Pearson Edexcel

Examiners' Report

October 2020

Pearson Edexcel GCE Advanced Level

in Further Mathematics

Paper 3D: Decision Mathematics 1 (9FM0/3D)

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Introduction.

Many candidates were able to demonstrate their knowledge and skills across a range of questions, and blank page non-attempts at individual questions were rare. Candidates made good use of tables and diagrams in the answer book. In general there were few problems caused by poor handwriting, an improvement on past series, and presentation of answers was largely satisfactory. A good proportion of candidates were able to attempt questions 2, 3 and 7, parts of which included topics recently added to the specification.

Question 1

Almost all candidates scored both marks in (a), with just a few omitting one of the arcs. Although the majority correctly applied Kruskal's algorithm to find the MST, a surprising number of candidates lost two of the three marks here, due to including extra arcs such as BD or AE. As ever, a few listed only those arcs selected, without any reference to rejections, consequently losing all three marks for failing to demonstrate their use of the algorithm. Also a few candidates lost the marks for using Prim instead. Presentation of the answer can create difficulties both for candidates and examiners. Listing the arcs vertically down the page, in ascending order, with ticks or crosses to indicate selections and rejections, generally proves the best way for candidates. Those that insist on writing "reject, forms a cycle" many times are simply wasting time. Part (c) was almost always correct if following the correct MST.

Question 2

The explanations in (a) describing the necessity for dummy activities were sometimes omitted or only stated in general terms. Candidates should be advised to name all relevant activities, using equivalent wording to that in this and previous mark schemes. In (b) most candidates showed their understanding of preceding activities, scoring both marks. Fully correct early and late event times diagrams were commonly seen. The most frequent error was 5, instead of 7, as the early time at the end of C, due to the failure to take account of the dummy activity. Minimum completion time and the critical activities were usually correct following a correct diagram. The resource histogram is a recent addition to the specification, and quite a few candidates did not attempt this in (d) or made a start but quickly gave up. From those who persevered there were many perfect histograms, and only a few lost all marks due to holes or overhangs. It was apparent that candidates had difficulty interpreting their histogram for (e). A number of candidates managed partial answers involving reduction from five workers to four by delaying D, G or H to time 10 or beyond, but it was very rare to see a complete correct answer.

Question 3

Floyd's algorithm is another topic new on the specification. Most candidates were well prepared to use the algorithm scoring well on (a) and (b) accurately completing both the distance and route tables. Only a few candidates failed to start by filling in infinity symbols where there is no direct route. In (b), however, some candidates had not read the question carefully and therefore attempted to complete first and second iterations, rather than third and fourth, losing at least two of the four marks. Only a minority of candidates found the correct Hamiltonian cycle ACBEDA in (c)(i), realising the necessity to use the nearest neighbour algorithm across rows, rather than down columns, due to the directed arc DC. The common error was cycle ACDEBA where the arc CD is incorrect. The next mark (c)(ii) was only available to those candidates with correct working In (i). Very few correct answers were seen in (iii), with some candidates misunderstanding the question and providing a description but not a route through the labelled villages.

Question 4

By no means all candidates wrote down the correct three constraints defining R in (a), some confusing the direction of their inequalities and others writing the strict inequality symbol. The four marks in (b) were for finding the exact value of P, as stated in the question, at each of the three vertices, and deducing the optimal vertex. Candidates should be reminded that 'exact' is the key word here so both vertex coordinates and P values must be left as fractions, which can be readily found from their calculator. Part (c) proved to be a challenge to all but the most able candidates, who compared expressions for Q at the relevant two pairs of vertices. Several excellent solutions were seen. Attempts at using the gradient comparison approach were not successful, on this occasion, probably due to the fractions involved.

Question 5

This was a good discriminator with only the most able gaining marks in all parts of the question. This demanded that candidates think about methods rather than just apply them, and resulted in a few very good answers and some commendable attempts. Precise use of strict and non-strict inequality symbols were essential in (a), but relatively few candidates realised this, particularly related to $x < 21$. Both marks were frequently scored in (b) where the answer could just be written down with no supporting working. Those who were successful in (a) were often also able to make a good attempt in (c). Not many candidates realised that the word 'distinct' could inform their answer here. As previously, precise use of the strict inequality symbol resulted in the correct answer. It is worth noting that when candidates are required to give explanations or reasons they must leave nothing vague. For example, having spotted that $21 + 19 + 10 = 50$, candidates must then state that therefore bin 2 is full, and not leave it to the examiner to make that deduction.

Question 6

Surprisingly some candidates left part (a) blank. Others correctly stated that the graph was semi-Eulerian with their reason that it had two odd nodes but omitted the word 'exactly' (or equivalent), losing the second mark. It is worth noting that the two odd nodes were A and G, which is key information to be used later in the question. It is commonly the case that candidates would be well advised to keep earlier content in mind throughout questions. Although the question said 'using appropriate algorithms', the diagram in the answer book provided a strong clue to use Dijkstra and route inspection was also clearly indicated. Almost all candidates set about filling in labels and values on the diagram, applying the algorithm largely correctly, with many realising that expressions in x and y resulted as the second working values at F and G respectively, and therefore their final values. As is always the case, the length(s) of the resulting shortest path(s) should be stated too. A minority of candidates scored M0, and lost the next four marks too, due to stating only one working value at all vertices, including C, D, F and G. They should be reminded that the working values demonstrate the application of the correct method for this algorithm. Many candidates struggled with the remainder of this question, though some scored just one mark by adding their two lengths to equal 140, obtaining an equation in x and y. Use of the two odd nodes A and G along with 409 produced a variety of second equations in x and y, but some correctly added AG($= 60 + y$) to $320 + x + y$ to complete their solution, by solving the two equations simultaneously.

Question 7

Only a few candidates were unable to make any attempt here. The two stage simplex is another recent addition to the specification, but a good proportion of candidates showed at least some understanding of the method. Many candidates realised what was required to formulate the linear programming problem and were able to interpret the content of the simplex tableau accordingly, though some had all three constraint inequalities reversed. Candidates should recognise that it is essential to state whether the objective is to be maximised or minimised and failure to do so will always result in one mark lost. It was pleasing to see a proportion of candidates showing clear working in order to go on to correctly complete the bottom row of the tableau in (b). In (c) (i) was often answered correctly but many then lost a mark when omitting the zero valued variables in (ii). There was some indication that candidates could be running out of time on this question with partially completed simplex tableaux, but a good number of continuing candidates scored four or five marks. Instances of choosing an incorrect pivot were extremely rare. The final three marks in (e) were only accessible to those who had completed their tableau. The last mark penalised those who stated values for all six variables as the question specifically asked for just the basic variables.