

97 學年度 核子工程與科學研究所 甲組 (工程) 碩士班入學考試

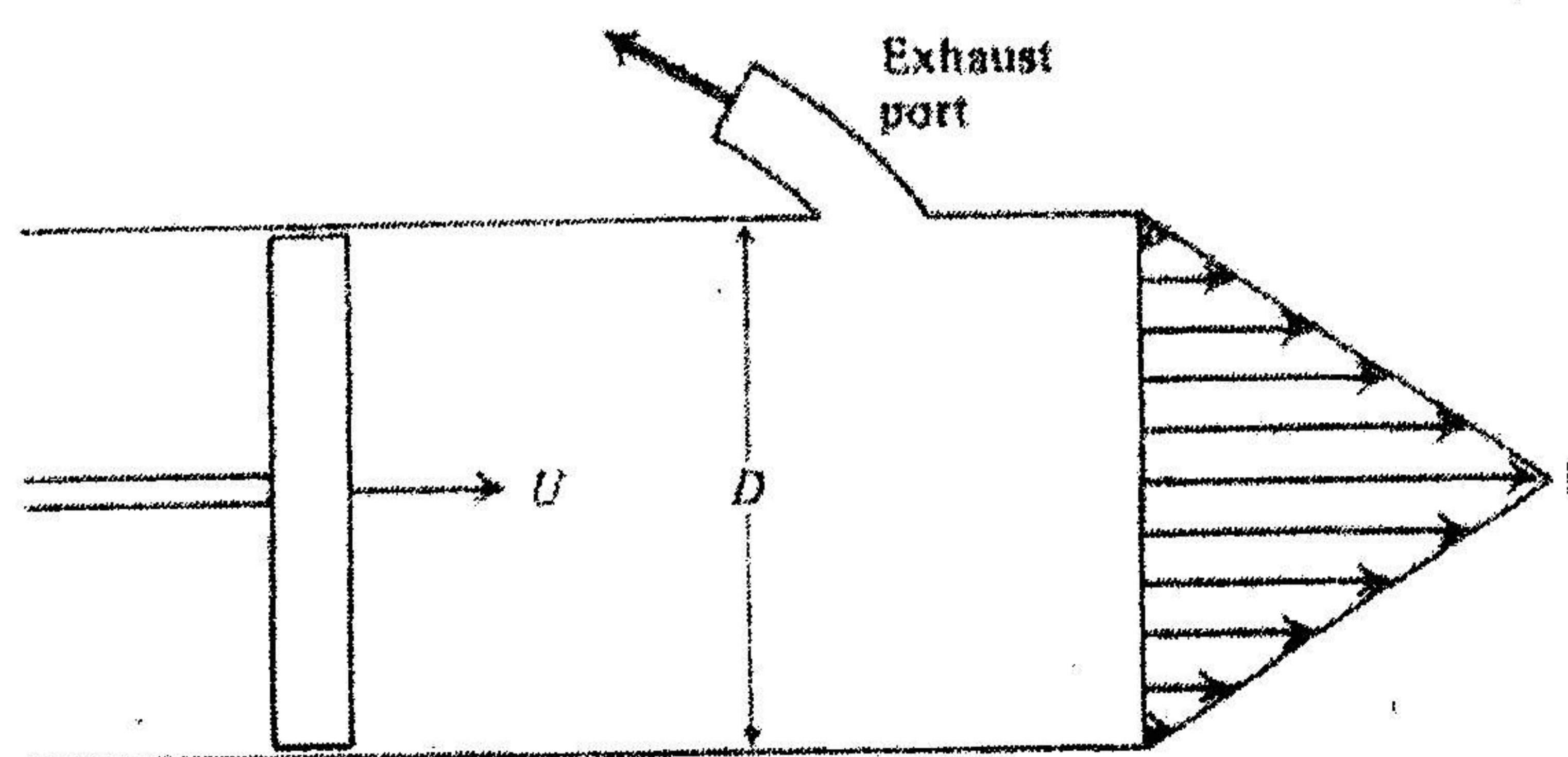
科目 流體力學 科目代碼 3104 共 2 頁第 1 頁 *請在試卷【答案卷】內作答

1. (40%) Answer the following questions

- Please write down the critical Reynolds numbers for a pipe flow and flow through the parallel plates? Please specify the characteristic length for both cases.
- please use two English keywords to characterize laminar and turbulent flows
- Is the entrance length longer for laminar flow than for turbulent flow? Why?
- Please write down the expressions for turbulent and laminar shear stress and give the physical meanings, use Cartesian coordinates
- Please define Darcy's friction factor, f . Please write down the relation between f and Re for laminar pipe flow,
- Please define hydraulic diameter? Please write down the equation with variables defined and calculate it for a flow through parallel plates
- Please use words, illustration diagrams and equations to define separation points
- Please define boundary layer thickness δ and write down the relating equation with Reynolds number for flows over a plate
- Please describe and write down the equation for no slip condition, what is it for?
- Please list the design guidelines of the shape to minimize the drag for a flying object?

3 (10%) An idealized velocity distribution is given by $u = \frac{x}{1+t}$, $v = \frac{y}{1+2t}$, $w=0$, Calculate (a) the streamline; (b) the pathline; and (c) the streakline which pass through the point $(x_0, y_0, 0)$ at time $t=0$

4 (10%) Consider a piston moving with velocity U in one end of a cylinder of diameter D . Liquid leaves the open end with a conical velocity profile and a maximum velocity V . Develop an expression for the volume flow rate leaving through the exhaust port.



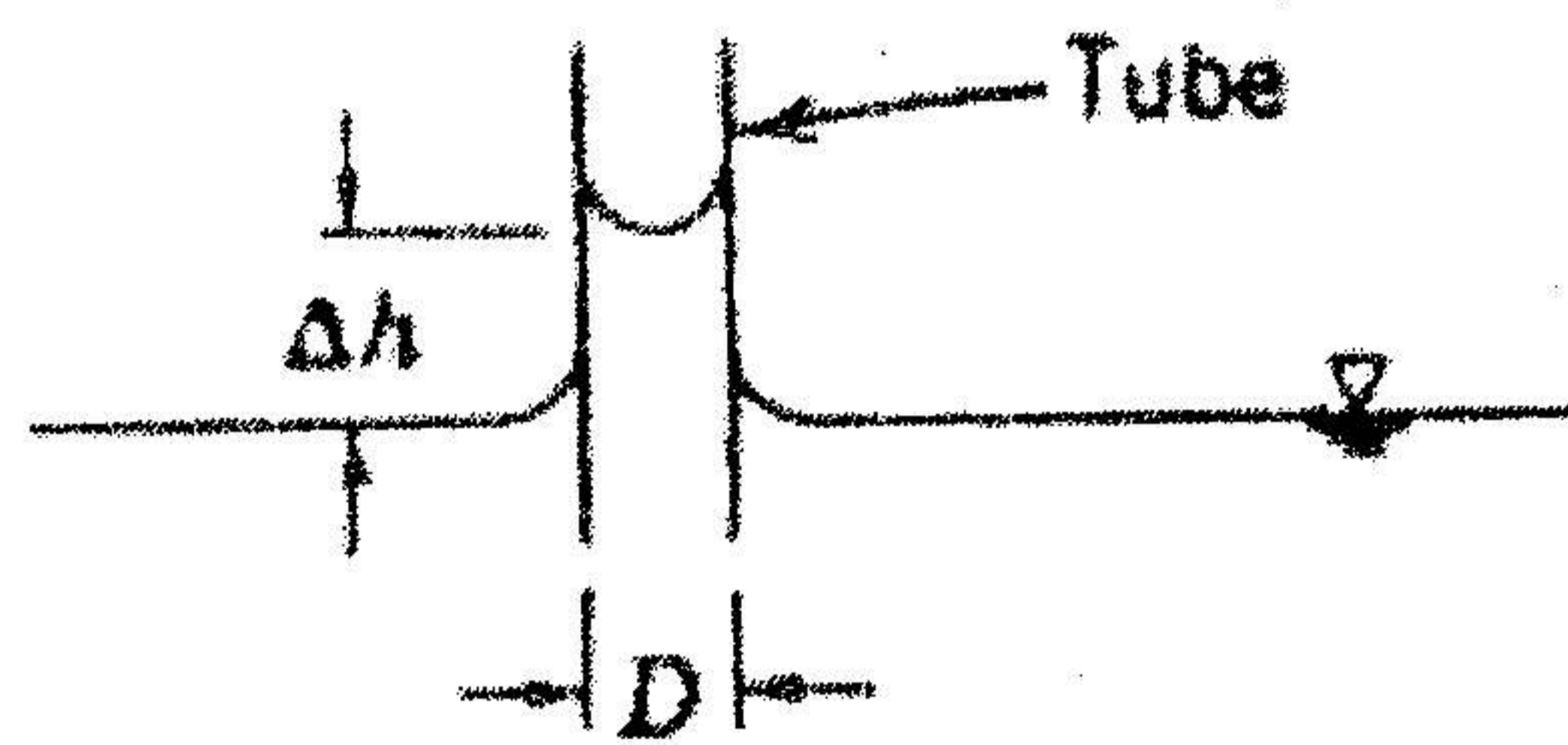
5. (14%) To get a numerical result for laminar flow over a flat-plate, we can assume the form for a cubic velocity profile polynomial as $u=A+By+Cy^2+Dy^3$, and then momentum thickness (θ) and wall shear stress (τ)

can be obtained via momentum-integral relation $D(x) = \int_0^{\delta(x)} u(U-u)dy$, (a) please derive the values of A,B,C,

and D via appropriate boundary conditions and assumptions. (b) derive the boundary layer thickness in terms of Reynolds number

6. (14%) When a small tube is dipped into a pool of liquid, surface tension causes a meniscus to form at the free surface, which is elevated or depressed depending on the contact angle at the liquid-solid-gas interface.

Experiments indicate that the magnitude of this capillary effect, Δh , is a function of the tube diameter, D, liquid specific weight, γ , and surface tensions, σ . Given: $\Delta h=f(D, \gamma, \sigma)$, find the independent dimensionless parameters. (hint: use Buckingham Pi theorem)



Liquid
(Specific weight = γ
Surface tension = σ)

7. (12%) Please derive the velocity distribution for flow flowing between parallel plates (hint: write down the continuity equations and x-momentum equations first)