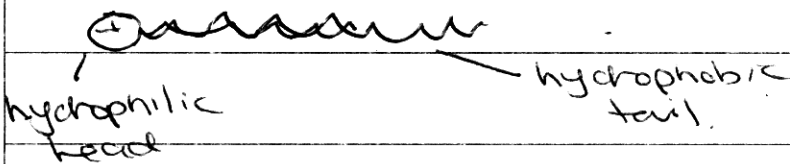


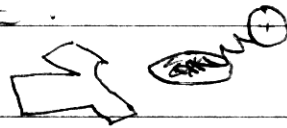
Question 28 - Industrial chemistry

a) (i) Saponification is the process of hydrolysis of fats and oils to produce glycerol and salts of fats and oils. In another words it is the production of soap.

(ii) A soap molecule consist of a polar anionic head <sup>(attracted to water)</sup> which is hydrophilic and a non-polar tail <sup>made of a long chain of hydrocarbons</sup> which is hydrophobic ~~(dislikes water)~~.

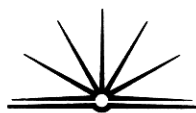


The non-polar tail is attracted to other non-polar grease and sticks itself into it while the polar head is attracted to water so the soap molecule ~~is lifted from~~ <sup>lifts the</sup> grease molecule of the clothing, plate etc.

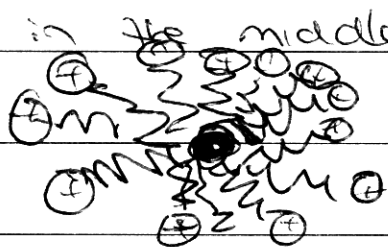


As there are many of these soap molecules floating around they form a circle around the grease with its tail pointing to the centre.

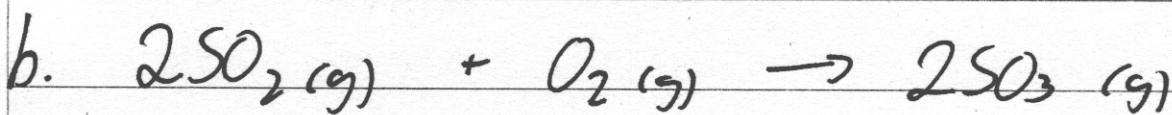




As they circle the grease, the grease is attracted to the tails and an emulsion is formed. Which means the grease is 'stuck' ~~but~~ in the middle of the soap molecules.



This prevents the grease from entering the material and dirtying it again. So the soap molecules keep the grease suspended safely in the water until it is washed away.



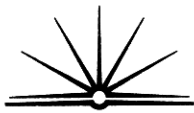
$$\therefore \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2 [\text{O}_2]} = \frac{(0.04)^2}{(0.08)^2 (0.02)}$$

∴ at equil.  $2\text{SO}_3 \rightarrow 0.04 \text{ mol L}^{-1}$

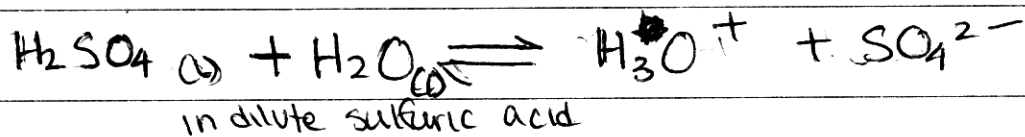
∴  $2\text{SO}_2 \rightarrow 0.04 \text{ mol L}^{-1}$

∴  $\text{O}_2 \rightarrow 0.02 \text{ mol L}^{-1}$

$$\frac{0.04^2}{0.08^2 \cdot 0.02} = 50$$



c.1) when sulfuric acid is added to the water because ~~substance~~ the reaction is very exothermic it releases so much heat that ~~there is a chance a molecular~~ sulfuric acid is ionised



This is also because a water molecules is tied up as

hydrated ion  $\text{H}_2\text{SO}_4 \cdot \text{H}_2\text{O}$ . so the sulfuric acid molecules ionise & release large amount of heat in the process

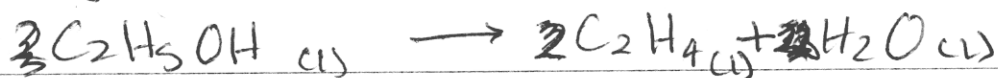
Therefore, due to lack of water,



c) ii) Sulfuric acid acts as an dehydrating agent as it oxidises Cu to  $\text{Cu}^{2+}$  and <sup>used to</sup> produces  $\text{SO}_2$ .

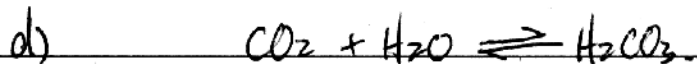
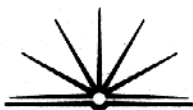


~~Sulfuric~~ Sulfuric acid acts as a dehydrating agent ~~used~~ in dehydrating ethanol to form ethene.



Sulfuric acid act as a means of precipitating  $\text{Pb}^{2+}$  from lead solution. This reaction is involved in lead acid car battery which allow to lower the conc. of  $\text{Pb}^{2+}$  ~~to~~ allow the battery to give a constant  $\text{e}$  voltage which otherwise would not occur.



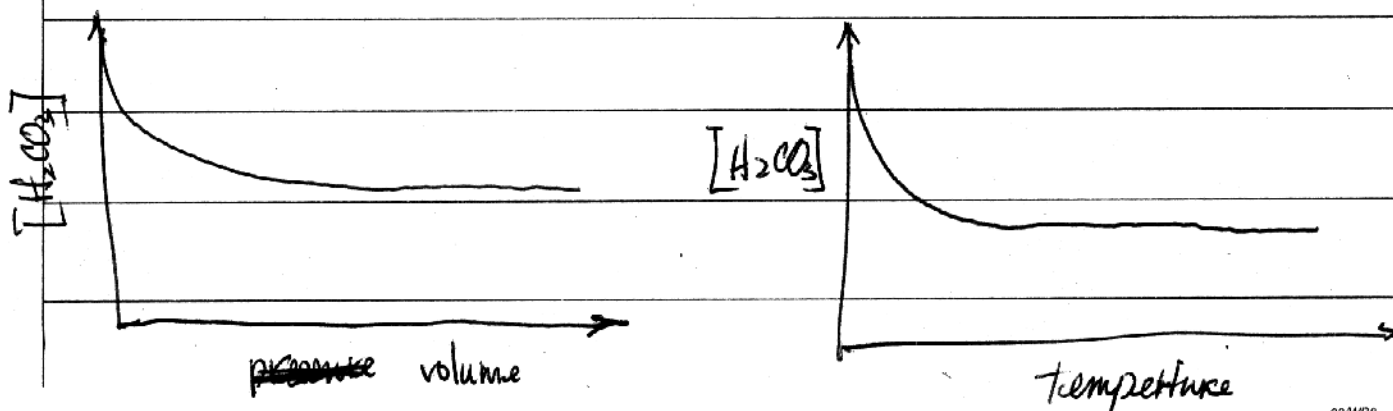


(i) in a close container has known volume of water and  $\text{CO}_2$ , by change the pressure, ~~temp~~ temperature, ~~of~~ ~~the~~ a change in equilibrium is show.

When increase the pressure by decrease the volume  $\text{CO}_2$  is force into  $\text{H}_2\text{O}$ . As the pressure is released, bubbles of  $\text{CO}_2$  is coming out of the solution.

(ii) From the experiment, it shows that when pressure is increased, the reaction goes to the right, when pressure is back to normal, the reaction goes from right to left ~~and stay at~~. When decreasing the temperature, the reaction tends to go to the right, but when the temperature is increased, ~~the reaction~~  $\text{CO}_2$  coming from the solution, the reaction goes to the left.

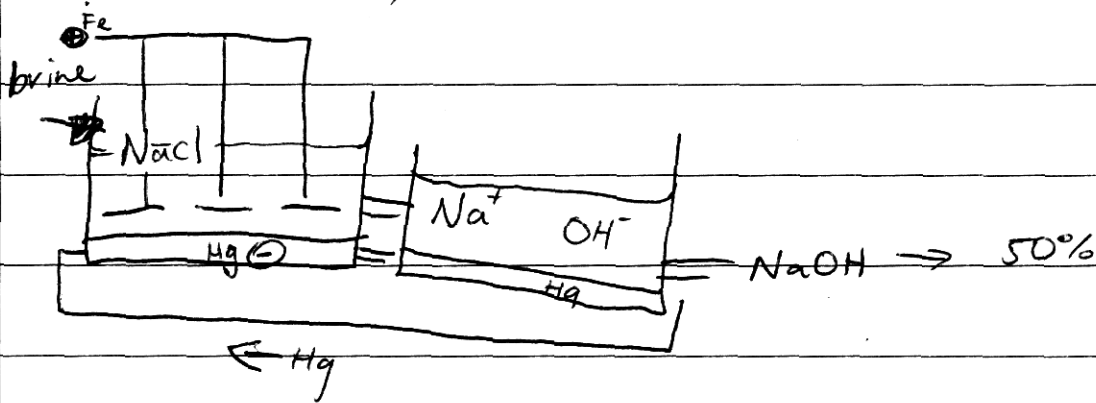
Measuring the volume and the concentration change ~~and~~ a graph is show



e) One of the original methods is the diaphragm method. This uses an asbestos diaphragm which is ~~toxic~~<sup>harmful</sup> to humans. ~~This process can use glycerol or chlorides to make soap and NaOH~~

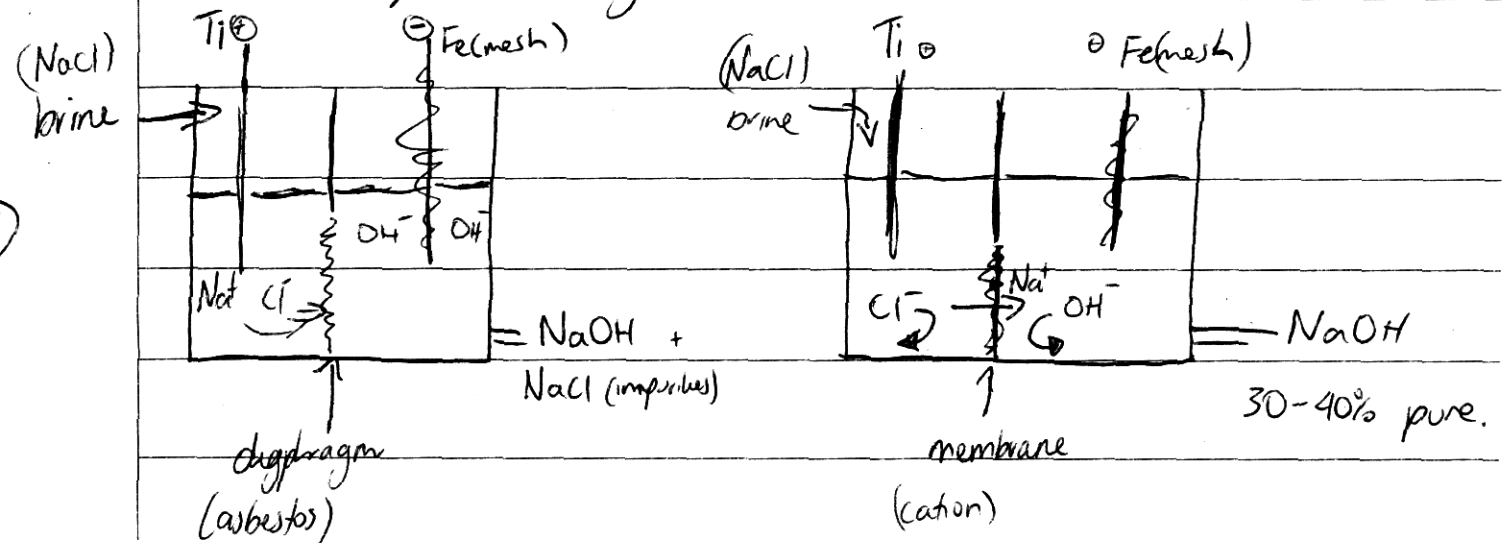
e) The diaphragm method uses an asbestos diaphragm that allows both  $\text{OH}^-$  &  $\text{Cl}^-$  ions to pass through it, this method has been changed as it wastes a lot of ~~product~~<sup>reactants</sup> for an impure product. Also the diaphragm is harmful to humans (respiratory) a titanium anode & a iron mesh cathode are used.

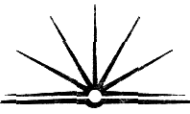
The mercury cell, this method gets an extreme amount of products relative to other methods (50%) it uses a Fe anode & a Hg anode.



The membrane process is now being used instead of the ~~diag~~ diaphragm method, with the use of a cation exchange membrane (only allows cations through).

This method stops Cl<sup>-</sup> from crossing through only allowing the Cl<sup>-</sup>, likewise for the OH<sup>-</sup> as it cannot pass through.





~~This waste~~ These changes have allowed more yield to be produced with less impurities. They are becoming more safe for human to use as Hg & Asbestos are harmful to humans.

They are also becoming cheaper to make & the leftover waste can be recycled.