## SOLUTIONS - PROBLEMS

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|---|---|
| 1 | **7.2 g of sucrose, $C_{12}H_{22}O_{11}$, have been dissolved in 103.5 g of water.**<br><br>**Calculate:**<br><br>• **the concentration in %**<br>• **the molarity**<br><br>**Suppose that the volume of the liquid phase remains constant (after adding the solute) and that de density is 1000 g/L.**<br><br>**(Atomic weights: C=12, H=1, O=16)** |
| 2 | **Calculate the volume we need to take from a solution of NaOH of 40 % of concentration in order to get a solution that has the following characteristics: 200 mL NaOH 2M (after diluting with water)**<br><br>**(Atomic weights: Na=23, O=16, H=1)**<br>**(density of the 40% NaOH solution: 1080 g/L** |
| 3 | **Two different solutions of NaOH are mixed together:**<br><br>• **the volume and concentration of the first are 50 mL 2M**<br>• **and the second is 150 mL 25 % (d=1020 g/L).**<br><br>**Calculate the concentration of the resulting solution in g/L.**<br><br>**(Atomic weights: Na=23, O=16, H=1)** |
| 4 | **Calculate how many grams of solid NaOH we need to add to a solution that is 200 mL 1.2 M in order to concentrate that solution to 65 g/L.**<br><br>**Suppose that the addition of the solid does not change the volume of the solution**<br><br>**(Atomic weights: Na=23, O=16, H=1)** |
| 5 | **Calculate the molarity of a solution when we take 75 mL of a solution 0.25 M on NaOH and dilute with water until a volume of 250 mL is reached.**<br><br>**(Atomic weights: Na=23, O=16, H=1)** |

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| 1 | **7.2 g of sucrose, $C_{12}H_{22}O_{11}$, have been dissolved in 103.5 g of water.**<br><br>**Calculate:**<br><br>• **the concentration in %**<br>• **the molarity**<br><br>**Suppose that the volume of the liquid phase remains constant (after adding the solute) and that de density is 1000 g/L.**<br><br>**(Atomic weights: C=12, H=1, O=16)** |

SOLUTION:

The molar mass of sucrose is:

M(sucrose)=12.12 + 22.1 + 11.16= 144 + 22 + 176 = 342 g / mol

- The concentration in %

$$m\ (solution) = 7.2\ g\ sucrose + 103.5\ g\ water = 110.7\ g\ solution$$

$$\%\ mass\ (sucrose) = \frac{7.2\ g\ sucr}{110.7\ g\ sol} * 100 = 6.5\ \frac{g\ sucr}{100\ g\ sol} = 6.5\ \%$$

- Molarity

$$c\ (sucrose\ (mol/L)) = \frac{7.2\ g\ sucr}{103.5\ g\ sol} * \frac{1000\ g\ sol}{1L\ sol} * \frac{1\ mole\ sucr}{342\ g\ sucr} =$$

$$= 0.2\ \frac{mol\ sucr}{L\ sol} = 0.2\ M$$

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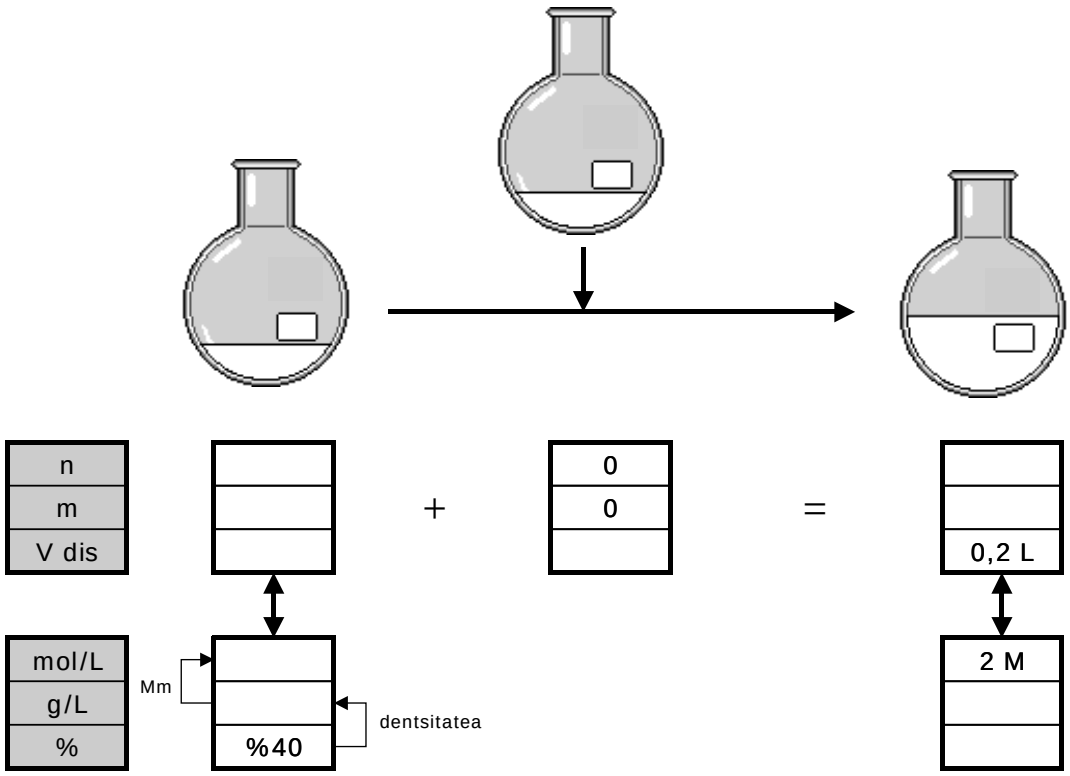
| 2 | **Calculate the volume we need to take from a solution of NaOH of 40 % of concentration in order to get a solution that has the following characteristics: 200 mL NaOH 2M (after diluting with water)**<br><br>**(Atomic weights: Na=23, O=16, H=1)**<br>**(density of the 40% NaOH solution: 1080 g/L)** |

SOLUTION:




First, let's try to calculate the additive magnitudes (n, m, V) we can.

- Knowing the concentration (40 %) and the density, we can calculate the concentration in g/L

$$c\ (NaOH(g/L)) = 40\ \frac{g\ NaOH}{100\ g\ sol}\ .\ \frac{1080\ g\ sol}{1\ L\ sol}\ =\ 432\ \frac{g\ NaOH}{L\ sol}$$

- We can also know the molarity of this first solution (after calculating the molar mass; 40 g/mol in our case)

$$c\ (NaOH(g/L)) = 40\ \frac{g\ NaOH}{100\ g\ sol}\ .\ \frac{1080\ g\ sol}{1\ L\ sol}\ .\ \frac{1\ mole\ NaOH}{40\ g\ NaOH}\ =\ 10{,}80\ M$$

From the third solution (the second is pure water) we can perform the following calculations.

- Number of moles of solute of the last solution

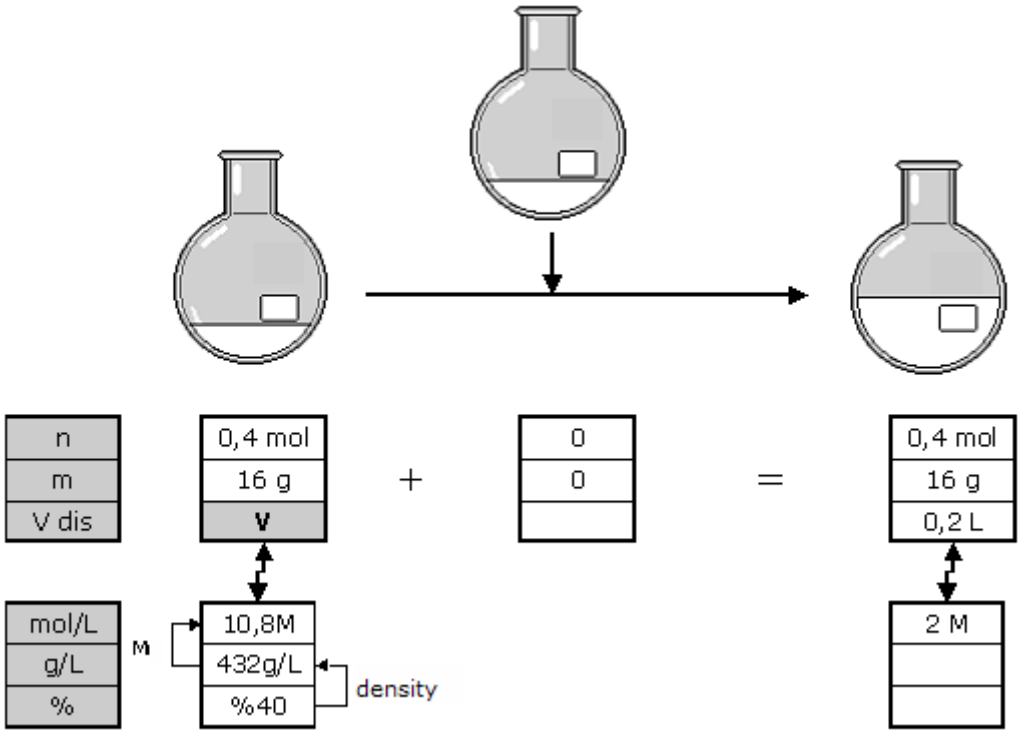
$$n(NaOH) = 2\ \frac{\text{mol NaOH}}{\text{L sol}}\ .\ 0.2\ \text{L sol}\ =\ 0.4\ \text{mol NaOH}$$

We have to remember that the number of moles of solute of the last solution comes from the first solution, because the second solution is just water.

- Number of grams of solute of the last solution (and the first solution, because the second solution is just water)

$$m(NaOH) = 2\ \frac{\text{mol NaOH}}{\text{L sol}}.\ \frac{40\ \text{g NaOH}}{1\ \text{mol NaOH}}\ .\ 0{,}2\ \text{L sol}\ =\ 16\ \text{g NaOH}$$

After filling the gaps with those values, we get the following table:




To finish, we need to calculate the volume of the first solution:

$$V = 16\ \text{g NaOH}\ .\ \frac{1\ \text{L sol}}{432\ \text{g NaOH}}\ .\ \frac{1000\ \text{mL sol}}{1\ \text{L sol}}\ =\ 37\ \text{mL NaOH sol.}$$

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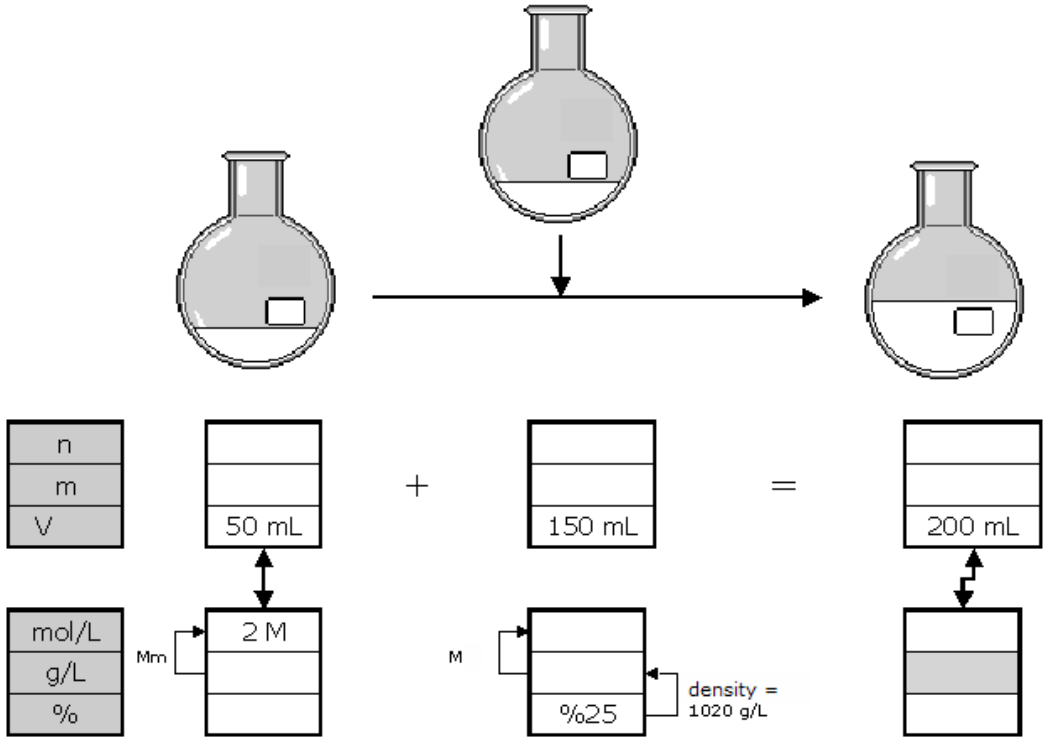
| 3 | **Two different solutions of NaOH are mixed together:**<br><br>• **the volume and concentration of the first are 50 mL 2M**<br>• **and the second is 150 mL 25 % (d=1020 g/L).**<br><br>**Calculate the concentration of the resulting solution in g/L.**<br><br>**(Atomic weights: Na=23, O=16, H=1)** |

SOLUTION:

Let's fill in the gaps with the information we have




Now, we will calculate the matter (grams and moles) we have in the first solution

$$n = 2\frac{\text{mol NaOH}}{\text{L sol}} * 50 \text{ mL sol} * \frac{1 \text{ L sol}}{1000 \text{ mL sol}} = 0.1 \text{ mol NaOH}$$

$$m = 2\frac{\text{mol NaOH}}{\text{L sol}} * 50 \text{ mL sol} * \frac{1 \text{ L sol}}{1000 \text{ mL sol}} * \frac{40 \text{ g NaOH}}{1 \text{ mol NaOH}} = 4 \text{ g NaOH}$$

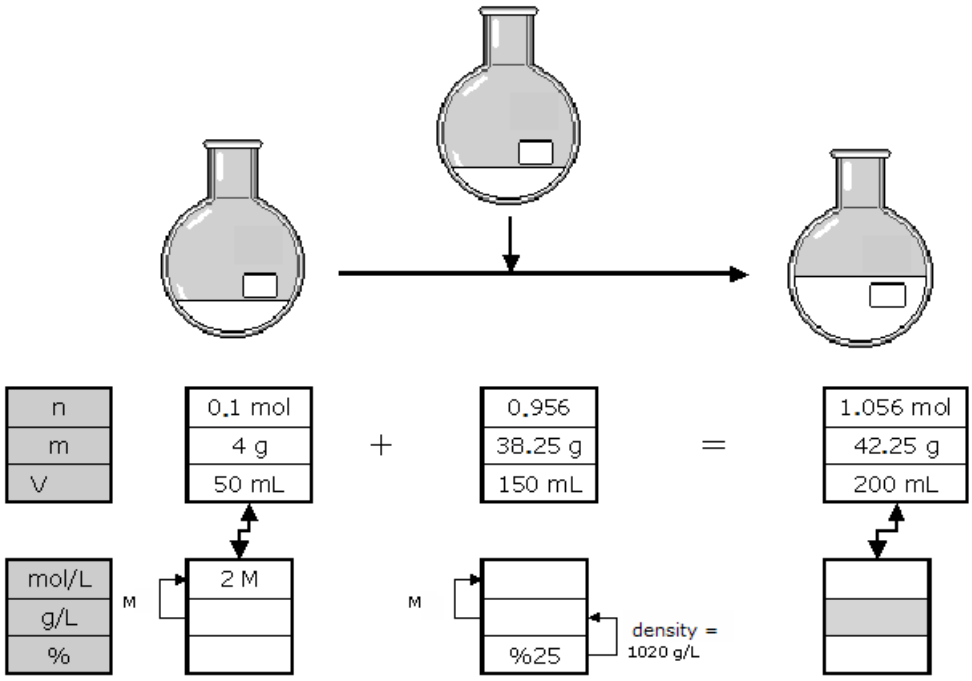
We will repeat the process for the second solution:

$$n = 25\frac{\text{g NaOH}}{100\ \text{g sol}} * 150\ \text{mL} * \frac{1\ \text{L sol}}{1000\ \text{mL}} * \frac{1\ \text{mol NaOH}}{40\ \text{g NaOH}} * \frac{1020\ \text{g sol}}{1\ \text{L sol}} =$$

$$= 0.956\ \text{mol NaOH}$$

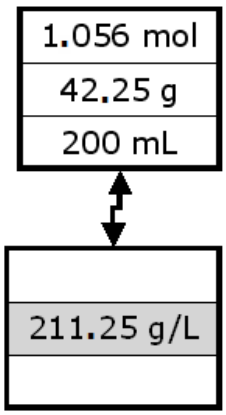
$$m = 0.956\ \text{mol NaOH} \cdot \frac{40\ \text{g NaOH}}{1\ \text{mol NaOH}} = 38.25\ \text{g NaOH}$$

According to those calculations, we get the following table:




The final concentration is:

$$c\ (\text{NaOH (g/L)}) = \frac{42.25\ \text{g NaOH}}{200\ \text{mL}} * \frac{1000\ \text{mL}}{1\ \text{L}} = 211.25\ \frac{\text{g NaOH}}{\text{L sol}}$$



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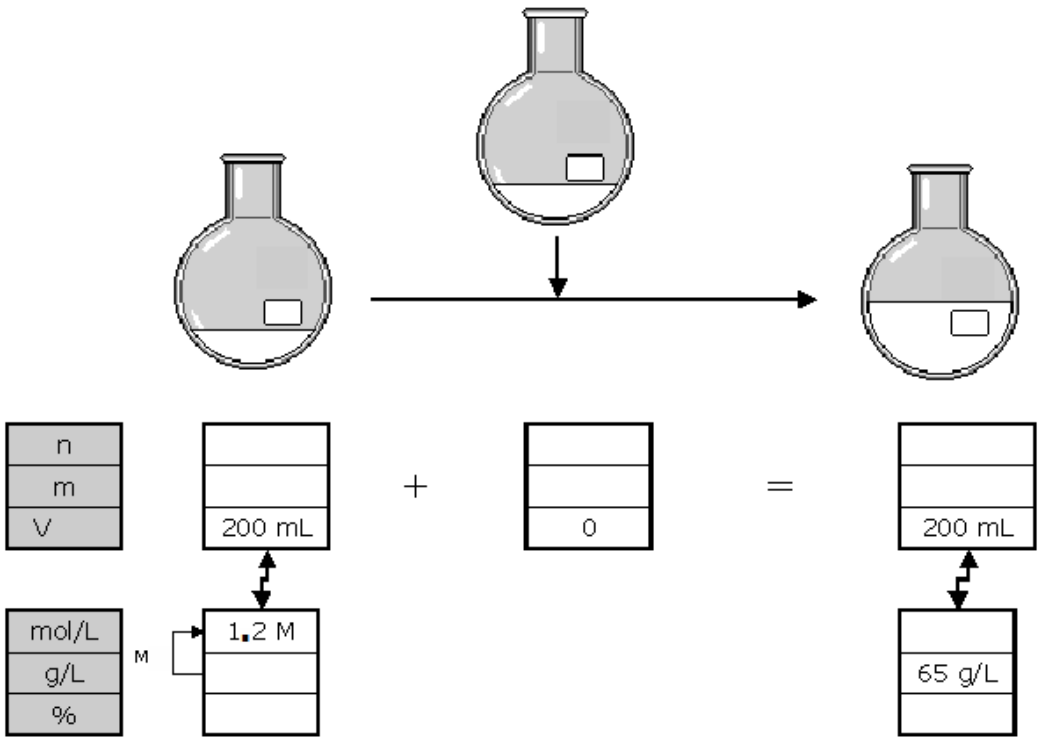
| 4 | **Calculate how many grams of solid NaOH we need to add to a solution that is 200 mL 1.2 M in order to concentrate that solution to 65 g/L.**<br><br>**Suppose that the addition of the solid does not change the volume of the solution**<br><br>**(Atomic weights: Na=23, O=16, H=1)** |

SOLUTION:

These are tha values we know:




Let's calculate the amount of solute (grams and moles) we have in those solutions.

- In the first solution we have:

$$n = 1.2\ \frac{\text{mol NaOH}}{\text{L sol}} * 200\ \text{mL sol} * \frac{1\ \text{L sol}}{1000\ \text{mL sol}} = 0.24\ \text{mol NaOH}$$

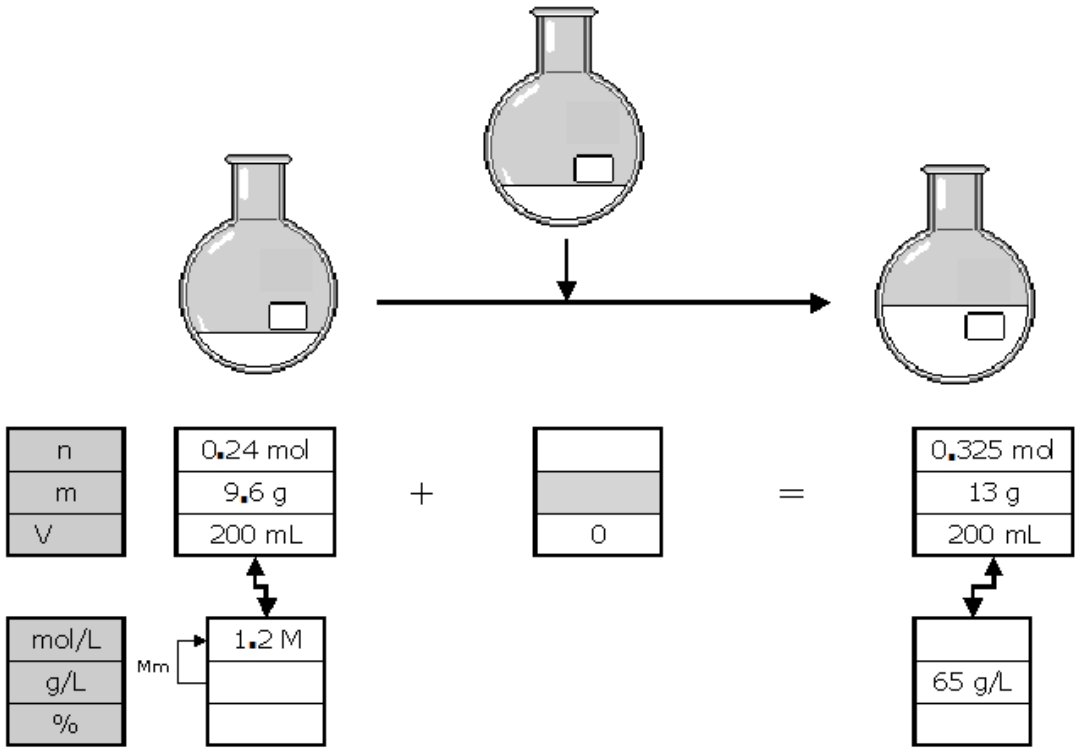
$$m = 1.2\ \frac{\text{mol NaOH}}{\text{L sol}} * 200\ \text{mL sol} * \frac{1\ \text{L sol}}{1000\ \text{mL sol}} \cdot \frac{40\ \text{g NaOH}}{1\ \text{mol NaOH}} = 9.6\ \text{g NaOH}$$

- In the last solution we have

$$n = 65\ \frac{g\ NaOH}{L\ sol} * 200\ mL\ sol * \frac{1\ L\ sol}{1000\ mL\ sol} \cdot \frac{1\ mol\ NaOH}{40\ g\ NaOH} = 0.325\ mol\ NaOH$$

$$m = 65\ \frac{g\ NaOH}{L\ sol} * 200\ mL\ sol * \frac{1\ L\ dis}{1000\ mL\ dis} = 13\ g\ NaOH$$

If we fill in the gaps with the calculated values we get:




The amount of solid NaOH needed is:

$$m(NaOH\ solid) = 13\ g\ NaOH - 9.6\ g\ NaOH = 3.4\ g\ NaOH$$

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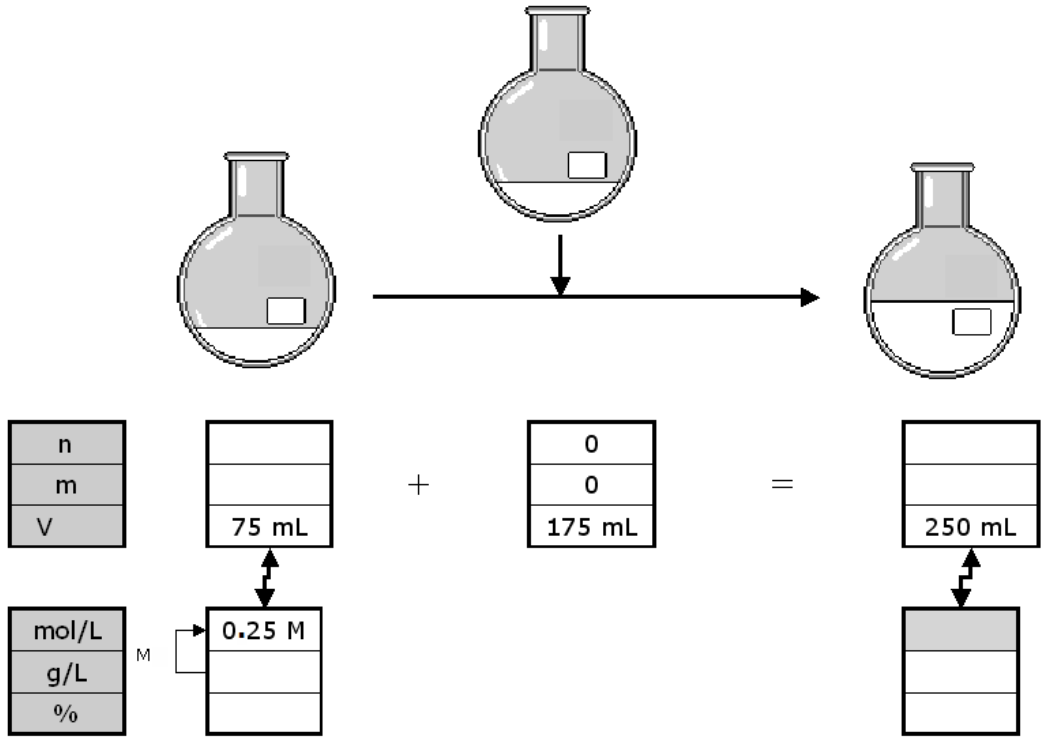
| 5 | **Calculate the molarity of a solution when we take 75 mL of a solution 0.25 M on NaOH and dilute with water until a volume of 250 mL is reached.**<br><br>**(Atomic weights: Na=23, O=16, H=1)** |

The values we have are:

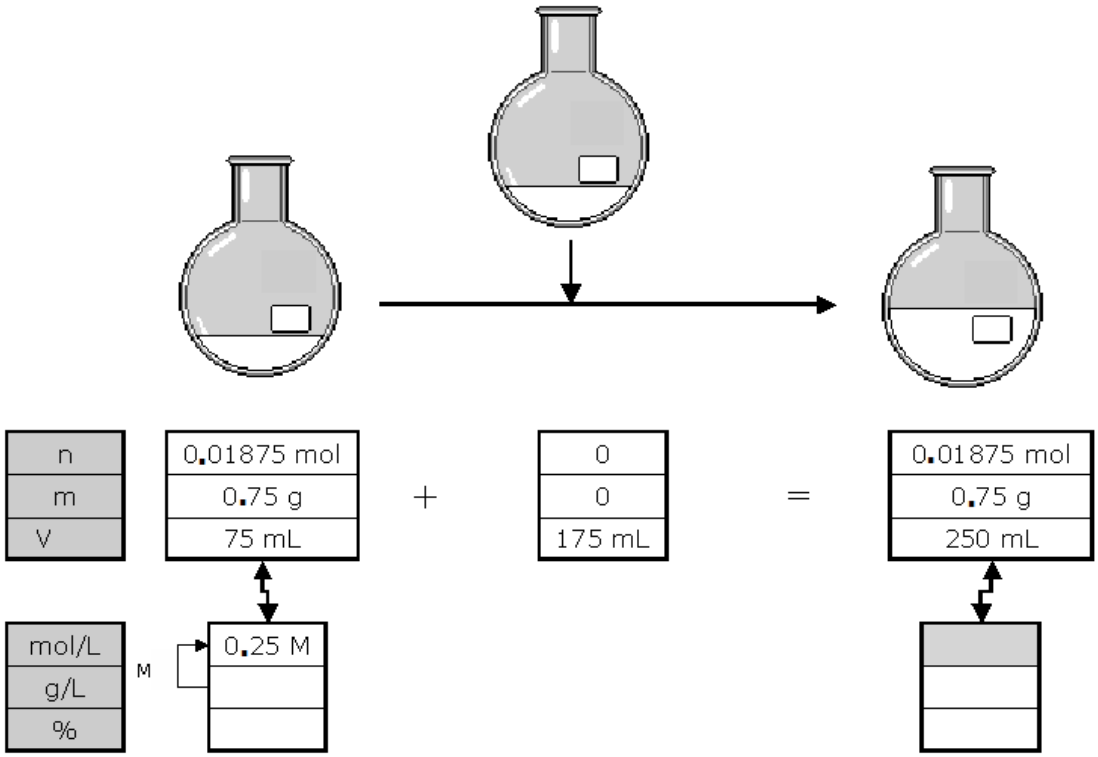



The amount of solute we have in the first solution (and in the final solution, because only water is added) is:

$$n = 0.25 \frac{\text{mol NaOH}}{\text{L sol}} * 75 \text{ mL sol} * \frac{1 \text{ L sol}}{1000 \text{ mL sol}} = 0{,}01875 \text{ mol NaOH}$$

$$m = 0.01875 \text{ mol NaOH} * \frac{40 \text{ g NaOH}}{1 \text{ mol NaOH}} = 0.75 \text{ g NaOH}$$

If we fill in the gaps with the calculated values we get:




The concentration of the final solution is:

$$c\ (NaOH(M)) = \frac{0.01875\ mol\ NaOH}{0.25\ L} = 0.075\ M$$