General Certificate of Education
Advanced Level Examination

MATHEMATICS A

Discrete 1

Paper A

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.

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D1 Paper A – Marking Guide

1. *(a)*

order: 4 3 5 1 2

	Durness	Helmsdale	Inverness	Thurso	Wick
~~Durness~~	–	(68)	~~123~~	~~81~~	~~92~~
~~Helmsdale~~	~~68~~	–	~~102~~	~~72~~	(64)
~~Inverness~~	~~123~~	(102)	–	~~148~~	~~127~~
~~Thurso~~	~~81~~	~~72~~	~~148~~	–	~~48~~
~~Wick~~	~~92~~	~~64~~	~~127~~	(48)	–

giving $T \overset{48}{—} W \overset{64}{—} H \overset{68}{—} D$, with I joined to H by 102

M2 A2

(b) 282 km A1 **(5)**

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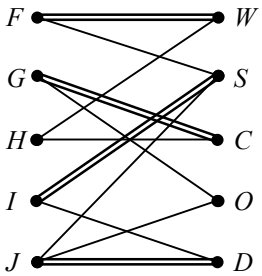
2. *(a)*



M1 A1

(b) initial matching shown by ═══

search for alternating path giving e.g. $H - C = G - O$ (breakthrough) M1 A1

change status giving $H = C - G = O$ M1

complete matching e.g. $F - W, G - O, H - C, I - S, J - D$ A1 **(6)**

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3. *(a)*

x	a	b	$(a - b) < 0.01$?
100	50	26	No
–	26	14.923	No
–	14.923	10.812	No
–	10.812	10.0305	No
–	10.0305	10.00004	No
–	10.00004	10	Yes

Final Output = 10 M2 A4

(b) it finds the square root of 100 B1 **(7)**

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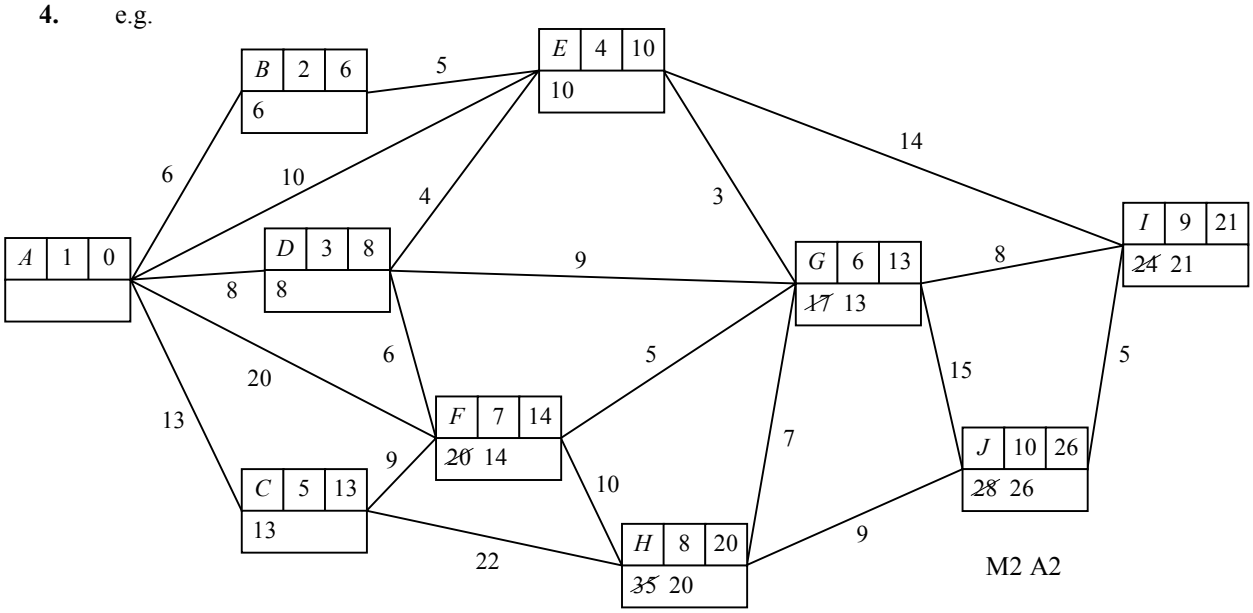
4. e.g.



M2 A2

label J – label I = 5 = weight IJ
label I – label G = 8 = weight GI
label G – label E = 3 = weight EG
label E – label A = 10 = weight AE M1
so $A\ E\ G\ I\ J$ is path of least weight; weight = 26 A2 **(7)**

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5. *(a)* e.g. there are 4 odd vertices, at each of these must arrive, leave and arrive again ∴ need to leave again to continue so must repeat B2

(b) odd vertices are C, F, H and I B1
shortest CF and HI = 132 + 134 = 266
CH and FI = 147 + 116 = 263
CI and FH = 233 + 72 = 305; ∴ lowest is 263 M1 A1
∴ should repeat CD, DH and FI A1
total = sum of all arcs + 263 = 902 + 263 = 1165 m M1 A1 **(8)**

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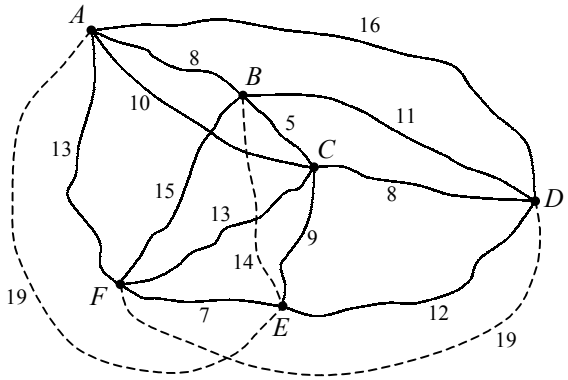
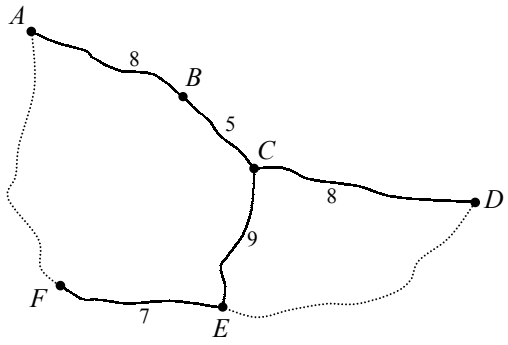
6. *(a)*



add $AE - 19$, $BE - 14$, $DF - 19$ M1 A1

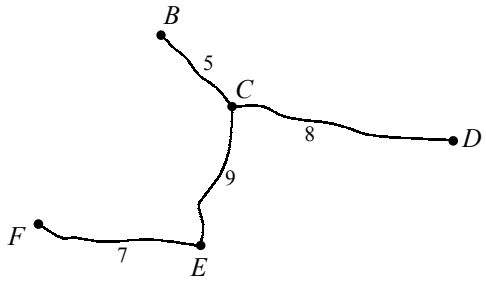
(b)



M1 A1

weight of MST = 37 miles
initial upper bound = $2 \times 37 = 74$ miles A1
use AF saving $8 + 5 + 9 + 7 - 13 = 16$
use DE saving $8 + 9 - 12 = 5$ M1 A1
new upper bound = $74 - 16 - 5 = 53$ miles A1

(c)



M1

lower bound = weight of MST + 2 × edge of least weight from A M1
$= (5 + 8 + 9 + 7) + (2 \times 8) = 45$ miles A1 **(11)**

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7. *(a)* $x + y + z = 240 \ \ \therefore z = 240 - x - y$ B1

(b) $C = 4x + 12y + 20z = 4x + 12y + 20(240 - x - y) = 4800 - 16x - 8y$ M1 A1

$x \geq 0.4 \times 240 \ \Rightarrow \ x \geq 96$ B1

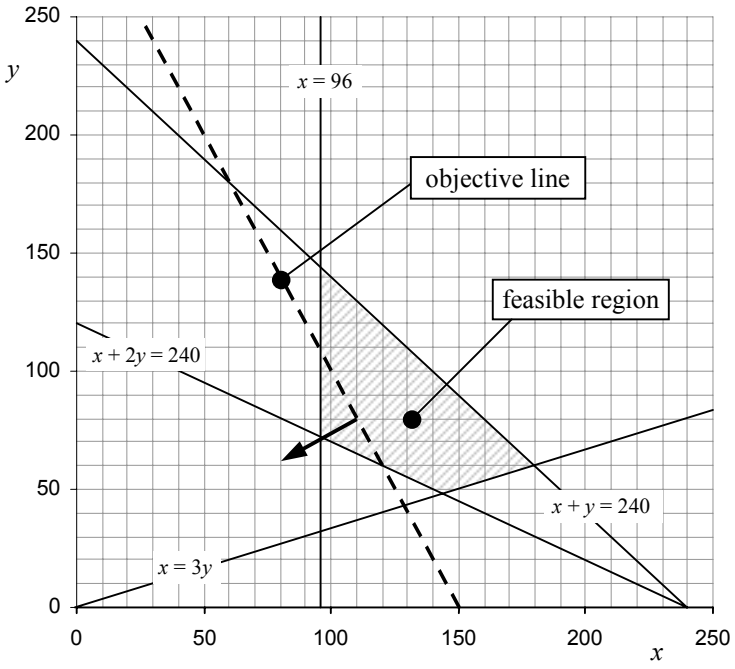
$x \leq 3y$ B1

$y \geq z \ \Rightarrow \ y \geq 240 - x - y \ \Rightarrow \ x + 2y \geq 240$ B1

$z \geq 0 \ \Rightarrow \ 240 - x - y \geq 0 \ \Rightarrow \ x + y \leq 240$ B1

$\therefore$ minimize $C = 4800 - 16x - 8y$
subject to $x \geq 96$
$x \leq 3y$
$x + 2y \geq 240$
$x + y \leq 240$
and $x \geq 0, y \geq 0$

(c)



M1 A1

B4

(d) minimum cost where $x = 96$ meets $x + 2y = 240$ M1

$\therefore x = 96, y = 72, z = 72$ 96 m^2 lawn, 72 m^2 paving, 72 m^2 flower beds A1

cost = £2688 A1 **(16)**

Total **(60)**

Performance Record – D1 Paper A

Question no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	Total
Topic(s)	Prim's	matching	flow chart	Dijkstra's	route inspection	TSP, shortcuts	linear prog. - graphical	
Marks	5	6	7	7	8	11	16	60
Student								