Math 705: Problem Set 1

Due Thursday September 17, 2015

1-3. Acheson 1.2, 1.3, 1.7

4. (a) Show that the potential vortex (1.21) is an acceptable flow, i.e. that it satisfies the equations of motion (except perhaps at $r = 0$). Determine the pressure distribution.

(b) Consider $u = [(D - \Omega)y, (D + \Omega)x, 0]$. Is this an acceptable flow? Calculate the vorticity and rate of strain tensor. Sketch the streamlines and obtain explicit formulas. If the streamlines are closed, what is the frequency at which particles go around?

5. A manager has installed a drinking fountain in his store. During a drive-by shooting, the bottle (0.6 m high, 0.2 m radius), filled with Arrowhead Spring water, is hit by two bullets. One bullet goes through the top of the bottle, and the other goes through the bottle near the bottom. Ignoring friction, estimate how long will it take for the bottle to be empty? (A bullet hole is about $10^{-4}$ m$^2$.)