Extracting Metals	Key Points
Explain how the industrial **process** used to **extract** a **metal** is **chosen**	An **ore** is a rock or mineral that contains enough metal to make extracting it economically viable. If a metal is **less reactive** than carbon then it can be extracted from its ore by reacting the compound with **carbon**. If a metal is **more reactive** than carbon then it can be extracted from its ore by **electrolysis**.
Describe how **copper** may be extracted from copper oxide	Copper can be **extracted** from copper sulphide in the following process: $2CuS + 3O_2 \rightarrow 2CuO + 2SO_2$ $2CuO + C \rightarrow 2Cu + CO_2$
Describe how **iron** may be extracted from iron oxide	A **blast furnace** is used to extract iron from its ore. The **iron ore**, **coke** (carbon) and **limestone** are added to the top of the blast furnace. Hot air is added to the bottom of the furnace. The reactions involved are as follows: $C + O_2 \rightarrow CO_2$ $C + CO_2 \rightarrow 2CO$ $3CO + Fe_2O_3 \rightarrow 3CO_2 + 2Fe$ Limestone is used to **purify** the iron. $CaCO_3 \rightarrow CaO + CO_2$ $CaO + SiO_2 \rightarrow CaSiO_3$
Explain why **electrolysis** is used to extract some metals from their ores	If a metal is more reactive than carbon then **electrolysis** is used to extract it from its ore.
Describe how **aluminium** may be extracted from aluminium oxide	Aluminium is extracted from an ore called **bauxite**, which is aluminium oxide. Aluminium oxide has a very high melting point so lots of energy would be needed to be used to melt it. Aluminium oxide is therefore dissolved in **cryolite**, which has a lower melting point and placed in an electrolysis cell. The cell is made from steel and lined with graphite. The graphite acts as the **cathode** and graphite blocks act as the **anode**. Aluminium is produced at the cathode. Oxygen is produced at the anode, which it reacts with to give carbon dioxide.
Evaluate **bioleaching** and **phytoextraction** as alternative methods of metal extraction	**Bioleaching** is cheaper than traditional ore extraction. Bioleaching can be used to extract metal from **low-grade ores** which do not contain enough metal to be profitable by traditional ore extraction methods. **Bioleaching** does not release sulfur dioxide into the atmosphere unlike traditional ore extraction methods. However, bioleaching is slow and can produce toxic substances which can escape into the local environment. **Phytomining** involves growing **plants** on soil containing low-grade ores then harvesting and burning the plants to extract the ore from the ashes. It is cheaper and less wasteful than traditional mining, and almost carbon-neutral, though it is a slower process.

Choosing Materials	Key Points
Explain how the uses of materials are related to their properties and **choose appropriate materials**	You must be able to use data tables of different physical properties such as electrical resistance and strength to decide which materials are suitable for different uses.
Describe the basic principles of **life-cycle assessments**	A life-cycle assessment is an analysis of the impact of making, using and disposing of a product which is manufactured. It should consider the sustainability, environmental impact, how long the product will last, whether it can easily be recycled and how easy it is to dispose of.
Evaluate data from a life-cycle assessment	You must be able to look at life-cycle assessment data and make a judgement about whether the product should be used.
Describe how materials or products are **recycled** for different uses	Materials are collected and sent to a recycling plant where they are sorted and made into smaller pieces. Metals, glass and polymers will be melted and then made into new materials or ingots. Paper is mixed with water, cleaned then rolled and heated.
Explain why **recycling** may be **viable**	Whether recycling occurs will depend on cost, how easily the waste can be collected and sorted, whether any by-products are made and the amount of energy needed.
Evaluate factors that affect **decisions** on **recycling**	You must be able to look at information on different materials and decide whether a material should be recycled or not.
Keywords: anode, batch process, bauxite, bioleaching, blast furnace, carbon-neutral, cathode, ceramics, coke, composite material, compressive strength, Contact process, continuous process, corrosion, cryolite, denatured, essential elements, fermentation, fertilisers, galvanising, Haber process, haematite, high-grade ore, hydration, ingot, landfill, life cycle assessment, liquified, low-grade ore, mineral deficiency, non-renewable, ore, phytoextraction, redox, raw materials, recycling, renewable, resin, rusting, sacrificial protection, slag, tensile strength	