# 8. Vorticity

5. December 2024

**Problem 1.**
Consider the following two examples of incompressible inviscid two-dimensional flow with constant density $\rho$, described by the velocities

$$\mathbf{u}_1 = (2Ay, -2Ax), \quad \mathbf{u}_2 = (\frac{Ay}{x^2+y^2}, -\frac{Ax}{x^2+y^2})$$

Find the vorticity for both the flows. If the flow is irrotational, find also the pressure, assuming that the gravity is negligible and the pressure for $r \to \infty$ equals a known value $p_\infty$.

**Problem 2.**
Find the velocities for the following stream functions. Test whether the velocities correspond to a potential flow and the fields are incompressible.

$$\psi_1 = Axy, \quad \psi_2 = A(x^2 - y^2).$$

**Problem 3.**
For the following fields, find the stream function and the velocity potential:

a) Couette flow: Flow between two infinitely long horizontal plates with distance $h$. One of them is moving with velocity $U$ and the second one is stationary. The velocity of the Couette flow is

$$u = U\frac{y}{h}, \quad v = 0.$$

b) Velocity field

$$u = A(x^2 - y^2), \quad v = -2Axy,$$

where $A$ is a constant.