國立臺灣科技大學103學年度碩士班招生試題

系所組別： 機械工程系碩士班丙組

科　　目： 熱力與流力

（總分為100分）

1. For a system undergoing a cycle, which of the following expressions are true? Here Q is the heat transfer, E is the total energy of the system, W is the done work, S is the entropy of the system and V is the volume of the system. (multiple choice) (10%)

(1) $\oint \delta Q = 0$ (2) $\oint dE = 0$ (3) $\oint \delta W = 0$ (4) $\oint dS = 0$ (5) $\oint dV = 0$.

2. (a) Complete the following table for H_2O:

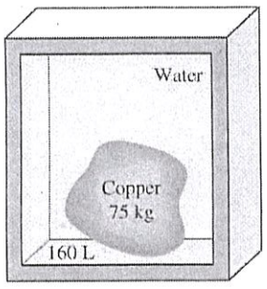
State	T, °C	P, kPa	h, kJ / kg	X	Phase description
1		200		0.7	
2	140		1800		Saturated mixture
3	350	800	3162.2	N/A	

Note: X is the quality of the saturated mixture, N/A for non-saturated state. (9%) (b) Please sketch the relative locations of states 1-3 in a T-v diagram of the water, where v is the specific volume. (6%)

3. Water is being heated in a vertical piston-cylinder device. The piston has mass of 20 kg and a cross-sectional area of 100 cm^2. If the local atmospheric pressure is 100 kPa, determine the temperature at which the water in the piston starts boiling. (10%)

4. A 75-kg copper block initially at 150℃ is dropped into an insulated tank that contains 160 L of water at 15℃. Determine (a) the final equilibrium temperature (8%) and, (b) the total entropy change for this process. (7%)

(Note: The density and specific heat of water are approximately ρ = 1000 kg/m^3 and Cp = 4.2 kJ/kg.°C. The density and specific heat of copper are approximately ρ = 8900 kg/m^3 and Cp = 0.386 kJ/kg.°C.)



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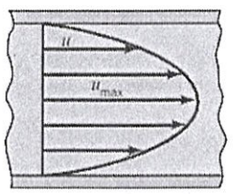
5. Please determine the pressure drop per unit length of steady and fully developed laminar pipe flow with axial velocity profile as follows

$$\frac{u}{u_{\max}} = (1 - \frac{r^2}{R^2})$$

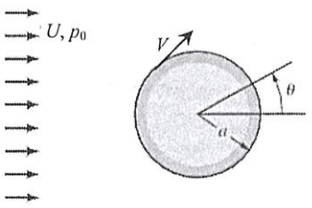
where r denotes the radial direction, R the pipe radius and $u_{\max}$ the flow velocity at the centerline. (15%)



6. The inviscid flow with density ρ around circular cylinder with radius a has a tangential velocity profile

$$V = 2U\sin\theta$$

on the outer surface of cylinder, where U and p_0 denote the far field velocity and pressure, respectively. Please determine the force acting on the cylinder per unit depth by the fluid, provided the gravitational effect can be ignored. (15%)



7. Please determine the dimensionless group of the problem describing a fluid droplet impinging on flat surface, where ρ denotes the fluid density, μ the dynamic viscosity of fluid, σ the surface tension of fluid, D the diameter of droplet, V the impinging velocity, and g the gravitational acceleration. (Hint: Surface tension is defined as the surface force per unit length at the fluid interface.) (20%)