Chemical and Fuel Cell Notes

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A chemical cell: is a device that produces a voltage due to reactions between the reactants stored inside it, until one of the reactants is used up. For example, a battery in a TV remote control.

How is a chemical cell made? A simple cell can be made by connecting two different metals in contact with an electrolyte. A number of cells can be connected in series to make a battery, which has a higher potential difference than a single cell. Just to remind ourselves, an electrolyte is the liquid (any liquid) that electricity can move through.

What does the potential difference depend on? The potential difference depends on the reactivity difference between the two metals. The further apart the metals are on the reactivity series the greater the potential difference.

Difference between Rechargeable and Non – Rechargeable Batteries

In rechargeable cells/ batteries, like the one used in your mobile phone, the chemical reactions can be reversed when an external circuit is connected.

In non-rechargeable cells, e.g. alkaline cells, a voltage is produced until one of the reactants is used up. This is what we call a battery 'going flat'. The chemical reactions cannot be reversed.

Exam note: we could be asked in an exam, what factor can affect the voltage of a chemical cell?

Answer: the difference between the reactivity of the two metals. Then give an example. Even if it's a one mark question, put down an example. Some examples are:

1. Potassium and sodium – will have a low voltage as they are close on the reactivity series.
2. Potassium and gold – will have a much larger voltage as they are at opposite ends of the reactivity series.

That is the full extent of what they can ask you in the exams on chemical cells. They are nice short questions, of no more than two marks on their own.

Fuel Cells

A fuel cell: is a device that produces voltage due to reactions involving a fuel and oxygen, for as long as the reactants are supplied.

The fuel is oxidised electrochemically, rather than being burned, so the reaction takes place at a lower temperature than if it was to be burned. Energy is released as electrical energy, not thermal energy.

Most fuel cell questions at GCSE are about hydrogen oxygen fuel cells.

Hydrogen-oxygen fuel cells are an alternative to rechargeable cells and batteries. In a hydrogen-oxygen fuel cell, hydrogen and oxygen are used to produce a voltage. Water is the only product. The overall reaction in a hydrogen-oxygen fuel cell is:

$$\text{hydrogen} + \text{oxygen} \rightarrow \text{water} \qquad 2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$$

They can ask us to write an electrode half equation:

At the negative electrode: $2H_2 + 4OH^- \rightarrow 4H_2O + 4e^-$ At the positive electrode: $O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$

Type of cell	Advantages	Disadvantages
Alkaline cell	They are cheaper to manufacture.	They may end up in landfill sites once fully discharged. They are recyclable though it is expensive.
Rechargeable cell	Can be recharged many times before being recycled, reducing the use of resources.	Costs more to manufacture.
Hydrogen fuel cell	Easy to maintain as there are no moving parts; small size; water is the only chemical product. It doesn't produce any CO_2.	Very expensive to manufacture; need a constant supply of hydrogen fuel, which is a flammable gas.