1(i) $x = 1$	B1 [1]	
(ii) $\frac{dy}{dx} = \frac{(x-1)2x-(x^2+3).1}{(x-1)^2}$ $= \frac{2x^2-2x-x^2-3}{(x-1)^2}$ $= \frac{x^2-2x-3}{(x-1)^2}$ $dy/dx = 0$ when $x^2 - 2x - 3 = 0$ $\Rightarrow (x-3)(x+1) = 0$ $\Rightarrow x = 3$ or -1 When $x = 3$, $y = (9 + 3)/2 = 6$ So P is (3, 6)	M1 A1 M1 M1 A1 B1ft [6]	Quotient rule correct expression their numerator = 0 solving quadratic by any valid method $x = 3$ from correct working $y = 6$
(iii) Area $= \int_2^3 \frac{x^2+3}{x-1}dx$ $u = x - 1 \Rightarrow du/dx = 1$, $du = dx$ When $x = 2$, $u = 1$; when $x = 3$, $u = 2$ $= \int_1^2 \frac{(u+1)^2+3}{u}du$ $= \int_1^2 \frac{u^2+2u+4}{u}du$ $= \int_1^2 (u+2+\frac{4}{u})du$ * $= \left[\frac{1}{2}u^2+2u+4\ln u\right]_1^2$ $= (2 + 4 + 4\ln 2) - (½ + 2 + 4\ln 1)$ $= 3½ + 4\ln 2$	M1 B1 B1 E1 B1 M1 A1cao [7]	Correct integral and limits Limits changed, and substituting $dx = du$ substituting $\frac{(u+1)^2+3}{u}$ www $[½ u^2 + 2u + 4\ln u]$ substituting correct limits
(iv) $e^y = \frac{x^2+3}{x-1}$ $\Rightarrow e^y \frac{dy}{dx} = \frac{x^2-2x-3}{(x-1)^2}$ $\Rightarrow \frac{dy}{dx} = e^{-y}\frac{x^2-2x-3}{(x-1)^2}$ When $x = 2$, $e^y = 7 \Rightarrow$ $\Rightarrow dy/dx = \frac{1}{7}.\frac{4-4-3}{1} = -\frac{3}{7}$	 M1 A1ft B1 A1cao [4]	 $e^y dy/dx$ = their $f'(x)$ or $xe^y - e^y = x^2 + 3$ $\Rightarrow e^y + xe^y\frac{dy}{dx} - e^y\frac{dy}{dx} = 2x$ $\Rightarrow \frac{dy}{dx} = \frac{2x-e^y}{e^y(x-1)}$ y = ln 7 or 1.95… or $e^y = 7$ or $\frac{dy}{dx} = \frac{4-7}{7(2-1)} = -\frac{3}{7}$ or –0.43 or better

2 $y^2 + y = x^3 + 2x$		
$x = 2 \Rightarrow y^2 + y = 12$	M1	Substituting $x = 2$
$\Rightarrow$ $y^2 + y - 12 = 0$		
$\Rightarrow$ $(y - 3)(y + 4) = 0$	A1	$y = 3$
$\Rightarrow$ $y = 3$ or -4.	A1	$y = -4$
$2y\frac{dy}{dx} + \frac{dy}{dx} = 3x^2 + 2$	M1	Implicit differentiation – LHS must be correct
$\Rightarrow \frac{dy}{dx}(2y+1) = 3x^2 + 2$		
$\Rightarrow \frac{dy}{dx} = \frac{3x^2+2}{2y+1}$	A1cao	
At (2, 3), $\frac{dy}{dx} = \frac{12+2}{6+1} = 2$	M1	substituting $x = 2$, $y = 3$ into their dy/dx, but must require both x and one of their y to be substituted
	A1 cao	2
At (2, –4), $\frac{dy}{dx} = \frac{12+2}{-8+1} = -2$	A1 cao	–2
	[8]	

Question			Answer	Marks	Guidance	
3	(i)		$f(-x) = \frac{-x}{\sqrt{2+(-x)^2}}$	M1	substituting $-x$ for x in $f(x)$	$\frac{-x}{\sqrt{2+-x^2}}, \frac{-x}{\sqrt{2+-(x^2)}}, \frac{-x}{\sqrt{2+(-x^2)}}$ M1A0
			$= -\frac{x}{\sqrt{2+x^2}} = -f(x)$	A1	1st line must be shown, must have $f(-x) = -f(x)$ oe somewhere	$\frac{-x}{\sqrt{2-x^2}}$ M0A0
			Rotational symmetry of order 2 about O	B1	must have 'rotate' and 'O' and 'order 2 or 180 or ½ turn'	oe e.g. reflections in both x- and y-axes
				[3]		
	(ii)		$f'(x) = \frac{\sqrt{2+x^2}.1 - x.\frac{1}{2}(2+x^2)^{-1/2}.2x}{(\sqrt{2+x^2})^2}$	M1 M1 A1	quotient or product rule used ½ $u^{-1/2}$ or – ½ $v^{-3/2}$ soi correct expression	QR: condone $u\mathrm{d}v \pm v\mathrm{d}u$, but u, v and denom must be correct $x(-1/2)(2+x^2)^{-3/2}.2x + (2+x^2)^{-1/2}$.
			$= \frac{2+x^2-x^2}{(2+x^2)^{3/2}} = \frac{2}{(2+x^2)^{3/2}}$ *	A1	**NB AG**	$= (2+x^2)^{-3/2}(-x^2+2+x^2)$
			When $x = 0$, $f'(x) = 2/2^{3/2} = 1/\sqrt{2}$	B1	oe e.g. $\sqrt{2}/2$, $2^{-1/2}$, $1/2^{1/2}$, but not $2/2^{3/2}$	allow isw on these seen
				[5]		
	(iii)		$A = \int_0^1 \frac{x}{\sqrt{2+x^2}}[\mathrm{d}x]$	B1	correct integral and limits	limits may be inferred from subsequent working, condone no dx
			let $u = 2 + x^2$, du = $2x$ dx		or $v = \sqrt{(2+x^2)}$, d$v = x(2+x^2)^{-1/2}$dx	
			$= \int_2^3 \frac{1}{2}\frac{1}{\sqrt{u}}\mathrm{d}u$	M1	$\int \frac{1}{2}\frac{1}{\sqrt{u}}[\mathrm{d}u]$ or $= \int 1[\mathrm{d}v]$ or $k(2+x^2)^{1/2}$	condone no du or dv, but not $\int \frac{1}{2}\frac{1}{\sqrt{u}}\mathrm{d}x$
			$= \left[u^{1/2}\right]_2^3$	A1	$[u^{1/2}]$ o.e. (but not $1/u^{-1/2}$) or $[v]$ or $k = 1$	
			$= \sqrt{3} - \sqrt{2}$	A1cao	must be exact	isw approximations
				[4]		

Question			Answer	Marks	Guidance	
3	**(iv)**	(*A*)	$y^2 = \frac{x^2}{2+x^2}$	M1	squaring (correctly)	must show $\left[\sqrt{(2+x^2)}\right]^2 + 2 + x^2$ (o.e.)
			$\Rightarrow \quad 1/y^2 = (2 + x^2)/x^2 = 2/x^2 + 1$ *	A1	or equivalent algebra **NB AG**	If argued backwards from given result without error, SCB1
				[2]		
	(iv)	(*B*)	$-2y^{-3}\mathrm{d}y/\mathrm{d}x = -4x^{-3}$	B1B1	LHS, RHS	condone $\mathrm{d}y/\mathrm{d}x\ -2y^{-3}$ unless pursued
			$\Rightarrow \quad \mathrm{d}y/\mathrm{d}x = -4x^{-3}/-2y^{-3} = 2y^3/\ x^3$ *	B1	**NB AG**	
			Not possible to substitute $x = 0$ and $y = 0$ into this expression	B1	soi (e.g. mention of 0/0)	Condone 'can't substitute $x = 0$' o.e. (i.e. need not mention $y = 0$).
				[4]		Condone also 'division by 0 is infinite'