Question			Answer	Marks	Guidance	
1			$\int_1^2 \frac{1}{\sqrt{3x-2}}\,dx = \left[\frac{2}{3}(3x-2)^{1/2}\right]_1^2$	M1 A2	$[k\,(3x-2)^{1/2}]$ $k = 2/3$	
			$= \frac{2}{3}.2 - \frac{2}{3}.1$ $= 2/3$*	M1dep A1	substituting limits dep 1st M1 NB **AG**	
			OR $u = 3x - 2 \Rightarrow du/dx = 3$ $\Rightarrow \int_1^2 \frac{1}{\sqrt{3x-2}}\,dx = \int_1^4 \frac{1}{\sqrt{u}}.\frac{1}{3}\,du$	M1 A1	$\int \frac{1}{\sqrt{u}}$ $\times\ 1/3\ (du)$	or $w^2 = 3x - 2 \Rightarrow \int \frac{1}{w}$ $\times\ 2/3\ w\ (dw)$
			$= \left[\frac{2}{3}u^{1/2}\right]_1^4 = \frac{2}{3}.2 - \frac{2}{3}.1$	A1	$\left[\frac{2}{3}u^{1/2}\right]$ o.	$\left[\frac{2}{3}w\right]$
			$= 2/3$*	M1dep A1 **[5]**	substituting correct limits dep 1st M1 NB **AG**	upper – lower, 1 to 4 for u or 1 to 2 for w or substituting back (correctly) for x and using 1 to 2

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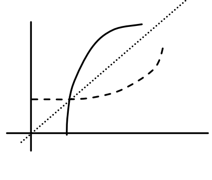
2	(i)		(*A*) (0, 6) and (1, 4 (*B*) −1, 5) and (0, 4)	B1B1 B1B1 **[4]**	Condone P and Q incorrectly labelled (or unlabelled)	
	(ii)		$f'(x)=\dfrac{(x+1).2x-(x^2+3).1}{(x+1)^2}$ $f'(x) = 0 \Rightarrow 2x\,(x + 1) - (x^2 + 3) = 0$ $\Rightarrow x^2 + 2x - 3 = 0$ $\Rightarrow (x - 1)(x + 3) = 0$ $\Rightarrow x = 1$ or $x = -3$ When $x = -3$, $y = 12/(-2) = -6$ so other TP is $(-3, -6)$	M1 A1 M1 A1dep B1B1cao **[6]**	Quotient or product rule consistent with their derivatives, condone missing brackets correct expression their derivative = 0 obtaining correct quadratic equation (soi) dep 1st M1 but withhold if denominator also set to zero must be from correct work (but see note re quadratic)	PR: $(x^2+3)(-1)(x+1)^{-2} + 2x(x+1)^{-1}$ If formula stated correctly, allow one substitution error. condone missing brackets if subsequent working implies they are intended Some candidates get $x^2 + 2x + 3$, then realise this should be $x^2 + 2x - 3$, and correct back, but not for every occurrence. Treat this sympathetically. Must be supported, but −3 could be verified by substitution into correct derivative
	(iii)		$f(x-1) = \dfrac{(x-1)^2+3}{x-1+1}$ $=\dfrac{x^2-2x+1+3}{x-1+1}$ $=\dfrac{x^2-2x+4}{x} = x-2+\dfrac{4}{x}$ *	M1 A1 A1 **[3]**	substituting $x - 1$ for both x's in f NB **AG**	allow 1 slip for M1
	(iv)		$\int_a^b (x-2+\frac{4}{x})\,dx=\left[\frac{1}{2}x^2-2x+4\ln x\right]_a^b$ $=(\frac{1}{2}b^2-2b+4\ln b)-(\frac{1}{2}a^2-2a+4\ln a)$ Area is $\int_0^1 f(x)\,dx$ So taking $a = 1$ and $b = 2$ area = (2 – 4 + 4ln 2) – (½ – 2 + 4ln 1) = 4 ln 2 – ½	B1 M1 A1 M1 A1 cao **[5]**	$\left[\frac{1}{2}x^2-2x+4\ln x\right]$ F(*b*) – F(*a*) condone missing brackets oe (mark final answer) must be simplified with ln 1 = 0	F must show evidence of integration of at least one term or $f(x) = x + 1 - 2 + 4/(x+1)$ $A = \int_0^1 f(x)\,dx=\left[\frac{1}{2}x^2-x+4\ln(1+x)\right]_0^1$ M1 = ½ − 1 + 4ln 2 = 4ln2 – ½ A1

3 $\int_0^{\pi/6} \sin 3x \, \mathrm{d}x = \left[-\frac{1}{3}\cos 3x\right]_0^{\frac{\pi}{6}}$ $= -\frac{1}{3}\cos\frac{\pi}{2} + \frac{1}{3}\cos 0$ $= \frac{1}{3}$	B1 M1 A1cao [3]	$\left[-\frac{1}{3}\cos 3x\right]$ or $\left[-\frac{1}{3}\cos u\right]$ substituting correct limits in $\pm k$ **cos** … 0.33 or better.

4(i) $y = 1/(1+\cos\pi/3) = 2/3$.	B1 [1]	or 0.67 or better
(ii) $\mathrm{f}\,'(x) = -1(1+\cos x)^{-2}.-\sin x$ $= \frac{\sin x}{(1+\cos x)^2}$ When $x = \pi/3$, $\mathrm{f}\,'(x) = \frac{\sin(\pi/3)}{(1+\cos(\pi/3))^2}$ $= \frac{\sqrt{3}/2}{(1\frac{1}{2})^2} = \frac{\sqrt{3}}{2} \times \frac{4}{9} = \frac{2\sqrt{3}}{9}$	M1 B1 A1 M1 A1 [5]	chain rule or quotient rule d/dx (cos x) = –sin x soi correct expression substituting $x = \pi/3$ oe or 0.38 or better. (0.385, 0.3849)
(iii) deriv = $\frac{(1+\cos x)\cos x - \sin x.(-\sin x)}{(1+\cos x)^2}$ $= \frac{\cos x + \cos^2 x + \sin^2 x}{(1+\cos x)^2}$ $= \frac{\cos x + 1}{(1+\cos x)^2}$ $= \frac{1}{1+\cos x}$ * Area $= \int_0^{\pi/3} \frac{1}{1+\cos x}\,dx$ $= \left[\frac{\sin x}{1+\cos x}\right]_0^{\pi/3}$ $= \frac{\sin\pi/3}{1+\cos\pi/3}(-0)$ $= \frac{\sqrt{3}}{2} \times \frac{2}{3} = \frac{\sqrt{3}}{3}$	M1 A1 M1dep E1 B1 M1 A1 cao [7]	Quotient or product rule – condone uv' – u'v for M1 correct expression $\cos^2 x + \sin^2 x = 1$ used dep M1 www substituting limits or $1/\sqrt{3}$ - must be exact
(iv) $y = 1/(1 + \cos x)$ $x \leftrightarrow y$ $x = 1/(1 + \cos y)$ $\Rightarrow$ $1 + \cos y = 1/x$ $\Rightarrow$ $\cos y = 1/x - 1$ $\Rightarrow$ $y = \arccos(1/x - 1)$ * Domain is $½ \leq x \leq 1$ 	M1 A1 E1 B1 B1 [5]	attempt to invert equation www reasonable reflection in $y = x$