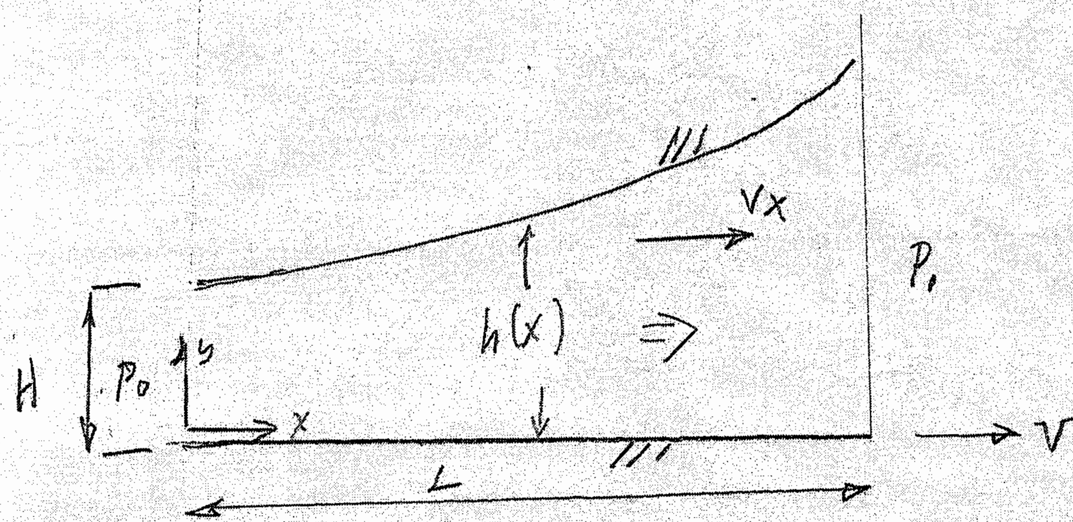
HW #4 F23

Assigned: 10/23

due: 10/30

MANE 6520 - Fluid Mechanics



Consider an exponential slider bearing, $h = H\exp\left(m\dfrac{x}{L}\right)$. The pressure is p_0 at the end $x = 0$, and p_L at the end $x = L$. Conditions are steady, 2D, incompressible, Newtonian, 'thin', and 'slow'. Neglect gravity.

The parameters are H, L, W, V, ρ, g, μ, p_L and p_0.

The results of parts (a)-(c) below are ugly. You may give your answer as one expression in terms of another, in terms of another, etc.

a) Find an expression for the pressure p, in terms of x and the above parameters.
b) Find an expression for the velocity profile v_x in terms of x, y, and the above parameters.
c) Find an expression for the force on the lower surface, in terms of the above parameters.

Now, use the following parameter values:

$H = 1$ mm, $L = 100$ mm, $W = 1$ m, $V = 1$ m/s, $\rho = 850$ kg/m^3, g = 9.81 m/s^2,
$\mu = 0.020$ Pa-s, ~~p_{atm} = 0.1 MPa.~~ $P_0 = 2$ Bar, $P_L = 1$ Bar

Plot h/H, $0 \le x/L \le 1$ for $m = 1$ and $m = 2$. Two curves on the same plot.
Plot $p(x)$, $0 \le x \le L$ for $m = 1$ and $m = 2$. Two curves on the same plot.
Plot $v_x(y)$, $0 \le y \le h$ for $m = 2$ and $x = 0$ and $x = L$. Two plots, each with one curve.
What is the numerical value of the force in part c)