Review problem for Midterm # 2

Consider the function $f(x, y) = x e^{-(x^2+y^2)}$ and its graph $S$. (1) Find the first partial derivatives and gradient of $f$. (2) (a) Find an equation for the tangent plane to $S$ at the point $(1, 1, e^{-2})$. (b) What is the steepest slope of a line in this plane? (c) Find a vector tangent to the level curve of $f$ through $(1,1)$. (3) Find the critical points of $f$, then find the local maxima and minima of $f$. Bonus: are these also global maxima/minima? (4) If $x = r \cos \theta$ and $y = r \sin \theta$, find the partial derivatives $\frac{\partial f}{\partial r}$ and $\frac{\partial f}{\partial \theta}$. 