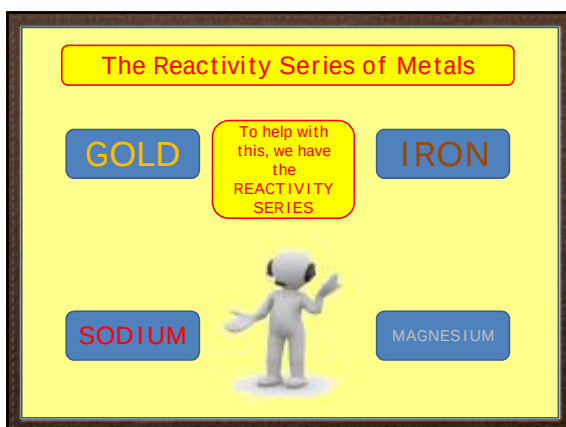
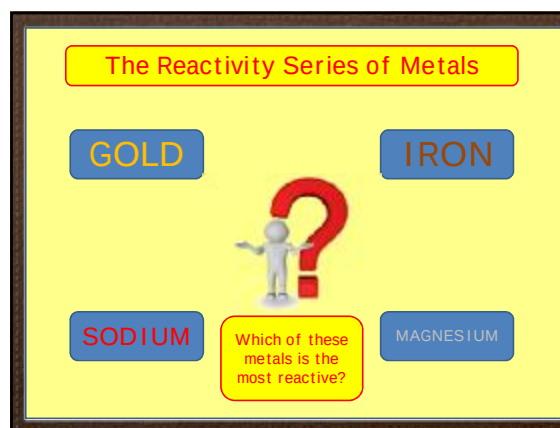
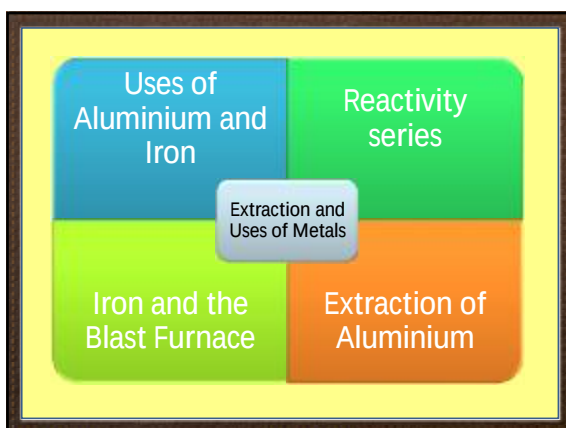
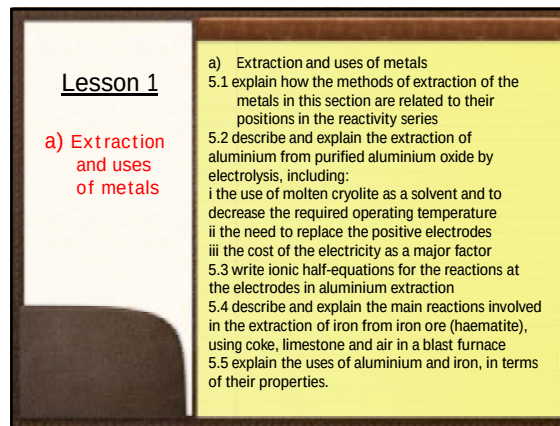
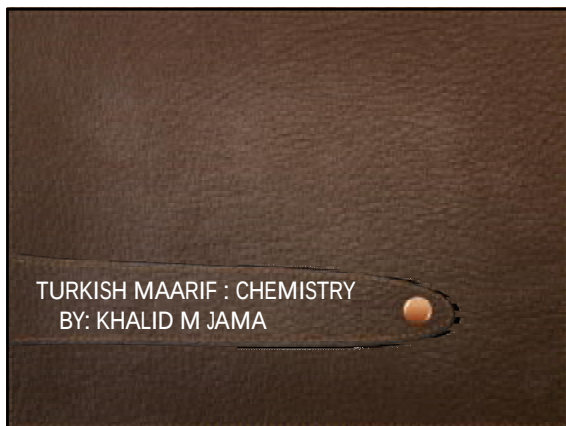




The Reactivity Series of Metals	
Very reactive	POTASSIUM K SODIUM Na CALCIUM Ca MAGNESIUM Mg ALUMINIUM Al
Fairly reactive	(CARBON) ZINC Zn IRON Fe
Not very reactive	LEAD Pb (HYDROGEN)
Not at all reactive	COPPER Cu SILVER Ag GOLD Au PLATINUM Pt

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Metals above carbon must be extracted from their ores by electrolysis

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An ORE is a type of rock that contains minerals with important elements including metals.

The Reactivity Series of Metals	
Very reactive	POTASSIUM K SODIUM Na CALCIUM Ca MAGNESIUM Mg ALUMINIUM Al
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ELECTROLYSIS is the process by which ionic substances are broken down into simpler substances when an electric current is passed through them.

The Reactivity Series of Metals	
Very reactive	POTASSIUM K SODIUM Na CALCIUM Ca MAGNESIUM Mg ALUMINIUM Al
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Metals below carbon can be extracted from their ores using reduction with coke or charcoal

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REDUCTION is a chemical reaction in which oxygen is removed from a compound.

The Reactivity Series of Metals

Very reactive	POTASSIUM K SODIUM Na CALCIUM Ca	Metals <u>above carbon</u> must be extracted from their ores by <u>electrolysis</u>
Fairly reactive	MAGNESIUM Mg ALUMINIUM Al (CARBON)	
Not very reactive	ZINC Zn IRON Fe LEAD Pb (HYDROGEN)	
Not at all reactive	COPPER Cu SILVER Ag GOLD Au PLATINUM Pt	Metals <u>below hydrogen</u> don't react with <u>water</u> or <u>acid</u> . They don't easily <u>tarnish</u> or <u>corrode</u> .

Metals below carbon can be extracted from their ores using reduction with coke or charcoal

The Reactivity Series of Metals

Very reactive	POTASSIUM K SODIUM Na CALCIUM Ca	The reactivity series depends upon three standard reactions. These reactions are with:
Fairly reactive	MAGNESIUM Mg ALUMINIUM Al (CARBON)	
Not very reactive	ZINC Zn IRON Fe LEAD Pb (HYDROGEN)	
Not at all reactive	COPPER Cu SILVER Ag GOLD Au PLATINUM Pt	1. AIR 2. WATER 3. DILUTE ACID

The Reactivity Series of Metals

Very reactive	POTASSIUM K SODIUM Na CALCIUM Ca	Reaction with AIR
Fairly reactive	MAGNESIUM Mg ALUMINIUM Al (CARBON)	
Not very reactive	ZINC Zn IRON Fe LEAD Pb (HYDROGEN)	
Not at all reactive	COPPER Cu SILVER Ag GOLD Au PLATINUM Pt	No reaction

Burn very easily with a bright flame

React slowly with air when heated

The Reactivity Series of Metals

Very reactive	POTASSIUM K SODIUM Na CALCIUM Ca	Reaction with WATER
Fairly reactive	MAGNESIUM Mg ALUMINIUM Al (CARBON)	
Not very reactive	ZINC Zn IRON Fe LEAD Pb (HYDROGEN)	
Not at all reactive	COPPER Cu SILVER Ag GOLD Au PLATINUM Pt	No reaction with water or steam

React with cold water

React with steam

Reacts reversibly with steam

The Reactivity Series of Metals

Very reactive	POTASSIUM K SODIUM Na CALCIUM Ca	Reaction with DILUTE ACID
Fairly reactive	MAGNESIUM Mg ALUMINIUM Al (CARBON)	
Not very reactive	ZINC Zn IRON Fe LEAD Pb (HYDROGEN)	
Not at all reactive	COPPER Cu SILVER Ag GOLD Au PLATINUM Pt	No reaction with dilute acids

Violent reaction with dilute acids

React fairly well with dilute acids

The Reactivity Series of Metals

Very reactive	POTASSIUM K SODIUM Na CALCIUM Ca	Metals <u>above carbon</u> must be extracted from their ores by <u>electrolysis</u>
Fairly reactive	MAGNESIUM Mg ALUMINIUM Al (CARBON)	
Not very reactive	ZINC Zn IRON Fe LEAD Pb (HYDROGEN)	
Not at all reactive	COPPER Cu SILVER Ag GOLD Au PLATINUM Pt	Metals <u>below hydrogen</u> don't react with <u>water</u> or <u>acid</u> . They don't easily <u>tarnish</u> or <u>corrode</u> .

Metals below carbon can be extracted from their ores using reduction with coke or charcoal

The Reactivity Series of Metals

Very reactive	POTASSIUM K SODIUM Na CALCIUM Ca MAGNESIUM Mg ALUMINIUM Al	Metals above carbon must be extracted from their ores by electrolysis eg. Aluminium
Fairly reactive	(CARBON) ZINC Zn IRON Fe LEAD Pb	Metals below carbon can be extracted from their ores using reduction with coke or charcoal
Not very reactive	(HYDROGEN) COPPER Cu SILVER Ag GOLD Au PLATINUM Pt	Metals below hydrogen don't react with water or acid. They don't easily tarnish or corrode.
Not at all reactive		

Extracting Aluminium from Bauxite

Extracting Aluminium from Bauxite

Bauxite is impure aluminium oxide, Al_2O_3



Extracting Aluminium from Bauxite

Bauxite is impure aluminium oxide, Al_2O_3

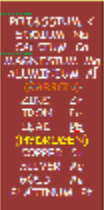


Because aluminium is high up in the reactivity series, a lot of energy is needed to extract it – this energy comes from ELECTRICITY

Extracting Aluminium from Bauxite

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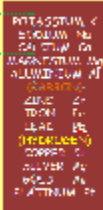
ELECTROLYSIS is the term used for the extraction of a metal from its ore. This technique is used for all metals above CARBON in the reactivity series.



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Extracting Aluminium from Bauxite

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ELECTROLYSIS is the term used for the extraction of a metal from its ore. This technique is used for all metals above CARBON in the reactivity series. After mining and purifying of bauxite, a white powder is left. This is pure aluminium oxide, Al_2O_3 , which melts at over $2000^\circ C$.

POTASSIUM	K
SODIUM	Na
CALCIUM	Ca
MAGNESIUM	Mg
ALUMINIUM	Al
ZINC	Zn
IRON	Fe
LEAD	Pb
(HYDROGEN)	
COPPER	Cu
SILVER	Ag
GOLD	Au
PATRIUM	Fr

Extracting Aluminium from Bauxite

Because aluminium is high up in the reactivity series, a lot of energy is needed to extract it – this energy comes from ELECTRICITY

For electrolysis to work, the oxide needs to be in a molten state. To achieve this, the aluminium oxide is dissolved in molten cryolite.

POTASSIUM	K
SODIUM	Na
CALCIUM	Ca
MAGNESIUM	Mg
ALUMINIUM	Al
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IRON	Fe
LEAD	Pb
(HYDROGEN)	
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Extracting Aluminium from Bauxite

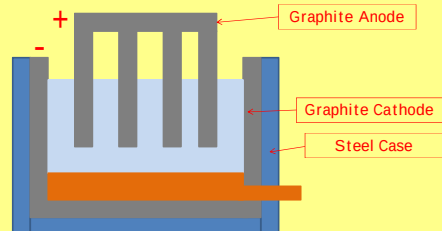
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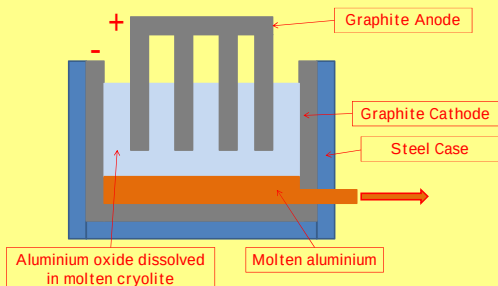
This reduces the temperature down to about $900^\circ C$ which makes the process of electrolysis much cheaper and easier.

POTASSIUM	K
SODIUM	Na
CALCIUM	Ca
MAGNESIUM	Mg
ALUMINIUM	Al
ZINC	Zn
IRON	Fe
LEAD	Pb
(HYDROGEN)	
COPPER	Cu
SILVER	Ag
GOLD	Au
PATRIUM	Fr

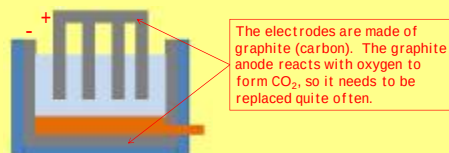
Extracting Aluminium from Bauxite



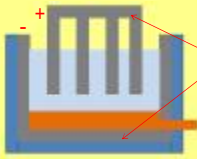
Extracting Aluminium from Bauxite



Extracting Aluminium from Bauxite



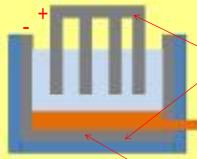
Extracting Aluminium from Bauxite



The electrodes are made of graphite (carbon). The graphite anode reacts with oxygen to form CO_2 , so it needs to be replaced quite often.

When molten, the Al_2O_3 dissociates into the ions, Al^{3+} and O^{2-} .

Extracting Aluminium from Bauxite

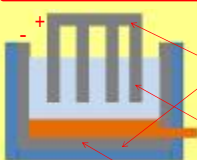


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The positive ion, Al^{3+} , will be attracted towards the negative cathode.

Extracting Aluminium from Bauxite



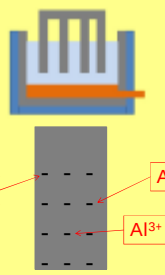
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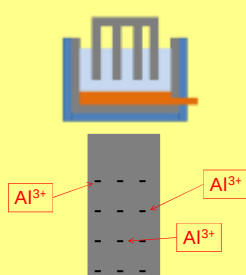
The negative ion, O^{2-} , will be attracted towards the positive anode.

Extracting Aluminium from Bauxite



At the cathode (-ve)

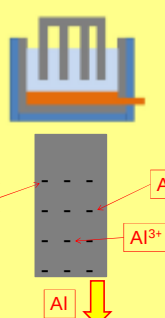
Extracting Aluminium from Bauxite



At the cathode (-ve)

$$\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}$$

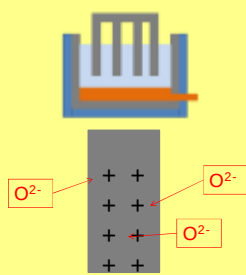
Extracting Aluminium from Bauxite



At the cathode (-ve)

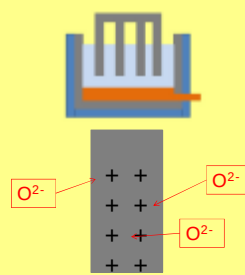
$$\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}$$

Extracting Aluminium from Bauxite



At the anode (+ve)

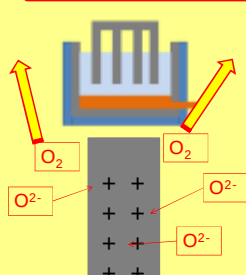
Extracting Aluminium from Bauxite



At the anode (+ve)

$$2\text{O}^{2-} - 4\text{e}^- \rightarrow \text{O}_2$$

Extracting Aluminium from Bauxite



At the anode (+ve)

$$2\text{O}^{2-} - 4\text{e}^- \rightarrow \text{O}_2$$

The Reactivity Series of Metals

Very reactive	POTASSIUM K	Metals <u>above carbon</u> must be extracted from their ores by <u>electrolysis</u>
	SODIUM Na	
	CALCIUM Ca	
	MAGNESIUM Mg	
	ALUMINIUM Al	
Fairly reactive	(CARBON)	Metals <u>below carbon</u> are extracted using <u>reduction</u> with <u>coke or charcoal</u>
	ZINC Zn	
	IRON Fe	
	LEAD Pb	
Not very reactive	(HYDROGEN)	Metals <u>below hydrogen</u> don't react with <u>water or acid</u> . They don't easily <u>tarnish</u> or <u>corrode</u> .
	COPPER Cu	
	SILVER Ag	
	GOLD Au	
Not at all reactive	PLATINUM Pt	

eg. Iron

Extracting Iron in a Blast Furnace

Extracting Iron in a Blast Furnace



Extracting Iron in a Blast Furnace



Because iron is below CARBON in the reactivity series, it can be removed from the ore by heating with carbon in a BLAST FURNACE. This is a REDUCTION reaction.

POTASSIUM	K
SODIUM	Na
CALCIUM	Ca
MAGNESIUM	Mg
ALUMINIUM	Al
(CARBON)	C
ZINC	Zn
IRON	Fe
LEAD	Pb
(HYDROGEN)	H
COPPER	Cu
SILVER	Ag
GOLD	Au
PLATINUM	Pt

Extracting Iron in a Blast Furnace



Remember that in a reduction reaction oxygen is removed

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SODIUM	Na
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Extracting Iron in a Blast Furnace

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The raw materials in the blast furnace are iron ore, coke and limestone.

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Iron ore is iron oxide, Fe_2O_3

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Iron ore is iron oxide, Fe_2O_3

Coke is almost pure carbon – it will reduce the iron oxide

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SODIUM	Na
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MAGNESIUM	Mg
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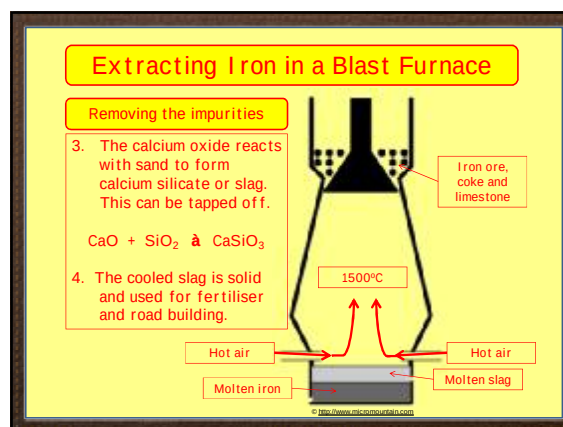
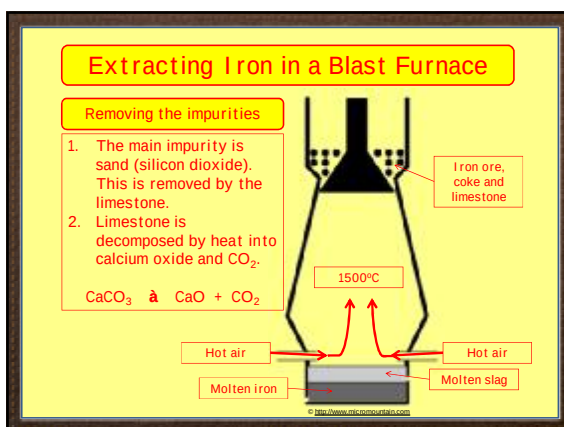
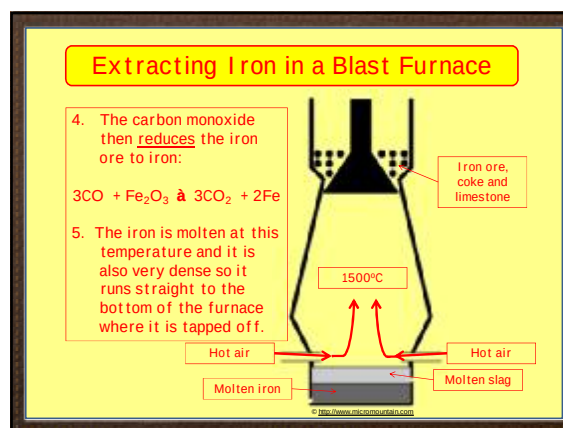
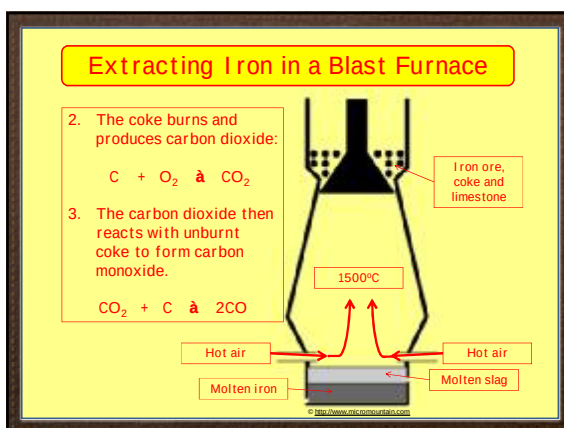
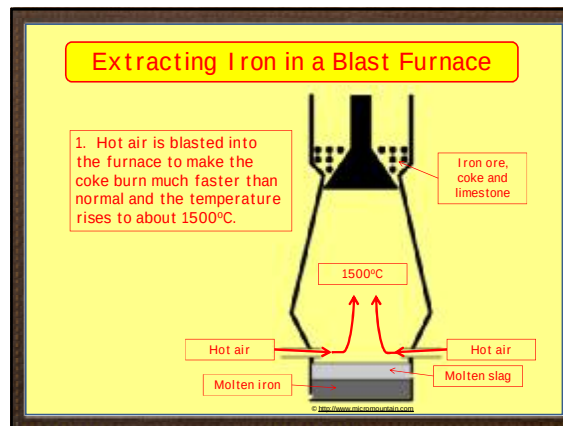
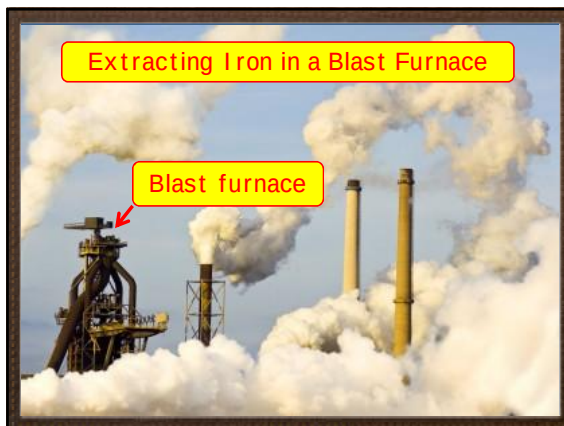
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Iron ore is iron oxide, Fe_2O_3

Coke is almost pure carbon – it will reduce the iron oxide

Limestone is calcium carbonate, CaCO_3 , and removes the impurities.

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CALCIUM	Ca
MAGNESIUM	Mg
ALUMINIUM	Al
(CARBON)	C
ZINC	Zn
IRON	Fe
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COPPER	Cu
SILVER	Ag
GOLD	Au
PLATINUM	Pt



Properties and uses of Aluminium

Property	Uses
Strong, malleable	
Low density	
Resistant to corrosion	
Good conductor of heat and electricity	
Can be polished to a highly reflective surface	

Properties and uses of Aluminium

Property	Uses
Strong, malleable	Low density and strength make it an ideal metal for the construction of aircraft, ladders and lightweight vehicles (alloy called <u>duralumin</u> often used)
Low density	Easily shaped and corrosion-free makes it ideal for drinks cans and roofing material.
Resistant to corrosion	Greenhouses and window frames.
Good conductor of heat and electricity	Heat conduction good for boilers, cookers and cookware
Can be polished to a highly reflective surface	Overhead power cables (good conductor, low density) Ideal for reflecting surfaces such as mirrors, and also heat resistant clothing for fire fighters.

Properties and uses of Iron

Most iron is used to manufacture steel. Carbon is added, along with small amounts of other elements

Properties and uses of Iron

Most iron is used to manufacture steel. Carbon is added, along with small amounts of other elements

Name and melting point	Property	Uses
Cast iron 1200°C	Hard skin, softer underneath, brittle, corrodes by rusting	Parts with complex shapes can be made by casting
Mild steel 1600°C	Tough, ductile, malleable, good tensile strength, corrodes	General purpose engineering material
High carbon steel 1800°C	Can be heat-treated to make it harder and tougher	Cutting tools, ball bearings
Stainless steel 1400°C	Hard and tough, resistant to wear and corrosion	Cutlery, kitchen equipment

End of Section 5 Lesson 1

In this lesson we have covered:

The Reactivity Series

Extraction of Aluminium

Extraction of Iron

Properties and Uses of Aluminium and Iron

END