

Task:

calculate the molaity of a solution made by dissolving 40g NaCl in 300g of water

Solution:

It's not clear what we have to find in the task. Is "molaity" a molarity or molality?

So let's find both of them.

1) Molarity

$$C(M) = n(\text{mol}) / V(L)$$

C – molarity of the solution (mol/L)

n – number of moles of NaCl

V – volume of solution (L)

The amount of NaCl is

$$n(\text{mol}) = m(\text{g}) / MW(\text{g/mol})$$

$$MW(\text{NaCl}) = MW(\text{Na}) + MW(\text{Cl}) = 23 + 35.5 = 58.5 \text{ g/mol}$$

$$n(\text{NaCl}) = 40 / 58.5 = 0.684 \text{ mol}$$

The density of water $d = 1.00 \text{ g/cm}^3$

The volume of solution \approx the volume of water

$$V(\text{water}) = m(\text{g}) / d (\text{g/cm}^3) = 300 / 1.00 = 300 \text{ mL} = 0.300 \text{ L}$$

The molarity of NaCl solution is

$$C(\text{NaCl}) = n(\text{NaCl}) / V(L)$$

$$C(\text{NaCl}) = 0.684 / 0.300 = 2.28 \text{ M}$$

2) Molality – number of moles of substance in 1 kg of solvent

$$M(\text{mol / kg}) = n(\text{mol}) / m(\text{kg})$$

The number of moles of NaCl we have already found

$$n(\text{NaCl}) = 0.684 \text{ mol}$$

$$m(\text{H}_2\text{O}) = 300 \text{ g} = 0.300 \text{ kg}$$

The molality of the solution is

$$M(\text{mol / kg}) = n(\text{mol}) / m(\text{kg})$$

$$M(\text{NaCl}) = n(\text{NaCl}) / m(\text{H}_2\text{O})$$

$$M(\text{NaCl}) = 0.684 / 0.300 = 2.28 \text{ mol / kg}$$

In our case the molarity is equal to molality

Answer: $C(\text{NaCl}) = 2.28 \text{ M}$; $M(\text{NaCl}) = 2.28 \text{ mol / kg}$