4771, June 2011, Markscheme

1.

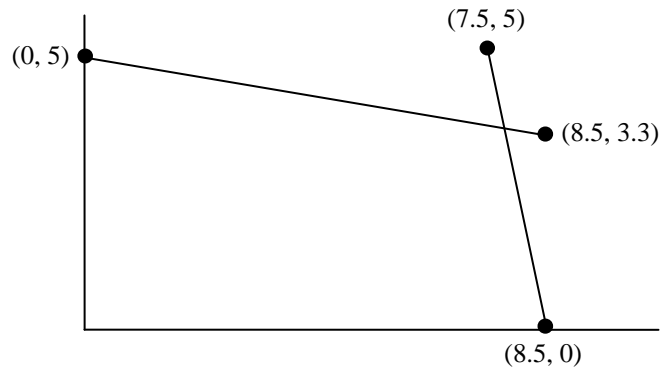| (i)			
		B1 3 to 4 deleted B1 1 to 4 deleted B1 4 to 4 added	-1 for each arc in error
(ii)	14	B1	
(iii)	47	M1 A1 cao	Award method mark if answer correct, or if wrong but with a sum of products shown.
(iv)	(0, 0) and (1, 0)	B1	Award only if correct **points** are specified in some way.
(v)	Explanation should recognise that a line is a set of points − not appropriate in this context.	B1	e.g. "Intermediate points have no meaning." e.g. "Can't have one and a half pairs of shoes." (sic)

2.

(i)	$X = \min(25, 8.5) = 8.5$ or equivalent	B1	cao	OK if only seen once or more on graph
	$Y = \min(5, 42.5) = 5$ oe	B1	cao	OK if only seen once or more on graph
	$X^* = (85-10)/10 = 7.5$ oe	B1	cao	OK if only seen on graph
	$Y^* = (25-8.5)/5 = 3.3$ oe	B1	cao	OK if only seen on graph

(7.5, 5)

(0, 5)

(8.5, 3.3)

(8.5, 0)

		B1	allow ft	sensibly scaled for their X and Y e.g. disallow if either of the lines in the question could intersect both axes.
		B1	cao	lines - can extend to beyond segment
		B1	cao	condone minor errors in plotting (e.g. 8.5 plotted at 9)
(ii)	Avoids tiny feasible regions.	B1		need comment on size of region

3.
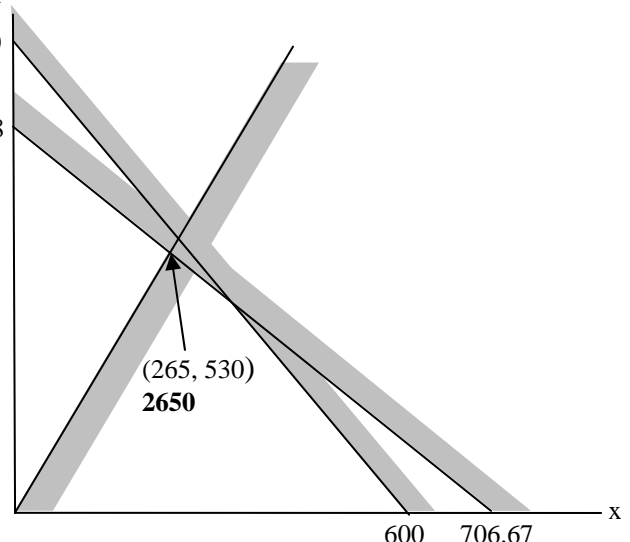
(i)   e.g.
     1, 2, 3 → 1
         4 → 2
       5, 6 → 3
	M1
	
	 A1
	 A1
		function with domain {1,2,3,4,5,6} and range {1,2,3}
		 (special cases are possible – if correct!)
		 proportions 3:2:1
		 all OK

(ii)   e.g.
      1, 2 → 1
        3 → 2
        4 → 3
    (5, 6 → reject and throw again)
	M1 reject some
	 A1 reject two
	 A1 rest
		(Special cases are possible – if correct! e.g. allow throwing die twice and allocating correct proportions of 36.)

(iii) non uniform allows 100	B1 B1	 "101 values" OK no credit for, e.g. "3 is not a two-digit number"

4.

(i)	e.g.		
	x = number of large houses y = number of standard houses	M1 A1	M1 for variables for large and for standard A1 for "number"
	land: 200x + 120y <= 120000 oe cash: 60x + 50y <= 42400 oe market: x <= 0.5y oe	B1 B1 B1	use "isw" for incorrect simplifications -1 once only for any " < "

(ii)

		B1 line 1, allow ft B1 line 2, allow ft B1 line 3, allow ft	for instance, if x <= 2y in part (i), then allow correct graph of x <= 0.5y or ft graph of x <= 2y plotting tolerance on axis intersection points – within correct small square
		B1 feasible region	must consider 3 lines ft if region includes y-axis interval from origin upwards allow any clear indication of feasible region ignore any indication(s) of boundary lines included or excluded
(iii)	intersection of y=2x and 6x+5y=4240, (265, 530) 2650	M1 correct point, cao A1	identification only - coordinates not required here their 4x+3y from (260-280, 520-540)
(iv)	their 60x + 50y <= 45000 or line from their (0, 900) to (750, 0)	B1 ft	can be implied from final M1 working
	Best point is at the intersection of the land constraint and the new cash constraint, and not on y=2x	M1 comparison of two (or more) points A1	not just ringing points their identified best point is not on y=2x or an axis
	(214, 643) 2785	M1 correct point, cao A1	identification, coordinates not required here bedrooms - their 4x+3y from (200-220, 620-660)

5.

(i)

Activity	Immediate predecessors
A	–
Pl	A
Demo	–
Fo	Pl; Demo
W	Fo
Pb	Fo
R	W
Fl	Pb; W
E	R; Fl
WD	W
Deco	WD; E

M1   Fl correct
A1   rest

(ii)

M1   at least one correct
     nontrivial join
A1   forward pass

M1   at least one correct
     nontrivial burst   excluding start node
A1   backward pass

(iii)   critical activities: A; Pl; Fo; W; R; E; Deco
       project duration = 41 days

B1   cao
B1   cao

act	A	Pl	Dm	Fo	W	Pb	R	Fl	E	WD	Dc
float	0	0	21	0	0	2	0	1	0	4	0

B1   A, Pl, Dm, Fo, W   cao
B1   rest   cao – most see zeros, dashes or empty spaces won't do

(iv)   Fl has both W and Pb as immediate predecessors.
       R and WD have only W as immediate predecessor.

B1
B1   one of R/WD

SC1 for a convincing but not specific answer, e.g. "A dummy is needed to cater for both joint and separate precedences".

(v)	M1 C between W and R A1 Fl + dummy OK A1 WD OK	
(vi) new duration = 42 days critical activities: A; Pl; Fo; W; C; R; E; Deco	B1 cao	both needed

6.

(i)

	1	7	9	8	2	10	3	6	11	5	4
	P	S	F	Ln	Br	Nr	Bm	Ld	Nc	Lv	M
P	–	150	–	240	125	–	–	–	–	–	–
S	150	–	150	80	(105)	–	135	–	–	–	–
F	–	150	–	(80)	–	–	–	–	–	–	–
Ln	240	(80)	80	–	120	115	120	–	–	–	–
Br	(125)	105	–	120	–	230	90	–	–	–	–
Nr	–			(115)	230	–	160	175	255	–	–
Bm	–	135	–	120	(90)	160	–	120	–	–	90
Ld	–	–	–	–	–	175	120	–	210	100	(90)
Nc	–	–	–	–	–	255	–	210	–	(175)	–
Lv	–	–	–	–	–	–	–	100	175	–	(35)
M	–	–	–	–	–	–	(90)	90	–	35	–
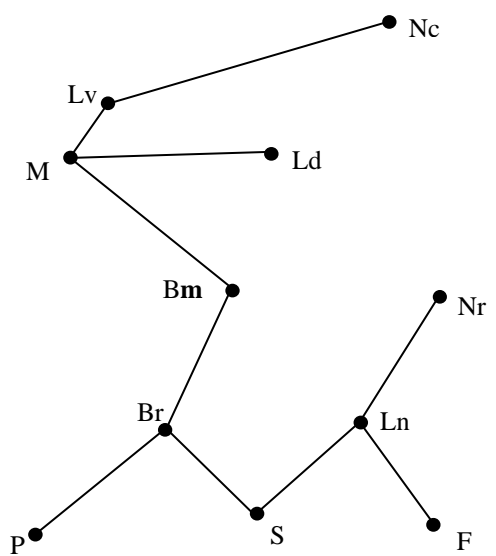
M1   tabular   125 in P column and 90 in Br column ringed, with both
        Prim   rows crossed
A2   choosings   all circles in correct place; -1 each error (watch for one
                          error making two changes to a row)
A1   crossings   all rows crossed out except, possibly, Nc row.
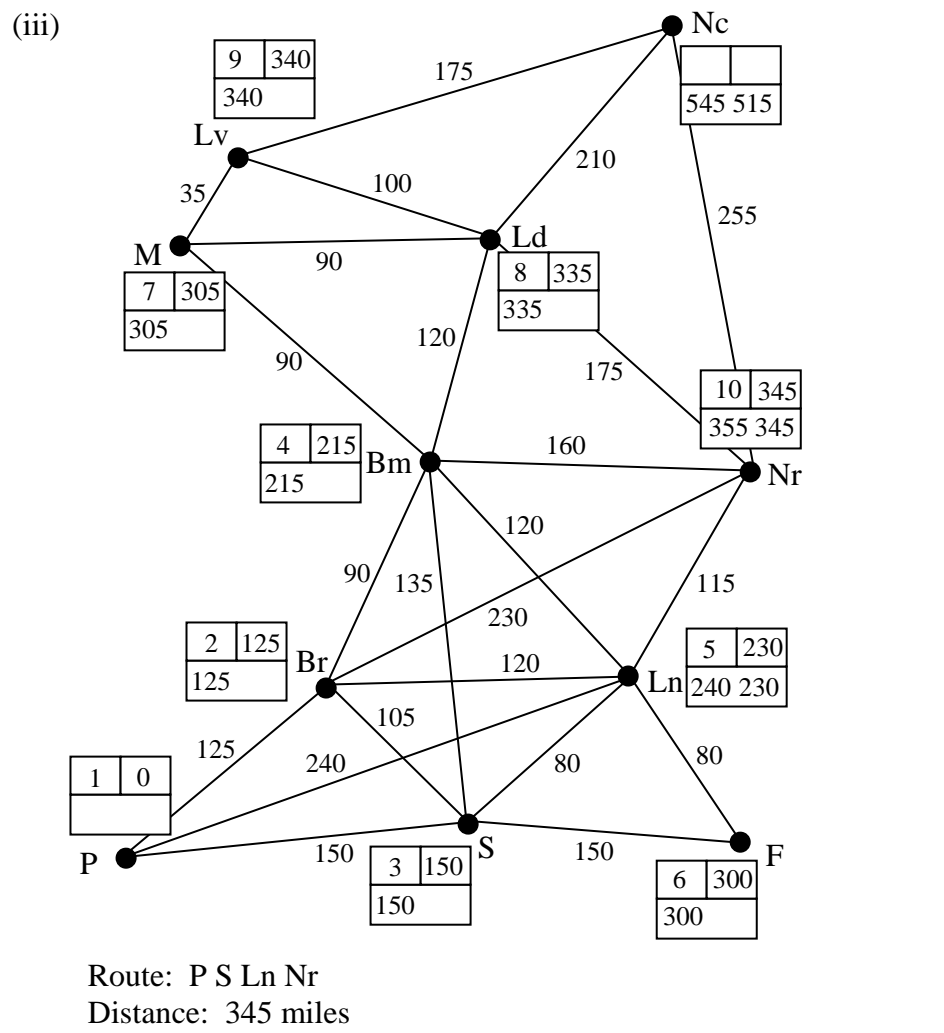
accept convincing transpose

B1   cao

Length = 985 miles

B1   cao

(ii)	Advantage: shortest length of track	B1 cao	allow cost minimisation
	Disadvantage: tree, no redundancy ≡ fragility (breakdown et al)	B1	could say "no cycles"
	Disadvantage: some journeys are not shortest paths	B1	disallow comments relating to direct connectivity, or relating to more stops

(iii)

Nc

9 | 340
340
Lv

545 515

175

210

35   100   255

M   Ld   8 | 335
90   335
7 | 305
305

90   120   175

10 | 345
355 345

4 | 215
215   Bm   160   Nr

120

90 135   115

230

2 | 125   5 | 230
125   Br   120   Ln 240 230
105

125   240   80   80
1 | 0

150   S   150   F
P   3 | 150   6 | 300
150   300

"longer journeys" or "takes longer" allowed
allow "min connector arcs may be more expensive" oe
don't allow two marks for the same point described differently. e.g. longer journeys/more time/more upkeep

M1 Dijkstra — correct working values (no extras) at Ln and Nr, and working values only superseded at Ln and Nr (ignore Nc for this M)

A1 working values — (need to check Nc here)

B1 labels

B1 order of labelling

Route: P S Ln Nr — B1 cao
Distance: 345 miles — B1 cao

(iv) Distance by min connector = 425 miles — B1 ft their mc