CANKAYA UNIVERSITY
FACULTY OF ENGINEERING AND ARCHITECTURE
MECHANICAL ENGINEERING DEPARTMENT
ME 212 THERMODYNAMICS II

CHAPTER 11

EXAMPLES

1) The pressure within a 23.3 m^3 tank should not exceed 105 bar. Check the pressure within the tank if filled with 1000 kg of water vapor maintained at $360\,^0$C using the

a) ideal gas equation
b) van der Waals equation
c) Redlich-Kwong equation
d) Compressibility chart
e) Steam tables

2) Using $\left(\frac{\partial \mathrm{T}}{\partial \mathrm{T}}\right)_{\mathrm{p}} = -\left(\frac{\partial \mathrm{s}}{\partial \mathrm{p}}\right)_{\mathrm{T}}$ check the consistency of

(a) the steam taples at 2 MPa,400 ^{0}C
(b) the refrigerant 134a at 2 bar , 50 ^{0}C

3) Evaluate the partial derivative $\left(\frac{\partial s}{\partial v}\right)_T$ for water vapor at a fixed state at temperature of 240^0C and specific volume of 0.4646 m^3/kg.

a) Use Redlich-Kwong equation of state and an appropriate Maxwell relation.
b) Check the value obtained using steam table data

4) Develop expressions for the volume expansivity β and the isothermal compressibility κ for

a) an ideal gas
b) a gas whose equation of state is p(v-b) = RT
c) a gas obeying the van der Waals equation

5) Oxygen (O_2) enters a control volume operating at steady state with a mass flow rate of 9 kg/min at 100 bar, 278 K and is compressed adiabatically to 150 bar, 400 K. Determine the power required, in kW, and the rate of entropy production, in kW/K. Ignore kinetic and potential energy effects.

6) A closed, rigid, insulated vessel having a volume of 0.142 m^3 contains oxygen (O_2) initially at 100 bar, $7\,^0C$. The oxygen is stirred by a paddle wheel until the pressure becomes 150 bar. Determine the

(a) final temperature, in ^0C.
(b) work, in kJ.
(c) amount of exergy destroyed in the process, in kJ.

Let $T_0 = 7\,^0C$

7) One kmol of gaseous mixture occupies a volume of 0.111 m^3 at 100^0C. The mixture consists of 69.5% carbon dioxide and 30.5% ethylene (C_2H_4) (molar-basis). Estimate the mixture pressure using

a) the ideal gas equation of state
b) Kay's rule together with the generalized compressibility chart.
c) The additive pressure rule together with the generalized compressibility chart.
d) The van der Waals equation together with mixture values for the constants a and b

8) A rigid vessel having a volume of 0.05 m^3 initially contains carbon dioxide gas at temperature 25^0C and pressure p. Ethylene gas is allowed to flow into the tank until a mixture consisting of 20% carbon dioxide and 80% ethylene (molar basis) exits within the tank at a temperature of 25^0C and a pressure of 100 bar. Determine the pressure p, in bar, using Kay's rule together with the generalized compressibility chart.