Question			Answer	Marks	Guidance	
1	(i)		graph of shape with vertices at (–2, –3), (0, 0) and (2, –4)	2 **[2]**	M1 for 2 vertices correct	condone lines unruled; condone just missing vertex: ¼ grid square tolerance
1	(ii)		graph of shape with vertices at (1, –1), (3, 2) and (5, –2)	2 **[2]**	M1 for 2 vertices correct or for shape with vertices at (–5, –1), (–3, 2) and (–1, –2)	condone lines unruled; condone just missing vertex: ¼ grid square tolerance

2	(i)		$x = 4$ (4, –3)	B1 B1 **[2]**	or $x = 4$, $y = -3$	condone 4, –3
2	(ii)		(0, 13) isw [when $y = 0$,] $(x-4)^2 = 3$ $[x =]4 \pm \sqrt{3}$ or $\frac{8 \pm \sqrt{12}}{2}$ isw	1 M1 A2 **[4]**	or [when $x = 0$], $y = 13$ isw 0 for just (13, 0) or (k, 13) where $k \neq 0$ or $x^2 - 8x + 13$ [= 0] need not go on to give coordinate form A1 for one root correct	annotate this question if partially correct may be implied by correct value(s) for x found allow M1 for $y = x^2 - 8x + 13$ only if they go on to find values for x as if y were 0
2	(iii)		replacement of x in their eqn by $(x-2)$ completion to given answer $y = x^2 - 12x + 33$, showing at least one correct interim step	M1 A1 **[2]**	may be simplified; eg [$y =$] $(x-6)^2 - 3$ or allow M1 for $(x - 6 - \sqrt{3})(x - 6 + \sqrt{3})$ [=0 or y] cao; condone using f(x – 2) in place of y	condone omission of '$y =$' for M1, but must be present in final line for A1

Question			Answer	Marks	Guidance	
2	**(iv)**		$x^2 - 12x + 33 = 8 - 2x$ or $(x - 6)^2 - 3 = 8 - 2x$	M1	for equating curve and line; correct eqns only; or for attempt to subst $(8 - y)/2$ for x in $y = x^2 - 12x + 33$	annotate this question if partially correct
			$x^2 - 10x + 25 = 0$	M1	for rearrangement to zero, condoning one error such as omission of '= 0'	
			$(x - 5)^2$ [= 0]	A1	or showing $b^2 = 4ac$	allow $\frac{10 \pm \sqrt{0}}{2}$ oe if $b^2 - 4ac = 0$ is not used explicitly A0 for $(x - 5)^2 = y$
			$x = 5$ www [so just one point of contact]	A1	may be part of coordinates $(5, k)$	allow recovery from $(x - 5)^2 = y$
			point of contact at $(5, -2)$	A1	dependent on previous A1 earned; allow for $y = -2$ found	
			<u>alt. method</u>	**or**		examiners: use one mark scheme or the other, to the benefit of the candidate if both methods attempted, but do not use a mixture of the schemes
			for curve, $y' = 2x - 12$	M1		
			$2x - 12 = -2$	M1	for equating their y' to -2	
			$x = 5$, and y shown to be -2 using eqn to curve	A1		
			tgt is $y + 2 = -2(x - 5)$	A1		
			deriving $y = 8 - 2x$	A1		condone no further interim step if all working in this part is correct so far
				[5]		

3	**(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
3	**(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

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

4	(i)		'tick' at (2,4)(3,1)(5,6)	2 **[2]**	mark intent M1 for two points correct or for 'tick' at (2,–2) (3,–5) and (5,0)	overlay to be provided condone tick unruled; allow M1 for points not joined but all correct:
4	(ii)		'tick' at (0,1)(1,–2)(3,3)	2 **[2]**	mark intent M1 for two points correct or for 'tick' at (4,1) (5,–2) and (7,3)	overlay to be provided condone tick unruled; allow M1 for points not joined but all correct:

5	(i) (10, 4)	**2**	**0** for (5, 4); otherwise **1** for each coordinate	ignore accompanying working / description of transformation; condone omission of brackets; (Image includes back page for examiners to check that there is no work there)
5	(ii) (5,4)	**2**	**0** for (5, 4); otherwise **1** for each coordinate	ignore accompanying working / description of transformation; condone omission of brackets

6 (i)	translation by $\begin{pmatrix} -4 \\ 0 \end{pmatrix}$ or 4 [units] to left	**B1** **B1**	**0** for shift/move or 4 units in negative *x* direction o.e.
6 (ii)	sketch of parabola right way up and with minimum on negative *y*-axis min at (0, −4) and graph through −2 and 2 on *x*-axis	**B1** **B1**	mark intent for both marks must be labelled or shown nearby

7	i	grad AB = $\frac{9-1}{3--1}$ or 2	M1		
		$y - 9 = 2(x - 3)$ or $y - 1 = 2(x + 1)$	M1	ft their *m*, or subst coords of A or B in y = their $m\,x + c$	
		$y = 2x + 3$ o.e.	A1	or B3	3
	ii	mid pt of AB = (1, 5)	M1	condone not stated explicitly, but used in eqn	
		grad perp = −1/grad AB	M1	soi by use eg in eqn	
		$y - 5 = -\frac{1}{2}(x - 1)$ o.e. or ft [no ft for just grad AB used]	M1	ft their grad and/or midpt, but M0 if their midpt not used; allow M1 for $y = -\frac{1}{2}x + c$ and then their midpt subst	
		at least one correct interim step towards given answer $2y + x = 11$, and correct completion NB ans $2y + x = 11$ given	M1	no ft; correct eqn only	

		<u>alt method working back from ans:</u>		mark one method or the other, to benefit of cand, not a mixture		
		$y = \frac{11-x}{2}$ o.e.	M1			
		grad perp = −1/grad AB and showing/stating same as given line	M1	eg stating $-\frac{1}{2} \times 2 = -1$		
		finding intn of their $y = 2x + 3$ and $2y + x = 11$ [= (1, 5)]	M1	or showing that (1, 5) is on $2y + x = 11$, having found (1, 5) first	4	
		showing midpt of AB is (1, 5)	M1	[for both methods: for M4 must be fully correct]		
	iii	showing $(-1-5)^2 + (1-3)^2 = 40$	M1	at least one interim step needed for each mark; M0 for just $6^2 + 2^2 = 40$ with no other evidence such as a first line of working or a diagram;		
		showing B to centre = √40 or verifying that (3, 9) fits given circle	M1	condone marks earned in reverse order	2	
	iv	$(x-5)^2 + 3^2 = 40$	M1	for subst $y = 0$ in circle eqn		
		$(x-5)^2 = 31$	M1	condone slip on rhs; or for rearrangement to zero (condone one error) <u>and</u> attempt at quad. formula [allow M1 M0 for $(x-5)^2 = 40$ or for $(x-5)^2 + 3^2 = 0$]		
		$x = 5 \pm \sqrt{31}$ or $\frac{10 \pm \sqrt{124}}{2}$ isw	A1	or $5 \pm \frac{\sqrt{124}}{2}$	3	12