 ***Name*_____**

Unified Quiz 5F

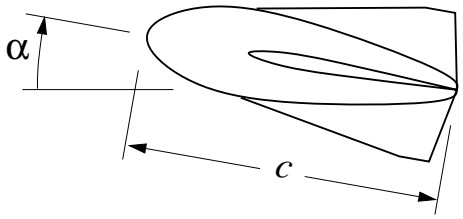
November 21, 2003

- Put your name on each page of the exam.
- Read all questions carefully.
- Do all work for each problem on the two pages provided.
- Show intermediate results.
- Explain your work --- don't just write equations.
- Partial credit will be given, but only when the intermediate results and explanations are clear.
- Please be neat. It will be easier to identify correct or partially correct responses when the response is neat.
- Show appropriate units with your final answers.
- Calculators and a 2-sided sheet of paper are allowed
- Box your final answers.

Exam Scoring

#1 (30 %)	
#2 (40%)	
#3 (30 %)	
Total	

1. (30 %) A proposed winged blimp design flies at some angle of attack α, and uses both aerodynamic lift and aerostatic lift (buoyancy) to generate its total lift force L. The blimp has a given shape, but its length c is as yet undecided.



a) In addition to the given α and c, list all the remaining physical parameters which significantly influence L.

$$g(L, \alpha, c, \ldots) \; = \; 0$$

b) Determine a set of nondimensional parameters (or Pi products) which describe this situation.

c) Identify the nondimensional parameter which determines whether or not the aerodynamic force is significant compared to the buoyancy force.

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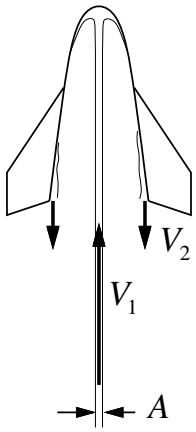
Problem #1 (continued)

2. (40 %) A toy rocket traveling at steady speed is propelled by a thin water jet with velocity V_1 and cross-sectional area A directed ino the rocket's open bottom end. The water then pours out of the bottom at speed V_2. These velocities are as seen by an observer moving alongside the rocket.



a) Draw a suitable control volume for analyzing this flow situation. Determine the mass and momentum flows for your chosen control volume.

b) What is the vertical thrust force imparted by the water? You may neglect the effect of gravity on the water velocities.

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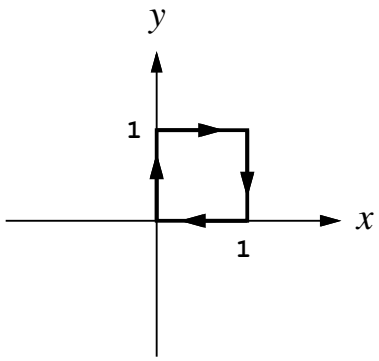
Problem #2 (continued)

3. (30 %) A 2-D velocity field is given by

$$u(x,y) = x \quad , \qquad v(x,y) = -y$$

a) Determine and sketch the streamline pattern.

b) Determine the circulation around the unit-square curve shown (Note: This is curve is <u>not</u> a streamline of this flow)



Name_____

Problem #3 (continued)