

# Warm-up for Electromagnetic Theory (PHYS330)

Dr. Jordan Hanson - Whittier College Dept. of Physics and Astronomy

January 30, 2022

## 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

$$\nabla \times (\nabla f) = 0 \quad (1)$$

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

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

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