

Answer on the Question #63510, Chemistry / General chemistry

When you dissolve 2.5 moles of ethanol in 1 kg of water, there is 1 ethanol molecule for how many water molecules? Give your answer to 3 s.f.

Solution:

At first we should know, how much molecules of ethanol in 2.5 moles:

$$N = n \cdot N_A = 2.5 \text{ mol} \cdot 6.02 \cdot 10^{23} \text{ mol}^{-1} = 15.05 \cdot 10^{23} \text{ molecules}$$

At second to know how much molecules of water correspond to $15.05 \cdot 10^{23}$ molecules of ethanol:

$$N = n \cdot N_A = \frac{m(H_2O)}{M(H_2O)} \cdot N_A = \frac{1000 \text{ g}}{18 \frac{\text{g}}{\text{mol}}} \cdot 6.02 \cdot 10^{23} \text{ mol}^{-1} = 334.11 \cdot 10^{23} \text{ molecules}$$

To know how many molecules of water correspond to 1 ethanol molecule we need to normalize the value of molecule number of water by ethanol molecule number:

$$N(H_2O) = \frac{N_{(H_2O)}^{all}}{N_{(Ethanol)}^{all}} = \frac{334.11 \cdot 10^{23} \text{ molecules}}{15.05 \cdot 10^{23} \text{ molecules}} = 22.2 \cdot 10^{23} \text{ molecules}$$

Answer: 1 molecule of ethanol for $2.220 \cdot 10^{23}$ molecules of water.