Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

January 2023

Pearson Edexcel International GCSE
Mathematics A (4MA1)
Paper 1H

Edexcel and BTEC Qualifications

January 2023
Publications Code 4MA1_1H_2301_ER

4MA1 1H
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Students who were well prepared for this paper were able to make a good attempt at a majority of questions.

Students were less successful with ratios (Q5), writing inequalities from a graph (Q11), differentiating functions in context (Q20) and using vectors to find ratios (Q24).

On the whole, working was shown and mostly easy to follow. Those students who produce untidy, unstructured written work to the extent that their writing is almost illegible risk losing marks. There were some instances where students failed to read the question properly; an example being question 21. Here some students either did not realise they had to use the formula for the area of sector, but instead used the formula for arc length.

Constructing a perpendicular bisector, finding probabilities in a context and using expected frequency, inverse proportion, upper and lower bounds dealing accuracy and manipulation of algebra in later questions, proved to be challenging for many. Reverse percentage in a context, (Q6b) also caused difficulty for less able students.

Generally, problem solving, and questions assessing mathematical reasoning were tackled well at the beginning of the paper.

Question 1

Many students answered this question well. The majority of the students showed clear working However, a common error by some students was to use the lower limits or the upper limits to work out $\sum fx$ so gained 2 out of the 4 marks available. This method is incorrect, and the students need to understand that they must use the mid points. Other common errors were to write $\frac{2160}{\text{their freq}}$ (students should note that the value of the sum of the frequencies was given in the question) or writing $\frac{2160}{5}$. A common error was to multiply the frequencies by the class width (12).

Question 2

Many students gained all 3 marks for this question, demonstrating an excellent understanding of, and ability to manipulate the algebra in this linear equation. Most students multiplied out the bracket correctly, however, a common error on the expansion was to write $6 – 4x$. Mistakes also crept in when some students attempted to gather their x or number terms; adding instead of subtracting or vice versa. Students who multiplied the LHS incorrectly were still given credit for gathering their x and number terms correctly using their 4-term equation.

Students who used the alternative method given in the mark scheme and divided the right side of the equation by 3 into two fractions, were generally unable to do so correctly. It was common for students to divide only one term by 3. However, if they isolated their x and number terms correctly, subsequently they could still gain the second method mark.

Question 3

Students who had access to a pair of compasses usually answered the question well and gained full marks.

A multitude of triangles, circles etc around the line *AB* were offered by a minority of students who had no idea how to proceed. Others who produced one pair of intersecting arcs and then used a protractor to draw the bisector scored one mark A number of students drew a pair of touching circles centred on *A* and *B*. Arcs of the same radius, from *A* and *B*, above and below the line *AB*, clearly intersecting, were needed to secure the first mark. Pairs of parallel arcs above *AB* only and then joined up to extrapolate down to *AB* scored one mark. In a minority of cases students produced two arcs at an equal distance from *A* and *B*, intersecting the line *AB*. The required intersecting arcs were then constructed from these two points, and this was accepted as a valid method. Some students lost a mark where they had the correct intersecting arcs but failed to draw in the line.

Students need to ensure they use a sufficiently dark pencil for their work to be visible.

Question 4

This question was answered well. Many students recalled that the sum of the angles in a pentagon is 540° either by memory or using $(n - 2) \times 180°$. The best students went on to produce concise and clear working leading to a correct answer while weaker students could not recall the sum of the angles in a pentagon.

Some students used an alternative method by working out the exterior angles and then subtracting the total from 360° to find 51°. The more able students subtracted this value from 180° to find the answer.

Some students were confused between interior and exterior angles.

Question 5

In order to make progress, students needed to associate corresponding parts from the two ratios. Those that wrote the ratio 1 : 5 as 3 : 15 were often able to go on and write down the ratio as 2 : 3 : 15. Many students did not understand how to combine the two ratios. A very common incorrect answer was 2 : 3 : 5 from students simply ignoring 1. The students who obtained the correct ratio went on successfully to find the number of green sweets.

A number of students achieved the correct answer of 28 sweets by an unexpected wrong method. From the given ratios 2: 3 and 1 : 5 they extracted 2, 3 and 5, added these together to make 10, and divided this value into 280 (scoring zero in the process).

Question 6

In part (a), many students gained full marks on this question. Most of the students worked out the cost for Theresa’s car and then subtracted 32 000 from 34 240 to find the difference of 2240. Using the values of 2240 and 32 000, the students went on to find the correct answer of 7%.

Some common errors were to write $\frac{32\,000}{34\,240}$ or $\frac{2240}{34\,240}$ thus leading to an incorrect answer.

In part (b) students answered this question in two different ways– those who used the correct method of division by 0.85 or those who used the incorrect method of multiplication by 0.85. Careful reading of the question would help students realise that the 15% is a percentage of the original price and not 15% of the given price. Many students made the familiar mistake of simply finding 15% and subtracting it, or multiplying by 0.85

Question 7

Many students could work out the probability of the thriller book by calculating 1 – (0.24 + 0.40) then dividing by 4. It was interesting to see students employ different methods to find the final answer. The common approach was to work out 48 ÷ 0.24 to find the total number of books as 200. Some students who worked out 200 did not know how to work out an estimate for the number of mystery books and gave up. The more able students multiplied 200 by 0.27 to find the final answer of 54. A common incorrect method was to add 0.24 to 0.40 to find 0.64 and then divide by 2 to find 0.32 for the probability of the mystery books or thriller books. This lost the first mark, but they could often recover to find 200 later. These then lost the final two marks by multiplying 200 by 0.32. A few wrote their answer incorrectly as a fraction, (54/200) and lost the final accuracy mark.

Question 8

The students read the question carefully generally gained full marks. Many students used trigonometry successfully to find the diameter of the semi-circle which was 28 cm. Some students worked out the length *BC* and then went on to use Pythagoras theorem to work out the diameter. After working out the diameter students worked out the circumference of the circle by using πd and obtaining an answer of 88 cm or using $\frac{1}{2}\pi d$ and obtaining an answer of 44 cm. Many students did not go on further to work out the perimeter of the semicircle. The misinterpretation was that the perimeter of the semicircle was just the length of the arc of the semicircle and did not include the diameter. A common error was to add 28 with 88.

Question 9

Part (a) was answered well.

Part (b) was generally answered well. Some students forgot to write the figure 25 000 000 in standard for. Some students wrote the final answer as 25×10^6 gaining the first method mark.

Question 10

(a) Many incorrect solutions were seen, and the main incorrect answer was to write the signs the wrong way round in the brackets e.g. $(y - 6)(y + 8)$ or $(y + 6)(y + 8)$ or $(y - 6)(y - 8)$; one mark was awarded for this. Some students tried to use the quadratic formula. Students should ensure they have the correct factors by multiplying back as a useful check for this type of question. Other incorrect answers such as $y(y - 2) + 48$ were seen. A number of students factorised correctly, but then went on to solve the expression as though it were an equation equal to zero. Even though they weren't penalised for doing this, it does show that students

should read the question carefully and reflect on whether or not it is an expression that needs factorising or an equation which needs solving.
(b) This part was answered well.

(c) Only the most able students gained full marks on this part of the question. Many students could not collect the *w* terms on one side and the numbers on the other side in other words algebraic manipulation let down many students. There were a number of students who calculated the correct inequality of −1.6 rather than $w < -1.6$; these students were able to gain the method marks for the correct method seen.

Question 11

There were not many students who scored all 3 marks, but getting 2 marks was a common achievement, with most being able to convert the given equation $2x + y = 6$ and $2y = 5x + 1$ into correct inequalities. The use of the 'greater than' and the 'greater than or equals to' symbols were both allowed, as were the 'less than' and the 'less than or equals to'.

The challenge for students was to identify the line on which the remaining boundary lay. A common error here was to write the inequality as $3y + 2x \leq 4$.

Some students rearranged the inequalities for y successfully and gave the correct inequalities. A minority lost marks for rearranging incorrectly for y.

There was a substantial minority of students who though they had to have 'R' in their answer, either in combination with y or on its own. Such cases included, for example, '$R \leq -2x + 6$'. Such cases were not awarded a mark.

Question 12

Parts (a) and (b) were answered well.

Question 13

Students usually scored well on this question, requiring the expansion of a product of three linear expressions to give a fully simplified cubic expression. Errors were usually restricted to incorrect terms rather than a flawed strategy although some students omitted terms from their expansion. It was common for students to earn two or three of the available marks. Less able students lacked a clear strategy and sometimes tried to multiply $3x$ with $(2x – 5)^2$ to obtain $(6x^2 – 15x)^2$ and then expanded $(6x^2 – 15x)$ $(6x^2 – 15x)$. Another common error by some students was to expand $(2x – 5)^2$ to give $4x^2 – 25$ or $4x^2 + 25$.

Common misconceptions were errors in signs, for example, expanding $(2x – 5)^2$ to give $4x^2 – 10x – 10x + 25$ and then simplifying this expression to $4x^2 + 25$ or $4x^2 + 20x + 25$. Some students made arithmetical errors with multiplying simple values like $–5 \times –5$ and writing –10 or –25 as their answer.

Question 14

The table was almost always completed correctly, and most students drew a smooth curve through their correctly plotted points although occasionally (0.5, 12) was plotted inaccurately.

There were a number who used a ruler to draw straight lines between points.

Question 15

(a) The majority of students were able to correctly complete the probabilities on the tree diagram. Some gave decimals rather than fractions as probabilities. A small proportion wrote whole numbers on the tree diagram, not fractions.

(b) This part was usually done well, sometimes taking advantage of the follow through from the tree diagram for full marks. Just a few students added probabilities, producing a probability value greater than one.

(c) The method marks were followed through from incorrect probabilities in (a) and several students were able to benefit from this. Some students did not realise that the probabilities needed to be multiplied together along the branches, often adding them. Some students got confused between when to add and when to multiply probabilities, this was demonstrated in their working out as $\frac{2}{9}+\frac{7}{8}\times\frac{7}{9}+\frac{2}{8}$.

In some cases, part (b) and (c) was completed more successfully with many who failed to gain full marks in part (a) going on to gain full marks in part (b) and (c).

Question 16

This question produced a wide variety of responses from students of all abilities. This question was targeting the more able student and many who are used to similar calculations made a very good attempt with the correct answer being seen a pleasing number of times. Many students recognised that the first part of the question was the application of the sine rule. As such, most made a successful start to the problem. Many students substituted the correct values into the sine rule to give a value of 44° for angle *ABC*. They went on to subtract 44° and 64° from 180° to find angle *ACB*. Some students did not realise that angle *ACB* was vertically opposite angle *DCF*. Some students used the sine rule and assumed that angle *ACB* was 44°. More able students identified the need to then use the cosine rule and they applied it accurately to reach the final answer of 20.7°. Those who did not start by using the sine rule to find angle *ABC* failed to make progress.

It was pleasing to see many students writing their methods clearly.

The students are reminded that the formula for the cosine rule and the sine rule is given on the formula sheet as some students quoted the cosine rule and/or the sine rule incorrectly.

Some students tried a right-angled triangle method to find sides and angles, although none were given on the diagram or stated as right angles and this method failed to deliver any marks.

Question 17

The responses to this question were mostly awarded full marks or no marks. A common misconception was to read the question as a direct proportion problem writing down $y = k\sqrt{x}$ Of those who started with the correct relationship most went on to achieve a correct answer although there were a significant number of students who failed to rearrange the formula correctly to find *k*. The letter *c* was allowed for the constant for the first method mark only as this letter had been used for the parameter linking *y* and *x*. Those students who approached the problem by a numerical route gained no marks.

Students do need to be reminded to use an 'equals' sign for a formula rather than a 'proportional' sign; this was a common reason for students losing the accuracy mark.

Question 18

(a) This part was answered well. A common error was to write the answer as $\frac{x}{k}$ or *kx*.

(b)(i) This part was well answered, and many students wrote down the correct answer of –46

(ii) Students generally struggled with the composite nature of the functions. A good number scored a single mark for finding $\frac{3\left(2-3x^4\right)}{2-\left(2-3x^4\right)}$. Many students could not simplify this expression, and many omitted the bracket around $2-3x^4$ thus losing the final mark.

There were a number of scripts where students did not know how to approach the question.

Question 19

Many students simply substituted the given value into the formula and so gained no marks. Those who showed an understanding of bounds generally gained at least two marks for showing a correct upper and/or lower bound for each of the variables. Some students then found all six possible combinations using their upper and lower bounds, not appreciating that only the combinations leading to the upper and lower bound for the calculation should be considered. A further error was to give the correct degree of accuracy after finding the mean of the upper and lower bound rather than considering the accuracy to which they agreed. Many students who understood how to find upper and lower bounds of an individual number did not realise that the upper bound for the quotient required the upper bound for *v and the lower bound for u for the numerator* combined with the lower bound for *t* for the denominator and vice versa.

Question 20

To make any progress on this question students needed to achieve a correct expression for the volume of the cylinder in terms of *x*. If done successfully, the second M mark could be gained by expanding the expression and then differentiating the expression for *V*. Many students missed out the bracket when writing down the expression for *V* and thus losing marks when multiplying out to fond the correct expression for *V*. The third mark was an M mark and required their expression in the form $800x \pm \pi x^3$ or $800x \pm ax^3$ or $bx \pm \pi x^3$ equated to zero. A good number were able to get to this stage but no further, not realising that calculus was required to complete their solution. Some did differentiate and equate to 0; found that $x = 9.2$ but then did not substitute back in to find the maximum value of *V*.

Question 21

It was pleasing to see students attempt this question. Many students worked out the area of the sector to be 14.4 cm^2. The second mark was to find the area of the triangle *OAC* and this was done successfully by using $\frac{1}{2}ab\sin C$ and obtain 10.9 cm^2. It was interesting to see some students using inefficient methods to work out the area of triangle *OAC* such as cosine rule/sine rule/SOHCAHTOA/Pythagoras theorem to find *AC* (5.6(427.8…)) and *OM* (3.8(8328…)) where *M* is the midpoint of *AC*. Many students worked out the shaded area by subtracting the area of the triangle from the area of the sector to give an answer of 3.5cm^2. Many students failed to progress to find the answer as they did not multiply 3.5 by (14 × 3 × 60). They were unable to interpret the final demand of the question in finding the volume of water flowing through the pipe every 3 minutes.

Question 22

Students were required to express *Sn* for an arithmetic series in terms of parameter *t*, in a given form, where the first term and the *n*th term were given in terms of *t* and the common difference was given as 3. There were very many blank responses. Of those that attempted the question some were able to gain two marks for using the *n*th term formula (not given) to obtain *n* in terms of *t* correctly. The next step of substituting their expression into *Sn* sometimes went wrong and the third mark could not be given. Some responses showed a lot of working out with *n* replaced by the given *n*th term in terms of *t*, which gained no mark. Those who got this far generally completed the question correctly, but many were unable to cope with the algebra required.

Question 23

Students were required to find the equation of the line through a diagonal of a kite given a line equation for a line parallel to the other diagonal. There were a significant number of blank responses to this question. Of those who attempted the question many were able to find the correct gradient of the given line and deduce the gradient of the perpendicular. There were many incorrect attempts at obtaining the required midpoint. Some incorrect midpoints were followed through from a given point with one unknown. 5 marks out of 6 were possible with follow through work which aided a considerable number of students to gain some credit. Some fell at the final step by not expressing their correct line equation in the required form.

Question 24

The first mark for this vector question was relatively accessible many. This mark was awarded for finding $\left(\overrightarrow{AB}=\right)2\mathbf{b}-2\mathbf{a}$ or $\left(\overrightarrow{BD}=\right)2\left(2\mathbf{b}-2\mathbf{a}\right)\left(=4\mathbf{b}-4\mathbf{a}\right)$ or equivalent expressions but very few students were then able to show the full process to find the value of λ leading to the correct answer. A common approach was to introduce a second constant and then compare vectors. The idea of a second constant caused a huge problem for many students. Where students were successful, their working tended to be clear and logically ordered. Often students were unsure and there was frequently little or no working and several cases where vectors **a** and **b** were muddled with scalar λ.

There were a number of ways of reaching the final answer of *OC : CE* =1 : 5. The mark scheme attempted to distinguish the main methods of approach but very able students were to be commended on their ingenuity in coming up with equally valid reasoning.

Summary

Based on their performance in this paper, students should:

- be able use formula given on formula sheet correctly
- be able to apply differentiation in the context of a problem
- be able to read graph scales accurately
- read the question carefully and review their answer(s) to ensure that the question set is the one that has been answered and their answer(s) represent a reasonable size
- make sure that their working is to a sufficient degree of accuracy that does not affect the required accuracy of the final answer.
- make their writing legible and their reasoning easy to follow
- students must, when asked, show their working or risk gaining no marks despite correct answers

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