

1. (7 points) Find and classify all of the critical points of $f(x, y) = (x^2 + y)e^{y/2}$ as either global or local minimums, maximums, or as a saddle point.

2. (6 points) Use Lagrange Multipliers to find the constrained global extreme values of $f(x, y) = \frac{1}{x} + \frac{1}{y}$ if the constraint is $\frac{1}{x^2} + \frac{1}{y^2} = 1$.

3. (6 points) Draw the contour plot and constraint curve corresponding to the Lagrange method for finding the constrained extreme values of $f(x, y) = x^2y$ with constraint $x^2 + y^2 = 1$. On your diagram label all global or local extreme values corresponding to the constrained critical points. **Do not** solve any system for the extreme values!

4. (6 points) Suppose $P = (0, 2)$ is a critical point of the function $f(x, y)$ that has continuous second partials. Use the second partials test to classify P as a minimum, maximum, or saddle point if possible, or write "DNA" for "does not apply." Show work to defend your answer.

(a) (2 points) $f_{xx}(0, 2) = -1$, $f_{xy}(0, 2) = 6$, and $f_{yy}(0, 2) = 1$.

(b) (2 points) $f_{xx}(0, 2) = -1$, $f_{xy}(0, 2) = 2$, and $f_{yy}(0, 2) = -8$.

(c) (2 points) $f_{xx}(0, 2) = 4$, $f_{xy}(0, 2) = 6$, and $f_{yy}(0, 2) = 9$.