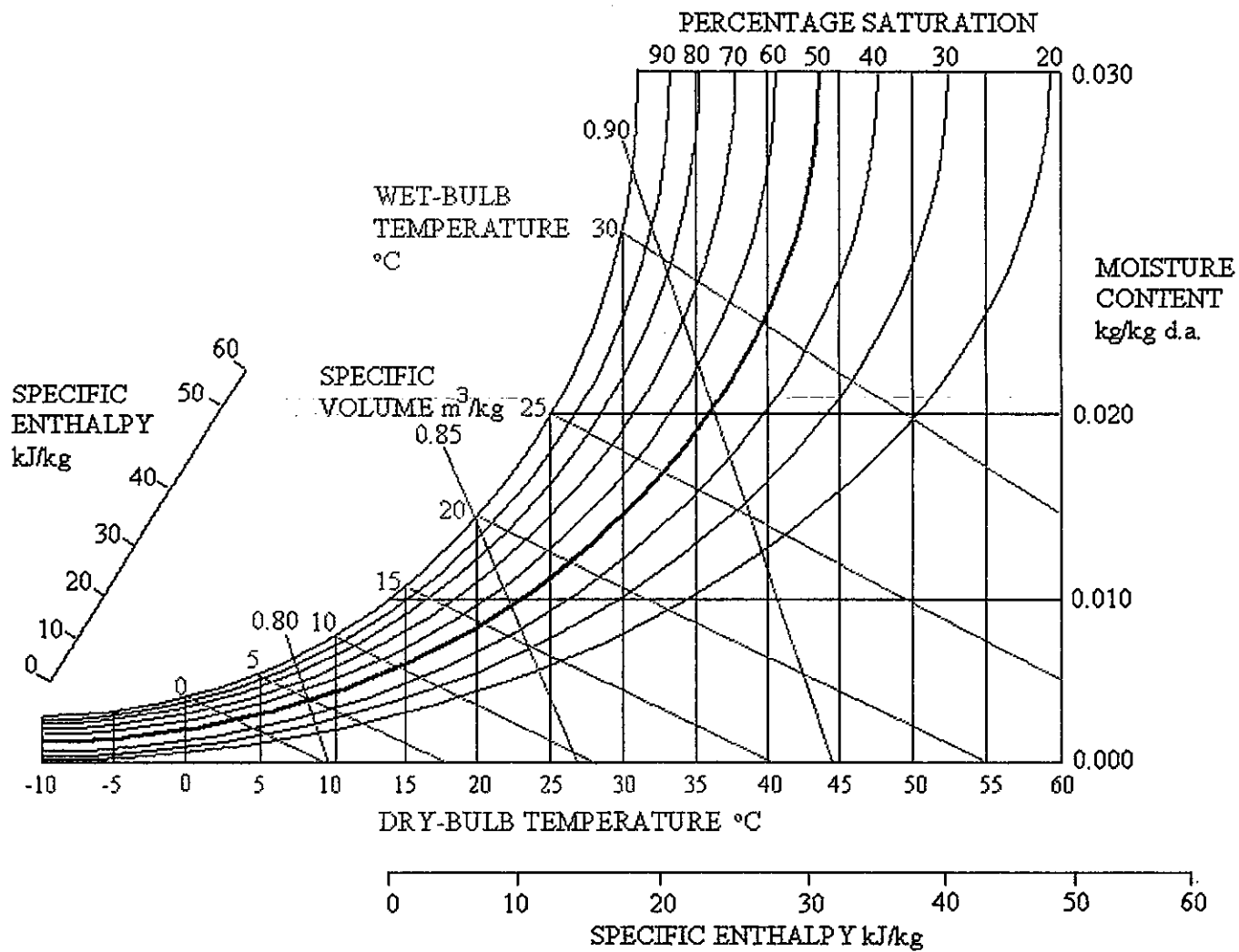


State the conditions you assume, if necessary.

1. A piston-cylinder device contains 0.03 m^3 of a gas initially at 120 kPa. At this state, a linear spring with a spring constant of 120 kN/m is touching the piston but exerting no force on it. Now heat is transferred to the gas, causing the piston to rise and compress the spring until the volume inside the cylinder doubles. If the cross-sectional area of the piston is 0.3 m^2 , please answer the following questions?
 - (1) The final pressure inside the cylinder (10%)
 - (2) The total work done by the gas (10%)
 - (3) The work done against the spring to compress it. (10%)
2. A plant factory is kept at relative humidity =40% and dew point temperature= 25 °C. Find out the corresponding (1) dry bulb temperature (2) wet bulb point (3) absolute humidity. (15%)



More problems on the next page

見背面

3. (1) During a isobaric process, the heat of evaporation of water at 50°C=? (5%)
 (2) For a space at 50 °C with water vapor pressure of 2.5 kPa, the relative humidity= ? (5%)
 (3) A space is filled with saturated liquid and maintained at 50 °C. The space then expands twice in volume. The specific volume=? The quality=? The internal energy=? Units have to be included. (30%)
4. (1) (5%) For an ideal air conditioner (chiller), COP=4 and cooling capacity is 6 kW. The electrical power to consume=?
 (2) (5%) With suitable configuration, the air conditioner (COP= 4) can also be a heater (heat pump). The COP_{HP}=?
 (3) (5%) For the ideal heater (heat pump) working between 27 °C and 7 °C, the best COP_{HP}=?

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
50	12.352	0.001012	12.026	209.33	2233.4	2442.7	209.34	2382.0	2591.3
55	15.763	0.001015	9.5639	230.24	2219.1	2449.3	230.26	2369.8	2600.1
60	19.947	0.001017	7.6670	251.16	2204.7	2455.9	251.18	2357.7	2608.8
65	25.043	0.001020	6.1935	272.09	2190.3	2462.4	272.12	2345.4	2617.5
70	31.202	0.001023	5.0396	293.04	2175.8	2468.9	293.07	2333.0	2626.1
75	38.597	0.001026	4.1291	313.99	2161.3	2475.3	314.03	2320.6	2634.6
80	47.416	0.001029	3.4053	334.97	2146.6	2481.6	335.02	2308.0	2643.0
85	57.868	0.001032	2.8261	355.96	2131.9	2487.8	356.02	2295.3	2651.4
90	70.183	0.001036	2.3593	376.97	2117.0	2494.0	377.04	2282.5	2659.6
95	84.609	0.001040	1.9808	398.00	2102.0	2500.1	398.09	2269.6	2667.6
100	101.42	0.001043	1.6720	419.06	2087.0	2506.0	419.17	2256.4	2675.6
105	120.90	0.001047	1.4186	440.15	2071.8	2511.9	440.28	2243.1	2683.4
110	143.38	0.001052	1.2094	461.27	2056.4	2517.7	461.42	2229.7	2691.1
115	169.18	0.001056	1.0360	482.42	2040.9	2523.3	482.59	2216.0	2698.6
120	198.67	0.001060	0.89133	503.60	2025.3	2528.9	503.81	2202.1	2706.0