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Principal Examiner Feedback

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Pearson Edexcel GCSE
In Mathematics A (1MA0)
Higher (Calculator) Paper 2H

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GCSE Mathematics 1MA0
Principal Examiner Feedback – Higher Paper 2

Introduction

Many of the students who entered the examination were unable to show much mathematics beyond the first third of the paper. Although number work and statistics were good, there was a strong indication of a weakness in algebra as evidenced by the approach of students to question 3 and to question 11. On questions testing Quality of Written Communication (QWC) most understood that they had to show working and reach a conclusion which had to be unambiguously stated.

Report on individual questions

Question 1

Students were generally successful with this stem and leaf diagram. Most used the standard procedure of writing the stem with the least number at the top. The main errors came from omitting a number in the leaves or from omitting a suitable key or for giving an incomplete key, such as 2|3 without the '= 23'. There were a few cases of two numbers being written in the wrong order. Students who had taken the trouble to check off the number of leaves in their diagram against the number of values given did not make an error or omission.

Question 2

Most students were able to plot the point correctly and state that the correlation was positive. A few drew a line up from 22 and across from 50 to intersect at (22, 50), but this did not score the first mark. Many students did complete the last two parts correctly, in part (c) frequently with the use of a line of best fit.

Question 3

Very few attempts using algebra were seen. When they were tried they were often wrong from the start. Common (mis)representations of the ages were y^2 and $3 - y$. More understandable was $2y$ and $2y - 3$, showing basic algebra skills combined with a lack of care when it comes to reading the text. However, students who did attempt an algebraic approach were able to pick up marks for writing at least one correct expression for one of the two ages, for setting up an equation involving the students' expressions for three ages and also for solving an equation of the form $ay + b = c$ using correct processes. Ages obtained from trial and improvement approaches were often seen – these scored either 4 marks for a completely correct answer to 0 marks for a partially correct or incorrect answer.

Question 4

The most common successful strategy was to convert the 18500 gallons to litres and then to divide the number of litres in the tank by 1700. It was not unusual for students who did this to then round off their answer of 48.97 (minutes) to 50, possibly from thinking that .97 meant 97 seconds. They were not penalised as the rounding instruction was advisory. Changing the rate of flow to gallons per minute was seen, but usually was less successful. Many students had no clear idea what to do with the numbers, so, for example, 18500 ÷ 4.5 was often seen, followed by a division of the answer by 1700. A few students decided to work in seconds - this usually was unfruitful. Alarmingly, there was evidence of some students using build up methods to find the time - usually unsuccessfully.

Question 5

The mathematical techniques required to do this question were not sophisticated and the question could have been set on a non-calculator paper but many students could not work out a correct answer. There were two general kinds of errors: those where the technique was lacking and those where the candidate did not understand the situation correctly.
The errors of technique can be split naturally between the percentage calculation and the fraction calculation. Many students could carry out the percentage calculation correctly from 0.65 × 80 (minutes) or its equivalent. A few tried a build up method which sometimes lead to an error, for example 50% = 40 followed by 10% = 4.
Students appeared to find the fraction calculation more difficult although there were many who did get the correct 50. For the remainder, they could not see that $\frac{5}{8}$ is equivalent to $\frac{50}{80}$ so the answer is immediately 50, or could not carry out the calculation required to find five eighths and a good number tried to convert the fraction to a percentage.
As for comprehension, there were many students who displayed errors. These students ignored at least one line of the question. Commonly, after finding 65% of 80 minutes they then assumed that Zoe sang for the remainder of the time and so found that she sang for 80 – 52 = 28 minutes. Consequently the difference in the times was 52 – 28 = 24 minutes. It may be that these students thought that 65% + $\frac{5}{8}$ = 100% or it may be that they just did not read the line carefully enough to realise its implication that there must be some simultaneous singing.

Question 6

Only very few students scored marks as they did not know that there are 100^2 centimetre^2 in a metre^2. Some did produce a rectangle with sides of 4 m and 1 m and changed this to 400 cm and 100 cm. If they followed this with 400 × 100 = 40000 then they got the two marks available.

Question 7

This question was designed to assess the Theorem of Pythagoras in a functional setting which required students to communicate their working and to reach a conclusion. Only a minority of students recognised this. Those that did work out the missing side from $10^2 + 7^2$ generally progressed to get full marks, although one or two miscalculated the perimeter by adding on the extra 7 they had written down to find the missing side or adding the perimeter of the rectangle they had drawn to the perimeter of the triangle they had used. Some students wrote down 12 after finding $\sqrt{149}$. They then used the 12 to find that the perimeter was 51 m and reach a suitable conclusion about the fence. This was allowed as being an appropriate course of action in this case.

Many students had no feel for the problem at all and attempted to calculate areas – often they thought the demand was about using the trapezium rule so demonstrating they had no understanding of the difference between area (the amount of space inside a region) and perimeter (the total length of all of the edges of the region)

Question 8

Students have generally got better at these best value questions over the last few series. The strategies offered in this case fell into two categories – one where unit prices or unit quantities were used and one where a common measure other than unity was used.

The first method proved to be a bigger mark earner when the cost per ml was calculated (even if the candidate did not know that their calculation was doing just that) as most automatically chose the lowest number. There is some evidence that some students could not pick the least number when the unit prices were quoted as 0.0218, 0.0224 0.02152, possibly because the least does have the greatest number of digits. Nevertheless, this method proved to be the most popular as well as being quite successful. Students who worked out the number of m*l* they could get for a pound (although they never indicated that) were generally less successful as they tended to pick the least value, which in this case is not the best value for money.

For the second method, a popular choice was 750 m*l* which allowed multiples of 15, 10 and 6. This method generally gave full marks, possibly because more mathematically sophisticated students adopted it. Some students adopted a strategy of comparing the cost of 75 m*l* using the 50 m*l* cost – typically 1.09 + 0.54 and concluding that the 50 m*l* was better value than the 75 m*l*. Many then went on to compare the cost of 150 m*l* using 1.09 + 1.09 + 0.54 and concluded the large tube was better value overall. This was an acceptable method, although in some cases the comparisons were not stated explicitly.

Virtually all students now indicate their answer in words. Answers involving arrows pointing or which show poor communication skills will not get the final communication mark.

Question 9

Students who brought a pair of compasses and used it within this question were usually at least partially successful. A surprising number drew intersecting arcs but did not join them with a straight line, possibly because they had half remembered the method or more prosaically did not have a ruler. Some students used arcs which were centred on each end of the line and they found that the intersections took place an uncomfortable long way up the page. Many used just one set of arcs, possibly thinking of the equilateral triangle construction and many drew arcs which just touched at the midpoint of the given line.

Question 10

The first part of the question involved abstracting some information from the given travel graph and then using it to calculate the speed. Most students saw that the distance was 9 (km) but then wrote that down on the answer line. A sizeable number used the 9 (km) and the 10 (minutes) to work out a correct value of the speed as 0.9 (km/minute) but did not go on to convert this to km/hour as they thought they had found the answer. A few used the 9 and the 10 to find 10 ÷ 9 = 1.1. Some did have a better understanding that speed can be thought of as how far you go in a unit time so were able to scale up from 9 km in 10 minutes to 6 × 9 = 54 km in one hour.
The second part of the question was not well answered as most students did not appreciate the implication of the 21 km. Most students were able to draw the 15 minutes at the rest part of the journey but then went astray on the sloping part. Often they joined (45, 21) to (70, 0). It is tempting to think that some of these students thought the time of return was the same as the time of approach without the stop. Another common error was to join to (80, 0). A few students had the last part of the journey still pointing upwards on the grid, so moving away from home.

Question 11

All 4 parts of this question were testing short techniques. Part (a) required knowledge of operator precedence for the first mark. There were many students who did not understand this, either finding the square root of 147 first or even subtracting 3 from 147. The second mark was harder to attain as it required students to recognise that the equation $x^2 = 49$ has two roots rather than just $x = 7$.
For part (b) students who knew how to use the power key on their calculator could pick up the single mark available. The fraction equivalent to $\frac{1}{8}$ was rarer. Many students gave a wrong answer with many opting for what they thought was the standard form equivalent 0.002
Part (c) was not well done. Students were being tested on the use of the power laws $(ab)^n = a^n b^n$ and $\left(a^b\right)^c = a^{bc}$ or alternatively the use of $(3x^2)^3 = 3x^2 \times 3x^2 \times 3x^2$ followed by application of a simpler rule. It was rare to give the two marks allocated for this part. The most common 1 mark answer was $3x^6$ where the power has been treated correctly but not the number followed by $9x^6$, which may have come from $3^3 = 9$. Very common was the incorrect response $3x^5$ although there were a variety of other responses which also gained no marks.
Part (d) tested ability to change the subject of a simple formula. There were students who could do this well, but many students were unable to show coherent algebra. For example $16w = 4p$ and $4w = p - 16$ were common. Some students had been taught a flowchart approach which generally worked well for them. They got their first mark for showing the correct reverse path and the second mark for writing the answer in correct algebraic form. This proved to be a problem for others.

Question 12

This was a standard ‘Describe the single transformation’ type question. Many students could do just that and a good proportion got at least 2 marks. Surprisingly, many of the students who lost a mark did it on the angle, deciding the answer was 90° although the shape of the original triangle makes it easy to see that the angle must be 180°. Others gave the centre of rotation as a column vector rather than as coordinates or gave the coordinates reversed. Many students scored zero on the question because they gave a combination of transformations in their answer. Typically this was a rotation followed by a translation where the students had assumed a start with a rotation of 180° in situ followed by a translation (often called a ‘move’) from the in situ position to the position of the image.

Question 13

Part (a) was a novel variant of listing integers which satisfied certain inequalities with the additional constraint of having to satisfy an equation. Many students had some idea on how to go about finding suitable values of *x* and suitable values of *y* and then finding correct pairs to write the values 5 and 6 on the answer line. There were also many students who were unsure of what the lowest and highest values of *x* should be presumably from uncertainty of the exact meaning of the '<' sign. In addition, many students thought the answer was 4, 5 and 6 which may have come from a similar misunderstanding for the '*y*' inequality

Part (b) proved to be challenging for the majority of the students with many blank grids. There were few students who linked the linear inequalities in *x* and *y* with appropriate straight lines. Those that did sometimes drew the line with equation $y = -1$ as the line with equation $x = -1$. Students who produced tables of values were generally more successful.

Question 14

This question assessed application of percentage. Part (a) was a 'working backwards' percentage question where the starting point was to recognise that the given time was 89% of the required time. This seemed to be unclear to many of the students who worked out 11% of the given time and added it on. They scored no marks.

Part (b) should have been notionally easier than part (a) and did have a higher success rate. The standard 'difference ÷ original × 100' was not often seen. A common error was 'difference ÷ final × 100' or even just 'difference ÷ final' Some students made good use of their calculator and used trial values of the percentage to calculate the decrease in time from 68 minutes trying to find a value near 60 minutes. Those students who quoted a percentage within the allowed interval scored the two marks. Otherwise they scored 0 marks.

Question 15

Both parts seemed to be beyond many students entered for this exam. Part (a) was a test of knowledge of circle theorems. Students could answer by using the classical 'The angle in a semi circle is a right angle' but reference to the alternate segment theorem was also accepted.

In part (b) students were expected to use sine to find the opposite, then double to get the diameter followed by using cosine to get the required length. Many students clearly had no knowledge of trigonometry so scored no marks. Others showed confusion between sine, cosine and tangent and also generally scored no marks. Some lost a mark because of premature approximation – they truncated 8 $\sin 35^\circ$ to 4, so their diameter was 8 and $8\cos 70^\circ$ was outside the allowed tolerance. This also tended to happen for those who used a combination of cosine and Pythagoras's Theorem in triangle *ABO* and a combination of sine and Pythagoras's Theorem in triangle *DBC*, although they could earn the three method marks.

Question 16

Part (a) was fairly well answered being based essentially on knowledge. Part (b) was less successfully answered as it was clear that many students could not use standard form on their calculator. The most common approach was to convert the standard form into ordinary numbers and then use a calculator (or not) to perform the division. This worked often, but many of these students left their answer as 500 or 'five hundred' rather than as 5×10^2. A few students worked out $3 \div 6 = 0.5$ and $10^7 \div 10^4 = 10^3$ all of which is correct but then missed the second mark because they wrote their answer as 0.5×10^3.

Question 17

This question tested knowledge and application of the form $y = mx + c$ The vast majority of students scored no marks for this question as they did not appear to know that parallel lines have the same gradient which is the 'm' in $y = mx + c$. A few students scored 3 marks.

Question18

This question was designed to test knowledge and interpretation of box plots. It was pleasing to see many students being able to get the first 3 marks by stating the median and working out the interquartile range although on occasion the median was written down as the interquartile range, although the value (53) of the midpoint of the box was frequently given for the median.
Students were less successful with carrying out a comparison of the two distributions based on the box plot and the given table. A comment about the median and the interquartile range was expected together with a statement of comparison in each case, rather than just the values stated. Values did not have to be quoted for the median but if they were they had to be correct (or the correct difference between the two). A few students also commented on the interquartile range; to earn the mark in this case the values had to be correct. For full marks at least one of the comparisons had to relate to the real events – for example 'this showed that on average the number of teams in the summer was greater than in the winter.'

Question 19

Most students did not understand the concept of a bound, so scored no marks for either part of this question. Those that did get the mark for part (a), often did have some strategy for dealing with the formula. However, very few appreciated that the upper bound of $\frac{1}{q}$ is found from using the lower bound of q. These students generally scored 1 mark for the 4.35. As often is the case, students also thought that bounds had to be applied to an exact answer, so worked out $4.3+\frac{1}{0.4}$ and the added 0.5 to their answer

Question 20

This question proved to be very challenging for the students that sat this question paper.
One possible approach, popular amongst students was to work directly with areas. They found the area of watch A, then the areas of the major and minor segments of watch B. They then had to weight the two areas in the ratio 3:2, find the total mass and set this against the mass of watch A. This had to be a notional mass as no densities or masses per unit areas were given. A few students managed to do this but most could not keep track of where they were due to the complexity of the problem, especially if the areas were not expressed in terms of multiples of π. For example, some gave answers which were comparisons of the two areas in B.
A second possible approach was to recognise that since the two watches have the same radius, the areas are proportional to the angles at the centre. This allowed a few students to work with 360^o in A and 20^o and 340^o respectively in B. The calculations then became 360×2 and $20 \times 3 + 340 \times 2$ followed by setting the ratio.

Question 21

This was a fairly standard 'find the size of a stratum in a stratified sample'. Since the population size (148) was given all the candidate had to do was to work out $\frac{35}{148}\times 40$ and then round of the answer to the calculation to either 9 or 10. Either was acceptable. Some students did try a proportionality approach like this but decided that they had to consider the number of girls who went to the Brighton Wheel (35) out of the total number of girls (95). They worked out $\frac{35}{95}\times 40$. Because the choice of numbers displays such a misunderstanding of stratified sample they got no marks. Many students had no idea of proportionality and wrote down the answer 35.

Question 22

This was an unusual question with the intention of testing knowledge of the quadratic formula. Many students were able to write down the value of *a* or of *b* but had to work a little harder when it came to finding the value of *c*. As when solving quadratic equations using the formula there were many students who made a sign error with *b*. Of course there where many students who thought this was an exercise in working out the value of the given expression(s). They were awarded no marks unless they explicitly identified the values of *a*, *b* and *c*.

Question 23

Neither of the two parts of this question, if answered at all, were answered well. There were a few good answers to part (a) and some further students managed to score 1 mark for a reasonably convincing translation parallel to the *y*-axis. Part (b) was less well answered: it did involve a combination of transformations which may have confused students, as there were some who had the curve inverted with a minimum at (0, -2), but the extreme values at ±180 on $y = -1$. As the answer was a reflection in the *x*-axis followed by a stretch parallel to the *y*-axis, students should have taken care to ensure that any points of the original curve on the *x*-axis actually are anchored there.

Question 24

This question was designed to assess the problem-solving capabilities of more able students. They had to recognise that by equating $\frac{1}{2}ab\sin C$ to the area, solving for the missing side *a*, they could then use the cosine rule to find the side opposite the 40^{o}. This proved to be very difficult for the students who sat this question paper. There were a few students who scored all the marks, and some who scored two marks, but for many the working space was blank or they attempted to use right angled triangle trigonometry inappropriately.

There was some indication that students could equate the formula $\frac{1}{2}ab\sin C$ to 100, substitute in the values correctly and even find the answer of 37 although some divided the 100 by 2 instead of multiplying by 2. However, they then stopped because they thought they had solved the problem. They had confused the *ab* in the area formula with the *AB* they were being asked to find.

Students who went on after finding side *a* often secured all 5 marks. Although some lost 1 mark because of overenthusiam in approximating their answer as they proceeded through the calculation.

A few students used a more indirect approach, first using sine to find the height of the appropriate altitude and then $\frac{1}{2}$ × base × height to work out the base. They then used a combination of right-angled triangle trigonometry and Pythagoras to find the length of the side.

Question 25

This was another question designed to assess the most able students. It did allow more students to score marks, often just by recognising that the second set of probabilities were conditional and writing down correctly. However, some students misinterpreted this and gave probabilities with denominators of 28. More successful students were able to pick up another mark by writing down one correct expression for a compound probability. Students who took the trouble to draw a tree diagram were generally more successful as they had the structure set out which made it more likely they would pick out all 6 possible expressions and then add them. Few students considered the complementary event approach; they were generally successful. Solving the corresponding problem with replacement could yield a maximum of two marks and there were a few students who did do this.

Summary

Based on their performance on this paper, students should be advised:

- to show all the stages in working, realising that if the question states this then they may gain no marks unless they do so.
- to read questions very carefully and try to ensure that they use the information given. Numbers given in lines of text (as opposed to tables) are going to have to be used in a full answer of a question
- to check their own working to ensure they have not misread work and put a different answer on the answer line to the one they have written in the working space.
- with stem and leaf diagrams to make sure the number of leaves matches the data at the start of the question.
- when a question asks to describe a single transformation, to realise that more than one in the answer (even if the combination would work) will score 0 marks
- to know it is a useful practice, for scatter diagrams, to draw the line of best fit, even if not asked for
- when dealing with units of area such as 4 m^2, to remember this is the area of a square 2m by 2m not 4m by 4m, for example.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:
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