Question			Answer	Marks	Guidance	
1			use of $f(2)$	M1	2 substituted in $f(x)$ or $f(2) = 42$ seen or correct division of $4x^3 + kx + 6$ by $x - 2$ as far as obtaining $4x^2 + 8x + (k + 16)$ oe [may have $4x^2 + 8x + 18$]	
			$4 \times 2^3 + 2k + 6 = 42$	M1	or $6 + 2(k + 16) = 42$ oe or finding (usually after division) that the constant term is 36 and then working with the x term to find k eg $kx + 16x = 18x$	
			$k = 2$	A1		
			$[x =] -1$	A1	as their answer, not just a trial; A0 for just $f(-1) = 0$ with no further statement A0 if confusion between roots and factors in final statement eg '$x + 1$ is a root', even if they also state $x = -1$	accept with no working since it can be found by inspection
				[4]		

2			f(2) = 18 seen or used	M1	or long division oe as far as obtaining a remainder (ie not involving x) and equating that remainder to 18 (there may be errors along the way)	
			$32 + 2k - 20 = 18$ oe	A1	after long division: $2(k + 16) - 20 = 18$ oe	A0 for just 2^5 instead of 32 unless 32 implied by further work
			[k =] 3	A1 **[3]**		

3	**(i)**		$3n$ isw	1 **[1]**	accept equivalent general explanation	
3	**(ii)**		at least one of $(n - 1)^2$ and $(n + 1)^2$ correctly expanded	M1	must be seen	M0 for just $n^2 + 1 + n^2 + n^2 + 1$
			$3n^2 + 2$	B1		accept even if no expansions / wrong expansions seen
			comment eg $3n^2$ is always a multiple of 3 so remainder after dividing by 3 is always 2	B1 **[3]**	dep on previous B1 B0 for just saying that 2 is not divisible by 3 – ust comment on $3n^2$ term as well allow B1 for $\frac{3n^2+2}{3} = n^2 + \frac{2}{3}$	SC: n, $n + 1$, $n + 2$ used similarly can obtain first M1, and allow final B1 for similar comment on $3n^2 + 6n + 5$

4	**(i)**		f(1) = 1–1 +1 + 9 – 10 [= 0]	B1	allow for correct division of f(x) by (x – 1) showing there is no remainder, or for (x − 1)($x^3 + x + 10$) found, showing it 'works' by multiplying it out	condone $1^4 - 1^3 + 1^2 + 9 - 10$
			attempt at division by (x − 1) as far as $x^4 - x^3$ in working	M1	allow equiv for (x + 2) as far as $x^4 + 2x^3$ in working or for inspection with at least two terms of cubic factor correct	eg for inspection, M1 for two terms right and two wrong
			correctly obtaining $x^3 + x + 10$	A1 **[3]**	or $x^3 - 3x^2 + 7x - 5$	if M0 and this division / factorising is done in part (ii) or (iii), allow SC1 if correct cubic obtained there; attach the relevant part to (i) with a formal chain link if not already seen in the image zone for (i)

Question			Answer	Marks	Guidance	
4	**(ii)**		[g(–2) =] –8 – 2 + 10 or f(–2) = 16 + 8 + 4 – 18 – 10	M1	[in this scheme $g(x) = x^3 + x + 10$] allow M1 for correct trials with at least two values of x (other than 1) using $g(x)$ or $f(x)$ or $x^3 - 3x^2 + 7x - 5$ (may allow similar correct trials using division or inspection)	eg f(2) = 16 – 8 + 4 + 18 – 10 or 20 f(3) = 81 – 27 + 9 + 27 – 10 or 80 f(0) = – 10 f(–1) = 1 + 1 + 1 – 9 – 10 or –16 No ft from wrong cubic 'factors' from (i)
			$x = -2$ isw	A1	allow these marks if already earned in (i)	
						NB factorising of $x^3 + x + 10$ or $x^3 - 3x^2 + 7x - 5$ in (ii) earns credit for (iii) [annotate with a yellow line in both parts to alert you – the image zone for (iii) includes part (ii)]
				[2]		

Question			Answer	Marks	Guidance	
4	(iii)		attempted division of $x^3 + x + 10$ by $(x + 2)$ as far as $x^3 + 2x^2$ in working	M1	or $x^3 - 3x^2 + 7x - 5$ by $(x - 1)$ as far as $x^3 - x^2$ in working or inspection with at least two terms of quadratic factor correct	alt method: allow M1 for attempted division of quartic by $x^2 + x - 2$ as far as $x^4 + x^3 - 2x^2$ in working, or inspection etc
			correctly obtaining $x^2 - 2x + 5$	A1	allow these first 2 marks if this has been done in (ii), even if not used here	
			use of $b^2 - 4ac$ with $x^2 - 2x + 5$	M1	may be in attempt at formula (ignore rest of formula)	or completing square form attempted or attempt at calculus or symmetry to find min pt NB M0 for use of $b^2 - 4ac$ with cubic factor etc
			$b^2 - 4ac = 4 - 20$ [$= -16$]	A1	may be in formula;	or $(x - 1)^2 + 4$ or min = (1, 4)
			so only two real roots[of f(x)] [and hence no more linear factors]	A1	or no real roots of $x^2 - 2x + 5 = 0$; allow this last mark if clear use of $x^2 - 2x + 5 = 0$, even if error in $b^2 - 4ac$, provided result negative, but no ft from wrong factor if last M1 not earned, allow SC1 for stating that the only factors of 5 are 1 and 5 and reasoning eg that $(x - 1)(x - 5)$ and $(x + 1)(x + 5)$ do not give $x^2 - 2x + 5$ [hence $x^2 - 2x + 5$ does not factorise]	or $(x - 1)^2 + 4$ is always positive so no real roots [of $(x - 1)^2 + 4 = 0$] [and hence no linear factors] or similar conclusion from min pt
				[5]		

5			$16 + 2b + c = 0$ oe	M1	need not be simplified; condone 8 or 32 as first term if 2^4 not seen	in this question use annotation to indicate where part marks are earned
			$81 - 3b + c = 85$ oe	B2	M1 for f(–3) seen or used, condoning one error except $+3b$ – need not be simplified or for long division as far as obtaining $x^3 - 3x^2$ in quotient	eg M1 for $81 - 3b + c = 0$ 'long division' may be seen in grid or a mixture of methods may be used eg B2 for $c - 3(b - 27) = 85$
			$20 + 5b = 0$ oe	M1	for elimination of one variable, ft their equations in b and c, condoning one error in rearrangement of their original equations or in one term in the elimination	correct operation must be used in elimination
			$b = -4$ and $c = -8$	A1 **[5]**	allow correct answers to imply last M1 after correct earlier equations	for misread of x^4 as x^3 or x^2 or higher powers, allow all 3 Ms equivalently

Question			er	Marks	Guidance	
6			6*n* + 9 isw or 3(2*n* + 3)	B1		
			6*n* is even [but 9 is odd], even + odd = odd or 2*n* + 3 is odd since even + odd = odd and odd × odd = odd	B1 dep	this mark is dependent on the previous B1 accept equiv. general statements using either 6*n* + 9 or 3(2*n* + 3)	
			‘*n* is a multiple of 3’ or ‘*n* is divisible by 3’ without additional incorrect statement(s)	B2 **[4]**	B2 for ‘it is divisible by 9, so *n* is divisible by 3’ M1 for ‘6*n* is divisible by 9’ or ‘2*n* + 3 is divisible by 3’ or for ‘*n* is a multiple of 3’ oe with additional incorrect statement(s)	B2 for just ‘it is divisible by 3’ but M1 for ‘it is divisible by 9, so it is divisible by 3’ eg M1 for ‘*n* is divisible by 9, so *n* is divisible by 3’ N.B. 0 for ‘*n* is a factor of 3’ (but M1 may be earned earlier)

7	$x + 2y = k$ ($k \neq 6$) or $y = -\frac{1}{2}x + c$ ($c \neq 3$)	**M1**	for attempt to use gradients of parallel lines the same; **M0** if just given line used;	eg following an error in manipulation, getting original line as $y = \frac{1}{2}x + 3$ then using $y = \frac{1}{2}x + c$ earns **M1** and can then go on to get **A0** for $y = \frac{1}{2}x - 4$, **M1** for (0, −4) **M1** for (8, 0) and **A0** for area of 16;
	$x + 2y = 12$ or [$y =$]$- \frac{1}{2}x + 6$ oe	**A1**	or **B2**; must be simplified; or evidence of correct 'stepping' using (10, 1) eg may be on diagram;	allow bod **B2** for a candidate who goes straight to $y = -\frac{1}{2}x + 6$ from $2y = -x + 6$; NB the equation of the line is not required; correct intercepts obtained will imply this **A1;**
	(12, 0) or ft	**M1**	or 'when $y = 0$, $x = 12$' etc or using 12 or ft as a limit of integration; intersections must ft from their line or 'stepping' diagram using their gradient	NB for intersections with axes, if both Ms are not gained, it must be clear which coord is being found eg **M0** for intn with x axis = 6 from correct eqn;; if the intersections are not explicit, they may be implied by the area calculation eg use of ht = 6 or the correct ft area found;
	(0, 6)or ft	**M1**	or integrating to give $-\frac{1}{4}x^2 + 6x$ or ft their line	allow ft from the given line as well as others for both these intersection Ms;
	36 [sq units] cao	**A1**	or **B3** www	NB **A0** if 36 is incorrectly obtained eg after intersection $x = -12$ seen (which earns **M0** from correct line);

8	$\frac{9y^{10}}{2x^2}$ oe as final answer	**3**	**1** for each 'term'; 27/6 gets 0 for first term if **0**, allow **B1** for $(3xy^4)^3 = 27x^3y^{12}$	allow eg $4.5x^{-2}y^{10}$

9	attempt at f(−3) $-27 + 18 - 15 + k = 6$ $k = 30$	**M1** **A1** **A1**	or **M1** for long division by $(x + 3)$ as far as obtaining $x^2 - x$ and **A1** for obtaining remainder as $k - 24$ (but see below) equating coefficients method: **M2** for $(x + 3)(x^2 - x + 8)$ [+6] o.e. (from inspection or division) eg M2 for obtaining $x^2 - x + 8$ as quotient in division

10	10 www	3	M1 for f(3) = 1 soi and A1 for $31 - 3k = 1$ or $27 - 3k = -3$ o.e. [a correct 3-term or 2-term equation] long division used: M1 for reaching $(9 - k)x + 4$ in working and A1 for $4 + 3(9 - k) = 1$ o.e. equating coeffts method: M2 for $(x - 3)(x^2 + 3x - 1)$ [+ 1] o.e. (from inspection or division)	3

11	$a = -5$ www	3	M1 for f(2) = 0 used and M1 for $10 + 2a = 0$ or better long division used: M1 for reaching $(8 + a)x - 6$ in working and M1 for $8 + a = 3$ equating coeffts method: M2 for obtaining $x^3 + 2x^2 + 4x + 3$ as other factor	3

12	f(2) used $2^3 + 2k + 7 = 3$ $k = -6$	M1 M1 A1	or division by $x - 2$ as far as $x^2 + 2x$ obtained correctly or remainder $3 = 2(4 + k) + 7$ o.e. 2nd M1 dep on first	3