Examiners' Report/
Principal Examiner Feedback

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Pearson Edexcel International A Level
in Decision Mathematics D1 (WDM01)
Paper 01

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General introduction

The paper proved accessible to the majority of candidates and there was little evidence of there not being enough time to complete the paper. The questions differentiated well, with most giving rise to a good spread of marks. All questions contained marks available to the E grade candidate and there also seemed to be sufficient material to challenge the A grade candidates also.

Candidates are advised to make their method clear; ‘spotting’ the correct answer, with no working, rarely gains any credit. Candidates are further reminded that they should not use methods of presentation that depend on colour or highlighters, but are advised to complete diagrams in (dark) pencil.

Candidates should ensure that they use technical terms correctly. This was a particular problem in question parts 2(c) (ii) and 3(a).

Report on individual questions

Question 1

This question provided an excellent start to the paper for the vast majority of candidates with 51.9% scoring full marks and only 23.7% scoring 5 marks or fewer. Candidates were clearly very well prepared for this topic and were familiar with all of the components required for a complete solution.

In part (a) the majority of candidates knew how to carry out a bubble sort and nearly all did so correctly. Unfortunately, many candidates did not read the question carefully and either showed each comparison and swap during the first pass or spent time carrying out the full sort on the list rather than just the first pass. There were occasional errors including the loss of one item or writing one item incorrectly, e.g. the number 7 being replaced by the number 17. A few candidates did not work consistently through the list of numbers.

In part (b) the majority of candidates used ‘middle right’ as their choice of consistent pivot throughout the quick sort and in the main there were a large number of fully correct solutions. There were a small number of candidates who attempted to use their partially sorted list from part (a) and one or two who attempted a quick sort on a fully sorted list. A minority of candidates sorted the list into ascending order, probably because that is what they had been asked to do in the first part. However, in most cases candidates clearly knew what was expected of them and carried out the sort well.

The errors which occurred in part (b) included:

- inconsistencies in the choice of pivot e.g. switching between middle left and middle right,
- failure to select two pivots simultaneously when appropriate,
- occasionally neglecting to choose 10 as a pivot in the 4th pass – candidates mistakenly assumed they had completed their sort given that the list was in numerical order by the end of the 3rd pass,
- occasional loss or change of items in the list when moving from one pass to the next

Part (c) was generally very successfully attempted. The vast majority carried out a correct calculation and rounded their value up to give the correct lower bound. It was rare to see '105' (the total of all the numbers) divided by 10. The most common mistake was to find a solution using 5 bins.

Question 2

This question discriminated well leading to a good spread of marks. The modal mark was 8, however, only 1.2% of candidates scored full marks. In part (a) candidates were in the main quite successful and most correctly applied Prim's algorithm starting at node A. Common errors were in the order of selection of CF and CE, which were sometimes interchanged. There were also sometimes errors in the choice of the 5th arc. Furthermore, a small minority of candidates incorrectly stated rejections. Some candidates painstakingly drew out a matrix in order to carry out Prim's instead of simply using inspection on the given network.

Where part (a) had been completed correctly part (b) was invariably correct.

Candidates seemed to be more successful with dealing with part (c) (i) compared to part (a). Some candidates, however, found it to be more challenging due to the specified inclusion of arcs BC and EF. Some candidates seem to lose their way with the rejections and while the majority often carried out the first few selections and rejections correctly they then would fail to give the final few rejections – either BE and/or DF were fairly commonly omitted rejections. A few candidates failed to give any rejections whatsoever.

Part (c) (ii) was not well answered and was one of the most discriminating parts of the paper. Many candidates simply listed the differences between Kruskal's and Prim's algorithms or explained how to apply Kruskal's algorithm for this problem. Others said that Kruskal's is easier/cheaper or said that Kruskal's adds arcs, while Prim's adds nodes therefore Kruskal's is a better choice. The vast majority did not recognise or articulate the key issue of connectedness (that is the two initial arcs were not connected and so Prim's algorithm could not be used).

Part (d) was also commonly incorrect. Many candidates gave an answer of 201 which came from not taking on board the sentence before this part which stated that “since arcs BC and EF already exist, there is no cost for these connections” although there were also many candidates who gave the correct cost.

Question 3

This question was done extremely well by many candidates with the mode being 7 marks obtained by 29.0% of candidates, 21.7% scored full marks and only 26.4% obtaining 5 marks or fewer.

In part (a) there was a good number of completely correct answers where candidates had clearly learnt the definition for the term ‘matching’. There were many others who scored one of the two marks for describing one of the key ideas. This part required precise mathematical language to be used (e.g. pairing/one-to-one and sets) and while many managed to convey the pairing or one-to-one nature required they did not use the correct terminology to be awarded the second mark.

In part (b) the majority of candidates could identify a first alternating path from B to 6 (or vice-versa). This was then usually followed by a correct second path from H to 3 (or vice versa) in part (c).

There was nonetheless the usual loss of marks for some candidates due to a lack of the change of status being stated or shown and/or failing to state the improved/complete matching – in some cases candidates may have drawn the improved matching on diagrams which were not clear due to multiple lines being drawn from individual vertices. If candidates are going to show these matchings on a diagram (rather than simply stating them) then only clean diagrams with the exact number of arcs will be accepted. Change of status errors and lack of stating the improved/complete matchings seem to be occurring less with each session but are unfortunately still evident.

Question 4

This question gave rise to a good spread of marks and proved to be a good discriminator. The mode was 6 marks gained by 29.2% of the candidates, full marks were gained by 15.0% and 65.9% of the candidates scored 5 or more marks.

While the application of the route inspection algorithm was understood by the majority of candidates it was rare for candidates to obtain full marks in part (a). The vast majority of candidates were able to write down the correct three pairings of the four odd nodes but they were often unable to find the correct three totals. Unfortunately, the most common incorrect total was the one associated with the pairing of (A with I) and (E with J) and therefore many candidates did not realise that this was the least of all possible pairings. Often however, more than one pairing was incorrect and most candidates managed to only obtain the total for the pairing of (A with E) and (I with J) correctly. There were a small number of candidates who either had the incorrect four odd nodes or who failed to write down three distinct pairings. Furthermore, some candidates did not write down any pairings whatsoever.

Part (b) was well done with the vast majority of candidates obtaining this mark (usually on the follow through from their answer to part (a).

Part (c) was quite well done and many candidates were able to score full marks on the follow through using their answers from parts (a) and (b). Most candidates carried out the correct calculation and gave a correct conclusion. However, some candidates carried out a calculation of only 367 + 56 (the sum of the weight of the network and the shortest path from A to E but ignoring the additional arc from I to J) or sometimes 367 + 35 (in this case forgetting to add the shortest path from A to E – therefore possibly assuming that a semi-Eulerian solution was required). Others simply worked out 35 + 56 and failed to carry out a direct comparison with their answer from part (a). Some candidates, who had incorrectly obtained (A with E), (I with J) as the least pairing, realised that they only needed to compare 35 (the new arc IJ) with 38 (the shortest path from I to J) and most did so accordingly.

Question 5

This question proved to be an excellent source of marks for nearly all candidates. The mode was full marks, gained by 48.1% of the candidates, only 18.7% of candidates scored 6 marks or fewer.

The boxes at each node in part (a) were usually completed correctly. When errors were made it was either an order of labelling error (some candidates repeated the same labelling at two different nodes) or working values were either missing, not in the correct order or simply incorrect (usually these errors occurred at C and/or D). The route was usually given correctly and most candidates realised that whatever their final value was at T this was therefore the value that they should give for their route.

Part (b) saw a variety of responses but a route length of 109 km was usually given even if both stated routes were not correct. Candidates usually gave at least one correct route of 109 km.

Question 6

This question discriminated well leading to a good spread of marks. The modal mark was 10, 10.7% of the candidates scored full marks and 34.8% gained 5 marks or fewer.

Most candidates were able to draw the required lines correctly in part (a) although some were unable to draw lines sufficiently accurately (some drew lines without a ruler) or sufficiently long enough. On this point the following general principle should always be adopted by candidates:

- lines should always be drawn which cover the entire graph paper supplied in the answer book and therefore,
- lines with negative gradient should always be drawn from axis to axis.

The rationale behind this is that until all the lines are drawn (and shaded accordingly) it is unclear which lines (or parts of lines) will define the boundary of the feasible region. If candidates only draw the line segments that they believe define the boundary of the feasible region then examiners are unaware of the order in which the lines were drawn and therefore it is unclear to examiners why some parts of the lines have been omitted.

In general the lines $x + y = 500$ and $5x + 4y = 4000$ were correctly drawn and were errors did occur they tended to be with the other two lines. Furthermore, a significant number of candidates were unable to select the correct feasible region.

Part (b) was more discriminating and many candidates incorrectly used the objective line method when point testing had been specified in the question. The feasible region only had two vertices to test but many candidates chose to include the points at the edge of the graph paper too. A significant number of candidates did not show sufficient working, even though the question said ‘show your working’, when obtaining the coordinates of the two required vertices. Simultaneous equations needed to be solved algebraically and not just stated. The question also specified the need for exact coordinates. Many candidates either read their vertices directly from the graph (so not accurately) or gave answers either as integers or correct to only 1 decimal place even after showing a complete method for obtaining them. Surprisingly, a number of candidates found both vertices correctly but then believed that the optimal point had to have integer coordinates. Candidates usually went on to evaluate their coordinates, but some candidates opted for a ‘maximisation’ point rather than the required minimisation point.

In part (c), the majority of candidates knew that they had to add together their x and y values (from part (b)) to find the greatest value of k but unfortunately, due to lack of accuracy in part (b), many tended not to score the two marks available in this part.

Question 7

This question, especially part (c), proved to be an excellent discriminator with the bimodal marks being 6 and 12, and only 6.8% of candidates scored full marks.

Part (a), in which candidates had to complete the early event and late event times, was often well attempted. Errors occasionally occurred in the late event times (most notable at the end of B and/or the end of F). However, either full marks or 3 marks out of 4 were common in this part.

Part (b) was also generally well attempted, and answered, by most candidates. Errors inevitable followed through from the corresponding error in part (a) and there were very occasionally additional errors such as the omission of one of the activities. It would be advisable for candidates to check that their cascade chart (and later their scheduling diagram) contains only the required number of activities.

Candidates found part (c) to be quite discriminating. A good number of candidates managed to answer this question correctly and others managed to obtain the correct activities and correct conclusion but made errors with the time. A significant number however, scored no marks. Some clearly knew what was expected but were unable to give a correct time and relevant activities (a number of candidates incorrectly referenced activities C, D, E, and F). Unfortunately, others stated a correct time and concluded a lower bound of 4 but did not reference the relevant activities. It was also common to see a lower bound calculation rather than use of the cascade chart in this part.

Part (d) was attempted by candidates with a reasonable level of success. Errors tended not to carry through from part (a) and most gained at least some marks. Errors tended to arise due to omission of one or more of the non-critical activities or occasionally errors in the duration of activities D or E and very occasional precedence errors.

Question 8

While 28.0% scored no marks on this question, only 9.6% scored all 6 marks and the modal mark was 1 (scored by 16.6% of candidates). Whilst the objective function was found correctly on many occasions, the absence of the word ‘minimise’ meant that the first mark could not be awarded. Some candidates failed to take into account the number of posters and flyers in their objective function. The first constraint (based on sending out at least 15000 flyers) was usually correct although not always simplified. Sometimes the 15000 was given as 1500. The constraint which required ‘between 40% and 60% of the total packs produced to be pack As’ was either dealt with very well by candidates or not attempted at all. Again, simplified inequalities was not always achieved and, on occasion, coefficients were left as fractions rather than integers.

Grade Boundaries

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