Question 1 1620

i. $\frac{d}{dx}\left[\log_e(\cos x)\right] = \frac{-\sin x}{\cos x}$
$= -\tan x$
(as $\frac{d}{dx}\left[\log_e f(x)\right] = \frac{f'(x)}{f(x)}$)

ii. $\int_0^{\frac{\pi}{4}} \tan x dx = \Big[-\log_e(\cos x)_0^{\frac{\pi}{4}}$
$= -\left[\log_e\left(\cos\frac{\pi}{4} - \cos 0\right)\right]$
$= -\left[\log_e \frac{1}{\sqrt{2}} - \log_e 1\right]$
$= -\left[\log_e \frac{1}{\sqrt{2}} - 0\right]$
$= -\log_e \frac{1}{\sqrt{2}}$
$= \log_e \sqrt{2}$
$= \log_e 2^{\frac{1}{2}}$
$= \frac{1}{2}\log_e 2$