

# Principal Examiner Feedback

Summer 2012

GCSE Mathematics (Linear) 1MA0  
Higher (Calculator)  
Paper 2

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Publications Code UG032624

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# GCSE Mathematics 1MA0

## Principal Examiner Feedback – Higher Paper 2

### Introduction

This was the first calculator paper from the 1MA0 linear specification in which there were substantial questions which assessed problem solving and communication in mathematics.

This paper gave candidates ample opportunity to demonstrate their understanding. Some very good attempts at the paper were seen. The performance of candidates on the questions which assessed AO2 and AO3 was generally very pleasing.

The majority of candidates showed working out to support their answers and this was often well set out and easy to follow. One problem that was evident on this calculator paper was the use of premature approximation. Many candidates rounded values at intermediate steps in their calculations which resulted in a loss of accuracy in the final answer and a loss of marks.

Several questions on this paper (e.g. 10b, 14b and 20) highlighted the problems that many candidates have when required to manipulate algebraic formulas and equations. In algebra work, candidates also need to be more accurate in their use of brackets as poorly written algebra can lead to marks being lost unnecessarily.

Candidates must take note when questions are labelled with an asterisk to indicate that quality of written communication is to be assessed. They should always make sure that full working is shown to demonstrate their answer to the question set and present this working in a logical manner. When geometric reasoning is involved candidates must use the correct terminology.

### Report on individual questions

#### Question 1

Many candidates gained two marks for finding  $x = 133$  but disappointingly few candidates achieved the third mark for giving correct reasons. Many either wrote no reason at all or, most commonly, just wrote one reason e.g. 'angles on a straight line add up to 180'. Most candidates were not able to give full clear statements with the correct naming of the types of angles. The minimal phrases that were often used were insufficient to gain any credit. Some candidates used the terms 'F angles', 'Z angles' and 'C angles' in their reasons rather than 'corresponding angles', 'alternate angles' and 'co-interior angles'. These terms are not acceptable. A small number of candidates thought that  $x$  was  $47^\circ$  despite the fact that it was clearly an obtuse angle.

## Question 2

Most candidates were able to score at least one mark in part (a). Those who were most successful often worked out the numerator and denominator separately and then did the division. Candidates who did the entire calculation in one go often forgot the need for brackets and lost both marks. Part (b) was not answered so well. An answer to 1 decimal place rather than 1 significant figure was frequently seen. Rounding or truncating to the nearest whole number was also commonly observed as were 40.0 and 4. Another common mistake was to include all decimal places, e.g. 40.000.

## Question 3

Many fully correct responses were seen in part (a). Candidates clearly know what to look for in this type of question and most managed to describe two things wrong with Pradeep's question, usually answering succinctly and correctly. In trying to explain that the boxes were not exhaustive some candidates stated that there was no box for those who don't play sport, failing to recognise that this was covered by '0 to 1 hours'. Part (b) was also answered well by most candidates. The vast majority included a question and at least three response boxes. The main error was failing to include either a time frame or, less commonly, a time unit with the question. Some candidates who identified a particular 'error' in part (a) did not go on to rectify this when designing their own question in part (b). A few candidates lost one mark by phrasing their question to ask 'how often' people played sport rather than 'how much time' they spent playing it. The response boxes needed to be either non-overlapping or exhaustive and most candidates managed to have at least one, and often both, of these criteria in their boxes. Examiners reported that some candidates used inequalities with their response boxes. Centres should note that this is not accepted. It was pleasing that very few candidates used a data collection approach.

## Question 4

This question was answered very well with many candidates drawing the correct straight line between  $x = -1$  and  $x = 3$ . An accurate table of values was often seen, but not always; substitution of  $x = -1$  proved to be the most challenging. Some candidates plotted the points correctly but failed to join them up to produce the straight line required. Candidates who attempted to use  $y = mx + c$  often failed to take into account the different scales on the two axes and gained one mark for drawing a straight line through the point  $(0, -2)$  with an incorrect gradient.

### Question 5

Many candidates had learnt to work systematically through this type of question, setting out their working clearly and remembering the requirement to add a sentence at the end. Decisions were generally well made following the working shown, with almost all candidates remembering to round up rather than down. Most mistakes were made with the calculation of the area of the circles – with candidates using an incorrect value for the radius or using the formula for the circumference instead. These candidates usually managed to gain three out of the five marks if they worked out the correct number of boxes that would be needed for their area.

### Question 6

There were many varied methods employed in this question to good effect with most candidates understanding the concept of 'better value'. Those that chose methods that led to the price for an equivalent amount, e.g. how much 12.5 kg of potatoes would cost at the supermarket, were the most successful, nearly always managing to reach the correct conclusion. Those who worked out the number of kg that could be bought for £1 at the farm shop and at the supermarket generally reached the wrong conclusion. In some cases the QWC mark was lost, not for the incorrect conclusion, but rather that candidates failed to state in words 'farm shop' or 'supermarket', choosing instead to indicate their answer by drawing arrows, circling or writing 'this one'. A question that assesses the quality of written communication requires candidates to communicate their conclusion clearly.

### Question 7

Part (a) was answered extremely well with the vast majority of candidates able to identify the correlation as negative. A few candidates described the relationship between the distance and the engine size. Most candidates answered part (b) correctly, often without drawing a line of best fit. Centres should encourage candidates to show a clear method on the graph as, without this, answers just outside the required range cannot be awarded any marks.

### Question 8

Part (a) was generally answered very well. The majority of candidates who failed to draw the triangle in the correct position did at least draw it in the correct orientation. A small number of candidates rotated the triangle  $90^\circ$  anticlockwise or  $180^\circ$  rather than  $90^\circ$  clockwise. Candidates were not quite as successful in part (b). It was clear that the majority of candidates understood that scale factor 3 increases each length threefold but enlarging from a given centre was not as well understood with candidates often plotting the bottom left vertex at (1, 2) or at the origin. Two marks for an enlargement of scale factor 3 in an incorrect position were frequently awarded. When candidates had used an incorrect scale factor this was most commonly scale factor 2. Some candidates did not use the same scale factor for both the base and the height.

### Question 9

Most candidates answered this question correctly and gained all 3 marks. For the majority the first step was to change £200 into koruna by multiplying 200 by 25.82. Common errors were to give 51.64 as the final answer or round it to 50 or 52 instead of to 51. Few candidates used the method that started with  $100 \div 25.82$  successfully. A few divided 200 by 25.82 and there were some who misread the number 25.82.

### Question 10

The vast majority of candidates gained at least one mark in part (a) and many listed the five correct integers. The most common error was to leave out one value (most commonly 3) and some candidates gave an extra value (most commonly -2). Some candidates clearly confused  $<$  and  $\leq$  as they included -2 and omitted 3. Seen less often, was writing the values in a non-numerical order and missing one out, usually 0 or 1. The term 'integer' was generally understood. Candidates were less successful in part (b). A significant number of candidates wrote '3.25' on the answer line, in some cases after showing  $x < 3.25$  in the working. Many approached solving the inequality by treating it as an equation which meant that they usually failed to use an inequality sign in their answer. Isolating the  $x$  terms and the non- $x$  terms proved to be a problem for many candidates and  $10x$ , 5 and  $-5$  were often seen. Some of those who got as far as  $4x < 13$  did not go on to complete the final step of the solution.

### Question 11

Many candidates set out their working well and obtained a fully correct answer. A significant number of candidates, however, lost the final mark by not giving the answer correct to 1 decimal place. Another common error was to carry out trials at  $x = 4.6$  and  $x = 4.7$  and then look at the differences from 72. This is not a valid method to establish an answer to 1 decimal place with certainty. Candidates needed to carry out a further trial to establish the fact that the value of  $x$  was between 4.6 and 4.65. A few candidates scored no marks either because they wrote 'too big' or 'too small' without showing the result of each trial or because they evaluated an incorrect expression such as  $x^3 - 6$ .

### Question 12

This question was generally answered very well with most candidates choosing to multiply 400 by 0.3. Some, though, gave the answer as '120/400' which only gained one mark. Commonly seen incorrect methods included  $400 \div 0.3$ ,  $400 \div 3$  and  $400 \times 0.3 \div 6$ .

### Question 13

The responses to this question were very mixed. When candidates knew how to tackle the question the use of the mid-interval values was very much in evidence but there were still some who used either the upper or the lower values of the class intervals. A significant number of candidates worked out the correct answer but then felt the need to round this to 28 on the answer line or to give the answer as the class interval itself. Those who had shown 28.25 in the working were not penalised for doing this. Some candidates realised that 'fx' could be involved and did the appropriate calculations but then decided not to use these results, choosing instead to divide the total of the frequencies by the number of class intervals (a very common incorrect method) and gaining no marks.

### Question 14

Candidates were generally quite successful in part (a). Most candidates appeared to know a method for expanding two sets of brackets with many achieving at least one mark. Methods seen included FOIL and the use of a grid. Common errors included ignoring the signs of the terms ( $-4p$  was often given as  $4p$ ) and adding the final two terms instead of multiplying. Simplifying the four-term expression sometimes resulted in errors, e.g.  $-4p + 9p$  being simplified to  $13p$  or  $-5p$  or to just 5.

Part (b) was not answered so well. Most candidates realised that they needed to multiply both sides of the equation by 3 but many weren't sure how to carry this out.  $15w - 24 = 12w + 6$  was seen often and the RHS was sometimes given as  $4w + 6$  or  $12w + 2$ . Some candidates were able to rearrange their four-term equation correctly but many made errors when attempting to do this. Some candidates who got as far as  $14 = -7w$  were unsure of how to deal with the minus sign.

Candidates who recognised the expression in part (c) as the difference of two squares almost invariably found the correct answer but there were many who gave the answer as either  $(x + 7)^2$  or  $(x - 7)^2$ . Others tried to find a common factor and  $x(x - 49)$  was a common incorrect answer.

Part (d) was answered less well although a good number of candidates did successfully apply the laws of indices to get either a fully correct answer or to gain one mark for having two correct terms within a product. Many candidates did not know that the power of  $1/2$  indicates square root and  $9^{1/2}$  was commonly given as '4.5' or left as '9'.

### Question 15

The better candidates coped well with the demands of this question and gained full marks but there were many who completely mixed up the units and the various possible methods of working by day and by year. By far the most successful were those who compared the annual running costs. A lack of awareness of what units they were working with was the biggest source of error for candidates. In some cases this resulted in bills of over £6000 because candidates multiplied the number of cubic metres by 91.22 pence and didn't convert to pounds before adding the standing charge of £28.20. It is disappointing that these candidates didn't realise that their answer was out of all proportion to the context of the question and thought that not having a water meter would save Henry almost £6000.

### Question 16

Those using the direct method of cosine usually managed to work through to a correct answer. The most common mistake was to round 0.666... to 0.6 and to find  $\cos^{-1}(0.6)$ . This resulted in an answer of 53.1 which meant that the accuracy mark had been lost. Those using Pythagoras (which gained no marks until a correct statement for sin or tan was seen) frequently lost their way in the calculations and here again early rounding too frequently resulted in a loss of accuracy. A few candidates worked in radians or gradians but these candidates could still to get two of the three marks available.

### Question 17

This question was well attempted and the majority of candidates gained at least one mark. The use of  $6200 \times 1.025^3$  was not as widely used as might have been expected and the question was often made much more "labour intensive" than it needed to be. Many candidates chose to work out each year individually and this frequently resulted in small mistakes that prevented full marks being awarded. Incorrect answers were often due to poor rounding either at the end or at the intermediate stages. Common errors included finding only one year's interest and using simple interest instead of compound interest. There were very few responses in which the candidate had found the total interest instead of the total amount in the account.



### Question 18

This question required the candidates to first find the side  $BD$  and then to use that to find the length of the side  $CD$ . Many got off to a good start by correctly using Pythagoras to find  $BD$ . At that point a number of candidates stopped, possibly believing that they had answered the question, and so lost the remaining three marks. Of those that realised they needed to continue, a good many managed to use a correct trigonometric expression to gain the third mark, although incorrect rearrangement often meant that they gained no further marks. Those that chose to use 'tan' often missed out on the remaining method mark for not realising that they had worked out the side  $BC$  and so still needed to do one further calculation. Candidates who used Pythagoras incorrectly in the first stage were still able to gain the two marks for the second stage if they used their value for the length  $BD$  correctly. Early rounding of the length  $BD$  to 10.6 in this question was not penalised as it still gave an answer within the range. Candidates should, however, be reminded not to prematurely round answers to 1dp at the intermediate stages of calculations.

### Question 19

Many candidates made hard work of this question which could have been done so easily with the correct use of a calculator. Many converted the values to ordinary numbers to do the calculation, producing cumbersome strings of zeros, often resulting in an answer not given in standard form or causing them to lose their way. Some candidates were able to evaluate either the numerator or the denominator correctly but not both. A very common error made by those candidates who did get to  $2.38 \times 10^{-9}$  was to overlook the fact that they needed to take the square root to get to the final answer, thus gaining two of the three marks. A number of candidates merely gave an answer with no working; candidates need to be made aware that if an answer has been rounded or truncated to outside the acceptable range and no working is shown then the examiner will not be able to award any marks.

### Question 20

This question was a good discriminator with a range of marks awarded. Most candidates began by attempting to expand the brackets. These expansions were generally correct although some candidates reached  $2d - t$  rather than  $2d - 2t$  and some candidates multiplied both sides by 2. Dividing by 2 as a first step was seldom seen. Progress after this first step was patchy. A large number of candidates were unable to isolate  $t$  correctly and failed to gain any further marks. The most common error was to move terms from one side to the other without a change of sign while some candidates could not cope with operations involving directed numbers, e.g. subtracting  $-2t$  from  $4t$  and getting  $2t$ . Those candidates reaching  $7 - 2d = -6t$  often lost the minus sign when dividing through by  $-6$ . There were very few answers involving decimals rather than fractions.

### Question 21

The majority of candidates had no understanding of what was required in this question. Candidates either attempted the proof by substituting various values of  $n$  into  $(2n + 3)^2 - (2n - 3)^2$  or they made no attempt at all. A significant number of those who did know what was required lost marks by failing to use brackets or by incorrectly writing their algebraic expressions. It was not uncommon to see ' $4n^2 + 12n + 9 - 4n^2 - 12n + 9 = 24n$ ' which is an incorrect statement. This question was an algebraic proof and required the algebra to be correctly written at all times. Many candidates gained one mark for the correct expansion of either  $(2n + 3)^2$  or  $(2n - 3)^2$  but were then unable to proceed any further. Some expanded  $(2n + 3)^2$  as  $4n^2 + 9$ .

### Question 22

Candidates who realised that they needed to use the quadratic equation formula were usually able to score the first method mark. Some, though, did not extend the dividing line between the numerator and denominator the full length of the formula. Candidates often only scored one mark as they were unable to deal successfully with the negative signs;  $b = -4$  created problems for the correct evaluation of both  $-b$  and  $b^2$ . Candidates sometimes failed to obtain the final mark because they did not give both answers to the required degree of accuracy, e.g. writing  $-0.39$  instead of  $-0.387$ . Some candidates showed little working and wrote their final answer with incorrect signs. Few attempted to use the completing the square method and those who tried "trial and improvement" were invariably unsuccessful.

### Question 23

In part (a)(i) the correct definition of a random sample was rarely seen. Many candidates talked about choosing at random with a whole host of suggestions about how to do this but never actually mentioned the notion that 'every member has an equal chance of being chosen'. Some candidates stated that a random sample was one where every member had an even chance of being chosen. This is not acceptable as the use of the word 'even' implies a 50/50 chance. Part (a)(ii) was reasonably well answered with the most popular answer being to write the names of the students on pieces of paper and pick them out of a hat. Some candidates talked about using a random number selector but sometimes failed to mention that each student had to be given a number first of all. There were many incorrect answers such as 'stop people at random' and 'ask the first ten people that you meet'. Part (b) was generally answered quite well. A common error was to round 20.96 to 20 instead of to 21. Some candidates, though, obtained the numbers 1140, 239 and 100 but had little, or no idea, how to link them together to work out a stratified sample. It was not uncommon to see answers such as 139 which were bigger than the sample size of 100.

### Question 24

This question was often omitted and it was generally not well done by those who did attempt it. A number of candidates treated the triangle as right angled and used cos/sin/tan to find one of the sides. Those who used the sine rule were mostly able to find at least one side successfully. Many candidates found both missing sides which was unnecessary. Most knew that they had to use  $\frac{1}{2}absinC$  for the area but sometimes did not use the angle included by their two sides.

### Question 25

This question was a good discriminator. Many of the weaker candidates were unable to make a good attempt at it but the more able candidates often gained full marks. Most candidates used a tree diagram with mostly correct branches and the majority recognised that there was no replacement. Some went on to include a third set of branches or had 18 as the denominator for the second set of branches. The most common approach was to add six products with most candidates selecting the correct pairs of probabilities. Arithmetic errors did occasionally lead to loss of the final accuracy mark. Far fewer candidates attempted the method of  $1 -$  (probability of two of the same type) which is a quicker way of working out the required probability. Those who used replacement often earned both of the two marks available for this approach and some scored one mark for having at least one correct product. Most candidates used fractions throughout and gave their answer as a fraction or converted it to a decimal at the end. Some converted to decimals at an earlier stage and often lost accuracy as a result of premature rounding. For the weaker candidates the tree diagram was often all they managed; they did not know what to do with the probabilities and some added rather than multiplied the probabilities.

### Question 26

Many candidates have a lack of confidence when it comes to working with vectors and this question was frequently not attempted. Those who did attempt it often gained at least one mark as part (a) was generally answered quite well. In part (b) correct expressions for the vector  $AP$  were much more common than correct expressions for the vector  $BP$ . Those trying to use  $BP$  often failed to recognise that the change in direction required a change of signs. Candidates with some idea of what was required often scored one mark for a suitable 'vector journey' although sign errors were often apparent. Some candidates lost marks by failing to include brackets. Those who scored the first two marks for a correct expression for  $OP$  were often unable to simplify their answer to gain the final accuracy mark. Misunderstanding of ratios led a considerable number of candidates using  $\frac{1}{3}$  instead of  $\frac{1}{4}$ . Responses to this question were often confused and difficult to follow making the marking of them more challenging for examiners.

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