

1. 2015 - Question 2 (TI)

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. 2015 - Question 6 (No TI)

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 $x = 0$.

3. The mystery polynomial, $p(x)$, is of degree 9 where $(p(x) - 1)$ is exactly divisible by $(x - 1)^5$.
- (a) Find the value of $p(1)$.
- (b) Show that $p'(x)$ is exactly divisible by $(x - 1)^4$.
- (c) Now also given that $(p(x) + 1)$ is exactly divisible by $(x + 1)^5$, find $p(x)$.

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