Question Number	Scheme	Notes	Marks
3. (a)	$\sum_{r=1}^{n} r^2(2r+3) = 2\sum_{r=1}^{n} r^3 + 3\sum_{r=1}^{n} r^2$		
	$= 2\left(\frac{1}{4}n^2(n+1)^2\right) + 3\left(\frac{1}{6}n(n+1)(2n+1)\right)$	Attempts to expand $r^2(2r+3)$ and attempts to substitute at least one correct formula for either $\sum_{r=1}^{n} r^3$ or $\sum_{r=1}^{n} r^2$ into their resulting expression	M1
		Obtains an expression of the form $\alpha n^2(n+1)^2 + \beta n(n+1)(2n+1);\ \alpha, \beta \neq 0$	M1
		$2\left(\frac{1}{4}n^2(n+1)^2\right) + 3\left(\frac{1}{6}n(n+1)(2n+1)\right)$ which can be simplified or un-simplified	A1
	$= \frac{1}{2}n(n+1)\left(n(n+1)+(2n+1)\right)$ $= \frac{1}{2}n(n+1)(n^2+3n+1)$ *	Achieves the given result via an appropriate intermediate step with no algebraic errors seen in their working	A1 * **cso**
			(4)
(b)	$\left\{\sum_{r=10}^{25} r^2(2r+3) = \right\}$	{**Note:** Let $f(n) = \frac{n}{2}(n+1)(n^2+3n+1)$ or their answer to part (a) or their un-simplified expression (for $f(n)$) of the form $\alpha n^2(n+1)^2 + \beta n(n+1)(2n+1);\ \alpha, \beta \neq 0$}	
	$= \frac{25}{2}(25+1)((25)^2+3(25)+1) - \frac{9}{2}(9+1)((9)^2+3(9)+1)$	Applies $f(25) - f(9)$ **Note:** Give M0 for applying $f(25) - f(10)$	M1
	$\left\{= \frac{25}{2}(26)(701) - \frac{9}{2}(10)(109) = 227825 - 4905\right\}$		
	$= 222920$	222920 **cao**	A1
			(2)
			6

Question 3 Notes

3. (a)

Note **Final A mark:**

$$\text{LHS} = \frac{1}{2}n^2(n+1)^2 + \frac{1}{2}n(n+1)(2n+1) = \frac{1}{2}n^2(n^2+2n+1) + \frac{1}{2}n(2n^2+3n+1)$$

$$= \frac{1}{2}n^4 + n^3 + \frac{1}{2}n^2 + n^3 + \frac{3}{2}n^2 + \frac{1}{2}n \ = \frac{1}{2}n^4 + 2n^3 + 2n^2 + \frac{1}{2}n$$

$$\text{RHS} = \frac{n}{2}(n+1)(n^2+3n+1) = \frac{n}{2}(n^3+3n^2+n+n^2+3n+1) = \frac{n}{2}(n^3+4n^2+4n+1)$$

$$= \frac{1}{2}n^4 + 2n^3 + 2n^2 + \frac{1}{2}n$$

Give final A1 cso for using algebra to show that the LHS and RHS are the same with some acknowledgment (e.g. 'proved', LHS = RHS, QED or □) that their proof is complete.

	Question 3 Notes Continued	
3. (a)	**Note**	Give final A0 for • jumping from $\frac{1}{2}n^4+2n^3+2n^2+\frac{1}{2}n$ to $\frac{n}{2}(n+1)(n^2+3n+1)$ with no intermediate working
	Note	Condone final A1 for • jumping from $\frac{n}{2}(n^3+4n^2+4n+1)$ to $\frac{n}{2}(n+1)(n^2+3n+1)$ with no intermediate working
	Note	Achieving the given result via an appropriate intermediate step with no algebraic errors seen in their working includes e.g. • $2\left(\frac{1}{4}n^2(n+1)^2\right)+3\left(\frac{1}{6}n(n+1)(2n+1)\right)=\frac{1}{2}n^2(n+1)^2+\frac{1}{2}n(n+1)(2n+1)$ $=\frac{1}{2}n(n+1)(n^2+3n+1)$ • $2\left(\frac{1}{4}n^2(n+1)^2\right)+3\left(\frac{1}{6}n(n+1)(2n+1)\right)=\frac{1}{2}n(n+1)(n^2+n)+\frac{1}{2}n(n+1)(2n+1)$ $=\frac{1}{2}n(n+1)(n^2+3n+1)$ • $2\left(\frac{1}{4}n^2(n+1)^2\right)+3\left(\frac{1}{6}n(n+1)(2n+1)\right)=\frac{1}{2}n(n+1)[n(n+1)]+\frac{1}{2}n(n+1)(2n+1)$ $=\frac{1}{2}n(n+1)(n^2+3n+1)$
3. (b)	**Note**	Allow M1 for $227825-4905$ and A1 for obtaining 222920
	Note	Allow M1 for $\left(\frac{1}{2}(25)^2(26)^2+\frac{1}{2}(25)(26)(51)\right)-\left(\frac{1}{2}(9)^2(10)^2+\frac{1}{2}(9)(10)(19)\right)$ $\{=(211250+16575)-(4050+855)=227825-4905\}$ and A1 for obtaining 222920
	Note	Give M0 A0 for writing 222920 by itself with no supporting working
	Note	Allow M1 A1 for writing $\sum_{r=1}^{25}r^2(2r+3)-\sum_{r=1}^{9}r^2(2r+3)=222920$
	Note	Give M0 A0 for listing individual terms i.e. $\sum_{r=10}^{25}r^2(2r+3)=(10)^2(23)+(11)^2(25)+(12)^2(27)+\ldots+(25)^2(53)$ $=2300+3025+3888+\ldots+33125=222920$ by itself is M0 A0
	Note	Give M0 A0 for applying $f(25)-f(10)=\frac{25}{2}(25+1)((25)^2+3(25)+1)-\frac{10}{2}(10+1)((10)^2+3(10)+1)$ $=\frac{25}{2}(26)(701)-5(11)(131)=227825-7205=220620$
	Note	For M1 allow only one slip when substituting in $n=25$ and $n=9$
	Note	Give M0 for • $\frac{25}{2}(25+1)((25)^2+3(25)+1)-\frac{9}{2}(9+1)((10)^2+3(10)+1)\{=227825-5895=221930\}$