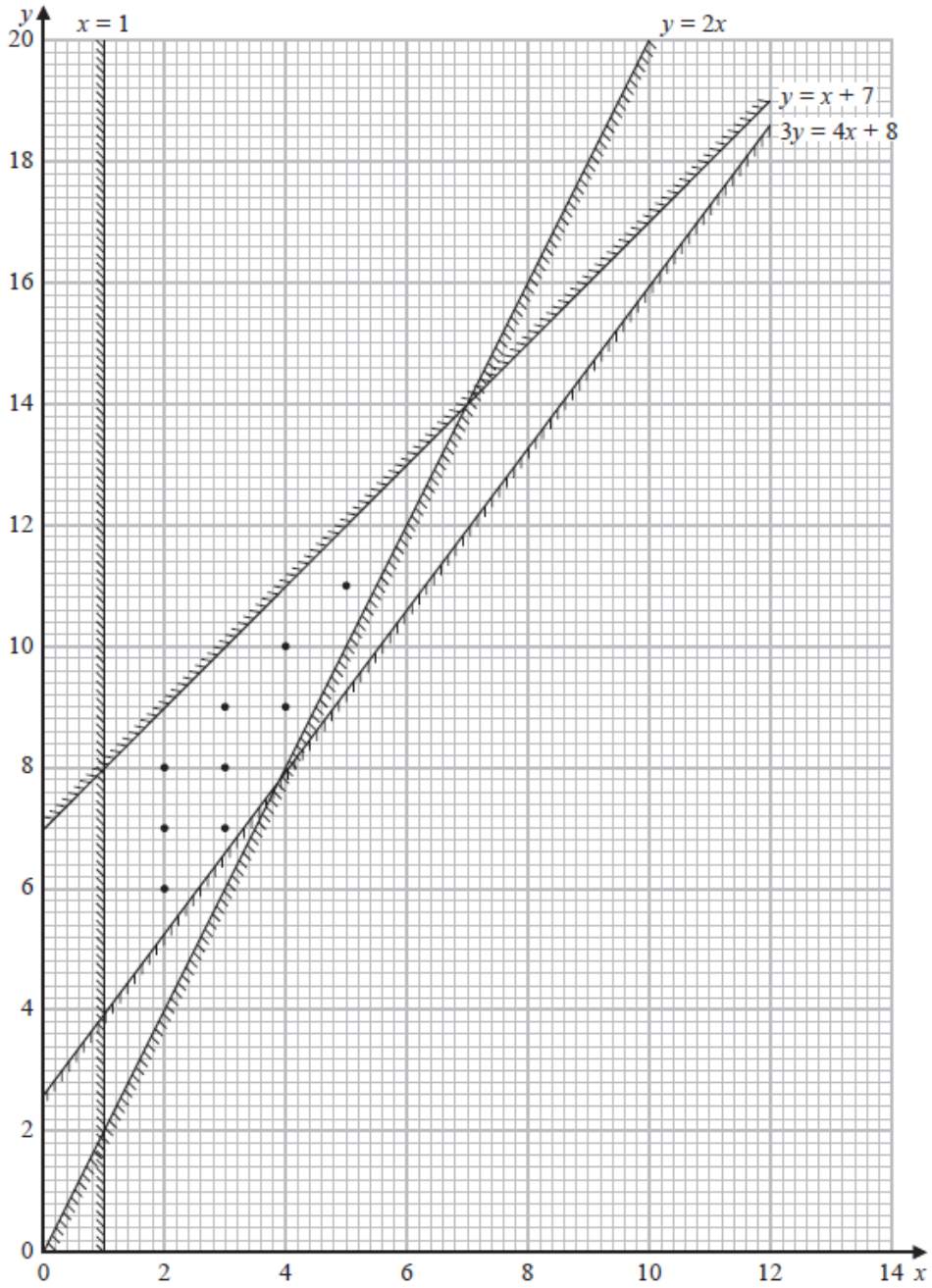
c1B1: Correct answer only (12)
c2B1: Correct answer only (C G H I L M)

Question Number	Scheme	Marks
7.(a)	If CD is not in the tree then AD must be as these are the only two arcs incident to D or the weight of CD is greater than the weight of AD	M1
	$2y + x > 3y - 7 \Rightarrow y < x + 7$ *	A1 **(2)**
(b)	$4x + 1 < 2y + 1 \Rightarrow y > 2x$ *	B1
	$4x + 1 < 8x - 3 \Rightarrow x > 1$	B1
	$4x + 1 < 3y - 7 \Rightarrow 3y > 4x + 8$	B1 **(3)**
(c)		B1 B1 B1 B1 **(4)**

		
(d)	$(2,6),(2,7),(2,8)$ $(3,7),(3,8),(3,9)$ $(4,9),(4,10)$ $(5,11)$	B1ft B1 **(2)**
(e)	Arcs in the tree are given as AB, AD, BC, CE, EF and GH – the one remaining arc in the MST is EH (because the weight of arcs EG and FG > weight of arc EH)	M1
	Total weight of the MST is therefore $14x+5y-4$	A1
	$14x+5y-4=73$ and testing integer value points inside FR	M1dep

	$x = 3$ and $y = 7$	A1 **(4)**
		15 marks

Notes for Question 7

a1M1: Explaining that if CD is not in the tree than AD must be e.g. 'the MST must contain D so if CD is not in the tree then AD is'. Must explicitly mention arc AD for this mark, so as a minimum accept, 'AD must be in the MST'

a1A1: Correct reasoning and derivation of the given result ($2y + x > 3y - 7 \Rightarrow y < x + 7$) – as the answer is given we must see at least $2y + x > 3y - 7$ or $3y - 7 < 2y + x$ before the required answer

SC (Special Case) **in (a)**: $2y + x > 3y - 7 \Rightarrow y < x + 7$ without any explanation given (or if explanation is incorrect) can score M1A0

b1B1: CAO – **must see at least** $4x + 1 < 2y + 1$ before the given answer of $y > 2x$ and not just arc AB < arc AC or $4x < 2y$

b2B1: CAO ($x > 1$) – but allow equivalents, e.g., $x - 1 > 0$, $1 < x$, $4x > 4$, etc. but must be two terms only

b3B1: CAO ($3y > 4x + 8$) – but allow **exact** equivalents e.g. $y > \frac{4}{3}x + \frac{8}{3}$, $4x - 3y < -8$, $4x + 8 - 3y < 0$, or equivalent but must be three terms only

In (c), the lines can be drawn as either dashed or non-dashed lines (or a combination of the two). The lines must be long enough to define the correct feasible region and pass through one small square of the points stated below:

$y = 2x$ must pass within one small square of (0, 0) and (7, 14)
$y = x + 7$ must pass within one small square of (0, 7) and (7, 14)
$x = 1$ must pass within one small square of (1, 0) and (1, 10)
$3y = 4x + 8$ must pass within one small square of $(1,4)$ and $(7,12)$

c1B1: Any one line correctly drawn (ignore any shading)
c2B1: Any two lines correctly drawn (ignore any shading)
c3B1: Any three lines correctly drawn (ignore any shading)
c4B1: All four lines correctly drawn and shading which implies the correct region (but region need not be labelled)

d1B1ft: At least 4 pairs of integer coordinates correctly stated for points inside their region. This mark is dependent on scoring at least the first two marks in (c) (so must have drawn at least two lines correctly) and the candidate must have drawn exactly four lines. The region must not be infinite but need not ncessarily be bounded by all four lines. If the candidate's region does not contain 4 integer coordinates then B0. Note that integer points on the lines that define the boundary of the region are not counted as being inside the region (regardless of if the candidate has strict inequalities or not)

d2B1: All 9 coordinates correct (and no others) – **dependent on all four lines correctly drawn in (c)**

e1M1: States that the remaining arc (in the MST) is one of either EH, EG or FG (and no others). Only one of these three arcs need to be stated for this mark. Allow this mark for either the expression $(4x+1)+(3y-7)+(2y-2)+(3x)+(x+y)+(6x-2y+3)+X$ or the equation

$(4x+1)+(3y-7)+(2y-2)+(3x)+(x+y)+(6x-2y+3)+X=73$ where $X=y+1$ or $2y+4$ or $5x+1$ (or equivalent equations/expressions). Their expression/equation need not be simplified but for reference (if correct) they are $14x+4y-5+X$ and $14x+4y-5+X=73$ (with the expression for X as before). Note that stating $14x + 4y - 5$ (or equivalent) and then separately stating one of the expressions for X would imply this mark

e2A1: A correct expression for the weight of the MST either simplified $(14x+5y-4)$ or not $((4x+1)+(3y-7)+(2y-2)+(3x)+(x+y)+(6x-2y+3)+(y+1))$. This mark can be implied if a correct equation is seen, e.g. $14x + 5y = 77$ (or equivalent and again need not be simplified). **If more than one equation or expression seen then they must clearly select the correct expression/equation for this mark** (so stating more than one expression for the weight of the MST is A0)

e1M1dep: This mark is dependent on the first M mark in this part and the first B mark in (d). Setting their linear expression (in x and y) for the weight of the MST equal to 73 and then substituting into this equation at least one integer pair of values of x and y from (d). This mark can also be awarded for substituting at least one integer pair of values of x and y into their linear expression. The correct answers can imply this mark

e1A1: Correct answers only ($x = 3$ **and** $y = 7$) from correct working – do not accept any other answers stated as well but accept as a coordinate (3, 7) – **must have drawn the correct four lines in (c) but need not have stated all nine correct coordinates in (d)**. As a minimum for full marks in (e) the candidate must have stated a correct expression (e.g. $14x + 5y - 4$ or equivalent) or equation (e.g. $14x + 5y = 77$ or equivalent) before then stating the correct answer

The correct answer with no method or working scores no marks in (e)

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