EDEXCEL DECISION MATHEMATICS D2 (6690) – JUNE 2004 PROVISIONAL MARK SCHEME
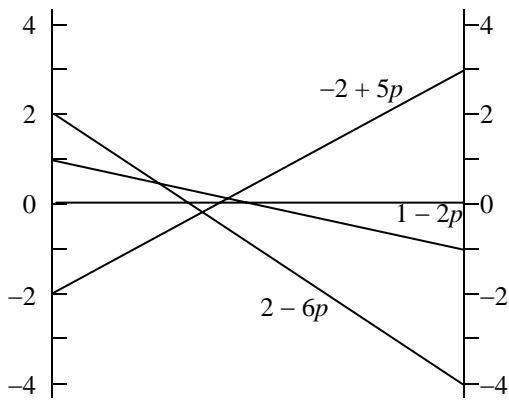
Question Number	Scheme	Marks
1. (*a*)	A game in which the gain to one player is equal to the loss of the other	B2, 1, 0 (2)
(*b*)	If there is a stable solution(s) a_{ij} in a game, the location of this stable solution is called the saddle point. It is the point(s) where row maximum = column maximum.	B2, 1, 0 (2)
		(4 marks)
2.	$\quad\quad\quad\quad\quad\quad 4 \quad 11 \quad 3 \quad 0$	M1
	Subtract all terms from $\quad 19 \quad 25 \quad 16 \quad 13$	A1
	some $n \geq 35$, e.g.35 $\quad\quad 16 \quad 21 \quad 15 \quad 14$	
	$\quad\quad\quad\quad\quad\quad 17 \quad 20 \quad 14 \quad 12$	
	$\quad\quad\quad\quad\quad\quad 2 \quad 4 \quad 2 \quad 0$	B1
	Reducing rows then $\quad 4 \quad 5 \quad 2 \quad 0$	
	columns $\quad\quad\quad\quad 0 \quad 0 \quad 0 \quad 0$	
	$\quad\quad\quad\quad\quad\quad 3 \quad 1 \quad 1 \quad 0$	
	$\quad\quad\quad\quad\quad\quad 1 \quad 3 \quad 1 \quad 0$	
	Minimum $\quad\quad\quad 3 \quad 4 \quad 1 \quad 0$	M1
	uncovered 1 $\quad\quad 0 \quad 0 \quad 0 \quad 1$	A1 ft
	$\quad\quad\quad\quad\quad\quad 2 \quad 0 \quad 0 \quad 0$	
	$\quad\quad\quad\quad\quad\quad 0 \quad 2 \quad 0 \quad 0$	
	Minimum $\quad\quad\quad 2 \quad 3 \quad 0 \quad 0$	M1
	uncovered 1 $\quad\quad 0 \quad 0 \quad 0 \quad 2$	A1 ft
	$\quad\quad\quad\quad\quad\quad 2 \quad 0 \quad 0 \quad 1$	
	e.g. matching D - A A M S	A1 ft
	$\quad\quad\quad\quad H$ - S or S or S or M	
	$\quad\quad\quad\quad K$ - M L A A	
	$\quad\quad\quad\quad T$ - L M L L	A1 (4)
	Total 88 points	
		(9 marks)

Question Number	Scheme	Marks
3. (*a*) (i)	Minimum connector using Prim: *AC*, *CB*, *CD*, *CE*	M1 A1
	Length = 98 + 74 + 82 + 103 = 357 {1, 3, 2, 4, 5}	
	So upper bound = 2 × 357 = 714	M1 A1 (4)
(ii)	*A* (98) *C* (74) *B* (131) *D* (134) *E* (115) *A*	M1 A1
	Length = 98 + 74 + 131 + 134 + 115 = 552	A1 (3)
(*b*)	Residual minimum connector is AC, CB, CD	M1
	Length 254	A1
	Lower bound = 254 + 103 + 115 = 472	M1 A1 (4)
(*c*)	472 ≤ solution ≤ 552	B1 ft (1)
		(12 marks)

Question Number	Scheme	Marks
4. (a)	row min $$\begin{pmatrix} -4 & -1 & 3 \\ 2 & 1 & -2 \end{pmatrix} \quad \begin{matrix} -4 \\ -2 \end{matrix} \quad \leftarrow \text{max}$$ Col. max $\qquad 2 \quad 1 \quad 3$ $\qquad\qquad\qquad \uparrow$ $\qquad\qquad\quad$ min	M1 A1
	$-2 \neq 1 \therefore$ not stable	A1 (3)
(b)	Let Emma play R_1 with probability p	
	If Freddie plays C_1, Emma's winnings are $-4p + 2(1-p) = 2 - 6p$	
	$\qquad\qquad\qquad C_2$, Emmas winnings are $-p + 1(1-p) = 1 - 2p$	M1 A1
	$\qquad\qquad\qquad C_3$, Emma's winnings are $3p - 2(1-p) = -2 + 5p$	A1 (3)
		M1 A1 ft (2)
	Need intersection of $2 - 6p$ and $-2 + 5p$	M1
	$\qquad 2 - 6p = -2 + 5p, \quad 4 = 11p, \ p = \dfrac{4}{11}$	A1
	So Emma should play R_1 with probability $\dfrac{4}{11}$	
	$\qquad\qquad\qquad R_2$ with probability $\dfrac{7}{11}$	A1 ft (8)
	The value of the game is $-\dfrac{2}{11}$ to Emma	
(c)	Value to Freddie $\dfrac{2}{11}$, matrix $\begin{pmatrix} 4 & -2 \\ 1 & -1 \\ -3 & 2 \end{pmatrix}$	B1 ft B1, B1 (3)
		(14 marks)

Question Number		Scheme	Marks	
5.	(*a*)	Idea of many supply and demand points and many units to be moved. Costs are variable and dependent upon the supply and demand points, need to minimise costs. <u>Practical</u>	B2, 1, 0	(2)
	(*b*)	Supply = 120 Demand = 110 so not balanced	B1	(1)
	(*c*)	Adds 0, 0, 0, 10 to column *f*	M1 A1	

$$\begin{array}{c|ccc} & d & e & f \\ \hline A & 45 & & \\ B & 5 & 30 & \\ C & & 30 & 10 \end{array} \qquad \text{Cost 545}$$

			Marks	
			M1 A1	
			B1 ft	(5)

(d) $R_1 = 0$ $R_2 = -1$ $R_3 = -3$

$k_1 = 5$ $k_2 = 7$ $k_3 = 3$ **M1 A1**

$Ae = 3 - 0 - 7 = -4$

$Af = 0 - 0 - 3 = -3$ **M1 A1 ft**

$Bf = 0 + 1 - 3 = -2$ **A1 ft   (5)**

$Cd = 2 + 3 - 5 = 0$

(e) $Ae^+ \rightarrow Be^- \rightarrow Bd^+ \rightarrow Ad^-$ send 30   **M1 A1 ft**

$$\begin{array}{c|ccc} & d & e & f \\ \hline A & 15 & 30 & \\ B & 35 & & \\ C & & 30 & 10 \end{array} \qquad \text{Cost 425}$$

M1

A1 ft

A1   (5)

(18 marks)

Question Number		Scheme	Marks
6.	(*a*)	Stage – Number of weeks to finish	B1
		State – Show being attended	B1
		Action – Next journey to undertake	B1 (3)

(*b*)

Stage	State	Action	Value	
1	F	F – Home	$500 - 80 = 420$ *	
	G	G – Home	$700 - 90 = 610$ *	M1 A1
	H	H – Home	$600 - 70 = 530$ *	
2	D	DF	$1500 - 200 + 420 = 1720$	
		DG	$1500 - 160 + 610 = 1950$ *	M1 A1 ft
		DH	$1500 - 120 + 530 = 1910$	A1 ft
	E	EF	$1300 - 170 + 420 = 1550$	
		EG	$1300 - 100 + 610 = 1810$ *	A1
		EH	$1300 - 110 + 530 = 1720$	
3	A	AD	$900 - 180 + 1950 = 2670$ *	M1 A1 ft
		AE	$900 - 150 + 1810 = 2560$	
	B	BD	$800 - 140 + 1950 = 2610$ *	A1 ft
		BE	$800 - 120 + 1810 = 2490$	
	C	CD	$1000 - 200 + 1950 = 2750$ *	A1
		CE	$1000 - 210 + 1810 = 2600$	
4	Home	Home – A	$-70 + 2670 = 2600$ *	
		Home – B	$-80 + 2610 = 2530$	M1 A1
		Home – C	$-150 + 2750 = 2600$ *	(12)

Note: <u>Special Case</u> If working forwards, max 8/12 for (*b*)

(*c*)

Home — A — D – G
Home — C — D – G

B2 ft 1 ft 0

Total profit £2 600

B1 ft (3)

(18 marks)