1. **TRUE/FALSE:**
   a. The activity $a_i$ is never negative.
   b. The activity coefficient $\gamma_i$ is never negative.
   c. In an ideal binary liquid solution of A and B, A-B interactions are negligible.
   d. When 30.0 mL of 3.0 M HCl (aq) is added to 50.0 mL of 1.0 M HCl (aq), the final volume will be 80.0 mL.

2. For each of the following solutions, state whether each component will approximately obey Raoult's Law, Henry's Law, or neither: \([A = \text{CCl}_4, \ B = \text{CH}_3\text{OH}, \ C = \text{SiCl}_4]\)
   a. $x_A = 0.5; \ x_B = 0.5$
   b. $x_A = 0.99; \ x_B = 0.01$
   c. $x_A = 0.01; \ x_B = 0.99$
   d. $x_A = 0.4; \ x_C = 0.6$

3. Benzene and toluene form nearly ideal solutions. At 25°C the vapor pressure of pure benzene and pure toluene are 95.1 torr and 28.4 torr, respectively. What is the mole fraction of benzene in the liquid in equilibrium with vapor having mole fraction $x_{\text{benzene}} = 0.40$ at 25°C?
   a. 0.40
   b. 0.30
   c. 0.23
   d. 0.17
   e. none of these