equation for the saturated liquid, and the vapor root for the saturated vapor. The difference between H_V and H_L is equal to the enthalpy of vaporization. Noting that all other terms on the right-hand side except for H_V^R and H_L^R are common to both equations, the enthalpy of vaporization is simply equal to the difference of the residual terms:

$$\boxed{\Delta H_{\text{vap}} = H_V^R - H_L^R.} \tag{7.2}$$

The same arguments apply to the entropy of vaporization, for which we find

$$\boxed{\Delta S_{\text{vap}} = S_V^R - S_L^R.} \tag{7.3}$$

These results are of practical importance because they allow us to calculate the enthalpy and entropy of vaporization from the equation of state.

Example 7.1: Heat of Vaporization Using SRK
Calculate the enthalpy and entropy of vaporization of ethylene at 170 K using the SRK equation. The saturation pressure is 1.0526 bar.

Solution The critical constants of ethylene are

$$T_c = 282.35 \text{ K}, \quad P_c = 50.418 \text{ bar}, \quad \omega = 0.0866.$$

5.10

The residual properties of the saturated vapor were calculated in Example 5.11. The calculation for the saturated liquid is done in the same manner and the results are summarized below:

	Liquid	**Vapor**	
H^R	-13751.3	-107.679	J/mol
S^R	-80.5552	-0.390262	J/mol K

The heat of vaporization is

$$\Delta H_{\text{vap}} = (-107.679) - (-13751.3) = 13643.6 \text{ J/mol},$$

and the entropy of vaporization is

$$\Delta S_{\text{vap}} = (-0.390262) - (-80.5552) = 80.1649 \text{ J/mol K}.$$

make lower case

Comments The Literature value for the heat of vaporization (Perry's *Handbook*) is

$$\Delta H_{\text{vap}} = 481370 \text{ kJ/kg} = 13504.4 \text{ J/mol}.$$

The error in the SRK value is 1.03%.

Exercise Show that the computed values of the enthalpy and entropy of vaporization satisfy the fundamental relationship

$$\frac{\Delta H_{\text{vap}}}{T} = \Delta S_{\text{vap}}.$$

Second printing corrections for Matsoukas, Fundamentals of Chemical Engineering Thermodynamics (9780132693066).
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