Problem 150A

Consider the laminar, viscous, planar flow of an incompressible fluid contained between two parallel plates distance H apart. The coordinates x and y are respectively measured parallel to and perpendicular to these plates. We shall take $y = 0$ at the static plate and $y = H$ at the moving plate for convenience. The plate at $y = H$ moves with a steady velocity, U, in the x direction. However, unlike simple Couette flow, a pressure gradient, dp/dx, is also applied to the fluid. Find:

[1] The velocity distribution, $u(y)$, in the flow as a function of y, U, H, dp/dx and the viscosity of the fluid, μ.

[2] The magnitude and direction of the particular pressure gradient for which there would be zero net volume flow in the x direction.