5.

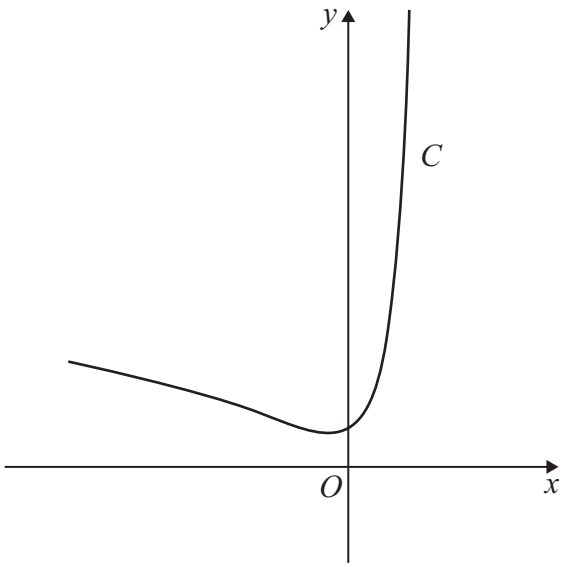


Figure 1

The curve C, shown in Figure 1, has parametric equations

$$x = \frac{4t - 5}{2t + 1} \qquad y = 2t^2 - 4t + 4 \qquad t \geqslant 0$$

The point P lies on C and has parameter $t = 3$

(a) Find the coordinates of P.

(2)

(b) Find $\dfrac{\mathrm{d}y}{\mathrm{d}x}$ in terms of t, writing the answer in simplest form.

(4)

(c) Hence find the equation of the tangent to C at P. Write the answer in the form $y = mx + c$, where m and c are constants.

(2)

Given that

- the Cartesian equation of C is $y = \mathrm{f}(x)$
- the function f is defined for all values of x on C

(d) (i) find the domain of f

(ii) find the range of f

(3)

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Question 5 continued

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Question 5 continued

(Total for Question 5 is 11 marks)

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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