(a) It's mercury cell. The salt and water (brine) into electrolysis cell, then the oxidation in the anode $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$, the chlorine gas been produced. The cathode only allow $\text{Na}^+$ dissolve in amalgam, $2\text{Na}/\text{Hg} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2 + 2\text{Hg}$, 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 operated. But this cell contain mercury which is toxic to damage the environment and cause lung cancer. And the NaOH must crystallise.

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

oxidation reaction: $\boxed{2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-}$

reduction reaction: $\text{Na}^+ + \text{e}^- \rightarrow \text{Na}(s)$, overall: $\text{Na}^+ + \text{Cl}^- \rightarrow \text{NaCl}$

• Aqueous sodium chloride contain three pieces: Na$^+$. Cl$^-$. H$_2$O.

The oxidation reaction is always $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$, as Na$^+$ required large energy, therefore the reaction not been occur, then the reduction is $2\text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{H}_2 + 2\text{OH}^-$. 

overall reaction: $\text{NaCl} + \text{H}_2\text{O} \rightarrow \text{H}_2 + \text{NaOH} + \text{Cl}^-$

Therefore the product of electrolysis aqueous sodium is H$_2$, Cl$_2$, and OH$^-$. 
(c) \( \text{2SO}_2 + \text{O}_2 \xrightarrow{\text{VSO}_3} \text{2SO}_3 \)

When at time A, \( n(\text{SO}_3) = 0.4 \text{ mol}, \ n(\text{SO}_2) = 0.5 \text{ mol} \)

\[ c = \frac{n}{V} \]

\[ C(\text{SO}_3) = \frac{0.4 \text{ mol}}{10 \text{ L}} = 0.04 \text{ M} \]

\[ C(\text{SO}_2) = \frac{0.5 \text{ mol}}{10 \text{ L}} = 0.05 \text{ M} \]

\[ C(\text{O}_2) = \frac{0.4 \text{ mol}}{10 \text{ L}} = 0.04 \text{ M} \]

\[ K_c = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2[\text{O}_2]} = \frac{0.04^2}{0.05^2 \times 0.04} = 16 \]

(iii) When at time B, the moles of SO\(_3\) and SO\(_2\) stay constant

\[ \text{2SO}_3 + \text{O}_2 \xrightarrow{\text{VSO}_3} \text{2SO}_3 \]

When the moles of SO\(_3\) and SO\(_2\) is the same as time A. The new equilibrium position is formed.
Start here.

(d) i) Soapification

reactant A: NaOH

ii) Hydrolysis then neutralise. Firstly add the water to coconut oil then add NaOH to form the soap, after making soap, "setting out" to produce soap. During the saponification, do not touch and straight use the soap.

(e) Solvay process is to produce Na$_2$CO$_3$ which the main use is glass, to remove the Ca$^{2+}$, Mg$^{2+}$ in hard water and make chemical ammonia.

During the solvay process, CO$_2$ is produce but it can be reused again.

\[
\begin{align*}
\text{CaCO}_3 + \text{H}_2\text{O} & \rightarrow \text{CaO} + \text{CO}_2 + \text{H}_2\text{O} \\
\text{CO}_2 + \text{NH}_4^+ + \text{OH}^- + \text{NaCl} & \rightarrow \text{NaHCO}_3 + \text{NH}_4\text{Cl} \\
\text{NaHCO}_3 & \rightarrow \text{Na}_2\text{CO}_3 + \text{CO}_2 + \text{H}_2\text{O} \\
\text{CaO} + \text{H}_2\text{O} & \rightarrow \text{Ca(OH)}_2 \\
\text{Ca(OH)}_2 + \text{CO}_2 & \rightarrow \text{CaCO}_3 + 2\text{H}_2\text{O} \\
\text{CaCl}_2 + \text{NaOH} & \rightarrow \text{Ca(OH)}_2 + \text{NaCl}
\end{align*}
\]

The overall reaction is CaCO$_3$ + NaCl → CaCl$_2$ + Na$_2$CO$_3$.

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 recently 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 thermal pollution.

Noise is also two pollution.