Question	Scheme	Marks	AOs
14	$y = 4xe^{-2x} \Rightarrow \left\{\begin{matrix} u = 4x & v = e^{-2x} \\ \frac{du}{dx} = 4 & \frac{dv}{dx} = -2e^{-2x} \end{matrix}\right\}, \left\{\begin{matrix} u = 4x & \frac{du}{dx} = 4 \\ \frac{dv}{dx} = e^{-2x} & v = -\frac{1}{2}e^{-2x} \end{matrix}\right\}$		
	$\frac{dy}{dx} = 4e^{-2x} - 8xe^{-2x}$	M1	2.1
		A1	1.1b
	At $P(1, 4e^{-2})$, $m_T = 4e^{-2} - 8e^{-2} = -4e^{-2} \Rightarrow m_N = \frac{-1}{-4e^{-2}}$ or $\frac{1}{4}e^2$	M1	1.1b
	l: $y - 4e^{-2} = \frac{e^2}{4}(x-1)$ and $y = 0 \Rightarrow -4e^{-2} = \frac{e^2}{4}(x-1) \Rightarrow x = ...$	M1	3.1a
	$\{y = 0 \Rightarrow x = 1 - 16e^{-4}\}$		
	$\int 4xe^{-2x}dx = -2xe^{-2x} - \int -2e^{-2x}\,dx$	M1	2.1
		A1	1.1b
	$= -2xe^{-2x} - e^{-2x}$	A1	1.1b
	<u>Criteria</u> • $\left[-2xe^{-2x} - e^{-2x}\right]_0^1 = \left(-2e^{-2} - e^{-2}\right) - \left(0 - 1\right)$ $\{= 1 - 3e^{-2}\}$ • Area triangle = $\frac{1}{2}\left(16e^{-4}\right)\left(4e^{-2}\right)$ $\{= 32e^{-6}\}$	M1	2.1
	$\text{Area}(R) = 1 - 3e^{-2} - 32e^{-6}$ or $\frac{e^6 - 3e^4 - 32}{e^6}$	M1	3.1a
		A1	1.1b
		(10)	
			(10 marks)

Question 14 Notes:	
M1:	Begins the process to find where l intersects the x-axis by differentiating $y = 4x\mathrm{e}^{-2x}$ using the product rule
A1:	$\dfrac{\mathrm{d}y}{\mathrm{d}x} = 4\mathrm{e}^{-2x} - 8x\mathrm{e}^{-2x}$, which can be simplified or un-simplified
M1:	A correct method to find the value for the gradient of the normal using $m_{\mathrm{N}} = \dfrac{-1}{\text{their } m_T}$
M1:	Complete strategy to find where l intersects the x-axis i.e. Applying $y - 4\mathrm{e}^{-2} = m_{\mathrm{N}}(x-1)$, (where $m_{\mathrm{N}} \neq$ their m_{T}) followed by setting $y = 0$ and rearranging to give $x = ...$
M1:	Begins the process of finding the area under the curve by applying integration by parts in the correct direction to give $\pm\alpha x e^{-2x} \pm \int \beta e^{-2x}\{\mathrm{d}x\};\ \alpha, \beta \neq 0; \alpha < 4$
A1:	$4x\mathrm{e}^{-2x} \to -2x\mathrm{e}^{-2x} - \int -2\mathrm{e}^{-2x}\{\mathrm{d}x\}$, which can be simplified or un-simplified
A1:	$4x\mathrm{e}^{-2x} \to -2x\mathrm{e}^{-2x} - \mathrm{e}^{-2x}$, which can be simplified or un-simplified
M1:	At least one of the two listed criteria
M1:	Both criteria satisfied, followed by a complete strategy of subtracting the areas to find $\mathrm{Area}(R)$
A1:	Correct exact answer. E.g. $1 - 3\mathrm{e}^{-2} - 32\mathrm{e}^{-6}$ or $\dfrac{\mathrm{e}^6 - 3\mathrm{e}^4 - 32}{\mathrm{e}^6}$, o.e.