

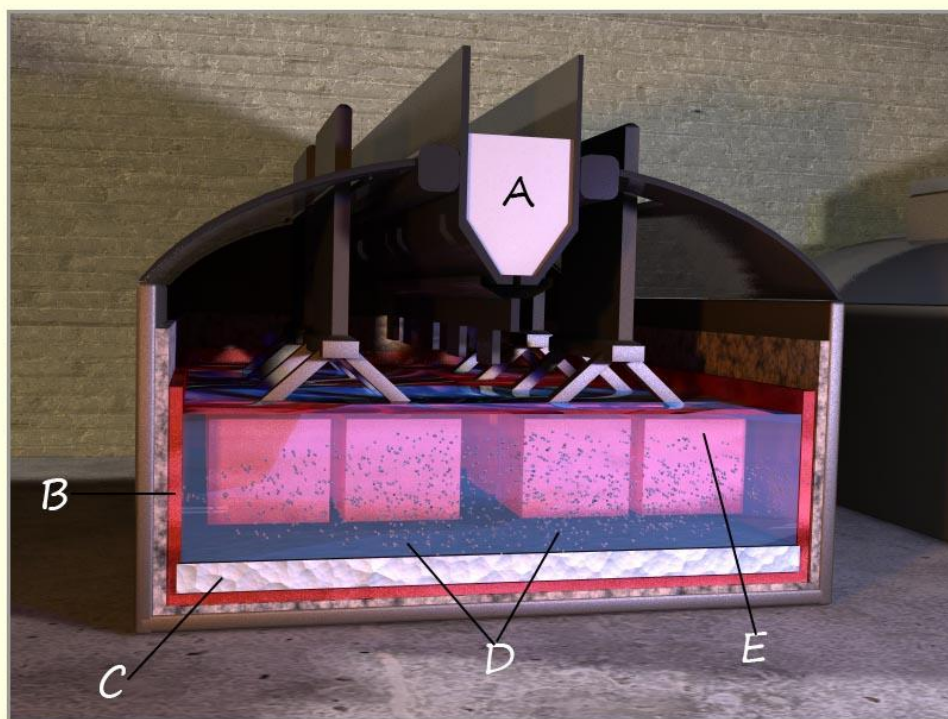
ALUMINIUM

USES, PROPERTIES AND EXTRACTION



Answer all the questions below then check your answers.

1. What is the main ore of aluminium called?
2. Aluminium is a reactive metal; it is fairly high up the reactivity series. How are reactive metal like aluminium extracted from their ores?
3. Below is an image showing a cell used to extract aluminium from its ore. Label the parts A-E as fully as you can.



A

B

C

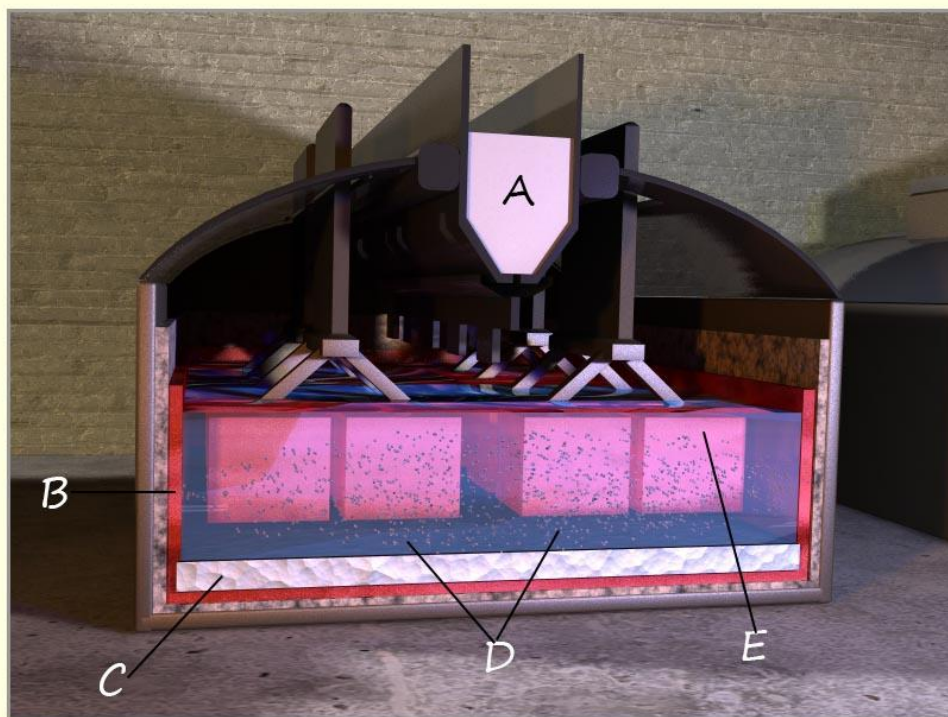
D

E

4. What materials are the anodes and cathodes made from? Why is this material used?
5. Why is cryolite added to the cell?
6. Why do the anodes need to be regularly replaced?
7. What gas is released at the anodes?
8. How is the aluminium removed from the cell?
9. Aluminium ore is mainly aluminium oxide, Al_2O_3 .
 - i. Aluminium is a group III metal, what charge do its ions have?
 - ii. Where in the cell does reduction take place?
 - iii. Where in the cell does oxidation take place?
 - iv. Write an ion electron half equation to show the reduction of aluminium ions.
 - v. Write an ion electron half equation to show the oxidation of oxide ions at the anode.
 - vi. Is the reaction to extract aluminium from its ore by electrolysis a redox reaction? Explain your answer
10. What are the main uses of the aluminium metal produced by electrolysis?

Answers

1. What is the main ore of aluminium called? *Bauxite*
2. Aluminium is a reactive metal, it is fairly high up the reactivity series. How are reactive metal like aluminium extracted from their ores? *electrolysis*
3. Below is an image showing a cell used to extract aluminium from its ore. Label the parts A-E as fully as you can.



- A. Hopper containing fresh bauxite and cryolite which is dropped into the cell to keep it topped up.
- B. This is the cathode. The cell is lined with a thick layer of graphite which acts as the cathode.

- C. This is the aluminium metal which is produced in the cell. The cell operates above the melting point of aluminium, so the aluminium which collects at the bottom of the cell is a liquid.
- D. This is the electrolyte. It is a solution of aluminium oxide dissolved in liquid cryolite at around 850°C .
- E. This is one of the many anodes in the cell. The gas bubbling off at the anodes is carbon dioxide gas, produced as they slowly burn away.

4. What materials are the anodes and cathodes made from? Why is this material used?

Graphite, it is a good conductor and fairly inexpensive and readily available.

5. Why is cryolite added to the cell? Aluminium oxide has a very high melting point. In order for electrolysis to work the aluminium oxide needs to be molten or in solution. It requires too much energy to melt the aluminium oxide, it would be too expensive. Aluminium oxide dissolves in molten cryolite at around 850°C , this is a much lower melting point than the aluminium ore, this is well above 2000°C , this molten solution or electrolyte will conduct electricity and so allow electrolysis to take place.

6. Why do the anodes need to be regularly replaced? Oxygen gas is produced at the anodes from the electrolysis of aluminium oxide, since the cell is at approximately 850°C , the carbon anodes simply burn away with the oxygen produced there.

7. What gas is released at the anodes? Carbon dioxide

8. How is the aluminium removed from the cell? It is a liquid in the cell so is either siphoned out or run out from the base of the cell.
9. Aluminium ore is mainly aluminium oxide, Al_2O_3 .
- i. Aluminium is a group III metal, what charge does its ions have? Al^{3+}
- ii. Where in the cell does reduction take place? *cathode*
- iii. Where in the cell does oxidation take place? *anode*
- iv. Write an ion electron half equation to show the reduction of aluminium ions.



- v. Write an ion electron half equation to show the oxidation of oxide ions at the anode.



Oxygen is a diatomic gas so the equation needs to be multiplied by 2.



- vi. Is the reaction to extract aluminium from its ore by electrolysis a redox reaction?

Yes, aluminium ions are REDuced and oxide ions are OXidised.

10. What are the main uses of the aluminium metal produced by electrolysis?

- *Alloys used in aircraft industries and construction.*
- *Door and window frames*
- *Car and motorbike manufacturers.*