Examiners' Report
Principal Examiner Feedback

November 2021

Pearson Edexcel GCE
In Further Mathematics
Paper 3D Decision 1

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General Introduction

This paper proved accessible to almost all candidates. The questions differentiated well, with most giving rise to a good spread of marks. All questions contained marks available to the E grade candidates and there also seemed to be sufficient material to challenge the A grade candidates. Candidates are reminded that they should not use methods of presentation that depend on colour but are advised to complete diagrams in (dark) pencil. Candidates are also reminded that this is a 'methods' paper. They need to make their method clear, 'spotting' the correct answer, with no working, rarely gains any credit. Some candidates are using methods of presentation that are too time-consuming and are therefore reminded that the space provided in the answer book, and the marks allotted to each part, should assist candidates in determining the amount of working they need to show. Some very poorly presented work was seen and some of the writing, particularly numbers, was very difficult to decipher. Candidates should ensure that they use technical terms correctly. This was a particular problem in questions 5(b) and 6(c).

Question 1
Part (a) was answered very well with almost all candidates giving the correct Hamiltonian cycle. When errors occurred it was usually in those who failed to return to C. In part (b) most candidates applied the planarity algorithm correctly although some did not make their method clear or just provided a pictorial justification for why the graph wasn't planar (which was not acceptable).

Question 2
This was a standard question on critical path analysis and was a good source of marks for most of the candidates. The main issues seen were in part (c) in which some candidates' schedules contained either 3 or 5 workers (rather than the correct number of 4). Candidates are reminded to check the duration, time-interval, and immediately preceding activities for each activity very carefully when constructing a schedule of the workers to activities.

Question 3
This was the best answered question on the paper covering the topic of minimum connectors and the travelling salesperson problem. Most candidates correctly saw the link between finding the MST and its weight in parts (a) and (b), and the link to the lower bound in (d).

Question 4
Almost all candidates correctly set up the initial time matrix in (a) and scored at least the method mark in (b) for attempting the first iteration of Floyd's algorithm. When errors occurred, it was usually down to arithmetical slips rather than a lack of understanding of the algorithm. In part (c) most candidates realised that the 'appropriate' algorithm was route inspection and correctly realised that they had to consider the pairings of nodes A, C, D and F. Most who did this were successful in the remaining two parts of the question.

Question 5
Most candidates found parts (a) and (c) of this question straight-forward (quick-sort and bin-packing). Part (b) less so, as candidates had to explain why n must be either 44 or 45. Very few gave an argument along the lines of:

- The 5 has been put in Bin 2 rather than Bin 1 which indicates that the size of the bins is less than 30 + 12 + 5 = 47 and so therefore $n \leq 46$
- The fact that there is still room for the 2 in Bin 1 indicates that $n \geq 44$
- The 18 cannot fit in Bin 2 and so therefore $n < 5 + 23 + 18 = 46$ which implies that n is either 44 or 45

Question 6
Part (a) was done extremely well with most students correctly applying Dijkstra's algorithm. Part (b), the most demanding part of the paper, was not answered correctly by any of the candidates taking the paper this series. No one realised that if one application of Dijkstra's algorithm had order n^2 then repeated applications of the same algorithm to produce a table of shortest distances would have order n^3. Even though no candidate scored full marks in (b), the mark in (c), for explaining why the value in (b) was only an approximation, could still be earned (and was by some).

Question 7
This second question on critical path analysis was answered extremely well with most scoring marks in the first two parts. Part (c), in which candidates had to explain why activity D could not be critical, was quite demanding with very few realising that if all activities have the same duration, then any critical path must contain 5 activities, and as all paths that pass-through D have only 4 activities D cannot be critical.

Question 8
It wasn't obvious if time was a factor in why a few attempts at the final question were left blank or whether it was the demand(s) of the question itself. Most candidates who did attempt this question scored a good number of marks in (a) and (b) for setting up the linear programming problem and the corresponding two-stage Simplex tableau. Most candidates knew what to do in part (c) but didn't give sufficient detail for why the 5 in the s_2 row was the pivot. In part (d) many attempted the iteration of the second stage, and while some got the correct values of x, y, and z, many did not give their final answer in the context of the number of hours spent swimming, cycling, and running.

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