

1. The curve  $C$  has parametric equations

$$x = \sin 2\theta \quad y = \operatorname{cosec}^3 \theta \quad 0 < \theta < \frac{\pi}{2}$$

(a) Find an expression for  $\frac{dy}{dx}$  in terms of  $\theta$  (3)

(b) Hence find the exact value of the gradient of the tangent to  $C$  at the point where  $y = 8$  (3)

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2.

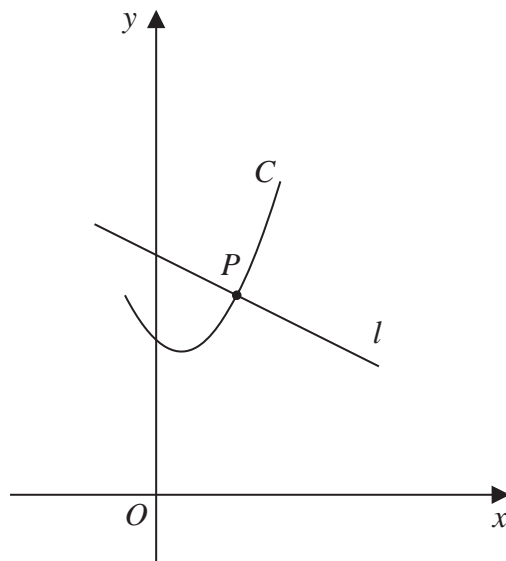


Figure 6

Figure 6 shows a sketch of the curve  $C$  with parametric equations

$$x = 2 \tan t + 1 \quad y = 2 \sec^2 t + 3 \quad -\frac{\pi}{4} \leq t \leq \frac{\pi}{3}$$

The line  $l$  is the normal to  $C$  at the point  $P$  where  $t = \frac{\pi}{4}$

(a) Using parametric differentiation, show that an equation for  $l$  is

$$y = -\frac{1}{2}x + \frac{17}{2} \quad (5)$$

(b) Show that all points on  $C$  satisfy the equation

$$y = \frac{1}{2}(x-1)^2 + 5 \quad (2)$$

The straight line with equation

$$y = -\frac{1}{2}x + k \quad \text{where } k \text{ is a constant}$$

intersects  $C$  at two distinct points.

(c) Find the range of possible values for  $k$ . (5)

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