

Show your work fully for all questions. Quiz has **front** and **back** sides.

**Problem 1:** Let  $f(x, y, z) = 3x^2 + yz$  and  $\mathbf{F}(x, y, z) = x\mathbf{i} + 2\sin(y)\mathbf{j} + xz\mathbf{k}$ . For each of the following expressions either evaluate the expression or state why it is not meaningful.

- $\nabla \times (\nabla f)$
- $\text{div}(f)$
- $\text{curl}(\mathbf{F})$
- $\nabla \cdot (\nabla f)$

**Problem 2:** Find a parametric representation for the part of the hyperboloid  $9x^2 - 9y^2 - z^2 = 9$  that lies in front of the  $yz$ -plane.

**Problem 3:** Find the area of the part of the paraboloid  $x = y^2 + z^2$  that lies in the cylinder  $y^2 + z^2 = 16$ .