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Oxford Cambridge and RSA

# GCE

# Mathematics (MEI)

Unit **4772**: Decision Mathematics 2

Advanced GCE

# Mark Scheme for June 2018

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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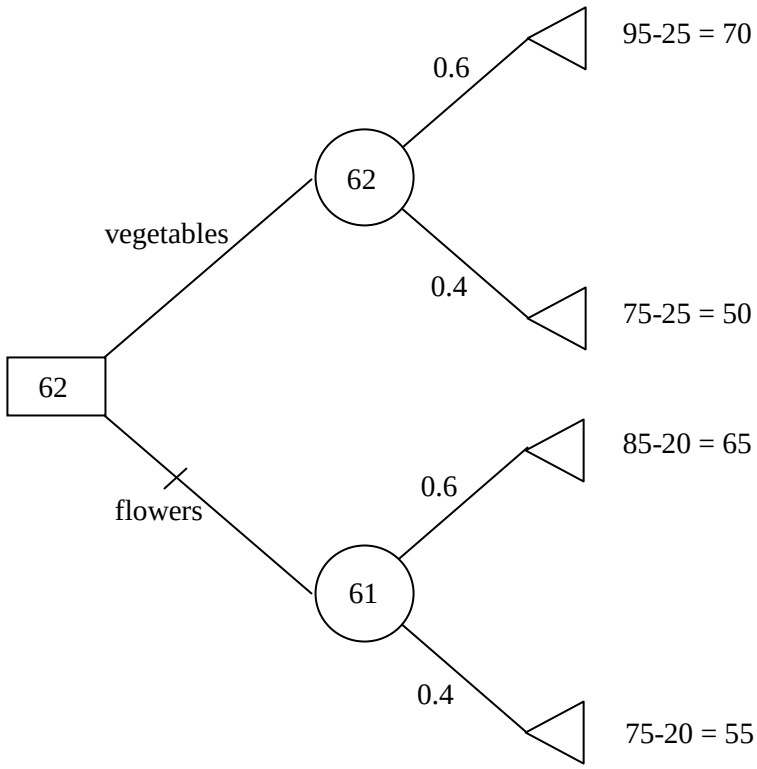
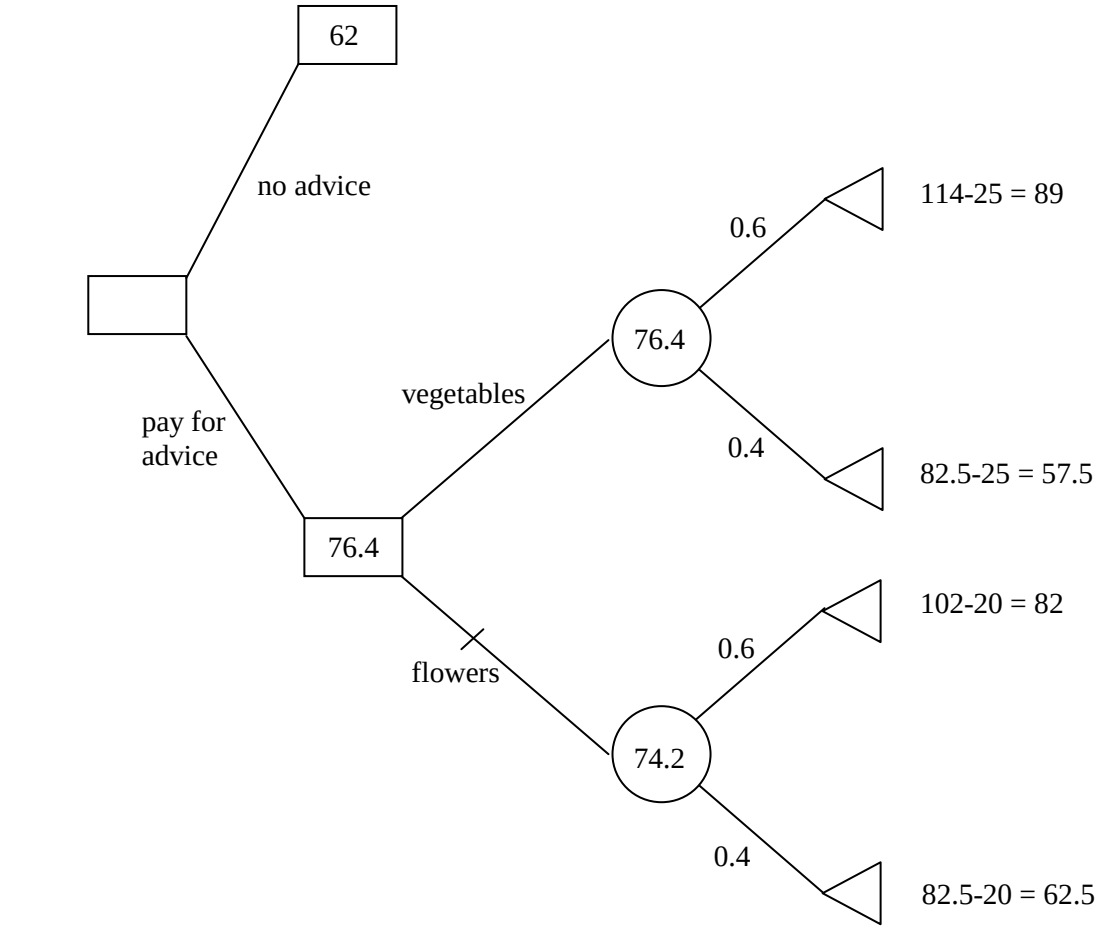
**Annotations and abbreviations**

| **Annotation in scoris** | **Meaning** |
|---|---|
| ✓and ✖ | |
| BOD | Benefit of doubt |
| FT | Follow through |
| ISW | Ignore subsequent working |
| M0, M1 | Method mark awarded 0, 1 |
| A0, A1 | Accuracy mark awarded 0, 1 |
| B0, B1 | Independent mark awarded 0, 1 |
| SC | Special case |
| ^ | Omission sign |
| MR | Misread |
| Highlighting | |
| | |
| **Other abbreviations in mark scheme** | **Meaning** |
| E1 | Mark for explaining |
| U1 | Mark for correct units |
| G1 | Mark for a correct feature on a graph |
| M1 dep* | Method mark dependent on a previous mark, indicated by * |
| cao | Correct answer only |
| oe | Or equivalent |
| rot | Rounded or truncated |
| soi | Seen or implied |
| www | Without wrong working |
| | |
| | |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| 1 | (i) & (ii) | |  <br>Plant vegetables<br>EMV = £62 | M1<br>M1<br>A1<br><br>B1<br>M1<br>A1<br>M1<br>A1<br>A1 | decision node at first branch<br>chance nodes at second branches<br>all correct<br><br>payoffs<br>computing OK at a chance node<br>62 and 61<br>deciding at the decision node<br>62 cao<br>action |

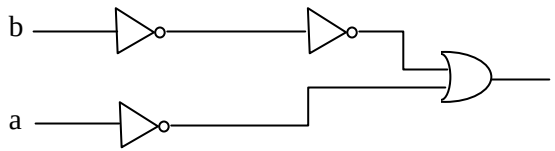
| Question | Answer | Marks | Guidance |
|---|---|---|---|
| (iii) |  <br>Value of advice = £14.40 | B1<br>M1<br>A1<br>B1 | advice or ~advice<br>repeat of structure with new pay-offs (allow if new payoffs incorrect)<br>all calculations cao<br>EMV = £14.40 √ |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| | (iv) | | Without advice … 0.5*62 + 0.5*61 = 61.5 | B1 | |
| | | | With advice … 0.5*76.4 + 0.5*74.2 = 75.3 | B1 | |
| | | | So value of advice is now £13.80. | B1 | |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| 2 | (i) | | <table><tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th></tr><tr><td>1</td><td>24</td><td>24</td><td>28</td><td>12</td><td>36</td></tr><tr><td>2</td><td>24</td><td>24</td><td>24</td><td>12</td><td>32</td></tr><tr><td>3</td><td>28</td><td>24</td><td>32</td><td>16</td><td>8</td></tr><tr><td>4</td><td>12</td><td>12</td><td>16</td><td>24</td><td>24</td></tr><tr><td>5</td><td>36</td><td>32</td><td>8</td><td>24</td><td>16</td></tr></table> <table><tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th></tr><tr><td>1</td><td>4</td><td>4</td><td>4</td><td>4</td><td>4</td></tr><tr><td>2</td><td>4</td><td>4</td><td>3</td><td>4</td><td>3</td></tr><tr><td>3</td><td>4</td><td>2</td><td>4</td><td>4</td><td>5</td></tr><tr><td>4</td><td>1</td><td>2</td><td>3</td><td>1</td><td>3</td></tr><tr><td>5</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td></tr></table> | B1<br><br><br><br><br>M1<br>A1<br>M1<br>A1 | 16 cells unchanged in distance matrix, with corresponding cells unchanged in route matrix<br>5 to 1 route entry correct<br>5 to 1 distance correct<br>rest of distance changes<br>rest of route changes |
| | (ii) | | Shortest distance from 1 to 5 in row 1 col 5 of distance matrix = 36<br>Shortest route from 1 to 5 is 1 to 4 (r1c5 of RM), 4 to 3 (r4c5 of RM), 3 to 5 (r3c5 of RM).<br>(Special case – two correct answers without method(s).) | M1<br>A1<br>(B1) | both methods |
| | (iii) | | <table><tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th></tr><tr><td>1</td><td>24</td><td>24</td><td>28</td><td>12</td><td>36</td></tr><tr><td>2</td><td>24</td><td>24</td><td>24</td><td>12</td><td>32</td></tr><tr><td>3</td><td>28</td><td>24</td><td>32</td><td>16</td><td>8</td></tr><tr><td>4</td><td>12</td><td>12</td><td>16</td><td>24</td><td>24</td></tr><tr><td>5</td><td>36</td><td>32</td><td>8</td><td>24</td><td>16</td></tr></table> Select 8, 24 and 24 (details not needed).<br>Add back in 12 and 12.<br>So 8+24+24+12+12 = 80 | B1<br>B1<br>B1 √ | |
| | (iv) | | **1** 12 **4** 12 **2** 24 **3** 8 **5** 36 **1** so distance = 12+12+24+8+36 = 92<br>Route is **1 4 2 3 5** (**3 4**) **1** | B1<br>B1 | 92 |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| | **(v)** | | Pairing (**1 2**) (**3 5**) has cost 32<br>Pairing (**1 3**) (**2 5**) has cost 60<br>Pairing (**1 5**) (**2 3**) has cost 60<br>So 169 + 32 = 201<br>(Special case – correct answer only.) | M1<br><br><br><br>A1<br>(B1) | |
| | **(vi)** | | Need number 3<br>Minimum connector | M1<br>A1 | |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| 3 | (i) | | a represents the volume of feed A in $m^3$, etc. | M1A1 | variables volumes |
| | | | Min 250a + 300b + 150c objective | B1 | |
| | | | st a + b + c = 100 order volume | B1 | |
| | | | 15a + 12b + 10c ≥ 1300 fibre constraint | M1 | constraints |
| | | | 3.5a + 4b + 2c ≥ 300 fat constraint | A1 | |
| | | | 10a + 15b + 10c ≥ 1300 protein constraint | | |
| | (ii) | | corresponds to minimum of {100/1, 100/1, 1300/12, 300/4, 1300/15) | B1 | |
| | (iii)&(iv) | | P A B C s1 s2 s3 s4 s5 a1 a2 a3 a4 rhs<br>1 1.5 0 7 0 -1 -1 7 -1 0 0 -8 0 600<br>0 12.5 0 0 0 0 0 -75 0 0 0 75 0 22500<br>0 0.125 0 0.5 1 0 0 0.25 0 0 0 -0.25 0 25<br>0 0.125 0 0.5 0 -1 0 0.25 0 1 0 -0.25 0 25<br>0 4.5 0 4 0 0 -1 3 0 0 1 -3 0 400<br>0 0.875 1 0.5 0 0 0 -0.25 0 0 0 0.25 0 75<br>0 -3.125 0 2.5 0 0 0 3.75 -1 0 0 -3.75 1 175 | M1<br><br>A1<br><br>A1<br><br>A1<br><br>A1<br><br>B1 | Use of pivot row to get zeros in B column.<br>infeasibility row<br>objective row<br>equality rows<br>other 3 constraint rows<br>any one of the indicated pivots |
| | (v) | | feasible | B1 | |
| | | | also optimal | B1 | |
| | | | cost is £27600 | B1 | |
| | | | $36m^3$ of A, $60m^3$of B and $4m^3$ of C | B1 | |
| | | | fibre constraint tight | B1 | |
| | | | protein constraint tight | B1 | |
| | | | fat constraint slack, with the mix having 3.74% fat content | B1 | |

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>4</td><td>(a)</td><td>(i)</td><td>Correct</td><td>B1</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Incorrect, eg you might have put up your umbrella to keep the sun off your head.</td><td>B1 B1</td><td></td></tr>
<tr><td></td><td></td><td>(iii)</td><td>Correct</td><td>B1</td><td></td></tr>
<tr><td></td><td></td><td>(iv)</td><td>Incorrect, eg other animals might also purr.</td><td>B1 B1</td><td></td></tr>
<tr><td></td><td></td><td>(v)</td><td>Incorrect, eg there may be no snow!</td><td>B1 B1</td><td></td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td> 
</td><td>B1<br>B1</td><td>swapping a and b<br>two negations (this lost if diagram shown with the two negations cancelling out.)</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>
<table>
<tr><td>(a</td><td>⇒</td><td>b)</td><td>⇔</td><td>(~b</td><td>⇒</td><td>~a)</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td></tr>
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</table>
</td><td>M1<br>A1<br>A1</td><td>4 rows, with correct combinations for a & b.<br>negations correct<br>implications correct</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>(a ⇒ b) ⇔ ~a ∨ b ⇔ b ∨ ~a ⇔ ~b ⇒ ~a<br><br>(special case -1 if assumes what is to be proved)</td><td>B1<br>B1<br>B1</td><td>def of ⇒<br>commutativity<br>def of ⇒</td></tr>
</table>

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| | (c) | | Try to re-set the RCCB.<br>If it will not re-set then switch light off and the garage door mechanism off and try to re-set the RCCB. If it re-sets then the problem is either the garage door or the light. | B1 | |
| | | | Switch on the garage door mechanism. If the RCCB trips then the garage door mechanism has been damaged. | B1 | |
| | | | If the RCCB does not trip then activate the garage door. If the RCCB trips then the garage door mechanism has been damaged. | B1 | |
| | | | Whether or not the garage door mechanism has been damaged, switch off the garage door mechanism and re-set the RCCB if necessary and switch on the light. If the RCCB trips then the light control has let water in. | B1 | |

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