1 Fig. 1 shows part of the curve $y = e^{2x}\cos x$.

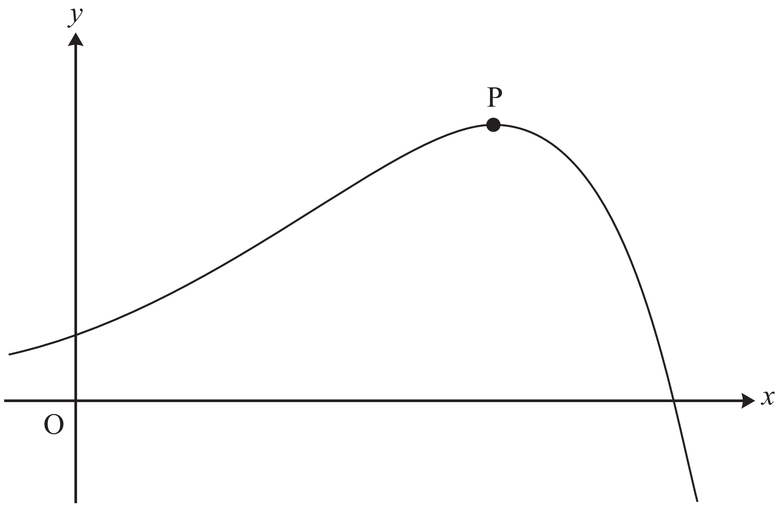

Fig. 1

Find the coordinates of the turning point P. **[6]**

2 Find the exact gradient of the curve $y = \ln(1 - \cos 2x)$ at the point with x-coordinate $\frac{1}{6}\pi$. **[5]**

3 **(i)** Given that $y = e^{-x}\sin 2x$, find $\frac{dy}{dx}$. **[3]**

(ii) Hence show that the curve $y = e^{-x}\sin 2x$ has a stationary point when $x = \frac{1}{2}\arctan 2$. **[3]**

4 Fig. 8 shows parts of the curves $y = \mathrm{f}(x)$ and $y = \mathrm{g}(x)$, where $\mathrm{f}(x) = \tan x$ and $\mathrm{g}(x) = 1 + \mathrm{f}(x - \frac{1}{4}\pi)$.

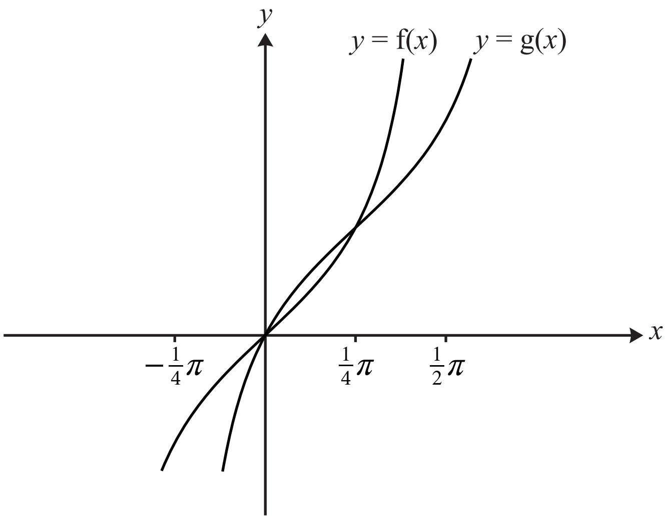

Fig. 8

(i) Describe a sequence of two transformations which maps the curve $y = \mathrm{f}(x)$ to the curve $y = \mathrm{g}(x)$. **[4]**

It can be shown that $\mathrm{g}(x) = \dfrac{2\sin x}{\sin x + \cos x}$.

(ii) Show that $\mathrm{g}'(x) = \dfrac{2}{(\sin x + \cos x)^2}$. Hence verify that the gradient of $y = \mathrm{g}(x)$ at the point $(\frac{1}{4}\pi, 1)$ is the same as that of $y = \mathrm{f}(x)$ at the origin. **[7]**

(iii) By writing $\tan x = \dfrac{\sin x}{\cos x}$ and using the substitution $u = \cos x$, show that $\displaystyle\int_0^{\frac{1}{4}\pi} \mathrm{f}(x)\,\mathrm{d}x = \int_{\frac{1}{\sqrt{2}}}^{1} \frac{1}{u}\,\mathrm{d}u$.

Evaluate this integral exactly. **[4]**

(iv) Hence find the exact area of the region enclosed by the curve $y = \mathrm{g}(x)$, the x-axis and the lines $x = \frac{1}{4}\pi$ and $x = \frac{1}{2}\pi$. **[2]**

5 Differentiate $x^2 \tan 2x$. **[3]**

6 Given that $y = \sqrt[3]{1 + x^2}$, find $\frac{dy}{dx}$. **[4]**

7 Given that $y = x^2\sqrt{1 + 4x}$, show that $\frac{dy}{dx} = \frac{2x(5x + 1)}{\sqrt{1 + 4x}}$. **[5]**