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# A-LEVEL MATHEMATICS

Decision 1 – MD01

Mark scheme

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6360  
June 2014

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Version/Stage: 1.0 Final

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Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available from [aqa.org.uk](http://aqa.org.uk)

**Key to mark scheme abbreviations**

|              |  |
|--------------|--|
| M            | mark is for method   |
| m or dM      | mark is dependent on one or more M marks and is for method         |
| A            | mark is dependent on M or m marks and is for accuracy              |
| B            | mark is independent of M or m marks and is for method and accuracy |
| E            | mark is for explanation  |
| √ 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 x 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)   |

**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.**

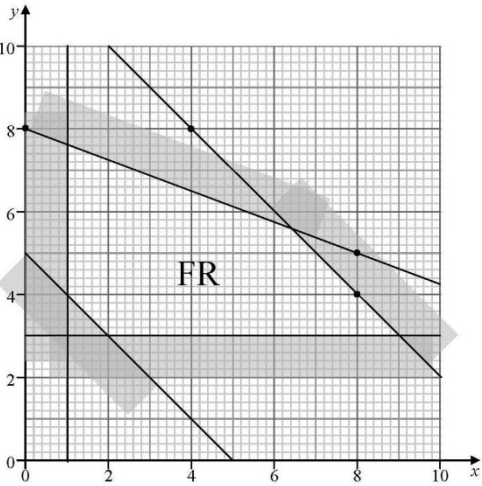
| Q      | Solution   | Mark     | Total  | Comment  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |   |  |
|--------|--|----------|--|--|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----|---|--|
| 1(a)   | <table border="1"> <tr> <td></td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> </tr> <tr> <td>A</td> <td>0</td> <td>0</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>B</td> <td>1</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>C</td> <td>0</td> <td>0</td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>D</td> <td>0</td> <td>1</td> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>E</td> <td>0</td> <td>1</td> <td>0</td> <td>1</td> <td>0</td> </tr> </table> |          | 1  | 2  | 3 | 4 | 5 | A | 0 | 0 | 1 | 0 | 0 | B | 1 | 1 | 1 | 0 | 0 | C | 0 | 0 | 1 | 1 | 1 | D | 0 | 1 | 0 | 1 | 0 | E | 0 | 1 | 0 | 1 | 0 | M1 | 2 | 5x5 matrix with some 0's, 1's oe<br>(or transpose) |
|        |  | 1        | 2  | 3  | 4 | 5 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |   |  |
|        | A  | 0        | 0  | 1  | 0 | 0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |   |  |
|        | B  | 1        | 1  | 1  | 0 | 0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |   |  |
|        | C  | 0        | 0  | 1  | 1 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |   |  |
|        | D  | 0        | 1  | 0  | 1 | 0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |   |  |
| E      | 0  | 1        | 0  | 1  | 0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |   |  |
| (b)(i) | Ignore paths that do not lead to a complete match.<br>For all paths, the order may start from 1 and/or 5.<br>Initial path MUST have only 4 'terms'<br>Correct 4 term path<br>Correct pair of paths (order is only important if second path has 6 terms)<br>$D - 2 + B - 1$ and $E - 4 + C - 5$<br>$D - 2 + B - 1$ then $E - 2 + D - 4 + C - 5$<br>$E - 4 + C - 5$ then $D - 4 + E - 2 + B - 1$   | M1<br>A1 | Or,<br>$D - 4 + C - 5$ and $E - 2 + B - 1$<br>$D - 4 + C - 5$ then $E - 4 + D - 2 + B - 1$<br>$E - 2 + B - 1$ then $D - 2 + E - 4 + C - 5$ |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |   |  |
|        | Match - must be stated and not simply 'shown' on a diagram<br>$A3, B1, C5, D2, E4$<br>or<br>$A3, B1, C5, D4, E2$   | B1       | 3  | If a candidate works on diagrams, then the marks can be earned, BUT only one path per diagram (2 paths on 1 diagram scores M0).<br>The start vertex and path must be clear and correct to score M1.<br>The start vertex and path on a <b>second</b> diagram must be clear and correct to score A1. |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |   |  |
|        | (ii) Match - must be stated and not simply 'shown' on a diagram<br>Match $A3, B1, C5, D4, E2$<br>or<br>$A3, B1, C5, D2, E4$  | B1       | 1  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |   |  |
|        | <b>Total</b>   |          | <b>6</b>   |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |   |  |

| Q       | Solution  | Mark     | Total     | Comment   |          |          |          |          |   |  |          |          |          |          |          |          |          |                     |  |     |     |    |     |     |     |                     |     |  |    |    |     |     |     |                     |     |    |  |    |     |    |    |                     |    |    |    |  |     |     |     |                     |     |     |     |     |  |     |     |                     |     |     |    |     |     |  |    |                     |     |     |    |     |     |    |  |    |  |   |
|---------|---|----------|-----------|---|----------|----------|----------|----------|---|--|----------|----------|----------|----------|----------|----------|----------|---------------------|--|-----|-----|----|-----|-----|-----|---------------------|-----|--|----|----|-----|-----|-----|---------------------|-----|----|--|----|-----|----|----|---------------------|----|----|----|--|-----|-----|-----|---------------------|-----|-----|-----|-----|--|-----|-----|---------------------|-----|-----|----|-----|-----|--|----|---------------------|-----|-----|----|-----|-----|----|--|----|--|---|
| 2(a)(i) | <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td>4</td> <td>1</td> <td>2</td> <td>3</td> <td>(7)</td> <td>5</td> <td>6</td> </tr> <tr> <td></td> <td><i>D</i></td> <td><i>E</i></td> <td><i>F</i></td> <td><i>G</i></td> <td><i>H</i></td> <td><i>I</i></td> <td><i>S</i></td> </tr> <tr> <td><del><i>D</i></del></td> <td></td> <td>120</td> <td>140</td> <td>80</td> <td>170</td> <td>140</td> <td>140</td> </tr> <tr> <td><del><i>E</i></del></td> <td>120</td> <td></td> <td>70</td> <td>80</td> <td>130</td> <td>130</td> <td>110</td> </tr> <tr> <td><del><i>F</i></del></td> <td>140</td> <td>70</td> <td></td> <td>90</td> <td>190</td> <td>85</td> <td>90</td> </tr> <tr> <td><del><i>G</i></del></td> <td>80</td> <td>80</td> <td>90</td> <td></td> <td>110</td> <td>100</td> <td>100</td> </tr> <tr> <td><del><i>H</i></del></td> <td>170</td> <td>130</td> <td>190</td> <td>110</td> <td></td> <td>140</td> <td>150</td> </tr> <tr> <td><del><i>I</i></del></td> <td>140</td> <td>130</td> <td>85</td> <td>100</td> <td>140</td> <td></td> <td>60</td> </tr> <tr> <td><del><i>S</i></del></td> <td>140</td> <td>110</td> <td>90</td> <td>100</td> <td>150</td> <td>60</td> <td></td> </tr> </table> |          | 4         | 1   | 2        | 3        | (7)      | 5        | 6 |  | <i>D</i> | <i>E</i> | <i>F</i> | <i>G</i> | <i>H</i> | <i>I</i> | <i>S</i> | <del><i>D</i></del> |  | 120 | 140 | 80 | 170 | 140 | 140 | <del><i>E</i></del> | 120 |  | 70 | 80 | 130 | 130 | 110 | <del><i>F</i></del> | 140 | 70 |  | 90 | 190 | 85 | 90 | <del><i>G</i></del> | 80 | 80 | 90 |  | 110 | 100 | 100 | <del><i>H</i></del> | 170 | 130 | 190 | 110 |  | 140 | 150 | <del><i>I</i></del> | 140 | 130 | 85 | 100 | 140 |  | 60 | <del><i>S</i></del> | 140 | 110 | 90 | 100 | 150 | 60 |  | M1 |  | Some (just) rows or (just) cols crossed out, with some values circled/highlighted |
|         |   | 4        | 1         | 2   | 3        | (7)      | 5        | 6        |   |  |          |          |          |          |          |          |          |                     |  |     |     |    |     |     |     |                     |     |  |    |    |     |     |     |                     |     |    |  |    |     |    |    |                     |    |    |    |  |     |     |     |                     |     |     |     |     |  |     |     |                     |     |     |    |     |     |  |    |                     |     |     |    |     |     |    |  |    |  |   |
|         |   | <i>D</i> | <i>E</i>  | <i>F</i>  | <i>G</i> | <i>H</i> | <i>I</i> | <i>S</i> |   |  |          |          |          |          |          |          |          |                     |  |     |     |    |     |     |     |                     |     |  |    |    |     |     |     |                     |     |    |  |    |     |    |    |                     |    |    |    |  |     |     |     |                     |     |     |     |     |  |     |     |                     |     |     |    |     |     |  |    |                     |     |     |    |     |     |    |  |    |  |   |
|         | <del><i>D</i></del>   |          | 120       | 140   | 80       | 170      | 140      | 140      |   |  |          |          |          |          |          |          |          |                     |  |     |     |    |     |     |     |                     |     |  |    |    |     |     |     |                     |     |    |  |    |     |    |    |                     |    |    |    |  |     |     |     |                     |     |     |     |     |  |     |     |                     |     |     |    |     |     |  |    |                     |     |     |    |     |     |    |  |    |  |   |
|         | <del><i>E</i></del>   | 120      |           | 70  | 80       | 130      | 130      | 110      |   |  |          |          |          |          |          |          |          |                     |  |     |     |    |     |     |     |                     |     |  |    |    |     |     |     |                     |     |    |  |    |     |    |    |                     |    |    |    |  |     |     |     |                     |     |     |     |     |  |     |     |                     |     |     |    |     |     |  |    |                     |     |     |    |     |     |    |  |    |  |   |
|         | <del><i>F</i></del>   | 140      | 70        |   | 90       | 190      | 85       | 90       |   |  |          |          |          |          |          |          |          |                     |  |     |     |    |     |     |     |                     |     |  |    |    |     |     |     |                     |     |    |  |    |     |    |    |                     |    |    |    |  |     |     |     |                     |     |     |     |     |  |     |     |                     |     |     |    |     |     |  |    |                     |     |     |    |     |     |    |  |    |  |   |
|         | <del><i>G</i></del>   | 80       | 80        | 90  |          | 110      | 100      | 100      |   |  |          |          |          |          |          |          |          |                     |  |     |     |    |     |     |     |                     |     |  |    |    |     |     |     |                     |     |    |  |    |     |    |    |                     |    |    |    |  |     |     |     |                     |     |     |     |     |  |     |     |                     |     |     |    |     |     |  |    |                     |     |     |    |     |     |    |  |    |  |   |
|         | <del><i>H</i></del>   | 170      | 130       | 190   | 110      |          | 140      | 150      |   |  |          |          |          |          |          |          |          |                     |  |     |     |    |     |     |     |                     |     |  |    |    |     |     |     |                     |     |    |  |    |     |    |    |                     |    |    |    |  |     |     |     |                     |     |     |     |     |  |     |     |                     |     |     |    |     |     |  |    |                     |     |     |    |     |     |    |  |    |  |   |
|         | <del><i>I</i></del>   | 140      | 130       | 85  | 100      | 140      |          | 60       |   |  |          |          |          |          |          |          |          |                     |  |     |     |    |     |     |     |                     |     |  |    |    |     |     |     |                     |     |    |  |    |     |    |    |                     |    |    |    |  |     |     |     |                     |     |     |     |     |  |     |     |                     |     |     |    |     |     |  |    |                     |     |     |    |     |     |    |  |    |  |   |
|         | <del><i>S</i></del>   | 140      | 110       | 90  | 100      | 150      | 60       |          |   |  |          |          |          |          |          |          |          |                     |  |     |     |    |     |     |     |                     |     |  |    |    |     |     |     |                     |     |    |  |    |     |    |    |                     |    |    |    |  |     |     |     |                     |     |     |     |     |  |     |     |                     |     |     |    |     |     |  |    |                     |     |     |    |     |     |    |  |    |  |   |
|         |   | A1       |           | Any 6 values circled/highlighted/listed <b>seen</b> either in table or body of script   |          |          |          |          |   |  |          |          |          |          |          |          |          |                     |  |     |     |    |     |     |     |                     |     |  |    |    |     |     |     |                     |     |    |  |    |     |    |    |                     |    |    |    |  |     |     |     |                     |     |     |     |     |  |     |     |                     |     |     |    |     |     |  |    |                     |     |     |    |     |     |    |  |    |  |   |
|         |   | A1       |           | First 3 correct,<br><i>EF</i> or <i>FE</i> , <i>EG</i> or <i>GE</i> , <i>GD</i> or <i>DG</i> , identified<br>AND <i>E</i> , <i>F</i> , <i>G</i> numbered (1, 2, 3 or (0), 1, 2)<br>(if <b>no</b> numbering on table, accept order if clearly shown by a correct list) |          |          |          |          |   |  |          |          |          |          |          |          |          |                     |  |     |     |    |     |     |     |                     |     |  |    |    |     |     |     |                     |     |    |  |    |     |    |    |                     |    |    |    |  |     |     |     |                     |     |     |     |     |  |     |     |                     |     |     |    |     |     |  |    |                     |     |     |    |     |     |    |  |    |  |   |
|         |   | A1       |           | All correct or fully correct transpose (numbering may be as first A mark, if <b>no</b> numbering on table, accept order if clearly shown by a correct list, condone omission of 7 at <i>H</i> . Condone row (or col) <i>H</i> not crossed out.)                       |          |          |          |          |   |  |          |          |          |          |          |          |          |                     |  |     |     |    |     |     |     |                     |     |  |    |    |     |     |     |                     |     |    |  |    |     |    |    |                     |    |    |    |  |     |     |     |                     |     |     |     |     |  |     |     |                     |     |     |    |     |     |  |    |                     |     |     |    |     |     |    |  |    |  |   |
|         |   | B1       | 5         | Correct edges (not lengths), either listed or values circled/highlighted <b>seen</b> either in table or body of script  |          |          |          |          |   |  |          |          |          |          |          |          |          |                     |  |     |     |    |     |     |     |                     |     |  |    |    |     |     |     |                     |     |    |  |    |     |    |    |                     |    |    |    |  |     |     |     |                     |     |     |     |     |  |     |     |                     |     |     |    |     |     |  |    |                     |     |     |    |     |     |    |  |    |  |   |
| (ii)    | 485   | B1       | 1         |   |          |          |          |          |   |  |          |          |          |          |          |          |          |                     |  |     |     |    |     |     |     |                     |     |  |    |    |     |     |     |                     |     |    |  |    |     |    |    |                     |    |    |    |  |     |     |     |                     |     |     |     |     |  |     |     |                     |     |     |    |     |     |  |    |                     |     |     |    |     |     |    |  |    |  |   |
| (iii)   |   | M1       |           | ST with 7 vertices and 6 edges  |          |          |          |          |   |  |          |          |          |          |          |          |          |                     |  |     |     |    |     |     |     |                     |     |  |    |    |     |     |     |                     |     |    |  |    |     |    |    |                     |    |    |    |  |     |     |     |                     |     |     |     |     |  |     |     |                     |     |     |    |     |     |  |    |                     |     |     |    |     |     |    |  |    |  |   |
|         |   | A1       | 2         | Correct including labelling   |          |          |          |          |   |  |          |          |          |          |          |          |          |                     |  |     |     |    |     |     |     |                     |     |  |    |    |     |     |     |                     |     |    |  |    |     |    |    |                     |    |    |    |  |     |     |     |                     |     |     |     |     |  |     |     |                     |     |     |    |     |     |  |    |                     |     |     |    |     |     |    |  |    |  |   |
| (b)(i)  | <i>IF</i> ( <i>FI</i> ), <i>IS</i> ( <i>SI</i> )  | B1, B1   |           | Must be in this order<br>If only 1 edge given then ‘last/2 <sup>nd</sup> last’ must be clearly stated   |          |          |          |          |   |  |          |          |          |          |          |          |          |                     |  |     |     |    |     |     |     |                     |     |  |    |    |     |     |     |                     |     |    |  |    |     |    |    |                     |    |    |    |  |     |     |     |                     |     |     |     |     |  |     |     |                     |     |     |    |     |     |  |    |                     |     |     |    |     |     |    |  |    |  |   |
| (ii)    | <i>IF</i> ( <i>FI</i> ), <i>GH</i> ( <i>HG</i> )  | B1       | 3         | Must be in this order<br>( <b>SC1</b> if B0 scored in part (i) <b>and</b> (ii), and <b>ONLY</b> <i>IS</i> given for part(i) and <i>GH</i> for part (ii).)   |          |          |          |          |   |  |          |          |          |          |          |          |          |                     |  |     |     |    |     |     |     |                     |     |  |    |    |     |     |     |                     |     |    |  |    |     |    |    |                     |    |    |    |  |     |     |     |                     |     |     |     |     |  |     |     |                     |     |     |    |     |     |  |    |                     |     |     |    |     |     |    |  |    |  |   |
|         | <b>Total</b>  |          | <b>11</b> |   |          |          |          |          |   |  |          |          |          |          |          |          |          |                     |  |     |     |    |     |     |     |                     |     |  |    |    |     |     |     |                     |     |    |  |    |     |    |    |                     |    |    |    |  |     |     |     |                     |     |     |     |     |  |     |     |                     |     |     |    |     |     |  |    |                     |     |     |    |     |     |    |  |    |  |   |

| Q            | Solution                     | Mark                       | Total     | Comment  |              |    |   |  |
|--------------|------------------------------|----------------------------|-----------|--|--------------|----|---|--|
| 3 (a)(i)     |                              | M1<br>A1<br>m1<br>m1<br>A1 | 6         | Use of Dijkstra, 2+ values at <i>F</i><br>Values of 44, 37, 36 only at <i>F</i><br>3 values at <i>I</i><br>3 values at <i>J</i><br>All correct, including cancelling and boxing. (condone omission of 0 at <i>A</i> )<br>Final value at <i>K</i> is 61<br>(diagram takes precedence over value in body of script)<br>( <b>Notation:</b> accept correct alternative notation eg 3 ‘box’ method etc)<br>If working from <i>K</i> to <i>A</i> :<br>M1 2 values at <i>F</i><br>A1 values of 34 and 26 at <i>F</i><br>m1 2 values at <i>A</i><br>m1 only one value at every other vertex<br>A1 as above, B1 final value at <i>A</i> is 61 |              |    |   |  |
|              |                              | B1                         |           |  | B1           | 1  | Or reverse<br>Condone <i>AB, BE, EI, IK</i> |  |
|              |                              | (ii)                       |           |  | <i>ABEIK</i> | B1 | 1   |  |
|              |                              | (b)                        |           |  | 63 (mins) oe | B1 | 1   |  |
| (c)          | 64 (mins) oe<br><i>ABFJK</i> | B1<br>B1                   | 2         | Or reverse   |              |    |   |  |
| <b>Total</b> |                              |                            | <b>10</b> |  |              |    |   |  |

| Q            | Solution   | Mark         | Total     | Comment   |
|--------------|--|--------------|-----------|---|
| 4(a)         | $AC + EG = (6 + 9.5) = 15.5$<br>$AE + CG = 11 + 12.5 \text{ or } 23.5$<br>$AG + CE = (7 + 8) = 15$<br><br>$79.5 + \text{their min total} = 94.5$ | M1<br>A2,1,0 | 5         | These 3 sets of pairs stated<br>All 3 correct, 2 correct<br><br>PI by their final answer<br>(if M0 scored then 94.5 scores SC2) |
|              |  | m1<br>A1 cso |           |   |
| (b)(i)       | 2  | B1           |           |   |
| (ii)         | 3  | B1           | 2         |   |
| (c)(i)       | $79.5 + \text{their min edge} = 85.5$  | M1<br>A1     |           | PI by their final answer (must have 6 ‘values’ in part (a))<br>If M0 scored then 85.5 scores 2/2                                |
|              |  | B1           |           |   |
| (ii)         | <i>E, G</i>  | B1           | 3         |   |
| <b>Total</b> |  |              | <b>10</b> |   |

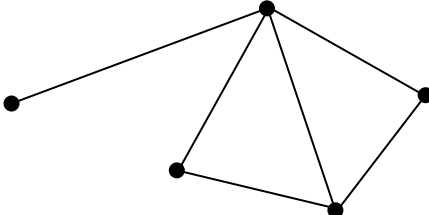


| Q   | Solution  | Mark  | Total                           | Comment  |
|---|---|---|---------------------------------|--|
| <p><b>5</b></p> <p><b>(a)</b> <math>x = 1, y = 3</math> and <math>x + y = 5</math><br/> <math>x + y = 12</math><br/> <math>3x + 8y = 64</math></p> <p>Correct feasible region</p> <p><b>(b)</b></p> <p><b>(i)</b> 30, (9, 3)</p> <p><b>(ii)</b> 29.6, (6.4, 5.6) oe</p> <p><b>(iii)</b> -15, (9, 3)</p> |  | <p>B1<br/>                     B1<br/>                     M1<br/>                     A1<br/>                     B1</p> <p>B1, B1</p> <p>B1, B1</p> <p>B1, B1</p> | <p><b>5</b></p> <p><b>6</b></p> | <p>Accuracy: All lines must be ruled, correct to within ½ small square both horizontally and vertically, at ‘key’ vertices, stated below.<br/>                     Ignore objective lines in part (a)</p> <p><math>x + y = 5</math>, correct at (0, 5) and (5, 0)<br/>                     Correct at (4, 8) and (8, 4)<br/>                     Line with ‘correct’ gradient (-0.5 to -0.3) passing through (0, 8).<br/>                     Correct at (8, 5)<br/>                     F.R. (a pentagon) <b>clearly identified</b> and labelled, must have scored previous 4 marks</p> <p>If multiple vertices are listed then final answer must be clearly identified.<br/>                     For the second B1, the coordinates must be stated explicitly. (allow <math>x=9, y=3</math> etc)</p> <p>SC1 for 29 - 31, <b>AND</b> (6 - 7, 5 - 6)</p> |
|   | <b>Total</b>  |   | <b>11</b>                       |  |



| Q              | Solution  | Mark   | Total     | Comment   |
|----------------|---|--|-----------|---|
| <b>6(a)(i)</b> | 30  | <b>B1</b>  |           |   |
| <b>(ii)</b>    | 20  | <b>B1</b>  | <b>2</b>  |   |
| <b>(b)(i)</b>  | Quicker going via <i>L</i> oe   | <b>E1</b>  | <b>1</b>  | <i>MLN</i> (= 236), allow 126 + 110   |
| <b>(ii)</b>    | 932 (mins) isw  | <b>B1</b>  | <b>1</b>  |   |
| <b>(iii)</b>   | <i>MLNLBLELM</i>  | <b>M1</b><br><b>A1</b>   | <b>2</b>  | Any correct 'expansion' eg <i>MLN</i> , <i>NLB</i> or <i>BLE</i>  |
| <b>(iv)</b>    | Script takes precedence over working on table.<br><i>MBLNEM</i> or <i>MBLNLEM</i><br><br>796 (mins) | <b>M1</b><br><b>m1</b><br><b>A1</b><br><b>A1</b><br><b>cs0</b> | <b>4</b>  | Any tour starting and finishing at <i>M</i><br>Visits all vertices<br>Correct order<br>If M0 scored, then 796 scores SC2<br><br>If a candidate works only on a table<br>M1 for 4 or 5 values circled<br>m1 for 5 values circled, one per row/col<br>A1 for correct values circled and order shown<br>A1 for 796 |
| <b>Total</b>   |   |  | <b>10</b> |   |

| Q            | Solution  | Mark   | Total    | Comment  |
|--------------|---|--|----------|--|
| <b>7</b>     | $4x + 10y + 10z \leq 240$<br>$7x + 14y + 14z \leq 210$<br>$14x + 21y + 28z \leq 420$<br><br>(Leading to)<br>$2x + 5y + 5z \leq 120$ ISW<br>$x + 2y + 2z \leq 30$ ISW<br>$2x + 3y + 4z \leq 60$ ISW<br><br>$x > y + z$ ISW<br>$y \geq z$ ISW<br><br>$y \geq \frac{15}{100}(x + y + z)$<br>(Leading to)<br>$17y \geq 3x + 3z$ ISW | <b>M1</b><br><br><b>A1</b><br><br><b>m1</b><br><br><b>A1</b><br><br><b>B1</b><br><b>B1</b><br><br><b>M1</b><br><br><b>A1</b> |          | One correct inequality, PI by correct simplified inequalities<br><br>All 3 correct,(PI by correct simplified inequalities)<br><br>Correctly simplifying one inequality<br><br>All correct<br><br>OE, must have all coefficients as $\pm 1$<br>OE, must have all coefficients as $\pm 1$<br><br>OE (but not 15%)<br><br>Any correct rearrangement involving integer coefficients<br>eg $17y - 3x - 3z \geq 0$ |
| <b>Total</b> |   |  | <b>8</b> |  |

| Q   | Solution   | Mark      | Total   | Comment   |
|---|--|-----------|---|---|
| <b>8(a)(i)</b>  | If $x$ is even, there would be three odds  | <b>M1</b> | <b>2</b>  | Or,<br>Sum = $5x + 7$ , must be even, M1<br>(so $5x$ must be odd),<br>so $x$ must be odd A1 |
|   | Hence $x$ is odd.  | <b>A1</b> |   |   |
|   | <b>(ii)</b> $x = 1$<br>( if only seen in part (i), this mark can be awarded if a correct graph is given in part (ii))<br>Graph <b>clearly having</b> 5 vertices and 5 or 6 edges<br>Correct graph must <b>clearly</b> have 5 vertices, 6 edges and degree of vertices as 1, 2, 2, 3, 4 | <b>B1</b> | <b>3</b>  | eg<br>   |
|   |  | <b>B1</b> |   |   |
|   | <b>B1</b>  |           |   |   |
|   | <b>(b)(i)</b> (Min =) 0<br>(Max =) 9   | <b>B1</b> | <b>2</b>  |   |
| <b>B1</b>   |  |           |   |   |
| <b>(ii)</b> (the degrees of the vertices must be 0, 1, 2...9)<br>There would be an odd number of odds<br>Impossible | <b>E1</b>  | <b>2</b>  | Or,<br>If all different, then sum = 45<br>Impossible, as sum must be even<br>Or,<br>Degrees of 0 and 9 would occur,<br>Impossible as '9' would connect to the '0' |   |
|   | <b>E1</b>  |           |   |   |
| <b>Total</b>  |  |           | <b>9</b>  |   |