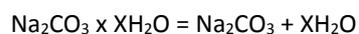


When a 2.558g sample of washing soda ($\text{Na}_2\text{CO}_3 \times \text{XH}_2\text{O}$) is heated, all the water of hydration is lost, leaving 0.948g of Na_2CO_3 . What is the value of X?

Solution: The process of dehydration can be described with the following equation:



$$\text{The quantity of moles of } \text{Na}_2\text{CO}_3 \text{ left: } \nu(\text{Na}_2\text{CO}_3) = \frac{m(\text{Na}_2\text{CO}_3)}{M(\text{Na}_2\text{CO}_3)} = \frac{0.948\text{g}}{106\text{g/mol}} = 0.0093\text{mol}$$

The quantity of moles of Na_2CO_3 is equal to the quantity of moles of the washing soda $\text{Na}_2\text{CO}_3 \times \text{XH}_2\text{O}$ (from the reaction equation), $\nu(\text{Na}_2\text{CO}_3 \times \text{XH}_2\text{O}) = \nu(\text{Na}_2\text{CO}_3) = 0.0093 \text{ mol}$. In order to solve the formula of the washing soda, the molar mass of it must be calculated:

$$\nu(\text{Na}_2\text{CO}_3 \times \text{XH}_2\text{O}) = \frac{m(\text{Na}_2\text{CO}_3 \times \text{XH}_2\text{O})}{M(\text{Na}_2\text{CO}_3 \times \text{XH}_2\text{O})}; M(\text{Na}_2\text{CO}_3 \times \text{XH}_2\text{O}) = \frac{m(\text{Na}_2\text{CO}_3 \times \text{XH}_2\text{O})}{\nu(\text{Na}_2\text{CO}_3 \times \text{XH}_2\text{O})} = \frac{2.558\text{g}}{0.0093\text{mol}} = 275\text{g/mol}$$

Molar mass of the substance is the sum of molar masses of its components (atoms):

$$M(\text{Na}_2\text{CO}_3 \times \text{XH}_2\text{O}) = M(\text{Na}_2\text{CO}_3) + X * M(\text{H}_2\text{O});$$

$$275\text{g/mol} = 106\text{g/mol} + (X * 18)\text{g/mol}$$

$$169\text{g/mol} = (X * 18)\text{g/mol}$$

$$X = \frac{169\text{g/mol}}{18\text{g/mol}} = 9.4$$

Answer: X=9.4