

1) Find and classify all of the critical points of  $f(x, y) = (x-1)^2(y-2) - y^2$ . **Use the second partials test** in your work. (7 points)

2) Use Lagrange multipliers to find and classify all constrained critical points of  $f(x, y) = x^2 - y^2$  if the constraint is  $x^2 + 4y^2 = 4$ . Sketch the appropriate level curves to verify your answer. (6 points)

3) Find the point on the plane  $z = 2x + y + 3$  closest to  $P = (1, 0, 1)$ . (6 points)

4) Find the maximum value of  $h(x, y) = xy^2$  on the unit circle. (6 points)