Examiners' Report/
Principal Examiner Feedback

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Pearson Edexcel International A Level
In Core Mathematics C34 (WMA02/01)

Paper 01

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This paper was the third January Core 34 paper from the IAL specification. It contained a mixture of straightforward questions that tested the student's ability to perform routine tasks, as well as some more challenging and unstructured questions that tested more able students. Most students were able to apply their knowledge on questions 1, 2, 3 5, 6, 7, 9, 10, 11 and 12. Timing did not seem to be a problem as most students seemed to finish the paper. Questions 4, 8, 10c, 11e and 12d required a deeper level of understanding. Overall the level of algebra was pleasing. Points that could be addressed in future exams is the lack of explanation given by some students in questions such as 5c and 6c involving proof. It is also useful to quote a formula before using it. Examples of this are when using the quotient rule in 7b or integration by parts in 8b.

Comments on Individual Questions:

Question 1

Most candidates were well prepared for this question and the majority managed to gain full marks. A few students struggled to take 3 out as a factor but most marks lost seemed to be from careless mistakes due to incorrect signs or coefficients of x. A very costly method error with (-4)(-3) appearing in the numerator instead of (-4)(-5) was frequently seen. The alternative method seen on the mark scheme was less popular and less successful with incorrect powers of 3 often appearing, either increasing or all positive. A few candidates tried to use the ${}^{n}C_{r}$ or the "vector" notation for the coefficients and lost the negative signs

Question 2

This question was answered well by the majority of the candidates with all but a few scoring at least 5 of the 6 marks available.

(a) The great majority of candidates got either k = -12 or the correct equation of cosec^2x – cosec x -12 = 0 using $\text{cosec}^2x = \cot^2x+1$. The most common error was in substituting $\cot^2x = 1 + \text{cosec}^2x$ leading to the equation cosec^2x –cosec x – 10 =0 meaning that only method marks were available in part (b). Also sign errors were quite common, leading to incorrect values for k.

(b) Candidates were confident in solving the quadratic equation in cosec$x$, usually by factorising, and then using cosec x = 1/sin x on at least the positive value of cosec x to find the required value(s) for sin x. A surprising number of candidates rejected the solution cosec x = -3 seemingly having confusion over the set of possible values for cosec x. A very few candidates erroneously thought cosec x was 1/cos x and thus could achieve no further marks. From their values (or value) for sin x candidates were usually able to find a correct second solution for x in the stated domain of 0^{o} to 360^{o} though occasionally only one solution was given from the negative value for sin x. Extra incorrect solutions in the domain were quite rare. A few candidates converted to a quadratic equation in sin x from the beginning. Virtually all solutions were stated to the required degree of accuracy and there were few radian solutions. Only a small minority gave incorrect solutions following correct principle values, suggesting that the sine function was well understood.

Question 3

This question was well answered, with most candidates being aware of the process of implicit differentiation. However, the 3^x term caused problems, with derivatives of 3^xln(x), $x3^{x-1}$, $x$ln3 or just 3^x seen. The product was well attempted, although candidates often did not simplify $\frac{3}{2}x(2y)\frac{dy}{dx}$, preferring to copy it in this form and substitute (2, 3) into this un-simplified expression at the end.

The majority of candidates rearranged to find an expression for $\frac{dy}{dx}$, and substituting in the values of x and y whereas as it is much easier to substitute in first and then rearrange.

Nearly everyone understood that there was an element of factorisation and substitution to get $\frac{dy}{dx}$. Candidates who scored the first four marks generally went on to get at least the next two. Those who tried to multiply the initial line by 2 made errors like 2 x $3^x = 6^x$. The final mark was also often lost, with candidates seemingly ignoring the demand of the question and leaving their answers in the form $\frac{p\ln q - r}{s}$.

Question 4

(a) This straight-forward exercise in integration was answered poorly by quite a large minority of candidates. First the correct integral needed to be stated, with π, limits and dx. Some candidates, even at this level, do not seem to appreciate the essential link between the integral sign and its accompanying dx. A final score of 01111 for this part was not uncommon.

In attempting to perform the integration, by far the most common error was to give some sort of logarithmic expression as the result. Other candidates tried to expand the denominator, with $(16 + 9x^2)$ being not uncommon, whilst some tried to split the denominator into partial fractions. For those who did manage to obtain an expression of the type $k(4 + 3x)^{-1}$, a frequent error was the omission of 3 in the denominator, leading typically to an answer of 10π/3. Several candidates used the substitution $u = 4 + 3x$, and thus ended integrating $4/3(u^{-2})$, with the 3 correctly in place. Finally it is worth reporting that a few candidates mistakenly wrote 180 for π in front of the integral sign.

(b) This part was answered successfully by less than 5% of the candidates. Many simply did not attempt a response, whilst for those who did, integration of the function from (a) between the limits of 0 and 15 was frequently encountered. A few realised that the linear scale factor was 9, but then failed to cube to obtain the corresponding volume ratio.

Question 5

(a) Most candidates evaluated both f(1) and f(2) correctly and included the necessary detail to achieve the two marks. A few did not refer to the change of sign and/or root despite evaluating f(1) and f(2) correctly and so lost the second mark.

(b) Many students did this part well and included all the required steps to achieve the given answer. Those who gained no marks often failed to state $f(x) = 0$ or set $-x^3 + 4x^2 - 6 = 0$ at the beginning of their answer. A few did attempt to work backwards. These generally gained the first mark but lost the second as they did not say that 'therefore $f(x) = 0$', or something similar.

(c) Most students gained the three marks for this part. Some gained just the first mark as they gave a truncated value for x_1.

(d) Many candidates used the expected interval [1.5715, 1.5725] correctly with the necessary detail and gained the two marks. Very few students used a tighter appropriate interval. Some used an unsuitable wider interval and lost both marks. Quite a few candidates used continued iteration despite the question telling them to 'use a suitable interval'. Some evaluated the iterative formula using the interval endpoints and hence lost both marks.

Question 6

Parts (a) and (b) were very well answered with part (c) proving to be more challenging.

(a) Nearly all candidates could complete this correctly. The most common error was to state T = 300.

(b) The majority of candidates substituted $T = 180$ into the given formula in (b) and successfully rearranged to make $e^{-0.04t}$ or occasionally $e^{0.04t}$ the subject of the equation. Most students then correctly applied a logarithm law to find a value for t. There were occasional errors with the manipulation of logs, with statements such as ln300 x $(-0.04t)$ = ln 160.

Occasionally the final accuracy mark was lost for unrounded answers; the question and the marks scheme required 3 significant figure accuracy for this answer.
(c) The majority differentiated correctly, but many did not know how to proceed from there. Although there were some efficient solutions, several of those who reached the desired expression did so in a very long-winded fashion. A few candidates obtained dT/dt = $kte^{-0.04t}$ Very few candidates were able to complete the proof, with many candidates doing no further work.
Those who realised the need to rearrange the original equation and substitute for $e^{-0.04t}$ usually gained full marks. Other methods included differentiating t = -25ln((T -20)/300) to find dt/dT. Whilst the occasional solution was correct this approach led to many errors, particularly the loss of a factor 1/300.

Question 7

Many candidates scored well on this question. However, weaker candidates often struggled with parts (a) and (b) but were able to gain marks on parts (c) and (d).
(a) The vast majority of candidates used the quotient rule as opposed to the product rule. Very few candidates quoted the rule, and a good proportion went straight into an answer without stating *u*=, *v*=, *u*'=, *v*'=. Although there were plenty of correct differentiations, many candidates lost marks as a result of neglecting to apply the chain rule when differentiating $3\ln(x^2+1)$. This error was costly as it usually meant they could not make appropriate progress in part (b)
(b) Most candidates knew that they had to set their d*y*/d*x*=0 and those with a correct numerator for the derivative in (a) usually proceeded to find $x=\sqrt{(e-1)}$. Additional answers of $x= - \sqrt{(e-1)}$ were disregarded. A few candidates failed to go on to find *y* by substituting in their value of *x* thus losing the final two marks. A few of those who did proceed failed to give the correct answer of $y = 3/e$, some leaving the answer for y as 3lne/e and others offering a decimal approximation.
(c) Almost all candidates gave the correct value for *y* when *x*=1 and entered their answer in the table. A minority gave a decimal value and were allowed the mark.
(d) This part of the question proved to be highly accessible with many candidates scoring full marks, the Trapezium Rule being generally well executed. Some candidates had correct working but an incorrect final answer suggesting inefficient calculator use.

Question 8

(a) Many candidates gained some credit in this part. Most began by using the identity $sin^2\theta + cos^2\theta \equiv 1$ to obtain an expression for f(θ) in either $sin^2\theta$ or $cos^2\theta$. A number did not get beyond this stage. Many chose to use the formulae for $\cos 2\Theta$ to convert both their $sin^2\theta$ and $cos^2\theta$ terms to reach an expression of the form $a + bcos2\theta$. Errors in dealing with signs were usually the reason for incorrect values for *a* and *b*.
(b) All three 'ways' shown in the mark scheme were seen. Completely correct solutions were few and far between. Very few candidates quoted the parts formula. A number ignored the θ^2 term integrating f(θ) instead or wrote a completely incorrect expression containing for example $cos2\theta^3$.
Those using 'way 1' were usually able to gain the B1ft mark early in their solution for integrating $a\theta^2$. They also often obtained the first M mark. Many did not integrate for the second time and so lost the dM and A marks. For those obtaining the first two M marks sign

errors in their final integral meant the loss of the A mark, commonly having $+sin2\theta$ instead of $-sin2\theta$. Slips where $cos2\theta$ became $cos\theta$ led to the loss of the dM and A marks.
Those choosing 'way 2' were less likely to obtain the B1ft mark. 'Way 2' also produced many bracketing errors (or omission of brackets) and sign errors leading to loss of marks as well as omission of terms. E.g. having $\int cos2\theta d\theta$ instead of $\int(\theta^2 \pm \cdots cos2\theta)d\theta$ after integrating for the second time..
Those reaching the correct integral usually obtained the correct answer $\left[\frac{5\pi^3}{24} - \pi\right]$. Very few gave the decimal answer 3.318. The substitution of the limit 0 was often not seen. Some candidates carried out substitution of limits en-route through their response rather than at the end.
The quality of presentation of answers varied widely and many repeated attempts were seen.

Question 9

This question was quite well answered well by most candidates with many scoring the first 8 of the 10 marks available.
(a) The majority of candidates scored full marks in part (a) being confident in how to split up the given expression into the three appropriate Partial Fractions of the form $\frac{A}{x} + \frac{B}{x^2} + \frac{C}{3x-2}$ and being able to calculate correctly the values for A, B and C.
Methods of substitution and comparison of coefficients were used with confidence and the majority obtained $B = 2$ and $C = -6$ but in many cases the value of A was incorrect.
Most of those who mistakenly split the given fraction in the form of $\frac{A}{x^2} + \frac{B}{3x-2}$ were able to score the first two marks allowed by the mark scheme in this case.
A few candidates converted the given fraction into $\frac{Ax+B}{x^2} + \frac{C}{3x-2}$ and from there were able to reach the correct final answer.

(b) Completely correct solutions of this part were fairly rare, although many candidates obtained a correct expression for ln y. The majority separated the variables and obtained the given expression in x; some had y rather than y^{-1} in their integrand . Almost all those with the correct expression attempted to use their partial fractions. Some obtained incorrect coefficients, and a few failed to recognise that the integral of x^{-2} should not give a ln.
Many candidates omitted the constant of integration, and those who included it often failed to treat it correctly when removing the logs to obtain an expression for y. There were also errors in the treatment of the reciprocal term at this stage, with many candidates obtaining a sum of terms rather than a product.

Question 10

(a) This part was generally well done with most candidates gaining full marks. A minority of candidates lost the first B mark for giving **R** as a decimal. This was often the case where candidates used sin or cos with their value of α to find R. A few candidates gave α in degrees and thus lost the final A mark.
(b) There were many excellent solutions, with many candidates gaining full marks. Most candidates gained the first mark for using their answer to part (a) and dividing 4 by their R. A few candidates found $x = -0.134..$, but then only attempted to find one other value for x, so

were only able to gain the first 3 marks. A common error was to use "$\pi + 0.755 \ldots$", leading to $x = 1.43$, rather than "$\pi - 0.755$"… Where only one correct attempt at a valid solution was obtained, candidates tended to use "$2\pi + 0.755 \ldots$".
(c) This part was generally well done, with many correct solutions to either (i) or (ii) but rarely both. (i) Most candidates used their answer to part (a) and attempted $4(R)^2+3$. A few candidates lost the second mark for squaring a rounded value of R. Another common error was to omit the squaring, leading to the minimum being "$3+4\sqrt{34}$", or to omit the $\sqrt{R}$, and find the maximum to be $4(1^2) + 3 = 7$. (ii) Despite many correct solutions, common errors were to assume that "$\sin(2x + 1.03) = -1$" would give the minimum value, leading to the minimum being "$4\times (\sqrt{34})^2 + 3 = 139$". Another common error seen was "$-136 + 3 = -133$".

Question 11

This question proved to have at least some of its parts accessible to most candidates with stronger candidates losing at most one or two marks.
(a) The majority of candidates were able to sketch the correct curve and indicate the correct x and y intercepts. A large number of candidates marked dotted lines on their sketches, but drew a curve which was too far away from the asymptote, or alternatively curved away from the asymptote. However most curves lay in the first and second quadrants, clearly showed the cusp and appeared to approach an asymptote. It was rare to see incorrect intercepts, although a few candidates did omit them. The most common errors related to the asymptote. This was either omitted or incorrectly labelled y = -4 . Sometimes 4 was marked on the y axis but the question required that the equation of the asymptote be stated.
(b) There were more mistakes with this sketch than in part (a) the although the correct shape was usually seen. The asymptote was often omitted or incorrectly placed. The most common incorrect lines were y = -1, y = -8, y = 2. Many curves did passed through the origin but a significant number passed through (0,-6).
In some cases the curve reached the x axis at the origin and then continued along the axis.
(c) Incorrect answers included having a closed integral which included -4 or reversing the inequality sign so $y < -4$.Whilst notation varied, only a minority used x instead of f(x) or y.
(d) In general, the notation for the inverse function was correctly interpreted but there were some candidates who confused this with differentiation, finding the reciprocal and even just giving the negative of the function. Most candidates made an attempt to change the subject of the equation and gained the first method mark. However there was a surprising number of candidates who could not do a simple rearrangement and incorrectly obtained (x-4) rather than (x+4). Elimination of the exponential by taking logarithms was problematic for some candidates as they tried to take logs of all individual terms. A lack of brackets caused many candidates to lose the final mark in this part. Most candidates used the correct notation for inverse functions with x as the variable.
(e) The majority of candidates understood the meaning of fg(x) and applied the correct ordering of functions and so the first method mark was often awarded. There were many incorrect simplifications which often included cancelling exponentials and logs without using the power law. Very often candidates would correctly manipulate the exponential to arrive at an

acceptable form for the second mark but then failed to realise that the question required a polynomial and left their answer as $(x+2)^3 - 4$.

Question 12

(a) The majority of candidates knew how to find the point of intersection of two vector lines gaining 5/6 marks. The lost mark being the B mark as they omitted to check their values of λ and μ in the third equation and hence did not show that the lines intersected. A few candidates just found λ by looking at the "**i**" component and going straight to the coordinates of *A* apparently seeing no need at all to use the other two equations whilst a few were determined to solve a pair of simultaneous equations so used the "**j**" and "**k**" components. In general these candidates rarely went back to check in the "**i**". Some candidates did check into the third equation however showing that 1 = 1 without making any comment.
(b) Substitution into the dot product rule in general was well done. Most candidates correctly used direction vectors but one or two just used various combinations of the direction vectors, commonly multiplying them by the values of λ and μ found in part (a). Pressure or not reading the question properly led several candidates to stop at 113.6.
(c) Very disappointing, $\lambda= -1$ was often found but then there was no evidence that they had checked all three coordinates. A fairly common mistake was to find lambda from one of the coordinates, and then check it in just one of the others. Candidates seemed reluctant to write any words by way of explanation in this part.
(d) Candidates favoured 'way 1' on the mark scheme using differences and Pythagoras with good success. Sadly that was often as far as they went. I think they truly thought they had completed what they were asked. Many of the ones that did go on used 'tan' rather than 'sin'. There were very few sketches which would have been helpful but candidates were going through a learned process rather than understanding what they were doing. Candidates that used the longer 'way 2' were in general more successful as I suspect they understood what they were doing.

Question 13

This question proved to be accessible, at least in parts, to the great majority of candidates. Only a small number of candidates attempted a Cartesian approach in parts (a) and (b) and then with limited success.

(a) In part (a) it was very unusual to see a response which didn't use dy/dx = (dy/dt)/ (dx/dt) followed by sin2t=2sintcost and 1/sin t = cosec t to obtain the gradient. Marks which were lost, were for numerical errors and mistakes such as -1/ (12sin*t*) = -12cosec*t*.
(b) Many candidates scored at least 5 of the 6 marks on this part of the question, losing perhaps the final mark by leaving the answer in the form $y = (18/\sqrt{3}) + 19\sqrt{3}$ with an unsimplified surd. There were the usual minority candidates who gave the equation of the tangent rather than the normal meaning that they could only score at most 3 of the 6 marks.
(c) This part was usually approached by using x=6cos2t, cos2t=1-2sin^{2}t and sin $t = y/2$. There was the occasional slip such as 6(1-2sin^2 t) = 6-2sin^{2}t but generally, accuracy was maintained and full marks were not at all uncommon. A small number of candidates used somewhat circuitous routes but, of these, some still managed to achieve the correct equation in the end.
(d) This part caused the most problems for candidates in this question. Since it does not require any method it is not easy to see what candidates were thinking, but common incorrect answers were k=√2 and k=6. A significant number of candidates made no attempt at part (d)

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