

Quadratics 2 MS

Q1.

5	$x^2 + x(k-2) + (k-2) = 0$ $(k-2)^2 - 4(k-2) (> 0)$ soi $(k-2)(k-6) (> 0)$ $k < 2$ or $k > 6$ (condone \leq, \geq) Allow $\{-\infty, 2\} \cup \{6, \infty\}$ etc.	M1 M1 DM1 A2 [5]	Equate and move terms to one side of equ. Apply $b^2 - 4ac (> 0)$. Allow \geq at this stage. Attempt to factorise or solve or find 2 solns. SCA1 for 2, 6 seen with wrong inequalities
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Q2.

10	(i) $(x-1)^2 - 16$	B1B1 [2]
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Q3.

3	(i) $(3x-2)^2 + 1$	B1B1B1 [3]	For either of 1 st 2 marks bracket must be in the form $(ax + b)^2$ except for SCB2 for $9\left(x - \frac{2}{3}\right)^2 + 1$
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Q4.

11	$f: x \mapsto 2x^2 - 6x + 5$ (i) $2x^2 - 6x + 5 - p = 0$ has no real roots Uses $b^2 - 4ac \rightarrow 36 - 8(5 - p)$ Sets to 0 $\rightarrow p < \frac{1}{2}$	M1 DM1 A1 [3]	Sets to 0 with p on LHS. Uses discriminant. co - must be " $<$ ", not " \leq ".
	(ii) $2x^2 - 6x + 5 = 2\left(x - \frac{3}{2}\right)^2 + \frac{1}{2}$	3 × B1 [3]	co

Q5.

1	$2(x-3)^2 - 11$	B1B1B1 [3]	For 2, $(x-3)^2, -11$. Or $a=2, b= 3, c= 11$
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Q6.

1	$x^2 - 4x + c = 2x - 7 \rightarrow x^2 - 6x + c + 7 (= 0)$ $36 - 4(c + 7) < 0$ $c > 2$	M1 DM1 A1 [3]	All terms on one side Apply $b^2 - 4ac < 0$. Allow \leq .
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Q7.

1	(i) $(x+3)^2 - 7$	B1B1 [2]	For $a = 3, b = -7$
	(ii) 1, -7 seen $x > 1, x < -7$ oe	B1 B1 [2]	$x > 1$ or $x < -7$ Allow $x \leq -7, x \geq 1$ oe

Q8.

11	$f: x \mapsto 6x - x^2 - 5$ (i) $6x - x^2 - 5 \leq 3$ $\rightarrow x^2 - 6x + 8 \geq 0$ $\rightarrow x = 2, x = 4$ $x \leq 2, x \geq 4$ condone $<$ and/or $>$	M1 A1 A1 [3]	$\pm(6x - x^2 - 8) =, \leq, \geq 0$ and attempts to solve Needs both values whether $=2, <2, >2$ Accept all recognisable notation.
	(ii) Equate $mx + c$ and $6x - x^2 - 5$ Use of " $b^2 - 4ac$ " $4c = m^2 - 12m + 16$. AG OR $\frac{dy}{dx} = 6 - 2x = m \rightarrow x = \left(\frac{6-m}{2}\right)$ $m\left(\frac{6-m}{2}\right) + c = 6\left(\frac{6-m}{2}\right) - \left(\frac{6-m}{2}\right)^2 - 5$ $4c = m^2 - 12m + 16$. AG	M1 DM1 A1 M1 M1 A1 [3]	Equates, sets to 0. Use of discriminant with values of a, b, c independent of x . $= (0)$ must appear before last line. Equates $\frac{dy}{dx}$ to m and rearrange Equates $mx + c$ and $6x - x^2 - 5$ and substitutes for x

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Q9.

9(i)	$1 + cx = cx^2 - 3x \rightarrow cx^2 - x(c+3) - 1 (=0)$	M1	Multiply throughout by x and rearrange terms on one side of equality
	Use $b^2 - 4ac = [(c+3)^2 + 4c = c^2 + 10c + 9 \text{ or } (c+5)^2 - 16]$	M1	Select their correct coefficients which must contain 'c' twice Ignore = 0, < 0, > 0 etc. at this stage
	(Critical values) $-1, -9$	A1	SOI
	$c \leq -9, c \geq -1$	A1	
		4	

9(ii)	Sub their c to obtain a quadratic $[c = -1 \rightarrow -x^2 - 2x - 1 (=0)]$	M1	
	$x = -1$	A1	
	Sub their c to obtain a quadratic $[c = -9 \rightarrow -9x^2 + 6x - 1 (=0)]$	M1	
	$x = 1/3$	A1	[Alt 1: $dy/dx = -1/x^2 = c$, when $c = -1, x = \pm 1, c = -9, x = \pm \frac{1}{3}$ Give M1 for equating the gradients, A1 for all four answers and M1A1 for checking and eliminating] [Alt 2: $dy/dx = -1/x^2 = c$ leading to $1/x - 1/x^2 = (-1/x^2)(x) - 3$ Give M1 A1 at this stage and M1A1 for solving]
		4	

Q10.

2(i)			A complete method as far as finding a set of values for k by:
	Either $(x-3)^2 + k - 9 > 0, k - 9 > 0$		Either completing the square and using 'their $k - 9$ ' > or ≥ 0 OR
	or $2x - 6 = 0 \rightarrow (3, k - 9), k - 9 > 0$	M1	Differentiating and setting to 0, using 'their $x=3$ ' to find y and using 'their $k - 9$ ' > or ≥ 0 OR
	or $b^2 < 4ac$ oe $\rightarrow 36 < 4k$		Use of discriminant < or ≤ 0 . Beware use of > and incorrect algebra.
	$\rightarrow k > 9$ Note: not \geq	A1	T&I leading to (or no working) correct answer 2/2 otherwise 0/2.
	2		

2(ii)	EITHER		
	$x^2 - 6x + k = 7 - 2x \rightarrow x^2 - 4x + k - 7 (=0)$	*M1	Equates and collects terms.
	Use of $b^2 - 4ac = 0$ ($16 - 4(k - 7) = 0$)	DM1	Correct use of discriminant = 0, involving k from a 3 term quadratic.
	OR		
	$2x - 6 = -2 \rightarrow x = 2$ ($y = 3$)	*M1	Equates their $\frac{dy}{dx}$ to ± 2 , finds a value for x .
	(their 3) or $7 - 2(\text{their } 2) = (\text{their } 2)^2 - 6(\text{their } 2) + k$	DM1	Substitutes their value(s) into the appropriate equation.
	$\rightarrow k = 11$	A1	
	3		

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Q11.

7(i)	$25 - 2(x + 3)^2$	B1 B1	Mark expression if present: B1 for 25 and B1 for $-2(x + 3)^2$. If no expression award $a = 25$ B1 and $b = 3$ B1.
		2	

Q12.

1	$(4x^{3/2} - 3)(x^{3/2} - 2)$ oe soi Alt: $4x + 6 = 11\sqrt{x} \Rightarrow 16x^2 - 73x + 36$	M1	Attempt solution for $x^{3/2}$ or sub $u = x^{3/2}$
	$x^{3/2} = 3/4$ or 2 $(16x - 9)(x - 4)$	A1	Reasonable solutions for $x^{3/2}$ implies M1 ($x = 2, 3/4$, M1A0)
	$x = 9/16$ oe or 4	A1	Little or no working shown scores SCB3, spotting one solution, B0
		3	