

Mathematics Prerequisite Test 2

Section 1: Differential and Integral Calculus

1. Derivatives:

- **Question 1:** Find the derivative of the function $f(x) = \frac{1}{x^2+1}$.

2. Integrals:

- **Question 2:** Evaluate the integral $\int \frac{e^x}{e^x+1} dx$.

3. Applications of Derivatives:

- **Question 3:** Find the maximum and minimum values of the function $f(x) = x^3 - 3x^2 + 4x + 2$ on the interval $[-1, 3]$.

4. Applications of Integrals:

- **Question 4:** Find the area enclosed by the curves $y = x^2$ and $y = 2x - x^2$.

Section 2: Vector Calculus

5. Vector Functions:

- **Question 5:** Given the vector function $\mathbf{r}(t) = \langle \sin(t), t^2, e^t \rangle$, find its velocity and acceleration vectors.

6. Line Integrals:

- **Question 6:** Evaluate the line integral $\int_C x^2 dx + y^2 dy$, where C is the curve defined by $x = t^2$ and $y = t^3$ for $0 \leq t \leq 1$.