

# Edexcel Chemistry A-level

## Topic 4 - Inorganic Chemistry and the Periodic Table

### Flashcards

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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



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



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  $\rightarrow$  oxidised

One hydrogen atom from each water  $\rightarrow$   
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

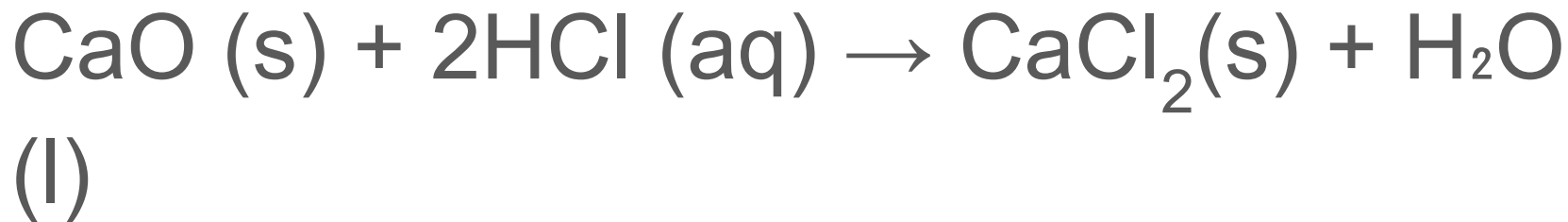


Write an equation for the reaction of calcium oxide and hydrochloric acid





Write an equation for the reaction of calcium and hydrochloric acid



What is formed when group 2 oxides react with water?



What is formed when group 2 oxides react with water?

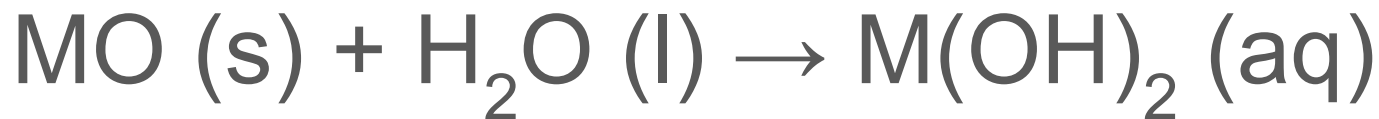
Metal hydroxide



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



What group 2 metal oxide is insoluble in water?



Which group 2 metal oxide is insoluble in water?

Beryllium oxide

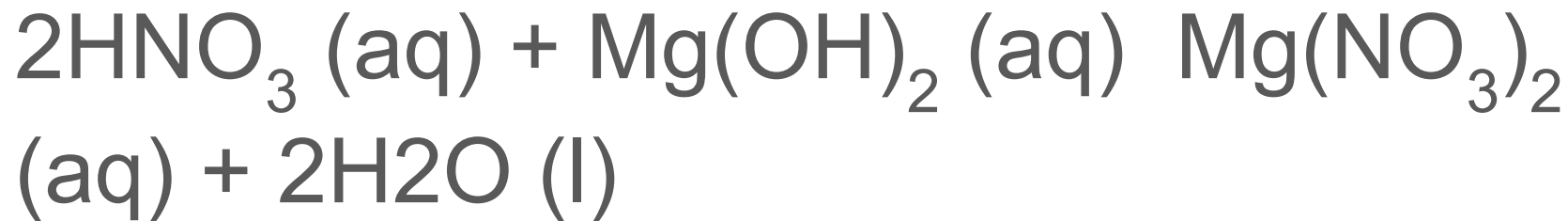


Write an equation for the reaction between  $\text{Mg}(\text{OH})_2$  and nitric acid





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



What is the trend in hydroxide solubility down group 2?



What is the trend in hydroxide solubility down group 2?

Increases down the group

$\text{Mg}(\text{OH})_2$  is slightly soluble

$\text{Ba}(\text{OH})_2$  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  $\text{BaSO}_4$  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?





What group elements are referred to as halogens?

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?



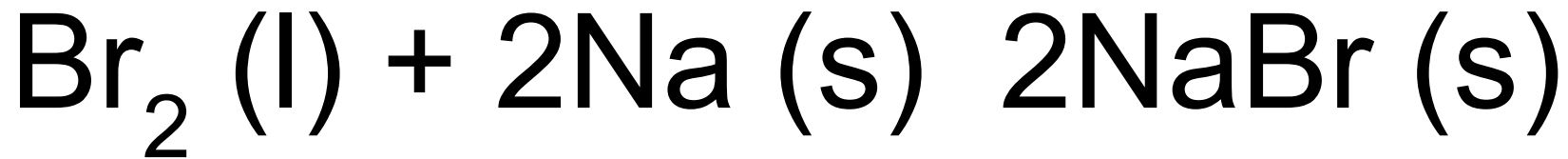
What is the trend in reducing ability of the halides down the group?  
Why?

Increases down the group ( $\text{Cl}^-$  weakest,  $\text{I}^-$  strongest)

This is because  $\text{I}^-$  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:



Which species is oxidised in this reaction:  $\text{Br}_2 (\text{l}) + 2\text{Na} (\text{s}) \rightarrow 2\text{NaBr} (\text{s})$

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  $\text{Cl}^-$ ,  $\text{Br}^-$  &  $\text{I}^-$ , which one of these can be oxidised by chlorine?



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

$\text{Br}^-$  &  $\text{I}^-$  ions



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





Write the equation for chlorine oxidising bromide ions



Yellow solution



Write the equation for  $\text{Cl}_2$   
oxidising  $2\text{I}^-$  in cyclohexane  
and associated colour change



Write the equation for  $\text{Cl}_2$  oxidising  $2\text{I}^-$



Purple solution



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



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

$\text{I}^-$  ions



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



Write the equation for bromine oxidising iodide ions



Brown solution



Out of the 3 halides  $\text{Cl}^-$  ,  $\text{Br}^-$  &  $\text{I}^-$  , which one of these can be oxidised by iodine?





Out of the 3 halides  $\text{Cl}^-$  ,  $\text{Br}^-$  &  $\text{I}^-$  , which one of these can be oxidised by iodine?

Does not oxidise  $\text{Cl}^-$  or  $\text{Br}^-$



# Define disproportionation



Define disproportionation

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



What is the equation for the reaction of  $\text{Cl}_2$  with water?



What is the equation for the reaction of  $\text{Cl}_2$  with water?



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?

$\text{ClO}^-$  is chlorate (I)

$\text{ClO}_3^-$  is chlorate (V)

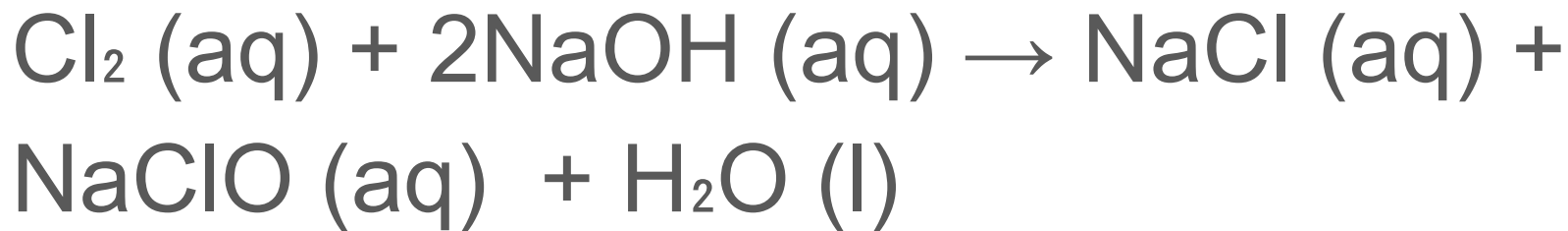


What is the equation for forming bleach and conditions?



What is the equation for forming bleach?

Cold dilute alkali



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



Chlorine is been reduced and oxidised.

Oxidation state of chlorine has gone from:

0 to -1 in NaCl = reduction

0 to +1 in NaClO<sub>3</sub> = oxidation



# What do you use to test for halide ions?





What do you use to test for halide ions?

Acidified  $\text{AgNO}_3$



Why do you add  $\text{HNO}_3$ ?

Why not  $\text{HCl}$ ?



Why do you add  $\text{HNO}_3$ ? Why not  $\text{HCl}$ ?

To remove  $\text{CO}_3^{2-}$

Adding  $\text{HCl}$  would add  $\text{Cl}^-$  ions, giving a false positive result

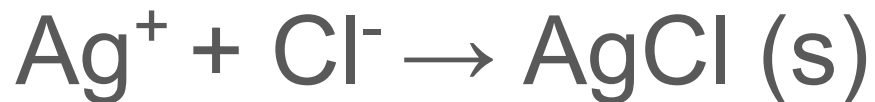


# Result and equation for Cl- test?



Result and equation for  $\text{Cl}^-$  test?

white ppt



What is the result and equation for the test for  $\text{Br}^-$ ?



What is the result and equation for the test for Br<sup>-</sup>?

Cream ppt



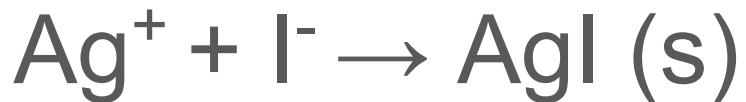
What is the result and equation for the test for  $I^-$ ?





What is the result and equation for the test for I<sup>-</sup>?

Yellow ppt



What happens (+ equations)  
to each of the silver halide  
precipitates when  
dilute/conc  $\text{NH}_3$  are added?



What happens (+ equations) to each of the silver halide precipitates when dilute/conc  $\text{NH}_3$  are added?

$\text{AgCl}$ - dissolves in both dilute and conc



$\text{AgBr}$ - only dissolves in conc



$\text{AgI}$ - 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 ( $\text{Cl}^-$  worst,  $\text{I}^-$  best)

Because:  $\text{I}^-$  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



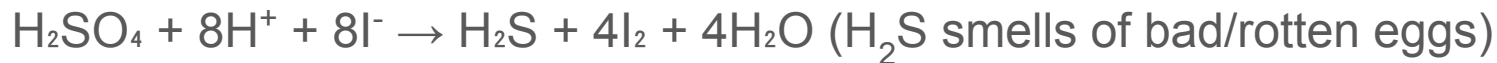
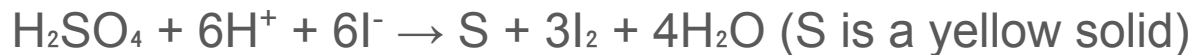
What products are formed  
when  $\text{I}^-$  reduces  $\text{H}_2\text{SO}_4$ ? Do  
equations for all 4.





What products are formed when  $\text{I}^-$  reduces  $\text{H}_2\text{SO}_4$ ?

Do equations for all 4.



What are the products of  $\text{Br}^-$   
+  $\text{H}_2\text{SO}_4$ ?



What are the products of  $\text{Br}^- + \text{H}_2\text{SO}_4$ ?

HBr and  $\text{SO}_2$



Does  $\text{Cl}^-$  reduce  $\text{H}_2\text{SO}_4$ ?



Does  $\text{Cl}^-$  reduce  $\text{H}_2\text{SO}_4$ ?

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,  $\text{CO}_3^{2-}$ ?





How can you test for carbonate ions,  $\text{CO}_3^{2-}$ ?

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,  $\text{CO}_3^{2-}$ ?



What are the observations for a positive test of carbonate ions,  
 $\text{CO}_3^{2-}$ ?

Fizzing

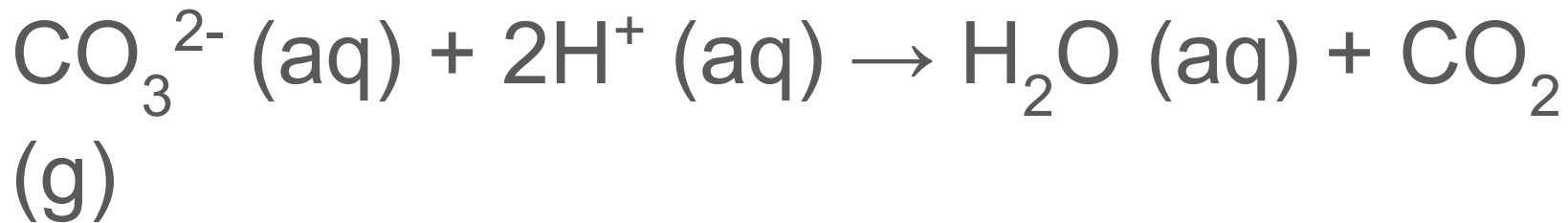
Limewater turns cloudy



Write an equation for the  
carbonate ion test



Write an equation for the carbonate ion test



How can you test for sulfate  
ions,  $\text{SO}_4^{2-}$ ?



How can you test for sulphate ions,  $\text{SO}_4^{2-}$ ?

- Add dilute hydrochloric acid and barium sulphate to the sample



What are the observations for  
a positive test of sulfate ions,  
 $\text{SO}_4^{2-}$ ?





What are the observations for a positive test of sulfate ions,  $\text{SO}_4^{2-}$ ?

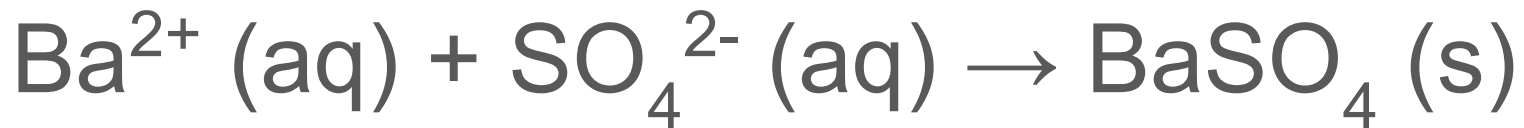
White precipitate of barium sulfate is produced



Write an equation for the  
sulfate ion test



Write an equation for the sulfate ion test



What do you use to test for halide ions?



What do you use to test for halide ions?

Acidified  $\text{AgNO}_3$



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  $\text{BaCO}_3$  and silver ions form insoluble precipitate of  $\text{Ag}_2\text{SO}_4$



# What are cations also known as?





What are cations also known as?

Positive ions



How can you test for  
ammonium ions,  $\text{NH}_4^+$ ?



How can you test for ammonium ions,  $\text{NH}_4^+$ ?

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

