

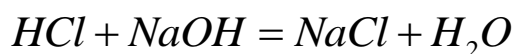
## Answer on Question #85043 – Chemistry – Other

### Task:

A sample of  $\text{CaCO}_3$  of mass 2.8 g was reacted with  $75 \text{ cm}^3$  of  $1.0 \text{ mol/dm}^3$  hydrochloride acid. The resulting solution was completely transferred into  $250 \text{ cm}^3$  of volumetric flask and the mixture made up to the mark with distilled water.  $25 \text{ cm}^3$  of this solution needed  $20.05 \text{ cm}^3$  of  $1.0 \text{ mol/dm}^3$  of  $\text{NaOH}$  to neutralize the excess acid. Calculate the percentage of  $\text{CaCO}_3$  present in the sample.

### Solution:

Reaction of neutralization of excess hydrochloric acid:



According to the chemical reaction equation:

$$n(\text{HCl}) = n(\text{NaOH})$$

$$n(\text{HCl}) = C(\text{NaOH}) * V(\text{NaOH})$$

Then,

$$n_{\text{excess}}(\text{HCl}) = 1.0 \text{ mol/dm}^3 * 0.02005 \text{ dm}^3 = 0.02005 \text{ mol}$$

$$n_{\text{excess}}(\text{HCl}) = 0.02005 \text{ mol}$$

Correcting for the aliquoting/dilution factor, you have:

$$n^0_{\text{excess}}(\text{HCl}) = \frac{V_f}{V_a} * n_{\text{excess}}(\text{HCl}) = \frac{250 \text{ cm}^3}{25 \text{ cm}^3} * 0.02005 \text{ mol} = 0.2005 \text{ mol}$$

$$n^0_{\text{excess}}(\text{HCl}) = 0.2005 \text{ mol}$$

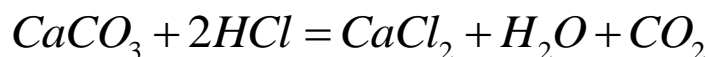
$$n_{\text{total}}(\text{HCl}) = C(\text{HCl}) * V_{\text{total}}(\text{HCl}) = 1.0 \text{ mol/dm}^3 * 0.075 \text{ dm}^3 = 0.075 \text{ mol}$$

$$n_{\text{total}}(\text{HCl}) < n^0_{\text{excess}}(\text{HCl}) = 0.075 \text{ mol} < 0.2005 \text{ mol}$$

There is a error with the way the question is presented because according to the above calculations, there is more HCl left over (in excess) than there was originally added.

$$n(\text{HCl}) = n_{\text{total}}(\text{HCl}) - n_{\text{excess}}^0(\text{HCl})$$

Reaction of  $\text{CaCO}_3$  with hydrochloric acid:



According to the chemical reaction equation:

$$n(\text{CaCO}_3) = \frac{n(\text{HCl})}{2} = \frac{n_{\text{total}}(\text{HCl}) - n_{\text{excess}}^0(\text{HCl})}{2};$$

$$m(\text{CaCO}_3) = n(\text{CaCO}_3) * M(\text{CaCO}_3) = \left( \frac{n_{\text{total}}(\text{HCl}) - n_{\text{excess}}^0(\text{HCl})}{2} \right) * M(\text{CaCO}_3)$$

Then,

$$m^o(\text{CaCO}_3) = 2.8 \text{ g}$$

$$\% \text{ yield} = \frac{m(\text{CaCO}_3)}{m^o(\text{CaCO}_3)} * 100\% = \frac{m(\text{CaCO}_3)}{2.8 \text{ g}} * 100\%$$

**Answer:** Error in the task. Problem is that more HCl left over (0.2005 moles) than was originally present (0.075 moles).

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