

STEP II, 1998, Q6

6 Two curves are given parametrically by

$$(1) \quad x_1 = (\theta + \sin \theta), \quad y_1 = (1 + \cos \theta),$$

and

$$(2) \quad x_2 = (\theta - \sin \theta), \quad y_2 = -(1 + \cos \theta).$$

Find the gradients of the tangents to the curves at the points where $\theta = \pi/2$ and $\theta = 3\pi/2$.

Sketch, using the same axes, the curves for $0 \leq \theta \leq 2\pi$.

Find the equation of the normal to the curve (1) at the point with parameter θ . Show that this normal is a tangent to the curve (2).



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