PRINT Your Name: ____________________________

There are 8 problems on 5 pages. Problems 1 through 7 are each worth 10 points. Problem 8 has three parts; each part is worth 10 points. SHOW your work. [CIRCLE] your answer. NO CALCULATORS! Check your answer whenever possible. If you want to pick up your exam before Tuesday, write a short note to that effect on the top of this page and I will leave your exam outside my office door, before I go home tonight.

1. If \( f(x, y) = xe^{xy} \), then find \( \nabla f \).

\[
\nabla f = (xe^{xy} + ye^{xy}) \hat{i} + x^2 e^{xy} \hat{j}
\]

2. Find the directional derivative of \( f(x, y) = x^2 y \) at \((1, 2)\) in the direction \( \hat{u} = \frac{3}{5} \hat{i} - \frac{4}{5} \hat{j} \).

\[
D_{\hat{u}} f \bigg|_{(1, 2)} = \nabla f \bigg|_{(1, 2)} \cdot \hat{u} = (2x^2 + x^2) \bigg|_{(1, 2)} \cdot \hat{u} = (4 \cdot 2 + 3) \cdot \left(\frac{3}{5} \cdot 2 - \frac{4}{5} \cdot 3\right) = \frac{11}{5} - \frac{4}{5} = \frac{8}{5}
\]