7.5 What proportions of ethanol and water should be mixed in order to produce 100 cm^3 of a mixture containing 50 per cent by mass of ethanol? What change in volume is brought about by adding 1.00 cm^3 of ethanol to the mixture? (Use data from Fig. 7.1.)

7.9 Plot the vapour pressure data for a mixture of benzene (B) and acetic acid (A) given below and plot the vapour pressure/composition curve for the mixture at 50°C. Then confirm that Raoult's and Henry's laws are obeyed in the appropriate regions. Deduce the activities and activity coefficients of the components on the Raoult's law basis and then, taking B as the solute, its activity and activity coefficient on a Henry's law basis. Finally, evaluate the excess Gibbs energy of the mixture over the composition range spanned by the data.

x_A	0.0160	0.0439	0.0835	0.1138	0.1714
p_A/Torr	3.63	7.25	11.51	14.2	18.4
p_B/Torr	262.9	257.2	249.6	244.8	231.8

x_A	0.2973	0.3696	0.5834	0.6604	0.8437	0.9931
p_A/Torr	24.8	28.7	36.3	40.2	50.7	54.7
p_B/Torr	211.2	195.6	153.2	135.1	75.3	3.5

7.20 Use the Gibbs–Helmholtz equation to find an expression for $\mathrm{d} \ln x_A$ in terms of $\mathrm{d}T$. Integrate $\mathrm{d} \ln x_A$ from $x_A = 0$ to the value of interest, and integrate the right-hand side from the transition temperature for the pure liquid A to the value in the solution. Show that, if the enthalpy of transition is constant, then eqns 33 and 36 are obtained.

7.21 The 'osmotic coefficient', ϕ, is defined as $\phi = -(x_A/x_B) \ln a_A$. By writing $r = x_B/x_A$, and using the Gibbs–Duhem equation, show that

we can calculate the activity of B from the activities of A over a composition range by using the formula

$$\ln\left(\frac{a_B}{r}\right) = \phi - \phi(0) + \int_0^r \left(\frac{\phi - 1}{r}\right) dr$$