THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
DIPLOMA IN TECHNOLOGY – LEVEL 4
FINAL EXAMINATION 2005/2006

MEX 4239 – REFRIGERATION AND AIR CONDITIONING
DATE : 04TH APRIL 2006
TIME : 1015 HRS TO 1230 HRS
DURATION : 2 HOURS AND 15 MINUTES

PART B

Answer any **five** questions. All questions carry equals marks.

(1) Explain the following giving their units of measurement:

(i) One ton of refrigeration

(ii) Internal energy of a gas

(iii) Enthalpy

(iv) Specific volume

(v) Pressure

(2) Explain,

(a) (i) Dalton's Law of Partial Pressure

(ii) Psychrometry

(iii) Dew point temperature

(b) The air temperature is 24°C and partial pressure is 0.018168 bar. Using water properties table, determine,

(i) Dew point of air.

(ii) Absolute humidity

(iii) Relative humidity

(3) Discuss the construction of a simple refrigerator that works on the principle of vapour compression cycle. Assume that a cylinder containing the refrigerant and other components are available.

Give reasons for incorporating a compressor after the evaporator and a pressure-reducing valve after the condenser.

(4) Express the corollary of 2nd Law of Thermodynamics.

Observe and comment the analogy between the said law and Refrigeration.

Saturated refrigerant (134a) vapour enters the compressor of an ideal Vapour Compression Refrigeration cycle at 1.6 bar. Saturated liquid enters the expansion valve at 7 bars.

For five-ton unit determine,

(a) The temperature of fluid leaving the compressor.

(b) The coefficient of performance.

(c) The power input to the compressor in kilowatts.

(5) In which way does the vapour compression system vary from the vapour absorption system?

Discuss it with the help of flow diagrams and T-s diagrams.

Show that the coefficient of performance of vapour absorption cycle is given by the equation,

$$\text{C.O.P} = \frac{\text{Evaporator work}}{\text{Generator work}} = \frac{T_C}{T_g} = \frac{T_g - T_a}{T_a - T_C}$$

Where ,

T_c = *Cold* space temperature

T_g = *Generator temperature*

T_a = Ambient temperature

For a vapour absorption refrigerator heat source of 110°C is available. If the ambient temperature is 30°C and cold space temperature expected is -10°C, calculate the coefficient of performance expected.

(6) It is desirable to have a closed cooling water circulation system incorporated with a cooling tower in industrial organization than with an open cooling water system. Give reasons.

Cooling water leaves the condenser of a power plant and enters the wet cooling tower at 35°C at the rate of 100 kgs/min. The water is cooled to 22°C in the tower by air, which enters at 1 atm and 20°C with Relative Humidity 60%, and leaves the tower fully saturated at 30°C.

Neglecting the fan power, determine,

(a)Volume flow rates of air in the cooling tower.

(b) Mass flow rate of Make up water.

(7) Illustrate various air conditioning processes in psychrometric chart.

Air is to be cooled and dehumidified by contact with a cooling coil in order to make the dry bulb temperature drop from 30°C to 16°C . The wet bulb temperature before cooling is 25°C.

(i) Using the psychrometric chart determine the final Wet Bulb temperature, change in relative humidity, DP, moisture content and specific enthalpy.

(ii) Illustrate the process diagrammatically in a psychrometric chart.

(8)

(i) Prepare a list of important tools and measuring equipment that should be available in a air conditioning workshop.

(ii) Explain how a refrigerant is recovered into a cylinder, to avoid it being released to the environment.

(iii) Explain the procedure involved in charging a refrigerant into an automobile air conditioning system.

(9)

(i) List out the types of loads that should be considered in formulating the specifications of a freezing unit in cold room.

(ii) Estimate the capacity of a refrigeration system suitable for a vegetable cold room, to suit the following conditions

Cold room temperature	= 4 °C
Ambient temperature	= 35 °C
Internal dimensions of room	– 3m length x 2m width x 2.5m height
Insulation	- Polyurethane foam panels of thickness 75 mm
External dimensions	= 3.15m x 2.15m x 2.65m
Product load	= 1200 kg/ day entering at 25°C
Total store load	= 4000 kg
Product specific heat	= 3.6 kJ/kg °C
Electric lights	= 100W for 6 hours/ day
Respiration factor	= 5.0 kJ/ kg day
Service factor	= normal
Thermal transmittance	= 0.28 Watts/m²/°C

Heat factor for considering air in filtration load = 96000 J/m³

No. of air change for the given volume per day = 19 in 24 hrs

Running hours per day = 16

Table 8.1 Water properties

Temp. (°C)	Saturation vapour pressure 10^5 Pa (bar)	Specific volume (m^3/kg)	
		Liquid	Vapour
0	0.006108	0.0010002	206.3
2	0.007055	0.0010001	179.9
4	0.008129	0.0010000	157.3
6	0.009345	0.0010000	137.8
8	0.010720	0.0010001	121.0
10	0.012270	0.0010003	106.4
12	0.014014	0.0010004	93.84
14	0.015973	0.0010007	82.90
16	0.018168	0.0010010	73.38
18	0.02062	0.0010013	65.09
20	0.02337	0.0010017	57.84
22	0.02642	0.0010022	51.49
24	0.02982	0.0010026	45.93
26	0.03360	0.0010032	41.03
28	0.03778	0.0010037	36.73
30	0.04241	0.0010043	32.93
32	0.04753	0.0010049	29.57
34	0.05318	0.0010056	26.60
36	0.05940	0.0010063	23.97
38	0.06624	0.0010070	21.63
40	0.07375	0.0010078	19.55
42	0.08198	0.0010086	17.69
44	0.09100	0.0010094	16.04
46	0.10086	0.0010103	14.56
48	0.11162	0.0010112	13.23
50	0.12335	0.0010121	12.05
52	0.13613	0.0010131	10.98
54	0.15002	0.0010140	10.02
56	0.16511	0.0010150	9.159
58	0.18147	0.0010161	8.381
60	0.19920	0.0010171	7.679
62	0.2184	0.0010182	7.044
64	0.2391	0.0010193	6.469
66	0.2615	0.0010205	5.948
68	0.2856	0.0010217	5.475
70	0.3116	0.0010228	5.046
72	0.3396	0.0010241	4.656
74	0.3696	0.0010253	4.300
76	0.4019	0.0010266	3.976
78	0.4365	0.0010279	3.680
80	0.4736	0.0010292	3.409
82	0.5133	0.0010305	3.162
84	0.5557	0.0010319	2.935

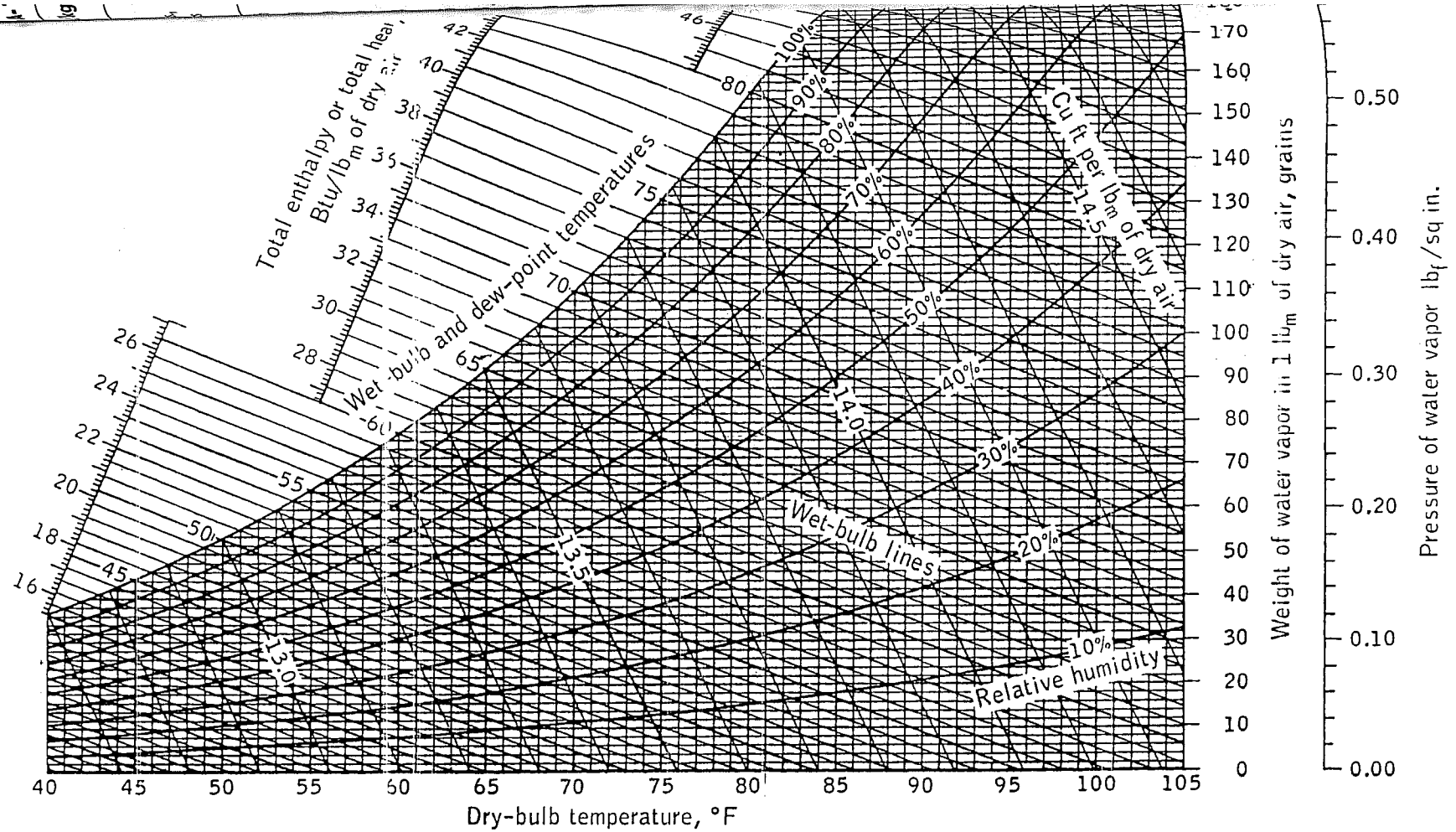

Figure A-25E Psychrometric chart, USCS units, barometric pressure 14.696 psia. (*Copyright, 1942, by General Electric Company.*)

Properties of saturated refrigerant 134a (CF_4H_2): Pressure table

kJ/kg; *h*, kJ/kg; *s*, kJ/kg·K)

emp., °C *T*	Specific Volume		Internal Energy		Enthalpy			Entropy	
	Sat. Liquid $v_f \times 10^3$	Sat. Vapor v_g	Sat. Liquid u_f	Sat. Vapor u_g	Sat. Liquid h_f	Evap. h_{fg}	Sat. Vapor h_g	Sat. Liquid s_f	Sat. Vapor s_g
37.07	0.7097	0.3100	3.41	206.12	3.46	221.27	224.72	0.0147	0.9520
31.21	0.7184	0.2366	10.41	209.46	10.47	217.92	228.39	0.0440	0.9447
26.43	0.7258	0.1917	16.22	212.18	16.29	215.06	231.35	0.0678	0.9395
22.36	0.7323	0.1614	21.23	214.50	21.32	212.54	233.86	0.0879	0.9354
18.80	0.7381	0.1395	25.66	216.52	25.77	210.27	236.04	0.1055	0.9322
15.62	0.7435	0.1229	29.66	218.32	29.78	208.19	237.97	0.1211	0.9295
12.73	0.7485	0.1098	33.31	219.94	33.45	206.26	239.71	0.1352	0.9273
10.09	0.7532	0.0993	36.69	221.43	36.84	204.46	241.30	0.1481	0.9253
-5.37	0.7618	0.0834	42.77	224.07	42.95	201.14	244.09	0.1710	0.9222
-1.23	0.7697	0.0719	48.18	226.38	48.39	198.13	246.52	0.1911	0.9197
2.48	0.7770	0.0632	53.06	228.43	53.31	195.35	248.66	0.2089	0.9177
5.84	0.7839	0.0564	57.54	230.28	57.82	192.76	250.58	0.2251	0.91660
8.93	0.7904	0.0509	61.69	231.97	62.00	190.32	252.32	0.2399	0.9145
15.74	0.8056	0.0409	70.93	235.64	71.33	184.74	256.07	0.2723	0.9117
21.58	0.8196	0.0341	78.99	238.74	79.48	179.71	259.19	0.2999	0.9097
26.72	0.8328	0.0292	86.19	241.42	86.78	175.07	261.85	0.3242	0.9080
31.33	0.8454	0.0255	92.75	243.78	93.42	170.73	264.15	0.3459	0.9066
35.53	0.8576	0.0226	98.79	245.88	99.56	166.62	266.18	0.3656	0.9054
39.39	0.8695	0.0202	104.42	247.77	105.29	162.68	267.97	0.3838	0.9043
46.32	0.8928	0.0166	114.69	251.03	115.76	155.23	270.99	0.4164	0.9023
52.43	0.9159	0.0140	123.98	253.74	125.26	148.14	273.40	0.4453	0.9003
57.92	0.9392	0.0121	132.52	256.00	134.02	141.31	275.33	0.4714	0.8982
62.91	0.9631	0.0105	140.49	257.88	142.22	134.60	276.83	0.4954	0.8959
67.49	0.9878	0.0093	148.02	259.41	149.99	127.95	277.94	0.5178	0.8934
77.59	1.0562	0.0069	165.48	261.84	168.12	111.06	279.17	0.5687	0.8854
86.22	1.1416	0.0053	181.88	262.16	185.30	92.71	278.01	0.6156	0.8735

d from a computer program provided by R. S. Basu, Allied Signal Corporation. *Literature Source:* D. P. Wilson and R. S. Basu, Properties of a New Stratospherically Safe Working Fluid—Refrigerant-134a," *ASHRAE Trans.*, **94** (Pt. 2): 2095–2118, 1988.

ble A-16 Properties of saturated refrigerant 134a (CF_4H_2): Temperature table

m^3/kg; u, kJ/kg; h, kJ/kg; s, kJ/kg·K)

Temp., °C T	Press., bars P	Specific Volume		Internal Energy		Enthalpy			Entropy	
		Sat. Liquid $v_f \times 10^3$	Sat. Vapor v_g	Sat. Liquid u_f	Sat. Vapor u_g	Sat. Liquid h_f	Evap. h_{fg}	Sat. Vapor h_g	Sat. Liquid s_f	Sat. Vapor s_g
−40	0.5164	0.7055	0.3569	−0.04	204.45	0.00	222.88	222.88	0.0000	0.9560
−36	0.6332	0.7113	0.2947	4.68	206.73	4.73	220.67	225.40	0.0201	09506
−32	0.7704	0.7172	0.2451	9.47	209.01	9.52	218.37	227.90	0.0401	0.9456
−28	0.9305	0.7233	0.2052	14.31	211.29	14.37	216.01	230.38	0.0600	0.9411
−26	1.0199	0.7265	0.1882	16.75	212.43	16.82	214.80	231.62	0.0699	0.9390
−24	1.1160	0.7296	0.1728	19.21	213.57	19.29	213.57	232.85	0.0798	0.9370
−22	1.2192	0.7328	0.1590	21.68	214.70	21.77	212.32	234.08	0.0897	0.9351
−20	1.3299	0.7361	0.1464	24.17	215.84	24.26	211.05	235.31	0.0996	0.9332
−18	1.4483	0.7395	0.1350	26.67	216.97	26.77	209.76	236.53	0.1094	0.9315
−16	1.5748	0.7428	0.1247	29.18	218.10	29.30	208.45	237.74	0.1192	0.9298
−12	1.8540	0.7498	0.1068	34.25	220.36	34.39	205.77	240.15	0.1388	0.9267
−8	2.1704	0.7569	0.0919	39.38	222.60	39.54	203.00	242.54	0.1583	0.9239
−4	2.5274	0.7644	0.0794	44.56	224.84	44.75	200.15	244.90	0.1777	0.9213
0	2.9282	0.7721	0.0689	49.79	227.06	50.02	197.21	247.23	0.1970	0.9190
4	3.3765	0.7801	0.0600	55.08	229.27	55.35	194.19	249.53	0.2162	0.9169
8	3.8756	0.7884	0.0525	60.43	231.46	60.73	191.07	251.80	0.2354	0.9150
12	4.4294	0.7971	0.0460	65.83	233.63	66.18	187.85	254.03	0.2545	0.9132
16	5.0416	0.8062	0.0405	71.29	235.78	71.69	184.52	256.22	0.2735	0.9116
20	5.7160	0.8157	0.0358	76.80	237.91	77.26	181.09	258.36	0.2924	0.9102
24	6.4566	0.8257	0.0317	82.37	240.01	82.90	177.55	260.45	0.3113	0.9089
26	6.8530	0.8309	0.0298	85.18	241.05	85.75	175.73	261.48	0.3208	0.9082
28	7.2675	0.8362	0.0281	88.00	242.08	88.61	173.89	262.50	0.3302	0.9076
30	7.7006	0.8417	0.0265	90.84	243.10	91.49	172.00	263.50	0.3396	0.9070
32	8.1528	0.8473	0.0250	93.70	244.12	94.39	170.09	264.48	0.3490	0.9064
34	8.6247	0.8530	0.0236	96.58	245.12	97.31	168.14	265.45	0.3584	0.9058
36	9.1168	0.8590	0.0223	99.47	246.11	100.25	166.15	266.40	0.3678	0.9053
38	9.6298	0.8651	0.0210	102.38	247.09	103.21	164.12	267.33	0.3772	0.9047
40	10.164	0.8714	0.0199	105.30	248.06	106.19	162.05	268.24	0.3866	0.9041
42	10.720	0.8780	0.0188	108.25	249.02	109.19	159.04	269.14	0.3960	0.9035
44	11.299	0.8847	0.0177	111.22	249.96	112.22	157.79	270.01	0.4054	0.9030
48	12.526	0.8989	0.0159	117.22	251.79	118.35	153.33	271.68	0.4243	0.9017
52	13.851	0.9142	0.0142	123.31	253.55	124.58	148.66	273.24	0.4432	0.9004
56	15.278	0.9308	0.0127	129.51	255.23	130.93	143.75	274.68	0.4622	0.8990
60	16.813	0.9488	0.0114	135.82	256.81	137.42	138.57	275.99	0.4814	0.8973
70	21.162	1.0027	0.0086	152.22	260.15	154.34	124.08	278.43	0.5302	0.8918
80	26.324	1.0766	0.0064	169.88	262.14	172.71	106.41	279.12	0.5814	0.8827
90	32.435	1.1949	0.0046	189.82	261.34	193.69	82.63	276.32	0.6380	0.8655
00	39.742	1.5443	0.0027	218.60	248.49	224.74	34.40	259.13	0.7196	0.8117

CE: Produced from a computer program provided by R. S. Basu, Allied Signal Corporation. *Literature Source:* D. P. Wilson and Basu, "Thermodynamic Properties of a New Stratospherically Safe Working Fluid–Refrigerant-134a," *ASHRAE Trans.*, **94** (Pt.2): -2118,1988.

ble A-14 *(Continued)*

Temp., °C	v	u	h	s	v	u	h	s
	160 bars (16.0 MPa) ($T_{sat.}$ = 347.44°C)				180 bars (18.0 MPa) (T_{sat} = 357.06°C)			
Sat.	0.00931	2431.7	2580.6	5.2455	0.00749	2374.3	2509.1	5.1044
360	0.01105	2539.0	2715.8	5.4614	0.00809	2418.9	2564.5	5.1922
400	0.01426	2719.4	2947.6	5.8175	0.01190	2672.8	2887.0	5.6887
440	0.01652	2839.4	3103.7	6.0429	0.01414	2808.2	3062.8	5.9428
480	0.01842	2939.7	3234.4	6.2215	0.01596	2915.9	3203.2	6.1345
520	0.02013	3031.1	3353.3	6.3752	0.01757	3011.8	3378.0	6.2960
560	0.02172	3117.8	3465.4	6.5132	0.01904	3101.7	3444.4	6.4392
600	0.02323	3201.8	3573.5	6.6399	0.02042	3188.0	3555.6	6.5696
640	0.02467	3284.2	3678.9	6.7580	0.02174	3272.3	3663.6	6.6905
700	0.02674	3406.0	3833.9	6.9224	0.02362	3396.3	3821.5	6.8580
740	0.02808	3486.7	3935.9	7.0251	0.02483	3478.0	3925.0	6.9623
	200 bars (20.0 MPa) (T_{sat} = 365.81°C)				240 bars (24.0 MPa)			
Sat.	0.00583	2293.0	2409.7	4.9269				
400	0.00994	2619.3	2818.1	5.5540	0.00673	2477.8	2639.4	5.2393
440	0.01222	2774.9	3019.4	5.8450	0.00929	2700.6	2923.4	5.6506
480	0.01399	2891.2	3170.8	6.0518	0.01100	2838.3	3102.3	5.8950
520	0.01551	2992.0	3302.2	6.2218	0.01241	2950.5	3248.5	6.0842
560	0.01689	3085.2	3423.0	6.3705	0.01366	3051.1	3379.0	6.2448
600	0.01818	3174.0	3537.6	6.5048	0.01481	3145.2	3500.7	6.3875
640	0.01940	3260.2	3648.1	6.6286	0.01588	3235.5	3616.7	6.5174
700	0.02113	3386.4	3809.0	6.7993	0.01739	3366.4	3783.8	6.6947
740	0.02224	3469.3	3914.1	6.9052	0.01835	3451.7	3892.1	6.8038
800	0.02385	3592.7	4069.7	7.0544	0.01974	3578.0	4051.6	6.9567
	280 bars (28.0 MPa)				320 bars (32.0 MPa)			
400	0.00383	2223.5	2330.7	4.7494	0.00236	1980.4	2055.9	4.3239
440	0.00712	2613.2	2812.6	5.4494	0.00544	2509.0	2683.0	5.2327
480	0.00885	2780.8	3028.5	5.7446	0.00722	2718.1	3949.2	5.5968
520	0.01020	3906.8	3192.3	5.9566	0.00853	2860.7	3133.7	5.8357
560	0.01136	3015.7	3333.7	6.1307	0.00963	2979.0	3287.2	6.0246
600	0.01241	3115.6	3463.0	6.2823	0.01061	3085.3	3424.6	6.1858
640	0.01338	3210.3	3584.8	6.4187	0.01150	3184.5	3552.5	6.3290
700	0.01473	3346.1	3758.4	6.6029	0.01273	3325.4	3732.8	6.5203
740	0.01558	3433.9	3870.0	6.7153	0.01350	3415.9	3847.8	6.6361
800	0.01680	3563.1	4033.4	6.8720	0.01460	3548.0	4015.1	6.7966
900	0.01873	3774.3	4298.8	7.1084	0.01633	3762.7	4285.1	7.0372

URCE: J. H. Keenan, F. G. Keyes, P. G. Hill, and J. G. Moore, "Steam Tables," Wiley, New York, 1969.

Table A-14 Properties of water: Superheated-vapor table

(v, m^3/kg; u, kJ/kg; h, kJ/kg; s, kJ/kg·K)

Temp., °C	v	u	h	s	v	u	h	s
	0.06 bar (0.006MPa) (T_{sat} = 36.16°C)				0.35 bar (0.035MPa) (T_{sat} = 72.69°C)			
Sat.	23.739	2425.0	2567.4	8.3304	4.526	2473.0	2631.4	7.7158
80	27.132	2487.3	2650.1	8.5804	4.625	2483.7	2645.6	7.7564
120	30.219	2544.7	2726.0	8.7840	5.163	2542.4	2723.1	7.9644
160	33.302	2602.7	2802.5	8.9693	5.696	2601.2	2800.6	8.1519
200	36.383	2661.4	2879.7	9.1398	6.228	2660.4	2878.4	8.3237
240	39.462	2721.0	2957.8	9.2982	6.758	2720.3	2956.8	8.4828
280	42.540	2781.5	3036.8	9.4464	7.287	2780.9	3036.0	8.6314
320	45.618	2843.0	3116.7	9.5859	7.815	2842.5	3116.1	8.7712
360	48.696	2905.5	3197.7	9.7180	8.344	2905.1	3197.1	8.9034
400	51.774	2969.0	3279.6	9.8435	8.872	2968.6	3279.2	9.0291
440	54.851	3033.5	3362.6	9.9633	9.400	3033.2	3362.2	9.1490
500	59.467	3132.3	3489.1	10.134	10.192	3132.1	3488.8	9.3194
	0.70 bar (0.07 MPa) (T_{sat} = 89.95°C)				1.0 bar (0.10 MPa) (T_{sat} = 99.63°C)			
Sat.	2.365	2494.5	2660.0	7.4797	1.694	2506.1	2675.5	7.3594
100	2.434	2509.7	2680.0	7.5341	1.696	2506.7	2676.2	7.3614
120	2.571	2539.7	2719.6	7.6375	1.793	2537.3	2716.6	7.4668
160	2.841	2599.4	2798.2	7.8279	1.984	2597.8	2796.2	7.6597
200	3.108	2659.1	2876.7	8.0012	2.172	2658.1	2875.3	7.8343
240	3.374	2719.3	2955.5	8.1611	2.359	2718.5	2954.5	7.9949
280	3.640	2780.2	3035.0	8.3162	2.546	2779.6	3034.2	8.1445
320	3.905	2842.0	3115.3	8.4504	2.732	2841.5	3114.6	8.2849
360	4.170	2904.6	3196.5	8.5828	2.917	2904.2	3195.9	8.4175
400	4.434	2968.2	3278.6	8.7086	3.103	2967.9	3278.2	8.5435
440	4.698	3032.9	3361.8	8.8286	3.288	3032.6	3361.4	8.6636
500	5.095	3131.8	3488.5	8.9991	3.565	3131.6	3488.1	8.8342
	1.5 bars (0.15 MPa) (T_{sat} = 111.37°C)				3.0 bars (0.30 MPa) (T_{sat} = 133.55°C)			
Sat.	1.159	2519.7	2693.6	7.2233	0.606	2543.6	2725.3	6.9919
120	1.188	2533.3	2711.4	7.2693				
160	1.317	2595.2	2792.8	7.4665	0.651	2587.1	2782.3	7.1276
200	1.444	2656.2	2872.9	7.6433	0.716	2650.7	2865.5	7.3115
240	1.570	2717.2	2952.7	7.8052	0.781	2713.1	2947.3	7.4774
280	1.695	2778.6	3032.8	7.9555	0.844	2775.4	3028.6	7.6299
320	1.819	2840.6	3113.5	8.0964	0.907	2838.1	3110.1	7.7722
360	1.943	2903.5	3195.0	8.2293	0.969	2901.4	3192.2	7.9061
400	2.067	2967.3	3277.4	8.3555	1.032	2965.6	3275.0	8.0330
440	2.191	3032.1	3360.7	8.4757	1.094	3030.6	3358.7	8.1538
500	2.376	3131.2	3487.6	8.6466	1.187	3130.0	3486.0	8.3251
600	2.685	3301.7	3704.3	8.9101	1.341	3300.8	3703.2	8.5892

ıle A-14 *(Continued)*

Temp., °C	v	u	h	s	v	u	h	s
	160 bars (16.0 MPa) ($T_{sat.}$ = 347.44°C)				180 bars (18.0 MPa) (T_{sat} = 357.06°C)			
Sat.	0.00931	2431.7	2580.6	5.2455	0.00749	2374.3	2509.1	5.1044
360	0.01105	2539.0	2715.8	5.4614	0.00809	2418.9	2564.5	5.1922
400	0.01426	2719.4	2947.6	5.8175	0.01190	2672.8	2887.0	5.6887
440	0.01652	2839.4	3103.7	6.0429	0.01414	2808.2	3062.8	5.9428
480	0.01842	2939.7	3234.4	6.2215	0.01596	2915.9	3203.2	6.1345
520	0.02013	3031.1	3353.3	6.3752	0.01757	3011.8	3378.0	6.2960
560	0.02172	3117.8	3465.4	6.5132	0.01904	3101.7	3444.4	6.4392
600	0.02323	3201.8	3573.5	6.6399	0.02042	3188.0	3555.6	6.5696
640	0.02467	3284.2	3678.9	6.7580	0.02174	3272.3	3663.6	6.6905
700	0.02674	3406.0	3833.9	6.9224	0.02362	3396.3	3821.5	6.8580
740	0.02808	3486.7	3935.9	7.0251	0.02483	3478.0	3925.0	6.9623
	200 bars (20.0 MPa) (T_{sat} = 365.81°C)				240 bars (24.0 MPa)			
Sat.	0.00583	2293.0	2409.7	4.9269				
400	0.00994	2619.3	2818.1	5.5540	0.00673	2477.8	2639.4	5.2393
440	0.01222	2774.9	3019.4	5.8450	0.00929	2700.6	2923.4	5.6506
480	0.01399	2891.2	3170.8	6.0518	0.01100	2838.3	3102.3	5.8950
520	0.01551	2992.0	3302.2	6.2218	0.01241	2950.5	3248.5	6.0842
560	0.01689	3085.2	3423.0	6.3705	0.01366	3051.1	3379.0	6.2448
600	0.01818	3174.0	3537.6	6.5048	0.01481	3145.2	3500.7	6.3875
640	0.01940	3260.2	3648.1	6.6286	0.01588	3235.5	3616.7	6.5174
700	0.02113	3386.4	3809.0	6.7993	0.01739	3366.4	3783.8	6.6947
740	0.02224	3469.3	3914.1	6.9052	0.01835	3451.7	3892.1	6.8038
800	0.02385	3592.7	4069.7	7.0544	0.01974	3578.0	4051.6	6.9567
	280 bars (28.0 MPa)				320 bars (32.0 MPa)			
400	0.00383	2223.5	2330.7	4.7494	0.00236	1980.4	2055.9	4.3239
440	0.00712	2613.2	2812.6	5.4494	0.00544	2509.0	2683.0	5.2327
480	0.00885	2780.8	3028.5	5.7446	0.00722	2718.1	3949.2	5.5968
520	0.01020	3906.8	3192.3	5.9566	0.00853	2860.7	3133.7	5.8357
560	0.01136	3015.7	3333.7	6.1307	0.00963	2979.0	3287.2	6.0246
600	0.01241	3115.6	3463.0	6.2823	0.01061	3085.3	3424.6	6.1858
640	0.01338	3210.3	3584.8	6.4187	0.01150	3184.5	3552.5	6.3290
700	0.01473	3346.1	3758.4	6.6029	0.01273	3325.4	3732.8	6.5203
740	0.01558	3433.9	3870.0	6.7153	0.01350	3415.9	3847.8	6.6361
800	0.01680	3563.1	4033.4	6.8720	0.01460	3548.0	4015.1	6.7966
900	0.01873	3774.3	4298.8	7.1084	0.01633	3762.7	4285.1	7.0372

CE: J. H. Keenan, F. G. Keyes, P. G. Hill, and J. G. Moore, "Steam Tables," Wiley, New York, 1969.

Table A-14 *(Continued)*

Temp., °C	v	u	h	s	v	u	h	s
	40 bars (4.0 MPa) (T_{sat} = 250.40°C)				60 bars (6.0 MPa) (T_{sat} = 275.64°C)			
Sat.	0.04978	2602.3	2801.4	6.0701	0.03244	2589.7	2784.3	5.8892
280	0.05546	2680.0	2901.8	6.2568	0.03317	2605.2	2804.2	5.9252
320	0.06199	2767.4	3015.4	6.4553	0.03876	2720.0	2952.6	6.1846
360	0.06788	2845.7	3117.2	6.6215	0.04331	2811.2	3071.1	6.3782
400	0.07341	2919.9	3213.6	6.7690	0.04739	2892.9	3177.2	6.5408
440	0.07872	2992.2	3307.1	6.9041	0.05122	2970.0	3277.3	6.6853
500	0.08643	3099.5	3445.3	7.0901	0.05665	3082.2	3422.2	6.8803
540	0.09145	3171.1	3536.9	7.2056	0.06015	3156.1	3517.0	6.9999
600	0.09885	3279.1	3674.4	7.3688	0.06525	3266.9	3658.4	7.1677
640	0.1037	3351.8	3766.6	7.4720	0.06859	3341.0	3752.6	7.2731
700	0.1110	3462.1	3905.9	7.6198	0.07352	3453.1	3894.1	7.4234
740	0.1157	3536.6	3999.6	7.7141	0.07677	3528.3	3989.2	7.5190
	80 bars (8.0 MPa) (T_{sat} = 295.06°C)				100 bars (10.0 MPa) (T_{sat} = 311.06°C)			
Sat.	0.02352	2569.8	2758.0	5.7432	0.01803	2544.4	2724.7	5.6141
320	0.02682	2662.7	2877.2	5.9489	0.01925	2588.8	2781.3	5.7103
360	0.03089	2772.7	3019.8	6.1819	0.02331	2729.1	2962.1	6.0060
400	0.03432	2863.8	3138.3	6.3634	0.02641	2832.4	3096.5	6.2120
440	0.03742	2946.7	3246.1	6.5190	0.02911	2922.1	3213.2	6.3805
480	0.04034	3025.7	3348.4	6.6586	0.03160	3005.4	3321.4	6.5282
520	0.04313	3102.7	3447.7	6.7871	0.03394	3085.6	3425.1	6.6622
560	0.04582	3178.7	3545.3	6.9072	0.03619	3164.1	3526.0	6.7864
600	0.04845	3254.4	3642.0	7.0206	0.03837	3241.7	3625.3	6.9029
640	0.05102	3330.1	3738.3	7.1283	0.04048	3318.9	3723.7	7.0131
700	0.05481	3443.9	3882.4	7.2812	0.04358	3434.7	3870.5	7.1687
740	0.05729	3520.4	3978.7	7.3782	0.04560	3512.1	3968.1	7.2670
	120 bars (12.0 MPa) (T_{sat} = 324.75°C)				140 bars (14.0 MPa) (T_{sat} = 336.75°C)			
Sat.	0.01426	2513.7	2684.9	5.4924	0.01149	2476.8	2637.6	5.3717
360	0.01811	2678.4	2895.7	5.8361	0.01422	2617.4	2816.5	5.6602
400	0.02108	2798.3	3051.3	6.0747	0.01722	2760.9	3001.9	5.9448
440	0.02355	2896.1	3178.7	6.2586	0.01954	2868.6	3142.2	6.1474
480	0.02576	2984.4	3293.5	6.4154	0.02157	2962.5	3264.5	6.3143
520	0.02781	3068.0	3401.8	6.5555	0.02343	3049.8	3377.8	6.4610
560	0.02977	3149.0	3506.2	6.6840	0.02517	3133.6	3486.0	6.5941
600	0.03164	3228.7	3608.3	6.8037	0.02683	3215.4	3591.1	6.7172
640	0.03345	3307.5	3709.0	6.9164	0.02843	3296.0	3694.1	6.8326
700	0.03610	3425.2	3858.4	7.0749	0.03075	3415.7	3846.2	6.9939
740	0.03781	3503.7	3957.4	7.1746	0.03225	3495.2	3946.7	7.0952