MAE 4230/5230 Homework 1 Prof. Wang

Due Date: Feburary 7, 2011

**1. Reynolds number, part I**

Estimate the Reynolds number for the following cases:

a) a 10mph steady wind passing a typical flag pole

b) a typical human swimmer

c) a dragonfly wing during flapping motion

For each case, choose an appropriate length scale and briefly justify your choice. For b) and c), assume a reasonable value for fluid free-stream velocity. If you are not sure of a reasonable value, do a brief internet search.

**2. Reynolds number, part II**

Give an example of three systems that have a Reynolds number on the order of $10^{-3}$ 100, $10^{5}$, respectively.

**3. Reynolds number, part III**

Describe a physical setup in which you can illustrate the relative effect of fluid inertia and viscous force, and thus the Reynolds number.

**4. Kinematic and dynamic viscosity**

a) Look up the definition of the kinematic and dynamic viscosity. Give the definition and the units of each.

b)Look up the values of kinematic viscosity of air, water, glycerin, motor oil, and honey.

**5. Flow past a circular cylinder**

a) Read the chapter 3 in Tritton (the pdf file is uploaded under references)

b) Describe at least three distinct flow patterns at a different range of Reynolds numbers.

c) From the wake structure, what can you say about the associated direction of the forces on the cylinder?

**6.A spinning golf ball**

The figure shows the wake of a traveling spinning golf ball. In which direction does the golf ball travel? Which direction does the ball spin? Justify your answer.