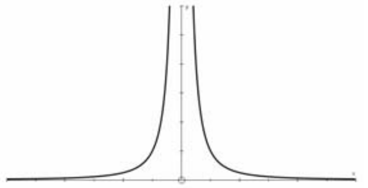
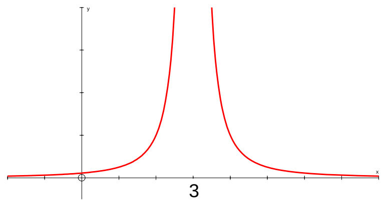
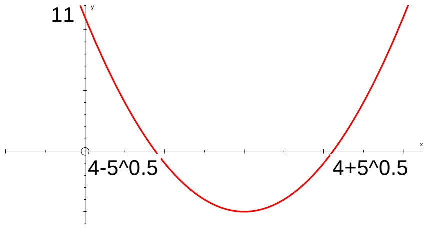
Mark Scheme 4721
January 2006

1	(i)	$x^{\frac{1}{3}} = 2$ $x = 8$	B1	**1**	(allow embedded values throughout question 1) 8
	(ii)	$10^t = 1$ $t = 0$	B1	**1**	0
	(iii)	$\left(y^{-2}\right)^2 = \frac{1}{81}$ $y^{-4} = \frac{1}{81}$ $y = \pm 3$	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 **N.B. www for these terms,** must be positive 12 or 12 x^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. **SR** 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 B1	2	$a=\frac{3}{2}$ $b=-\frac{9}{4}$ o.e.
	(ii)	$y^2-4y-\frac{11}{4}=(y-2)^2-\frac{27}{4}$	B1 B1	2	$p=-2$ $q=-\frac{27}{4}$ 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 A1	2	$\sqrt{-their'b'-their'q'}$ or use $\sqrt{(f^2+g^2-c)}$ 3 (±3 scores A0)
6	(i)	$y=x^3-3x^2+4$ $\frac{dy}{dx}=3x^2-6x$ $3x^2-6x=0$ $3x(x-2)=0$ $x=0$ $x=2$ $y=4$ $y=0$	B1 B1 M1 M1 A1 A1√	6	$3x^2-6x$ 1 term correct Completely correct $\frac{dy}{dx}=0$ Correct method to solve quadratic $x=0, 2$ $y=4, 0$ **SR** one correct (x,y) pair **www** **B1**
	(ii)	$\frac{d^2y}{dx^2}=6x-6$ $x=0$ $y''=-6$ $-$ve max $x=2$ $y''=6$ $+$ve min	M1 B1 B1	3	Correct method to find nature of stationary points (can be a sketch) $x=0$ max $x=2$ min (N.B. If no method shown but both min and max correctly stated, award all 3 marks)
	(iii)	Increasing $x<0$ $x>2$	M1 A1	2	Any inequality (or inequalities) involving both their x values from part (i) Allow $x\leq 0$ $x\geq 2$

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

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 $x^2 - 10x + 25 = 0$ **AG** 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 ft 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) $x + 5y = 80$

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