

國立成功大學

112學年度碩士班招生考試試題

編 號： 121

系 所： 工程科學系

科 目： 熱力學

日 期： 0207

節 次： 第 1 節

備 註： 可使用計算機

※ 考生請注意：本試題可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

第 1 至 5 題為選擇題及繪圖題。

1. As Fig. 1, an insulated piston-cylinder device contains 0.01 m^3 of saturated liquid water at a constant pressure of 450 kPa. Water is stirred by a paddle wheel while a voltage of 240 volt flows for 60 min through a resistor placed in the water. If 75% of the liquid is evaporated during this constant-pressure process and the paddle-wheel work amounts to 5000 kJ. Determine (20%)
 - (1) the mass of water (kg) (a) 5.1, (b) 10.2, (c) 7.8, (d) 12.5, (e) 9.2, (f) 8.5.
 - (2) the final enthalpy (h_2 , kJ/kg) (a) 2213, (b) 2506, (c) 2005, (d) 2897, (e) 2317, (f) 2135.
 - (3) the current of the source (A) (a) 7.2, (b) 9.3, (c) 10.5, (d) 11.2, (e) 12.5, (f) 13.6.
 - (4) Show the process on a P - v diagram with respect to saturation lines.

2. As Fig. 2, air is contained in a cylinder device fitted with a piston-cylinder. The piston initially rests on a set of stops, and a pressure of 250 kPa is required to move the piston. Initially, the air is at 150 kPa and 27°C and occupies a volume of 0.5 m^3 . The final temperature of this device is 700K. Assume air has constant specific heats evaluated at 300K. The properties of air are $R = 0.287 \text{ kJ/kg}\cdot\text{K}$ and $c_v = 0.718 \text{ kJ/kg}\cdot\text{K}$. Determine (20%)
 - (1) the mass of air (kg) (a) 1.01 (b) 0.96, (c) 0.87, (d) 0.75, (e) 0.65 (f) 0.52.
 - (2) the temperature of state 2 (K) (a) 450, (b) 500, (c) 550, (d) 600, (e) 625, (f) 650
 - (3) the boundary work (kJ) (a) 72.1, (b) 65.3, (c) 60.5, (d) 58.2, (e) 53.5, (f) 49.9.
 - (4) the amount of heat transferred to the air (kJ) (a) 300, (b) 325, (c) 350, (d) 375, (e) 400, (f) 425.

3. As Fig. 3, an insulated 2 m^3 rigid tank contains R-134a at 1 MPa and 40°C . A valve connected to the tank is now opened, and R-134a is allowed to escape until the pressure inside drops to 200 kPa. The R-134a temperature during this process is maintained constant by an electric resistance heater placed in the tank. Assumption the R-134a is ideal gas. The property of R-134a is $R = 0.0815 \text{ kJ/kg}\cdot\text{K}$. Determine (20%)
 - (1) the electrical work done during this process (kJ)
 - (a) 1160, (b) 1280, (c) 1340, (d) 1420, (e) 1510, (f) 1600.
 - (2) If the resistance heater is out of order. The final mass of R-134a is $m_2 = m_1/4.5$. Find the final temperature in the tank ($^\circ\text{C}$).
 - (a) 0, (b) 3, (c) 6, (d) 9, (e) 12, (f) 15.

4. As Fig. 4, saturated liquid-vapor mixture of water, called wet steam, in a steam line at 575 kPa is throttled to 100 kPa and 100°C . Determine (20%)
 - (1) the enthalpy of state 2 (h_2 , kJ/kg) (a) 2506, (b) 2606, (c) 2676, (d) 2720, (e) 2800
 - (2) the quality of state 1 (x_1 , %)? (a) 90.2, (b) 91.6, (c) 92.9, (d) 94.0, (e) 95.1, (f) 96.3.

5. As Fig. 5, R-134a enters an adiabatic compressor as saturated vapor at 100 kPa at a rate of $6 \text{ m}^3/\text{min}$ and exit at 1.0 MPa pressure. If the isentropic efficiency of the compressor is 75%. Determine (20%)
 - (1) the isentropic enthalpy of state 2 (h_{2s} , kJ/kg) (a) 323, (b) 313, (c) 303, (d) 293, (e) 283, (f) 273.
 - (2) the actual enthalpy of state 2 (h_{2a} , kJ/kg) (a) 277, (b) 288, (c) 299, (d) 311, (e) 322, (f) 333.
 - (3) the temperature of exit (T_{2a} , $^\circ\text{C}$) (a) 52.1, (b) 55.4, (c) 58.8, (d) 61.5, (e) 63.2, (f) 65.3.
 - (4) the power input (\dot{W}_{in} , kW) (a) 35.2, (b) 33.6, (c) 31.2, (d) 29.8, (e) 27.5, (f) 25.3.

Figures and Tables

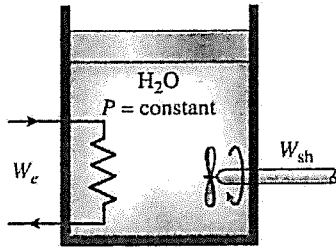


Fig. 1

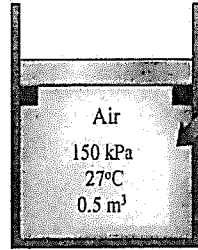


Fig. 2

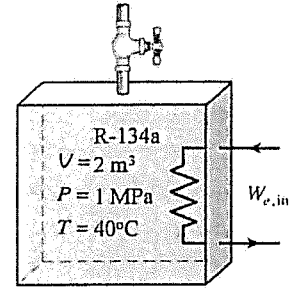
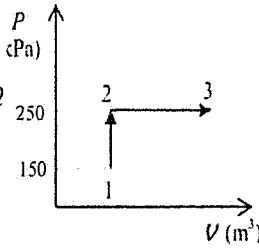


Fig. 3

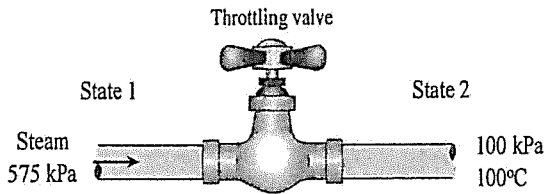


Fig. 4

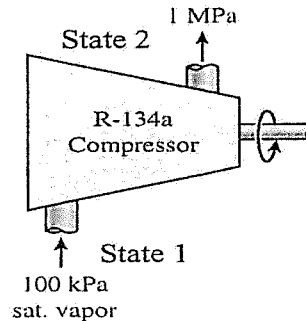


Fig. 5

TABLE A-5

Saturated water—Pressure table

Press., P kPa	Sat. temp., T _{sat} °C	Specific volume, m ³ /kg		Internal energy, kJ/kg			Enthalpy, kJ/kg		
		Sat. liquid, v _f	Sat. vapor, v _g	Sat. liquid, u _f	Evap., u _{fg}	Sat. vapor, u _g	Sat. liquid, h _f	Evap., h _{fg}	Sat. vapor, h _g
100	99.61	0.001043	1.6941	417.40	2088.2	2505.6	417.51	2257.5	2675.0
125	105.97	0.001048	1.3750	444.23	2068.8	2513.0	444.36	2240.6	2684.9
150	111.35	0.001053	1.1594	466.97	2052.3	2519.2	467.13	2226.0	2693.1
200	120.21	0.001061	0.88578	504.50	2024.6	2529.1	504.71	2201.6	2706.3
250	127.41	0.001067	0.71873	535.08	2001.8	2536.8	535.35	2181.2	2716.5
300	133.52	0.001073	0.60582	561.11	1982.1	2543.2	561.43	2163.5	2724.9
400	143.61	0.001084	0.46242	604.22	1948.9	2553.1	604.66	2133.4	2738.1
450	147.90	0.001088	0.41392	622.65	1934.5	2557.1	623.14	2120.3	2743.4
500	151.83	0.001093	0.37483	639.54	1921.2	2560.7	640.09	2108.0	2748.1
550	155.46	0.001097	0.34261	655.16	1908.8	2563.9	655.77	2096.6	2752.4
600	158.83	0.001101	0.31560	669.72	1897.1	2566.8	670.38	2085.8	2756.2

TABLE A-6

Superheated water

T °C	v m ³ /kg	u kJ/kg	h kJ/kg	s kJ/kg·K
P = 0.10 MPa (99.61°C)				
Sat. [†]	1.6941	2505.6	2675.0	7.3589
100	1.6959	2506.2	2675.8	7.3611
150	1.9367	2582.9	2776.6	7.6148
200	2.1724	2658.2	2875.5	7.8356
250	2.4062	2733.9	2974.5	8.0346
300	2.6389	2810.7	3074.5	8.2172
400	3.1027	2968.3	3278.6	8.5452
500	3.5655	3132.2	3488.7	8.8362
600	4.0279	3302.8	3705.6	9.0999

TABLE A-12

Saturated refrigerant-134a—Pressure table

Press., P kPa	Sat. temp., T _{sat} °C	Specific volume, m ³ /kg		Internal energy, kJ/kg			Enthalpy, kJ/kg			Entropy, kJ/kg·K		
		Sat. liquid, v _f	Sat. vapor, v _g	Sat. liquid, u _f	Evap., u _{fg}	Sat. vapor, u _g	Sat. liquid, h _f	Evap., h _{fg}	Sat. vapor, h _g	Sat. liquid, s _f	Evap., s _{fg}	Sat. vapor, s _g
80	-31.13	0.0007184	0.23749	11.14	201.33	212.48	11.20	220.27	231.47	0.04707	0.91009	0.95716
90	-28.65	0.0007222	0.21261	14.30	199.60	213.90	14.36	218.67	233.04	0.06003	0.89431	0.95434
100	-26.37	0.0007258	0.19255	17.19	198.01	215.21	17.27	217.19	234.46	0.07182	0.88008	0.95191
120	-22.32	0.0007323	0.16216	22.38	195.15	217.53	22.47	214.52	236.99	0.09269	0.85520	0.94789
400	8.91	0.0007905	0.051266	63.61	171.49	235.10	63.92	191.68	255.61	0.24757	0.67954	0.92711
450	12.46	0.0007983	0.045677	68.44	168.58	237.03	68.80	188.78	257.58	0.26462	0.66093	0.92555
500	15.71	0.0008058	0.041168	72.92	165.86	238.77	73.32	186.04	259.36	0.28021	0.64399	0.92420
550	18.73	0.0008129	0.037452	77.09	163.29	240.38	77.54	183.44	260.98	0.29460	0.62842	0.92302
600	21.55	0.0008198	0.034335	81.01	160.84	241.86	81.50	180.95	262.46	0.30799	0.61398	0.92196

TABLE A-13

Superheated refrigerant-134a (Concluded)

T °C	v m ³ /kg	u kJ/kg	h kJ/kg	s kJ/kg·K
P = 1.00 MPa (T _{sat} = 39.37°C)				
Sat.	0.020319	250.71	271.04	0.9157
40	0.020406	251.32	271.73	0.9180
50	0.021796	260.96	282.76	0.9526
60	0.023068	270.33	293.40	0.9851
70	0.024261	279.61	303.87	1.0160
80	0.025398	288.87	314.27	1.0459
90	0.026492	298.17	324.66	1.0749
100	0.027552	307.52	335.08	1.1032