

Q	Marking instructions	AO	Marks	Typical solution
17(a)	Obtains $\frac{du}{dx} = e^x$ OE	1.1b	B1	$u = e^x + 1$ $\frac{du}{dx} = e^x$ $\int \frac{e^{2x}}{e^x + 1} dx = \int \frac{e^{2x}}{u} \frac{1}{e^x} du$ $= \int \frac{e^x}{u} du$ $= \int \frac{u-1}{u} du$ $= \int 1 - \frac{1}{u} du$ $= u - \ln u + c$ $= e^x + 1 - \ln(e^x + 1) + c$ $= e^x - \ln(e^x + 1) + k$
	Makes a partial substitution to obtain $\int \frac{e^{2x}}{u} \frac{1}{e^x} du$ or better If they simplify the fraction first $\int e^x - \frac{e^x}{e^x + 1} dx$ need to see $\int e^x - \frac{e^x}{u} \frac{1}{e^x} du$ or better for this mark	3.1a	M1	
	Obtains $\int \frac{u-1}{u} du$ OE	1.1b	A1	
	Integrates their two-term integrand, which is in terms of u, with at least one of their terms integrated correctly.	1.1a	M1	
	Completes reasoned argument to obtain $e^x - \ln(e^x + 1) + k$ Must see constant of integration introduced as they integrate and dealt with consistently AG	2.1	R1	
	Subtotal		5	

Q	Marking instructions	AO	Marks	Typical solution
17(b)	Obtains $\frac{1}{\cos^2 y} \frac{dy}{dx} = \frac{e^{2x}}{e^x + 1}$ or better	3.1a	B1	$\int \sec^2 y \, dy = \int \frac{e^{2x}}{e^x + 1} \, dx$ $\tan y = e^x - \ln(e^x + 1) + k$ $\tan \pi = e^0 - \ln(e^0 + 1) + k$ $k = \ln(2) - 1$ $\tan y = e^x + \ln\left(\frac{2}{e^x + 1}\right) - 1$
	Integrates to obtain one correct side. Uses given answer from (a) or recalls $\int \sec^2 y \, dy = \tan y$	1.1a	M1	
	Obtains $\tan y = e^x - \ln(e^x + 1) + k$ Condone missing or extra constants of integration.	1.1b	A1	
	Substitutes $y = \pi$ and $x = 0$ into their integrated equation which must be formed from exponential functions of x and trigonometric function(s) of y to obtain the constant of integration	1.1a	M1	
	Completes reasoned argument to obtain $\tan y = e^x + \ln\left(\frac{2}{e^x + 1}\right) - 1$	2.1	R1	
	Subtotal		5	
	Question 17 Total		10	