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MPC4 Pure Core 4

Report on the Examination

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General

Although a full range of marks was seen, there were relatively fewer very weak candidates or outstandingly good candidates compared to previous years. Most candidates attempted all the questions, although weaker candidates left gaps intending to return to questions and never did. Most managed the time allowed well, although there was evidence that some candidates had spent a disproportionate amount of time on the first half of the paper and thus were rather rushed in the remaining questions. Most candidates in general presented their work clearly, although there are those who were seemingly unable to do a simple deletion when they want to change their solution and just produced an illegible mess. Those parts of the paper found to be demanding by most candidates were Q5 (b)(ii), Q6 (c), Q7(c) and Q8 (a). In contrast Q1and Q2 were done well in terms of marks achieved, although the solutions were often not efficient or were poorly presented. Question 6(a) and (b) and Q8 (b) were also generally done well.

Question 1

Most candidates did part (a) successfully using the remainder theorem, although some evaluated $\mathrm{f}\left(\frac{1}{3}\right)$ and some numerical errors were made. Other candidates chose to use algebraic division, again usually successfully. This was acceptable as long as the answer was clear.

In part (b)(i) most candidates showed sufficient arithmetic to justify the given result; those who simply wrote down $\mathrm{f}\left(-\frac{2}{3}\right)$ without any evaluation seen were not awarded this mark.

In part (b)(ii) most candidates did achieve the correct answer to this question, although it often was not clear how they had got to it. The clearest and most efficient method was used by those who divided $\mathrm{f}(x)$ by $(2x+3)$ and factorised the resulting quadratic expression. Those candidates who used a method based on determining coefficients often assumed a quadratic expression ax^2+bx+c and took time to fully multiple this by $2x+3$ when the values of *a* and *c* should have been immediate. Others proceeded by, essentially, trial and improvement, often dividing by $3x+1$, apparently not noting from part (a) that this could not be a factor.

For part (b)(iii) full marks were dependent on candidates being able to factorise the quadratic denominator, which many did successfully, although many also made an error. Those who got to the simplified result usually displayed it clearly, whereas others left an algebraic fraction apparently abandoned.

Question 2

The vast majority of candidates showed they understood the requirements of this question although often algebraic errors were made.

Many candidates could not find the derivative of $\frac{1}{2t}$ correctly in part (a), the 2 moving between the numerator and denominator position to various powers; the derivative of $\frac{1}{t}$ itself was usually correct. However, most candidates used the chain rule correctly to find a gradient. Some candidates actually found a cartesian equation before differentiating, with some completing successfully.

In part (b) most candidates went on to use their gradient to find that of the normal, and bar a few slips in calculating the x and y coordinates, were successful in finding a correct equation, using their gradient.

In part (c) most candidates found t from $x = 4t + 3$ and substituted in $y = \frac{1}{2t} - 1$, often without any simplification, which was quite acceptable. Those who did attempt some simplification often made algebraic errors, but these were condoned following a correct substitution. Those who attempted an alternative method of eliminating t were more prone to error. For some candidates, poor presentation led to $\frac{1}{2t}$ becoming $\frac{1}{2}t$.

Question 3

It was notable in this question that candidates tended to be successful in one part or the other but not both, although some good fully correct solutions were seen.

In part (a) many clear derivations of the given result were seen. These often involved some unnecessary steps, such as returning to double angles to eliminate $\cos^2 x$. Those who didn't complete this part successfully usually had an error in the double angle formulae, often omitting a 2. Many candidates wrote down the given answer even though this clearly did not follow from the previous line.

For part (b) most candidates knew they were expected to use the result from part (a) to do this integral; although some just ignored it, with $\sin^4 x$ often appearing in such solutions. Few correct alternative methods to the one expected were seen. The common errors in the expected method were in sign and coefficient errors in the integrals of $\sin x$ and $\sin 3x$.

Question 4

In part (a)(i) nearly all candidates achieved the first mark, for $1 \pm \frac{1}{4}x$, and obtained the correct coefficient in the x^2 term, although many made a sign error.

Most candidates attempted to take out the 81 in part (a)(ii) and the majority did it correctly, with some forgetting to include the power. The approach to the expansion then varied between substituting $\frac{16}{81}$ into the result from part (a)(i) or starting the expansion again, and often a mix of the two was seen. As the result was given, complete accuracy in the expression leading to the result was expected for full marks. This included the few who had chosen to use the expansion of $(a+b)^n$ from the formula book. There were many who made errors including sign errors, omitting brackets, and omitting $x \text{ or } x^2$ in the expression.

Many candidates worked out that they needed to substitute $x = \frac{1}{16}$ in part (b) and evaluated correctly, a few not noting the request for 7 decimal places. Some candidates just found the 4th root of 80 direct from a calculator and gained no credit. Some candidates substituted the 4th root of 80 into the binomial expansion.

Question 5

It was anticipated that candidates would find most of this question accessible, but many made mistakes or showed misunderstandings of what the question parts required.

In part (a)(i) relatively few candidates could just write down the result for $\cos\alpha$; some sensibly drew a right angled triangle to help them, whilst others derived the result from $\cos^2\alpha + \sin^2\alpha = 1$. Many candidates, though, found the angle on their calculator and then its sine, some giving the result as 0.600.

Most candidates gave a correct expansion of $\cos(\alpha-\beta)$ for part (a)(ii) but then left that as their answer, without substituting the now known values of $\sin\alpha$ and $\cos\alpha$.

Relatively few candidates responded to the word "exact" in part (a)(iii) by using the compound angle formulae to give $\cos(\alpha-\beta)$ as a rational number. Some candidates confused the angles with the values of their sines and cosines. Other candidates just calculated angles, and gave an interpretation of "exact", as the requested cosine given to many decimal places.

In part (b)(i) most candidates used the double angle formula for tangent successfully, and went on to derive the given quadratic equation. The rarely seen errors were to confuse the denominator and numerator in the expression for $\tan 2x$ or to actually leave $\tan 2x$ in the expression in place of $\tan x$. Having derived a quadratic equation, few candidates proceeded to try to solve it by conventional methods in part (b)(ii) and some did not attempt this part of the question at all. Many manipulated the equation, either in $\tan x$ or $\tan 22\frac{1}{2}^\circ$, in various ways before abandoning it. Some made progress through completing the square but often forgot to consider both the positive and negative square root. Of those who did solve the quadratic equation correctly, few could give a convincing justification for rejecting the negative root, usually just writing something to the effect that the result must be positive, if they wrote anything at all.

Question 6

Nearly all candidates successfully found the partial fractions in part (a), most substituting $x=1$ and $x=-1$; although some used other values or equated coefficients.

In part (b) most candidates then went on to use their partial fractions to integrate the given expression correctly. The error that was sometimes seen was to integrate $(x-1)^{-1}$ to $(x-1)^0$, and similarly for $(x+1)^{-1}$.

Most candidates could make a start to part (c) of the question, but many rearranged the 2 and 3, and this detracted from the realisation that with y and 3 taken to the other side of the equation, they had the integral they had just done in part (b). Some who did realise this, proceeded to give an incorrect integral because they had "lost" the 2. Most candidates knew they needed to separate the variables but for many candidates the algebra and ensuing attempts at integration were full of errors. Turning the denominators y and (x^2-1) into numerators was common, as was integrating $(x^2-1)^{-1}$ to an expression involving $\ln(x^2-1)$. Those who had taken the 2 to the left hand side, often got confused with the integral of $(2y)^{-1}$, this becoming $\ln 2y$. The problem for most candidates seemed to be that they associated the 2 in the question with the 2 in the answer, although the 2 in the answer came from the given values of x and y. Most candidates did include an arbitrary constant and tried to use the given values to find it, often claiming, after some dubious manipulation, that they had derived the given result. Few fully correct answers were seen, but where they were, it was reassuring to see confident use of the log laws in deriving the result.

Question 7

In part (a) relatively few candidates went directly to the distance formula, with most finding the vector $\overrightarrow{AB}$ first. Some stopped there and thus gained no credit. Many candidates obtained the correct result, with any errors made usually occurring in misread signs or coefficients.

For part (b) many candidates identified the correct vectors to use and found the required angle correctly. The common error was to use the vectors $\overrightarrow{OA}$ and $\overrightarrow{OB}$; such candidates gained partial credit for knowledge and use of the appropriate formula. Other candidates had a mix of vectors, and for some of these it was not possible to see what was intended and where they had got their vectors from. Some candidates used one pair of vectors for a scalar product and another pair for the moduli in their formula for $\cos\theta$.

There were few complete good answers to part (c), although some candidates were very inventive in their solutions, showing good geometrical insight. Many candidates showed little understanding of the geometry, with those who drew a diagram usually being the more successful. Many candidates equated the vectors $\overrightarrow{AC}$ and $\overrightarrow{AB}$ and went on to find *B* and *C* were the same point, without apparently realising any error had been made. Some candidates attempted to find the intersection of line l with line *AB*, again not noting the intersection point was *B*. Some candidates did take the expected approach and found $\overrightarrow{AC}$ in terms of parameter λ, but then didn't know what to do with it. Some who did equate the distances, made an error in their algebra, and ultimately few fully correct solutions were seen.

Question 8

Many candidates seemed to have little experience of formulating a differential equation as often a derivative was missing from their answer to part (a)(i). Attempts at a derivative often involved variables other than the given x and t. Some candidates interpreted the question as 'find x in terms of t', and many expressions involving an exponential function were seen. Some candidates, who essentially had a correct differential equation, also thought they were required to solve it. Few candidates actually responded to the word 'decreasing' in the question, and many had a minus sign missing from an otherwise correct expression.

The given values of 500 and 20000 were often misinterpreted in part (a)(ii); the 500 often being taken to mean time. However, many candidates did indicate they had understood 500 to be a rate and 20000 the current value of x, but often also had a spurious t or another term in x in their differential equation. Some had a correct value of k, but negative, not apparently noting $k > 0$ had been given in the question. Relatively few fully correct answers to pa
rt (a) were seen.

Most candidates found the value of *A* correctly in part (b)(i), the common error being an apparent misinterpretation of the given information and finding *A* to be 700.

Part (b)(i) of the question was generally done well with many fully correct answers, and very few solutions by a trial and improvement approach. The majority of candidates could manipulate the expression and take logarithms correctly. Some algebraic errors were seen; in particular those who divided 1900 by 2000, rather than subtracting it, gained no further credit. Some first subtracted the 2000, and then tried to take logarithms of the expression as it stood, usually with an error. Some candidates incorrectly used base 10 logarithms. In completing the question most candidates rounded down their result to give the correct year. Some, who had made an error, did not round down and so had their year incorrect. Some candidates misinterpreted the last request in the question giving their answer as the 51st or 52nd year, rather than 2059.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the **Results statistics** page of the AQA Website.