Mathematical Physics — PHZ 3113
Curl Classwork (February 1, 2013)

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1. Use the Levi-Civita tensor to calculate $\nabla \times \vec{r}$, where $\vec{r}$ is the position vector.

2. Calculate $\nabla \times \vec{r} f(r)$, where $\vec{r}$ is the position vector and $r = |\vec{r}|$.

3. Use the Levi-Civita tensor to calculate $\nabla \times \nabla f$, where f is an arbitrary scalar function.

4. Derive the wave equation for the magnetic field $\vec{B}$ from Maxwell's equations in vacuum

$$\nabla \cdot \vec{B} = 0, \quad \nabla \cdot \vec{E} = 0,$$

$$\nabla \times \vec{B} = \epsilon_0 \mu_0 \frac{\partial \vec{E}}{\partial t}, \quad \nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}.$$

5. Calculate $\nabla \times \vec{F}$ for $\vec{F} = -\hat{x}_1 x_2 + \hat{x}_2 x_1$.