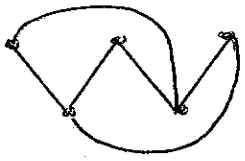
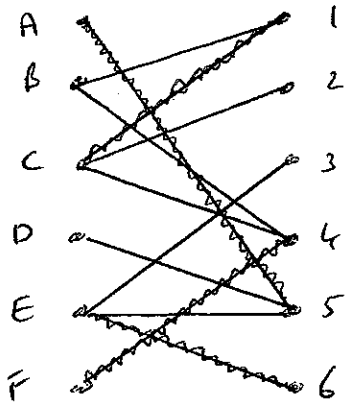
November 2004
6689 Decision Mathematics D1
Mark Scheme

Question Number	Scheme	Marks
1 (a)	(By conservation of flow at B, C and D) $x = 11$ $y = 5$ $z = 12$ $(\sqrt{x-6})$ $(\sqrt{y+7})$	B3, 2√, 1√, 0 (3)
(b)	Flow is 31 (max flow = min cut), cut through AB, AC and SD	B1 B1 (2) 5
2 (a) (i)	A graph is planar if it can be drawn so that no arcs cross – other than at vertices	B1
(ii)	A cycle that passes through every vertex of a graph once and returns to its starting vertex	B2, 1, 0 (3)
(b) (i)	e.g. 	M1 A1
(ii)	It is not possible to find an Hamiltonian cycle	B1 (3) 6

Question Number	Scheme	Marks
3) (a)		B1
(b)		B1 (2)
(c)	eg $B-1=C-2$ c.s. $B=1-C=2$ $A=5,\ B=1,\ C=2,\ E=6,\ F=4$	M1A1 B1(c.s) A1√ (4)
(d)	eg. • Both A and D are only matched to 5, once one has been assigned the other can not be. • E is the only person who can do 3, and the only person who can do 6 if they are assigned to one of these the other can not be done.	B2,1,0 (2) 8

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4) (a)	e.g. 45 37 18 [46] 56 79 90 81 51 or 37 18 [45] 56 79 46 90 81 51 or 45 37 46 18 [51] 56 79 90 81	m1 A1 (2)
(b)	56 45 79 46 37 90 81 51 18 or 90 45 56 37 79 46 18 81 51	m1 A1 (2)
(c)	$\left[\frac{1+11}{2}\right] = 6$ value 46 discard top $\left[\frac{7+11}{2}\right] = 9$ value 71 discard top $\left[\frac{10+11}{2}\right] = 11$ value 94 discard bottom List reduces to 10th value. This $\leq$ 73 so 73 has been located as the 10th value	m1 A1 A1 A1 (4) [8]
5 (a)	$B_1G + B_2E = 26 + 30 = 56$ $B_1B_2 + EG = 65 + 18 = 83$ $B_1E + B_2G = 41 + 42 = 83$ Repeat B_1D, DG, B_2A, AE Route e.g. F A B_2 A C E A E F D B_1 D H G D G F length = 129 + 56 = 185 km	m1 A1 A1 A1 (4) B1 m1 A1 (3)
(b)	new only E and G are odd – repeat EF, FG only length = 129 + 18 = 147 km	B1 m1 A1 (3) [10]

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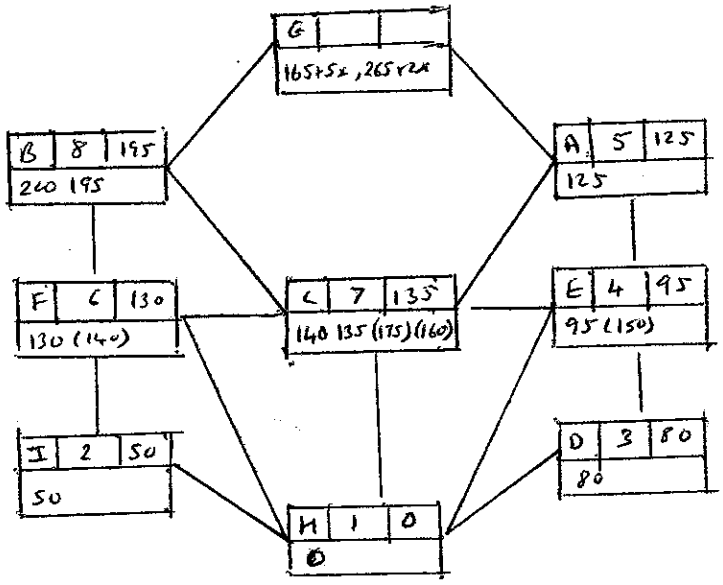
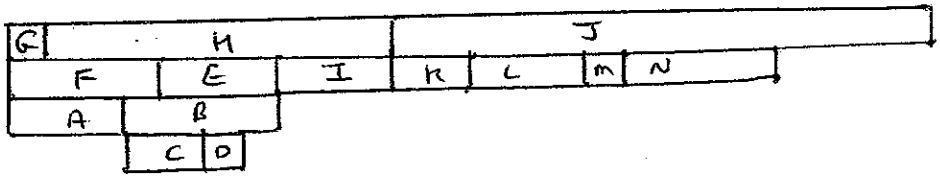
6 (a)		M1 A1 A1✓ A1✓ (4)
	Via A HEAG Length $165+5x$ Via B HECBG Length $265+2x$	M1 A1 A1 (3)
(b)	$165+5x < 265+2x \Rightarrow x < 33\frac{1}{3}$ So range is $0 \leq x < 33\frac{1}{3}$	M1 A1✓ A1✓ (3)
		10

Question Number	Scheme	Marks
7 (a)	maximum (P=) $0.4x + 0.2y$ (accept $40x + 20y$)	B1
	subject to $x \leq 6.5$	
	$y \leq 8$	
	$x + y \leq 12$	B5,4,3,2,1,0
	$y \leq 4x$	
	$y \geq 0$	(6)
(b)	Point testing or Profit line	
	$(6.5, 5.5) \Longrightarrow$ 6500 type x and 5500 type y	M1 A1 A1 (3)
(c)	$P = 0.4(6500) + 0.2(5500)$	M1
	$= £3700$	A1 (2)
		11

Question Number	Scheme	Marks
8(a)	$x = 12$ $y = 24$ $z = 19$	B3,2,1,0 (3)
(b)	Allow J and K to be given a unique representation using events	B1 (1)
(c)	F – E – I – J G – H /	M1 A1 (2)
(d)	No effect, B has a total float of 2	M1 A1 (2)
(e)	eg. • Total of activities = 54, $54 \div 24 = 2.25$ so 2 workers not enough • $54 \div 2 = 27$ hours per worker, so 2 workers cannot finish in 24 hours • Argument about the activities that need to be completed by $t = 7$ or 10	B2,1,0 (2)
(f)		M1 A1 A1 A1 (5)
(g)	10 extra hours ∴ £280	M1 A1 (2)
		17