Pearson Edexcel

Examiners' Report

Principal Examiner Feedback

Summer 2022

Pearson Edexcel GCE

AL Further Mathematics (9FM0)

Paper 4A Further Pure Mathematics 2

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Question 1
Most candidates made good progress with this question, demonstrating good knowledge of permutation notation, although some only wrote ‘1’ or ‘e’ for the identity, and expressed the inverse in an unconventional order.
Part (c) caused more issues. Candidates demonstrated that the axiom associative with many candidates however composing the permutations the wrong way round.
Part (d) most candidates demonstrated that they knew the required condition on subgroup orders, but many gave the wrong value for the order of S_4.

Question 2
Part (a) Most candidates understood the need to produce the characteristic equation but some made slips in finding the coefficients usually by omitting a term or making sign errors. It was less common for them to make a mistake in solving their simultaneous equations.
Part (b) Most candidates understood what they needed to do, using their values of *a*, *b* and *c* to find the Cayley Hamilton equation. They then were able to multiply through by $\mathbf{M}^{-1}$ and rearrange to find matrix expression for $\mathbf{M}^{-1}$. Due to an error in the value of *c* many failed to reach the correct answer, with some giving up before finding the required matrix.

Question 3
Almost all candidates were able to successfully answer part a, explaining the constraints. Part (c) was also generally very well done, with a variety of different notations used. The induction in part (b) was more variable. It was generally obvious which candidates had practiced the structure and layout of an induction proof, and these candidates usually scored highly, although it was common to lose marks due to not enough lines of working being shown in the induction step.

Question 4
Part (a) This was mostly done well but quite a high proportion did not give a complete conclusion, thereby losing the 2nd mark by failing to conclude their proof properly.
Part (b) The majority of candidates solved this part correctly with many using Bezout’s identity. A few lost the third mark because they did not multiply their earlier result by 10. Very able candidates spotted that they could use the first line from part (a) $124 = 17 \times 7 + 5$ to find 10 as a multiply of 124 and 17
(c) Many candidates score both marks by correct use of modular arithmetic. A few left their answer as 42, for example.

Question 5
Part (a) In general, candidates seemed familiar with this style of question, with almost all of them attempting to solve it by forming the equation of a circle and extracting the centre and radius. There were a number of numeric and algebraic slips in this part of the question, though, with the most common being sign errors, and doubling rather than halving while completing the square. It was quite common for candidates to miss the key information about the solutions being in the ‘third quadrant’, and so get $a = 4$ rather than $a = -4$
Part (b) candidates who had the correct method in part (a) were able to pick out their centre coordinate correctly

Question 6

Part (a) Most candidates formed and solve the auxiliary equation obtaining the correct complementary. A few candidates used the wrong form of the complementary function, and others substituted incorrectly in their attempts to find the particular solution.

Part (b) Those that achieved the correct answer in (a) mainly followed this through with the correct solution. Most of the others gained the method mark for using the information give to find the value for their constants

Question 7

Candidates were very successful at (i) (a) however for (i) (b) a large number wrote the answer 360, not realising that they had to remove the cases where the leading coefficient was 0, which does not lead to a quartic equation

Part (ii) (a) received a wide variety of responses, with some very well argued, clear and concise arguments, but a much larger number that lost marks due to their reasoning not being clear. It was very important that the candidates explained exactly what the conditions given in the question implied for the values of the digits, and this was not always done well for the condition that the sum of the digits is even.

Part (ii) (b) was often more successful, even with candidates who had made errors in part (a). Candidates successfully used the result from part (a) to find that $b = 4$ and therefore $a + c = 4$ leading to the four correct possible value for N.

Question 8

Part (a) Almost all candidates had the correct two points marked ut some did not produce a major arc while a few had the arc below the points.

Part (b) Most candidates explained that the centre lay above the midpoint of (2,5) and (8,5)

Part (c) This part was not well done in the main, with some attempts at complicated methods being abandoned part way through. Those with a suitable sketch from part (a) tended to use trigonometry to reach the result more easily.

Part (d) Most candidates recognised that they needed to use their answer from part (c) and picked up at least one mark for this question. Those with incorrect answers to part (c) often could not reconcile their result with the geometry.

Question 9

Part (a) the reduction formula proof gained a number of well written and completely correct responses, mostly among those candidates who used the main approach given in the mark scheme. Those who attempted the alternative approach found it much harder to make progress, often gaining no marks for this part of the question. Marks lost tended to be for algebraic slips,

Part (b) Most candidates noticed the transformation needed in part (b), although a significant number found an incorrect coefficient of 32 rather than 2, leading to a loss of the final accuracy mark. Aside from that, candidates generally did well on this part of the question, including those who struggled with part (a).

Question 10

Candidates understood how to find the surface area of revolution with most using the formula for rotation about the *y*-axis. A few rotated about the wrong axis, but could gain later method marks for their algebraic manipulation. Some found manipulating $\left(\frac{\mathrm{d}x}{\mathrm{d}t}\right)^2+\left(\frac{\mathrm{d}y}{\mathrm{d}t}\right)^2$ into a form that one could easily square root tricky.

Part (b) Most candidates used the result form part (a) and integrated to achieve 675π. The majority of the candidates did not recognise that they needed to find the area of the circular base and add this on find the area of the inner surface of the plant pot.

Part (c) Although candidates mainly recognised the need to divide 120 000 by twice their area some used just 12 or made other slips with the units, while others coated only the inner surface of the pot

Part (d) Most candidates identified a limitation of the model, some recognising that the thickness had not been taken into account, others noting that there would be a rim. A few candidates suggested for example that some paint might be spilt or that more than one coat might be needed, but these comments did not relate to the model.