國立交通大學八十八學年度碩士班入學考試試題

科目：243 流體力學（環境工程研究所 甲組）                                        第 1 頁，共 3 頁
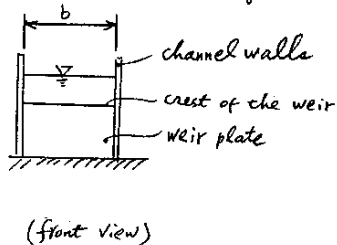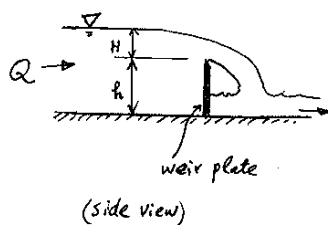＊作答前，請先核對試題、答案卷（試卷）與准考證上之所組別與考試科目是否相符！！

1. (30%) Fill in the following blanks:

(a) Standard sea-level atmospheric pressure = 101.33 kPa (abs)= _____ N/m².

(b) Standard sea-level atmospheric pressure = _____ psi (abs).

(c) If the gas pressure is P, the absolute temperature T, the density $\rho$, and the gas constant R, then the expression for the idea gas law is _____ .

(d) Fluids that do not follow the linear stress versus rate of strain relationships are called _____ fluid.

(e) In SI unit, the dimension of kinematic viscosity is _____ .

(f) In an isentropic process, the relationship between the gas pressure, P, the gas density, $\rho$, and the ratio of the specific heat at constant pressure to the specific heat at constant volume, k, is _____ ..

(g) For ideal gases, the speed of sound, c, can be written as _____, where k, R and T are defined in previous questions.

(h) A flow in which the velocity at a given point in space does not vary with time is called _____ .

(i) For flows over immersed bodies, the drag coefficient $C_d$ can be related to the drag force, D, the upstream velocity U, the characteristic area of the objects, A, and the density of the fluid, $\rho$, as _____ .

(j) In the x-y coordinate, the boundary layer equations are _____ and _____ , where u and v are fluid velocities in x and y directions, and $\nu$ the kinematic viscosity of the fluid.

2. (20 %) A sharp crested rectangular weir is used to measure the fluid flow rate Q based on the height of the upstream free surface above the crest of the rectangular weir (長方型堰的頂端), H. Refer to the following figure and derive the expression $Q = C_{wr} \frac{2}{3}\sqrt{2g}bH^{3/2}$. ($g$: acceleration of gravity; $C_{wr}$: rectangular weir coef.)

$h \gg H$



(side view)
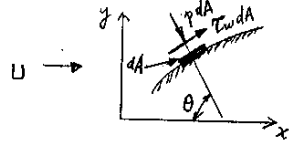
(front view)

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科目：243 流體力學（環境工程研究所 甲組）                    第 2 頁，共 3 頁
＊作答前，請先核對試題、答案卷（試卷）與准考證上之所組別與考試科目是否相符！！

3. (10 %) Refer to the following figure, write down the expressions for the fluid drag, D, and lift, L, on a two-dimensional object. (p: fluid pressure, $\tau_w$: wall shear stress; dA: differential surface area of the object)



4. (15%) Exact solution to the laminar boundary layer equations exist for a steady, viscous flow over an infinitely long flat plate parallel to the upstream velocity, U. Using the dimensionless similarity variable $\eta = (\frac{U}{vx})^{1/2}y$, and the stream function $\psi = (vxU)^{1/2}f(\eta)$ (where f = f($\eta$) is an unknown function), derive the third order ordinary differential equation from the boundary layer equations, and write down the boundary conditions necessary to solve this equation.
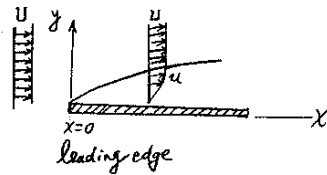


5. (10%) For an irrotational flow, the velocity is expressible as the gradient of a scalar function $\phi$, the velocity potential.　(i) Show that inviscid, incompressible, irrotational flow fields are governed by Laplace's equations. (ii) Obtain velocity potential and stream function for an uniform flow at an angle $\alpha$ with the x axis.
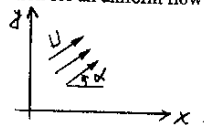
6. (15 %) (i) Refer to figure "A" in the following, identify the laminar, turbulent and transitional zones for an uniform flow over a flat plate with zero incidence by filling the following blanks:

Zone "1" is ＿＿＿＿＿＿＿；

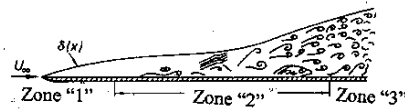Zone "2" is ＿＿＿＿＿＿＿；

and Zone "3" is ＿＿＿＿＿＿＿．



figure "A"

(ii) Refer to the figure "B" in the following, identify the typical boundary layer profiles for laminar, turbulent and transitional flows over the flat plate by filling the following blanks:

Curve "1" is ＿＿＿＿＿＿＿；

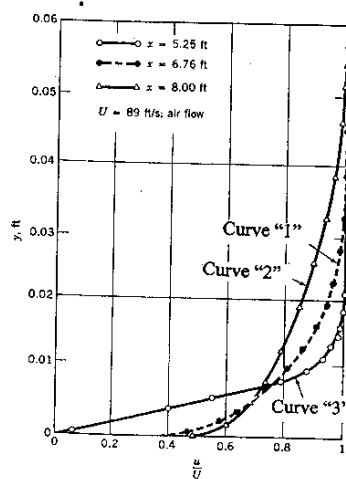Curve "2" is ＿＿＿＿＿＿＿；

and Curve "3" is ＿＿＿＿＿＿＿．



figure "B"
(also refer to the figure in problem 4 for coordinates and symbols)