

Task:

148.2 g of Cupric sulfate are dissolved in enough water to make 2.00×10^3 mL of total solution. What is the molar concentration?

When the same amount of cupric sulfate from problem 1 is dissolved in 1,375 g of water, what is the molal concentration of the resulting solution?

Solution:*Problem 1.*

The molarity of solution is

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

C – molarity (M)

n – number of moles of substance

V- volume of solution (L)

First of all we have to convert mL to L

$$1 \text{ L} = 1.0 \cdot 10^3 \text{ mL}$$

The volume of solution is

$$V = 2.00 \cdot 10^3 \text{ mL} = 2.00 \text{ L}$$

The mass of CuSO_4 is

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

The molar weight consists of atomic weights of elements taken from the periodic table

$$\text{MW} (\text{CuSO}_4) = \text{MW} (\text{Cu}) + \text{MW} (\text{S}) + 4 \cdot \text{MW} (\text{O}) = 63.5 + 32 + 3 \cdot 16 = 159.5 \text{ g/mol}$$

The number of moles of CuSO_4

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

$$n \text{ (mol)} = 148.2 / 159.5 = 0.929 \text{ mol}$$

The molarity is

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

$$C (\text{CuSO}_4) = 0.929 / 2.00 = 0.46 \text{ M}$$

Problem 2.

The molal concentration is the amount of substance (mol) in 1 kg of solvent.

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

We have to convert g to kg

$$1 \text{ kg} = 1.0 \cdot 10^3 \text{ g}$$

The mass of solvent (water) is

$$m \text{ (kg)} = 1,375 / 1.0 \cdot 10^3 = 1.375 \text{ kg}$$

The molality of solution is

$$M = 0.929 / 1.375 = 0.676 \text{ mol/kg}$$

Answer: 1) C (CuSO_4) = 0.46 M

2) M (CuSO_4) = 0.676 mol/kg