Question	Scheme	Marks	AOs
6 (a)	$\left\{u = e^{\frac{1}{2}x} \text{ or } x = 2\ln u \Rightarrow\right\}$		
	$\frac{du}{dx} = \frac{1}{2}e^{\frac{1}{2}x}$ **or** $\frac{du}{dx} = \frac{1}{2}u$ **or** $\frac{dx}{du} = \frac{2}{u}$ **or** $dx = \frac{2}{u}du$ **or** $2du = u\,dx$, etc.	B1	1.1b
	Criteria 1 $\left\{x = 0 \Rightarrow a = e^0 \text{ and } x = 2 \Rightarrow b = e^{\frac{1}{2}(2)}\right\}$ $a = 1, b = e$ **or** evidence of $0 \to 1$ and $2 \to e$ **Criteria 2 (dependent on the first B1 mark)** $\int \frac{6}{(e^{\frac{1}{2}x} + 4)}dx = \int \frac{6}{(u+4)}.\frac{2}{u}du = \int \frac{12}{u(u+4)}du$		
	Either Criteria 1 or Criteria 2	B1	1.1b
	Both Criteria 1 and Criteria 2 **and** correctly achieves the result $\int_1^e \frac{12}{u(u+4)}du$	B1	2.1
		(3)	
(b)	$\frac{12}{u(u+4)} \equiv \frac{A}{u} + \frac{B}{(u+4)} \Rightarrow 12 \equiv A(u+4) + Bu$	M1	1.1b
	$u = 0 \Rightarrow A = 3;\ \ u = -4 \Rightarrow B = -3$	A1	1.1b
	$\left\{\int \frac{12}{u(u+4)}du = \right\} \int \left(\frac{3}{u} - \frac{3}{(u+4)}\right)du = 3\ln u - 3\ln(u+4)$	M1 A1ft	3.1a 1.1b
	$\left\{\text{So, } \left[3\ln u - 3\ln(u+4)\right]_1^e\right\}$		
	$= (3\ln e - 3\ln(e+4)) - (3\ln 1 - 3\ln 5)$		
	$= 3\ln e - 3\ln(e+4) + 3\ln 5$		
	$= 3\ln\left(\frac{5e}{e+4}\right)$ *	A1*	2.1
		(5)	
			(8 marks)

Question 6 Notes:

(a)	
B1:	See scheme
B1:	See scheme
B1:	See scheme
	Note for Criteria 2: Must start from one of • $\int y\,\mathrm{d}x$, with integral sign and $\mathrm{d}x$ • $\int \frac{6}{e^{\frac{1}{2}x}+4}\,\mathrm{d}x$, with integral sign and $\mathrm{d}x$ • $\int \frac{6}{e^{\frac{1}{2}x}+4}\frac{\mathrm{d}x}{\mathrm{d}u}\,\mathrm{d}u$, with integral sign and $\frac{\mathrm{d}x}{\mathrm{d}u}\mathrm{d}u$ **and** end at $\int \frac{12}{u(u+4)}\,\mathrm{d}u$, with integral sign and $\mathrm{d}u$, **with no incorrect working**
(b)	
M1:	Writing $\frac{12}{u(u+4)} \equiv \frac{A}{u} + \frac{B}{(u+4)}$, o.e. or $\frac{1}{u(u+4)} \equiv \frac{P}{u} + \frac{Q}{(u+4)}$, o.e. and a complete method for finding the values of both **their** *A* and **their** *B* (or **their** *P* and **their** *Q*) **Note:** This mark can be implied by writing down $\frac{"A"}{u} + \frac{"B"}{(u+4)}$ with values stated for **their** *A* and **their** *B* where either **their** $A=3$ or **their** $B=-3$
A1:	Both **their** $A=3$ and **their** $B=-3$ (or **their** $P=\frac{1}{4}$ and **their** $Q=-\frac{1}{4}$ with a factor of 12 in front of the integral sign)
M1:	Complete strategy for finding $\int \frac{12}{u(u+4)}\,\mathrm{d}u$, which consists of • expressing $\frac{12}{u(u+4)}$ in partial fractions • and integrating $\frac{12}{u(u+4)} \equiv \frac{M}{u} \pm \frac{N}{(u \pm k)}$; $M, N, k \neq 0$; (i.e. ***a two-term partial fraction***) to obtain **both** $\pm\lambda\ln(\alpha u)$ **and** $\pm\mu\ln(\beta(u \pm k))$; $\lambda, \mu, \alpha, \beta \neq 0$
A1ft:	Integration of both terms is **correctly followed through** from **their** *M* and **their** *N*
A1*:	Applies limits of e and 1 in *u* (or applies limits of 2 and 0 in *x*), subtracts the correct way round and uses laws of logarithms to correctly obtain $3\ln\left(\frac{5e}{e+4}\right)$ with no errors seen.