

Electrolysis of molten ionic compounds

4.4.3.2 · Chemical changes · revision notes

What is produced when a binary ionic compound (a metal combined with a non-metal) is electrolysed in the molten state: the metal forms at the cathode and the non-metal at the anode. Expect prediction questions.

Key facts

- Molten binary compound: metal at the cathode (-), non-metal at the anode (+)
- Halogens are diatomic: Cl_2 , Br_2 , I_2
- Lead bromide $\rightarrow$ lead + bromine
- Must be molten so the ions can move

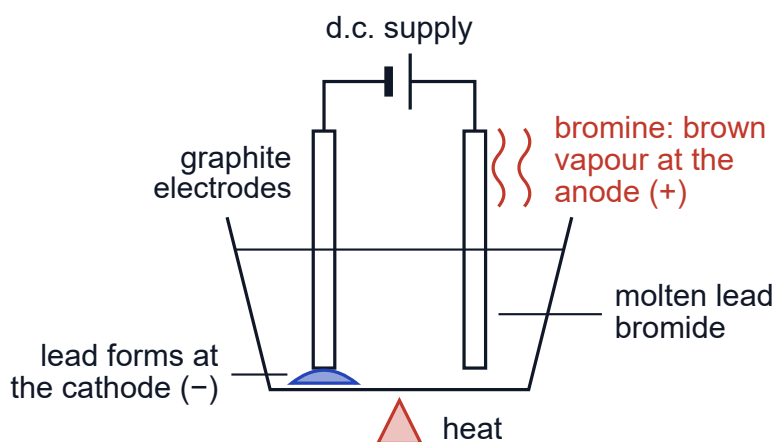
Notes

Molten binary ionic compounds

- A **binary ionic compound** is made of just two elements, a metal and a non-metal, e.g. lead bromide, PbBr_2 .
- It must be heated until it melts, so the ions are free to move.
- With **inert electrodes** (e.g. graphite), the **metal** is produced at the **cathode** (negative) and the **non-metal** is produced at the **anode** (positive).
- This is simpler than a solution: there is no water, so only the two ions of the compound are present.

Example: lead bromide

- Lead ions, Pb^{2+} , move to the cathode and form lead, which appears as a silvery metal (molten at this temperature).
- Bromide ions, Br^- , move to the anode and form bromine, seen as brown vapour.



The solid must be melted first so that its ions can move. Do this in a fume cupboard.

- Bromine is toxic, so this is done in a fume cupboard.
- Overall: lead bromide $\rightarrow$ lead + bromine

More examples

- Molten sodium chloride → sodium (cathode) + chlorine (anode)
- Molten zinc chloride → zinc (cathode) + chlorine (anode)
- Molten potassium iodide → potassium (cathode) + iodine (anode)
- Molten aluminium oxide → aluminium (cathode) + oxygen (anode)

How to answer each type of question

Predict the products at each electrode

2 marks

Grade 4

1. Split the compound into its metal ion and non-metal ion.
2. Metal at the cathode; non-metal at the anode.
3. Name the non-metal as an element: chlorine, not chloride.

Example. Molten calcium bromide is electrolysed using inert electrodes.
Name the product at (a) the cathode and (b) the anode.

Model answer. (a) calcium (1)
(b) bromine (1)

Don't lose marks

- ✗ Writing 'chloride' or 'bromide' as the product at the anode instead of chlorine or bromine.
- ✗ Putting the metal at the anode.

More tips

Memory tricks

- Molten: the Metal goes to the cathode (M for molten, M for metal).
- Name change at the anode: chloride → chlorine, bromide → bromine, iodide → iodine, oxide → oxygen.

Exam technique

- Say 'molten' or 'melted', not 'dissolved', when the question is about a molten compound.
- If asked why a fume cupboard is used, name the toxic product (e.g. bromine or chlorine).
- Describe observations precisely: 'brown vapour at the anode', 'silvery metal at the cathode'.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3

State the products from molten lead bromide

Lead is produced at the cathode and bromine at the anode.

Grade 4

Predict products for any molten binary compound

The metal forms at the cathode and the non-metal forms at the anode.

Grade 5

Describe what is seen at each electrode

For lead bromide, silvery lead forms at the cathode and brown bromine vapour at the anode.

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