1. Find the derivatives of the following functions:
   a). \( f(x) = e^{x^4}(x^3 + 1) \)
   b). \( g(x) = \ln x^{-\frac{3}{2}} \)

2. Prove the mean value theorem.

3. Show that \( \int_{0}^{\infty} e^{-t^2} dt = \frac{\sqrt{\pi}}{2} \)

4. Show that \( \ln(1-x) = -x - x^2/2 - x^3/3 - x^4/4 - \ldots, |x| < 1 \).

5. Calculate the following integral.
   a). \( \int_{2}^{3} x \sqrt{2} x - 1 \, dx \)
   b). \( \int_{2}^{3} x^3 \ln x \, dx \)

6. Find the derivative of the function \( f(x, y) = xy - 4y^2 \) at \( P_1(3,2) \) in the direction of \( T = (1,2) \).

7. Find the limit
   \[ \lim_{(x, y) \to (0,0)} \frac{x \sqrt{x} - y \sqrt{y} + 3 \sqrt{x} - 3 \sqrt{y}}{\sqrt{x} - \sqrt{y}} \]

8. If \( f(x, y) = (x-y)/(x+y) \), show that \( \int_{0}^{1} \int_{3}^{4} f(x, y) \, dy \, dx = -1/2 \)

9. Explain why the equation \( x = \cos(x) \) has at least one solution?

10. Is the following statement true or false, give the reason and example. \( \int_{a}^{b} f(x) g(x) \, dx = \int_{a}^{b} f(x) \, dx \int_{a}^{b} g(x) \, dx \)