Identifying Potential Functions

1. Show $\mathbf{F} = \langle 3x^2 + 6xy, 3x^2 + 6y \rangle$ is conservative and find the potential function $f$ such that $\mathbf{F} = \nabla f$.

2. Let $\mathbf{F} = (x + xy^2) \mathbf{i} + (x^2 y + 3y^2) \mathbf{j}$. Show $\mathbf{F}$ is a gradient field and find the potential function using both methods.