Strong acid Strong base Reaction Example

Note : M = mol dm^{-3}

Question : 0.1M HCl 50 cm^3 solution and 0.05M NaOH 50 cm^3 solution is mixed.

a) is final solution acidic or basic?

b) pH?

HCl is a strong acid. NaOH is a strong base.

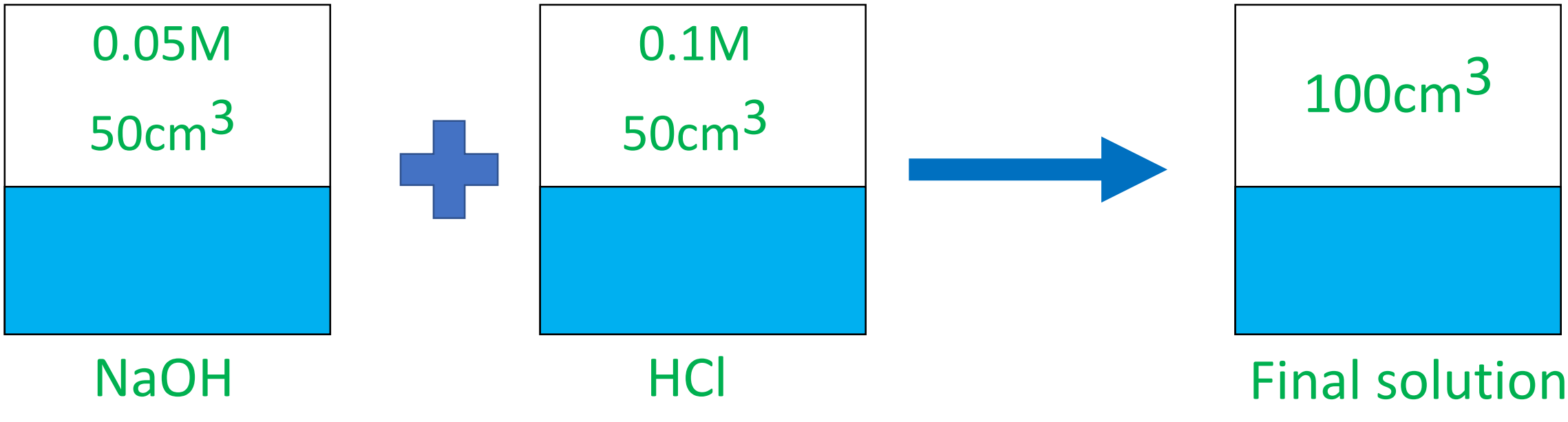
Hence they react until one reactant finishes.

$$NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$$

Assumption: No volume change when mixing two solutions. That means final volume is 100ml.

Solving steps :

- Calculate amount of moles(n) of each solution.
- Write the reaction and balance it.
- Find the ratio that reactants react.
- Find the reactant which remains in the solution. (HCl or NaOH)
- Calculate the concentration of remaining reactant.
- Calculate pH.



Find amount of mole

For solutions,

$$\text{concentration (c)} = \frac{\text{amount of moles (n)}}{\text{volume of solution (v)}}$$

$$n = c * v$$

for HCl,

amount of HCl = 0.1 mol dm^{-3} * 50/1000 dm^3 = 0.005 mol

for NaOH,

amount of NaOH = 0.05 mol dm^{-3} * 50/1000 dm^3 = 0.0025 mol

When we balance the equation, we can see reaction ratio of NaOH & HCl is 1:1. It means same amount of both substance react together.

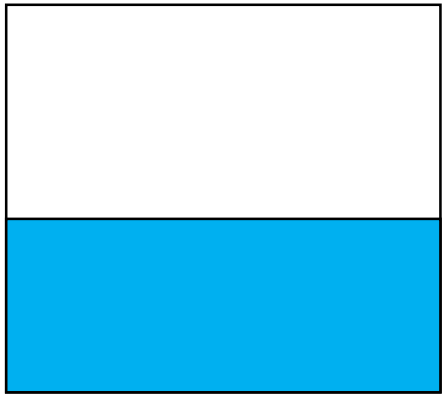
Finally one substance remains. It will decide solution is acidic or basic. Below table show amount of reactants and products.

	$NaOH_{(aq)}$ +	$HCl_{(aq)}$ →	$NaCl_{(aq)}$ +	$H_2O_{(l)}$
Initial amount	0.0025	0.005	_	_
Reacting / producing amount	-0.0025	-0.0025	0.0025	_
Final amount	0	0.0025	0.0025	_

We can see HCl remains in the solution. Hence final solution will be acidic.
NaCl is a salt. Therefore it does not effect to the solution's acidic or basic property.

Final solution

Final solution contains NaCl, Water and remaining HCl.



HCl concentration = 0.0025 mol/ $(100 * 10^{-3})$ dm^3

= 0.025mol dm^{-3}

Total volume 100cm^3

H_3O^+ are received by mainly HCl and bit from water to the solution. But K_a of water is very small. Hence H_3O^+ from water is negligible.

HCl completely dissociate in the water

$$HCl_{(aq)} + H_2O_{(l)} \rightarrow H_3O^+_{(aq)} + Cl^-_{(aq)}$$

Therefore

$$[H_3O^+_{(aq)}] = [HCl_{(aq)}] = 0.025 mol\ dm^{-3}$$

$$pH = -\log[H_3O^+_{(aq)}]$$

$$pH = -\log (0.025)$$

$$pH = 1.602$$