Pearson Edexcel

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Principal Examiner Feedback

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General Introduction

The majority of students seemed to have been well prepared for this examination and some excellent responses were seen. It proved to be an accessible paper with a mean mark of 83 out of 125. Timing did not seem to be an issue, with most students able to complete the paper. There continues to be an improvement in attempting" show that" questions. Points that should be addressed by centres for future examinations are;

care should be taken by students in the use of brackets. This was highlighted in responses to question 2(a) where $2(2x + 1)$ was frequently expanded as $4x + 1$. Also, in question 5(b) the poor use of brackets led to numerous errors

the rules of indices and logarithms proved to be an area of weakness for some candidates and this was highlighted in responses to question 2 and question 12(i)

Question 1

This question was attempted by almost all candidates and almost all scored at least 1 mark for an attempt at integration, for raising any power by one. Most candidates found the $-6x$ term and so scored at least 2 marks, although $(-6^2)/2$ resulting in -18 was also seen several times.
The most common error was to write the first term as $2x^{-3}$ before integrating to obtain $-x^{-4}$. Many candidates did not remember to include the constant of integration. The second term was sometimes incorrect after simplification, due to difficulty for some when dividing 3 by 3/2, in some cases resulting in 9/2 as the coefficient. However, a good number of candidates did achieve full marks on this first question.

Question 2

Part (a) was usually correct although some students found $a = 2(2x+1)$ and then continued to expand the brackets incorrectly to give $4x + 1$.
In part (b), many candidates did not apply the addition law of indices correctly. A common errors was to write $2^x \times 2^{4x+2}$ as $2^{x(4x+2)}$ or as 4^{5x+2}. However, many students could apply the multiplication law correctly on the right-hand side of the equation and usually wrote 16^{3x} as 2^{12x} and so could at least obtain the method mark. Of the candidates who did arrive at the correct linear equation, usually $5x + 2 = 12x$, there were many instances where this was followed correctly by $2 = 7x$, but then incorrectly by $x = 7/2$.
Attempts at solving by taking logs of both sides were seen only rarely.

Question 3

Answers to this question demonstrated that while candidates recognised that this was about the remainder theorem and most knew the mechanics of its application, few actually answered the question which was, in part (a) to *show that* $(x - 2)$ is not a factor of the function and in part (c) to *show that* $(x + 2)$ is a factor. Candidates need to appreciate that in cases like these, as specified in previous reports and mark schemes, conclusions are required.
In part (b) the majority of candidates attempted f (1/2) and found the correct value for k with the exception of those who attempted long division.

In part (c), those who correctly substituted -3 as the value of k usually found $f(-2) = 0$ with no difficulty. In a number of cases $f(-2) = 0$ was written down directly, even for incorrect values of k.

There were some excellent, clearly explained responses but many lost the accuracy marks in parts (a) and (c). Long division methods were often unsuccessful.

Question 4

This question was a good source of marks for many candidates.
Marks were rarely lost in (a) although some students had difficulty with the $16x\sqrt{x}$ term. It was sometimes interpreted as $16x^{\frac{1}{2}}$ and subsequently differentiated to give $8x^{-\frac{1}{2}}$.
In part (b), the majority of students knew what they needed to do and those who had made any errors in part (a) could access 4 out the 5 marks. Of those with an incorrect approach in (b), the majority found the equation of the tangent rather than the normal. Of those with a fully correct part (a) and a correct method in part (b), a significant number of candidates made errors in rearranging to the required form. The most common of these was to move from
$24y - 48 = -x + 4$ to $x + 24y - 44 = 0$. Others lost the final mark for failing to put '= 0' at the end and/or for leaving coefficients as fractions, despite the clear instructions in the question.

Question 5

In part (a), although candidates realised that Pythagoras theorem (or equivalent) was the method to use, there were many errors. A common mistake was to find the value of $\sqrt{2x^2 + 2x^2}$ instead of $\sqrt{(2x)^2 + (2x)^2}$ but many other incorrect answers were seen such as $QR = 4x$ or $QR = 8x$. Unfortunately, errors such as these changed the nature of the question so that candidates could only gain one mark in part (b).
In part (b) there were two principal reasons for failure to obtain full marks: (i) failure to use brackets which often led to forgetting which terms to include, so that, for example, $4x$ became x, and (ii) in spite of the instruction at the top of the question many otherwise correct responses lost the last two marks as they did not show the method of rationalising the denominator. Other mistakes, such as confusing perimeter with area, were uncommon.

Question 6

Part (a) was very routine and was accessible to all candidates. Mistakes were often due to arithmetic slips and/or sign errors in the expansion.
As highlighted in previous reports, the clear instruction in part (b) to give the coefficient as the answer, was largely ignored or possibly misunderstood. Only a minority gave the actual coefficients required and many students with correct working, included the x^2 with their answers (however, this was only penalised once). Some candidates laboriously worked out every term in the expansions in (i) and (ii) but failed to identify the coefficients required, and so lost both accuracy marks. In part (ii), the most surprising errors occurred when attempting to split $(2 + x)/(2x)$ into two fractions (often yielding an x^2 term). This meant both marks for this part were lost. Also, in part (ii), a significant number of candidates thought that multiplication by $(2 + x)/(2x)$ could be achieved by multiplying by $(2 + x)$ first and then multiplying by $2x$.

Question 7

Most attempts in part (a) correctly applied the Sine Rule to the triangle and gained the method mark. Some then went straight to the given answer and lost the accuracy mark as they failed to give an intermediate line of working. The required angle was sometimes referred to in different ways and the use of x was inappropriate considering the other x's in the question.

In part (b) both marks were gained by only a minority of candidates. Most did not find the *obtuse* angle ACB. Some gave the angle ABC as their answer but then proceeded correctly in the last two parts of the question. A few candidates assumed triangle ABC to be isosceles or even right-angled.

The method marks for parts (c) and (d) were generous and available for the use of, for example, an *acute* angle ACB. In part (c), many candidates used the correct, appropriate area formula for a triangle and gained the first method mark. An unexpected number of students then went on to write $4x \times 3x$ as $12x$ thus gaining no further marks. A few candidates did a lot more work and found the perpendicular to side AB in terms of x and then used the area formula ½ base$\times$height.

For part (d) many candidates used the Cosine Rule or the Sine Rule correctly with their angle and gained at least the method mark. Only a few used the area formula for this part and a few attempted lengthier methods which were sometimes correct.

Question 8

In part (a), almost all candidates could obtain both marks and only a few candidates made sign errors and gave the coordinates as (–3, –7) or failed to halve the coefficients of x and y, thus giving the centre as (6, 14).

In part (b), the method was largely known but a sign error on the '32' was sometimes seen, giving an incorrect radius of $\sqrt{26}$.

Part (c) discriminated well. Some candidates approached the problem efficiently and concisely, writing down $0 < 58 - k < 9$ and so $49 < k < 58$. However, it was generally the case that many students did not know how to approach this part of the question or in some cases could made some progress in establishing one of the limiting values.

Question 9

The first two parts of this question were accessible to the majority of candidates and many gained full marks for them. The third part was a challenge, with many candidates gaining no marks or just the first, failing to understand the demands of the question.

Many candidates gained full marks in part (a), forming the two required equations and solving them correctly. Occasionally there were sign errors, usually leading to the loss of both accuracy marks.

In part (b) most candidates used the correct formula for the n^{th} term of the sequence as given in the question with $n = 100$, gaining at least the method mark. A few used the formula for the n^{th} term of an arithmetic sequence which meant that they had to first do extra work in finding the first term of the sequence and the common difference. Those who used this method often did so successfully.

In part (c) many candidates misunderstood the sigma notation and just found the sum of the first six terms of the sequence which gained no marks. Others just worked out the sixth term of the sequence and gave this as their answer. Some found the sum of the first thirty terms of the sequence and gave this as their final answer gaining the first method mark if they used the correct formula with appropriate values of the variables. Some used the value of their sixth term of the sequence as the first term and gained no marks. Many, who realised that the question wanted the sum of the terms of the sequence from the sixth to the thirtieth, incorrectly believed that the number of terms in this sum was 24 rather than 25 and gained just the first method mark for using an appropriate, correct formula. Some candidates, realising that the number of terms in the required sum was 25, used the value of their first term of the sequence in the question rather than the sixth term as the start of the required sum, and gained no marks. A few candidates used a listing method successfully.

Question 10

Part (a) was attempted by most candidates with almost all getting full marks. Out of those that did not achieve full marks, some were due to the use of an incorrect formula such as $s = \frac{1}{2}r\theta$. Others found the value of 6 using the correct formula, but then halved their answer to obtain 3. This was usually due to them thinking that *OB* was 6 and *OA* was 3. Candidates that did this could potentially have the special case for the next part of the question.
Part (b) saw a mixed response. Some students correctly found 135π by a correct method and thus, obtained full marks. Other candidates who made a mistake in part (a) could potentially pick up all of the method marks here. There were a few responses of this kind and others where the candidates had used incorrect sector area formulae such as $\frac{1}{2}r\theta$ or $r^2\theta$. These could score no marks for this part of the question. There were also quite a few responses where the candidates either found 3π or 132π but not both. Those that incorrectly found $OA = 3$ generally tended to pick up the first two method marks as a special case.
In part (c), there were many responses where candidates achieved the correct exact unsimplified answer but sometimes either put their answer as a decimal before collecting terms or made slips when simplifying. The mark scheme did make an allowance in these cases and full marks were achievable for the correct unsimplified expression. Many candidates scored the first mark for the major arc of the circle to obtain 22π and added the given arc *AE* but significant number of candidates did not add the two-line segments *AB* and *ED* and so obtained the incorrect vale of 23π. Where no marks were scored in (c), this was usually due to the use of an incorrect arc length formula such as $\frac{1}{2}r\theta$.

Question 11

Most of the sketches in part (a) were good and those candidates who factorised the function into $(x-2)(x+2)(x-3)$ found the correct *x* intercepts, although a few drew a negative cubic curve. Some candidates did not indicate the *y* intercept on their sketch. There were, however, a few quadratics and even straight-line graphs.

For part (b), in order to identify the region above the *x* axis and gain full marks it was necessary to have the correct *x* intercepts, so those candidates who had not factorised the difference of two squares sometimes selected 3 and 4 as the limits of integration. On the whole the integration was well done apart from some careless errors. Candidates need to be aware of the importance of showing that they have applied the limits and subtracted, as in the event of a mistake it can be difficult to award method marks which they may otherwise have earned.

A few candidates added the area below the x-axis to their value for R. A small minority never integrated but substituted the limits into the expanded function. Just a few used the trapezium rule.

Part (c)(i) seemed to cause great difficulty. The most frequent wrong answer was f(x/2) and many wrote $(2x^2 - 4)(2x - 3)$.

Responses to part (c)(ii) were variable, and while most candidates knew that x values were halved, too many answers were vague and lacking in detail, with geometrical descriptions being rather confused. Some candidates backed up their description by sketching the transformed graph, which was a sensible strategy.

Question 12

Performance in part (i) was varied with some students getting full marks and others did not achieve any marks. Candidates who achieved no marks often applied incorrect log rules such as $\log_p a + \log_p b = \log_p(a + b)$ but in such cases the first method mark could still be scored for subsequent correct work or for correct work on the right hand side of the equation. Quite a few students obtained the correct equation thus, gaining the first accuracy mark, but some then went on to score no further marks as they made p the subject despite the clear instruction to make x the subject. Other students did not deal with their fraction correctly and interpreted $\frac{\frac{2x}{5}}{8}$ as $\frac{16x}{5}$ and lost the last accuracy mark but did obtain the second method mark as they removed the logs correctly. However, some candidates wrote 3^p on the RHS thus losing the second method mark. Interestingly, there were some candidates that correctly achieved $\frac{20}{x} = p^{-3}$ and then went on to score full marks for this part of the question.

In part (ii) there were quite a few cases where the candidates failed to spot that they needed to solve a quadratic equation and did not obtain any marks. Those that did spot the quadratic managed to achieve at least the first two marks for getting the correct solutions. Of the students that achieved the correct values, almost all went on to score at least the method mark for 2^a with a being one of their solutions to the quadratic. There were quite a few candidates who rejected -5 and then went on to find just $2^{1.5}$ and some did not score any of the last two accuracy marks due to not obtaining a simplified value. The majority of the time one of the last two accuracy marks was awarded was due to the candidate writing 2^{-5} as many candidates left $2^{1.5}$ in numerous forms other than $2\sqrt{2}$. The majority of students went on to write $\frac{1}{32}$ as their final answer for 2^{-5} with a small minority who tried other forms for this answer. This was probably due to the demand in the question to write the answers as simplified surds where appropriate.

Question 13

Part (i) was well answered by most of the candidates with full marks being very common. The most common errors involved using 7/5 instead of 5/7 or finding 2θ only. Just a few used the alternative squaring method and most of these scored only the first method mark. Some candidates seemed confused by the double angle, and some failed to give the second solution in the required range.

Many good answers were also seen for part (ii), although some candidates could not manipulate the initial equation correctly and lost most of the marks. Use of the correct trigonometric identities was usually sound and the correct quadratic equation was obtained by many. The equation was solved correctly by all but a few. The last accuracy mark was lost by some through premature rounding and a few candidates gave their answers in degrees rather than radians. Most, however, were able to produce two appropriate answers in the required range.

Question 14

In part (a), most candidates realised that the number of ants in the colony at the end of each year formed a geometric sequence, but many failed to note that the second number of ants given in the question was the number at the *end* of the second year. Many candidates wrote down an equation involving the common ratio for the number being at the end of the first year and hence gained no marks.

The common ratio of the sequence was often labelled with the standard r. However, many other different expressions were used, such as p or $1 + p$, due to the fact that the question asked for the annual percentage increase p%. A large majority of candidates could not achieve the correct link between the common ratio and the percentage increase. Few obtained the value of p to an appropriate degree of accuracy and so lost the B mark.

The first three marks in part (b) were generous, allowing the use of the candidate's p or r as the common ratio. Many used $N - 1$ as the power of r rather than the correct N.

Most candidates who wrote down an appropriate inequality/equation for the number of ants at the end of the N^{th} year were able to progress to find their value of N or $N - 1$ by using logarithms correctly. Accuracy marks were often lost at this stage since the value of r was taken as 1.04 rather than the more accurate 1.0351.

A large minority of students wrongly equated the formula for the *sum* of N terms of a geometric series to the N^{th} term to solve for N and gained no marks. A significant number of students (26%) scored no marks for the whole question.

Question 15

Part (a) was the least correctly answered part of this question. Many candidates could not find correct expressions for the volume or surface area and so made little progress and often scored no marks in this part. Some gave a volume formula by incorrectly treating the entire shape as a cylinder. In most cases the incorrect formulas were dimensionally incorrect – e.g. attempting to add terms of units squared to a term of units cubed or units to fourth or fifth powers. Some formulas included π^2 instead of π. Often candidates who started with correct formulas scored at least 3 marks in part (a) but a significant number of candidates made copying errors from line to line, and some completed the proof correctly until the penultimate line and then combined terms to give $A = \frac{10}{r} - \frac{4}{3}\pi r^2$ rather than the printed $A = \frac{10}{r} + \frac{4}{3}\pi r^2$.

In part (b) the first two marks were almost always scored. If there were any errors here they were often sign errors or omitting the π in the second term. Some candidates with a correct derivative did not use algebra correctly to arrive at a value for r^3 however many did continue to find a correct value of the radius, either as a decimal or exact value. Of those who found the exact value correctly, some incorrectly moved the pi from the denominator to the numerator and so continued with an incorrect value for the radius. Most candidates did then continue by substituting their value for r into the correct equation and finding a value for the area, although a significant number of candidates stopped after finding the radius.

In part (c) many different errors were commonly seen. Some candidates did not differentiate correctly, but more commonly after a correct second derivative, many candidates set this equal to zero and solved to obtain a different value for r. Some candidates also proceeded correctly by differentiating and substituting but failed to refer to the sign of the second derivative. It is worth highlighting the fact that in proving the nature of a maximum or minimum, the sign of the second derivative must be considered to access marks. Some incorrectly substituted the value of the area (14.1) into the second derivative rather than the radius.

Part (d), when attempted, usually resulted in 1 mark for the candidate, as the method mark was allowed despite errors in the formulae used in part (a). Some candidates used their volume formula, and some used their area formula to solve for h. A minority of candidates incorrectly used the value of the second derivative found in part (c) (usually 25.1 or 25.2) instead of the area value of 14.1 in their area formula. As most students used approximate decimal values for the radius, few found the correct final answer of $h = 0$.

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