CARLETON UNIVERSITY
Department of Mechanical and Aerospace Engineering

ENGINEERING MAAE 2300 - FLUID MECHANICS I
Midterm Examination - October 2003 (1 1/2 hrs.)

ATTEMPT BOTH QUESTIONS. THE QUESTIONS ARE OF EQUAL VALUE. PLEASE USE BOTH SIDES OF THE PAGE IN THE ANSWER BOOKLET.

1. The drawing shows the cross-section of a small, open-circuit wind tunnel. The air flow is pulled through the wind tunnel by the fan located downstream of the test section. The wind tunnel draws air from the laboratory throught the bellmouth inlet and discharges it again to the laboratory at the diffuser outlet. Assume that the flow is one-dimensional and that the density of the air is constant throughout the wind tunnel. The fluid in the manometers is water with a density of 1000 kg/m^3.

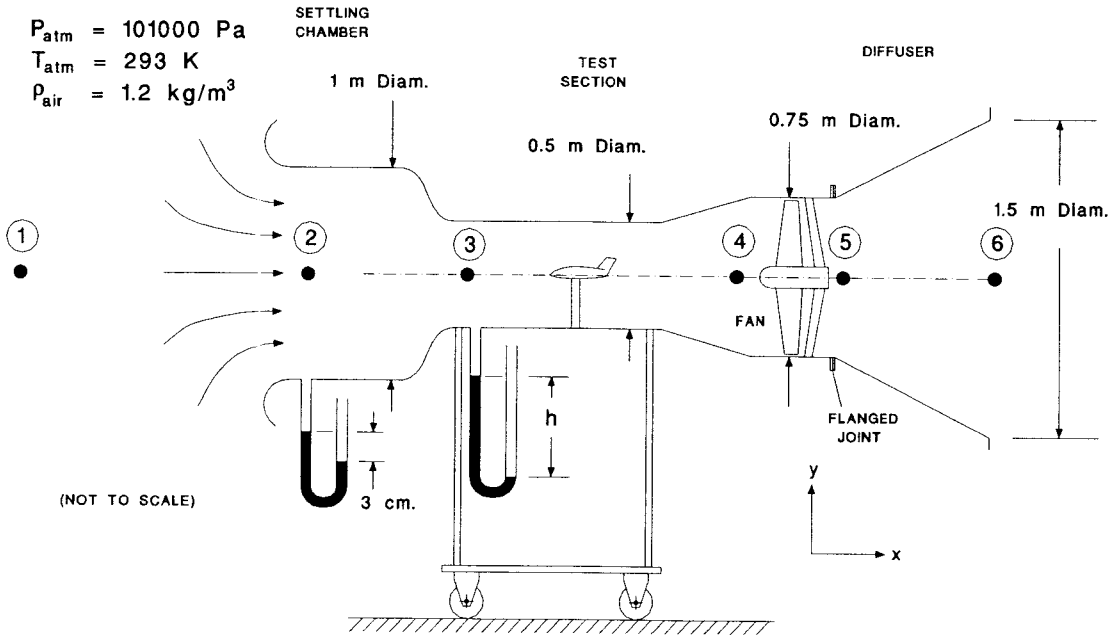
[4] (a) Can Bernoulli's equation be applied between the following points in the flow. Answer YES or NO. If your answer is NO, explain in one sentence why Bernoulli's is not applicable.
(i) Between (1) and (2)? (ii) Between (1) and (4)?
(iii) Between (1) and (5)? (iv) Between (4) and (6)?
(v) Between (6) and (5)?

[5] (b) What is the velocity in the plane of point (2)?

[6] (c) What is the difference in column heights, h, which will be shown by the second manometer?

[5] (d) What is the static pressure in plane (5)?

[20]



2. Water is pumped into an open tank at a rate of 0.10 m^3/s using the nozzle arrangement shown in the drawing.

[6] (a) Estimate the value of the pressure, P_A, will be shown by the pressure gauge located just below flange A? Quote the result in kPa(a).

[4] (b) Draw and fully label the control volume you would use analyze the forces and moments in the flanged joint A.

[10] (c) Assuming P_A = +300 kPa(a) (**Note**: This is <u>not</u> the value you should have obtained in part (a)), determine the magnitude and direction of the vertical (y direction) force in the flanged joint A. Neglect the weight of the piping and the weight of the water inside it. Is the flanged joint in tension or compression?

[20]