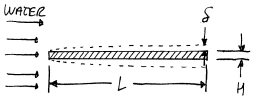
Fundamentals of Fluid Mechanics B
Assignment 7 — Boundary Layer

Instructions

Write your solutions in single column format, with one statement following another vertically. Write your solutions neatly so that they are easy to read and verify. Don't write one line with two equal signs. Highlight your answers using a box. Failure to do this will result in a lower score and fewer comments on my part.

Question #1

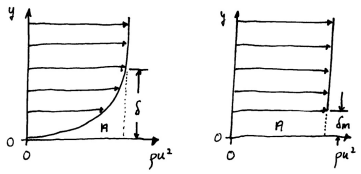
You perform an experiment in which liquid water at a temperature of 27° C flows on a flat plate as follows:



The flat plate has a length L of 2 meters, a height H of 2 mm, and a depth D of 1 meter. Knowing that the boundary layer thickness at the trailing edge of the plate is of $\delta = 2.76$ cm, estimate as well as possible the total drag force on the plate caused by the flowing water. Please use the following data for liquid water: density $\rho = 1000$ kg/m^3, viscosity $\mu = 10^{-3}$ kg/ms, heat capacity $c = c_p = c_v = 4200$ J/kgK, conductivity $k = 0.6$ W/mK.

Question #2

(a) The momentum thickness of the boundary layer corresponds to the height of the inflow that is responsible for the momentum within the boundary layer, as follows:



Find an expression for δ_m that is applicable to a constant pressure boundary layer over a flat plate in which the **density is not constant** but the viscosity is constant. Simplify the expression as much as possible.

(b) For the case of a constant density and constant viscosity boundary layer, find an expression for δ_m/δ and simplify as much as possible. Outline all assumptions.

Answers

1. 0.0246 N.

Due on April 22nd at 11:00. Do both problems.