DO NOT WRITE ON THIS PROBLEM SHEET. Nothing written here will be read or graded.
WRITE YOUR ANSWERS IN AN EXAM BOOKLET

Second Hour Exam

(20 pts) 1. Let \( f(x, y) = y \cos(x^2y) \). Compute the directional derivative at \( P = (0, 0) \) in the direction \( u = (0, 1) \).
Find the direction of the steepest descent at \( P \).

(20 pts) 2. Find and classify all local extrema of the function \( f(x, y) = xye^{y-x} \) on the plane.

(20 pts) 3. Find the maximum and minimum values of the function \( f(x, y) = 2x^2 + 3y^2 + 1 \), where \( x \) and \( y \) lie on the ellipse \( 4x^2 + y^2 - 4 = 0 \).

(20 pts) 4. Evaluate the following integral by reversing the order of integration:
\[
\int_{\sqrt{\pi}}^{\sqrt{\pi}} \int_{0}^{y} \sin(x^2) \, dx \, dy.
\]

(20 pts) 5. Find the mass of the solid cylinder \( D = \{(x, y, z) \mid x^2 + y^2 \leq 9, 0 \leq z \leq 1\} \) with density function \( f(x, y, z) = 3 - 2z \).

Hand in this sheet along with your exam booklet!