

Additional problem.

The planar vector field \mathbf{F} has the form $\mathbf{F}(x, y) = (3x^2y + e^y) \mathbf{i} + Q(x, y) \mathbf{j}$.

- (a) Find the most general function Q such that the vector field \mathbf{F} be conservative.
- (b) Find a function $f : \mathbb{R}^2 \rightarrow \mathbb{R}$ 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.