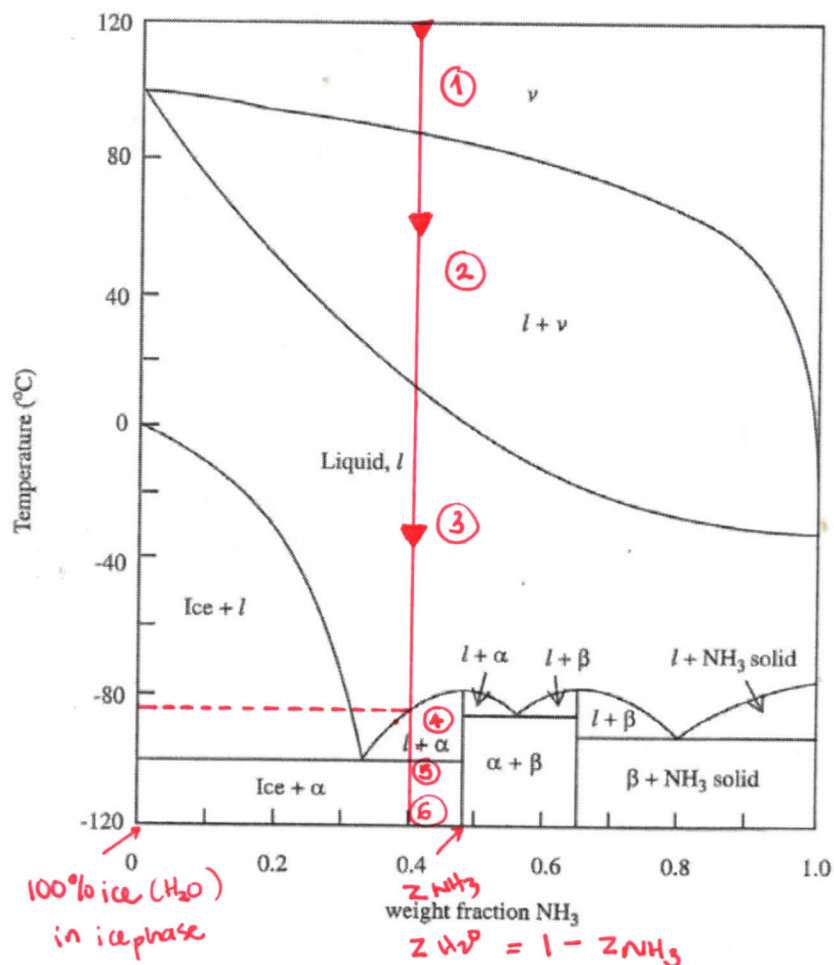


Name: Solutions

The figure below shows the complete phase behavior for ammonia (1) and water (2) mixtures at 1 atm as a function of temperature and composition. A peculiarity of the ammonia/water system is that in addition to pure solids, it can form mixed crystals with two distinct stoichiometries:  $\alpha$ )  $\text{NH}_3 \cdot \text{H}_2\text{O}$  and  $\beta$ )  $2\text{NH}_3 \cdot \text{H}_2\text{O}$



A binary vapor mixture with an ammonia weight fraction of 40% is slowly cooled down isobarically at 1 atm from 120°C to -120°C.

a) What is the progression of phases that will be encountered during this process?

✓ → VLE → L → SLE → SSLE → SSE  
 ①      ②      ③      ④      ⑤      ⑥

b) What is the suppression of the freezing point of this binary system in comparison to pure water?

≈ -84°C

c) What is the composition of the phases once the system reaches -120°C

- Ice phase: 100% Ice (or  $\text{H}_2\text{O}$ )
- $\alpha$  phase: 48%  $\text{NH}_3$ , 52%  $\text{H}_2\text{O}$