

國立臺北科技大學 100 學年度碩士班招生考試

系所組別：1330 車輛工程系碩士班丙組

第一節 熱力學 試題

第一頁 共二頁

注意事項：

1. 本試題共五題，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。

- 一、 A 10-L rigid tank contains R-134a at -10°C with a quality of 80%. A 10-A electric current (from a 6-V battery) is passed through a resistor inside the tank for 10 min, after which the R-134a temperature is 40°C . What was the heat transfer to or from the tank during this process? (20%)
- 二、 An air compressor takes in air in 150 kPa and 20°C , and delivers it at 1 MPa and 600 K to a constant-pressure cooler, which the air exits at 250 K. Find the specific compressor work and the specific heat transfer in the cooler. (Air $C_p = 1.004 \text{ kJ/kg} \cdot \text{K}$) (20%)
- 三、 Air at 40°C and 100 kPa flows in a 100-mm \times 150mm rectangular duct in a heating system. The volumetric flow rate is $0.02 \text{ m}^3/\text{s}$. What is the velocity of the air flowing in the duct and what is the mass flow rate? (air $R = 0.287 \text{ kNm/kgK}$) (20%)
- 四、 A cylinder containing of R-134a at 10°C and 300 kPa has an initial volume of 20 L. A piston compresses the R-134a in a reversible, isothermal process until it reaches the saturated vapor state. Calculate the required work and heat transfer to accomplish this process. (20%)
- 五、 A mass of 1.5kg of air contained in a cylinder at 1 MPa and 1000 K expands in a reversible isothermal process to a volume 10 times larger. Calculate the heat transfer during the process and the change of entropy of the air. (20%)

Saturated R-134a

Temp. (°C)	Press. (kPa)	SPECIFIC VOLUME, m^3/kg			INTERNAL ENERGY, kJ/kg		
		Sat. Liquid v_f	Evap. v_{fg}	Sat. Vapor v_g	Sat. Liquid u_f	Evap. u_{fg}	Sat. Vapor u_g
-70	8.3	0.000675	1.97207	1.97274	119.46	218.74	338.20
-65	11.7	0.000679	1.42915	1.42983	123.18	217.76	340.94
-60	16.3	0.000684	1.05199	1.05268	127.52	216.19	343.71
-55	22.2	0.000689	0.78609	0.78678	132.36	214.14	346.50
-50	29.9	0.000695	0.59587	0.59657	137.60	211.71	349.31
-45	39.6	0.000701	0.45783	0.45853	143.15	208.99	352.15
-40	51.8	0.000708	0.35625	0.35696	148.95	206.05	355.00
-35	66.8	0.000715	0.28051	0.28122	154.93	202.93	357.86
-30	85.1	0.000722	0.22330	0.22402	161.06	199.67	360.73
-26.3	101.3	0.000728	0.18947	0.19020	165.73	197.16	362.89
-25	107.2	0.000730	0.17957	0.18030	167.30	196.31	363.61
-20	133.7	0.000738	0.14576	0.14649	173.65	192.85	366.50
-15	165.0	0.000746	0.11932	0.12007	180.07	189.32	369.39
-10	201.7	0.000755	0.09845	0.09921	186.57	185.70	372.27
-5	244.5	0.000764	0.08181	0.08257	193.14	182.01	375.15
0	294.0	0.000773	0.06842	0.06919	199.77	178.24	378.01
5	350.9	0.000783	0.05755	0.05833	206.48	174.38	380.85
10	415.8	0.000794	0.04866	0.04945	213.25	170.42	383.67
15	489.5	0.000805	0.04133	0.04213	220.10	166.35	386.45
20	572.8	0.000817	0.03524	0.03606	227.03	162.16	389.19
25	666.3	0.000829	0.03015	0.03098	234.04	157.83	391.87
30	771.0	0.000843	0.02587	0.02671	241.14	153.34	394.48
35	887.6	0.000857	0.02224	0.02310	248.34	148.68	397.02
40	1017.0	0.000873	0.01915	0.02002	255.65	143.81	399.46
45	1160.2	0.000890	0.01650	0.01739	263.08	138.71	401.79
50	1318.1	0.000908	0.01422	0.01512	270.63	133.35	403.98
55	1491.6	0.000928	0.01224	0.01316	278.33	127.68	406.01
60	1681.8	0.000951	0.01051	0.01146	286.19	121.66	407.85
65	1889.9	0.000976	0.00899	0.00997	294.24	115.22	409.46
70	2117.0	0.001005	0.00765	0.00866	302.51	108.27	410.78
75	2364.4	0.001038	0.00645	0.00749	311.06	100.68	411.74
80	2633.6	0.001078	0.00537	0.00645	319.96	92.26	412.22
85	2926.2	0.001128	0.00437	0.00550	329.35	82.67	412.01
90	3244.5	0.001195	0.00341	0.00461	339.51	71.24	410.75
95	3591.5	0.001297	0.00243	0.00373	351.17	56.25	407.42
100	3973.2	0.001557	0.00108	0.00264	368.55	28.19	396.74
101.2	4064.0	0.001969	0	0.00197	382.97	0	382.97

注意：背面尚有參考資料

(continued)
Saturated R-134a

Temp. (°C)	Press. (kPa)	ENTHALPY, kJ/kg			ENTROPY, kJ/kg-K		
		Sat. Liquid	Evap.	Sat. Vapor	Sat. Liquid	Evap.	Sat. Vapor
		h_f	h_{fg}	h_g	s_f	s_{fg}	s_g
-70	8.3	119.47	235.15	354.62	0.6645	1.1575	1.8220
-65	11.7	123.18	234.55	357.73	0.6825	1.1268	1.8094
-60	16.3	127.53	233.33	360.86	0.7031	1.0947	1.7978
-55	22.2	132.37	231.63	364.00	0.7256	1.0618	1.7874
-50	29.9	137.62	229.54	367.16	0.7493	1.0286	1.7780
-45	39.6	143.18	227.14	370.32	0.7740	0.9956	1.7695
-40	51.8	148.98	224.50	373.48	0.7991	0.9629	1.7620
-35	66.8	154.98	221.67	376.64	0.8245	0.9308	1.7553
-30	85.1	161.12	218.68	379.80	0.8499	0.8994	1.7493
-26.3	101.3	165.80	216.36	382.16	0.8690	0.8763	1.7453
-25	107.2	167.38	215.57	382.95	0.8754	0.8687	1.7441
-20	133.7	173.74	212.34	386.08	0.9007	0.8388	1.7395
-15	165.0	180.19	209.00	389.20	0.9258	0.8096	1.7354
-10	201.7	186.72	205.56	392.28	0.9507	0.7812	1.7319
-5	244.5	193.32	202.02	395.34	0.9755	0.7534	1.7288
0	294.0	200.00	198.36	398.36	1.0000	0.7262	1.7262
5	350.9	206.75	194.57	401.32	1.0243	0.6995	1.7239
10	415.8	213.58	190.65	404.23	1.0485	0.6733	1.7218
15	489.5	220.49	186.58	407.07	1.0725	0.6475	1.7200
20	572.8	227.49	182.35	409.84	1.0963	0.6220	1.7183
25	666.3	234.59	177.92	412.51	1.1201	0.5967	1.7168
30	771.0	241.79	173.29	415.08	1.1437	0.5716	1.7153
35	887.6	249.10	168.42	417.52	1.1673	0.5465	1.7139
40	1017.0	256.54	163.28	419.82	1.1909	0.5214	1.7123
45	1160.2	264.11	157.85	421.96	1.2145	0.4962	1.7106
50	1318.1	271.83	152.08	423.91	1.2381	0.4706	1.7088
55	1491.6	279.72	145.93	425.65	1.2619	0.4447	1.7066
60	1681.8	287.79	139.33	427.13	1.2857	0.4182	1.7040
65	1889.9	296.09	132.21	428.30	1.3099	0.3910	1.7008
70	2117.0	304.64	124.47	429.11	1.3343	0.3627	1.6970
75	2364.4	313.51	115.94	429.45	1.3592	0.3330	1.6923
80	2633.6	322.79	106.40	429.19	1.3849	0.3013	1.6862
85	2926.2	332.65	95.45	428.10	1.4117	0.2665	1.6782
90	3244.5	343.38	82.31	425.70	1.4404	0.2267	1.6671
95	3591.5	355.83	64.98	420.81	1.4733	0.1765	1.6498
100	3973.2	374.74	32.47	407.21	1.5228	0.0870	1.6098
101.2	4064.0	390.98	0	390.98	1.5658	0	1.5658

(continued)
Superheated R-134a

Temp. (°C)	v (m³/kg)	u (kJ/kg)	h (kJ/kg)	s (kJ/kg-K)	300 kPa (0.56)		400 kPa (8.84)	
					v	u	v	u
					(m³/kg)	(kJ/kg)	(m³/kg)	(kJ/kg)
Sat.	0.06787	378.33	398.69	1.7259	0.05136	383.02	403.56	1.7223
10	0.07111	385.84	407.17	1.7564	0.05168	383.98	404.65	1.7261
20	0.07441	393.80	416.12	1.7874	0.05436	392.22	413.97	1.7584
30	0.07762	401.81	425.10	1.8175	0.05693	400.45	423.22	1.7895
40	0.08075	409.90	434.12	1.8468	0.05940	408.70	432.46	1.8195
50	0.08382	418.09	443.23	1.8755	0.06181	417.03	441.75	1.8487
60	0.08684	426.39	452.44	1.9035	0.06417	425.44	451.10	1.8772
70	0.08982	434.82	461.76	1.9311	0.06648	433.95	460.55	1.9051
80	0.09277	443.37	471.21	1.9582	0.06877	442.58	470.09	1.9325
90	0.09570	452.07	480.78	1.9850	0.07102	451.34	479.75	1.9595
100	0.09861	460.90	490.48	2.0113	0.07325	460.22	489.52	1.9860
110	0.10150	469.87	500.32	2.0373	0.07547	469.24	499.43	2.0122
120	0.10437	478.99	510.30	2.0631	0.07767	478.40	509.46	2.0381
130	0.10723	488.26	520.43	2.0885	0.07985	487.69	519.63	2.0636
140	0.11008	497.66	530.69	2.1136	0.08202	497.13	529.94	2.0889
150	0.11292	507.22	541.09	2.1385	0.08418	506.71	540.38	2.1139
160	0.11575	516.91	551.64	2.1631	0.08634	516.43	550.97	2.1386
					500 kPa (15.66)		600 kPa (21.52)	
Sat.	0.04126	386.82	407.45	1.7198	0.03442	390.01	410.66	1.7179
20	0.04226	390.52	411.65	1.7342	—	—	—	—
30	0.04446	398.99	421.22	1.7663	0.03609	397.44	419.09	1.7461
40	0.04656	407.44	430.72	1.7971	0.03796	406.11	428.88	1.7779
50	0.04858	415.91	440.20	1.8270	0.03974	414.75	438.59	1.8084
60	0.05055	424.44	449.72	1.8560	0.04145	423.41	448.28	1.8379
70	0.05247	433.06	459.29	1.8843	0.04311	432.13	457.99	1.8666
80	0.05435	441.77	468.94	1.9120	0.04473	440.93	467.76	1.8947
90	0.05620	450.59	478.69	1.9392	0.04632	449.82	477.61	1.9222
100	0.05804	459.53	488.55	1.9660	0.04788	458.82	487.55	1.9492
110	0.05985	468.60	498.52	1.9924	0.04943	467.94	497.59	1.9758
120	0.06164	477.79	508.61	2.0184	0.05095	477.18	507.75	2.0019
130	0.06342	487.13	518.83	2.0440	0.05246	486.55	518.03	2.0277
140	0.06518	496.59	529.19	2.0694	0.05396	496.05	528.43	2.0532
150	0.06694	506.20	539.67	2.0945	0.05544	505.69	538.95	2.0784
160	0.06869	515.95	550.29	2.1193	0.05692	515.46	549.61	2.1033
170	0.07043	525.83	561.04	2.1438	0.05839	525.36	560.40	2.1279