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Version1.0



General Certificate of Education (A-level) January 2011

Mathematics

MD01

(Specification 6360)

Decision 1



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Mark Scheme – General Certificate of Education (A-level) Mathematics – Decision 1 – January 2011

| М | mark is for method |
|-------------------------|--|
| m or dM | mark is dependent on one or more M marks and is for method |
| А | mark is dependent on M or m marks and is for accuracy |
| В | mark is independent of M or m marks and is for method and accuracy |
| E | mark is for explanation |
| \checkmark or ft or F | follow through from previous incorrect result |
| CAO | correct answer only |
| CSO | correct solution only |
| AWFW | anything which falls within |
| AWRT | anything which rounds to |
| ACF | any correct form |
| AG | answer given |
| SC | special case |
| OE | or equivalent |
| A2,1 | 2 or 1 (or 0) accuracy marks |
| –x EE | deduct <i>x</i> marks for each error |
| NMS | no method shown |
| PI | possibly implied |
| SCA | substantially correct approach |
| c | candidate |
| sf | significant figure(s) |
| dp | decimal place(s) |

Key to mark scheme abbreviations

No Method Shown

Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded.

Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn **no marks**.

Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

Otherwise we require evidence of a correct method for any marks to be awarded.

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| MD01 | | | | |
|------|--|--------------|--------|--|
| Q | Solution | Marks | Total | Comments |
| 1(a) | $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | M1 | | (6×6) matrix labelled with some \sqrt{s} or $\times s$ or 0's or 1's or $-s$ |
| (b) | $\begin{array}{c ccccc} F & 1 & 0 & 1 & 0 & 1 & 0 \\ \hline A - 4 + E \\ A - 5 + B \end{array}$ | A1 M1 | 2 | CAO 1 correct |
| | $ \begin{array}{c} C - 4 + E \\ 6 - D + 2 \\ 6 - B + 5 \\ 1 - E + 3 \end{array} $ | M1 | | 1 correct, from a different start point |
| | A - 5 + B - 3 + F - 1 C - 4 + E - 2 + D - 6 or first | A1 A1 | | Either order |
| | $ \begin{array}{c} A - 4 + E - 2 + D - 6 \\ \text{then} \\ C - 4 + A - 5 + B - 3 + F - 1 \end{array} $ | (A1) (A1) | | Must be in this order |
| | or first A-5+B-6 then C-4+E-2+D-6+B-3+F-1 | (A1) (A1) | | Must be in this order |
| | Match A5, B3, C4, D6, E2, F1 | B1 | 5 7 | Must be stated (not solely on diagram) |
| | 10141 | 1 | 1 | |

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| MD01 (cont) | | | | | | |
|-------------|--|-------|-------|---|--|--|
| Q | Solution | Marks | Total | Comments | | |
| 2(a) | 7 | B1 | | A correct pivot (7 or 22) | | |
| | 22 | B1 | 2 | 2 nd correct pivot and no others | | |
| | | | | | | |
| (b) | <i>C</i> | | | | | |
| | 1st 7 | B1 | | | | |
| | 2nd 5 | B1 | | Condone 7, 5, 3 or $7 + 5 + 3 (= 15)$ | | |
| | 3rd 3 | B1 | 3 | unlabelled but must be in this order | | |
| | | | | | | |
| (c) | No – 16, 19 haven't been compared (OE) | E1 | 1 | BOTH "No" (or equiv) AND "16, 19" | | |
| | | | | (only) mentioned or highlighted in script | | |
| | Total | | 6 | | | |
| 3(a)(i) | EB (5) | M1 | | Prim's, MST, 6+ edges (no cycles), edges | | |
| | | | | not lengths or vertices, with first 2 edges | | |
| | | | | correct | | |
| | | D 1 | | 0 - 1 | | |
| | HI 9 | BI | | 8 eages | | |
| | AD 10 | Δ1 | | AB 3rd | | |
| | DG 4 | AI | | AD SIG | | |
| | EF 12 | A1 | 4 | All correct | | |
| | EC 6 | | | | | |
| | | | | | | |
| (••) | <u></u> | D 1 | 1 | | | |
| (11) | 61 | BI | 1 | | | |
| (:::) | A- B E | | | | | |
| (111) | | | | | | |
| | | M1 | | 6 days connected no cycles | | |
| | D E | 1111 | | 0+ edges, connected, no cycles | | |
| | | | | | | |
| | | A1 | 2 | Correct including labelling | | |
| | b 0 | | 2 | | | |
| | | | | | | |
| (b) | Delete BA, BE and reconnect with 1 edge | M1 | | PI from their diagram in (iii) | | |
| | or | | | | | |
| | a spanning tree with 7 edges not including | | | | | |
| | B (either as a list or diagram) | | | | | |
| | _ | | | | | |
| | (61 - 13 + 11) = 59 | A1 | 2 | Note: 59 scores 2/2 | | |
| | Total | | 9 | | | |

Mark Scheme – General Certificate of Education (A-level) Mathematics – Decision 1 – January 2011

| MD01 (cont |) | | | |
|--------------|---|----------|-------|---|
| Q | Solution | Marks | Total | Comments |
| 4(a)(i) | B9 3 G12 | M1 | | (2 values at E or F) |
| | 0 45 3 0 | A1 | | Correct values at <i>E</i> and <i>F</i> |
| | A 7.5 6 H 6 J | m1 | | 2 values at <i>I</i> |
| | 6 4.5 IB | m1 | | 3 values at J |
| | | B1 | | 18 at <i>J</i> |
| | D 7.5 1815 | A1 | 6 | All correct, condone 0 missing at <i>A</i> , with rejected values crossed and final values boxed and no extra values at other vertices |
| (ii) | A D F I J | B1 | 1 | or reverse |
| (b) | $7.5 + x < 12$ OE $16.5 + x \ge 18$ OE | M1 | | Either correct condone $7 \cdot 5 + x \le 12$ or $16 \cdot 5 + x > 18$ |
| | | A1 | | Both correct |
| | 1.5 ≤ <i>x</i> < 4.5 | A1 | 3 | $1.5 \le x < 4.5$ seen (with or without working) scores $3/3$ Condone $1.5 \le x$ and $x < 4.5$ or exact equiv in words but must see "and" |
| | | | | $1.5 < x$ or $1.5 \leq x$ or $x < 4.5$ or $x \leq 4.5$ |
| | | | | with no working M1A0 |
| | Total | | 10 | |
| 5 (a) | A vertex / vertices of odd order (A, B, G, H) OE | E1 | 1 | Condone statement of non-Eulerian graph |
| (b) | AB + GH = (180 + 165) = 345 AG + BH = (90 + 210) = 300 | M1 | | These 3 correct sets of pairs |
| | AH + BG = (150 + 210) = 360 | A2,1 | | 3 correct totals, 2 correct totals |
| | Dist 1215 + 300 PI = 1515 | M1 A1 | 5 | 1215 + their smallest CSO |
| (c)(i) | 3 | B1 | 1 | |
| (ii) | 2 | B1 | 1 | |
| | Total | | 8 | |

| Mark Scheme – | General Ce | ertificate of Education | on (A-level) Mathema | atics – Decision 1 | – January 2011 |
|---------------|------------|-------------------------|----------------------|--------------------|----------------|
| | | | | | January 2011 |

| MD01 (cont |) | | | | |
|--------------|-------------------|-------|------------|-------|---------------------------------|
| Q | Solution | | Marks | Total | Comments |
| 6(a)(i) | 10 | | B1 | 1 | |
| | | | | | |
| (ii) | 4 | | B1 | 1 | |
| | | | | | |
| (iii) | 5 | | B1 | 1 | |
| | | | | | |
| (b) | eg | | | | |
| | | | | | |
| | | | MI | | Simple graph, 6 vertices |
| | | | A 1 | 2 | Eulerian graph with 0 adapa |
| | $\langle \rangle$ | | AI | Z | Eulerian graph with 9 edges |
| | | | | | |
| | | | | | |
| | | | | | |
| | | Total | | 5 | |
| 7(9) | 33 | 10141 | B 1 | 1 | |
| /(a) | 55 | | DI | 1 | |
| (b) | BAEDCB | | M1 | | Tour that visits all vertices |
| (~) | | | A1 | | Correct tour |
| | = 41 | | B1 | 3 | |
| | | | | | |
| (c) | A (3) B | | | | Spanning tree without C |
| | | | | | (aither drawn or adges listed) |
| | (4) | | | | (entiel drawn of edges listed) |
| | (10) | | M1 | | and |
| | E | | | | 2 different edges from <i>C</i> |
| | | | | | (either drawn or edges listed) |
| | 2 | | | | |
| | | | A 1 | | |
| | \mathbf{i} | | AI | | Correct MST |
| | D | | | | |
| | (1) | | | | |
| | | | Δ1 | | Compact 2 adapted from C |
| | (5) | | ЛІ | | Correct 2 edges from C |
| | | | | | |
| | č | | | | |
| | = | = 33 | B1 | 4 | |
| | | | | | |
| (d) | A B | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | E | | M1 | | Correct network |
| | | | | | Possibly earned in (c) |
| | | | | | |
| | | | | | |
| | C | | | | |
| | Optimal | OE | A1 | 2 | |
| | | Total | | 10 | |

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| MD01 (cont |) | | | | | · · · · |
|--------------|----------------|----------|-------|-------|-------|---|
| Q | | Solution | | Marks | Total | Comments |
| 8 (a) | | | | | | |
| | X | A | В | | | |
| | 0 | | | | | Condone omission of $X = 0, A = 20, B = 8$ |
| | | 20 | 8 | | | |
| | | 10 | | | | |
| | | | 16 | M1 | | SCA Trace as far as their '10' at A and |
| | | 5 | | | | their '16' at <i>B</i> , ignore values in <i>X</i> column |
| | | | 32 | A1 | | All correct up to and including 32 at <i>B</i> |
| | 32 | | | | | |
| | | 2 | | | | |
| | | | 64 | A1 | | All correct up to and including 64 at <i>B</i> |
| | | 1 | | | | |
| | | | 128 | | | |
| | 160 | | | A1 | 4 | All correct and no further working |
| | ("160") | | | | | |
| | | | | | | |
| (b) | Multiplication | | OE | B1 | 1 | |
| | | | | | | |
| (c) | Continuous lo | ор | OE | E1 | | |
| | as never reach | Line 90 | OE | E1 | 2 | |
| | | | Total | | 7 | |

| Mark Scheme - | General Certificate of | f Education (A-level) | Mathematics – Dec | cision 1 – January 2011 |
|---------------|------------------------|-----------------------|-------------------|-------------------------|
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| MD01 (cont |) | | | |
|------------|--|---------------------------|-------------------|--|
| Q | Solution | Marks | Total | Comments |
| 9(a) | $6x + 9y + 9z \le 600$ | M1 | | Any of the three inequalities correct (un)simplified, condone strict inequalities |
| | $2x + 3y + 3z \le 200$ | A1 | | CAO |
| | $9x + 6y + 9z \le 600$ | | | |
| | $3x + 2y + 3z \le 200$ | A1 | | CAO |
| | $6x + 12y + 18z \ge 480$ | | | |
| | $x + 2y + 3z \ge 80$ | A1 | 4 | CAO |
| (b)(i) | (z = y) | | | |
| | $2x+3y+3y \le 200$ or $2x+6y \le 200$ | M1 | | Correctly substitute into this inequality - either simplified or unsimplified form |
| | $x + 3y \le 100 \qquad \qquad \text{AG}$ | | | |
| | $3x + 2y + 3z \le 200$ | | | Correctly substitute into this inequality - either simplified or unsimplified form |
| | $(\Rightarrow) 3x + 5y \le 200 \qquad \text{AG}$ | | | |
| | $x + 2y + 3z \ge 80$ | | | Correctly substitute into this inequality - either simplified or unsimplified form |
| | $(\Rightarrow) x + 5y \ge 80 \qquad \text{AG}$ | A1 | 2 | All correct – must link their original inequality to the stated answers |
| (ii) | Each line must be straight to have the B ma For all lines, must be correct to ¹ / ₂ square ho | rk availab prizontal a | le. nd vertica | l at the indicated vertices. |
| | 50 | B 1 | | Line through (10, 30) and (40, 20) |
| | 30 | B1 | | Line through (50, 10) and (0, 40) |
| | 20 FR | B1 | | Line through (80, 0) and (0, 16) |
| | | B1 | 4 | FR, must have all lines correct and labelled region (condone no shading) |
| (iii) | Max $x + 2y$ PI | M1 | | If no statement (PI), then check OL on diagram, which must be correct for M1 |
| | Max (= 25 + 50) = 75 | A1 | 2 | Note: 75 with no working 2/2 |
| (iv) | 25 basic, 25 standard, 25 luxury | B1F | 1 | Condone "25 of each type" ONLY if (b)(iii) fully correct Note $x = 25 = y = z$ B0 |
| | Total | | 13 | 1000 x - 20 - y - 2 00 |
| | TOTAL | | 75 | |
| | 101111 | | | 1 |