ME 300 Special Problem Homework Set #1: SP1, SP2

Due Wednesday, January 18, 2017

SP1. One (1.0) kg of ice and 0.05 kg of water vapor exist in equilibrium in a closed, rigid vessel at a temperature $T_1 = -30^\circ C$ and a pressure of $p_1 = 0.0381$ kPa (state1). The tank and the contents are then heated until a state on the liquid-vapor equilibrium line (saturation dome) is reached (state 2).

(a) What is the volume of the tank? (Hint: Use Table A-6)

(b) What is the initial pressure in bar?

(c) At the final condition, state 2, is the mixture a saturated liquid or a saturated vapor? (Hint: is the specific volume greater than or less than specific volume at the critical point?)

(d) What is the final temperature at state 2?

(e) Sketch this process on p-T and p-v diagrams similar to those shown below (Chapter 3, Moran et al, 8th edition).

![Diagram](b)

![Diagram](c)

SP2. Water vapor, initially at $T_1 = 160^\circ C$ and a pressure of $p_1 = 0.30$ MPa, expands to $p_2 = 0.040$ MPa in a piston-cylinder system. For the process from state 1 to state 2, $pv^{1.25} = const$.

(a) Determine the specific volume and temperature of the final state in $m^3/kg$.

(b) For 1.0 kg of water, calculate the work in kJ.

(c) Sketch the process on a carefully labeled p-v diagram.