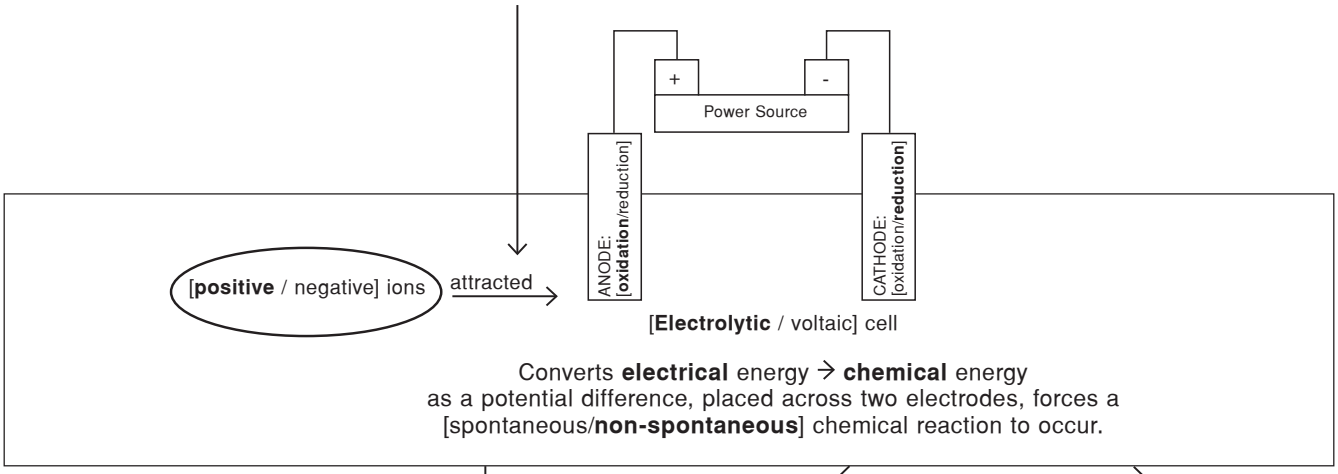
CHLOR-ALKALI MEMO

Overview

1 Complete / choose from the options to summarise the purpose and process of the chlor-alkali industry.
Input: **Sodium chloride solution** (brine)



Outputs:	**Chlorine : Cl_2** (g)	**Sodium hydroxide : NaOH** (aq)	Hydrogen: H_2 (g)
Uses:	**Bleach** **Disinfectant** **Used to make PVC**	**Soap-making** **Water purification** **Drain cleaning**	**Rocket fuel** **Possible alternative car fuel** **Needed for making plastics**

2 Complete / choose from the options to summarise the types of chlor-alkali cells.

	Membrane	**Diaphragm**	**Mercury**
Cathode material	carbon	carbon	**mercury**
Input	**brine (NaCl(aq)) and an electric potential difference (PD)**		
Oxidation ½ reaction at anode	**$2Cl^-(aq) \rightarrow Cl_2 + 2e^-$**		
Reduction ½ reaction at cathode	**$H_2O(\ell)$** reduced to **$H_2(g)+OH^-(aq)$** Since there are Na^+ ions present too, **NaOH** can be produced.		**Na^+** reduced to **Na,** which then reacts with **H_2O** to form **NaOH** + **H_2**
What divides the electrolyte into two half cells?	**a semi-permeable membrane**	**a semi-permeable diaphragm**	**reduction ½ reaction occurs inside the liquid mercury cathode**
Disadvantages		**diaphragm allows Cl^- ions into the reduction ½ cell, contaminating the product with significant amounts of NaCl**	**mercury is poisonous**

3 Choose from the options for an **electrolytic cell**.

ELECTROLYTIC CELL	
Anode	**Cathode**
[**oxidation** / reduction]	[oxidation / **reduction**]
[**positive** / negative]	[positive / **negative**]

4 Circle the correct option (True / False) for each of the following referring to an **electrolytic cell**.

a A battery makes one electrode positive and the other negative, and this causes a chemical reaction to occur. [**True** / False]

b A chemical reaction occurs, and this causes one electrode to be made positive and the other negative. [True / **False**]

c As oxidation happens, chemicals lose electrons, which then go onto the anode, making it positive. [True / **False**]

d The battery makes the anode positive, and this makes chemicals lose electrons there as the battery sucks electrons away from them, causing oxidation to happen. [**True** / False]

e As reduction happens, chemicals accept electrons, taking them from the cathode, causing it to become negative. [True / **False**]

f The battery makes the cathode negative, and this makes chemicals gain electrons there, causing reduction to happen. [**True** / False]

5 Link each element from Column A with its corresponding element in Column B. Write the letter from A next to each item in B in the last column.

Column A	Column B	A
a anode	colour-remover	**k**
b cathode	a site at which the redox reactions of an electrochemical cell occur; often a rod	**c**
c electrode	a half reaction in which one chemical loses electrons, donating them to another chemical	**e**
d electrolyte	a half reaction in which one chemical gains electrons from another chemical	**f**
e oxidation	an electrode at which oxidation occurs	**a**
f reduction	a kind of reaction in which electrons are transferred from a reducing agent to an oxidising agent	**g**
g redox	attracted to water	**i**
h soap	an ionic solution, therefore able to conduct electricity	**d**
i hydrophilic	repelled by water	**j**
j hydrophobic	an electrode at which reduction occurs	**b**
k bleach	an organic chemical which is able to make fat dissolve	**h**
l chlorine (Cl_2)	a strong alkali; can be used to make soap; caustic soda	**m**
m sodium hydroxide	a substance which kills germs	**n**
n disinfectant	a dense green gas useful as bleach and disinfectant	**l**

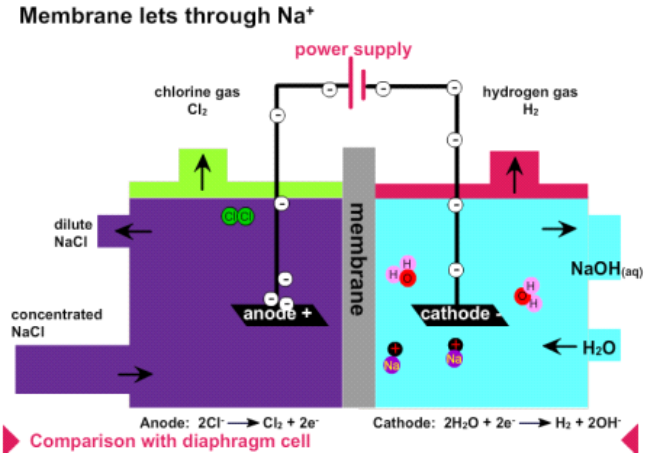
Membrane Cell

6 Complete the explanation by filling the gaps or choosing from the options.
Do this before, or after, but not during, watching the animations.
Mark during re-watching.

Cell composition

The membrane cell is a(n) [**electrolytic**/voltaic] cell. It consists of an external power supply (a battery), two **electrodes**, and **electrolytes**. The cell is divided into two halves. The two halves are separated by a semi-permeable membrane. Semi-permeable means **it only allows certain ions through**.

Membrane cell



Electrolyte

Brine serves as the electrolyte for the anode's half reaction. An electrolyte is **a solution which conducts electricity**. Brine consists of **sodium chloride** dissolved in water. When sodium chloride dissolves in water, its positively charged [**sodium**/chloride] ions are separated from its negatively charged [sodium/**chloride**] ions, and each ion is surrounded by **water**.

Anode

The battery creates a **potential difference** across the electrodes. The positive terminal of the battery [**pulls electrons away from**/pushes electrons into] the electrode connected to it, charging the electrode [**positively**/negatively]. This attracts the [positively/**negatively**/neutrally] charged [sodium/**chloride**] ions in the brine. When these reach the electrode, the battery [**pulls an electron away from**/pushes electrons into] each of them. This converts them from [positively/**negatively**/neutrally] charged chloride ions into [positive/negative/**neutral**] chlorine atoms. These are unstable, so they bond covalently with one another in pairs, forming diatomic molecules of **Cl_2**. This is what we often mean when we refer to chlorine. Chlorine is a dense green gas which bubbles away from this electrode and is collected. Chlorine was formed as chloride ions were stripped of electrons, so we call this half reaction [**oxidation**/reduction], which is the [gain/**loss**] of electrons. Each [chlorine atom/**chloride ion**] loses one electron to change it into a [**chlorine atom**/chloride ion]. The electrode at which oxidation occurs is called the [cathode/**anode**]. In an electrolytic cell, such as this, the battery charges the anode [**positively**/negatively].

Cathode

The semi-permeable membrane allows [**positively**/negatively] charged sodium [**ions**/atoms] through into the other electrolytic half-cell. The electrode in this half-cell is connected to the negative terminal of the battery. The battery [pulls electrons away from/**pushes electrons into**] it, charging the electrode [positively/**negatively**/neutrally]. This causes water molecules to react at this electrode. The water molecules [lose/**accept**] the electrons. We say the water is [oxidised/**reduced**]. These electrons cause water to change into **hydrogen** gas (H_2) and [positively/**negatively**/neutrally] charged hydroxyl ions (OH^-). These hydroxyl ions are dissolved in water, as are the sodium ions which moved through the membrane. Sodium ions and hydroxyl ions are therefore present in the solution. We call this a sodium hydroxide solution. The electrode at which reduction occurs is called the [**cathode**/anode]. In an electrolytic cell, such as this, the battery charges the cathode [positively/**negatively**].