國　立　清　華　大　學　命　題　紙

96 學年度 工程與系統科學系 （所） 乙 組 碩士班入學考試

科目 流體力學 科目代碼 2903 共 2 頁第 1 頁 *請在【答案卷卡】內作答

1. (15%) Derive Bernoulli equation starting from Euler equation, please list all the assumptions

2. (15%) Please plot the velocity profiles and stress distributions for flows (a) between two parallel and stationery plates (b) between two parallel plates if upper and lower plates are sliding with velocities U_U and U_L respectively (3) inside pipe flow, please plot the profiles for both laminar and turbulent flows.

3. (15%) please explain why a golf ball have dimples on the surface by the following diagrams

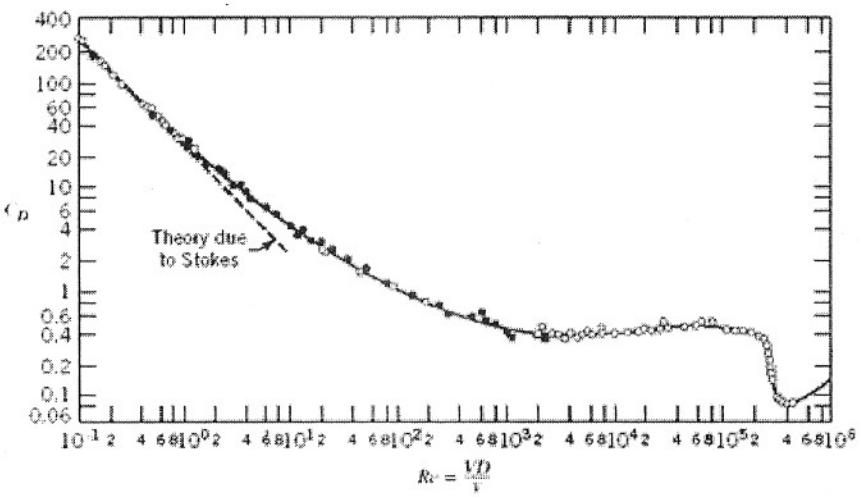
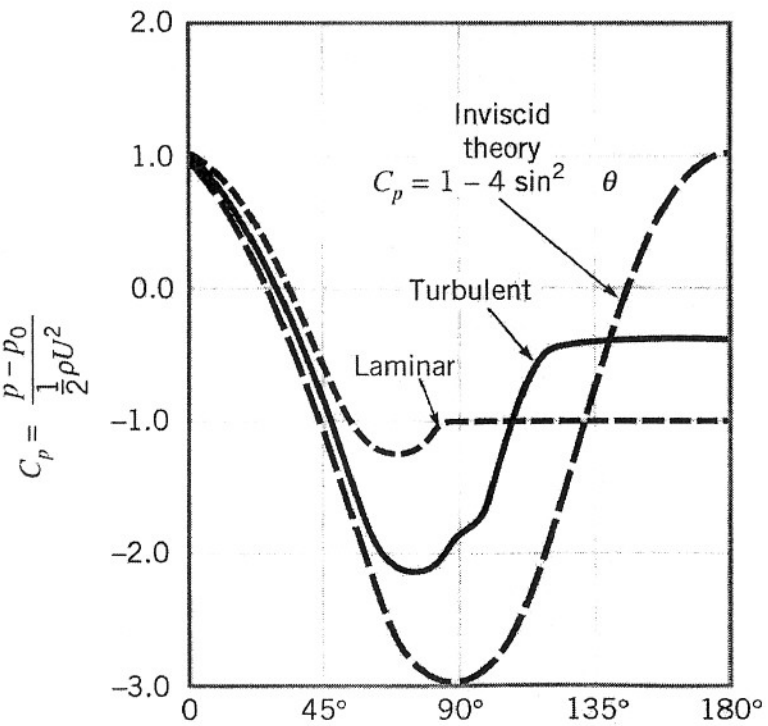


Fig. 9.11 Drag coefficient of a smooth sphere as a function of Reynolds number [3].



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4. (20%) Two immiscible fluids are contained between infinite parallel plates. The plates are separated by distance 2h, and the two fluid layers are of equal thickness. The dynamic viscosity and density of the upper fluid is half that of the lower fluid. Please find the velocity at the interface. What is the maximum velocity of the flow? Plot the velocity distribution. Both the plates are stationary.

5. (15%) Please derive turbulent stresses from Navier Stokes Equations

$$\frac{\partial u}{\partial t}+u\frac{\partial u}{\partial x}+v\frac{\partial u}{\partial y}+w\frac{\partial u}{\partial z}=g_x-\frac{1}{\rho}\frac{\partial p}{\partial x}+\frac{\mu}{\rho}[\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}+\frac{\partial^2 u}{\partial z^2}]$$

Hint: starting from $u=\overline{u}+u'$ where $\overline{u}$ is the mean velocity and u' is the fluctuating velocity

6. (20%) The most general sinusoidal velocity profile for laminar boundary layer flow on a flat plate is u=A sin (By) +C. State three boundary layer conditions applicable to the laminar boundary-layer velocity profile and evaluate constants A, B, and C. Use the momentum integral equation with this profile to obtain expressions for δ/x and C_f.where δ is the boundary layer thickness and C_f is the skin friction factor.

hint momentum integral equation is $\frac{\tau_w}{\rho}=\frac{d}{dx}(U^2\theta)+\delta^* U\frac{dU}{dx}$