國立成功大學

111學年度碩士班招生考試試題

編　號：136

系　所：航空太空工程學系

科　目：流體力學

日　期：0219

節　次：第 2 節

備　註：不可使用計算機

編號： 136

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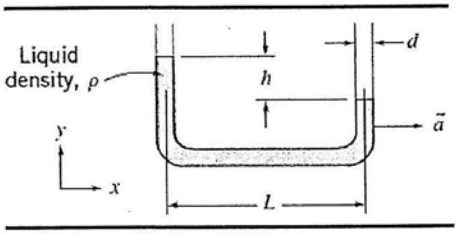
※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

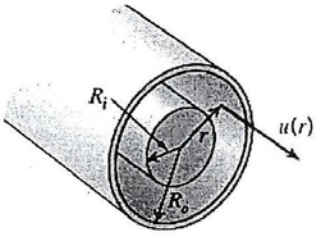
1. A crude accelerometer can be made from a liquid-filled U-tube as shown. Derive an expression for the liquid level difference h caused by an acceleration $\vec{a}$, in terms of the tube geometry and fluid properties. (15%)



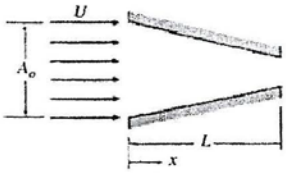
2. The velocity profile for laminar flow in an annulus is given by

$$u(r) = -\frac{\nabla p}{4\mu L}\left[R_o^2 - r^2 + \frac{R_o^2 - R_i^2}{ln(R_i/R_o)} ln\frac{R_o}{r}\right]$$

where $\nabla p/L = -10\ kPa/m$ is the pressure gradient, $\mu = 0.1\ N \cdot s/m^2$ is the viscosity, and $R_o = 5\ mm$ and $R_i = 1\ mm$ are the outer and inner radii. Find the volume flow rate, the average velocity, and the maximum velocity. Plot the velocity distribution. (15%)



3. Consider the incompressible flow of a fluid through a nozzle as shown. The area of the nozzle is given by $A = A_0(1 - bx)$ and the inlet velocity varies according to $U = U_0(0.5 + 0.5\cos\omega t)$ where $A_0 = 0.5\ m^2$, $L = 5\ m$, $b = 0.1\ m^{-1}$, $\omega = 0.16\ rad/s$, and $U_0 = 5\ m/s$. Find and plot the acceleration on the centerline, with time as a parameter. (20%)



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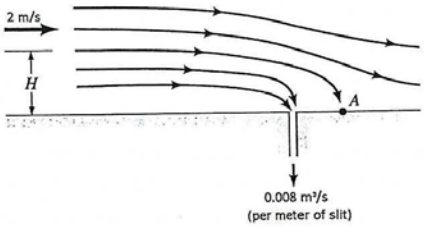
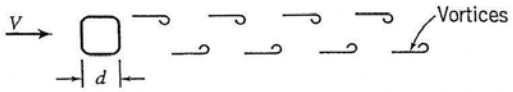
4. Water flow over a flat surface at 2 m/s, as show in the figure. A pump draws off water through a narrow slit at a volume rate of 0.008 m^3/s per meter length of the slit. Assume that the fluid is incompressible and inviscid. Locate the stagnation point on the wall (point A) and determine the equation for the stagnation streamline. How far above the surface, H, must the fluid be so that it does not get sucked into the slit? (15%)



5. In some speed ranges, vortices are shed from the rear of bluff cylinders placed across a flow. The vortices alternately leave the top and bottom of the cylinder, as shown, causing an alternating force normal to the freestream velocity. The vortex shedding frequency, f, is thought to depend on ρ, d, V, and μ. Use dimensional analysis to develop a functional relationship for f. Vortex shedding occurs in standard air on two cylinders with a diameter ration 2. Determine the velocity ration for dynamic similarity, and the ratio of vortex shedding frequencies. (15%)



6. The figure shown on the right is a simple viscometer which is a circular pipe connected to a cylindrical container. The radius of circular pipe a is much smaller than the radius of container. When the fluid was filled into the container, we can calculate the viscosity of the fluid by measuring the volume flow rate out of the pipe. Please derive the relation between the viscosity and the volume flow rate of fluid. (20%)