1. Jet from a point source of momentum

Consider a laminar jet formed by fluid forced out of a hole by high pressure. Apply boundary layer approximation for a jet of high initial momentum flux. Let the momentum source be at \((r = 0, z = 0)\) and the \(z\) axis be also the jet axis. Start from the continuity equation

\[
\frac{\partial (ur)}{\partial r} + \frac{\partial (wr)}{\partial z} = 0
\]

and the momentum equation

\[
u \frac{\partial w}{\partial r} + w \frac{\partial w}{\partial z} = \frac{\partial}{\partial r} \left( r \frac{\partial w}{\partial r} \right)
\]

Show first that the momentum flux across the jet is constant in \(z\) and is equal to the value \(M\) at the source. Express the velocity components and all boundary conditions in terms of a stream function, then solve the problem by the method of similarity. Plot the result and discuss.