**Problem 1**: (7 points) Find the absolute maximum and absolute minimum of the function \( y = x\sqrt{1-x} \) on the interval \([-3,1]\).

**Problem 2**: (7 points) Show that the function \( f(x) = x + \ln x \) satisfies the hypotheses of the Mean Value Theorem on the interval \([1, e]\). Find a number \( c \) that satisfies the conclusion of the MVT.

**Problem 3**: (14 points) Find the limit if it exists.

a) \( \lim_{x \to 0} \left( \frac{1}{x} - \frac{1}{\sin x} \right) \)
b) \( \lim_{x \to 0} \left( x + e^x \right)^{\frac{1}{x}} \)

**Problem 4: (12 points) **The first and second derivatives of the function \( y = f(x) = \frac{x^2}{x-1} \) are \( y' = \frac{x^2 - 2x}{(x-1)^2} \) and \( y'' = \frac{2}{(x-1)^3} \) respectively. Find

(a) the critical numbers, if any exists,

(b) the increasing and decreasing intervals,

(c) the local extrema,

(d) concavity intervals,

(e) inflection points, if any exists.