Question	Scheme	Marks
8. **(a)**	$y \leqslant 2x + 5$ $x + 5y \leqslant 150$ $2x + y \leqslant 70$ $5y \geqslant 3x - 15$	**B1** **B1**
		(2)
(b)	$3x + 2y = 48$ $\quad$ $x + 5y = 150$ $5y = 3x - 15 \Rightarrow \left(\frac{90}{7}, \frac{33}{7}\right)$ $\quad$ $2x + y = 70 \Rightarrow \left(\frac{200}{9}, \frac{230}{9}\right)$ $\frac{90}{7}a + \frac{33}{7}b = \frac{1419}{7} \Rightarrow 30a + 11b = 473$ $\frac{200}{9}a + \frac{230}{9}b = \frac{1730}{3} \Rightarrow 20a + 23b = 519$ $a = 11 \quad b = 13$ or $P = 11x + 13y$	**M1** **A1** **M1** **A1**
		(4)
(c)	Considers the gradient of $Q = 3x + 2y$ and attempts to find a limiting value for k Considers the gradient of $Q = 2x + y$ and attempts to find a limiting value for k e.g. $-\frac{1}{k} < -\frac{3}{2}$ and $-\frac{1}{k} > -2$ $\Rightarrow k < \frac{2}{3}$ or $k > \frac{1}{2}$ $\frac{1}{2} < k < \frac{2}{3}$	**M1** **M1** **A1** **A1**

	Alternative 1 Compares value of objective function at A and E Compares value of objective function at C and D $\frac{38}{7} + \frac{111}{7}k < \frac{90}{7} + \frac{33}{7}k \quad \Rightarrow k < \frac{2}{3}$ $\frac{200}{9} + \frac{230}{9}k > \frac{365}{13} + \frac{180}{13}k \quad \Rightarrow k > \frac{1}{2}$ giving $\frac{1}{2} < k < \frac{2}{3}$	**M1** **M1** **A1** **A1**
	Alternative 2 Rearranges $3x + 2y = 48$ to compare with $x + ky$ Rearranges $2x + y = 70$ to compare with $x + ky$ $x + \frac{2}{3}y = 16 \quad \Rightarrow k < \frac{2}{3}$ $x + \frac{1}{2}y = 35 \quad \Rightarrow k > \frac{1}{2} \qquad \frac{1}{2} < k < \frac{2}{3}$	**M1** **M1** **A1** **A1**
		(4)
	For reference the coordinates of all points of intersection A $\left(\frac{38}{7}, \frac{111}{7}\right)$ $3x + 2y = 48$ and $y = 2x + 5$ B $\left(\frac{125}{11}, \frac{305}{11}\right)$ $y = 2x + 5$ and $x + 5y = 150$ C $\left(\frac{200}{9}, \frac{230}{9}\right)$ $x + 5y = 150$ and $2x + y = 70$ D $\left(\frac{365}{13}, \frac{180}{13}\right)$ $2x + y = 70$ and $5y = 3x - 15$ E $\left(\frac{90}{7}, \frac{33}{7}\right)$ $5y = 3x - 15$ and $3x + 2y = 48$	
		(10 marks)

Notes	
a1B1 **a2B1**	Any two inequalities correct (accept equivalent rearrangements) CAO – all four correct (ignore any mention of $3x + 2y \geq 48$ (SC B1 B0 for all four strict inequalities)
b1M1	Attempts to solve both correct pairs of simultaneous equations (candidates may use their calculator to solve these, so the correct values for both points implies both marks) Ignore any additional work to find other points of intersection
b1A1	CAO – both pairs of coordinates (accept awrt (12.9, 4.7) and (22.2, 25.6)) Ignore additional points of intersection
b2M1	Forms a pair of simultaneous equations using their minimum and maximum points and solves to obtain *a* and *b* (may be unsimplified). If they have calculated additional points of intersection, then they must use their answer for the correct two points here
b2A1	CAO – must be exact values (either stating *a* and *b* or as function *P* =)
c1M1	Considers $3x + 2y$ and attempts to find a value for *k* by comparing gradients or compares the value of the objective function at A and E (accept the use of *m* for -1/*k* to compare gradients even if not clearly defined)
c2M1	Considers $2x + y$ and attempts to find a value for *k* by comparing gradients or compares the value of the objective function at C and D
c1A1	Either $k < \frac{2}{3}$ or $k > \frac{1}{2}$ (allow use of $\leqslant$ and $\geqslant$) (If gradients are compared please check inequalities carefully to ensure that any working shown is fully correct) (this mark can be awarded following either of the M marks so M0 M1 A1 A0 or M1 M0 A1 A0 are possible)
c2A1	Both values correct and correct interval stated (allow use of ≤) (both M marks must be awarded and must not come from incorrect working)

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