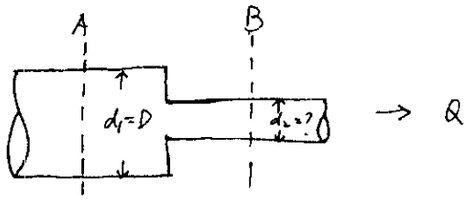
國立交通大學八十九學年度碩士班入學考試試題

科目名稱：流體力學(233)　　考試日期：89 年 4 月 22 日 第 2 節

系所班別：環境工程研究所　　組別：甲組　　第 1 頁，共 2 頁

＊作答前，請先核對試題、答案卷（試卷）與准考證上之所組別與考試科目是否相符!!

(14%)1. Consider the water flow sudden contraction of a circular tube as shown below. The pressure difference between Section A and Section B is P KN/m^2. Assume that the desired volumetric flow is equal to Q m^3/sec and d_1=D cm. Please derive the equation for determining d_2.



(14%)2. Consider a flow through a circular pipe (radius=R) with the velocity profile

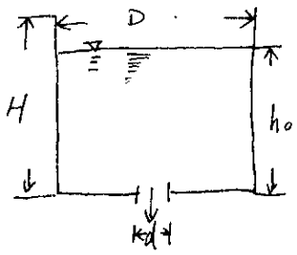
$$u=u_{max}(1-r/R)^a$$

where u_{max} is the maximum velocity at the centerline and a is a constant. Please derive the equation for determining the average velocity.

(8%)3. A flow is represented by the velocity field $\vec{V}=7x\vec{i}+13\vec{j}-7z\vec{k}$.

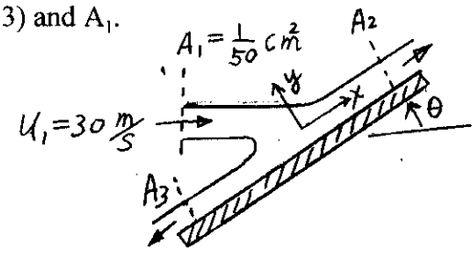
Determine if the flow is (a) incompressible and (b) irrotational. (Be sure to explain your answer. No credit will be given if no explanation is provided.)

(14%)4. A cylindrical tank, as shown below, is to be slowly drained out by gravity. The time required to drain the tank completely out is t seconds. Please derive the equation for determining d.



(15 %)5. The drag force, **F**, on a stationary object (such as a ball) immersed in a uniform stream depends on the relative velocity between the object and the flow, **U**, the characteristic dimension of the object, **L**, the fluid density, **ρ**, and the fluid viscosity, **μ**. Obtain a set of dimensionless groups that can be used to correlate experimental data of **F**.

(15 %)6. (i) Determine the force of the water jet in Newton on the inclined plate as a function of the angle θ as shown below. Consider two-dimensional case and assume that the flow is inviscid. (ii) Determine the relationship between A_2 (area of flow section 2) and A_1 (area of entering flow section 1); and the relationship between A_3 (area of flow section 3) and A_1.



(11 %)7. The velocity profile for fully developed turbulent flow through a smooth circular pipe is divided into three regions. Answer the following questions:

(i)(5%) In the region very close to the wall where viscous shear is dominant, what is the name of the region? What is the relationship between the local time average velocity $\bar{u}$ in axial direction and y.

(ii)(3%) In the region where both viscous and turbulent shear are important, what is the equation for the velocity profile of $\bar{u}$?

(iii)(3%) In the central region where turbulent shear is dominant, what is the equation for the velocity profile of $\bar{u}$?

Note: symbol y is the distance measured from the wall (y = R-r; R is the pipe radius), u* is the friction velocity, U is the centerline velocity, ν is the kinematic viscosity of the flow.

(9 %)8. The region of flow near where the fluid enters the pipe is termed the entrance region.

(i) (6%) What is the dimensionless number that governs the dimensionless entrance length, L/D (L: length of the entrance region, D: pipe diameter)? Define this dimensionless number.

(ii) (3 %) Beyond the entrance region, does the velocity profile vary with distance along the pipe?