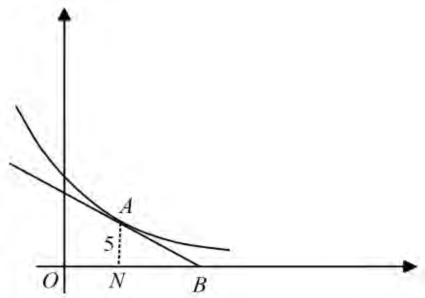
Question Number	Scheme	Marks
8(a)	$5\mathrm{e}^{-2x}+4=\mathrm{e}^{2x}\quad 5\mathrm{e}^{-2x}+4-\mathrm{e}^{2x}=0$ OR $y=\dfrac{5}{y}+4\Rightarrow y^2-4y-5=0$	M1
	$\left(5\mathrm{e}^{-x}-\mathrm{e}^{x}\right)\left(\mathrm{e}^{-x}+\mathrm{e}^{x}\right)=0$ | $(y-5)(y+1)=0$	M1
	$5\mathrm{e}^{-x}=\mathrm{e}^{x}\quad \mathrm{e}^{2x}=5\quad x=\dfrac{1}{2}\ln 5$ (oe eg $\ln\sqrt{5}$) | $y=5$	A1
	$\left(\mathrm{e}^{-x}=-\mathrm{e}^{x}\right.$ not possible$\left.\right)$ | $\mathrm{e}^{2x}=5\quad x=\dfrac{1}{2}\ln 5$	
	A is $\left(\dfrac{1}{2}\ln 5,5\right)$	A1 (4)
(b)	$y=5\mathrm{e}^{-2x}+4\Rightarrow\dfrac{\mathrm{d}y}{\mathrm{d}x}=-10\mathrm{e}^{-2x}$	M1
	At A $\dfrac{\mathrm{d}y}{\mathrm{d}x}=-10\mathrm{e}^{-2x}=-10\times\dfrac{1}{5}=-2$	A1ft
	Eqn tgt: $y-5=-2\left(x-\dfrac{1}{2}\ln 5\right)$	dM1A1
	$y=0\Rightarrow x=\dfrac{1}{2}(5+\ln 5)$ (= x coordinate of B)*	A1cso (5)
ALT	For last 3 marks:	
	Hence $\dfrac{5}{NB}=2\Rightarrow NB=\dfrac{5}{2}$	dM1A1
	$ON=\dfrac{1}{2}\ln 5$	
	$OB=\dfrac{1}{2}\ln 5+\dfrac{5}{2}=\dfrac{1}{2}\ 5+\ln 5$ * 	A1cso
(c)	$C_2:\dfrac{\mathrm{d}y}{\mathrm{d}x}=2\mathrm{e}^{2x}\Rightarrow$ grad tgt at A is $2\times 5=10$	B1ft
	Eqn tgt: $y-5=10\left(x-\dfrac{1}{2}\ln 5\right)$	M1
	At D: $x=\dfrac{1}{2}(-1+\ln 5)$	A1
	Area $\Delta ABD=\dfrac{1}{2}\left(\dfrac{1}{2}(5+\ln 5)-\dfrac{1}{2}(-1+\ln 5)\right)\times 5$	M1A1
	$=\dfrac{15}{2}$ or $7\dfrac{1}{2}$ (units^2)	A1 (6)
	See notes for area by "determinant" method	

ALT	For second and third marks: $\dfrac{5}{ND}=10 \Rightarrow ND=\dfrac{1}{2}$ $OD=\dfrac{1}{2}\ln 5-\dfrac{1}{2}$	M1 A1 [15]
(a) **M1** **M1** **A1** **A1**	 Equate the 2 curve equations. No need to simplify Factorise their equation Obtain the one possible value for x (other root need not be seen; if seen it must be rejected) **Must be exact** Obtain the corresponding value for y. **Must be exact.** Need not be shown in coordinate brackets. Use of $e^{2x} = 5$ leads to $y = 5$ without use of a value of x, so M1M1A0A1 can be scored. There must only be one correct y shown. Accept $y=e^{\ln 5}$	
(b) **M1** **A1ft** **dM1** **A1** **A1cso**	 Differentiate the equation of C_1 $5e^{-2x} \to ke^{-2x}$ where $k=\pm 5$ or ± 10 and no integration seen Grad at A = -2 follow through their x coordinate Obtain the equation of the tangent at A using their gradient and their coordinates of A. Can be in any form but if $y=mx+c$ is used a value for c must be found. Gradient of the tangent must be numerical. Correct equation in any form Correct x coordinate of B obtained from correct working.	
ALT **dM1** **A1** **A1cso**	For last 3 marks Use their y coordinate of A and their (numerical) gradient of the tangent to find the length NB (where N is the foot of the perpendicular from A to the x-axis) Correct length of NB Add the x coordinate of A to obtain the x coordinate of B	
(c) **B1ft** **M1** **A1** **M1** **A1** **A1**	 Correct gradient of tangent to C_2 at A follow through their x coordinate Obtain an equation for the tangent using their gradient and their coordinates of A Gradient of the tangent must be numerical. Correct x coordinate of D (exact or minimum 3 sf) Use a correct formula for the area of a triangle with their y coordinate of A, their x coordinate of D and the **given** x coordinate of B Correct, unsimplified area Allow use of correct but non-exact coordinates Correct area Accept only $7\dfrac{1}{2}, \dfrac{15}{2}$ or 7.5 **Heron's formula:** Nos which may be seen: $AB=\frac{5\sqrt{5}}{2}, AD=\frac{\sqrt{101}}{2}, BD=3, s=\frac{1}{2}(a+b+c)=6.8$	
ALT **M1** **A1**	For second and third marks: Use their y coordinate of A and their gradient of the tangent to find the length ND Use the x coordinate of A to obtain the x coordinate of D	

ALT	Area by "determinant" method:
M1	Eg Area $=\frac{1}{2}\begin{vmatrix} \frac{1}{2}\ln 5 & \frac{1}{2}(5+\ln 5) & \frac{1}{2}(\ln 5-1) & \frac{1}{2}\ln 5 \\ 5 & 0 & 0 & 5 \end{vmatrix}$ y coordinates of B and D must be 0 Must include the ½ and have 4 sets of coordinates with first and last the same.
A1	$=\frac{1}{2}\left(\frac{1}{2}(\ln 5-1)\times 5-\frac{1}{2}(\ln 5+1)\right)$ Allow use of correct but non-exact coordinates
A1	Correct area Accept only $7\frac{1}{2}$, $\frac{15}{2}$ or 7.5 **Must be positive**