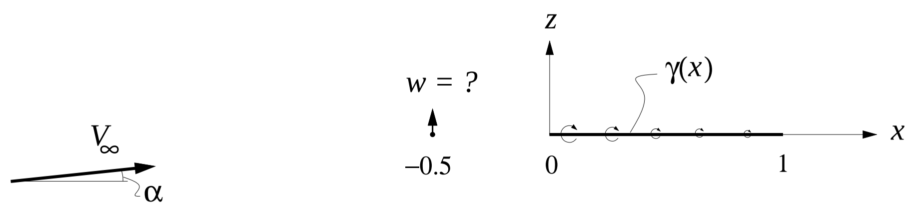
Unified Engineering Spring 2008
Fluids Problem F2

A zero-camber airfoil of chord $c = 1$ is in a flow of $V_\infty = 1$ at angle of attack $\alpha = 0.1$ radians. As derived in the notes, the vortex sheet strength needed to represent the flow about this airfoil is

$$\gamma(x) \;=\; 2V_\infty\alpha\sqrt{\frac{c-x}{x}}$$



1a) Determine an expression for the vertical velocity w at the location $(x, z) = (-0.5, 0)$. Use numerical integration to get a numerical value for w.
Note: Do not attempt to use the trigonometric variable θ here — it won't work. Evaluate the integral in the physical x coordinate.

1b) Determine the flow angle at the location $(x, z) = (-0.5, 0)$, and compare to the freestream flow angle α.

1c) Why is it difficult to measure the freestream α on an actual airplane?