

國立臺北科技大學九十七學年度碩士班招生考試

系所組別：1410 能源與冷凍空調工程系碩士班甲組

第二節 冷凍空調原理 試題

填准考證號碼

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第一頁 共二頁

注意事項：

1. 本試題共 5 題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. A meeting hall is to be maintained at 25°C db and 18°C wb. The barometric pressure is 101.3 kPa. The space has a load of 50 kW sensible and 50 kW latent. The temperature of supply air cannot be lower than 18°C db. (30%)

- (1) How many kilograms per second of air must be supplied?
- (2) What is the required wet bulb temperature of the supply air?
- (3) What is the sensible heat ratio?

2. How many people could occupy a room where the concentration level of CO₂ is to be kept below 900 ppm if air with a concentration of 300 ppm CO₂ is being supplied to the room at the rate of 2.0 m³/s? Assume that each person is producing CO₂ at the average rate of 5.0 mL/s and that the incoming air is completely mixed with the room air. (10%)

3. The flow rate, head, and shaft power are related to the new and old speeds. They may be stated as equation (1). What is the value of the exponent a, b, c in equation (1) and explain the reasons? (10%)

$$\begin{aligned} \dot{Q}_n &= \dot{Q}_0 \left[\frac{rpm_n}{rpm_0} \right]^a \\ \dot{H}_n &= \dot{H}_0 \left[\frac{rpm_n}{rpm_0} \right]^b \dots\dots\dots(1) \\ \dot{W}_n &= \dot{W}_0 \left[\frac{rpm_n}{rpm_0} \right]^c \end{aligned}$$

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4. What is the volumetric efficiency of an eight-cylinder Vilter 458XL ammonia compressor operating at 1152 rpm when the saturated suction temperature is 0°C and the condensing temperature is 40°C? The bore and stroke of the compressor are 114 by 114mm. The catalog lists the refrigerating capacity at this condition as 576 kW.(20%)

5. A two-stage ammonia system using flash-gas removal and intercooling operates on the cycle shown in Fig. 2. The condensing temperature is 40°C. The saturation temperature of the intermediate-temperature evaporator is 0°C. The saturation temperature of the low-temperature evaporator is -40°C, and its capacity is 100 kW. Calculate the power required by the compressors, the heat rejection of condenser and COP of the system? Assume that refrigerant enters the low-stage and high-stage compressors as saturated vapor and leaves condenser without subcooling. (30%)

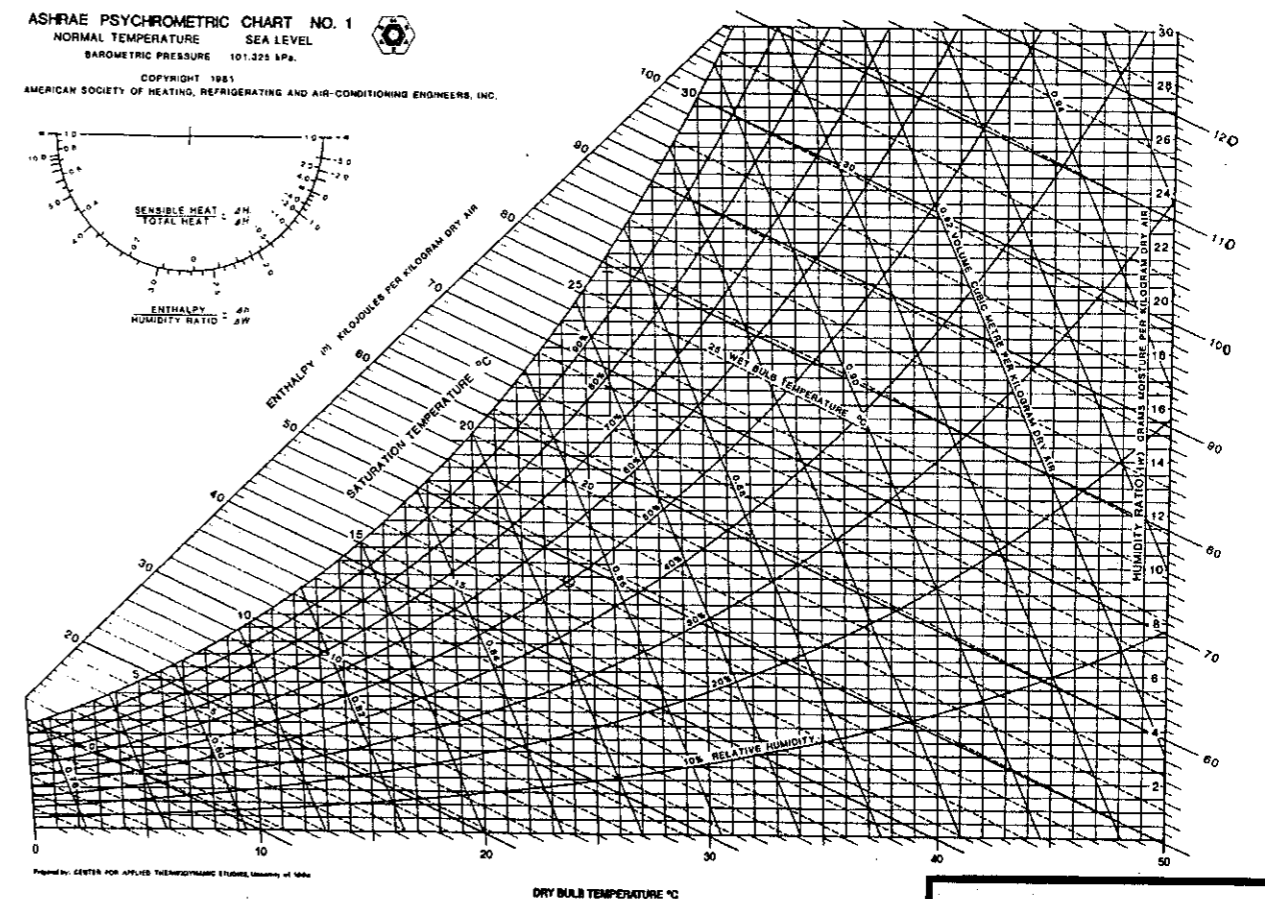


Figure 1. Psychrometric chart at sea level

注意：背面尚有試題

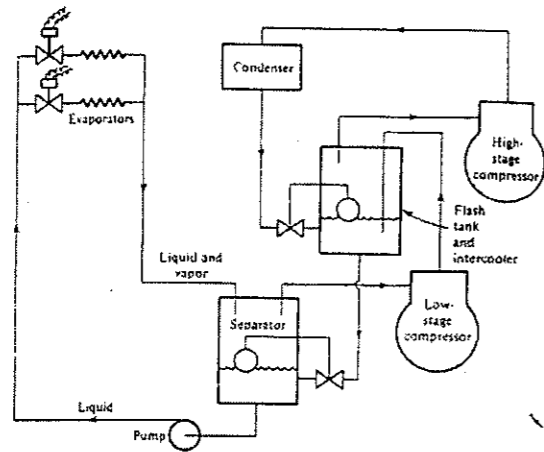


Figure 2 Two-stage compressors and two evaporators operating with intercooling and flash-gas removal

Table 1 Properties of ammonia saturated liquid and vapor

Temp [C]	Pressure [MPa]	Volume (f) [m ³ /kg]	Volume (g) [m ³ /kg]	Enthalpy (f) [kJ/kg]	Enthalpy (g) [kJ/kg]	Entropy (f) [kJ/K-kg]	Entropy (g) [kJ/K-kg]
-40	0.0717	0.00145	1.55300	0.00	1389	0.0000	5.96
-35	0.0931	0.00146	1.21700	22.15	1397	0.0939	5.87
-30	0.1194	0.00148	0.96400	44.43	1404	0.1863	5.78
-20	0.1901	0.00150	0.62370	89.38	1419	0.3670	5.62
-15	0.2362	0.00152	0.50870	112.00	1425	0.4554	5.54
-10	0.2907	0.00153	0.41830	134.80	1432	0.5425	5.47
-5	0.3548	0.00155	0.34660	157.80	1437	0.6285	5.40
0	0.4294	0.00157	0.28930	180.80	1443	0.7133	5.33
5	0.5157	0.00158	0.24300	204.00	1448	0.7970	5.27
10	0.6150	0.00160	0.20540	227.40	1453	0.8796	5.21
15	0.7285	0.00162	0.17460	250.90	1457	0.9613	5.15
20	0.8575	0.00164	0.14920	274.60	1461	1.0420	5.09
30	1.1670	0.00168	0.11050	322.60	1467	1.2010	4.98
35	1.3510	0.00170	0.09563	346.90	1469	1.2800	4.92
40	1.5550	0.00173	0.08310	371.50	1471	1.3580	4.87

Table 2 Properties of superheated ammonia			
Saturation = 0°C, p= 0.4294MPa			
Temp [C]	Volume [m ³ /kg]	Enthalpy [kJ/kg]	Entropy [kJ/K-kg]
75	0.3860	1624	5.922
76	0.3872	1627	5.929
77	0.3884	1629	5.935
78	0.3896	1631	5.942
79	0.3908	1633	5.948
80	0.3921	1636	5.955
81	0.3933	1638	5.961
82	0.3945	1640	5.968
83	0.3957	1643	5.974
84	0.3969	1645	5.981
85	0.3981	1647	5.987

Table 3 Properties of superheated ammonia			
Saturation = 40°C, p=1.5554MPa			
Temp [C]	Volume [m ³ /kg]	Enthalpy [kJ/kg]	Entropy [kJ/K-kg]
90	0.1048	1620	5.311
91	0.1052	1622	5.318
92	0.1056	1625	5.325
93	0.1060	1628	5.333
94	0.1064	1630	5.340
95	0.1068	1633	5.347
96	0.1072	1636	5.354
97	0.1075	1638	5.362
98	0.1079	1641	5.369
99	0.1083	1644	5.376
100	0.1087	1646	5.383
101	0.1091	1649	5.390
102	0.1095	1651	5.397