

1. Evaluate the line integral $\int_C (x + 2y) dx + (x - y) dy$ along the curve $C : x = \cos t, y = 2 \sin t, 0 \leq t \leq \pi/4$.

2. (a) Find the work done by the force field $F(x, y) = (x^2 + xy) \mathbf{i} + (y - x^2y) \mathbf{j}$ on a particle that moves along the curve $C : x = t, y = 1/t, 1 \leq t \leq 3$.
(b) Is the vector field in part (a) conservative? Justify your answer.

3. (a) Verify that the vector field $F(x, y) = 2xy^3 \mathbf{i} + (1 + 3x^2y^2) \mathbf{j}$ is conservative in the whole plane and find a potential function ϕ .
(b) Use the potential you found in part (a) to find the work of the field \mathbf{F} along any smooth path from the point $(1, -1)$ to the point $(1, 1)$.

4. Compute the divergence and the curl of a inverse square-field in 2D and in 3D.