

AQA Chemistry A-level

Topic 1.11 - Electrode Potentials and Electrochemical Cells

Flashcards

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What happens when a rod of a metal is dipped into a solution of its own ions?



What happens when a rod of a metal is dipped into a solution of its own ions?

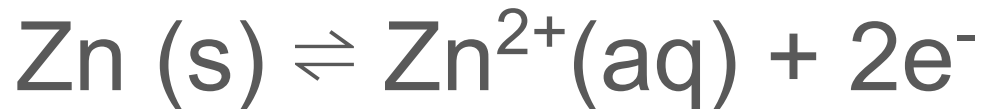
An equilibrium is set up between the solid metal and the aqueous metal ions



Write a half-equation for
zinc (s) to zinc (II).



Write a half-equation for zinc (s) to zinc (II).



Write a half-equation for
copper (II) to copper (III).



Write a half-equation for copper (II) to copper (III).



What is the simplest salt bridge made of?



What is the simplest salt bridge made of?

Filter paper soaked in saturated solution of KNO_3
(potassium nitrate)



Why are salt bridges necessary?



Why are salt bridges necessary?

Complete the circuit, but avoid further metal/ion potentials as does not perform electrochemistry. Allows ion movement to balance the charge. Do not react with electrodes



What symbol is used to represent a salt bridge in standard notation?



What symbol is used to represent a salt bridge in standard notation?

||



What type of species goes on the outside (furthest from the salt bridge) in standard cell notation?



What type of species goes on the outside (furthest from the salt bridge) in standard cell notation?

The most reduced species



What does | indicate?



What does | indicate?

Phase boundary (solid/liquid/gas)



How would an
Aluminium/Copper cell be
represented?



How would an Aluminium/Copper cell be represented?



What happens at the left-hand electrode?



What happens at the left-hand electrode?

Left hand electrode is where oxidation occurs.

Left hand electrode is the half cell with the most negative E^\ominus value



What happens at the right-hand electrode?



What happens at the right hand electrode?

right hand electrode is where reduction occurs.

Right hand electrode is the half cell with the most positive E° value



Which side of the cell has
the most negative E^\ominus value?
what happens to the metal
with the most negative E^\ominus
value?



Which side of the cell has the most negative E^\ominus value? what happens to the metal with the most negative E^\ominus value?

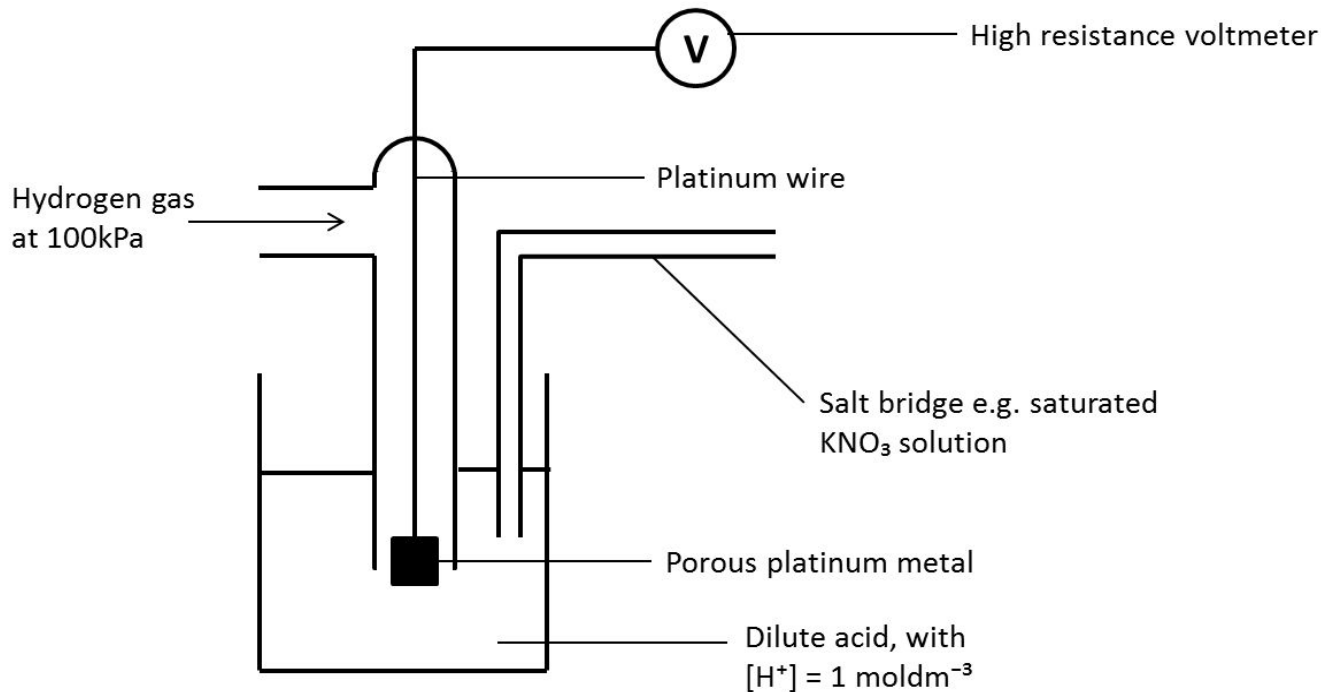
Oxidation - left hand electrode



Draw the standard hydrogen electrode



Draw the standard hydrogen electrode



What conditions is the
standard hydrogen
electrode used in?



What conditions is the standard hydrogen electrode used in?

Temperature = 298 K

Pressure = 100 kPa

$[H^+] = 1.00 \text{ mol dm}^{-3}$



What is the standard
hydrogen electrode used
for?



What is the standard hydrogen electrode used for?

Comparing other cells against. E^\ominus of SHE is defined as 0, so all other E^\ominus values are compared against it.



Why might you use other standard electrodes occasionally?



Why might you use other standard electrodes occasionally?

They are cheaper/easier/quicker to use and can provide just as good a reference.

Platinum is expensive



If an E° value is more negative, what does it mean in terms of oxidising/reducing power?



If an E^\ominus value is more negative, what does it mean in terms of oxidising/reducing power?

Better reducing agent (easier to oxidise)



If an E° value is more positive, what does it mean in terms of oxidising/reducing power?



If an E° value is more positive, what does it mean in terms of oxidising/reducing power?

Better oxidising agent (easier to reduce)



What factors will change E° values?



What factors will change E° values?

Concentration of ions

Temperature



What happens if you reduce the concentration of the ions in the left hand half cell?



What happens if you reduce the concentration of the ions in the left hand half cell?

Equilibrium moves to the left to oppose the change of removing ions; this releases more electrons, the E° of the left hand cell becomes more negative, so the e.m.f. Of the cell increases.



How do you calculate the
emf of a cell from E°
values?



How do you calculate the emf of a cell from E° values?

$$E^\circ_{\text{cell}} = E^\circ_{\text{right}} - E^\circ_{\text{left}}$$



When would you use a Platinum electrode?



When would you use a Platinum electrode?

When both the oxidised and reduced forms of the metal are in aqueous solution



Why is Platinum chosen?



Why is Platinum chosen?

Inert so does not take part in the electrochemistry

Good conductor to complete circuit



How would you predict if a reaction would occur?



How would you predict if a reaction would occur?

Take the 2 half equations.

Find the species that is being reduced (this is effectively the right hand electrode)

Calculate its E° value minus the E° value of the species that is being oxidised (effectively the left hand cell).

If E° overall > 0 , reaction will occur.



What was the first
commercial cell made from
(Daniell cell)?



What was the first commercial cell made from (Daniell cell)?

Zinc/copper (II)



What are zinc/carbon cells more commonly known as?



What are zinc/carbon cells more commonly known as?

Disposable batteries



What are the two reactions
that take place in
zinc/carbon cells?



What are the two reactions that take place in zinc/carbon cells?

Zn oxidised to Zn^{2+}

NH_4^+ reduced to NH_3 at carbon electrode



What are the reactions that occur in a lead/acid battery (car batteries)?



What are the reactions that occur in a lead/acid battery (car batteries)?



How are cells recharged (if they are rechargeable)?



How are cells recharged (if they are rechargeable)?

Reactions are reversible and are reversed by running a higher voltage through the cell than the cell's E^{\ominus}



Nickel/cadmium cells are rechargeable AA batteries etc. What reactions occur at the electrodes?



Nickel/cadmium cells are rechargeable AA batteries etc. What reactions occur at the electrodes?



Where are lithium-ion cells used?



Where are lithium-ion cells used?

Mobile phones

Laptops



What reactions occur on discharge in lithium-ion cells?



What reactions occur on discharge in lithium-ion cells?



What is a fuel cell?



What is a fuel cell?

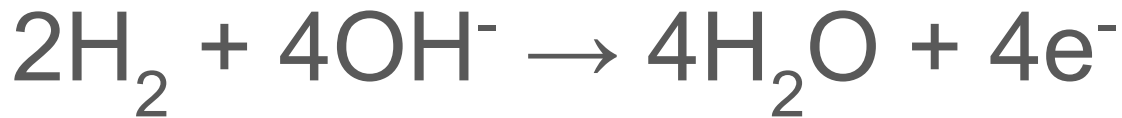
A cell that is used to generate electric current;
does not require electrical recharging



What are the reactions that take place at the two electrodes in an alkaline hydrogen fuel cell?



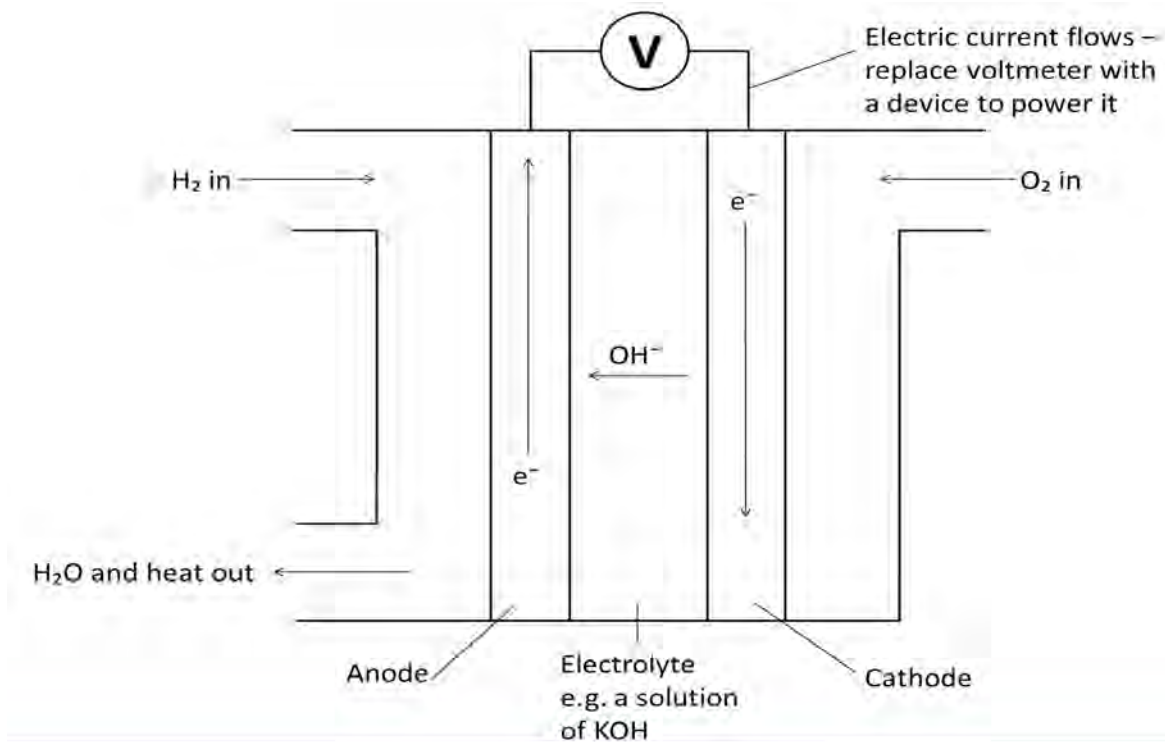
What are the reactions that take place at the two electrodes in an alkaline hydrogen fuel cell?



Draw a diagram of a
hydrogen fuel cell.



Draw a diagram of a hydrogen fuel cell.



Why is it better to use a fuel cell than to burn H_2 in air, even though the same overall reaction occurs?



Why is it better to use a fuel cell than to burn H_2 in air, even though the same overall reaction occurs?

In combustion, sulfur containing compounds (SO_2 , SO_3) and nitrogen containing compounds (NO_2 , NO_x) are produced due to the high temperatures and the S and N in air. These are bad for the environment.

This does not occur in a fuel cell; the only product is water.

More efficient



Disadvantages of fuel cells?



Disadvantages of fuel cells?

Hydrogen is a flammable gas with a low b.p. → hard and dangerous to store and transport → expensive to buy

Fuel cells have a limited lifetime and use toxic chemicals in their manufacture



How do you find the
weakest reducing agent
from a table of electrode
potential data?



How do you find the weakest reducing agent from a table of electrode potential data?

Most positive E^\ominus value. Then it is the **PRODUCT** of the reduction equation i.e. imagine equation going from right to left



What is the reason that
some cells cannot be
recharged?



What is the reason that some cells cannot be recharged?

Reaction of the cell is not reversible - a product is produced that either dissipates or cannot be converted back into the reactants



Why might the e.m.f. Of a cell change after a period of time?



Why might the e.m.f. Of a cell change after a period of time?

Concentrations of the ions change - the reagents are used up



How can the e.m.f. Of a cell be kept constant?



How can the e.m.f. Of a cell be kept constant?

Reagents are supplied constantly, so the concentrations of the ions are constant; E^{\ominus} remains constant

