AS Further Mathematics 8FM0

Specimen Paper – Decision Mathematics 1 Mark Scheme

<table>
<tr><th>Question</th><th>Scheme</th><th>Marks</th><th>AOs</th></tr>
<tr><td>1(a)</td><td>(i)
<table>
<tr><td>n</td><td>A</td><td>B</td><td>C</td><td>Is B > 0?</td></tr>
<tr><td>6</td><td>1</td><td>4</td><td>4</td><td>–</td></tr>
<tr><td></td><td>2</td><td>3</td><td>11</td><td>Yes</td></tr>
<tr><td></td><td>3</td><td>2</td><td>19</td><td>Yes</td></tr>
<tr><td></td><td>4</td><td>1</td><td>26</td><td>Yes</td></tr>
<tr><td></td><td>5</td><td>0</td><td>30</td><td>No</td></tr>
</table>
(ii) Final output = 30</td><td>M1
A1
A1
A1</td><td>1.1b
1.1b
1.1b
1.1b</td></tr>
<tr><td></td><td></td><td>(4)</td><td></td></tr>
<tr><td>(b)</td><td>$\frac{1}{6}(6)^3+6k+1=30$
$k=-\frac{7}{6}$</td><td>M1
A1ft</td><td>3.1a
2.2a</td></tr>
<tr><td></td><td></td><td>(2)</td><td></td></tr>
<tr><td>(c)</td><td>Prim’s algorithm is of cubic order/has cubic complexity</td><td>B1</td><td>2.2b</td></tr>
<tr><td></td><td></td><td>(1)</td><td></td></tr>
<tr><td colspan="4">(7 marks)</td></tr>
<tr><td colspan="4">Notes:</td></tr>
<tr><td colspan="4">(a)(i)
M1: At least three rows of cells in columns A, B and C completed with a correct first row for A, B and C only
A1: Cao – second and third rows correct
A1: Cao – fourth and fifth rows correct
(ii)
A1: Cao (output = 30)
(b)
M1: Using f(n) with n = 6 and their final output
A1ft: Cao following through their final output
(c)
B1: Cao</td></tr>
</table>

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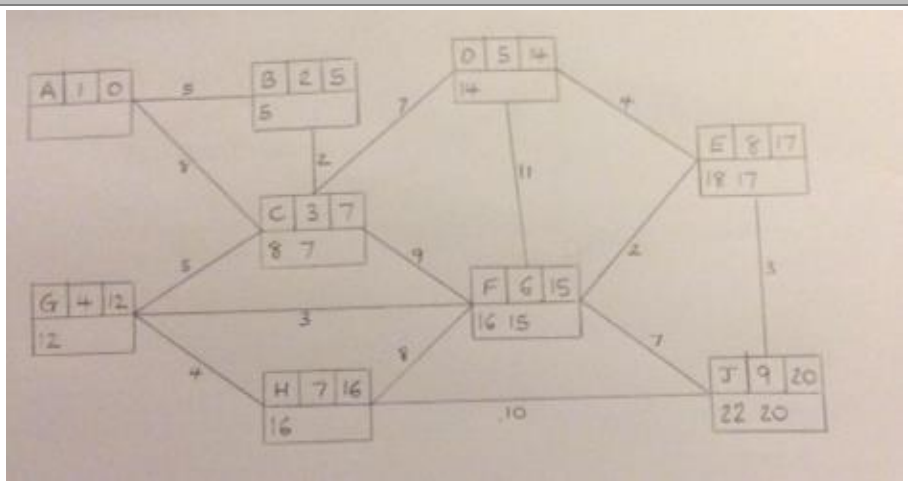
Question	Scheme	Marks	AOs
2(a) **(i)**		M1 A1 A1	1.1b 1.1b 1.1b
(ii)	Shortest path from A to J is ABCGFEJ Length of shortest path is 20	A1 A1ft	1.1b 1.1b
		(5)	
(b)	G(FE)D + EJ = 9 + 3 = 12 G(F)E + D(E)J = 5 + 7 = 12 G(FE)J + DE = 8 + 4 = 12 Repeat arcs: DE, EF, FG, EJ	M1 A1 A1 A1	3.1b 1.1b 1.1b 2.2a
		(4)	
(c)	Length of route = 88 + 6 + 12 = 106	B1ft	1.1b
		(1)	
			(10 marks)

Notes:

(a)(i)
M1: For a larger number replaced by a smaller one in the working values boxes at C, E, F or J
A1: For all values correct (and in correct order) at A, B, C, G and D
A1: For all values correct (and in correct order) at F, H, E and J
A1: Cao of ABCGFEJ
(ii) A1ft: Follow through their final value at J
(b)
M1: Three pairings of the correct four odd nodes
A1: Two pairings correct including correct totals
A1: All three pairings correct including correct totals
A1: Correct arcs to repeat (DE, EF, FG, EJ)
(c)

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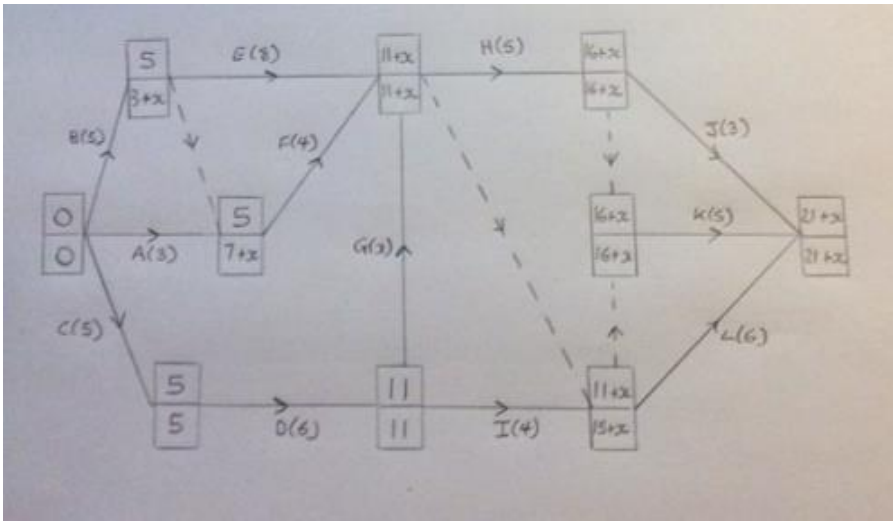
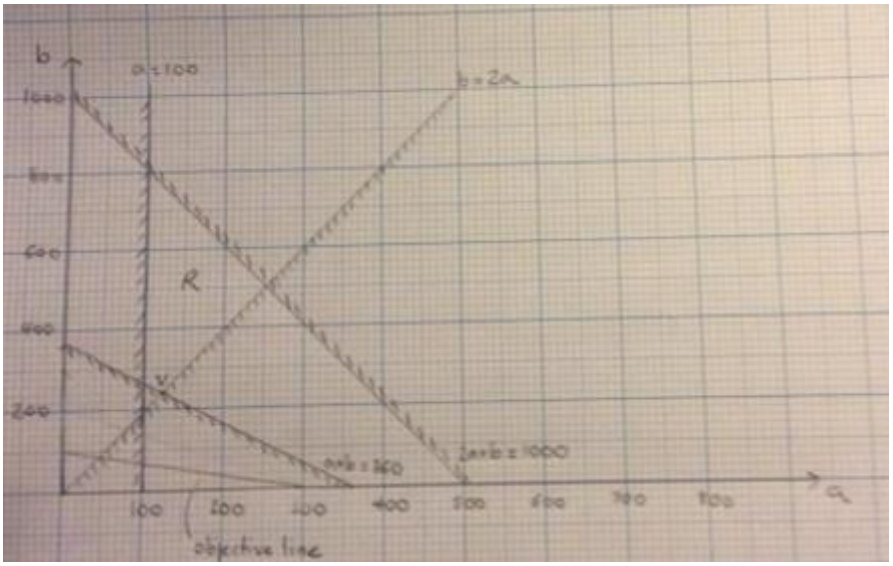
B1ft: Cao following through their smallest repeat (from a choice of at least two totals)

Question	Scheme	Marks	AOs
3(a)		M1 A1 M1 A1 **(4)**	1.1b 1.1b 1.1b 1.1b
(b)	Critical activities: C, D, G, H and K	B1	2.2a
		(1)	
(c)	Total float for activities A: $(7 + x) – 3$ E: $(11 + x) – 8 – 5$ $(4+x)+(x-2)=21+x$ $x=19$ Minimum completion time = $21 + x = 40$ days	B1ft M1 A1 A1	1.1b 2.1 1.1b 2.2a
		(4)	
			(9 marks)

Notes:

(a)
M1: top values generally increasing from left to right (dealing with *x* correctly at least twice)
A1: top values correct
M1: bottom values generally decreasing from right to left (dealing with *x* correctly at least twice)
A1: bottom values correct
(b)
B1: Cao
(c)
B1ft: One correct total float following through their values
M1: Constructing a correct equation using their total floats and minimum completion time (all three terms must include *x*)

A1: Cao (for x)
A1: Cao (minimum completion time)

Question	Scheme	Marks	AOs
4(a)	Let x be the number of lemon cakes the baker makes and let y be the number of cherry cakes the baker makes	B1	2.5
	Minimise $P = x + 3y$	B1	1.2
	Subject to		
	$x + y \geq 360$	B1	3.3
	$2x + y \leq 1000$	B1	3.3
	$y \geq 2x$	B1	3.3
	$x \geq 100$	B1	3.3
	$(y \geq 0)$		
		(6)	
(b)		B1	1.1b
	(Note to typesetters: change x-axis label to 'number of lemon cakes' and y-axis to 'number of cherry cakes')	B1	1.1b
		B1	1.1b
		B1	2.2a
	Objective line drawn or at least two vertices tested	M1	3.1a
	Solving correct simultaneous equations for their optimal vertex	M1	1.1a
	The baker should make 120 lemon cakes and 240 cherry cakes	A1	3.2a
		(7)	
(c)	$200 - \frac{2}{5}(120) - \frac{1}{5}(240) = £104$	B1ft	3.4
		(1)	

(14 marks)
Notes:
(a) **B1:** Defining variables **B1:** Cao (for objective) - must contain 'minimise' **B1:** Any one correct (accept any equivalent form for each constraint) **B1:** Any two correct **B1:** Any three correct **B1:** All four correct
(b) **B1:** Any two correct lines **B1:** Any three correct lines **B1:** All four correct lines **B1:** Deduce correct feasible region distinctly labelled **M1:** Selecting an appropriate mathematical process to solve the problem – either drawing an objective line with the correct gradient (or reciprocal gradient), or testing at least two vertices in R **M1:** Solving simultaneous equations for their optimal vertex **A1:** Cao (in context – so not in terms of e.g. x and y)
(c) **B1ft:** Using correct constraint with their optimal vertex