Mole fraction of salt in sea water

Sea water is approximately 0.6 M. Assuming (for simplicity) that the salt in sea water is 100% NaCl calculate the mole fraction of NaCl and H_2O in sea water. [Assume that the density is 1.02 gm/cm^3]

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Calculate the mole fraction of NaCl (0.6 M) and H_2O in sea water. [Assume that the density is 1.02 gm/cm^3]

Solution: Since the concentration is given in molarity we need the density to obtain the mass of the solvent. The mass of H_2O is 1020 gm/L so the number of moles is

$$n_1 = \frac{m}{M_m} = \frac{1020\ gm}{18\ gm/mol} = 56.7\ mol$$

The number of moles of NaCl is given as $n_2 = 0.6$ in one liter. The total number of moles is $n_1 + n_2 = 57.3\ mol$. Therefore, the mole fraction of NaCl is:

$$x_2 = \frac{n_2}{n} = \frac{0.6\ mol}{57.3\ mol} = 0.0105$$

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To calculate the mole fraction of the water we could go through a similar process. However, it is much simpler to recognize that

$$x_1 + x_2 = 1$$

and therefore that

$$x_1 = 1 - x_2$$

In this case

$$x_1 = 1 - 0.0105$$

$$x_1 = 0.9895$$