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Mark Scheme (Results)
Summer 2010

GCE

GCE Decision Mathematics D2 (6690/01)

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Summer 2010

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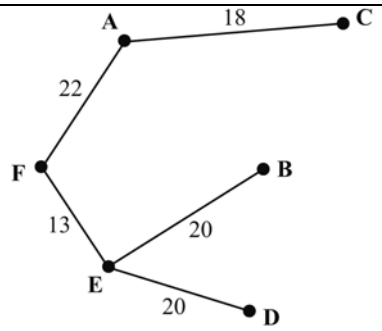
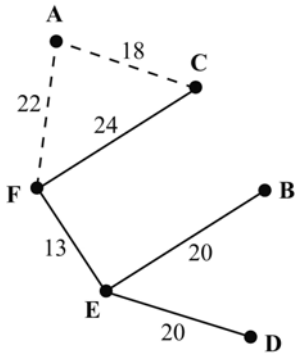
Decision Mathematics D2 6690
Mark Scheme

Question Number	Scheme	Marks
Q1 (a)		M1 A1 (2)
(b)	Minimum Spanning tree length 93, so upper bound is £186	B1ft (1)
(c)	A C F E B D A 18 24 13 20 22 28 Length 125 A C F E D B A 18 24 13 20 22 36 Length 133	M1 A1 A1 (3)
(d)	Best upper bound is £125	B1ft (1)
(e)	Delete A  RMST weight = 77 Lower bound = 77 + 18 + 22 = £117	M1 A1 M1 A1 (4) **[11]**

Question Number	Scheme	Marks
Q2 (a)	Since maximising, subtract all elements from some $n \geq 27$	
	$\begin{bmatrix} 12 & 6 & 8 & 13 \\ 10 & 5 & 11 & 60 \\ 5 & 6 & 3 & 8 \\ 11 & 4 & 7 & 16 \end{bmatrix}$	1M1 2M1
	Reduce rows $\begin{bmatrix} 6 & 0 & 2 & 7 \\ 5 & 0 & 6 & 55 \\ 2 & 3 & 0 & 5 \\ 7 & 0 & 3 & 12 \end{bmatrix}$ then columns $\begin{bmatrix} 4 & 0 & 2 & 2 \\ 3 & 0 & 6 & 50 \\ 0 & 3 & 0 & 0 \\ 5 & 0 & 3 & 7 \end{bmatrix}$	3M1 A1
	$\begin{bmatrix} 2 & 0 & 0 & 0 \\ 1 & 0 & 4 & 48 \\ 0 & 5 & 0 & 0 \\ 3 & 0 & 1 & 5 \end{bmatrix}$	4M1 A1ft
	$\begin{bmatrix} 2 & 1 & 0 & 0 \\ 0 & 0 & 3 & 47 \\ 0 & 6 & 0 & 0 \\ 2 & 0 & 0 & 4 \end{bmatrix}$	5M1A1 (8)
(b)	Three optimal allocations:	
	Harry 3 4 4 Jess 1 1 2 Louis 4 3 1 Saul 2 2 3	M1
	Total amount earned by team: £90	A1 (2) **[10]**

Question Number	Scheme	Marks
Q3 (a)		

	A	B	C	D
X	18	31	4	
Y			18	29

B1 (1)

(b) e.g.

		28 A	20 B	19 C	22 D
0	X	x	x	x	-6
-5	Y	-8	-3	x	x

M1
A1

	A	B	C	D
X	18 – θ	31	4+θ	
Y	θ		18 – θ	29

2M1

Entering cell: AY θ = 18

Either

Exiting cell: XA

	A	B	C	D
X		31	22	
Y	18		0	29

		20 A	20 B	19 C	22 D
0	X	8	x	x	-6
-5	Y	x	-3	x	x

Entering cell: XD

	A	B	C	D
X		31	22 – θ	θ
Y	18		0 + θ	29 – θ

Exiting cell: XC

θ = 22

	A	B	C	D
X		31		22
Y	18		22	7

		14 A	20 B	13 C	16 D
0	X	14	X	6	x
1	Y	x	-9	x	x

Or

Exiting cell: YC

	A	B	C	D
X	0	31	22	
Y	18			29

		28 A	20 B	19 C	30 D
0	X	x	x	x	-14
-13	Y	x	5	8	x

Entering cell: XD

	A	B	C	D
X	0 – θ	31	22	θ
Y	18 + θ			29 – θ

Exiting cell: XA

θ = 0

	A	B	C	D
X		31	22	0
Y	18			29

		14 A	20 B	19 C	16 D
0	X	14	x	x	x
1	Y	x	-9	-6	x

2A1ft
3M1
3A1
4M1
4A1ft
5A1
(9)

(c) Negative improvement index so not optimal — B1ft (1)

[11]

Q4 (a) Minimax route

Question Number	Scheme	Marks

Stage	State	Action	Dest.	Value
	G	GT	T	17*
1	H	HT	T	21*
	I	IT	T	29*
2	D	DG	G	max(22, 17) = 22*
		DH	H	max(31, 21) = 31
	E	EH	H	max(34, 21) = 34*
		EI	I	max(39, 29) = 39
	F	FI	I	max(52, 29) = 52*
3	A	AD	D	max(41, 22) = 41
		AE	E	max(38, 34) = 38*
	B	BE	E	max(44, 34) = 44*
	C	CE	E	max(36, 34) = 36*
		CF	F	max(35, 52) = 52
4	S	SA	A	max(37, 38) = 38*
		SB	B	max(39, 44) = 44
		SC	C	max(41, 36) = 41

1M1
A1

2M1 A1

A1

3M1 A1ft

A1ft

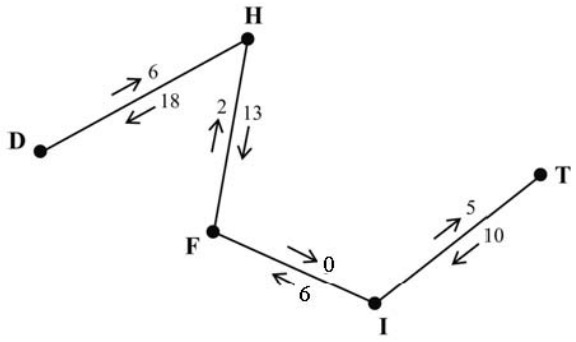
A1ft

(9)

(b) Route: SAEHT Greatest annual cost: £38 000 M1 A1ft (2)

(c) Average expenditure $\frac{37+38+34+21}{4} = \frac{130}{4} =$ £32 500 M1A1 (2)

[13]

Question Number		Scheme	Marks
Q5	(a)	Initial flow = 41	B1 (1)
	(b)	Capacity of $C_1 = 69$ Capacity of $C_2 = 64$	B1 B1 (2)
	(c)		M1 A1 (2)
	(d)	e.g. SBADHT – 2 SCGEDHT – 2	M1 A1 A1 (3)
	(e)	maximum flow = minimum cut e.g. cut through SA, SB, CE, GE, GI or HT, FI, GI	DM1 A1 (2) **[10]**

Notes:

(a) 1B1: cao

(b) 1B1: cao (permit B1 if 2 correct answers, but transposed)
2B1: cao

(c) 1M1: Two numbers on each arc
1A1: cao

(d) 1M1: One valid flow augmenting route, S to T, found and value (≤ 4) stated.
1A1: Flow increased by at least 2
2A1: Flow increased by 4

(e) 1DM1: Must have attempted (d) and made an attempt at a cut.
1A1: cut correct – may be drawn. Refer to max flow-min cut theorem
three words out of four.

Question Number	Scheme	Marks
Q6 (a)	$P - x - 2y - 6z = 0$	B1 (1)
(b)		

b.v	x	y	z	r	s	t	Value
r	0	1	2	1	0	0	24
s	2	1	4	0	1	0	28
t	-1	$\frac{1}{2}$	3	0	0	1	22
P	-1	-2	-6	0	0	0	0

b.v.	x	y	z	r	s	t	Value	Row Ops.
r	-1	$\frac{1}{2}$	0	1	$-\frac{1}{2}$	0	10	$R_1 - 2R_2$
z	$\frac{1}{2}$	$\frac{1}{4}$	1	0	$\frac{1}{4}$	0	7	$R_2 \div 4$
t	$-\frac{5}{2}$	$-\frac{1}{4}$	0	0	$-\frac{3}{4}$	1	1	$R_3 - 3R_2$
P	2	$-\frac{1}{2}$	0	0	$\frac{3}{2}$	0	42	$R_4 + 6R_2$

M1 A1

M1 A1ft

A1 (5)

b.v.	x	y	z	r	s	t	Value	Row Ops.
y	-2	1	0	2	-1	0	20	$R_1 \div \frac{1}{2}$
z	1	0	1	$-\frac{1}{2}$	$\frac{1}{2}$	0	2	$R_2 - \frac{1}{4}R_1$
t	-3	0	0	$\frac{1}{2}$	-1	1	6	$R_3 + \frac{1}{4}R_1$
P	1	0	0	1	1	0	52	$R_4 + \frac{1}{2}R_1$

M1 A1ft

M1 A1 (4)

(c) $P = 52 \quad x = 0 \quad y = 20 \quad z = 2 \quad r = 0 \quad s = 0 \quad t = 6$

M1 A1ft A1 (3)

[13]

Notes:

(a) 1B1: cao

(b) 1M1: correct pivot located, attempt to divide row
1A1: pivot row correct including change of b.v.
2M1: (ft) Correct row operations used at least once or stated correctly.
1A1ft: Looking at non zero-and-one columns, one column ft correct
2A1: cao.
3M1: (ft)Correct pivot identified – negative pivot gets M0 M0
1A1: ft pivot row correct including change of bv – but don't penalise b.v. twice.
4M1: (ft) Correct row operations used at least once or stated correctly.
1A1: cao

(c) 1M1: At least 4 values stated. No negative. Reading off bottom row gets M0.
1A1ft: At least 4 values correct.
2A1: cao

Question Number	Scheme	Marks
Q7	$\begin{bmatrix} -4 & 5 & 1 \\ 3 & -1 & -2 \\ -3 & 0 & 2 \end{bmatrix} \rightarrow$ add 5 to all entries $\begin{bmatrix} 1 & 10 & 6 \\ 8 & 4 & 3 \\ 2 & 5 & 7 \end{bmatrix}$	M1
	Either	
	Define variables e.g. let p_1, p_2 and p_3 be the probability that A plays rows 1, 2 and 3 respectively.	B1
	Maximise P = V	B1
	Subject to: $V - p_1 - 8p_2 - 2p_3 \leq 0$ $V - 10p_1 - 4p_2 - 5p_3 \leq 0$ $V - 6p_1 - 3p_2 - 7p_3 \leq 0$ $p_1 + p_2 + p_3 \leq 1$ $p_1, p_2, p_3 \geq 0$	M1 A1 A1 A1
	Or	
	Define variables e.g. let p_1, p_2 and p_3 be the probability that A plays rows 1, 2 and 3 respectively. Let $x_i = \frac{p_i}{V}$	B1
	Minimise $P = x_1 + x_2 + x_3$	B1
	Subject to $x_1 + 8x_2 + 2x_3 \geq 1$ $10x_1 + 4x_2 + 5x_3 \geq 1$ $6x_1 + 3x_2 + 7x_3 \geq 1$ $x_1, x_2, x_3 \geq 0$	M1 A1 A1 A1
	Notes: 1M1: Adding n (≥ 4) to all entries 1B1: Defining variables 1B1: Objective correct 2M1: At least 3 constraints, using columns, one of correct form 1A1ft: one correct constraint – excluding non-negativity constraint 2A1ft: two correct constraints – excluding non-negativity constraint 3A1: cao including non-negativity constraint	**[7]**

Notes for Question 1

(a) 1M1: Spanning tree found. Allow 1x2x43 across top of table or 93
1A1: CAO must see tree or list of arcs

(b) 1B1ft: 186 their ft93 x 2

(c) 1M1: One Nearest Neighbour each vertex visited at least once (condone lack of return to start)
1A1: One correct route and length CAO – must return to start.
2A1: Second correct route and length CAO – must return to start.

(d) 1B1ft: ft but only on three different values.

(e) 1M1: Finding correct RMST (maybe implicit) 77 sufficient, or correct numbers. 4 arcs.
1A1: CAO tree or 77.
2M1: Adding 2 least arcs to A, 18 and 22 or 40 only
2A1: CAO 117

Notes for Question 2

(a) 1M1: Subtracting from some $n \geq 27$, condone up to two errors
2M1: Dealing with (Jess, 4) entry.
3M1: Reducing rows then columns
1A1: cao (pick up (J,4) value here)
4M1: Double covered +e; one uncovered – e; and one single covered unchanged.
2 lines needed to 3 lines needed.
2A1ft: ft correct - no errors
5M1: Double covered +e; one uncovered – e; and one single covered unchanged.
3 line to 4 line solution.
3A1: correct - no errors

(b) 1M1: A complete, correct solution.
1A1: cao

Q2 Special case (Minimises)

M0
M1

$$\begin{bmatrix} 18 & 24 & 22 & 17 \\ 20 & 25 & 19 & 60 \\ 25 & 24 & 27 & 22 \\ 19 & 26 & 23 & 14 \end{bmatrix} \xrightarrow{\text{row reduction}} \begin{bmatrix} 1 & 7 & 5 & 0 \\ 1 & 6 & 0 & 41 \\ 3 & 2 & 5 & 0 \\ 5 & 12 & 9 & 0 \end{bmatrix}$$

M1

$$\xrightarrow{\text{column reductions}} \begin{bmatrix} 0^* & 5 & 5 & 0 \\ 0 & 4 & 0^* & 41 \\ 2 & 0^* & 5 & 0 \\ 4 & 10 & 9 & 0^* \end{bmatrix}$$

A1

M0
M0

Solution:
Harry - 1
Jess - 3
Louis - 2
Saul - 4

M1

Total £75

A1

Maximum 5 marks

Notes for Question 3

(a) 1B1: Cao

(b) 1M1: 6 shadow costs and precisely 3 improvement indices stated. (no extra zeros)
1A1: cao.
2M1: A valid route, negative II chosen, only one empty square used, θ's balance.
2A1ft: improved solution (no extra zeros)
3M1ft: 6 shadow costs and precisely 3 improvement indices stated (no extra zeros)
3A1: cao.
4M1ft:A valid route, negative II chosen, only one empty square used, θ's balance.
4A1ft: improved solution (no extra zeros)
5A1=5M1: 6 shadow costs and precisely 3 improvement indices, (or 1 negative improvement index), stated (no extra zeros).

(c) 1B1ft=1A1ft: cao for conclusion, but must follow from at least one negative in a third 'set' of IIs.

Misreads for Q3b Not choosing most negative.

	A	B	C	D
X	18	31	4	
Y			18	29

		28	20	19	22
		A	B	C	D
0	X	x	x	x	-6
-5	Y	-8	-3	x	x

Either

Entering cell: XD

	A	B	C	D
X	18	31	4– θ	θ
Y			18+ θ	29– θ

Exiting cell: XC

θ =4

	A	B	C	D
X	18	31		4
Y			22	25

		28	20	13	16
		A	B	C	D
0	X	x	x	6	x
1	Y	-14	-9	x	x

Or

Entering cell: YB

	A	B	C	D
X	18	31- θ	4+ θ	
Y		θ	18- θ	29

Exiting cell: YC

θ = 18

	A	B	C	D
X	18	13	22	
Y		18		29

		28	20	19	25
		A	B	C	D
0	X	x	x	x	-9
-8	Y	-5	x	3	x

Candidates can get

2M1 2A1 for first route and the improved solution

3M1 3A0 – 6 shadow costs and 3 IIs

4M1 for finding a valid route and 4A1 if their route leads to an improved solution

[A0 – 6 shadow costs and 3 IIs but it is CAO]

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Notes for Question 4

Throughout section (a):

- **Condone lack of destination column and/or reversed stage numbers throughout.**
- **Only penalise incorrect result in Value – ie ignore working values.**
- **Penalise absence of state or action column with first two A marks earned only**
- **Penalise empty/errors in stage column with first A mark earned only.**

(a) 1M1: First, T, stage complete and working backwards.
1A1: CAO (condone lack of *)
2M1: Second stage completed. Penalise reversed states here and in (b). Bod if something in each column.
2A1: Any 2 states correct. Penalise * errors, with an A mark, only once in the question).
3A1: All 3 states correct. (Penalise * errors only once in the question).
3M1: 3rd and 4th stages completed. Bod if something in each column.
4A1ft: Any 2 states correct. (Penalise * errors only once in the question). A, B or C
5A1ft: All 3 states correct. (Penalise * errors only once in the question). A, B and C.
6A1ft: Final, S, state correct. (Penalise * errors only once in the question).

(b) 1M1: Route (S to T or vv.) and cost stated
1A1ft: CAO (Penalise reversed states here)

(c) 1M1: Sum of four arcs /4 (do not isw here if they 'add' to this method)
1A1: CAO (32 500 gets both marks)

Special cases (and misreads)

SC1 Maximin: treat as misread. **MAX 11/13**

SC2 Maximum: 1M1,1A1; 2M0; 3M1,4A1ft,5A0,6A1ft, M1A1ft M1A1ft **MAX 9/13**

SC3 Minimum: Marks awarded as above SC2

SC4 Maximax: 1M1,1A1; 2M0; 3M1,4A0,5A0,6A0,M1A1ft M1A1ft **MAX 7/13**

SC5 Minimin: Marks awarded as above SC4

SC6 Working forwards:
1M1,1A0; 2M0; 3M1,4A0,5A0,6A0,M1A1ft M1A1ft **MAX6/13**

Anything else annotate and send to review.

Q4 Misreads

SC 1 Maximin

Stage	State	Action	Dest	Value
1	G	GT	T	17*
	H	HT	T	21*
	I	IT	T	29*
2	D	DG	G	min(22, 17) = 17
		DH	H	min(31, 21) = 21*
	E	EH	H	min(34, 21) = 21
		EI	I	min(39, 29) = 29*
	F	FI	I	min(52, 29) = 29*
3	A	AD	D	min(41, 21) = 21
		AE	E	min(38, 29) = 29*
	B	BE	E	min(44, 29) = 29*
	C	CE	E	min(36, 29) = 29*
		CF	F	min(35, 29) = 29*
4	S	SA	A	min(37, 29) = 29*
		SB	B	min(39, 29) = 29*
		SC	C	min(41, 29) = 29*

SC 2 Maximum route

Stage	State	Action	Dest	Value
1	G	GT	T	17*
	H	HT	T	21*
	I	IT	T	29*
2	D	DG	G	22 + 17 = 39
		DH	H	31 + 21 = 52*
	E	EH	H	34 + 21 = 55
		EI	I	39 + 29 = 68*
	F	FI	I	52 + 29 = 81*
3	A	AD	D	41 + 52 = 93
		AE	E	38 + 68 = 106*
	B	BE	E	44 + 68 = 112*
	C	CE	E	36 + 68 = 104
		CF	F	35 + 81 = 116*
4	S	SA	A	37 + 106 = 143
		SB	B	39 + 112 = 151
		SC	C	41 + 116 = 157*

Route: SCFIT

SC3 Minimum route

Stage	State	Action	Dest	Value
1	G	GT	T	17*
	H	HT	T	21*
	I	IT	T	29*
2	D	DG	G	22 + 17 = 39*
		DH	H	31 + 21 = 52
	E	EH	H	34 + 21 = 55*
		EI	I	39 + 29 = 68
	F	FI	I	52 + 29 = 81*
3	A	AD	D	41 + 39 = 80*
		AE	E	38 + 55 = 93
	B	BE	E	44 + 55 = 99*
	C	CE	E	36 + 55 = 91*
		CF	F	35 + 81 = 116
4	S	SA	A	37 + 80 = 117*
		SB	B	39 + 99 = 138
		SC	C	41 + 91 = 132

Route: SADGT

SC 4 Maximax route

Stage	State	Action	Dest.	Value
	G	GT	T	17*
1	H	HT	T	21*
	I	IT	T	29*
2	D	DG	G	max(22, 17) = 22
		DH	H	max(31, 21) = 31*
	E	EH	H	max(34, 21) = 34
		EI	I	max(39, 29) = 39*
	F	FI	I	max(52, 29) = 52*
3	A	AD	D	max(41, 31) = 41
		AE	E	max(38, 39) = 39*
	B	BE	E	max(44, 39) = 44*
	C	CE	E	max(36, 39) = 39
		CF	F	max(35, 52) = 52*
4	S	SA	A	max(37, 39) = 39
		SB	B	max(39, 44) = 44
		SC	C	max(41, 52) = 52*

Route SCFIT

SC 5 Minimin

Stage	State	Action	Dest	Value
1	G	GT	T	17*
	H	HT	T	21*
	I	IT	T	29*
2	D	DG	G	min(22, 17) = 17*
		DH	H	min(31, 21) = 21
	E	EH	H	min(34, 21) = 21*
		EI	I	min(39, 29) = 29
	F	FI	I	min(52, 29) = 29*
3	A	AD	D	min(41, 17) = 17*
		AE	E	min(38, 21) = 21
	B	BE	E	min(44, 21) = 21*
	C	CE	E	min(36, 21) = 21*
		CF	F	min(35, 29) = 29
4	S	SA	A	min(37, 17) = 17*
		SB	B	min(39, 21) = 21
		SC	C	min(41, 21) = 21

Route SADGT

SC 6 Working forwards S to T

Stage	State	Action	Dest	Value
1	A	AS	S	37*
	B	BS	S	39*
	C	CS	S	41*
	D	DA	A	max(41, 37) = 41*
	E	EA	A	max(38, 37) = 38*
		EB	B	max(44, 39) = 44
		EC	C	max(36, 41) = 41
	F	FC	C	max(35, 41) = 41*
3	G	GD	D	max(22, 41) = 41*
	H	HD	D	max(31, 41) = 41
		HE	E	max(34, 38) = 38*
	I	IE	E	max(39, 38) = 39*
		IF	F	max(52, 41) = 52
4	T	TG	G	max(17, 41) = 41
		TH	H	max(21, 38) = 38*
		TI	I	max(29, 39) = 39

Route SAEHT

Q6b Misreads Alternative 1

Increasing x first,

b.v.	x	y	z	r	s	t	value	row ops
r	0	1	2	1	0	0	24	R_1 no change
x	1	$\frac{1}{2}$	2	0	$\frac{1}{2}$	0	14	$R_2 \div 2$
t	0	1	5	0	$\frac{1}{2}$	1	36	$R_3 + R_2$
P	0	$-\frac{3}{2}$	–4	0	$\frac{1}{2}$	0	14	$R_4 + R_2$

then y next

b.v.	x	y	z	r	s	t	value	row ops
y	0	1	2	1	0	0	24	$R_1 \div 1$
x	1	0	1	$-\frac{1}{2}$	$\frac{1}{2}$	0	2	$R_2 - \frac{1}{2}R_1$
t	0	0	3	–1	$\frac{1}{2}$	1	12	$R_3 - R_1$
P	0	0	–1	$\frac{3}{2}$	$\frac{1}{2}$	1	50	$R_4 + \frac{3}{2}R_1$

then z.

b.v.	x	y	z	r	s	t	value	row ops
y	-2	1	0	2	-1	0	20	$R_1 - 2R_2$
z	1	0	1	$-\frac{1}{2}$	$\frac{1}{2}$	0	2	$R_2 \div 2$
t	-3	0	0	$\frac{1}{2}$	-1	1	6	$R_3 - 3R_2$
P	0	0	0	1	1	1	52	$R_4 + R_2$

Q6b Misreads Alternative 2

Increasing x first

b.v.	x	y	z	r	s	t	value	row ops
r	0	1	2	1	0	0	24	R_1 no change
x	1	$\frac{1}{2}$	2	0	$\frac{1}{2}$	0	14	$R_2 \div 2$
t	0	1	5	0	$\frac{1}{2}$	1	36	$R_3 + R_2$
P	0	$-\frac{3}{2}$	–4	0	$\frac{1}{2}$	0	14	$R_4 + R_2$

Increasing z next

b.v.	x	y	z	r	s	t	value	row ops
r	-1	$\frac{1}{2}$	0	1	$-\frac{1}{2}$	0	10	$R_1 - 2R_2$
z	$\frac{1}{2}$	$\frac{1}{4}$	1	0	$\frac{1}{4}$	0	7	$R_2 \div 2$
t	$-\frac{5}{2}$	$-\frac{1}{4}$	0	0	$\frac{3}{4}$	1	1	$R_3 - 5R_2$
P	2	$-\frac{1}{2}$	0	0	$\frac{3}{2}$	0	42	$R_4 + 4R_2$

then increasing y

b.v.	x	y	z	r	s	t	value	row ops
y	-2	1	0	2	-1	0	20	$R_1 \div \frac{1}{2}$
z	1	0	1	$-\frac{1}{2}$	$\frac{1}{2}$	0	2	$R_2 - \frac{1}{4}R_1$
t	-3	0	0	$\frac{1}{2}$	-1	1	6	$R_3 + \frac{1}{4}R_1$
P	1	0	0	1	1	0	52	$R_4 + \frac{1}{2}R_1$

Q6b Misreads Alternative 3

Increasing y first

b.v.	x	y	z	r	s	t	value	row ops
y	0	1	2	1	0	0	24	$R_1 \div 1$
s	2	0	2	-1	1	0	4	$R_2 - R_1$
t	-1	0	2	$-\frac{1}{2}$	0	1	10	$R_3 - \frac{1}{2}R_1$
P	-1	0	-2	2	0	0	48	$R_4 + 2R_1$

Increasing x next

b.v.	x	y	z	r	s	t	value	row ops
y	0	1	2	1	0	0	24	R_1 no changw
x	1	0	1	$-\frac{1}{2}$	$\frac{1}{2}$	0	2	$R_2 \div 2$
t	0	0	3	-1	$\frac{1}{2}$	1	12	$R_3 - 3R_2$
P	0	0	-1	$\frac{3}{2}$	$\frac{1}{2}$	0	50	$R_4 + R_2$

then increasing z

b.v.	x	y	z	r	s	t	value	row ops
y	-2	1	0	2	-1	0	20	$R_1 - 2R_2$
z	1	0	1	$-\frac{1}{2}$	$\frac{1}{2}$	0	2	$R_2 \div 1$
t	-3	0	0	$\frac{1}{2}$	-1	1	6	$R_3 + R_2$
P	1	0	0	1	1	0	52	$R_4 + R_2$

Q6b Misreads Alternative 4

Increasing *y* first

b.v.	*x*	*y*	*z*	*r*	*s*	*t*	value	row ops
y	0	1	2	1	0	0	24	$R_1 \div 1$
s	2	0	2	-1	1	0	4	$R_2 - R_1$
t	-1	0	2	$-\frac{1}{2}$	0	1	10	$R_3 - \frac{1}{2}R_1$
P	-1	0	-2	2	0	0	48	$R_4 + 2R_1$

Increasing *z* next

b.v.	*x*	*y*	*z*	*r*	*s*	*t*	value	row ops
y	-2	1	0	2	-1	0	20	$R_1 - 2R_2$
z	1	0	1	$-\frac{1}{2}$	$\frac{1}{2}$	0	2	$R_2 \div 2$
t	-3	0	0	$\frac{1}{2}$	-1	1	6	$R_3 - 2R_2$
P	1	0	0	1	1	0	52	$R_4 + 2R_2$

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