Examiner's Report

Principal Examiner Feedback

Summer 2018

Pearson Edexcel GCE Mathematics

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Introduction

This paper proved accessible to most students although examiners noted that a significant number of students struggled to cope with the new content not previous seen in the legacy module 6689/01, and some had difficulty with the problem solving nature of some of the questions (which is now 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 students and there also seemed to be sufficient material to challenge the A grade students.

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. 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 2(b) and 2(c).

Report on Individual Questions

Question 1

This question was the most successfully attempted question on the paper. Application of Dijkstra's algorithm in (a) is familiar fare and most students made reasonable attempts. There were a number of common errors including:

- Missing out the labelling of node D.
- Order of labelling errors with two or more nodes having the same label.
- The working values were sometimes incorrect with a '55' instead of a '45' at H.
- A number of errors in the order of the working values, for example, at node G and sometimes extra working values appeared, for example, a value of 35 at C.
- A few responses contained no working values.

Overall students appeared to find it more challenging than might have been the case for a similar question in recent sessions for the legacy module 6689/01. Often students neglected to state the shortest time and/or the quickest route. Part (b) was generally well attempted. A significant proportion of students were clearly well prepared for this question. Others were confused though and treated the relationship as linear rather than as quadratic. Others incorrectly squared the constant of proportionality. A lot of students carried out a fairly substantial amount of working which sometimes lead to a correct answer (albeit sometimes with errors).

Part (c) was generally something of a challenge to many students. There were a large number of creative solutions which often featured discussions about the differing processing speeds of different computers, the validity of scaling up the relationship to a far larger value of n, and the impact of the rounding of 1.5 seconds. Some students were confused by the meaning of 'run' in the context of algorithms and talked about getting tired when 'running long distances'. Very few gave 'textbook' explanations but there were a reasonable number of students who were able to refer to the lack of exact direct proportionality between run-time and n^2.

Question 2

This question contained new content which has not appeared previously in 6689/01 and this was clear in the general standard of responses seen. It was common for (a) not to be completely correct. Common answer for this part were 4 and 6 but examiners saw a whole range of answers for the minimum and maximum number of arcs.

Part (b)(i) was more successful and most students managed to drawn a correct graph. In (ii) most stated that there were two odd nodes, so the graph was semi-Eulerian, but relatively few gained both marks as they failed to state the key point that the graph contained exactly two odd nodes.

Part (c) proved to be extremely challenging for students with many responses scoring no marks. The most common marks to be earned were the first mark for stating that the orders of the vertices summed to 10 and the second method mark for the identification that the order of the vertices could be 2, 2, 3 and 3. A reasonable number of students were able to identify that no order could be greater than 3 but they were then usually unable to develop this argument into a discussion of what this implied about possible orders and most did not consider orders of 1, 3, 3 and 3. The final mark for this part was the least commonly earned. Many students approached this question in terms of building up the graph from the bottom up and as such often did not properly consider the orders of the vertices as requested in the question. Most often students discussed the number of odd vertices and the number of even vertices rather than considering directly the possible numerical order of vertices. Examiners noted very few good attempts although there was very often a tendency to write copious amounts rather than to focus on the key issues. This was furthermore problematic given the standard of some handwriting which made reading responses very challenging.

Question 3

This question was, at times, very well answered but the construction of an activity network with an efficient number of dummies proved to be something of a challenge for many students. Some of the issues noted by examiners were:

- There were often several extra dummies added after activities. Students often drew straight lines for activities and whenever a change in direction was required to connect the activity to the correct node, an event was added followed by a dummy. In addition, dummies were added joining the node at the end of activities A or C to the end point of the network.
- Missing dummy between the nodes at the end of activities I and J so that the network had two end points. Or occasionally, I and J violated the uniqueness rule by both passing between these two nodes.
- Both dummies and activities had missing arrows for a significant number of students. Sometimes no arrows whatsoever were added but more often there were one or two missing arrows.
- Activities G and D were drawn incorrectly feeding into the node at the start of activity J.
- Activity J missing.
- A missing event node at the end of activity J.

Diagrams were often unclear and some students redrew their diagrams multiple times. For those students who were able to draw a workable activity network it was quite straightforward to write down the critical activities in (c). Although activity I appeared regularly in place of J or as an addition to A, D, H and J.

In (d)(i), most students were able to recognise that the removal of activity G would have no effect on the shortest completion time. Although some did state that it would be reduced.

Similarly, for (d)(ii), the question asked for a comment on the timings of the remaining activities – so to gain both marks here, students needed to mention both that activity C was the only affected activity, and also that the timing of this activity would now be adjusted to finish at time 16 (or start as late as time 12).

Question 4

This question proved to be very challenging for most students. Even the familiar parts of the question were not well answered and many students did not define the variables correctly. Many believed they referred to ‘cost’ or ‘time taken’ or simply stated ‘x = week one’ without referring to the fact that x is the number of cabinets produced in week 1, etc.

In (b) the inequalities were not always stated correctly but the vast majority of students got at least one correct. Often errors arose from students stating $2z \leq y$ and the direction of the inequalities caused a number of problems too.

For (c), the vast majority of students were simply unable to deal with the conversion of the 3-variable problem to a 2-variable problem even though all the constraints had been done for the students. All students had to do was to realise that the information in the question implied that $x + y + z = 150$, re-write this equation in terms of z, substitute for z in the original objective function and then obtain a new objective function in terms of x and y only. The most common approach, however, was to simply ignore the z term in the objective function and to work with the constraint $250x + 275y$. Some students were even more creative and eliminated z using one of the inequality constraints. Some students kept z in the objective function and ignored the fact that it was effectively then a variable and would take different values at different vertices. Most surprisingly of all, a significant number of students never stated an objective function at all.

For the remaining part of this question candidate responses were split between the methods of objective line and point testing.

For the objective line method, most students drew an acceptable line based on their objective function although the scale on the graph seemed to cause some difficulties. Furthermore, the often fairly complex gradients that students had produced for themselves provided a challenge for some.

For those point testing, it was unfortunate that so many students took so long to calculate the coordinates of their vertices and then rounded to integer values before evaluating in the objective function. Some students calculated the coordinates of the vertices and then ruled out all vertices except (25, 50) because they were not integer-valued. There were quite a few students who did work with the exact coordinates and evaluated them correctly in the objective function but then did not consider the context that an integer solution was required. Examiners noted that a small minority of students calculated the z-values at each vertex although this also often involved premature rounding too.

By the nature of the problem, even with incorrect objective functions, inaccurate objective line drawings and incorrect point testing, most students were able to get to the correct optimum vertex. The vast majority however did not give their solution in context and many forgot to reintroduce z at this point.

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