6. With respect to a fixed origin O, the line l_1 has equation

$$\mathbf{r} = \begin{pmatrix} -3 \\ 0 \\ 5 \end{pmatrix} + \lambda \begin{pmatrix} 2 \\ 1 \\ -3 \end{pmatrix}$$

where λ is a scalar parameter.

The point P lies on l_1

Given that P is the point on l_1 that is nearest O,

(a) find the coordinates of P.

(4)

With respect to the same fixed origin O, the line l_2 has equation

$$\mathbf{r} = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix} + \mu \begin{pmatrix} 4 \\ a \\ -2 \end{pmatrix}$$

where a is a constant and μ is a scalar parameter.

Given that l_1 and l_2 intersect at the point Q,

(b) find the value of a,

(4)

(c) find the coordinates of Q.

(2)

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Question 6 continued

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(Total for Question 6 is 10 marks)

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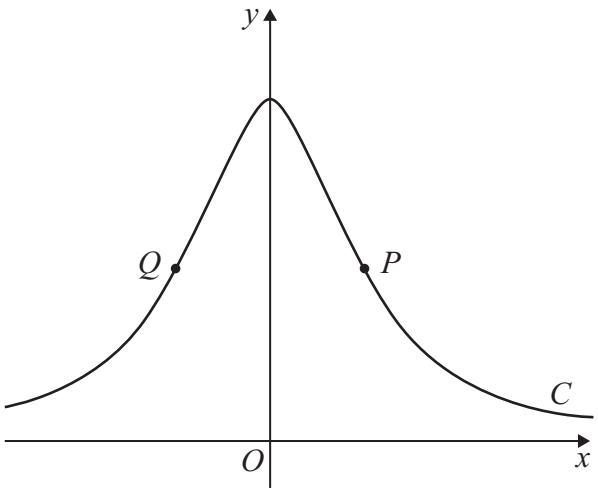

Figure 2

The curve C, shown in Figure 2 has equation

$$x^2 \tan y + \frac{32y^2}{\pi^2} = 11 \qquad 0 < y \leqslant \frac{\pi}{2}$$

The points P and Q, shown in Figure 2, lie on C and have y coordinate $\frac{\pi}{4}$

(a) Find the x coordinate of P and the x coordinate of Q.

(2)

(b) Use algebraic differentiation to find the exact value of $\frac{\mathrm{d}y}{\mathrm{d}x}$ at P.

(5)

(c) Hence, showing your working, find the value of

(the gradient of the tangent to C at P) $\times$ (the gradient of the normal to C at Q)

(2)

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