1	$c = 6$ $k = -7$	1 2	M1 for f(2) = 0 used or for long division as far as $x^3 - 2x^2$ in working	3

2	(i) $x + 1)(2x - 3) = 9$ o.e. $2x^2 - x - 3 = 18$ or $x^2 - \frac{1}{2}x - 3/2 = 9$ (ii) $x - 7)(x + 3)$ -3 and 7/2 o.e. or ft their factors base 4, height 4.5 o.e. cao	M1 A1 B1 B1 B1	for clear algebraic use of ½ bh; condone $(x + 1)(2x - 3) = 18$ allow x terms uncollected. NB ans $2x^2 - x - 21 = 0$ given NB B0 for formula or comp. sq. if factors seen, allow omission of -3 B0 if also give $b = -9$, $h = -2$	5

3	f(2) = 3 seen or used $2^3 + 2k + 5 = 3$ o.e. $k = -5$	M1 M1 B1	allow M1 for divn by $(x - 2)$ with $x^2 + 2x + (k + 4)$ or $x^2 + 2x - 1$ obtained alt: M1 for $(x - 2)(x^2 + 2x - 1) + 3$ (may be seen in division) then M1dep (and B1) for $x^3 - 5x + 5$ alt divn of $x^3 + kx + 2$ by $x - 2$ with no rem.	3

4	f(1) used $1^3 + 3 \times 1 + k = 6$ $k = 2$	M1 A1 A1	or division by $x - 1$ as far as $x^2 + x$ or remainder = $4 + k$ B3 for $k = 2$ www	3

5	$5 + 2k$ soi $k = 12$ attempt at f(3) $27 + 36 + m = 59$ o.e. $m = -4$ cao	**M1** **A1** **M1** **A1** **A1**	allow M1 for expansion with $5x^3 + 2kx^3$ and no other x^3 terms or M1 for (29 – 5) / 2 soi must substitute 3 for x in cubic not product or long division as far as obtaining $x^2 + \; x$ in quotient or from division $m - (-63) = 59$ o.e. or for $27 + 3k + m = 59$ or ft their k

6 (i)	trials of at calculating f(x) for at least one factor of 30 details of calculation for f(2) or f(−3) or f(−5) attempt at division by (x − 2) as far as $x^3 - 2x^2$ in working correctly obtaining $x^2 + 8x + 15$ factorising a correct quadratic factor (x – 2)(x + 3)(x + 5)	**M1** **A1** **M1** **A1** **M1** **A1**	**M0** for division or inspection used or equiv for (x + 3) or (x + 5); or inspection with at least two terms of quadratic factor correct or B2 for another factor found by factor theorem for factors giving two terms of quadratic correct; M0 for formula without factors found condone omission of first factor found; ignore '= 0' seen allow last four marks for (x – 2)(x + 3)(x + 5) obtained; for all 6 marks must see factor theorem use first
6 (ii)	sketch of cubic right way up, with two turning points values of intns on x axis shown, correct (–5, –3, and 2) or ft from their factors/ roots in (i) y-axis intersection at −30	**B1** **B1** **B1**	0 if stops at x-axis on graph or nearby in this part mark intent for intersections with both axes or x = 0, y = −30 seen in this part if consistent with graph drawn

6 (iii)	$(x - 1)$ substituted for x in either form of eqn for $y = f(x)$ $(x - 1)^3$ expanded correctly (need not be simplified) or two of their factors multiplied correctly correct completion to given answer [condone omission of '$y =$']	**M1** **M1 dep** **M1**	correct or ft their (i) or (ii) for factorised form; condone one error; allow for new roots stated as $-4, -2$ and 3 or ft or **M1** for correct or correct ft multiplying out of all 3 brackets at once, condoning one error $[x^3 - 3x^2 + x^2 + 2x^2 + 8x - 6x - 12x - 24]$ unless all 3 brackets already expanded, must show at least one further interim step allow **SC1** for $(x + 1)$ subst <u>and</u> correct exp of $(x + 1)^3$ or two of their factors ft <u>or</u>, for those using given answer: **M1** for roots stated or used as $-4, -2$ and 3 or ft **A1** for showing all 3 roots satisfy given eqn **B1** for comment re coefft of x^3 or product of roots to show that eqn of translated graph is not a multiple of RHS of given eqn

7		f(–2) used –8 + 36 – 40 + 12 = 0	M1 A1	or M1 for division by (x + 2) attempted as far as $x^3 + 2x^2$ then A1 for $x^2 + 7x + 6$ with no remainder	2
	ii	divn attempted as far as $x^2 + 3x$ $x^2 + 3x + 2$ or $(x + 2)(x + 1)$	M1 A1	or inspection with $b = 3$ or $c = 2$ found; B2 for correct answer	2
	iii	$(x + 2)(x + 6)(x + 1)$	2	allow seen earlier; M1 for $(x + 2)(x + 1)$	2
	iv	sketch of cubic the right way up <u>through</u> 12 marked on y axis intercepts –6, –2, –1 on x axis	G1 G1 G1	with 2 turning pts; no 3rd tp curve must extend to $x > 0$ condone no graph for $x < -6$	3
	v	$[x](x^2 + 9x + 20)$ $[x](x + 4)(x + 5)$ $x = 0, -4, -5$	M1 M1 A1	or other partial factorisation or B1 for each root found e.g. using factor theorem	3