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

2	**(i**		$y = 2x + 3$ drawn accurately (–1.6 to –1.7, –0.2 to –0.3) (2.1 to 2.2, 7.2 to 7.4)	M1 B1 B1 **[3]**	at least as far as intersecting curve twice intersections may be in form $x = ..., y = ...$	ruled straight line and within 2mm of (2, 7) and (–1, 1) if marking by parts and you see work relevant to (ii), put a yellow line here and in (ii) to alert you to look
2	**(ii**		$\frac{1}{x-2} = 2x+3$ $1 = (2x + 3)(x - 2)$ $1 = 2x^2 - x - 6$ oe $\frac{1 \pm \sqrt{1^2 - 4 \times 2 \times -7}}{2 \times 2}$ oe $\frac{1 \pm \sqrt{57}}{4}$ isw	M1 M1 A1 M1 A1 **[5]**	or attempt at elimination of x by rearrangement and substitution condone lack of brackets for correct expansion; need not be simplified; NB A0 for $2x^2 - x - 7 = 0$ without expansion seen [given answer] use of formula or completing square on given equation, with at most one error is eg coordinates; after completing square, accept $\frac{1}{4} \pm \sqrt{\frac{57}{16}}$ or better	may be seen in (i) – allow marks; the part (i) work appears at the foot of the image for (ii) so show marks there rather than in (i) implies first M1 if that step not seen implies second M1 if that step not seen after $\frac{1}{x-2} = 2x+3$ seen completing square attempt must reach at least $[2](x - a)^2 = b$ or $(2x - c)^2 = d$ stage oe with at most one error

2	**(iii**		$\frac{1}{x-2}=-x+k$ and attempt at rearrangement	M1		
			$x^2-(k+2)x+2k+1[=0]$	M1	for simplifying and rearranging to zero; condone one error; collection of x terms with bracket not required	eg M1 bod for $x^2-(k+2)x+2k$ or M1 for $x^2-2kx+2k+1[=0]$
			b^2-4ac = 0 oe seen or used	M1		= 0 may not be seen, but may be implied by their final values of k
			[k =] 0 or 4 as final answer, both required	A1 **[4]**	SC1 for 0 and 4 found if 3rd M1 not earned (may or may not have earned first two Ms)	eg obtained graphically or using calculus and/or final answer given as a range

3	**(i)**		(–1, 6) (0,1) (1,–2) (2,–3) (3,–2) (4, 1) (5,6) seen plotted	B2	or for a curve within 2 mm of these points; B1 for 3 correct plots or for at least 3 of the pairs of values seen eg in table	use overlay; scroll down to spare copy of graph to see if used [or click 'fit height' also allow B1 for ($2\pm\sqrt{3}$, 0) and (2, –3) seen or plotted and curve not through other correct points
			smooth curve through all 7 points	B1 dep	dep on correct points; tolerance 2 mm;	condone some feathering/ doubling (deleted work still may show in scans); curve should not be flat-bottomed or go to a point at min. or curve back in at top;
			(0.3 to 0.5, –0.3 to –0.5) and (2.5 to 2.7, –2.5 to –2.7) and (4, 1)	B2 **[5]**	may be given in form x = ..., y = ... B1 for two intersections correct or for all the x values given correctly	
3	**(ii)**		$\frac{1}{x-3}=x^2-4x+1$	M1		
			$1 = (x - 3)(x^2 - 4x + 1)$	M1	condone omission of brackets only if used correctly afterwards, with at most one error;	condone omission of '=1' for this M1 only if it reappears allow for terms expanded correctly with at most one error
			at least one further correct interim step with '=1' or '=0' ,as appropriate, leading to given answer, which must be stated correctly	A1 **[3]**	there may also be a previous step of expansion of terms without an equation, eg in grid if M0, allow SC1 for correct division of given cubic by quadratic to gain (x – 3) with remainder –1, or vice-versa	NB mark method not answer - given answer is $x^3 - 7x^2 + 13x - 4 = 0$

Question			er	Marks	Guidance	
3	**(iii)**		quadratic factor is $x^2 - 3x + 1$	B2	found by division or inspection; allow M1 for division by $x - 4$ as far as $x^3 - 4x^2$ in the working, or for inspection with two terms correct	
			substitution into quadratic formula or for completing the square used as far as $\left(x - \frac{3}{2}\right)^2 = \frac{5}{4}$	M1	condone one error	no ft from a wrong 'factor';
			$\dfrac{3 \pm \sqrt{5}}{2}$ oe	A2 **[5]**	A1 if one error in final numerical expression, but only if roots are real	isw factors

4	(i) $x + 4x^2 + 24x + 31 = 10$ oe $4x^2 + 25x + 21$ [= 0] $(4x + 21)(x + 1)$ $x = -1$ or $-21/4$ oe isw $y = 11$ or $61/4$ oe isw	**M1** **M1** **M1** **A1** **A1**	for subst of x or y or subtraction to eliminate variable; condone one error; for collection of terms and rearrangement to zero; condone one error; for factors giving at least two terms of their quadratic correct or for subst into formula with no more than two errors [dependent on attempt to rearrange to zero]; or **A1** for (−1, 11) and **A1** for (−21/4, 61/4) oe	or $4y^2 - 105y + 671$ [= 0]; eg condone spurious $y = 4x^2 + 25x + 21$ as one error (and then count as eligible for 3rd **M1**); or $(y - 11)(4y - 61)$; [for full use of completing square with no more than two errors allow 2nd and 3rd **M1**s simultaneously]; from formula: accept $x = -1$ or $-42/8$ oe isw
4	(ii) $4(x + 3)^2 - 5$ isw	**4**	**B1** for $a = 4$, **B1** for $b = 3$, **B2** for $c = -5$ or **M1** for $31 - 4 \times$ their b^2 soi or for −5/4 or for 31/4 − their b^2 soi	eg an answer of $(x + 3)^2 - {}^5/_4$ earns **B0 B1 M1**; $1(2x + 6)^2 - 5$ earns **B0 B0 B2**; 4(earns first **B1**; condone omission of square symbol
4	(iii)(*A*) $x = -3$ or ft (–their b) from (ii)	**1**		**0** for just –3 or ft; **0** for $x = -3$, $y = -5$ or ft
4	(iii)(*B*) −5 or ft their c from (ii)	**1**	allow $y = -5$ or ft	**0** for just (−3, −5); bod **1** for $x = -3$ stated then $y = -5$ or ft

5 **(i)**	$(2x - 3)(x + 1)$ $x = 3/2$ and -1 obtained	**M2** **B1**	**M1** for factors with one sign error or giving two terms correct allow M1 for $2(x - 1.5)(x + 1)$ with no better factors seen or ft their factors
5 **(ii)**	graph of quadratic the correct way up and crossing both axes crossing x-axis only at 3/2 and -1 or ft from their roots in (i), or their factors if roots not given crossing y-axis at -3	**B1** **B1** **B1**	 for $x = 3/2$ condone 1 and 2 marked on axis and crossing roughly halfway between; intns must be shown labelled or worked out nearby
5 **(iii)**	use of $b^2 - 4ac$ with numbers subst (condone one error in substitution) (may be in quadratic formula) $25 - 40 < 0$ or -15 obtained	**M1** **A1**	may be in formula or $(x - 2.5)^2 = 6.25 - 10$ or $(x - 2.5)^2 + 3.75 = 0$ oe (condone one error) or $\sqrt{-15}$ seen in formula or $(x - 2.5)^2 = -3.75$ oe or $x = 2.5 \pm \sqrt{-3.75}$ oe

5 (iv)	$2x^2 - x - 3 = x^2 - 5x + 10$ o.e.	**M1**	attempt at eliminating y by subst or subtraction
	$x^2 + 4x - 13$ [= 0]	**M1**	or $(x + 2)^2 = 17$; for rearranging to form $ax^2 + bx + c\ [= 0]$ or to completing square form condone one error for each of 2nd and 3rd **M1s**
	use of quad. formula on resulting eqn (do not allow for original quadratics used)	**M1**	or $x + 2 = \pm\sqrt{17}$ o.e. 2nd and 3rd **M1s** may be earned for good attempt at completing square as far as roots obtained
	$-2 \pm \sqrt{17}$ cao	**A1**	

6		$y = 2x + 3$ drawn on graph $x = 0.2$ to 0.4 and -1.7 to -1.9	M1 A2	1 each; condone coords; must have line drawn	3
	ii	$1 = 2x^2 + 3x$ $2x^2 + 3x - 1$ [= 0]	M1 M1	for multiplying by x correctly for correctly rearranging to zero (may be earned first) or suitable step re completing square if they go on	
		attempt at formula or completing square	M1	ft, but no ft for factorising	
		$x = \dfrac{-3 \pm \sqrt{17}}{4}$	A2	A1 for one soln	5
	iii	branch through (1,3), branch through (−1,1),approaching $y = 2$ from below	1 1	and approaching $y = 2$ from above and extending below x axis	2
	iv	−1 and ½ or ft intersection of their curve and line [tolerance 1 mm]	2	1 each; may be found algebraically; ignore y coords.	2