Prince of Songkla University
Faculty of Engineering

Final Test
11 October 2004
216-342 Mechanics of Fluids II

Semester 1/2547
13:30-16:30
Room A401

Name _____ ID _____

Direction:
1. All types of calculators, and dictionary are permitted.
2. There are totally 5 problems, 9 pages. Solve them all!!
3. Two sheets of self-written A4 paper are allowed. No photocopy, please.

Perapong Tekasakul
Instructor

Problem No.	**Full score**	**Your mark**
1	**15**	
2	**20**	
3	**15**	
4	**15**	
5	**15**	
Total	**80**	

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ME 342 – Mechanics of Fluids II
Final Test
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1. Answer all questions as good as you can. Give sufficient detail of your description. (15 points)

1.1 Explain when the Bernoulli Equation is applicable. (3 points)

1.2 What is flownet? Explain why the tangents of equipotential line and streamline are perpendicular at point of intersection. (3 points)

1.3 What is the boundary layer thickness? Is the boundary layer thickness for laminar flow is larger or smaller than that of turbulent flow? Why? (3 points)

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1.4 Explain meanings of friction drag and pressure drag. In which case that both drags are effective? Also give examples where each drag is individually applicable.. (4 points)

1.5 What is the difference between transonic flows which $M_\infty < 1$ and $M_\infty > 1$? (2 points)

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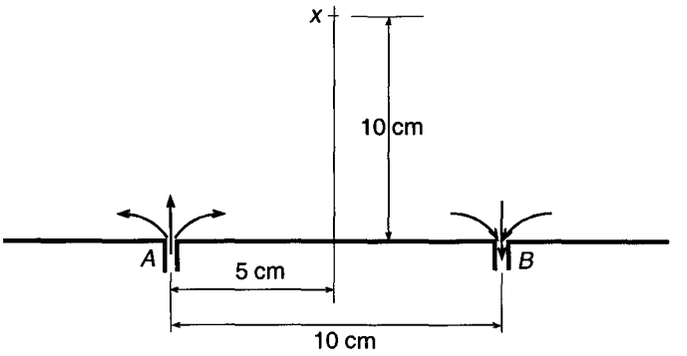
2. Water flows out of slit A and flows into slit B at the same volume flow rate of 0.5 m^3/sec per m length of the slits. Slits A and B are separated by a distance of 10 cm as shown. Determine (20 points)
   (a) The stream function, ψ.
   (b) The stream function at position x.
   (c) The velocity at position x.
   (d) The flownet (just draw a few streamlines and equi-potential lines).



Hints: - The strength is twice the value of the volume flowrate per unit length.

- $\frac{d}{dx}\tan^{-1} x = \frac{1}{1+x^2}$

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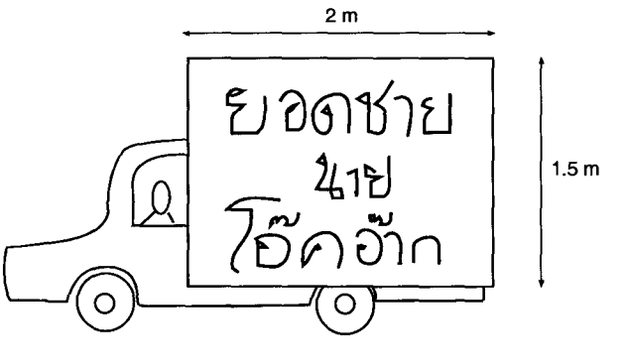
3. An advertisement car of a theatre in Hat Yai is clawling at the speed of 10 km/hr. On each side of the car, a movie advertising board of 2 m (long) x 1.5 m (high) is attached. Determine the total drag on each board. Assume the following properties of air: $\nu = 1.5 \times 10^{-5}$ m^2/s and $\rho = 1.2$ kg/m^3. What happens if the driver decides to increase the speed of the car to 40 km/hr? (15 points)



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4. On the first day of the Ryder Cup 2004, Tiger Woods was paired with Phil Mickelson at the four-ball morning round. At tee-off from hole#7, Tiger hit the golf ball (diameter of 4.3 cm) sloppily so that it left the tee at the low speed of 14 m/sec. Assume the following properties of air: $\nu = 1.5 \times 10^{-5}$ m^2/s and $\rho = 1.2$ kg/m^3. (15 points)
   (a) Determine the drag force on the golf ball.
   (b) At what speed should the ball leave the tee so that the drag coefficient is minimized? What is the drag force at this speed?
   (c) Why the golf ball is made so that the surface is not smooth?

Picture from www.tigerwoods.com

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5. Air flow steadily and isentropically from standard atmospheric conditions to a receiver pipe through a converging duct. the cross section area of the throat of the converging duct is 0.05 ft^2. Determine the mass flow rate through the duct if the receiver pressure is 10 psia and sketch the temperature-entropy diagram. Assume $\rho_0 = 2.38 \times 10^{-3}$ slug/ft^3, $p_0 =$ 14.7 psia, $T_0 = 59°F$ and $R = 1716$ lbf-ft/(slug °R). (15 points)

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Drag coefficient for sphere and golf ball.