

SG P. 241 #13

The solubility of KNO_3 at 70°C is 135 g per 100 g of water. At 10°C , the solubility is 21 g per 100 g of water. What mass of KNO_3 will crystallize out of solution if exactly 100 g of its saturated solution at 70°C is cooled to 10°C ?

There are two ways to solve this problem. First, determine the mass of KNO_3 that will crystallize from a saturated solution at 70°C containing 135 g KNO_3 in 235 g saturated solution:

$$\text{Mass } \text{KNO}_3 = 135 \text{ g} - 21 \text{ g} = 114 \text{ g crystallized from 235 g solution}$$

Now take the ratio of the saturated solution with a total of 100 g to that containing 235 g total solute and solvent:

$$114 \text{ g } \text{KNO}_3 \times \frac{100 \text{ g solution}}{235 \text{ g solution}} = 48.5 \text{ g } \text{KNO}_3 \text{ crystallizes}$$

The other method involves taking the ratios of each of the solutions first, then subtracting:

$$\text{Mass } \text{KNO}_3 \text{ in 100 g sat'd sol'n at } 70^\circ\text{C}: 135 \text{ g } \text{KNO}_3 \times \frac{100 \text{ g solution}}{235 \text{ g solution}} = 57.4 \text{ g } \text{KNO}_3$$

$$\text{Mass } \text{H}_2\text{O} \text{ in 100 g sat'd sol'n at } 70^\circ\text{C}: 100 \text{ g sol'n} - 57.4 \text{ g } \text{KNO}_3 = 42.6 \text{ g } \text{H}_2\text{O}$$

$$\text{Mass } \text{KNO}_3 \text{ in 42.6 g } \text{H}_2\text{O} \text{ at } 10^\circ\text{C}: 21 \text{ g } \text{KNO}_3 \times \frac{42.6 \text{ g } \text{H}_2\text{O}}{100 \text{ g } \text{H}_2\text{O}} = 8.9 \text{ g } \text{KNO}_3$$

Mass KNO_3 crystallized from cooling 100g saturated solution from 70°C to 10°C :

$$\text{Mass } \text{KNO}_3 = 57.4 \text{ g} - 8.9 \text{ g} = 48.5 \text{ g } \text{KNO}_3 \text{ crystallized}$$