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Examiners' Report
Principal Examiner Feedback

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Paper 1HR

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Students who were well prepared for this paper were able to make a good attempt at all questions.

Students were less successful in showing algebraic proof and being able to do differentiation in the context of a problem.

On the whole, working was shown and usually easy to follow. There were some instances where students failed to read the question properly, for example, in question 11 some students did not realise that they had to recall the area of sector of a circle formula but recalled the formula for an arc length.

Finding probabilities in a context, using a histogram, bounds and vectors seemed to be weaknesses for many students. Reverse percentage in a context, in an early question, also caused difficulty for less able students.

Generally, problem solving and questions assessing mathematical reasoning were tackled well.

Question 1

(a) Many students found this to be straightforward. Common errors included a confusion between the signs $\leq$ and $<$. Some students scored 1 mark because they omitted one of the values required or they included one extra value.

(b) There were a number of correct answers and many that scored 1 mark. A common mistake was for students to draw an open circle at 1 and then a line with an arrow in the wrong direction. Another common error was to draw two circles, often the second was at $x = -3$. Students should be encouraged to put an arrowhead on the line since some students lost the mark since an indication that the line needs to go to at least to −3 is necessary.

Question 2

The majority of students got this question correct, although there were some, who knowing it was a probability question, thought the answer should be less than one and so wrote down 0.195 or as $\frac{195}{300}$ as the answer. Others did not know what to do and wrote $(300 \times 0.65) \div 100$. Students should be made fully aware that it is foolhardy to just write down an answer without working, as showing their method can gain method marks even though their answer may be incorrect.

Question 3

This was a straightforward embedded Pythagoras question which the majority answered well. While some students appreciated the need to square the given values and then subtract, some squared the values and added them, denying them any marks. It is surprising to see a number of students simply used the given values in a variety of ways, for example adding the lengths or doubling them or multiplying them, strategies that clearly led nowhere. A few attempted to use trigonometry to find an angle, but then did nothing beyond this, and, somewhat inevitably, their efforts did not lead to any degree of success. Some students did not work out the missing length of 12.8 – 9.6 to find the correct value of the perimeter thus losing 2 marks. A common mistake at this point was to subtract the 9.6 from 16

Question 4

This whole question was very well answered by the vast majority of students.

(a) Most students calculated the correct missing values; only a few weaker students got 7 instead of 15 for y when $x = -2$. Substitution of the negative x value was the usual cause of error.

(b) The majority of students were able to plot the points they had created from the table. Most likely errors were those that included a zero value. Some students did not plot any points at all. There was obviously a lack of understanding about the shape of a quadratic graph, as those who plotted the correct points sometimes failed to join the points at all, or joined them with straight lines, some failed to go beneath the x axis at the bottom of the curve. If those students who miscalculated the first point had recognised that their graph was incorrect for a quadratic function, they would have been able to correct their error.

Often students joined their points together with line segments as well as curved sections. Students do need to take more care to ensure their curve passes through the plotted points more accurately.

Question 5

The marks were well spread out in this question with few failing to score at all. Those who adopted a systematic approach usually found the three correct numbers. Trial and improvement was more likely to score one or two marks. Some students felt that they could manipulate 74 to be the median by putting it in the middle of their list, regardless of the order of the numbers. Similarly, the range was sometimes taken to be the difference between the first and last numbers instead of the lowest and highest values. A common error was to find the highest value as 84 and then work out 84 – 16 to find 68 as the lowest value. There were a few instances where an attempt was made to involve the mean, usually in place of the median.

Question 6

(a) A range of approaches was used to find the LCM. Expressing the LCM as $2^3 \times 3^2 \times 5$ or using lists of multiples were the usually seen methods but LCM = $\frac{36 \times 120}{\text{HCF}}$ was also seen occasionally. Several incorrect products were used to find the LCM, including $2 \times 3^3 \times 5^2$, $2 \times 3^2 \times 5^2$, $2 \times 3^3 \times 5^3$ and $3^2 \times 5^2$. Some students confused LCM with HCF and gave an answer of 12 but frequently gained the first mark as they correctly listed the prime factors of 36 and 120.

(b) Most students realised their answer needed to be in the form $5^a \times 7^b \times 11^c$, although a few wrote the sum rather than the product! Some tried to use some form of a diagram but this did not always lead to a correct answer. Others wrote the correct answer but then wrote 660 275 on the answer line, however, they were not penalised for doing this. In general, the values of a, b and c tended to be correct in their answer. Some students found the LCM rather than the HCF.

Question 7

This question was well attempted and many students gained full marks. Some students failed to realise the significance of the different speeds and the need to calculate the time of the journey first. The most common error made in this question was by those students who assumed that average speed was found by finding the mean of the three speeds and then calculated, unnecessarily, the speed from Anesey to Breigh. Conversion between hours and minutes was poor at times; often 50 minutes was written as 0.8 hours. Many students found the correct time taken from Breigh to Clando in hours and a few used 3.15 as their time. Some students worked out the distance from Clando to Duckbridge but instead of using $\frac{5}{6}$ they used 0.8 thus losing the method mark unless $\frac{5}{6} = 0.8$ was written down. Students are encouraged not to use decimals as frequently they will lose the accuracy marks. Centres should remind students that if they do work in decimals, to use a minimum of 2 decimal places and preferably more.

Question 8

Parts (a) and (b) were fairly well answered being based essentially on knowledge.

(c) This part of the question was challenging to some students as they could not use a calculator to work out the final answer. Many students obtained full marks. Some common incorrect answers were 2.5^{-188} or 2.5×10^{188}.

Question 9

(a) Almost all students gave the correct response to $x^4 \times x^5$.

(b) Majority of the students gained full marks. Students were being tested on the use of the power laws $(ab)^n = a^n b^n$ or alternatively the use of $(4y^2)^3 = 4y^2 \times 4y^2 \times 4y^2$ followed by the application of a simpler rule. Common incorrect answers were to write down $12y^6$ or $4y^6$ where the power of y had been treated correctly, this was awarded 1 mark.

(c) Many incorrect solutions were seen and the main incorrect answer was to write the signs the wrong way round in the brackets e.g. $(n – 4)(n + 3)$ or $(n + 4)(n – 3)$ or $(n + 4)(n + 3)$; 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 $n(n – 7) + 12$ 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.

Question 10

This question was a challenge to some students. Those who read the question carefully and understood what was required tended to gain full marks by showing that Jonty was right by correctly finding £196. Some students found the area of all the **six** sides, it was clearly written in the question that ‘to cover the four sides and the top’. A few students calculated volume rather than surface area. Some students could not use reverse percentages to find the cost of the paint prior to the 10% increase in price. Often students worked out 117 and then divided by 15 to find 7.8 but did not round up their answer, incorrectly calculating 7.8 × 24.50, to find the total cost of the paint. Students need to be reminded that when answering practical questions of this nature to work in realistic numbers, in this case whole tins of paint. It was encouraging to see many students clearly writing their method.

Question 11

Students who recalled the formula of area of sector of a circle tended to gain full marks. Some of the errors included using 14.2 cm as the radius rather than 7.1 cm and using the formula for the circumference rather than the area of a circle. A common error was to divide the total circle area by the angle 110 rather than multiplying by $\frac{110}{360}$. Students tended to earn either no marks or full marks. Of those using the area formula correctly, a significant number failed to attempt any division, giving their answer as 158.(...), so failed to gain any credit.

Question 12

(a) Students usually scored well on this part of the 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 all three brackets together at once, which always led to an incorrect response as they could not keep track of all the multiplications necessary. Common misconceptions were errors in signs once the negative bracket was used, or when collecting the like terms such as $+5n – 12n$ giving $17n$ or $7n$ whilst other students made arithmetical errors with multiplying simple values like $–4 × 5$ and writing –9 or 9 as their answer. Missing brackets after achieving $n^2 - 4n$ frequently led to loss of marks.

(b) Many students found this part of the question difficult. Most understood a common denominator was required and attempted to find one. It was only the more able who were able to show any understanding of what was needed. The *three* denominators caused problems for students who knew how to manipulate fractions. A number of students added all three denominators, which was unfortunate. Overall, few made progress with this question. There was clear evidence of incorrect cancelling throughout. This was also seen at the conclusion, following the correct answer, in which case the candidate could not be awarded the final accuracy mark.

Question 13

(a) The majority of students were able to correctly complete the probabilities on the tree diagram. Some gave numbers rather than probabilities.

(b) This part was usually done well, sometimes taking advantage of the follow through from the tree diagram for M1. Those who used decimal probabilities usually lost accuracy. Just a few students added probabilities.

(c) Many students found this part of the question challenging. The more able students set up a correct equation $2\times\frac{7}{12}\times\frac{5}{12}\times\frac{x}{15}=\frac{7}{24}$ and correctly solved for x or for their variable. A common error was to write $\frac{7}{12}\times\frac{5}{12}\times\frac{x}{15}=\frac{7}{24}$ and obtain an answer of 18, not realising that there are 2 combinations (GRB and RGB).

Question 14

It was evident that some students did not understand the three letter angle notation. A number of students arrived at the correct answer for angle *ADB* which had clearly come from incorrect working and consequently scored no marks. Some students incorrectly marked angle *ABD* as 55° with some quoting 'base angles of an isosceles triangle are the same'; which was incorrect. When answering questions such as this, students would be well advised to either mark found angles on the diagram or refer to found angles unambiguously in the working space using three-letter angle notation. Angles of 55, 90, 35 were frequently seen on the diagram, but not always in the right place. Even where the angles were stated in the students' working, they were often not clearly labelled. Other incorrect methods assumed that the opposite angles of a cyclic quadrilateral are equal and that triangles *ABD* and *ABC* were similar.

Students should give reasons at each stage of the working. It was disappointing to see students only give 2 reasons rather than the 3 required to gain full marks. Students are encouraged to look at mark schemes for the correct words needed to gain marks when giving reasons. Many students confuse sector and segment.

Question 15

Many students failed to realise an algebraic proof was needed here and just used values in an attempt at a proof. Students who knew how to define 3 consecutive numbers tended to gain full marks. Some students wrote down 3 consecutive odd numbers or even numbers.

If an attempt at an algebraic proof was made students often got full marks, although a number lost the final mark by failing to state that two expressions they found had a difference of 2. Some mistakes were made by not reading the question properly, for example, failing to multiply $(n + 1)^2$ by 2, thus losing the second mark.

In this question incorrect algebra was penalised.

Question 16

This was answered well by the more able students. The students who worked out the sum of the first 100 terms gained the first mark. A common error was to subtract the sum of the first 41 terms (3321) from the sum of the first 100 terms (19 900) thus achieving the first 2 marks. However, the students should have worked out the sum of the first 40 terms (3160) and then subtracted this value from 19 900 to obtain the correct answer. There ought to be classroom discussion about the use of the word inclusive.

Some students listed all the numbers from 161 up to 397 but had no idea what to do next, so only gained 1 mark.

Credit must be given to some students who worked out the difference between the sum of the first 100 terms and the sum of the first 41 terms and then went on to add the 40^{th} term (397) gaining the correct answer of 16 740. Several students found 161 and 397 but used 59 rather than 60 as the number of terms in the formula for the required sum.

Question 17

Many students found this question difficult. The errors were diverse suggesting that most students did not have a working knowledge of set theory. Many students presented a list of numbers, again suggesting that they did not understand what was being asked.

Question 18

Students found this question challenging as the surface area and the volume were written in ratio form. Some students realised that they had to square root the ratio 4 : 9 to find 2 : 3 as the scale factor and cube root the ratio 125 : 343 to find 5 : 7 as the scale factor, thus gaining 2 marks. Often students who found the linear scale did not know how to progress to find the ratio of the height of A to the height of C. Frequently students did not know how to combine the ratios 2 : 3 and 5 : 7 as a single ratio. Some left theirs answers as 10 : 15 : 21 rather than 10 : 21 thus losing the final mark for accuracy. Many students' working was muddled in this question with false starts and reworking appearing without explanation.

Question 19

(a) Students who knew the correct index rules gave a correct answer of $-\frac{4}{3}$.

(b) This part of the question was poorly attempted. The majority of students could not factorise before completing the square and the manipulation of algebra was very poor. Some students who factorised correctly lost marks due to missing brackets when attempting to complete the square, for example, $3(x + 2)^2 – 16 + 9$, $3(x + 4)^2$ … and to a lesser extent $4(x + 12)^2$ were quite common. Generally, this part of the question was left unattempted by many.

Question 20

(a)(i) Some of students realised that the transformation represented a translation of $\begin{pmatrix} 0 \\ 5 \end{pmatrix}$ and gave the correct coordinates. Many students left this question blank failing to understand transformations at the higher end.

(a)(ii) This proved to be more discriminating and few students realised that the transformation was a stretch in the *x* direction. Again, there were many blank scripts.

(b) Many students did not identify that the transformation was a stretch in the *y* direction. Only the more able students gained the 2 marks. There were many incorrect diagrams drawn. Although some students were able to score B1 for a V shape with a least value at (3, –2).

(c) The majority of students found this question difficult and could not find the two values of *a*.

Generally, the topic of transformations is not answered well.

Question 21

Many correct answers were seen from those students who appreciated that the area of each bar is proportional to the frequency in histograms. Most students made some attempt at answering the question and produced a mass of figures but, it was not always clear as to what the figures represented; it is incumbent on the student to ensure that they make their method of solution clear.

Several students used the vertical scale as a frequency scale thereby ignoring the column width, this often led to the incorrect answer of 56 being seen, and hence students were unable to earn any credit.

Question 22

Combining the sine rule with error bounds confused many students. It was common to see them concentrating on the sine rule, using the given values, and then attempting to give an upper bound for their answer. Students should be encouraged when answering these questions to list the appropriate upper and lower bounds before starting to solve the problem. This will usually enable then to gain the first B mark even if they can progress no further. Many students gained one mark for correctly identifying a correct value for a bound. Those students who understood what was required often failed to find the correct value for angle *ABC* and hence failed to gain the last two marks. Those that were able to work with limits often failed to understand which bounds to use in the calculation to give the upper bound for *b*, due to the rearrangement of the Sine Rule. Again, this is a topic which is not answered well.

Question 23

It is pleasing to see the improvement in responses on differentiation and it was encouraging to see some students able to score at least one mark. The more able students mostly gained 5 marks as they tended not to give the answers in the form of the required inequalities. Many students did not know the relationship between displacement and velocity and so didn't link the question with differentiation. Some students differentiated the two given expressions and then equated them with each other. A number of students did a second differentiation for the section *PQ* (thus finding the acceleration) and equated this to 0 giving $t = \frac{4}{3}$.

In general, a clearer understanding of the links between displacement and velocity is needed.

Question 24

The first mark for this vector question was relatively accessible many. This mark was awarded for finding $(\overrightarrow{ON} =)\lambda(\mathbf{a}+\mathbf{b})(= \lambda\mathbf{a}+\lambda\mathbf{b})$ but very few students were then able to show the full process to find the value of $\lambda = \frac{3}{7}$. 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.

Summary

Based on their performance in this paper, students should:

- be able to interpret error bounds

- 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 answer.

- Students must, when asked, show their working or risk gaining no marks despite correct answers

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