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(a) It's mercury cell. The salt and water (Brine) into electrolysis cell, then the oxidation in the anode $2Cl^- \rightleftharpoons Cl_2 + 2e^-$, the chlorine gas been produced. The cathode only allow Na^+ to go through and dissolve in amalgam, $2Na/Hg + 2H_2O \longrightarrow 2NaOH + H_2 + 2Hg$, the NaOH is produced in the water chamber, it produce high purity of NaOH and release H_2 gas, the Hg can be reused. It's safety that Cl_2 and H_2 are sperated. But this cell contain mercury which is toxic to damage the enviroment and cause lung cancer. And the NaOH must crystalise.

(b) • molten sodium chloride only contain two ions : Na^+. Cl^-

oxidation reaction : $2Cl^- \longrightarrow Cl_2 + 2e^-$

reduction reaction : $Na^+ + e^- \longrightarrow Na(s)$ overall : $Na^+ + Cl^- \rightarrow NaCl$

• aqueous sodium chloride contain three pieces : Na^+. Cl^-. H_2O

The oxidation reaction is always $2Cl^- \rightarrow Cl_2 + 2e^-$, as Na^+ required large energy, therefore the reaction not been occur, then the reduction is $2H_2O + 2e^- \rightarrow H_2 + OH^-$

overall reaction : $NaCl + H_2O \longrightarrow H_2 + NaOH + Cl_2$

Therefore the product of electrolysis aqueous sodium is H_2. Cl_2. and OH^-

(c) (ii) $2SO_2 + O_2 \overset{V_2O_5}{\rightleftharpoons} 2SO_3$

when at time A . $n(SO_3) = 0.4\,mol$, $n(SO_2) = 0.5\,mol$

$\because c = \frac{n}{V}$

$\therefore C_{(SO_3)} = \frac{0.4\,mol}{10\,L} = 0.04\,M$

$C_{(SO_2)} = \frac{0.5\,mol}{10\,L} = 0.05\,M$

$C_{(O_2)} = \frac{0.4\,mol}{10\,L} = 0.04\,M$

$\therefore K_c = \frac{[SO_3]^2}{[SO_2]^2[O_2]} = \frac{0.04^2}{0.05^2 \times 0.04} = 16$

(iii) when at time B. the moles of SO_3 and SO_2 stay constant $2SO_2 + O_2 \overset{V_2O_5}{\rightleftharpoons} 2SO_3$, when the moles of SO_3 and SO_2 is the same as time A. The new equilibrium position is formed.

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(d) (i) soaponification

reactant A : NaOH

(ii) Hydrolysis then neutralise. Firsty add the water to coconut oil then add NaOH to form the soap, after making soap, "salting out" to produce soap. During the soponification, do not toach and straight use the soap.

(e) • Solvay process is to produe Na_2CO_3 which the main use is glass, to remove the Ca^{2+}. Mg^{2+} in hard water and make chemical

• During the solvay process, CO_2 (ammonia) is produce but it can be reused again

• $CaCO_3 + H_2O \longrightarrow CaO + CO_2 + H_2O$

$CO_2 + NH_4^+ + OH^- + NaCl \longrightarrow NaHCO_3 + NH_4Cl$

$2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$

$CaO + H_2O \longrightarrow Ca(OH)_2$

$2NH_4Cl + Ca(OH)_2 \rightarrow CaCl_2 + 2NH_3 + H_2O$

∴ The overall reaction is $CaCO_3 + 2NaCl \longrightarrow CaCl_2 + Na_2CO_3$

• The $CaCl_2$ is major waste, although it can be transfer to water and reused in solvay process, but the amount of $CaCl_2$ is still too large and recenly no technology to use the $CaCl_2$, and cool the $CaCl_2$ before transfer to sea water

• As solvay process produce large amount of heat. therefore the thermol pollution

• Noice is also the pollution