

- 8 Part of the track of a roller-coaster is modelled by a curve with the parametric equations

$$x = 2\theta - \sin \theta, \quad y = 4 \cos \theta \quad \text{for } 0 \leq \theta \leq 2\pi.$$

This is shown in Fig. 8. B is a minimum point, and BC is vertical.

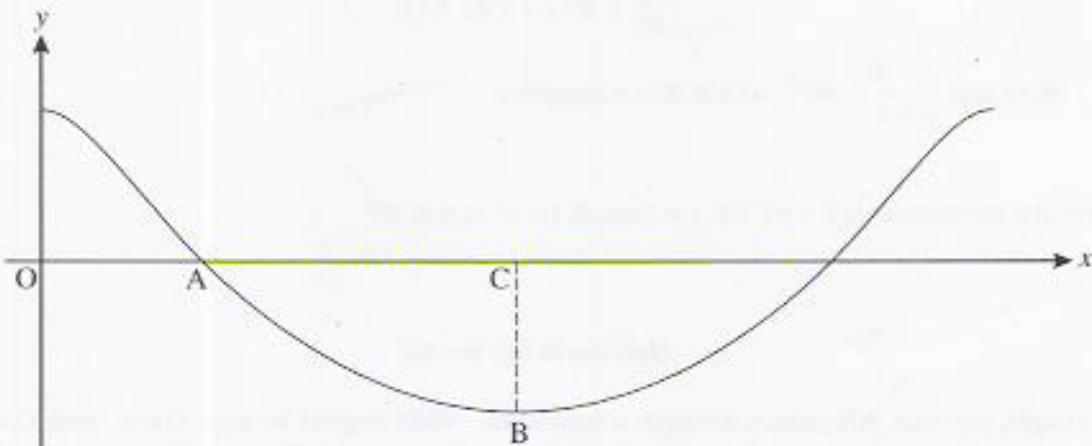


Fig. 8

- (i) Find the values of the parameter at A and B.

Hence show that the ratio of the lengths OA and AC is $(\pi - 1) : (\pi + 1)$. [5]

- (ii) Find $\frac{dy}{dx}$ in terms of θ . Find the gradient of the track at A. [4]

- (iii) Show that, when the gradient of the track is 1, θ satisfies the equation

$$\cos \theta - 4 \sin \theta = 2. \quad [2]$$

- (iv) Express $\cos \theta - 4 \sin \theta$ in the form $R \cos(\theta + \alpha)$.

Hence solve the equation $\cos \theta - 4 \sin \theta = 2$ for $0 \leq \theta \leq 2\pi$. [7]

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