Pearson

Examiners' Report
Principal Examiner Feedback

Summer 2018

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

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GCSE (9 – 1) Mathematics – 1MA1
Principal Examiner Feedback – Higher Paper 3

Introduction

The time allowed for the examination appears to have been sufficient for students to complete this paper.

Many students set out their working in a clear and logical manner. It is encouraging to report that students who did not give fully correct answers often obtained marks for showing a correct process or method. Most of the students entered for this paper seemed well suited to entry at the higher tier.

The paper gave the opportunity for students of all abilities to demonstrate positive achievement. While all questions were accessible to some students, there were few students able to work confidently on all questions. In particular, questions 13 (similar shapes), 16a (quadratic sequence), and 21 (geometrical proof) proved a challenge to most students.

There were a number of questions which required students to "comment" or "explain" or "give reasons". Many students would benefit from further practice in answering such questions and in particular when to give an answer involving the context of the question, for example in question 12(b) and when to give an answer explaining what they have learned about a specific topic in mathematics, for example question 1(b).

Report on individual questions

Question 1

Part (a) of this question requiring students to write down the type of correlation was very well done with few students attempting to describe the relationship between the two variables. Many students also commented on the strength of the correlation. Students who were unfamiliar with the term "negative correlation" and used words such as "decreasing" or "descending" or used expressions involving proportionality were unable to access this mark.

The second and third parts of the question were answered well by a good proportion of students. In part (b) examiners could give credit where students explained that the point would be an outlier because it would lie a significant distance away from other points representing data for 11 year olds. It was not good enough to say that Kristina was faster than other 11 year olds but examiners did accept an answer stating she was much faster than other 11year olds. Statements suggesting that the point would not fit in with the correlation shown or with the pattern of the data or with the line of best fit were also awarded the mark. A common error made was for students to miss the point of the question and state a time that Kristina should take to complete the 100m, for example, "she should run 100m in 15.6 s".

In part (c) students were expected to comment that extrapolation of data, which is unreliable, would be involved if the scatter diagram was used to predict the time taken for a 15 year old to run 100 metres. Many students did not appreciate this and assumed that they could use a line of best fit to predict the time.

Question 2

This question was a good discriminator. Just over a half of students entered for the examination scored full marks for their responses to this question testing the expansion of brackets and collection of terms. More able students could deal accurately with the signs involved in expanding and subtracting the second set of brackets whereas weaker students usually scored one mark for the correct expansion of the first set of brackets. Less successful students who found the expansion of brackets problematic often presented work along the lines, "$5(p + 3) - 2(1 - 2p) = 5p + 15 - 2 - 4p = p + 13$".

Question 3

A majority of students scored at least one of the two marks available for responses to this question. There were many correct triangles drawn with area 18 cm², often right-angled triangles with base 6 cm and height 6 cm. Of those students who made an error with the calculation of the area of the trapezium, a substantial number were able to use their area to construct a triangle with the same area. Examiners awarded one mark to these students. Some students relied on counting squares to find the area of the trapezium and errors were often made in these cases.

Question4

This question was generally well answered and descriptions of the things wrong with the tree diagram were generally clearly written. Nearly all students were able to identify the fact that the two probabilities for the first throw of the dice did not sum to one and make a valid comment on this. Most students were also able to see that two of the probabilities for the second throw were the wrong way round but some of the explanations were a little too vague for the award of the mark. Examiners noted that those students who annotated the tree diagram usually scored this mark.

Question 5

Students were usually able to work out the angle *ABC* by using the cosine function. A small number of students used Pythagoras' rule to find the length of the unknown side. They then usually used the sine function successfully to find angle *ABC.* Some students built some inaccuracy into their calculation by evaluating $\frac{7}{11}$ as 0.63 and then finding an angle outside the range accepted for the accuracy mark.

Part (b) of the question was very poorly answered across the ability range. Students often appeared not to have read the question carefully and answered the question "Will the size of angle *ABC* increase or decrease?" instead of the question asked. Most of the students who did give a correct answer together with an acceptable explanation compared the sizes of the fractions $\frac{7}{10}$ and $\frac{7}{11}$ sometimes stating that a reduction in the size of the denominator leads to an increase in the value of cos *ABC*.

Question 6

This question was a good discrminator. In part (a) nearly all students realised that they needed to subtact 0.45 and 0.25 from 1 to find the total of the probabilities of taking a red counter or a white counter. They could often also work out the separate probabilities, 0.2 and 0.1. However, only more able students could find the total number of counters in the bag then use the 0.2 to find the number of red counters. Instead many students worked out 0.2 × 18, 18 being the number of blue counters in the bag, so 3.6 (sometimes rounded to 4) was a commonly seen incorrect answer. Other common incorrect approaches involved reversing the probabilities for the numbers of red and white counters or working out the probability for a red counter as 0.15 (0.30 ÷ 2). Very few students used an algebraic approach.

In part (b) there were many clear explanations seen but there were also many incomplete or unclear statements seen. For example "you cannot half an odd number" was a commonly seen response which just fell short of an acceptable response. Students needed to use the fact that 0.5 multiplied by an odd number will not give an integer in some way to score the mark in this part of the question. Answers including statements equivalent to "you cannot have half a marble" usually scored the mark available.

Question 7

Though there were many correct solutions to the equation seen, this question was poorly done by a large proportion of students taking the paper. Examiners were surprised by the number of students who could not carry out a correct first step with accuracy when all that was needed was $5 - x = 2(2x - 7)$ in order to score a mark. Instead, statements such as $10 - 2x = 2x - 7$, $10 - 2x = 4x - 14$ and $5 - x = 4x - 7$ were often seen. Of those students who did carry out a first step correctly, some students then made errors in trying to isolate terms in x, obtaining equations such as $3x = 19$.

Question 8

A majority of students were able to score some marks for their responses to this question involving the angles in a non-regular pentagon together with some work on ratio. More able students knew, or could quickly find, the sum of the interior angles of a pentagon and complete their answer to score full marks. Less able students did not know how to find the sum of the interior angles of a polygon and often assumed it was 360°. These students could not be awarded any credit. Students who used a total sum of over 400° could access up to 2 marks for their working if they were able to work with the statement "Angle *BCD* = 2 × angle *ABC*". Few students followed either an algebraic approach or a method involving the sum of the exterior angles of a polygon. Those students who did follow such a strategy were rarely successful.

A fairly common mistake was to split the pentagon into other shapes by drawing lines then make assumptions in order to calculate the size of angles, for example, a line joining vertex *A* to vertex *B* followed by the assumption that this creates two angles of equal size (62.5°) at *A* or that *AE* = *ED* or that *AB* = *BC*. Students are reminded that they should not make assumptions about the size of angles or the lengths of sides where this information is not stated in the question.

Question 9

This question acted as a good discriminator. The most able students were able to provide a correct and complete answer to both parts of the question.

Most students were able to make a start on the evaluation of T for the given values of w and d. Students generally showed a proficiency in being able to use their calculators with numbers in standard form and found a correct value for T. Unfortunately a significant proportion of these students did not give their answer in standard form so scored one of the two marks for their answers. There were some students who did not cube their value of d. Examiners were able to award one mark to students who worked out the correct value of $\sqrt{\frac{w}{d}}$ and gave their answer in standard form.

Part (b) of the question, involving percentage increases in the values of *w* and *d* was found to be more challenging and many students attempted to give an explanation of why Lottie was wrong without sufficient justification. Examiners expected to see either a re-calculation of *T* with increased and correct values of *w* and *d* followed by a comparison with the answer the student gave in part (a) or a full explanation involving a comparison of the effect of the 10% increase in *w* and the 5% increase in *d* on the value of *T*. This may have been demonstrated through a calculation of the total scale factor for the change in value of *T* or by a comparison of the effect of the percentage increases of 10% and 5% on the values of *w* and d^3. Most students who were successful in part (b) took the re-calculation route.

Question 10

The most popular approach to answering this question was by writing down multiples of 20, 45 and 120 to find out how long it would take for the three lamps to flash again at the same time (360 seconds). This approach proved to be successful for many students and where the correct answer was not obtained, at least one mark was usually earned for writing down at least 3 multiples of 45 and 3 multiples of 120. Some students used minutes as their unit of time and found that the three lamps flashed together again after 6 minutes. A minority of students split 20, 45 and 120 into prime factors but often they were unable to proceed any further. These students also earned at least one mark. Some weaker students found the number of times that each lamp flashed in one hour but were unable to make any further progress or score any credit for their attempts. A small number of students did reach the answer "10" from a flawed method. These students, could not be awarded any marks.

Question 11

Reverse percentage problems prove to be straightforward to those students who have a good understanding of the use of a scale factor approach in this topic area. Students who had such an understanding and used the scale factors 1.20 and 0.90 usually solved this problem efficiently and accurately. Those with only a partial grasp of the scale factor approach often used the scale factors 1.20 and 1.10 and, for example, multiplied the value of the house in 2012 (£162,000) by 1.10 to find its value in 2007 instead of the correct method of dividing by 0.9. This incorrect approach could not be given any credit. Weaker students did not use a scale factor approach and merely added 10% onto £162,000 then subtracted 20% off their answer to find a value for the house in 2003.

Question 12

There were many good answers to this question. Most students used the scales correctly to find the gradient of the straight line instead of counting squares though some students gave the gradient as "1.5*x*" or divided the increase in *x* values by the increase in *y* values. Good explanations were often seen in responses to parts (b) and (c) of the question.

Examiners expected to see explanations in context so statements such as "the gradient represents the slope of the line" and "the value of y when $x = 0$" were not acceptable for the award of marks. Instead, in part (b), it was expected that students would describe, in some way, that the gradient represents the rate of flow of liquid into the container. The statement "litres per second" alone was not accepted nor was "as time increases volume increases". A good proportion of the unacceptable answers seen were equivalent to the second of these two statements. In part (c) statements equivalent to "there were 4 litres of liquid in the container at the start" were expected.

Question 13

A small minority of students scored full marks for their responses to this question and when the question was completed correctly, answers were usually accurate and within the range of acceptable values. Some students could write down the ratio of lengths or linear scale factor to score the first available mark but could not make any further progress with the question. Weak students merely worked out $\frac{3}{4}$ of 10 and gave their answer as 7.5 or cubed 3 and 4 to get the ratio of the volumes, thereby failing to realise the need to find the ratio of lengths first. Some very able students worked in exact terms to express the ratio of volumes as $3\sqrt{3}$: 8 before successfully working out the volume of shape A. Students who worked with approximations to scale factors, expressing them in decimal form, usually retained enough accuracy to obtain an answer within the acceptable range of values.

Question 14

Most students scored at least one mark in this question. 480 was the most common answer seen and was awarded one mark for the correct strategy of multiplying 16 by 15 to find the number of matches played then multiplying by 2 as students did not realise that 16×15 would include each team playing two matches against each of the other teams. 120 was also credited with one mark, students giving this answer having divided the correct answer, 240, by 2. Commonly seen incorrect answers which could not be credited with any marks included 32 ($= 16 \times 2$), 256 (16×16) and 512 ($16 \times 16 \times 2$), though some students worked out the correct answer by evaluating $16^2 - 16$.

Question 15

Many students worked out an estimate for the distance the car travelled by splitting the area into 4 trapezia, or a triangle and 3 trapezia. Work seen by these students was generally accurate and acceptable answers in the range 488 to 507 were common. These answers scored the full three marks available for part (a). Another possible route was to use 4 rectangles (or a triangle and 3 rectangles) though this usually lead to a poorer estimate outside the range acceptable for the accuracy mark. A number of students merely multiplied 20 by 35 (= 700). These students were not awarded any marks. Some students who used more than 4 strips gained one mark for showing an appreciation that they needed to work out an estimate for the area under the curve.

Answers to part (b) were often clear and well expressed. The mark was awarded for a clear answer linked to their method for estimating the area in part (a) provided the student had gained at least one mark in part (a). Vague answers such as "an underestimate because of the curve" could not be given the mark. Some students based their answers on the effects of rounding values of the speed rather than comparing the estimates calculated for areas under the curve with exact areas.

Question 16

Relatively few students wrote down two simultaneous equations to solve in the first part of this question. Those who did often proceeded to complete their solution successfully and determine the sixth term of the sequence. A good number of students wrote down at least one equation then got no further. A large number of students wrote down the terms −2 and 12 in the hope of establishing a pattern. Many of these students found the difference between −2 and 12 (14) and gave their sixth term as 26 (12 + 14).

Part (b) was answered successfully by a much greater number of students. Many students followed the strategy of finding second differences apparently realising that second differences all equal to 2 were the key to finding an expression for the *n*th term of the sequence. Most of these students gave an expression which included the term "n^2" but some of them included "$2n^2$". The former usually gained at least one mark for their final answer. A common incorrect answer seen was $n^2 + n$. This scored one mark. Many students gave a fully correct expression and scored two marks.

Question 17

This question was answered well by many students who produced a clearly written and accurate solution. Where students did not score full marks, they often found the length of *BD* successfully by applying the sine rule. Unfortunately a good number of these students then mistakenly used Pythagoras' rule on triangle *ABD*. Students who used the cosine rule for the second stage in finding the length of *AD* sometimes did not process their calculation using the correct order of operations, instead working out $\boldsymbol{AD^2 = (11.4^2 + 7.39^2 - 2 \times 11.4 \times 7.39) \times \cos 86}$. A small proportion of students did not retain enough accuracy in intermediate calculations to obtain a final answer within the acceptable range of values. Some students did not attempt this question.

Question 18

Students often scored well on this question, particularly in part (c) where the application of an iteration was required. There were many good attempts to answer part (a) of the question by substituting both 1 and 2 into one of the expressions $x^3 + x$ or $x^3 + x - 7$ then comparing the results with 7 or 0 respectively to reach the required conclusion. Some students used inequality notation to do this whilst other students gave clear written statements. Either was acceptable to examiners.

Part (b) was usually well answered with the critical stage "$x^3 = 7 - x$" being clearly shown. In part (c) values of x_1, x_2 and x_3 were usually worked out with accuracy and the overwhelming majority of students who attempted this part of the question scored all three marks. Students are advised that they should write down the value of each of x_1, x_2 and x_3 from their calculator and not just the value of x_3. Some students did not restrict their calculations to the values of x_1, x_2 and x_3 and unnecessarily worked out values for x_4, x_5, etc.

Question 19

This question proved to be a good discriminator between more able students sitting this paper and there was a wide spread of marks awarded. Some students did not attempt the question but many students were able to write down tan *e* and tan *f* and equate them to score the first mark. Attempts to deal with the fractions in order to obtain a quadratic equation in *x* to solve varied in success.

Some students did not ensure all the terms of the quadratic equation were taken to one side of the equation before attempting to solve it. Students were split between those who used factorisation and those who used the formula to solve their equation. A substantial number of responses included two answers on the answer line despite the hint ("find the value of *x*") to rule out one of the values as a possible length of a side. The best students produced concise, clear and accurate solutions to this question.

Question 20

There were relatively few fully complete and correct solutions to this question due to most students either making an error when calculating the number of students who only speak Spanish or failing to appreciate the non-replacement nature of the probability calculation. Having said that, many students were able to make a good start on the question and they drew an appropriate Venn diagram to help them. Students using a different approach were seldom successful. Students using a Venn diagram were generally able to place some elements in the Venn diagram correctly though many students interpreted the statement "7 speak German and Spanish" as "7 speak German and Spanish but not French".

This meant that further calculations would inevitably result in incorrect values placed in the diagram. Where a value 0 is found, in this case the number of students who speak only German, students are advised to write this on the Venn diagram rather than leaving a blank space. Students who did not get a correct value for the number of students who only speak Spanish could still access a mark for a correct probability calculation using their value.

Question 21

This, the last question on the paper targeted the most able students sitting the examination. A complete and well reasoned proof that the two triangles are congruent was required to gain full credit in part (a) of the question. Many students showed some understanding of what they needed to do and they often scored the mark for pairing up angle *ADP* with angle *QBC* and giving justification that they are both 90° or that it was "given" that they are equal. Statements relating to the pair of sides *AD* and *BC* or the pair of angles *DAB* and *BCQ* were much less convincing so students more often scored one mark rather than the two marks possible for the complete identification of all three aspects with reasons. Reasons were often incomplete or poorly expressed. For example "*AD* = *BC* because they are parallel" was just one response which was seen quite often and could not be accepted. Some students mistakenly argued the case for a proof involving SAS rather than ASA. A logical progression of statements needed in part (b) to explain why *AQ* is parallel to *PC* was only rarely seen. Few students used the congruency of the triangles *ADP* and *CBQ* to start their explanation. Instead they often stated that *APCQ* was a parallelogram without any or without sufficient justification.

Summary

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

- practise writing clear explanations, bearing in mind exactly what is asked in the question and what evidence you should give to support your answer.
- learn standard techniques involving the use of scale factors in the context of similar shapes.
- practise expanding brackets and collecting terms especially where negative signs are involved.
- carry out a common sense check on the answers to calculations, so for example you should expect the number of red counters in question 6a to be a whole number.
- carry out a check of your solution(s) for an equation by substituting them back into the equation.
- practise solving equations involving algebraic fractions, eg question 7 and question 19 in this paper.

Grade Boundaries

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