Extracting metals in the middle of the activity series eg: Iron, Zinc, lead

These are present as sulphides or carbonates in nature It is easier to obtain a metal from its oxide as compared to its sulphides and carbonates. Therefore, prior to reduction, the metal sulphides and carbonates must be converted into metal oxides.

Carbonate ore

The carbonate ores are changed to oxides by heating strongly in limited air. This process is known as calcination.

$$ZnCO_3(s) \xrightarrow{\Delta} ZnO(s) + CO_2(g)$$

Sulphide ore

The sulphide ores are converted to oxides by heating strongly in the presence of excess air. This process is known as roasting

$$2ZnS(s) + 3O_2(g) \xrightarrow{\Delta} 2ZnO(s) + 2SO_2(g)$$

The metal oxides are then reduced to the corresponding metals by using suitable reducing agents such as carbon.

$$ZnO(s) + C(s) \longrightarrow Zn(s) + CO(g)$$

Besides using carbon (coke) to reduce metal oxides to metals, sometimes displacement reactions can also be used. The highly reactive metals such as sodium, calcium, aluminium etc are used as reducing agents because they can displace metals of lower reactivity from their

compounds.

eg: $3MnO_2(s) + 4Al(s) \longrightarrow 3Mn(l) + 2Al_2O_3(s) + heat$

These displacement reactions are highly exothermic such that heat evolved melts the metals.

Thermit reaction

Fe^{3+} O^{2-}

The reaction of iron (III) oxide (Fe_2O_3) with aluminium is used to join railway tracks or cracked machine parts. This reaction is known as thermit reaction.

$Fe_2O_3(s) + 2Al(s) \longrightarrow 2Fe(l) + Al_2O_3(s) + heat$