Question Number	Scheme	Marks
8.(a)	(Maximise) $x+y+z$	B1
	Subject to:	
	$14x+8y+12z \leqslant 976$	B1
	$5z \geqslant 2x$	B1
	$\frac{1}{2}(x+y+z) \leqslant x \left(\Rightarrow -x+y+z \leqslant 0\right)$	M1
	$\frac{1}{5}(x+y+z) = y \left(\Rightarrow x-4y+z=0\right)$	B1
	Substituting $z=4y-x$ into objective and constraints	M1
	Maximise $(P=)5y$ Subject to: $x+28y \leqslant 488$ $7x-20y \leqslant 0$ $2x-5y \geqslant 0$ $x-4y \leqslant 0$ $x \geqslant 0 \quad y \geqslant 0$	A1 A1 **(8)**
(b)	Substituting $y=16$ into constraints gives $x \leqslant 40, x \leqslant \frac{320}{7}, x \geqslant 40, x \leqslant 64$	M1
	$\Rightarrow x=40$ and therefore the maximum number of leadership prizes is 24	A1 **(2)**
		10 marks

Notes for Question 8

a1B1: CAO ($x + y + z$) – can be implied by seeing $5y$ as the objective – do not penalise lack of 'maximise' here. Allow equal to any letter but not equal to a numerical value

a2B1: CAO ($14x+8y+12z \leqslant 976$ or an unsmplified inequality equivalent to $x+28y \leqslant 488$)

a3B1: CAO ($5z \geqslant 2x$ (or equivalent) or an unsimplified inequality equivalent to $7x-20y \leqslant 0$)

a1M1: Correct method - must see $\frac{1}{2}(x+y+z) \bullet x$ where $\bullet$ is any inequality or =. The bracket must be present or implied by later working – this mark is implied by the stating of a correct/incorrect inequality that would come from $\frac{1}{2}(x+y+z) \bullet x$ (possibly with $z = 4y – x$ substituted)

a4B1: CAO $\frac{1}{5}(x+y+z) = y$ (allow any equivalent unsimplified/simplified form for this mark) – simply stating that e.g. $x + z = 4y$ scores this mark

a2M1: Eliminating z using the correct equation $z=4y-x$ from all three non-trivial constraints and objective

a1A1: At least two simplified constraints correct + correct objective (in x/y only) – condone lack of 'maximise' for this mark - accept any equivalent forms for the constraints provided that coefficients are integers and only a single term in x and/or y

a2A1: CAO – must include 'maximise' or 'max' (but not 'maximum') and all 6 constraints – accept any equivalent forms for the constraints provided that coefficients are integers and only a single term in x and/or y

Condone using *a* for *x*, *s* for *y* and *l* for *z* – if any other letter used then send to review

Must be using inequalities in *x* and *y* only in (b) – if inequalities are still in terms of *z* then *z* must be eliminated using the correct equation (e.g. *z* = 64 – *x*). Attempting part (b) with equations (rather than inequalities) scores no marks (even if the correct answer of 24 is seen).

b1M1: Substituting $y = 16$ into at least two correct constraints from the following four: $x + 28y \leqslant 488$, $7x - 20y \leqslant 0$, $2x - 5y \geqslant 0$ and $x - 4y \leqslant 0$

b1A1: Correctly obtaining $x \leqslant 40$ from $x + 28y \leqslant 488$ **and** $x \leqslant \frac{320}{7}$ from $7x - 20y \leqslant 0$ **and** $x \geqslant 40$ from $2x - 5y \geqslant 0$ (condone lack of $x \leqslant 64$ from $x - 4y \leqslant 0$) then stating/implying that *x* = 40 and therefore *z* = 24 (or equivalent in context e.g. 24 leadership prizes)

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