CM3230, Fall 2015
Quiz 6a
Name ___________________________________

Answer 5 items for full 100 points. The 6th correct answer will be considered a 20 point bonus.

1. A binary liquid solution of A and B at $T = 350K$ was found to have an excess Gibbs energy $g^E = 54\,J/mol$. If the activity coefficients were also given as $\gamma_A = 2.1$ and $\gamma_B = 0.8$, then the mole fraction of B is closest to (within 2%)
   a. $x_B = 0.10$
   b. $x_B = 0.25$
   c. $x_B = 0.50$
   d. $x_B = 0.75$
   e. None of the above

2. A binary liquid solution containing 78% A and 22% B at $T = 400K$ was found to have an activity coefficients of $\gamma_A = 1.5$ and $\gamma_B = 2.5$. If at this temperature the fugacities of pure A and B are $f_A^{liq} = 2\ bars$ and $f_B^{liq} = 4\ bars$, then the fugacity of B in the mixture is closest to (within $\pm$ 2%)
   a. $\hat{f}_B^{liq} = 0.8\ bars$
   b. $\hat{f}_B^{liq} = 1.6\ bars$
   c. $\hat{f}_B^{liq} = 2.2\ bars$
   d. $\hat{f}_B^{liq} = 3.4\ bars$
   e. None of the above

3. The virial equation of state for pure B around $P = 3\ bars$ and $T = 420K$ is given by

$$\frac{Pv}{RT} = 1 + B'P + C'P^2 \qquad \text{where} \quad B' = 0.08\ bar^{-1} \ \text{and}\ C' = 0.01\ bar^{-2}$$

   The fugacity of B at $P = 3\ bars$ is then closest to (within $\pm$2%)
   a. $f_B = 1.3\ bars$
   b. $f_B = 2.2\ bars$
   c. $f_B = 3.1\ bars$
   d. $f_B = 4.0\ bars$
   e. None of the above

4. For a binary liquid mixture of 25% A and 75% B at $T = 400K$, the activity coefficients were found to be $\gamma_A = 1.8$ and $\gamma_B = 3.2$. Then the molar Gibbs energy change in mixing is closest to (within $\pm 2\%$)
   a. $\Delta g_{mix} = 1.52\ kJ/mol$
   b. $\Delta g_{mix} = 2.21\ kJ/mol$
   c. $\Delta g_{mix} = 3.07\ kJ/mol$
   d. $\Delta g_{mix} = 5.11\ kJ/mol$
   e. None of the above

5. A binary liquid solution of 32% A and 68% B is in equilibrium with its vapor phase at $P = 2\ bars$ and $T = 350K$. At this conditions, assuming that $\phi_A^{sat} = 0.85$, $P_A^{sat} = 3\ bars$ and $\gamma_A = 0.92$ (with Poynting correction factor of 1) in the liquid phase, while $\hat{\phi}_A^{vap} = 0.9$ in the vapor phase, the mole fraction of A in the vapor phase will be closest to (within $\pm$ 2%)
   a. $y_A = 0.142$
   b. $y_A = 0.221$
   c. $y_A = 0.379$
   d. $y_A = 0.417$
   e. None of the above

6. A plot showing molar Gibbs energy of a liquid solution of A and B at $T = 280K$ is shown in Figure 1 as a function of x_A. Then the molar excess Gibbs energy at $x_A = 0.1$ is closest to (within $\pm 2\%$)
   a. $g^E = 0.057 \frac{kJ}{mol}$
   b. $g^E = -0.50 \frac{kJ}{mol}$
   c. $g^E = -1.12 \frac{kJ}{mol}$
   d. None of the above

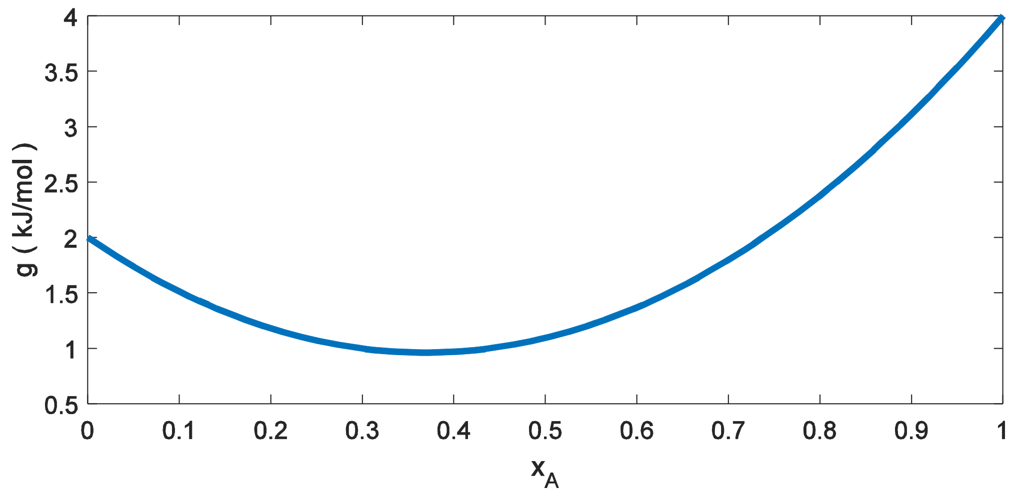

Figure 1. Molar Gibbs energy for a liquid solution of A and B.