1. Define $f : \mathbb{R}^3 \to \mathbb{R}$ by $f(x, y, z) = x^3 y + \dfrac{xy^2}{1 + z^2}$.

(a) Find $\nabla \times (\nabla f)$.

(b) Calculate $\int_C \nabla f \cdot d\mathbf{s}$, where C is the path contained in the x-y plane shown below.