元智機械所博士班資格考 911，流力考題(一)

1. (15%) There two general approaches in analyzing fluid mechanics problems. One is Eulerian method, another is Lagrangian method. The following figure 1 show the two methods to descript the temperature in a flow field, One is the temperature located at o, $T=T(x_o, y_o,t)$, another one is particle A, moving with a streamline, and its temperature $T_A=T_A(t)$. Could you tell which one is Eulerian method, and which one is Lagrangian method.

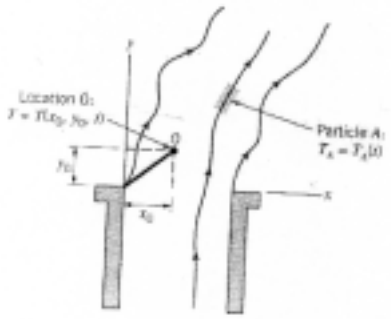

Fig. 1

2. (15%) Develop an expression for the pressure variation in a liquid in which the specific weight increases with depth, h, as $\gamma=Kh+\gamma_0$, where K is a constant and $\gamma_0$is the specific weight at the free surface , p(z)

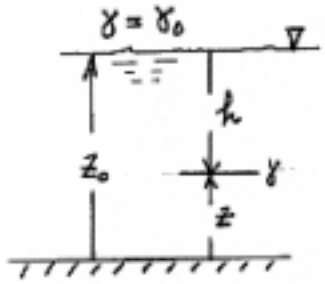

Fig.2

3. (20%) Consider the inviscid, incompressible, steady flow along the horizontal streamline A-B in front of the sphere of radius a as show in Fig 3. From a more advanced theory of flow past a sphere, the fluid velocity along this streamline is

$$V = V_0\left(1+\frac{a^3}{x^3}\right)$$

Determine the pressure variation along the streamline from point A far in front of the sphere ($x_A=-\infty$ and $V_A=V_0$) to point B on the sphere ($x_B=-a$ and $V_B=0$).

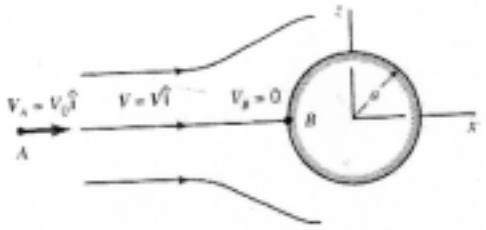

Fig. 3

Fluid Mechanics Qualify Exam (2002/10/8)

1. In a two-dimensional, incompressible flow field, the x component of velocity is given by the equation u=2x. (a) Determine the corresponding equation for the y component of velocity if v=0 along the x axis. (b) For this flow field what is the magnitude of the average velocity of the fluid crossing the surface OA of Fig. 1. Assume that the velocities are in ft/s when x and y are in feet. (20%)

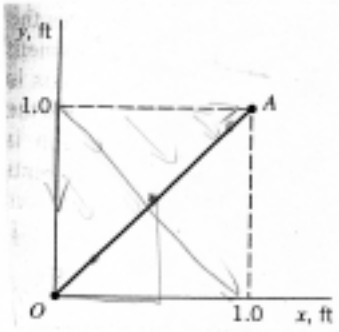

Figure 1

2. A two-dimensional flow field described by

$$\vec{V} = (2x^2y + x)\,\vec{i} + (2xy^2 + y + 1)\,\vec{j}$$

Where the velocity is in m/s when x and y are in meters. Determine the angular rotation of a fluid element located at x=o.5 m, y=1.0 m. (15%)

3. Please explain the mechanism of the shear stress caused in laminar and turbulent flow and point out their major difference. (use figure to explain will be better) 15%