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MPC4 Pure Core 4

Report on the Examination

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General

A full range of marks was seen with candidates varying from the very weak to good confident mathematicians producing high quality work. Most candidates attempted all the questions except for the very weak, who only superficially attempted the paper, leaving many gaps. Most candidates attempted the questions in the order set on the paper and presentation was generally good although some candidates' work, particularly in questions 6, 7 and 8, was very difficult to follow. Such candidates, if they find themselves in difficulties, would do better to stop and reflect on what they have done so far and then start again, rather than trying to overwrite a first attempt with parts of it seemingly crossed out, making it difficult to identify the intended solution. The questions found most demanding on the paper were question 3, particularly part (c), question 4 parts (b)(i) and (c)(i), question 6 part (b) and question 7 part (c). In contrast, questions 2 and 5 were done well by most candidates and most made a reasonable attempt at solving the differential equation in question 8.

Question 1

This question proved more difficult than expected, with many candidates who went on to score highly in the rest of the paper not achieving full marks here.

In part (a), candidates used both the remainder theorem and division, but often with an arithmetical error in the former and a lack of clear algebra in the latter.

In part (b), a considerable number of candidates could not factorise the quadratic expressions correctly and there were many poor attempts at division. It is possible that candidates are familiar with working with cubic expressions and had difficulty applying the same techniques to quadratic expressions.

Question 2

This question was generally done very well apart from part (c)(ii).

In part (a), most candidates did the two expansions accurately and clearly, with the common error being not to raise the 3 to the same power as x.

For part (b), most candidates knew what was required and used an appropriate technique, either substituting values of x or setting up simultaneous equations. A few candidates added in a constant, which was acceptable if they showed it was zero. Errors tended to be algebraic and/or numerical.

For part (c)(i), most candidates knew that they were supposed to use their result from part (b), although some did not indicate this and started with an incorrect expression, having inverted their coefficients, and thus scored no marks. Another error often seen here was to raise $(1+x)$ and $(1+3x)$ to the power of the coefficients found in part (b). A few candidates tried to use their expansions in place of the denominator. An algebraic slip in simplification cost many otherwise successful candidates the final mark. A few candidates did not use the partial fractions and wrote the expression as a product using their expansions; this is quite acceptable but involves a lot more work to achieve the correct answer.

In part (c)(ii), most candidates seemed unfamiliar with defining a valid range for a binomial expansion. Some attempted to use the modulus notation, but errors such as $|x|<-3$ showed a lack of understanding of it. Some more successful candidates only gave half the range, omitting the negative numbers, and the inequality often went the wrong way. Many candidates argued that $x \neq -1$ and $x \neq -\frac{1}{3}$ defined the range as you cannot divide by zero.

Question 3

Part (a) was done well by most candidates, although some did a lot of unnecessary work in obtaining the correct answer. It should be possible to write down the values of R and $\tan\alpha$ from the expression.

For part (b), most candidates understood what was expected, with many getting both solutions correct. Others were unsure whether or not there was a second solution, and often did not give one or gave more than one. A common wrong answer was $256.7°$, from $360°–103.3°$.

Although some candidates answered part (c) confidently, many did not and some did not attempt it. There was confusion between maximum and minimum, and the common errors were to say that the minimum occurred at $90°$ or $180°$ with the expression equated to 0 or -1 and not -5. Some thought the minimum value was an angle. The few attempts to use calculus were usually unsuccessful with candidates again unable to demonstrate that they had found a minimum value.

Question 4

The evaluations in part (a) were done correctly by most candidates, although some made numerical errors. In part (a)(ii), the request for three significant figures was largely adhered to, although some interpreted this as three decimal places.

Candidates started part (b) well but many were confused as to how to handle the negative signs. Many attempts to take logs of negative numbers were seen. Many got to $14\ln\left(\frac{5}{12}\right)$ or $-14\ln\left(\frac{5}{12}\right)$ and gave this as their answer. Despite this, the vast majority gave the correct answer of 12 to part (b)(ii), some just ignoring their negative sign or saying it must be positive. They apparently did not respond to a negative answer by reviewing their answer to part (b)(i). Very few candidates explained what they were doing with the negative index to obtain the expected answer.

In part (c)(i), very few candidates derived the differential equation with confidence. Some made a start by attempting to differentiate the expression for x, although, of those, many made the error of bring down the t together with $\frac{1}{14}$. Others attempted to find an expression for t and differentiate that. There was usually little progress beyond these starting points, although several candidates attempted to convince the examiner that they had found the requested result, with much abuse of the $\ln$ function seen in such attempts.

Some tried to integrate the given differential equation to recover the expression in x, and some very neat solutions were seen this way, although those who did not consider limits or a constant could make no further progress. Again, handling negative signs with logarithmic expressions caused difficulties. Most candidates scored the final mark for applying the result from part (c)(i), although some did say that $\frac{1}{14}(7) = 2$.

Question 5

This question was generally done well with most candidates demonstrating at least some knowledge and ability with implicit differentiation.

For part (a), many candidates only verified that $a = 1$ was a possible solution and thus failed to show that it was the only positive solution. Those who did form a quadratic equation as expected usually factorised it correctly, with some giving a clear argument as to why $a = 1$.

In part (b), a few candidates rearranged the given equation before attempting differentiation, and some attempted to divide through by y^2, often making algebraic errors and leading to poor attempts at differentiation.

Most took the expression as given and were nearly always correct in differentiating the left hand side; they usually made a good attempt at either the product rule or chain rule, and often both, on the right hand side. Many fully correct solutions were seen. Errors varied from dropping a 5 or 2, to attaching $\frac{dy}{dx}$ to the wrong term or bringing in a spurious $\frac{dy}{dx}$ having started their solution with $\frac{dy}{dx} =$. Some candidates did not evaluate their derivative at $(1, 1)$ as requested.

In part (c), most candidates were able to use their answer to part (b) to find an equation of the tangent, although a few found an equation of the normal instead.

Question 6

Most candidates differentiated the functions in part (a) correctly, but with some making sign or coefficient errors. Most also used the chain rule correctly, with relatively few getting it upside down or as a product. Evaluation was not always successful, with the common error being to have the calculator in degrees mode when working with radian measure.

Answers in part (b) varied from no attempt to very well presented clear demonstrations of the result with $k = 4$. Curiously, some well-presented solutions had $k = 2$, with candidates omitting to square this term.

Many candidates got themselves into difficulties through trying to recollect and manipulate trigonometric identities, with little apparent thought as to where they were heading, often making algebraic errors. Their work was often difficult to follow. Other candidates showed a misunderstanding of the question in that they gave a value for k from their working, without finding the whole expression. Some candidates got confused between the variables x and θ, with some just using cos or sin with no variable attached.

Question 7

In part (a), most candidates were successful, both showing that they knew the condition for two lines to be perpendicular and demonstrating that the scalar product was zero. A few failed to state the conclusion after finding a zero scalar product. Quite a number of candidates started their solution to part (a) as if they were answering part (b), with some stating the conclusion that the lines intersect and so are perpendicular. Although this gained no credit for part (a), it was credited in part (b).

In part (b), most candidates knew they were to set up simultaneous equation and solve them which most did successfully. Both elimination and substitution techniques were seen, the latter usually requiring rather more work. The common errors were in the signs. Some candidates failed to verify that an independent third equation was also satisfied by their solutions or that their intersection point indeed lay on both lines. Some, who attempted verification and found that it did not work, did not then check their own working for an error; they simply concluded that the lines did not intersect, with some adamantly stating that the question was wrong.

Fully correct solutions to part (c) of the question were rare. Many candidates got no further than finding the vector $\overrightarrow{AP}$ from their previous result, then taking the question to mean $\overrightarrow{AP} = \overrightarrow{BP}$ rather than that the lengths of these two vectors were the same. Those candidates who did realise that the question was about lengths of vectors and drew a diagram were generally successful. Others were determined that they could find the point B by using an arbitrary point on the line l_1, often assuming $\lambda = 0$. Many concluded that A and B were the same point and so the distance between them was zero.

Question 8

For part (a), most candidates knew that they were supposed to separate the variables and integrate, although interpretations of this varied widely. There were some impressive answers with clear integration leading to the final requested result. In contrast, some candidates were not sure what to do with $\mathrm{d}y$ and $\mathrm{d}x$, these sometimes appearing as denominators. The weakest candidates simply substituted the given values of x and y into the differential equation and produced meaningless nonsense. Most candidates who had separated correctly at least got as far as $k\sqrt{1+2y}$ for their y integral, although an index of $\frac{3}{2}$ or $-\frac{1}{2}$ was a fairly common error. It was pleasing to see the integration of $\frac{1}{x^2}$ done correctly by many candidates, with the common error being in the index. It was also pleasing that most candidates included an arbitrary constant in their solution and tried to find it using the given condition.

In part (b), most candidates who had $k\sqrt{1+2y}$ in their solution realised that they were to square it to move towards the given result, but many attempts were poor, with $\left(\mathrm{f}(x)+c\right)^2 = \left(\mathrm{f}(x)\right)^2 + c^2$ being frequently seen, despite there being a term in $\frac{1}{x}$ in the given solution. Some candidates who had correctly introduced a constant c in part (a) proceeded to manipulate their solution without including c in the manipulation, and thus failed to score the mark for finding it.

Mark Ranges and Award of Grades

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