1. Show that the function \( f(x, y) = 3xe^y - x^3 - e^{3y} \) has a unique critical point and that, at this point, the function \( f(x, y) \) has a local maximum but not a global maximum.

2. Using Lagrange multipliers, find the maximum and minimum values of the function \( f(x, y) = 2x + 3y \) on the curve \( x^2 + xy + 2y^2 = 37 \).

3. Sketch the domain of integration and then compute

\[
\int_0^2 \int_x^2 \frac{\ln y}{\sqrt{y}} \, dy \, dx
\]

by changing the order of integration.

4. Use cylindrical coordinates to find the volume of the solid that lies between the cylinders \( x^2 + y^2 = 1 \) and \( x^2 + y^2 = 4 \), above the \( xy \)-plane, and below the plane \( z = x + 2 \).