5	**(a)**		$\frac{dy}{dt} = 3t^2e^{-2t} + t^3\left(-2e^{-2t}\right)$	**M1***	**2.1**	Attempts to differentiate y with respect to t using the product rule – answer of the form $\frac{dy}{dt} = \lambda t^2e^{-2t} + \mu t^3e^{-2t}$ or $y' = \alpha x^{-5}e^{-6x^{-1}}(\beta x + \gamma)$	Where $\lambda, \mu \neq 0$ Where $\alpha, \beta, \gamma \neq 0$
			$\frac{dy}{dt} = 0 \Rightarrow t^2e^{-2t}(3-2t) = 0 \Rightarrow t = \ldots$	**M1dep***	**1.1**	Sets their derivative equal to zero and solves for t	Or their $\frac{dy}{dx}$ set = 0 and solve for x
			$t = \frac{3}{2}$	**A1**	**1.1**	From correct working only (or for $x = 2$)	
			$P\left(2, \frac{27}{8}e^{-3}\right)$	**A1**	**2.2a**	From correct working only y-coordinate must be exact but ISW	
				[4]			
5	**(b)**		$\frac{dx}{dt} = -3t^{-2}$ and $\int y\frac{dx}{dt}\,dt$	**M1**	**2.1**	Differentiates x with respect to t and attempts to set up integral for the required area	With $\frac{dx}{dt} = kt^{-2}$ with non-zero k
			$x = 6 \Rightarrow t = 0.5$ and $x = 1 \Rightarrow t = 3$	**B1**	**1.1**	Stating 0.5 and 3 is sufficient for this mark	If not attempted in **(b)** then this B mark can be awarded if seen in **(c)**
			Area $= \int_3^{0.5} t^3e^{-2t}\left(-\frac{3}{t^2}\right)dt = \int_3^{0.5} -3te^{-2t}\,dt = \int_{0.5}^{3} 3te^{-2t}\,dt$	**A1**	**2.2a**	Must be correctly shown	
				[3]			

5	**(c)**		$u=3t,$ and $\mathrm{d}v$ or $\dfrac{\mathrm{d}v}{\mathrm{d}t}=\mathrm{e}^{-2t}$	**M1***	**1.1**	Integrating by parts as far as $\mathrm{f}\left(t\right)\pm\int \mathrm{g}\left(t\right)\mathrm{d}t$	Ignore limits for first three marks and allow those who consider $-\int 3t\mathrm{e}^{-2t}\mathrm{d}t$ for possibly full marks
			$\int 3t\mathrm{e}^{-2t}\,\mathrm{d}t=-\frac{3}{2}t\mathrm{e}^{-2t}+\frac{3}{2}\int \mathrm{e}^{-2t}\,\mathrm{d}t$	**A1**	**1.1**		
			$=\ldots-\frac{3}{4}\mathrm{e}^{-2t}(+c)$	**A1**	**1.1**	Allow correct un-simplified for both A marks	
			$\left[-\frac{3}{2}t\mathrm{e}^{-2t}-\frac{3}{4}\mathrm{e}^{-2t}\right]_{0.5}^{3}=\left(-\frac{3}{2}(3)\mathrm{e}^{-6}-\frac{3}{4}\mathrm{e}^{-6}\right)$ $-\left(-\frac{3}{2}(0.5)\mathrm{e}^{-1}-\frac{3}{4}\mathrm{e}^{-1}\right)$	**M1dep***	**1.1**	Use of their *t*-limits (so not 1 and 6) in fully integrated expression (must subtract bottom limit from top limit)	
			Area $=-\frac{21}{4}\mathrm{e}^{-6}+\frac{3}{2}\mathrm{e}^{-1}$	**A1**	**2.2a**	ISW once correct exact answer seen	
				[5]			