Warm-up for Electromagnetic Theory (PHYS330)

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Abstract

Review of two important vector calculus theorems in two dimensions.

1 The curl of a gradient of a scalar function is zero

Let $f(x, y)$ be some scalar function. Show that the curl of the gradient of $f(x, y)$ is always zero. That is, show that

$$\nabla \times (\nabla f) = 0 \tag{1}$$

Would anything change if the proof was done in three-dimensions?

2 The divergence of a curl of a vector function is zero

Let $\vec{f}(x, y)$ be some vector function of x and y only. Show that the divergence of the curl of $\vec{f}(x, y)$ is always zero. That is, show that

$$\nabla \cdot (\nabla \times f) = 0 \tag{2}$$

Now try the proof in three dimensions: $\vec{f}(x, y, z)$.