Homework #2 **Deadline: March 6, 2018, 12:20.**

1. Consider an incompressible fluid whose Cauchy stress tensor is in the form

$$\mathbf{T} = -p\mathbf{I} + 2\mu_0|\mathbf{D}|^{r-2}\mathbf{D}.$$

Study a simple shear flow between two infinite parallel plates located in $y = -1$ and $y = 1$. At the boundary assume Navier's slip boundary condition with $\gamma^* = 0, 1, \infty$. 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: $\mu_0 = 1$ Pa s, $Q = 2$ m^2/s. Plot the results in three graphs corresponding to $r = 1.5, 2, 10$.

2. Using the balance of mass show that the following two balance equations of energy are equivalent:

$$\varrho\dot{E} = \operatorname{div}(\mathbf{T}\mathbf{v} - \mathbf{j}_e) + \varrho\mathbf{b}\cdot\mathbf{v} + \varrho r, \tag{1}$$

$$\frac{\partial(\varrho E)}{\partial t} + \operatorname{div}(\varrho E\mathbf{v}) = \operatorname{div}(\mathbf{T}\mathbf{v} - \mathbf{j}_e) + \varrho\mathbf{b}\cdot\mathbf{v} + \varrho r. \tag{2}$$

3. Whose name is "hidden" in the unit of dynamic viscosity Poise? Provide few interesting facts about this scientist – what was his area of interest?