1	**(i)**		$\left(x-\frac{5}{2}\right)^2-\frac{1}{4}$ oe	B3	B1 for $a = 5/2$ oe and M1 for $6 - \textit{their}\ a^2$ soi;	condone $\left(x-\frac{5}{2}\right)^2-\frac{1}{4}$ oe = 0 condone omission of index –can earn all marks bod M1 for 6 – 4.25 or 6 – 25/2 etc, if bearing some relation to an attempt at $6 - \textit{their}\ 2.5^2$; M0 for just 1.75 etc without further evidence
			$\left(\frac{5}{2}, -\frac{1}{4}\right)$ oe or ft	B1	accept $x = 2.5$, $y = –0.25$ oe	condone starting again and finding using calculus
				[4]		

1	**(ii)**		(2, 0) and (3, 0)	B2	B1 each or B1 for both correct plus an extra or M1 for $(x – 2)(x – 3)$ or correct use of formula or for $\textit{their}\ a \pm \sqrt{\textit{their}\ b}$ ft from (i)	condone not expressed as coordinates, for both x and y values; accept eg in table or marked on graph
			(0, 6)	B1		
			graph of quadratic the correct way up and crossing both axes	B1	ignore label of their tp; condone stopping at y-axis	condone ‘U’ shape or slight curving back in/out; condone some doubling / feathering – deleted work sometimes still shows up in scoris; must not be ruled; condone fairly straight with clear attempt at curve at minimum; be reasonably generous on attempt at symmetry
				[4]		

1	**(iii)**		$x^2 - 5x + 6 = 2 - x$	M1	for attempt to equate or subtract eqns or attempt at rearrangement and elimination of x	accept calculus approach: $y' = 2x - 5$
			$x^2 - 4x + 4$ [= 0]	M1	for rearrangement to zero ft and collection of terms; condone one error; if using completing the square, need to get as far as $(x - k)^2 = c$, with at most one error [$(x - 2)^2 = 0$ if correct]	use of $y' = -1$ M1
			$x = 2$, [$y = 0$]	A1	condone omission of $y = 0$ since already found in (ii) if they have eliminated x, $y = 0$ is not sufft for A1 – need to get $x = 2$ A0 for $x = 2$ and another root	$x = 2$ A1
			'double root at $x = 2$ so tangent' oe; www;	A1 **[4]**	eg 'only one point of contact, so tangent'; or showing $b^2 - 4ac = 0$, and concluding 'so tangent'; www	tgt is y [– 0] = –(x – 2) and obtaining given line A1

Question			er	Marks	Guidance	
2	**(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	
2	**(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; allow for terms expanded correctly with at most one error	condone omission of '=1' for this M1 only if it reappears
			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	
2	**(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';
			$\frac{3 \pm \sqrt{5}}{2}$ oe	A2 **[5]**	A1 if one error in final numerical expression, but only if roots are real	isw factors

3		**M1**	for subst of x or y or subtraction to eliminate variable; condone one error;	
	$4x^2 + 25x + 21$ [= 0]	**M1**	for collection of terms and rearrangement to zero; condone one error;	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**);
	$(4x + 21)(x + 1)$	**M1**	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 $(y - 11)(4y - 61)$; [for full use of completing square with no more than two errors allow 2nd and 3rd **M1**s simultaneously];
	$x = -1$ or $-21/4$ oe isw	**A1**	or **A1** for $(-1, 11)$ and **A1** for $(-21/4, 61/4)$ oe	from formula: accept $x = -1$ or $-42/8$ oe isw
	$y = 11$ or $61/4$ oe isw	**A1**		
3	(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
3	(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
3	(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

4 (i)	$(2x - 3)(x + 1)$	**M2**	**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
	$x = 3/2$ and -1 obtained	**B1**	or ft their factors
4 (ii)	graph of quadratic the correct way up and crossing both axes	**B1**	
	crossing x-axis only at 3/2 and -1 or ft from their roots in (i), or their factors if roots not given	**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
	crossing y-axis at -3	**B1**	
4 (iii)	use of $b^2 - 4ac$ with numbers subst (condone one error in substitution) (may be in quadratic formula)	**M1**	may be in formula or $(x - 2.5)^2 = 6.25 - 10$ or $(x - 2.5)^2 + 3.75 = 0$ oe (condone one error)
	$25 - 40 < 0$ or -15 obtained	**A1**	or $\sqrt{-15}$ seen in formula or $(x - 2.5)^2 = -3.75$ oe or $x = 2.5 \pm \sqrt{-3.75}$ oe

4 (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**	