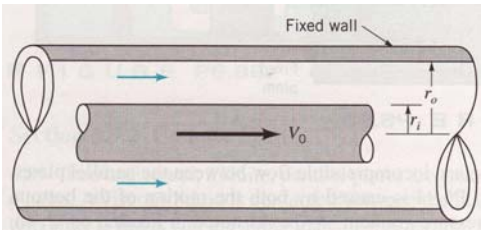
ID:----------	**Midterm 2**	**Time: 50 minutes**
Name: ----------	**Course: 58:160, Fall 2009**	

1. An incompressible Newtonian fluid flows steadily between two infinitely long, concentric cylinders as shown in the figure. The outer cylinder is fixed, but the inner cylinder moves with a longitudinal velocity V_0 as shown. The pressure gradient in the axial direction is $-\frac{\Delta p}{l}$. For what value of V_0 will the drag on the inner cylinder be zero? Assume that the flow is laminar, axisymmetric, and fully developed.



2. A thin layer of an incompressible fluid flows steadily over a horizontal smooth plate as shown in the figure. The fluid surface is open to the atmosphere, and an obstruction having a square cross section is placed on the plate as shown. A model with a length scale of ¼ and a fluid density scale of 2.0 is to be designed to study the mean velocity V at upstream. Assume that only Froude, Reynolds, and Weber numbers are important. Find scaled surface tension and viscosity.