國立清華大學 105 學年度碩士班考試入學試題

系所班組別：核子工程與科學研究所 甲組(工程組)

考試科目（代碼）：流體力學(2604)

1. 解釋名詞 (30%)

- Largrangian Method
- Eulerian Method
- Streamline, Pathline, Streakline
- (a)What is the Bernoulli equation?

  (b)應用 Bernoulli equation 的假設為何?

  (c)以 pressure 的觀點解釋 Bernoulli equation 內每一項

  (d)以 head 的觀點解釋 Bernoulli equation 內每一項
- Fully developed and developing
- Major loss and Minor loss
- boundary layer thickness and momentum thickness

2. (20%)

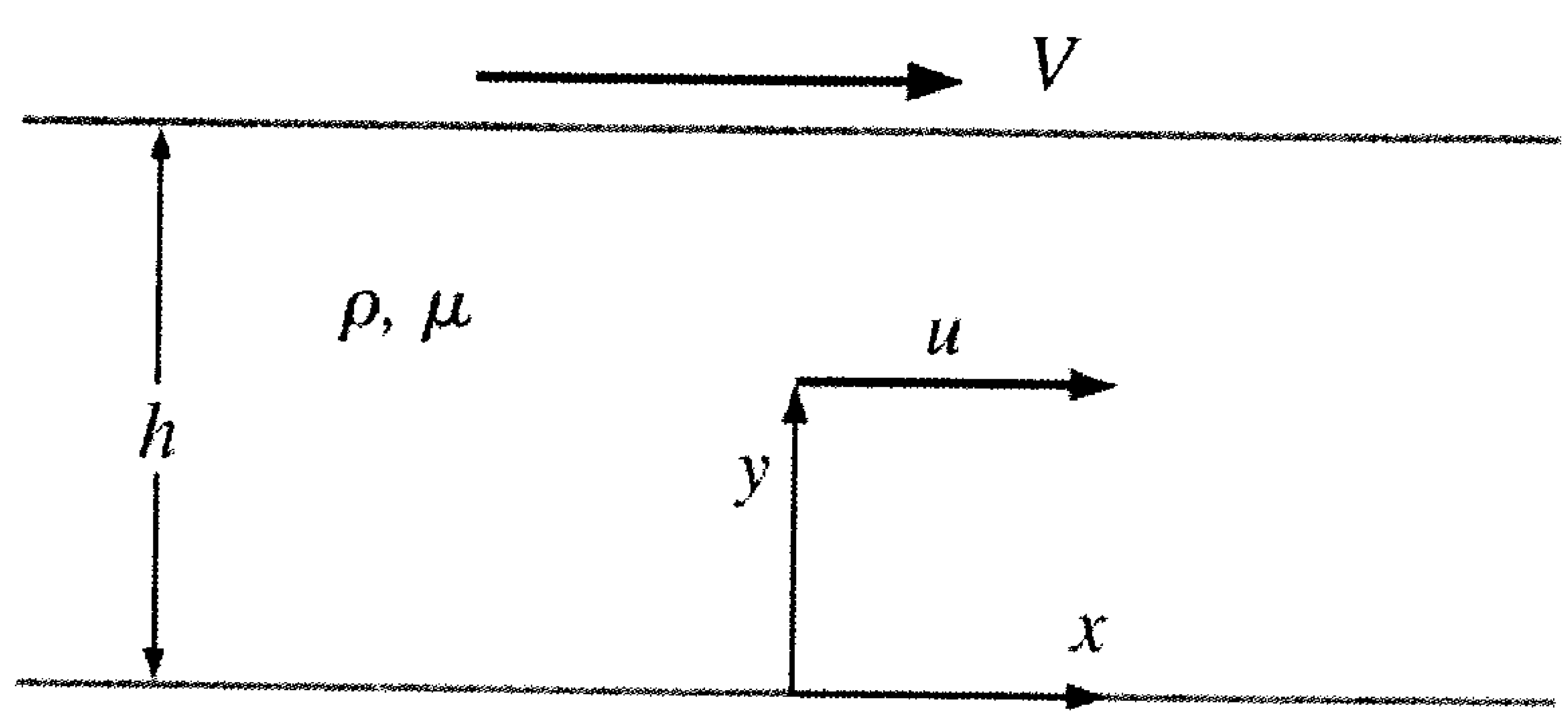
(1)描繪 Moody Diagram

(2)說明摩擦係數與壓降的關係

(3)說明層流與紊流的流動阻力與牆壁粗糙度的關係

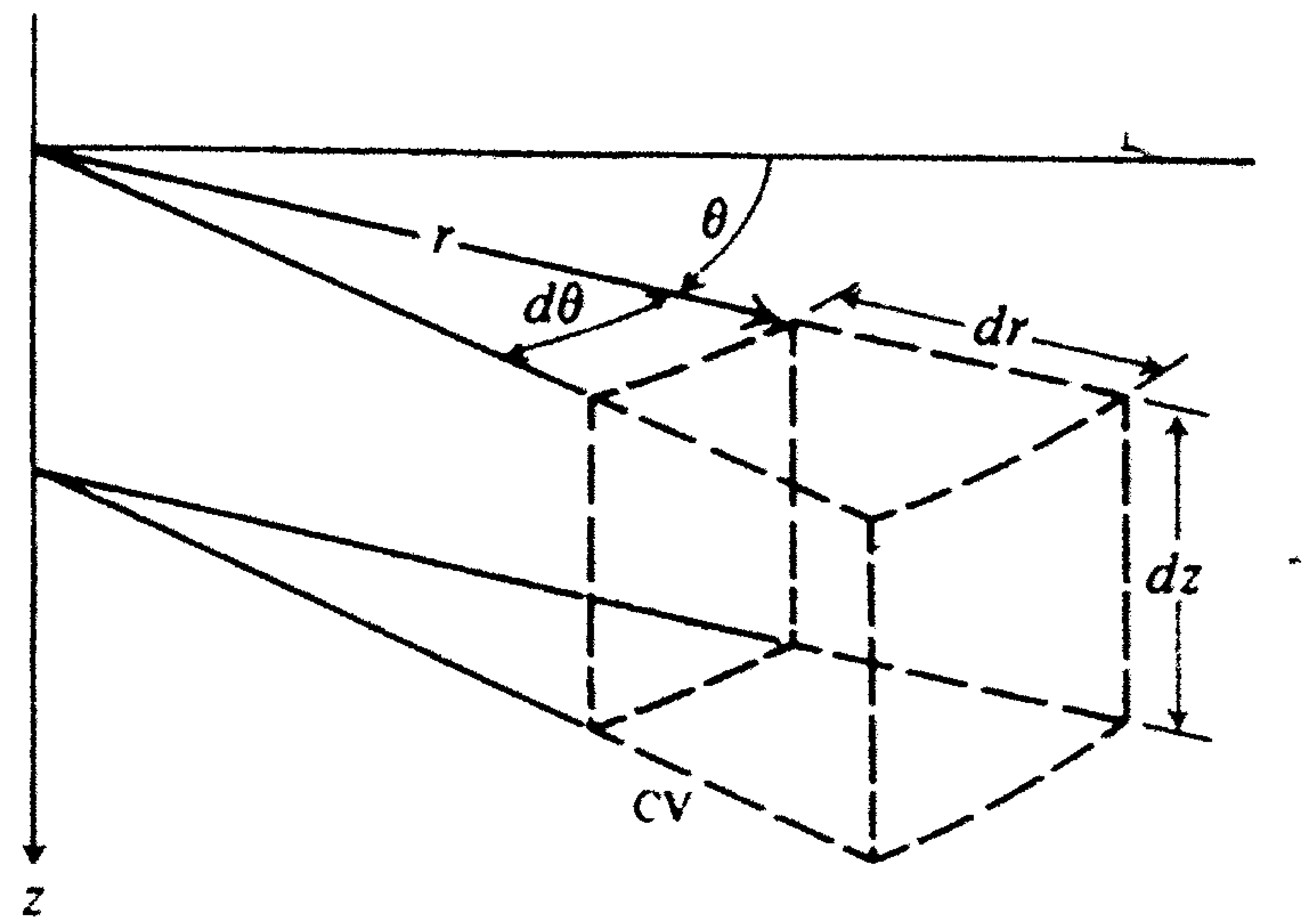
3. (20 %)

Consider fully developed flow between two infinite parallel plates separated by distance h, with the top plate moving and the bottom plate stationary as shown below. The flow is steady, incompressible, and two –dimensional in the xy-plane. With the aid of dimensional analysis, determine the x-component velocity u as a function of viscosity μ, top plate velocity V, distance h, density ρ, and distance y.



4. (30 %)

Develop the differential equation for conservation of linear momentum (i.e. Navier-Stokes equation) in cylindrical coordinates by applying the control volume method to an infinitesimal control volume of dimensions $rd\theta, dr, dz$. (σ is the normal stress and τ is the shear stress)



[Hint]

$$\sigma_{rr} = -p + 2\mu \frac{\partial v_r}{\partial r}$$

$$\sigma_{\theta\theta} = -p + 2\mu\left(\frac{1}{r}\frac{\partial v_\theta}{\partial \theta} + \frac{v_r}{r}\right)$$

$$\sigma_{zz} = -p + 2\mu \frac{\partial v_z}{\partial z}$$

$$\tau_{r\theta} = \tau_{\theta r} = \mu\left(r\frac{\partial}{\partial r}\left(\frac{v_\theta}{r}\right) + \frac{1}{r}\frac{\partial v_r}{\partial \theta}\right)$$

$$\tau_{\theta z} = \tau_{z\theta} = \mu\left(\frac{\partial v_\theta}{\partial z} + \frac{1}{r}\frac{\partial v_z}{\partial \theta}\right)$$

$$\tau_{rz} = \tau_{zr} = \mu\left(\frac{\partial v_r}{\partial z} + \frac{\partial v_z}{\partial r}\right)$$