BE 159 Winter 2018
Homework #4
Due at the start of class, February 21, 2018

Problem 4.1 (Flow patterns in a cavity (15 points))**.**
A classic problem in beginning fluid mechanics courses features a channel with a lid sliding over it, as depicted below.

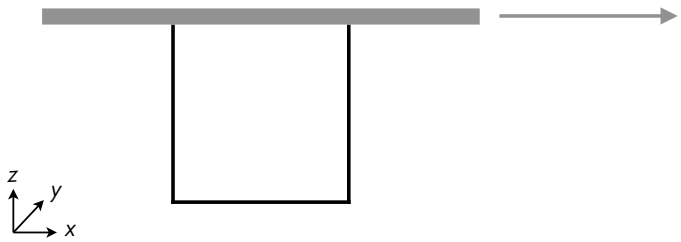

Figure 1: Depiction for a channel with a lid sliding over it. The channel and lid are very long in the *y*-direction.

a) Assuming the lid is sliding slowly enough such that the Reynolds number is very small, sketch the streamlines of the flow in the channel.

b) Imagine a cross-section of the channel in the *y*-*z* plane. What is the *net* flux of fluid through this cross-section as the lid is slid?

Problem 4.2 (Flow past and object (15 points))**.**
Take a look at the picture below of a cylinder moving in a tank of water. Is the Reynolds number above or below unity? Explain your reasoning.

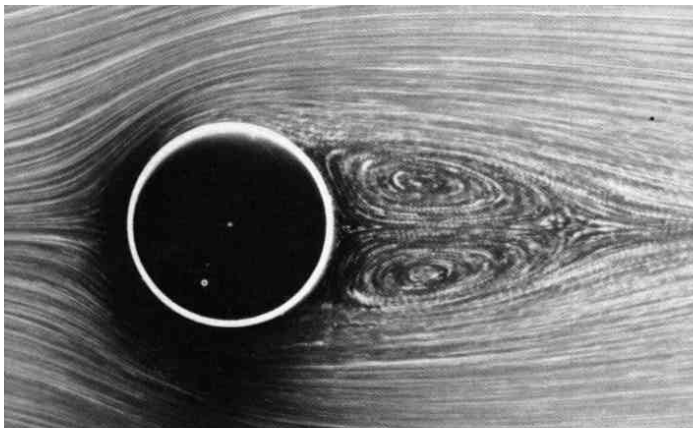

Figure 2: Photograph by Sadatoshi Taneda a cylinder moving through a tank of water. The flow is visualized using aluminum powder. The image is taken from *An Album of Fluid Motion* by Milton Van Dyke, Parabolic Press, 1982.

Problem 4.3 (Hydrodynamic coupling (20 points))**.**

Say I have two beads or radius a (say of order one micron) next to each other in a very viscous fluid, such that the distance between them is not too big, say of order a. The bead on the right is ferromagnetic, but the one on the left is not.

a) If I pull the ferromagnetic bead to the right using a magnet, what happens to both beads?

b) Now, say the ferromagnetic bead moves leftward. What happens to both beads?

c) Repeat (a), except with the beads now embedded in an elastic medium.

d) Why am I asking you this? In other words, what consequences might the physics exposed by these toy questions have on developmental processes?

Problem 4.4 (Use of Green's functions (10 points))**.**
Explain in words why it is useful to use Green's functions of the Stokes equations to construct solutions of the Stokes equations in more complicated geometries.