Redox reactions:

Redox reactions also known as oxidation and reduction reactions are reactions in which one species is reduced and another is oxidized at the same time because when there is a reaction if one species is oxidised another species must be reduced. Therefore, this means the oxidation state of the species involved must change and therefore means that electrons must be transferred between species.

How do redox reactions work?

Using an example of a chemical reaction we can see if it is a redox reaction for an example:

2Fe2O3 (s) + 3C (s) —> 4Fe (s) + 3CO2 (g)

For a chemical reaction to be a redox reaction there must be a transfer of electrons you can work this out by finding the oxidation states:

Working out oxidation states reminder:

2Fe2O3 (s) + 3C (s) —> 4Fe (s) + 3CO2 (g)

- For 2Fe2O3 (fe2) has the oxidation state of +3 and O3 has the oxidation state of -2 (because oxygen is in group 6 it needs to gain two electrons when reacted therefor it has a -2 charge but because its (O3) there's 3 atoms of oxygen giving it an overall charge of -6 which means the Fe needs a oxidation number of -6 to cancel it out but since there's two of them (fe2) you would divide the +6 charge into 2 so it would have a +3 charge.

- 3C and 4Fe both have an oxidation state is 0 because there on their own (combined) they have not been oxidised or reduced.

- For 3CO2 the oxygen would have an oxidation state of -2 (because it's in group 6 and needs to gai two electrons) and carbon would have an oxidation state of +4 (because its in group 4 and the overall compound has no charge and therefor it would lose the 4 electrons (+4) to cancel out the 2 oxygens which both have a -2 charge.)

2Fe2O3 (s) + 3C (s) —> 4Fe (s) + 3CO2 (g)

+3 -2 0 0 +4 -2

Once you have worked out the oxidation numbers of the species in the reaction you can look at the individual elements to see if they have been oxidized or reduced.

Because there is a change in the oxidation numbers of carbon and iron from the reactants to the products this is a redox reaction and there has been an electron transfer between the iron and carbon species.

- The carbon when from a charge of 0 to a charge of +4 therefore its lost electrons hence why it has a positive charge therefor this show that it has been oxidized and would also be the reducing agent.
- The iron went from a +3 charge to a charge of 0 therefor its gained electrons this shows that it has been reduced and would also be the oxidizing agent in this reaction.
- **As part of the OCR B specification, you must be able to understand and apply this knowledge for redox reactions of s-, p- and d-block elements and their compounds.**

Balancing redox reactions using oxidation sates:

From the exam board: use of oxidation states to balance redox equations that do not also involve acid–base reactions.

- First work out the oxidation numbers of each of the species in the reaction making sure you remember their charges.
- Then work out which species have been oxidised and which ones have been reduced.
- Work out the change that the species have.
- Notice that if electrons gained does not equal electrons lost you need to balance the redox equation.
- Use coefficients to make sure the charges are balanced and cancel out each other.

To understand this more, we can use an example:

Fe2O3 + CO → Fe + CO2

- Find the oxidation numbers of the species:

Fe2O3 + CO → Fe + CO2

+3 -2 +2 -2 0 +4 -2

- Find which species have been oxidized and which have been reduced (carbon went from a +2 to +4 so it has been reduced (+2)) (iron went from a +3 to a 0 so it has been oxidized) (oxygen is neutral overall)
- Notice that electrons gained do not equal electrons lost so it needs balancing.
- Use coefficients to make them balance each other. Finding a multiple is a good way to start the -2 and the +3 need to be balanced and they are both multiples of six. So, the oxidation number -2 can be multiplied by 3 and the oxidation number +3 can be multiplied by 2.
- Therefor on the products side if you time the CO2 by 3 and on the reactants side you times CO by 3 you increase the oxidation agent (carbon by a scale factor of 3) so overall instead of the oxidation number being +2 it would be +6.
- And then for the oxidation agent (Fe) if you time the Fe on the product side by 2 then that would make the overall charge -6. You do not need to change the Fe on the product side because there are already 2 iron atoms (Fe2)
- Giving you the overall balanced equation of : Fe2O3 + 3CO → 2Fe + 3CO2

- Remember you completely ignore the oxygen it this reaction because its not a reducing or oxidising agent.