Question Number	Scheme	Marks
8.(a)	Minimise $P = 8x + 10y + 14z$	B1
	Subject to $x + y + z \geq 200$	B1
	$3y \leq x$	B1
	$\frac{7}{10}(x + y + z) \geq x$ or $\frac{1}{5}(x + y + z) \leq y$	M1
	$x + z \leq 4y$ $3x \leq 7y + 7z$ $(x, y, z \geq 0)$	A1 A1 **(6)**
(b)(i)	$z = 200 - x - y$ substituted into constraints gives	M1
	$x \leq 140, y \geq 40$	A1
	Using their least value of y and greatest value of x to find z	dM1
	140 ring doughnuts, 40 jam doughnuts and 20 custard doughnuts	A1
(b)(ii)	£18 or 1800	A1 **(5)**
		11 marks

Notes for Question 8

a1B1: Expression correct <u>together</u> with 'minimise' or 'min' but not 'minimum' – isw if coefficients are subsequently simpified but $8x + 10y + 14z$ must be seen at some point for this mark to be awarded. The 'min' must appear beside (or near to) the correct expression

a2B1: CAO ($x + y + z \geq 200$) oe

a3B1: CAO **(** $3y \leq x$) oe

a1M1: $\frac{7}{10}(x + y + z)\square x$ oe or $\frac{1}{5}(x + y + z)\square y$ oe where $\square$ is any inequality or equals – allow 0.7 and 0.2 but not 70% or 20% unless recovered to a fraction or decimal later

a1A1: Either $x + z \leq 4y$ or $3x \leq 7y + 7z$ **or** both correct but not simplified or with integer coefficients (so $\frac{7}{10}(x + y + z) \geq x$ and $\frac{1}{5}(x + y + z) \leq y$ can score this mark)

a2A1: Both correct – must be simplified (e.g. only one term in each variable) and integer coefficients but allow positive integer multiplies (e.g. $2x + 2z - 8y \leq 0$)

bi1M1: Using $x + y + z = 200$ to obtain either an inequality (or value) for either x or y

bi1A1: Any one of $x \leq 140$ or $y \geq 40$ correct (this mark can be implied for either $x = 140$ or $y = 40$ seen provided not from incorrect working)

bi2dM1: Using their least value of y and greatest value of x to find z (so not from the inequality $3y \leq x$) - the total of x, y and z must be 200 (and dependent on first M mark)

bi2A1: All three types of doughnuts correct (in context) - so not just in terms of x, y and z

bii1A1: CAO for cost – if 1800 given then this is fine (without pence) but if 18 then must be £

SC in (b): If correct answers from either no working or from explicitly solving three correct equations e.g. $x - 4y + z = 0$ $3x - 7y - 7z = 0$ with no algebraic working then award M0A0 M1 (for correct values of x, y and z) A1 (for $x + y + z = 200$ answers in context) and A1 for 1800. If solving these three equations with algebraic working then full marks can be awarded. If no marks awarded according to the notes above and solving any other (e.g. incorrect) sets of equations then no marks in **(b)**.

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