Basic calculations

By Ola Amland

How many g of NaCl and water are there in 80 g of 20% solution?

First, calculate the amount of NaCl in the solution:

$$\mathrm{NaCl} = 20\% \text{ of } 80 \text{ g}$$

$$\mathrm{NaCl} = 0.20 \times 80 \text{ g}$$

$$\mathrm{NaCl} = 16 \text{ g}$$

Next, find the amount of water in the solution:

$$\text{Water} = 80 \text{ g} - \mathrm{NaCl}$$

$$\text{Water} = 80 \text{ g} - 16 \text{ g}$$

$$\text{Water} = 64 \text{ g}$$

How many grams of KCl should be dissolved in 50g of water to obtain 5% solution?

50g H_2O + 0,05x KCl = x

Where x is total amount in grams

50g H_2O = 0,95x

$$\frac{50g\ \mathrm{H_2O}}{0,95} = x \longrightarrow x = 52,63g$$

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$$x = 52{,}63g$$

52,63g - 50g = <u>2,63g</u>

Moles

1 mole = 6,022 x 10^{23} particles

6,022 x 10^{23} = Avogadros number

$$Moles(n) = \frac{Mass\ (g)}{Molar\ mass\ g/mol}$$

$$Molar(M) = \frac{Moles\ (n)}{Volume\ (l)}$$

SI Prefixes

Factor	Name	Symbol	Numerical Value
10^{12}	tera	T	1 000 000 000 000
10^{9}	giga	G	1 000 000 000
10^{6}	mega	M	1 000 000
10^{3}	kilo	k	1 000
10^{2}	hecto	h	100
10^{1}	deka	da	10
10^{-1}	deci	d	0.1
10^{-2}	centi	c	0.01
10^{-3}	milli	m	0.001
10^{-6}	micro	µ	0.000 001
10^{-9}	nano	n	0.000 000 001
10^{-12}	pico	p	0.000 000 000 001

Calculate molar [M], milimolar [mM] and micromolar [µM] concentration if HCl solution contains 3.65 mg in 1 mL. MHCl = 36.5g/mol

$$Moles(HCl) = \frac{Mass}{Molar\ mass}$$

$$Moles(HCl) = \frac{3{,}65 * 10^{-3} g}{36{,}5 g/mol}$$

$$Moles(HCl) = 0{,}0001$$

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Calculate molar [M], milimolar [mM] and micromolar [µM] concentration if HCl solution contains 3.65 mg in 1 mL. MHCl = 36.5g/mol

$$Moles(HCl) = 0{,}0001$$

Molarity = moles/l

M (HCl) = 0,0001n/1*10^{-3}l

M(Hcl) = 0,1 moles/l = <u>0,1M</u>

mM = 0,1 moles/l * 1000 = <u>100mM</u>

µM = 0,1 moles/l *10^{6} = <u>100 000µM</u>

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How many grams of 1% solution(A) and 0.1% solution (B) should be mixed to obtain 180 g of 0.5% solution (C)?

Equation 1: $0.01x + 0.001y = 0.9$

Equation 2: $x + y = 180$ (since the total weight is 180 grams)

How many grams of 1% solution(A) and 0.1% solution (B) should be mixed to obtain 180 g of 0.5% solution (C)?

- Equation 1: $0,01*A + 0,001*B = 0,005*C$, $C=180g$
- Equation 2: $A+B = 180g$
- Equation 2: $A=180g-B$
- Put 2 in 1: $0,01(180g-B) +0,001B = 0,9$
- $1,8-0,01B + 0,001B = 0,9$
- $0,9=0,009B$
- $B=\underline{100g}$

KCl solution contains 2 mg of this compound in 1ml of solution (d =1g/ml). Calculate the % concentration. Calculations could be performed on an assumption that densities of all solutions are approximately 1g/ml.

- Total density = 1g
- 2mg/1g
- 0,002g/1g
- <u>0,2%</u>

You

How many mg in a gram

ChatGPT

There are 1000 milligrams (mg) in one gram (g).

How many mL of water should be added to 20 mL of 0.2M solution to obtain 0.01M solution. Calculations could be performed on assumption that densities of all solutions approximately are equal to 1 g/mL

$$\text{volume of added water} = 0\,\text{mL}$$

So, to obtain a $0.01\ \mathrm{M}$ solution from $20\ \mathrm{mL}$ of a $0.2\ \mathrm{M}$ solution, you don't need to add any water. The initial solution already has the desired concentration.

OL **You**

I think you are wrong

ChatGPT

I appreciate your patience. Let's reevaluate the calculation.

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The dilution formula is:

$$C_1 V_1 = C_2 V_2$$

Given that:

- $C_1 = 0.2\,\mathrm{M}$ (initial concentration),
- $V_1 = 20\,\mathrm{mL}$ (initial volume),
- $C_2 = 0.01\,\mathrm{M}$ (final concentration),
- V_2 is the volume of the final solution (which is $20\,\mathrm{mL} + \text{volume of added water}$).

ChatGPT

I apologize for any confusion in my previous responses. Let me clarify:

$$(0.2\,\mathrm{M}) \times (20\,\mathrm{mL}) = (0.01\,\mathrm{M}) \times (20\,\mathrm{mL} + \text{volume of added water})$$

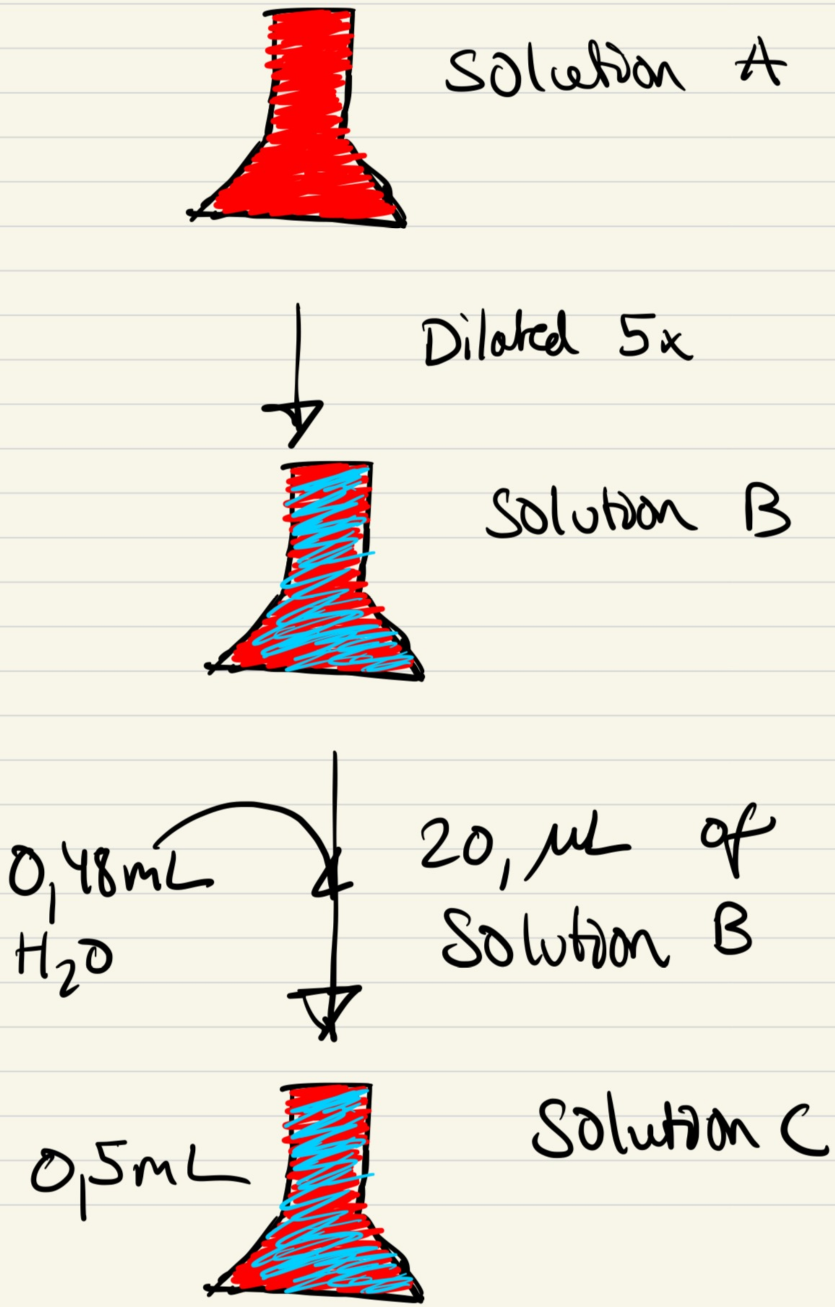
$$4 = 0.01 \times (20 + \text{volume of added water})$$

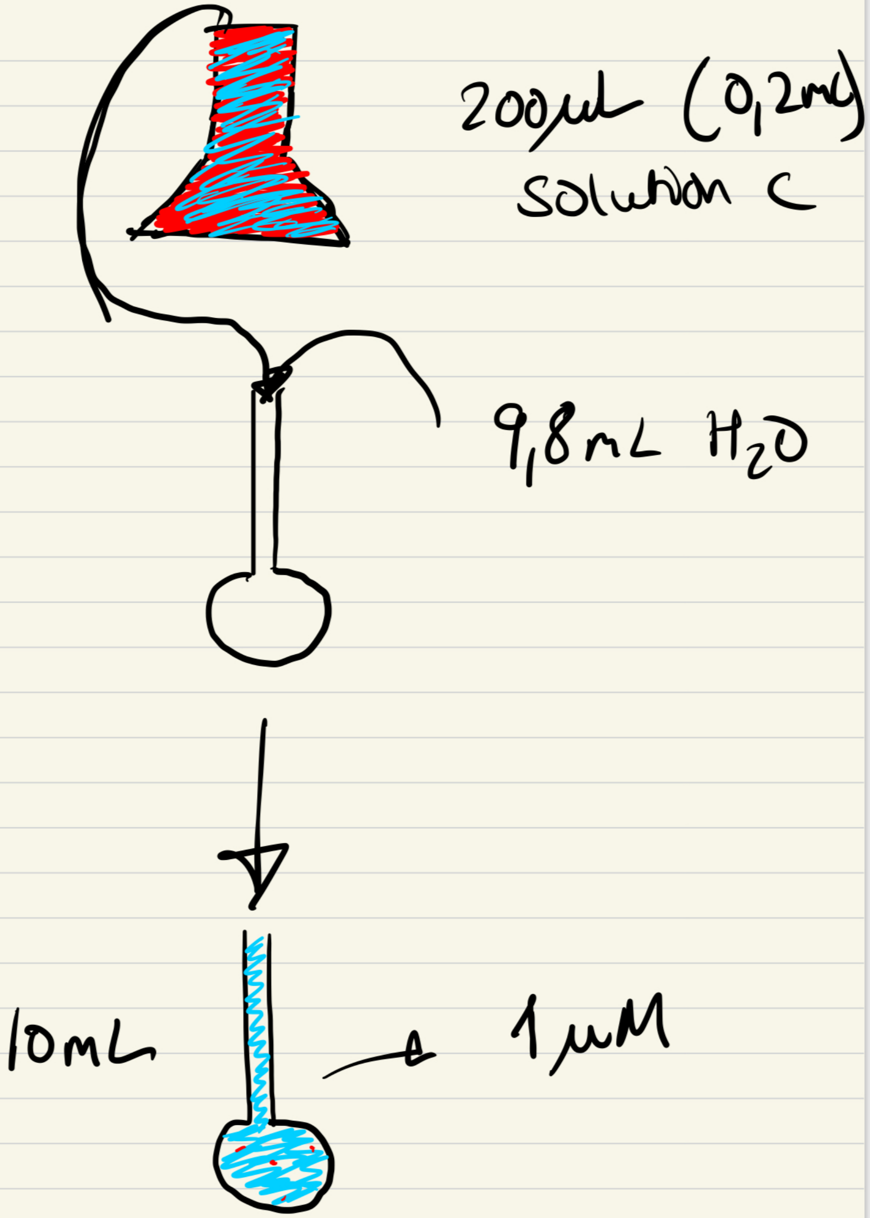
$$20 + \text{volume of added water} = \frac{4}{0.01}$$

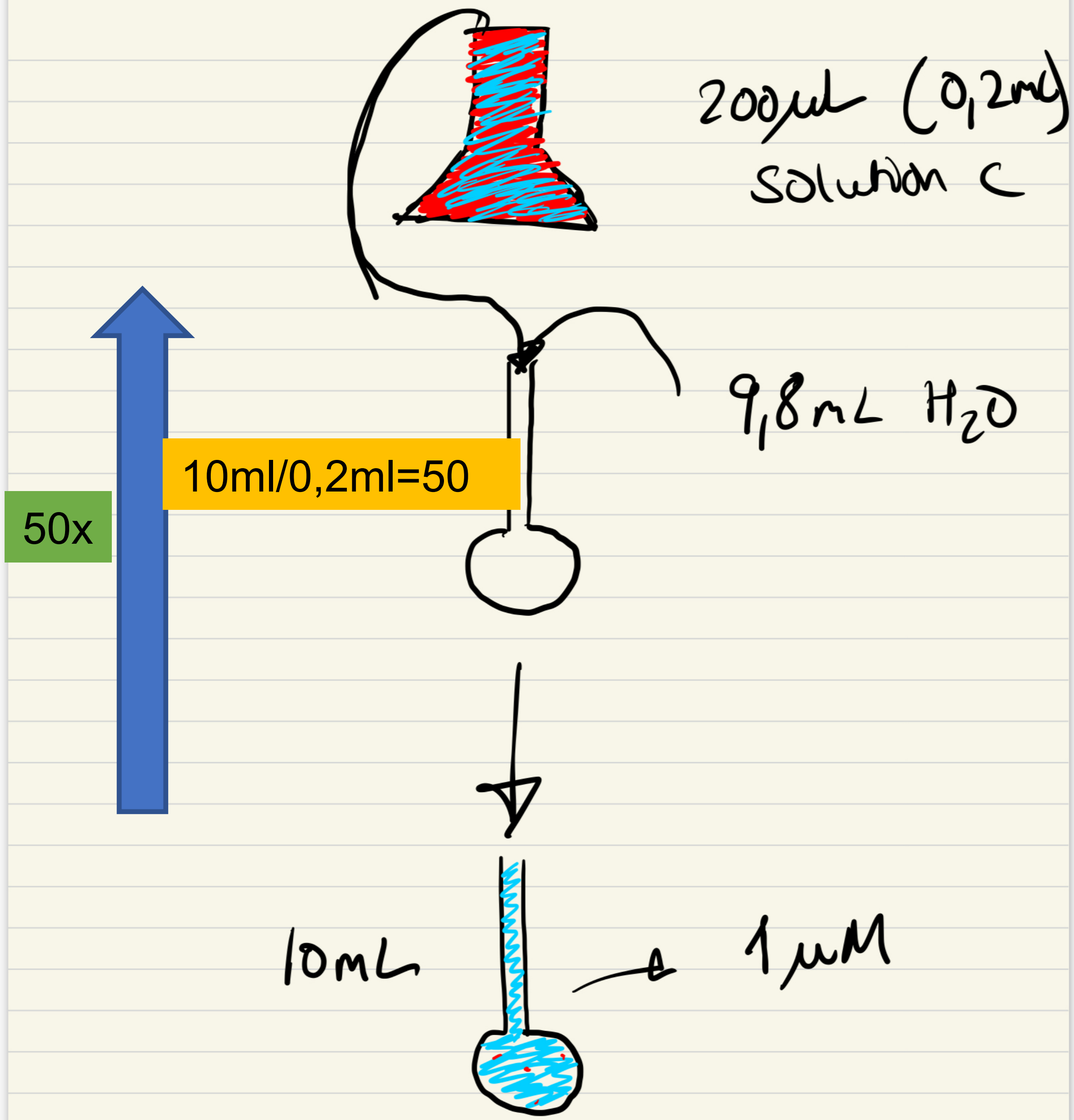
$$20 + \text{volume of added water} = 400$$

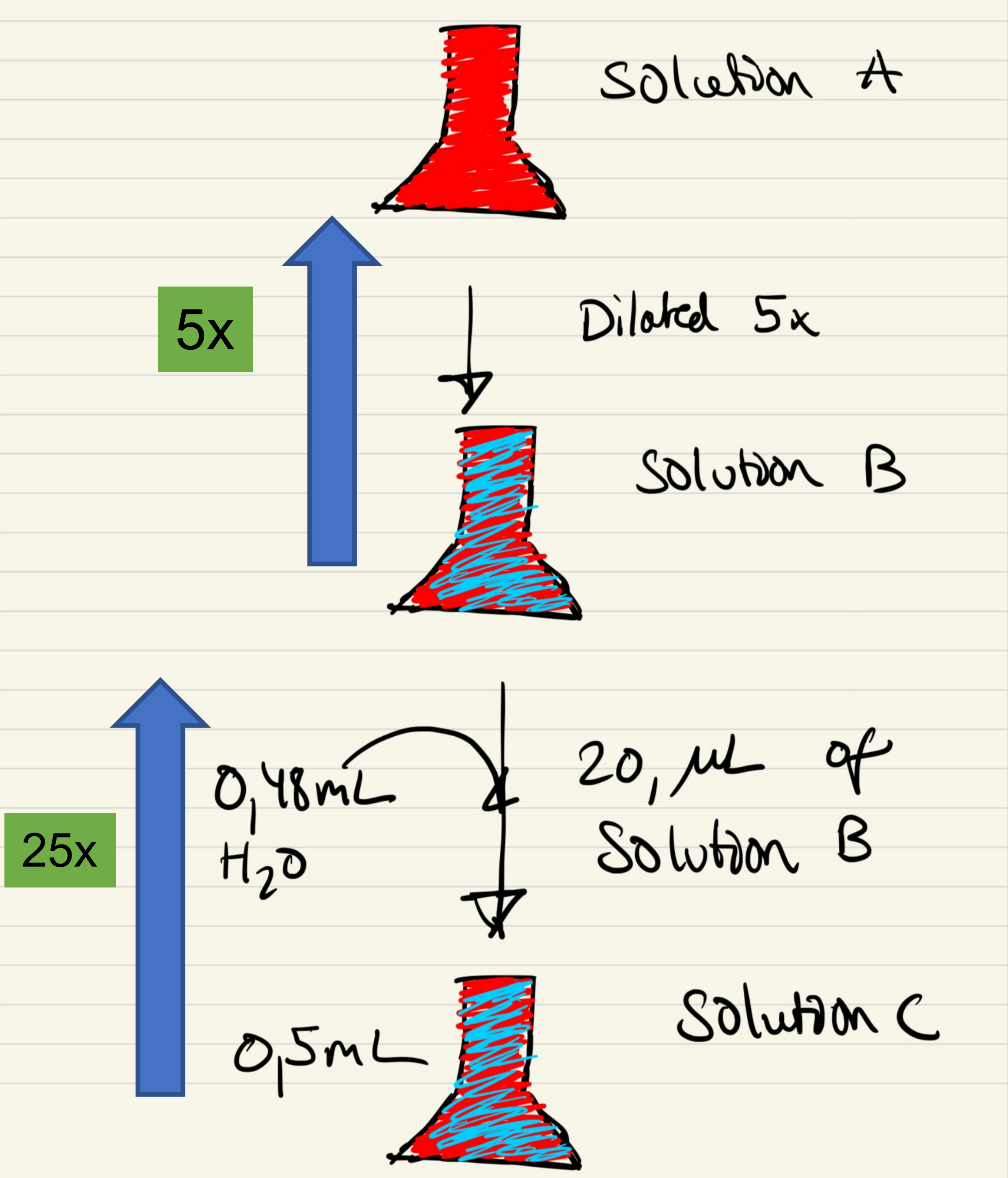
$$\text{volume of added water} = 380\,\mathrm{mL}$$

Solution A was diluted 5 times with water. Then 20μL of the resulting solution B was mixed with 0.48 mL of water (solution C) and finally 200μL of solution C was introduced to the volumetric flask of the nominal volume 10 mL. The flask was filled with water and the molarity of the solution in the flask was assayed 1μM. Calculate the initial molarity of solution A.


Solution A
Diluted 5x
Solution B
0,48mL
H_2O
20, μL of
Solution B
0,5mL
Solution C


200µL (0,2mL)
solution C
9,8mL H_2O
10mL
1µM


200µL (0,2mL)
solution C
9,8mL H_2O
10ml/0,2ml=50
50x
10mL
1µM



0,5mL/0,02mL=25

- 50*25*5=6250
- 1μM*6250=<u>6250μM or 6,25mM</u>

Calculations could be performed on assumption that densities of all solutions approximately are equal to 1 g/mL

a) 100 mL of 2mM KOH solution was mixed with 400 ml of 1 mM HCl solution. Calculate molar concentrations (M) of all compounds in the reaction mixture.

b) 100 mL of 1.2 mM KOH solution was mixed with 100 ml of 1 mM H2SO4 solution. Calculate molar concentrations (M) of salts in the reaction mixture.

a) 100 mL of 2mM KOH solution was mixed with 400 ml of 1 mM HCl solution. Calculate molar concentrations (M) of all compounds in the reaction mixture.

- 0,1L*2mM=0,2mmol KOH
- 0,4L*1mM=0,4mmol HCl

$$KOH + HCl \rightarrow KCl + H_2O$$

0,2 mmol   0,4 mmol

$$KOH + HCl \rightarrow KCl + H_2O$$

HCl: 0,2 mmol   KCl: 0,2 mmol H_2O: 0,2 mmol

$$\frac{0{,}2\ \text{mmol}}{0{,}5\ \text{L}} = 0{,}4\ \text{mM}$$

$$\frac{0{,}2\ \text{mmol}}{0{,}5\ \text{L}} = 0{,}4\ \text{mM}$$

100 mL of 1.2 mM KOH solution was mixed with 100 ml of 1 mM H2SO4 solution. Calculate molar concentrations (M) of salts in the reaction mixture.

- 0,1L*1,2mM = 0,12mmol KOH
- 0,1L*1mM = 0,1mmol H2SO4

$$KOH + H_2SO_4 \longrightarrow KHSO_4 + H_2O$$

0,12mmol — 0,1mmol — 0,1mmol

$$KHSO_4 + KOH \longrightarrow K_2SO_4 + H_2O$$

0,1mmol — 0,02mmol — 0,02mmol

$$\downarrow$$

$$0{,}1 - 0{,}02$$

$$\downarrow$$

$$\frac{0{,}08\text{mmol}}{0{,}2L} = \underline{\underline{0{,}4mM}}$$

$$\frac{0{,}02\text{mmol}}{0{,}2L} = \underline{\underline{0{,}1mM}}$$

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How many g of KOH and water are there in 50 g of 10% solution?

1. **Mass of KOH:**

$$\text{Mass of KOH} = \text{Percentage of KOH} \times \text{Total Mass of Solution}$$

$$\text{Mass of KOH} = 0.10 \times 50\,\text{g} = 5\,\text{g}$$

2. **Mass of Water:**

$$\text{Mass of Water} = \text{Total Mass of Solution} - \text{Mass of KOH}$$

$$\text{Mass of Water} = 50\,\text{g} - 5\,\text{g} = 45\,\text{g}$$

How many mL of 0.09M solution (A) and 0.01M solution (B) should be mixed to obtain 100 mL of 0.02M solution (C)?

- Eq1: 0,09* A + 0,01*B = 0,02M *C, c=0,1L
- Eq2: A+B=0,1L
- Eq2: A=0,1L-B
- 0,09(0,1-B) +0,01B = 0,002
- 0,009-0,09B+0,01B= 0,002
- 0,08B=0,007

- <u>B=87,5mL</u>
- <u>A=12,5mL</u>

Solution A was diluted 2 times with water. Then 10µL of the resulting solution B was mixed with 0.49 mL of water (solution C) and finally 0,5mL of solution C was introduced to the volumetric flask of the nominal volume 10 mL. The flask was filled with water and the molarity of the solution in the flask was assayed 10mM. Calculate the initial molarity of solution A.

- 1st step: 2x dilution
- 2nd step:0,5mL/0,01mL=50x dilution
- 3rd step: 10mL/0,5mL=20x
- 2*50*20=2000
- 10mM*2000= 20M