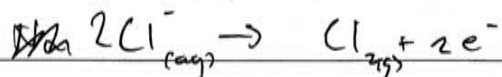


Start here.

a) - Mercury cell

- Brine is electrolysed in the electrolysis cell, where the anode reaction occurs:

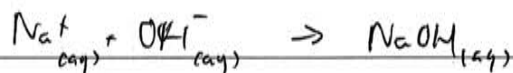


- and aqueous  $\text{Na}^+$  ion is dissolved in the flowing mercury

- aqueous  $\text{Na}^+$  is then ~~deposited~~ passed through the decomposer, where the cathode reaction occurs:



The product  $\text{OH}^-$  ion then forms with  $\text{Na}^+$  in mercury



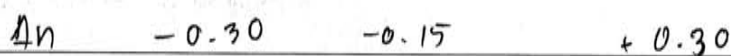
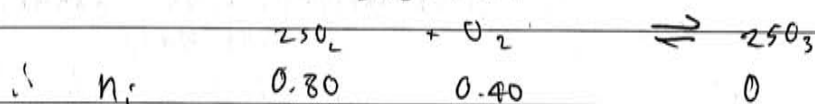
- and so sodium hydroxide is extracted.

b)	Molten NaCl	aqueous NaCl (concentrated)
anode	$2\text{Cl}^-_{(aq)} \rightarrow \text{Cl}_{2(g)} + 2e^-$	$2\text{Cl}^-_{(aq)} \rightarrow \text{Cl}_{2(g)} + 2e^-$
cathode	due to lack of $\text{H}_2\text{O}$ $\text{Na}^+_{(aq)} + e^- \rightarrow \text{Na}_{(s)}$	due to presence of $\text{H}_2\text{O}$ $2\text{H}_2\text{O} + 2e^- \rightarrow \text{H}_{2(g)} + 2\text{OH}^-_{(aq)}$
overall	$2\text{Cl}^-_{(aq)} + 2\text{Na}^+_{(aq)} \rightarrow \text{Cl}_{2(g)} + 2\text{Na}_{(s)}$	$2\text{Cl}^-_{(aq)} + 2\text{H}_2\text{O}_{(l)} \rightarrow \text{H}_{2(g)} + \text{Cl}_{2(g)} + 2\text{OH}^-_{(aq)}$

i) Though both are similar in anode reaction, there are differences in cathode reaction, where, due to lack of  $H_2O(l)$ , solid  $Na(s)$  is formed in electrolysis of molten  $NaCl$ .



$$K = \frac{[SO_3]^2}{[SO_2]^2[O_2]}$$



$$ii) \quad q = \frac{[SO_3]^2}{[SO_2]^2[O_2]}$$

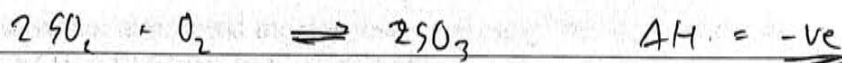
$$= \frac{[3.0]^2}{[5.0]^2[2.5]}$$

$$= 0.144$$

$$\approx 0.14 \quad \text{at time A}$$

$K_{eq}$  constant at time A is 0.14.

ii) The temperature could have been lowered.



The forward reaction is exothermic.

- By reducing the temperature of the system, the eqm, according to Le Chatelier's principle, would counteract the changes applied to it. Therefore, the system could release heat to counteract the drop of temperature, thus the exothermic reaction

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is favoured, and so is the forward reaction. Thus, more  $\text{SO}_3$  is produced and the ~~concn~~ mole of  $\text{SO}_2$  decreased, eqn shifts to the right.

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Start here.

d) i) - reactant A - sodium ~~hydroxide~~ hydroxide

- saponification

ii) - Safety: <sup>conc</sup> sodium <sup>hydroxide</sup> is caustic and so gloves should be worn when handling it

- oil are placed in a big test tube  
(olive oil)

- ~~200~~ 200 mL of <sup>hot</sup> water bath is prepared

- the excess sodium chloride (around 20 mL) is added to the test tube and the test tube is put in the hot water bath.

- The mixture is stirred for 10 minutes.

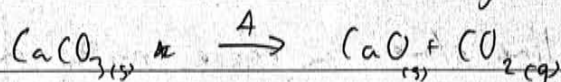
- the <sup>conc</sup> concentrated NaCl solution is then added.

- The soap is then further stirred until all the soaps has precipitated out

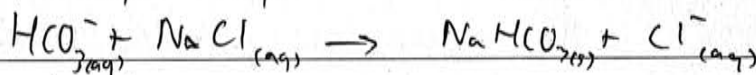
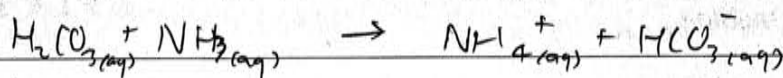
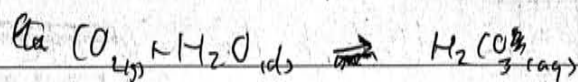
- The soap is taken out and dried.

- safety! water bath is used to prevent the oil from lighting up  
(as the oils can possibly be volatile, though unlikely)

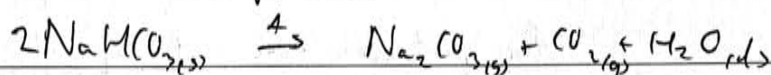
e) Importance: - Limestone is used to generate  $\text{CO}_2$



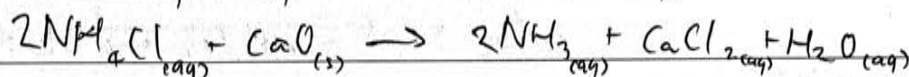
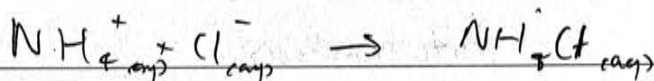
which is used to produce sodium bicarbonate



and ~~heated~~ heated to produce sodium carbonate



the  $\text{CaO}$  is also used to recover ammonia



Thus, limestone is a vital part of the Solvay process, as it is not only used for production of  $\text{Na}_2\text{CO}_3$ , but also for recycling of  $\text{NH}_3(aq)$  which is also used in the production.

- By using limestone, there are both positive and negative environmental impact.

- positive

- assist in recycling of ammonia.

-  $\text{CaO}$  obtained from generating  $\text{CO}_2$  can be used to recycle ammonia from ammonium ion.

Thus, there is no need of using more ammonia.

- also, there is no need to dispose ammonia, which is ~~not~~ toxic to the environment

- causes respiratory problems if inhaled.

- however, there is also the bad environmental impact

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- mining of limestone

- mining of limestone can cause noises and <sup>increase the</sup> particles in the air

- the noise can disturb the wild life around the mining area

- the increase in particles in the air is also bad for various organisms

- the particles can clog up the plant's leaf, <sup>(and stomata)</sup> preventing the plant's respiration and also hindering the photosynthesis

- the small particles are bad to breathe in.

- mining in sensitive area can also cause instability of land, and so, collapse

Thus, the <sup>location of the</sup> mine must be considered to minimise the impact to the environment

You may ask for an extra Writing Booklet if you need more space.