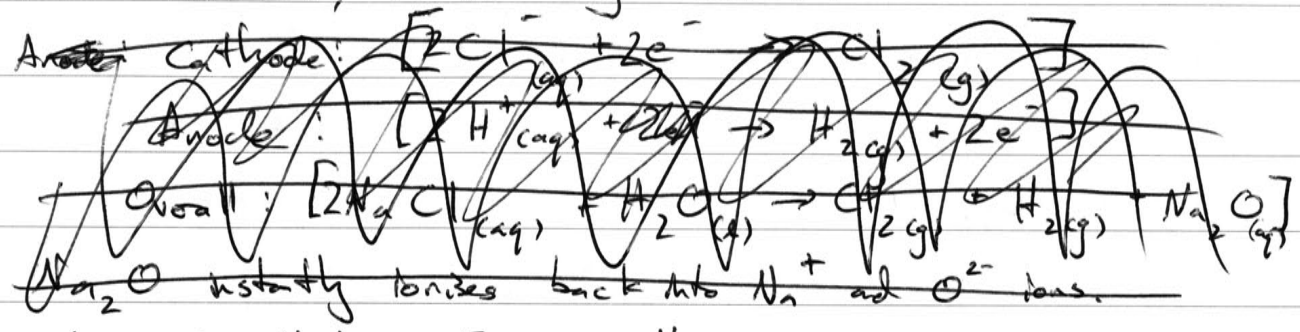
Start here.

Mercury Process of extracting NaOH

a) It is an electrolytic cell, with a liquid mercury anode and an inert cathode (possibly titanium). Sodium Chloride is electrolysed in the cell, with Cl^- being attracted to the positive cathode and being converted into Cl_2 a gas, while ~~sodium~~ Na^+ ions are attracted to the negative anode, where they form an amalgam of sodium metal in mercury. This amalgam is pumped into a decomposition chamber, where it comes into contact with water. The mercury does not react, while the sodium reacts like so: $[2Na_{(s)} + 2H_2O_{(l)} \rightarrow 2NaOH_{(aq)} + H_{2(g)}]$. Sodium hydroxide is removed, while the mercury is recycled through a cooler and back into the electrolysis cell.

b) The electrolysis of molten sodium chloride and aqueous sodium chloride are slightly different. When electrolysing molten sodium chloride, the following occurs:



Anode: $Na^+_{(l)} + e^- \rightarrow Na_{(l)}$

Cathode: $2Cl^-_{(l)} \rightarrow Cl_{2(g)} + 2e^-$

Overall: $2NaCl_{(l)} \rightarrow 2Na_{(s)} + Cl_{2(g)}$

Electrolysis of sodium chloride in water, however, yields different results. Instead of electrolysing the NaCl, it electrolyses H_2O. The reactions are:

Anode: $2H^+_{(aq)} + 2e^- \rightarrow H_{2(g)}$

Cathode: $2Cl^-_{(aq)} \rightarrow Cl_{2(g)} + 2e^-$

Overall: $2NaCl_{(aq)} + H_2O_{(l)} \rightarrow Cl_{2(g)} + H_{2(g)} + 2Na^+_{(aq)} + O^{2-}_{(aq)}$

Please Turn Over

Additional writing space on back page.

c) Limestone is incredibly important to the Solvay process, as it is an incredibly common and efficient source of carbon dioxide for the synthesis of sodium carbonate. While there are other sources of carbon dioxide available, most of them would be very impure and require extensive purification, or appear in quantities so low as to be commercially invisible. Limestone ($CaCO_3$), on the other hand, is readily available from mining and is relatively pure. At the very least, it is very easy to purify it to an adequate degree. Limestone's role in the solvay process is as follows:

$CaCO_3$ is baked in a kiln to produce CaO and CO_2

CaO is slaked (reacted with water) to produce $Ca(OH)_2$

CO_2 is reacted with $NaCl$ and NH_3, and H_2O

$$2CO_2 + 2NaCl + 2NH_3 + 2H_2O \rightarrow 2NaHCO_3 + 2NH_4Cl$$

$Ca(OH)_2$ is reacted with NH_4Cl to recycle the amonium

$$Ca(OH)_2 + 2NH_4Cl \rightarrow CaCl_2 + 2NH_3 + 2H_2O$$

It can be seen that calcium carbonate (limestone) is incredibly important to the solvay process.

The environmental impacts, however, are quite severe. Limestone quarries often take the form of huge, shallow bites out of the earth's surface, destroying a large surface area of plants and wildlife habitats. However, limestone often contacts with the oxide of lime, a highly dangerous and corrosive material, which limits the amount of flora and fauna that would live in the area, and thus the amount of affected wildlife.

The dumping of the waste product $CaCl_2$ is also an environmental

Additional writing space on back page.

Start here.

d) i] It is a saponification reaction, where A is potassium hydroxide (KOH)

ii] Oil (i.e. coconut oil) is placed in a beaker, and then potassium hydroxide is added. The mixture is stirred, then left in a fume ~~cu~~ cupboard for several days to react. After the time has elapsed, there are two distinguishable layers - one of a clear liquid, the other an opaque solid with a creamy colour. The former is glycerol, the latter soap.

Safety precautions include wearing safety ~~goggl~~ goggles, glasses and lab coats while very clearly with KOH, as it is highly corrosive. The reaction is allowed to take place in a fume cupboard for the same reason, and to prevent accidental contact between soap and students, who can have allergies thereto.

concern. However, as it is largely unreactive, it does not pose a threat to the environment.

Therefore, it can be seen that the importance of limestone to the Solvay process outweighs the detrimental effect its use has on the environment.

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