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1. Using the Peng-Robinson EOS to calculate the fugacity coefficient of pure carbon dioxide, estimate the vapor pressure and saturated liquid and vapor molar volumes at these temperatures – 10, 20, and 30°C. How do your predictions compare with data for pure CO₂ (see Table below)? You might want to refer to Example 8.4 on p. 276-277, Example 9.7 on p. 350-351, and Figure 8.12. If you use Matlab or a similar mathematical software package please document your results and describe the approach you followed in reaching a solution.

Experimental Data for Pure CO₂

Temp (°C)	Pressure (bar)	Liquid Volume (cm ³ /mole)	Vapor Volume (cm ³ /mole)
10	45.02	51.11	325.6
20	57.29	56.91	226.6
30	72.14	74.18	127.5

2. Problem 15.31 in the textbook.
3. Estimate the critical constants (T_c , P_c), acentric factor (ω) and vapor pressure of pure caffeine as described in Problem 13.4 of the text. To solve this problem you will have to review the methods presented in Chapter 13 for predicting physical properties using molecular group contributions. (Note: Since the >N– (ring) group is not listed, use the >N– (non-ring) group in its place).
4. Problem 15.38 in the textbook.
5. Problem 15.29 in the textbook.

Be sure to state and justify all assumptions made.
