Edexcel Chemistry A-level

Topic 4 - Inorganic Chemistry and the Periodic Table

Flashcards

What is a common name given to group 2 metals?

What is a common name given to group 2 metals?

Alkaline earth metals

What is the most reactive metal of group 2?

What is the most reactive metal of group 2?

Barium

List 3 physical properties of group 2 metals

List 3 physical properties of group 2 metals

- High melting and boiling points
- Low density metals
- Form colourless (white) compounds

The highest energy electrons of group 2 metals are in which subshell?

The highest energy electrons of group 2 metals are in which subshell?

S subshell

Does reactivity increase or decrease down group 2? Why?

Does reactivity increase or decrease down group 2? Why?

- Increases
- Electrons are lost more easily because larger atomic radius and more shielding.

What happens to the first ionisation energy as you go down group 2? Why?

What happens to the first ionisation energy as you go down group 2? Why?

Decreases because:

-Number of filled electron shells increases down the group → increased shielding

- Increased atomic radius → weaker force between outer - -

-Electron and nucleus → less energy needed to remove electron

What type of reaction is the reaction between group 2 elements and oxygen?

What type of reaction is the reaction between group 2 elements and oxygen?

Redox reaction

Write an equation for the reaction of calcium and oxygen

Write an equation for the reaction of calcium and oxygen

$$2Ca\ (s) + O_2\ (g) \rightarrow 2CaO\ (s)$$

What are the products when group 2 elements react with water?

What is the product when group 2 elements react with water?

Hydroxide and hydrogen gas

Which group 2 element doesn't react with water?

Which group 2 element doesn't react with water?

Beryllium

Which group 2 element reacts very slowly with water?

Which group 2 element reacts very slowly with water?

Magnesium

What type of reaction is the reaction between group 2 metal and water?

What type of reaction is the reaction between group 2 metal and water?

Redox reaction

Write an equation for the reaction of barium and water

Write an equation for the reaction of Barium and water

$$Ba\ (s) + 2H_2O\ (l) \rightarrow Ba(OH)_2\ (aq) + H_2\ (g)$$

What is oxidised and what is reduced in a reaction between group 2 metal and water?

What is oxidised and what is reduced in a reaction between group 2 metal and water?

Metal → oxidised

One hydrogen atom from each water → reduced

What are the products when a group 2 oxide reacts with an dilute acid?

What are the products when group 2 oxide reacts with dilute acid?

Salt and water

Write an equation for the reaction of calcium oxide and hydrochloric acid

Write an equation for the reaction of calcium and hydrochloric acid

$$CaO\ (s) + 2HCl\ (aq) \rightarrow CaCl_2(s) + H_2O\ (l)$$

What is formed when group 2 oxides react with water?

What is formed when group 2 oxides react with water?

Metal hydroxide

Write an equation for the reaction between a group 2 oxide and water

Write an equation for the reaction between a group 2 oxide and water

$$MO\ (s) + H_2O\ (l) \rightarrow M(OH)_2\ (aq)$$

What group 2 metal oxide is insoluble in water?

Which group 2 metal oxide is insoluble in water?

Beryllium oxide

Write an equation for the reaction between $Mg(OH)_2$ and nitric acid

Write an equation for the reaction between $Mg(OH)_2$ and nitric acid

$$2HNO_3\ (aq) + Mg(OH)_2\ (aq) \rightarrow Mg(NO_3)_2\ (aq) + 2H2O\ (l)$$

What is the trend in hydroxide solubility down group 2?

What is the trend in hydroxide solubility down group 2?

Increases down the group

$Mg(OH)_2$ is slightly soluble

$Ba(OH)_2$ creates a strong alkaline solution

What is the trend in sulphate solubility down group 2?

What is the trend in sulphate solubility down group 2?

Group 2 sulphates become less soluble down the group with $BaSO_4$ being the least soluble.

Explain the reasons for the trend of thermal stability in group 1 and 2 carbonates

Explain the reasons for the trend of thermal stability in group 1 and 2 carbonates

Group 2 carbonates are more thermally stable as you go down the group this is because the cations get bigger so therefore have less of a polarising effect distorting the carbonate ion less. As C-O bond is not weakened as much it harder to break down

Group 1 carbonates do not decompose except for lithium. This is because they don't have a big enough charge density to polarise the carbonate ion as they only form 1+ ions. However Lithium ion is small enough to have a polarising effect so therefore lithium carbonate can decompose.

Explain the reasons for the trend of thermal stability in group 1 and 2 nitrates

Explain the reasons for the trend of thermal stability in group 1 and 2 nitrates

The ease of thermal decomposition decreases down group 2 and this is because down the group the ions get larger and therefore has less charge density = less polarisation of nitrate anion and less weakening of the N—O bond.

Group 1 nitrate do not decompose with the exception of Lithium nitrate. Lithium ion is smaller enough to charge polarisation of the nitrate anion and thus weakening the N-O bond.

Fill in the flame colours for these group 1 and group 2 elements:

Lithium
Sodium
Potassium
Rubidium
Caesium
Magnesium
Calcium
Strontium
Barium

Fill in the flame colours for these group 1 and 2 elements

Lithium : Scarlet red

Sodium : Yellow

Potassium : lilac

Rubidium : red

Caesium: blue

Magnesium: no flame colour (the energy emitted is outside visible spectrum)

Calcium: brick red

Strontium: red

Barium: apple green

How do you carry out a flame test?

How do you carry out a flame test?

1. Use a nichrome wire
2. Sterilise the wire by dipping in concentrated hydrochloric acid and then heating in Bunsen flame
3. Make sure the sample powdered or grinded
4. Dip wire in solid and put in Bunsen flame and observe flame

How are the colours from the flame test formed?

How are the colours from the flame test formed?

The heat causes the electron to get excited and thus move to a higher energy level but at this higher level the electron is unstable so then moves back down. As it moves from a higher to lower energy level energy is emitted in the form of visible light energy which is the colour you see.

What group elements are referred to as halogens?

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Group 7

List 2 properties of halogens

List 2 properties of halogens

- Low melting and boiling points
- Exist as diatomic molecules

What is the trend in boiling point down group 7? Why?

What is the trend in boiling point down group 7? Why?

Increases down the group because:

-size of atom increases as more occupied electron shells → stronger London forces of attraction between molecules, take more energy to break

What is the trend in reactivity down group 7? Why?

What is the trend in reactivity down group 7? Why?

Reactivity decreases because:

- Atomic radius increases
- Electron shielding increases
- Ability to gain an electron and form 1- ions decreases

Explain the trend of electronegativity down group 7

Explain the trend of electronegativity down group 7

Down the group the electronegativity of the elements decreases. This is because the atomic radii increases due to the increasing number of shells so there is reduced nuclear attraction between the outermost electron and the nucleus.

What is the trend in oxidising ability down the group? Why?

What is the trend in oxidising ability down the group? Why?

Decreases down group (Cl strongest, I weakest)

This is because Cl has the fewest occupied electron shells, greatest force of attraction between outer electrons and nucleus and thus is the easiest to gain electrons and be reduced → best oxidising agent

What is the trend in reducing ability of the halides down the group? Why?

What is the trend in reducing ability of the halides down the group? Why?

Increases down the group (Cl^- weakest, I^- strongest)

This is because I^- has the most occupied electron shell so outer electrons are further from the nucleus, weakest force of attraction between outer electrons and positive charge of nucleus and thus is the easiest to be oxidised and lose electrons → best reducing agent

Which species is oxidised in this reaction:

Br_2 (l) + 2Na (s) $\rightarrow$ 2NaBr (s)

Which species is oxidised in this reaction: Br_2 (l) + 2Na (s) 2NaBr (s)

Na has been oxidised

Oxidation state of 0 to +1

When a more reactive halogen displaces a less reactive halide, what is the reaction called?

When a more reactive halogen displaces a less reactive halide, what is the reaction called?

Displacement reaction

What is the colour of chlorine in water?

What is the colour of chlorine in water?

Pale green

What is the colour of bromine in water?

What is the colour of bromine in water?

Orange

What is the colour of iodine in water?

What is the colour of iodine in water?

Brown

What is the colour of chlorine in cyclohexane?

What is the colour of chlorine in cyclohexane?

Pale green

What is the colour of bromine in cyclohexane?

What is the colour of bromine in cyclohexane?

Orange

What is the colour of iodine in cyclohexane?

What is the colour of iodine in cyclohexane?

Violet

Out of the 3 halides Cl^-, Br^- & I^-, which one of these can be oxidised by chlorine?

Out of the 3 halides Cl^-, Br^- & I^-, which one of these can be oxidised by chlorine?

Br^- & I^- ions

Write the equation for chlorine oxidising bromide ions in water and associated colour change

Write the equation for chlorine oxidising bromide ions

$Cl_2\ (aq) + 2Br^-\ (aq) \rightarrow 2Cl^-\ (aq) + Br_2\ (aq)$

Yellow solution

Write the equation for Cl_2 oxidising 2I- in cyclohexane and associated colour change

Write the equation for Cl_2 oxidising 2I-

$$Cl_2\ (aq) + 2I^-\ (aq) \rightarrow 2Cl^-\ (aq) + I_2\ (aq)$$

Purple solution

Out of the 3 halides Cl^-, Br^- & I^-, which one of these can be oxidised by bromine?

Out of the 3 halides Cl- , Br- & I- , which one of these can be oxidised by bromine?

I^- ions

Write the equation for bromine oxidising iodide ions in water and associated colour change

Write the equation for bromine oxidising iodide ions

$$Br_2\ (aq) + 2I^-\ (aq) \rightarrow 2Br^-\ (aq) + I_2\ (aq)$$

Brown solution

Out of the 3 halides Cl- , Br- & I- , which one of these can be oxidised by iodine?

Out of the 3 halides Cl- , Br- & I- , which one of these can be oxidised by iodine?

Does not oxidise Cl^- or Br^-

Define disproportionation

Define disproportionation

The oxidation and reduction of the same element in a redox reaction

What is the equation for the reaction of Cl_2 with water?

What is the equation for the reaction of Cl_2 with water?

$$Cl_2\ (g) + H_2O\ (l) \rightarrow HClO\ (aq) + HCl\ (aq)$$

What type of reaction is the reaction of chlorine with water?

What type of reaction is the reaction of chlorine with water?

Disproportionation; chlorine is both oxidised and reduced

Why is chlorine added to drinking water?

Why is chlorine added to drinking water?

It kills the bacteria in the water and makes it safer to drink

What are the two forms of the chlorate ion?

What are the two forms of the chlorate ion?

ClO^- is chlorate (I)

ClO_3^- is chlorate (V)

What is the equation for forming bleach and conditions?

What is the equation for forming bleach?

Cold dilute alkali

Cl_2 (aq) + 2NaOH (aq) → NaCl (aq) + NaClO (aq) + H_2O (l)

NaClO is bleach

Show that the reaction of chlorine with hot dilute NaOH is a disproportionation reaction

Show that the reaction of chlorine with hot dilute NaOH is a disproportionation reaction

$3Cl_2$ (aq) + 6 NaOH(aq) 5 NaCl (aq) + $NaClO_3$ (aq) + $3H_2O$ (l)

Chlorine is been reduced and oxidised.

Oxidation state of chlorine has gone from:

0 to -1 in NaCl = reduction

0 to +1 in $NaClO_3$ = oxidation

What do you use to test for halide ions?

What do you use to test for halide ions?

Acidified $AgNO_3$

Why do you add HNO_3?

Why not HCl?

Why do you add HNO_3? Why not HCl?

To remove CO_3^{2-}

Adding HCl would add Cl- ions, giving a false positive result

Result and equation for CI-test?

Result and equation for Cl^- test?

white ppt

$Ag^+ + Cl^- \rightarrow AgCl\ (s)$

What is the result and equation for the test for Br^-?

What is the result and equation for the test for Br^-?

Cream ppt

$Ag^+ + Br^- \rightarrow AgBr\ (s)$

What is the result and equation for the test for I^-?

What is the result and equation for the test for I^-?

Yellow ppt

$Ag^+ + I^- \rightarrow AgI\ (s)$

What happens (+ equations) to each of the silver halide precipitates when dilute/conc NH_3 are added?

What happens (+ equations) to each of the silver halide precipitates when dilute/conc NH_3 are added?

AgCl- dissolves in both dilute and conc

$$AgCl\ (s) + 2NH_3\ (aq) \rightarrow [Ag(NH_3)_2]^+\ (aq) + Cl^-$$

AgBr- only dissolves in conc

$$AgBr\ (s) + 2NH_3\ (aq) \rightarrow [Ag(NH_3)_2]^+\ (aq) + Br^-$$

AgI- will not dissolve in either

What is the trend in oxidising ability down the group? Why?

What is the trend in oxidising ability down the group? Why?

Decreases down group (Cl best, I worst)

Because: Cl has fewest occupied electron shells, greatest force of attraction between outer electrons and nucleus, easiest to gain electrons and be reduced → best oxidising agent

What is the trend in reducing ability of the halides down the group? Why?

What is the trend in reducing ability of the halides down the group? Why?

Increases down the group (Cl^- worst, I^- best)

Because: I^- has the most occupied electron shells, so outer electrons are further from the nucleus, weakest force of attraction between outer electrons and positive charge of nucleus → easiest to be oxidised and lose electrons → best reducing agent

What products are formed when I^- reduces H_2SO_4? Do equations for all 4.

What products are formed when I^- reduces H_2SO_4?

Do equations for all 4.

$H_2SO_4 + 2I^- \rightarrow SO_4^{2-} + 2HI$

$H_2SO_4 + 2H^+ + 2I^- \rightarrow SO_2 + I_2 + 2H_2O$ (SO_2 is a choking gas with a pungent odour)

$H_2SO_4 + 6H^+ + 6I^- \rightarrow S + 3I_2 + 4H_2O$ (S is a yellow solid)

$H_2SO_4 + 8H^+ + 8I^- \rightarrow H_2S + 4I_2 + 4H_2O$ (H_2S smells of bad/rotten eggs)

What are the products of Br^- + H_2SO_4?

What are the products of Br^- + H_2SO_4?

HBr and SO_2

Does Cl^- reduce H_2SO_4?

Does Cl^- reduce H_2SO_4?

No, not a powerful enough reducing agent; only HCl is formed

What are anions also known as?

What are anions also known as?

Negative ions

How can you test for carbonate ions, CO_3^{2-}?

How can you test for carbonate ions, CO_3^{2-}?

Add strong acid to the sample

Collect the gas produced

Pass through lime water

What are the observations for a positive test of carbonate ions, CO_3^{2-}?

What are the observations for a positive test of carbonate ions, CO_3^{2-}?

Fizzing

Limewater turns cloudy

Write an equation for the carbonate ion test

Write an equation for the carbonate ion test

$$CO_3^{2-}(aq) + 2H^+(aq) \rightarrow H_2O(aq) + CO_2(g)$$

How can you test for sulfate ions, SO_4^{2-}?

How can you test for sulphate ions, SO_4^{2-}?

- Add dilute hydrochloric acid and barium sulphate to the sample

What are the observations for a positive test of sulfate ions, SO_4^{2-}?

What are the observations for a positive test of sulfate ions, SO_4^{2-}?

White precipitate of barium sulfate is produced

Write an equation for the sulfate ion test

Write an equation for the sulfate ion test

$$Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$$

What do you use to test for halide ions?

What do you use to test for halide ions?

Acidified $AgNO_3$

When testing for carbonate, sulfate and halide ions, in which order should the tests be carried out and why?

When testing for carbonate, sulfate and halide ions, in which order should the tests be carried out and why?

1. Carbonate test
2. Sulfate test
3. Halide test

Because barium ions forms insoluble precipitate of $BaCO_3$ and silver ions form insolube precipitate of Ag_2SO_4

What are cations also known as?

What are cations also known as?

Positive ions

How can you test for ammonium ions, NH_4^+?

How can you test for ammonium ions, NH_4^+?

Add sodium hydroxide to the sample and warm it

Test the gas produced with red litmus paper

What are the observations for positive ammonium ions test?

What are the observations for positive ammonium ions test?

- Red litmus paper turns blue
- Ammonia has a pungent smell

Write the equation for ammonium ions test

Write the equation for ammonium ions test

$$NH_4^+ (aq) + OH^- (aq) \rightarrow NH_3 (aq) + H_2O (aq)$$