-redcat -1-

Start here.

a) Mercury cell. NaCl brine enters the first chamber for the mercury cell where the sodium forms an amalgam with the mercury cathode. The chlorine is now a gas and is removed

$2NaCl_{(aq)} + 2Hg_{(l)} \rightarrow 2NaHg_{(aq)} + Cl_{2(g)}$

The sodium amalgam is the sent to a different vat where it it reacted with water. The amalgam is decomposed and the sodium reacts with the water to produce NaOH with Hydrogen gas released. The mercury is then sent to a new vat where it is cooled down (by a coolant such as water in this case) and pumped back to the first vat where it is used again as the cathode to form an amalgum with the sodium.

$2NaHg_{(aq)} + 2H_2O_{(l)} \rightarrow 2NaOH_{(aq)} + 2H_{2(g)} + 2Hg_{(l)}$

Office Use Only – Do NOT write anything, or make any marks below this line.

b) [redacted]

The molten sodium chloride [redacted] and aqueous sodium chloride both produce chlorine at the anode. The difference between the two is basically the reaction that occurs at the cathode. For molten sodium chloride [redacted] oxygen is produced at the cathode [redacted] where the aqueous sodium chloride produces water [redacted].

$O_{2(g)} + 4H^+_{(aq)} + 4e^- \rightleftharpoons 2H_2O_{(l)}$.

Molten NaCl =

anode: $2Cl^- + [redacted] 2e^- \rightleftharpoons Cl_2$

cathode: Na

overall:

Aqueous NaCl =

anode:

cathode: $O_{2(g)} + 4H^+_{(aq)} + 4e^- \rightleftharpoons 2H_2O_{(l)}$

overall:

Additional writing space on back page.

(i) $K = \frac{P}{R}$

$2SO_{2(g)} + O_{2(g)} \rightarrow 2SO_{3(g)}$

	SO_2	O_2	SO_3
I	0.6	0.8	0
C	-0.3	-0.3	0.3
E	0.3	0.5	0.3

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

$$= \frac{0.3^2}{0.5^2 \cdot 0.5}$$

$$= \frac{0.09}{0.125}$$

$$K = 0.72$$

(ii) ~~Because at time A the reaction was not yet at equilibrium. This must be the case because the only factor which can change K is temperature and the question has stated that~~

A new equilibrium position was established because the concentrations of the products and reactants changed, Although K kept constant.

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

Start here.

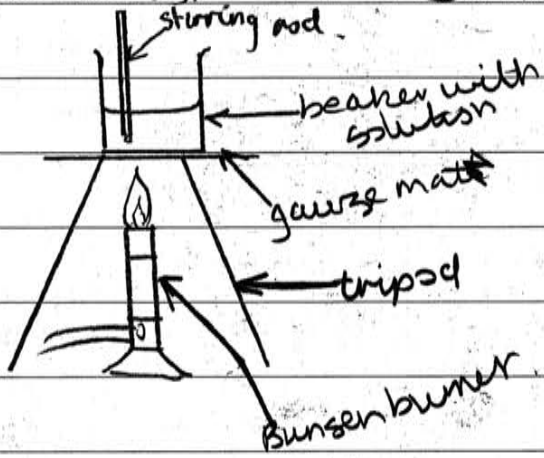
d) (i) Saponification

A = NaOH

(ii) In a school laboratory this reaction could be followed out as follows:

1) Add about equal amounts of NaOH and an oil such as olive oil in a [redacted] beaker.

2) Put this solution over a Bunsen burner, ie.



3) Stir this solution constantly, adding boiling chips to help boil evenly and adding water if it starts to dry out.

[redacted]

4) Once solution has gone cloudy, take about 20mL of water & 20mL of oil & add about 10mL of each to two test tubes.

Adding soap to one and leaving the other. Shake each test tube, water-oil-solution and the one with

the soap inside should have emulsified the water oil liquid where in the other, the oil and water should have separated out again to their individual layers.

e) Limestone in the solvay process is very important. It provides the carbonate in the final product and is used to recycle the ammonia - which without this recycling, would have the costs of production much higher than the profit.

Limestone is easily extracted for use in the solvay process but still has the associated environmental costs associated with mining, like cave formations where the limestone was, which can lead to collapsing.

In the solvay process, the limestone is required to be broken down using heat. This heat released becomes thermal pollution. This is very bad for the environment due to its ability to decrease the dissolved oxygen content of the water from which the underwater inhabitants need to survive.

~~Limestone is used in the~~ The solvay process could not be done without the use of the Limestone. For example, there are the reactions in which

Additional writing space on back page.

...limestone and its products are used as in the solvay process -

$CaCO_{3(s)} \xrightarrow{\text{decomposed}} CaO_{(s)} + CO_{2(g)}$

CO_2 reacts later to form the $NaHCO_3$

$CaO_{(s)} + H_2O_{(l)} \rightarrow Ca(OH)_2$

ammonia recovery

$Ca(OH)_2 + NH_4Cl \rightarrow NH_{3(aq)} + CaCl_{(aq)} + 2H_2O_{(l)}$

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

Office Use Only – Do NOT write anything, or make any marks below this line.