**5.**

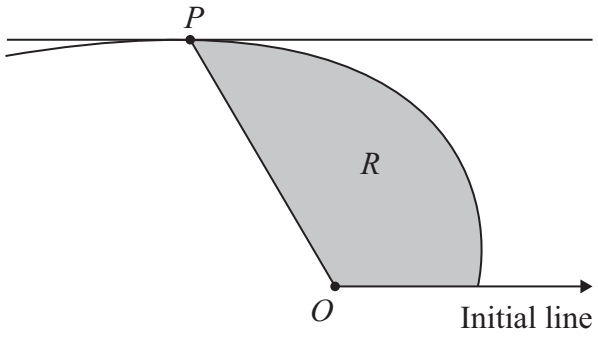



**Figure 1**

**In this question you must show all stages of your working.**
**Solutions relying entirely on calculator technology are not acceptable.**

Figure 1 shows a sketch of part of the curve with polar equation

$$r = \sqrt{3} + \tan\frac{\theta}{2} \qquad 0 \leqslant \theta < \pi$$

The tangent to the curve at the point $P$ is parallel to the initial line.

(a) Using the identity $\tan\frac{\theta}{2} \equiv \frac{1-\cos\theta}{\sin\theta}$ or otherwise, determine the exact value of $\theta$ at $P$.

**(4)**

The region $R$, shown shaded in Figure 1, is bounded by the initial line, the curve and the line $OP$, where $O$ is the pole.

(b) Use algebraic integration to determine the exact area of $R$, giving your answer in the form $p\ln 2 + q\pi + r$ where $p$, $q$ and $r$ are constants.

**(6)**

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**Question 5 continued**

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**(Total for Question 5 is 10 marks)**

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