Examiner's Report
Principal Examiner Feedback

October 2018

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

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General

This paper was the second October Core 34 paper from the IAL specification. It contained a mixture of straightforward questions that tested the students 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, 4, 5, 6, 9 and 10. Timing did not seem to be a problem as most students seemed to finish the paper. Questions 11, 12, and 13 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 involving proof, for example 6a, 7a and 8iiaa. It is also useful to sketch a diagram when attempting a question on vectors. (See comments on Qu 11d)

Question 1

Part (a) was usually correct, although a small number of students worked in degrees or used arctan ¼ instead of arctan4. In part (b) the first solution was usually correctly found and it was rare to see an incorrect order of operations. Despite this occurring on past papers, finding the second solution was often ignored or found within the range 0 to 2π and then deleted. Hence 3.17 > π was a popular answer scoring no extra marks. The main and more serious errors in part (b) however, were to ignore the 2θ and incorrectly use $2\cos(\theta-\alpha)=1.2,\ \cos(2\theta-2\alpha)=1.2$ or $\cos(\theta-\alpha)=1.2$ in their attempts to find θ.

Question 2

The majority of students scored well on this question with many achieving full marks.

The need to apply both the Product Rule and the Chain Rule was the most significant test for students. Most students recognised the need to use the Product Rule but a disappointing proportion failed to deal with the $-4xy$ successfully thanks to failure to either bracket the two terms or to apply the minus to both terms. The application of the Chain Rule was rather more successful with most students dealing with the $3y^2$ correctly. A not insignificant number of students began their attempt by writing d*y*/d*x* = ….. There is a need for students to understand the concept of differentiating an equation term by term. Once an attempt at differentiation had been made students were on familiar ground and were generally able to score method marks for obtaining a numerical value for d*y*/d*x*, using this to obtain a gradient for the normal and then going on to construct the normal equation. Only a very few students dropped the final accuracy mark as a result of failing to express the equation in the form stipulated by the question.

Question 3

Many students were able to achieve full marks on this question.

As a result very few incorrect answers to part (a) were seen.

Part (b) required the candidate to use the compound angle formula to expand $\sin(\theta-90)^\circ$ and use $\cos\theta^\circ = p$. . Most students were successful and achieved the given answer although a few errors were seen, mainly due to an incorrect expansion or a slip when applying $\sin 90^\circ = 1$ and $\cos 90^\circ = 0$.

Part (c) was usually started by the use of the double angle formula for sin 2ϑ. The most common error seen was to leave the answer in the form $2p\cos\vartheta$, thus losing the final two marks. Of those students who achieved a fully correct answer of $2p\sqrt{(1-p^2)}$, some then continued to perform an incorrect simplification to $2p(1-p)$ and thus lost the final accuracy mark. An alternative approach using the Pythagorean identity and an identity for cos 2ϑ was seen rarely but was usually carried through to a successful completion.

Question 4

In part (a), whilst almost all students were able to score the method mark, only a small proportion of them went on to fully simplify their answer and reach the result $x = \ln 2$. Most left the result as (1/3) ln8.

Part (b) proved to be accessible to most students with many scoring all five marks. It was very pleasing to see the high number of students who dealt proficiently with differentiating the $-xe^{3x}$ term. As is usually the case with a 'show' that question, some students needlessly lost a mark for not showing sufficient steps in their method. It is vital that students appreciate the requirement that all steps must be shown in these circumstances.

In part (c) the use of an iterative formula was well known to virtually all students so that a very high proportion were able to score all three marks.

Question 5

The creation of the identity $4x^2 + 5x + 3 = A(1-x)^2 + B(1-x)(x+2) + C(x+2)$ was usually correct, but we did witness a few cases where an additional $(1-x)$ appeared on the right hand side. The constants *A* and *C* were found correctly (by substituting $x = -2$ and $x = 1$) but there were careless errors in finding *B* from equating coefficients or solving equations

In part (b) the integration commonly led to the usual sign errors for the $\ln(1-x)$ and $(1-x)^{-1}$ terms. Another common error was to integrate the $C(1-x)^{-2}$ term into logarithms or with power -3.

There were some very good solutions to part (c) with some careful log work. It should be emphasised to others, however, that it is wrong to assume that substituting zero as a limit would result in zero.

Question 6

For part (a), the use of the Binomial Expansion was well known and many students were able to achieve at least four marks in this part. Most students adopted the most straightforward route shown on the main mark scheme via $(1+2x)^{\frac{1}{2}}(1-x)^{-\frac{1}{2}}$. Alternative approaches were far more difficult and only rarely achieved more than the first two marks. It is advisable that when applying the binomial expansion it is advisable to write down an un simplified expression before attempting to simplify. The show that element to the question also resulted in some students losing out in the final two marks by simply writing out the given answer with no intermediate working.

In part (b) almost all students achieved the correct result with just a few failing to convert 2/√3 to the required form.

Part (c) was less well done with many students simply substituting *x* =1/10 into the expansion given in part (a) but then failing to use this by equating it with their *k*√3. Those students who had 2/√3 in part (b) were allowed by the scheme to gain both marks in part (c) for reaching 1600/923 or exact equivalent

Question 7

Part (a) was another 'show that' question and another example of students making huge leaps in an attempt to reach the given result. The majority of students proceeded by first differentiating

ln(1 – cos 2*x*) and then applying two double angle identities before reaching the form $k\cot x$. There were occasional slips such as replacing $\sin 2x$ by $\sin x \cos x$ and $\cos 2x$ with $1-\sin^2 x$. However the large majority of students who proceeded by this method successfully reached the correct value for *k*. Those students who made use of the identity $1-\cos 2x = 2\sin^2 x$ before differentiating were less likely to achieve all four marks. For example, students who simply wrote down $y=\ln(2\sin^2 x) \rightarrow \frac{\mathrm{d}y}{\mathrm{d}x} = 2\cot x$ were penalised. Most students who scored full marks on part (a) went on to do so in part (b). It was pleasing to note that only a few students gave the value of *x* in degrees rather than radians. Occasionally the accuracy mark for the value of *y* was lost when two values for (*x*,*y*) within the range were given. Students who guessed the value for *k* to be 2 in part (a) were only allowed to qualify for the method marks in part (b).

Question 8

In part (i), students were expected to use integration by parts on the given function. Most students proceeded to use the correct integration by parts formula, but errors in the signs when integrating the trigonometric functions caused the loss of the accuracy mark.

In part (ii) the substitution for $\mathrm{d}x$ and *x* was often completed successfully, as was the change of limits. Students need to remember that all steps in the proof were needed so that a jump from

$\sqrt{\sin^2\theta} \times \sec\theta \tan\theta$ to the stated answer of $\tan^2 \vartheta$ was not insufficient for the award of the A1*.

A number of students did not appreciate the link between (ii) (a) and (ii)(b). Similarly, a number thought that the integral of $\tan^2 \vartheta$ involved $\tan^3 \vartheta$. Many, however, could express $\tan^2 \vartheta$ correctly in terms of $\sec^2 \vartheta$ and proceed correctly to the final exact answer. There were instances of incorrect signs in the expression involving $\sec^2 \vartheta$ which resulted in the loss of both accuracy marks.

Question 9

In part (a) most students substituted *t* = 0 and obtained the correct answer of 450, although incorrect answers of 0 (from the error $e^0 = 0$), 900 (from just considering the numerator) and 300 (omission of the "–1" from the denominator) were all seen.

It was rare to see errors in part (b). Most students were able to reach $45e^{\frac{1}{4}t} = 315$ by cross-multiplying and then find the exact value of *t* using the correct order of operations. The final mark was lost very occasionally from answers not in the form *a*ln*k* with *a* and *k* being integers.

In (c)(i) most students attempted the Quotient Rule with varying degrees of success. Occasionally, incorrect formulae were used (usually a missing denominator, or numerators of *vu*′ + *uv*′ or *uv*′ – *vu*′). A use of the Product Rule was more likely to result in errors. Part (c)(ii) Whilst simplification of dP/dt was not required in part (c)(i), such correct simplification did perhaps make the calculation in part (ii) a little easier. Simplification errors such as $e^{\frac{1}{4}t} \times e^{\frac{1}{4}t}$ becoming $e^{\frac{1}{16}t^2}$ were in evidence. Most substituted $t = 8$ appropriately but a significant number had problems with the relatively sophisticated algebra. It was pleasing to see most give the final answer to the required degree of accuracy and the minus sign from the –3.71 was only lost by a few students. A small number gave the answer with no working and no correct expression seen for $\frac{dP}{dt}$. The question said "hence" and purely using the differentiation function on a calculator was not acceptable.

Question 10

This question was a useful source of marks so late in the paper – even weaker students gained some marks. In part (a) the range of the function, as in previous examinations was not well known. Part (b) was done well by most and relatively few students did not achieve both marks. In part (c) gg(x) was understood, but some basic algebraic mistakes in simplifying the fractions resulted in the loss of accuracy marks. Examples of this included multiplying both numerator and denominator of a fraction by 3. poor expansion of brackets and multiplying numerators and denominators by different expressions.

In part (d) it was disappointing to see many students not producing a careful sketch. More care needed to be taken with curvature so that curves don't bend back at the right hand end or bend down at the left hand end. The $y = 3$ asymptote was usually missing even if the range had been found.

Part (e) was usually answered well, although many found the extra value 4, hence losing the final mark. Again there was some poor algebra in evidence, such as making both the numerator and denominator of fraction negative, after a correct starting equation. This meant some never found the correct solution.

Question 11

In part (a), students seemed unfamiliar as to what constituted an equation. The accuracy mark was frequently lost due to a missing left hand side and unacceptable forms such as l_2 = ….. were common. Part (b) was answered much more confidently and there were many correct answers although slips in signs were often seen. There were also many fully correct solutions to part (c). However, there was a sizeable number of students who did not appreciate that to find the angle required, it was necessary to have two direction vectors rather than two position vectors.

Many students attempted to find the required area using side *AB* first and then finding the required area by *OA* x *AB* x sin ϑ or the two triangle equivalent. There were cases were students could not find the area of the parallelogram believing it to be *OA* x *OB* or *OA* x *AB* . Students who sketched out the problem were far more successful than those who didn't. Many who didn't merely applied 1/2 *OA* x *AB* x sin ϑ without any reference to the problem.

Question 12

As is often the case with questions where curves are defined parametrically, this question proved fairly discriminating, particularly part (c).

In part (a) most students were able to score marks with a majority gaining all five. The method of obtaining dy/dx using (dy/dt)/(dx/dt) was widely known and used correctly. Some slips were seen with the individual differentiations – often from incorrect expansions of $t(9 - t^2)$ or from a needless use of the product rule. Almost all attempts used the correct point, although some students mistakenly converted their tangent gradient to a normal gradient. The correct final form of the tangent equation was widely seen although non-integer coefficients or a missing "= 0" were occasional slips. Attempts via a Cartesian equation were rare and prone to error.

Part (b) was generally well answered with just occasional slips seen. A few attempts using a Cartesian equation were evident and these too were also largely successful.

Only the most able students however, were able to successfully complete part (c). The idea of finding an area under a parametric curve was not fully understood by many, with use of $\int y\,dt$ being a particularly common misconception. It was in this part that Cartesian methods were most commonly attempted. However, the algebra via this route was unforgiving (particularly if they opted for integration by parts) and hence progress tended to be limited. Those who applied the conventional method usually performed the integration correctly, achieving 3 out of the 5 marks. The last two marks were much less accessible. Occasionally x limits rather than those for t were used but the most common error was to fail to appreciate that the limits of $t = 0$ and $t = 3$ only produced half the area of the given region. The question stated "Use integration" so those producing 907.2 or half that amount via a calculator were unlikely to obtain much credit.

Question 13

For a 'connected rates of change/ differential equation' question this was often attempted well, with many using appropriate methods.

For part (a) $\frac{dV}{dr}$ was almost invariably written down correctly.

In part (b) most knew to use a version of the Chain Rule, and the vast majority used it correctly. However a significant minority left the expression for $\frac{\mathrm{d}r}{\mathrm{d}t}$ in terms of r, t and V without substituting in for V. Those who did substitute usually found the correct expression, though a few made algebraic slips, occasionally misusing their $\frac{\mathrm{d}V}{\mathrm{d}r}$ for V.

In part (c) the majority knew to separate the differential equation into V terms and t terms, although a significant minority either made no separation at all, or had V and t terms still together when they attempted the integration. The integration was usually of the correct form, but there were many numerical errors collecting terms to get the required form. The vast majority knew that there was a constant to be found, and so it was common for students to score all the method marks.

The main errors were integrating the $(0.05t + 1)^{-3}$ into $k(0.05t + 1)^{-4}$ or $k(0.05t + 1)^{4}$, while those who separated one side to $\frac{k}{V}$ dV had a ln$V$ term and then had difficulty with the remainder of the question.

For those who were successful in (c) the correct answer was usually found in (d). Most knew to find a value of *V* and substitute into the volume equation to find a value of *r*.

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