Examiner's Report

Principal Examiner Feedback

Summer 2018

Pearson Edexcel GCE Mathematics

In Decision 1 (6689) Paper 01

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Summer 2018
Publications Code 6689_01_1806_ER

Introduction

This paper proved accessible to the students. The questions differentiated well, with most giving rise to a good spread of marks. All questions contained marks available to the E grade students and there also seemed to be sufficient material to challenge the A grade students.

Students are reminded that they should not use methods of presentation that depend on colour, but are advised to complete diagrams in (dark) pencil. Furthermore, a number of students are using highlighter pens even though the front cover of the examination paper specifically mentions that this type of pen should not be used.

Students 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. Some students are using methods of presentation that are very time-consuming, this was particularly true in question 1(b), the application of Prim's algorithm, where a number of students ran out of space (and possibly time) unnecessarily completing the algorithm in tabular form. The space provided in the answer book and the marks allotted to each section should assist students 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. Students should ensure that they use technical language correctly. This was a particular problem in questions 1(a) and 2(a).

Report on Individual Questions

Question 1

Many students had learnt the definitions needed and gained all three marks in (a). Others struggled and often misused technical terms. Few said that a tree needed to be connected and many students lost marks by saying that a MST was made up of *arcs* (or routes or paths) of least weight rather than that the *total* arc length should be least.

Part (b) was generally well answered with the majority of students applying Prim's algorithm correctly starting from vertex A. A few students attempted to construct a table to perform Prim, clearly believing that Prim can only be performed when expressed in tabular form. Finally, there is still a small minority of students who appear to be rejecting arcs when applying Prim's algorithm so scoring only one of the three possible marks in this part.

Those students who found the correct minimum spanning tree in (b) usually went on to both draw the tree and state its weight in (c).

Question 2

A lack of completeness and precision on the part of many students meant that scoring both marks was rare in (a). Most responses, which were along the right track, were often too vague about comparing adjacent items in the list rather than specifying which items were being compared. To score any marks in this part it was vital that the candidate made it explicitly clear that in the first pass the first value in the list is being compared with the second value and the values are then swapped if the second is larger. Many students who scored the first mark did not score the second because their argument did not contain the salient points on how the first pass was completed. Even those students who did specify that the second value is then compared to the third value often did not explain that similar comparisons must continue to the end of the list.

It was clear in (b) that the majority of students understood that if the bubble sort had been used then the smallest value (the 15) would be at the far right-hand end of the list. However, most failed to realise that the bubble sort could have been used from right to left meaning that the largest number (the 35) would at the far left-hand end of the list.

It was encouraging to note that most students correctly stated that the value of 27 had been used as the pivot for the first pass in (c), however, in (d) many students took the list given in the question paper and used the 20 (rather than the 33 and the 21) as the pivot for completing the sort. In (d) the pivots were usually chosen consistently although the spacing and notation on some solutions made these difficult for examiners to follow. Some students over complicated the process by insisting on using a different 'symbol' to indicate the pivots for each pass.

The first-fit decreasing in (e) was well carried out with only a small minority failing to attempt this part. There were a large number of wholly correct answers. A small number performed first-fit increasing therefore scoring no marks. A small minority of students lost all three marks by placing the 27 in the 3rd rather than 2nd bin (so failing to apply the algorithm at its first real test). Some students wrote totals in the bin rather than the next value. A variety of different layouts were used but in nearly all cases were easy to read and decipher.

The vast majority of students in (f) correctly used an argument based on the total of all 10 values in the list. Of those that decided to use an argument based on the wastage in each bin most were unsuccessful.

Question 3

Students generally showed a good understanding of the process of constructing an activity network from a precedence table in (a), using arcs drawn with arrows and labelled for activities. Some scripts lacked a sink node at the end and a small number did not have a single source node. Some of the diagrams and labels were challenging to read, especially when they were very small and/or drawn with lines that crossed over. Some students were unsure about the placement of their dummies, putting them in 'anywhere' so that they had four dummies included. Some also had three, five or more dummies even though the question clearly stated that they were to use exactly four. A very small number of students put activity on node, and some failed to check that they had all activities present, with activity K being the activity that was missing most often.

In (b) only the most able students realised that if D was critical then A and E are the only activities that are guaranteed to be critical. Many students either randomly wrote down a string of activities or wrote down one or more possible critical paths.

Question 4

Part (a) was usually very well done with most students applying Dijkstra's algorithm correctly. The boxes at each node in (a) were usually completed correctly. When errors were made it was either an order of labelling error (some students 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 nodes E, D, G and/or J). The path was usually given correctly and most students realised that whatever their final value was at J, this was therefore the value that they should give for the quickest route. As noted in previous reports because the working values are so important in judging the candidate's proficiency at applying the algorithm it would be wise to avoid methods of presentation that require values to be crossed out.

The vast majority of students did not realise the connection between (a), in which the shortest distances from vertex A to any other vertex had been found and (b). Therefore many students went on to make at least one error in the totals for the pairings in (b). Most students stated the repeated arcs correctly although there were a few who simply stated "AE, CD". Very few students failed to give three distinct pairings and corresponding totals in this part. A number of students gave a duration of 343 rather than 333 (forgetting that that the weight of arc GJ needed to be removed).

Part (c) was answered well with the majority correctly stating that both vertex E and F would be visited three times in the corresponding inspection route.

Question 5

Parts (a) and (b) differentiated well. This style of question was quite unfamiliar and threw many weaker students and therefore it was often either left blank or students jumped straight in to stating the improved matching in (c).

Part (d) was answered extremely well but there was the usual loss of marks for some students due to not stating or showing the change of status, or for failing to state or draw the complete matching. In some cases students may have drawn the complete matching on a diagram which was not clear due to multiple arcs being drawn from individual vertices.

Question 6

Part (a), in which students had to complete the early event and late event times, was often done extremely well. Errors occasionally occurred in the early event time at the end of I or with one or two of the late event times (most notable at the end of E and/or at the end of H). However, either full marks or three marks out of four were common in this part.

In (b) the critical activities of A, D, J and N were usually stated correctly.

Part (c) was generally well answered by students with many successfully drawing a correct Gantt chart. Most errors in this question occurred because students had failed to answer (a) correctly. Students would be well advised to check they have included all 14 activities, as a minority lost marks due to omitting one (or sometimes more) activities.

In (d) many students correctly stated that 4 workers were required as activities D, E, F and G must be taking place at the same time. However, many did not state a correct time; students are reminded that they do not need to state a time in context (e.g. hours, days, etc.) but only need to give a time directly from the Gantt chart (so for this question a time of 11.5 was perfectly acceptable). Even though this part clearly stated that students should use their Gantt chart and make specific reference to times and activities many attempted to schedule the activities to workers.

Question 7

In (a) the objective function was often found correctly but the absence of the word ‘maximise’ meant that the first mark could not be awarded. The first two constraints (the requirements that there must be at least 400 scones and that there must be at most 350 fruit scones) were usually correct. The next constraint based on the fact that there needed to be at most 5 plain scones for every 3 fruit scones was almost always correct with the most common incorrect answer being $3y \geq 5x$. The final constraints regarding the fact that the manager had £77 to spend was either dealt with very well or not attempted at all. Simplified inequalities were not always seen and, on occasion, coefficients were left as fractions rather than integers.

Most students were able to draw the required lines correctly in (b) although some were unable to draw lines sufficiently accurately (some drew lines without a ruler) or sufficiently long enough. As stated in previous reports the following general principle should always be adopted by students.

- 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 students 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 $x + y = 400$ and $y = 350$ were drawn correctly. Furthermore, a significant number of students were unable to select (or even label) the correct feasible region.

In (c), the majority of students drew the correct objective line, however, a line with reciprocal gradient was sometimes seen or, in a number of cases, no objective line was drawn (and therefore no marks could be awarded in this part). Some used obscure constant values to plot the objective line and some students did not label the optimal vertex clearly.

Most students in (d) correctly stated the exact coordinate of V as requested.

In (e) many students did not state in context the number of scones that the manager should buy and the corresponding cost was often given incorrectly as either £540 or £541 rather than the correct £540.50.

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