Question 28.

a)(i) Saponification is the hydrolysis in basic solution of fats and oils to produce glycerol and the salt of fatty acids.

(ii) The cleaning action of soap can be related to its molecular structure. Dirt is non polar, grease ~~contains~~ consists of a large chain of non-polar hydrocarbons. ~~We~~ However water is polar and it does not dissolve this non-polar grease and dirt.

Soap contain fatty acid anions, which have a non-polar tail consisting of ~~hydrocarbons~~ a chain of hydrocarbons, and a polar anionic head. The non polar tail is hydrophobic and the ~~anion~~ polar anion head is hydrophillic.

~~The~~ when Non polar grease molecules fallen from clothing are coated with non polar grease molecules from the centre of the glue. Sugar grease water soap ~~change~~ ~~they~~ together ~~the~~ form an emulsion, with the soap acting a ~~dessolver~~ emulsifier. suspending the normally incompatible ~~salt~~ grease in water.

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

moles	$2SO_{2(g)}$ (2)	+ $O_{2(g)}$ (1)	$\rightleftharpoons 2SO_{3(g)}$ (2)
initially	0·06	0·05	0
equilibrium	0·04	0·02	0·04
	0·02	0·03	0·04

@ equilibrium: $K = \frac{[0 \cdot 04]^2}{[0 \cdot 02]^2 \times [0 \cdot 03]}$

$= \frac{[0 \cdot 04]^2}{1 \cdot 2 \times 10^{-5}}$

$\therefore K = 133 \cdot 33$

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(c) (i) ~~$H_2SO_{4(l)} + H_2O \rightarrow H_3O^+ + HSO_4^-$ ΔH=-ve~~

$H_2SO_{4(l)} + H_2O_{(l)} \rightarrow H_3O^+_{(aq)} + HSO^-_{4(aq)}$ ΔH=-ve

(ii) Barium ions is insoluble in sulfates which will perecipitate as Barium sulfate if reacted with sulfuric acid.

~~$Ba^{2+} + SO_4$~~

$Ba(OH)_{2(aq)} + H_2SO_{4(aq)} \rightarrow BaSO_{4(ppt)} + 2H_2O_{(l)}$

When concentrated H_2SO_4 added to sugar $C_{12}H_{22}O_{11}$ water is removed to leave behind pure carbon.

~~$H_2SO_4 + C_{12}H_{22}O_{11}$~~.

$C_{12}H_{22}O_{11(s)} \xrightarrow{conc.\ H_2SO_4}$ ~~C~~ $12C_{(s)} + 11H_2O_{(l)}$

$H_2SO_{4(aq)} + Mg_{(s)} \rightarrow MgSO_{4(s)} + H_{2(g)}$

where hydrogen is ~~oxide~~ ~~was~~ oxidised.

d. $Fe^{3+} + SCN^- \rightleftharpoons FeSCN^{2-}$ + heat

i. we placed Fe^{3+} + SCN^- in 5 test tubes, and peformed different procedures.

A - control

B - we added Fe^{3+}

C - we added Scn^-

D - we heated it

E - we cooled it.

Then we observed what happened, and compared it with the equilibrium.

ii $Fe^{3+}_{(aq)} + SCN^-_{(aq)} \rightleftharpoons FeSCN^{2-}_{(aq)}$ + heat.

- The control experiment was a light brown colours

- When we add Fe^{3+} it made the equilibrium shift to the right to use it up. This was seen by the tube going darker as $FeSCN^{2-}$ is a dark substance. The same happened when we added SCN^- as this has the same effect on equilibrium

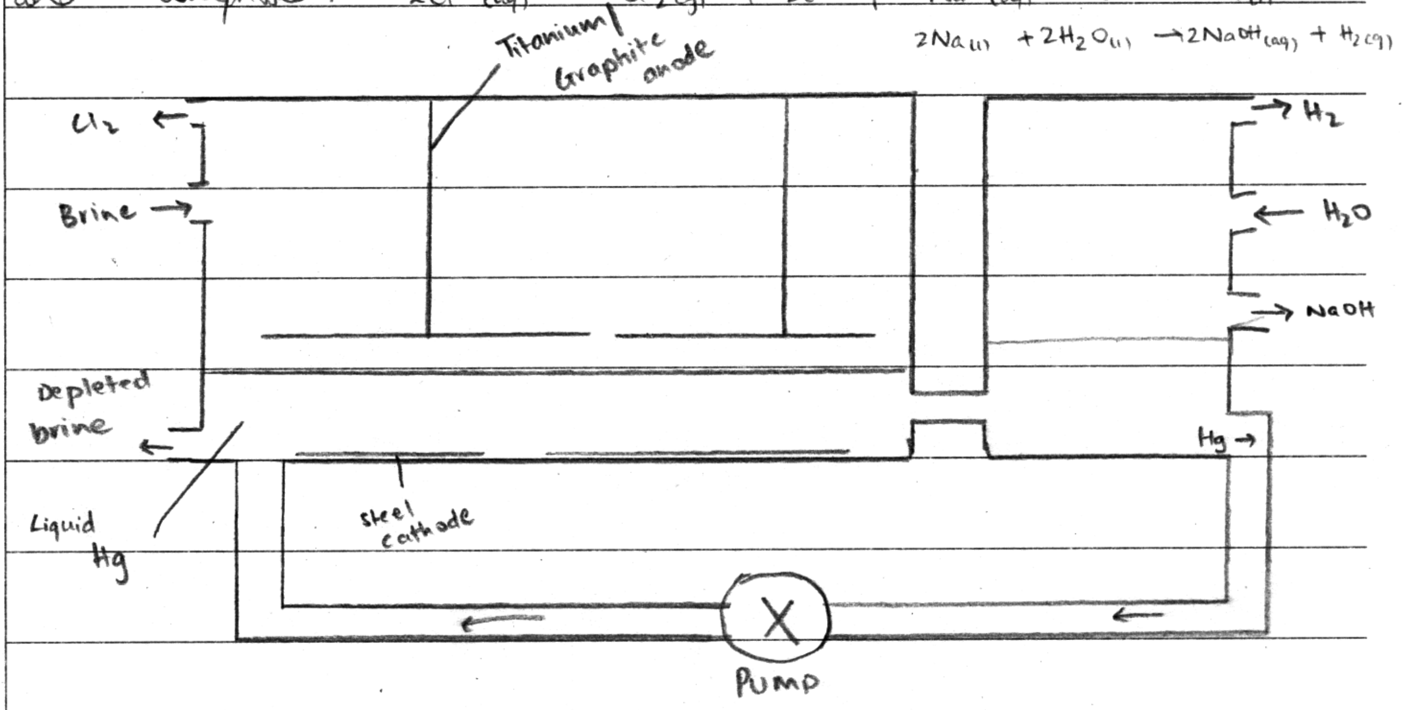
- Due to it being an exothermic reaction when we heated it it, shifted to the left to ↓ the temp, resulting in a lighter colour.

- when we put ice on it the equilibrium shifted to the right to absorb heat ~~the~~ to counteract the imposed change. As a result turning a much darker colour.

This was all due to le chaliters principle.

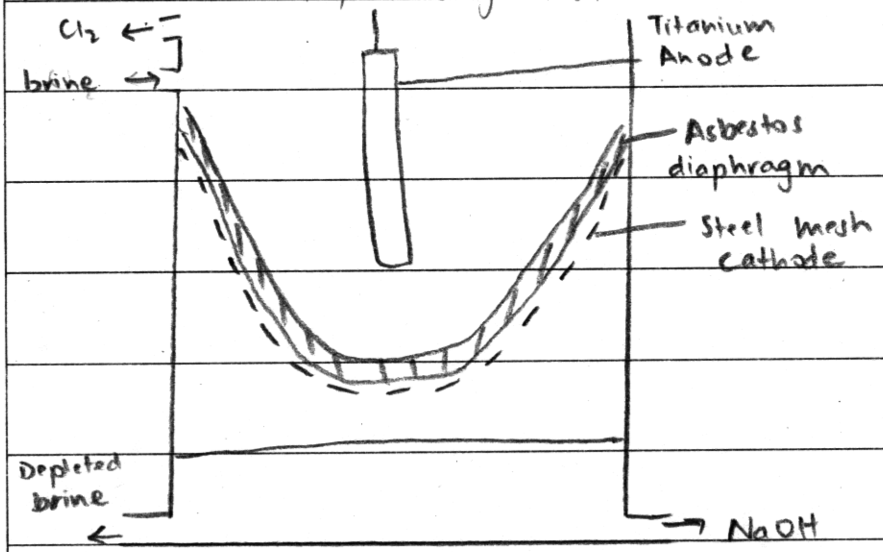
e) The first cell used to produce sodium hydroxide was the mercury cell. It used liquid mercury over steel cathodes, and a titanium or graphite anode placed relatively close to the mercury to produce large current flows. The sodium reduced formed an amalgam with the ~~mercury~~ mercury which flowed to the water chamber where sodium hydroxide was formed. The chlorine oxidised was collected as a gas and compressed. $2Cl^-_{(aq)} \rightarrow Cl_{2(g)} + 2e^-$, $Na^+_{(aq)} + e^- \rightarrow Na_{(l)}$

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



However, technical and environmental issues arose. The mercury that was theoretically supposed to be recycled was found to contaminate the NaOH produced, leading to environmental concerns as mercury is a heavy metal that accumulates in the body and causes brain damage. This led to the development of the diaphragm cell.

The diaphragm cell uses a titanium anode and steel mesh cathode, with an asbestos diaphragm separating the electrodes. The brine passes by the ~~diag~~ titanium anode where chlorine is oxidised; then through the diaphragm and cathode where water is reduced, reacting with sodium to form sodium hydroxide.



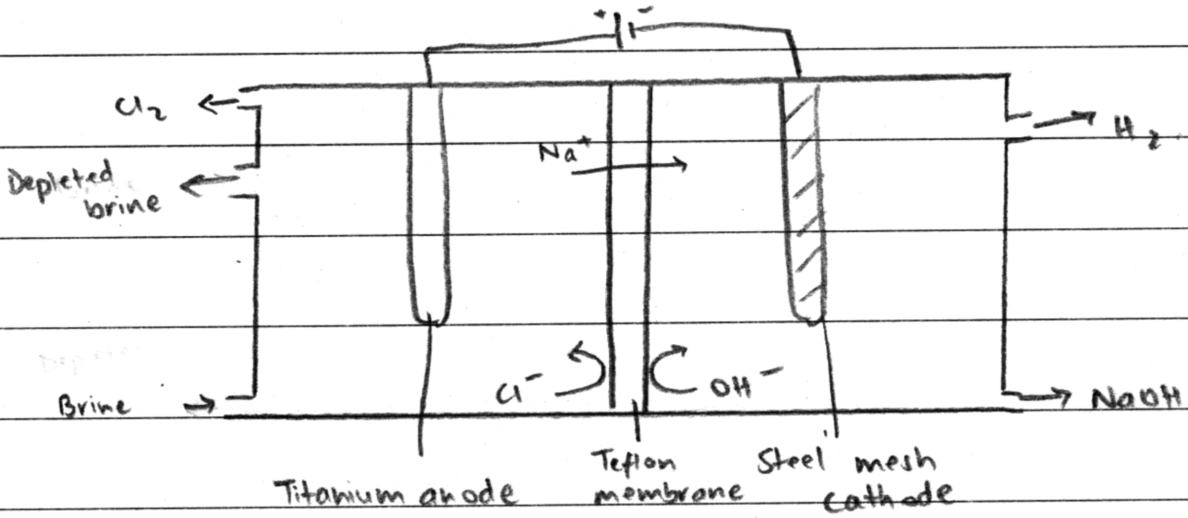
$2Cl^-_{(aq)} \rightarrow Cl_{2(g)} + 2e^-$

$2H_2O_{(l)} + 2e^- \rightarrow H_{2(g)} + 2OH^-_{(aq)}$

$Na^+_{(aq)} + OH^-_{(aq)} \rightarrow NaOH_{(aq)}$

However, the ~~brine~~ NaOH produced was contaminated with chlorine and the asbestos diaphragm was found to be harmful to humans. Thus further developments and ~~avata~~ advancements in technology led to the membrane cell.

The membrane cell uses a teflon membrane that is permeable to only sodium ions. ~~An~~ A titanium anode and steel mesh cathode are used, with the membrane separating the two electrodes.



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

$2H_2O_{(l)} + 2e^- \rightarrow H_{2(g)} + 2OH^-_{(aq)}$

$Na^+_{(aq)} + OH^-_{(aq)} \rightarrow NaOH_{(aq)}$.

Thus the technical and environmental concerns surrounding the other two cells: mercury and diaphragm as well as the industrial demand for a pure sodium hydroxide led to the development of the membrane cell. While this process produces relatively pure NaOH, further advancements in technology and scientific understanding may lead to more changes to the method in the future.