

CIE Chemistry IGCSE

Topic 10 - Metals

Flashcards



What are the general physical properties of metals?

- High melting and boiling points
- Good conductors of heat and electricity
- Malleable
- Ductile



What are the general physical properties of metals?



Why do metals have relatively high melting and boiling points?



Why do metals have relatively high melting and boiling points?

Metals are giant structures with strong metallic bonding. There is strong electrostatic attraction between the positive ions and the negative electrons so lots of energy is required to break these bonds to change state.



Why are metals good conductors?



In terms of their structure, why are metals good conductors?

Metals contain delocalised electrons which are free to move throughout the structure and carry charge.



Why are metals malleable?



Why are metals malleable?

The positive ions are arranged in uniform rows which are able to slide over one another. This makes a metal malleable.



What is produced when a metal reacts with acid?



What is produced when a metal reacts with acid?

Salt and hydrogen



What type of reaction occurs when a metal reacts with an acid? Why does this reaction occur?



What type of reaction occurs when a metal reacts with an acid? Why does this reaction occur?

Displacement reaction:

The metal is more reactive than hydrogen so it will displace hydrogen and combine with the ion from the acid (e.g. chloride or sulfate ion).



Write the word equation for the reaction between metals and hydrochloric acid



Write the word equation for the reaction between metals and hydrochloric acid

metal+hydrochloric acid→metal chloride+hydrogen



Write the word equation for the reaction
between metals and sulfuric acid



Write the word equation for the reaction between metals and sulfuric acid

metal + sulfuric acid → metal sulfate + hydrogen



How does the position of a metal in the reactivity series affect whether it will react with a dilute acid?



How does the position of a metal in the reactivity series affect whether it will react with a dilute acid?

If a metal is above hydrogen in the reactivity series, it will react with dilute hydrochloric or sulfuric acid to form a salt and hydrogen.



Why don't metals lower than hydrogen in the reactivity series react with dilute hydrochloric or sulfuric acid?



Why don't metals lower than hydrogen in the reactivity series react with dilute hydrochloric or sulfuric acid?

They are less reactive than hydrogen so are unable to displace hydrogen from the acid to form a salt.



How could you compare how different metals react with an acid?



How could you compare how different metals react with an acid?

- Pour the chosen acid into a conical flask.
- Add the metal to the flask.
- Record any observations (including the rate at which bubbles are produced).
- Repeat with different metals and compare.



What is produced when a metal reacts with oxygen?



What is produced when a metal reacts with oxygen?

Metal oxide

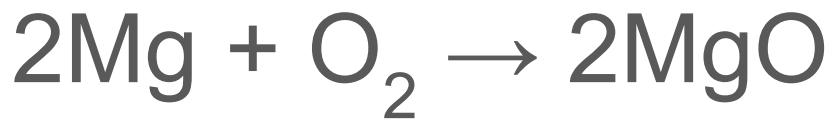


Write the word and chemical symbol equations for the reaction between magnesium and oxygen



Write the word and chemical symbol equations for the reaction between magnesium and oxygen

Magnesium + oxygen \rightarrow Magnesium oxide



What is an alloy?



What is an alloy?

A mixture containing a metal and another element (metal or non-metal).



Why is gold jewellery often an alloy?



Why is gold jewellery often an alloy?

Gold is very soft so it must be alloyed with another metal to make it harder and more suitable for jewelry.



Why are alloys harder than pure metals?



Why are alloys harder than pure metals?

Atoms in pure metals are arranged in uniform rows which can slide over each other easily, making them very malleable.

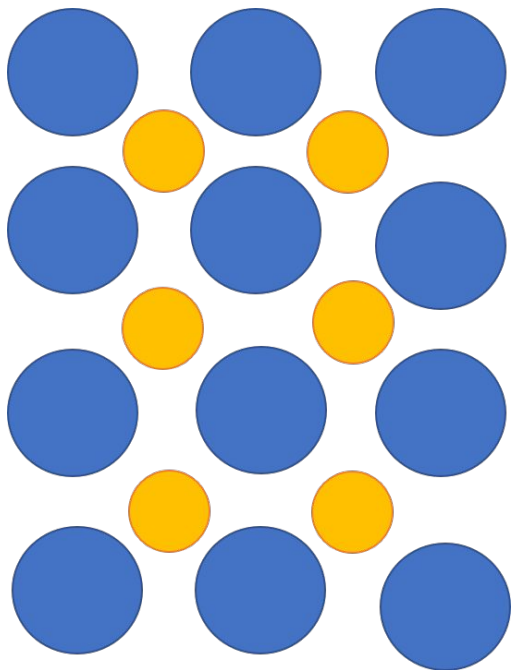
The atoms in alloys are different sizes which distorts the layers meaning they are unable to slide over one another, increasing hardness.



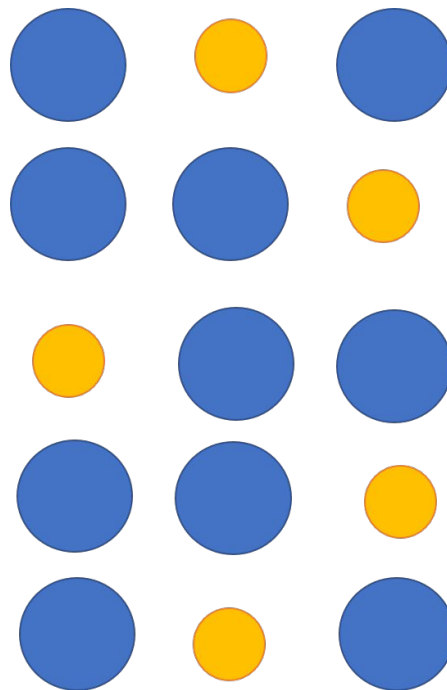
Draw diagrams to show the structure of an alloy



Draw diagrams to show the structure of an alloy



OR

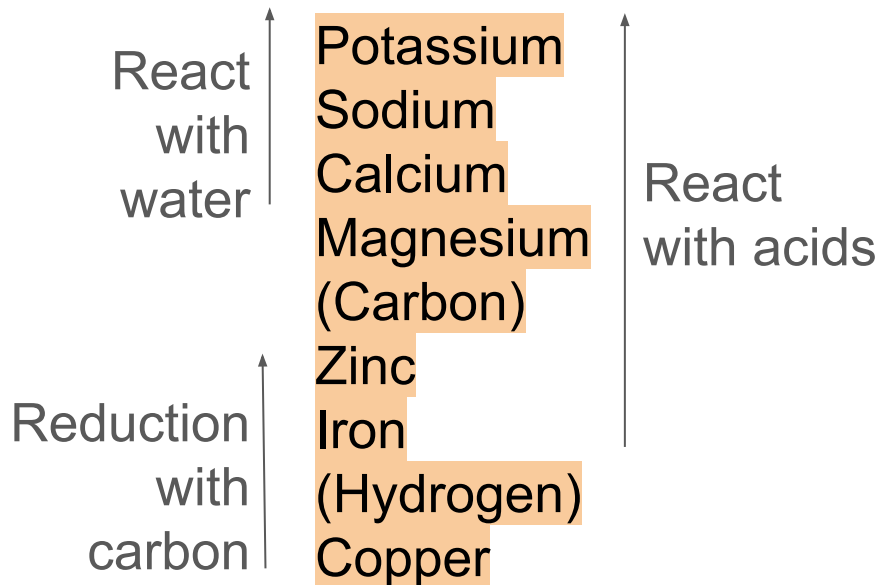


What is the order of the reactivity series and how can this order be deduced?



What is the order of the reactivity series and how can this order be deduced?

The order can be deduced by the different metals reactions with acid, water and reduction with carbon.



What is meant by the reactivity of metals?

(extended only)



What is meant by the reactivity of metals?
(extended only)

The tendency of a metal atom to lose electrons and form its positive ion.



What is formed during the thermal decomposition of a metal carbonate?
Write the general equation for the reaction that occurs
(extended only)



What is formed during the thermal decomposition of a metal carbonate? Write the general equation for the reaction that occurs (**extended only**)

Metal oxide and carbon dioxide

Metal carbonate \rightarrow metal oxide + carbon dioxide



What is formed when a metal hydroxide is heated? Write the general equation for the reaction that occurs
(extended only)



What is formed when a metal hydroxide is heated?
Write the general equation for the reaction that occurs (**extended only**)

Metal oxide and steam

Metal hydroxide \rightarrow metal oxide + steam



Which metal hydroxides decompose
when heated to produce steam and a
metal oxide?
(extended only)



Which metal hydroxides decompose when heated to produce steam and a metal oxide? (**extended only**)

Zinc, iron and copper decompose when heated.

Potassium, sodium, calcium and magnesium are too stable to decompose when heated.



Write the general equation for each reaction that can occur when a metal nitrate decomposes
(extended only)



Write the general equation for each reaction that can occur when a metal nitrate decomposes
(extended only)

Either:

Metal nitrate \rightarrow metal oxide + nitrogen dioxide + oxygen

Metal nitrate \rightarrow metal nitrite + oxygen



Which metal nitrates decompose to form a metal nitrite and which decompose to form a metal oxide?
(extended only)



Which metal nitrates decompose to form a metal nitrite and which decompose to form a metal oxide?
(extended only)

Zinc, iron and copper nitrates decompose to form metal oxides.

Potassium, sodium, calcium and magnesium nitrates decompose to form metal nitrites.



Write a balanced chemical equation for
the decomposition of calcium carbonate
(extended only)



Write a balanced chemical equation for the decomposition of calcium carbonate (**extended only**)



Why doesn't aluminium appear to
undergo oxidation?
(extended only)



Why doesn't aluminium appear to undergo oxidation? (**extended only**)

Aluminium reacts with oxygen in the air to form aluminium oxide (Al_2O_3). This very unreactive oxide coats the surface of the metal, preventing any further oxidation.



Where are most metals extracted from?



Where are most metals extracted from?

From ores found in the Earth's crust.



What is an ore?



What is an ore?

A rock which contains metals, often chemically combined with other substances.



Which metals are found in the Earth's crust as uncombined elements?



Which metals are found in the Earth's crust as uncombined elements?

Unreactive metals such as gold



Most ores contain metals chemically combined with oxygen. What process must be carried out to extract the metal?



Most ores contain metals chemically combined with oxygen. What process must be carried out to extract the metal?

Reduction



Which two methods could be used to extract metals from their ores?



How can metals be extracted from their ores?

Reduction with carbon: Can only be done if the metal is less reactive than carbon (links to reactivity series).

Electrolysis: Can be done with all metals, but requires a large amount of energy (high cost).



How is zinc extracted from its ore zinc
blende?
(extended only)



How is zinc extracted from its ore zinc blende? (extended only)

Zinc blende (or zinc sulfide) is heated to form zinc oxide.

Zinc oxide is reduced by carbon monoxide or it is dissolved in sulfuric acid then electrolysed to produce pure zinc.



How can iron be extracted from its oxide,
hematite?



How can iron be extracted from its oxide, hematite?

Iron is less reactive than carbon so can be extracted by reduction with carbon:

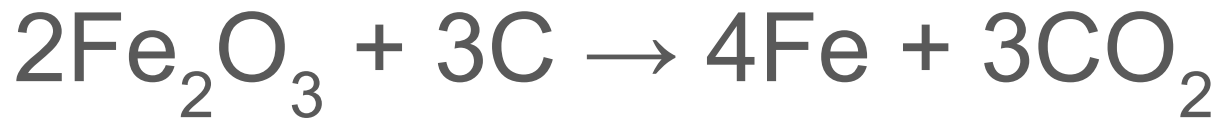
- Iron ore, limestone and coke are added to a blast furnace.
- Hot air enters at the bottom and moves to the top.
- CO is formed by reaction between oxygen and coke.
- CO and some carbon reduces iron oxide to iron.
- Molten iron runs out the bottom of the furnace.



Write a balanced chemical equation for the reduction of iron with carbon



Write a balanced chemical equation for the reduction of iron with carbon



How can iron be converted into steel?



How can iron be converted into steel?

Oxygen is blown onto the molten iron. The oxygen reacts with excess carbon to form gaseous CO and CO_2 which escape. Oxygen also reacts with impurities in the iron to form acidic oxides. These are removed using calcium oxide (a basic oxide).

The amount of oxygen blown through is controlled so that the final carbon content is correct to produce steel.



What is aluminium ore called?



What is aluminium ore called?

Bauxite



How can aluminium be extracted from its ore?



How can aluminium be extracted from its ore?

Aluminium is more reactive than carbon so electrolysis must be used.

When the molten ore undergoes electrolysis, the pure metal forms at the cathode.



When aluminium is extracted from aluminium oxide, why is it first dissolved in molten cryolite?
(extended only)



When aluminium is extracted from aluminium oxide, why is it first dissolved in molten cryolite?

(extended only)

Aluminium oxide has a very high melting point. It is dissolved in molten cryolite to produce reduce the melting point of the electrolyte, reducing energy usage and cost.



What occurs at each electrode during the electrolysis of aluminium oxide?
(extended only)



What occurs at each electrode during the electrolysis of aluminium oxide? (extended only)

Cathode - Al^{3+} ions gain electrons to form aluminium atoms.

Anode - O^{2-} ions lose electrons to form oxygen gas.



What are the advantages of recycling metals?



What are the advantages of recycling metals?

- Economically beneficial because electrolysis is expensive.
- Reduces environmental impact of mining and extraction of new metals.
- Less waste produced so less landfill.
- Less energy required compared to electrolysis.
- More sustainable - not using up the finite resources.
- Recycling process provides employment.



What are the disadvantages of recycling metals?



What are the disadvantages of recycling metals?

- Collection and transportation to recycling centres is required.
- Sorting requires time and labour.
- Energy saving varies between metals.



What are the uses of aluminium? Relate the uses to its properties



What are the uses of aluminium? Relate the uses to its properties

- Aluminium is used to manufacture aircrafts because it is strong and has a low density.
- Aluminium is used in food containers (cans) because it is resistant to corrosion.



How is zinc used in the galvanization process?
(extended only)



How is zinc used in the galvanization process?
(extended only)

Zinc can coat steel to prevent rusting.

This protects the steel because the zinc layer is oxidised before the steel.



How and why is zinc used to make brass?

(extended only)



How and why is zinc used to make brass?
(extended only)

Zinc is alloyed with copper to increase the strength and hardness of the material.



Why is copper used in electrical wiring
and cooking equipment?



Why is copper used in electrical wiring and cooking equipment?

Copper is used in electrical wiring because it is a good electrical conductor and it can be bent easily.

Copper is used in cooking equipment because it is a good thermal conductor so it heat up food quickly.



What properties of mild steel make it suitable for use in car bodies and machinery?



What properties of mild steel make it suitable for use in car bodies and machinery?

- Tough
- Ductile
- Malleable
- Good tensile strength



What is stainless steel used for? Why?



What is stainless steel used for? Why?

Stainless steel is used for cutlery and chemical plants because it is resistant to corrosion.



How is iron able to form steel alloys with different properties and uses?
(extended only)



How is iron able to form steel alloys with different properties and uses? (extended only)

Different additives can be added to iron to make different forms of steel. The amount of carbon added to the iron affects how hard the alloy is.



Mild steel has 0.25% carbon and high carbon steel has 2.5% carbon. Which steel is harder?
(extended only)



Mild steel has 0.25% carbon and high carbon steel has 2.5% carbon. Which steel is harder?

(extended only)

High carbon steel is harder because there are more carbon atoms distorting the uniform layers of iron atoms.

