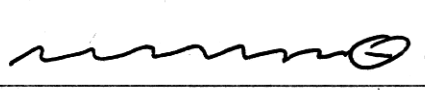
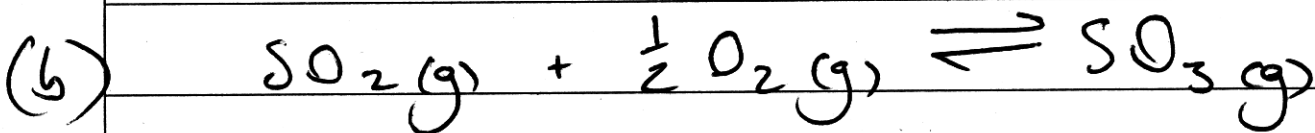


## Question 28 - Industrial Chemistry.

a.) i) Saponification - is the process used to make soap. It is the reaction between an ester and  $\text{NaOH}$  to produce glycerol and a carboxylate (which is soap)

ii) Soap is a polar ~~molecules~~ molecule. . Its negative head is hydrophilic (water loving) which attracts the  $\text{H}_2\text{O}$  ~~mole~~ molecules. While its tail which is hydrophobic (water hating) attacks the oily, greasy particles on the material. An <sup>emulsion</sup> ~~emulsion~~ occurs, the material ~~act~~ acting as the surfactant as the <sup>oily</sup> particles are lifted off the material by the hydrophobic tail. The soap acts as the emulsifier.



$$0.06 \qquad \qquad 0.05 \qquad \qquad - \qquad \text{mol. L}^{-1}$$

$$- \qquad \qquad - \qquad \qquad 0.04 \text{ mol. L}^{-1}$$

$$0.06 - x \qquad \qquad 0.05 - x \qquad \qquad 2x$$

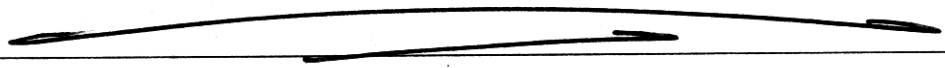
$$\therefore x = 0.02 \text{ mol. L}^{-1}$$

$$0.04 \qquad \qquad 0.03 \qquad \rightleftharpoons \qquad 0.04$$

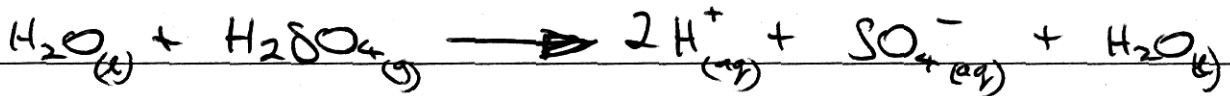
$$K = \frac{[\text{SO}_3]}{[\text{SO}_2] \cdot [\text{O}_2]^{\frac{1}{2}}}$$

$$= \frac{0.04}{0.04 \times (0.03)^{\frac{1}{2}}}$$

$$\therefore K = 5.77 \quad (2. \text{d.p.})$$



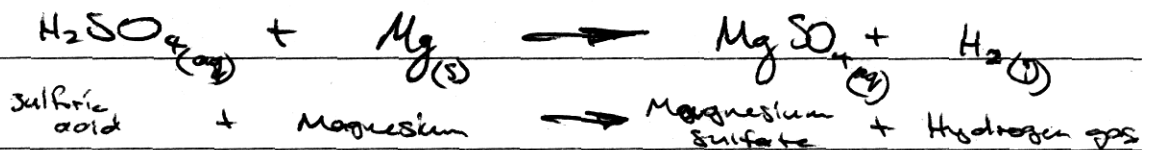
(c) (i) ~~acid~~



~~It~~

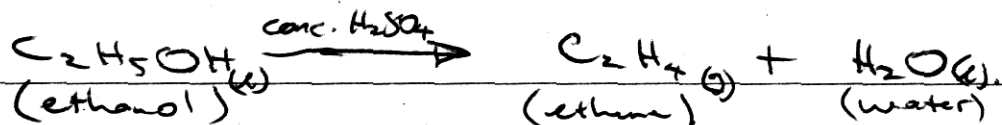
~~It~~ ~~is~~ ~~an~~ ~~acid~~ The sulfuric acid completely ionises when added to  $\text{H}_2\text{O}$ .

(ii) ① Oxidising agent:



In this reaction the Magnesium has been oxidised, + the sulfuric acid reduced, hence  $\text{H}_2\text{SO}_4$  is acting as an ~~acid~~ <sup>oxidising</sup> agent.

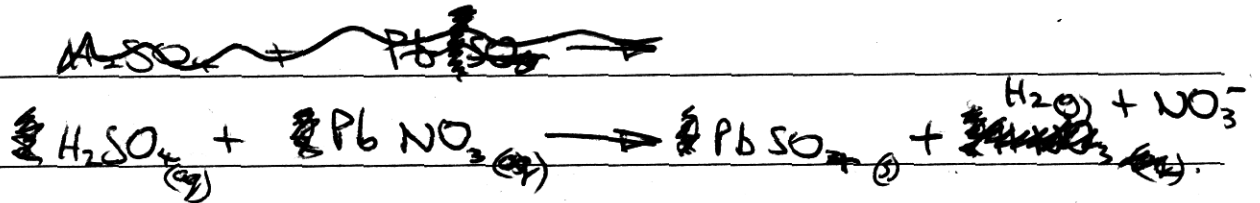
② Dehydrating agent:



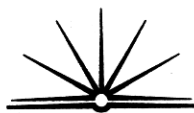
$\text{H}_2\text{SO}_4$  is used as a ~~it~~ dehydrating agent (take water out). dehydrate to ~~ethene~~ ~~water~~ ~~ethene~~ ~~water~~ ethanol to form ethene and water.

(3)

### Precipitating sulfates:



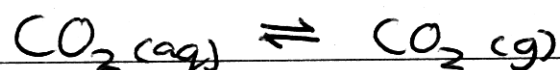
Sulfuric acid is used in this case as an agent to precipitate lead sulfate out of a solution. This process can be utilised in many other situations (e.g. Use something other than lead nitrate).



d) (i) We investigated the equilibrium reaction in a coke bottle.

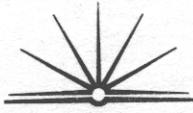
The procedure was to sample the solution then leave the cap of the bottle off for 2 days. Sampling the same solution again after that period of time resulted in a drastically different taste.

(ii) The equilibrium reaction was:



inside the closed system. But once the cap was off the bottle, the pressure of the system decreased causing a shift in the equilibrium to the right (product). As a result more  $\text{CO}_2(\text{g})$  formed as the solution of coke became 'flat'.

An analysis of the equilibrium reaction



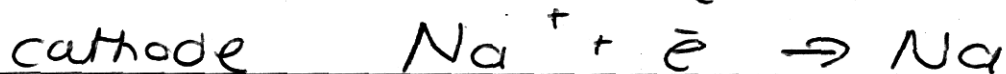
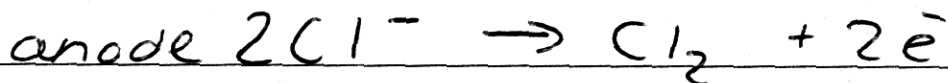
was achieved by tasting the difference in the solution. The quality of the solution after 2 days left open was much less than the newly opened, initial sample.

e) Sodium hydroxide (NaOH) is produced by the electrolysis of NaCl, ~~which~~ the other products are  $H_2$  and  $Cl_2$  gas.

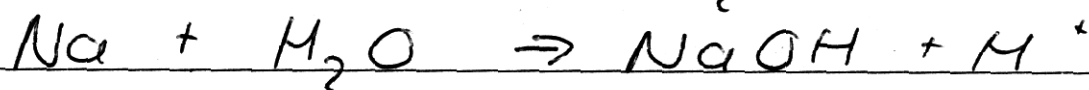
The general method for producing NaOH is  $2NaCl + 2H_2O \xrightarrow{\text{electrolysis}} 2NaOH + H_2 + Cl_2$

There are various methods/processes used to produce NaOH, one process is by using the Mercury cell.

In the Mercury cell this occurs



The Na ~~is~~ forms an amalgam with mercury and travels to another chamber where it ~~is~~ reacts with  $H_2O$



The mercury process is able to produce large quantities of NaOH, which is reasonably pure and cheap. Yet it is not entirely pure as there will always

be  $\text{Cl}^-$  present. The method also is harmful to the environment, as it ~~produces~~ uses mercury. The mercury can enter the waterways and kill marine animals and also reach humans, where it could send health problems.

Another method used industrially to produce  $\text{NaOH}$  is the diaphragm method. Where at the anode  $-2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$  occurs and at the cathode  $\text{H}^+$  is produced by  $-2\text{H}_2\text{O} + 2\text{e}^- \rightarrow 2\text{H}^+ + 2\text{OH}^-$

The diaphragm cell uses asbestos diaphragm which makes this method environmentally unfriendly, because asbestos is damaging to living things. ~~That is~~

Because the cathode and anode are separated there is no chance that the  $\text{H}^+$  and  $\text{Cl}^-$  will react or the  $\text{Cl}^-$  react with  $\text{OH}^-$  to produce the unwanted by product of  $\text{ClO}$ .

~~The~~ This method does ~~not~~ produce



pure NaOH, as there is always  $\text{Cl}^-$  present.

The latest industrial process used to produce NaOH is ~~the~~ by ~~is~~ using the membrane cell. This process is similar to the diaphragm method but is more environmentally friendly. Instead of using asbestos for the diaphragm, it uses a polymer, PMX. ~~This is the~~ This cell represents the change in methods to produce NaOH. The mercury process is rarely used in <sup>industry</sup> ~~industrial~~ nowadays because of its harmful nature, and the diaphragm cell is being transformed into the membrane cell, which produces pure NaOH and is friendly to the environment.