

1. Let $f(x, y, z) = (x^2 - y) \cos(\pi z)$. You do not need to repeat work.

(a) (3 points) Find the gradient of $f(x, y, z)$; that is, find ∇f .

(b) (3 points) Find and simplify $f_{zz}(x, y, z)$.

(c) (3 points) Find and simplify $\frac{\partial^2 f}{\partial x \partial y}$.

2. (4 points) Find $\lim_{(x,y) \rightarrow (0,2)} \frac{(e^x - 1)(e^y - 1)}{2x}$, or prove that the limit does not exist. Show organized work to defend your answer.

3. (6 points) Set-up and evaluate an integral that represents the mass of the wire lying on the curve $x = e^y$ from the point $(1, 0)$ to the point $(2, \ln(2))$ if its density is $\delta(x, y) = xe^y$ grams per centimeter.

4. (6 points) Evaluate $I = \int_C y^2 x dx + 2 dy$ if C is the trace of $\vec{\alpha}(t) = \langle e^t, e^{-t} \rangle$ for $0 \leq t \leq 1$.