OCR
Oxford Cambridge and RSA

GCE

Mathematics (MEI)

Unit **4773**: Decision Mathematics Computation

Advanced GCE

Mark Scheme for June 2018

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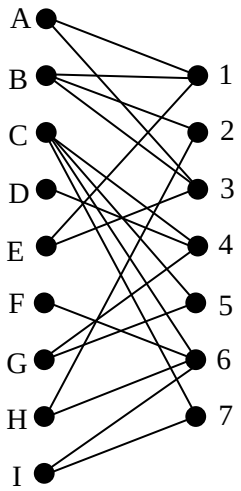
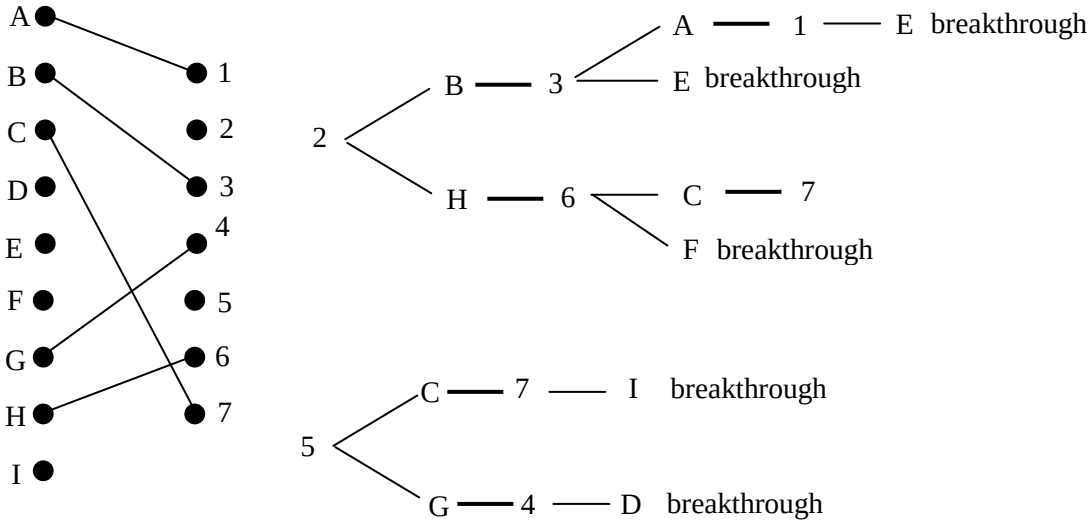
This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

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.

Question			Answer	Marks	Guidance
1	(i)			M1 A1	A and I correct
	(ii)			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

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>(iii)</td><td></td><td>Max 4A1 + 4A3 + 4B1 + 3B2 + 4B3 + 5C4 + 5C5 + 5C6 + 5C7 + 4D4 + 3E1 + 3E3
+ 4F6 + 4G4 +4G5 + 2H2 + 3H6 + 5I6 + 4I7

st A1 + A3 ≤ 1
B1 + B2 + B3 ≤ 1
C4 + C5 + C6 + C7 ≤ 1
D4 ≤ 1
E1+E3 ≤ 1
F6 ≤ 1
G4 + G5 ≤ 1
H2 + H6 ≤ 1
I6 + I7 ≤ 1
A1 + B1 + E1 ≤ 1
B2 + H2 ≤ 1
A3 + B3 + E3 ≤ 1
C4 + D4 + G4 ≤ 1
C5 + G5 ≤ 1
C6 + H6 + F6 + I6 ≤ 1
C7 + I7 ≤ 1

end</td><td>B1

M1
A1

M1
A1</td><td>objective

player constraints
“<” is correct (throughout)

position constraints
allow (grudgingly) “=”

Penalise -1 for setting it up as an IP.</td></tr>
<tr><td></td><td>(iv)</td><td></td><td>running successfully

<table><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>
Total manager score = 28.</td><td>B1

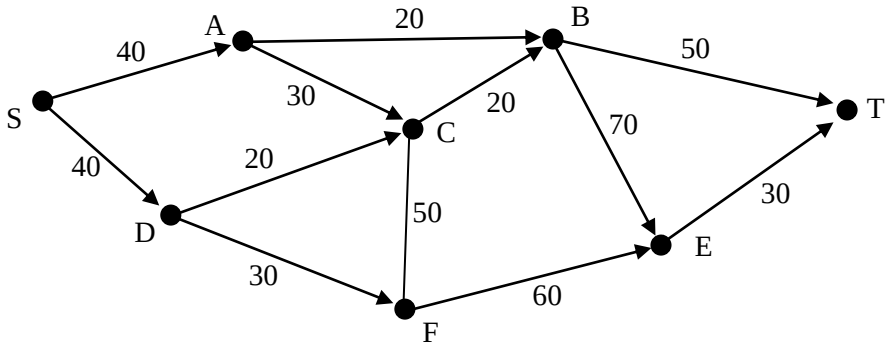
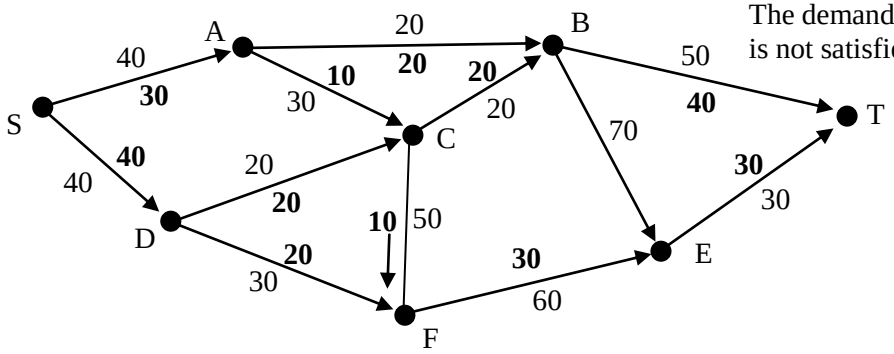
B1
B1
B1</td><td>

positions 1, 2 and 3
positions 4, 5, 6 and 7</td></tr>
</table>

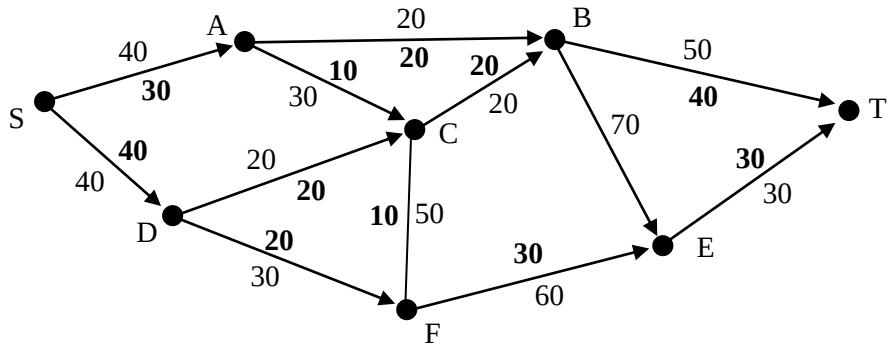
<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>2</td><td>(i)</td><td></td><td>eg
λ β time f(t) s(t) 10-f(t)-s(t) P(+) P(-) + - f(t+1) s(t+1)
0.04 0.2 0 2 8 0 0.64 0.4 1 0 3 7
1 3 7 0 0.84 0.6 1 -1 3 6</td><td>B1
B1
B1
B1
B1
B1
B1
B1</td><td>λ and β OK
time
f, s and recovered
above updated
probabilities
use of absolute addresses
“IF” statements
computation of f(t+1) and s(t+1)</td></tr>
<tr><td></td><td>(ii)</td><td></td><td>running
time t and s(t) noted</td><td>B1
B1</td><td></td></tr>
<tr><td></td><td>(iii)</td><td></td><td>eg
<table>
<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</td><td>B1
B1 B1
B1 B1</td><td>SC for means only
B1
B1 B1</td></tr>
<tr><td></td><td>(iv)</td><td></td><td>less time
more survivors</td><td>B1
B1</td><td></td></tr>
<tr><td></td><td>(v)</td><td></td><td>t in minutes</td><td>B1</td><td>Implies more runs, but “more runs” scores zero</td></tr>
</table>

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)	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 … and then repeated to line 20.	M1 A1 B1	RR - use of absolute addressing or equivalent formula
		(iii)	$7\frac{5}{6}$	B1	

Question			Answer	Marks	Guidance
	(iv)		a 0.8 7 b 0.2 8 c 0.1 7.9 8.02 8.096 8.1808 8.26384 8.347232 8.4305536 8.51388928 8.597222144 8.680555571 8.763888886 8.847222223 8.930555555 9.013888889 9.097222222 9.180555556 9.263888889 9.347222222 Differences converge to 1/12	B1 B1	
	(v)		eg $T_n = (643/72) + (n - 15)/12$	B1	
	(vi)		$a = 0.6$ $b = 0.4$ $c = 0.2$	B1B1B1	2/3 for solutions from simultaneous eqns

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

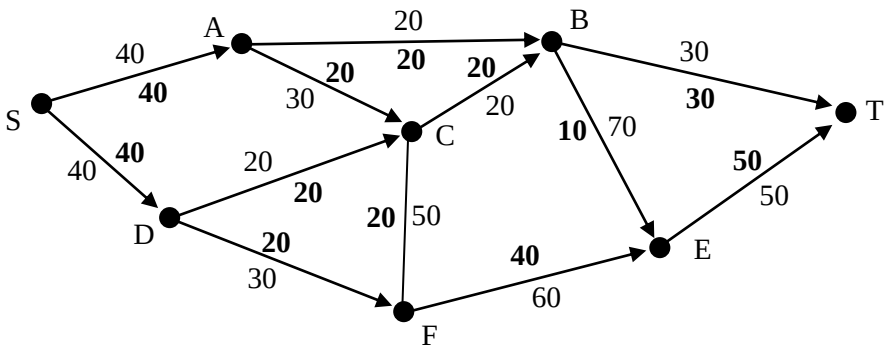
Question			Answer	Marks	Guidance
	(iii)		Max SA+SD (or BT + ET)	B1	objective
			st SA<40		
			SD<40		
			BT<50		
			ET<30		
			AB<20		
			AC<30		
			DC<20		
			DF<30		
			CB<20	B1	one-way capacities
			CF<50	B1	two-way capacities
			FC<50		
			FE<60		
			BE<70		
			SA-AC-AB=0		
			SD-DC-DF=0		
			AC+DC+FC-CF-CB=0		
			DF+CF-FC-FE=0	M1	balancing at A, D, B and E
			AB+CB-BE-BT=0	A1	balancing at C and F
			BE+FE-ET=0		
			end		

Question	Answer	Marks	Guidance
(iv)	Objective value: 70.00000 Variable Value SA 30.00000 SD 40.00000 BT 40.00000 ET 30.00000 AB 20.00000 AC 10.00000 DC 20.00000 DF 20.00000 CB 20.00000 CF 50.00000 FC 40.00000 FE 30.00000 BE 0.000000  CF=50 and FC=40 means CF=10	B1 B1 B1	running rest

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>(v)</td><td></td><td>Objective value: 80.00000

Variable Value
SA 40.00000
SD 40.00000
BT 30.00000
ET 50.00000
AB 20.00000
AC 20.00000
DC 20.00000
DF 20.00000
CB 20.00000
CF 50.00000
FC 30.00000
FE 40.00000
BE 10.00000

CF=50 and FC=30 means CF=20

 
</td><td>B1

B1</td><td>modification

result</td></tr>
<tr><td></td><td>(vi)</td><td></td><td>
<table>
<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>
<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>
</table>
</td><td>B1

B1

B1</td><td></td></tr>
</table>

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