Examiners' Report

Principal Examiner Feedback

Summer 2025

Pearson Edexcel GCSE (9 – 1)
In Mathematics (1MA1)
Higher (Non-Calculator) Paper 3H

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

Summer 2025
Publications Code 1MA1_1H_2506_ER

GCSE Mathematics 1MA1
Principal Examiner Feedback – Higher Paper 3

General comments

Scripts showed many of the questions being attempted within the time available, demonstrating understanding across many topics. The initial section was generally answered with a high level of accuracy. Responses were typically clear and logically structured, which supports access to marks, particularly in questions where the mark scheme uses squared brackets to reward method and process.

Responses to standard questions involving standard form, error intervals, speed calculations, calculator use, and indices were generally accurate. The latter questions in the paper, including those on tangents to a circle and vectors, presented more challenge. Calculator use was evident throughout, though there are minor aspects in question 10 that may warrant further consideration to support improved outcomes. For questions requiring written explanations, clear reasoning was demonstrated, particularly in question 2a and question 12a.

Comments on individual questions

Question 1

This question on drawing a frequency polygon required plotting frequencies at the midpoints of each interval and joining these points with straight lines. Responses with a single error were awarded one of the two available marks, the most common error being plotting at the end of the interval rather than the midpoint. Other observed errors included plotting a frequency at the wrong height, using a curve instead of straight lines, or incorrectly connecting the first and last points. Responses with multiple errors did not gain credit. In some cases, a histogram was drawn instead; no marks were awarded for this unless the correct midpoints were also plotted. It is recommended that points are joined with straight lines using a ruler rather than freehand.

Question 2

In part (a), many responses correctly identified that –5 had not been multiplied by 3. Others clearly explained that brackets were needed around the expression, such as in $3(p – 5)$ or $3p – 15$. In cases where the written explanation was brief, the working shown often helped to support the response and gain credit. Less successful responses included general statements like "multiply everything," without specifying the use of 3, or vague references to the order of operations. Responses could have been improved by giving a full and clear explanation; for example, "they only multiplied the *p*" was not sufficient, whereas "they only multiplied the *p* by 3" was accepted.

In part (b), most responses recognised the need to rewrite the expression using brackets. While some attempted to factorise into two brackets, most used a single bracket. Where one mark was awarded, it was often due to not fully factorising the expression, for example, taking out $2x$ or $2y$ instead of the correct common factor, xy. One mark could also be given for identifying the correct highest common factor and partially forming the expression inside the brackets. Some responses indicated a lack of clarity about the word “factorise,” with attempts to simplify the expression by adding or multiplying the terms instead.

Question 3

As a problem-solving question, a range of approaches were used. The most common and successful method involved calculating the selling price of 200 oranges, followed by determining the overall profit and then the percentage profit. Responses that gained one mark typically calculated the percentage based on the selling price rather than the cost price, often dividing by 40 to get 37.5% instead of dividing by 25 to reach the correct answer of 60%. Where two marks were awarded, this was usually due to the response being one step away from calculating the percentage profit, usually for the method to determine the total revenue as being 160% of the initial cost.

Question 4

This problem-solving question was approached in various ways, with the most common and effective method involving the calculation of cost per pound in dollars to produce comparable values of 1.02 and 0.98. Clear and well-structured responses were more successful, and centres may wish to encourage labelling of working with correct units to support clarity. In some cases, the number of pounds per dollar was correctly calculated, but the conclusion was incorrect, stating that carrots in London were better value due to the lower figure. Many responses included correct conversions between kilograms and pounds, with more opting to convert 2kg to 4.4lb rather than 5lb to 2.27kg. Currency conversions were also commonly attempted, with more responses converting £3.75 to $4.50 rather than $4.90 to £4.08, both of which were credited with two marks. Where only two marks were awarded, this was usually due to not identifying two comparable figures. Responses that gained three of the four marks often missed the final mark due to an incorrect conclusion, such as stating London was better value, or due to errors like misinterpreting 0.98 > 1.02 or premature rounding affecting accuracy.

Question 5

This question required recognition that the bounds were +/-0.05 from 23.8 and placement of these values correctly within an inequality. Most responses attempted the question, with many successfully identifying at least one bound, more commonly the lower bound than the upper. The use of a number line to identify bounds was frequently seen in responses that achieved full marks. A significant number of responses, both correct and incorrect, included no working. The most common error was an incorrect evaluation of the upper bound, such as truncating to 23.849 or 23.84. Where the upper bound was correctly stated, it was usually given as 23.85 rather than 23.8499 or using recurring notation. Some responses placed the bounds in the wrong order, which was not credited. Others used symmetric bounds around 23.8 (e.g. 23.7 and 23.9), which did not reflect the correct rounding process.

Question 6

Most responses correctly applied the speed formula by dividing distance by time. Many also converted 2 hours and 24 minutes into total minutes (144) or into seconds. However, a notable number showed difficulty converting this time into decimal hours, with 2.24 hours often used instead of the correct 2.4 hours. Additionally, while many responses correctly converted the time to 144 minutes, some did not recognise that this resulted in a speed in kilometres per minute. In these cases, the final step of multiplying by 60 to convert to kilometres per hour was missing, and only partial credit could be awarded.

Question 7

Many responses followed a successful approach by calculating the difference between the coordinates and halving the values, recognising the need to work with horizontal and vertical distances. A common error was not adding the halved values to the relevant coordinate to complete the method, with some responses either adding to the coordinate of point A or leaving the intermediate values (e.g. 3 and 2.5) as the final answer. An alternative method involved finding the midpoint of the coordinates first. While this approach sometimes led to the correct answer, it was generally less successful, though often gained partial credit. Some responses gained one mark by identifying the differences of 6 and 5 but then attempted methods such as Pythagoras' Theorem or using the equation of a straight line, which did not lead to a correct solution. A common error in these methods involved calculating and halving the gradient, which prevented progress towards full marks.

Responses that included annotations on the diagram to show horizontal and vertical differences were more likely to reach the correct final answer. Arithmetic errors were also present in some cases, resulting in the loss of the accuracy mark and highlighting the importance of checking calculations carefully.

Question 8

Most responses began by either applying the formula for the area of a trapezium or by dividing the shape into a rectangle and a triangle to calculate the area. Both methods were generally successful in gaining the first two marks, either for identifying the length of *CD* or the length from point *C* to the point where the perpendicular from *B* meets *CD.* The trapezium formula route was more complex and occasionally led to errors, such as using 12 and 8 as the parallel sides or incorrect rearrangement of the formula, resulting in an inaccurate value for *CD*. Some responses used an incorrect triangle area formula, often omitting the division by 2 after multiplying the base and height.

Where the initial steps were not completed accurately, many responses still gained marks through correct use of Pythagoras' Theorem. While this was generally applied correctly, some responses involved subtracting rather than adding the squares of the sides, which prevented progress. A small number attempted trigonometry to find the length of *BC,* but this method was rarely successful. A few responses began by forming a right-angled triangle *DAB* and used Pythagoras' Theorem to calculate *BD*, which did not lead to further progress.

Some responses could not gain the final accuracy mark due to incorrectly including the internal length of 8 cm in the total or by leaving the correct answer in surd form. Use of the formula sheet and practice with substituting values and rearranging formulae would support improved accuracy. Arithmetic errors were also noted and often affected the final mark, highlighting the importance of checking calculations carefully.

Question 9

In part (a), responses that did not gain credit typically included incorrect values such as 573,000; 573,000,000; or 0.00000573.

In part (b), responses that were not awarded the mark often included values such as 3.5×10^{-3} or 3.5×10^{2}

Question 10

Many responses correctly gave the final answer of 12.6, which was often the only value written in the answer space. In some cases, the full calculator value was shown before rounding. This was helpful as, where 12.58 was incorrectly rounded to 12.5, both marks could still be awarded if the full value was shown. However, responses that only stated 12.5 without any supporting working or intermediate value were not credited.

Some responses showed calculations in radians rather than degrees. This resulted in no marks being awarded, highlighting the importance of checking calculator settings before the exam.

Other frequent errors included –2.582… from cube rooting only the 17.4 rather than the full denominator, 2.157… from not squaring the 1.83, and 2.63… from not squaring the numerator. In these cases, partial credit was often awarded for correct intermediate steps, such as a correct numerator of 22.822… or a correct denominator of 1.814…

Question 11

In part (a), many responses demonstrated a secure understanding of index laws, with common approaches including applying the rule for multiplying powers with the same base (e.g. $3^{n} \times 3^{12} = 3^{14}$ or $3^{n} \times 3^{20} = 3^{22}$) or forming a linear equation such as $n + 20 - 8 = 14$. Clear and methodical working was often seen in more successful responses. Some responses included errors such as multiplying the bases while adding the powers (e.g. simplifying $3^{14} \times 3^{8}$ to 9^{22}) or incorrectly multiplying the indices (e.g. $14 \times 8 \div 20$), which led to inaccurate answers such as 5.6.

In part (b), most responses showed understanding of fractional indices and recognised the need to apply both cube root and square operations. Stronger responses often separated the numerical and algebraic components, for example: (√643)2=16 and (m12)23=m8 leading to the final expression $16m^{8}$. Less successful responses tended to complete only one of the two operations or applied the correct process to only one part of the expression (either 64 or m^{12}), leaving the other unchanged. Partial simplifications such as 16 or m^{8} were common and credited where appropriate.

Centres may wish to encourage step-by-step presentation of working, particularly when applying fractional powers. A secure understanding of how powers apply to both numbers and algebraic terms can help improve accuracy and clarity in future responses.

Question 12

In part (a), many responses demonstrated a sound understanding of reverse percentages. A common correct approach involved recognising that £440 represents a 10% increase on the original amount, identifying this as 110% of the original value, and dividing by 1.1 to find £400. Some responses focused on the £396 and showed that a 10% increase did not result in £440. In other cases, correct calculations were accompanied by incorrect statements, such as referring to 90% being "left," which implied a decrease rather than an increase, or attempting to find 10% of the new value instead of applying the reverse percentage method. Where such inconsistencies occurred, no marks were awarded. Responses that included vague explanations were sometimes supported by correct working, which allowed credit to be given. Most responses that scored zero marks gave the incorrect conclusion that Jim was correct.

In part (b), the most effective responses included labelled diagrams and followed a logical chain of reasoning. These often involved forming and solving equations, showing a clear understanding of percentage change and inverse operations. While many responses included successful percentage calculations, a significant number did not recognise the need to apply a reverse percentage. Instead, they focused on finding a percentage of a given amount, which did not address the question. A common incorrect method involved halving 180 to find 90 bikes in November, then increasing this by 25% to estimate October's figure. Most responses treated the question in two stages: first finding November, then October, rather than using a combined multiplier (1.5 × 0.75) and dividing by 1.125 to find October's sales directly. Where the process for finding November was incorrect, some responses still gained credit for a correct method to find October using their own value for November. In these cases, it was important that the method was clearly shown to be awarded the mark.

Question 13

Most responses correctly identified the quadratic and cubic graphs. The reciprocal graph was the most frequently mislabelled, with the exponential graph also commonly confused. Common mismatches included F instead of E, G instead of C, D instead of B, and A instead of H. Where graph recognition was uncertain, some responses used substitution to generate tables of values and compare outcomes with the graph shapes provided. This method supported more reliable matching and was often credited.

In responses where working was unclear or absent, reliance on guesswork limited the demonstration of understanding. To improve accuracy, familiarity with different graph types and the identification of key features such as *x*- and *y*-intercepts would be beneficial.

Question 14

This question assessed the application of the area of a triangle formula involving sine: $\text{Area} = \frac{1}{2}ab\,\text{Sin}\,C$. Many responses correctly identified and applied the formula, resulting in answers within the expected range of 23.3 to 23.33. However, misreading the given lengths or angle was a common issue and often led to the loss of accuracy marks. Centres may wish to emphasise the importance of checking substitutions carefully. A frequent error involved assuming that angle *C* must be used, regardless of the sides provided. Responses following this approach often included use of the cosine rule to find a third side (*BC*), followed by the sine rule to find angle C, and then substitution into the area formula. This method often led to calculation errors, premature rounding, or use of incorrect values, and rarely produced the correct final answer.

Question 15

Although not required, most responses included tree diagrams to structure the approach. In some cases, the diagram was drawn but no products were calculated, resulting in no marks. Other responses calculated probabilities for all possible combinations without identifying which were relevant to the problem, which limited credit to two marks.

More successful responses identified the required combinations and calculated the associated probabilities. A small number of responses selected the correct combinations but did not clearly show that these were being added together to get $\frac{98}{125}$, or included calculation errors such as using $\frac{147}{100}$ rather than $\frac{147}{1000}$. In these cases, the communication mark could not be awarded. Some responses delayed working with fractions until after they had multiplied together the 7s and 3s for all their combinations and in these instances, it was important to justify the origin of any denominators used.

A common error involved assuming the pens were taken without replacement. Where this method was applied correctly, one mark could be awarded, but it did not align with the conditions of the question. Careful reading of the question is essential to determine whether events are with or without replacement, as using the incorrect assumption limits the marks available.

Another error, seen less frequently, involved misreading the question and treating it as though four pens were taken instead of three. While method marks remained available, this approach made the task more complex, often requiring identification of up to eleven combinations to reach the third mark. In some responses, probabilities were added along branches of the tree diagram instead of multiplied, which did not reflect correct probability methods and resulted in no marks.

A small number of responses did not consider all relevant cases for “at least two blue pens,” omitting either the two-blue or three-blue scenarios. Overall, many responses demonstrated a good understanding of basic probability techniques, but greater attention to detail, clear working, and accurate interpretation of the question would support improved performance. Where a printed answer is provided, responses should include sufficient detail to justify full marks and ensure the final answer matches the printed value exactly.

Question 16

A range of successful approaches were seen in this question. Many responses set up an accurate equation using a consistent variable for height. Some did not distinguish between the two different heights and made no further progress, gaining only the first mark for correctly stating the volume formula. In other cases, errors occurred during processing of a correct equation. More effective responses substituted r=8 early and simplified the volume expressions before rearranging to find the height. Some responses recognised that equal heights implied equal volumes and worked with a single volume expression (e.g. 320π), which led to more efficient processing.

A few responses did not provide a final answer despite correct working, and it is important to check that the question has been fully answered. Trial and error was also used successfully in some cases, and while this method can lead to full marks, it is recommended that formulae with substituted values are shown to ensure method marks can be awarded if the final answer is not reached.

Question 17

Many responses began by correctly identifying the need for a common denominator. However, transcription errors were common, such as omitting a variable or changing a minus sign to a plus, which affected the final accuracy mark despite method marks being awarded. A frequent error occurred during bracket expansion, where multiplying $-2x$ by -1 was incorrectly simplified to $-2x$ instead of $+2x$. Centres may wish to reinforce practice with single bracket expansion, especially where negative values are involved. Other bracket expansion errors were also noted, and responses that did not show method clearly were more prone to mistakes.

Some responses successfully cleared the fractions and removed brackets with at most one error in expansion, gaining partial credit. Less successful responses struggled with equation manipulation, often incorrectly cancelling $9x^2$ from the numerator and denominator, despite it not being a common factor across all terms. Although this sometimes led to the correct final answer, it was derived from an incorrect method and could not be fully credited.

A minority of responses used an alternative method by multiplying all terms by $(3x - 1)(3x + 1)$ to form an equation, followed by bracket expansion. This approach was often successful, with many responses reaching the correct final answer and gaining full marks. Other responses used subtraction and a common denominator to simplify the equation, while some added the second fraction to the 1 on the right-hand side before simplifying. These approaches demonstrated growing familiarity with algebraic fractions.

To improve performance, learners should be encouraged to present working clearly and in an organised format. Marks may be lost if numerators or denominators are calculated separately and not recombined into a correct fraction or equation. Correct use of brackets is also essential, as missing brackets that are not recovered prevent marks from being awarded.

Question 18

In part (a), many responses gained at least one mark by correctly placing two or three of the given values 5, 32, and 15, into the appropriate regions of the Venn diagram. These values were provided in the question and did not require calculation, so were generally placed accurately. However, difficulties were often seen in interpreting the language used, particularly in distinguishing between phrases such as “like coffee and tea,” “like coffee and hot chocolate but not tea,” and “like coffee.” This led to values being placed in incorrect regions, especially within overlapping sections. Some responses went further and correctly calculated all remaining regions, though a common issue was omitting the value 17, despite it being calculated correctly in the working. Another frequent error involved placing the value 67, representing the total number who like coffee. into the “coffee only” section, rather than using it to derive values across the coffee set. This often resulted in Venn diagrams totalling more than 100.

Learners should be encouraged to check that the sum of all values matches the total frequency.

The second part of the question involved conditional probability, where one mark could be awarded for a partially correct response. This was most often achieved by identifying 47 as the correct numerator. The denominator was less frequently accurate, with many responses using 100 instead of the restricted sample space of 67. This led to common incorrect answers such as $\frac{47}{100}$.

Question 19

This question required the use of bounds within a division and a conversion between centimetres and millimetres to calculate an upper bound. Most responses gained the first mark by identifying one of the bounds, often using a number line or finding midpoints between values either side of 10.4 and 0.17. Where only one mark was awarded, it was typically due to an incomplete calculation for the upper bound. This was often seen in responses that did not attempt to convert units, such as leaving the calculation in centimetres rather than converting to millimetres. Responses that converted centimetres to millimetres, recognising that 10.4 cm is equivalent to 104 mm, were more likely to be fully correct.

Less successful responses applied bounds to the final answer rather than during the calculation, which limited the marks available. More accurate responses began by converting the total height of the pile to 104.5 mm as the upper bound and identified the lower bound of the sheet thickness as 0.165 mm. These responses then divided 104.5 by 0.165 and rounded the result down to the nearest whole number, producing a correct final answer.

Question 20

Many responses demonstrated a good understanding of circle theorems. The diagram was used effectively, with angles such as 160° and 100° often placed correctly on the diagram rather than written in the answer space. It was more common for responses to correctly identify angle *BOD* than angle *BCD*, partly due to some interpreting *DOBC* instead of *ABCD* as a cyclic quadrilateral, which led to incorrect calculations such as angle *DCB* being given as 20°. Some responses applied the theorem that the angle at the centre is twice the angle at the circumference but used the reflex angle *DOB* instead of the obtuse angle, resulting in errors. A number of responses divided the quadrilateral *DOBC* into an isosceles triangle, with varying success, some calculated missing angles accurately, while others made incorrect assumptions.

Where full marks were not achieved, the correct theorems were often applied, but explanations lacked precision or key terminology. Centres may wish to reinforce the importance of using accurate mathematical language in justifications. Abbreviations such as “opp” for opposite or “circ” for circumference should be avoided. In particular, terms like “circumference” should be used instead of “perimeter” or “edge of the circle,” and “centre” should be preferred over “origin” or “middle of the circle.”

Question 21

This question assessed the ability to solve a pair of simultaneous equations, one linear and one quadratic. The most effective approach involved using the equation $y = 2 - 3x$ as the basis for substitution. Responses that began this way generally showed greater confidence and accuracy in subsequent steps. In contrast, those that attempted to rearrange the linear equation into an alternative form often introduced errors during the rearrangement process.

Many responses that formed a three-term quadratic, whether correct or not, were able to access the method mark for attempting to solve the equation, with the quadratic formula being used more frequently than factorisation. In these cases, it was important to show the substitution of values for a, b, and c into the formula, rather than relying solely on calculator functions. More successful responses continued by finding the corresponding values of the second variable. Some responses missed a method mark by not explicitly showing the substitution of their solutions into the original linear equation. This mark was available even if the values were incorrect, provided the substitution was clearly shown.

Question 22

This question assessed understanding of tangents and circles, alongside algebraic skills involving gradients and equations of lines. Many responses recognised the presence of a circle but attempted to link the straight-line equation directly to the general equation of a circle. These responses often substituted into the circle's equation and solved the resulting quadratic, without recognising that this would represent a single point of contact rather than directly identifying the coordinates of the tangent point.

More successful responses began by rearranging the linear equation into the form $y = mx + c$, allowing identification of the gradient of the tangent. This step was frequently completed accurately and led to correct identification of the perpendicular gradient. These responses typically progressed to forming and solving equations to find the point of intersection, demonstrating a clear understanding of the geometric relationship between the radius and the tangent. Working was generally shown step by step, with accurate application of algebraic techniques.

In some responses, the rearrangement of the tangent equation was incorrect or incomplete, such as writing $-y = -\frac{3}{2}x + 26$, which led to the use of an incorrect gradient. Diagrams were occasionally used to support working, though some were misleading and not well integrated into the problem-solving process. Where the negative reciprocal of the tangent's gradient was identified, some responses did not proceed further, either omitting to equate equations or not recognising that the perpendicular line would pass through the centre of the circle, implying a y-intercept of 0.

Most responses used fractional gradients correctly, though some used decimals, which occasionally introduced rounding errors. To improve performance, learners should develop a secure understanding of the geometric relationship between tangents and circles, specifically that the radius meets the tangent at a right angle and that the point of contact lies on both the circle and the tangent line. Centres may wish to focus practice on solving simultaneous equations involving gradients and coordinates and encourage clear working that links algebraic methods with geometric reasoning.

Question 23

This question provided a high level of challenge. Most responses gained at least one mark for correctly expressing a vector in terms of **a** and **b**. Where initial vectors were incorrect, some responses still progressed by clearly showing the method used to derive subsequent vectors, allowing partial credit. A common strength was the correct use of the given ratio 5:3 to partition a vector. Only a few responses used the incorrect ratio or used $\frac{3}{5}$ instead of $\frac{3}{8}$.

Errors with direction were frequently seen, such as using $\mathbf{b} - \mathbf{a}$ instead of $\mathbf{a} - \mathbf{b}$, or omitting brackets, which affected accuracy in later steps. More successful responses progressed by identifying appropriate vectors, typically for intermediate points and final positions. However, many responses struggled to determine the value of **k** for the final mark.

Vector notation was often inconsistent, with some vectors either unlabeled or labelled in the wrong direction. Centres may wish to reinforce the importance of clear labelling and attention to direction when working with vectors. The question required sustained reasoning and careful application of vector methods, and learners would benefit from setting out their working systematically, showing how position vectors relate and contribute to solving the problem.

Summary

Based on their performance on this paper, learners are offered the following advice:

- Write down all steps in your working, ensuring work is structured and easy to follow to have access to as many marks as possible. This can partly be done by annotating given diagrams eg labelling sides and angles.

- Check all your working for errors and to make sure you have not miscopied numbers or algebraic expressions either given in the question or in a previous line of your working.

- Use a ruler to draw straight lines on required diagrams.

- Practise factorising expressions into single brackets especially when there are multiple common factors in each term.

- Practise spotting questions that require reverse percentage calculations.

- Practise solving non-linear simultaneous equations and show full working so that method marks may be awarded.

- Take care with algebraic notation and ensure that brackets are used when necessary.

- In vector questions, set out working systematically, label vectors clearly and consistently, with correct direction. Check vector direction carefully and include brackets where needed

Pearson Education Limited. Registered company number 872828
with its registered office at 80 Strand, London, WC2R 0RL, United Kingdom