Examiners' Report/
Principal Examiner Feedback

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Pearson Edexcel International A Level
in Core Mathematics C4 (6666A)
Paper 01

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General Introduction

This paper proved to be a good test of Core 4 material and discriminated well across candidates of all abilities. There was enough opportunity for grade E candidates to gain marks in at least 6 of the 8 questions on this paper. There were some testing questions involving differential equations, rates of change, parametric equations, integration and vectors that allowed the paper to discriminate well across the higher ability levels.

The standard of algebra was good, although a number of candidates made basic sign or manipulation errors in Q1(a), Q2, Q4(c), Q5 and Q7(b). In summary, Q1(a), Q2, Q3(a), Q3(b), Q4(a), Q4(b), Q7(a), Q7(b), Q8(a), Q8(b), Q8(c) and Q8(d) were a good source of marks for the average candidate, mainly testing standard ideas and techniques; and Q3(c), Q4(c), Q6 and Q7(c) were all discriminating at the higher grades. Q5, Q8(e) and Q8(f) were the most challenging questions on the paper and full marks to these questions were only accessible to potential grade A*/A candidates.

Report on individual questions

Question 1

Part (a) was generally well answered with the majority of candidates scoring all 6 marks. Most candidates manipulated $\dfrac{1}{(4+3x)^3}$ to give $\dfrac{1}{64}\left(1+\dfrac{3x}{4}\right)^{-3}$, with the $\dfrac{1}{64}$ outside the brackets sometimes written incorrectly as either 1, 4 or 64 and a few incorrectly used a power of 3. Many candidates were able to use a correct method for applying a binomial expansion to an expression of the form $(1+ax)^n$. A variety of incorrect values of a were seen, with the most common being either 3 or $\dfrac{4}{3}$. Some candidates, having correctly expanded $\left(1+\dfrac{3x}{4}\right)^{-3}$, forgot to multiply their expansion by $\dfrac{1}{64}$. Sign errors, bracketing errors, and simplification errors were also seen in this part.

Part (b) was more discriminating and was only answered correctly by a minority of candidates most of whom expanded $\dfrac{1}{(4-9x)^3}$ as far as the term in x^3 to achieve the correct term in x^2. Few candidates made the link with part (a) and were able to apply "f(–3x)" and deduce that the coefficient of x^2 was 9 times its value in part (a).

Common errors in part (b) included stating the coefficient of x^2 as $\dfrac{243x^2}{512}$ and not $\dfrac{243}{512}$, quoting the x^2 coefficient from their binomial expansion in part (a) or multiplying their x^2 coefficient in part (a) by either 3 or -3.

Question 2

In (i), the majority of candidates were able to apply the integration by parts formula in the correct direction. Some candidates, however, did not assign u and $\frac{\mathrm{d}v}{\mathrm{d}x}$ and then write down their $\frac{\mathrm{d}u}{\mathrm{d}x}$ and v before applying the by parts formula, which meant that if errors were made the method used was not always clear. $\int \cos\left(\frac{x}{2}\right)\mathrm{d}x$ caused problems for a significant minority of candidates who produced responses such as $\pm\sin\left(\frac{x}{2}\right)$ or $\pm\frac{1}{2}\sin\left(\frac{x}{2}\right)$ or $-2\sin\left(\frac{x}{2}\right)$. After correctly applying the by parts formula, few candidates then incorrectly applied $-\int 2\sin\left(\frac{x}{2}\right)\mathrm{d}x$ to give $-4\cos\left(\frac{x}{2}\right)$.

In (ii)(a), the majority of candidates were able to split up $\frac{1}{x^2(1-3x)}$ in the correct form of $\frac{A}{x}+\frac{B}{x^2}+\frac{C}{(1-3x)}$, although a significant number missed the x factor to give the incorrect form of $\frac{B}{x^2}+\frac{C}{(1-3x)}$. Many candidates were successful in either substituting values and/or equating coefficients in order to find their constants.

In (ii)(b), most candidates were able to integrate both $\frac{A}{x}$ and $\frac{B}{x^2}$ correctly with a few candidates integrating $\frac{B}{x^2}$ to give $B\ln(x^2)$. The most common error was to integrate $\frac{C}{(1-3x)}$ to give either $\frac{C}{3}\ln(1-3x)$ or $C\ln(1-3x)$.

Question 3

The majority of candidates provided the correct answer to part (a) and a fully correct solution for part (b). The most common error in part (b) was to divide the increase of 408 by 5408 instead of 5000 to give an incorrect percentage increase of 7.54%.

Only a minority of candidates gave a fully correct solution for part (c). Many candidates were unable to differentiate $N = 5000(1.04)^t$ with $\frac{dN}{dt} = 5000t(1.04)^{t-1}$ or $\frac{dN}{dt} = 5000(1.04)^{t-1}$ being common incorrect attempts. Even amongst those who achieved $\frac{dN}{dt} = 5000(1.04)^t \ln(1.04)$, few appreciated that this could be rewritten as $\frac{dN}{dt} = N\ln(1.04)$. Many candidates, however, applied $N = 15000$ to $N = 5000(1.04)^t$ and the majority found a correct value for T (usually 28.01). Whilst some substituted their value for T into their $\frac{dN}{dt}$, others made no further progress.

Question 4

In part (a), the missing y-value was found correctly by a large majority of candidates.

In part (b), most candidates applied the trapezium rule to find the approximate area for R. The most common error was for candidates to use an incorrect strip width, h, of either $-\ln 2$, $\frac{3\ln 2}{4}$ or $\frac{\ln 2}{3}$.

In (c)(i), the majority of candidates differentiated the substitution correctly. They struggled, however, to apply the substitution in order to give an integral of the form $\pm\lambda\int \frac{1}{\sqrt{u}}\,du$ and sometimes tried to manipulate complicated erroneous expressions in u. For those who obtained an integral of the form $\pm\lambda\int \frac{1}{\sqrt{u}}\,du$, integration proceeded accordingly, but a large majority left their answer to (c)(i) in terms of u, and thus did not return to an expression in terms of x, as the question required.

In (c)(ii), most candidates who had progressed this far maintained their expression from part (c)(i) in terms of u, found u-limits of 4 and 25, and proceeded to a final numerical answer for the area. A number of candidates placed their limits the wrong way round, resulting in a negative answer, whilst a few used the limits for x in their expression in u.

Question 5

The responses to this question were very varied with few gaining full marks and a significant number gaining no marks. A number of candidates had not covered this topic and thought they needed to substitute the given x and y-values into the $\frac{\mathrm{d}y}{\mathrm{d}x}$ expression to find a gradient and then use this gradient to find the equation of a straight line through a point.

Some candidates separated the variables successfully and integrated $\frac{1}{y^2}$ correctly. Those who integrated $\frac{1}{3y^2}$, however, often found $\int 3y^{-2}\mathrm{d}y$ instead of $\int \frac{y^{-2}}{3}\mathrm{d}y$. Candidates frequently found difficulty with $\int \frac{1}{\sin^2 2x}\,\mathrm{d}x$ and some rewrote $\int \frac{1}{2\sin^2 2x}\,\mathrm{d}x$ as $\int \frac{1}{1-\cos 4x}\,\mathrm{d}x = \ln(1-\cos 4x)$. Some candidates realised that $\int \operatorname{cosec}^2 2x\ \mathrm{d}x = a\cot 2x$, but some used $a = \pm 1$ or $a = \frac{1}{2}$ instead of $a = -\frac{1}{2}$.

A significant number of candidates substituted $y = 2$ and $x = \frac{\pi}{8}$ into their integrated equation containing $+c$, but in most cases previous integration errors prevented them achieving the correct answer.

Of those candidates who had worked correctly throughout with a correct constant of integration, there were few who could rearrange their final expression into the form $y = \mathrm{f}(x)$ without making errors. A common misconception was that an expression of the form $\frac{1}{A} = B + C$ could be rearranged to $A = \frac{1}{B} + \frac{1}{C}$.

Question 6

This question about rates of change proved challenging for many candidates with about 40% of the candidature making no creditable attempt.

The majority of candidates were unable to write down a correct expression for the volume of the pool of oil formed. Common errors included writing V as either $\frac{1}{3}\pi r^2 h$, $2\pi r^2 h$, $\frac{4}{3}\pi r^3$, πr^2 or $2\pi r^2$, whilst some candidates wrote down expressions for area *A*, instead of volume *V*. Interestingly, 3 mm was often applied as 3 cm, 0.03 cm or even 0.003 cm. Many candidates who had written down an expression for *V* were able to use the Chain Rule correctly to set up an equation for $\frac{\mathrm{d}r}{\mathrm{d}t}$. They then divided 0.48 by their $\frac{\mathrm{d}V}{\mathrm{d}r}$ and substituted $r = 5$ in order to find a value for $\frac{\mathrm{d}r}{\mathrm{d}t}$. Rounding their answer to 3 significant figures proved to be a problem for some candidates, with final answers of either 0.05 or 0.051 being seen.

Question 7

In part (a), the majority of candidates applied the process of parametric differentiation, and many gained both marks. There were occasional sign errors and some candidates differentiated $y = \sqrt{3}\cos 2t$ incorrectly to give $\frac{\mathrm{d}y}{\mathrm{d}t} = -\sqrt{3}\sin 2t$.

In part (b), some errors were made when substituting $t = \frac{2\pi}{3}$ into their $\frac{\mathrm{d}y}{\mathrm{d}x}$, but most candidates stated the correct coordinates for *P* and correctly applied $\mathrm{m}(\mathbf{N}) = -\frac{1}{\mathrm{m}(\mathbf{T})}$. The majority of candidates were able to use a correct method for finding the equation of the normal, and there were many fully correct solutions, with clear steps leading to the final printed answer.

Part (c) was generally attempted by the more able candidates. Of those candidates who made progress in this part, most formed a Cartesian equation for *y* by applying $\cos 2t = 2\cos^2 t - 1$, and substituted their Cartesian equation into the equation of *l*.

Fewer candidates attempted to substitute the parametric equations into the equation of *l* to obtain an equation in *t*, although those who attempted this method generally found it easier to achieve a correct quadratic equation in $\cos t$. After finding values for $\cos t$, errors were sometimes made when attempting to find the coordinates for *x* and *y*.

Question 8

Most candidates scored well in parts (a) to (d). Parts (e) and (f) proved to be good discriminators.

In part (a), most candidates who attempted to find a scalar product correctly used the direction vectors for the two given lines and successfully found the angle 77.2°. The final answer was regularly seen as was the obtuse angle 102.8° and occasionally this was given in radians.

Part (b) was well answered with $\lambda = 2$ substituted into l_1 to give $\mathbf{j} + 6\mathbf{k}$. Some candidates confirmed that $\lambda = 2$ was true for all three 3 coordinates.

In part (c), whilst some candidates immediately recognised the point of intersection, X, from the two given line equations and simply wrote this point down. Many, however, found X by solving the two equations simultaneously.

In part (d), the majority of candidates confidently found an expression for the vector $\overrightarrow{AX}$. A small number, however, thought this was all they had to do and did not find its length, though the majority confidently used Pythagoras on all three components usually obtaining the correct answer.

It was disappointing to see so few good responses to part (e). Successful responses almost always followed a good diagram of the situation and candidates need to be encouraged to set out the given information in such a form before attempting a response. Often the area of a triangle was found using $\frac{1}{2}ab\sin C$ with candidates using their answers to parts (a) and (d), but only those with a sensible diagram realised that this gave the area of triangle AXB_1 or AXB_2 and that this answer needed to be doubled to obtain the area of triangle AB_1B_2.

Part (f) was often not attempted. Candidates who were able to form an appropriate equation in μ also usually knew how to use their value(s) of μ to find the coordinates of B_1 and B_2 but sometimes only found one of the two points. Some errors were made with the algebraic solution of their equation in μ and some arithmetical errors were made in calculating the coordinates.

Grade Boundaries

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