Examiners' Report
Principal Examiner Feedback

Summer 2024

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

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Report on Individual Questions

Question 1

This was generally a very accessible start to the paper and the majority of candidates scored highly overall.

In part a) the candidates performed the quick sort algorithm efficiently and the majority scored full marks. There were few attempts at middle left pivot seen but, where seen, these were performed equally well. Common mistakes were to use a mixture of middle left and middle right pivots, or to 'move' the 4.5 too far on the second pass and then pivot on it. Both errors lost the second and third mark. Scores of 110 were seldom seen – candidates who completed the first three passes usually completed the sort. As always, a small number of candidates sorted the list into ascending order (then reversing their list in many cases) but this was heavily penalised, as were errors in ordering either side of the pivot.

In part b) the first-fit decreasing algorithm was generally performed well, with scores of 2 and 3 out of 3 being extremely common. The most common mistakes here were with the 1.3 or 1, which lost the final A mark only. A small minority of candidates attempted full bin method, although a surprising number attempted first-fit increasing (including those who had sorted into descending order).

Part c) was again generally well-attempted, with the most common reason for losing the A mark being simply an incorrect packing from part b). There were a reasonable number of candidates who divided their sum of weights by 11 rather than 10, demonstrating a misconception with the lower bound calculation. A very small number of candidates stated that n-1/2 or n+1/2 gave the minimum number of bins, which is an entirely false statement.

Finally, part d) was generally well answered with candidates able to describe that 1.6 should be the penultimate number in the list, but very few appreciated that the sort could have been carried out from right to left, as opposed to left to right. Several candidates focused on the larger values in the list, which didn't result in thorough enough reasoning, and a small group of candidates ignored or overlooked this final part.

Question 2

This was generally a high-scoring question, with the vast majority of candidates scoring at least 6 out of a possible 8 marks.

Part a) was a relatively straightforward network, with the additional scaffold of a partially drawn network. Whilst the significant majority of candidates scored full marks, a surprising number lost the last accuracy mark for omitting activity J. Despite the network being given, several candidates still attempted to put activities on nodes. However fewer candidates lost marks for missing arrows, or additional dummies.

Part b) was again well-answered with the majority scoring 2 or 3 marks. The most frequent errors were in the late times for U (29), M (38) and N (49, leading to a rogue value here) but mistakes were exceptionally rare in the forward pass.

In part c) the majority of candidates correctly identified the critical activities, although activity P was included by some.

Part d) caused issues for less secure candidates; some obtained 7:27pm (subtracting 33 minutes from 8pm), many achieved 7:29pm and 7:31pm or 7:34pm following numerical errors or misusing the 4 minutes of float. A surprising number seemed to misinterpret the question and gave answers beyond 8pm. Others correctly identified 33 minutes but then failed to add the pm for the correct time or gave a time of 8.33pm. This served as a reasonable discriminator mark for stronger candidates.

Question 3

This question saw a much wider range of scores awarded.

Part a) required pupils to accurately define a “tree”, however few candidates correctly used the appropriate technical terms; those that did had clearly learnt the definition. Many incorrectly described a spanning tree or used “loops” instead of “cycles” or missed that it needed to be connected. Candidates were clearly unfamiliar with how to accurately convey the definition and often confused it with elements of other definitions that have been previously assessed and hence this part was often omitted.

In part b) it was clear that candidates had learned Dijkstra’s algorithm, however the use of unknowns proved too much for some who either tried to deal with purely numerical values, or quickly made significant errors. However, a pleasing number of candidates scored 4, 5 or 6 marks on part i) for generally accurate attempts along with correct routes and lengths in terms of x. Common errors tended to occur at H (either 22 or 21 missing), G (30 or 26 missing), E and F or G and L labelled in the wrong order. Most candidates achieved the shortest route from A to M, but candidates were not necessarily clear that the length of their shortest route could be given as an expression, even though the question asked for the answer in this format. Some candidates are

still obliterating their working values or writing them down in the incorrect order, indicating a lack of understanding of the process required.

In part c) most candidates recognised the nodes BCHM as odd, however the most common response was to fail to appreciate that B and C were the start and end nodes and were not required as part of the correct calculation. Those that did identify HM as the pair, generally gave the correct arcs, however it was not uncommon to see vertices listed as opposed to arcs.

Part d) produced a slender majority of correct answers, however frequently candidates stated 2, 6, or other integers, possibly from listing the nodes as opposed to the arcs.
Most understood the need to add in the length of the repeated arcs from c) in part e). Those that had listed BC as one of their arcs ended up with e.g. $x + y = 20$ and were then able to progress further, often giving a wrong answer such as $x = 9$, $y = 11$. Those that correctly identified HL and LM in c) generally achieved both marks in e).

Question 4

This question highlighted just how challenging many students find it to accurately use and understand inequalities in terms of shading regions. There may have also been an issue with time management with many incomplete or even blank responses.

A majority of students in part a) understood how to find the line equations correctly but slipped up on one or more inequalities. Most achieved at least two of the required inequalities, however the equation $5y=2x-10$ tended to be the one causing loss of the final mark, either due to poor multiplying from a fractional gradient or failing to multiply out to get integer coefficients. A not insignificant number of candidates stated all three inequalities the incorrect way around, however scored a generous M mark through the special case.

Part b) saw a range of responses, with some candidates incorrectly confusing multiplication (e.g. $y = 10x$) and addition ($y = x + 5$ e.g.), whilst others continued to struggle with the inequalities, and many inverted the relationship between the stated x and y (e.g. $y = x + 10$ and $x = 5y$).

The frequent errors in part b) led to further issues with candidates in part c) drawing an array of lines; scores of M1A1ftA0 were frequent as the MS generously allowed the ft on their erroneous lines if a line of gradients 1, 5 or 1/5 were seen. Line drawing and shading inequalities caused significant difficult for a large proportion of candidates. Drawing $y =1$ first, seemed to cause a lot of confusion between the line and the axis, although there were many $x=1$ lines drawn, even when the other diagonal lines were drawn correctly. It should be noted that a significant number of candidates either didn't shade at all or shaded on the wrong side of the line. Some shading was difficult to follow, and general accuracy levels and clarity on the diagram was poor with many candidates failing to label the feasible region. It was also disheartening to see a number of candidates attempt to indicate a region already shaded out by the examiner as invalid.

Part di) enforced the requirement for candidates to demonstrate their methods fully, and as such a large number of candidates scored zero despite their work indicating they may have identified

the optimal vertex. A significant number of candidates did not know to (or chose not to) draw an OL on their graph to demonstrate the method. Of those who did, some drew the reciprocal so were only able to score one mark, and of those who got the correct objective line, many went on to find the correct optimal point.

In part dii), very few candidates scored the final two marks, as tables of integer points and inequality testing were rarely seen. Those that did mostly identified the correct point, but then failed to calculate the total to achieve the final mark. Very few full mark responses were seen. A good number of candidates actually identified the optimal solution/value but without demonstrating how they had reached their integer solution. A number of candidates gave solutions outside the range, whilst others erroneously thought an integer solution just involved rounding their x, y and/or value obtained. Some candidates gave non-integer values, not appreciating the context of the question in this part.

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