

Edexcel Chemistry A-level

Topic 14 - Redox II

Flashcards

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What is oxidation?



What is oxidation?

- **The loss of electrons**

OR

- **Gain of Oxygen**

OR

- **Loss of Hydrogen**



What is reduction?



What is reduction?

- **The gain of electrons**

OR

- **Loss of Oxygen**

OR

- **Gain of Hydrogen**



What is oxidation in terms of oxidation number?



What is oxidation in terms of oxidation number?

Oxidation is an increase of oxidation number.

E.g if the oxidation number of Cl goes from 0 to 1+ it has been oxidised.



What is reduction in terms of oxidation number?



What is reduction in terms of oxidation number?

Reduction is a decrease in oxidation number.

E.g if the oxidation number of F goes from 1- to 0 it has been reduced.



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.



What are the two methods
to measure standard
electrode potential (E^\ominus)?



What are the two methods to measure standard electrode potential?

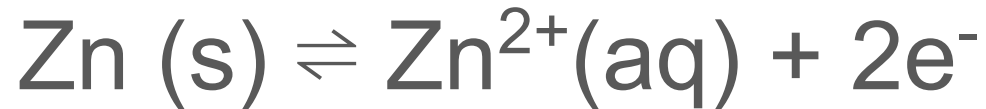
1. Metals or non-metals in contact with their ions in aqueous solution.
2. Ions of the same element with different oxidation numbers.



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 a saturated solution of KNO_3 (potassium nitrate).



Why are salt bridges necessary?



Why are salt bridges necessary?

They complete the circuit allowing a flow of charge through ion movement. They also contain inert ions so they don't react with the 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 in
standard cell notation?



What does | indicate in standard cell notation?

Phase boundary (solid/liquid/gas)



How would an
Aluminium/Copper cell be
represented using standard
cell representation?



How would an Aluminium/Copper cell be represented using standard cell representation?



What happens at the left-hand electrode?



What happens at the left-hand electrode?

Oxidation occurs.

The left-hand electrode is the half cell with the most negative E° value.



What happens at the right-hand electrode?



What happens at the right hand electrode?

Reduction occurs.

The 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 and what happens to the metal with the most negative E^\ominus value?



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

The left-hand electrode is most negative.

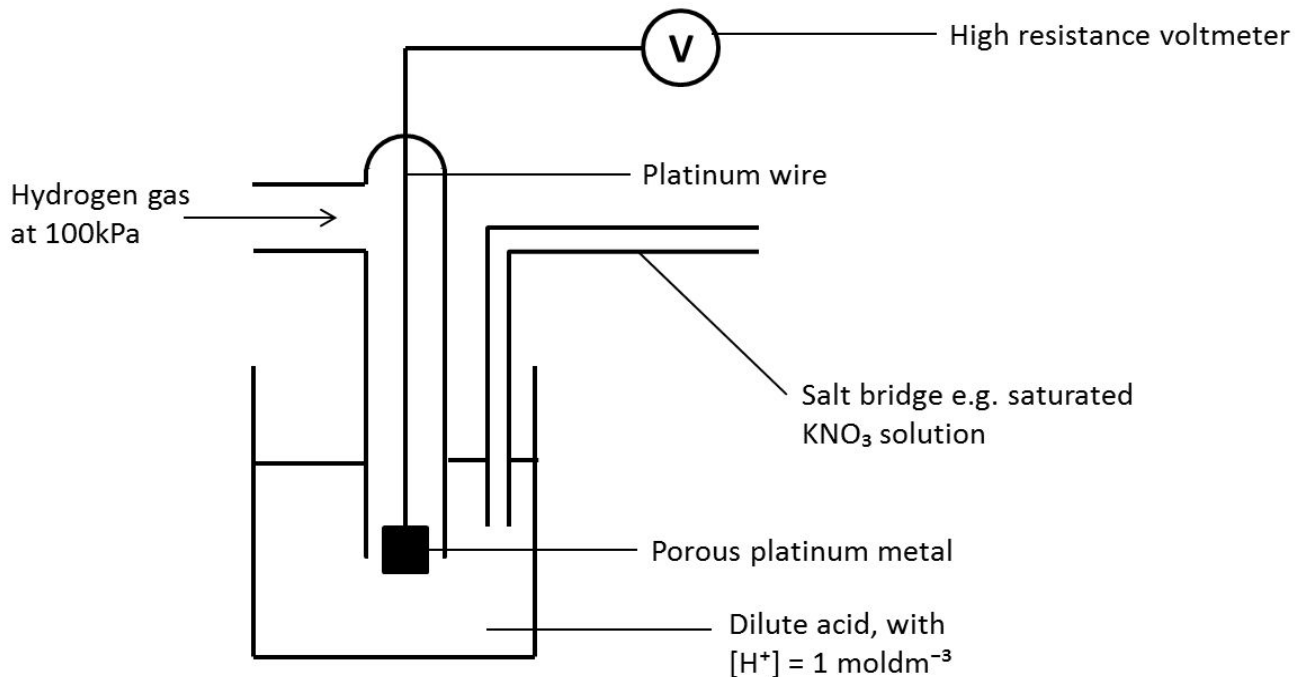
The metal will be oxidised.



Draw the standard
hydrogen electrode.



Draw the standard hydrogen electrode.



What conditions are required to use the standard hydrogen electrode?



What conditions are required to use the standard hydrogen electrode?

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?

Used as a standard for comparing other cells against.

E° of SHE is defined as 0, so all other E° values are compared to it.



Why might you
occasionally use other
standard electrodes?



Why might you occasionally use other standard electrodes?

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

Platinum electrodes of the SHE are expensive.



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



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

It means it is a better reducing agent.
(ie. 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?

It means it is a better oxidising agent
(ie. 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^{\ominus} 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 used?



Why is Platinum used?

1. It is inert so does not take part in the electrochemistry.
2. It is a good conductor that completes the circuit.



How would you predict if a reaction would occur?



How would you predict if a reaction would occur?

1. Take the 2 half equations.
2. Identify the species that is being reduced (this is effectively the right hand electrode).
3. Calculate its E° value minus the E° value of the species that is being oxidised (effectively the left hand cell).
4. If $E^\circ_{\text{cell}} > 0$, a 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 is oxidised to Zn^{2+}

NH_4^+ is 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 some cells able to be recharged?



How are some cells able to be recharged?

If the cell reactions are reversible, they can be reversed by running a higher voltage through the cell than the cell's E° .



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



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



Where are lithium-ion cells commonly used?



Where are lithium-ion cells commonly used?

Mobile phones and 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; it does not require electrical recharging.



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



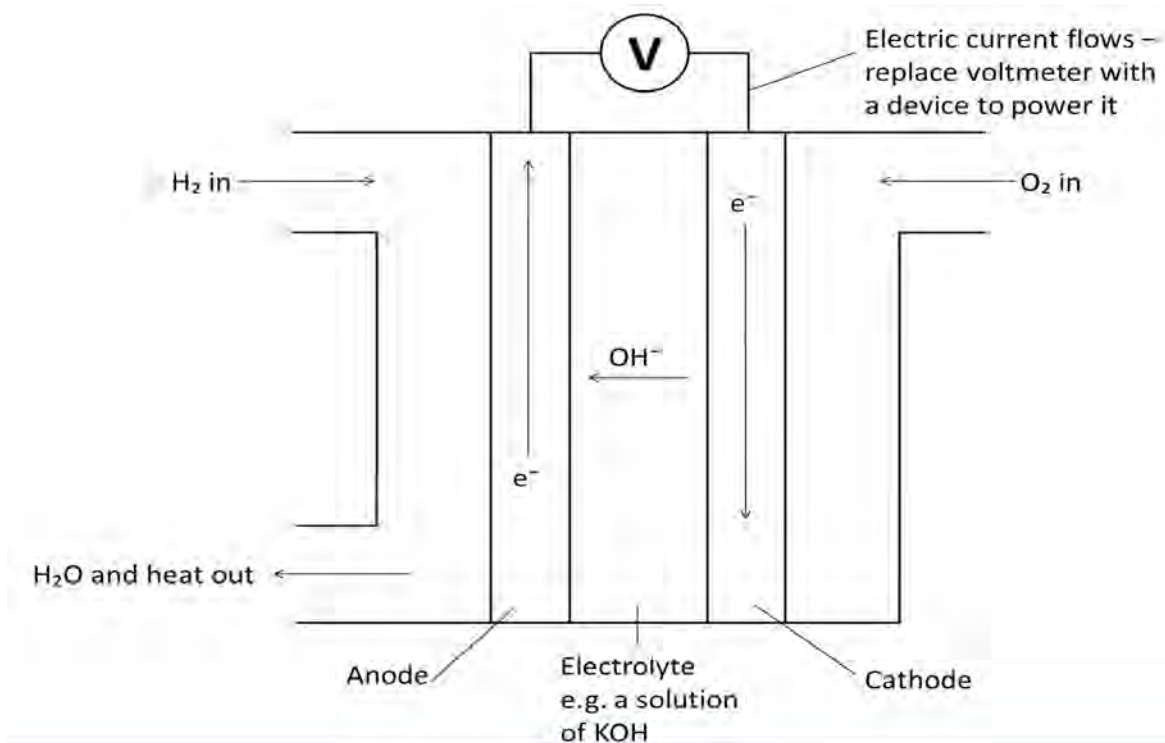
What are the reactions that take place at the two electrodes in an alkaline hydrogen fuel cell?



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 and nitrogen containing compounds 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. They are also more efficient.



Disadvantages of fuel cells?



Disadvantages of fuel cells?

Hydrogen is a flammable gas with a low b.p. meaning it is hard and dangerous to store and transport. It is also 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?

The weakest reducing agent will have the most positive E^θ value.

The species is the product of the reduction equation i.e. when the equation goes from right to left.



What is the reason that
some cells cannot be
recharged?



What is the reason that some cells cannot be recharged?

When the reaction of the cell is not reversible.

The product produced 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?

The concentrations of the ions change as 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?

If the reagents are supplied constantly, the concentrations of the ions will be constant meaning E^{\ominus} remains constant.

