Review 3: Practice Final
Friday, May 6

1. Find the point(s) on the unit disk \{(x, y) : x^2 + y^2 = 1\} that maximize the function \( f(x, y) = x^2 - 2x + 2y^2 \). 

2. Find the volume of the solid that lies within the sphere \( x^2 + y^2 + z^2 = 4 \), above the \( xy \)-plane, and below the cone \( z = \sqrt{x^2 + y^2} \).
3. If $\mathbf{F}(x, y) = (2xe^{-y}, 2y - x^2e^{-y})$, evaluate the integral $\int \mathbf{F} \cdot d\mathbf{r}$ where $C$ is a series of line segments from $(1, 0)$ to $(3, 3)$ to $(-4, 7)$ to $(\pi, 3\sqrt{2\pi})$ to $(2, 1)$. 
4. If \( \mathbf{F}(x, y) = \langle x, 2y, 3z \rangle \), evaluate the surface integral \( \iint_S \mathbf{F} \cdot d\mathbf{S} \), where \( S \) is the cube with vertices \((\pm1, \pm1, \pm1)\) (oriented outward).
5. Evaluate $\int_C \mathbf{F} \cdot d\mathbf{r}$ where $\mathbf{F}(x, y, z) = \langle yz, 2xz, e^{xy} \rangle$ and $C$ is the circle $x^2 + y^2 = 16, z = 5$, oriented counterclockwise as viewed from above.