

熱力學(一) Thermodynamics I

小考

98. 11. 14

請在答案紙上標明題號、作答，並請註明學號及姓名。

問答題：

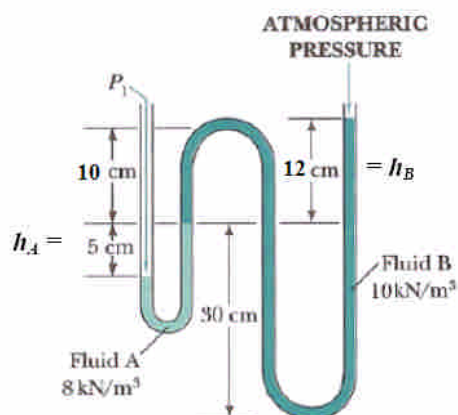
- (10%) 「過冷液體」之物性近似於同 (壓力, or 體積, or 溫度)_____下之飽和 (固體, or 液體, or 氣體)_____之物性。
- (10%) 氣體在何種情形下，其性質接近理想氣體？請以 Reduced Pressure (P_R)及 Reduced Temperature (T_R)之大小說明之。

- (30%) 請填入下列純水(H_2O)物性表中(A)~(E)之空格。

P [kPa]	T [°C]	h [kJ/kg]	x (vapor quality)	Phase description
(A)	40	1800	(B)	Saturated liquid-vapor mixture
200	(C)	(D)	0.0	Saturated liquid
100	25	(E)	--	(F)

- (25%) 有一剛性容器內部以隔板分隔為等體積的兩部分。開始時，容器一側有 2kg 的水，其壓力溫度分別為 200kPa 及 30°C，另一側則為真空。然後，將分隔板移除而讓水膨脹至整個容器，此系統之水可與其環境進行熱交換直到其溫度回復至原來之 30°C。請計算：(a)此容器內之總體積，(b)此過程完成後之壓力，(c)系統在此過程中之傳熱率。

- (25%) 請計算如下圖之壓力量測系統中 P_1 之壓力。設其大氣壓力(atmosphere pressure)為 760 mmHg.



Saturated water—Temperature table

Temp., T °C	Sat. press., P_{sat} kPa	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
0.01	0.6117	0.001000	206.00	0.000	2374.9	2374.9	0.001	2500.9	2500.9
5	0.8725	0.001000	147.03	21.019	2360.8	2381.8	21.020	2489.1	2510.1
10	1.2281	0.001000	106.32	42.020	2346.6	2388.7	42.022	2477.2	2519.2
15	1.7057	0.001001	77.885	62.980	2332.5	2395.5	62.982	2465.4	2528.3
20	2.3392	0.001002	57.762	83.913	2318.4	2402.3	83.915	2453.5	2537.4
25	3.1698	0.001003	43.340	104.83	2304.3	2409.1	104.83	2441.7	2546.5
30	4.2469	0.001004	32.879	125.73	2290.2	2415.9	125.74	2429.8	2555.6
35	5.6291	0.001006	25.205	146.63	2276.0	2422.7	146.64	2417.9	2564.6
40	7.3851	0.001008	19.515	167.53	2261.9	2429.4	167.53	2406.0	2573.5
45	9.5953	0.001010	15.251	188.43	2247.7	2436.1	188.44	2394.0	2582.4

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
75	91.76	0.001037	2.2172	384.36	2111.8	2496.1	384.44	2278.0	2662.4
100	99.61	0.001043	1.6941	417.40	2088.2	2505.6	417.51	2257.5	2675.0
101.325	99.97	0.001043	1.6734	418.95	2087.0	2506.0	419.06	2256.5	2675.6
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
175	116.04	0.001057	1.0037	486.82	2037.7	2524.5	487.01	2213.1	2700.2
200	120.21	0.001061	0.88578	504.50	2024.6	2529.1	504.71	2201.6	2706.3
225	123.97	0.001064	0.79329	520.47	2012.7	2533.2	520.71	2191.0	2711.7
250	127.41	0.001067	0.71873	535.08	2001.8	2536.8	535.35	2181.2	2716.5
275	130.58	0.001070	0.65732	548.57	1991.6	2540.1	548.86	2172.0	2720.9

Superheated water

T °C	v m^3/kg	u kJ/kg	h kJ/kg	s $\text{kJ/kg} \cdot \text{K}$		v m^3/kg	u kJ/kg	h kJ/kg	s $\text{kJ/kg} \cdot \text{K}$
$P = 0.10 \text{ MPa (99.61}^\circ\text{C)}$						$P = 0.20 \text{ MPa (120.21}^\circ\text{C)}$			
Sat. [†]	1.6941	2505.6	2675.0	7.3589	Sat.	0.88578	2529.1	2706.3	7.1270
50					150	0.95986	2577.1	2769.1	7.2810
100	1.6959	2506.2	2675.8	7.3611	200	1.08049	2654.6	2870.7	7.5081
150	1.9367	2582.9	2776.6	7.6148	250	1.19890	2731.4	2971.2	7.7100
200	2.1724	2658.2	2875.5	7.8356	300	1.31623	2808.8	3072.1	7.8941
250	2.4062	2733.9	2974.5	8.0346	400	1.54934	2967.2	3277.0	8.2236
300	2.6389	2810.7	3074.5	8.2172	500	1.78142	3131.4	3487.7	8.5153
400	3.1027	2968.3	3278.6	8.5452	600	2.01302	3302.2	3704.8	8.7793
500	3.5655	3132.2	3488.7	8.8362	700	2.24434	3479.9	3928.8	9.0221
600	4.0279	3302.8	3705.6	9.0999	800	2.47550	3664.7	4159.8	9.2479
700	4.4900	3480.4	3929.4	9.3424	900	2.70656	3856.3	4397.7	9.4598
800	4.9519	3665.0	4160.2	9.5682	1000	2.93755	4054.8	4642.3	9.6599
900	5.4137	3856.7	4398.0	9.7800	1100	3.16848	4259.6	4893.3	9.8497
1000	5.8755	4055.0	4642.6	9.9800	1200	3.39938	4470.5	5150.4	10.0304
1100	6.3372	4259.8	4893.6	10.1698	1300	3.63026	4687.1	5413.1	10.2029

Saturated water—Temperature table

Temp., T °C	Sat. press., P_{sat} kPa	Specific volume, m^3/kg		Internal energy, kJ/kg			Enthalpy, kJ/kg			Entropy, $\text{kJ/kg} \cdot \text{K}$		
		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
0.01	0.6117	0.001000	206.00	0.000	2374.9	2374.9	0.001	2500.9	2500.9	0.0000	9.1556	9.1556
5	0.8725	0.001000	147.03	21.019	2360.8	2381.8	21.020	2489.1	2510.1	0.0763	8.9487	9.0249
10	1.2281	0.001000	106.32	42.020	2346.6	2388.7	42.022	2477.2	2519.2	0.1511	8.7488	8.8999
15	1.7057	0.001001	77.885	62.980	2332.5	2395.5	62.982	2465.4	2528.3	0.2245	8.5559	8.7803
20	2.3392	0.001002	57.762	83.913	2318.4	2402.3	83.915	2453.5	2537.4	0.2965	8.3696	8.6661
25	3.1698	0.001003	43.340	104.83	2304.3	2409.1	104.83	2441.7	2546.5	0.3672	8.1895	8.5567
30	4.2469	0.001004	32.879	125.73	2290.2	2415.9	125.74	2429.8	2555.6	0.4368	8.0152	8.4520
35	5.6291	0.001006	25.205	146.63	2276.0	2422.7	146.64	2417.9	2564.6	0.5051	7.8466	8.3517
40	7.3851	0.001008	19.515	167.53	2261.9	2429.4	167.53	2406.0	2573.5	0.5724	7.6832	8.2556
45	9.5953	0.001010	15.251	188.43	2247.7	2436.1	188.44	2394.0	2582.4	0.6386	7.5247	8.1633

Saturated water—Pressure table

Press., P kPa	Sat. temp., T_{sat} °C	Specific volume, m^3/kg		Internal energy, kJ/kg			Enthalpy, kJ/kg			Entropy, $\text{kJ/kg} \cdot \text{K}$		
		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
75	91.76	0.001037	2.2172	384.36	2111.8	2496.1	384.44	2278.0	2662.4	1.2132	6.2426	7.4558
100	99.61	0.001043	1.6941	417.40	2088.2	2505.6	417.51	2257.5	2675.0	1.3028	6.0562	7.3589
101.325	99.97	0.001043	1.6734	418.95	2087.0	2506.0	419.06	2256.5	2675.6	1.3069	6.0476	7.3545
125	105.97	0.001048	1.3750	444.23	2068.8	2513.0	444.36	2240.6	2684.9	1.3741	5.9100	7.2841
150	111.35	0.001053	1.1594	466.97	2052.3	2519.2	467.13	2226.0	2693.1	1.4337	5.7894	7.2231
175	116.04	0.001057	1.0037	486.82	2037.7	2524.5	487.01	2213.1	2700.2	1.4850	5.6865	7.1716
200	120.21	0.001061	0.88578	504.50	2024.6	2529.1	504.71	2201.6	2706.3	1.5302	5.5968	7.1270
225	123.97	0.001064	0.79329	520.47	2012.7	2533.2	520.71	2191.0	2711.7	1.5706	5.5171	7.0877
250	127.41	0.001067	0.71873	535.08	2001.8	2536.8	535.35	2181.2	2716.5	1.6072	5.4453	7.0525
275	130.58	0.001070	0.65732	548.57	1991.6	2540.1	548.86	2172.0	2720.9	1.6408	5.3800	7.0207

Superheated water

T °C	v m^3/kg	u kJ/kg	h kJ/kg	s $\text{kJ/kg} \cdot \text{K}$	v m^3/kg	u kJ/kg	h kJ/kg	s $\text{kJ/kg} \cdot \text{K}$
$P = 0.20 \text{ MPa} (120.21^\circ\text{C})$					$P = 0.30 \text{ MPa} (133.52^\circ\text{C})$			
Sat.	0.88578	2529.1	2706.3	7.1270	0.60582	2543.2	2724.9	6.9917
150	0.95986	2577.1	2769.1	7.2810	0.63402	2571.0	2761.2	7.0792
200	1.08049	2654.6	2870.7	7.5081	0.71643	2651.0	2865.9	7.3132
250	1.19890	2731.4	2971.2	7.7100	0.79645	2728.9	2967.9	7.5180
300	1.31623	2808.8	3072.1	7.8941	0.87535	2807.0	3069.6	7.7037
400	1.54934	2967.2	3277.0	8.2236	1.03155	2966.0	3275.5	8.0347
500	1.78142	3131.4	3487.7	8.5163	1.18672	3130.6	3486.6	8.3271
600	2.01302	3302.2	3704.8	8.7793	1.34139	3301.6	3704.0	8.5915
700	2.24434	3479.9	3928.8	9.0221	1.49580	3479.5	3928.2	8.8345
800	2.47550	3664.7	4159.8	9.2479	1.65004	3664.3	4159.3	9.0605
900	2.70656	3856.3	4397.7	9.4598	1.80417	3856.0	4397.3	9.2725
1000	2.93755	4054.8	4642.3	9.6599	1.95824	4054.5	4642.0	9.4726
1100	3.16848	4259.6	4893.3	9.8497	2.11226	4259.4	4893.1	9.6624
1200	3.39938	4470.5	5150.4	10.0304	2.26624	4470.3	5150.2	9.8431
1300	3.63026	4687.1	5413.1	10.2029	2.42019	4686.9	5413.0	10.0157

20	60.06	0.001017	7.6481	251.40	2204.6	2456.0	251.42	2357.5	2608.9	0.8320	7.0752	7.9073
25	64.96	0.001020	6.2034	271.93	2190.4	2462.4	271.96	2345.5	2617.5	0.8932	6.9370	7.8302
30	69.09	0.001022	5.2287	289.24	2178.5	2467.7	289.27	2335.3	2624.6	0.9441	5.8234	7.7675
40	75.86	0.001025	3.9933	317.58	2158.8	2476.3	317.62	2318.4	2636.1	1.0261	6.6430	7.6691
50	81.32	0.001030	3.2403	340.49	2142.7	2483.2	340.54	2304.7	2645.2	1.0912	6.5019	7.5931
75	91.76	0.001037	2.2172	384.36	2111.8	2496.1	384.44	2278.0	2662.4	1.2132	6.2426	7.4558
100	99.61	0.001043	1.6941	417.40	2088.2	2505.6	417.51	2257.5	2675.0	1.3028	6.0562	7.3589
101.325	99.97	0.001043	1.6734	418.95	2087.0	2506.0	419.06	2256.5	2675.6	1.3069	6.0476	7.3545
125	105.97	0.001048	1.3750	444.23	2068.8	2513.0	444.36	2240.6	2684.9	1.3741	5.9100	7.2841
150	111.35	0.001053	1.1594	466.97	2052.3	2519.2	467.13	2226.0	2693.1	1.4337	5.7894	7.2231
175	116.04	0.001057	1.0037	486.82	2037.7	2524.5	487.01	2213.1	2700.2	1.4850	5.6865	7.1716
200	120.21	0.001061	0.88578	504.50	2024.6	2529.1	504.71	2201.6	2706.3	1.5302	5.5968	7.1270
225	123.97	0.001064	0.79329	520.47	2012.7	2533.2	520.71	2191.0	2711.7	1.5706	5.5171	7.0877
250	127.41	0.001067	0.71873	535.08	2001.8	2536.8	535.35	2181.2	2716.5	1.6072	5.4453	7.0525
275	130.58	0.001070	0.65732	548.57	1991.6	2540.1	548.86	2172.0	2720.9	1.6408	5.3800	7.0207
300	133.52	0.001073	0.60582	561.11	1982.1	2543.2	561.43	2163.5	2724.9	1.6717	5.3200	6.9917
325	136.27	0.001076	0.56199	572.84	1973.1	2545.9	573.19	2155.4	2728.6	1.7005	5.2645	6.9650
350	138.86	0.001079	0.52422	583.89	1964.5	2548.5	584.26	2147.7	2732.0	1.7274	5.2128	6.9402
375	141.30	0.001081	0.49133	594.32	1956.6	2550.9	594.73	2140.4	2735.1	1.7526	5.1646	6.9171
400	143.61	0.001084	0.46242	604.22	1948.9	2553.1	604.66	2133.4	2738.1	1.7765	5.1191	6.8955