

Department of Mechanical Engineering

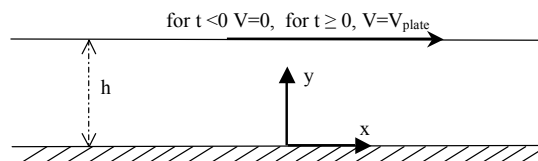
ME/AA507 Fluid Mechanics

Homework #3, due 03-01-2019

Problem 1

Find the solution to transient Couette flow. That is the flow between two infinite plates (separated by a distance h) induced when the top plate starts to move at a constant velocity from rest.

Hint: The solution should tend to Couette flow when t tends to infinity.



Problem 2

Wind blowing over the surface of a lake of uniform depth d exerts a constant and uniform shear stress S over the surface of the lake. Initially, the water in the lake is at rest. Find the velocity of the water at the surface as a function of time for $\nu t \ll d^2$ (the flow near the top surface does not “see” the bottom and thus, the flow behaves as if the lake is infinitely deep).

Hint: this problem looks at the initial motion of water in the lake (thus, unsteady) and when the water surface is flat (thus, no pressure gradient) and where the depth of the lake does not play a role (thus, no length scale). However, the solution can be checked by taking the limit when time goes to infinity and verifying that the velocity (very near the top surface) should tend to the steady state value in the midterm problem.