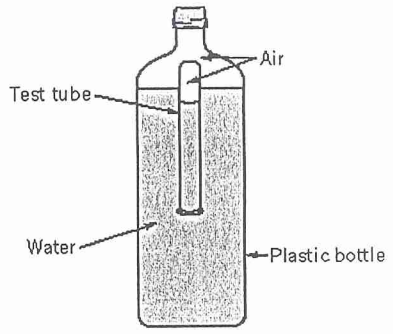
國立中央大學103學年度碩士班考試入學試題卷

所別：機械工程學系碩士班 丙組(熱流)(一般生)　科目：流體力學及熱傳學　共 2 頁 第 1 頁

本科考試可使用計算器，廠牌、功能不拘　＊請在試卷答案卷（卡）內作答

流體力學 (50 分)

1. An inverted test tube partially filled with air floats in a plastic water-filled bottle. The amount of air in the tube has been adjusted so that it just floats. The bottle cap is securely fastened. What will happen to the test tube if we slight squeeze the plastic bottle? Explain it. (5%)

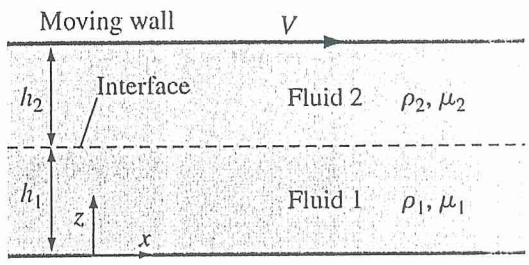


2. (a) Explain the difference between a solid and a liquid. (2%)

   (b) Why is the incompressible fluid has large values of the bulk modulus (E_v= - $dp/(dV/V)$)? (3%)

3. Flow through a converging nozzle (length=L) can be approximated by a one-dimensional velocity distribution $u=u(x)$. Assume the velocity varies linearly from $u=u_o$ at the inlet to $u=3u_o$ at the exit. Compute the acceleration du/dt as a general function of x/L. (5%)

4. Consider a modified form of Couette flow in which there are two immiscible fluids sandwich between two infinitely long and wide, parallel flat plates as shown in the figure. Assume the flow is steady, incompressible, parallel and laminar. The top plate moves at velocity V and the bottom plate is fixed. Gravity acts in the –Z direction. There is no forced pressure gradient pushing the fluids through the channel. The pressure at the bottom plate (z=0) is P_0.



   (a) Please obtain the simplified Navier-Stoke equation for this problem. Please show your derivation as detail as possible. (12%)

   (b) Please list all the appropriate boundary conditions on both velocity and pressure. (9%)

   (c) Please solve the velocity field u_1 and u_2 for fluid 1 and fluid 2 respectively. (7%)

   (d) Please solve the pressure field P_1 and P_2 for fluid 1 and fluid 2 respectively. (7%)

參考用

注意：背面有試題

熱傳學 (50 分)

5. Explain and plot the profile of $T(y)$ of a heating wall with heat source for two types of boundary conditions: (a) isothermal wall $T=T_s$, (b) adiabatic wall. The plot should starts from the surface (y=0) and into the wall. (10%)

6. Define the overall heat transfer coefficient (U) and the resistance coefficient (R) first. Then describe when and how to use these two values in analysis heat transfer. (10%)

7. Please write down the definition and physical meaning of the following terms. (8 %)
   (a) Velocity boundary layer thickness
   (b) Blackbody
   (c) Wien's displacement law
   (d) Total hemispherical emissivity

8. Fully developed air flow at 300 K is heated in a 10 mm inside diameter circular tube under constant heat flux condition. The flow rate is 10 g/min. Please calculate the average heat transfer coefficients of the air flow. You must check if it is laminar or turbulent before applying any equations. (10%)

9. A square plate (30 cm x 30 cm) with constant surface temperature of 350 K is cooled by atmospheric air in parallel flow at u_∞ = 10 m/s and T_∞ = 300 K. What is the heat transfer rate between the plate and air? (12%)

The properties of air at 300 K and 350 K at 1 atm are listed below.

	ρ (kg/m^3)	c_p (kJ/kg K)	α (m^2/s)	μ (Ns/m^2)	k (W/mK)	Pr
300 K	1.1614	1.007	22.5×10^{-6}	184.6×10^{-7}	0.0263	0.707
350 K	0.9950	1.009	29.9×10^{-6}	208.2×10^{-7}	0.0300	0.700