Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
1	States $20\times\left(\frac{1}{2}\right)(21)(22)=3\times\left(\frac{1}{2}\right)(k)(k+1)$	**M1**	1.1b	TBC
	Makes an attempt to simplify the expression, for example $4620=\frac{3}{2}k(k+1)$ or $3080=k^2+k$	**M1**	1.1b	
	Correctly solves the quadratic.	**M1**	1.1b	
	As k must be a positive integer, states $k = 55$	**A1**	2.3	
		(4)		
				(4 marks)

Notes

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
2	States or implies that $\sum_{r=n-1}^{2n+1} r = \sum_{r=1}^{2n+1} r - \sum_{r=1}^{n-2} r$	**M1**	2.1	TBC
	Correctly substitutes into the standard formulae: $\sum_{r=n-1}^{2n+1} r = \frac{1}{2}(2n+1)(2n+2) - \frac{1}{2}(n-2)(n-1)$	**M1**	1.1b	
	Makes an attempt to simplify, for example $2n^2 + 3n + 1 - \frac{1}{2}(n^2 - 3n + 2)$ is seen	**M1**	1.1b	
	Follows a logical progression to obtain $\frac{3}{2}(n^2 + 3n)$ **cso**.	**A1**	1.1b	
		(4)		
(4 marks)				
Notes				

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
3a	States or implies that $\sum_{r=1}^{k}(6r-3)=6\sum_{r=1}^{k}r-3\sum_{r=1}^{k}1$	**M1**	2.1	TBC
	Correctly substitutes into the standard formulae: $\sum_{r=1}^{k}(6r-3)=6\times\left(\frac{1}{2}\right)(k)(k+1)-3k$	**M1**	1.1b	
	Follows a logical progression to obtain $3k^2$ **cso**.	**A1**	1.1b	
		(3)		
b	States $3k^2>4800$ or $k^2>1600$	**M1**	2.2a	
	Solves the inequality and states that as *k* must be a positive integer, *k* = 41.	**A1**	2.3	
		(2)		
				(5 marks)

Notes

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
4	States or implies that $\sum_{r=1}^{n}(ar+b)=a\sum_{r=1}^{n}r+b\sum_{r=1}^{n}1$	**M1**	2.1	TBC
	Correctly substitutes into the standard formulae: $\sum_{r=1}^{n}(ar+b)=a\times\left(\frac{1}{2}\right)(n)(n+1)+bn$	**M1**	1.1b	
	Simplifies to state: $\sum_{r=1}^{n}(ar+b)=\frac{a}{2}n^2+\left(\frac{a}{2}+b\right)n$ oe.	**M1**	1.1b	
	Equates n^2 coefficients and states that a = 7 and equates n coefficients and states that b = –4	**A1**	1.1b	
		(4)		

(4 marks)

Notes

Alternative Method

M1: States that when r = 1, $a + b$ = 3.

M1: States that when r = 2, $(a + b) + (2a + b)$ = 13.

M1: Makes attempt to solve simultaneous equations.

A1: States that a = 7 and equates n coefficients and states that b = –4

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
5a	Attempts to use the fact that $\sum_{r=1}^{5} \mathrm{f}(r) = 125$ to substitute into the standard formulae: $a \times \left(\frac{1}{2}\right)(5)(6) + 5b = 125$	M1	2.1	TBC
	Simplifies to state $3a + b = 25$ oe.	A1	1.1b	
	Attempts to use the fact that $\sum_{r=1}^{10} \mathrm{f}(r) = 4755$ to substitute into the standard formulae: $a \times \left(\frac{1}{2}\right)(10)(11) + 10b = 475$	M1	2.1	
	Simplifies to state $11a + 2b = 95$ oe.	A1	1.1b	
	Correctly finds $a = 9$ and $b = -2$	A1	1.1b	
	Attempts to find an expression for $\sum_{r=1}^{n} \mathrm{f}(r)$, for example $\frac{9n(n+1)}{2} - 2n$ is seen.	M1	1.1b	
	Simplifies to obtain $\sum_{r=1}^{n} \mathrm{f}(r) = \frac{n(9n+5)}{2}$ oe.	A1	1.1b	
		(7)		
b	States or implies $\sum_{r=8}^{18} \mathrm{f}(r) = \frac{18(9(18)+5)}{2} - \frac{7(9(7)+5)}{2}$	M1	2.1	
	Simplfies to obtain 1265	A1	1.1b	
		(4)		
				(9 marks)

Notes

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
6a	Substitutes at least one of the standard formulae into their expanded expression.	**M1**	2.1	TBC
	Correctly finds: $\sum_{r=1}^{n}(r+4)(r+1)=\sum_{r=1}^{n}(r^2+5r+4)$ $=\frac{1}{6}n(n+1)(2n+1)+5\times\frac{1}{2}n(n+1)+4n$	**A1**	1.1b	
	Factorises the n: $\frac{1}{6}n\left[(n+1)(2n+1)+15(n+1)+24\right]$	**M1***	1.1b	
	Obtains $\frac{1}{3}n(n^2+9n+20)$, showing all work clearly. cso.	**A1**	1.1b	
		(4)		
b	States or implies that $\sum_{r=6}^{14}(r+4)(r+1)=\sum_{r=1}^{14}(r+4)(r+1)-\sum_{r=1}^{5}(r+4)(r+1)$	**M1**	2.1	
	Substitutes into the standard formulae: $\sum_{r=6}^{14}(r+4)(r+1)$ $=\frac{1}{3}(14)\left[14^2+9(14)+20\right]-\frac{1}{3}(5)\left[5^2+9(5)+20\right]$	**A1**	1.1b	
	Solves to obtain 1446	**M1**	1.1b	
		(3)		
				(7 marks)

Notes

6a: Award second method mark providing n is factored out of the expression. Student does not need to factor the $\frac{1}{6}$ at this point in order to achieve the method mark.

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
7a	States or implies that $\sum_{r=n+1}^{2n} r^3 = \sum_{r=1}^{2n} r^3 - \sum_{r=1}^{n} r^3$	M1	2.1	TBC
	Correctly substitutes into the standard formulae: $\sum_{r=n+1}^{2n} r^3 = \frac{1}{4}(2n)^2(2n+1)^2 - \frac{1}{4}(n)^2(n+1)^2$	M1	1.1b	
	Factors out the n^2 term. For example, $\frac{1}{4}n^2\left[4(2n+1)^2 - (n+1)^2\right]$ is seen.	M1	1.1b	
	Follows a logical progression to obtain $\frac{1}{4}n^2(5n+3)(3n+1)$ **cso**.	A1	1.1b	
		(4)		
b	Makes an attempt to substitute n = 20 into $\frac{1}{4}n^2(5n+3)(3n+1)$. For example, $\frac{1}{4}(20)^2(5(20)+3)(3(20)+1)$ is seen.	M1	2.2a	
	Correctly finds 628 300	A1	1.1b	
		(2)		
				(6 marks)

Notes

7a: Award third method mark providing n^2 is factored out of the expression. Student does not need to factor the $\frac{1}{4}$ at this point in order to achieve the method mark.

For the 3rd method mark, it is acceptable to use the method of difference of squares:

$\frac{1}{4}n^2\left[2(2n+1)-(n+1)\right]\left[2(2n+1)+(n+1)\right]$ and then simplify.

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
8	Substitutes at least one of the standard formulae into their expanded expression.	**M1**	2.1	TBC
	Correctly finds: $\sum_{r=1}^{n} r^2 = \frac{1}{6}n(n+1)(2n+1)$ and finds $\sum_{r=1}^{n+1} r + 8\sum_{r=1}^{n+1} 1 = 6 \times \frac{1}{2}(n+1)(n+2) + 8(n+1)$	**A1**	1.1b	
	Equates both expressions and cancels all terms by $(n+1)$, obtaining $\frac{1}{6}n(2n+1) = 3(n+2)+8$	**M1**	1.1b	
	Simplifies to obtain $2n^2 - 17n - 84 = 0$	**M1**	1.1b	
	Solves to find n = 12, recognising that n must be a positive integer.	**A1**	2.3	
		(5)		
				(5 marks)

Notes

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
9a	Correctly finds: $\sum_{r=1}^{n} r^3 + 2\sum_{r=1}^{n} r^2 = \frac{1}{4}n^2(n+1)^2 + 2\times\frac{1}{6}n(n+1)(2n+1)$	**M1**	2.2a	TBC
	Factorises $n(n+1)$: $\frac{1}{6}n(n+1)\left[3n(n+1)+4(2n+1)\right]$	**M1***	1.1b	
	Obtains $\frac{1}{3}n(n+1)(3n^2+11n+4)$, showing all work clearly. cso.	**A1**	1.1b	
		(3)		
b	Correctly substitutes into the standard formulae: $\sum_{r=1}^{2n+1} r^2(r+2)$ $= \frac{1}{12}(2n+1)(2n+2)\left[3(2n+1)^2+11(2n+1)+4\right]$	**M1**	2.2a	
	Makes an attempt to simplify, for example $\frac{1}{12}(2n+1)(2n+2)\left[12n^2+34n+18\right]$ is seen	**M1**	1.1b	
	Follows a logical progression to obtain $\frac{1}{3}(2n+1)(n+1)(6n^2+17n+9)$ **cso**.	**A1**	1.1b	
		(3)		
				(6 marks)

Notes

9a: Award second method mark providing n is factored out of the expression. Student does not need to factor the $\frac{1}{12}$ at this point in order to achieve the method mark.