set P in math type

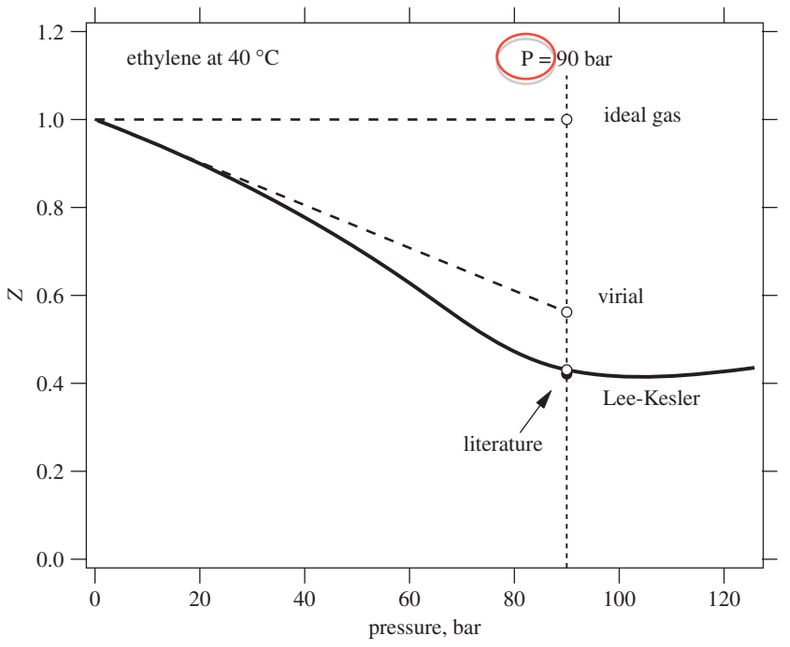

Figure 2-11: Calculated isotherms of ethylene at 40 °C using the ideal-gas law, the truncated virial equation, and the Pitzer method with the Lee-Kesler values of $Z^{(0)}$ and $Z^{(1)}$ (see Example 2.9).

2.6 Cubic Equations of State

For engineering calculations it is important to have equations of state that are accurate over a wide range of pressures and temperatures. The ideal gas law is very simple to use, but its validity is restricted to gases at low pressures. The truncated virial equation is applicable over a somewhat wider range of pressures, but only for gases. If the pressure is high or the phase liquid, neither of these equations can be used. Numerous empirical equations of state have appeared in the literature to overcome these difficulties. Such equations usually have some theoretical basis, but the primary consideration is sufficient accuracy for engineering applications. It is typical for these equations to contain parameters that are fine-tuned to improve accuracy. No single mathematical equation of state can describe all fluids. Nonetheless, it is convenient in having one equation whose mathematical form is the same for many fluids but with parameters that are specific to a particular fluid. Among the most important engineering equations of state is the family of cubic equations, which can be viewed as variants of the van der Waals equation of state.