1	(a)	$-3\left(x^2-4x\right)+7$ or $-3\left(x^2-4x-\frac{7}{3}\right)$		4	M1	for factorising the expression to find b or $b=-3$ stated or shown clearly in answer.
		$-3\left[(x-2)^2 .....\right]$ or c = –2 $-3\left[(x-2)^2-4\right]+7$ or $-3\left[(x-2)^2-4-\frac{7}{3}\right]$			M1	or for c shown clearly in answer.
		$-3(x-2)^2+12+7$ or $-3\left[(x-2)^2-\frac{19}{3}\right]$			M1	fully correct method.
			$19-3(x-2)^2$		A1	for $19-3(x-2)^2$ oe
	(b)		(2, 19)	1	B1 ft	dep on M1 in part (a) answer must follow answer from (a) if given
						Total 5 marks

Alternative mark scheme for 1						
1	(a)	$a+bx^2+2bcx+bc^2$		4	M1	for multiplying out $a+b(x+c)^2$ to obtain $a+bx^2+2bcx+bc^2$ oe
		$b=-3$ or $2bc=12$ or $a+bc^2=7$ oe			M1	for equating coefficients
		$b=-3$ and $c=-2$			M1	for correctly finding b and c
		$a=19$	$19-3(x-2)^2$		A1	for $19-3(x-2)^2$ oe
	(b)		(2, 19)	1	B1 ft	dep on M1 in part (a)
						Total 5 marks

2	a	$5-(x\pm q)^2+9$ oe **or** $p-(x-3)^2$ oe **or** $p-q^2+2qx-x^2$ and one of $2q=6$ **or** $p-q^2=5$			M1	may be seen in working eg $-[(x-3)^2-9-5]$ **or** expanding $p-(x-q)^2$ correctly and equating one of the coefficient of x or the constant term
			$14-(x-3)^2$	2	A1	fully correct SCB1 for $(x-3)^2-14$
	b	e.g. $(x-3)^2=14-y$ [or $(y-3)^2=14-x$]			M1	correct steps to isolate their bracket ft from (a) dep on expression in form $\pm p\pm(x-q)^2$
		$x=3\pm\sqrt{14-y}$ [or $y=3\pm\sqrt{14-x}$]			M1	complete method to find y in terms of x or x in terms of y. Condone + for ± ft from (a) dep on expression in form $\pm p\pm(x-q)^2$
		$(f^{-1}(x)=)\ 3-\sqrt{14-x}$			M1	for the correct inverse
					M1	method to solve $0<3-\sqrt{14-x}$ or a lower bound of 5 clearly shown, eg $x>5$ as part of the answer
			$5<x\leq 14$	5	A1	cao
						Total 7 marks

3	b	E.g. $(x-5)^2-5^2\ (+40)$ or $(x-5)^2-25\ (+40)$ $\left(x^2+2ax+a^2\left(+b^2\right)\right)$ $2a=-10$ or $a=-5$		2	M1	for a correct first step **or** for equating coefficients
			$(x-5)^2+15$		A1	accept $a=-5$, $b=15$ SC B1 for $(-x+5)^2+15$ or $(5-x)^2+15$

4	$(v=)\ 3t^2-9\times 2t+33$			5	M1	for differentiating at least 2 terms correctly
	$(a=)\ 3\times 2t-$ '18' or $(t=)-\dfrac{-18}{2\times 3}\left(=\dfrac{18}{6}\right)$	$(v=)3\left[(t-3)^2-(3)^2\right](+33)$ **or** $(v=)3\left[(t-3)^2-(3)^2(+11)\right]$			M1	dep ft must be a two term linear equation **or** for the use of $(t=)-\dfrac{b}{2a}$ **or** for a **correct** first step for completing the square on at least a two term quadratic
	$6t-18=0$ **or** $t=3$	$(v=)3\left[(t-3)^2-(3)^2\right]+33$ **or** $(v=)3\left[(t-3)^2-(3)^2+11\right]$			M1	dep on at least M2 for equating their acceleration to 0 **or** for a **correct** method for completing the square on at least a two term quadratic
	$3\times '3'^2-18\times '3'+33$	$(v=)3(t-3)^2+6$ **or** $(v=)3\left[(t-3)^2+2\right]$			M1	dep on at least M2 for substituting their t into v **or** for a seeing a **correct** simplified expression after completing the square
			6		A1	
						Total 5 marks

5	(a)	$2(x^2-6x)+3$ **or** $2(x^2-6x+\dfrac{3}{2})$		3	M1	**or** for one of a, b or c correct **OR** expanding $a(x^2+2bx+b^2)+c$
		$2\left[(x-3)^2-9\right]+3$ **or** $2\left[(x-3)^2-3^2+\dfrac{3}{2}\right]$ oe			M1	**or** for two of a, b or c correct **OR** $-12=2ab$ **or** $3=ab^2+c$
			$2(x-3)^2-15$		A1	accept $a=2$, $b=-3$, $c=-15$

6	$-q\left(x^2-\dfrac{12}{q}x\right)+q$ or $-q\left(x^2-\dfrac{12}{q}x-\dfrac{q}{q}\right)$ oe		4	M1 for a correct factorisation of the expression or $b=q$ (must be stated)
	$-q\left[\left(x-\dfrac{12}{2q}\right)^2.....\right]$ oe or $-q\left[\left(x-\dfrac{6}{q}\right)^2.....\right]$ oe			M1 for starting the correct process to complete the square
	E.g. $-q\left(x-\dfrac{6}{q}\right)^2+\dfrac{36}{q}+q$ oe or $-q\left(x-\dfrac{12}{2q}\right)^2+\dfrac{144q}{4q^2}+q$ oe			M1 for a complete process of completing the square. (Does not need to be simplified)
		$a=\dfrac{36}{q}+q$ $b=q$ $c=\dfrac{6}{q}$		A1 oe a and c must come from a correct process of completing the square. (Does not need to be simplified)
				Total 4 marks

6 **ALT**	$a-bx^2+2bcx-bc^2$ oe or $-bx^2+2bcx-bc^2+a$ oe or $b=q$		4	M1 for correctly multiplying out $a-b(x-c)^2$
	$2bc=12$ or $a-bc^2=q$ oe			M1 for correctly equating coefficients
	$c=\dfrac{12}{2q}$ or $a=q\left(\dfrac{12}{2q}\right)^2+q$ or $c=\dfrac{6}{q}$ or $a=q\left(\dfrac{6}{q}\right)^2+q$			M1 for correctly finding a or c (Does not need to be simplified)
		$a=\dfrac{36}{q}+q$ $b=q$ $c=\dfrac{6}{q}$		A1 oe (Does not need to be simplified)
				Total 4 marks

7 (b)	$3(x^2+4x)+19$ **and** $3[(x+2)^2-2^2]+19$ **or** $3\left(x^2+4x+\frac{19}{3}\right)$ **and** $3\left((x+2)^2-2^2+\frac{19}{3}\right)$ **or** $a=3$ and $2ab=12$ oe and $b^2a+c=19$ oe **or** $a=3$ and $b=\frac{12}{2\times3}$ oe and $c=-\frac{12^2}{4\times3}+19$ oe			M1 for correctly taking out a factor of 3 and correctly completing the square **or** for equating coefficients by expanding $a(x+b)^2+c=ax^2+2abx+b^2a+c$ **or** for equating coefficients by using $ax^2+bx+c=a\left(x+\frac{b}{2a}\right)^2-\frac{b^2}{4a}+c$
		$3(x+2)^2+7$		A1 accept $a=3$, $b=2$, $c=7$	

8 (a)	$7-3(x^2-4x)$		3	M1	**or** for one of a, b or c correct	
	$7-3[(x-2)^2-4]$			M1	**or** for two of a, b or c correct	
		$19-3(x-2)^2$		A1		
(b)		(2, 19)	1	B1	ft their expression	
						Total 4 marks

9 (c)	$5\left(x^2-4x\right)$..... **or** $5\left(x^2-4x.....\right)$ **or** $5(x-2)^2\ldots$		3	M1	
	$5\left[(x-2)^2-(-2)^2\right]$..... **or** $5\left[(x-2)^2-(-2)^2.....\right]$ **or** $5(x-2)^2-20$ ..... **or** $5\left[(x-2)^2+\frac{3}{5}\right]$			M1	$(-2)^2$ can be 2^2 or 4 or $\left(\pm\frac{4}{2}\right)^2$
	Correct answer scores full marks (unless from obvious incorrect working)	$5(x-2)^2+3$		A1	

Alternative mark scheme for 9c					
	$ax^2-2abx+ab^2+c$		3	M1	for multiplying out $a(x-b)^2+c$ to obtain $ax^2-2abx+ab^2+c$ oe
	2 of: $a=5$ $2ab=20$ oe $ab^2+c=23$ oe			M1	for equating coefficients and making 2 correct statements
		$5(x-2)^2+3$		A1	

10	$3\left(x^2-2x\right)$..... or $3\left(x^2-2x+.....\right)$ oe or		3	M1	(where …… is any number or no number)
	$3(x-1)^2$…… or $3\left[(x-1)^2.....\right]$ oe			M1	(where …… is any number or no number)
	Correct answer scores full marks (unless from obvious incorrect working)	$3(x-1)^2+2$		A1	(if student continues to solve a quadratic equation, ISW)
					Total 3 marks
Alternative mark scheme for 10					
10	$ax^2-2abx+ab^2+c$		3	M1	for multiplying out $a(x-b)^2+c$ to obtain $ax^2-2abx+ab^2+c$ oe
	Any 2 of the following: $a=3$ or $2ab=6$ or $ab^2+c=5$ oe			M1	for equating coefficients with any 2 of $a=3$ or $2ab=6$ or $ab^2+c=5$ oe seen
	Correct answer scores full marks (unless from obvious incorrect working)	$3(x-1)^2+2$		A1	(if student continues to solve a quadratic equation, ISW)
					Total 3 marks