

MA1037 / MA1F37 Coursework Exercises

These questions should be answered clearly and neatly in the order given. All working must be shown.

This work should be submitted together with your Maple exercises.

1. Find the first derivative of each of the following, simplifying your answers:

a) $f(p) = p^4 \sqrt{p-4}$ b) $f(x) = \frac{\ln(x^2+1)}{x^2+1}$

c) $y = \sin^{-1}(4t)$ d) $y = 8^{\cos t}$

2. Use partial fractions to find $\int \frac{2x^3 - 4x^2 - x - 3}{x^2 - 2x - 3} dx$.

3. a) Find the slope of the devil's curve $y^4 - 4y^2 = x^4 - 9x^2$ at the point $(-3, -2)$.

- b) Find the equation of the tangent to the curve $2xy + \pi \sin y = 2\pi$ at the point $(1, \frac{\pi}{2})$.

4. Determine the co-ordinates and nature of the stationary points of the function $y = x^4 + \frac{8}{3}x^3 + 2x^2 - 1$.
Hence sketch the function.

5. Complete the following integrations, simplifying your answers.
Show your working clearly.

a) $\int \cos^3 2x \, dx$ b) $\int \frac{x}{\sqrt{1-x^2}} \, dx$

6. Complete the following integrations, simplifying your answers.
Show your working clearly.

a) $\int_{-\frac{1}{3}}^{\frac{1}{3}} \frac{2}{1-x^2} \, dx$ b) $\int (2x+3)e^{2x-3} \, dx$

7. a) Express the following complex numbers in the form $a+ib$ where a and b are real:

(i) $i(-4+2i)(3-i)$ (ii) $\frac{(3+i)}{(-2+2i)3i}$

- b) Find the possible values of z that satisfy the equation $z\bar{z} + 2\bar{z} = 9-2i$ where z is a complex number of the form $x+iy$ and \bar{z} is its conjugate.

8. Solve the differential equation $xy^2 \frac{dy}{dx} = x^3 + y^3$, given initial value $y(\frac{1}{2}) = 0$.