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Examiners' Report  
Principal Examiner Feedback

Summer 2022

Pearson Edexcel GCE  
Further Mathematics (8FM0)  
Paper 22 Further Pure Mathematics 2

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Publications Code 8FM0\_22\_2206\_ER\*

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Overall, the paper performed well with a good range of scores in each question, and no parts of the paper proving inaccessible, even though the candidature was very small. Even where maximum marks was not achieved by any of the candidates (question 3) every mark was gained by at least one with different errors being made.

There was good progress seen in some of the newer topics, such as number theory and recurrence relations, though group theory is still a weak point overall. The familiar topic of matrix diagonalisation was the best answered question of the paper.

### **Question 1**

This proved a useful opening question with the majority of candidates scoring at at least two marks, usually the two method marks. The correct sector was not always identified, though the origin of the sector was correct in nearly all cases. Those with the wrong sector generally had a span of angles from  $\frac{\pi}{4}$  to  $\frac{3\pi}{4}$ , in the upper half plane. The strip was usually correct, but not always well drawn. However a few did have a horizontal, rather than vertical strip.

Specific instructions on the boundaries were given in the question and were followed well by most, though some did have all boundaries as solid lines.

Overall, a quarter of students were able to access all four marks, with three quarters accessing at least two.

### **Question 2**

This familiar topic was answered very well with 75% of candidates scoring 6/7 or 7/7, and only those who offered no answer at all failing to score at least three marks. The process for diagonalisation is well known and was carried out well, with few errors made, and follow through marks enabling the latter marks to be accessed even when slips calculating the eigenvectors had been made.

### **Question 3**

The question overall worked well as far as can be ascertained from the small candidature. However, it is clear group theory is still an unfamiliar topic which has yet to settle in candidates minds. Over time, with more past papers to practice, no doubt the topic will become more familiar, but still early in the new specification there are still some new ideas being assessed. It was the only question in which maximum marks was not achieved by any of the small candidature, though each individual mark was awarded to some.

Part (i) was left out entirely by most, but those who did attempt it were generally successful. The idea of a proof perhaps put off some people, but the need for the divisibility test was shown by all those attempting. Not all identified Lagrange's theorem explicitly, though most at least alluded to the result. Setting up a formal assumption for contradiction was not well done, but the scheme allowed flexibility with the approach. Two or three marks were common for those attempting this part.

In part (ii) many did just the table and nothing more, picking up a few easy marks without attempting the rest. Only a couple left out the question entirely, but the modal score for the question was 3 marks, usually for the table and nothing more, though a couple made an error in the table but picked up one mark elsewhere. Spotting 16 as the identity proved the most difficult challenge to the group axioms, with some assuming it should be 1, and concluding there is no identity so not a group (for which a special case

was allowed for one of the last three marks). Those who were able to spot the identity generally went on to score full marks for part (ii).

#### **Question 4**

There was a good spread of marks for this question, with good access for part (i) and a mode 8 closely followed by 11 out of 11 (scored by about a third of candidates). Of the students who attempted the question, all scored at least 5 marks. Part (ii) proved to be a good discriminator for the paper.

The required process for parts (i)(a) and (b) were shown by most, and usually carried out well with nearly all able to obtain the correct highest common factor. Occasional slips in back substitution did occur, but the method itself was demonstrated well. Most, however, did not spot the connection between (i)(b) and (c), but used direct calculation instead, which was an allowable method so the marks could be scored. It would be useful for candidates to look for connections within parts such as this, though, as it can speed up the work.

Part (ii) did prove to be a more challenging part, as it was expected to be, with many making no progress. Some did identify  $5^2 \equiv 12 \pmod{13}$  but were unable to see how to use this to suitably simplify the equation, while others made no progress at all. For those who could find a method to find a solution, they generally did so successfully.

#### **Question 5**

There was a wide spread of marks again for this question, showing it worked well as a final question discriminator. Only 3 candidates did not score at all (no attempt made), with three modes of 0, 4 or 5 marks, the majority did score 4 or more.

The explanations required in part (a) are becoming familiar to people with most able to score both marks, though some did omit to explain the starting term, with a couple omitting (a) entirely but proceeding to attempt subsequent parts.

It was interesting to note that in part (b) most adopted an unanticipated approach via forming an auxiliary equation and particular solution (Alt 2 on the mark scheme), rather than using the information in the question about the given form and setting up and solving equations using the first two terms. Candidates were going through the process they have been taught, rather than taking in the question as given and using the information already presented. However, the process was usually carried out correctly leading to the correct values for  $a$  and  $b$ .

Part (c) was another good discriminating part, fitting for the last part of the paper.

Although many were able to identify the long term behaviour (sometimes by substitution of large values), only very few realised they needed to subtract the 10 from this value to find the least amount of vitamin in the body before drawing a conclusion. Those who did realise this went on to make a correct conclusion.

