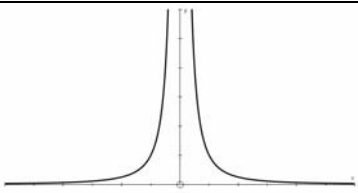
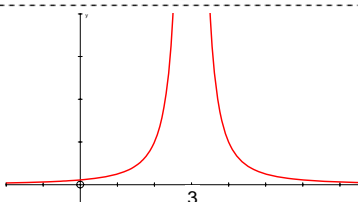
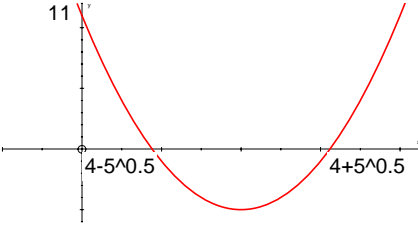


**Mark Scheme 4721**  
**January 2006**

1	(i)	$x^3 = 2$ $x = 8$	B1	1	8	(allow embedded values throughout question 1)
	(ii)	$10^t = 1$ $t = 0$	B1	1	0	
	(iii)	$(y^{-2})^2 = \frac{1}{81}$ $y^{-4} = \frac{1}{81}$ $y = \pm 3$	B1 B1	2	$y = 3$ $y = -3$	
2	(i)	$(3x+1)^2 - 2(2x-3)^2$ $= (9x^2 + 6x + 1) - 2(4x^2 - 12x + 9)$ $= x^2 + 30x - 17$	M1 A1 A1	3	Square to get at least one 3 or 4 term quadratic $9x^2 + 6x + 1$ or $4x^2 - 12x + 9$ soi $x^2 + 30x - 17$	
	(ii)	$2x^3 + 6x^3 + 4x^3 = 12x^3$  12	B1  B1	2	2 of $2x^3, 6x^3, 4x^3$ soi <b>N.B. www for these terms, must be positive</b>  12 or $12x^3$	
3	(i)	$\frac{dy}{dx} = 15x^4 - \frac{1}{2}x^{-\frac{1}{2}}$	B1 B1 B1	3	$15x^4$ $kx^{-\frac{1}{2}}$ $cx^4 - \frac{1}{2}x^{-\frac{1}{2}}$ only	
	(ii)	$\frac{d^2y}{dx^2} = 60x^3 + \frac{1}{4}x^{-\frac{3}{2}}$	M1  A1	2	Attempt to differentiate their 2 term $\frac{dy}{dx}$ and get one correctly differentiated term $60x^3 + \frac{1}{4}x^{-\frac{3}{2}}$	
4	(i)		B1  B1	2	Correct curve in one quadrant  Completely correct	
	(ii)		M1  A1√	2	Translate (i) horizontally  Translates all of their (i) $\begin{pmatrix} 3 \\ 0 \end{pmatrix}$ 3 must be labelled or stated	
	(iii)	(One-way) stretch, sf 2, parallel to the y-axis	B1 B1 B1	3	Stretch (Scale) factor 2 Parallel to y-axis o.e.  <b>SR</b> Stretch B1 Sf $\sqrt{2}$ parallel to x-axis B2	

5	(i)	$x^2 + 3x = \left(x + \frac{3}{2}\right)^2 - \frac{9}{4}$	B1		$a = \frac{3}{2}$
			B1	2	$b = -\frac{9}{4}$ o.e.
	(ii)	$y^2 - 4y - \frac{11}{4} = (y - 2)^2 - \frac{27}{4}$	B1		$p = -2$
			B1	2	$q = -\frac{27}{4}$ o.e.
	(iii)	Centre $\left(-\frac{3}{2}, 2\right)$	B1√	1	$\left(-\frac{3}{2}, 2\right)$ N.B. If question is restarted in this part, ft from part (iii) working only
	(iv)	Radius = $\sqrt{\frac{27}{4} + \frac{9}{4}}$ $= \sqrt{9}$ $= 3$	M1		$\sqrt{-\text{their}'b'-\text{their}'q'}$ or use $\sqrt{(f^2 + g^2 - c)}$
			A1	2	3 (±3 scores A0)
6	(i)	$y = x^3 - 3x^2 + 4$ $\frac{dy}{dx} = 3x^2 - 6x$ $3x^2 - 6x = 0$ $3x(x - 2) = 0$ $x = 0 \quad x = 2$ $y = 4 \quad y = 0$	B1 B1 M1 M1 A1 A1√		$3x^2 - 6x$ 1 term correct Completely correct $\frac{dy}{dx} = 0$ Correct method to solve quadratic $x = 0, 2$ $y = 4, 0$ <b>SR</b> one correct (x,y) pair <b>www B1</b>
	(ii)	$\frac{d^2y}{dx^2} = 6x - 6$ $x = 0 \quad y'' = -6 \quad -\text{ve max}$ $x = 2 \quad y'' = 6 \quad +\text{ve min}$	M1 B1 B1	3	Correct method to find nature of stationary points (can be a sketch) $x = 0 \quad \text{max}$ $x = 2 \quad \text{min}$ (N.B. If no method shown but both min and max correctly stated, award all 3 marks)
	(iii)	Increasing $x < 0 \quad x > 2$	M1 A1	2	Any inequality (or inequalities) involving both their x values from part (i) Allow $x \leq 0 \quad x \geq 2$

7	(i)	$x = \frac{8 \pm \sqrt{64 - 44}}{2}$ $= \frac{8 \pm \sqrt{20}}{2}$ $= 4 \pm \sqrt{5}$	<p>M1</p> <p>A1</p> <p>B1</p> <p>A1</p>	4	<p>Correct use of formula</p> $\frac{8 \pm \sqrt{20}}{2} \text{ aef}$ $\sqrt{20} = 2\sqrt{5} \text{ soi}$ $4 \pm \sqrt{5}$ <p><u>Alternative method</u></p> $(x-4)^2 - 16 + 11 = 0 \quad \text{M1}$ $(x-4)^2 = 5 \quad \text{A1}$ $x = 4 + \sqrt{5} \quad \text{A1}$ <p>or <math>4 - \sqrt{5} \quad \text{A1}</math></p>
(ii)			<p>B1</p> <p>B1√</p> <p>B1</p>	3	<p>+ve parabola</p> <p>Root(s) in correct places</p> <p>Completely correct curve with roots and (0, 11) labelled or referenced</p>
(iii)		$y = x^2 = (4 \pm \sqrt{5})^2$ $= 16 + 5 \pm 8\sqrt{5}$ $= 21 \pm 8\sqrt{5}$	<p>M1</p> <p>M1</p> <p>A1√</p> <p>A1</p>	4	<p><math>y = x^2</math> soi</p> <p>Attempt to square at least one answer from part (i)</p> <p>Correct evaluation of <math>(a + b\sqrt{c})^2</math> (<math>a, b, c \neq 0</math>)</p> $21 \pm 8\sqrt{5}$

8	(i)	$y = x^2 - 5x + 15$ $y = 5x - 10$ $x^2 - 5x + 15 = 5x - 10$ $x^2 - 10x + 25 = 0$	M1  A1	2	Attempt to eliminate y  $x^2 - 10x + 25 = 0$ <b>AG</b> Obtained with no wrong working seen
	(ii)	$b^2 - 4ac = 100 - 100$ $= 0$	B1	1	0 Do not allow $\sqrt{(b^2 - 4ac)}$
	(iii)	Line is a tangent to the curve )	B1√	1	Tangent or 'touches' N.B. Strict fit from their discriminant
	(iv)	$x^2 - 10x + 25 = 0$ $(x - 5)^2 = 0$ $x = 5 \quad y = 15$	M1  A1 A1	3	Correct method to solve 3 term quadratic  $x = 5$ $y = 15$
	(v)	Gradient of tangent = 5  Gradient of normal = $-\frac{1}{5}$  $y - 15 = -\frac{1}{5}(x - 5)$ $x + 5y = 80$	B1  B1√ M1 A1	4	Gradient of tangent = 5  Gradient of normal = $-\frac{1}{5}$  Correct equation of straight line, any gradient, passing through (5, 15) $x + 5y = 80$

<p>9 (i)</p>	<p>Length AC =  <math>\sqrt{(8-5)^2 + (2-1)^2}</math>  <math>= \sqrt{3^2 + 1^2}</math>  <math>= \sqrt{10}</math></p> <p>Length AB = <math>\sqrt{(p-5)^2 + (7-1)^2}</math>  <math>= \sqrt{(p-5)^2 + 36}</math></p> <p><math>\sqrt{(p-5)^2 + 36} = 2\sqrt{10}</math>  <math>p^2 - 10p + 25 + 36 = 40</math>  <math>p^2 - 10p + 21 = 0</math>  <math>(p-7)(p-3) = 0</math>  <math>p = 7, 3</math></p>	<p>M1  A1 A1  M1  M1  A1 A1</p>	<p>7</p>	<p>Uses <math>\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}</math></p> <p><math>\sqrt{10}</math> (<math>\pm \sqrt{10}</math> scores A0)</p> <p><math>\sqrt{(p-5)^2 + (7-1)^2}</math></p> <p>AB = 2AC (with algebraic expression) used</p> <p>Obtains 3 term quadratic = 0 suitable for solving <u>or</u> <math>(p-5)^2 = 4</math> _</p> <p><math>p = 7</math>  <math>p = 3</math></p> <p><b>SR If no working seen, and one correct value found, award B2 in place of the final 4 marks in part (i)</b></p>
<p>(ii)</p>	<p><math>7 = 3x - 14</math>  <math>x = 7</math></p> <p>(5, 1) (7, 7)</p> <p>Mid-point (6, 4)</p>	<p>M1 A1  M1  A1√</p>	<p>4</p>	<p>Correct method to find x  <math>x = 7</math></p> <p>Use <math>\left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)</math></p> <p>(6, 4) or correct midpoint for their AB</p> <p><u>Alternative method</u>  y coordinate of midpoint = 4 M1 A1  sub 4 into equation of line M1  obtains <math>x = 6</math> A1</p>