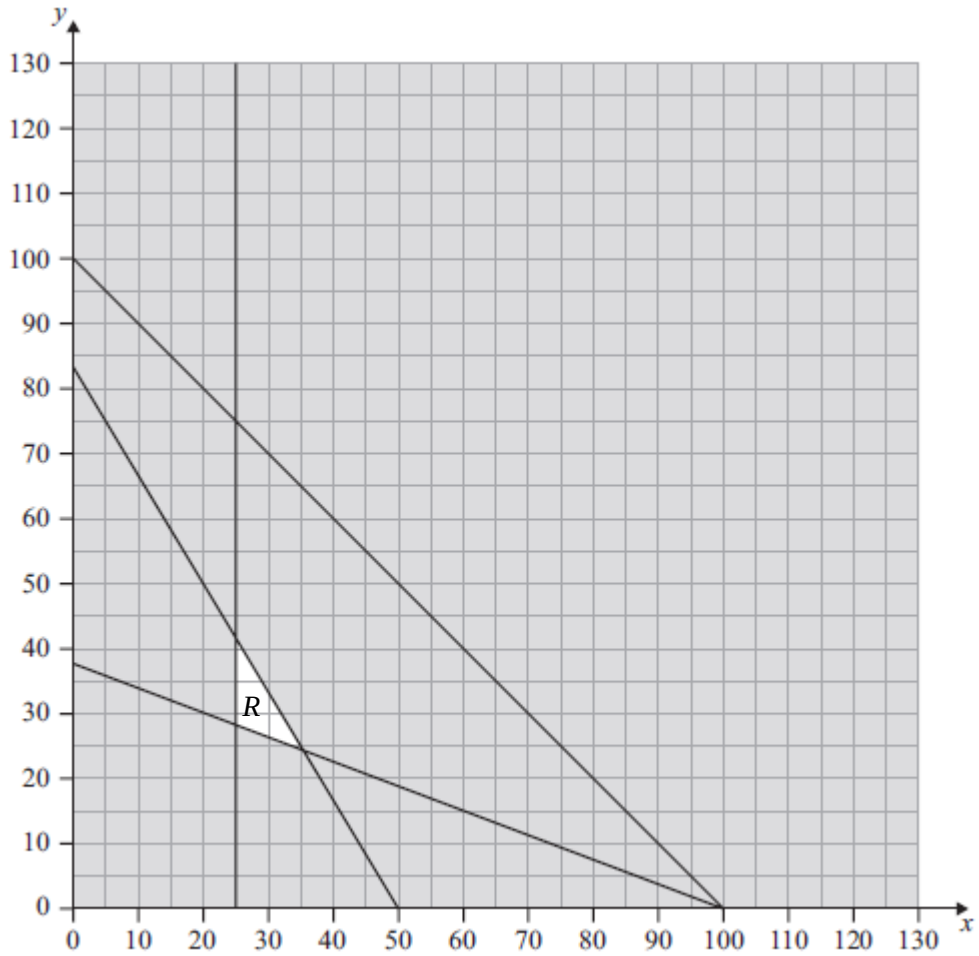
7.(a)	$(P=)\ 160x+75y+125z$ **and** maximise	B1
	Subject to:	
	$x+y+z \leqslant 100$	B1
	$\frac{1}{4}(x+y+z) \leqslant x(\Rightarrow 3x-y-z \geqslant 0)$	M1
	$3z \leqslant 5y$	M1
	$2x+1.5y+0.75z \leqslant 138\ (\Rightarrow 8x+6y+3z \leqslant 552)\ (120x+90y+45z \leqslant 8280)$	M1
	$3x-y-z \geqslant 0$ $3z \leqslant 5y$ $8x+6y+3z \leqslant 552$ $x \geqslant 0 \quad y \geqslant 0 z \geqslant 0$	A1 **(6)**
(b)	Substitute $x+y+z=100$ into $P=160x+75y+125z$ and simplify	M1
	$P=5(7x-10y)+12500$ so maximising a (positive) multiple of $7x-10y$ is equivalent to minimising the negative of this expression, that is, $-(7x-10y)=-7x+10y$*	A1* **(2)**
(c)		B1 B1 B1 B1 **(4)**
(d)(i)	Vertices of R are $\left(25, \frac{225}{8}\right), \left(25, \frac{127}{3}\right), (36, 24)$	M1 A1

(ii)	$-7x+10y$ | $160x+75y+125z$ $\left(25, \frac{225}{8}\right)$ | $\frac{425}{4}$ (106.25) | $\frac{47875}{4}$ (11,968.75) $\left(25, \frac{127}{3}\right)$ | $\frac{745}{3}$ (248.3) | $\frac{33775}{3}$ (11,258.3) $(36, 24)$ | -12 | 12560 So 36 acres for crop A, 24 for crop B and 40 acres for crop C	dM1 A1
(iii)	Maximum expected profit is (£) 12 560	A1 **(5)**
		17 marks
	Notes for Question 7	
	If using A, B and C throughout (a) instead of *x*, *y* and *z* send to review	
a1B1	CAO – expression ($160x + 75y + 125z$) together with 'max' or 'maximise' not 'maximum'	
a2B1	CAO ($x+y+z \leqslant 100$)	
a1M1	$\frac{1}{4}(x+y+z)$ $\square$ x where $\square$ is any inequality or equals – brackets must be present or implied by later working (accept correct equivalent unsimplified forms)	
a2M1	$3z$ $\square$ $5y$ where $\square$ is any inequality or equals. Also allow $5z \leqslant 3y$ for this mark (accept correct equivalent unsimplified forms)	
a3M1	$2x+1.5y+0.75z$ $\square$ 138 (oe) where $\square$ is any inequality or equals. Time may be converted to minutes (must be all 4 values) (accept correct equivalent unsimplified forms)	
a1A1	All three constraints ($3x \geqslant y+z$, $3z \leqslant 5y$, $8x+6y+3z \leqslant 552$) correct – must have integer coefficients with only one term in each variable. Condone omission of the trivial constraints $x \geqslant 0$, $y \geqslant 0$, $z \geqslant 0$ (Accept e.g. $24x+18y+9z \leqslant 1656$ oe if working in minutes)	
b1M1	Substitute $x+y+z=100$ into their linear objective function and simplify to a single term in *x* and a single term in *y* only	
b1A1*	Explaining why maximising the correct objective $35x - 50y$ (+12500) is equivalent to minimising $-7x+10y$	
c1B1	Any two lines correctly drawn ($5x+3y=252$ should pass within half a small square of (18, 54) and (42, 14)) ($3x+8y=300$ should pass within half a small square of (20, 30) and (100, 0)) ($x+y=100$ should pass within half a small square of (0, 100), (50, 50) and (100, 0)) ($x=25$ must be drawn through the middle of the small square from (24, 0) to (26, 0))	
c2B1	Any three lines correctly drawn	
c3B1	All four lines correctly drawn (penalise any poorly drawn lines with the loss of this mark)	
c4B1	Correct *R* labelled – dependent on all three previous B marks	
d1M1	Attempt to find the exact coordinates (must be finding at least two pairs of coordinates) of their *R* – dependent on at least two B marks in (c)	
d1A1	CAO - all three exact coordinates of the correct *R* (accept 28.125 and $42.\dot{3}$ but not 42.3 or 42.33)	
d2M1	Point testing (objective line method is M0) – testing at least two of their vertices of their *R* in either $-7x+10y$ or $160x+75y+125z$ - dependent on previous M mark	
d2A1	All three values of *P* found (either exact or decimal equivalent for either objective function) and stating the correct allocation of the three crops. Allocation must be in context for crop A, B, C not $x =$, $y =$, $z =$	
d3A1	Maximum expected profit stated correctly (units not required)	

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