MEMS 0051 - Introduction to Thermodynamics
Quiz #3

Name: Solution

Problem 1

Determine the specific volume for water existing at T=900°C and P=919 [kPa]

$T > T_{sat}(950\ [\text{kPa}]) \implies$ superheated vapor existing at 900 [°C].

P [kPa]	v [m^3/kg]
800	0.67610
919	v
1,000	0.54075

$$\frac{919 - 900\ [\text{kPa}]}{1,000 - 800\ [\text{kPa}]} = \frac{v - 0.67610\ [\text{m}^3/\text{kg}]}{0.54075 - 0.67610\ [\text{m}^3/\text{kg}]}$$

$$v = 0.5956\ [\text{m}^3/\text{kg}]$$

Problem 2

Consider helium taken at 298 [K] and a pressure of 150 [kPa]. The critical pressure and temperature are P_c=227,000 [Pa] and T_c=5.19 [K]. Calculate the reduced temperature and pressure and determine if we can treat it as an ideal gas.

$$P_r = \frac{P}{P_c} = \frac{150\ [\text{kPa}]}{227\ [\text{kPa}]} = 0.6607 \not< 1; \qquad T_r = \frac{T}{T_c} = \frac{298\ [\text{K}]}{5.19\ [\text{K}]} = 57.42 > 2$$

No, it cannot be treated as an Ideal Gas: $P_r \ll$ is not satisfied

Problem 3

Determine the quality of water existing at 500 [kPa] with a specific volume of 0.20 [m^3/kg]
From Table B.1.1, we find:
v_f=0.001093 [m^3/kg]
v_g=0.37489 [m^3/kg]

$$x = \frac{v - v_f}{v_g - v_f} = \frac{(0.20 - 0.001093)[\text{m}^3/\text{kg}]}{(0.37489 - 0.001093)[\text{m}^3/\text{kg}]} = 0.532$$