

Parametric equations

A-level Pure Mathematics (Year 2) | Edexcel 9MA0 | 12 questions, 70 marks

A-level Maths topic practice



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Name: _____ **Date:** _____ **Score:** _____ / 70

1 A curve C has parametric equations

$$x = 2t - 1, \quad y = t^2 + 3, \quad t \in \mathbb{R}$$

- Find the coordinates of the point on C where $t = 3$
- Find a Cartesian equation for C in the form $y = f(x)$

(3 marks)

Answer _____

2 A curve C has parametric equations

$$x = 1 + 4 \cos \theta, \quad y = 4 \sin \theta - 2, \quad 0 \leq \theta < 2\pi$$

Show that C is a circle and state its centre and radius.

(3 marks)

Answer _____

3 A curve C has parametric equations

$$x = t^3 - 2t, \quad y = t^2 + 4t$$

- Find $\frac{dy}{dx}$ in terms of t
- Find an equation of the tangent to C at the point where $t = 2$, giving your answer in the form $ax + by + c = 0$, where a , b and c are integers.

(5 marks)

Answer _____

4 A curve C has parametric equations

$$x = 1 + 2 \sin t, \quad y = 3 - \cos 2t, \quad -\frac{\pi}{2} \leq t \leq \frac{\pi}{2}$$

- Show that a Cartesian equation of C is $y = 2 + \frac{1}{2}(x - 1)^2$
- State the domain of values of x and the range of values of y for C .
- Explain why C does not include every point of the curve with equation $y = 2 + \frac{1}{2}(x - 1)^2, x \in \mathbb{R}$

(5 marks)

Answer _____

5 A curve C has parametric equations

$$x = \frac{3}{t-1}, \quad y = \frac{t^2}{t-1}, \quad t > 1$$

Show that a Cartesian equation of C is

$$y = \frac{(x+a)^2}{bx}, \quad x > 0$$

where a and b are integers to be found.

(3 marks)

Answer _____

6 A curve C has parametric equations

$$x = t^2 - 4t, \quad y = t^3 - 3t, \quad t \in \mathbb{R}$$

- Find the coordinates of the points on C where the tangent is parallel to the x -axis.
- Find the coordinates of the point on C where the tangent is parallel to the y -axis.

(6 marks)

Answer _____

7 A curve C has parametric equations

$$x = t^2 + 1, \quad y = 2t - 1, \quad t \in \mathbb{R}$$

The point P on C has parameter $t = 2$

- Show that the normal to C at P has equation $y = 13 - 2x$
- The normal meets C again at the point Q . Find the coordinates of Q .

(7 marks)

Answer _____

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

A curve C has parametric equations

$$x = 2 \cos t, \quad y = \sin 2t, \quad 0 \leq t < 2\pi$$

Find the exact coordinates of all the points where C meets the line with equation $y = \frac{\sqrt{3}}{2}x$

(5 marks)

Answer _____

9 A curve C has parametric equations

$$x = 2 \cos t, \quad y = 1 + \cos 2t, \quad 0 \leq t \leq \pi$$

- Show that all points on C satisfy $y = \frac{1}{2}x^2$ and state the domain of values of x for C .
- The line with equation $y = x + k$, where k is a constant, meets C at two distinct points. Find the range of possible values of k , writing your answer in set notation.

(7 marks)

Answer _____

10 A curve C has parametric equations

$$x = \cos 2\theta, \quad y = \sec \theta, \quad 0 < \theta < \frac{\pi}{2}$$

- Show that $\frac{dy}{dx} = k \sec^3 \theta$, where k is a constant to be found.
- Find an equation of the tangent to C at the point where $y = 2$, giving your answer in the form $y = mx + c$

(6 marks)

Answer _____

11 A reflector is fixed to the rim of a bicycle wheel of radius 0.3 m. As the bicycle moves along level ground, the position of the reflector is modelled by

$$x = 0.3(\theta - \sin \theta), \quad y = 0.3(1 - \cos \theta), \quad 0 < \theta < 2\pi$$

where x metres is the horizontal distance moved by the reflector, y metres is its height above the ground and θ is the angle in radians that the wheel has turned through.

- Show that $\frac{dy}{dx} = \cot\left(\frac{\theta}{2}\right)$
- Find the exact coordinates of the reflector at the moment its path has gradient 1
- The reflector is 0.45 m above the ground at two points in this interval. Find the gradient of the path at each of these points, giving exact answers.
- State one assumption made in this model.

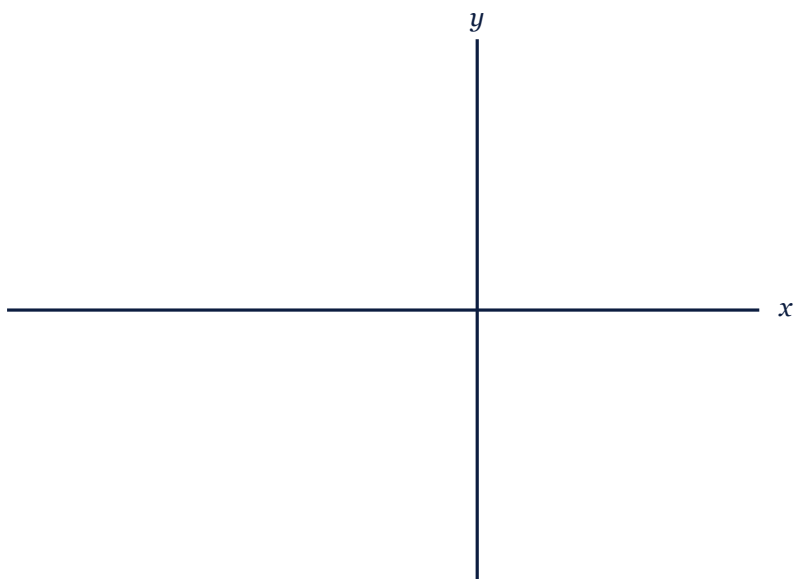
(9 marks)

Answer _____

12 A curve C has parametric equations

$$x = t^2 - 4, \quad y = t^3 - 4t, \quad t \in \mathbb{R}$$

- Find the values of t at which C meets the x -axis, and hence show that C passes through the origin O twice.
- Find the gradients of the two tangents to C at O .
- Show that a Cartesian equation of C is $y^2 = x^2(x + 4)$
- Find the exact coordinates of the points on C where the tangent is parallel to the x -axis.
- Sketch C for $-2.5 \leq t \leq 2.5$ on the axes below.



(11 marks)

Answer _____

End of questions | Total 70 marks