

1. 說明氣、液、固三相平衡。
(10%)
2. 某 moist-air mixture 之 Dry bulb temperature 為 30°C 而其 Relative Humidity 為 60%, total pressure 為 100 kPa。請計算 Water Vapor 之 partial pressure 及此系統之 Dew-point temperature。
(16%)
3. Steam 通過一內徑為 15 cm 之管線進入 Steam turbine。其 Inlet
(16%) Steam velocity 為 90 m/s, Inlet pressure 為 20 MPa, 而 Inlet steam temperature 為 600°C 。Steam turbine 之 exit pipe 內徑為 60 cm, 其 exit pressure 和 temperature 分別為 300 kPa 和 150°C 。假設 steam 穩定地通過 Steam turbine, 請計算下列之值:
(1) Inlet steam density (2) Mass flow rate of steam through the turbine
(3) Exit steam velocity
4. 說明 Carnot Cycle。
(10%)
5. 氣溫 (25°C) 空氣 (101 kPa) 以 steady flow 進入 Compressor 被壓縮
(16%) 至 800 kPa。假設 Specific heats, Kinetic, & potential energy 在壓縮的過程中皆不變, 請依下列兩種 processes 分別計算 Work per unit mass required 及 Exit air temperature: ($k = \gamma = c_p/c_v = 1.4$ for air)
(1) An isentropic-compression process (2) An isothermal-compression process
6. 一個 closed system 含有 1 kg 之 liquid water 及 1 kg 之 water vapor 且
(16%) 在 700 kPa 下達到平衡。(1) 請計算 the initial temperature (2) 假設有外界之 heat 使此系統加熱至 350°C , 而此系統之壓力保持固定, 請計算此系統之熵變化。
7. 某煤炭之元素分析 (Dry Basis) 如下: C (79.2%) H (5.7%)
(16%) N (1.5%) S (0.6%) O (10.0%) Ash (3.0%), 若將此煤炭以 30% 之 Excess Air 燃燒, 請計算 its mass 基之 Air/Fuel ratio。

Table B-1 SATURATED WATER—TEMPERATURE TABLE

TEMP., °C	PRESS., MPa	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
0.01	0.0113	0.001 000	206.14	0.00	2375.3	2375.3	0.01	2501.3	2501.4	0.0000	9.1562	9.1562
5	0.0721	0.001 000	147.12	20.97	2361.3	2382.3	20.90	2489.6	2510.6	0.0761	8.9496	9.0257
10	1.2276	0.001 000	106.38	42.00	2347.2	2389.2	42.01	2477.7	2519.8	0.1510	8.7498	8.9008
15	1.7051	0.001 001	77.93	62.99	2333.1	2396.1	62.99	2465.9	2528.9	0.2245	8.5569	8.7814
20	2.339	0.001 002	57.79	83.95	2319.0	2402.9	83.96	2454.1	2538.1	0.2966	8.3706	8.6672
25	3.169	0.001 003	43.36	104.88	2304.9	2409.8	104.89	2442.3	2547.2	0.3674	8.1905	8.5580
30	4.246	0.001 004	32.89	125.78	2290.8	2416.6	125.79	2430.5	2556.3	0.4369	8.0164	8.4533
35	5.628	0.001 006	25.22	146.67	2276.7	2423.4	146.68	2418.6	2565.3	0.5053	7.8478	8.3531
40	7.384	0.001 008	19.52	167.56	2262.6	2430.1	167.57	2406.7	2574.3	0.5725	7.6845	8.2570
45	9.593	0.001 010	15.26	188.44	2248.4	2436.8	188.45	2394.8	2583.2	0.6387	7.5261	8.1648
50	12.349	0.001 012	12.03	209.32	2234.2	2443.5	209.33	2382.7	2592.1	0.7038	7.3725	8.0763
55	15.758	0.001 015	9.568	230.21	2219.9	2450.1	230.22	2370.7	2600.9	0.7679	7.2234	7.9913
60	19.940	0.001 017	7.671	251.11	2205.5	2456.6	251.12	2358.5	2609.6	0.8312	7.0784	7.9096
65	25.05	0.001 020	6.197	272.02	2191.1	2463.1	272.03	2346.2	2618.3	0.8936	6.9375	7.8310
70	31.19	0.001 023	5.042	292.95	2176.6	2469.6	292.96	2333.8	2626.8	0.9549	6.8004	7.7553
75	38.58	0.001 026	4.131	313.90	2162.0	2475.9	313.91	2321.4	2635.3	1.0155	6.6669	7.6824
80	47.39	0.001 029	3.407	334.86	2147.4	2482.2	334.87	2308.8	2643.7	1.0753	6.5369	7.6122
85	57.83	0.001 033	2.828	355.84	2132.6	2488.4	355.85	2296.0	2651.9	1.1343	6.4102	7.5445
90	70.14	0.001 036	2.361	376.85	2117.7	2494.5	376.86	2283.2	2660.1	1.1925	6.2866	7.4791
95	84.55	0.001 040	1.982	397.88	2102.7	2500.6	397.89	2270.2	2668.1	1.2500	6.1659	7.4159

TEMP., °C	PRESS., MPa	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
100	0.101 35	0.001 044	1.6729	418.94	2087.6	2506.5	418.94	2257.0	2676.1	1.3069	6.0480	7.3549
105	0.120 82	0.001 048	1.4194	440.02	2072.3	2512.4	440.15	2245.7	2683.8	1.3630	5.9328	7.2958
110	0.143 27	0.001 052	1.2102	461.14	2057.0	2518.1	461.30	2235.0	2691.5	1.4185	5.8202	7.2387
115	0.169 06	0.001 056	1.0366	482.30	2041.4	2523.7	482.48	2224.5	2699.0	1.4734	5.7100	7.1833
120	0.198 53	0.001 060	0.8919	503.50	2025.8	2529.3	503.71	2214.2	2706.3	1.5276	5.6020	7.1296
125	0.2321	0.001 065	0.7706	524.74	2009.9	2534.6	524.99	2204.5	2713.5	1.5813	5.4962	7.0775
130	0.2701	0.001 070	0.6685	546.02	1993.9	2539.9	546.31	2194.2	2720.5	1.6344	5.3925	7.0269
135	0.3130	0.001 075	0.5822	567.35	1977.7	2545.0	567.69	2184.7	2727.3	1.6870	5.2907	6.9777
140	0.3613	0.001 080	0.5089	588.74	1961.3	2550.0	589.15	2174.7	2733.9	1.7391	5.1908	6.9299
145	0.4154	0.001 085	0.4463	610.18	1944.7	2554.9	610.65	2164.6	2740.3	1.7907	5.0926	6.8833

150	0.4758	0.001 091	0.3928	631.68	1927.9	2559.5	632.20	2154.3	2746.5	1.8418	4.9960	6.8379
155	0.5431	0.001 096	0.3468	653.24	1910.8	2564.1	653.84	2098.6	2752.4	1.8925	4.9010	6.7935
160	0.6178	0.001 102	0.3071	674.87	1893.5	2568.4	675.55	2082.6	2758.1	1.9427	4.8075	6.7502
165	0.7005	0.001 108	0.2727	696.56	1876.0	2572.5	697.34	2066.5	2763.5	1.9925	4.7153	6.7076
170	0.7917	0.001 114	0.2428	718.33	1858.1	2576.5	719.21	2049.5	2768.7	2.0419	4.6244	6.6663
175	0.8920	0.001 121	0.2168	740.17	1840.0	2580.2	741.17	2032.4	2773.6	2.0909	4.5347	6.6256
180	1.0021	0.001 127	0.1945	762.09	1821.6	2583.7	763.22	2015.0	2778.2	2.1396	4.4461	6.5857
185	1.1227	0.001 134	0.17409	784.10	1802.9	2587.0	785.37	1997.8	2782.4	2.1879	4.3586	6.5465
190	1.2544	0.001 141	0.15654	806.19	1783.8	2590.0	807.62	1978.8	2786.4	2.2359	4.2720	6.5079
195	1.3978	0.001 149	0.14105	828.37	1764.4	2592.8	829.98	1960.0	2790.0	2.2835	4.1863	6.4698
200	1.5538	0.001 157	0.12736	850.65	1744.7	2595.3	852.45	1940.7	2793.2	2.3309	4.1014	6.4325
205	1.7230	0.001 164	0.11521	873.04	1724.5	2597.5	875.04	1921.0	2796.0	2.3780	4.0172	6.3952
210	1.9062	0.001 173	0.10441	895.53	1703.9	2599.5	897.76	1900.7	2798.5	2.4248	3.9337	6.3585
215	2.104	0.001 181	0.09479	918.14	1682.9	2601.1	920.62	1879.9	2800.5	2.4714	3.8507	6.3221
220	2.318	0.001 190	0.08619	940.87	1661.5	2602.4	943.62	1858.3	2802.1	2.5178	3.7683	6.2861
225	2.548	0.001 199	0.07849	963.73	1639.6	2603.3	966.78	1836.5	2803.3	2.5639	3.6863	6.2503
230	2.795	0.001 209	0.07158	986.74	1617.2	2603.9	990.12	1813.8	2804.0	2.6099	3.6047	6.2146
235	3.060	0.001 219	0.06537	1009.89	1594.2	2604.1	1013.62	1790.5	2804.2	2.6558	3.5233	6.1791
240	3.344	0.001 229	0.05976	1033.21	1570.8	2604.0	1037.32	1766.5	2803.8	2.7015	3.4422	6.1437
245	3.648	0.001 240	0.05471	1056.71	1546.7	2603.4	1061.23	1741.7	2803.0	2.7472	3.3612	6.1083
250	3.973	0.001 251	0.05013	1080.39	1522.0	2602.4	1085.36	1716.2	2801.5	2.7927	3.2802	6.0730
255	4.319	0.001 263	0.04598	1104.28	1496.7	2600.9	1109.73	1689.8	2799.5	2.8383	3.1992	6.0378
260	4.688	0.001 276	0.04221	1128.39	1470.6	2599.0	1134.37	1662.5	2796.9	2.8838	3.1181	6.0019
265	5.081	0.001 289	0.03877	1152.74	1443.9	2596.6	1159.28	1634.4	2793.6	2.9294	3.0368	5.9662
270	5.499	0.001 302	0.03564	1177.36	1416.3	2593.7	1184.31	1605.2	2789.7	2.9751	2.9551	5.9301
275	5.942	0.001 317	0.03279	1202.23	1387.9	2590.2	1210.07	1574.9	2785.0	3.0208	2.8730	5.8938
280	6.412	0.001 332	0.03017	1227.46	1358.7	2586.1	1235.99	1543.6	2779.6	3.0668	2.7903	5.8571
285	6.909	0.001 348	0.02777	1253.00	1328.4	2581.4	1262.31	1511.0	2773.3	3.1130	2.7070	5.8199
290	7.436	0.001 366	0.02557	1278.92	1297.1	2576.0	1289.07	1477.1	2766.2	3.1594	2.6227	5.7821
295	7.993	0.001 384	0.02354	1305.2	1264.7	2569.9	1316.3	1441.8	2758.1	3.2062	2.5375	5.7437
300	8.581	0.001 404	0.02167	1332.0	1231.0	2563.0	1344.0	1404.9	2749.0	3.2534	2.4511	5.7045
305	9.202	0.001 425	0.019948	1359.3	1195.9	2555.2	1372.4	1366.4	2738.7	3.3010	2.3633	5.6643
310	9.856	0.001 447	0.018350	1387.1	1159.4	2546.4	1401.3	1326.0	2727.3	3.3493	2.2737	5.6240
315	10.547	0.001 472	0.016867	1415.5	1121.1	2536.6	1431.0	1283.5	2714.5	3.3982	2.1821	5.5832
320	11.274	0.001 499	0.015488	1444.6	1080.9	2525.3	1461.5	1238.6	2700.1	3.4480	2.0882	5.5362
330	12.845	0.001 561	0.012996	1505.3	993.7	2498.9	1525.3	1140.6	2665.9	3.5507	1.8909	5.4417
340	14.588	0.001 638	0.010797	1570.3	894.3	2464.6	1594.2	1027.9	2622.0	3.6594	1.6763	5.3357
350	16.513	0.001 740	0.008813	1641.9	776.6	2418.4	1670.6	893.4	2563.9	3.7777	1.4355	5.2112
360	18.651	0.001 893	0.006945	1725.2	626.3	2351.5	1760.5	720.5	2481.0	3.9147	1.1379	5.0526
370	21.05	0.002 213	0.004925	1844.0	384.5	2228.5	1890.5	441.6	2332.1	4.1106	0.6865	4.7971
374.14	22.09	0.003 155	0.003 155	2029.6	0	2029.6	2099.5	0	2099.3	4.4298	0	4.4298

SOURCE: Gordon J. Van Wylen and Richard E. Sonntag, *Fundamentals of Classical Thermodynamics*, 5th Edition 2d ed., John Wiley & Sons, Inc. 1976, pp. 645-647, table A.1.1. Originally published in Joseph H. Keenan, Fredrick G. Keyes, Philip G. Hill and Joan G. Moore, *Steam Tables*, SI Units, Copyright © 1969, 1978 by John Wiley and Sons, Inc.

Table B-2 SATURATED WATER—PRESSURE TABLE

PRESS. MPa P	TEMP. °C T	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
0.6113	0.01	0.001 000	206.14	.00	2375.3	2375.3	.01	2501.3	2501.4	.0000	9.1562	9.1562
1.0	6.98	0.001 000	129.21	29.30	2355.7	2385.0	29.30	2464.9	2514.2	.1059	8.8697	8.9756
1.5	13.03	0.001 001	87.98	54.71	2358.6	2393.3	54.71	2470.6	2525.3	.1957	8.6322	8.8279
2.0	17.50	0.001 001	67.00	73.48	2356.0	2399.5	73.48	2460.0	2533.5	.2607	8.4629	8.7232
2.5	21.08	0.001 002	54.25	88.48	2355.9	2404.4	88.48	2451.5	2540.0	.3120	8.3311	8.6432
3.0	24.08	0.001 003	45.67	101.04	2357.5	2408.5	101.05	2444.5	2545.3	.3545	8.2231	8.5776
4.0	28.96	0.001 004	34.80	121.45	2293.7	2415.2	121.46	2432.9	2554.4	.4226	8.0520	8.4746
5.0	32.88	0.001 005	28.19	137.81	2282.7	2420.5	137.82	2423.7	2561.5	.4764	7.9187	8.3951
7.5	40.29	0.001 008	19.24	168.78	2261.7	2430.5	168.79	2406.0	2574.8	.5764	7.6750	8.2515
10	45.81	0.001 010	14.67	191.82	2246.1	2437.9	191.83	2392.8	2584.7	.6493	7.5009	8.1502
15	53.97	0.001 014	10.02	225.92	2222.8	2448.7	225.94	2373.1	2599.1	.7549	7.2536	8.0085
20	60.06	0.001 017	7.649	251.38	2205.4	2456.7	251.40	2358.3	2609.7	.8320	7.0766	7.9085
25	64.97	0.001 020	6.204	271.90	2191.2	2463.1	271.93	2346.3	2618.2	.8931	6.9383	7.8314
30	69.10	0.001 022	5.229	289.20	2179.2	2468.4	289.23	2336.1	2625.3	.9439	6.8247	7.7686
40	75.87	0.001 027	3.993	317.33	2159.5	2477.0	317.58	2319.2	2635.8	1.0259	6.6441	7.6700
50	81.33	0.001 030	3.240	340.44	2143.4	2483.9	340.49	2305.4	2645.9	1.0910	6.5029	7.5939
75	91.78	0.001 037	2.217	384.31	2112.4	2496.7	384.39	2278.6	2663.0	1.2130	6.2454	7.4564
0.100	99.63	0.001 043	1.6940	417.36	2088.7	2506.1	417.46	2258.0	2675.5	1.3026	6.0560	7.3594
0.125	105.99	0.001 048	1.3749	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	2693.0	1.4356	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	7.1713
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	0.7953	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	0.6575	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	1.6716	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	5.0559	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	2076.5	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	0.2401	720.22	1856.6	2576.8	721.11	2048.0	2769.1	2.0462	4.6166	6.6628
0.85	172.95	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	0.001 135	0.177 53	780.09	1806.3	2586.4	781.34	2000.4	2781.7	2.1792	4.3744	6.5536
1.20	187.94	0.001 139	0.163 33	797.29	1791.5	2588.8	798.65	1986.2	2784.8	2.2166	4.3067	6.5233
1.30	191.69	0.001 144	0.151 25	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	0.140 84	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	0.131 77	843.16	1751.3	2594.5	844.89	1947.3	2792.2	2.3150	4.1298	6.4448
1.75	205.76	0.001 166	0.113 49	876.46	1721.4	2597.8	878.50	1917.9	2796.4	2.3854	4.0044	6.3896
2.00	212.42	0.001 177	0.099 63	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	0.088 75	933.85	1668.2	2602.0	936.49	1865.2	2801.7	2.5035	3.7937	6.2972
2.50	223.90	0.001 197	0.079 98	959.11	1644.0	2603.1	962.11	1841.0	2803.1	2.5547	3.7028	6.2575
3.0	242.60	0.001 217	0.066 68	1004.78	1599.3	2604.1	1008.42	1795.7	2804.2	2.6457	3.5412	6.1869
3.5	250.40	0.001 232	0.057 07	1045.43	1558.3	2603.7	1049.75	1753.7	2803.4	2.7253	3.4000	6.1253
4	258.99	0.001 248	0.049 78	1082.31	1520.0	2602.3	1087.31	1714.1	2801.4	2.7964	3.2737	6.0701
5	265.94	0.001 266	0.039 44	1147.81	1449.3	2597.1	1154.23	1640.1	2794.3	2.9202	3.0532	5.9734
6	275.64	0.001 319	0.032 44	1205.44	1384.3	2589.7	1213.35	1571.0	2784.3	3.0267	2.8625	5.8892
7	285.88	0.001 351	0.027 37	1257.35	1325.0	2580.5	1267.00	1505.1	2772.1	3.1211	2.6922	5.8133
8	295.06	0.001 384	0.023 52	1305.57	1264.2	2569.8	1316.64	1441.3	2758.0	3.2068	2.5364	5.7432
9	303.40	0.001 418	0.020 48	1350.51	1207.3	2557.8	1363.26	1378.9	2742.1	3.2858	2.3915	5.6772
10	311.06	0.001 452	0.018 026	1393.04	1151.4	2544.4	1407.56	1317.1	2724.7	3.3596	2.2544	5.6141
11	318.15	0.001 489	0.015 967	1433.7	1096.0	2529.8	1450.1	1255.5	2705.6	3.4295	2.1233	5.5527
12	324.75	0.001 527	0.014 263	1473.0	1040.7	2513.7	1491.3	1193.6	2684.9	3.4962	1.9962	5.4924
13	330.93	0.001 567	0.012 780	1511.1	985.0	2496.1	1531.5	1130.7	2662.2	3.5606	1.8718	5.4323
14	336.75	0.001 611	0.011 485	1548.6	928.2	2476.8	1571.1	1066.5	2637.6	3.6232	1.7485	5.3717
15	342.24	0.001 658	0.010 337	1585.6	869.8	2455.5	1610.5	1000.0	2610.5	3.6848	1.6249	5.3098
16	347.44	0.001 711	0.009 306	1622.7	809.0	2431.7	1650.1	930.6	2580.6	3.7461	1.4994	5.2455
17	352.37	0.001 770	0.008 364	1660.2	744.8	2405.0	1690.3	856.9	2547.2	3.8079	1.3698	5.1775
18	357.06	0.001 840	0.007 489	1698.9	675.4	2374.3	1732.0	777.1	2509.1	3.8715	1.2329	5.1044
19	361.54	0.001 924	0.006 657	1739.9	598.1	2338.1	1776.5	688.0	2464.5	3.9388	1.0839	5.0228
20	365.81	0.002 036	0.005 834	1785.6	507.5	2293.0	1826.3	583.4	2409.7	4.0139	.9130	4.9269
21	369.89	0.002 207	0.004 952	1842.1	388.5	2230.6	1888.4	446.2	2334.6	4.1075	.6988	4.8013
22	373.80	0.002 742	0.003 568	1961.9	125.2	2087.1	2022.2	143.4	2165.6	4.3110	.2216	4.5327
22.09	374.14	0.003 155	0.003 155	2029.6	0	2029.6	2029.3	0	2099.3	4.4298	0	4.4298

SOURCE: Gordon J. Van Wylen and Richard E. Sonntag, *Fundamentals of Classical Thermodynamics*, SI Version 2d ed., John Wiley & Sons, Inc., 1976, pp. 648-650, table A.12. Originally published in Joseph H. Keenan, Fredrick G. Keyes, Philip G. Hill and Jean G. Moore, *Steam Tables*, SI Units, Copyright © 1969, 1978 by John Wiley and Sons, Inc.

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Table B-3 SUPERHEATED WATER

T, °C	v _g , m ³ /kg	u _g , kJ/kg	h _g , kJ/kg	s _g , kJ/kg·K	v _g , m ³ /kg	u _g , kJ/kg	h _g , kJ/kg	s _g , kJ/kg·K	v _g , m ³ /kg	u _g , kJ/kg	h _g , kJ/kg	s _g , kJ/kg·K
14.667	23.179	2384.7	81.802	3.240	23.116	2384.3	79.993	1.6940	23.061	2375.5	77.994	1.7294
15.000	23.159	2382.6	81.749	3.241	23.053	2383.8	78.047	1.6934	23.007	2376.6	76.164	1.7614
15.333	23.139	2380.5	81.696	3.242	22.990	2382.1	76.101	1.6928	22.953	2377.7	74.335	1.7934
15.667	23.119	2378.4	81.643	3.243	22.927	2380.4	74.155	1.6922	22.890	2378.8	72.506	1.8254
16.000	23.099	2376.3	81.590	3.244	22.864	2378.7	72.209	1.6916	22.827	2379.9	70.677	1.8574
16.333	23.079	2374.2	81.537	3.245	22.801	2377.0	70.262	1.6910	22.764	2381.0	68.848	1.8894
16.667	23.059	2372.1	81.484	3.246	22.738	2375.1	68.315	1.6904	22.701	2382.1	67.019	1.9214
17.000	23.039	2370.0	81.431	3.247	22.675	2373.2	66.368	1.6898	22.638	2383.2	65.190	1.9534
17.333	23.019	2367.9	81.378	3.248	22.612	2371.3	64.421	1.6892	22.575	2384.3	63.361	1.9854
17.667	22.999	2365.8	81.325	3.249	22.549	2369.4	62.474	1.6886	22.512	2385.4	61.532	2.0174
18.000	22.979	2363.7	81.272	3.250	22.486	2367.5	60.527	1.6880	22.449	2386.5	59.703	2.0494
18.333	22.959	2361.6	81.219	3.251	22.423	2365.6	58.576	1.6874	22.386	2387.6	57.874	2.0814
18.667	22.939	2359.5	81.166	3.252	22.360	2363.7	56.629	1.6868	22.323	2388.7	56.045	2.1134
19.000	22.919	2357.4	81.113	3.253	22.297	2361.8	54.682	1.6862	22.260	2389.8	54.216	2.1454
19.333	22.899	2355.3	81.060	3.254	22.234	2359.9	52.735	1.6856	22.197	2390.9	52.387	2.1774
19.667	22.879	2353.2	81.007	3.255	22.171	2358.0	50.788	1.6850	22.134	2392.0	50.558	2.2094
20.000	22.859	2351.1	80.954	3.256	22.108	2356.1	48.841	1.6844	22.071	2393.1	48.729	2.2414
20.333	22.839	2349.0	80.901	3.257	22.045	2354.2	46.894	1.6838	22.008	2394.2	46.900	2.2734
20.667	22.819	2346.9	80.848	3.258	21.982	2352.3	44.947	1.6832	21.945	2395.3	45.071	2.3054
21.000	22.799	2344.8	80.795	3.259	21.919	2350.4	43.000	1.6826	21.882	2396.4	43.242	2.3374
21.333	22.779	2342.7	80.742	3.260	21.856	2348.5	41.053	1.6820	21.819	2397.5	41.413	2.3694
21.667	22.759	2340.6	80.689	3.261	21.793	2346.6	39.106	1.6814	21.756	2398.6	39.584	2.4014
22.000	22.739	2338.5	80.636	3.262	21.730	2344.7	37.159	1.6808	21.693	2399.7	37.755	2.4334
22.333	22.719	2336.4	80.583	3.263	21.667	2342.8	35.212	1.6802	21.630	2400.8	35.926	2.4654
22.667	22.699	2334.3	80.530	3.264	21.604	2340.9	33.265	1.6796	21.567	2401.9	34.097	2.4974
23.000	22.679	2332.2	80.477	3.265	21.541	2339.0	31.318	1.6790	21.504	2403.0	32.268	2.5294
23.333	22.659	2330.1	80.424	3.266	21.478	2337.1	29.371	1.6784	21.441	2404.1	30.439	2.5614
23.667	22.639	2328.0	80.371	3.267	21.415	2335.2	27.424	1.6778	21.378	2405.2	28.610	2.5934
24.000	22.619	2325.9	80.318	3.268	21.352	2333.3	25.477	1.6772	21.315	2406.3	26.781	2.6254
24.333	22.599	2323.8	80.265	3.269	21.289	2331.4	23.530	1.6766	21.252	2407.4	24.952	2.6574
24.667	22.579	2321.7	80.212	3.270	21.226	2329.5	21.583	1.6760	21.189	2408.5	23.123	2.6894
25.000	22.559	2319.6	80.159	3.271	21.163	2327.6	19.636	1.6754	21.126	2409.6	21.294	2.7214
25.333	22.539	2317.5	80.106	3.272	21.100	2325.7	17.689	1.6748	21.063	2410.7	19.465	2.7534
25.667	22.519	2315.4	80.053	3.273	21.037	2323.8	15.742	1.6742	21.000	2411.8	17.636	2.7854
26.000	22.499	2313.3	80.000	3.274	20.974	2321.9	13.795	1.6736	20.937	2412.9	15.807	2.8174
26.333	22.479	2311.2	79.947	3.275	20.911	2320.0	11.848	1.6730	20.874	2414.0	13.978	2.8494
26.667	22.459	2309.1	79.894	3.276	20.848	2318.1	9.901	1.6724	20.811	2415.1	12.149	2.8814
27.000	22.439	2307.0	79.841	3.277	20.785	2316.2	7.954	1.6718	20.748	2416.2	10.320	2.9134
27.333	22.419	2304.9	79.788	3.278	20.722	2314.3	6.007	1.6712	20.685	2417.3	8.491	2.9454
27.667	22.399	2302.8	79.735	3.279	20.659	2312.4	4.060	1.6706	20.622	2418.4	6.662	2.9774
28.000	22.379	2300.7	79.682	3.280	20.596	2310.5	2.113	1.6700	20.559	2419.5	4.833	3.0094
28.333	22.359	2298.6	79.629	3.281	20.533	2308.6	0.166	1.6694	20.496	2420.6	3.004	3.0414
28.667	22.339	2296.5	79.576	3.282	20.470	2306.7	-1.781	1.6688	20.433	2421.7	1.175	3.0734
29.000	22.319	2294.4	79.523	3.283	20.407	2304.8	-3.728	1.6682	20.370	2422.8	-0.654	3.1054
29.333	22.299	2292.3	79.470	3.284	20.344	2302.9	-5.675	1.6676	20.307	2423.9	-2.485	3.1374
29.667	22.279	2290.2	79.417	3.285	20.281	2301.0	-7.622	1.6670	20.244	2425.0	-4.316	3.1694
30.000	22.259	2288.1	79.364	3.286	20.218	2299.1	-9.569	1.6664	20.181	2426.1	-6.147	3.2014
30.333	22.239	2286.0	79.311	3.287	20.155	2297.2	-11.516	1.6658	20.118	2427.2	-7.978	3.2334
30.667	22.219	2283.9	79.258	3.288	20.092	2295.3	-13.463	1.6652	20.055	2428.3	-9.809	3.2654
31.000	22.199	2281.8	79.205	3.289	20.029	2293.4	-15.410	1.6646	19.992	2429.4	-11.640	3.2974
31.333	22.179	2279.7	79.152	3.290	19.966	2291.5	-17.357	1.6640	19.929	2430.5	-13.471	3.3294
31.667	22.159	2277.6	79.099	3.291	19.903	2289.6	-19.304	1.6634	19.866	2431.6	-15.302	3.3614
32.000	22.139	2275.5	79.046	3.292	19.840	2287.7	-21.251	1.6628	19.803	2432.7	-17.133	3.3934
32.333	22.119	2273.4	78.993	3.293	19.777	2285.8	-23.198	1.6622	19.740	2433.8	-18.964	3.4254
32.667	22.099	2271.3	78.940	3.294	19.714	2283.9	-25.145	1.6616	19.677	2434.9	-20.795	3.4574
33.000	22.079	2269.2	78.887	3.295	19.651	2282.0	-27.092	1.6610	19.614	2436.0	-22.626	3.4894
33.333	22.059	2267.1	78.834	3.296	19.588	2280.1	-29.039	1.6604	19.551	2437.1	-24.457	3.5214
33.667	22.039	2265.0	78.781	3.297	19.525	2278.2	-30.986	1.6598	19.488	2438.2	-26.288	3.5534
34.000	22.019	2262.9	78.728	3.298	19.462	2276.3	-32.933	1.6592	19.425	2439.3	-28.119	3.5854
34.333	21.999	2260.8	78.675	3.299	19.399	2274.4	-34.880	1.6586	19.362	2440.4	-29.950	3.6174
34.667	21.979	2258.7	78.622	3.300	19.336	2272.5	-36.827	1.6580	19.299	2441.5	-31.781	3.6494
35.000	21.959	2256.6	78.569	3.301	19.273	2270.6	-38.774	1.6574	19.236	2442.6	-33.612	3.6814
35.333	21.939	2254.5	78.516	3.302	19.210	2268.7	-40.721	1.6568	19.173	2443.7	-35.443	3.7134
35.667	21.919	2252.4	78.463	3.303	19.147	2266.8	-42.668	1.6562	19.110	2444.8	-37.274	3.7454
36.000	21.899	2250.3	78.410	3.304	19.084	2264.9	-44.615	1.6556	19.047	2445.9	-39.105	3.7774
36.333	21.879	2248.2	78.357	3.305	19.021	2263.0	-46.562	1.6550	18.984	2447.0	-40.936	3.8094
36.667	21.859	2246.1	78.304	3.306	18.958	2261.1	-48.509	1.6544	18.921	2448.1	-42.767	3.8414
37.000	21.839	2244.0	78.251	3.307	18.895	2259.2	-50.456	1.6538	18.858	2449.2	-44.598	3.8734
37.333	21.819	2241.9	78.198	3.308	18.832	2257.3	-52.403	1.6532	18.795	2450.3	-46.429	3.9054
37.667	21.799	2239.8	78.145	3.309	18.769	2255.4	-54.350	1.6526	18.732	2451.4	-48.260	3.9374
38.000	21.779	2237.7	78.092	3.310	18.706	2253.5	-56.297	1.6520	18.669	2452.5	-50.091	3.9694
38.333	21.759	2235.6	78.039	3.311	18.643	2251.6	-58.244	1.6514	18.606	2453.6	-51.922	4.0014
38.667	21.739	2233.5	77.986	3.312	18.580	2249.7	-60.191	1.6508	18.543	2454.7	-53.753	4.0334
39.000	21.719	2231.4	77.933	3.313	18.517	2247.8	-62.138	1.6502	18.480	2455.8	-55.584	4.0654
39.333	2											

Table B-3 SUPERHEATED WATER (Continued)

T, °C	P = 9.0 MPa (303.40°C)				P = 10.0 MPa (311.06°C)				P = 12.5 MPa (327.89°C)			
	v, m³/kg	u, kJ/kg	h, kJ/kg	s, kJ/kg·K	v, m³/kg	u, kJ/kg	h, kJ/kg	s, kJ/kg·K	v, m³/kg	u, kJ/kg	h, kJ/kg	s, kJ/kg·K
Sat.	0.020 48	2557.8	2742.1	5.6772	0.018 076	2544.4	2724.7	5.6141	0.015 495	2505.1	2675.8	5.4674
325	0.23 27	2646.6	2856.0	5.8712	0.19 861	2610.4	2809.1	5.7568				
350	0.25 80	2724.4	2956.6	6.0361	0.22 42	2699.2	2923.4	5.9443	0.16 126	2624.6	2886.2	5.7110
400	0.29 93	2848.4	3117.8	6.2854	0.26 41	2832.4	3096.3	6.2120	0.20 00	2789.5	3039.3	6.0417
450	0.33 50	2955.2	3256.6	6.4844	0.29 75	2943.4	3240.9	6.4190	0.22 99	2912.5	3199.8	6.2719
500	0.36 77	3055.2	3386.1	6.6576	0.32 79	3045.8	3373.7	6.5966	0.25 60	3021.7	3341.8	6.4618
550	0.39 87	3152.2	3511.0	6.8142	0.35 64	3144.5	3500.9	6.7561	0.28 01	3125.0	3475.2	6.6390
600	0.42 85	3248.1	3633.7	6.9589	0.38 37	3241.7	3625.3	6.9029	0.30 29	3225.4	3604.0	6.7810
650	0.45 74	3343.6	3755.3	7.0943	0.41 01	3338.2	3748.2	7.0398	0.32 48	3324.4	3730.4	6.9218
700	0.48 57	3439.3	3878.5	7.2221	0.43 58	3434.7	3870.5	7.1687	0.34 60	3422.9	3855.3	7.0536
800	0.54 09	3632.5	4119.3	7.4596	0.48 89	3628.9	4114.8	7.4077	0.38 69	3620.0	4103.6	7.2956
900	0.59 80	3829.2	4364.8	7.6783	0.53 49	3826.3	4361.2	7.6272	0.42 67	3819.1	4352.5	7.5182
1000	0.64 85	4030.3	4614.0	7.8821	0.58 32	4027.8	4611.0	7.8315	0.46 58	4021.6	4603.8	7.7237
1100	0.70 16	4236.3	4867.7	8.0740	0.63 12	4234.0	4865.1	8.0237	0.50 45	4228.2	4858.8	7.9165
1200	0.75 44	4447.2	5126.2	8.2556	0.67 89	4444.9	5123.8	8.2035	0.54 30	4439.3	5118.0	8.0987
1300	0.80 72	4662.7	5389.2	8.4284	0.72 65	4660.5	5387.0	8.3783	0.58 13	4654.8	5381.4	8.2717
P = 15.0 MPa (342.24°C) P = 17.5 MPa (354.75°C) P = 20.0 MPa (365.81°C)												
325	0.10 337	2455.5	2610.5	5.3098	0.07 920	2390.2	2528.8	5.1415	0.05 834	2295.0	2402.7	4.9269
350	0.11 470	2520.4	2692.4	5.4421								
400	0.15 449	2740.7	2975.5	5.8111	0.12 447	2685.0	2902.9	5.7213	0.09 942	2619.3	2816.1	5.5540
450	0.18 645	2879.3	3156.2	6.1404	0.15 174	2844.2	3109.7	6.0184	0.12 695	2806.2	3060.1	5.9017
500	0.20 80	2996.6	3308.6	6.3443	0.17 358	2970.3	3274.1	6.2383	0.14 768	2942.9	3238.2	6.1401
550	0.22 93	3104.7	3448.6	6.5199	0.19 288	3083.9	3421.4	6.4230	0.16 555	3062.4	3393.5	6.3548
600	0.24 91	3208.6	3582.3	6.6776	0.21 06	3191.5	3560.1	6.5866	0.18 178	3174.0	3537.6	6.5048
650	0.26 80	3310.3	3712.3	6.8224	0.22 74	3296.0	3693.9	6.7357	0.19 693	3281.4	3673.3	6.6582
700	0.28 61	3410.9	3840.1	6.9572	0.24 34	3398.7	3824.6	6.8736	0.21 13	3386.4	3809.0	6.7993
800	0.32 10	3610.9	4092.4	7.2040	0.27 38	3601.8	4081.1	7.1244	0.23 85	3592.7	4069.7	7.0544
900	0.35 46	3811.9	4343.8	7.4279	0.30 31	3804.7	4335.1	7.3507	0.26 45	3797.5	4326.4	7.2830
1000	0.38 75	4015.4	4596.6	7.6348	0.33 16	4009.3	4589.5	7.5589	0.28 97	4003.1	4582.5	7.4925
1100	0.42 00	4222.6	4852.6	7.8285	0.35 97	4216.9	4846.4	7.7531	0.31 45	4211.5	4840.2	7.6874
1200	0.45 23	4433.8	5112.5	8.0108	0.38 76	4428.5	5106.6	7.9360	0.33 91	4422.8	5101.0	7.8707
1300	0.48 45	4649.1	5376.0	8.1840	0.41 54	4643.5	5370.5	8.1093	0.36 36	4638.0	5365.1	8.0442
P = 25.0 MPa P = 30.0 MPa P = 35.0 MPa												
325	0.01 973 1	1798.7	1848.0	4.0320	0.01 789 2	1757.8	1791.5	3.9305	0.01 700 3	1702.9	1762.4	3.8722
400	0.06 004	2450.1	2580.2	5.1418	0.02 790	2067.4	2151.1	4.4728	0.02 100	1914.1	1987.6	4.2126
425	0.07 881	2609.3	2806.3	5.4723	0.03 303	2455.1	2614.2	5.1504	0.03 428	2353.4	2373.4	4.7247
450	0.09 162	2720.7	2949.7	5.6744	0.04 735	2619.3	2821.4	5.4424	0.04 961	2496.7	2672.4	5.1962
500	0.11 123	2884.5	3162.4	5.9592	0.06 678	2820.7	3081.1	5.7905	0.06 927	2751.9	2994.4	5.6282
550	0.12 724	3017.5	3335.6	6.1765	0.10 168	2970.3	3275.4	6.0342	0.08 345	2921.9	3213.0	5.9026
600	0.14 137	3137.9	3491.4	6.3602	0.11 446	3100.5	3443.9	6.2331	0.09 527	3062.0	3395.5	6.1179
650	0.15 433	3251.6	3637.5	6.5229	0.12 596	3221.0	3598.9	6.4058	0.10 575	3189.8	3559.9	6.3010
700	0.16 646	3361.3	3773.5	6.6707	0.13 661	3335.8	3745.6	6.5676	0.11 533	3320.8	3713.5	6.4631
800	0.21 045	3574.3	4047.1	6.9345	0.15 623	3535.5	4024.2	6.8332	0.13 278	3536.7	4001.5	6.7450
900	0.21 045	3783.0	4309.1	7.1680	0.17 448	3768.5	4291.9	7.0718	0.14 883	3754.0	4274.9	6.9886
1000	0.23 10	3990.9	4568.5	7.3802	0.19 196	3978.8	4554.7	7.2867	0.16 410	3966.7	4541.1	7.2064
1100	0.25 12	4200.2	4828.2	7.5765	0.20 905	4189.2	4816.3	7.4845	0.17 895	4178.3	4808.3	7.4057
1200	0.27 11	4412.0	5089.9	7.7605	0.22 589	4401.5	5079.0	7.6692	0.19 360	4390.7	5068.3	7.5910
1300	0.29 10	4626.9	5354.4	7.9342	0.24 266	4616.0	5344.0	7.8432	0.20 815	4605.1	5333.6	7.7653
P = 40.0 MPa P = 50.0 MPa P = 60.0 MPa												
325	0.01 640 7	1677.1	1742.8	3.8290	0.01 559 4	1638.6	1716.6	3.7659	0.01 502 8	1606.4	1699.5	3.7141
400	0.01 907 7	1854.6	1930.9	4.1135	0.01 730 9	1788.1	1874.6	4.0051	0.01 635 8	1745.4	1843.4	3.9318
425	0.02 532	2096.9	2198.1	4.5029	0.02 007	1954.7	2060.0	4.2754	0.01 816 5	1892.7	2001.7	4.1626
450	0.03 693	2363.1	2518.8	4.9459	0.02 486	2159.6	2284.0	4.5884	0.02 085	2053.9	2179.0	4.4121
500	0.05 623	2568.4	2905.3	5.4700	0.03 892	2523.5	2720.1	5.1726	0.02 956	2390.6	2567.9	4.9321
550	0.06 984	2869.7	3149.1	5.7785	0.05 118	2763.6	3019.5	5.5483	0.03 956	2658.8	2866.2	5.3441
600	0.08 094	3022.6	3346.4	6.0114	0.06 112	2942.0	3247.6	5.8178	0.04 834	2861.1	3151.2	5.6452
650	0.09 063	3158.0	3520.6	6.2054	0.06 966	3093.5	3441.8	6.0342	0.05 595	3028.8	3364.5	5.8829
700	0.09 941	3283.6	3681.2	6.3750	0.07 727	3230.5	3616.8	6.2189	0.06 272	3177.2	3533.5	6.0824
800	0.11 523	3517.8	3978.7	6.6662	0.09 076	3479.8	3933.6	6.5290	0.07 459	3441.5	3889.1	6.4109
900	0.12 962	3739.4	4257.9	6.9150	0.10 283	3710.5	4224.4	6.7882	0.08 508	3681.0	4171.5	6.6803
1000	0.14 324	3954.6	4527.6	7.1356	0.11 411	3930.5	4501.1	7.0146	0.09 480	3906.4	4475.2	6.9127
1100	0.15 642	4167.4	4793.1	7.3364	0.12 496	4143.7	4770.5	7.2184	0.10 409	4124.1	4748.6	7.1195
1200	0.16 940	4380.1	5057.7	7.5224	0.13 561	4359.1	5037.2	7.4058	0.11 317	4338.2	5017.2	7.3083
1300	0.18 229	4594.5	5323.5	7.6969	0.14 616	4572.8	5303.6	7.5808	0.12 215	4551.4	5284.3	7.4837