

Memorandum for Tutorial 1

NCHE111

Question 1 (SU3)

Balancing redox reactions

Balanseer die volgende redoksreaksie in suurmedium.

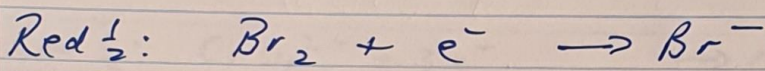
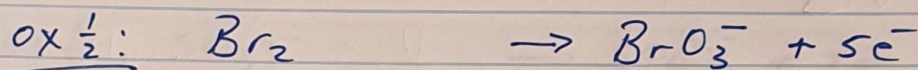
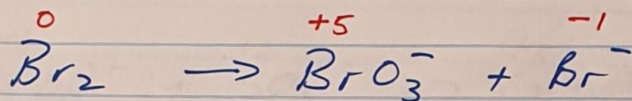
Balance the following redox equation in an acidic medium.



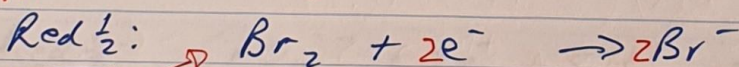
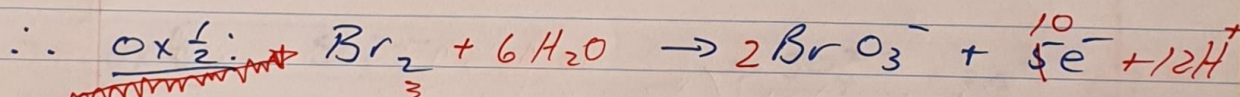
Q1

Acidic medium

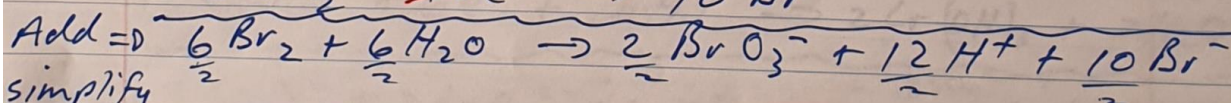
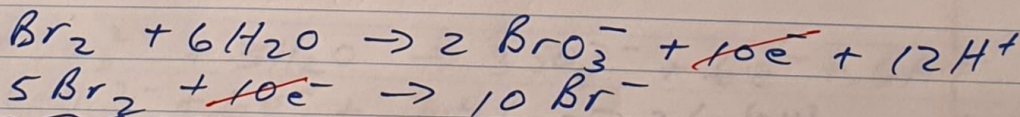
oxidation numbers.



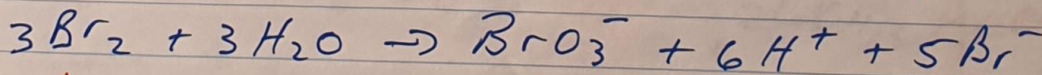
- ① Balance for atoms other than O and H
- ② " " O by adding H_2O to side with O shortage.
- ③ Balance for H by adding H^+ to side with H shortage.
- ④ Balance for e^-



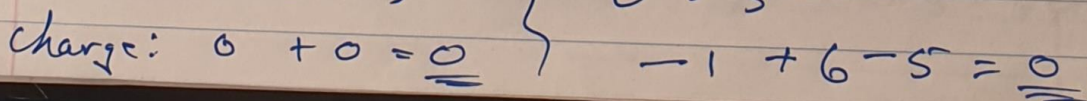
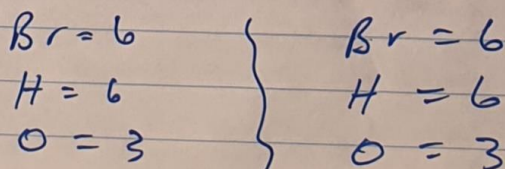
Add two half reactions after balancing for charge



simplify by $\div 2$



Final balanced equation.

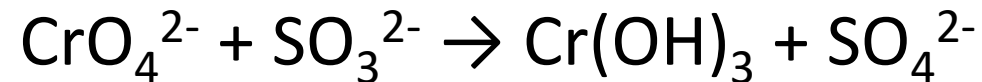


Question 2 (SU3)

Balancing redox reactions

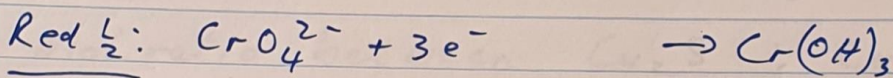
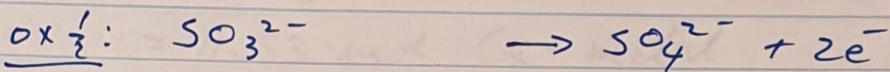
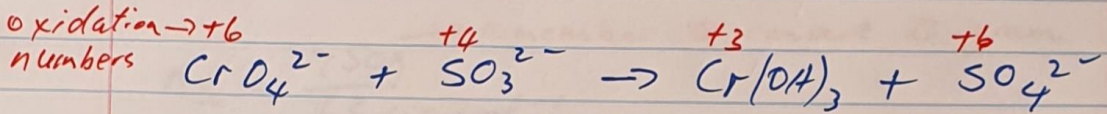
Balanseer die volgende redoksreaksie in alkaliese (basiese) medium.

Balance the following redox equation in alkaline (basic) medium.

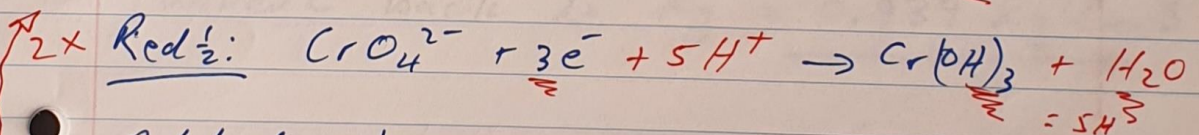
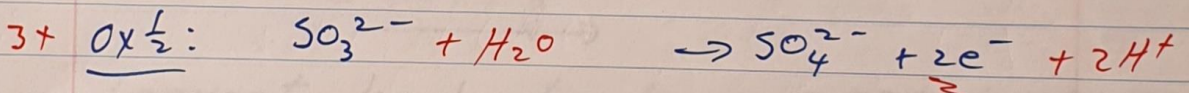


Q2

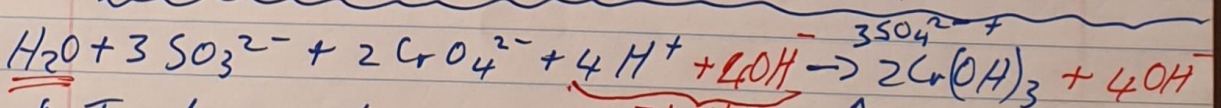
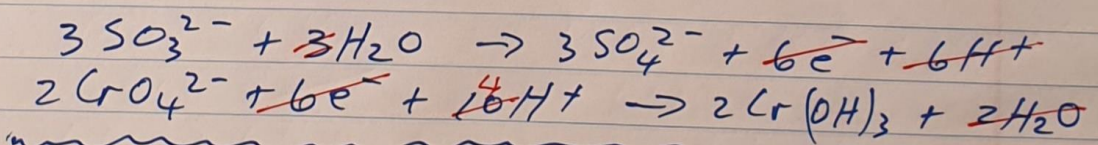
Alkaline medium (but treat as acidic)



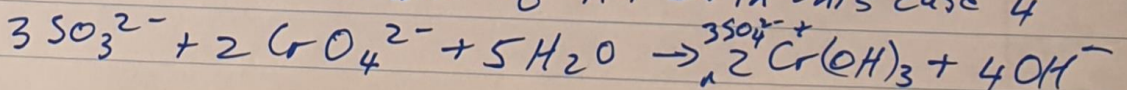
- ① Balance for atoms other than O and H.
- ② " " O by adding H_2O to side with an O shortage.
- ③ Balance for H by adding H^+ to side with H shortage.
- ④ Balance for e^-



Add two $\frac{1}{2}$ reactions after balancing for charge



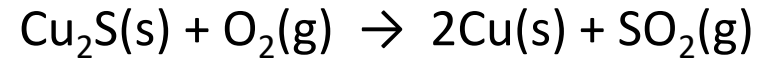
* To change to an alkaline medium add OH^- ions to both sides. The number of OH^- ions must equal the number of H^+ \rightarrow in this case 4



Question 3 (SU4)

Suiwer koper kan geproduseer word deur die reaksie van koper(I)sulfied met suurstofgas soos volg:

Pure copper may be produced by the reaction of copper(I) sulfide with oxygen gas as follows:



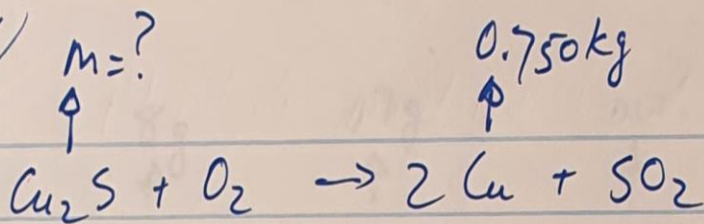
Bereken die massa (in kg) koper(I)sulfied wat nodig is om 0.750 kg kopermetaal te berei.

Calculate the mass (in kg) of copper(I) sulfide that is required in order to prepare 0.750 kg of copper metal.

(Gegee: / Given: $M_{\text{Cu}_2\text{S}} = 158.9 \text{ g.mol}^{-1}$; $M_{\text{O}_2} = 32 \text{ g.mol}^{-1}$; $M_{\text{Cu}} = 63.4 \text{ g.mol}^{-1}$; $M_{\text{SO}_2} = 64.1 \text{ g.mol}^{-1}$)

- a. 0.750 kg
- b. 0.375 kg
- c. 0.564 kg
- d. 1.88 kg
- e. 0.939 kg

Q3



→ remember to convert to gram

$$n_{\text{Cu}} = \frac{750\text{g}}{63.4\text{g}\cdot\text{mol}^{-1}}$$

$$= 11.83\text{ mol Cu-metal}$$

Mol ratio between $\text{Cu}_2\text{S} : \text{Cu}$
1 : 2

$$\therefore n_{\text{Cu}_2\text{S}} = \frac{n_{\text{Cu}}}{2} = \frac{11.83\text{ mol}}{2} = 5.91\text{ mol Cu}_2\text{S needed}$$

$$\begin{aligned} M_{\text{Cu}_2\text{S}} &= n \times M \\ &= 5.91\text{ mol} \times 158.9\text{g}\cdot\text{mol}^{-1} \\ &= \underline{939.1\text{ g}} \end{aligned}$$

Convert back to kg = 0.939 kg Cu₂S

Question 4 (SU4)

Stikstofoksied word gemaak deur die oksidasie van ammoniak. Bereken die massa stikstofoksied (in gram) wat gemaak kan word deur die reaksie van 8.00 g NH_3 met 17.0 g O_2 .

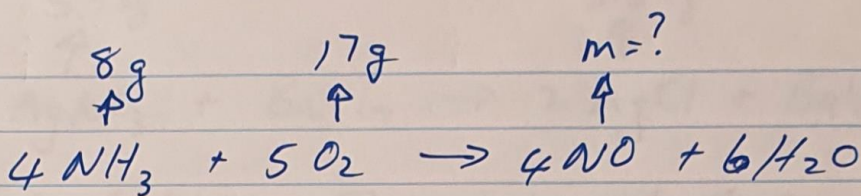
Nitric oxide is made from the oxidation of ammonia. Calculate the mass (in gram) of nitric oxide that can be made from the reaction of 8.00 g NH_3 with 17.0 g O_2 .



(Gegee: / Given: $M_{\text{NH}_3} = 17.03 \text{ g.mol}^{-1}$; $M_{\text{O}_2} = 32 \text{ g.mol}^{-1}$; $M_{\text{NO}} = 30 \text{ g.mol}^{-1}$; $M_{\text{H}_2\text{O}} = 18.02 \text{ g.mol}^{-1}$)

- a. 4.54 g
- b. 12.8 g
- c. 14.1 g
- d. 15.9 g
- e. 25.0 g

Q4



Calculate the mol amounts you have:

$$\begin{aligned} n_{\text{NH}_3} &= 8g / 17.03 \text{ g}\cdot\text{mol}^{-1} \\ &= 0.47 \text{ mol of NH}_3 \end{aligned} \rightarrow$$

$$\begin{aligned} n_{\text{O}_2} &= 17g / 32 \text{ g}\cdot\text{mol}^{-1} \\ &= 0.53 \text{ mol of O}_2 \end{aligned} \rightarrow$$

Now look for mol ratio from balanced equation between $\text{NH}_3 : \text{O}_2$

4 : 5

- * For every 4 mol of NH_3 you will need 5 mol of O_2 for complete reaction.
- * Do I have enough O_2 ?

From mol ratio: For 0.47 mol of NH_3 I will need $\frac{(0.47)5}{4}$

$$= 0.59 \text{ mol O}_2 \rightarrow$$

But you only have 0.53 mol O_2 . Therefore O_2 is the limiting reagent. NH_3 will be in excess. O_2 is the only reagent that will be fully converted to product, and therefore I use O_2 to determine how much NO will form.

\therefore Mol ratio between $\text{O}_2 : \text{NO}$

5 : 4

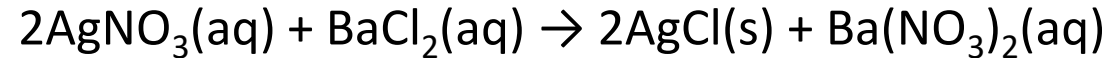
$$\text{So: } \frac{(0.53 \text{ O}_2)4}{5} = 0.42 \text{ mol of NO will form}$$

$$m_{\text{NO}} = n \times M = 0.42 \times 30 \text{ g}\cdot\text{mol}^{-1} = 12.72 \text{ g NO} \rightarrow$$

Question 5 (SU4)

'n 5.95 g monster van AgNO_3 reageer met 'n oormaat BaCl_2 volgens die volgende reaksievergelyking om 3.57 g AgCl te lewer. Bereken die % opbrengs van die AgCl .

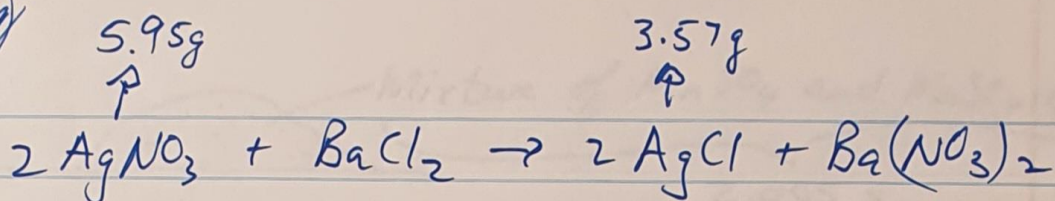
A 5.95 g sample of AgNO_3 is reacts with an excess of BaCl_2 according to the following equation to yield 3.57 g of AgCl . Calculate the % yield of AgCl .



(Gegee: / Given: $M_{\text{AgNO}_3} = 169.9 \text{ g.mol}^{-1}$; $M_{\text{BaCl}_2} = 208.2 \text{ g.mol}^{-1}$; $M_{\text{AgCl}} = 143.35 \text{ g.mol}^{-1}$)

- a. 47.4 %
- b. 35.6 %
- c. 71.1 %
- d. 60.0 %
- e. 100 %

Q5



Calculate the % yield of AgCl

$$n_{\text{AgNO}_3} = \frac{5.95\text{g}}{169.9\text{g}\cdot\text{mol}^{-1}} = \underline{\underline{0.035\text{ mol AgNO}_3}}$$

Mol ratio between AgNO_3 : AgCl
2 : 2
1 : 1

\therefore 0.035 mol AgCl will form

$$\begin{aligned} m_{\text{AgCl}} \text{ that will (should) form} &= n \times M \\ &= 0.035\text{ mol} \times 143.35\text{ g/mol} \\ &= \underline{\underline{5.02\text{ g}}} \\ &\quad \hookrightarrow \text{should form} \end{aligned}$$

\Rightarrow But only 3.57g formed

$$\begin{aligned} \therefore \% \text{ Yield} &= \frac{3.57\text{g}}{5.02\text{g}} \times 100 \\ &= \underline{\underline{71.1\%}} \end{aligned}$$

Question 6 (SU4)

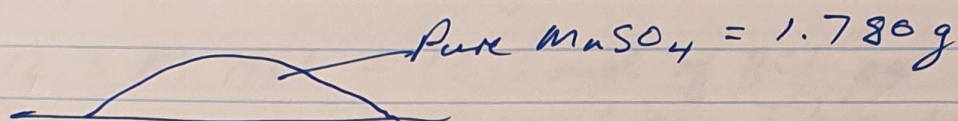
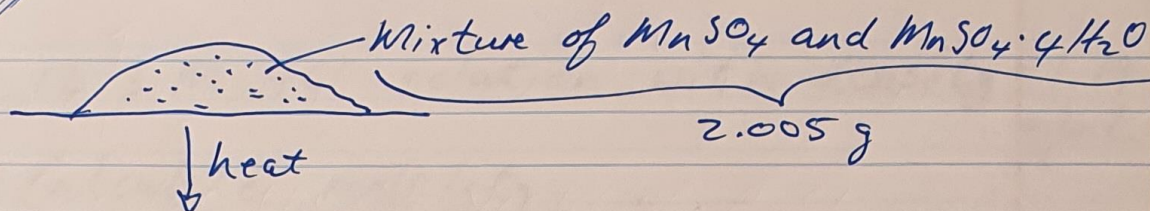
'n Mengsel van MnSO_4 en $\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$ het 'n massa van 2.005 g. Na verhitting om al die water af te dryf is die massa 1.780 g. Bereken die massa % van $\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$ in die oorspronklike mengsel.

A mixture of MnSO_4 and $\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$ has a mass of 2.005 g. After heating to drive off all the water the mass is 1.780 g. Calculate the mass % of $\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$ in the original mixture?

(Gegee: / Given: $M_{\text{MnSO}_4} = 151 \text{ g.mol}^{-1}$; $M_{\text{MnSO}_4 \cdot 4\text{H}_2\text{O}} = 223.08 \text{ g.mol}^{-1}$; $M_{\text{H}_2\text{O}} = 18.02 \text{ g.mol}^{-1}$)

- a. 11.2%
- b. 34.7%
- c. 65.3%
- d. 69.6%
- e. 88.8%

Q6



Mass difference = H_2O lost during heating

$$\therefore m_{\text{H}_2\text{O}} = 2.005 \text{ g} - 1.780 \text{ g} = 0.225 \text{ g } \text{H}_2\text{O}$$

$$n_{\text{H}_2\text{O}} = \frac{0.225 \text{ g}}{18.02 \text{ g/mol}} = 0.0125 \text{ mol } \text{H}_2\text{O}$$

For every 1 mol of $\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$ there are 4 moles of H_2O

So the mol amount of $\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$ in the original sample = $(0.0125/4)$

$$= 0.00313 \text{ mol of } \text{MnSO}_4 \cdot 4\text{H}_2\text{O} \text{ in the original mixture.}$$

3.13×10^{-3}

$$\begin{aligned} \therefore m_{\text{MnSO}_4 \cdot 4\text{H}_2\text{O}} &= n \times M \\ &= (3.13 \times 10^{-3} \text{ mol}) (223.08 \text{ g} \cdot \text{mol}^{-1}) \\ &= 0.698 \text{ g} \end{aligned}$$

\therefore So, in the original 2.005 g of mixture, 0.698 g were $\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$; the rest was MnSO_4 .

$$\text{Mass } \% = \frac{0.698 \text{ g}}{2.005 \text{ g}} \times 100 = 34.8\%$$

Question 7 (SU4)

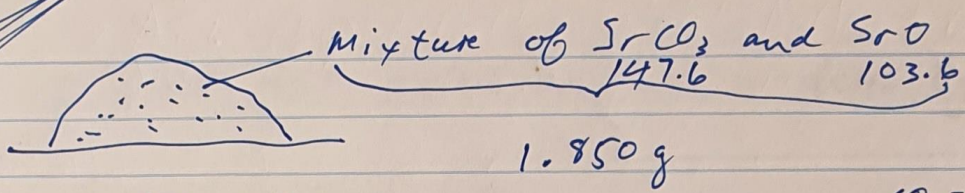
'n 1.850 g mengsel van SrCO_3 en SrO word verhit. Die SrCO_3 ontbind na SrO en CO_2 . Bereken die massa % SrCO_3 in die oorspronklike mengsel indien die massa na verhitting 1.445 g is.

A 1.850 g mixture of SrCO_3 and SrO is heated. The SrCO_3 decomposes to SrO and CO_2 . Calculate the mass % of SrCO_3 in the original mixture if the mass after heating is 1.445 g.

(Gegee: / Given: $M_{\text{SrCO}_3} = 147.6 \text{ g.mol}^{-1}$; $M_{\text{SrO}} = 103.6 \text{ g.mol}^{-1}$; $M_{\text{CO}_2} = 44 \text{ g.mol}^{-1}$)

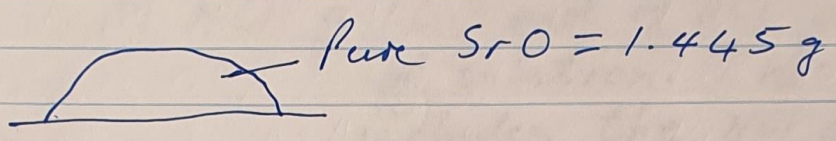
- a. 26.6%
- b. 21.9%
- c. 13.7%
- d. 73.4%
- e. 78.1%

Q7



↓ heating

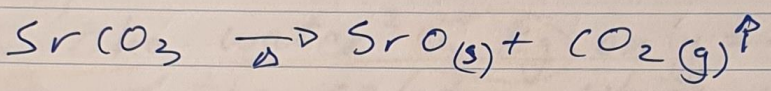
CO₂ = 44



Mass % of SrCO₃ in original sample = ?

$$m_{CO_2} = 1.850 \text{ g} - 1.445 \text{ g} = 0.405 \text{ g}$$

$$n_{CO_2} = \frac{0.405 \text{ g}}{44 \text{ g/mol}} = 0.00920 \text{ mol}$$



mol ratio SrCO₃ : CO₂ = 1 : 1

∴ 0.00920 mol SrCO₃ in original sample

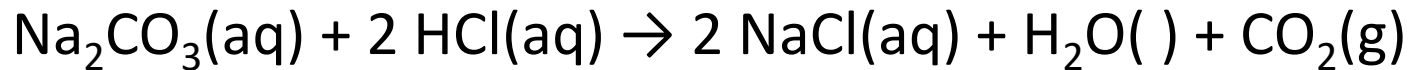
$$m_{SrCO_3} = n \times M = 0.00920 \times 147.6 \text{ g/mol} = \underline{1.358 \text{ g}}$$

$$\text{mass \%} = \frac{1.358 \text{ g}}{1.850 \text{ g}} \times \frac{100}{1} = \underline{73.4\%}$$

Question 8 (SU4)

Indien 0.1800 g onsuier soda-as (Na_2CO_3) getitreer word met 15.66 mL van n 0.1082 M HCl oplossing, wat is die % suiwerheid van die soda-as?

If 0.1800 g of impure soda ash (Na_2CO_3) is titrated with 15.66 mL of 0.1082 M HCl, what is the % purity of the soda ash?



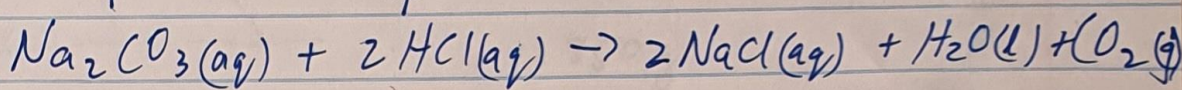
(Gegee: / Given: $M_{\text{Na}_2\text{CO}_3} = 106 \text{ g.mol}^{-1}$; $M_{\text{HCl}} = 36.46 \text{ g.mol}^{-1}$)

- a. 17.96%
- b. 49.89%
- c. 50.11%
- d. 94.13%
- e. 99.77%

Q8

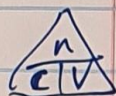
0.1800g
↑

0.1082 M
15.66 mL
↑



↓

% purity



$$n = c \times V = 0.1082 \text{ M} \times 0.01566 \text{ L}$$

$$= 1.69 \times 10^{-3} \text{ mol HCl}$$

mol ratio $\text{Na}_2\text{CO}_3 : \text{HCl}$

1 : 2

$$\therefore n_{\text{Na}_2\text{CO}_3} = (1.69 \times 10^{-3} / 2) = 0.000845 \text{ mol}$$

$8.45 \times 10^{-4} \text{ mol.}$

$$m_{\text{Na}_2\text{CO}_3} = n \times M$$

$$= 8.45 \times 10^{-4} \times 106 \text{ g} \cdot \text{mol}^{-1}$$

$$= 0.0896 \text{ g}$$

$$\% \text{ purity} = \frac{0.0896 \text{ g}}{0.1800 \text{ g}} \times \frac{100}{1} = 49.7\%$$

Question 9

Gekonsentreerde HCl is 12.3 M. Die digtheid van die oplossing is 1.19 g.mL^{-1} . Bereken die molaliteit van die oplossing.

Concentrated HCl is 12.3 M. The density of the solution is 1.19 g.mL^{-1} . Calculate the molality of the solution.

(Gegee: / Given: $M_{\text{H}_2\text{O}} = 18.02 \text{ g.mol}^{-1}$; $M_{\text{HCl}} = 36.46 \text{ g.mol}^{-1}$)

Q9

12.3 M HCl solution with density = 1.19 g/mL

* Calculate molality.

12.3 M HCl = 12.3 mol of HCl per 1 L of solution. This 1 L solution includes the HCl and the H₂O.

We can calculate the mass of this solution: 1 L = 1000 mL

$$\therefore 1000 \text{ mL solution} \times 1.19 \text{ g mL}^{-1} = 1190 \text{ g} \rightarrow$$

* But, for molality we need the mass of the water in kg only \Rightarrow not the mass of the solution which includes the HCl and H₂O.

* We need to calculate the mass of the HCl in the solution and subtract that from the mass of the solution to obtain the mass of the H₂O only.

$$\begin{aligned} \text{mass of HCl} &= n_{\text{HCl}} \times M_{\text{HCl}} \\ &= 12.3 \text{ mol} \times 36.46 \text{ g mol}^{-1} \\ &= 448.46 \text{ g HCl} \rightarrow \end{aligned}$$

$$\begin{aligned} \therefore \text{mass of solution} - \text{mass of HCl} \\ &= 1190 \text{ g} - 448.46 \text{ g} = 741.54 \text{ g H}_2\text{O} \\ &= 0.742 \text{ kg H}_2\text{O} \rightarrow \end{aligned}$$

$$\begin{aligned} \therefore \text{molality} &= \frac{\text{mol HCl}}{\text{mass H}_2\text{O (kg)}} \\ &= (12.3 \text{ mol} / 0.742 \text{ kg}) = 16.58 \text{ mol/kg} \rightarrow \end{aligned}$$

Thank you!!