Cambridge IGCSE Chemistry

Topic 10: Metals

Extraction of metals

Notes

Describe the ease in obtaining metals from their ores by relating the elements to the reactivity series

- The second to last element in the reactivity series is gold, since it is very unreactive, it is found in the Earth as the metal itself
- But, most metals are found as compounds that require chemical reactions to extract the metal
- Metals less reactive than carbon:
    - Can be extracted from their oxides by reduction with carbon
    - Don't forget: reduction involves the loss of oxygen

(Extended only) Describe, in outline, the extraction of zinc from zinc blende

- Zinc sulfide is turned into zinc oxide by heating
- Zinc oxide is either reduced by carbon monoxide or it is dissolved in sulfuric acid and then electrolysed

Describe and state the essential reactions in the extraction of iron from hematite

In the blast furnace (very high temperatures) iron oxide is reduced with carbon:

- Iron ore, coke and limestone are added into a blast furnace
- Hot air enters from bottom and goes to top of furnace
- Oxygen reacts with coke to form CO_2, which reacts again with coke to form CO
- CO is a reducing agent, turning iron oxide into iron
- Some carbon will also reduce the iron oxide to iron
- Molten iron runs to the bottom of the furnace and then runs off

Describe the conversion of iron into steel using basic oxides and oxygen

- Carbon is removed from molten iron by blowing oxygen into it
- Oxygen reacts with carbon → carbon monoxide + carbon dioxide
    - Both gases escape from the iron
- Sufficient oxygen is used to produce steel with the desired carbon content

Know that aluminium is extracted from the ore bauxite by electrolysis

- Extraction by electrolysis (including aluminium)
    - Metals that are more reactive than carbon e.g aluminium are extracted by electrolysis of molten compounds.
    - Metals that react with carbon can be extracted by electrolysis as well

(Extended only) Describe in outline, the extraction of aluminium from bauxite including the role of cryolite and the reactions at the electrodes

- aluminium extraction:
  - aluminium oxide is dissolved in molten cryolite (means electrolysis can happen at a lower temperature)
  - cathode- Al^{3+} ions gain electrons and are reduced to Al (s)
  - anode- O^{2-} loses electrons and is oxidised to O_2 (g)
  - anodes must be replaced regularly (oxygen reacts with the graphite)

Discuss the advantages and disadvantages of recycling metals, limited to iron/steel and aluminium

- advantages of recycling:
  - Requires less energy to melt and remould metals than it does to extract new metals from their ores
  - fewer quarries and mines needed than to extract metals, so less noise and dust pollution
  - Recycling allows for waste metals to be reused, saving money, helping the environment and the supply of valuable raw materials.
- disadvantages of recycling:
  - Requires energy to transport metals to recycling centre
  - metals must be sorted into types
  - for different metals, the amount of energy saved varies