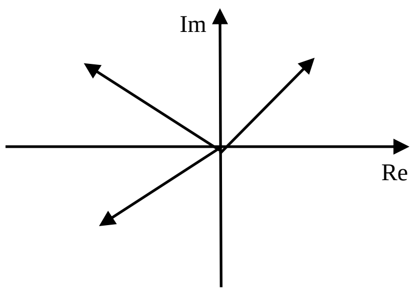
Mark Scheme (Results)

Summer 2022

Pearson Edexcel International Advanced Level
In Further Pure Mathematics F1 (WFM01)
Paper 01

Question Number	Scheme	Notes	Marks
1(a)	$z_1 = 3+3\text{i} \qquad z_2 = p+q\text{i} \qquad p,q \in \mathbb{R}$		
	$\lvert z_1 \rvert = \sqrt{3^2+3^2}$ $\lvert z_1 z_2 \rvert = \lvert z_1 \rvert \lvert z_2 \rvert \Rightarrow \lvert z_2 \rvert \sqrt{18} = 15\sqrt{2} \Rightarrow \lvert z_2 \rvert = \ldots$	Attempts $\lvert z_1 \rvert$ using Pythagoras and uses $\lvert z_1 z_2 \rvert = \lvert z_1 \rvert \lvert z_2 \rvert$ to find $\lvert z_2 \rvert$	M1
	$\lvert z_2 \rvert = 5$	Cao	A1
			(2)
ALT	$\lvert z_1 z_2 \rvert = 15\sqrt{2}$ $\lvert (3p-3q)+\text{i}(3p+3q) \rvert = 15\sqrt{2}$ $\sqrt{18p^2+18q^2} = 15\sqrt{2}$ $p^2+q^2 = 25$ $\lvert z_2 \rvert = \sqrt{p^2+q^2} = 5$	Uses $\lvert z_1 z_2 \rvert = \lvert z_1 \rvert \lvert z_2 \rvert$ to reach $p^2+q^2 = \ldots$	M1 A1 **(2)**
(b)	$\lvert z_2 \rvert = 5 \Rightarrow p^2+q^2 = 25$ $\Rightarrow (-4)^2+q^2 = 25 \Rightarrow q = \ldots$	Uses $p^2+q^2 = \text{"}5\text{"}^2$ with $p = \pm 4$ leading to a value for *q*.	M1
	$q = \pm 3$	Both values. Must be clear $p = 4$ has not been used	A1
			(2)
(c)	 Points to be in the correct quadrants and either with correct numbers on the axes or labelled correctly	3 + 3i plotted correctly and labelled Vectors/ lines not needed; point(s) alone are sufficient	B1
		A conjugate pair plotted correctly following through their *q*.	B1ft
			(2)
			Total 6

<table>
<tr><th>Question Number</th><th>Scheme</th><th>Notes</th><th>Marks</th></tr>
<tr><td>2</td><td colspan="2">$\mathrm{f}(x)=10-2x-\dfrac{1}{2\sqrt{x}}-\dfrac{1}{x^3} \qquad x>0$</td><td></td></tr>
<tr><td rowspan="3">(a)</td><td>$\mathrm{f}(0.4)=-7.21\ldots,\ \mathrm{f}(0.5)=0.292\ldots$</td><td>Attempts both f(0.4) and f(0.5)</td><td>M1</td></tr>
<tr><td>Sign change (positive, negative) and $\mathrm{f}(x)$ is continuous therefore (a root) α is between $x=0.4$ and $x=0.5$</td><td>Both f(0.4) = awrt -7 and f(0.5) = awrt 0.3, sign change and conclusion. Must mention continuity. Can have $\mathrm{f}(0.4)\times \mathrm{f}(0.5)<0$ instead of "sign change"</td><td>A1</td></tr>
<tr><td></td><td></td><td>(2)</td></tr>
<tr><td rowspan="4">(b)</td><td rowspan="3">$\mathrm{f}'(x)=-2+\dfrac{1}{4}x^{-\frac{3}{2}}+3x^{-4}$</td><td>$x^n\to x^{n-1}$ in at least 1 term other than 10</td><td>M1</td></tr>
<tr><td>2 of the 3 terms shown correct</td><td>A1</td></tr>
<tr><td>All correct</td><td>A1</td></tr>
<tr><td></td><td></td><td>(3)</td></tr>
<tr><td rowspan="3">(c)</td><td>$x_1=0.5-\dfrac{\mathrm{f}(0.5)}{\mathrm{f}'(0.5)}=0.5-\dfrac{0.29289321\ldots}{46.70710678\ldots}$</td><td>Correct application of Newton-Raphson</td><td>M1</td></tr>
<tr><td>= 0.494</td><td>Correct value 3dp. A correct derivative must have been used</td><td>A1</td></tr>
<tr><td></td><td></td><td>(2)</td></tr>
<tr><td rowspan="3">(d)</td><td>$\dfrac{4.9-\beta}{\lvert \mathrm{f}(4.9)\rvert}=\dfrac{\beta-4.8}{\mathrm{f}(4.8)}\Rightarrow \beta=\ldots$</td><td>Uses a correct interpolation method (Signs to be correct)</td><td>M1</td></tr>
<tr><td>$\beta=4.883$</td><td>Correct value 3dp unless penalised in (c)</td><td>A1</td></tr>
<tr><td colspan="2"></td><td>(2)</td></tr>
<tr><td rowspan="3">ALT 1</td><td>$\beta=\dfrac{a\lvert \mathrm{f}(b)\rvert+b\lvert \mathrm{f}(a)\rvert}{\lvert \mathrm{f}(a)\rvert+\lvert \mathrm{f}(b)\rvert}$
$\beta=\dfrac{4.8\times 0.0344+4.9\times 0.1627}{0.0344+0.1627}=\ldots$</td><td>Uses a correct interpolation method (Signs to be correct)</td><td>M1</td></tr>
<tr><td>$\beta=4.883$</td><td>Correct value 3dp unless penalised in (c)</td><td>A1</td></tr>
<tr><td colspan="2"></td><td>(2)</td></tr>
<tr><td rowspan="3">ALT 2</td><td>Gradient = $\dfrac{-0.0344-0.1627}{4.9-4.8}=-1.971$
Equation of line: $y-0.1627=-1.971(x-4.8)$
or $y=-1.971+9.6235$
Substitute $y=0$ $x=\ldots$</td><td>Complete method for line equation followed by substitution to obtain a value for x</td><td>M1</td></tr>
<tr><td>$\beta=4.883$</td><td>Correct value 3dp unless penalised in (c)</td><td>A1</td></tr>
<tr><td></td><td></td><td>(2)</td></tr>
<tr><td></td><td colspan="2"></td><td>Total 9</td></tr>
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Question Number	Scheme	Notes	Marks
3(a)	$\mathbf{M}^{-1}=\dfrac{1}{5k-3k}\begin{pmatrix}5 & -k\\ -3 & k\end{pmatrix}$	Attempts $\mathbf{M}^{-1}=\dfrac{1}{\det\mathbf{M}}\times\operatorname{adj}(\mathbf{M})$ Either part correct but $\operatorname{adj}(\mathbf{M})=\mathbf{M}$ scores M0	M1
	$=\dfrac{1}{2k}\begin{pmatrix}5 & -k\\ -3 & k\end{pmatrix}$ or $\begin{pmatrix}\dfrac{5}{2k} & -\dfrac{1}{2}\\ \dfrac{-3}{2k} & \dfrac{1}{2}\end{pmatrix}$	Correct matrix $2k$ must be seen for this mark	A1
			(2)
(b)	$(\mathbf{MN})^{-1}=\mathbf{N}^{-1}\mathbf{M}^{-1}=\dfrac{1}{2k}\begin{pmatrix}k & k\\ 4 & -1\end{pmatrix}\begin{pmatrix}5 & -k\\ -3 & k\end{pmatrix}$	Applies $(\mathbf{MN})^{-1}=\mathbf{N}^{-1}\mathbf{M}^{-1}$	M1
	$=\dfrac{1}{2k}\begin{pmatrix}2k & 0\\ 23 & -5k\end{pmatrix}$ or e.g. $\begin{pmatrix}1 & 0\\ \dfrac{23}{2k} & \dfrac{-5}{2}\end{pmatrix}$	Correct matrix	A1
			(2)
ALT (b)	Find **N** (ie inverse of $\mathbf{N}^{-1}$) Find **MN** $=-\dfrac{1}{5k}\begin{pmatrix}-5k & 0\\ -23 & 2k\end{pmatrix}$ Find $(\mathbf{MN})^{-1}$	Complete method needed	M1
	$=\dfrac{1}{2k}\begin{pmatrix}2k & 0\\ 23 & -5k\end{pmatrix}$ or e.g. $\begin{pmatrix}1 & 0\\ \dfrac{23}{2k} & \dfrac{-5}{2}\end{pmatrix}$	Correct matrix	A1
			(2)
			Total 4

Question Number	Scheme	Notes	Marks
4	$\mathrm{f}(z) = 2z^4 - 19z^3 + Az^2 + Bz - 156$		
(a)	$(z=)5+\mathrm{i}$	Correct complex number	B1
			(1)
	Mark (b) and (c) together – ignore any labelling seen. **Award marks in the order given for their choice of method**		
(b)/(c) With (b) first	$z = 5 \pm \mathrm{i} \Rightarrow (z-(5+\mathrm{i}))(z-(5-\mathrm{i})) = ...$ Or e.g. Sum of roots = 10 Product of roots = 26	Correct strategy to find the quadratic factor using the conjugate pair	M1
	$z^2 - 10z + 26$	Correct quadratic	A1
	$\mathrm{f}(z) = (z^2 - 10z + 26)(2z^2 + ...z + k)$	Attempts to find the other quadratic. May use inspection (apply rules for quadratic factorisation ie $"26"\lvert k \rvert = 156$) or e.g. long division with quotient $2z^2 + ...z + ...$	M1
	NB long division gives quotient $2z^2 + z + (A - 42)$ and remainder $(10A + B - 446)z + 936 - 26A$		
	$2z^2 + z - 6$	Correct quadratic	A1
	$\Rightarrow z = \frac{3}{2},\ -2\ \ (, 5 \pm \mathrm{i})$	Correct real roots. The complex roots do not have to be stated.	A1
			(5)
	$\mathrm{f}(z) = (z^2 - 10z + 26)(2z^2 + z - 6)$ $= \dots$	Multiplies out both quadratics or extracts the terms needed	M1
	$A = 36$, $B = 86$	Correct values (can be seen in the quartic equation)	A1
			(2)
			Total 8
(b)/(c) With (c) first	$952+960\mathrm{i}-2090-24A+10A\mathrm{i}+5B\mathrm{i}-156=0$	Substitute $(5+\mathrm{i})$ into the quartic (by calculator) and equate real and imag parts (can be done with $(5-\mathrm{i})$)	M1
	$-1294+24A+5B=0$ $-446+10A+B=0$	Correct equations	A1
	$A=36\ \ B=86$	M1 Solve simultaneously A1 One correct A1 Both correct	M1 A1A1
			(5)
	$2z^4 - 19z^3 + 36z^2 + 86z - 156 = 0$ $z = ...$	Solve the equation by long division, inspection or by calculator	M1
	$\Rightarrow z = \frac{3}{2},\ -2\ \ (, 5 \pm \mathrm{i})$	Correct real roots. The complex roots do not have to be stated.	A1
			(2)
			Total 8

Question Number	Scheme	Notes	Marks
5	$2x^2 - 3x + 5 = 0$		
(a)	$\alpha+\beta=\frac{3}{2}, \quad \alpha\beta=\frac{5}{2}$	Both	B1
			(1)
(b)(i)	$\alpha^2+\beta^2=(\alpha+\beta)^2-2\alpha\beta$	Uses a correct identity	M1
	$=\left(\frac{3}{2}\right)^2-2\left(\frac{5}{2}\right)=-\frac{11}{4}\ (=-2.75)$	Correct value Allow to come from $\alpha+\beta=-\frac{3}{2}$	A1
(ii)	$\alpha^3+\beta^3=(\alpha+\beta)^3-3\alpha\beta(\alpha+\beta)$	Reaches an identity ready for substitution	M1
	$=\left(\frac{3}{2}\right)^3-3\left(\frac{3}{2}\right)\left(\frac{5}{2}\right)=-\frac{63}{8}\ (=-7.875)$	Correct value	A1
			(4)
(c)	$\text{Sum}=\alpha^3+\beta^3-(\alpha+\beta)=-\frac{63}{8}-\frac{3}{2}\left(=-\frac{75}{8}\right)$	Attempts sum Allow eg $(\alpha^3-\beta)+(\beta^3-\alpha)$ followed by $(\alpha^3+\beta^3)+(\alpha+\beta)=\ldots$	M1
	$\text{Prod}=(\alpha\beta)^3-\alpha^4-\beta^4+\alpha\beta$ and $\alpha^4+\beta^4=(\alpha^2+\beta^2)^2-2(\alpha\beta)^2$	Expands $(\alpha^3-\beta)(\beta^3-\alpha)$ and uses a correct identity for $\alpha^4+\beta^4$	M1
	Alt identities: $\alpha^4+\beta^4=$ $(\alpha+\beta)^4-4\alpha\beta(\alpha^2+\beta^2)-6\alpha^2\beta^2;\ \alpha^4+\beta^4=(\alpha^3+\beta^3)(\alpha+\beta)-\alpha\beta(\alpha^2+\beta^2)$		
	$(\alpha\beta)^3-\alpha^4-\beta^4+\alpha\beta=\left(\frac{5}{2}\right)^3+\frac{5}{2}-\left(\left(-\frac{11}{4}\right)^2-2\left(\frac{5}{2}\right)^2\right)=\frac{369}{16}$		A1
	$x^2+\frac{75}{8}x+\frac{369}{16}(=0)$	Applies x^2 – (their sum)x + their prod (= 0)	M1
	$16x^2+150x+369=0$	Allow any integer multiple	A1
			(5)
			Total 10

Question Number	Scheme	Notes	Marks
6(a)	$x=9t^2, y=18t \Rightarrow \frac{dy}{dx}=\frac{18}{18t}$ or $y^2=36x \Rightarrow 2y\frac{dy}{dx}=36 \Rightarrow \frac{dy}{dx}=\frac{18}{y}=\frac{18}{18t}$ or $y^2=36x \Rightarrow y=6\sqrt{x} \Rightarrow \frac{dy}{dx}=\frac{3}{\sqrt{x}}=\frac{3}{3t}$	Correct $\frac{dy}{dx}$ in terms of t There must be evidence of use of calculus ($\frac{dy}{dx}=\frac{1}{t}$ with no working scores B0)	B1
	$m_T=\frac{1}{t} \Rightarrow m_N=-t$	Correct use of the perpendicular gradient rule.	M1
	$y-18t=-t\left(x-9t^2\right)$	Correct straight line method for the normal. Must use their perpendicular gradient – not dy/dx. (Any complete method – use of $y = mx + c$ requires an attempt at "c")	dM1
	$y+tx=9t^3+18t$ *	Cso All previous marks must have been earned	A1*
			(4)
(b)	$x=54, y=0 \Rightarrow 54t=9t^3+18t$ $\Rightarrow 9t^3-36t=0$	Substitutes x = 54 and y = 0 into the equation from part (a) and attempts to collect terms.	M1
	$9t^3-36t=0 \Rightarrow 9t\left(t^2-4\right)=0$ $\Rightarrow t=\pm 2 \Rightarrow y \pm 2x=9(\pm 2)^3+18(\pm 2)$	Solves to obtain at least one non zero value for t and attempts at least one normal equation	dM1
	$y=-2x+108$ **or** $y=2x-108$	One correct equation in any equivalent form	A1
	$y=-2x+108$ **and** $y=2x-108$	Both correct and in the required form	A1
			(4)
(c)	$x=-9 \Rightarrow y=18+108$ or $-18-108$	Uses x = –9 to find the y coordinate of A or B	M1
	Area = $\frac{1}{2}\times 252\times 18$	Fully correct strategy for the area Award M0 if their x coord of the focus is not doubled	M1
	= 2268	Cao	A1
			(3)
			Total 11
ALT	Last 2 marks by "shoelace" method: eg $\left\lvert \frac{1}{2}\begin{vmatrix} -9 & 9 & -9 & -9 \\ 126 & 0 & -126 & 126 \end{vmatrix} \right\rvert$ $=\left\lvert \frac{1}{2}\left(9\times -126-9\times 126-\left(-9\times -126+9\times 126\right)\right) \right\rvert$	Their coordinates with first and last the same ½ must be included Attempt to expand also needed	M1
	= 2268	Must be positive	A1

Question Number	Scheme	Notes	Marks
7(a)	$\mathbf{A}^2 = \begin{pmatrix} \frac{1}{2} & \frac{\sqrt{3}}{2} \\ -\frac{\sqrt{3}}{2} & \frac{1}{2} \end{pmatrix}$	Correct matrix	B1
			(1)
(b)	Rotation –60° (anticlockwise) about the origin	Rotation	M1
		–60° (anticlockwise) (Or 60° clockwise or 300° (anticlockwise)) about (0, 0)	A1
			(2)
(c)	$n = 12$	Cao but can be embedded ie $A^{12} = I$	B1
			(1)
(d)	$\mathbf{B} = \begin{pmatrix} 4 & 0 \\ 0 & 1 \end{pmatrix}$	Correct matrix	B1
			(1)
(e)	$\mathbf{C} = \mathbf{BA} = \begin{pmatrix} 4 & 0 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} -\frac{\sqrt{3}}{2} & -\frac{1}{2} \\ \frac{1}{2} & -\frac{\sqrt{3}}{2} \end{pmatrix}$	Multiplies the right way round.	M1
	$\mathbf{C} = \begin{pmatrix} -2\sqrt{3} & -2 \\ \frac{1}{2} & -\frac{\sqrt{3}}{2} \end{pmatrix}$	Correct matrix Accept unsimplified	A1
			(2)
(f)	$\det \mathbf{C} = -2\sqrt{3} \times -\frac{\sqrt{3}}{2} - \frac{1}{2}(-2) = 4$ So area of P is $\frac{20}{\det \mathbf{C}} = ...$	Attempts determinant of **C** (or deduces area scale factor is 4) and divides into 20	M1
	$= 5$	Cao Must follow a correct matrix in (e)	A1
			(2)
			Total 9

Question Number	Scheme	Notes	Marks
8	$\sum_{r=0}^{n}(r+1)(r+2)$		
(a)	$\sum_{r=0}^{n} r^2+3r+2 \ = 2+\frac{1}{6}n(n+1)(2n+1)+\frac{3}{2}n(n+1)+2n$ M1: Attempt to use at least one of the standard formulae correctly A1: For $\frac{1}{6}n(n+1)(2n+1)+\frac{3}{2}n(n+1)+(2n \text{ or } 2n+2)$ A1:Fully correct expression		M1A1A1
	$\frac{1}{6}n(n+1)(2n+1)+\frac{3}{2}n(n+1)+2n+2=(n+1)\left[\frac{1}{6}n(2n+1)+\frac{3}{2}n+2\right]$ Attempt to factorise $(n+1)$ It is a "show" question so this must be seen (in any equivalent form). If their expression does not allow for factorising $(n+1)$ score M0		M1
	$\frac{1}{3}(n+1)\left[n^2+5n+6\right]$	May obtain a cubic and extract a different factor ie $n + 2$ or $n + 3$	
	$\frac{1}{3}(n+1)(n+2)(n+3)$*	Cso At least one intermediate step in the working must be seen.	A1*
			(5)
(a) Way 2	$\sum_{r=0}^{n}(r+1)(r+2) \ = \sum_{r=1}^{n+1}r(r+1)$ $=\sum_{r=1}^{n+1}r^2+r=\frac{1}{6}(n+1)(n+2)(2(n+1)+1)+\frac{1}{2}(n+1)(n+2)$ M1: Attempt to use at least one of the standard formulae correctly with $n = n + 1$ A1: For $\frac{1}{6}(n+1)(n+2)(2(n+1)+1)$ or $\frac{1}{2}(n+1)(n+2)$ A1:Fully correct expression		M1A1A1
	$\frac{1}{6}(n+1)(n+2)(2(n+1)+1)+\frac{1}{2}(n+1)(n+2)=(n+1)\left[\frac{1}{6}(n+1)(2n+3)+\frac{1}{2}(n+2)\right]$ Attempt to factorise $(n+1)$ (see additional comments above)		M1
	$\frac{1}{3}(n+1)\left[n^2+5n+6\right]$	May obtain a cubic and extract a different factor ie $n + 2$ or $n + 3$	
	$\frac{1}{3}(n+1)(n+2)(n+3)$*	Cso At least one intermediate step in the working must be seen.	A1*
(b)	Upper limit = 99	Correct upper limit	B1
	$10\times11+11\times12+12\times13+...+100\times101=\sum_{r=0}^{99}(r+1)(r+2)-\sum_{r=0}^{8}(r+1)(r+2)$ Fully correct strategy for the sum using their upper limit for the first sum and upper limit 8 for the second in the result from (a). Lower limits 0 or 1		M1
	$=\frac{1}{3}(100)(101)(102)-\frac{1}{3}(9)(10)(11)$ = 343 070	Correct value	A1

			(3)
			Total 8

Question Number	Scheme	Notes	Marks
9(i)	$u_n = 5\times 2^{n-1} - n\times 2^n$		
	$n=1 \Rightarrow u_1 = 5\times 2^0 - 1\times 2 = 3$ (Shows the result is true for n = 1)		B1
	Assume true for n = k so that $u_k = 5\times 2^{k-1} - k\times 2^k$		
	$u_{k+1} = 2\left(5\times 2^{k-1} - k\times 2^k\right) - 2^{k+1}$	Attempts u_{k+1} using the recurrence relationship	M1
	$= 5\times 2^k - k\times 2^{k+1} - 2^{k+1}$	Correct expanded expression	A1
	$= 5\times 2^k - (k+1)2^{k+1}$	Achieves this result with no errors	A1
	If the result is true for n = k then it is true for n = k + 1. As the result has been shown to be true for n = 1, then the result is true for all n.		A1cso
	The final mark depends on all except the B mark, though a check for n = 1 must have been attempted.		
			(5)
(ii)	$\mathrm{f}(n) = 5^{n+2} - 4n - 9$		
	$\mathrm{f}(1) = 125 - 4 - 9 = 112 = 16\times 7$	Shows f(1) is divisible by 16 Either of 112 or 16×7 must be seen	B1
	Assume true for n = k so that $5^{k+2} - 4k - 9$ is divisible by 16		
	$\mathrm{f}(k+1) = 5^{k+3} - 4(k+1) - 9$	Attempts f(k + 1)	M1
	$= 5\times\left(5^{k+2} - 4k - 9\right) + ...$	Attempts to express in terms of f(k)	dM1
	$= 5\times\left(5^{k+2} - 4k - 9\right) + 16k + 32$	Correct expression for f(k + 1)	A1
	If the result is true for n = k then it is true for n = k + 1. As the result has been shown to be true for n = 1, then the result is true for all n.		A1cso
	The final mark depends on all except the B mark, though a check for n = 1 must have been attempted		**(5)**
			Total 10

ii ALT 1	$\mathrm{f}(1) = 125 - 4 - 9 = 112 = 16 \times 7$	Shows f(1) is divisible by 16 Either of 112 or 16×7 must be seen	B1
	Assume $5^{k+2} - 4k - 9$ is divisible by 16		
	$\mathrm{f}(k+1) - m\mathrm{f}(k) = 5^{k+3} - 4(k+1) - 9 - m(5^{k+2} - 4k - 9)$ Attempt f(k+1) – mf(k)		M1
	$= (5 - m)(5^{k+2} - 4k - 9) + ...$	Attempts to express in terms of f(k)	dM1
	$\mathrm{f}(k+1) = 5 \times (5^{k+2} - 4k - 9) + 16k + 32$	Correct expression for f(k + 1)	A1
	If the result is true for n = k then it is true for n = k + 1. As the result has been shown to be true for n = 1, then the result is true for all n.		A1cso
	The final mark depends on all except the B mark, though a check for n = 1 must have been attempted		
ii ALT 2	$\mathrm{f}(1) = 125 - 4 - 9 = 112 = 16 \times 7$	Shows f(1) is divisible by 16 Either of 112 or 16×7 must be seen	B1
	Assume $5^{k+2} - 4k - 9$ is divisible by 16		
	$\mathrm{f}(k+1) - \mathrm{f}(k) = 5^{k+3} - 4(k+1) - 9 - (5^{k+2} - 4k - 9)$ Attempt f(k+1) – f(k)		M1
	$\mathrm{f}(k+1) - \mathrm{f}(k) = 5 \times 5^{k+2} - 5^{k+2} - 4k - 4 - 9 + 4k + 9$ $= 4 \times 5^{k+2} - 4 = 4(5^{k+2} - 1)$ Obtains a simplified expression for the difference **and** attempts to prove $(5^{k+2} - 1)$ is divisible by 4 using induction		dM1
	Correct proof for $(5^{k+2} - 1)$ being divisible by 4 and states that thus as the difference is divisible by 16, $\mathrm{f}(k+1)$ is divisible by 16		A1
	If the result is true for n = k then it is true for n = k + 1. As the result has been shown to be true for n = 1, then the result is true for all n.		A1 cso
	The final mark depends on all except the B mark, though a check for n = 1 must have been attempted		
ii ALT 3	$\mathrm{f}(1) = 125 - 4 - 9 = 112 = 16 \times 7$	Shows f(1) is divisible by 16 Either of 112 or 16×7 must be seen	B1
	f(k) is divisible by 16 so set $\mathrm{f}(k) = 16\lambda$		
	$5^{k+2} = 16\lambda + 4k + 9$		M1
	$\mathrm{f}(k+1) = 5^{k+3} - 4(k+1) - 9$ $= 5 \times 5^{k+2} - 4k - 13 = 5(16\lambda + 4k + 9) - 4k - 13$	Expresses f(k + 1) in terms of λ and k and collects terms	dM1
	$= 80\lambda + 16k + 32$	Correct expression May have factor of 16 taken out	A1
	If the result is true for n = k then it is true for n = k + 1. As the result has been shown to be true for n = 1, then the result is true for all n.		A1cso
	The final mark depends on all except the B mark, though a check for n = 1 must have been attempted		