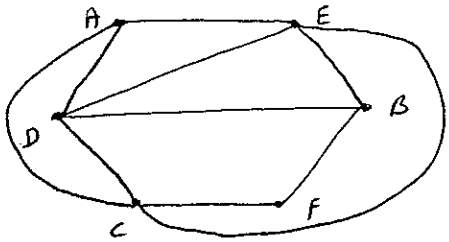
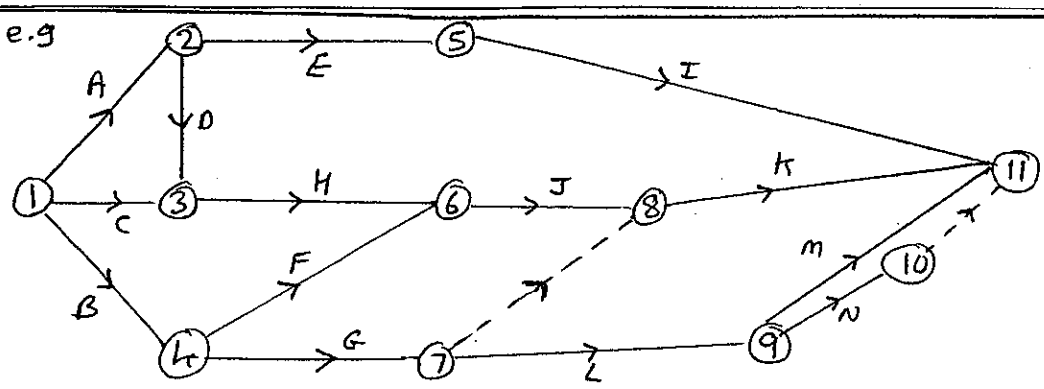
Publication Scheme.

edexcel

June 2005
6689 Decision D1
Mark Scheme

Question Number	Scheme	Marks
1)	e.g. 74 28 63 54 (54) 49 37 68 — 54 74 63 (54) 68 [54] 28 (49) 37 — 54 49 74 (63) 68 [54] [49] 28 (37) — 63 37 74 (68) [63] [37] (28) — 68 (28) (74) [68] [28] 74 68 63 54 54 49 37 28 sort complete ∴ Ali, Sophie, Eun-Jung, {Katie + Marciana}, Peter, Rory, Bobby	m1 A1 A1✓ A1 (4) A1 (1) [5]
2)(a)	e.g. A E B F C D A	m1 A1 (2)
(b)	e.g. 	m1 A1 A1 (3)
(c)	State that one of these arcs (AF or EF) [Named], crosses at least one arc in each set. [Named arcs]	B2,1,0 (2) [7]
3)(a)	AC + DF = 8 + 9 = 17 ← AD + CF = 15 + 16 = 31 AF + CD = 13 + 7 = 20 length = 77 + 17 = 94 km	m1 A1 A1 (3) m1 A1✓ (2)
(b)	shortest arc is CD (7) so use A and F as end points	B2,1,0 (2) [7]

4) (a) e.g.



m1
A1
A1
A1 (4)

(b) Reference to K, J, G and L – K depends on J and G, but L depends on G only
Both M and N must be uniquely represented in terms of events.

B2, 1, 0
B1 (3)
[7]

5) (a) E – 4 = B – 2 = D – 1 = A – 3 = C – 5 change status to give
matching A = 3 B = 2 C = 5 D = 1 E = 4

m1 A1
A1 (3)

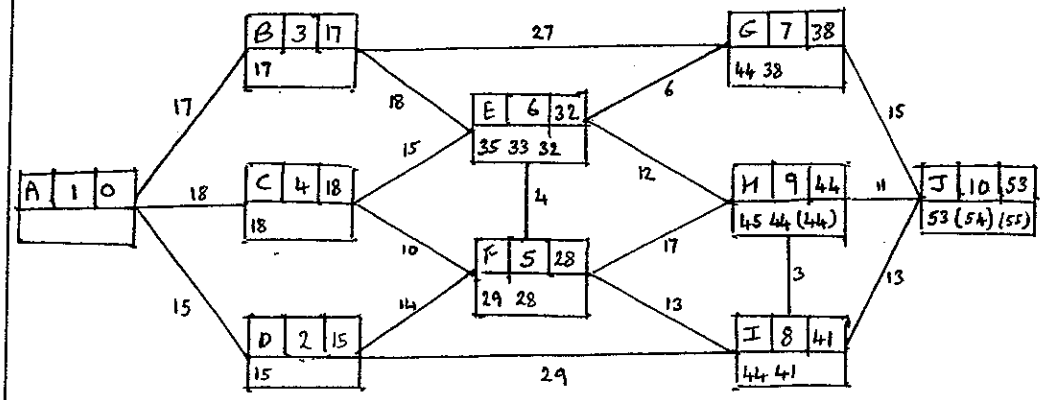
E – 4 = B – 2 = D – 3 = C – 5 change status to give
matching A = 1 B = 2 C = 5 D = 3 E = 4

m1 A1
A1 (3)

(b) e.g. Reference to B + E and 4 + 2

B2, 1, 0 (2)
[8]

6) (a)



Route: A C F E G J
Length: 53 km

m1
A1
A1✓
A1✓
A1 (5)

(b) General explanation – trace back from J
– Include arc XY if Y is already on path and if difference in final labels equals length of arc.

Specific explanation – 53 – 15 = 38 GJ
38 – 6 = 32 EG
32 – 4 = 28 FE
28 – 10 = 18 CF
18 – 18 = 0 AC

B2✓1✓0 (2)

(c) e.g. A D F E G J or A C E G J ; length 54 km

m1A1 ; A1 (3)
[10]

7) (a) r, s and t are unused amounts of bird seed (in kg), suet blocks and peanuts (in kg) that Polly has at the end of each week after she has made up and sold her packs.

B2, 1, 0 (2)

(b)

b.v.	x	y	z	r	s	t	value	
z	$\frac{2}{5}$	$\frac{1}{2}$	1	$\frac{1}{10}$	0	0	14	$R_1 \div 10$
s	$\frac{2}{5}$	-1	0	$-\frac{2}{5}$	1	0	4	$R_2 - 4R_1$
t	$-\frac{1}{5}$	$\frac{1}{2}$	0	$-\frac{3}{10}$	0	1	18	$R_3 - 3R_1$
P	-90	-25	0	65	0	0	9100	$R_4 + 650R_1$

M1 A1

M1

A2√, 1√, 0 (5)

(c) $x = 0$ $y = 0$ $z = 14$ $r = 0$ $s = 4$ $t = 18$ $P = £91$

M1 A2√1√0 (3)

(d) $P - 90x - 25y + 65r = 9100$ (o.e.)

M1 A1√

(e) $P = 9100 + 90x + 25y - 65r$

So increasing x or y would increase the profit

B1√ (3)

(f) The $\frac{2}{5}$ in the x column and 2nd (s) row.

B2√1√0 (2)

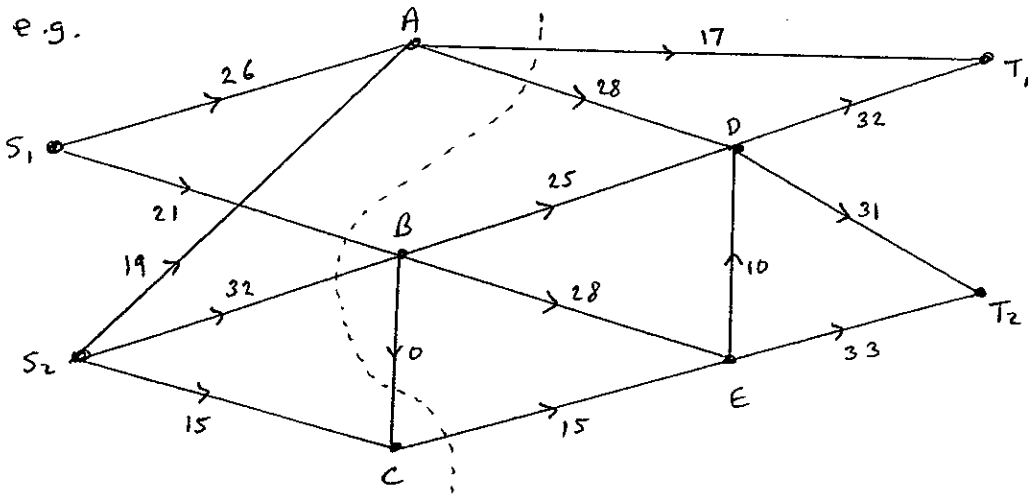
15

8 (a) $SS_1 - 47$, $SS_2 - 87$, $T_1T - 51$, $T_2T - 73$ added to diagram 1 — M1 A1 (2)

(b) $SS_1 \rightarrow 0$, $\leftarrow 47$; $SS_2 \rightarrow 38$, $\leftarrow 49$; $T_1T \rightarrow 8$, $\leftarrow 43$; $T_2T \rightarrow 20$, $\leftarrow 53$ — M1 A1 (2)

(c) e.g. SS_2ADT_1T — 2
SS_2CET_2T — 1
SS_2CEDT_2T — 10
SS_2CEBDT_1T — 4
maximum flow = 113 — M1 A4,3,2,1,0

(d) e.g.



B1 (6)

(e) max flow - min cut theorem; cut AT_1, AD, S_1B, S_2B, BC, CE — M1 A1 (2)

(f) Idea of a directed flow along arcs; from S to T; through a system; practical network — B2, 1, 0 (2)

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final scheme

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Q1 M1 Pivot clear list > [P] > . Bubble sort etc. M0

A1 1st pass correct, next pivot correctly selected consistently

A1✓ 2nd + 3rd passes correct, pivots for next pass selected consistently each time. Penalise fragmented list here (or list rewritten or all chosen as pivots)

A1 c.s.o. + stop statement (o.e.). Penalise non-sig no. error here. Penalise "sloppiness" here

A1 c.a.o. accept c.a. even if MR.

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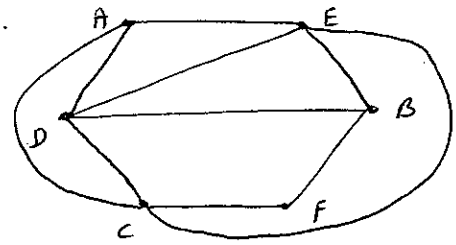
2)(a) e.g. A E B F C D A — M1 A1 (2)

(b) e.g.



M1 A1 A1 (3)

(c) State that one of these arcs (AF or EF) [Named], crosses at least one arc in each set. [Named arcs] — B2, 1, 0 (2)

[7]

Q2(a) M1 Each letter, written and present exactly once – apart from possibly start + finish vertex

A1 a correct route - starts and finishes at A

(b) M1 Cycle drawn as hexagon + at least 1 other arc added to diagram

A1 at least 2 arcs added to hexagon

A1 c.a.o.

(c) B2 Good explanation AF or EF crosses named "inside" arc + named "outside" arc.

B1✓ AF or EF crosses named arc. "close". 'bad' gets B1. If 1 carries visible on graph give bad

Q1 Alternative correct answer

(i) 74 28 63 54 (54) 49 37 68 — 54 — m1

74 (63) 68 [54] 28 54 (49) 37 — 63 49 — A1

74 (68) [63] | (54) [49] 28 (37) — 68 37 (54)

(74) [68] | [54] | [37] (28) — A1✓

(ii) 74 28 63 (54) 54 49 37 68 — 54 — m1

74 (63) 54 68 [54] 28 (49) 37 — 63 49 — A1

(74) 68 [63] (54) | [49] (28) 37 — 74 28 (54)

[74] (68) | [54] | (37) [28] — A1✓

(iii) 74 28 63 (54) 54 49 37 68 — 54 — m1

74 (63) 68 [54] 28 (54) 49 37 — 63, 54 — A1

(74) 68 [63] | [54] 28 (49) 37 — 74, 49

[74] (68) | | [49] (28) 37 — 28 (68)

| | | | (37) [28] — (37) — A1✓

pt in list

(iv) (74) 28 63 54 54 49 37 68 — 74 — m1

[74] (28) 63 54 54 49 37 68 — 28

(63) 54 54 49 37 68 [28] — 63 — A1✓

(68) [63] (54) 54 49 37 — (68) 54

[68] [54] (54) 49 37 — 54

[54] (49) 37 — 49

[49] (37) — (37) — A1

74 68 63 54 54 49 37 28

Ali, Sophie, Eun-Jing, Kate+Marciana, Peter, Rory, Bobby

Q1 MISREADS

-2 for mR

(a)

74	28	63	54	(54)	49	37	68	54		mR
28	54	(49)	37	[54]	74	(63)	68	49	63	m1
28	(37)	[49]	(54)		[63]	74	(68)	37	68 (54)	A1
(28)	[37]		[54]			[68]	(74)			A1✓

(b)

74	28	63	54	(54)	49	37	68	54	mR
28	(49)	37	[54]	74	63	(54)	68	49, 54	m1
28	(37)	[49]		[54]	74	(63)	68	37, 63	A1
(28)	[37]				[63]	74	(68)	68 (28)	
						[68]	(74)		A1✓

(c)

74	28	63	(54)	54	49	37	68	54	mR
28	(54)	49	37	[54]	74	(63)	68	54, 63	m1
28	(49)	37	[54]		[63]	(74)	68	49 74	A1
(28)	37	[49]				68	[74]	28	
[28]	(37)								A1✓

(d)

74	28	63	(54)	54	49	37	68	54	mR
28	(49)	37	(54)	74	(63)	54	68	49 63	m1
(28)	37	[49]		(54)	[63]	(74)	68	28, 74, (54)	A1
[28]	(37)			[54]		(68)	[74]		A1✓

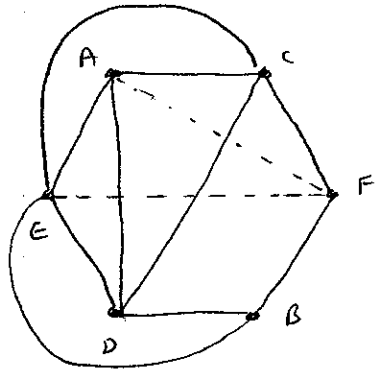
If candidates reverse list then restore full marks.
names or numbers

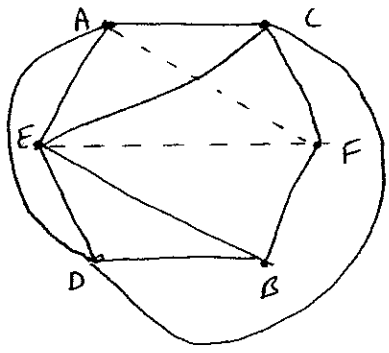
Bobby, Rory, Peter, Kate + Marciana, Eun-Jung, Sophie, Ali

Q2 Some eqp. Hamiltonian cycles + diagrams for Q2.

A C F B D E A

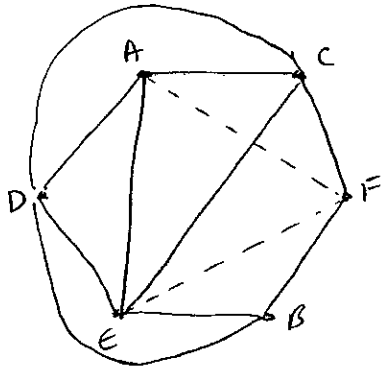
A E D B F C A

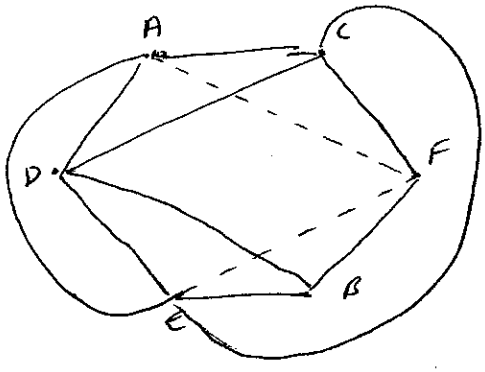




A C F B E D A

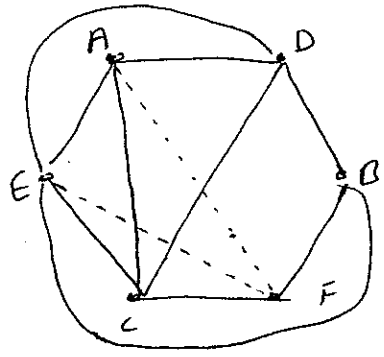
A D E B F C A

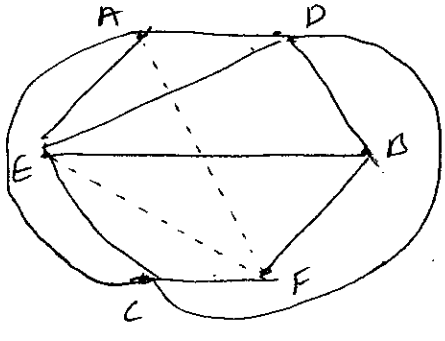




A D B F C E A

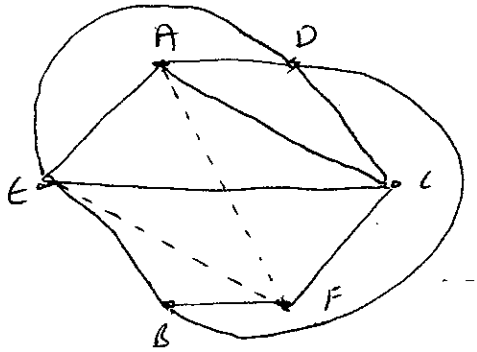
A E C F B D A

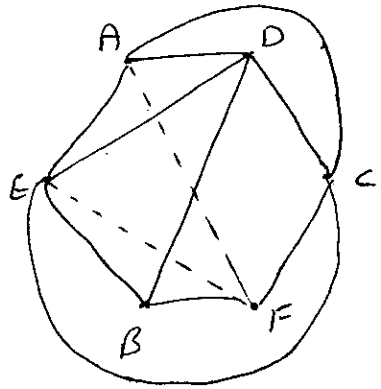




A D C F B E A

A E B F C D A





3)(a) AC + DF = 8 + 9 = 17 ←
AD + CF = 15 + 16 = 31
AF + CD = 13 + 7 = 20
length = 77 + 17 = 94 km

M1 A1
A1 (3)

M1 A1√ (2)

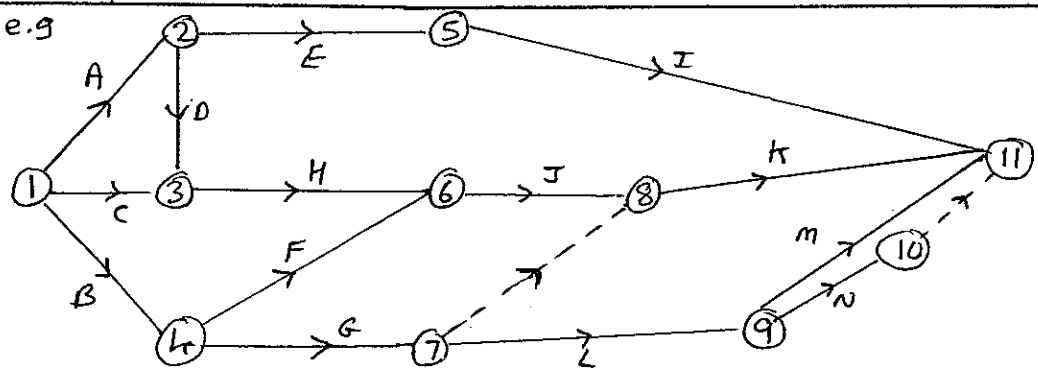
(b) Shortest arc is CD (7) so use A and F as end points

B2, 1, 0 (2)
7

Q3(a) M1 3 pairs of 4 odd vertices (different) ACDF
A1 2 pairs + "totals" correct
A1 All 3 pairs + totals correct 17 31 20
M1 77 + their shortest or plausible list
A1√ cao + km

(b) B2 CD identified as the smallest arc to be repeated and A+F stated as end points
B1 either CD identified as the smallest arc to be repeated or A+F stated as end points. 'bod' gets B1 or picks smallest out of at least 4√ routes

4) (a) e.g.



M1
A1
A1
A1
(4)

(b) Reference to K, J, G and L – K depends on J and G, but L depends on G only
Both M and N must be uniquely represented in terms of events.

B2, 1, 0
B1 (3)
7

4 (a) M1 6 activities + 1 dummy, activity on arc. Condone lack of events throughout
A1 A – F + arrows + 1 start
A1 G – K + dummy "⑦–⑧" (ignore label on dummy) + arrows on dummy + other arrows (penalise once only)
A1 L – N + dummy + 1 finish "⑩–⑪" Note: dummy may be on M or N (ignore label on dummy) + arrows on dummy + other arrows (penalise once only)

(max 2 off for arrows)

(b) B2 Complete + clear K, J, G, L referred to explanation clear + correct
B1 Nearly there. "Bod" gets B1. All there but confused explanation / vague. KJGL referred to
B1 Unique representation (o.e.). Start + finish as same events.

5) (a)	$E-4=B-2=D-1=A-3=C-5$ change starts to give matching $A=3$ $B=2$ $C=5$ $D=1$ $E=4$	M1 A1 A1 (3)
	$E-4=B-2=D-3=C-5$ change starts to give matching $A=1$ $B=2$ $C=5$ $D=3$ $E=4$	M1 A1 A1 (3)
(b)	e.g. Reference to $B+E$ and $4+2$	B2, 1, 0 (2) [8]

Q5 (a) M1 1st path E to 5

A1 c.a.o + c.s.

A1 matching c.a.o must be clear, must ✓

M1 2nd path E to 5

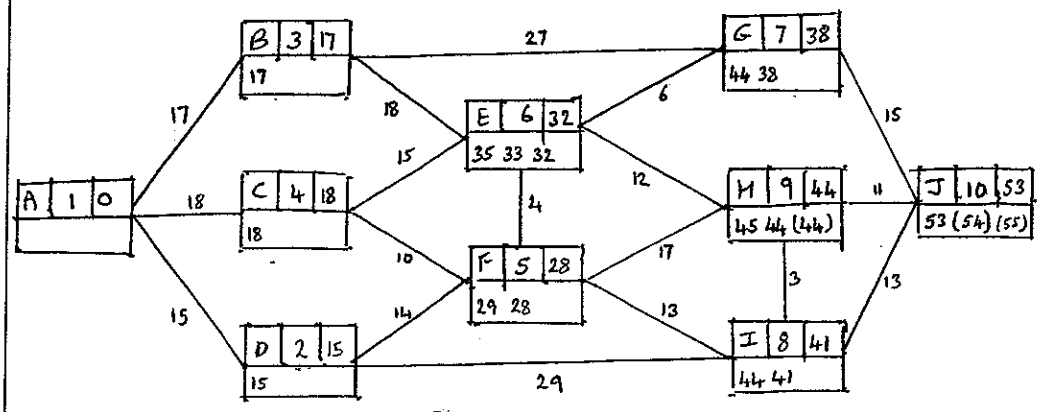
A1 c.a.o. + c.s. (don't penalise c.s. twice)

A1 matching c.a.o. must be clear, must ✓

(b) B2 Full clear explanation B, E, 2 and 4 listed. (+D) o.e - lots of alternatives

B1 Probably 3 out of 4 referred to, may be explanation confused, superfluous films or times introduced. "b.o.d gets B1"

6) (a)



Route: A C F E G J
length: 53 km

M1
A1
A1 ✓
A1 ✓
A1
(5)

(b) General explanation - trace back from J
- Include arc XY if Y is already on path and if difference in final labels equals length of arc.

Specific explanation -
53 − 15 = 38 G J
38 − 6 = 32 E G
32 − 4 = 28 F E
28 − 10 = 18 C F
18 − 18 = 0 A C

B2 / 1 / 0
(2)

(c) e.g. A D F E G J or A C E G J ; length 54 km

M1 A1 ; A1 (3)

10

6 (a) M1 In E or F or G or H or I w.v. large replaced by small . 1

A1 A, B, C, D, F correct (order in rising sequence)

A1 ✓ E G I correct + labelling order (penalise order of labelling only once)

A1 ✓ H, J correct + labelling (penalise order of labelling only once)

A1 Route + length (both) condone lack of km.

(b) B2 ✓ Complete version of one of the 2 given explanations

B1 ✓ All there bar one step. 'bad' gets B1

(c) M1 Route A to J avoiding C F

A1 c.a.o or a description

A1 54 (condone lack of km)

7) (a) r, s and t are unused amounts of bird seed (in kg), suet blocks and peanuts (in kgs) that Polly has at the end of each week after she has made up and sold her packs. B2,1,0 (2)

(b)

b.v.	x	y	z	r	s	t	value	
z	$\frac{2}{5}$	$\frac{1}{2}$	1	$\frac{1}{10}$	0	0	14	$R_1 \div 10$
s	$\frac{2}{5}$	-1	0	$-\frac{2}{5}$	1	0	4	$R_2 - 4R_1$
t	$-\frac{1}{5}$	$\frac{1}{2}$	0	$-\frac{3}{10}$	0	1	18	$R_3 - 3R_1$
P	-90	-25	0	65	0	0	9100	$R_4 + 650R_1$

m1 A1 m1 A2√, 1√, 0 (5)

(c) $x = 0$ $y = 0$ $z = 14$ $r = 0$ $s = 4$ $t = 18$ $P = £91$ m1 A2√1√0 (3)

(d) $P - 90x - 25y + 65r = 9100$ (o.e.) m1 A1√

(e) $P = 9100 + 90x + 25y - 65r$
So increasing x or y would increase the profit B1√ (3)

(f) The $\frac{2}{5}$ in the x column and 2nd (s) row. B2√1√, 0 (2)

15

7 (a) B2 Ref to "unused" & "bird seed, suet blocks & peanuts".
B1 Ref to "unused" or bird seed etc or muddled explanation. "bad" sets B1 must engage with context

(b) m1 correct pivot chosen
A1 pivot row correct c.a.o. incl b.v.
m1√ correct row operations used (all 3) - at least 1 non zero or 1 term correct in each row. Whole row √ ⇒ m0
A2√ non-pivoted rows correct; -1 each error √ on error in pivot choice only. Penalise b.v once only

(c) m1 3 variables stated - must have completed b.v. + value columns (or 1's and zeros) on tableau. Any negatives m0
A2√ all 7 c a o Need £91√ but accept 9100
A1√ at least 4 c a o (condone P=9100√)

(d) m1√ P, (-)90x, (-)25y, 65r and 9100 (or 91) all present and one = sign
A1√ c a o (o.e.)

(e) B1√ stating that increasing x or y would increase profit, probably re-arranging profit equation. Generous.

(f) B2√ $\frac{2}{5}$ identified, x column and 2nd (s) row. Accept ringed in last tableau
B1√ 'bad' sets B1, If √ from their "optimal" tableau B1,

Q 7(b) notes

1) Wrong pivot chosen in col z. (- usually 4) M0 then for M1 A2✓

(a) (chain)

b.v.	x	y	z	r	s	t	value	
r	-1	$2\frac{1}{2}$	0	1	$-2\frac{1}{2}$	0	-10	$R_1 - 10R_2$
z	$\frac{1}{2}$	$\frac{1}{4}$	1	0	$\frac{1}{4}$	0	15	$R_2 \div 4$
t	$-\frac{1}{2}$	$(1\frac{1}{4})$	0	0	$-\frac{3}{4}$	1	15	$R_3 - 3R_2$
P	-25	$-187\frac{1}{2}$	0	0	$162\frac{1}{2}$	0	9750	$R_4 + 650R_2$

(b) (chains)

b.v.	x	y	z	r	s	t	value	
r	$\frac{2}{3}$	$-1\frac{2}{3}$	0	1	0	$-\frac{10}{3}$	-60	$R_1 - 10R_3$
s	$\frac{2}{3}$	$-1\frac{2}{3}$	0	0	1	$-\frac{4}{3}$	-20	$R_2 - 4R_3$
z	$(\frac{1}{3})$	$\frac{2}{3}$	1	0	0	$\frac{1}{3}$	20	$R_3 \div 3$
P	$-133\frac{1}{3}$	$83\frac{1}{3}$	0	0	0	$216\frac{2}{3}$	13000	$R_4 + 650R_3$

2) MISREADS - use col x or col y — −2A marks if earned.

(a)

b.v.	x	y	z	r	s	t	value	
r	0	(3)	2	1	-2	0	20	$R_1 - 4R_2$
x	1	$\frac{1}{2}$	2	0	$\frac{1}{2}$	0	30	$R_2 \div 2$
t	0	$1\frac{1}{2}$	1	0	$-\frac{1}{2}$	1	30	$R_3 - R_2$
P	0	-175	50	0	175	0	10500	$R_4 + 350R_2$

(b)

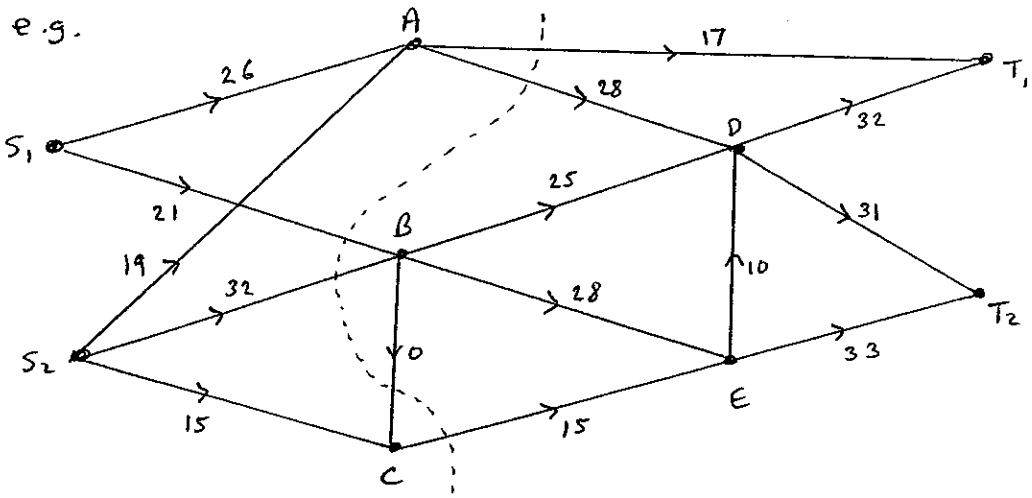
b.v.	x	y	z	r	s	t	value	
y	$\frac{4}{5}$	1	2	$\frac{1}{5}$	0	0	28	$R_1 \div 5$
s	$(1\frac{1}{5})$	0	2	$-\frac{1}{5}$	1	0	32	$R_2 - R_1$
t	$-\frac{3}{5}$	0	-1	$-\frac{2}{5}$	0	1	4	$R_3 - 2R_1$
P	-70	0	50	70	0	0	9800	$R_4 + 350R_1$

8 (a) $SS_1 - 47$, $SS_2 - 87$, $T_1T - 51$, $T_2T - 73$ added to diagram 1 — M1 A1 (2)

(b) $SS_1 \rightarrow 0$, $\leftarrow 47$; $SS_2 \rightarrow 38$, $\leftarrow 49$; $T_1T \rightarrow 8$, $\leftarrow 43$; $T_2T \rightarrow 20$, $\leftarrow 53$ — M1 A1 (2)

(c) e.g. SS_2ADT_1T — 2
SS_2CET_2T — 1
SS_2CEDT_2T — 10
SS_2CEBDT_1T — 4
maximum flow = 113 — M1 A4, 3, 2, 1, 0

(d) e.g.



B1 (6)

(e) max flow - min cut theorem; cut AT_1, AD, S_1B, S_2B, BC, CE — M1 A1 (2)

(f) Idea of a directed flow along arcs; from S to T; through a (network) system; practical — B2, 1, 0 (2)

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8(a) M1 4 ars added correctly + 4 numbers given (diagram 1 only) Condone lack of arrows
If all 4 nos. zero then M0

A1 c.a.o (diagram 1 only) penalise arrow errors here

(b) M1 4 arcs, 2 numbers and 2 arrows $\rightleftarrows$ per arc

A1 c.a.o.

(c) M1 2 correct routes + flows found (flow > 10 gets M0) (condone initial f. a. routes only if clearly repeated from new ones.)

A4 all flows + routes found to 17 more.

A3 ≥3 flows + routes to 15 more or flow increased above 17 more.

A2 ≥3 flows + routes to 11 more or

A1 at least 2 flows + routes found to 5 more.

B1 113 c.a.o.

(d) M1 Consistent flow of 101+, complete clear (doesn't need to √ from (c))

A1 correct flow of 113 including arrows

(e) M1 Flow of 113 + cut attempted + max flow - min cut theorem referred to (3 out of 4)

A1 c a o

(f) B2 all 4 bits there

B1 2 out of 4 there.