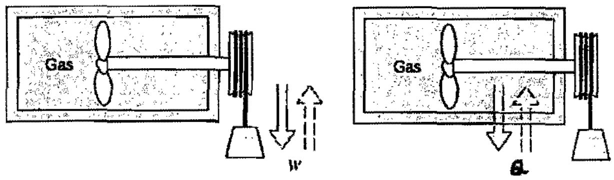
系所組別： 工程科學系丁、己組
考試科目： 熱力學

1. Describe the two thermodynamic cycles (solid and dotted arrows) for the system shown below. Is this system related to heat engines or refrigerators? Why? Then, state the first law of thermodynamics for the solid arrow cycle. (13%)



2. What is the specific heat? Define it. Derive C_p and C_v in terms of thermodynamic properties. Then, show that $dh \approx du = CdT$ for solid and liquids, where C is either the constant-volume or the constant pressure specific heat. (11%)

3. Write out the first law of thermodynamics (a) for a control mass (C.M.) undergoing a cycle; (b) for a change in state of a C.M. process; (c) for a general one-flow control volume (C.V.) process; (d) for a one-flow steady-state C.V. process. Under what conditions the first law of a control volume transient process reduces to that of a control mass process? (11%)

4. Derive and explain the thermodynamics property "entropy" (do not need to derive the inequality of Clausius).(7%)

5. Clearly describe the second law of thermodynamics qualitatively and quantitatively.(10%)

6. When does one use $\int Pdv$ for calculating work? When does one use $\int vdp$ for calculating work ? When does one need to use the First Law for calculating work? (9%)

7. Carefully derive $w = -\int_i^e vdp$. (10%)

(背面仍有題目,請繼續作答)

8. A piston/cylinder contains air at 300 K, 100 kPa. A reversible polytropic process with n = 1.3 brings the air to 500 K. Find the specific work and specific heat transfer in the process. Given $C_P = 1.004$ kJ/kg-K, $R = 0.287$ kJ/kg-K. (8%)

9. A small pump takes in water at 20°C, 100 kPa and pumps it to 2.5 MPa at a flow rate of 100 kg/min isentropically. Find the required pump power input in terms of the water specific volume. (6%)

10. A mass of 2 kg ethane gas at 500 kPa, 100℃, undergoes a reversible polytropic expansion with exponent, n=1.3, to a final temperature of the ambient, 20℃. Calculate the total entropy generation for the process if the heat is exchanged with the ambient. Given $C_P = 1.77$ kJ/kg-K, $R = 0.28$kJ/kg-K, $Tds = dh - vdp$. 注意: 不需要對數字之非整數次方作計算,如 $5^{0.2}$,以 $5^{0.2}$ 表示即可,亦不須對數字之自然對數作計算。 (15%)