Extraction of iron on a match head

Learning objectives

1. Safely investigate heating iron oxide on a match head to reduce iron.
2. Explain why metals need to be extracted from their ores.
3. Explain the process of extracting metals using reduction with carbon.
4. Identify which species are oxidised and which are reduced.

Introduction

In this experiment, you will reduce iron(III) oxide with carbon on a match head to produce iron.

Equipment

Apparatus

- Safety glasses
- Match (non-safety)
- Tongs (crucible tongs)
- Weighing boat (small white plastic ones are ideal)
- Spatula
- Bunsen burner
- Heat resistant mat
- Magnet (e.g. bar magnet)

Chemicals

Small amounts of the following:



- Iron(III) oxide powder
- Sodium carbonate powder (IRRITANT)
- Water

Health and safety

Wear safety glasses throughout.

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Method

1. Dip the head of a match in water to moisten it.
2. Roll the damp match head first in sodium carbonate powder, then in iron(III) oxide powder.
3. Hold the match in a pair of tongs. Put the head of the match into a blue Bunsen flame (air-hole open). The match will flare and burn. Do not allow the match to burn more than halfway along its length.
4. Allow the match to cool for about 30 seconds.
5. Use a spatula to crush the charred part of the match into a small plastic weighing boat.
6. Move a magnet around under the weighing boat - some of the small particles will move around in the weighing boat following the track of the magnet. Do not dip the magnet into the particles directly.

Follow-up questions

1. In this experiment, iron was produced by reacting the iron(III) oxide with carbon from the matchstick.

   (a) Iron(III) oxide is made up of Fe^{3+} and O^{2-} ions. Write the chemical formula of iron(III) oxide.

   _____

   (b) Use the information in the question and your answer for (a) to complete and balance the symbol equation for the reaction.

_____	+	____C	→	_____Fe	+ ____CO_2
iron(III)oxide		carbon		iron	carbon dioxide

   (c) Tick the **two** correct boxes to describe oxidation in terms of oxygen and electrons.

   - ☐ Oxidation is the loss of oxygen
   - ☐ Oxidation is the gain of oxygen
   - ☐ Oxidation is the loss of electrons
   - ☐ Oxidation is the gain of electrons

   (d) Identify which species has been oxidised and which has been reduced.

   _____

   _____

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2. Use the reactivity series to explain why iron can be reduced by carbon in this way.

_____

_____

3. Lead is often extracted from its main ore, galena, which primarily contains lead sulfide, PbS.

a) Select the correct words to complete the definition of the term 'ore'.

Ores are rocks that are found naturally in the Earth's **atmosphere/crust**. They contain enough **metal/oxygen** to make it **expensive/profitable** to extract.

b) The first stage of the process involves reacting lead sulfide with oxygen to produce lead oxide. Sulfur dioxide is also produced. Write a word equation for this process.

_____ + _____ →_____ + _____

c) The lead oxide can then be reacted with carbon to produce lead.
Lead oxide is made up of Pb^{2+} and O^{2-} ions.
Use this information to complete and balance the symbol equation for the reaction.

_____	+	C	→	_____Pb + CO_2
lead oxide		carbon		lead carbon dioxide

d) How does this reaction show us that lead is **below** carbon on the reactivity series?

_____

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