4772, June 2011, Markscheme

1.

(a) To not discontinue, i.e. to continue. "Will the minister not …" is a form of words in which the negation is not intended.	B1 to continue B1 double negation B1 understanding ~~ B1 language confusion	
(b)(i) $[(A\wedge B) \vee (A\wedge C)] \wedge [D \vee (E\wedge \sim F)]$ $\Leftrightarrow[(A\vee(A\wedge C)) \wedge (B\vee(A\wedge C))] \wedge [(D\vee E) \wedge (D\vee \sim F)]$ $\Leftrightarrow(A\vee(A\wedge C)) \wedge (B\vee(A\wedge C)) \wedge [(D\vee E) \wedge (D\vee \sim F)]$ $\Leftrightarrow A \wedge [(B\vee A) \wedge (B\vee C)] \wedge (D\vee E) \wedge(D\vee \sim F)$ $\Leftrightarrow A \wedge(B\vee A) \wedge (B\vee C) \wedge (D\vee E) \wedge(D\vee \sim F)$ $\Leftrightarrow A \wedge (B\vee C) \wedge (D\vee E) \wedge(D\vee \sim F)$	M1 uses distributive rule A1 distributive rule A1 "distributive rule" M1 uses associative rule A1 associative rule A1 "associative rule" B1 rest correct	 ft ft SC if refers to "absorption" then +1
or $A \wedge (B\vee C) \wedge (D\vee E) \wedge(D\vee \sim F)$ $\Leftrightarrow[A \wedge (B\vee C)] \wedge (D\vee E) \wedge (D\vee \sim F)$ $\Leftrightarrow[A \wedge (B\vee C)] \wedge [(D\vee E) \wedge (D\vee \sim F)]$ $\Leftrightarrow[(A\wedge B) \vee (A\wedge C)] \wedge [(D\vee E) \wedge (D\vee \sim F)]$ $\Leftrightarrow[(A\wedge B) \vee (A\wedge C)] \wedge [D \vee (E\wedge \sim F)]$	M1 uses distributive rule A1 distributive rule A1 "distributive rule" M1 uses associative rule A1 associative rule A1 "associative rule" B1 rest correct	 ft ft
(ii) Out, LBW! Either first square bracket and second square bracket, or all 4 conditions are satisfied	B1 "out" B1 using either test	
(iii) Can't have D and E both true at the same time. Logic still valid. Logic not concerned with consistency of input, only whether out or not.	B1 B1 B1	

2.

(i)

	1	**2**	**3**	**4**
1	∞	15	7	2
2	15	∞	2	2
3	7	2	∞	10
4	2	2	10	∞

	1	**2**	**3**	**4**
1	1	2	3	4
2	1	2	3	4
3	1	2	3	4
4	1	2	3	4

B1 time matrix
B1 route matrix

	1	**2**	**3**	**4**
1	∞	15	7	2
2	15	30	2	2
3	7	2	14	9
4	2	2	9	4

	1	**2**	**3**	**4**
1	1	2	3	4
2	1	1	3	4
3	1	2	1	1
4	1	2	1	1

M1 replacing an ∞ by a correct value

A1

	1	**2**	**3**	**4**
1	30	15	7	2
2	15	30	2	2
3	7	2	4	4
4	2	2	4	4

	1	**2**	**3**	**4**
1	2	2	3	4
2	1	1	3	4
3	1	2	2	2
4	1	2	2	1

A1 ft

	1	**2**	**3**	**4**
1	14	9	7	2
2	9	4	2	2
3	7	2	4	4
4	2	2	4	4

	1	**2**	**3**	**4**
1	3	3	3	4
2	3	3	3	4
3	1	2	2	2
4	1	2	2	1

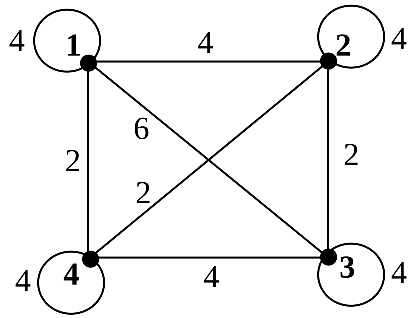
A1 ft

	1	**2**	**3**	**4**
1	4	4	6	2
2	4	4	2	2
3	6	2	4	4
4	2	2	4	4

	1	**2**	**3**	**4**
1	4	4	4	4
2	4	3	3	4
3	2	2	2	2
4	1	2	2	1

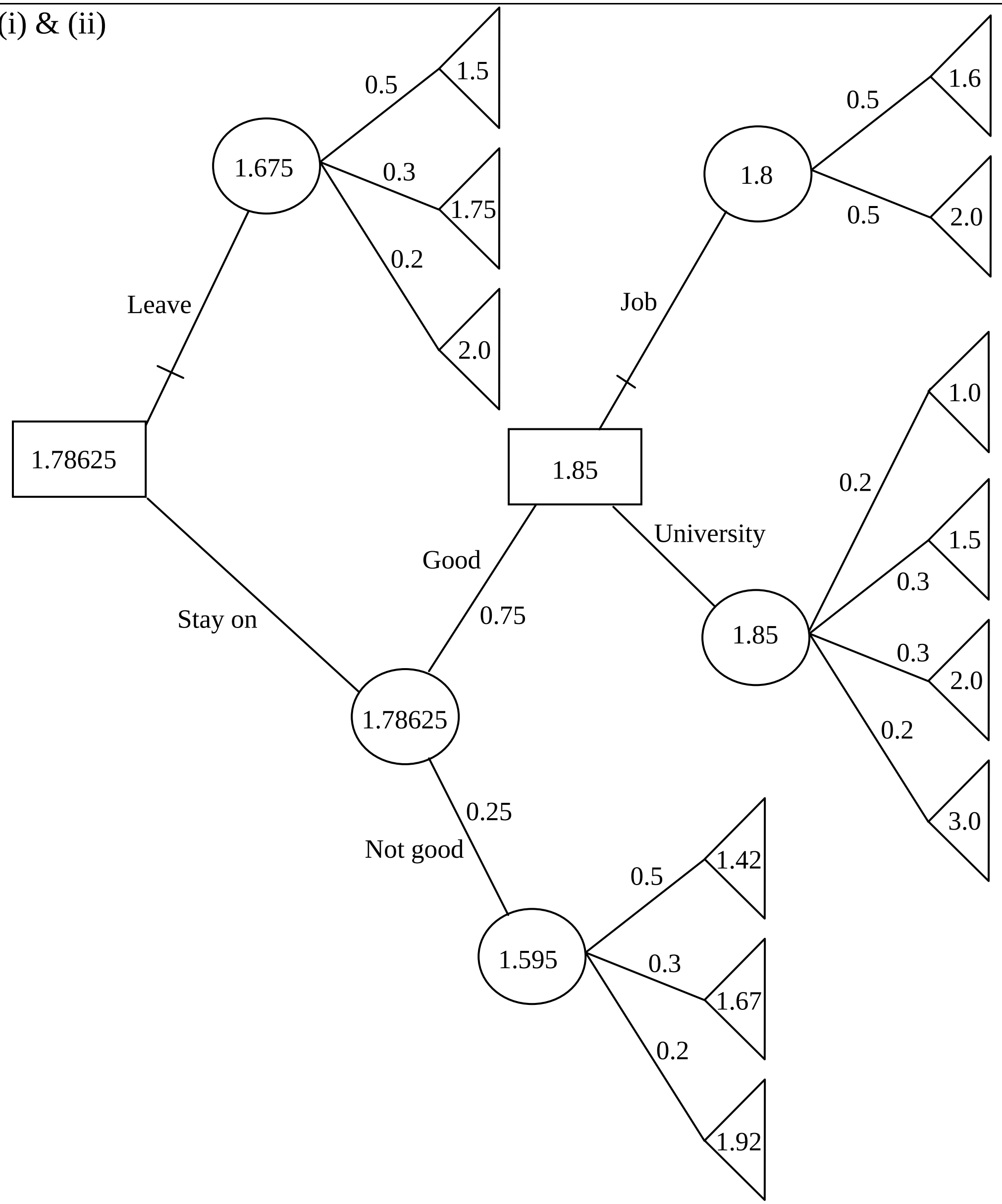
A1 entries other than row 3 col 1 of route matrix ... ft

B1 row 3 col 1 of route matrix ... cao

(ii) 	B1 ft	
(iii) Upper – nearest neighbour – e.g. 2+2+2+6 = 12	M1 nearest neighbour A1	mention of nearest neighbour or a nearest neighbour computation allow 2+2+2+7=13 etc for working in original network
Lower – e.g. “delete” **1**, and compute (2+2)+2+4 = 10	M1 delete a vertex A1 rest of computation	needs to be consistent with above
(iv) e.g. if the requirement is for part loads, and deliver to one department en route to another, then might save time. e.g. if the requirement is for part whole loads then might not be relevant.	B1 B1	answer should be valid and refer to the specific situation of the DAA
(v) A directed network.	B1	

3.

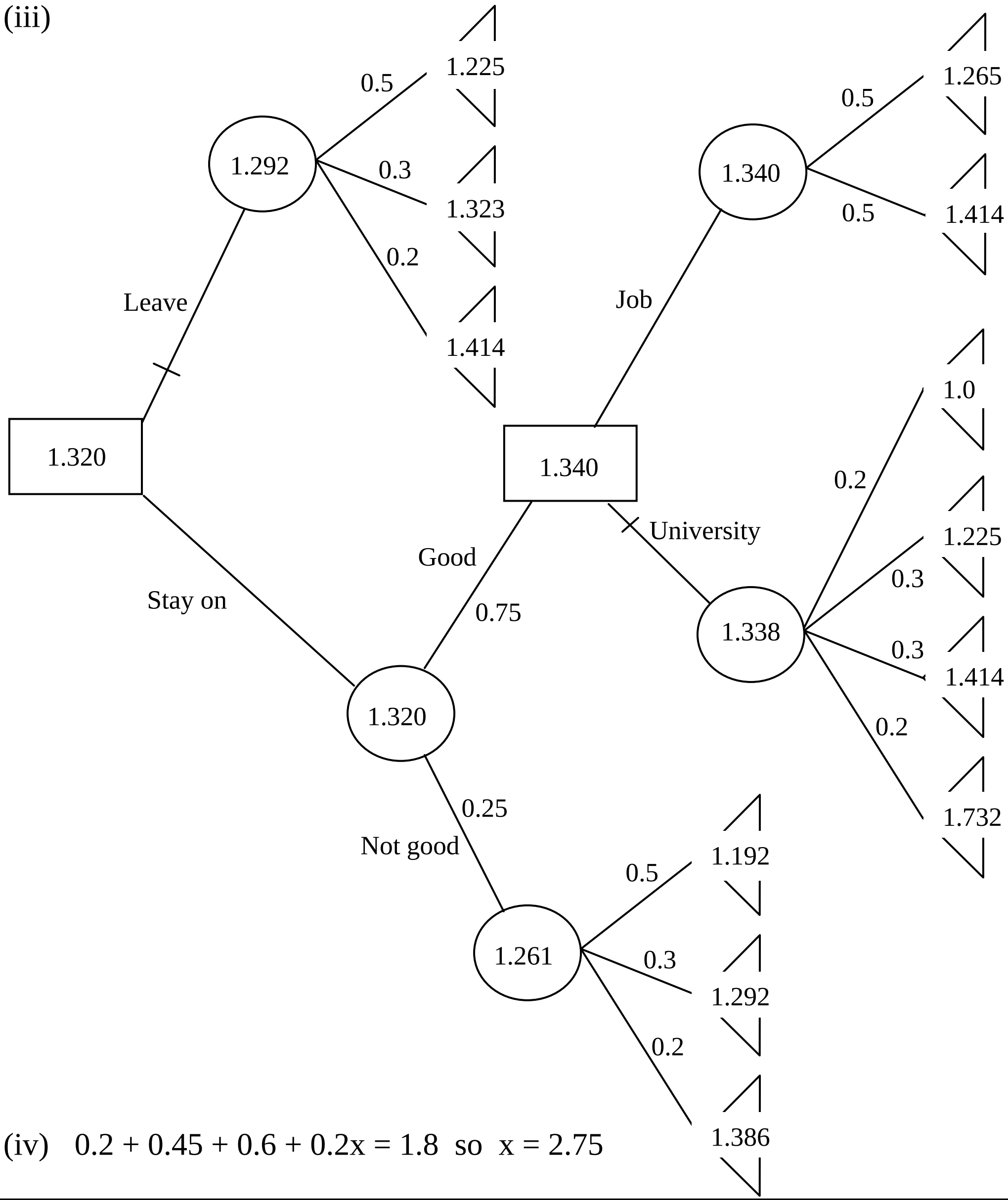
(i) & (ii)



B1	stay on/leave	decision node
B1	leave	chance node with 3 branches
B1	good A/not good	chance node
B1	not good	chance node with 3 branches
B1	job/uni	decision node
B1	job	chance node with 2 branches
B1	uni	chance node with 4 branches
B1	leave computation	cao
B1	job computation	cao
B1	uni computation	cao
B1	good comp	ft
B1	not good comp	cao
B1	good/not good	ft
B1	stay on for 1.78625	cao

3 (cont)

(iii)



M1 utilities of outcomes
A1 cao

M1 computing backwards
A1 ft

(iv) $0.2 + 0.45 + 0.6 + 0.2x = 1.8$ so $x = 2.75$

M1 A1 cao

equation with 0.2 x or division by 0.2

4.

(i) Definition of variables	B1	needs to say "number of"
Max $5x + 9y + 15z$	B1 objective	
st $x + 2y + 4z \leq 60$ $15x + 25y + 40z \leq 700$	B1 constraints	

(ii)

P	x	y	z	s1	s2	RHS
1	–5	–9	–15	0	0	0
0	1	2	4	1	0	60
0	15	25	40	0	1	700
1	–5/4	–3/2	0	15/4	0	225
0	1/4	1/2	1	1/4	0	15
0	5	5	0	–10	1	100
1	1/4	0	0	3/4	3/10	255
0	–1/4	0	1	5/4	–1/10	5
0	–1	1	0	–2	1/5	20

initial tableau	M1 initial tableau A1 ft	two slack variables
first iteration	M1 first iteration A1 ft	identifying correct pivot
second iteration	M1 second iteration A1 ft	identifying correct pivot

Identification of basic variables (y and z) — B1 ft
+ values (inc objective) — B1 ft

(iii)

A	P	x	y	z	s1	s2	s3	a	RHS
1	0	1	0	0	0	0	–1	0	5
0	1	1/4	0	0	3/4	3/10	0	0	255
0	0	–1/4	0	1	5/4	–1/10	0	0	5
0	0	1	1	0	–2	1/5	0	0	20
0	0	1	0	0	0	0	–1	1	5
1	0	0	0	0	0	0	0	–1	0
0	1	0	0	0	3/4	3/10	1/4	–1/4	253.75
0	0	0	0	1	5/4	–1/10	–1/4	1/4	6.25
0	0	0	1	0	–2	1/5	1	–1	15
0	0	1	0	0	0	0	–1	1	5

B1 $\geq$ row
B1 new objective

M1 pivot
A1 objectives cao
A1 constraints cao for basic variables

If from scratch, then M1 for first pivot, A1 for final objective row(s) and A1 for final constraint rows.

or

P	x	y	z	s1	s2	s3	RHS
1	–M+1/4	0	0	3/4	3/10	M	255–5M
0	–1/4	0	1	5/4	–1/10	0	5
0	1	1	0	–2	1/5	0	20
0	1	0	0	0	0	–1	5
1	0	0	0	3/4	3/10	1/4	253.75
0	0	0	1	5/4	–1/10	–1/4	6.25
0	0	1	0	–2	1/5	1	15
0	1	0	0	0	0	–1	5

or (same scheme)

B1 $\geq$ row
B1 new objective

M1 pivot
A1 objective cao
A1 constraints cao for basic variables

(iv) 5, 15 and 6 at £250000 — B1

(v) 8, 12 and 7 is feasible and gives £253000 — B1 B1
IP solution need not be "near" to LP solution — B1