Problem 115C

(a) Confirm that for axisymmetric incompressible flow one can define a streamfunction, ψ (known as Stokes' streamfunction), such that

$$u_r = \frac{1}{r}\frac{\partial \psi}{\partial z} \quad and \quad u_z = -\frac{1}{r}\frac{\partial \psi}{\partial r}$$

(b) Confirm that for steady, planar compressible flow one can define a streamfunction, ψ, such that

$$\rho u = \rho_0 \frac{\partial \psi}{\partial y} \quad and \quad \rho v = -\rho_0 \frac{\partial \psi}{\partial x}$$

where ρ_0 is some arbitrary but constant reference density.