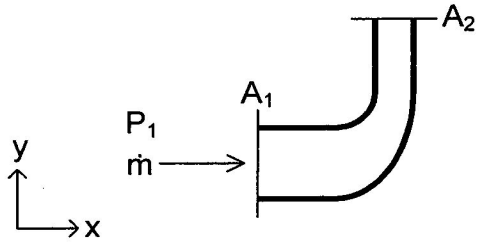
國立交通大學 101 學年度碩士班考試入學試題

科目：流體力學(3023)　　考試日期:101年2月17日 第 2 節

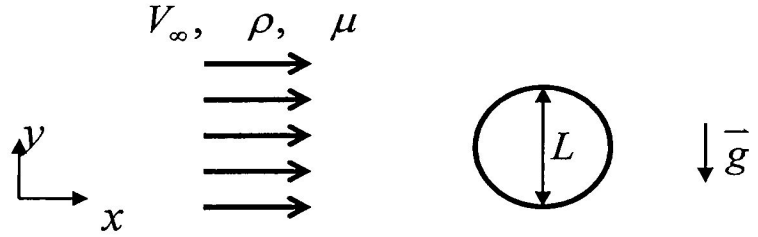
系所班別：機械工程學系　　組別：機械系乙組　　第 1 頁,共 1 頁

【可使用計算機】＊作答前請先核對試題、答案卷(試卷)與准考證之所組別與考科是否相符！！

1. Consider water flow through a 90°-bend. The mass flow rate is $\dot{m}$ and the water density is ρ. The cross-sectional areas before and after the bend are A_1 and A_2. The upstream pressure is p_1 and the downstream pressure is zero. Assume that the flow is uniform at each section, incompressible, steady and lossless. Ignore the weight of elbow and the weight of water in the elbow. Determine the **force** exerted on the elbow by the water flow. (30%)



2. In the following figure, a uniform flow having velocity of V_∞ flows through a circular cylinder with a diameter of L. Other related parameters of the flow are indicated as follows. ρ :density of fluid, μ :viscosity of fluid, g :gravity
   (a) Write the correct two-dimensional mass conservation equation and Navier-Stokes equation. (10%).
   (b) Use the related parameters to nondimensionalize mass conservation equation and Navier-Stokes equation and to obtain nondimensional forms of these two equations. (10%)
   (c) Explain the physical meanings of nondimensional parameters derived in the above equations. (10%)



3. External flow across a flat plate with constant surface temperature T_s (higher than the inlet temperature T_∞), the inlet velocity V_∞ is also constant and the working fluids include air, water, engine oil, or mercury, assume laminar flow and at a constant inlet temperature of 300 K, give (1) a sketch showing the velocity and thermal boundary layer development for these 4 working fluids along the flat plate direction. (20%). (2) Continue from previous question, consider only water flows across the flat plate with constant temperature for the flat plate, and the flow may change from laminar, transition, and finally into turbulent flow, sketch the corresponding variation of thermal boundary layer thickness and heat transfer coefficient alongside the flat plate, and explain the mechanism associated with these changes. Is it possible to achieve the fully developed flow hydro-dynamically or thermally? (20%)