CE 3305 Engineering Fluid Mechanics
Exercise Set 23
Summer 2018 – GERMANY

1. (Problem 9.42 pg 355) A flat plate 1.5 m long and 1.0 m wide is towed in water at 20^oC in the direction of its length and at a speed of 15 cm/s. Determine the resistance of the plate and the boundary layer thickness at its aft end.
2. (Problem 9.48 pg 355) An airplane wing of $2m$ chord length (leading edge to trailing edge distance)and 11 m span flies at 200 km/hr in air at 30^oC. Assume the resistance of the wing surfaces is like that of a flat plate.
   (a) What is the friction drag on the wing?
   (b) What power will be required to overcome this friction?
   (c) How much of the chord is laminar?
   (d) What will be the change in drag if a turbulent boundary layer is tripped at the leading edge?
3. (Problem 11.16 pg 439) Figure 1 is a schematic of wind blowing on a 55-gallon storage drum. Estimate the wind speed needed to tip the drum over. The mass of the drum is 48 lbm, the diameter is 22.5 inches, and the height is 34.5 inches.

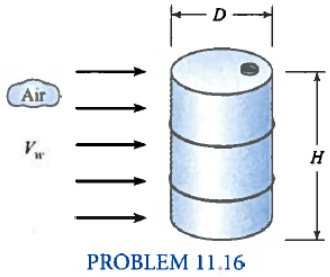

Figure 1: Wind blowing over a storage drum