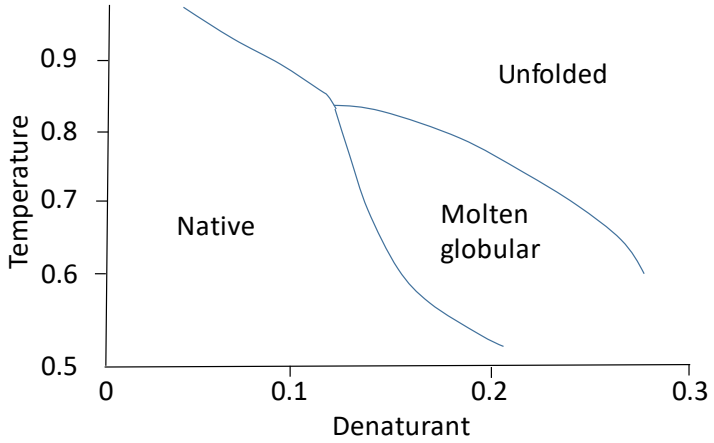
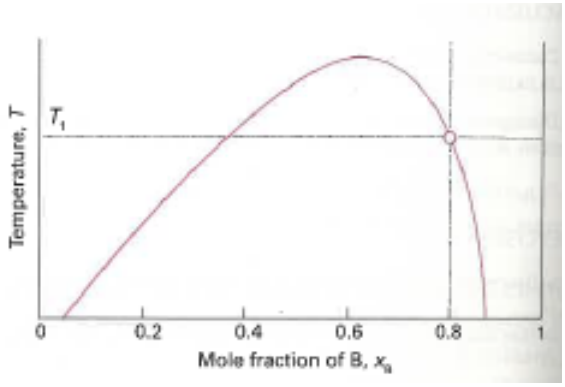
1. Define and provide examples of the following terms; phase, constituent component, and degree of freedom.
2. In a theoretical study of protein, the temperature-composition diagram (below) was obtained. It shows three structural regions: the native form, the unfolded form, and ta 'molten globule' form, a partially unfolded but still compact form of the protein. (i) Is the molten globule form ever stable when the denaturant concentration is below 0.1? (ii) Describe what happens to the polymer as the native form is heated in the presence of denaturant at concentration 0.15.



3. The below figure shows the phase diagram of water (A) and 2-methyl-1-propoanol (B). Describe what will be observed when a mixture of composition x_B=0.8 is heated, at each stage giving the number, composition and relative amounts of the phases present.



4. Why does the chemical potential of a substance depend on the pressure even if the substance is incompressible?
5. A mixture of water and ethanol is prepared with a mole fraction of water of 0.60. If a small change in the mixture composition results in an increase in the chemical potential of water by 0.25 J mol^{-1}, by how much will the chemical potential of ethanol change?
6. The temperature dependence of the vapour pressure of solid sulphur dioxide can be approximately represented by the relation log(p/Torr)=10.5916-1871.2/(T/K) and that of liquid sulphur dioxide by log(p/Torr)=8.3186-1425.7(T/K). Estimate the temperature and pressure of the triple point of sulphur dioxide.

Useful equations:

$$\left(\frac{\partial \mu}{\partial p}\right)_T = V_m$$

$n_\alpha l_\alpha = n_\beta l_\beta$

$$d\mu_B = -\frac{n_A}{n_B} d\mu_A$$

$$dG = Vdp - SdT + \sum_J \mu_J dn_J$$