

(1) 請繪圖說明一理想蒸氣-壓縮冷凍循環 (the ideal vapor-compression refrigeration cycle) 的基本原理和主要構件, 並繪 T-s 圖說明循環內工作介質之熱力特性變化。請定義並說明此一冷凍循環的 COP 值 (Coefficient of performance), 若考慮將其作為熱泵 (heat pump), 則其對應的 COP 值為何? (25%)

(2) 右圖顯示一般冷却水塔的構造示意, 請說明其基本原理。圖中 T, m, ω 分別代表溫度、質量流率和濕度比 (humidity ratio); 下標 a, w, v 分別代表乾空氣、水和水蒸氣, 而 1, 2, 3, 4, 5 分別對應圖中所示的各個位置。根據質量守恆得知

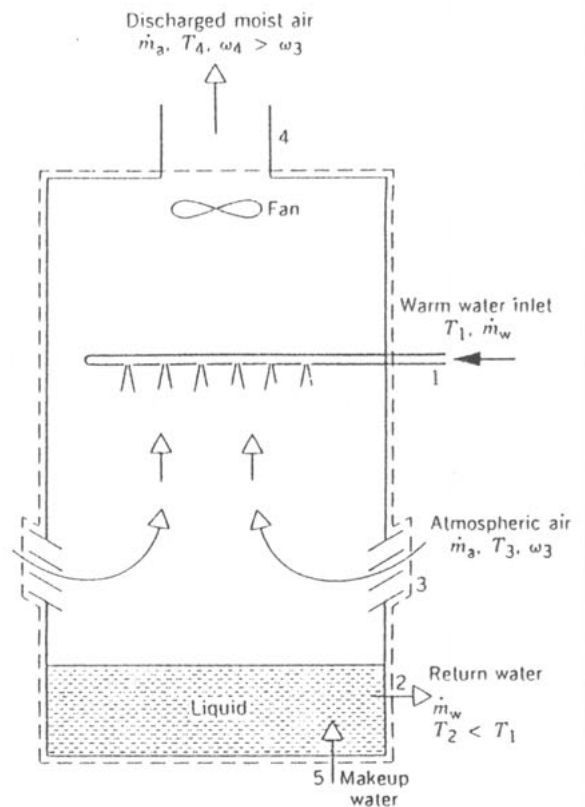
$$\dot{m}_a = \dot{m}_{a3} = \dot{m}_{a4}$$

$$\dot{m}_w = \dot{m}_{w1} = \dot{m}_{w2}$$

$$\text{且 } \dot{m}_{w1} + \dot{m}_{w5} + \dot{m}_{v3} = \dot{m}_{w2} + \dot{m}_{v4}$$

試寫出能量平衡方程式, 並求得 \dot{m}_a 表示式。

(25%)



(背面仍有題目, 請繼續作答)

3. Answer as indicated:

- (a) List three similarities between heat and work. (6%)
- (b) During a phase change process of a pure substance, its entropy and temperature remain unchanged. True or False? Why? (4%)
- (c) From a viewpoint of thermal- fluid science, give a practical interpretation for the second law of thermodynamics. (10%)

4. Air at 27°C is contained in a rigid tank, which is placed on an electric burner. The sides and top of the tank is insulated while the bottom allows free heat transfer. A thermometer is inserted into this device to record the temperature while the air is heated. After 20 minutes, it was found that the air temperature inside the tank was 138°C and the amount of electric energy required to heated up the air was 1.0 Watt-hour. Determine C_v and c_v for the air. Assume the mass of air contained is 0.045 kg. (30%)