- 1. The Navier-Stokes equations are obtained by inserting the constitutive equations for the Navier-Stokes fluids (compressible, incompressible non-homogeneous, incompressible homogeneous) into the balance equations for mass and linear momentum. Perform this operation for all three cases and distinguish the situations μ, λ are depending on ρ or being constant, simplify whenever possible.
- 2. Consider a steady simple shear flow of the incompressible Navier-Stokes fluid between two infinite parallel plates located in y = -1 and y = 1. At the boundary assume three different boundary conditions:
 - Navier's slip at upper plate and no-slip at lower plate
 - perfect slip at upper plate and no-slip at lower plate
 - no-slip at both plates

Find the solution u(y) assuming that the flow is normalized by

$$Q := \int_{-1}^1 u(y) \,\mathrm{d}y.$$

Use the following material parameters in the calculations: kinematic viscosity $\nu^* = 1 \text{ m}^2/\text{s}$, Navier-slip coefficient $\gamma^* = 1 \text{ Pa.s/m}$.