

GCE

Mathematics (MEI)

Unit **4773**: Decision Mathematics Computation

Advanced GCE

Mark Scheme for June 2018

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

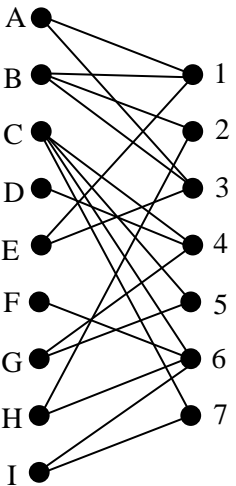
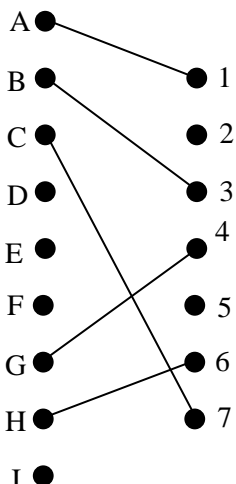
It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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.

© OCR 2018

Question	Answer	Marks	Guidance
1 (i)		M1 A1	A and I correct
(ii)	 <div style="display: flex; justify-content: space-around; margin-top: 20px;"> <div style="text-align: center;"> <p>2</p> <p>B — 3</p> <p>H — 6</p> </div> <div style="text-align: center;"> <p>A — 1 — E breakthrough</p> <p>E breakthrough</p> <p>C — 7</p> <p>F breakthrough</p> </div> </div> <div style="margin-top: 20px;"> <p>5</p> <p>C — 7 — I breakthrough</p> <p>G — 4 — D breakthrough</p> </div>	B1 M1 A1 B1 M1 A1 B1	bipartite an alternating path from 2 E1, B2, A3 or A1, B2, E3 or A1, H2, B3 (with F6) an alternating path from 5 G4, C5, H6, I7 or D4, G5, H6, C7

Question	Answer	Marks	Guidance																
(iii)	<p>Max $4A1 + 4A3 + 4B1 + 3B2 + 4B3 + 5C4 + 5C5 + 5C6 + 5C7 + 4D4 + 3E1 + 3E3$ $+ 4F6 + 4G4 + 4G5 + 2H2 + 3H6 + 5I6 + 4I7$</p> <p>st $A1 + A3 \leq 1$ $B1 + B2 + B3 \leq 1$ $C4 + C5 + C6 + C7 \leq 1$ $D4 \leq 1$ $E1 + E3 \leq 1$ $F6 \leq 1$ $G4 + G5 \leq 1$ $H2 + H6 \leq 1$ $I6 + I7 \leq 1$ $A1 + B1 + E1 \leq 1$ $B2 + H2 \leq 1$ $A3 + B3 + E3 \leq 1$ $C4 + D4 + G4 \leq 1$ $C5 + G5 \leq 1$ $C6 + H6 + F6 + I6 \leq 1$ $C7 + I7 \leq 1$</p> <p>end</p>	<p>B1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p>	<p>objective</p> <p>player constraints</p> <p>“<” is correct (throughout)</p> <p>position constraints</p> <p>allow (grudgingly) “=”</p> <p>Penalise -1 for setting it up as an IP.</p>																
(iv)	<p>running successfully</p> <table border="1"> <tr> <td>Position</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> <td>7</td> </tr> <tr> <td>Player</td> <td>B</td> <td>H</td> <td>A</td> <td>D</td> <td>G</td> <td>I</td> <td>C</td> </tr> </table> <p>Total manager score = 28.</p>	Position	1	2	3	4	5	6	7	Player	B	H	A	D	G	I	C	<p>B1</p> <p>B1</p> <p>B1</p> <p>B1</p>	<p>positions 1, 2 and 3</p> <p>positions 4, 5, 6 and 7</p>
Position	1	2	3	4	5	6	7												
Player	B	H	A	D	G	I	C												

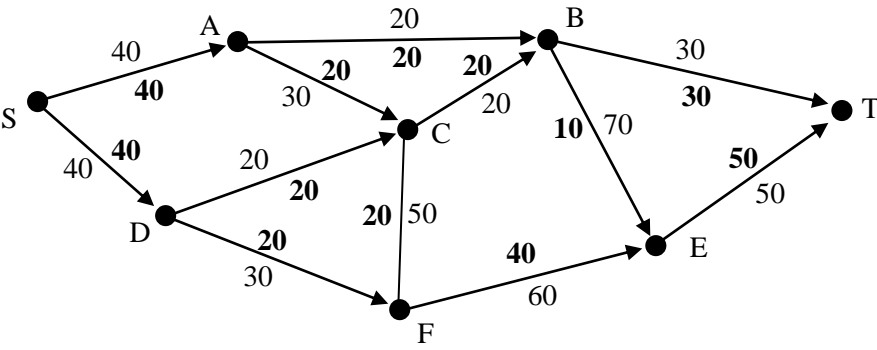
Question		Answer	Marks	Guidance																																																																
2	(i)	eg λ β time $f(t)$ $s(t)$ $10-f(t)-s(t)$ $P(+)$ $P(-)$ + - $f(t+1)$ $s(t+1)$ 0.04 0.2 0 2 8 0 0.64 0.4 1 0 3 7 1 3 7 0 0.84 0.6 1 -1 3 6	B1 B1 B1 B1 B1 B1 B1	λ and β OK time <i>f</i> , <i>s</i> and <i>recovered</i> above updated probabilities use of absolute addresses “IF” statements computation of $f(t+1)$ and $s(t+1)$																																																																
		(ii)	running time t and $s(t)$ noted	B1 B1																																																																
		(iii)	eg <table border="1"> <tr> <td>Run</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td> </tr> <tr> <td>t</td><td>37</td><td>33</td><td>16</td><td>3</td><td>12</td><td>15</td><td>18</td><td>17</td><td>15</td><td>27</td><td>24</td><td>16</td><td>25</td><td>18</td><td>19</td><td>23</td><td>8</td><td>17</td><td>34</td><td>16</td> </tr> <tr> <td>$s(t)$</td><td>3</td><td>0</td><td>2</td><td>8</td><td>3</td><td>2</td><td>0</td><td>0</td><td>4</td><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>7</td><td>4</td><td>0</td><td>4</td> </tr> </table> t is time to infection dying out – usually within 24 hours, but occasionally longer $s(t)$ is the number who survive without being infected – usually few but occasionally more	Run	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	t	37	33	16	3	12	15	18	17	15	27	24	16	25	18	19	23	8	17	34	16	$s(t)$	3	0	2	8	3	2	0	0	4	1	0	1	1	1	1	1	7	4	0	4	B1 B1 B1 B1 B1	SC for means only B1 B1 B1
			Run	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20																																													
			t	37	33	16	3	12	15	18	17	15	27	24	16	25	18	19	23	8	17	34	16																																													
		$s(t)$	3	0	2	8	3	2	0	0	4	1	0	1	1	1	1	1	7	4	0	4																																														
		(iv)	less time more survivors	B1 B1																																																																
(v)	t in minutes	B1	Implies more runs, but “more runs” scores zero																																																																	

Question			Answer	Marks	Guidance																																																							
3	(a)	(i)	Auxiliary ... $\lambda^2 - 0.8\lambda - 0.2 = 0$, so $\lambda = 1$ or -0.2 Gives $A + B(-0.2) = 7$ and $A + B(-0.2)^2 = 8$ So $A = 47/6$ and $B = 25/6$ giving $T_n = 47/6 + (25/6)(-1/5)^n$	B1 B1 B1 B1 B1 B1 B1 B1																																																								
		(ii)	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%; text-align: left;">a</td> <td style="width: 15%;">0.8</td> <td style="width: 15%;">7</td> <td style="width: 10%;">1</td> <td style="width: 10%;">7</td> </tr> <tr> <td>b</td> <td>0.2</td> <td>8</td> <td>2</td> <td>8</td> </tr> <tr> <td>c</td> <td>0</td> <td>7.8</td> <td>3</td> <td>7.8</td> </tr> <tr> <td></td> <td></td> <td>7.84</td> <td>4</td> <td>7.84</td> </tr> <tr> <td></td> <td></td> <td>7.832</td> <td>5</td> <td>7.832</td> </tr> <tr> <td></td> <td></td> <td>7.8336</td> <td>6</td> <td>7.8336</td> </tr> <tr> <td></td> <td></td> <td>7.83328</td> <td>7</td> <td>7.83328</td> </tr> <tr> <td></td> <td></td> <td>7.833344</td> <td>8</td> <td>7.833344</td> </tr> <tr> <td></td> <td></td> <td>7.833331</td> <td>9</td> <td>7.833331</td> </tr> <tr> <td></td> <td></td> <td>7.833334</td> <td>10</td> <td>7.833334</td> </tr> <tr> <td></td> <td></td> <td>7.833333</td> <td>11</td> <td>7.833333</td> </tr> </table> <p>... and then repeated to line 20.</p>	a	0.8	7	1	7	b	0.2	8	2	8	c	0	7.8	3	7.8			7.84	4	7.84			7.832	5	7.832			7.8336	6	7.8336			7.83328	7	7.83328			7.833344	8	7.833344			7.833331	9	7.833331			7.833334	10	7.833334			7.833333	11	7.833333	M1 A1 B1	RR - use of absolute addressing or equivalent formula
a	0.8	7	1	7																																																								
b	0.2	8	2	8																																																								
c	0	7.8	3	7.8																																																								
		7.84	4	7.84																																																								
		7.832	5	7.832																																																								
		7.8336	6	7.8336																																																								
		7.83328	7	7.83328																																																								
		7.833344	8	7.833344																																																								
		7.833331	9	7.833331																																																								
		7.833334	10	7.833334																																																								
		7.833333	11	7.833333																																																								
		(iii)	$7\frac{5}{6}$	B1																																																								

Question	Answer	Marks	Guidance
(iv)	<p>a 0.8 7</p> <p>b 0.2 8</p> <p>c 0.1 7.9</p> <p> 8.02</p> <p> 8.096</p> <p> 8.1808</p> <p> 8.26384</p> <p> 8.347232</p> <p> 8.4305536</p> <p> 8.51388928</p> <p> 8.597222144</p> <p> 8.680555571</p> <p> 8.763888886</p> <p> 8.847222223</p> <p> 8.930555555</p> <p> 9.013888889</p> <p> 9.097222222</p> <p> 9.180555556</p> <p> 9.263888889</p> <p> 9.347222222</p> <p>Differences converge to 1/12</p>	<p>B1</p> <p>B1</p>	
(v)	<p>eg $T_n = (643/72) + (n - 15)/12$</p>	<p>B1</p>	
(vi)	<p>$a = 0.6$ $b = 0.4$ $c = 0.2$</p>	<p>B1B1B 1</p>	<p>2/3 for solutions from simultaneous eqns</p>

Question		Answer	Marks	Guidance
4	(i)		M1 A1	geometry and two correct weights
	(ii)	<p>eg</p> <p>Cut {S, A, D, C, F, E} / {B, T} has capacity of 70.</p>	B1 B1	B not satisfied max flow/min cut

Question	Answer	Marks	Guidance
(iv)	<p>Objective value: 70.00000</p> <p>Variable Value</p> <p>SA 30.00000</p> <p>SD 40.00000</p> <p>BT 40.00000</p> <p>ET 30.00000</p> <p>AB 20.00000</p> <p>AC 10.00000</p> <p>DC 20.00000</p> <p>DF 20.00000</p> <p>CB 20.00000</p> <p>CF 50.00000</p> <p>FC 40.00000</p> <p>FE 30.00000</p> <p>BE 0.00000</p> <p>CF=50 and FC=40 means CF=10</p>	<p>B1</p> <p>B1</p> <p>B1</p>	<p>running</p> <p>rest</p>

Question	Answer	Marks	Guidance																																																				
(v)	<p>Objective value: 80.00000</p> <p>Variable Value</p> <p>SA 40.00000</p> <p>SD 40.00000</p> <p>BT 30.00000</p> <p>ET 50.00000</p> <p>AB 20.00000</p> <p>AC 20.00000</p> <p>DC 20.00000</p> <p>DF 20.00000</p> <p>CB 20.00000</p> <p>CF 50.00000</p> <p>FC 30.00000</p> <p>FE 40.00000</p> <p>BE 10.00000</p> <p>CF=50 and FC=30 means CF=20</p> 	<p>B1</p> <p>B1</p>	<p>modification</p> <p>result</p>																																																				
(vi)	<table border="1"> <thead> <tr> <th></th> <th>SA</th> <th>SD</th> <th>AB</th> <th>AC</th> <th>DC</th> <th>DF</th> <th>CB</th> <th>CF</th> <th>FE</th> <th>EB</th> <th>BT</th> <th>ET</th> </tr> </thead> <tbody> <tr> <td>AB=30</td> <td>50</td> <td>50</td> <td>30</td> <td>20</td> <td>20</td> <td>30</td> <td>20</td> <td>20</td> <td>50</td> <td>0</td> <td>50</td> <td>50</td> </tr> <tr> <td>CB=30</td> <td>50</td> <td>50</td> <td>20</td> <td>30</td> <td>20</td> <td>30</td> <td>30</td> <td>20</td> <td>50</td> <td>0</td> <td>50</td> <td>50</td> </tr> <tr> <td>BE undirected</td> <td>50</td> <td>50</td> <td>20</td> <td>30</td> <td>20</td> <td>30</td> <td>20</td> <td>30</td> <td>60</td> <td>10</td> <td>50</td> <td>50</td> </tr> </tbody> </table>		SA	SD	AB	AC	DC	DF	CB	CF	FE	EB	BT	ET	AB=30	50	50	30	20	20	30	20	20	50	0	50	50	CB=30	50	50	20	30	20	30	30	20	50	0	50	50	BE undirected	50	50	20	30	20	30	20	30	60	10	50	50	<p>B1</p> <p>B1</p> <p>B1</p>	
	SA	SD	AB	AC	DC	DF	CB	CF	FE	EB	BT	ET																																											
AB=30	50	50	30	20	20	30	20	20	50	0	50	50																																											
CB=30	50	50	20	30	20	30	30	20	50	0	50	50																																											
BE undirected	50	50	20	30	20	30	20	30	60	10	50	50																																											

OCR (Oxford Cambridge and RSA Examinations)
The Triangle Building
Shaftesbury Road
Cambridge
CB2 8EA

OCR Customer Contact Centre

Education and Learning

Telephone: 01223 553998

Facsimile: 01223 552627

Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Oxford Cambridge and RSA Examinations
is a Company Limited by Guarantee
Registered in England
Registered Office; The Triangle Building, Shaftesbury Road, Cambridge, CB2 8EA
Registered Company Number: 3484466
OCR is an exempt Charity

OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553

© OCR 2018

