Edexcel IAL Chemistry A-Level

Topic 8 - Redox Chemistry and Groups 1, 2 and 7

Flashcards

What are the common oxidation states of oxygen and hydrogen?

What are the common oxidation states of oxygen and hydrogen?

Oxygen: –2

Hydrogen: +1

What are the oxidation numbers of the metals in the following compounds?

$NaOH$ MgO Al_2O_3

What are the oxidation numbers of the metals in the following compounds? NaOH MgO Al_2O_3

NaOH: Na $\rightarrow$ 1+

MgO: Mg $\rightarrow$ 2+

Al_2O_3: Al $\rightarrow$ 3+

What is the oxidation state of oxygen in hydrogen peroxide?

What is the oxidation state of oxygen in hydrogen peroxide?

H_2O_2:

Hydrogen has a +1 charge so oxygen has a -1 charge in hydrogen peroxide.

What oxidation state is hydrogen in metal hydrides like NaH?

What oxidation state is hydrogen in metal hydrides like NaH?

Hydrogen has the oxidation state -1 in metal hydrides.

What is the oxidation state of Fe in iron(III) chloride?

What is the oxidation state of Fe in iron(III) chloride?

+3

This can be deduced from the roman numerals after iron in the compound name.

Write the chemical formula of an uncharged compound containing sulfur with an oxidation state of +6 and oxygen with an oxidation state of -2.

Write the chemical formula of an uncharged compound containing sulfur with an oxidation state of +6 and oxygen with an oxidation state of -2.

SO_3

What is reduction?

What is reduction?

Reduction is the gain of electrons by an atom/ion, resulting in the decrease of the oxidation number of that atom/ion.

What is oxidation?

What is oxidation?

Oxidation is the loss of electrons by an atom/ion, resulting in the increase of the oxidation number of that atom/ion.

What is a reducing agent?

What is a reducing agent?

The species which brings about reduction by donating electrons to the species being reduced.

What is an oxidising agent?

What is an oxidising agent?

The species which brings about oxidation by gaining electrons from the species being oxidised.

What is a redox reaction?

What is a redox reaction?

A redox reaction is one in which oxidation and reduction occur in different species simultaneously.

How do you balance two half equations?

$$Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} + 2e^-$$

$$Fe^{3+}_{(aq)} + e^- \rightarrow Fe^{2+}_{(aq)}$$

How do you balance two half equations?

Half equations:

$Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} + 2e^-$ (oxidised)

$Fe^{3+}_{(aq)} + e^- \rightarrow Fe^{2+}_{(aq)}$ (reduced)

Balance so that the number of electrons are the same:

$Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} + 2e^-$

$2Fe^{3+}_{(aq)} + 2e^- \rightarrow 2Fe^{2+}_{(aq)}$

How do you combine two balanced half equations?

$$Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} + 2e^-$$

$$2Fe^{3+}_{(aq)} + 2e^- \rightarrow 2Fe^{2+}_{(aq)}$$

How do you combine two balanced half equations?

$Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} + 2e^-$ $\qquad$ $2Fe^{3+}_{(aq)} + 2e^- \rightarrow 2Fe^{2+}_{(aq)}$

- Combine the equations into one and cancel any common species that appear on both sides of the equation:

$Zn_{(s)} + 2Fe^{3+}_{(aq)} + \cancel{2e^-} \rightarrow Zn^{2+}_{(aq)} + \cancel{2e^-} + 2Fe^{2+}_{(aq)}$

- Overall redox equation:

$Zn_{(s)} + 2Fe^{3+}_{(aq)} \rightarrow Zn^{2+}_{(aq)} + 2Fe^{2+}_{(aq)}$

Why does the first ionisation energy decrease down Groups 1 and 2?

Why does the first ionisation energy decrease down Groups 1 and 2?

Down Groups 1 and 2, there are more electron shells and a greater atomic radius, this increases the shielding of the outer electrons. The outer electrons feel less nuclear attraction and so they are removed more easily.

Explain the trend in reactivity down Group 1 from lithium to potassium

Explain the trend in reactivity down Group 1 from lithium to potassium

Group 1 elements want to lose an electron to form a 1+ ion.

Down Group 1, the atomic radius and shielding increases so the outer electron is lost more easily. This means reactivity increases down Group 1.

Explain the trend in reactivity down Group 2 from magnesium to barium

Explain the trend in reactivity down Group 2 from magnesium to barium

Group 2 elements want to lose two electrons to form 2+ ions.

Down Group 2, the atomic radius and shielding increases so the outer electrons are lost more easily. This means reactivity increases down Group 2.

What are the products of the reaction between lithium and water?

What are the products of the reaction between lithium and water?

Lithium Hydroxide

Hydrogen

What is the chemical equation for the reaction between sodium and water?

What is the chemical equation for the reaction between sodium and water?

$$2Na + 2H_2O \rightarrow 2NaOH + H_2$$

What is formed when potassium reacts with oxygen?

What is formed when potassium reacts with oxygen?

Potassium oxide

What is the chemical equation for the reaction between lithium and oxygen?

What is the chemical equation for the reaction between lithium and oxygen?

$$4Li + O_2 \rightarrow 2Li_2O$$

What is formed when Group 1 elements react with chlorine?

What is formed when Group 1 elements react with chlorine?

Metal chloride

E.g. NaCl

How do Group 2 elements react with oxygen?

How do Group 2 elements react with oxygen?

$$2X + O_2 \rightarrow 2XO$$

Where X is the Group 2 element.

How do Group 2 elements react with water?

How do Group 2 elements react with water?

$$X + 2H_2O \rightarrow X(OH)_2 + H_2$$

Where X is the Group 2 element.

How do Group 2 elements react with chlorine?

How do Group 2 elements react with chlorine?

$$X + Cl_2 \rightarrow XCl_2$$

Where X is the Group 2 element.

What is produced when a Group 2 or Group 1 hydroxide/oxide reacts with a dilute acid?

What is produced when a Group 2 or Group 1 hydroxide/oxide reacts with a dilute acid?

Salt and water

What is the chemical equation for the reaction between sodium hydroxide and dilute hydrochloric acid?

What is the chemical equation for the reaction between sodium hydroxide and dilute hydrochloric acid?

$$NaOH + HCl \rightarrow NaCl + H_2O$$

What is the chemical equation for the reaction between magnesium hydroxide and dilute sulfuric acid?

What is the chemical equation for the reaction between magnesium hydroxide and dilute sulfuric acid?

$$Mg(OH)_2 + H_2SO_4 \rightarrow MgSO_4 + 2H_2O$$

What is the chemical equation for the reaction between lithium oxide and dilute sulfuric acid?

What is the chemical equation for the reaction between lithium oxide and dilute sulfuric acid?

$$Li_2O + H_2SO_4 \rightarrow Li_2SO_4 + H_2O$$

What is the chemical equation for the reaction between barium oxide and dilute hydrochloric acid?

What is the chemical equation for the reaction between barium oxide and dilute hydrochloric acid?

$$BaO + 2HCl \rightarrow BaCl_2 + H_2O$$

What is produced when Group 1 and 2 oxides react with water?

What is produced when Group 1 and 2 oxides react with water?

Metal Hydroxides

What is the chemical equation for the reaction between calcium oxide and water?

What is the chemical equation for the reaction between calcium oxide and water?

$$CaO + H_2O \rightarrow Ca(OH)_2$$

What is the trend in solubility of Group 2 hydroxides down the group?

What is the trend in solubility of Group 2 hydroxides down the group?

The solubility of Group 2 hydroxides increases down the group.

What is the trend in solubility of Group 2 sulfates down the group?

What is the trend in solubility of Group 2 sulfates down the group?

The solubility of Group 2 sulfates decreases down the group.

What is the trend in thermal stabilities of Group 1 and 2 carbonates?

What is the trend in thermal stabilities of Group 1 and 2 carbonates?

The thermal stabilities of Group 1 and 2 carbonates increase down the group.

What is the trend in thermal stabilities of Group 1 and 2 nitrates?

What is the trend in thermal stabilities of Group 1 and 2 nitrates?

The thermal stabilities of Group 1 and 2 nitrates increase down the group.

Why do the thermal stabilities of carbonates and nitrates increase down Groups 1 and 2?

Why do the thermal stabilities of carbonates and nitrates increase down Groups 1 and 2?

Down the groups, the ionic radii increase whilst the magnitude of charge remains the same. Therefore the charge densities of the Group 1 and 2 ions decrease. As the ions have less charge density, they distort the CO_3^{2-} and NO_3^- ions less, so the compounds take more energy to break.

What is the flame test colour for Na^+?

What is the flame test colour for Na^+?

Orange

What is the flame test colour for Li^+?

What is the flame test colour for Li^+?

Red

What is the flame test colour for K^+?

What is the flame test colour for K^+?

Lilac

What is the flame test colour for Rb^+?

What is the flame test colour for Rb^+?

Red-Violet

What is the flame test colour for Cs^+?

What is the flame test colour for Cs^+?

Blue-Violet

What is the flame test colour for Ca^{2+}?

What is the flame test colour for Ca^{2+}?

Brick Red

What is the flame test colour for Ba^{2+}?

What is the flame test colour for Ba^{2+}?

Green

What is the flame test colour for Sr^{2+}?

What is the flame test colour for Sr^{2+}?

Red

Why do some cations produce coloured flames when burnt?

Why do some cations produces coloured flames when burnt?

When some metal ions are heated, their electrons can be excited into higher energy orbitals. When the electrons return to their ground states they release the extra energy as photons of certain wavelengths, which produces a certain colour.

How can carbonate (CO_3^{2-}) and hydrogencarbonate (HCO_3^-) ions be identified in a reaction?

How can carbonate (CO_3^{2-}) and hydrogencarbonate (HCO_3^-) ions be identified in a reaction?

- Add an aqueous acid.
- Carbon dioxide gas will be produced. It can be identified by bubbling the gas through limewater. The limewater will turn cloudy if carbon dioxide is present.

How can sulfate ions be identified in a solution?

How can sulfate ions be identified in a solution?

Add barium chloride to the solution.

A white precipitate ($BaSO_4$) will be produced if sulfate ions are present.

How can ammonium ions be identified in a solution?

How can ammonium ions be identified in a solution?

Add sodium hydroxide and gently warm.

The gas produced (ammonia) will turn turn moist red litmus paper blue.

What colour is aqueous chlorine?

What colour is aqueous chlorine?

Colourless

What colour is aqueous bromine?

What colour is aqueous bromine?

Orange

What colour is aqueous iodine?

What is colour is aqueous iodine?

Brown

Why are the halogens at different states at room temperature? What is the trend down the group?

Why are the halogens at different states at room temperature? What is the trend down the group?

At room temperature, chlorine is gaseous, bromine is liquid and iodine is solid because they have different melting and boiling points. As you go down the group, melting and boiling point increases.

Why does melting and boiling point increase down Group 7?

Why does melting and boiling point increase down Group 7?

The molecules get bigger down the group so there are more intermolecular forces to overcome during melting/boiling so more energy is required.

What is the trend in electronegativity down Group 7?

What is the trend in electronegativity down Group 7?

Electronegativity decreases down Group 7. This is because atomic radius and shielding increases down the group so there is a weaker attraction between the nucleus and outer electrons as you go down the group.

Why does reactivity decrease down Group 7?

Why does reactivity decrease down Group 7?

As you go down Group 7, the outer shell is further from the nucleus and electron shielding increases. Attraction between the nucleus and outer electrons decreases so it is harder for the atom to gain an electron meaning reactivity decreases.

When does a halogen displacement reaction occur?

When does a halogen displacement reaction occur?

When a more reactive halogen displaces a less reactive halogen from an aqueous solution of its halide.

What type of reactions are halogen and halide ion displacement reactions?

What type of reactions are halogen and halide ion displacement reactions?

Redox

Why will halogen A only be displaced by halogen B if B is above A in Group 7?

Why will halide ions A only be displaced by halogen B if B is above A in Group 7?

The most reactive halogen (B) will displace the less reactive halogen (A) to become part of the ionic compound. Reactivity increases as you go up the group so B must be higher in Group 7 to be more reactive than A.

Which halogens can chlorine displace from an aqueous ionic solution?

Which halogens can chlorine displace from an aqueous ionic solution?

Chlorine can displace any halogens below it in Group 7. It will displace iodine and bromine.

Which halogens can't be displaced from an aqueous ionic solution by bromine?

Which halogens can't be displaced from an aqueous ionic solution by bromine?

Bromine can't displace any halogens above it in Group 7. These are chlorine and fluorine.

Why can’t iodine displace chloride or bromide ions from an aqueous ionic solution?

Why can iodine not displace chloride or bromide ions from an aqueous ionic solution?

Because reactivity decreases down the group and iodine is below chlorine and bromine in Group 7. Displacement will only occur if iodine is more reactive than the halogen in the ionic compound.

Write the word equation for the reaction between chlorine and potassium bromide

Write the word equation for the reaction between chlorine and potassium bromide

Chlorine + potassium bromide → potassium chloride + bromine

Write the balanced symbol equation for the reaction that takes place between bromine and potassium iodide

Write the balanced symbol equation for the reaction that takes place between bromine and potassium iodide

$$Br_2 + 2KI \rightarrow I_2 + 2KBr$$

What would you observe when chlorine is added to potassium bromide?

What would you observe when chlorine is added to potassium bromide?

$Cl_2 + 2KBr \rightarrow Br_2 + 2KCl$

Colour change from colourless (due to $Cl_{2\,(aq)}$) to orange (due to $Br_{2\,(aq)}$).

What is the chemical equation for the reaction between chlorine and sodium?

What is the chemical equation for the reaction between chlorine and sodium?

$$2Na + Cl_2 \rightarrow 2NaCl$$

What is a disproportionation reaction?

What is a disproportionation reaction?

A reaction in which an element undergoes oxidation and reduction to form two different products.

What is the chemical equation for the disproportionation reaction that chlorine undergoes with sodium hydroxide?

What is the chemical equation for the disproportionation reaction that chlorine undergoes with sodium hydroxide?

$$2NaOH + Cl_2 \longrightarrow NaClO + NaCl + H_2O$$

What is the chemical equation for the disproportionation reaction that chlorine undergoes with water?

What is the chemical equation for the disproportionation reaction that chlorine undergoes with water?

$$Cl_2 + H_2O \rightleftharpoons 2H^+ + Cl^- + ClO^-$$

How do chlorine and fluorine react with concentrated sulfuric acid?

How do sodium chloride and sodium fluoride react with concentrated sulfuric acid?

Chlorides and fluorides aren't oxidised by sulfuric acid:

$$NaCl + H_2SO_4 \longrightarrow NaHSO_4 + HCl$$

$$NaF + H_2SO_4 \longrightarrow NaHSO_4 + HF$$

How do bromide ions react with concentrated sulfuric acid?

How do bromide ions react with concentrated sulfuric acid?

Bromide ions can reduce concentrated sulfuric acid:

$$2Br^- + H_2SO_4 + 2H^+ \longrightarrow Br_2 + SO_2 + 2H_2O$$

How do iodide ions react with concentrated sulfuric acid?

How do iodide ions react with concentrated sulfuric acid?

Iodide ions are stronger reducing agents than bromide ions:

$$8I^- + H_2SO_4 + 8H^+ \longrightarrow 4I_2 + H_2S + 4H_2O$$

How can the halide ions be identified in a solution?

How can the halide ions be identified in a solution?

Add nitric acid followed by silver nitrate solution. Silver halide precipitates will form. Ammonia solution can be added to further distinguish between the halide precipitates.

Silver chloride: White precipitate soluble in dilute ammonia.

Silver bromide: Cream precipitate soluble in concentrated ammonia.

Silver iodide: Yellow precipitate insoluble in ammonia.

How do hydrogen halides produce acids with ammonia and water?

How do hydrogen halides produce acids with ammonia and water?

The hydrogen halides donate protons.

$$HX + H_2O \longrightarrow H_3O^+ + X^-$$

$$HX + NH_3 \longrightarrow NH_4^+ + X^-$$