

29 Which statement about the extraction of aluminium by electrolysis is correct?

- A** Aluminium oxide is dissolved in molten cryolite to increase its melting point.
- B** At the cathode, oxygen ions lose electrons to form oxygen gas.
- C** The carbon in the graphite anode reacts with oxygen gas forming carbon dioxide.
- D** The reaction at the anode is $Al^{3+} + 3e^{-} \rightarrow Al$.

28 Iron is extracted from hematite in the blast furnace.

Which reaction increases the temperature in the blast furnace to over 1500 °C?

- A** calcium carbonate → calcium oxide + carbon dioxide
- B** calcium oxide + silicon(IV) oxide → calcium silicate
- C** carbon + oxygen → carbon dioxide
- D** carbon dioxide + carbon → carbon monoxide

29 Aluminium is extracted by the electrolysis of purified bauxite.

Which row shows the half-equations at the electrodes and explains why one of the electrodes has to be replaced regularly?

	half-equation at anode	half-equation at cathode	electrode replacement
A	$2O^{2-} \rightarrow O_2 + 4e^{-}$	$Al^{3+} + 3e^{-} \rightarrow Al$	cathode replaced as it gets coated with aluminium
B	$2O^{2-} \rightarrow O_2 + 4e^{-}$	$Al^{3+} + 3e^{-} \rightarrow Al$	anode replaced as it burns away in oxygen
C	$Al^{3+} + 3e^{-} \rightarrow Al$	$2O^{2-} \rightarrow O_2 + 4e^{-}$	cathode replaced as it burns away in oxygen
D	$Al^{3+} + 3e^{-} \rightarrow Al$	$2O^{2-} \rightarrow O_2 + 4e^{-}$	anode replaced as it gets coated with aluminium

32 Iron is extracted from iron(III) oxide in the blast furnace.

Three steps in the process are listed.

- 1 Carbon (coke) is completely oxidised.
- 2 Iron(III) oxide is reduced.
- 3 Carbon dioxide is reduced to carbon monoxide.

What is the correct order of the steps in the extraction of iron?

- A** 1 → 2 → 3 **B** 1 → 3 → 2 **C** 2 → 1 → 3 **D** 3 → 1 → 2

33 Three different reactions that occur during the extraction of aluminium from purified bauxite are listed.

- 1 $Al^{3+} + 3e^{-} \rightarrow Al$
- 2 $C + O_2 \rightarrow CO_2$
- 3 $2O^{2-} \rightarrow O_2 + 4e^{-}$

Which reactions occur at the anode?

- A** 1 and 2 **B** 1 only **C** 2 and 3 **D** 3 only

2 Iron is extracted from iron ore in a blast furnace.

(a) The iron compound in the main iron ore used in the blast furnace is iron(III) oxide.

(i) State the name of the main iron ore used in the blast furnace.

..... [1]

(ii) State how the main source of heat is provided in the blast furnace.

..... [1]

(iii) Name the gaseous reducing agent in the blast furnace.

..... [1]

(iv) Write a symbol equation for the reduction of iron(III) oxide by the gaseous reducing agent in (a)(iii).

..... [2]

(v) The main impurity in iron ore is silicon(IV) oxide.

Write **two** symbol equations to show the role of limestone in removing silicon(IV) oxide from iron ore.

1

2

[2]

(b) Table 2.1 shows four different isotopes of iron, A, B, C and D.

Table 2.1

A	B	C	D
^{54}Fe	^{56}Fe	^{57}Fe	^{58}Fe

Explain why A, B, C and D are isotopes of iron.

.....

..... [2]

(c) Iron can form two different ions, Fe^{2+} and Fe^{3+} .

(i) Complete Table 2.2 to show the number of protons, neutrons and electrons in the two iron ions shown.

Table 2.2

	$^{54}\text{Fe}^{2+}$	$^{58}\text{Fe}^{3+}$
protons		
neutrons		
electrons		

[3]

(ii) Describe a test for aqueous Fe^{2+} ions.

test

observations

.....

[2]

(d) An oxidising agent converts Fe^{2+} ions to Fe^{3+} ions.

(i) Define the term oxidising agent.

.....

..... [2]

(ii) Explain why the conversion of Fe^{2+} ions to Fe^{3+} ions is described as oxidation.

..... [1]

(iii) The oxidising agent for the conversion of Fe^{2+} ions to Fe^{3+} ions is aqueous potassium manganate(VII).

State **one** condition needed for the oxidation to take place.

..... [1]

(e) Iodide ions, I^- , reduce Fe^{3+} ions to Fe^{2+} ions in aqueous solution.

Suggest the identity of the other product formed in this reaction.

..... [1]

28 Which process is used in the extraction of iron from hematite?

- A** electrolysis
- B** precipitation
- C** reduction
- D** fractional distillation

28 Which equation represents a reaction that occurs in a blast furnace during the extraction of iron from hematite?

- A** $\text{Ca} + \text{CO}_2 \rightarrow \text{CaO} + \text{CO}$
- B** $\text{Fe}_2\text{O}_3 + 3\text{Ca} \rightarrow 2\text{Fe} + 3\text{CaO}$
- C** $\text{Ca}(\text{OH})_2 \rightarrow \text{CaO} + \text{H}_2\text{O}$
- D** $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$

30 Which row gives the symbol equation for the formation of carbon monoxide and for the reduction of iron(III) oxide in a blast furnace?

	equation for the formation of carbon monoxide	equation for the reduction of iron(III) oxide
A	$2\text{C} + \text{O}_2 \rightarrow 2\text{CO}$	$\text{FeO} + \text{CO} \rightarrow \text{Fe} + \text{CO}_2$
B	$\text{CO}_2 + \text{C} \rightarrow 2\text{CO}$	$\text{FeO} + \text{CO} \rightarrow \text{Fe} + \text{CO}_2$
C	$\text{C} + \text{O}_2 \rightarrow \text{CO}_2$	$\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$
D	$\text{CO}_2 + \text{C} \rightarrow 2\text{CO}$	$\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$