

Instructions: Show all work. Use exact answers unless otherwise asked to round.

1. Find ∇f and $\nabla^2 f$ for $f(x, y, z) = xy^2z^2$.

$$\nabla f = \langle y^2z^2, 2xy^2z, 2xy^2z \rangle$$

$$\nabla^2 f = 0 + 2xz^2 + 2xy^2$$

2. Find $\nabla \cdot \vec{F}$ and $\nabla \times \vec{F}$ for $\vec{F}(x, y, z) = x^2z\hat{i} - 2xz\hat{j} + yz\hat{k}$.

$$\nabla \cdot \vec{F} = 2xz - 0 + y$$

$$\nabla \times \vec{F} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ x^2z & -2xz & yz \end{vmatrix} = (z + 2x)\hat{i} - (0 - x^2)\hat{j} + (-2z - 0)\hat{k}$$

$$\langle z + 2x, x^2, -2z \rangle$$