

Answer on the question #42752, Chemistry, Physical Chemistry

Question:

A 20mL portion of 40% NaOH solution is diluted to 200mL with water. What is the percent of the NaOH after dilution?

Solution:

According to the mass fraction definition,

$$w = \frac{m(\text{NaOH})}{m(\text{solution})} = \frac{m(\text{NaOH})}{m(\text{NaOH}) + m(\text{H}_2\text{O})} \cdot 100\%$$

Let's find the mass of NaOH in solution. In water solutions, the mass of water is generally close to the mass of the same volume of pure water, while the presence of solute causes the density increase. Hence

$$m(\text{H}_2\text{O}) = \rho V = 1 \frac{\text{g}}{\text{ml}} \cdot 20 \text{ ml} = 20 \text{ g}$$

Let x denote the mass of NaOH.

$$w(\text{NaOH}) = \frac{m(\text{NaOH})}{m(\text{solution})} = \frac{x}{x + 20} \cdot 100\% = 40\%$$
$$x = 13.3 \text{ g}$$

The final mass of the solution after dilution is the sum of masses of the water and the sodium hydroxide:

$$m(\text{solution}) = 13.3 + 200 = 213.3 \text{ g}$$

According to the equation (1), the mass fraction of NaOH is:

$$w = \frac{13.3}{213.3} \cdot 100\% = 6.2\%$$

Answer: 6.2%