Homework #0 • MATH 462 • Think Fluids!

- please respect page limits.
- submit your write-up Wednesday 16 January (unless indicated otherwise).
- remember that the class e-mail is open for discussion.
- refer to *Guidelines for Reports*.

A) Think Fluids! ($\leq$1 page, due 14 January) Discover a personal interest in fluids by researching a topic of individual choice and writing a short two-paragraph essay. The topic can really be anything which raises awareness of the ubiquity of fluid motion. For instance: a specific fluid phenomena (waterspouts, the Antarctic circumpolar current), a biography (Ernst Mach, Gustave-Gaspard Coriolis), a technology (artificial heart valves, inkjet printers), or a current socio-scientific concern (global warming, oil spills). Creativity counts. Discuss the fluid aspects of your topic (especially mention those that are quantitative/mathematical); be specific and state facts. Give references; they can be either print, or web-based (please verify accuracy). You may attach one image. Be prepared to announce your topic in next Monday's lecture.

bonus: Post your essay on the web.

B) Line Plots in Matlab (1 page) Matlab is a computing environment which allows both interactive use and pre-programmed scripts. Plotting is simple. As a first example, download *code01.m* from the class webpage. It is a script which reproduces the line plots shown in Figure 2.12 (equation 2.37, page 47, Acheson) for $u_\theta(r)$. Play around by editing the file *code01.m* to see how it works. If you mess up the file, just download a new copy! Make the very minor modifications to reproduce the line plots shown in Figure 2.16 (problem 2.6, page 52, Acheson) for $u(y)$. Give the values of the constants you used (write on your submitted plots).

C) Some Vector Calculus (3 pages) Consider a scalar function of two variables,

$$\psi(x,y) = y\left(1 - \frac{1}{r^2}\right) + \frac{B}{2}\ln(r^2) \ ,$$

where $r^2 = x^2 + y^2$. Define a vector field $\vec{U}(x,y) = (u(x,y), v(x,y))$ where the scalar functions $u(x,y)$ and $v(x,y)$ are related to $\psi(x,y)$ by

$$u(x,y) = +\frac{\partial \psi}{\partial y} \quad ; \quad v(x,y) = -\frac{\partial \psi}{\partial x} \ .$$

This vector field (exterior to the unit circle) is plotted by the script *code02.m*, where the value of B can be changed at the top of the file. Under what conditions are there locations (x^*, y^*) where the vector field $\vec{U}$ is exactly the zero vector? The matlab command *plot(xstar,ystar,'r*')* will plot a red asterisk at a single point. Include two annotated plots which substantiate your results.