Examiners' Report

Principal Examiner Feedback

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In Mathematics B (4MB1)

Paper 02R

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Introduction

In general, this paper was well answered by the overwhelming majority of students. Some parts of questions did prove to be quite challenging to a few students and centres would be well advised to focus some time on these areas when preparing for a future examination.

In particular, to enhance performance, centres should focus their student's attention on the following topics:

- Showing clear working particularly when it is requested in the question
- Percentage profit and reverse percentage questions
- Perimeter of compound shapes
- Solving simultaneous equations graphically
- Rules of indices
- Finding tangent to curves using differnetiation

In general, students should be encouraged to identify the number of marks available for each part of a question and allocate a proportionate amount of time to each part of the question. In addition, students should also be advised to read the demands of the question very carefully before attempting to answer. It should be pointed out that the methods identified within this report and on the mark scheme may not be the only legitimate methods for correctly solving the questions. Alternative methods, whilst not explicitly identified, earn the equivalent marks unless explicitly stated otherwise. Some students use methods which are beyond the scope of the syllabus and, where used correctly, the corresponding marks are given.

Report on Individual Questions

Question 1

An accessible question which provided a good start for most candidates. The majority of candidates gained full marks on this question with the majority of those failing to gain full marks losing only one or two marks, most usually on part (b).
Part (a) this was generally well answered but a number of candidates did not us the correct formula for percentage profit dividing by the sale price rather than the cost price.
Part (b) caused the most issues. A number of candidates clearly do not understand reverse percentage calculations and either reduced $ 203 by 16% or in a few cases even increased $203 by 16%. These candidates gained no marks for this part of the question.
Part (c) was generally answered well but their were two common issues seen. Firstly converting the time 12 hours and 48 minutes into a form usable for the question, 12.8 hour being the usual one seen, proved beyond some candidates. Secondly a number of candidates erroneously used speed / time to find distance .

Part (d) was generally very well answered. The most common errors seen were purely numerical with a correct calculation seen in the working.

Question 2

Another accessible question where the majority of candidates gained 6 or 7 of the 7 marks available. Candidates generally were more successful with the earlier parts of this question.
Part (a) and (b) generally well answered although a small number of candidates answer part (b) as 8.3×10^4
Part (c) was also generally well answered although a few candidates made error adjusting their answer from 0.5×10^{25} or failed to proceed from this point and so only gained 1 mark. A small number gave an answer of 2×10^{25} presumably transposing the 3 and 6 when dividing, this failed to gain any marks.
Part (d) was unusual and so caused candidates more of a problem. Many candidates realised that the 1.6 would lead to 16 giving 2^4 thus gaining some marks even if they were not able to gain full marks. It was pleasing to see how many candidates gained full marks for this question.

Question 3

Another accessible question with the majority of candidates gaining full marks. Most candidates managed to find the height of the cone with no issues. A number of candidates then failed to appreciate the difference between the height and the slant height and so gained no more marks. Candidates who did realise their was a difference generally had no problem calculating the slant height. A small number of candidates who proceeded this far failed to gain full marks as they did not include the flat bottom of the cone when calculating the surface area, it is crucial that candidates read questions carefully to ensure they find what is required in the demand. It was pleasing to note that few candidates had problems dealing with the volume and surface area in terms of pi.

Question 4

Another accessible question where the majority of candidates gained at least 7 of the 10 marks available. Mistakes were seen across all parts of this question.
Part (a) surprisingly some candidates failed to state this was an enlargement but still gave a scale factor. This did allow candidates to gain a mark. We also allowed candidates who stated 2 transformations to pick up the mark for the scale factor as well. As is usually the case in a question of this nature the final mark for the centre of enlargement was awarded less often with many candidates failing to state any centre.
Part (b) most candidates managed to gain full marks here. A small number either failed to make the correct translation, usually going in the wrong direction on either the vertical or horizontal aspect of the translation.
Part (c) caused a few candidates issues. The most common errors seen were either rotating about an incorrect centre or rotating by 90° anticlockwise.
Part (d) was the part of the question which caused the most issues. A number of candidates failed to multiple in the correct order attempting to place the transformation matrix second within an expression. This led to incorrect results.

Question 5

Both parts of this question acted independently and both were well answered with the majority of candidates gaining full marks.
Part(a) saw the majority of candidates finding the height of the prism correctly with only a few errors seen, usually adding the two squares within their attempt at Pythagoras' theorem. Candidates who gained the height correctly then often went on to find the correct volume, although a few did omit the $\frac{1}{2}$ from the formula finding double the volume required.
Part (b) proved to be a little more challenging. A small number of candidates tried to use the triangle QRT to find QR, often incorrectly assuming that QTR was a right angle. This was not a viable methodology and gained no marks. Candidates using triangle PQT to find QT and PT generally managed this, a few did use more complex methods, such as the sine rule than the expected right angled trigonometry. Most candidates who found QT and PT correctly then went on to gain the correct answer. However a few candidates either found the area of PQT or found the perimeter of rectangle PQRS and triangle PQT separately and then subtracted the results. The first would be easily combated by candidates checking the demand of the question carefully. The second shows a fundamental misunderstanding of perimeter.

Question 6

Another accessible question that allowed the vast majority of candidates to gain some marks. All parts of the question relied on the first part but the majority of marks allowed for candidates to follow on from an incorrect tree diagram, although correct working following an incorrect diagram was rarely seen.
Part (a) was generally well answered. Where errors were seen they were generally caused by candidates attempting something that looked like selection without replacement, given that 2 separate containers with different numbers of buttons was used this is clearly inappropriate for this question.
Part (b) was also generally well answered. The most common issue was candidates finding the probability of selecting exactly one white button rather than at least one white button. This gained these candidates one mark. In some cases these candidates then managed to gain full marks on the final, more complex part of the question suggesting a misreading of the demand.
Part (c) a number of candidates showed some additional working on the tree diagram to assist with this part of the question. This was perfectly reasonable and may well have helped some candidates gain some marks. In order to gain any marks at least one correct product of three probabilities was required. Most candidates who managed this then also managed to gain the next two marks for finding the sum of all three correct products and equating this to the given probability. A number of candidates then made errors in solving the resulting equation but this only cost them the final mark.

Question 7

A functions question which discriminated well allowing candidates to show which aspects of this topic they understood.
Part (a) tested understanding of the domain of the function, most candidates answered this well.
Part (b) tested the ability to solve an equation using a function. Most candidates answered this well with a small number misinterpreting this as a substitution into a function.
Part (c) tested substitution of a number into a function. This was answered well, even by those who

had misinterpreted the previous part of the question.
Part (d) proved to be much more demanding than the other parts of this question. The inverse of a quadratic function requires either that candidates complete the square and operate on the equation in that form or use the quadratic formula to solve for one variable where the constant coefficient is in terms of the other variable. Both of these techniques require high levels of algebraic skills and it was pleasing to see the proficiency many candidates managed to demonstrate here. One point which did cause some candidates to lose the final mark was the principle that a function or its inverse should be one-to-one and so when the square root was taken only the positive part should be retained.

Question 8

Another accessible question, this time testing graph drawing and use.
Part (a) was well answered with the vast majority of candidates gaining full marks for this part.
Part (b) showed that most candidates have good graph drawing skills with many candidates gaining full marks. The most commonly seen issues were with candidates plotting the final point incorrectly as it was not at the far right of the graph or candidates plotting points at coordinates with the wrong sign.
Part (c) this proved to be the most demanding part of this question. Often candidates need to find an equation of a line to plot but in this instance this was given so this was still more accessible than this type of question often is. This did allow many candidates to gain marks on this part. Unfortunately a number of candidates gave fully correct answers with no visible working or which did not follow from their graph, occasionally to a degree of accuracy not achievable by reading off the graph. This suggests candidates using calculator technology to solve the cubic equation. Candidates need to be aware that when a graphical method is required candidates who give answers which could not come from their graph will gain no credit for their answer.

Question 9

Another accessible question which allowed candidates to demonstrate their understanding of inequalities well.
Part (a) was generally well answered although a number of candidates either failed to attempt the second part of showing the inequality on a number line or failed to gain the mark for this. When showing an unbounded inequality on a number line it would be helpful for candidates to remember that the standard convention is to show an arrow in the direction that the inequality would go beyond the diagram. Otherwise a line will be expected to be seen beyond the end of the marked scale.
Part (b) proved more demanding. A significant number of candidates found the critical values for the quadratic with no problems but then failed to deal with the inequality aspect correctly. This is a fairly standard technique which it would benefit candidates to practice. The second part of (b) was often well attempted with many candidates realising they needed to combine their results from the two inequalities. A small number of candidates however attempted to treat this as a simultaneous equation which both failed to gain the mark available and wasted considerable time.

Question 10

Both parts of this question did work independently but those who performed well on one part also tended to do well on the other part.

Part (a) often showed candidates gaining the correct answer or $2\sqrt{10}$ however some did not gain full marks even if they gained the correct answer. It is essential that candidates show full working in a question such as this as many calculators would give an answer of $2\sqrt{10}$ if the given expression were typed in. The expected route was for candidates to express $\sqrt{98}$ and $\sqrt{18}$ in terms of $\sqrt{2}$ then to combine these and rationalise the denominator. Of course equivalent working would be acceptable but sufficient evidence that these have been carried out without a calculator need to be seen.

Part (b) required candidates to express several separate parts as powers of 3 then combine them together. Again candidates could combine parts first but would need to show sufficient working to gain full marks. In this part most candidates performed well but of those who had problems more often had issues with combining the indices than in expressing the parts as powers of 3.

Question 11

Again both parts of this question performed independently of each other and it was notable that a number of candidates failed to gain any marks on this question.

Part (a) was a simultaneous linear and quadratic equation. Many candidates did seem to know the technique required but lost marks for a variety of reasons. The quadratic equation gained did factorise but was not trivial which caused some issues. Also a number of candidates failed to take note of the requirement to show clear algebraic working and so were penalised if they failed to show their method for solving their quadratic. A small number of candidates also lost the final mark as they found both x values but failed to find the y values or used the quadratic and gave at least one of the wrong y values from those found.

Part (b) required the candidate to find a tangent to a curve. Given this it was surprising to see that some candidates failed to attempt to differentiate the equation of the curve, this should have been a very accessible mark. The candidate then needed to find the intercepts of the axes and then find the mid-point. Those who had equations of line generally had no problems finding the intercepts but some did not have a good technique to find a mid-point and were attempting much more complex methodologies based on use of Pythagoras' theorem to find distance.

Question 12

The final question of the paper proved to be a challenge for many candidates and many blank responses were seen. Part (a) and (b) tended to work fairly independently of each other despite the fact that the length of an edge found in (a) was needed in (b) most of the marks did not require that this was a correct length. Part (a) was completed with considerably more success than part (b)

Part (a) required candidates to use the area of the hexagon to find the length of the hexagon. Apart from memorising the formula for a regular hexagon, which a few candidates clearly had the most straightforward way to manage this was to consider an equilateral triangle being $\frac{1}{6}$ of the total area and use this to find the length of an edge. This was often seen but almost as frequently were more complex schemes such as considering trapezia or a rectangle and two triangles. Most candidates who had a viable methodology managed to gain the correct method here.

Part (b) generally required candidates to calculate several lengths and angles and often it was difficult to award marks as many candidates did not clearly state what they were finding. Probably the simplest methodology was to find the total vertical displacement of F from K and the total horizontal displacement of F from K but methods involving the triangles AFK, BFM and FGK were all seen carried through successfully by candidates. In any case the first mark was for finding an internal or external angle of one of the polygons which would be required for any of these methods. This was a relatively easy mark which many candidates gained as their only mark in this part.

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