be the same on both tests. The minimum mark for grade A* on Test 2 was 76.

Find the minimum mark for grade A* on Test 1. **[1]**

Here, the instruction was 'find' so no explanation or working was required. Most candidates obtained a correct value for the A* threshold on Test 1 (within the range given on the scheme).

Question 9 (e)

A teacher commented that the median marks on both tests were very similar. This suggests that, on average, the levels of difficulty on both tests were about the same.

(e) Use the cumulative frequency diagram to make another comparison between Test 1 and Test 2 about the easier questions on both papers. **[1]**

Around half of candidates scored the mark in this part, with many making a correct observation similar to the list of examples shown in the scheme. Some candidates appeared to confuse Test 1 and Test 2 here or made general comments about the overall distribution of marks – which could not be credited because the question specifically asked about the 'easier questions' so a comment about the lower end of the distributions was required.

Question 9 (f) (i)

The marks for Test 1 are summarised in the table.

Test 1 mark	$\leqslant 29$	30–39	40–49	50–59	60–69	70–79	$\geqslant 80$
Frequency	0	10	40	60	33	7	0

(f) **(i)** Find estimates of the mean and standard deviation of the Test 1 marks. **[3]**

Many candidates made an error in calculating one or both of the required values here. Some of those who showed working (which meant that they could score the M mark for an appropriate method for the mean of the grouped data, even if their answer was incorrect) appeared to be using incorrect midpoints. Candidates should be encouraged to use their calculator's full functionality to obtain (and/or verify) their answers to this type of question. As the instruction was 'find' no working was required, but it is still advisable for candidates to include their working to potentially gain method marks an incorrect final answer.

Some candidates obtained the correct value and then rounded it incorrectly (or to fewer than the 3 significant figures required by default). Mistakes in rounding were forgiven provided a correct value was seen first, but candidates should be reminded to be careful when writing down their final answers.

Question 9 (f) (ii)

(ii) Use your answers to part **(f)(i)** to comment on whether there may be any outliers amongst the Test 1 marks. **[2]**

Only a minority of candidates scored both marks in this part. The method mark was available for any use of the correct calculations for outliers, but many candidates did not use the correct expression (or only calculated once, rather than twice). Candidates should be reminded of the two methods shown in the specification for finding outliers. The context of the question will usually make it clear which is to be used (here, the instruction 'use your answers to (f) (i)' made it clear that the mean and standard deviation should be used rather than IQR). A number of candidates gave the method shown in the special case (i.e. using 3σ rather than 2σ).

Question 10 (a)

10 **(a)** The random variable W has the distribution $B(12, \frac{1}{3})$.

Find $P(W \geqslant 7)$. **[2]**

Most candidates scored 2/2 marks here. A few candidates made a place value error when writing down their answer (e.g. writing 0.664 instead of 0.0664).

Throughout all three parts of Q10 (and across Section B more generally), many candidates did not gain marks for giving insufficiently precise (or incorrectly rounded answers). The mark scheme, as is usual, allows for small variations which may arise from using different calculators (or statistical tables) but candidates should be reminded that on this specification, answers should be given to 3 significant figures – and be correct to 3 significant figures – unless otherwise specified in the question.

'0.066 (3sf)' [sic] was a common answer here, which could score M1A0 only (as not correct to 3sf).

Question 10 (b)

(b) The random variable X has the distribution $N(45, 4^2)$.

Find $P(X > 50)$. **[1]**

Almost all candidates gave a correct answer in this part.

Question 10 (c)

(c) The random variable Y has the distribution $N(25, \sigma^2)$.

Given that $P(Y < 30) = 0.75$, find σ. **[2]**

Most candidates obtained the correct answer here. Some candidates omitted the inverse normal calculation (setting their expression =0.75 directly), which was not sufficient to score either mark.

Question 11 (a)

11 A train company claims that a particular daily service arrives on time on 95% of days. Riley suspects that the true percentage is less than 95%. Riley tests the company's claim by choosing a random sample of 50 days during the period November 2023 to March 2024. Riley finds that the service arrived on time on 44 of these days.

(a) Use a binomial distribution to test at the 5% significance level whether Riley's suspicion is justified. **[7]**

As in previous years, the mark scheme for this hypothesis testing question provides useful detail on the structure of answer that candidates should aim to provide. Almost all candidates appeared to know what was expected and gave the right sequence of overall working.

The hypotheses setup (for B1B1) were generally very well done, with most candidates scoring both of these marks.

Most candidates identified the appropriate Binomial distribution and went on to obtain an appropriate probability using the given value of 44 successes (for M1A1A1). Some candidates over-complicated the problem at this point by attempting to find an inverse or complement probability – which could score if correct but was not required in this case. Most candidates correctly compared their probability to the significance level (0.05) and gave the first part of the conclusion correctly.

Just under a half of the cohort finished the question will a clear, non-assertive conclusion (for the final M1A1). However, many candidates were over-assertive in their conclusion (for instance, stating 'therefore Riley is correct' without appropriate caveats) and could not score the final accuracy mark. Candidates should be reminded that, even within the context of a question like this, it is important that they demonstrate their understanding of what a hypothesis test does and doesn't indicate by including suitable caveats (such as 'there is sufficient evidence to suggest that…') in their conclusion.

Question 11 (b)

(b) By referring to one of the necessary assumptions for using a binomial distribution, suggest a reason why the conclusion may **not** be reliable. **[1]**

Most candidates gave a sufficiently good answer to score the mark in this part. As set out in the scheme, candidates needed to give a reason in context that directly links to one of the required assumptions for using a Binomial distribution. Most candidates argued that the probability may not be constant, or that the train service's on-time arrival on successive days may not be independent of previous days. A few candidates identified that there may be more than two possible outcomes (e.g. 'early' or 'cancelled' as distinct from 'on-time' or 'late'), which was acceptable.

Some candidates appeared to struggle with the combination of mathematical and in-context language required to score the mark in this part – for instance, answers that did not specifically link to one of the assumptions in reasonably precise mathematical language were not sufficient (e.g. 'chance not always the same'). Other candidates gave generic reasons why the result may not be reliable (e.g. 'small sample size') which were not acceptable as they did not relate to one of the required assumptions.

A number of candidates appeared unsure about the distinction (in definition) between 'independent events' and 'constant probability' and seemed to confuse these concepts in their answer.

Question 12 (a) (i)

12 Sam has 9 cards, each with a different non-zero digit printed on it.

1	2	3	4	5	6	7	8	9

Sam chooses 5 cards at random and places them in a random order in a straight line, to form a 5-digit number.

(a) **(i)** Find the probability that the 5-digit number is greater than 50 000. **[1]**

Almost all candidates gave the correct answer in this part.

Question 12 (a) (ii)

(ii) Show that the probability that the 5-digit number is greater than 58 600 is $\frac{13}{28}$. **[4]**

Many candidates made a good start to this part, scoring at least one of the three available method marks, but relatively few provided a fully complete justification of the given result. As this was a 'show that' question, candidates needed to provide a clear and convincing argument. Some candidates correctly deduced part of the required probability (e.g. $\frac{4}{9}$) from their answer to part (a) (i), and then 'produced' the difference between that and $\frac{13}{28}$ without any justification, claiming the given result. This was not sufficient to gain full marks. Candidates needed to provide working (typically by demonstrating probabilities based on a logical breakdown of the combinations) that justified their answer in order to score full marks. Similarly, candidates who just wrote down $\frac{7020}{15120}$ could not score full marks unless they first demonstrated how the numerator was derived.

Question 12 (b)

(b) Given that the 5-digit number is greater than 50 000, determine the probability that it is greater than 58 600. **[2]**

Fewer than half of candidates obtained the correct answer in this part (even considering that full follow-through was permitted from candidates' answers to part (a) (i)). There was no follow-through from part (a) (ii) –although some candidates mistakenly used their incorrect attempt at the result instead of the given value $\frac{13}{28}$. Some candidates did not use the correct formula for conditional probability, and some of these obtained the correct value but from wrong working (perhaps as a result of calculator input or changing the formula later) and so could not gain full marks here.

Question 13 (a)

13 The table shows excerpts from the census data for Age Structure in 2001 and 2011 for four Local Authorities (LAs) in South West England.

		Age								
LA	**Year**	**0 to 4**	**5 to 7**	**8 to 9**	**10 to 14**	**15**	**16 to 17**	**18 to 19**	**20 to 24**	**25 to 29**
Bournemouth	2001	8171	5103	3579	8752	1681	3255	4289	12901	11785
	2011	10275	4862	2999	8399	1732	3517	6141	17130	14935
City of Bristol	2001	23453	12887	8794	22871	4791	8690	11812	34798	32001
	2011	29633	14371	8466	21703	4408	8922	13711	44371	40752
Plymouth	2001	13213	8535	6091	16078	3106	6103	7454	17245	14885
	2011	15336	7956	4991	13645	2954	6011	8839	24343	18888
Swindon	2001	11392	7194	4862	12121	2178	4337	3798	10212	13816
	2011	14083	7551	4722	12433	2593	5141	4690	12859	15075

Researchers want to investigate whether there is evidence that those people who were residents in these LAs in 2001 were still resident in the same LAs in 2011.

(a) One researcher suggests that, for each of the LAs, they should compare the sum of the data for 2001 for Age 15 to 19 with the data for 2011 for Age 25 to 29.

Explain why this comparison is relevant. **[1]**

Throughout Question 13, as in previous years, candidates were awarded marks for reasonable answers that are correctly justified and given in the context of the question. This LDS question was better answered than in previous years, with fewer candidates relying on 'generic facts'.

Most candidates gave an acceptable answer to this part. Those who didn't tended to be stating generic facts which perhaps suggested a misunderstanding of the question, e.g. 'it is normal to move back home after finishing university'. Candidates are always encouraged to use their knowledge and understanding of the Large Data Set but should make sure that they have read the full context of the question they are being asked to answer. Some candidates went on to say much more than they needed to here (e.g. also starting to explain some of the flaws in this methodology – as was asked later in part (d) (ii)).

Question 13 (b)

(b) The census data also includes data for the following age ranges:

Age						
30 to 44	**45 to 59**	**60 to 64**	**65 to 74**	**75 to 84**	**85 to 89**	**90 +**

Explain why **none** of these data ranges are helpful in this context. **[1]**

Many candidates gave a good answer here. Many candidates used their knowledge of the Large Data Set to observe that the population across this range of ages is decreasing (due to elderly mortality) for reasons other than movement, so may not be useful for a comparison. Other candidates observed that some of the age ranges were more than 10 years wide, so a comparison 10 years apart would not be useful. A broad range of answers (as shown in the scheme) were credited, but candidates who made over-generalised statements such as 'no one in this age range moves house' could not receive the mark.

Question 13 (c)

(c) The data for one of these four LAs show that some of the 0 to 4 year olds living in that LA in 2001 are definitely no longer living there in 2011.

Explain which LA this is. **[1]**

Most candidates correctly identified (City of) Bristol as the LA required here, and were able to explain that they could identify this because it is the only LA where the number of 10-14 year olds in 2011 is lower than the number of 0-4 year olds in 2001. Candidates needed to be specific (and correct) in their explanation and did not need to quote values here, but if they did then these needed to be correct. Some candidates quoted incorrect values from the table which could not be credited as it did not demonstrate correct interpretation of the data. Some candidates referred to 'the same age group' which was not specific enough (and incorrect) – creditable responses needed to demonstrate understanding of the right groups to compare in order to draw the required conclusion.

Question 13 (d) (i)

(d) One of the researchers says that there has been little movement in or out of Bournemouth between 2001 and 2011 for those who were aged 5 to 7 in 2001.

(i) Use values from the table to show that this statement is **not** contradicted by the data. **[2]**

In this part candidates needed to identify the right values from the table to compare (noting that the question specified 'use values from the table' so these needed to be quoted, and correct) – i.e. 5103 and 5249 – and then explain how these values demonstrated that the given statement was not contradicted by the data. Candidates needed to show they understood that these values being similar were consistent with the statement that there has been 'little movement' within this group of people.

Question 13 (d) (ii)

(ii) Explain why the statement is **not** necessarily correct. **[1]**

Most candidates provided a correct explanation here, noting that the population figure being approximately the same does not confirm that the same group of people are still living there since there could have been significant movement both in and out of the LA.

Question 14 (a)

14 The masses of stones on a certain beach are normally distributed with mean 0.36 kg and standard deviation 0.12 kg.

(a) Find the probability that two stones chosen at random from this beach both have masses between 0.3 kg and 0.4 kg. **[2]**

Most candidates obtained the correct answer here. Quite a few candidates correctly used the given distribution to obtain 0.322 but then either left this as the final answer, or multiplied by 2 (rather than squaring), scoring M1A0.

Question 14 (b)

(b) Determine the probability that the mean mass of a random sample of 40 stones from this beach is less than 0.32 kg. **[2]**

As this question asked candidates to 'determine', candidates needed to demonstrate appropriate working to support their answer. In this case, this meant correctly demonstrating the distribution used to show understanding of the normal distribution. Many candidates wrote down an incorrect distribution (which did not correspond to their answer), often confusing σ and σ^2 – perhaps because the form that they had input to their calculator does not match the standard notation for describing a normal distribution.

Question 14 (c)

Some geologists suspect that the mean mass, μ kg, of stones on a second beach is different from the mean for the first beach. They carry out a hypothesis test, at the 5% significance level, of the null hypothesis $\mu = 0.36$ against the alternative hypothesis $\mu \neq 0.36$.

They weigh each of a random sample of 40 stones on the second beach and find the sample mean, $\bar{X}$ kg, of their masses. You may assume that the standard deviation of the masses of stones on the second beach is 0.12 kg.

(c) Determine the range of values of $\bar{X}$ for which the null hypothesis would **not** be rejected. **[5]**

As in part (b), this question (as noted by the command word 'determine') is designed to allow candidates to demonstrate their understanding of, and working with, the normal distribution. Candidates are encouraged to make full use of their calculator when answering this type of question but need to make sure that they are showing enough working to demonstrate their understanding of the method in full. The 'inverse normal' command on modern calculators can handle much of the computation required to answer a question like this, but candidates need to make sure that their working is still sufficiently complete to give confidence in their understanding of the method. Here, a special case was available for candidates who gave the correct answer without sufficient supporting working.

Some candidates misused the notation Φ^{-1} to mean this general 'inverse normal' (rather than the standardised normal, which is the conventional usage) – this was condoned if, and only if, it was accompanied by the correct distribution and correct values. Some candidates confused the standardised and general normal distributions (again, perhaps due to over-reliance on their calculator's inbuilt functions) which led to erroneous values. For the final accuracy mark, candidates needed to give the range of values in appropriate notation, including the given variable $\bar{X}$.

Question 15

15 The probability distribution of the random variable X is modelled as follows.

- $P(X = 1) = p$ where p is a constant.
- $P(X = x) = 2P(X = x - 1)$ for $x = 2, 3, 4$.
- $P(X = x) = 0$ for all other values of x.

Three values, X_1, X_2 and X_3, of X are chosen at random.

Determine $P(X_3 > X_1 + X_2)$. **[4]**

This final question was well answered, with many candidates scoring at least 2 marks. Candidates needed to interpret the information given in the question to deduce four probabilities for M1A1 and then combine these appropriately to find the required answer. Most candidates were able to find $p = \frac{1}{15}$ correctly and often made an acceptable attempt at combining their probabilities (3-4 terms of 3 probabilities each), but not all candidates had the right combination to obtain the correct answer. A minority of candidates chose to work in terms of *p* throughout (but fewer than on the equivalent question in 2024). Some candidates misinterpreted the given information and used 6*p* instead of 8*p*.

Candidates did not need to itemise all 4 probabilities as shown in the scheme, but this approach is encouraged – candidates who 'deduced as they went along' sometimes made errors or did not include all 4 probabilities which meant that this mark could not be implied.

Exemplar 3

$P(X=1)=p \quad P(X=x)=2P(X=x-1)$

$\therefore P(X=2)=2P(X=1)=2p$

$\therefore P(X=3)=2P(X=2)=4p$

$P(X=4)=2P(X=3)=8p$

x	1	2	3	4
p	p	$2p$	$4p$	$8p$

$p+2p+4p+8p=15p=1 \quad p=1/15$

x	1	2	3	4
p	$1/15$	$2/15$	$4/15$	$8/15$

$X_1 + X_2 < X_3$

1	1	3	$(1/15)^2 \times (4/15)$	$= 4/3375$
1	1	4	$(1/15)^2 \times (8/15)$	$= 8/3375$
1	2	4	$(1/15)\times(2/15)\times(8/15)\times 2$	$= 32/3375$
2	1	4		

$\frac{4}{3375}+\frac{8}{3375}+\frac{32}{3375}=\frac{44}{3375}=0.0130$

This candidate has given a fully correct solution. Notice that they have itemised their probabilities before proceeding to combine them – this step was not explicitly required (so these probabilities could be 'implied' if seen used later) but it is good practice and ensures that the working is clear (so that, for instance, a later error doesn't remove the opportunity to 'imply' that first A mark), 4/4.

Supporting you

Teach Cambridge

Make sure you visit our secure website **Teach Cambridge** to find the full range of resources and support for the subjects you teach. This includes secure materials such as set assignments and exemplars, online and on-demand training.

Don't have access? If your school or college teaches any OCR qualifications, please contact your exams officer. You can forward them this link to help get you started.

Reviews of marking

If any of your students' results are not as expected, you may wish to consider one of our post-results services. For full information about the options available visit the OCR website.

Access to Scripts

We've made it easier for Exams Officers to download copies of your candidates' completed papers or 'scripts'. Your centre can use these scripts to decide whether to request a review of marking and to support teaching and learning.

Our free, on-demand service, Access to Scripts is available via our single sign-on service, My Cambridge. Step-by-step instructions are on our website.

Keep up-to-date

We send a monthly bulletin to tell you about important updates. You can also sign up for your subject specific updates. If you haven't already, sign up here.

OCR Professional Development

Attend one of our popular professional development courses to hear directly from a senior assessor or drop in to a Q&A session. Most of our courses are delivered live via an online platform, so you can attend from any location.

Please find details for all our courses for your subject on **Teach Cambridge**. You'll also find links to our online courses on NEA marking and support.

Signed up for ExamBuilder?

ExamBuilder is the exam paper builder platform for a range of our qualifications. Find out more.

Free for all OCR centres with an Interchange account, it allows unlimited users per centre. We require an Interchange username to verify your centre's users for ExamBuilder.

If you do not have an Interchange account, please contact your centre administrator (usually the Exams Officer) to request a username.

Once you have an Interchange username, use the form on this page to sign up for ExamBuilder, or ask an existing user at your centre to create an ExamBuilder account for you.

Active Results

Review students' exam performance with our free online results analysis tool. It is available for all GCSEs, AS and A Levels and Cambridge Nationals (examined units only).

Find out more.

Tell us what you think

Your feedback plays an important role in how we develop, market, support and resource qualifications now and into the future. We want you and your students to enjoy and get the best out of our qualifications and resources, but to do that we need your honest opinions to tell us whether we're on the right track or not.

You can email your thoughts to resources.feedback@ocr.org.uk or visit our feedback page to learn more about how you can help us improve our resources.

Designing and testing in collaboration with you and your students

Helping young people develop an ethical view of the world

Equality, diversity, inclusion and belonging (EDIB) are part of everything we do

---

Contact the team at:

01223 553998

ocr.org.uk

To stay up to date with all the relevant news about our qualifications, register for email updates at ocr.org.uk/updates

Visit our Online Support Centre at support.ocr.org.uk