AS

# MATHEMATICS

MD01 Decision 1

Report on the Examination

6360

June 17

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**General**

The vast majority of students were well prepared in the routine use of the algorithms which constitute much of this specification. As a consequence, comparatively few scripts earned less than half marks.

To gain the higher grades it was necessary to solve problems, describe them and their solutions clearly, and perform basic algebraic techniques accurately. Decision mathematics is a subject which demands not only mathematical precision but also clarity in the presentation of results. Too casual an approach to the latter can lead to students unnecessarily losing marks.

Working and answers should be carefully considered as to whether it is clear what these actually represent. Improvements were evident in presentation this year in comparison to last year, although language issues were still apparent where explanations of understanding were required.

In general the standard of presentation was quite good with a significant minority being excellent. Students are well advised to cross out and replace incorrect work rather than trying to overwrite their first attempt, or show multiple attempts with no clear solution identified.

**Question 1**

Marks lost in part (a) were rare. It was pleasing to note that idiosyncratic methods of recording alternating paths were seen far less this year.

Most students opted for the first solution in the mark scheme, usually starting at $C$, in which case they almost always scored full marks. A smaller number of students chose to use the second method given in the mark scheme, which proved problematic for most, with very few students then gaining full marks. Very few marks were lost by a failure to list the final matching, although some students are still showing their final matching on a diagram.

Part (b) raised issues with the students' ability to express their understanding. Most students only scored 1 mark for this part. The best answers were logical, simple and concise.

**Question 2**

In part (a) almost all students were able to apply the Chinese postman algorithm correctly, including the requirement to evaluate the three totals. Where this was not seen, most students gained at least 3 marks for a correct total of $130$.

In part (b) most students correctly identified that she will pass through $B$ 3 times.

**Question 3**

In part (a), a few bubble sorts and shuttle sorts did appear. Students who correctly used the Shell sort had quite differing styles of demonstrating how they were sorting each sublist. However, most answers clearly exhibited the requisite three merged lists. Some candidates neglected to show the first or final merged list, resulting in lost marks.

Part (b) was a little more testing. The most common wrong answer was 5.

## Question 4

In (a)(i) a routine application of Dijkstra's algorithm was very high scoring, with many students scoring full marks. More than two values at $D$ was rare and the omission of required crossings out only a little more frequent. Few students used different notation. Students usually scored the B1 mark for a final value of $67$ at $H$ even if they had not scored full marks up to that point, and part (a)(ii) was almost always correct.

Part (b) was not answered quite so well. A common incorrect solution was $ABDFH$ with a total of $69 \text{ km}$.

## Question 5

The first part of this question was the most successfully attempted.

One needless cause of mark loss in (b) and (c) was to draw several diagrams in the search for the correct answers and then fail to make clear which was intended as the final answer. In part (b) most students attempted to draw the MST first and then 'fit' the other edges around this spanning tree. This was not always successful, usually as students failed to keep the graph simple.

In other unsuccessful attempts where the final graph was simple, students had altered their intended MST by the addition of the other edges. Some students appeared to abandon their attempt part way through, or added too many or too few edges to their diagram.

Most students were able to score at least one mark for part (c) with a significant number gaining full marks. Students were often able to produce a simple, connected graph but not always able to show vertices of the required order $4, 4, 4, 2, 2, 2$. It was common in this part to see multiple attempts, with some candidates failing to identify their final solution.

## Question 6

The routines required for Kruskal's algorithm appeared to be generally well-known and used. This was a well answered part with very few students losing any marks. There were a variety of approaches in how students showed which edges they were selecting, but almost all were clear and easy to follow. The loss of marks usually arose from an incorrect total for the length of the MST or an incorrectly drawn MST. Generally students scoring well in part (a) gave the correct edges in part (b)(i) and (ii), although some students lost marks for stating vertices, rather than edges.

## Question 7

Most students were able to state the length of the tour $ADBECA$ in part (a), but not all were able to articulate why it was an upper bound.

The majority of students were able to find a tour starting from $C$ in part (b)(i), but not all listed the vertices in the correct order. Another common wrong answer was $CAEDB$, ie not returning to $C$. Where full marks were scored in part (b)(i), usually students then scored full marks in (b)(ii). If no marks were scored in part (b)(i), occasionally students still scored SC1 in part (b)(ii) for a correct tour from $A$, with the same length as their solution in part (b)(i).

The majority obtained the correct value for the lower bound in part (c) but the usual failure to clearly state the edges involved caused the usual loss of marks. Students regularly lost marks for not stating the correct edges from $A$; most just listed values. Students who showed their working on the table for this part rarely scored full marks as they usually omitted to fully label $C$ as $5$ (or $6$) in addition to $0$ (or $1$).

Most students were able to score at least 1 mark in part (d), with almost all attempting to show the required single inequality, rather than two separate inequalities. When candidates lost a mark, the most common error was to use <, rather than ≤, '48' or to select the greater of their upper bounds, rather than the lower.

**Question 8**

This proved a very difficult question for most students.

In part (a), students regularly failed to show all values correct to four decimal places as required.

The common errors were; students using exact fractions, failing to stop after writing $N = 2$, or failing to write $N = 2$. Again, not rounding the final value to four decimal places cost some students.

Exact fractions or working to at least three decimal places was allowed in part (b). This part was more successfully attempted than either part (a) or part (c). Most students scored at least 1 mark, with many scoring full marks. The most common error was the failure to write $N = 5$.

Part (c) was rarely correct and indeed most students began by writing "(c)" and then nothing more. The majority of students who attempted to answer the question, but were incorrect, usually wanted to add a step or wrote something that was complete nonsense in the context of the question. Only the most able students were able to identify a correct change and then continued to show the effect.

**Question 9**

All students achieved at least some success but with only the very best getting near maximum marks.

Part (a) was usually correct, although some students expressed $y \geq 0.5x$ incorrectly as $0.5y \geq x$.

In part (b), the candidates who correctly obtained $z = \frac{x+y+z}{5}$ (or equivalent) usually went on to gain full marks, with very few losing marks for poor notation. However, a lot of students resorted to trying to find $80\%$ or $20\%$ of the totals only. In some cases, students used inequalities for $z$, resulting in a significant loss of marks.

In part (c) graphs were generally poorly-drawn. Although most drew the lines $x + y = 180$ and $x + y = 300$ accurately, most did not then continue on with the correct level of accuracy when drawing $y = 0.5x$ or $y = 3x$. Inevitably, following this the feasible region was also incorrect. In a few cases, lines were clearly not ruled.

In part (d)(i), those who were able to write an expression for $C$ usually went on to produce a correct objective line for their cost function. This resulted in a correct minimum for their graph. A large proportion of students were unable to create an expression for $C$ at all, or were unable to proceed beyond $10x + 20y + 40z = C$. In these cases the minimum point was guessed, or, in a few instances, simultaneous equations were used or, if a cost function had been found, multiple points from their graph were tested. Students who used this approach rarely stated the coordinates of the points they were testing. In the few instances where simultaneous equations were used, some students were able to correctly identify the minimum point and stated it.

Very few students correctly arrived at a cost of £4200 or the required 120 Economy, 60 Standard, 45 Deluxe in the final part.

## Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

## Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

## Converting Marks into UMS marks

Convert raw marks into Uniform Mark Scale (UMS) marks by using the link below.
UMS conversion calculator