

**Hydrodynamics**  
**Homework 1: Helmholtz decomposition**  
**3. October 2024**

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**Exercise:**

Find a scalar and velocity potentials  $\phi$  and  $\mathbf{A}$  for the vector field  $\mathbf{u} = (-y^2, x^2, 0)$ , so that

$$\mathbf{u} = \nabla\phi + \nabla \times \mathbf{A}$$

inside a bounded subdomain in  $\mathbb{R}^3$ .