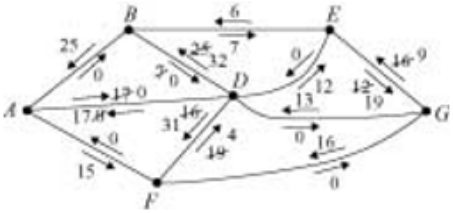
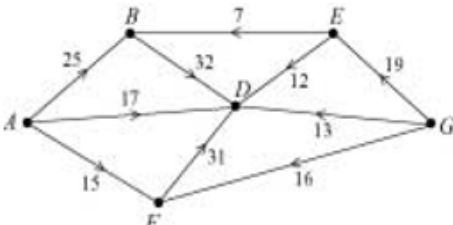


Decision 2 Network Flows Answers

4(a)		B1 B1 B1 B1	4	MN NT PQ NP
(b)(i)	<p>e.g. SMNT 2 SPQT 2</p>	M1 M1 A1 A1		initial flow indicated as surplus forward and backward flows use of flow augmentation one flow correctly identified all possible flows correct
(ii)		M1 A1	6	amending flows (dep on first M1) final situation with saturation at M and P
(c)	<p>Max flow = 14</p>	B1 B1	2	cut on original network
(c)	Cut through 2 of their saturated arcs $\left\{ \begin{array}{l} \{S, M\} / \{P, N, Q, T\} \\ \text{or cuts through } MN, MP \text{ \& } SP \end{array} \right\}$	M1 A1	2	described or drawn
Total			14	

4(a)	D	B1	1																	
(b)	$(17 + 25 + 35 + 13 + 12 + 13 = 115)$	B1	1																	
(c)	$ABD_{\max} = 25$; $GED_{\max} = 12$	B1B1	2																	
(d)(i)	 <table border="1"> <thead> <tr> <th>Route</th> <th>ABD</th> <th>GED</th> <th>GFD</th> <th>GD</th> <th>AD</th> <th>AFD</th> <th>GEED</th> </tr> </thead> <tbody> <tr> <td>Flow</td> <td>25</td> <td>12</td> <td>16</td> <td>13</td> <td>17</td> <td>15</td> <td>7</td> </tr> </tbody> </table>	Route	ABD	GED	GFD	GD	AD	AFD	GEED	Flow	25	12	16	13	17	15	7	M1 M1 M1 A1 A1		Forward and backward flows Adjusting flows on diagram Routes and flows in chart One correct other than ABD, GED Another correct
Route	ABD	GED	GFD	GD	AD	AFD	GEED													
Flow	25	12	16	13	17	15	7													
		A1	6	All correct																
(ii)	<p style="text-align: center;">Total = 105 Max flow</p> 	B1																		
		B1	2																	
(iii)	Cut through AF, AD, BD, DE, DG, and GF	M1 A1	2	Through 3 saturated arcs (<i>fairly generous</i>) Correct																
(e)	Reduce max flow by their EG changing 19 to 15 \Rightarrow New max = 101	M1 A1	2	Reduce by 4 since everywhere else saturated Correct answer \Rightarrow 2 marks																
Total			16																	

6(a)(i) $15 + 0 + 14 + 7 + 9 = 45$

(ii) Maximum flow ≤ 45

(b) *SABT* flow 10
SDET flow 14
SFT flow 9

(may appear in table below)

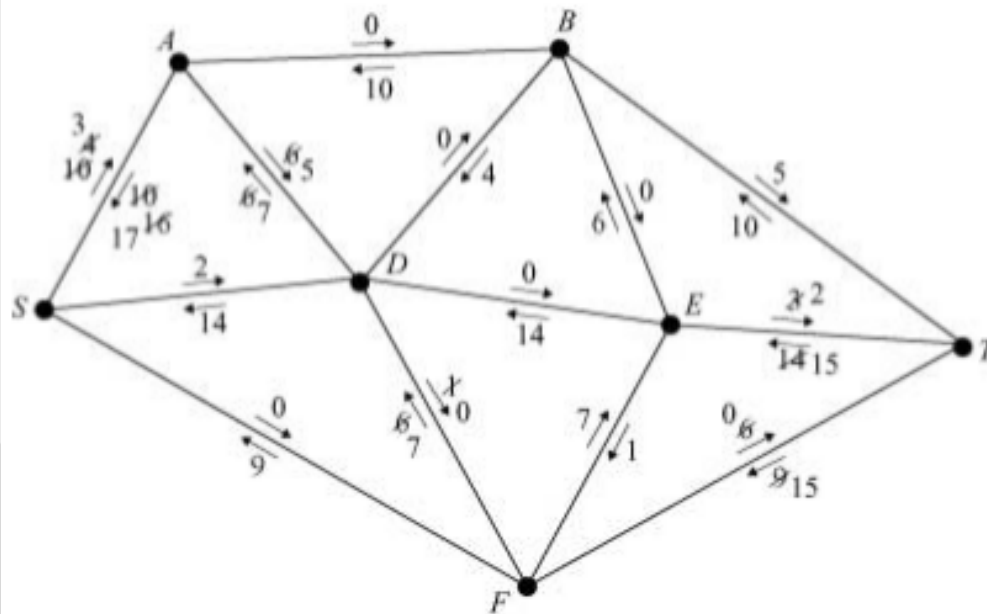
B1 1

M1
 A1 2 \leq their value or < 45
 correct

B1 one correct

B1 2 two more correct

(c)(i)



Additional route
 with correct flow
 one more correct route and flow
 table complete
 correct use of potential and used flows
 values correctly updated

M1
 A1
 A1
 A1
 M1
 A1

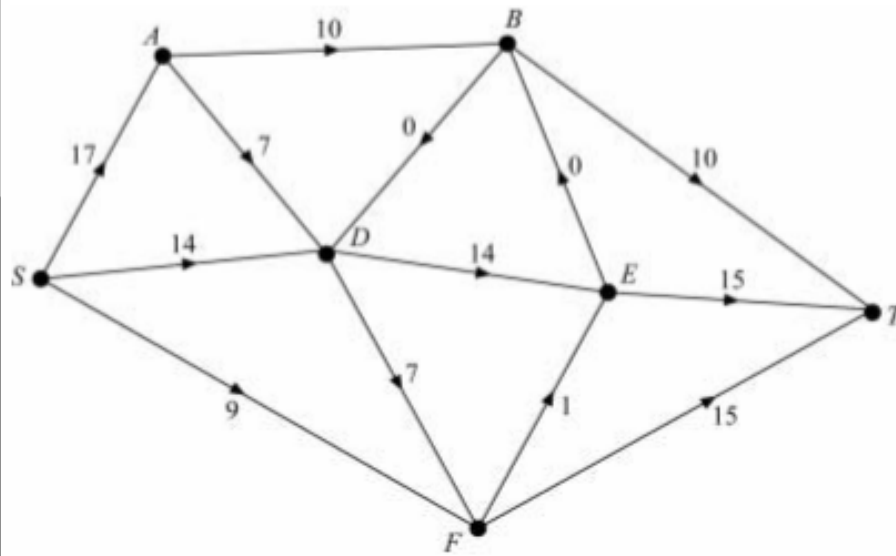
6

correct total flow of 40
 on network (may use double edges)
 strict

Route	Flow
<i>SABT</i>	10
<i>SDET</i>	14
<i>SFT</i>	9
<i>SADFT</i>	6
<i>SADFET</i>	1

several possibilities

6 (cont)
(c)(ii)



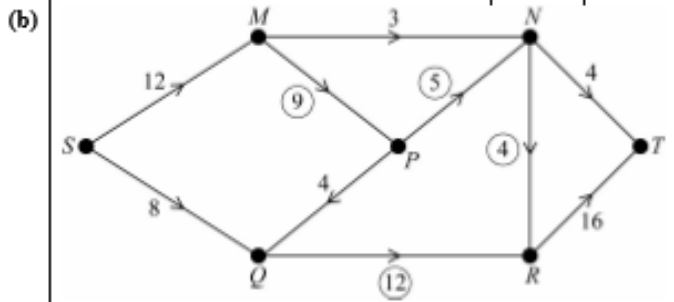
Maximum flow = 40
Network showing flow of 40

(iii) Cut through saturated arcs
AB, BD, DE, DF, SF
Minimum cut shown to be 40 with
statement linking to maximum flow

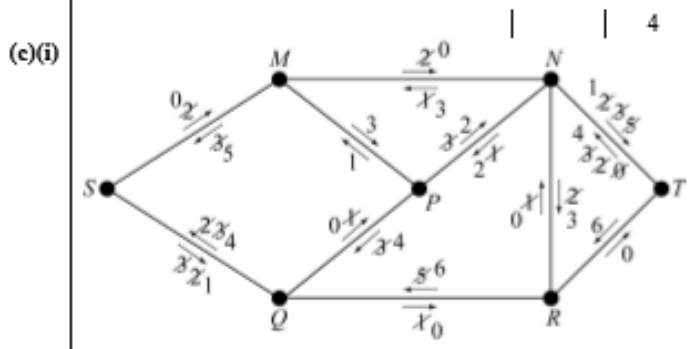
B1	
B1	2
M1	
A1	2

	Total		15
	TOTAL		75

6(a)(i) $5 + 8 + 16 - 3 = 26$ | B1 | 1
(ii) Max flow ≤ 26 | E1✓ | 1



B1 $MP - 9$
B1 $PN - 5$
B1 $NR - 4$
B1 $QR - 12$



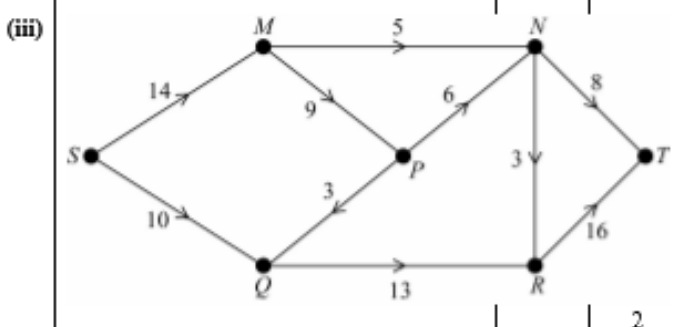
M1 initial flow – forward and backward
6 pairs correct
A1 correct
OM 2 & 3; MN 2 & 1
NT 5 & 0; MP 3 & 1
SQ 3 & 2; PQ 3 & 1
PN 3 & 1; QR 1 & 5
NR 2 & 1; RT 0 & 6

(ii) Adjusting flows on network | M1A1 | 2

Path	Flow
SMNT	2
SQPNT	1
SORNT	1

| B1 | 5
| B1 | 5

First correct path and flow
Second correct
Rest



M1 6 flows correct
A1 all correct
Or or

Total	15
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