GCE Examinations Advanced Subsidiary / Advanced Level

Decision Mathematics Module D1

Paper F MARKING GUIDE

This guide is intended to be as helpful as possible to teachers by providing concise solutions and indicating how marks should be awarded. There are obviously alternative methods that would also gain full marks.

Method marks (M) are awarded for knowing and using a method.

Accuracy marks (A) can only be awarded when a correct method has been used.

(B) marks are independent of method marks.



Written by Shaun Armstrong & Dave Hayes © Solomon Press

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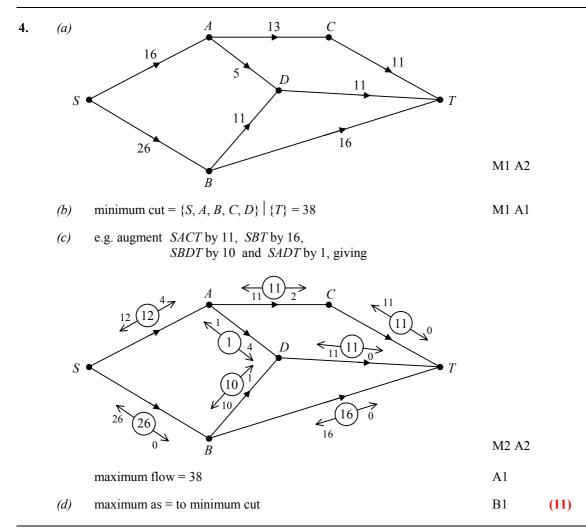
D1 Paper F – Marking Guide

1.	(a)	list of 14 names \therefore mid-point = 8 th = KINCARDINE PENICUIK is after this alphabetically so reduced list is:		
		LARGS MALLAIG MONTROSE PENICUIK ST. ANDREWS THURSO		
		list of 6 names \therefore mid-point = 4 th = PENICUIK \therefore found	M2 A1	
	(b)	list of 14 names \therefore mid-point = 8 th = KINCARDINE PENDINE is after this alphabetically so reduced list is:		
		LARGS MALLAIG MONTROSE PENICUIK ST. ANDREWS THURSO		
		list of 6 names \therefore mid-point = 4 th = PENICUIK PENDINE is before this alphabetically so reduced list is:		
		LARGS MALLAIG MONTROSE		
		list of 3 names \therefore mid-point = 2^{nd} = MALLAIG PENDINE is after this alphabetically so reduced list is:		
		MONTROSE list of 1 name, not PENDINE : not in list	M2 A1	
	(c)	it means each new list is at most half of previous list	B1	(7)
2.	(a)	total of lengths = 96 m; $96 \div 24 = 4$ \therefore least no. of rolls = 4	Al	
	(b)	by inspection we have: 14, 14, 12, 8, 8, 8, 6, 6, 6, 6, 4, 4		
		24		
		8 8 6		
		8 6		
		6		
		Bin 1 2 3 4 5		
		$\therefore 5 \text{ rolls needed}$	M2 A1	
	(c)	full-bins: $(14 + 6 + 4)$, $(14 + 6 + 4)$, $(12 + 6 + 6)$ and $(8 + 8 + 8)$	M1 A1	
	(d)	first-fit decreasing algorithm does not always give an optimal solution	B1	(7)

 $\begin{array}{ccc} (a) & P & & D \\ Q & & G \\ R & & E \\ S & & L(H) \\ T & & L \end{array}$ A1

3.

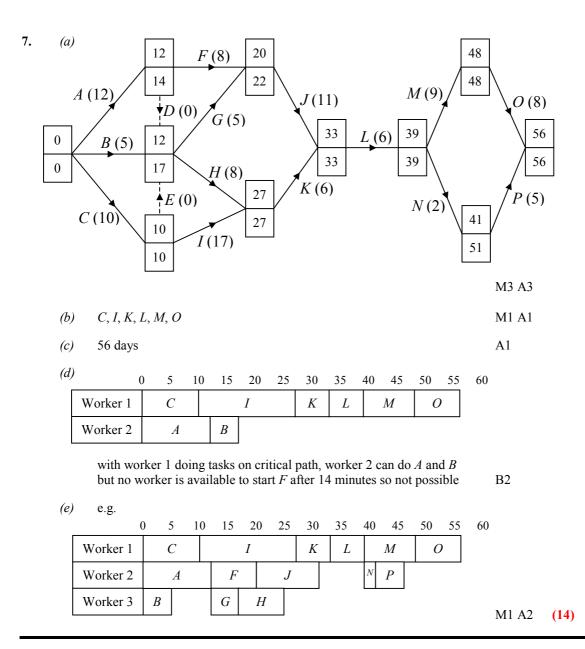
<i>(b)</i>	both <i>S</i> and <i>T</i> can only be linked with E , \therefore not possible	B1	
(c)	$P \longrightarrow D$		
	$Q \bullet G$		
	$R \bullet E$		
	S L(H)		
		A1	
(d)	initial matching shown by	B1	
(e)	search for alternating path giving e.g. $T - L$ (breakthrough)	M1 A1	
	change status giving $T = L$	M1	
	alternating path e.g. $Q - D = P - L(H)$ (breakthrough)	M1 A1	
	change status giving $Q = D - P = L(H)$	M1	
	complete matching e.g. $P - L(H)$, $Q - D$, $R - G$, $S - E$, $T - L$	A1	(11)



5. (

6.

(c) $\begin{bmatrix} x & a & b & (a-b) < 0.01? \\ N_0 & 50 & 26 & 14.923 & N_0 \\ - & 26 & 14.923 & 10.812 & N_0 \\ - & 10.812 & 10.0305 & N_0 \\ - & 10.00004 & 10 & Yes \end{bmatrix}$ Final Output = 10 M2 A4 (b) it finds the square root of 100 B1 (c) $\begin{bmatrix} x & a & b & (a-b) < 0.01? \\ 100 & 5 & 12.5 & (a-b) < 0.01? \\ Yes \end{bmatrix}$ e.g. it stops instead of looping because $(a - b)$ becomes negative A1 B1 (d) $a \ge 10$ A2 (11) (a) $let x = no.$ of children and $y = no.$ of adults maximise $R = 50x + 100y$ $y \le 40$ $7x + 5y \le 600$ $2x + 6y \le 300$ $(x + 3y \le 150)$ $x \ge 0, y \ge 0$ M2 A2 (b) $y \frac{100}{10} 100$	(a)						
$\begin{vmatrix} - & 26 & 14.923 & No \\ - & 14.923 & 10.812 & No \\ - & 10.812 & 10.0305 & No \\ - & 10.0305 & 10.00004 & No \\ - & 10.0004 & 10 & Nc \\ - & 10.0004 & Nc & 10 \\ - & 10.0004 & $		x a	b	(a-b) < 0.01?			
$\begin{vmatrix} - & 14.923 & 10.812 & N_0 \\ - & 10.0305 & 10.0004 & N_0 \\ - & 10.0004 & 10 & Yes \end{vmatrix}$ Final Output = 10 M2 A4 (b) it finds the square root of 100 B1 (c) $\begin{vmatrix} x & a & b & (a-b) < 0.017 \\ 100 & 5 & 12.5 & Yes \end{vmatrix}$ e.g. it stops instead of looping because $(a - b)$ becomes negative A1 B1 (d) $a \ge 10$ A2 (11) (a) let $x = no.$ of children and $y = no.$ of adults maximise $R = 50x + 100y$ subject to $x + y \le 90$ $y \le 40$ $7x + 5y \le 600$ $2x + 6y \le 300$ $(x + 3y \le 150)$ M2 A2 (b) $100 + 5x + y \le 90$ $y \le 40$ $7x + 5y \le 600$ $2x + 6y \le 300$ $(x + 3y \le 150)$ M2 A2 (c) considering vertices / lines of constant revenue maximum R where $x + y = 90$ meets $x + 3y = 150$ giving $x = 60, y = 30$ \therefore should accept 60 children and 30 adults giving revenue of £6000 M2 A2				No			
$\begin{vmatrix} - & 10.812 & 10.0305 & N_0 \\ - & 10.0305 & 10.0004 & N_0 \\ - & 10.0004 & 10 & Yes \end{vmatrix}$ Final Output = 10 M2 A4 (b) it finds the square root of 100 B1 (c) $\begin{vmatrix} x & a & b & (a-b) < 0.01? \\ 100 & 5 & 12.5 & (a-b) < 0.01? \\ Yes \end{vmatrix}$ e.g. it stops instead of looping because $(a - b)$ becomes negative A1 B1 (d) $a \ge 10$ A2 (11) (a) let $x = no$. of children and $y = no$. of adults maximise $R = 50x + 100y$ $y \le 40$ $7x + 5y \le 600$ $2x + 6y \le 300$ $(x + 3y \le 150)$ $x \ge 0, y \ge 0$ M2 A2 (b) $\sqrt{100} \sqrt{100} \sqrt{100}$							
$\begin{vmatrix} - & 10.0305 & 10.0004 & No \\ - & 10.0004 & 10 & Yes \end{vmatrix}$ Final Output = 10 M2 A4 (b) it finds the square root of 100 B1 (c) $\begin{vmatrix} x & a & b & (a-b) < 0.017 \\ 100 & 5 & 12.5 & Yes \end{vmatrix}$ e.g. it stops instead of looping because $(a - b)$ becomes negative A1 B1 (d) $a \ge 10$ A2 (11) (a) let $x = no.$ of children and $y = no.$ of adults maximise $R = 50x + 100y$ subject to $x + y \le 90$ $y \le 40$ $7x + 5y \le 600$ $2x + 6y \le 300 (x + 3y \le 150)$ $x \ge 0, y \ge 0$ M2 A2 (b) $100 + 50 + 500 + 5$							
$\begin{vmatrix} - & 10.0004 & 10 & Yes \end{vmatrix}$ Final Output = 10 M2 A4 (b) it finds the square root of 100 B1 $\begin{pmatrix} x & a & b & (a-b) < 0.01? \\ 100 & 5 & 12.5 & (a-b) < 0.01? \\ Yes \end{vmatrix}$ e.g. it stops instead of looping because $(a - b)$ becomes negative A1 B1 (d) $a \ge 10$ A2 (11) (a) let $x = n0$. of children and $y = n0$. of adults maximise $R = 50x + 100y$ $y \le 40$ $7x + 5y \le 600$ $2x + 6y \le 300$ $(x + 3y \le 150)$ $x \ge 0, y \ge 0$ M2 A2 (b) $100 + 100 +$							
Final Output = 10 M2 A4 (b) it finds the square root of 100 B1 (c) $\left \frac{x}{100} \right \frac{a}{5} \right \frac{b}{12.5} \left \frac{(a-b) < 0.01?}{Yes} \right $ e.g. it stops instead of looping because $(a - b)$ becomes negative A1 B1 (d) $a \ge 10$ A2 (11) (a) let $x = no.$ of children and $y = no.$ of adults maximize $R = 50x + 100y$ subject to $x + y \le 90$ $y \le 40$ $7x + 5y \le 600$ $2x + 6y \le 300 (x + 3y \le 150)$ $x \ge 0, y \ge 0$ M2 A2 (b) $\int_{0}^{10} \int_{0}^{10} $							
(b) it finds the square root of 100 B1 (c) $\frac{x}{100} = \frac{a}{5} = \frac{b}{12.5} = \frac{(a-b) < 0.01?}{Yes}$ is g. it stops instead of looping because $(a - b)$ becomes negative A1 B1 (d) $a \ge 10$ A2 (11) (a) let $x = no.$ of children and $y = no.$ of adults maximise $R = 50x + 100y$ subject to $x + y \le 90$ $y \le 40$ $7x + 5y \le 600$ $2x + 6y \le 300 (x + 3y \le 150)$ $x \ge 0, y \ge 0$ M2 A2 (b) $\sqrt{\frac{100}{100} \sqrt{\frac{100}{100} \sqrt{\frac{100}{100}$		- 10.00004	10	1 65			
(c) $\begin{vmatrix} x & a & b & a \\ 100 & 5 & 12.5 & (a-b) < 0.01? \\ Yes \\ yes \\ e g. it stops instead of looping because (a - b) becomes negative A1 B1(d) a \ge 10 A2 (11)(a) let x = no. of children and y = no. of adultsmaximise R = 50x + 100ysubject to x + y \le 90y \le 407x + 5y \le 6002x + 6y \le 300 (x + 3y \le 150), M2 A2(b) \sqrt{900}\sqrt$		Final Output = 10				M2 A4	
$\begin{vmatrix} x \\ 100 \end{vmatrix} = \frac{a}{5} \end{vmatrix} = \frac{b}{12.5} \end{vmatrix} (a - b) < 0.01? \\ Yes \end{vmatrix}$ e.g. it stops instead of looping because $(a - b)$ becomes negative A1 B1 (d) $a \ge 10$ A2 (11) (a) let $x = no.$ of children and $y = no.$ of adults maximise $R = 50x + 100y$ subject to $x + y \le 90$ $y \le 40$ $7x + 5y \le 600$ $2x + 6y \le 300 (x + 3y \le 150)$ M2 A2 (b) $\int_{0}^{100} \int_{0}^{100} \int_{0}^{10}$	<i>(b)</i>	it finds the square root of	100			B1	
$\begin{vmatrix} x \\ 100 \end{vmatrix} = \frac{a}{5} \end{vmatrix} = \frac{b}{12.5} \end{vmatrix} (a - b) < 0.01? \\ Yes \end{vmatrix}$ e.g. it stops instead of looping because $(a - b)$ becomes negative A1 B1 (d) $a \ge 10$ A2 (11) (a) let $x = no.$ of children and $y = no.$ of adults maximise $R = 50x + 100y$ subject to $x + y \le 90$ $y \le 40$ $7x + 5y \le 600$ $2x + 6y \le 300 (x + 3y \le 150)$ M2 A2 (b) $\int_{0}^{100} \int_{0}^{100} \int_{0}^{10}$	(c)						
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(d) $a \ge 10$ A2 (11) (a) let $x = n0$. of children and $y = n0$. of adults maximize $R = 50x + 100y$ subject to $x + y \le 90$ $y \le 40$ $7x + 5y \le 600$ $2x + 6y \le 300$ ($x + 3y \le 150$) $x \ge 0, y \ge 0$ M2 A2 (b) $\int_{0}^{10} \int_{0}^{10} \int_$		100 5	12.5	Yes			
(a) let $x = no.$ of children and $y = no.$ of adults maximise $R = 50x + 100y$ subject to $x + y \le 90$ $y \le 40$ $7x + 5y \le 600$ $2x + 6y \le 300 (x + 3y \le 150)$ $x \ge 0, y \ge 0$ M2 A2 (b) 120 1000 1000 1000 1000		e.g. it stops instead of loop	oing because	(a - b) becomes no	egative	A1 B1	
(a) let $x = no.$ of children and $y = no.$ of adults maximise $R = 50x + 100y$ subject to $x + y \le 90$ $y \le 40$ $7x + 5y \le 600$ $2x + 6y \le 300 (x + 3y \le 150)$ $x \ge 0, y \ge 0$ M2 A2 (b) 120 1000 1000 1000 1000	(d)	$a \ge 10$				Α2	(11)
maximize $k = 50k + 100y$ $y \le 40$ $7k + 5y \le 600$ $2x + 6y \le 300 (x + 3y \le 150)$ $x \ge 0, y \ge 0$ M2 A2 (0) $10^{-10^{-10^{-10^{-10^{-10^{-10^{-10^{-$	(4)	<i>u</i> = 10				112	(11)
subject to $x + y \le 90$ $y \le 40$ $7x + 5y \le 600$ $2x + 6y \le 300 (x + 3y \le 150)$ $x \ge 0, y \ge 0$ M2 A2 (b) 1000 100 100 100 100 100 1000 1000 100	(a)	let $x = no.$ of children and	y = no. of ad	ults			
subject to $x + y \le 90$ $y \le 40$ $7x + 5y \le 600$ $2x + 6y \le 300 (x + 3y \le 150)$ $x \ge 0, y \ge 0$ M2 A2 (b) 1000 100 100 100 100 100 1000 1000 100		maximize $P = 50x \pm 1$	00.				
$y \le 40 \\ 7x + 5y \le 600 \\ 2x + 6y \le 300 (x + 3y \le 150) \\ x \ge 0, y \ge 0$ M2 A2 $\begin{pmatrix} 0 \\ y \\ 10 \\ 10$			00 <i>y</i>				
$2x + 6y \le 300 (x + 3y \le 150) \\ x \ge 0, y \ge 0$ M2 A2 (b) $100 + 1$		$y \le 40$					
(b) 120^{-1} $120^{$				1.50)			
(b) 10^{-1}			$00 (x+3y \le$	150)		M2 A2	
(c) considering vertices / lines of constant revenue maximum R where $x + y = 90$ meets $x + 3y = 150$ giving $x = 60, y = 30$ \therefore should accept 60 children and 30 adults giving revenue of £6000 M2 A2		<i>x</i> = 0, <i>y</i> = 0				1012 / 12	
(c) considering vertices / lines of constant revenue maximum R where $x + y = 90$ meets $x + 3y = 150$ giving $x = 60, y = 30$ \therefore should accept 60 children and 30 adults giving revenue of £6000 M2 A2	<i>(b)</i>	120					
(c) considering vertices / lines of constant revenue maximum R where $x + y = 90$ meets $x + 3y = 150$ giving $x = 60, y = 30$ \therefore should accept 60 children and 30 adults giving revenue of £6000 M2 A2		y X					
(c) considering vertices / lines of constant revenue maximum R where $x + y = 90$ meets $x + 3y = 150$ giving $x = 60, y = 30$ \therefore should accept 60 children and 30 adults giving revenue of £6000 M2 A2							
(c) considering vertices / lines of constant revenue maximum R where $x + y = 90$ meets $x + 3y = 150$ giving $x = 60, y = 30$ \therefore should accept 60 children and 30 adults giving revenue of £6000 M2 A2		80					
(c) considering vertices / lines of constant revenue maximum R where $x + y = 90$ meets $x + 3y = 150$ giving $x = 60, y = 30$ \therefore should accept 60 children and 30 adults giving revenue of £6000 M2 A2							
(c) considering vertices / lines of constant revenue maximum R where $x + y = 90$ meets $x + 3y = 150$ giving $x = 60, y = 30$ \therefore should accept 60 children and 30 adults giving revenue of £6000 M2 A2		60					
(c) considering vertices / lines of constant revenue maximum R where $x + y = 90$ meets $x + 3y = 150$ giving $x = 60, y = 30$ \therefore should accept 60 children and 30 adults giving revenue of £6000 M2 A2							
(c) considering vertices / lines of constant revenue maximum R where $x + y = 90$ meets $x + 3y = 150$ giving $x = 60, y = 30$ \therefore should accept 60 children and 30 adults giving revenue of £6000 M2 A2		40	\mathbf{X}	<i>y</i> = 40			
(c) considering vertices / lines of constant revenue maximum R where $x + y = 90$ meets $x + 3y = 150$ giving $x = 60, y = 30$ \therefore should accept 60 children and 30 adults giving revenue of £6000 M2 A2			M-				
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		region		x + 3y = 150			
<i>x</i> B4 (c) considering vertices / lines of constant revenue maximum <i>R</i> where $x + y = 90$ meets $x + 3y = 150$ giving $x = 60, y = 30$ \therefore should accept 60 children and 30 adults giving revenue of £6000 M2 A2		0					
(c) considering vertices / lines of constant revenue maximum R where $x + y = 90$ meets $x + 3y = 150$ giving $x = 60, y = 30$ \therefore should accept 60 children and 30 adults giving revenue of £6000 M2 A2		0 20 40	60 80	100 120		B /	
maximum <i>R</i> where $x + y = 90$ meets $x + 3y = 150$ giving $x = 60, y = 30$ \therefore should accept 60 children and 30 adults giving revenue of £6000 M2 A2					л	т	
∴ should accept 60 children and 30 adults giving revenue of £6000 M2 A2	(c)				-60 = 30		
						M2 A2	
(a) no, as the windstitting restriction is not a factor in optimal solution B2 (14)	(1)	-					(14)
	(<i>a</i>)	no, as the windsurning rest	i iction is not	a factor in optimal	solution	D2	(14)



Total (75)

Performance Record – D1 Paper F

Question no.	1	2	3	4	5	6	7	Total
Topic(s)	binary search	bin packing	matching	flows	flow chart	linear prog. - graphical	critical path, schedul'g	
Marks	7	7	11	11	11	14	14	75
Student								