$\bar{R}$=8.314 kJ/kmol·K, M_{air}=28.97 kg/kmol, T(K)=T(°C) + 273.15

1. A rigid and closed cylinder of length L and diameter d contains a two-phase mixture of quality x_1 at pressure T_1, where the specific volume of water is v_1. A heat transfer Q from the surrounding to the cylinder occurs during a thermodynamic process of the water in the cylinder. Only saturated water vapor of mass m is found after the thermodynamic process. Please finish the following table. [第(1)~(3)格每格 10 分，共 30 分]

L (m)	D (m)	x_1	T_1 (K)	v_1 (m^3/kg)	m (kg)	Q (kJ)
2	0.798	0.6836	393.35	(1)	(2)	(3)

2. The net power output of an ideal Rankine cycle with steam flowrate $\dot{m}$ is $\dot{W}$, where the thermal efficiency is η, Figure 1. The back work ratio of the cycle is bwr and the quality of steam exiting the turbine is x_2. The pressure of saturated vapor is p_1 before water entering the turbine, while the condenser operates at pressure p_2. Please finish the following table. [第(4)格 5 分，第(5)~(7)格每格 10 分，共 35 分]

$\dot{W}$(MW)	p_1 (MPa)	p_2 (kPa)	x_2	η	$\dot{m}$(kg/h)	bwr
100	8	80	(4)	(5)	(6)	(7)

3. The net power developed by an ideal air-standard Brayton cycle with volumetric flowrate $\dot{V}$ is $\dot{W}$, where the thermal efficiency is η and the back work ratio of the cycle is bwr, Figure 2. The mass flowrate of air is $\dot{m}$. The temperature of air before entering the heat exchanger is T_2, and the temperature of air leaving the heat exchanger is T_3. A compression ratio of γ is designed for the compressor, where air enters the compressor at pressure p_1. Please finish the following table. [第(8)格 5 分，第(9)~(11)格每格 10 分，共 35 分]

T_2 (°C)	T_3 (°C)	$\dot{V}$(m^3/min)	γ	p_1 (bar)	bwr	η	$\dot{m}$(kg/h)	$\dot{W}$(kW)
302.256	726.850	6	8.5	1	(8)	(9)	(10)	(11)

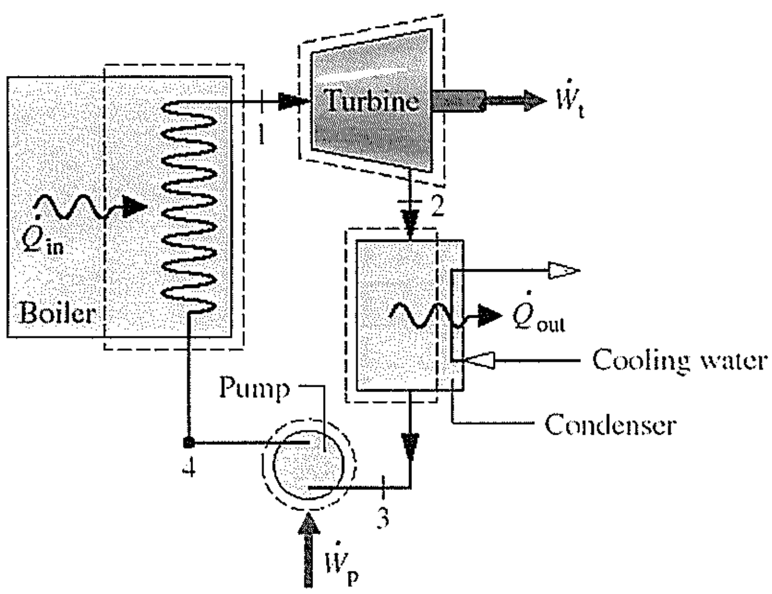

Figure 1: Ideal Rankine Cycle

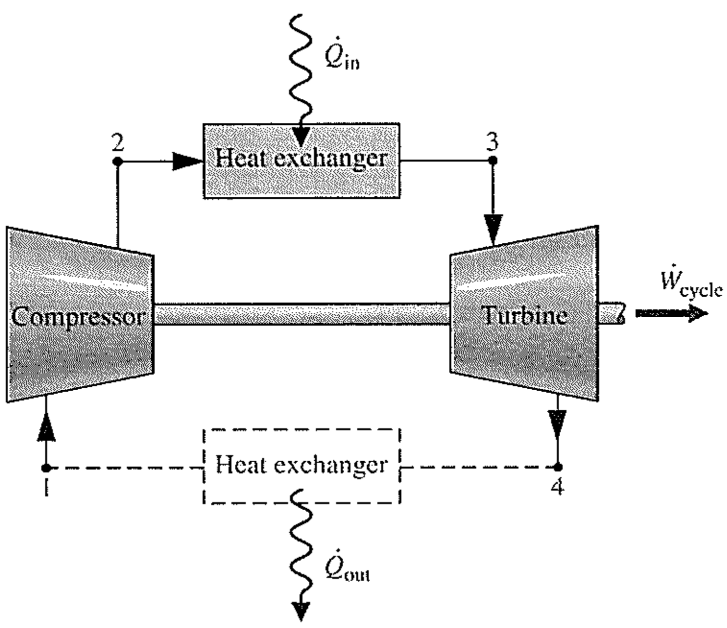

Figure 2: Ideal Brayton Cycle

見背面

Properties of Saturated Water (Liquid-Vapor):

Pressure (Bar) p	Temp. (°C) T	Specific Volume (m^3/kg) Sat. Liquid $v_f \times 10^3$	Sat. Vapor v_g	Internal Energy (kJ/kg) Sat. Liquid u_f	Sat. Vapor u_g	Enthalpy (kJ/kg) Sat. Liquid h_f	Sat. Vapor h_g	Entropy (kJ/kg·K) Sat. Liquid s_f	Sat. Vapor s_g
0.08	41.51	1.0084	18.103	173.87	2432.2	173.88	2577.0	0.5926	8.2287
0.8	93.50	1.0380	2.087	391.58	2498.8	391.66	2665.8	1.2329	7.4346
1.0	99.63	1.0432	1.6940	417.36	2506.1	417.76	2675.5	1.3026	7.3594
1.5	111.4	1.0528	1.1590	466.94	2519.7	467.11	2693.6	1.4336	7.2233
2.0	120.2	1.0605	0.8857	504.49	2529.5	504.70	2706.7	1.5301	7.1271
2.5	127.4	1.0672	0.7187	535.10	2537.2	535.37	2716.9	1.6072	7.0527
3.0	133.6	1.0732	0.6058	561.15	2543.6	561.47	2725.3	1.6718	6.9919
8.0	170.4	1.1148	0.2404	720.22	2576.8	721.11	2769.1	2.0462	6.6628
80	295.1	1.3842	0.02352	1305.6	2569.8	1316.6	2758.0	3.2068	5.7432

Temp. (°C) T	Pressure (Bar) p	Specific Volume (m^3/kg) Sat. Liquid $v_f \times 10^3$	Sat. Vapor v_g	Internal Energy (kJ/kg) Sat. Liquid u_f	Sat. Vapor u_g	Enthalpy (kJ/kg) Sat. Liquid h_f	Sat. Vapor h_g	Entropy (kJ/kg·K) Sat. Liquid s_f	Sat. Vapor s_g
15	0.01705	1.0009	77.926	62.99	2396.1	62.99	2528.9	0.2245	8.7814
20	0.02339	1.0018	57.791	83.95	2402.9	83.96	2538.1	0.2296	8.6672
25	0.03169	1.0029	43.360	104.88	2409.8	104.89	2547.2	0.3674	8.5580
30	0.04246	1.0043	32.894	125.78	2416.6	125.79	2556.3	0.4369	8.4533
35	0.05628	1.0060	25.216	146.67	2423.4	146.68	2565.3	0.5053	8.3531
40	0.07384	1.0078	19.253	167.56	2430.1	167.57	2574.3	0.5725	8.2570

Ideal Gas Properties of Air:

Temp. T (K)	Enthalpy h (kJ/kg)	Internal Energy u (kJ/kg)	Entropy s° (kJ/kg·K)	when $\Delta s=0$ Relative Pressure p_r	Relative Volume v_r
300	300.19	214.07	1.70203	1.3860	621.2
315	315.27	224.85	1.75106	1.6442	549.8
320	320.29	228.42	1.76690	1.7375	528.6
350	350.49	250.02	1.85708	2.3790	422.2
400	400.98	286.16	1.99149	3.8060	301.6
450	451.80	322.62	2.11161	5.7750	223.6
460	462.02	329.97	2.13407	6.2450	211.4
470	472.24	337.32	2.15604	6.7420	200.1
500	503.02	359.49	2.21952	8.4110	170.6
560	565.17	404.42	2.33685	12.660	127.0
570	575.59	411.97	2.35531	13.500	121.2
580	586.04	419.55	2.37348	14.380	115.7
790	810.99	584.21	2.70400	45.550	49.86
800	821.95	592.30	2.71787	47.750	48.08
810	832.96	600.45	2.73146	50.170	46.46
1000	1046.04	758.94	2.96770	114.00	25.17

試題隨卷繳回