9.

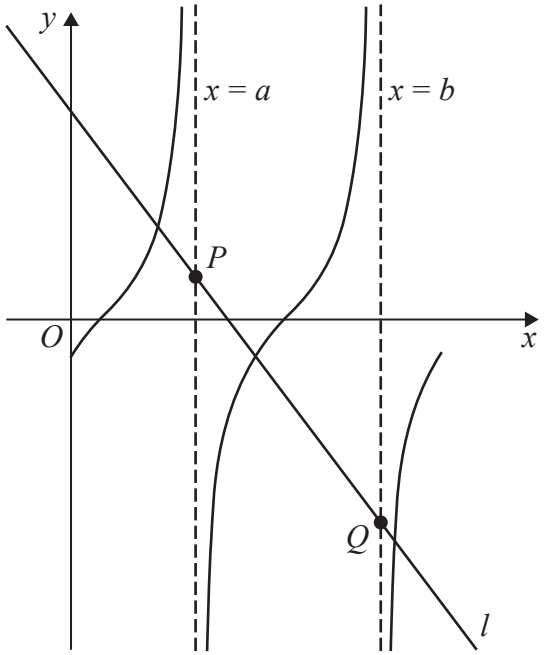


Figure 3

Figure 3 shows a sketch of

- the curve with equation $y = \tan\left(x - \frac{\pi}{6}\right)$ for $0 \leqslant x \leqslant 2\pi$
- part of the straight line l with equation $y = \pi - x$

(a) State the number of solutions of the equation

(i) $\tan\left(x - \frac{\pi}{6}\right) = \pi - x$ in the interval $0 \leqslant x \leqslant 2\pi$

(ii) $\tan\left(x - \frac{\pi}{6}\right) = \pi - x$ in the interval $0 \leqslant x \leqslant 100\pi$

(iii) $\tan\left(x - \frac{\pi}{6}\right) = \pi + x$ in the interval $0 \leqslant x \leqslant 2\pi$

(3)

The line with equation $x = a$, shown in Figure 3, is the asymptote to the curve with the smallest positive x coordinate.

(b) State the value of a

(1)

The line with equation $x = b$, also shown in Figure 3, is the asymptote to the curve with the second smallest positive x coordinate.

The line l meets $x = a$ at point P and meets $x = b$ at point Q as shown in Figure 3.

(c) Find the midpoint of the line segment PQ.

(4)

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Question 9 continued

(Total for Question 9 is 8 marks)

10. **In this question you must show all stages of your working.**

Solutions relying on calculator technology are not acceptable.

The curve C has equation

$$y = \frac{2}{3}x^3 - 25x - \frac{56}{x} + \frac{194}{3} \qquad x > 0$$

The point P, which lies on C, has coordinates $(2, -8)$

(a) Show that an equation of the tangent to C at P is

$$y = -3x - 2$$

(5)

The point Q also lies on C.

Given that the tangent to C at Q is parallel to the tangent to C at P,

(b) find, using algebra and showing your working, the exact x coordinate of Q.

(5)

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