

八十四學年度核子工程物理所 組碩士班研究生入學考試

科目 工程熱力學 科號 3303 共 5 頁第 1 頁 *請在試卷【答案卷】內作答

- Superheated steam originally at 10 atm and 250°C expands through a nozzle to an exhaust pressure of 2 atm, when the equilibrium is attained and neglect the kinetic energy and the potential energy.
 - If the process is adiabatic and reversible, what is the temperature of the steam at the nozzle exit? If it is in saturated state, also write down the quality of the steam exit of the nozzle. (10%)
 - If the process is adiabatic, what is the temperature of the steam at the nozzle exit? If it is in saturated state, also write down the quality of the steam exit of the nozzle. (10%)

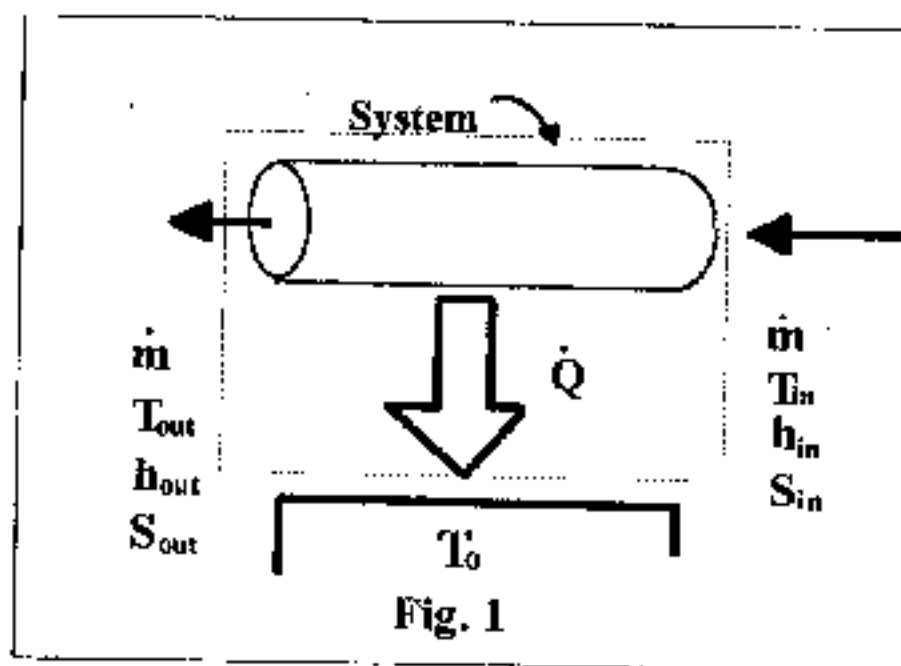
- Show that any flow of heat between two heat reservoirs at temperature T_H and T_C , where $T_H > T_C$, must be from the hotter to the cooler reservoir. (10%)

- Consider the steady flow of a two-phase mixture through a duct in thermal contact with a heat reservoir of temperature T_0 . (Fig. 1)

Assume:

- it is steady-state, steady-flow
- both the inlet and outlet are two-phase mixture

- please draw the T-S diagram from inlet state to outlet state, and mark the "in" as the inlet state, "out" as the outlet state. (10%)
- if state "a" represents the outlet state (out) in the theoretical limit of zero pressure drop, where the thermo properties of state "a" are S_a, h_a, T_a , please draw the line from state "a" to "out" state (5%) also remarks the line is in isothermal? Isoentropic? Isobaric? Isochoric or isoenthalpy? (5%)
- derive the total entropy generation rate \dot{S}_{gen} as function of $\dot{Q}, T_0, T_{in}, \dot{m}, S_{out}$ and S_a (15%)



八十四學年度 銜工務工程物理所 組碩士班研究生入學考試

科目 工程熱力學 科號 $\frac{3303}{33,2}$ 共 5 頁第 2 頁 *請在試卷【答案卷】內作答

4. Please give the three methods to increase the Ran Kine Cycle efficiency? (6%), for which is the best way to increase the efficiency (2%) and why (2%)
5. Air in a closed system undergoes a cycle composed of the following three reversible process: (1) a constant-pressure expansion from 80 kPa, 10⁰C, to 90⁰C, (2) a constant-volume cooling to 10⁰C, and (3) an isothermal compression to 80 kPa.

Assume Air is an ideal gas and $C_{v(\text{air})} = 0.7165 \text{ KJ/Kg, } ^{\circ}\text{K}$

$$R = 8.314 \text{ KJ/Kmole, } ^{\circ}\text{K}$$

$$M_{(\text{air})} = 28.96 \text{ Kg/Kmole}$$

determine:

- (a) please draw the P-V diagram (5%)
- (b) the heat transfer per kilogram of air for each process (9%)
- (c) the thermal efficiency of the cycle. (5%)
- (d) the heat transfer for each process when air undergoes this cycle in reverse. (6%)

組碩士班研究生入學考試

八十四學年度 校子工程及工程物理所

科目 工程熱力學 科號 3303 共 5 頁第 3 頁 *請在試卷【答案卷】內作答

TABLE A.1.25I Saturated Steam: Pressure Table (SI Units)

Press. kPa P	Temp. °C T	Specific Volume		Internal Energy			Enthalpy			Entropy		
		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
0.100	99.63	0.001 043	1.6940	417.36	2088.7	2506.1	417.46	2258.0	2675.5	1.3026	6.0568	7.3594
0.125	105.99	0.001 048	1.3745	444.19	2069.3	2513.5	444.32	2241.0	2685.4	1.3740	5.9104	7.2844
0.150	111.37	0.001 053	1.1593	466.94	2052.7	2519.7	467.11	2226.5	2693.6	1.4336	5.7897	7.2233
0.175	116.06	0.001 057	1.0036	486.80	2038.1	2524.9	486.99	2213.6	2700.6	1.4849	5.6868	7.1717
0.200	120.23	0.001 061	0.8857	504.49	2025.0	2529.5	504.70	2201.9	2706.7	1.5301	5.5970	7.1271
0.225	124.00	0.001 064	0.7933	520.47	2013.1	2533.6	520.72	2191.3	2712.1	1.5706	5.5173	7.0878
0.250	127.44	0.001 067	0.7187	535.10	2002.1	2537.2	535.37	2181.5	2716.9	1.6072	5.4455	7.0527
0.275	130.60	0.001 070	0.6573	548.59	1991.9	2540.5	548.89	2172.4	2721.3	1.6408	5.3801	7.0209
0.300	133.55	0.001 073	0.6058	561.15	1982.4	2543.6	561.47	2163.8	2725.3	1.6718	5.3201	6.9919
0.325	136.30	0.001 076	0.5620	572.90	1973.5	2546.4	573.25	2155.8	2729.0	1.7006	5.2646	6.9652
0.350	138.88	0.001 079	0.5243	583.95	1965.0	2548.9	584.33	2148.1	2732.4	1.7275	5.2130	6.9405
0.375	141.32	0.001 081	0.4914	594.40	1956.9	2551.3	594.81	2140.8	2735.6	1.7528	5.1647	6.9175
0.40	143.63	0.001 084	0.4625	604.31	1949.3	2553.6	604.74	2133.8	2738.6	1.7766	5.1193	6.8959
0.45	147.93	0.001 088	0.4140	622.77	1934.9	2557.6	623.25	2120.7	2743.9	1.8207	5.0359	6.8565
0.50	151.86	0.001 093	0.3749	639.68	1921.6	2561.2	640.23	2108.5	2748.7	1.8607	4.9606	6.8213
0.55	155.48	0.001 097	0.3427	655.32	1909.2	2564.5	655.93	2097.0	2753.0	1.8973	4.8920	6.7893
0.60	158.85	0.001 101	0.3157	669.90	1897.5	2567.4	670.56	2086.3	2756.8	1.9312	4.8288	6.7600
0.65	162.01	0.001 104	0.2927	683.56	1886.5	2570.1	684.28	2076.0	2760.3	1.9627	4.7703	6.7331
0.70	164.97	0.001 108	0.2729	696.44	1876.1	2572.5	697.22	2066.3	2763.5	1.9922	4.7158	6.7080
0.75	167.78	0.001 112	0.2556	708.64	1866.1	2574.7	709.47	2057.0	2766.4	2.0200	4.6647	6.6847
0.80	170.43	0.001 115	0.2404	720.22	1856.6	2576.8	721.11	2048.0	2769.1	2.0462	4.6166	6.6628
0.85	172.96	0.001 118	0.2270	731.27	1847.4	2578.7	732.22	2039.4	2771.6	2.0710	4.5711	6.6421
0.90	175.38	0.001 121	0.2150	741.83	1838.6	2580.5	742.83	2031.1	2773.9	2.0946	4.5280	6.6226
0.95	177.69	0.001 124	0.2042	751.95	1830.2	2582.1	753.02	2023.1	2776.1	2.1172	4.4869	6.6041
1.00	179.91	0.001 127	0.1944	761.68	1822.0	2583.6	762.81	2015.3	2778.1	2.1387	4.4478	6.5865
1.10	184.09	0.001 133	0.17753	780.09	1806.3	2586.4	781.34	2000.4	2781.7	2.1792	4.3744	6.5536
1.20	187.99	0.001 139	0.16333	797.29	1791.5	2588.8	798.65	1986.2	2784.8	2.2166	4.3067	6.5233
1.30	191.64	0.001 144	0.15125	813.44	1777.5	2591.0	814.93	1972.7	2787.6	2.2515	4.2438	6.4953
1.40	195.07	0.001 149	0.14084	828.70	1764.1	2592.8	830.30	1959.7	2790.0	2.2842	4.1850	6.4693
1.50	198.32	0.001 154	0.13177	843.16	1751.3	2594.5	844.69	1947.3	2792.2	2.3150	4.1298	6.4448
1.75	205.76	0.001 166	0.11349	876.46	1721.4	2597.8	878.50	1917.9	2796.4	2.3851	4.0064	6.3896
2.00	212.42	0.001 177	0.09963	906.44	1693.8	2600.3	908.79	1890.7	2799.5	2.4474	3.8935	6.3409
2.25	218.45	0.001 187	0.08875	933.83	1668.2	2602.0	936.49	1865.7	2801.7	2.5035	3.7937	6.2972
2.5	223.99	0.001 197	0.07998	959.11	1644.0	2603.1	962.11	1841.0	2803.1	2.5547	3.7028	6.2575
3.0	233.90	0.001 217	0.06668	1004.78	1599.3	2604.1	1008.42	1795.7	2804.2	2.6457	3.5412	6.1869

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組碩士班研究生入學考試

八十四學年度 機子工機与工務物理所

科目 工程熱力學 科號 3303 共 5 頁第 4 頁 *請在試卷【答案卷】內作答

TABLE A.1.3SI Superheated Vapor (SI Units)

T	P = 0.10 MPa (45.81)					P = 0.50 MPa (81.33)					P = 1.0 MPa (99.63)				
	v	u	h	s		v	u	h	s		v	u	h	s	
Sat.	14.674	2437.9	2584.7	8.1502		3.240	2483.9	2645.9	7.5939		1.6940	2506.1	2675.5	7.3594	
50	14.869	2443.9	2592.6	8.1749											
100	17.196	2515.5	2687.5	8.4479		3.418	2511.6	2682.5	7.6947		1.6958	2506.7	2676.2	7.3614	
150	19.512	2587.9	2781.0	8.6882		3.889	2585.6	2780.1	7.9401		1.9364	2582.8	2776.4	7.6134	
200	21.825	2661.3	2879.5	8.9038		4.356	2659.9	2877.7	8.1580		2.172	2658.1	2875.3	7.8343	
250	24.136	2736.0	2977.3	9.1002		4.820	2735.0	2976.0	8.3556		2.406	2733.7	2974.3	8.0333	
300	26.445	2812.1	3076.5	9.2813		5.284	2811.3	3075.5	8.5373		2.639	2810.4	3074.3	8.2158	
400	31.063	2968.9	3279.6	9.6077		6.209	2968.5	3278.9	8.8642		3.101	2967.9	3278.2	8.5435	
500	35.679	3132.3	3489.1	9.8978		7.134	3132.0	3488.7	9.1546		3.565	3131.6	3488.1	8.8342	
600	40.295	3302.5	3705.4	10.1608		8.057	3302.2	3705.1	9.4178		4.028	3301.9	3704.7	9.0976	
700	44.911	3479.6	3928.7	10.4028		8.981	3479.4	3928.5	9.6599		4.490	3479.2	3928.2	9.3398	
800	49.526	3663.8	4159.0	10.6281		9.904	3663.6	4158.9	9.8852		4.952	3663.5	4158.6	9.5652	
900	54.141	3855.0	4396.4	10.8396		10.828	3854.9	4396.3	10.0967		5.414	3854.8	4396.1	9.7767	
1000	58.757	4053.0	4640.6	11.0393		11.751	4052.9	4640.5	10.2964		5.875	4052.8	4640.3	9.9764	
1100	63.372	4257.5	4891.2	11.2287		12.674	4257.4	4891.1	10.4859		6.337	4257.3	4891.0	10.1659	
1200	67.987	4467.9	5147.8	11.4091		13.597	4467.8	5147.7	10.6662		6.799	4467.7	5147.6	10.3463	
1300	72.602	4683.7	5409.7	11.5811		14.521	4683.6	5409.6	10.8382		7.260	4683.5	5409.5	10.5183	
P = 2.0 MPa (190.23)															
Sat.	8.857	2579.5	2706.7	7.1272		6.058	2543.6	2725.3	6.9919		4.625	2553.6	2738.6	6.8959	
150	9.996	2576.9	2768.8	7.2795		6.339	2570.8	2761.0	7.0778		4.708	2564.5	2752.8	6.9299	
200	1.0803	2654.4	2870.5	7.5066		7.163	2630.7	2865.6	7.3115		5.342	2646.8	2860.5	7.1706	
250	1.1988	2731.2	2971.0	7.7086		7.964	2728.7	2967.6	7.5166		5.951	2726.1	2964.2	7.3789	
300	1.3162	2808.6	3071.8	7.8926		8.753	2806.7	3069.3	7.7022		6.548	2804.8	3066.8	7.5662	
400	1.5493	2966.7	3276.6	8.2218		1.0315	2965.6	3275.0	8.0330		7.726	2964.4	3273.4	7.8985	
P = 3.0 MPa (133.55)															
P = 4.0 MPa (143.63)															

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八十四學年度 機械工程研究所 組碩士班研究生入學考試

科目 工程熱力學 科號 3303 共 5 頁第 5 頁 *請在試卷【答案卷】內作答

TABLE A.1.351 (Continued) Saturated Vapor (SI Units)

T	P = 1.00 MPa (179.91)					P = 1.20 MPa (187.99)					P = 1.40 MPa (198.07)				
	r	v	u	h	s	r	v	u	h	s	r	v	u	h	s
Sat.	194.44	2583.6	2778.1	6.5865	163.33	2588.8	2784.8	6.5233	140.84	2592.8	2790.0	6.4693			
200	2060	2621.9	2827.9	6.6944	169.30	2612.8	2815.9	6.5898	143.02	2603.1	2803.3	6.4975			
250	2327	2709.9	2942.6	6.9247	192.34	2704.2	2935.0	6.8294	163.50	2698.3	2927.2	6.7467			
300	2579	2793.2	3051.2	7.1229	2138	2789.2	3045.8	7.0317	182.28	2785.2	3040.4	6.9534			
350	2825	2875.2	3157.7	7.3011	2345	2872.2	3153.6	7.2121	2003	2869.2	3149.5	7.1360			
400	3066	2957.3	3263.9	7.4651	2548	2954.9	3260.7	7.3774	2178	2952.5	3257.5	7.3026			
500	3541	3134.4	3478.5	7.7622	2946	3122.8	3476.3	7.6759	2521	3121.1	3474.1	7.6027			
600	4011	3296.8	3697.9	8.0290	3339	3295.6	3696.3	7.9435	2860	3294.4	3694.8	7.8710			
700	4478	3475.3	3923.1	8.2731	3729	3474.4	3922.0	8.1881	3195	3473.6	3920.8	8.1160			
800	4943	3660.4	4154.7	8.4996	4118	3659.7	4153.8	8.4148	3528	3659.0	4153.0	8.3431			
900	5407	3852.2	4392.9	8.7118	4505	3851.6	4392.2	8.6272	3861	3851.1	4391.5	8.5556			
1000	5871	4050.5	4637.6	8.9119	4892	4050.0	4637.0	8.8274	4192	4049.5	4636.4	8.7559			
1100	6335	4255.1	4888.6	9.1017	5278	4254.6	4888.0	9.0172	4524	4254.1	4887.5	8.9457			
1200	6798	4465.6	5145.4	9.2822	5665	4465.1	5144.9	9.1977	4855	4464.7	5144.4	9.1262			
1300	7261	4681.3	5407.4	9.4543	6051	4680.9	5407.0	9.3698	5186	4680.4	5406.5	9.2984			

P = 1.60 MPa (201.41)					P = 1.80 MPa (207.15)					P = 2.00 MPa (212.42)				
Sat.	123.80	2596.0	2794.0	6.4218	110.42	2598.4	2797.1	6.3794	89.63	2600.3	2799.5	6.3409		
225	132.87	2644.7	2857.3	6.5518	116.73	2636.6	2846.7	6.4808	103.77	2628.3	2835.8	6.4147		
250	141.84	2692.3	2919.2	6.6732	124.97	2686.0	2911.0	6.6066	111.44	2679.6	2902.5	6.5453		
300	158.62	2781.1	3034.8	6.8844	140.21	2776.9	3029.2	6.8226	125.47	2772.6	3023.5	6.7664		
350	174.56	2866.1	3145.4	7.0694	154.57	2863.0	3141.2	7.0100	138.57	2859.8	3137.0	6.9563		
400	190.05	2950.1	3254.2	7.2374	168.47	2947.7	3250.9	7.1794	151.20	2945.2	3247.6	7.1271		
500	2203	3119.5	3472.0	7.5190	195.50	3117.9	3469.8	7.4825	175.68	3116.2	3467.6	7.4315		
600	2500	3293.3	3693.2	7.8080	2220	3292.3	3691.7	7.7523	199.60	3290.9	3690.1	7.7024		
700	2794	3472.7	3919.7	8.0555	2482	3471.8	3918.5	7.9983	2232	3470.9	3917.4	7.9487		

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