

DELFT UNIVERSITY OF TECHNOLOGY

COMPUTATIONAL TRANSPORT PHENOMENA
CH3421

Assignment 1

Date: 11/02/2026



Q1 - The Navier-Stokes equations can be written using the Einstein summation notation:

$$\frac{\partial \rho u}{\partial t} + u_j \frac{\partial \rho u_i}{\partial x_j} = \mu \frac{\partial^2 u_i}{\partial x_j^2} - \frac{\partial p}{\partial x_i}. \quad (1)$$

Write out the full form for $i = 1$ and $i = 2$ for a 3-D velocity field (u_1, u_2, u_3) .

Q2 - Calculate numerically the plane 2-D flow through the channel in Fig. 1. The flow rate per unit width is $5 \text{ m}^2/\text{s}$. Work in terms of the stream function. Use the grid given in the figure with uniform spacing Δ in the x - and y -directions. Write a numerical code (Matlab, Python, etc.) to find the stream function values at the grid points and plot 10 or more streamlines. Then repeat the simulation for a finer grid, e.g. refine by a factor 2 or 3.

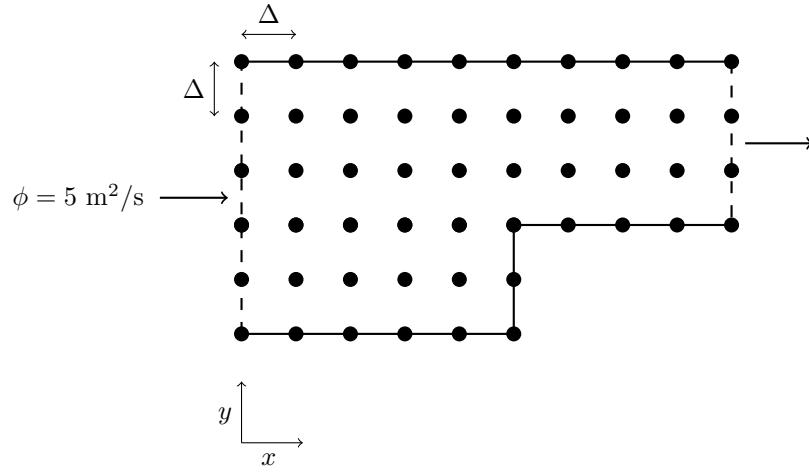


Figure 1: 2D contraction