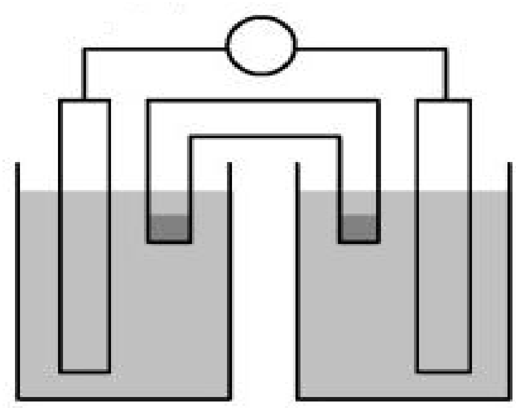
Electrochemical Cells

Electrochemical cells are . They must have a . A will be produced if they are connected into a circuit., this can be measured by a .

Look at the electrochemical cell below:



A zinc half-cell has more tendency to and release . This half cell becomes the .

The flow into the copper half-cell. The from the solution the electrons to form . The copper half-cell is the .

A is created between the two electrodes. This is measured using a and is called the

The connects the circuit through the transfer of in the . A salt bridge is usually soaked in a , such as . The salt solution must be in the electrochemical cell.

Standard notation of an electrochemical cell:

In general, an electrochemical cell will be made from:

If it is a metal:

A containing the metal.

An electrode made from the . (Apart from when the solution contains two or more ions, then it is or .

A and a .

All solutions at .

Temperature at .

If there is a gas involved:

A containing the of the gas.

An electrode made from .

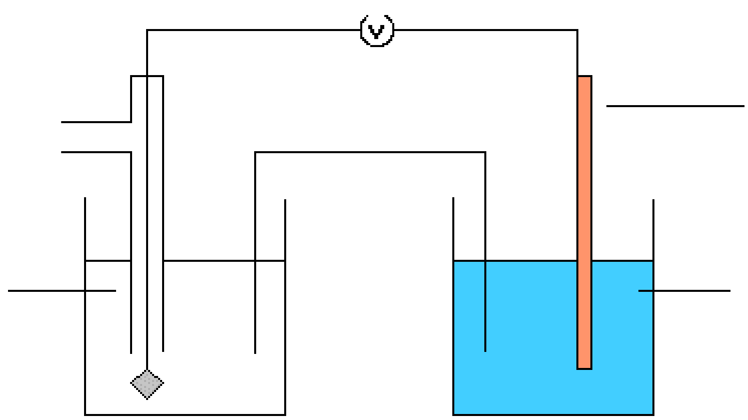
A and a .

All solutions at and all gases at .
Temperature at .

Standard hydrogen electrode (SHE)

To measure the of a half-cell. The half-cell in question is measured against the . The SHE is given the cell potential of under , concentration of solutions at , pressure of gas at and temperature at .

By connecting a half-cell to SHE we can work out the strength of the ability of the half-cell. This is called the . It is always shown as a .



Drawing electrochemical cells:

You **must** include:

1.
2.
3.
4.
5.
6.

Using E values to predict cell voltages:

Electrode potentials can show the of change in a reaction.

Electrode potentials are always written as their ability to . Hence their ability to act as an .

For any two half-equations:

The more half-cell will always .

The more half-cell will always .

Therefore, the overall equation is:

We can work out the voltage of an electrochemical cell by using the formula:

Write the overall equation and calculate the Ecell for the following species:

1)

2)

3)

Draw the electrochemical cell for question one and complete the standard notation:

Using standard electrode potentials to predict redox reactions:

If the overall voltage of the electrochemical cell is +ve then the reaction is

If the overall voltage of the electrochemical cell is -ve then the reaction is

e.g. Can bromine oxidise silver metal to Ag^+ ions?

Can iodine oxidise silver metal to Ag^+ ions?

Limitations of the standard electrode potential approach:

All electrode potentials are measured under standard conditions, in reality experiments are not always carried out under standard conditions.

Changing concentrations affects the E value.

Increasing the concentration of will make the E value more or less . This is because of , the equilibrium will shift to the therefore the concentration of and the E value.

Reaction rates:

A feasible reaction may occur according to E values however the rate of the reaction may be unsatisfactory, because the is too . A change in could also affect the due to . However, this is less of a factor.

Storage and fuel cells

You do not have to any construction of fuel cells only how to calculate the .

Storage cell:

Storage cells are used to supply electricity in many appliances such as shavers. They are generally cells, an example is .

Construct an overall equation and calculate the Ecell for the Nickel cadmium cell.

Hydrogen fuel cell

A fuel cell produces power from a reaction of a with e.g. . An example of a fuel cell is the .

The electrodes are made from coated in . The is an or membrane that allows to move from one part to the other.

In alkaline conditions:

What is the overall equation and the Ecell?

In acidic conditions:

What is the overall equation and the Ecell?

Advantages fuel cells

Disadvantages of fuel cells

and hydrogen is
and dangerous (under high pressure).

Limited and production costs.

Use of chemicals in their production.

Electrode potentials for half cells

	Reduction Half-Reaction		E° (V)	
Stronger oxidizing agent	$F_2(g) + 2e^-$	$\longrightarrow 2F^-(aq)$	2.87	Weaker reducing agent
	$H_2O_2(aq) + 2H^+(aq) + 2e^-$	$\longrightarrow 2H_2O(l)$	1.78	
	$MnO_4^-(aq) + 8H^+(aq) + 5e^-$	$\longrightarrow Mn^{2+}(aq) + 4H_2O(l)$	1.51	
	$Cl_2(g) + 2e^-$	$\longrightarrow 2Cl^-(aq)$	1.36	
	$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^-$	$\longrightarrow 2Cr^{3+}(aq) + 7H_2O(l)$	1.33	
	$O_2(g) + 4H^+(aq) + 4e^-$	$\longrightarrow 2H_2O(l)$	1.23	
	$Br_2(l) + 2e^-$	$\longrightarrow 2Br^-(aq)$	1.09	
	$Ag^+(aq) + e^-$	$\longrightarrow Ag(s)$	0.80	
	$Fe^{3+}(aq) + e^-$	$\longrightarrow Fe^{2+}(aq)$	0.77	
	$O_2(g) + 2H^+(aq) + 2e^-$	$\longrightarrow H_2O_2(aq)$	0.70	
	$I_2(s) + 2e^-$	$\longrightarrow 2I^-(aq)$	0.54	
	$O_2(g) + 2H_2O(l) + 4e^-$	$\longrightarrow 4OH^-(aq)$	0.40	
	$Cu^{2+}(aq) + 2e^-$	$\longrightarrow Cu(s)$	0.34	
	$Sn^{4+}(aq) + 2e^-$	$\longrightarrow Sn^{2+}(aq)$	0.15	
	$2H^+(aq) + 2e^-$	$\longrightarrow H_2(g)$	0	
	$Pb^{2+}(aq) + 2e^-$	$\longrightarrow Pb(s)$	−0.13	
	$Ni^{2+}(aq) + 2e^-$	$\longrightarrow Ni(s)$	−0.26	
	$Cd^{2+}(aq) + 2e^-$	$\longrightarrow Cd(s)$	−0.40	
	$Fe^{2+}(aq) + 2e^-$	$\longrightarrow Fe(s)$	−0.45	
	$Zn^{2+}(aq) + 2e^-$	$\longrightarrow Zn(s)$	−0.76	
	$2H_2O(l) + 2e^-$	$\longrightarrow H_2(g) + 2OH^-(aq)$	−0.83	
	$Al^{3+}(aq) + 3e^-$	$\longrightarrow Al(s)$	−1.66	
	$Mg^{2+}(aq) + 2e^-$	$\longrightarrow Mg(s)$	−2.37	
	$Na^+(aq) + e^-$	$\longrightarrow Na(s)$	−2.71	
Weaker oxidizing agent	$Li^+(aq) + e^-$	$\longrightarrow Li(s)$	−3.04	Stronger reducing agent