CENG 102 HDA Project Equation Sheet

Relevant Data and Equations:

Use data from your CENG 102 textbook for molecular weights and thermodynamic data.

Data for Biphenyl:

$$\omega = 0.423;\ T_C = 772.16\,K;\ P_C = 34.74\,bar;\ Z_C = 0.269;\ V_C = 497.5\ cm^3/mol$$

$$MW = 154.21\,g/mol;\ \Delta H_f(gas) = 1.8 \times 10^5\,J/mol\,;\ \Delta G_f(gas) = 2.77 \times 10^5\,J/mol$$

$$C_P/R \text{ constants: } A = 13.83; B = 51.7 \times 10^{-3}; C = -16.33 \times 10^{-6}; D = -7.578 \times 10^5$$

$$\text{Antoine's Constants: } A = 14.6372; B = 4576.67; C = 201.594$$

Critical Properties of H_2:

For the quantum gases (H_2, He, Ne) do not act like normal fluids. For use in various correlations (finding reduced temperature or pressure, residuals, fugacity coefficients, etc.), the reported values (in Table B.1) are found to be incorrect and replaced with temperature-dependent effective critical parameters (as noted in Section 3.7). The effective critical parameters for H_2 are defined in equations (3.54) – (3.56):

$$T_C = \frac{43.6}{1 + \frac{21.8}{2.016T}};\quad P_C = \frac{20.5}{1 + \frac{44.2}{2.016T}};\quad V_C = \frac{51.5}{1 - \frac{99.1}{2.016T}};\quad \omega = 0$$

Critical Properties for Gas Mixtures:

When needing to find the residuals for gas mixtures, DO NOT evaluate the residual for each individual species. Instead, create "averaged" parameters for the entire stream. These are referred to as "pseudocritical parameters" (AKA "pc"), and the corresponding reduced properties are "pseudoreduced parameters" (AKA "pr"). As noted above, when in mixtures, the acentric factor for H_2 is considered 0. As shown in equations (6.78) – (6.82):

$$\omega_{mix} = \sum y_i \omega_i\,;\quad T_{pc} = \sum y_i T_{ci}\,;\quad P_{pc} = \sum y_i P_{ci}\,;\quad T_{pr} = \frac{T}{T_{pc}};\quad P_{pr} = \frac{P}{P_{pc}}$$

Other Equations:

$$\%Error = 100\% \left|\frac{estimate - actual}{estimate}\right|;\quad \%Change = 100\% \left|\frac{new - old}{old}\right|$$