**3.**

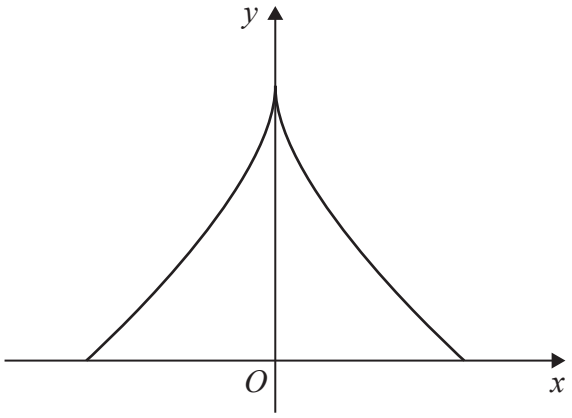



**Figure 1**

Figure 1 shows a sketch of the curve $C$ with parametric equations

$$x = 3\sin^3\theta \qquad y = 1 + \cos 2\theta \qquad -\frac{\pi}{2} \leqslant \theta \leqslant \frac{\pi}{2}$$

(a) Show that

$$\frac{\mathrm{d}y}{\mathrm{d}x} = k\,\mathrm{cosec}\,\theta \qquad \theta \neq 0$$

where $k$ is a constant to be found.

**(3)**

The point $P$ lies on $C$ where $\theta = \frac{\pi}{6}$

(b) Find the equation of the tangent to $C$ at $P$, giving your answer in the form $ax + by + c = 0$ where $a$, $b$ and $c$ are integers.

**(3)**

(c) Show that $C$ has Cartesian equation

$$8x^2 = 9(2 - y)^3 \qquad -q \leqslant x \leqslant q$$

where $q$ is a constant to be found.

**(3)**

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**Question 3 continued**

**Question 3 continued**

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**Question 3 continued**

**(Total for Question 3 is 9 marks)**

**4.**

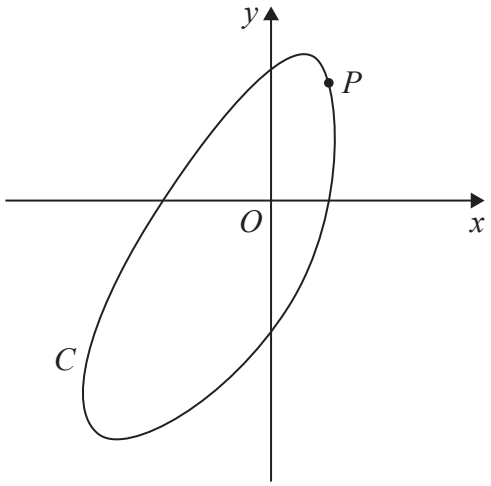



**Figure 2**

Figure 2 shows a sketch of the curve $C$ with equation

$$3x^2 + 2y^2 - 4xy + 8^x - 11 = 0$$

The point $P$ has coordinates $(1, 2)$.

(a) Verify that $P$ lies on $C$.

**(1)**

(b) Find $\dfrac{dy}{dx}$ in terms of $x$ and $y$.

**(5)**

The normal to $C$ at $P$ crosses the $x$-axis at a point $Q$.

(c) Find the $x$ coordinate of $Q$, giving your answer in the form $a + b\ln 2$ where $a$ and $b$ are integers.

**(3)**

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