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Mathematics MPC4

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Pure Core 4

Report on the Examination

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General

A full range of marks was seen on this paper, although a relatively small number of very poor scripts were seen. Most candidates were able to demonstrate some knowledge of the specification with questions 2 and 3 generally being done well. Most candidates attempted all the questions, although a few omitted question 1, and the latter parts of questions 6, 7 and 8. Questions 6, 7 and 8 were found to be the most demanding, with few gaining full marks for these questions. Part (b)(ii) of question 8 was found particularly difficult by most candidates, with some omitting it or some giving a simplistic wrong answer. Presentation of candidates' work was generally good, with working out set out clearly, although some candidates did get over zealous when deleting what they believed to be wrong working. Candidates should be advised that crossing through unwanted work with a single line is sufficient.

Question 1

This question provided a good start for the candidates with over half the entry gaining full marks , although some candidates omitted it altogether.

Part (a) The most common error was to equate $\tan\alpha$ to $\frac{2}{5}$ instead of $\frac{5}{2}$. Some candidates didn't make explicit their value for R so didn't answer the question, and so lost a mark even if they gave the correct answer to part (b)(i).

Part (b) Despite having quoted R as $\sqrt{29}$ in part (a) , some candidates went on to state the maximum of $2\sin x + 5\cos x$ as 5, and said the maximum occurred at $x = 0$, or other similar errors. Some candidates had the correct answer for where the maximum occurred in their answer, but then went on to give more than one value, and so lost the mark. A few candidates correctly found the minimum value and where it occurred, but gained no credit. Almost all candidates heeded the instruction to give values of angles to the nearest 0.1°.

Question 2

Overall, this question was answered well and was a good source of marks for most candidates.

Part (a)(i) Many candidates lost a mark here through not giving a full proof of the result. Although most recognised the need to find f(-1/3) many candidates merely wrote this in an unsimplified form followed by $= 0$. An extra line of working was required as well as a concluding statement.
A few candidates used the method of long division which gained no marks as the question asked for use of the Factor Theorem.

Part (a)(ii) This was answered very well and most candidates obtained the correct three factors and presented them as a product. Methods used, though, varied considerably from those who just wrote the factors down by inspection, to those who used long division to find a quadratic factor and factorised that, to those who used a complete method of undetermined coefficients. All methods are valid, although some are much more efficient than others.

Part (a)(iii) Although there were many correct solutions, some candidates lost either a factor of 3 or x or sometimes both so could not complete correctly. Also, some stopped after correct cancelling of one factor, for which they gained some credit.

Part (b) The majority of candidates found f(2/3) and equated it to −4, although a few equated it to 4. However, arithmetic errors often occurred so some did not reach the correct answer. A few candidates attempted this part by long division which, although valid, is a most inefficient method.

Question 3

The majority of candidates did well on this question, with nearly half the candidates scoring 10 of the 12 marks or more.

Part (a) Candidates were generally confident and competent in finding partial fractions and *A* and *B* were usually found correctly. The most common method was to substitute $x = -1$ and $x = -3/5$. The latter occasionally caused arithmetic problems. However, those who chose to use simultaneous equations or a mix of the two usual methods were just as successful.

Part (b) It was pleasing to see that candidates could generally use the binomial expansions correctly and accurately and there were many complete correct solutions. The most common errors occurred in the expansion of $(3+5x)^{-1}$. Instead of $3^{-1}\left(1+\frac{5}{3}x\right)^{-1}$ some used $3\left(1+\frac{5}{3}x\right)^{-1}$. Some omitted the brackets around $\left(\frac{5x}{3}\right)^2$ too, although some continued correctly from here. Almost all knew they were to combine the two series to get to the final result, although many sign and arithmetic errors were seen in attempting to do this. Very few misused the constants A and B found earlier, with just a few raising their result to these powers. Few candidates attempted this question by multiplying their expansions together.

Part (c) Many candidates showed they were not familiar with finding the range of valid values of x. Some just stated $-1 < x < 1$ while others assumed the answer to be $-5/3 < x < 5/3$. Some didn't even use an inequality but gave specific values for which they believed the expansions were not valid. Those who did find the correct limits often included the equality, so lost a mark.

Question 4

This question was also done well, with again nearly half the entry gaining full marks.

Part (a)(i) Most candidates found the derivatives $\frac{\mathrm{d}x}{\mathrm{d}t}$ and $\frac{\mathrm{d}y}{\mathrm{d}t}$ successfully and went on to divide to find $\frac{\mathrm{d}y}{\mathrm{d}x}$ correctly. The most common, although rare, error was the omission of the minus sign when differentiating e^{-2t}. Occasionally a candidate used $\frac{\mathrm{d}x}{\mathrm{d}t} / \frac{\mathrm{d}y}{\mathrm{d}t}$.

Part (a)(ii) Almost all candidates gained this mark for a correct tangent equation using their numerical gradient from part (a)(i). Only a few took the negative reciprocal to find the equation of the normal.

Part (b) Most candidates were successful here too. Whilst some used the quickest method of substituting $\mathrm{e}^t = \frac{x}{3}$ or $\mathrm{e}^{2t} = \frac{x^2}{9}$, others used logarithms. Candidates were required to conclude with the correct equation, which some failed to do; a verification was given no credit.

Question 5

Most candidates scored well on this question although some misinterpreted the information given.

Part (a) Most candidates substituted and evaluated correctly. A few, having written the unsimplified form, could not cope with the index and combined the 10 and 2 incorrectly. Some misinterpreted the information and found a mass that decayed to 10 grams in 14 days.

Part (b) Most candidates substituted the 16 correctly and then, usually, took logs in order to solve for d. Only a minority recognised that $\frac{1}{16} = 2^{-4}$ and so $\frac{d}{8} = 4$. Some candidates began incorrectly by writing $2^{-\frac{d}{8}} = 16$ which led to a negative answer. Most of these then just dropped the minus sign rather than looking for an error in their working.

Part (c) Most candidates set up the correct equation and used logarithms to various bases to solve it. The most common answer here was 53.15, as candidates failed to heed the request to give the answer as an integer. Many also rounded down to 53, misinterpreting what the question was asking.
Not all understood the question and assumed the mass had decayed by 1%, so used 99%.

Question 6

There was a wide range of responses to this question and relatively few candidates gained full marks.

Part (a)(i) Most candidates wrote down a correct form for $\tan 2x$ with only a few writing $\tan^2 x$ instead of $2\tan x$. Most multiplied by the denominator to obtain a cubic equation in $\tan x$. However, many divided throughout by $\tan x$ to get $\tan^2 x = 3$ and failed to demonstrate that $\tan x = 0$ is also a solution. Some used verification which did not warrant any marks.

Part (a)(ii) Very few candidates gained this mark. The solution of 120° was almost always omitted. Most wrote 0° and 180° too. This in itself was not penalised this time as these values were outside the range of x requested.

Part (b)(i) This was answered very well, as candidates showed familiarity with double angle formulae and handled the algebra involved with confidence.

Part (b)(ii) The quadratic formula was used correctly by most candidates and most demonstrated where the $\sqrt{3}$ came from. The majority of candidates, though, just seemed to ignore the negative root and gave no explanation as to why. If they found only one root then they lost 2 marks. Some gave unsatisfactory explanations for the exclusion of the negative root, such as $\sin x$ cannot be negative or that it was >1. Those who used completion of the square to solve the equation almost invariably just took the positive square root.

Question 7

A full range of marks were seen in this question. Some candidates had little or no idea as to how to solve a differential equation, whereas some gave concise and correct solutions and could use their solution to solve the problem in the given context.

Part (a)(i) Most candidates separated the variables correctly, although some poor notation was seen and some mishandled the $\sqrt{x}$. Many also made errors in the integration, often getting the coefficient wrong in one or both integrals. Although many did add an arbitrary constant, many also failed to complete the question as requested and by writing x in terms of t. Of those that did, many failed to square their expression in t correctly; $\left(\mathrm{f}(t)+C\right)^2=\left(\mathrm{f}(t)\right)^2+C^2$ was a common error. Many apparently didn't review their solution when given the form of answer in part (a)(ii). When manipulating an expression containing a constant some, for example, renamed $\frac{C}{2}$ as C and sometimes then confused themselves; whereas others correctly introduced a new letter for the revised constant.

Part (a)(ii) Many went on to find a correct value for the constant and give the required form, as they used a previous line of working from part (a)(i) rather than their final answer. Any attempt to find a constant using the information given was credited, but many tried to force their solution into the form of the answer given, rather than review their work for an error.

Part (b)(i) This question confused a lot of candidates and many assumed the greatest height occurred at $\cos bt = 0$ and not −1. Many candidates didn't attempt this part.

Part (b)(ii) For those who set up a correct equation, the most common error here was to use degrees instead of radians; so the more common answer was 207.3, it apparently not occurring to candidates that a time of over 3 minutes was rather long for a fairground car to reach a height of 5 m. Many did not set up a correct form of the equation and so could gain no marks.

<u>Question 8</u>

The first part of this question was found to be fairly straight forward by most candidates, but then the second part defeated most; although some fully, or almost fully correct solutions were seen.

Part (a)(i) This was answered well, although some candidates made arithmetic errors. . A few lost a mark for giving their answer in coordinate form and a few found $\boldsymbol{OA}-\boldsymbol{OB}$.

Part (a)(ii) Most candidates worked with the correct vectors, although some used the position vectors of A and/or B. The scalar product was usually found correctly and the formula for finding the cosine of the angle was well known. However, having set up the correct equation, some candidates equated the product of $\sqrt{14}\sqrt{14}$ to $2\sqrt{14}$, so found an incorrect angle. Some made an error in finding a modulus.

Part (b)(i) Almost all found the vector $\boldsymbol{OD}$ correctly. However very few candidates gained the mark for the equation of the line as most wrote $l_2 =$.. instead of $\underline{r}$ =.. so they didn't actually have a vector equation of the line.

Part b)(ii) This problem required the candidates to both devise a strategy for its solution and carry it out.
The key to the solution was realising that the moduli of $\boldsymbol{AD}$ and $\boldsymbol{BC}$ were equal, which could then be used directly or in setting up an equation involving equal angles. However, many candidates either took the vectors $\boldsymbol{AD}$ and $\boldsymbol{BC}$ to be equal, or that $\boldsymbol{AD} = -\boldsymbol{BC}$. They got a wrong result for the coordinates of C very quickly from this assumption. Those few candidates who got as far as finding $p = 5/7 \text{ or } 1$ usually opted for the latter root (some stating μ had to be an integer) and apparently didn't think about the geometry of the trapezium. .
Those who did have an appropriate strategy often made an error in setting up an equation and/or made an algebraic or numerical error in solving it.

Mark Ranges and Award of Grades

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