八十五學年度 核子工程與工程物理 系（所） 組碩士班研究生入學考試

科目 流體力學 科號 3810 共 3 頁第 1 頁 *請在試卷【答案卷】內作答

1. Given the steady two-dimensional velocity distribution :

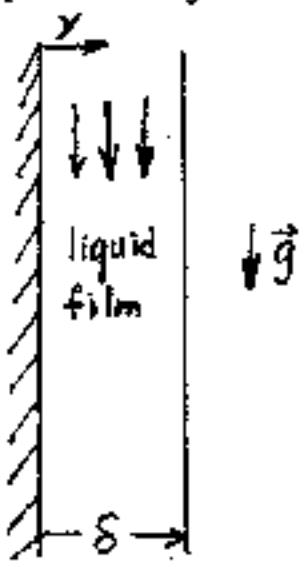
$$\vec{V} = x\hat{i} - y\hat{j}$$

(a) Is the flow incompressible ? (5%)
(b) Find the acceleration of a fluid particle. (7%)
(c) Compute and sketch the streamlines of the flow. (8%)

2. Consider a falling liquid film on a vertical plate as shown with fully-developed laminar flow distribution. Determine

(a) the velocity distribution in the film.
(b) the film thickness (δ) if the volumetric flow rate per unit plate width is Q.
(c) the shear stress on the plate due to the liquid film flow.

(Assume the liquid density and viscosity is ρ and μ, respectively.) (20%)



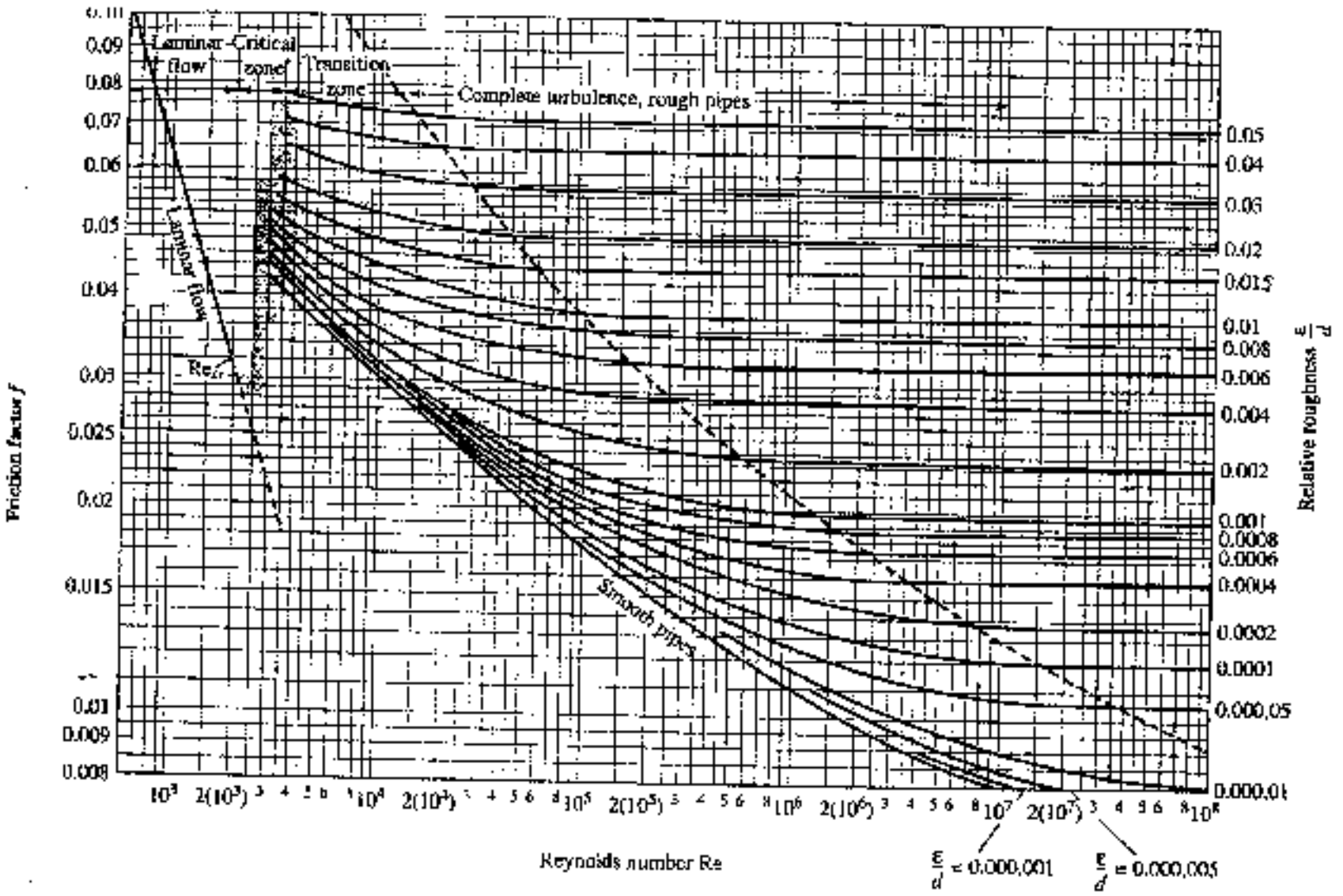
3. In an apartment water comes from a tank on its roof through a circular pipe with an inner diameter of 2.54 cm. The vertical distance from the tank outlet to the pipe outlet in the apartment is 30 m and the total pipe length is 40 m. Along the pipe there are three 90^0 regular bends and 3 globe valves Estimate the maximum possible flow rate and velocity of the water supply in the apartment. Is the flow turbulent ? Do you expect a larger flow rate from the same system during a hot summer day ? Why or why not ? (20%)
The following information is also provided.

— The average pipe roughness is 0.254 mm.

- The viscosity of water under room temperature (20°C) is 1×10^{-3} $N \cdot s/m^2$

— The loss coefficients for the 90^o regular bends and fully open globe valves are 1.5 and 8.2, respectively. Neglect the pipe entrance and exit loss coefficients.

— A Moody chart is also given below



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4. Consider a laminar flow over a flat plate with a free stream velocity of U, using the momentum-integral analysis and assuming that the velocity profile in the boundary layer is $u(x,y)/U=2y/\delta-y^2/\delta^2$, $0\leqq y\leqq\delta(x)$, to show that $\delta/x=5.5/(Re_x)^{0.5}$, and $C_f=0.73/(Re_x)^{0.5}$, where u(x,y) is the fluid velocity in the boundary layer, δ is the boundary layer thickness, x is the distance from the leading edge, y is the distance from the wall, Re_x is the local Reynolds number defined as $Re_x=Ux/\nu$, ν is the kinematic viscosity of the fluid and C_f is the skin-friction coefficient. (20%)

5. Consider a piping system with two parallel channels, which have common ends. The channel length is L. The diameter for the channel 1 is D and for the channel 2 is 2D. The total mass flow rate through the system is W. Assume the pipe wall is smooth and the flow is turbulent. Thus, the friction factor can be evaluated by the Blasius equation： $f=0.316/Re^{0.25}$.

(a) Neglect all minor losses, determine the mass flow rate through each channel.

(b) If an orifice is to be installed at the inlet of the channel with a larger mass flow rate to make the flow rate in both channels be the same. Obtain an expression for the loss coefficient of the inlet orifice.

(c) If the flow is laminar, repeat(a). (20%)

(Assume the fluid density and viscosity is ρ and μ, respectively.)