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Examiners' Report
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Question 1
Many candidates understood how to answer this question, using the cosine rule to find one of the angles. However, a surprising minority, given this is pre-knowledge from GCSE, found the demand of problem solving here difficult.

Common errors included, treating the triangle as isosceles, splitting it into two right-angled triangles and using the wrong formula for area and even assuming one of the angles to be a right angle and incorrectly using Pythagoras.

Those candidates making progress, generally understood how to use the cosine rule to find an angle, though there were occasional errors in rearrangement seen. Failing to square the expressions correctly, was another error seen with some frequency. Some candidates forgot to root their final value. Where candidates worked with the relevant trig identity, to find the exact value of sine(angle) to make further progress, they were generally successful.

The use of Heron's formula was seldom seen. Those who did use it, generally used it correctly.

Question 2
Part (a) – Many candidates correctly found the values of the constants *A*, *B* and *C*, by completing the square. Much less frequently, candidates equated coefficients. The value of *A* was correctly found by nearly all candidates and any errors were usually seen in finding *B* or *C*.

Part (b) – This part of the question allowed follow through marks for any errors from (a), which helped some candidates gain marks. Many candidates knew how to find the value of *x* for which there was a maximum value of $\frac{1}{f(x)}$. A very small number were generally successful in using differentiation. There were less correct answers to part (ii).

There were a small number of candidates who wrote the answers to (i) and (ii) in the wrong order or labelling was ambiguous, for which they gained no marks, despite a candidate focused approach to this in the mark scheme.

Question 3
Part (a) – An overwhelming majority of candidates made good progress, successfully identifying the series as arithmetic, with most finding the first term and common difference and using this in the formula for the sum to n terms. Fewer candidates used the first and last term to substitute into the alternative formula for the sum to n terms. Very occasionally, arithmetic or sign errors were observed. As this was a 'show' question, candidates could be encouraged to state the values of the first term and common difference, before using them, which a few candidates didn't. Occasionally, use of a formula for a geometric series was seen.

Part (b) – The responses to this part were more varied. Many candidates realised the need to subtract the sum of 30 terms from the sum of 60. In some cases, sum(60) - sum(31) was seen, though some credit was given in the mark scheme for this. A small group ignored the answer to (a) and tried to work from first principles again, often with one or two errors along the way. Centres could encourage candidates to look for links between the parts in a question.

Part (c) – was largely well completed, even by those unable to complete earlier parts of the question. Setting up and solving a quadratic seemed secure for most candidates. Most rearranged and solved correctly, rejecting as required, the inappropriate negative solution. It is worth noting, as in previous series, that use of a calculator to find solutions when a rearrangement has led to an incorrect quadratic, loses a method mark that candidates could gain. Though many candidates now show their working, this is still an area that centres could work on to encourage full method to be shown, with use of a calculator for back up.

Question 4

This was a question answered either very well or not at all well.

There were a significant number of candidates who failed to identify $\frac{dr}{dt} = \frac{5}{12}$, trying to use the value as the radius and put it into the formula for volume. Some candidates stated $50\pi = 8\pi r$, solved to find r and substituted this value into the formula for volume. A significant number of candidates tried to create a chain rule which included the rate of change of volume with respect to time. This almost universally led to incorrect calculations being carried out. Some candidates attempted to find $\frac{dV}{dt}$ rather than the volume.

Those candidates gaining the first 3 B marks often continued to present a fully correct solution. Very few candidates didn't write the final answer in exact form – most giving it as 4500π.

Question 5

Part (a) – This was answered well by most, although many candidates did not find the constant of integration. As this was a 0 constant, the MS allowed full marks.

Part (b) – Some candidates did not integrate and solved an equation by placing the expression for the acceleration equal to 0, so the most common wrong answer given was $\frac{4}{3}$. Many candidates gained full marks here.

Part (c) – Almost all candidates gained the 1st mark by integrating their expression for the velocity. A significant number of candidates did not calculate the constant of integration, which cost them further marks. Some candidates gave the constant of integration as 10 rather than negative – 10.

The final mark wasn't always given as a significant minority of candidates removed the negative sign to give a distance rather than a displacement.

Question 6
Part (a) – Only 2 marks but often incredible amounts of work was seen, before reaching the correct values, with a significant minority of candidates getting incorrect values. Centres could emphasise the use of the formula for splitting a line in a given ratio.

Part (b) – Most candidates responded well to this. It is worth centres reminding candidates that the method shown in the mark scheme attracts method marks more quickly than use of $y = mx + c$

Part (c) – $x = 17$ was found by most candidates and a majority found the correct value for *CD* or at least gained a mark for the correct method to find *CD* if their values of *p* and *q* were incorrect.

Part (d) – A variety of methods were used here. Whichever scheme was applied, the third mark was usually gained first and often taken from a previous part of the question where the equation wasn't required, though it had to be used or appear in this part to gain credit. The method in the main scheme was used by many students. If m was found it was unusual for n to be incorrect. Few candidates used Alt 1 or Alt 2, the preferred methods being the main scheme and Alt 3 (even though this remains not part of the specification).

Although a significant number of candidates did not make much progress, of those that did, many candidates set out their work well. Alt 3 caused some problems in that if the array was used in a different direction for the calculation of the determinant, the result wasn't the positive value of *m*. In the use of the main scheme, some candidates used the incorrect right-angled triangle.

Question 7
Part (a) – This was answered almost universally very well, with most candidates substituting into the given equation successfully.

Part (b) – A very small number of candidates did not realise differentiation was required. However, those that did were generally able to do so correctly, leading to many successful solutions. Centres could remind candidates that the nature of 'show' questions is that enough work must be shown for the solution to gain full credit. And again, that the use of $y = mx + c$ gains method marks more slowly and is more prone to errors being made than the use of the technique shown in the mark scheme.

Part (c) – Many candidates found this challenging and there were very few completely correct solutions. The mathematical skills required (integration, substitution and evaluating the area of a triangle) were not the issue (excepting inevitable errors occurring in an exam situation). What was lacking was a clear vision of how to construct the desired area and determine relevant limits.

The approaches to answering the question were very varied, with some candidates deciding to integrate the line – curve and others the curve –line. Others only integrated the line or the curve, so there was confusion as to the required area. Relatively few candidates used the area of a triangle to find the area under the line, often choosing to integrate instead. Similarly, though this wasn't required to gain marks, very few used the diagram provided to help them to construct their strategy for finding the required area.

Candidates often incorrectly used limits of 0 and 1. Many students used the same limits for both the line and the curve, namely 1 and 4.

Question 8

Part (a) – Most candidates formed the correct equations and correctly derived the given answer of $r = \frac{1}{4}$. Some proofs were long, while others were brief but showed the essential steps. There were some unusual starting equations, often using the sum to *n* terms, rather than individual terms, which led to more complex solutions than required. Centres could emphasise the use of creative techniques to solve simultaneous equations.

Part (b) – This was generally answered well and most candidates gained both marks.

Part (c) – This was also generally answered well, although some candidates wrote their answer as a decimal without showing the exact answer. Answers which didn't indicate a recurring decimal with crude rounding, lost the accuracy mark.

Part (d) – Many candidates correctly used the sum to n terms and began with the correct inequality. Such candidates often made progress to gain the second, fairly relaxed mark, for the inequality (or equation allowed) in $\left(\frac{1}{4}\right)^n$. When incorrect algebra was seen, this was most frequently arriving at an inequality involving 80^n. Further progression required the use of logs.

Throughout their solutions, many candidates were unsure about the use of equals or inequality signs, often using a mix of both and did not know when reversal of the inequality sign was required. A significant number of candidates arrived at the correct answer of $n = 7$ and a fully correct answer condoned poor use of inequality signs in a solution. With an incorrect final answer, this could only be condoned for the first 2 marks and is where many candidates lost the third mark.

Question 9

Part (a) - This was answered well, with many candidates achieving the correct answer by undoing the given log equation.

Part (b) – Many candidates struggled to show the given result. Almost all candidates were able to demonstrate an understanding of change of base of log and gain the first mark. Most were able to demonstrate sufficient knowledge of log rules to gain one or both of the next 2 marks. But relatively few candidates were able to demonstrate the necessary rigour to reach the result and gain all 4 marks.

If candidates failed to recognise the importance of converting expressions to $\log_2$ and instead changed logs to number form, they struggled to continue to make further progress. A relative minority of these candidates did, for example, change – 3 back to – 3 $\log_2 2$ and continued from there to gain full marks. There were many who got to $\log_2 x^{3x} - 3 + 9x - \log_2 x$ and made no further progress.

There were many examples where students showed an understanding of one of the logarithm laws only once. Candidates could be encouraged to take time to plan through their answers for such questions before writing to minimise unnecessary lines of working and focus their time more efficiently. Successful candidates often completed one set of log manipulations at a time and used the given result, from the beginning, to understand what their next manipulation might be.

Those who tried to do manipulate using the power rule and the addition/subtraction rule simultaneously, often ended up with incorrect work. There was a significant minority of candidates who didn't convert to base 2 and instead, tried converting to base 16.

There were some successful attempts to work on both sides and this was often well presented. Unusually, a concession was made to allow a fully correct solution completed this way to gain full credit. This will not generally be a feature of this specification.

Part (c) – Candidates often scored well but a significant number failed to get two answers and missed out on full marks. They were able to get either $\frac{1}{3}$ or $\frac{1}{8}$ but not both.

Question 10

Part (a) – Many responses had correct values for *a* and *b*. Problems occurred when candidates' algebraic manipulation was poor or through conceptual misunderstanding of an asymptote. If *a* or *b* were incorrect, candidates often continued to use the values correctly in methods later in the question.

Part (b) – Responses to this part were very mixed. The most common error was sketching a positive, rather than negative reciprocal curve. Sometimes, asymptote(s) were shown but no curve present. Asymptotes were sometimes drawn as $y = 4$ or with $y = -4$ as the vertical and $x = 3$ as the horizontal, which then gave problems placing the curve, with the points of intersection. It was good to see, a very large majority of candidates labelling correctly.

Part (c) – Almost no students completed this question using the intended method with almost all using used the ALT method. Responses ranged from some very competent and well-presented solutions to blank responses. The algebra involved in following the ALT method was tough in parts and many students were prone to making errors.

However, of those attempting this part of question, most candidates achieved the first mark for setting up the equation using their values for a and b from part (a). If they didn't go on to get subsequent marks for this part of the question, then rearranging this into a 3TQ was predominantly when errors appeared. These mistakes usually involved slips with negatives, particularly when factorising to identify the coefficients.

Most candidates then were familiar using the discriminant to get a quadratic in k and in identifying 2 solutions. Again, candidates could be encouraged to show method in solving, as method marks were available if working with the incorrect quadratic.

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