淡江大學 99 學年度碩士班招生考試試題

51-1

系別：機械與機電工程學系　　科目：熱　力　學

准帶項目請打「V」	
V	計 算 機

本試題共 2 頁，5 大題

本試題雙面印製

1. As shown in Fig. 1, an oven wall of a 2.5-in-thick layer of steel (κ_s=8.7 Btu/h·ft·°R) and a layer of brick (κ_b = 0.42 Btu/h·ft·°R). At steady state, a temperature decrease of 1.2°F occurs over the steel layer. The inner temperature of the steel layer is 540°F. If the temperature of the outer surface of the brick must be no greater than 105°F, determine the minimum thickness of the brick, in inch, that ensures this limit is met. (20%)

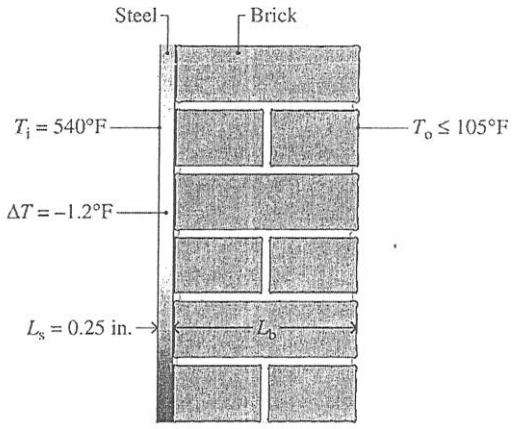

Fig. 1

2. Fig. 2 shows a piston-cylinder assembly fitted with a spring. The cylinder contains water, initially at 1000°F, and the spring is in a vacuum. The piston face, which has an area of 20 in.^{2}, is initially at x_1=20 in. The water is cooled until the piston face is at x_2=16 in. The force exerted by the spring varies linearly with x according to $F_{Spring} = kx$, where k = 200 lbf/in. Friction between the piston and cylinder is negligible. For the water, determine the work in Btu. (2×10%)

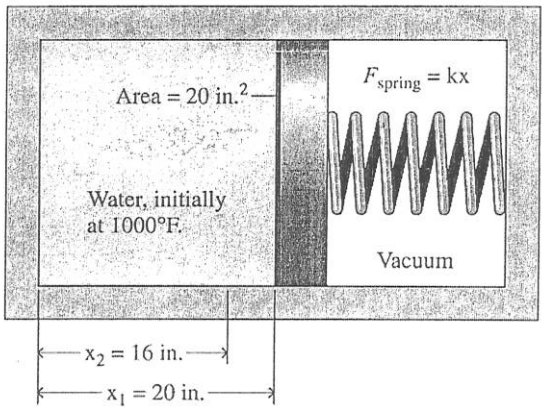

Fig. 2

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3. As shown in Fig. 3, air enters the diffuser of a jet engine operating at steady state at 18 kPa, 216 K and a velocity of 265 m/s, all data corresponding to high-altitude flight. The air flows adiabatically through the diffuser and achieves a temperature of 250 K at the diffuser exit. Using the ideal gas model for air, determine the velocity of the air at the diffuser exit, in m/s.

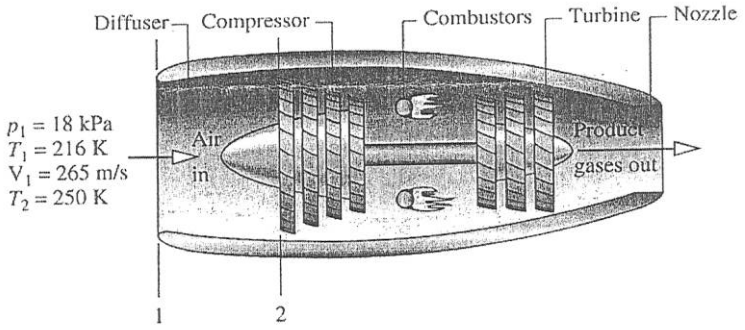

Fig. 3

4. The pressure volume diagram of a Carnot power cycle executed by an ideal gas with constant specific heat ratio k is shown in Fig. 4. Find the relation for V_1, V_2, V_3, V_4. (20%)

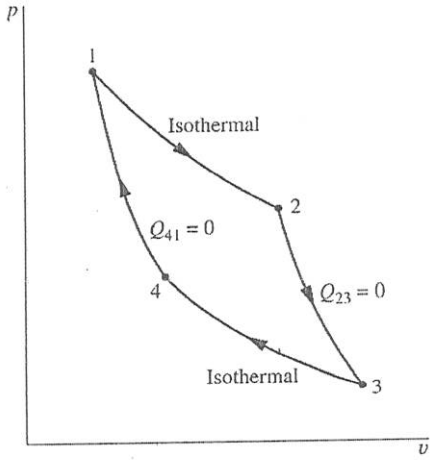

Fig. 4

5. Carbon Dioxide (CO_2) as an ideal gas executes a Carnot cycle while operating between thermal reservoirs at 450 and 100°F. The pressures at the initial and final states of the isothermal expansion are 400 and 200 lbf/in.^{2}, respectively. The specific heat ratio is k =1.24. Determine the thermal efficiency. (20%)