RAFFLES INSTITUTION RAFFLES PROGRAMME - YEAR THREE CHEMISTRY

REDOX REACTIONS

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Redox Reactions are a type of reaction where Reduction and Oxidation occur simultaneously.

Definitions of Reduction and Oxidation

There are 4 ways to define redox, only two are required to know in the syllabus but the other two methods can be helpful as well.

	Reduction	Oxidation
1) Oxidation state/number	Decrease	Increase
2) Electrons (OIL RIG)	Gain	Loss
3) Oxygen	Loss	Gain
4) Hydrogen	Gain	Loss

Half Equations

To write Half Equations:

1) Write the balanced chemical equation.

2) Select one of the atoms in the reaction and pull out its ions/atoms on both sides of the reaction.

3) Balance the charges of the equation by adding electrons on the relevant side.

4) Simplify if you can.

To obtain the Chemical Equation from Half Equations:

1) Write all the half equations for all reacting ions.

2) Make sure that the numbers of electrons gained or lost are the same by multiplying the equation throughout.

3) Put the LHS and the RHS formulae together and cancel out the ions.

4) Combine the free ions into compounds.

Oxidation Numbers

1) All single elements have an ON of 0.

2) In simple ions, the charge of the ion is its ON.

3) In polyatomic ions, the charge of the ion is the sum of the ONs of the individual elements.

4) The ON of H in compounds is +1, except in metal hydrides where it is -1.

5) The ON of O of compounds is -2, except in hydroxides where it is -1.

6) The ON for Group I and II metals is +1 and +2 respectively, and +3 for aluminium.

7) Most of the time it is the ON for non-metals that varies in questions for calculating ON.

8) In a molecule/compound, sum of ONs of elements is 0.

Note that ON is +/-no, whereas charge is no+/-

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Redox Agents

Oxidising agents cause other reactants to be oxidised and they themselves get reduced.

Reducing agents cause other reactants to be reduced and they themselves get oxidised.

1) Test for Reducing Agents: Potassium Manganate (VII) $KMnO_4$

Manganate (VII) ions MnO_4^- undergo reduction to Manganese (II) ions Mn^{2+} in the presence of reducing agents, their oxidation state decreases from +7 to +2. Colour change from purple to colourless.

2) Test for Reducing Agents: Potassium Dichromate (VI) $K_2Cr_2O_7$

Dichromate (VI) ions $Cr_2O_7^{2-}$ undergo reduction to Chromium (III) ions Cr^{3+} in the presence of reducing agents, their oxidation state decreases from +6 to +2. Colour change from orange to green.

3) Test for Oxidising Agents: Potassium Iodide KI

Iodide ions I^- undergo oxidation to Iodine I_2 in the presence of oxidising agents, its oxidation state increases from -1 to 0. Colour change from colourless to brown/orange/yellow.

Answering Techniques

Why is this reaction a redox reaction?

1) Reduction and oxidation occurs simultaneously.

2) (Element) is reduced as its oxidation state decreases from (no) in (atom/compound) to (no) in (atom/compound). **OR** (Element) is reduced as it gains electrons from (no) in (atom/compound) to (no) in (atom/compound).

3) (Element) is oxidised as its oxidation state increases from (no) in (atom/compound) to (no) in (atom/compound). **OR** (Element) is oxidised as it loses electrons from (no) in (atom/compound) to (no) in (atom/compound).

4) Since reduction and oxidation occur simultaneously, this is a redox reaction.

Why is (Reactant) an reducing agent?

1) (Reactant) causes (Another reactant) to be reduced while it itself is being oxidised.

2) (Another reactant) is being reduced as its oxidation state decreases from (no) in (atom/compound) to (no) in (atom/compound). **OR** (Another reactant) is reduced as it gains electrons from (no) in (atom/compound) to (no) in (atom/compound).

3) (Reactant) is being oxidised as its oxidation state increases from (no) in (atom/compound) to (no) in (atom/compound). **OR** (Element) is oxidised as it loses electrons from (no) in (atom/compound) to (no) in (atom/compound).

4) Since (Reactant) causes (Another reactant) to be reduced while it itself is being oxidised, (Reactant) is a reducing agent.

5) Vice versa for oxidising agents.