Introduction to Thermodynamics and Heat Transfer (ECE 309)
Suggested Problems for Chapter 2

1. A 0.5-m^3 rigid vessel initially contains saturated liquid-vapor mixture of water at 100 °C. The water is now heated until it reaches the critical state. Determine the mass of the liquid water and the volume occupied by the liquid at the initial state.
Answer: 158.28 kg, 0.165 m^3

2. A closed, rigid container of volume 0.5 m^3 is placed on a hot plate. Initially, the container holds a two-phase mixture of saturated liquid water and saturated water vapor at P_1=1 bar with a quality of 0.5. After heating, the pressure in the container is P_2 =1.5 bar. Indicate the initial and final states on a T-ν diagram, and determine (a) The temperature, in °C, at each state (b) The mass of vapor present at each state, in kg. (c) If heating continued, determine the pressure, in bar, when the container holds only saturated vapor.

3. A 0.01677-m^3 tank contains 1 kg of refrigerant-134a at 110 °C. Determine the pressure of the refrigerant using (a) the ideal gas equation of state and (b) the generalized compressibility chart. Compare your result with the actual value of 1.6 MPa.
Answers: (a) 1.861 MPa, (b) 1.586 Mpa

4. R-134a is contained in a piston-cylinder device at T1= -12 (C) and P1= 0.4 (MPa). The fluid is heated isobarically such that V2=20V1. Heat then added at constant volume until we get T3=52(C).

- Calculate h1, h2, and h3.
- Show the process on a T-v diagram.

5. Using property tables for water, complete the following table.

T (C)	*P (MPa)*	*x*	*h (kJ/kg)*	*v (m^3/kg)*	*u (kJ/kg)*
410				0.106	
	0.275		1200		
250	0.01				
	2.5				2662.6
100	2				