Question			Answer	Marks	Guidance	
1			$[r =]\sqrt{\frac{A}{\pi(x+y)}}$ or $[r =]\sqrt{\frac{A}{\pi x+\pi y}}$ as final answer	2 **[2]**	square root symbol must extend below fraction line; accept to power ½ with appropriate brackets **M1** for a triple decker fraction or for $r^2 = \frac{A}{\pi(x+y)}$ or for $[r =]\pm\sqrt{\frac{A}{\pi(x+y)}}$ or for their final answer for r ft their r^2	condone missing end bracket in denominator eg M1 for $[r =]\sqrt{\frac{A}{\frac{\pi}{(x+y)}}}$

2	(i)		$9x^2 = h^2 + 4x^2 + 4x + 1$ and completion to given answer , $h^2 = 5x^2 - 4x - 1$	B1 B1 **[2]**	for a correct Pythagoras statement for this triangle, in terms of x, with correct brackets for correct expansion, with brackets or correct signs; must complete to the given answer with no errors in any interim working may follow $3x^2 = h^2 + (2x + 1)^2$ oe for **B0 B1**	condone another letter instead of h for one mark but not both unless recovered at some point eg B1 for $h^2 = 9x^2 - (4x^2 + 4x + 1)$ and completion to correct answer but B0 for $h^2 = 9x^2 - 4x^2 + 4x + 1$

3	**(i)**		$3x^2 + 12x + 13 = 2x + k$	M1	oe eg M1 for $3x^2 + 10x + 13 = k$	condone $3x^2 + 10x + 13 - k = y$ for this M1
			$3x^2 + 10x + 13 - k$ [= 0]	M1	for rearranging to 0; condone one error in adding/subtracting; but M0 for $3x^2 + 10x + 13 = k$ or $3x^2 + 10x + 13 - k = y$	$3x^2 + 10x + 13 - k$ [= 0] will also earn the first M1 if a separate statement has not already done so
			$b^2 - 4ac > 0$ oe soi	M1	may be earned near end with correct inequality sign used there	allow '$b^2 - 4ac$ is positive' oe; 0 for just 'discriminant > 0' unless implied by later work
			$100 - 4 \times 3 \times (13 - k)$ (> 0) oe	M1	for correct substitution ft into $b^2 - 4ac$, dep on second M1 earned; brackets / signs must be correct	can be earned with equality or wrong inequality, or in formula M0 for trials of values of k in $b^2 - 4ac$
			$k > 14/3$ oe	A1	accept $k >$ 56/12 or better, isw incorrect conversion of fraction but not wrong use of inequalities if A0, allow **B1** for 56/12 oe obtained with equality or wrong inequality (ie 3rd M1 has not been earned)	
				[5]		

3	**(ii)**		$3(x + 2)^2 + 1$ www as final answer	B4	**B1** for $a = 3$ and **B1** for $b = 2$ and **B2** for $c = 1$ or **M1** for $13 - 3 \times$ their b^2 or for $13/3 -$ their b^2 or **B3** for $3\left[(x+2)^2 + \frac{1}{3}\right]$	condone omission of square symbol; ignore equating to zero in working or answer
			y-minimum = 1 [hence curve is above x-axis]	B1 **[5]**	Stating min pt is (–2, 1) is sufft allow ft if their $c > 0$ B0 for only showing that discriminant is negative oe; need also to justify that it is all above not all below x-axis B0 for stating min point = 1 or ft	must be done in this part; ignore wrong x-coordinate
3	**(iii)**		5 cao	B2 **[2]**	**M1** for substitution of their (–2, 1) in $y = 2x + k$	allow M1 ft their $3(x + 2)^2 + 1$; or use of (–2,1) found using calculus; M0 if they use an incorrect minimum point inconsistent with their completed square form

4			$3a + 12$ [$= ac + 5f$]	M1	for expanding brackets correctly	annotate this question if partially correct
			$3a - ac = 5f - 12$ or ft	M1	for collecting a terms on one side, remaining terms on other	ft only if two a terms
			$a(3 - c) = 5f - 12$ or ft	M1	for factorising a terms; may be implied by final answer	ft only if two a terms, needing factorising may be earned before 2nd M1
			$[a =] \dfrac{5f - 12}{3 - c}$ oe or ft as final answer	M1 **[4]**	for division by their two-term factor; for all 4 marks to be earned, work must be fully correct	

5			substitution to eliminate one variable	M1	or multiplication to make one pair of coefficients the same; condone one error in either method	
			simplification to $ax = b$ or $ax - b = 0$ form, or equivalent for y	M1	or appropriate subtraction / addition; condone one error in either method	independent of first M1
			(0.7, 0.1) oe or $x = 0.7$, $y = 0.1$ oe isw	A2 **[4]**	A1 each	

6			$3(x-2)^2 - 7$ isw or $a = 3$, $b = 2$ $c = 7$ www	4	B1 each for $a = 3$, $b = 2$ oe and B2 for $c = 7$ oe or M1 for $[-]\frac{7}{3}$ or for $5 - \textit{their } a(\textit{their } b)^2$ or for $\frac{5}{3} - (\textit{their } b)^2$ soi	condone omission of square symbol; ignore '= 0' may be implied by their answer
			-7 or ft	B1 **[5]**	B0 for (2, –7)	may be obtained by starting again eg with calculus

7			$4x^4y^{-3}$ or $\frac{4x^4}{y^3}$ as final answer	3 **[3]**	B1 each 'term'; or M1 for numerator = $64x^{15}y^3$ and M1 for denominator = $16x^{11}y^6$	B0 if obtained fortuitously mark B scheme or M scheme to advantage of candidate, but not a mixture of both schemes

8			$4 + 2k + c = 0$ or $2^2 + 2k + c = 0$	B1	may be rearranged	
			$9 - 3k + c = 35$	B1	may be rearranged; the $(-3)^2$ must be evaluated / used as 9	condone -3^2 seen if used as 9
			correct method to eliminate one variable from their eqns	M1	eg subtraction or substitution for c; condone one error	M0 for addition of eqns unless also multiplied appropriately
			$k = -6$, $c = 8$	A1	from fully correct method, allowing recovery from slips	if no errors and no method seen, allow correct answers to imply M1 provided B1B1 has been earned
			or	**or**		
			$[x^2 + kx + c =] (x - 2)(x - a)$	M1	or $(x - 2)(x + b)$	
			$-5 \times (-3 - a) = 35$ oe	M1		
			$a = 4$	A1		
			$k = -6$, $c = 8$	A1		
				[4]		

9			$5c + 9t = 2ac + at$ $5c - 2ac = at - 9t$ oe $c(5 - 2a) = at - 9t$ oe $[c =]\frac{at - 9t}{5 - 2a}$ or $\frac{t(a - 9)}{5 - 2a}$ oe as final answer	M1 M1 M1 M1 **[4]**	for correct expansion of brackets for correct collection of terms, ft eg after M0 for $5c + 9t = 2ac + t$ allow this M1 for $5c - 2ac = -8t$ oe for correctly factorising, ft; must be $c \times$ a two-term factor for correct division, ft their two-term factor	 for each M, ft previous errors if their eqn is of similar difficulty; may be earned before t terms collected treat as MR if t is the subject, with a penalty of 1 mark from those gained, marking similarly

10			$\frac{x-3}{x+2}$ or $1-\frac{5}{x+2}$ as final answer www	3 **[3]**	B2 for correct answer seen and then spoilt M1 for $(x + 3)(x - 3)$ and M1 for $(x + 2)(x + 3)$	

11			$4h + ha^2 = 9a - 5$ $h(4 + a^2) = 9a - 5$ $[h =]\frac{9a-5}{4+a^2}$ oe as final answer	M1 M1 M1 **[3]**	correctly collecting h terms on one side, remaining terms on other for factorising, ft eg sign error for division by their factor; ft only for equiv difficulty	 M0 if seen and spoilt, eg by incorrect 'cancelling'