

Mark Scheme 4771
January 2006

1.

<p>(i) & (ii)</p> <p>Critical: A, E</p> <p>(iii) A, E and D 6 days</p>	<p>B1 C OK B1 D OK B1 E OK</p> <p>M1 early and late A1 times</p> <p>B1 critical</p> <p>B1 B1</p>
--	--

2.

(i)					
Step number	List 1	List 2	A	B	List 3
1	2, 34, 35, 56	13, 22, 34, 81, 90, 92			
3	34, 35, 56	22, 34, 81, 90, 92	2	13	
4	35, 56	22, 34, 81, 90, 92	34	13	2
4	35, 56	34, 81, 90, 92	34	22	2, 13
4	35, 56	81, 90, 92	34	34	2, 13, 22
3	56	81, 90, 92	35	34	2, 13, 22, 34
4	56	90, 92	35	81	2, 13, 22, 34, 34
3		90, 92	56	81	2, 13, 22, 34, 34, 35
3		90, 92	56	81	2, 13, 22, 34, 34, 35, 56, 81, 90, 92
<p>M1 sca A1 to first step 3 inc. A1 to second step 3 A1 rest</p>					
(ii)	Merges ordered lists to give an ordered list				B1
(iii)	7				B1
(iv)	$\text{Max} = x + y - 1$ $\text{Min} = \min(x, y)$				B1 B1

3.

(i) Ins and outs One more out than in at D. Vice-versa at A. Start at D and end at A	M1 A1 B1
(ii) Existence – A B D C A Uniqueness – Only alternative is A B C ...!!! Extra arc – New possibility A D C B ... !!!	B1 M1 A1 A1
(iii) B D C A B	B1

4.

(i) 12.5 kg 250 g (of butter) 10 kg 3 kg (of sugar)	B1 B1 B1 B1
(ii) Identification of variables e.g. Let x = kg of toffee made Let y = kg of fudge made	
Max $x + y$ st $100x + 150y \leq 1500$ $800x + 700y \leq 10000$	B1 B1 B1
	B1 axes labelled and scaled B1 butter line B1 sugar line B1 shading
Make 9 kg toffee and 4 kg fudge	B1 max $x+y$ + solution
(iii) 12.5 kg of toffee and no fudge – either by comparing 68.75 with 67.50 with 45, or by a gradient argument	M1 A1
Toffee price must <u>decrease</u> by £0.36, or to £5.14.	B1 B1

5.

(i)

	1	2	5	6	4	7	3
	A	B	C	D	E	F	G
A	-	10	-	-	-	12	15
B	(10)	-	15	20	-	-	8
C	-	15	-	7	-	-	(11)
D	-	20	(7)	-	20	-	13
E	-	-	-	20	-	17	(9)
F	(12)	-	-	-	17	-	13
G	15	(8)	11	13	9	13	-

Total length = 57 miles
 Might be used to determine where to lay pipes or cables to connect the towns.

(ii)

Shortest route: AGE
 Length: 24

(iii) Shortens mst to 53 miles ($\sqrt{\text{by } 4}$)
 New shortest route ABGE – 23 miles ($\sqrt{\text{by } 1}$)

M1
 A1 selections
 A1 order of selecting
 A1 deletions

B1

B1
 B1

M1 sca Dijkstra
 A1 labels
 A1 order of labelling
 A1 working values

B1
 B1

B1
 B1 B1

6.

<p>(i) e.g. 0 – 6 petrol 7 – 9 other</p>	<p>B1</p>																																																																																
<p>(ii) e.g. 0 – 2 1 min 3 – 6 1.5 mins 7 – 8 2 mins 9 2.5 mins</p>	<p>M1 A1</p>																																																																																
<p>(iii) e.g. 00 – 13 1 min 14 – 41 1.5 mins 42 – 69 2 mins 70 – 83 2.5 mins 84 – 97 3 mins 98, 99 reject</p> <p style="text-align: center;">Two digits – fewer rejects</p>	<p>M1 some rejected A1 2 rejected A1</p> <p style="text-align: right;">B1</p>																																																																																
<p>(iv)</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Customer number</th> <th>Inter-arrival time</th> <th>Arrival time</th> <th>Type of customer</th> <th>Arrival at till</th> <th>Time at till</th> <th>Departure time</th> <th>Queuing + paying</th> </tr> </thead> <tbody> <tr><td>1</td><td>1</td><td>1</td><td>F</td><td>1</td><td>1</td><td>2</td><td>1</td></tr> <tr><td>2</td><td>0.5</td><td>1.5</td><td>N</td><td>2</td><td>2</td><td>4</td><td>2.5</td></tr> <tr><td>3</td><td>3.5</td><td>5</td><td>N</td><td>5</td><td>1.5</td><td>6.5</td><td>1.5</td></tr> <tr><td>4</td><td>3</td><td>8</td><td>F</td><td>8</td><td>1.5</td><td>9.5</td><td>1.5</td></tr> <tr><td>5</td><td>1</td><td>9</td><td>F</td><td>9.5</td><td>1</td><td>10.5</td><td>1.5</td></tr> <tr><td>6</td><td>0.5</td><td>9.5</td><td>F</td><td>10.5</td><td>1</td><td>11.5</td><td>2</td></tr> <tr><td>7</td><td>1.5</td><td>11</td><td>F</td><td>11.5</td><td>2.5</td><td>14</td><td>3</td></tr> <tr><td>8</td><td>2</td><td>13</td><td>N</td><td>14</td><td>2.5</td><td>16.5</td><td>3.5</td></tr> <tr><td>9</td><td>2</td><td>15</td><td>F</td><td>16.5</td><td>2</td><td>18.5</td><td>3.5</td></tr> </tbody> </table>		Customer number	Inter-arrival time	Arrival time	Type of customer	Arrival at till	Time at till	Departure time	Queuing + paying	1	1	1	F	1	1	2	1	2	0.5	1.5	N	2	2	4	2.5	3	3.5	5	N	5	1.5	6.5	1.5	4	3	8	F	8	1.5	9.5	1.5	5	1	9	F	9.5	1	10.5	1.5	6	0.5	9.5	F	10.5	1	11.5	2	7	1.5	11	F	11.5	2.5	14	3	8	2	13	N	14	2.5	16.5	3.5	9	2	15	F	16.5	2	18.5	3.5
Customer number	Inter-arrival time	Arrival time	Type of customer	Arrival at till	Time at till	Departure time	Queuing + paying																																																																										
1	1	1	F	1	1	2	1																																																																										
2	0.5	1.5	N	2	2	4	2.5																																																																										
3	3.5	5	N	5	1.5	6.5	1.5																																																																										
4	3	8	F	8	1.5	9.5	1.5																																																																										
5	1	9	F	9.5	1	10.5	1.5																																																																										
6	0.5	9.5	F	10.5	1	11.5	2																																																																										
7	1.5	11	F	11.5	2.5	14	3																																																																										
8	2	13	N	14	2.5	16.5	3.5																																																																										
9	2	15	F	16.5	2	18.5	3.5																																																																										
<p>(v) $24.5/10 = 2.45$ mins</p>	<p>B1 arrival times M1 types M1 service start M1 service duration M1 service end M1 time in shop A1</p> <p>M1 A1</p>																																																																																