1. Differentiate (1) \( f(x) = (x^2 - 1)(3x + 2) \) (2) \( f(x) = \frac{3x + 2}{5x^2 + 1} \) (3) \( f(x) = (x^2 + 1)^{100} \) (15%)

2. Given (1) \( y = \sqrt[3]{x+\sqrt{x+\sqrt{x+\sqrt{\ldots}}}} \) (2) \( y = x^{(x-1)} \), find the derivative \( \frac{dy}{dx} \)? (10%)

3. Find (1) \( \int x\sqrt{x^2 + 5}\ dx \) (2) \( \int \frac{x + 3}{x^2 + 6x - 4}\ dx \) (10%)

4. Find (1) \( \int \frac{x + 1}{x^2 + x - 2}\ dx \) (2) \( \int x^3 \ln x\ dx \) (10%)

5. What are the dimensions of an aluminum can that holds 40 in\(^3\) of juice and that uses the least material (i.e., aluminum)? Assume that the can is cylindrical, and is capped on both ends. (10%)

6. Calculate (1) \( \lim_{x \to 0} xe^{-x} \) (2) \( \lim_{x \to 0} \frac{\sin x}{x} \) (10%)

7. Find the radius and interval of convergence of the series: \( 1 + 2^2x^2 + 2^4x^4 + \ldots + 2^{2n}x^{2n} + \ldots \) (10%)

8. Find the Taylor series centered at \( x = 0 \) for \( \cos x \)? (10%)

9. (1) Find an equation of the plane containing the points \( P = (1, 3, 0) \), \( Q = (3, 4, -3) \), \( R = (3, 6, 2) \)? (2) Find the area of the parallelogram with edges \( \vec{u} = 2\hat{i} + \hat{j} - 3\hat{k} \) and \( \vec{v} = \hat{i} + 3\hat{j} + 2\hat{k} \) (10%)

10. Let \( \psi = x^2 e^y \), and \( \psi = 3u^2 - 2v \). Compute \( \frac{\partial \psi}{\partial u} \) and \( \frac{\partial \psi}{\partial v} \) using the chain rule. (5%)