Answer all questions

1) Draw a temperature-specific volume *(T-v)* diagram, showing constant pressure lines for a pure substance.   [2]

2) Explain the terms: [4]

   a. Saturated liquid .

   b. Critical point

   c. Compressibility factor

   d. Acentric factor

3) What is meant by quality of a mixture? A tank of 1 m^3 contains 2.5 kg wet steam at 120°C. Determine the quality of steam in the tank.   [2]

4) An ideal gas C_P = *(5/2) R* and C_V = *(3/2) R*, is changed from P_1 = 1 bar and V_1 = 12 m^3 to P_2 = 12 bar and V_2 = 1 m^3 by the following mechanically reversible processes: [4]

   a) Isothermal compression

   b) Adiabatic compression followed by cooling at constant pressure

   c) Adiabatic compression followed by cooling at constant volume

   Calculate Q, W, ΔU and ΔH for each of these processes, and sketch the paths of all processes on a single pressure specific volume (*P-v*) diagram.

5) A rigid tank with a volume of 1.8 m^3 contains 15 kg of saturated liquid-vapor mixture of water at 90°C. Now the water is slowly heated. Determine the temperature at which the liquid in the tank is completely vaporized. Also, show the process on a *T-v* diagram with respect to saturation lines.   [2]

6) Calculate the pressure to which a tank of volume 50 m^3 is to be filled if the tank is to contain 750 kg of methane at 25°C. Use the generalized Redlich Kwong equation of state.   [3]

7) Using the generalized virial coefficient correlation, calculate the capacity of a tank which can hold 500 kg ethylene at 25°C, when filled to a pressure of 10 bar.   [3]