What is the specific internal energy of water at a pressure of 7 bar (abs) and temperature of 164.95 °C at a quality of 0.5?

SOLUTION:
From the SLVM-pressure table, at a pressure of 7 bar (abs), the corresponding saturation temperature is T_{sat} = 164.95 °C. Since this is the same as the temperature in the problem statement, the water is in a SLVM phase. From the same table, u_f = 696.23 kJ/kg and u_g = 2571.8 kJ/kg. The specific internal energy at the given quality of x = 0.5 is,

$$u = (1 - x)u_f + xu_g, \quad (1)$$

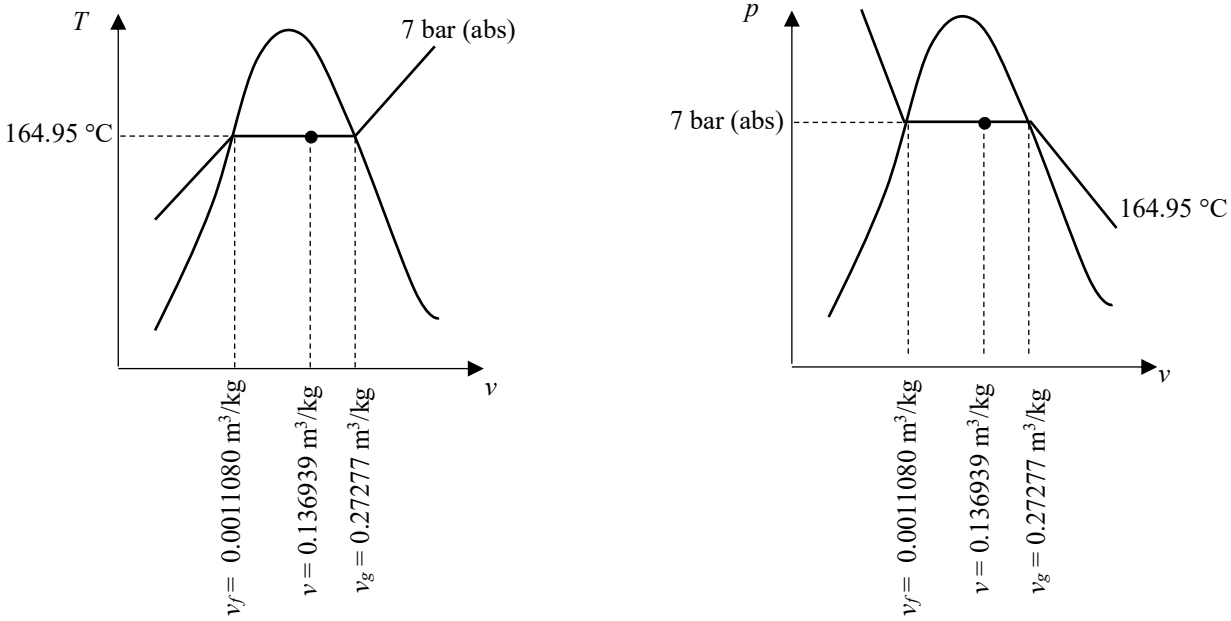
u = 1634.0 kJ/kg.

Also from the table, v_f = 0.0011080 m³/kg and v_g = 0.27277 m³/kg. Thus, the specific volume is,

$$v = (1 - x)v_f + xv_g, \quad (2)$$

⇨ v = 0.136939 m³/kg.

		Liquid				Vapor			
Press. (bar)	Temp. (C)	Volume (v_f, m³/kg)	Internal Energy (u_f, kJ/kg)	Enthalpy (h_f, kJ/kg)	Entropy (s_f, kJ/kg/K)	Volume (v_g, m³/kg)	Internal Energy (u_g, kJ/kg)	Enthalpy (h_g, kJ/kg)	Entropy (s_g, kJ/kg/K)
6	158.83	0.0011006	669.72	670.38	1.9308	0.31558	2566.8	2756.1	6.7592
7	164.95	0.0011080	696.23	697.00	1.9918	0.27277	2571.8	2762.8	6.7071
8	170.41	0.0011148	719.97	720.86	2.0457	0.24034	2576.0	2768.3	6.6616



Note that we will obtain slightly different results if we linearly interpolate values from the SLVM-temperature table.

		Liquid				Vapor			
Temp. (C)	Press. (bar)	Volume (v_f, m³/kg)	Internal Energy (u_f, kJ/kg)	Enthalpy (h_f, kJ/kg)	Entropy (s_f, kJ/kg/K)	Volume (v_g, m³/kg)	Internal Energy (u_g, kJ/kg)	Enthalpy (h_g, kJ/kg)	Entropy (s_g, kJ/kg/K)
160	6.1823	0.0011020	674.79	675.47	1.9426	0.30678	2567.8	2757.4	6.7491
170	7.9219	0.0011143	718.20	719.08	2.0417	0.24259	2575.7	2767.9	6.6650

Linearly interpolating values at T = 164.95 °C,

p_{sat} = 7.043 bar (abs), u_f = 696.28 kJ/kg, u_g = 2571.7 kJ/kg, v_f = 0.0011081 m³/kg, v_g = 0.27500 m³/kg,

=> u = 1633.99 kJ/kg, v = 0.13806 m³/kg.

The difference between these values and those found previously are due to the errors associated with having discrete data entries in the tables and linear interpolation. If the data entries were spaced closer together in both tables, the differences in the values found from the two tables would be smaller.