大葉大學 95 學年度　研究所碩士班　招生考試試題紙

系 所 別	組 別	考 試 科 目 （中文名稱）	考試 日期	節次	備　　註 共二頁
機械工程研究所	乙組	流體力學或熱力學	4月23日	第二節	可使用不可程式計算機，答題應詳列步驟

註：考生可否攜帶計算機或其他資料作答，請在備註欄註明（如未註明，一律不准攜帶）(10:30～12:00)　P2-1

請由流体力學及熱力學試題中任選五題作答，答題數目不可超過六題，第六題(含)以上不予計分，每題20分，總分100分

1) (20 %) As shown in Fig. 1, water flows without viscous effect from the nozzle with p_1= 85 kpa (gage). Determine the flowrate and the height h, to which the water can flow.

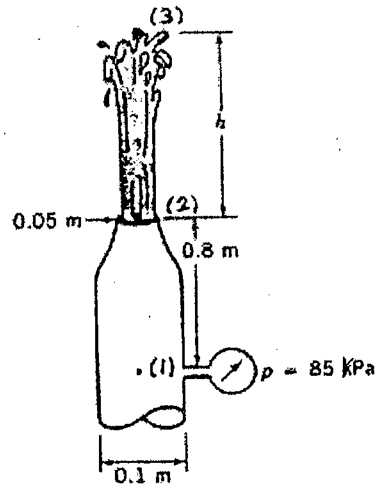

Figure 1

2) (20 %) A circular plate is held vertically to an axisymmetric horizontal jet of air with a velocity of 40 m/s and a diameter of 80 mm as shown Fig. 2. A hole at the center of the plate causes a discharge jet of air having a velocity of 40 m/s and a diameter of 20 mm. Solve the horizontal force required to hold the plate still.

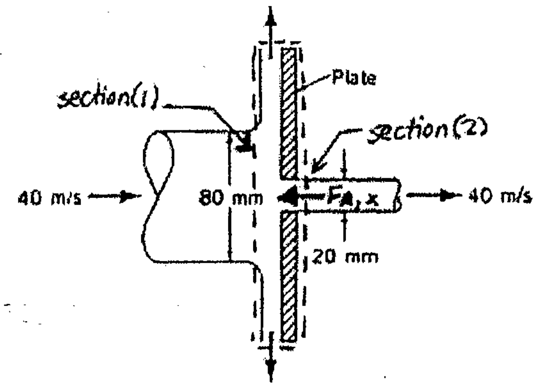

Figure 2

3) (20 %) The viscous, incompressible, laminar flow between the parallel plates shown in Fig. 3 is caused by a pressure gradient ($\partial p/\partial x$) and the motion of the bottom plate at a constant velocity of U. Hint: The velocities can be expressed as $u = -\dfrac{1}{2\mu}(\partial p/\partial x)y^2 + c_1 y + c_2$; $v = 0$. Here c_1 and c_2 are two constants to be solved by the boundary conditions. Determine the relationship between U and $\partial p/\partial x$ so that the shearing stress acting on the fixed plate is zero.

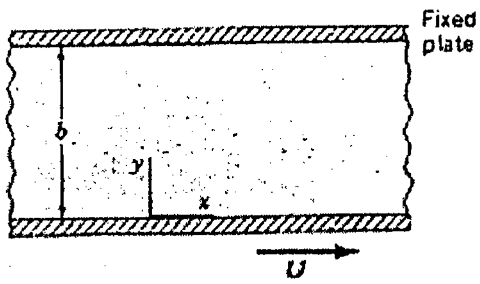

Figure 3

4) (20 %) The buoyancy force F_B, acting on a body in a fluid is a function of the specific weight (γ) of the fluid and the volume (V) of the body, i.e., $F_B = f$ (γ, V). Show, by dimensional analysis, that the buoyancy force F_B is directly proportional to γ.

5) (20 %) Considering as fully developed laminar flows, an oil with a viscosity of μ= 0.40 N-s/m^2 and density ρ = 900 kg/m^3 flows in a pipe of diameter D = 0.02 m. If the pipe is horizontal with the traveling distance l = 10 m, determine the pressure drop (Δp) needed to produce a flowrate of Q = 2.0 × 10^{-5} m^3/s.

6) (20 %) A 50-kg iron block at 80°C is dropped into an insulated tank that contains 0.5 m^3 of liquid water with the specific volume of 0.001 m^3/kg. The specific heats of iron and liquid water are given as C_{iron}= 0.45 kJ/kg.°C and C_{water}=4.184 kJ/kg.°C. Determine the temperature when the thermal equilibrium is reached.

7) (20 %) Air at 100 kPa and 7 °C is steadily compressed to 600 kPa and 127 °C. The mass flow rate of the air is 0.02 kg/s with a heat loss of 16 kJ/kg during the process. Assuming the changes in kinetic and potential energies are negligible and the specific heat (C_p) of air is 1.005 kJ/kg.K, determine the work input to the compressor in kW.

8) (20 %) A 0.5 m^3 rigid tank contains refrigerant R-134a initially at 200 kPa and 40% quality. Heat is transferred to the refrigerant from a heat source until the pressure rises to 400kPa. Using the following thermodynamic data to determine the mass and the total entropy change of the refrigerant.

Property	v_f, m^3/kg	v_g, m^3/kg	s_f, kJ/(kg.K)	s_g kJ/(kg.K)
P= 200 kPa	0.0007532	0.0993	0.1481	0.9253
P= 400 kPa	0.0007904	0.0509	0.2399	0.9145

9) (20 %) Consider a steam power plant operating on the simple ideal Rankine cycle. The turbine and the pump are isentropic, and there are no pressure drops in the boiler and condenser. Steam leaves the condenser and goes into the pump as saturated liquid at the condenser pressure. Currently, Steam enters the turbine at 3 Mpa and 350 °C, and is condensed in the condenser at 75 kPa. Determine the steady-state thermal efficiency of the cycle.

$\underline{P= 3\text{ MPa}, T= 350°C}$ => h= 3115.3 kJ/kg. s= 6.7428 kJ/kg.K

$\underline{P= 75\text{ KPa}}$ => h_f= 384.39 kJ/kg, h_{fg}= 2278.6 kJ/kg

v_f= 0.001037 m^3/kg, s_f= 1.213 kJ/(kg.K), s_{fg}= 6.2434 kJ/(kg.K)

10) (20 %) A refrigerator uses refrigerant R-134a as the working fluid and operates on an ideal vapor-compression refrigeration cycle between 0.12 and 0.8 Mpa. The compression process is isentropic. The refrigerant enters the compressor as a saturated vapor, and leaves the condenser as saturated liquid. If the steady-state mass flow rate of the refrigerant is 0.05 kg/s, determine the COP_R of the refrigerator.

$\underline{P= 120\text{ KPa}}$=> h_g= 233.86 kJ/kg, s_g= 0.9354 kJ/kg.K

$\underline{P= 0.8\text{ MPa}, s_2=s_1}$ => h_2= 273.04 kJ/kg, T_2= 39.4 °C

$\underline{P= 0.8\text{ MPa}}$ => h_f= 93.42 kJ/kg