

(Problems are from *Vector Calculus* by Marsden and Tromba, sixth edition.)

1

Compute the line integral $\int_{\gamma} 2xyz \, dx + x^2z \, dy + x^2y \, dz$ where γ is an oriented simple curve connecting $(1, 1, 1)$ to $(1, 2, 4)$.

2

Suppose $\nabla f(x, y, z) = 2xyz e^{x^2} \vec{i} + ze^{x^2} \vec{j} + ye^{x^2} \vec{k}$. If $f(0, 0, 0) = 5$, find $f(1, 1, 2)$.

3

Suppose $\vec{\Phi} : \mathbb{R}^2 \rightarrow \mathbb{R}^3$ is given by $(u, v) \mapsto (u - v, u + v, 2uv)$. Find all points $\vec{\Phi}(u_0, v_0)$ where $\vec{\Phi}$ is not regular.

4

Suppose $\vec{\Phi} : \mathbb{R}^2 \rightarrow \mathbb{R}^3$ is given by $(u, v) \mapsto (u^2, v^2, u^2 + v^2)$. Find an equation of the tangent plane to the parametrized surface $\vec{\Phi}$ at the point $\vec{\Phi}(1, 1)$