

EDEXCEL

190 High Holborn London WC1V 7BH

January 2005

Advanced Subsidiary/Advanced Level

General Certificate of Education

Subject: **Decision Maths**

Paper: **D1**

Question Number	Scheme	Marks
1)(a)		B1 (1)
(b)	e.g. $S-3 = J-4 = P-6$ c.s. $S = 3 - J = 4 - P = 6$ and $T-2 = A-1 = D-5$ c.s. $T = 2 - A = 1 - D = 5$ $A=1$ $D=5$ $J=4$ $P=6$ $S=3$ $T=2$	m1 A1 (2) (m1) A1 A1 (3) 6
2 (a)	D depends on A and C, but E depends on A only H depends on G only, but J and K depend on G and I	B1 B1 (2)
(b)	eg.	m1 A1 A1 A1 A1 (5) 7
3) (a)	(i) FH, AD, DE, CE, (not DC), {BC}, {EG}, (not AC), CF, HI, (not FI), IJ stop (ii) AD, DE, EC, {BC}, {EG}, CF, FH, HI, IJ stop.	m1 A1 A1 (3) m1 A1 A1 (3)
(b)	Start off the tree with AB and FI, then apply Kruskal	B2, 1, 0 (2) 8

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<p>4) (a)</p>	<p>E.g.</p> <table style="border-collapse: collapse; margin-left: 20px;"> <tr> <td style="border: 1px solid black; padding: 2px;">650</td> <td style="border: 1px solid black; padding: 2px;">431</td> <td style="border: 1px solid black; padding: 2px;">245</td> <td style="border: 1px solid black; padding: 2px;">643</td> <td style="border: 1px solid black; padding: 2px; border-radius: 50%;">455</td> <td style="border: 1px solid black; padding: 2px;">710</td> <td style="border: 1px solid black; padding: 2px;">234</td> <td style="border: 1px solid black; padding: 2px;">162</td> <td style="border: 1px solid black; padding: 2px;">452</td> <td style="border: 1px solid black; padding: 2px; border-radius: 50%;">134</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">650</td> <td style="border: 1px solid black; padding: 2px; border-radius: 50%;">643</td> <td style="border: 1px solid black; padding: 2px;">710</td> <td style="border: 1px solid black; padding: 2px; border-radius: 50%;">455</td> <td style="border: 1px solid black; padding: 2px;">431</td> <td style="border: 1px solid black; padding: 2px;">245</td> <td style="border: 1px solid black; padding: 2px; border-radius: 50%;">234</td> <td style="border: 1px solid black; padding: 2px;">162</td> <td style="border: 1px solid black; padding: 2px;">452</td> <td style="border: 1px solid black; padding: 2px;">134</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">650</td> <td style="border: 1px solid black; padding: 2px; border-radius: 50%;">710</td> <td style="border: 1px solid black; padding: 2px; border-radius: 50%;">643</td> <td style="border: 1px solid black; padding: 2px;">455</td> <td style="border: 1px solid black; padding: 2px;">431</td> <td style="border: 1px solid black; padding: 2px; border-radius: 50%;">245</td> <td style="border: 1px solid black; padding: 2px;">452</td> <td style="border: 1px solid black; padding: 2px; border-radius: 50%;">234</td> <td style="border: 1px solid black; padding: 2px; border-radius: 50%;">162</td> <td style="border: 1px solid black; padding: 2px;">134</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px; border-radius: 50%;">710</td> <td style="border: 1px solid black; padding: 2px; border-radius: 50%;">650</td> <td style="border: 1px solid black; padding: 2px;">643</td> <td style="border: 1px solid black; padding: 2px;">455</td> <td style="border: 1px solid black; padding: 2px;">431</td> <td style="border: 1px solid black; padding: 2px; border-radius: 50%;">452</td> <td style="border: 1px solid black; padding: 2px; border-radius: 50%;">245</td> <td style="border: 1px solid black; padding: 2px;">234</td> <td style="border: 1px solid black; padding: 2px; border-radius: 50%;">162</td> <td style="border: 1px solid black; padding: 2px;">134</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">710</td> <td style="border: 1px solid black; padding: 2px; border-radius: 50%;">650</td> <td style="border: 1px solid black; padding: 2px;">643</td> <td style="border: 1px solid black; padding: 2px;">455</td> <td style="border: 1px solid black; padding: 2px; border-radius: 50%;">452</td> <td style="border: 1px solid black; padding: 2px;">431</td> <td style="border: 1px solid black; padding: 2px;">245</td> <td style="border: 1px solid black; padding: 2px;">234</td> <td style="border: 1px solid black; padding: 2px;">162</td> <td style="border: 1px solid black; padding: 2px;">134</td> </tr> </table> <p style="text-align: right; margin-right: 50px;">stop.</p>	650	431	245	643	455	710	234	162	452	134	650	643	710	455	431	245	234	162	452	134	650	710	643	455	431	245	452	234	162	134	710	650	643	455	431	452	245	234	162	134	710	650	643	455	452	431	245	234	162	134	<p>M1 A1 A1✓ A1✓ A1 (5)</p>
650	431	245	643	455	710	234	162	452	134																																											
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<p>(b)</p>	<table style="margin-left: 20px;"> <tr> <td>Bin 1</td> <td>710 + 245</td> <td>Bin 3</td> <td>643 + 162 + 134</td> <td>Bin 5</td> <td>431</td> </tr> <tr> <td>Bin 2</td> <td>650 + 234</td> <td>Bin 4</td> <td>455 + 452</td> <td></td> <td></td> </tr> </table>	Bin 1	710 + 245	Bin 3	643 + 162 + 134	Bin 5	431	Bin 2	650 + 234	Bin 4	455 + 452			<p>M1 A1 A1✓ A1 (4)</p>																																						
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<p>(c)</p>	<p>$\frac{4116}{1020} = 4.116 \therefore 5 \text{ bins needed } \therefore \text{optimal}$</p>	<p>M1 A1✓ (2)</p>																																																		

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5) (i)	<p style="text-align: center;">shortest distance is 385m</p>	<p style="text-align: center;"> m1 A1 A1 ✓ A1 ✓ A1 (5) m1 A1 A1 A1 (4) B1 B1 (2) II </p>
(ii)	<p>Odd vertices B, C, D, G</p> $BC + DG = 95 + 145 = 240 *$ $BD + CG = 169 + 179 = 348$ $BG + CD = 249 + 74 = 323$ <p>Repeat BC, DE and EG</p> <p>eg. $A \underline{BC} B \underline{FH} G \underline{FE} G \underline{EC} D \underline{ED} A$</p> <p>length $1241 + 240 = 1481m$</p>	

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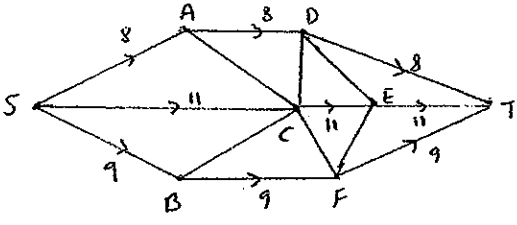
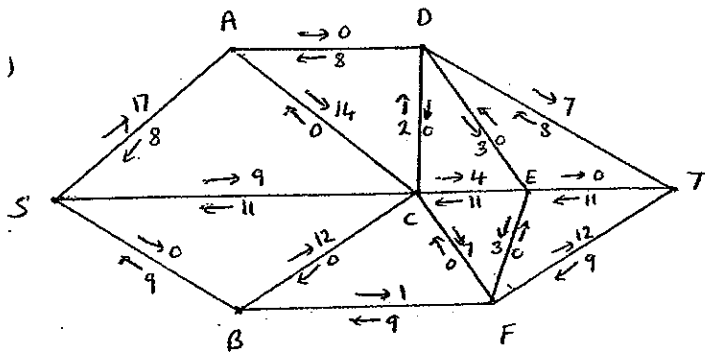
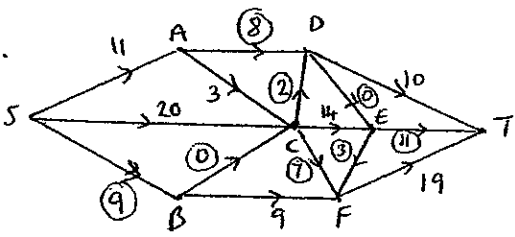
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6)(a)	SADT - 8 SCET - 11 SBFT - 9	B 2, 1, 0
(b)		B 1 (3)
(c) (i)	 <p>e.g.</p> <p>SACDT - 2 SCFT - 6</p> <p>SACEFT - 3 SACFT - 1 <u>max flow 40</u></p>	<p>m 1</p> <p>A 1 (2)</p> <p>A 1</p> <p>A 1 (3)</p>
(ii) eg.		<p>m 1</p> <p>A 1 (2)</p>
(iii)	<p>Max flow - min cut theorem</p> <p>cut AD, CD, DE, ET, EF, CF, BC, SB is {SACE} {BDFT}</p>	<p>m 1</p> <p>A 2, 0 (3)</p>
(d)	<p>Idea of a <u>directed</u> flow through a <u>system</u> of arcs from <u>S</u> to <u>T</u></p> <p><u>practical</u></p>	<p>B 1 (1)</p> <p style="border: 1px solid black; display: inline-block; padding: 2px;">14</p>

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7) (a)	<p>Maximize $P = 50x + 80y + 60z$ Subject to $x + y + 2z \leq 30$ $x + 2y + z \leq 40$ $3x + 2y + z \leq 50$ where $x, y, z \geq 0$</p>	<p>B1 B3, 2, 1, 0 (4)</p>																																																																																
(b)	<p>Initialising tableau</p> <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>bv</th> <th>x</th> <th>y</th> <th>z</th> <th>r</th> <th>s</th> <th>t</th> <th>value</th> </tr> </thead> <tbody> <tr> <td>r</td> <td>1</td> <td>1</td> <td>2</td> <td>1</td> <td>0</td> <td>0</td> <td>30</td> </tr> <tr> <td>s</td> <td>1</td> <td>2</td> <td>1</td> <td>0</td> <td>1</td> <td>0</td> <td>40</td> </tr> <tr> <td>t</td> <td>3</td> <td>2</td> <td>1</td> <td>0</td> <td>0</td> <td>1</td> <td>50</td> </tr> <tr> <td>P</td> <td>-50</td> <td>-80</td> <td>-60</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> </tr> </tbody> </table> <p>chooses correct pivot, divides R2 by 2 states correct row operations $R_1 - R_2, R_3 - 2R_2, R_4 + 80R_2, R_2 \div 2$</p>	bv	x	y	z	r	s	t	value	r	1	1	2	1	0	0	30	s	1	2	1	0	1	0	40	t	3	2	1	0	0	1	50	P	-50	-80	-60	0	0	0	0	<p>B1 ✓ m1 A1 ✓ A1 (4) B2, 1, 0 (2)</p>																																								
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t	3	2	1	0	0	1	50																																																																											
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(c)	The solution found after one iteration has a slack of 10 units of black per day																																																																																	
(d) (i)	<table border="1" style="margin-left: 20px;"> <thead> <tr> <th>bv</th> <th>x</th> <th>y</th> <th>z</th> <th>r</th> <th>s</th> <th>t</th> <th>value</th> </tr> </thead> <tbody> <tr> <td>r</td> <td>$\frac{1}{2}$</td> <td>0</td> <td>$\frac{3}{2}$</td> <td>1</td> <td>$-\frac{1}{2}$</td> <td>0</td> <td>10</td> </tr> <tr> <td>y</td> <td>$\frac{1}{2}$</td> <td>1</td> <td>$\frac{1}{2}$</td> <td>0</td> <td>$\frac{1}{2}$</td> <td>0</td> <td>20</td> </tr> <tr> <td>t</td> <td>2</td> <td>0</td> <td>0</td> <td>0</td> <td>-1</td> <td>1</td> <td>10</td> </tr> <tr> <td>P</td> <td>-10</td> <td>0</td> <td>-20</td> <td>0</td> <td>40</td> <td>0</td> <td>1600</td> </tr> </tbody> </table> <p style="margin-left: 20px;">(given)</p> <table border="1" style="margin-left: 20px; margin-top: 10px;"> <thead> <tr> <th>bv</th> <th>x</th> <th>y</th> <th>z</th> <th>r</th> <th>s</th> <th>t</th> <th>value</th> </tr> </thead> <tbody> <tr> <td>z</td> <td>$\frac{1}{3}$</td> <td>0</td> <td>1</td> <td>$\frac{2}{3}$</td> <td>$-\frac{1}{3}$</td> <td>0</td> <td>$6\frac{2}{3}$</td> </tr> <tr> <td>y</td> <td>$\frac{1}{3}$</td> <td>1</td> <td>0</td> <td>$-\frac{1}{3}$</td> <td>$\frac{2}{3}$</td> <td>0</td> <td>$16\frac{2}{3}$</td> </tr> <tr> <td>t</td> <td>2</td> <td>0</td> <td>0</td> <td>0</td> <td>-1</td> <td>1</td> <td>10</td> </tr> <tr> <td>P</td> <td>$-3\frac{1}{3}$</td> <td>0</td> <td>0</td> <td>$13\frac{1}{3}$</td> <td>$33\frac{1}{3}$</td> <td>0</td> <td>$1733\frac{1}{3}$</td> </tr> </tbody> </table> <p style="margin-left: 20px;"> $R_1 \div \frac{1}{2}$ $R_2 - \frac{1}{2}R_1$ R_3 — no change $R_4 + 20R_1$ </p>	bv	x	y	z	r	s	t	value	r	$\frac{1}{2}$	0	$\frac{3}{2}$	1	$-\frac{1}{2}$	0	10	y	$\frac{1}{2}$	1	$\frac{1}{2}$	0	$\frac{1}{2}$	0	20	t	2	0	0	0	-1	1	10	P	-10	0	-20	0	40	0	1600	bv	x	y	z	r	s	t	value	z	$\frac{1}{3}$	0	1	$\frac{2}{3}$	$-\frac{1}{3}$	0	$6\frac{2}{3}$	y	$\frac{1}{3}$	1	0	$-\frac{1}{3}$	$\frac{2}{3}$	0	$16\frac{2}{3}$	t	2	0	0	0	-1	1	10	P	$-3\frac{1}{3}$	0	0	$13\frac{1}{3}$	$33\frac{1}{3}$	0	$1733\frac{1}{3}$	<p>m1 A1 m1 A1 (4) B1 ✓ m1 A1 ✓ A1 ✓ (4)</p>
bv	x	y	z	r	s	t	value																																																																											
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(ii)	Not optimal, a negative value in profit row																																																																																	
(iii)	<p>$x = 0 \quad y = 16\frac{2}{3} \quad z = 6\frac{2}{3}$ $P = £1733.33 \quad r = 0, s = 0, t = 10$</p>																																																																																	