MATH 231-01: Homework Assignment 9

10 November 2025

Due: 17 November 2025 by 10:00pm Eastern time, submitted on Moodle as a single PDF.

Instructions: Write your solutions on the following pages. If you need more space, you may add pages, but make sure they are in order and label the problem number(s) clearly. You should attempt each problem on scrap paper first, before writing your solution here. Excessively messy or illegible work will not be graded. You must show your work/reasoning to receive credit. You do not need to include every minute detail; however the process by which you reached your answer should be evident. You may work with other students, but please write your solutions in your own words.

Name:

Score:

1. Determine whether the vector field $\mathbf{F}(x, y, z) = \langle e^{y^2}, 2xye^{y^2} + \sin(z), y\cos(z)\rangle$ is conservative. If it is, find a function f such that $\mathbf{F} = \nabla f$.

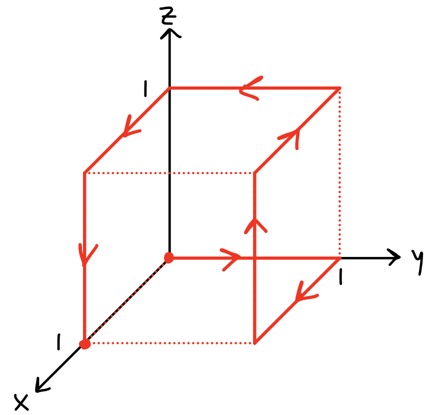
2. Determine whether the vector field $\mathbf{F}(x, y, z) = \langle \sin(x) + y^2 z, 2xyz + \sin(z), xy^2 \rangle$ is conservative. If it is, find a function f such that $\mathbf{F} = \nabla f$.

3. Let C be the helix parametrized by $\mathbf{r}(t) = \langle 3\cos(t), 3\sin(t), 4t \rangle$ for $t \in [0, 4\pi]$. Find the mass of C, assuming its density is given by $\rho(x, y, z) = z$.

4. Let $\mathbf{F}$ be a conservative vector field, and let C be an oriented closed curve (i.e. a loop). Prove that

$$\int_C \mathbf{F} \cdot d\mathbf{r} = 0.$$

5. Let $\mathbf{F}(x,y,z) = \langle 2x + z^2, 4y^3 z, 2xz + y^4 \rangle$, and let C be the following oriented curve:



Evaluate

$$\int_C \mathbf{F} \cdot d\mathbf{r}.$$

6. Let C be the curve of intersection of the cylinder $x^2 + y^2 = 1$ and the hyperbolic paraboloid $z = x^2 - y^2$, with counterclockwise orientation when viewed from above. Let $\mathbf{F}(x, y, z) = \langle -y, x, z \rangle$. Evaluate

$$\int_C \mathbf{F} \cdot d\mathbf{r}.$$