

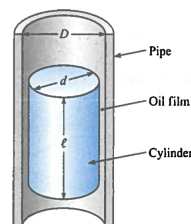
**CE 3305 Engineering Fluid Mechanics**  
**Exercise Set 3**  
**Summer 2018 – GERMANY**

**Purpose :** Application of steady fall velocity and viscosity definition to relate kinematic behavior of objects. Application of surface tension to find water column rise height in a capillary tube.

**Assessment Criteria :** Completion, plausible solutions, use **R** as a calculator.

**Exercises**

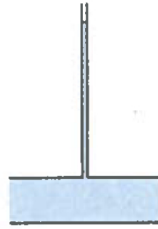
1. (Problem 2.37 pg 57) Figure 1 is a schematic of a cylinder falling inside a pipe that is filled with oil. The annular space between the cylinder and the pipe is lubricated with an oil film that has viscosity  $\mu$ .
  - a) Derive a formula for the steady rate of descent of a cylinder with weight  $W$ , diameter  $d$ , and length  $l$  sliding inside a vertical smooth pipe that has inside diameter  $D$ . Assume the cylinder remain concentric with the pipe as it falls.
  - b) Use the general formula you develop to estimate the rate of descent for a cylinder 100 millimeters in diameter that slides inside a 100.5 millimeter inside diameter pipe. The cylinder is 200 millimeters long and weighs 15 Newtons. The lubricant is SAE 20W oil at  $10^\circ\text{C}$ .



PROBLEM 2.37

Figure 1: Falling cylinder in an oil-filled pipe

2. (Problem 2.61 pg 59) Figure 2 is a schematic of two glass plates spaced 1 millimeter apart. Calculate the maximum capillary rise of water between the two plates.



**PROBLEM 2.61**

Figure 2: Parallel plates immersed in water