

(a)(i) Saponification is the process used to make soap from sodium hydroxide and castor oil.

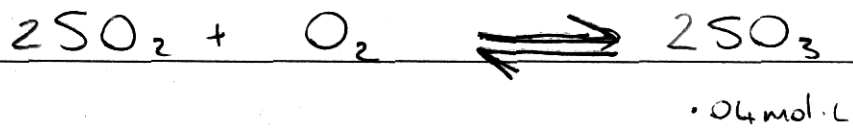
(ii) The cleaning action of soap makes use of the physical properties of water and 'dirt'. The polar end of the soap bonds with water molecules while the long fatty acid chain at the other end bonds with ^{oil} and 'dirt' molecules.

In this way soap allows water to ~~the~~ 'clean' a surface by creating a ^{previously not possible} connection between water molecules and oil/dirt molecules.



(b)

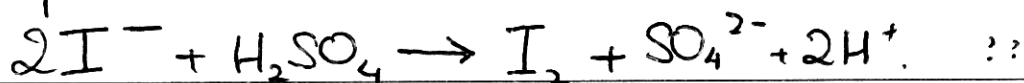
H_2SO_4 b
before $.06 \text{ mol.L}$ before $.05 \text{ mol.L}$ at equilibrium $.04 \text{ mol.L}$



2 : 1 \longrightarrow 2 (pretend 1 litre)
 $.04$ $.02$ $.04$

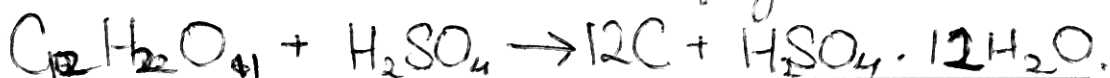
$$K = \frac{[SO_3]^2}{[SO_2]^2 [O_2]}$$
$$= \frac{.04^2}{(.04)^2 (.02)}$$
$$= 50$$

(iii) Sulfuric acid is used as an oxidising agent.
Such an example includes iodine.



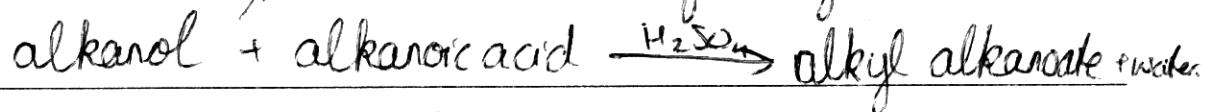
It is used to oxidise substances that are usually very inert and ~~stand~~ stable.

Sulfuric acid is also used as a dehydrating agent. This can be used to extract carbon out of glucose.

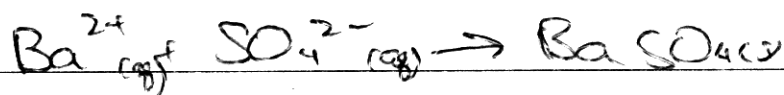
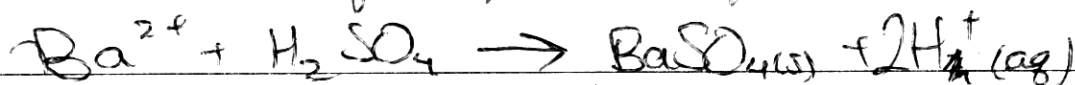


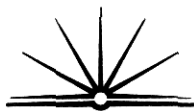
It can also be used to dry the chlorine gas after it is produced.

Sulfuric acid is used as a catalyst for esterification as it allows the water ^{formed} to be absorbed quickly.



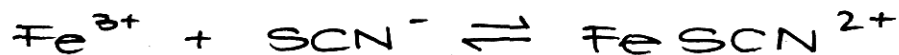
Sulfate ions are mostly insoluble in water so when ~~to~~ sulfuric acid is ~~not~~ mixed with these ions, such as barium, precipitates of sulfates are formed





28 INDUSTRIAL CHEMISTRY

d) (i)



We set up ^{several} test tubes containing solutions of the above in equilibrium.

Then one test tube was slowly heated, and changes observed.

One test tube was placed in a water bath of ice, and changes observed.

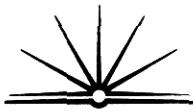
To one test tube was added Fe^{3+} , and changes observed.

To one test tube was added FeSCN^{2+} , and changes observed.

d) (ii)

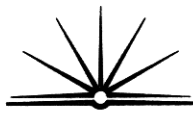
When beginning experiment, it was known that the left was red, and the right orange. As the equilibrium reactions occurred, colour changes were observed. With an increase in temp., the endothermic reaction was favoured, and the colour changed accordingly. With a decrease in temp., the exothermic reaction was favoured, and the colour changed accordingly. When reactants added, reaction

Reaction analysed using the concept that when ^{system is} equilibrium is changed, equilibrium shifts to accommodate change.



28 INDUSTRIAL CHEMISTRY

d) (ii) shifted to the right, when products added, reaction shifted to left.



(c) There are three ~~typ~~ methods of producing sodium hydroxide industrially.

- Mercury process:- In the mercury process the ~~can~~ sodium hydroxide is produced at the cathode. Sodium ions are converted to

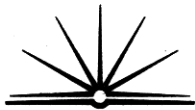
sodium metal which is mixed with mercury to produce Na(Hg) , and then it is sprayed onto the water to produce OH^- ions. In the process there are many environmental problems and is therefore being abolished. The mercury from the process leaks out into waterways, ~~a~~ rivers which can poison fish and threaten the aquatic life at the bottom of the food chain. ~~The~~

- Nelson daphnam cell - This uses the concentrated electrolysis to produce hydroxide at the cathode. ~~Water is reduced at the~~ ~~cathode~~ ^{water} hydrogen gas is reduced at the cathode. Sodium ions to ~~OH~~ form hydroxide. Sodium ions are then passed through the cathode

to form a ~~solid~~ hot cone. solution of sodium ~~chloride~~ hydroxide. A major problem with ~~these~~ this process is that the sodium hydroxide is mixed with small ~~dose~~ ^{amount} of sodium chloride and the sodium hydroxide has to be separated from the sodium chloride by crystallography. Also this process uses asbestos diaphragm. lines to produce. Separate the anode and the cathode, this asbestos diaphragm is said to cause cancer of a particular type.

The two processes named above are being replaced by Membrane process. The membrane process does not use mercury and uses a permeable water membrane to separate the cathode and the anode. ~~Sodium Chloride. The chlorine gas, hydroxide and sodium metal is passed the sodium metal use.~~

The membrane does not allow the



Chloride ~~ions~~^{gas} or the hydrogen ions to
pass through the membrane. So the
sodium hydroxide is not mixed
with sodium chloride