Question Number	Scheme	Notes	Marks
9	$f(n)=4^n+6n-10 \quad n\in\mathbb{Z} \quad n\geqslant 2$		

General guidance:
Apply the way that best fits the overall approach.
Condone work in e.g., *n* instead of *k*.
Attempts with no induction e.g., not using f(*k*) in an equation with f(*k* +1) score a max of 11000.
Using e.g., f(*k* + 2) – f(*k* + 1) requires a clear indication of assuming f(*k* + 1) is true to access the last three marks.
Alternative explanations are unlikely to access the last three marks unless there is a fully convincing justification of divisibility, e.g., $f(k+1)-f(k)=3\times4^k+6$ followed by "Since 3×4^k is a multiple of both 3 and 4 and hence 12, $3\times4^k+6$ is divisible by 18" is not a sound argument. Attempts that involve further induction on different expressions must be complete methods to access the last 3 marks.
Allow use of –18 but if any different multiples of 18 are involved e.g., 36, the first A1 requires "36 is a multiple of/divisible by (but not "factor of") 18" oe for each case
B1: Any correct numerical expression that is not just "18" is sufficient for this mark
e.g., 16 + 12 –10, 28 – 10, 4^2 + 2. Starting with e.g., f(3) scores a max of 01110.
Ignore an extra evaluation of $f(1)$ but a comment on $f(1)$'s divisibility is final A0 since $n\geqslant 2$
Final A1: There must be evidence that $\text{true for } n=k \Rightarrow \text{true for } n=k+1$ but it could be minimal and be scored in a conclusion or a narrative or via both. So if e.g., "Assume true for $n=k$ ..." is seen in the work followed by "true for $n=k+1$" in a conclusion this is sufficient.
Condone "for all $n\in\mathbb{Z}$", "all $n\in\mathbb{Z}$ $n>2$", "all $\mathbb{Z}>$ **(**or $\geqslant$) 2" but **not** $n\in\mathbb{R}$

Way 1 $f(k+1)-f(k)$	$f(2)=4^2+6\times2-10=18$	Obtains f(2) = 18 with substitution	B1
	$f(k+1)=4^{k+1}+6(k+1)-10$	Attempts $f(k+1)$	M1
	$f(k+1)-f(k)=4^{k+1}+6(k+1)-10-(4^k+6k-10)$ $=4^{k+1}-4^k+6=3\times4^k+6$ $=3(4^k+6k-10)-18k+36$	Attempts $f(k+1)-f(k)$, uses $4^{k+1}=4\times4^k$ & obtains $pf(k)+g(k)$ with g(*k*) linear (allow constant $\neq 0$)	M1
	$f(k+1)=4f(k)+18(2-k)$ f(*k*) may be written in full	Correct factorised expression Allow $4f(k)+18\times2-18\times k$ If f(*k* + 1) is not made the subject then e.g., "true for f(*k* + 1) – f(*k*)" is also required	A1
	True for *n* = 2, if **true for *n* = *k* then true for *n* = *k* + 1** so **true for all** $n\in\mathbb{Z}$ $(n\geqslant 2)$ Minimum in bold.	Full conclusion/narrative and no errors. All marks needed but allow if B0 provided this mark was only withheld for insufficient working.	A1
			(5)
Way 2 $f(k+1)=...$	$f(2)=4^2+6\times2-10=18$	Obtains f(2) = 18 with substitution	B1
	$f(k+1)=4^{k+1}+6(k+1)-10$	Attempts $f(k+1)$	M1
	$=4\times4^k+6k-4$ $=4(4^k+6k-10)-18k+36$	Uses $4^{k+1}=4\times4^k$ & obtains $pf(k)+g(k)$ with g(*k*) linear (allow constant $\neq 0$)	M1
	$=4f(k)+18(2-k)$ f(*k*) may be written in full	Correct factorised expression Allow $4f(k)+18\times2-18\times k$	A1
	True for *n* = 2, if **true for *n* = *k* then true for *n* = *k* + 1** so **true for all** $n\in\mathbb{Z}$ $(n\geqslant 2)$ Minimum in bold.	Full conclusion/narrative and no errors. All marks needed but allow if B0 provided this mark was only withheld for insufficient working.	A1
			(5)

Question Number	Scheme	Notes	Marks
9 cont.	$f(n)=4^n+6n-10 \quad n\in\mathbb{Z} \quad n\geqslant 2$		
Way 3 $f(k+1)-mf(k)$	$f(2)=4^2+6\times 2-10=18$	Obtains f(2) = 18 with substitution	B1
	$f(k+1)=4^{k+1}+6(k+1)-10$	Attempts $f(k+1)$	M1
	$f(k+1)-mf(k)=4^{k+1}+6(k+1)-10-m(4^k+6k-10)$ $=(4-m)4^k+(6-6m)k-4+10m$ e.g. $m=-14\Rightarrow 18\times 4^k+90k-144$ e.g. $m=4\Rightarrow -18k+36$	Attempts $f(k+1)-mf(k)$ and uses a value of m to obtain $c\times 4^k+...$ where c is a multiple of their 18 or uses $m = 4$	M1
	e.g., $f(k+1)=-14f(k)+18(4^k+5k-8)$ $f(k+1)=4f(k)+18(2-k)$ f(k) may be written in full	A correct factorised expression Allow $-14f(k)+18\times 4^k+18\times 5k-18\times 8$ If f(k + 1) is not made the subject then e.g., "true for f(k + 1) – mf(k)" is also required	A1
	True for n = 2, if **true for $n = k$ then true for $n = k + 1$** so **true for all** $n\in\mathbb{Z}$ $(n\geqslant 2)$ Minimum in bold.	Full conclusion/narrative and no errors. All marks needed but allow if B0 provided this mark was only withheld for insufficient working.	A1
			(5)
Way 4 $f(k)=18M$	$f(2)=4^2+6\times 2-10=18$	Obtains f(2) = 18 with substitution	B1
	$f(k+1)=4^{k+1}+6(k+1)-10$	Attempts $f(k+1)$	M1
	$f(k)=18M$, $f(k+1)=4\times 4^k+6k-4$ $=4\times 18M-18k+36$	Sets $f(k)=18M$, uses $4^{k+1}=4\times 4^k$ & obtains $pf(k)+g(k)$ with g(k) linear (allow constant $\neq 0$)	M1
	$f(k+1)=18(4M+2-k)$	A correct factorised expression Allow $18\times 4M+18\times 2-18\times k$	A1
	True for n = 2, if **true for $n = k$ then true for $n = k + 1$** so **true for all** $n\in\mathbb{Z}$ $(n\geqslant 2)$ Minimum in bold.	Full conclusion/narrative and no errors. All marks needed but allow if B0 provided this mark was only withheld for insufficient working.	A1
			(5)
			PAPER TOTAL: 75

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