Problem 1. The planar vector field $\mathbf{F}$ has the form $\mathbf{F}(x, y)=\left(3 x^{2} y+\mathrm{e}^{y}\right) \mathbf{i}+Q(x, y) \mathbf{j}$.
(a) Find the most general function $Q$ such that the vector field $\mathbf{F}$ be conservative.
(b) Find a function $f$ such that $\mathbf{F}=\nabla f$.
(c) Let the closed curve $C$ consist of the line segments from $(0,1)$ to $(0,0)$ and from $(0,0)$ to $(1,0)$, and the parabola $y=1-x^{2}$ from $(1,0)$ to $(0,1)$. Find the line integral of $\mathbf{F}$ along this curve. Explain briefly how you computed this.

