NAME:
AME 20231, Thermodynamics
Examination 1
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1. (5) A three phase mixture of H_2O exists at the triple point. The material is isothermally compressed to a pressure just above the triple point pressure. Which phase is observed: solid, liquid, or gas? Provide a sketch of the process in the $P - T$ plane that includes the various phase boundaries and the triple point.

2. (15) A box contains one kmole of the the noble gas helium, He, at $T = 6.2$ K, $P = 0.227$ MPa. Determine the volume of the box by two different methods:

   (a) assume an ideal gas,

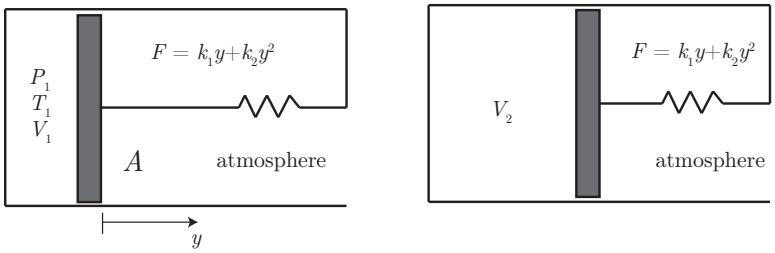
   (b) use the compressibility chart, Fig. D.1.

3. (15) The gas CO_2 exists at $P = 10000$ kPa, $T = 203°C$. Determine the specific volume of the gas by two different methods:

   (a) assume an ideal gas,

   (b) use Table B.3.2.

4. (30) A piston-cylinder arrangement contains an ideal gas with gas constant R at initial temperature, pressure, and volume T_1, P_1, V_1. The piston, of cross-sectional area A, is constrained by a nonlinear spring that exerts no force in the initial configuration. The force in the spring is given by the formula $F = k_1 y + k_2 y^2$, where y is the displacement of the spring from its initial unstreched position at $y = 0$. The gas is heated to a final volume V_2. Find



   (a) the initial specific volume, v_1,

   (b) the mass m of the gas,

   (c) the atmospheric pressure,

   (d) the final pressure P_2,

   (e) the work done in the process ${}_1W_2$,

5. (35) A piston-cylinder configuration contains 10 kg of H_2O at an initial state of $P_1 = 10000$ kPa, and quality $x_1 = 0$. It is isothermally compressed to $P_2 = 15000$ kPa. It is then isobarically heated to $T_3 = 600°C$. Find

   (a) the intermediate specific volume v_2,

   (b) the final specific volume v_3,

   (c) the total work done in the process ${}_1W_3$,

   (d) sketches of the process in the $P - v$, $T - v$, and $P - T$ planes, taking special care to include relevant vapor domes and saturation lines and the correct orientation of the processes relative to these features.