Primer examen de métodos numéricos

6.15 The *Redlich-Kwong* equation of state is given by

$$p = \frac{RT}{v-b} - \frac{a}{v(v+b)\sqrt{T}}$$

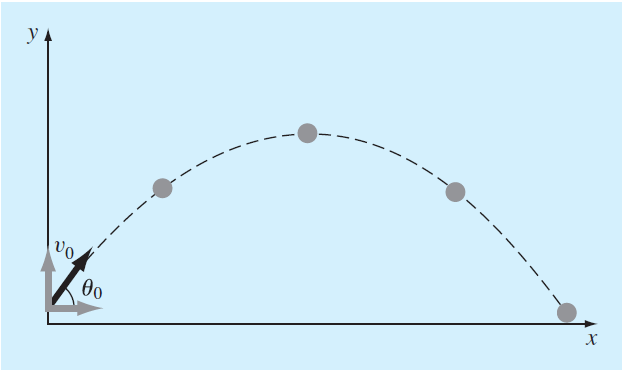
where R = the universal gas constant [= 0.518 kJ/(kg K)], T = absolute temperature (K), p = absolute pressure (kPa), and v = the volume of a kg of gas (m^3/kg). The parameters a and b are calculated by

$$a = 0.427\frac{R^2 T_c^{2.5}}{p_c} \qquad b = 0.0866R\frac{T_c}{p_c}$$

where $p_c = 4600$ kPa and $T_c = 191$ K. As a chemical engineer, you are asked to determine the amount of methane fuel that can be held in a 3-m^3 tank at a temperature of −40 °C with a pressure of 65,000 kPa. Use a root-locating method of your choice to calculate v and then determine the mass of methane contained in the tank.

6.21 Aerospace engineers sometimes compute the trajectories of projectiles such as rockets. A related problem deals with the trajectory of a thrown ball. The trajectory of a ball thrown by a right fielder is defined by the (x, y) coordinates as displayed in Fig. P6.21. The trajectory can be modeled as

$$y = (\tan\theta_0)x - \frac{g}{2v_0^2\cos^2\theta_0}x^2 + y_0$$



6.17 A catenary cable is one which is hung between two points not in the same vertical line. As depicted in Fig. P6.17*a*, it is subject to no loads other than its own weight. Thus, its weight acts as a uniform load per unit length along the cable w (N/m). A free-body diagram of a section AB is depicted in Fig. P6.17*b*, where T_A and T_B are the tension forces at the end. Based on horizontal and vertical force balances, the following differential equation model of the cable can be derived:

$$\frac{d^2y}{dx^2} = \frac{w}{T_A}\sqrt{1+\left(\frac{dy}{dx}\right)^2}$$

Calculus can be employed to solve this equation for the height of the cable y as a function of distance x:

$$y = \frac{T_A}{w}\cosh\left(\frac{w}{T_A}x\right) + y_0 - \frac{T_A}{w}$$

(a) Use a numerical method to calculate a value for the parameter T_A given values for the parameters $w = 10$ and $y_0 = 5$, such that the cable has a height of $y = 15$ at $x = 50$.

(b) Develop a plot of y versus x for $x = -50$ to 100.

Find the appropriate initial angle θ_0, if $v_0 = 30$ m/s, and the distance to the catcher is 90 m. Note that the throw leaves the right fielder's hand at an elevation of 1.8 m and the catcher receives it at 1 m.