

## 1. Calculator OK

At time  $t \geq 0$ , a particle moving along a curve in the  $xy$ -plane has position  $(x(t), y(t))$  with velocity vector  $v(t) = (\cos(t^2), e^{0.5t})$ . At  $t = 1$ , the particle is at the point  $(3, 5)$ .

- Find the  $x$ -coordinate of the position of the particle at time  $t = 2$ .
- For  $0 < t < 1$ , there is a point on the curve at which the line tangent to the curve has a slope of 2. At what time is the object at that point?
- Find the time at which the speed of the particle is 3.
- Find the total distance traveled by the particle from time  $t = 0$  to time  $t = 1$ .

## 2. No Calculator

The Maclaurin series for a function  $f$  is given by  $\sum_{n=1}^{\infty} \frac{(-3)^{n-1}}{n} x^n = x - \frac{3}{2}x^2 + 3x^3 - \dots + \frac{(-3)^{n-1}}{n} x^n + \dots$  and converges to  $f(x)$  for  $|x| < R$ , where  $R$  is the radius of convergence of the Maclaurin series.

- Use the ratio test to find  $R$ .
- Write the first four nonzero terms of the Maclaurin series for  $f'$ , the derivative of  $f$ . Express  $f'$  as a rational function for  $|x| < R$ .
- Write the first four nonzero terms of the Maclaurin series for  $e^x$ . Use the Maclaurin series for  $e^x$  to write the third-degree Taylor polynomial for  $g(x) = e^x f(x)$  about  $x = 0$ .