1. [**ACJC 17 Promos**]

   (a) Find $\int x \tan^{-1} x \, \mathrm{d}x$. [3]

   (b) Use the substitution $x = 1 + \cos\theta$, where $0 < \theta < \pi$, to find $\displaystyle\int \frac{x}{\sqrt{2x - x^2}} \, \mathrm{d}x$. [4]

2. [**DHS 17 Promos (modified)**]

   Find $\dfrac{\mathrm{d}}{\mathrm{d}x}\left(\tan(x^2)\right)$ and $\dfrac{\mathrm{d}}{\mathrm{d}x}\left(\ln(\sec(x^2))\right)$.

   Hence find $\displaystyle\int x^3 \sec^2(x^2) \, \mathrm{d}x$.

3. [**EJC 17 Promos**]

   (a) Find $\displaystyle\int \frac{e^{2\tan^{-1}x}}{1 + x^2} \, \mathrm{d}x$. [2]

   (b) Find $\displaystyle\int \frac{2x + 1}{\sqrt{2x^2 + 2x - 5}} \, \mathrm{d}x$. [2]

Answers

1. (a) $\frac{x^2}{2}\tan^{-1}x - \frac{x}{2} + \frac{1}{2}\tan^{-1}x + C$.

   (b) $-\cos^{-1}(x-1) - \sqrt{x(2-x)} + C$.

2. $\frac{1}{2}(x^2\tan(x^2) - \ln(\sec(x^2))) + C$.

3. (a) $\frac{1}{2}e^{2\tan^{-1}x} + C$.

   (b) $\sqrt{2x^2 + 2x - 5} + C$.