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Examiners' Report
Principal Examiner Feedback

Summer 2022

Pearson Edexcel GCE
Further Mathematics (8FM0)
Paper 27 Decision Mathematics 1

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Introduction

This paper proved accessible to most candidates although examiners noted that a significant number of candidates are still struggling to cope with the new content not previously seen in the legacy module 6689/01, and some had difficulty with the problem-solving nature of some of the questions (which forms part of the assessment objectives for this qualification). However, 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 should be reminded of the importance of displaying their method clearly. Decision Mathematics is a methods-based examination and spotting the correct answer, with no working, rarely gains any credit. The space provided in the answer book and the marks allotted to each section 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 language correctly. This was a problem in questions Q2(a), Q3(a) and Q5(b).

Report on Individual Questions

Question 1

Examiners commented on the fact that many fully complete and correct responses were seen to this question. For the quick sort, most candidates used middle right pivots, rather than middle left. A few lost marks for using both middle left and right pivots during the sort. In rare cases candidates lost three of the four marks due to using only one pivot per iteration, after the first pass. Some lost the final mark for failing to pivot on the 56 (or the 59, for middle left) in the sub-list '59 56'. Candidates need to look out for correctly ordered two item sub-lists like this and pivot accordingly. Incorrectly sorting into ascending order, followed by reversing the resulting list, was penalised with the loss of two marks (as the question specifically asked for the sort to be completed in descending order).

Question 2

Part (a), in which candidates were required to give a reason for the dummy from event 3 to event 4, were mixed, with many candidates either giving a general precedence argument (so failing to reference specific activities) or failing to mention all required activities. Although not penalised if omitted, the use of the word 'only' usually makes the candidate's argument easier to understand (e.g. in this case the dummy is required because activity F depends only on activity C, but activities G, H and J depend on activities B, C and E).

The completing of the early and late event times in part (b) was done well with almost all candidates scoring the first method mark (and most picking up one of the two accuracy marks too) – if errors occurred it was usually on the backward pass (either at the beginning of either activity F or H). Most candidates went on to correctly state the critical activities in part (c) and to use the correct method to calculate the lower bound in (d) (although some candidates are still doing the incorrect calculations of: project completion time / total number of activities). The drawing of the cascade chart in part (e) was done well by most candidates with the majority using the standard approach of placing the critical activities on a single line at the top of the chart and then placing each non-critical activity on a separate line with their corresponding float, usually shaded or shown in a way to differentiate from the duration, appearing after. Very

few scheduling diagrams were seen (which are not on spec. anyway) and the most common error was to either forgot one (or more) activities or have an incorrect duration/float on one or more activities.

Question 3

In part (a) candidates were asked to explain why Dijkstra's algorithm should begin at C (to find the route from A to J via C) and most candidates struggled with this part. Examiners commented that it was very rare for candidates to state that as Dijkstra's algorithm only finds the shortest path from a given starting node to all other nodes (in the network) therefore, if the shortest route from A to J via C is required, then this is equivalent to finding the shortest paths from C to A **and** C to J and so therefore (as C is common to both paths) then this is where the algorithm should begin.

It was disappointing therefore in part (b) that almost half the candidates applied Dijkstra's from A, even though part (a) had told them it should begin at C. Those that did apply Dijkstra's from A could score at most three of the six marks available. Many candidates, who did start at C, gained all six marks for correctly using Dijkstra's algorithm, though errors were often seen in the order of labelling. There were a few isolated scripts with just one working value at every vertex, which scored no marks. In part (c) many candidates did apply Prim's algorithm correctly (from C) but it was common to see candidates scoring only one mark in this part for explicitly rejecting arcs (by design Prim's algorithm grows in a connected fashion by only considering nodes that are not already part of the MST and therefore cycles are never formed (and therefore there is no need to 'reject' arcs)). Those candidates who had found the correct MST usually went on to score the mark in part (d) for stating its total length.

Question 4

In part (a) most candidates scored at least one mark for stating at least two correct inequalities that defined the given feasible region. Even though the stem specifically said that the feasible region included its boundaries several candidates used strict inequalities.

A good number of candidates, in part (b), went on to solve the correct pairs of simultaneous equations and found the coordinates of the maximum and minimum vertices (so scoring the first three marks in this part). However, very few used the given values of the objective function (at these two points) to successfully derive the correct linear expression for the objective function.

Question 5

The responses to this question were mixed; some candidates left the entire question blank or only attempted the first two parts. Part (a), when attempted, was usually answered correctly (with most realising that adding a single arc between B and C would make G Eulerian). Similarly, in part (b), most candidates realised that the given route was not an example of a path but not all correctly articulated the reason why; general arguments were not accepted and specific mention had to be made to vertex C appearing twice (or the appearance of the cycle CFEC). Several candidates in this part thought that the given route was a path because all vertices appeared at least once (or thought this was the reason why it wasn't a path). The responses, as expected, to part (c) were mixed with very few candidates scoring all six marks. Candidates are reminded that the number of marks is a good indication of the amount of work required when answering any question at this level. It was clear that many candidates failed to read the question carefully and did not engage with the line in the stem to part (c) that said that

the given inspection route contained two roads that needed to be traversed twice (and so many formed an equation containing the incorrect expression $5x - 8$). What was expected in this part was for candidates to realise that as the inspection route contained two roads (that were repeated) this therefore meant that either pairing AB, AC or BD, CD were repeated, and when considering the linear expressions for these two pairings, it was therefore clear that it was BD, CD that was repeated (as $3x + 2 < 3x + 6$ for all x). Those candidates who realised this usually went on to correctly find that x was at most 8. However, this was not the end of the story as many did not then realise that as two roads were repeated in the inspection route this implied that $5x - 8 > 3x + 2$ (that is the direct route of B to C must be greater than the

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