

## Section 2: Parametric differentiation and integration

### Crucial points

1. **It can help to sketch any curve first on your graphic calculator**
2. **Make sure that you are able to differentiate functions involving sine and cosine confidently**  
See the work in Further differentiation section 2.
3. **You need to be able to use the chain rule**

Make sure that you remember the chain rule:  $\frac{dy}{dx} = \frac{dy}{dt} \times \frac{dt}{dx}$ .

This will help you find the gradient of a curve at a particular point. You can then use it to identify any turning points or find the gradient of the normal.

You may find it helpful to use it in this form:  $\frac{dy}{dx} = \frac{dy/dt}{dx/dt}$ ,  $\frac{dx}{dt} \neq 0$

4. **Remember the relationship between the gradients of a tangent and a normal**

You will need to use the relationship  $m_{\text{normal}} = \frac{-1}{m_{\text{tangent}}}$ .

5. **Be careful when integrating**

Remember that when you are finding the area under a curve defined parametrically, you need to change the variable by using  $\frac{dx}{dt}$ , and you need to use the appropriate values of  $t$ , not  $x$ , as limits of integration.