**7.** The curve $C$ has equation

$$x = 3\tan\left(y - \frac{\pi}{6}\right) \qquad x \in \mathbb{R} \quad -\frac{\pi}{3} < y < \frac{2\pi}{3}$$

(a) Show that

$$\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{a}{x^2 + b}$$

where $a$ and $b$ are integers to be found.

**(4)**

The point $P$ with $y$ coordinate $\frac{\pi}{3}$ lies on $C$.

Given that the tangent to $C$ at $P$ crosses the $x$-axis at the point $Q$.

(b) find, in simplest form, the exact $x$ coordinate of $Q$.

**(5)**

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**Question 7 continued**

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**Question 7 continued**

**(Total for Question 7 is 9 marks)**

**8.** Find, in simplest form,

$$\int (2\cos x - \sin x)^2 \, dx$$

**(5)**

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