編號： 141

國立成功大學 107 學年度碩士班招生考試試題

系　　所：航空太空工程學系

考試科目：流體力學　　考試日期：0205，節次：2

※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. (a) A triangular access port must be provided in the side of a form containing liquid concrete. Using the coordinates and dimension shown in Fig. 1, determine the resultant force that acts on the port and its point of application. The specific weight of liquid concrete is 2.5. (5% for each answer, 10% in total)

   (b) As Fig. 2, the water flows at low speed through a circular tube with inside diameter of 50 mm. A smoothly contoured body of 40 mm diameter is held in the end of the tube where the water discharges to atmosphere. Neglect frictional effects and assume uniform velocity profiles at each section. Determine the pressure measured by the gage and the force required to hold the body. (5% for each answer, 10% in total)

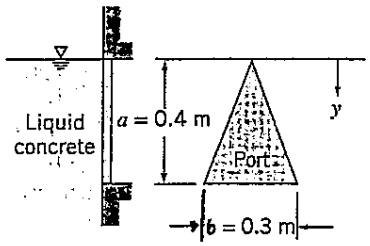


Fig. 1

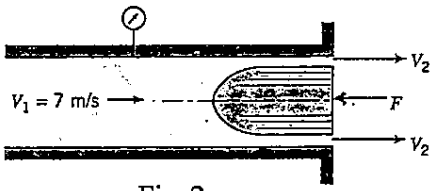


Fig. 2

2. The temperature field around Taiwan are decreasing from south to north (shown as Fig. 3, assume there is no elevation difference of temperature). We release a sounding balloon follow the wind flow to measure the rate of change of temperature. Please find the rate of change of temperature when the wind speed and direction shown as follows:

   (a) Northeast wind, wind speed is $\sqrt{2}$ m/s, the temperature measured by the sounding balloon is constant. (10%)

   (b) Southeast wind, wind speed is $\sqrt{2}$ m/s, the temperature difference measured by the sounding balloon is $0.5\times10^{-4}\ ^{\circ}C/s$. (10%)

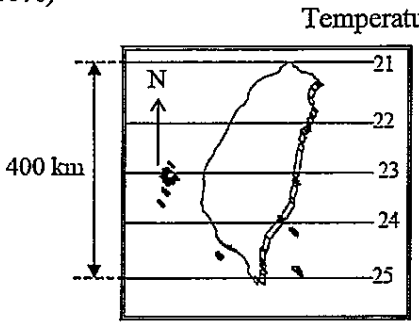


Fig. 3

※ 考生請注意：本試題不可使用計算機。 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

3. A wind generator with a 30-ft-diameter blade span (as Fig. 4) has a cut-in wind speed (minimum speed for power generation) of 7 mph, at which velocity the turbine generates 0.4 kW of electric power. Determine:
   (a) The efficiency of the wind turbine-generator unit. (10%)
   (b) The horizontal force exerted by the wind on the supporting mast of the wind turbine. (10%)
   Take the density of air to be 0.076 lbm/ft^3
   1 mile = 5280 ft, g = 32.2 ft/s^2, 1kW = 737.56 lbf•ft/s

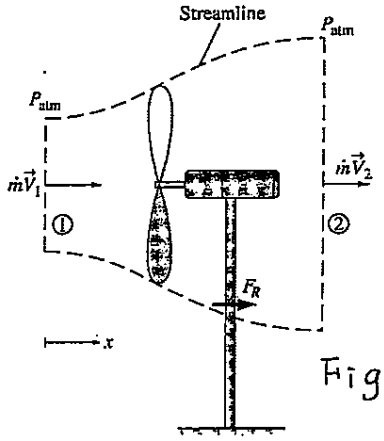
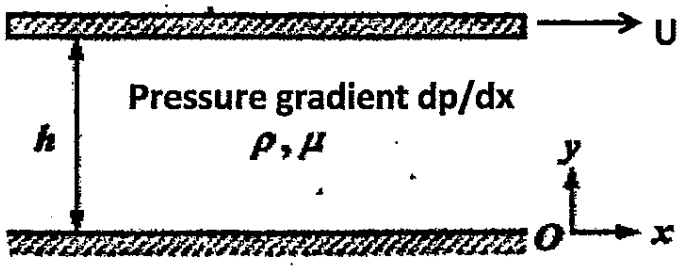


Fig.4

4. As shown in the figure below, incompressible fluid with density ρ and viscosity μ is sandwiched between two infinite parallel flat plates. The fluid is subjected to pressure gradient $\frac{dp}{dx}$. The distance between the two flat plates is h; the bottom plate is stationary; and the top plate is moving with a constant velocity of U.
(a) Derive the simplified governing equation of the flow. (5%)
(b) Find the velocity distribution $u(y)$. (5%)
(c) Find the minimum pressure gradient for the flow starting to reverse at the bottom plate. (10%)



5. The velocity profile of a flat-plate boundary layer flow can be expressed as:

$u(y)=U_0\left[\frac{3}{2}\frac{y}{\delta}-\frac{1}{2}\left(\frac{y}{\delta}\right)^3\right]$, where U_0 is constant free-stream velocity, and δ is boundary-layer thickness. Find

$\frac{\delta}{x}=?$ (Hint: $Drag=U_0\int_0^{\delta}\rho u dy-\int_0^{\delta}\rho u^2 dy$) (20%)