Sample 1 Test #3 for CEE-3500 (borrowed from Dr. Rahmeyer's notes)

#1. For Reynolds similitude, derive the Force ratio in terms of only geometric and fluid properties (i.e., no velocity).

#2. Given a flow of 100,000 cfs over a sharp edged weir that is 20 feet wide and 10 feet high. A model is built of the weir so that the model flow is 50 cfs. How wide and tall is the model?

#3. Given a viscous flow in a water tunnel around a cylinder of length L and diameter D. The velocity V is measured in the water tunnel along with the drag force Fd on the cylinder. Derive the Π(Pi) term from dimensional analysis that includes the variables F and D.

#4. Given an upstream reservoir that has its water surface elevation at 80 feet. A downstream reservoir has its water surface at an elevation of 40 feet. A 12" diameter pipe connects the two reservoirs with a loss coefficient of 0.5 for the pipe entrance and a loss coefficient of 1.0 for the pipe exit. The pipe is 2000 feet long with a roughness e of 0.002 inches. The kinematic viscosity of the water is 1.2×10^{-5} ft^2/s. With a guess of f = 0.01466 find the flow Q. Was the guess of .01466 good? Show how to check your guess using Haaland's equation for the friction factor.

#5. Given an upstream reservoir that has its water surface elevation at 80 feet. A downstream reservoir has its water surface at an elevation of H feet. A 12" diameter pipe connects the two reservoirs with a loss coefficient of 0.5 for the pipe entrance and a loss coefficient of 1.0 for the pipe exit. The pipe is 2000 feet long with a roughness e of 0.002 inches. The viscosity of the water is 1.2×10^{-5} ft^2/s. The discharge in the pipe is 7.177 cfs and there is a pump in the pipe that provides 150 horsepower of hydraulic power to the flow. Find the elevation H using the Swamee-Jain equation to calculate the friction factor.