1			let $u = 2x - 1$, $du = 2\,dx$			
			$\int \sqrt[3]{2x-1}\,dx = \int \frac{1}{2}u^{\frac{1}{3}}\,du$	M1 M1	substituting $u = 2x - 1$ in integral $\times$ ½ o.e.	i.e. $u^{1/3}$ or $\sqrt[3]{u}$ seen in integral condone no du, or dx instead of du
			$= \frac{3}{8}u^{\frac{4}{3}} + c$	M1	integral of $u^{1/3} = u^{4/3}/(4/3)$ (oe) soi	not $x^{1/3}$
			$= \frac{3}{8}(2x-1)^{\frac{4}{3}} + c$	A1cao	o.e., but must have + c and single fraction mark final answer	so $\frac{3}{4}(2x-1)^{\frac{4}{3}} + c$ is M1M0M1A0
			or			
			$\int \sqrt[3]{2x-1}\,dx = ½ \times (2x - 1)^{4/3} \div 4/3$	M1 M1 M1	$(2x - 1)^{4/3}$ seen $\div$ 4/3 (oe) soi $\times$ ½	e.g. correct power of $(2x - 1)$ e.g. ¾ $(2x - 1)^{4/3}$ seen
			$= \frac{3}{8}(2x-1)^{\frac{4}{3}} + c$	A1cao **[4]**	o.e., but must have + c and single fraction mark final ans	so $\frac{3}{8}(2x-1)^{\frac{4}{3}}$ is M1M1M1A0

2	**(i)**		$f'(x) = \frac{x.2(x-2)-(x-2)^2}{x^2}$	M1 A1	quotient (or product) rule, condone sign errors only correct exp, condone missing brackets here	e.g. $\frac{\pm x.2(x-2) \pm (x-2)^2}{x^2}$ PR: $(x - 2)^2.(-x^{-2}) + (1/x).2(x-2)$
			$= \frac{2x^2 - 4x - x^2 + 4x - 4}{x^2}$ $= (x^2 - 4)/x^2 = 1 - 4/x^2$ *	A1	simplified correctly **NB AG**	with correct use of brackets
			or $f(x) = (x^2 - 4x + 4)/x$ $= x - 4 + 4/x$ $\Rightarrow f'(x) = 1 - 4/x^2$ *	M1 A1 A1	expanding bracket and dividing each term by x correctly not from wrong working **NB AG**	must be 3 terms: $(x^2 - 4)/x$ is M0 e.g. $x - 4 + 2/x$ is M1A0
			$f''(x) = 8/x^3$ $f'(x) = 0$ when $x^2 = 4$, $x = \pm 2$ so at Q, $x = -2$, $y = -8$. $f''(-2)$ [$= -1$] < 0 so maximum	B1 M1 A1 B1dep **[7]**	o.e. e.g. $8x^{-3}$ or $8x/x^4$ $x = \pm 2$ found from $1 - 4/x^2 = 0$ $(-2, -8)$ dep first B1. Can omit -1, but if shown must be correct. Must state < 0 or negative.	 allow for $x = -2$ unsupported must use 2nd derivative test

Question			Answer	Marks	Guidance	
2	(ii)		$f(1) = (-1)^2/1 = 1$ $f(4) = (2)^2/4 = 1$	B1	verifying $f(1) = 1$ and $f(4) = 1$	or $(x-2)^2 = x \Rightarrow x^2 - 5x + 4 = 0$ $\Rightarrow (x-1)(x-4) = 0, x = 1, 4$
			$\int_1^4 \frac{(x-2)^2}{x}\,dx = \int_1^4 (x - 4 + 4/x)dx$	M1	expanding bracket and dividing each term by x 3 terms: $x - 4/x$ is M0	if $u = x - 2$ $\int \frac{u^2}{u+2}du = \int (u - 2 + \frac{4}{u+2})du$
			$= \left[x^2/2 - 4x + 4\ln x\right]_1^4$	A1	$x^2/2 - 4x + 4 \ln x$	$u^2/2 - 2u + 4 \ln(u + 2)$
			$= (8 - 16 + 4\ln4) - (\frac{1}{2} - 4 + 4\ln1)$			
			$= 4\ln4 - 4\frac{1}{2}$	A1cao		
			Area enclosed = rectangle – curve	M1	soi	
			$= 3\times1 - (4\ln4 - 4\frac{1}{2}) = 7\frac{1}{2} - 4\ln4$	A1cao	o.e. but must combine numerical terms and evaluate ln 1 – mark final ans	
			or			
			Area $= \int_1^4 [1 - \frac{(x-2)^2}{x}]dx$	M1	no need to have limits	
			$= \int_1^4 (5 - x - 4/x)dx$	M1 A1	expanding bracket and dividing each term by x $5 - x - 4/x$	must be 3 terms in $(x-2)^2$ expansion
			$= \left[5x - x^2/2 - 4\ln x\right]_1^4$	A1	$5x - x^2/2 - 4 \ln x$	
			$= 20 - 8 - 4\ln 4 - (5 - \frac{1}{2} - 4\ln1)$ $= 7\frac{1}{2} - 4\ln4$	A1cao **[6]**	o.e. but must combine numerical terms and evaluate ln 1 – mark final ans	
	(iii)		$[g(x) =]\ f(x+1) - 1$	M1	soi [may not be stated]	
			$= \frac{(x+1-2)^2}{x+1} - 1$	A1		
			$= \frac{x^2 - 2x + 1 - x - 1}{x+1} = \frac{x^2 - 3x}{x+1}$ *	A1 **[3]**	correctly simplified – not from wrong working **NB AG**	

Question			Answer	Marks	Guidance	
2	**(iv)**		Area is the same as that found in part (ii)	M1	award M1 for ± ans to 8(ii) (unless zero)	
			4ln4 – 7½	A1cao **[2]**	need not justify the change of sign	

Question			Answer	Marks	Guidance	
3			$\int_0^{\pi/6}(1-\sin 3x)\,\mathrm{d}x=\left[x+\frac{1}{3}\cos 3x\right]_0^{\pi/6}$	M1	±1/3 cos 3x seen or $\int \frac{1}{3}(1-\sin u)[\mathrm{d}u]$	i.e. condone sign error
				A1	$\left[x+\frac{1}{3}\cos 3x\right]$ or $\left[\frac{1}{3}(u+\cos u)\right]$	condone '+ c'
			= π/6 – 1/3	A1cao **[3]**	o.e., must be exact	isw after correct answer seen

4	**(i)**		$xe^{-2x} = mx$ $\Rightarrow \quad e^{-2x} = m$ $\Rightarrow \quad -2x = \ln m$ $\Rightarrow \quad x = -½ \ln m$ * **or** If $x = -½ \ln m$, $y = -½ \ln m \times e^{\ln m}$ $= -½ \ln m \times m$ so P lies on $y = mx$	M1 M1 A1 M1 A1 A1 **[3]**	may be implied from 2nd line dividing by x, or subtracting ln x **NB AG** substituting correctly	 o.e. e.g. $[\ln x] - 2x = \ln m + [\ln x]$ or factorising: $x(e^{-2x} - m) = 0$
	(ii)		let $u = x$, $u' = 1$, $v = e^{-2x}$, $v' = -2e^{-2x}$ $dy/dx = e^{-2x} - 2xe^{-2x}$ $= e^{-2(-\frac{1}{2}\ln m)} - 2.(-\frac{1}{2}\ln m)e^{-2(-\frac{1}{2}\ln m)}$ $= e^{\ln m} + e^{\ln m} \ln m \quad [= m + m \ln m]$	M1* A1 M1dep A1cao **[4]**	product rule consistent with their derivs o.e. correct expression subst $x = -½ \ln m$ into their deriv dep M1* condone $e^{\ln m}$ not simplified	 but not $-2(-½ \ln m)$, but mark final ans

Question			Answer	Marks	Guidance	
4	(iii)		$m + m\ln m = -m$	M1	their gradient from (ii) $= -m$	
			$\Rightarrow \quad \ln m = -2$			
			$\Rightarrow \quad m = e^{-2}$ *	A1	**NB AG**	
			or			
			$y + \frac{1}{2}m\ln m = m(1 + \ln m)(x + \frac{1}{2}\ln m)$ $x=-\ln m$, $y=0 \Rightarrow \frac{1}{2}m\ln m = m(1+\ln m)(-\frac{1}{2}\ln m)$ $\Rightarrow 1 + \ln m = -1$, $\ln m = -2$, $m = e^{-2}$	B2	for fully correct methods finding x-intercept of equation of tangent and equating to $-\ln m$	
			At P, $x = 1$	B1		
			$\Rightarrow \quad y = e^{-2}$	B1	isw approximations	not $e^{-2} \times 1$
				[4]		
	(iv)		Area under curve $= \int_0^1 xe^{-2x}dx$			
			$u = x$, $u' = 1$, $v' = e^{-2x}$, $v = -\frac{1}{2} e^{-2x}$	M1	parts, condone $v = k e^{-2x}$, provided it is used consistently in their parts formula	ignore limits until 3rd A1
			$= \left[-\frac{1}{2}xe^{-2x}\right]_0^1 + \int_0^1 \frac{1}{2}e^{-2x}dx$	A1ft	ft their v	
			$= \left[-\frac{1}{2}xe^{-2x} - \frac{1}{4}e^{-2x}\right]_0^1$	A1	$-\frac{1}{2}xe^{-2x} - \frac{1}{4}e^{-2x}$ o.e	
			$= (-\frac{1}{2}e^{-2} - \frac{1}{4}e^{-2}) - (0 - \frac{1}{4}e^{0})$ $[= \frac{1}{4} - \frac{3}{4}e^{-2}]$	A1	correct expression	need not be simplified
			Area of triangle $= \frac{1}{2}$ base $\times$ height	M1	ft their 1, e^{-2} or $[e^{-2}x^2/2]$	o.e. using isosceles triangle
			$= \frac{1}{2} \times 1 \times e^{-2}$	A1		M1 may be implied from 0.067…
			So area enclosed $= \frac{1}{4} - 5e^{-2}/4$	A1cao	o.e. must be exact, two terms only	isw
				[7]		

Question			Answer	Marks	Gui
5			$\int_0^{\pi/2} \frac{\sin 2x}{3+\cos 2x}\mathrm{d}x = \left[-\frac{1}{2}\ln(3+\cos 2x)\right]_0^{\pi/2}$	M1 A2	k ln(3 + cos 2x) – ½ ln(3 + cos 2x)
			or u = 3 + cos 2x, du = – 2sin2x dx	M1	o.e. e.g. du/dx = – 2sin2x or if v = cos2x, dv = – 2sin2xdx o.e. condone 2sin2x dx
			$\int_0^{\pi/2} \frac{\sin 2x}{3+\cos 2x}\mathrm{d}x = \int_4^2 -\frac{1}{2u}\mathrm{d}u$	A1	$\int -\frac{1}{2u}\mathrm{d}u$, or if v = cos2x, $\int -\frac{1}{2(3+v)}\mathrm{d}v$
			$=\left[-\frac{1}{2}\ln u\right]_4^2$	A1	− ½ ln$u$] or [– ½ ln(3 + v)] ignore incorrect limits
			= − ½ ln 2 + ½ ln 4	A1	from correct working o.e. e.g. – ½ ln(3+cos(2.π/2)) + ½ ln(3 + cos(2.0))
			= ½ ln (4/2)		o.e. required step for final A1, must have evaluated to 4 and 2 at this stage
			= ½ ln 2 *	A1	**NB AG**
				[5]	