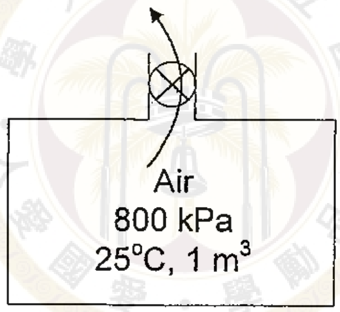
1. The reversed Carnot cycle is the most efficient refrigeration cycle but it is not a realistic model for refrigeration cycles. Many of the impracticalities can be eliminated by vaporizing the refrigerant completely before it is compressed and by replacing the turbine with a throttling device. The cycle that results is called the ideal vapor-compression refrigeration cycle.
   (a) Sketch the T-S diagram of the reversed Carnot Cycle and the Ideal Vapor-Compression Refrigeration Cycle respectively. (6%)
   (b) Does the area enclosed by the cycle on a T-S diagram represent the net work input for the reversed Carnot cycle? How about for the ideal vapor-compression refrigeration cycle? Explain. (6%)
   (c) What are the COP for these cycles? (6%)
   (d) How can we achieve the isothermal heat transfer processes in the cycles? (7%)

2. A tank with an internal volume of 1 m^3 contains air at 800 kPa and 25°C. A valve on the tank is opened allowing air to escape and the pressure inside quickly drops to 150 kPa, at which point the valve is closed. Assume there is negligible heat transfer from the tank to the air left in the tank. Calculate the mass withdrawn during the process. (gas constant of air is 0.287 $kPa\cdot m^3/kg\cdot K$; Cp=1.005 $kJ/kg\cdot K$; Cv=0.718 $kJ/kg\cdot K$; k=1.4) (25%)



3. (a) Schematically draw the T-s and P-*v* diagrams of Otto cycle and explain the processes of the cycle. (10%)
   (b) Under the same compression ratio the efficiency of Otto cycle is higher than that of Diesel cycle. Explain the situation with the help of a T-s or h-s diagram. (15%)

4. A computer chip of 20 x 20 mm in dimension is cooled by air, at 20°C and atmospheric pressure, flowing over the surface of the chip. If the maximum allowable chip surface temperature is 65 °C and the air velocity is 3.4 m/s, how much heat can be moved by forced convection (in W)? The density, viscosity, and thermal conductivity of air are 1.13 kg/m^3, 1.92×10^{-5} kg/m.s, and 0.027 W/m.K, respectively. The data given in Problem 2 may also be used. (25%)

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