

Math 136 Homework 8

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1.

Problem. Let $r = \|\vec{r}\|$ where $\vec{r} = (x, y, z)$. If f is a continuously differentiable function of r , show that, where $r \neq 0$

$$\nabla f(r) = f'(r) \frac{\vec{r}}{r}.$$

With $\|\vec{r}\| = \sqrt{x^2 + y^2 + z^2}$,

$$\nabla f(r) = \nabla f\left(\sqrt{x^2 + y^2 + z^2}\right) = \left(\frac{df}{dr} \frac{\partial r}{\partial x} + \frac{df}{dr} \frac{\partial r}{\partial y} + \frac{df}{dr} \frac{\partial r}{\partial z}\right).$$

We find $\frac{\partial r}{\partial x}$,

$$\frac{\partial r}{\partial x} = \frac{\partial}{\partial x}.$$