Worksheet: Viscous flow in two connected pipes

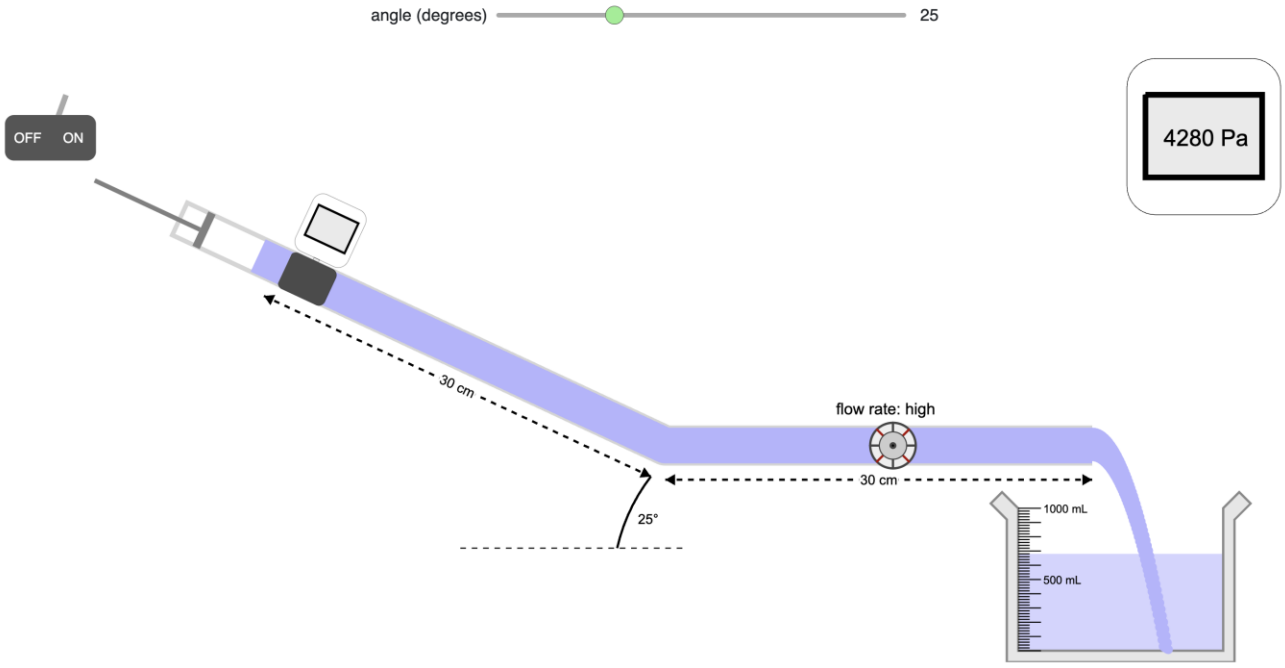
Name(s):_____

Fill in all sections – These are today's notes

Student learning objectives

1. Effect of gravity on laminar pipe flow
2. Understanding hydrodynamic resistance of a pipe low in the laminar regime
3. Using experiments to calculate fluid properties

Dimensions and details of the experiment



The experiment consists of two cylindrical pipes of equal diameters and 30 cm in length, where water is being pumped through a syringe pump. The flowrate can be set to low, medium, and high. The beaker next to the pipe helps calculate the flowrate by using a stopwatch and measuring the volume as a function of time. There is a gauge pressure sensor that displays the value at the inlet of the first pipe. The goal of this experiment is to calculate the diameter of the pipe and the density and viscosity of the fluid that is flowing through the pipes.

Before starting the experiment.

1. If flowrate is kept constant, and the angle is increased, do you think the pressure will increase or decrease? Explain your reasoning.

2. If the flowrate is increased, do you think the pressure will increase or decrease? Explain your reasoning.

3. How will you infer if the flow is laminar or turbulent?

4. Do you think the hydrodynamic resistance of the two pipes is similar or different? Explain your reasoning.

During the experiment.

1. Set the angle to zero and measure the P and flowrate for “low”, “medium”, and “high” settings. Report the values.

2. Repeat 1 for two additional angles. Report the values.

After the experiment.

1. Assume the flow is laminar and derive the relationship between flow rate, pressure at the inlet. diameter, viscosity, density of fluid, pipe length, pipe diameter, and the gravitational constant.

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2. Calculate the density and viscosity of the fluid. Can you calculate everything from the zero angle data? Why/why not? Which fluid is being used in experiments?

3. Calculate the diameter of pipes.

4. Based on the calculations, show that the flow is laminar.