Given and Required: $kJ := 1000J$

Determine the specific volume of R-134a at 1 MPa and 50°C. Use the ideal gas equation and also use the compressibility chart. What is it listed as in the tables in the back of your textbook?

$P_1 := 1MPa \qquad T_1 := 50\,°C$

Solution:

Going to Table A-1 @ R-134a shows

$R_{R134a} := 0.08149\,\frac{kJ}{kg \cdot K} \qquad T_{cr} := 374.2K \qquad P_{cr} := 4.059MPa$

Beginning with the IGL.

$P \cdot V = m \cdot R \cdot T$

Solving for specific volume yields

$$\nu = \frac{V}{m} = \frac{R \cdot T}{P} \qquad \text{or} \qquad \boxed{\nu_a := \frac{R_{R134a} \cdot T_1}{P_1} = 0.02633\,\frac{m^3}{kg}}$$

To use the compressibility chart, the reduce temperature and pressure values, T_R and P_R, must be calculated. This is shown below.

$$T_R := \frac{T_1}{T_{cr}} = 0.864 \qquad P_R := \frac{P_1}{P_{cr}} = 0.246$$

Going to Figure A-15 @ $T_R = 0.864$ & $P_R = 0.246$ shows

$z := 0.84$

Now the specific volume may be calculated with the compressibility factor accounted for. This is shown below.

$$\nu = \frac{V}{m} = z \cdot \frac{R \cdot T}{P} \qquad \text{or} \qquad \boxed{\nu_b := z \cdot \frac{R_{R134a} \cdot T_1}{P_1} = 0.02212\,\frac{m^3}{kg}}$$

To look up the specific volume from the table, we start at Table A-12 @ $P := P_1 = 1000\,kPa$ showing

$T_{sat} := 39.37\,°C$

Since the temperature is greater than the saturation temperature at the pressure given (i.e. $T_1 > T_{sat}$), the state is superheated. Going to Table A-13 @ $P := P_1 = 1 \cdot MPa$ & $T := T_1 = 50 \cdot °C$ shows

$$\boxed{\nu_c := 0.021796\,\frac{m^3}{kg}}$$

Comparing the results of using the IGL and the method using compressibility chart to the table values shows the percent error as

$$\%e_a := \left|\frac{\nu_a - \nu_c}{\nu_c}\right| = 20.818 \cdot \% \qquad \%e_b := \left|\frac{\nu_b - \nu_c}{\nu_c}\right| = 1.487 \cdot \%$$

It should be noted that the table value is considered the most accurate of the three methods and for this reason the other two methods are compared to it.