1	**(i)**		graph of cubic correct way up	B1	**B0** if stops at *x*-axis	must not have any ruled sections; no curving back; condone slight 'flicking out' at ends but not approaching a turning point; allow max on *y*-axis or in 1st or 2nd quadrants; condone some 'doubling' or 'feathering' (deleted work still may show in scans)
			crossing *x*-axis at –3, 2 and 5	B1	on graph or nearby; may be in coordinate form mark intent for intersections with both axes	allow if no graph, but marked on *x*-axis condone intercepts for *x* and / or *y* given as reversed coordinates
			crossing *y*-axis at 30	B1 **[3]**	or $x = 0$, $y = 30$ seen if consistent with graph drawn	allow if no graph, but eg B0 for graph with intn on *y*-axis nowhere near their indicated 30
1	**(ii)**		correct expansion of two of the linear factors	M1	may be 3 or 4 terms	condone lack of brackets if correct expansions as if they were there
			correct expansion and completion to given answer, $x^3 - 4x^2 - 11x + 30$	A1 **[2]**	must be working for this step before given answer	or for direct expansion of all three factors, allow M1 for $x^3 + 3x^2 - 2x^2 - 5x^2 - 6x - 15x + 10x + 30$, condoning an error in one term , and A1 if no error for completion by stating given answer

Question			Answer	Marks	Guidance	Question
1	(iii)		translation	B1	0 for shift or move etc without stating translation	0 if eg stretch also mentioned
			$\begin{pmatrix} 0 \\ -36 \end{pmatrix}$	B1	or 36 down, or –36 in *y* direction oe	if conflict, eg between '–36 in *y* direction' and wrong vector, award B0 0 for '–36 down'
				[2]		
1	(iv)		$-1-4+11-6=0$	B1	or **B1** for correct division by $(x+1)$ or for the quadratic factor found by inspection, <u>and</u> the conclusion that no remainder means that $g(-1)=0$	NB examiners must use annotation in this part; a tick where each mark is earned is sufficient
			attempt at division by $(x+1)$ as far as x^3+x^2 in working	M1	or inspection with at least two terms of three–term quadratic factor correct; or finding $f(6)=0$	M0 for trials of factors to give cubic unless correct answer found with clear correct working, in which case award the M1A1M1A1
			correctly obtaining x^2-5x-6	A1	or $(x-6)$ found as factor	
			factorising the correct quadratic factor x^2-5x-6, that has been correctly obtained	M1	for factors giving two terms of quadratic correct or for factors ft one error in quadratic formula or completing square; **M0** for formula etc without factors found for those who have used the factor theorem to find $(x-6)$, **M1** for working with cubic to find that $(x+1)$ is repeated	allow for $(x-6)$ and $(x+1)$ given as factors eg after quadratic formula etc
			$(x-6)(x+1)^2$ oe isw	A1	condone inclusion of '= 0'	isw roots found, even if stated as factors just the answer $(x-6)(x+1)^2$ oe gets last 4 marks
				[5]		

Question			Answer	Marks	Guidance	
2	**(i)**		$y = (x + 5)(x + 2)(2x - 3)$ or $y = 2(x + 5)(x + 2)(x - 3/2)$	2 **[2]**	M1 for $y = (x + 5)(x + 2)(x - 3/2)$ or $(x + 5)(x + 2)(2x - 3)$ with no equation or $(x + 5)(x + 2)(2x - 3) = 0$ but M0 for $y = (x + 5)(x + 2)(2x - 3) - 30$ or $(x + 5)(x + 2)(2x - 3) = 30$ etc	allow 'f(x) =' instead of 'y = ' ignore further work towards (ii) but do not award marks for (i) in (ii)
2	**(ii)**		correct expansion of a pair of their linear two-term factors ft isw correct expansion of the correct linear and quadratic factors and completion to given answer $y = 2x^3 + 11x^2 - x - 30$	M1 M1 **[2]**	ft their factors from (i); need not be simplified; may be seen in a grid must be working for this step before given answer or for direct expansion of all three factors, allow M2 for $2x^3 + 10x^2 + 4x^2 - 3x^2 + 20x - 15x - 6x - 30$ oe (M1 if one error) or M1M0 for a correct direct expansion of $(x + 5)(x + 2)(x - 3/2)$ condone lack of brackets if used as if they were there	allow only first M1 for expansion if their (i) has an extra −30 etc do not award 2nd mark if only had $(x - 3/2)$ in (i) and suddenly doubles RHS at this stage condone omission of 'y =' or inclusion of '= 0' for this second mark (some cands have already lost a mark for that in (i)) allow marks if this work has been done in part (i) – mark the copy of part (i) that appears below the image for part (ii)

Question			Answer	Marks	Guidance	
2	**(iii)**		ruled line drawn through (–2, 0) and (0, 10) and long enough to intersect curve at least twice –5.3 to –5.4 and 1.8 to 1.9	B1 B2 **[3]**	tolerance half a small square on grid at (–2, 0) and (0, 10) B1 for one correct ignore the solution –2 but allow B1 for both values correct but one extra or for wrong 'coordinate' form such as (1.8, –5.3)	insert BP on spare copy of graph if not used, to indicate seen – this is included as part of image, so scroll down to see it accept in coordinate form ignoring any *y* coordinates given;
2	**(iv)**		$2x^3 + 11x^2 - x - 30 = 5x + 10$ $2x^3 + 11x^2 - 6x - 40$ [= 0] division by $(x + 2)$ and correctly obtaining $2x^2 + \ x - 20$ substitution into quadratic formula or for completing the square used as far as $x + \frac{7}{4}\ ^{2} = \frac{209}{16}$ oe $[x =]\frac{-7 \pm \sqrt{209}}{4}$ oe isw	M1 M1 M1 M1 A1 **[5]**	for equating curve and line; correct eqns only for rearrangement to zero, condoning one error or showing that $(x + 2)(2x^2 + 7x - 20) = 2x^3 + 1\ x^2 - 6x - 40$, with supporting working condone one error eg *a* used as 1 not 2, or one error in the formula, using given $2x^2 + 7x - 20 = 0$ dependent only on 4th M1	annotate this question if partially correct

3	**(i**		sketch of cubic the right way up, with two tps and clearly crossing the *x* axis in 3 places	B1		no section to be ruled; no curving back; condone slight 'flicking out' at ends but not approaching another turning point; condone some doubling (eg erased curves may continue to show); accept min tp on *y*-axis or in 3rd or 4th quadrant; curve must clearly extend beyond the *x* axis at both 'ends'
			crossing/reaching the *x*-axis at –4, –2 and 1.5	B1	intersections must be shown correctly labelled or worked out nearby; mark intent	accept curve crossing axis halfway between 1 and 2 if 3/2 not marked
			intersection of *y*-axis at –24	B1 **[3]**		NB to find –24 some are expanding f(*x*) here, which gains M1 in iiiA. If this is done, put a yellow line here and by (iii)A to alert you; this image appears again there
3	**(ii**		–2, 0 and 7/2 oe isw or ft their intersections	2 **[2]**	B1 for 2 correct or ft or for (–2, 0) (0, 0) and (3.5, 0) or M1 for $(x + 2)\,x\,(2x - 7)$ oe or SC1 for –6, –4 and –1/2 oe	

3	**(iii**	(*A*)	correct expansion of product of 2 brackets of f(x)	M1	need not be simplified; condone lack of brackets for M1 or allow M1 for expansion of all 3 brackets, showing all terms, with at most one error: $2x^3 + 4x^2 + 8x^2 - 3x^2 + 16x - 12x - 6x - 24$	eg $2x^2 + 5x - 12$ or $2x^2 + x - 6$ or $x^2 + 6x + 8$ may be seen in (i) – allow the M1; the part (i) work appears at the foot of the image for (iii)A, so mark this rather than in (i)
			correct expansion of quadratic and linear and completion to given answer	A1 **[2]**	for correct completion if all 3 brackets already expanded, with some reference to show why –24 changes to –9	condone lack of brackets if they have gone on to expand correctly; condone '+15' appearing at some stage NB answer given; mark the whole process

3	**(iii**	(*B*)	$g(1) = 2 + 9 - 2 - 9$ [=0]	B1	allow this mark for $(x - 1)$ shown to be a factor and a statement that this means that $x = 1$ is a root [of $g(x) = 0$] oe	B0 for just $g(1) = 2(1)^3 + 9(1)^2 - 2(1) - 9$ [=0]
			attempt at division by $(x - 1)$ as far as $2x^3 - 2x^2$ in working	M1	or inspection with at least two terms of quadratic factor correct	M0 for division by $x + 1$ after $g(1) = 0$ unless further working such as $g(-1) = 0$ shown, but this can go on to gain last M1A1
			correctly obtaining $2x^2 + 11x + 9$	A1	allow B2 for another linear factor found by the factor theorem	NB mixture of methods may be seen in this part – mark equivalently eg three uses of factor theorem, or two uses plus inspection to get last factor;
			factorising a correct quadratic factor	M1	for factors giving two terms correct; eg allow M1 for factorising $2x^2 + 7x - 9$ after division by $x + 1$	allow M1 for $(x + 1)(x + 18/4)$ oe after -1 and $-18/4$ oe correctly found by formula
			$(2x + 9)(x + 1)(x - 1)$ isw	A1 **[5]**	allow $2(x + 9/2)(x + 1)(x - 1)$ oe; dependent on 2nd M1 only; condone omission of first factor found; ignore '= 0' seen	SC alternative method for last 4 marks: allow first M1A1 for $(2x + 9)(x^2 - 1)$ and then second M1A1 for full factorisation

4	**(i)**		sketch of cubic the right way up, with two tps	B1		No section to be ruled; no curving back; condone some curving out at ends but not approaching another turning point; condone some doubling (eg erased curves may continue to show); ignore position of turning points for this mark
			their graph touching the x-axis at -2 and crossing it at 3 and no other places	B1	if intns are not labelled, they must be shown nearby	mark intent if 'daylight' between curve and axis at $x = -2$
			intersection of y-axis at -12	B1		if no graph but -12 marked on y-axis, or in table, allow this 3rd mark
				[3]		
4	**(ii)**		-5 and 0	B2	B1 each; allow B2 for -5, -5, 0; or B1 for both correct with one extra value or for $(-5, 0)$ and $(0, 0)$ or SC1 for both of 1 and 6	if their graph wrong, allow -5 and 0 from starting again with eqn, or ft their graph with two intns with x-axis
				[2]		

Question			Answer	Marks	Guidance	
5	(i)		$(2x + 1)(x + 2)(x - 5)$	M1	or $(x + 1/2)(x + 2)(x - 5)$; need not be written as product	throughout, ignore '=0'
			correct expansion of two linear factors of their product of three linear factors	M1		for all Ms in this part condone missing brackets if used correctly
			expansion of their linear and quadratic factors	M1	dep on first M1; ft one error in previous expansion; condone one error in this expansion	
					or for direct expansion of all three factors, allow M2 for $2x^3 - 10x^2 + 4x^2 + x^2 - 20x - 5x + 2x - 10$ [or half all these], or M1 if one or two errors,	dep on first M1
			[y =] $2x^3 - 5x^2 - 23x - 10$ or $a = -5$, $b = -23$ and $c = -10$	A1		condone poor notation when 'doubling' to reach expression with $2x^3$...
					for an attempt at setting up three simultaneous equations in a, b, and c: M1 for at least two of the three equations	$250 + 25a + 5b + c = 0$ $-16 + 4a - 2b + c = 0$ $-\frac{1}{4} + \frac{1}{4}a - \frac{1}{2}b + c = 0$ oe
					then M2 for correctly eliminating any two variables or M1 for correctly eliminating one variable to get two equations in two unknowns	
				[4]	and then A1 for values.	

Question			Answer	Marks	Guidance	
5	(ii)		graph of cubic correct way up	B1	B0 if stops at x-axis	must not be ruled; no curving back; condone slight 'flicking out' at ends; allow min on y axis or in 3rd or 4th quadrants; condone some 'doubling' or 'feathering' (deleted work still may show in scans)
			crossing x axis at –2, –1/2 and 5	B1	on graph or nearby in this part mark intent for intersections with both axes	allow if no graph, but marked on x-axis
			crossing y axis at –10 or ft their cubic in (i)	B1 **[3]**	or $x = 0$, $y = -10$ or ft in this part if consistent with graph drawn;	allow if no graph, but eg B0 for graph nowhere near their indicated –10 or ft
5	(iii)		(0, –18); accept –18 or ft their constant – 8	1 **[1]**	or ft their intn on y-axis – 8	
5	(iv)		roots at 2.5, 1, 8	M1	or attempt to substitute $(x - 3)$ in $(2x + 1)(x + 2)(x - 5)$ or in $(x + 1/2)(x + 2)(x - 5)$ or in their unfactorised form of f(x)– attempt need not be simplified	
			$(2x - 5)(x - 1)(x - 8)$	A1	accept $2(x - 2.5)$ oe instead of $(2x - 5)$	M0 for use of $(x + 3)$ or roots –3.5, –5, 2 but then allow SC1 for $(2x + 7)(x + 5)(x - 2)$
			(0, –40); accept –40	B2 **[4]**	M1 for $-5 \times -1 \times -8$ or ft or for f(–3) attempted or g(0) attempted or for their answer ft from their factorised form	eg M1 for (0, –70) or –70 after $(2x + 7)(x + 5)(x - 2)$ after M0, allow SC1 for f(3) = –70