Metals – 2023 IGCSE Chemistry 0620

1. Nov/2023/Paper_0620/11/No.25

Zinc oxide reacts with carbon to produce zinc.

Which equation represents this reaction?

A $2ZnO + C \rightarrow 2Zn + CO$

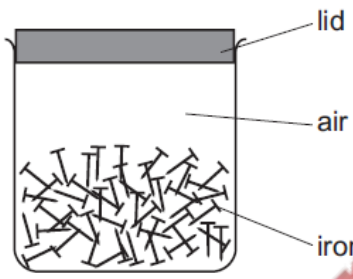
B $2ZnO + 2C \rightarrow 2Zn + 2CO_2$

C $ZnO + C \rightarrow Zn + CO$

D $ZnO + 2C \rightarrow Zn + 2CO_2$

2. Nov/2023/Paper_0620/11/No.26

Iron nails are stored in an airtight container.



The nails begin to rust after a few days.

How can the rusting of the nails be prevented?

A Leave the lid off.

B Replace the air with argon.

C Put the container in a warm place.

D Seal the container in a bag.

3. Nov/2023/Paper_0620/11/No.27

Four substances present in the blast furnace during iron extraction are listed.

1 calcium carbonate

2 carbon dioxide

3 carbon monoxide

4 iron(III) oxide

Which substances are both a reactant and a product during the reactions occurring in the blast furnace?

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

4. Nov/2023/Paper_0620/12/No.24

Which row describes the properties of a metal that can be used in the manufacture of aircraft?

	strength	density	ease of corrosion
A	high	high	corrodes easily
B	high	low	resists corrosion
C	low	high	corrodes easily
D	low	low	resists corrosion

5. Nov/2023/Paper_0620/12/No.25

Which metallic element is added to iron in the manufacture of stainless steel?

A carbon

B copper

C lead

D nickel

6. Nov/2023/Paper_0620/12/No.26

Which statement about the uses of metals is correct?

A Aluminium is used in the manufacture of overhead electrical cables as it has a high density.

B Aluminium is used to make food containers as it conducts electricity.

C Stainless steel is used in cutlery because it is resistant to rusting.

D Stainless steel is used to make chemical reactors because it is a soft alloy.

7. Nov/2023/Paper_0620/12/No.27

The list gives the order of some metals and hydrogen in the reactivity series.

Metal X is also included.

most reactive	K
	Mg
	Zn
	H
	X
least reactive	Cu

Which row shows the properties of metal X?

	reacts with dilute acids	oxide reduced by carbon
A	no	no
B	no	yes
C	yes	no
D	yes	yes

8. Nov/2023/Paper_0620/12/No.28

Which gas in the air is needed for iron to rust?

A argon

B carbon dioxide

C nitrogen

D oxygen

9. Nov/2023/Paper_0620/13/No.24

Cobalt is a transition element.

What is a property of cobalt?

A It can form coloured compounds.

B It is a poor electrical conductor.

C It has a low density.

D It has a low melting point.

10. Nov/2023/Paper_0620/13/No.25

Which statements about brass are correct?

1 It is an alloy of zinc and copper.

2 It is a compound of zinc and copper.

3 It is a mixture of zinc and copper.

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

11. Nov/2023/Paper_0620/13/No.26

Aluminium is used to make containers for storing food.

Which property makes it suitable for this use?

A conducts heat

B low density

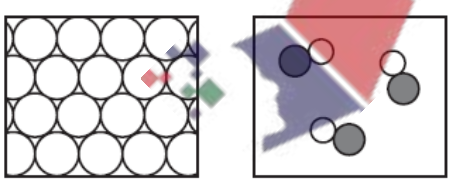
C resists corrosion

D shiny surface

12. Nov/2023/Paper_0620/13/No.27

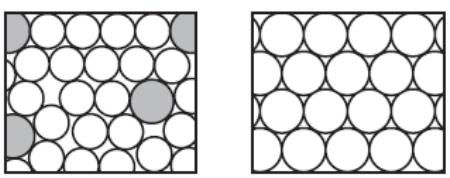
Which pair of diagrams represents both a pure metal and an alloy?

A



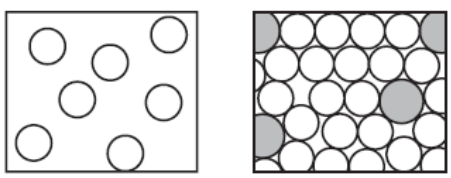
pure metal alloy

B



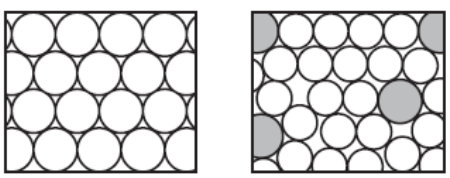
pure metal alloy

C



pure metal alloy

D



pure metal alloy

13. Nov/2023/Paper_0620/13/No.28

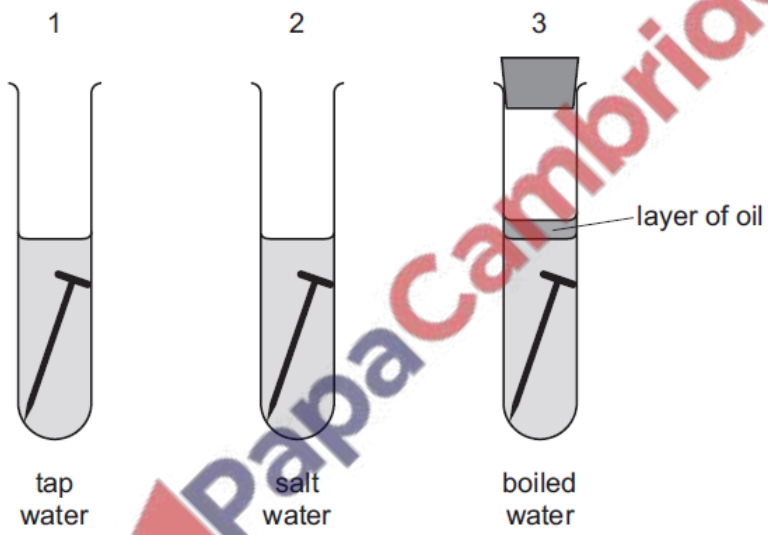
A metal M is between sodium and magnesium in the reactivity series.

Which reactions occur with M and its oxide?

	M reacts with steam	M can be extracted by heating its oxide with carbon
A	no	no
B	no	yes
C	yes	no
D	yes	yes

14. Nov/2023/Paper_0620/13/No.29

The diagrams show experiments to investigate rusting of iron nails.



In which test-tubes do the nails rust?

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

15. Nov/2023/Paper_0620/21/No.21

Which statements about the metal zinc are correct?

1 It is extracted from the ore bauxite.

2 It is used to galvanise steel.

3 It is used to make the alloy brass.

4 It reacts with dilute hydrochloric acid to produce hydrogen gas.

A 1, 2 and 4 **B** 1, 3 and 4 **C** 2, 3 and 4 **D** 2 and 3 only

16. Nov/2023/Paper_0620/21/No.23

Which row compares the strength of alloys with pure metals and explains the difference in strength?

	strength of an alloy compared to a pure metal	explanation
A	weaker	larger atoms slide more easily over smaller atoms
B	weaker	larger atoms make it harder for layers to slide over one another
C	stronger	larger atoms slide more easily over smaller atoms
D	stronger	larger atoms make it harder for layers to slide over one another

17. Nov/2023/Paper_0620/21/No.24

Zinc oxide reacts with carbon to produce zinc.

Which equation represents this reaction?

A $2ZnO + C \rightarrow 2Zn + CO$

B $2ZnO + 2C \rightarrow 2Zn + 2CO_2$

C $ZnO + C \rightarrow Zn + CO$

D $ZnO + 2C \rightarrow Zn + 2CO_2$

18. Nov/2023/Paper_0620/21/No.25

When a piece of aluminium foil is added to dilute hydrochloric acid, no effervescence is seen.

Which statement explains why no effervescence is seen?

A Aluminium does not make a gas when it reacts with an acid.

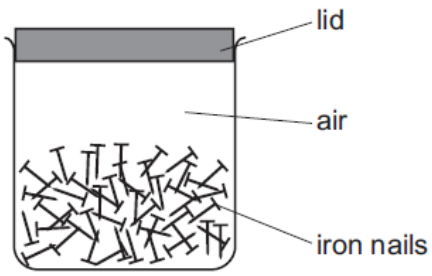
B Aluminium has a surface layer of aluminium oxide.

C Aluminium is less reactive than hydrogen.

D Aluminium only reacts with concentrated acid.

19. Nov/2023/Paper_0620/21/No.27

Iron nails are stored in an airtight container.



The nails begin to rust after a few days.

How can the rusting of the nails be prevented?

A Leave the lid off.

B Replace the air with argon.

C Put the container in a warm place.

D Seal the container in a bag.

20. Nov/2023/Paper_0620/21/No.28

Four substances present in the blast furnace during iron extraction are listed.

1 calcium carbonate

2 carbon dioxide

3 carbon monoxide

4 iron(III) oxide

Which substances are both a reactant and a product during the reactions occurring in the blast furnace?

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

21. Nov/2023/Paper_0620/22/No.25

The list gives the order of some metals and hydrogen in the reactivity series.

Metal X is also included.

most reactive	K
	Mg
	Zn
	H
	X
least reactive	Cu

Which row shows the properties of metal X?

	reacts with dilute acids	oxide reduced by carbon
A	no	no
B	no	yes
C	yes	no
D	yes	yes

22. Nov/2023/Paper_0620/22/No.26

When zinc is added to an aqueous solution containing magnesium ions, there is no reaction.

Which species has the greatest tendency to lose electrons?

A Mg **B** Mg^{2+} **C** Zn **D** Zn^{2+}

23. Nov/2023/Paper_0620/22/No.27

Which gas in the air is needed for iron to rust?

A argon

B carbon dioxide

C nitrogen

D oxygen

24. Nov/2023/Paper_0620/22/No.28

Which coating prevents iron from rusting even when the coating is damaged?

A grease

B paint

C plastic

D zinc

25. Nov/2023/Paper_0620/22/No.29

Why is limestone added to the blast furnace?

A It neutralises the molten slag produced.

B It reacts with impurities to form slag.

C It releases carbon dioxide which reduces the iron(III) oxide.

D It removes acidic gases such as carbon dioxide.

26. Nov/2023/Paper_0620/23/No.26

Which metal has variable oxidation numbers?

A aluminium

B calcium

C copper

D sodium

27. Nov/2023/Paper_0620/23/No.27

Which statement about alloys is correct?

A Alloys are pure metal elements.

B At least two or more metals react together to make alloys.

C Alloys can be harder and stronger than a pure metal.

D Steel is **not** an alloy because it can contain the non-metal carbon.

28. Nov/2023/Paper_0620/23/No.28

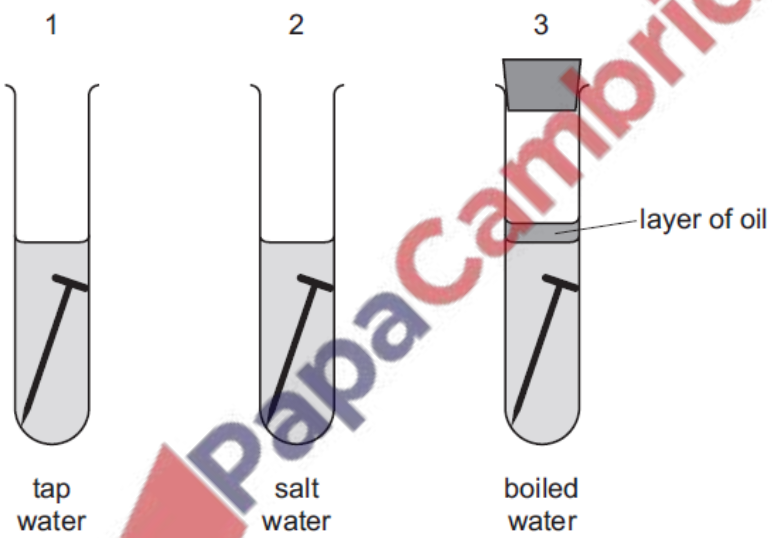
A metal M is between sodium and magnesium in the reactivity series.

Which reactions occur with M and its oxide?

	M reacts with steam	M can be extracted by heating its oxide with carbon
A	no	no
B	no	yes
C	yes	no
D	yes	yes

29. Nov/2023/Paper_0620/23/No.29

The diagrams show experiments to investigate rusting of iron nails.



In which test-tubes do the nails rust?

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

30. Nov/2023/Paper_0620/23/No.30

Which equation represents a reaction that takes place when iron is extracted from its ore in the blast furnace?

A $CaO + SiO_2 \rightarrow CaSiO_3$

B $CaO + CO_2 \rightarrow CaCO_3$

C $2CO \rightarrow C + CO_2$

D $2Fe + 3CO_2 \rightarrow Fe_2CO_3 + 3CO$

31. Nov/2023/Paper_0620/31/No.5

This question is about metals and metal compounds.

(a) Table 5.1 shows some properties of some Group I metals.

Table 5.1

metal	melting point in °C	boiling point in °C	observations on reaction with water	solubility of metal hydroxide in g/dm^3 at room temperature
sodium	98	883	bubbles form rapidly but no flame	
potassium	63	760		1130
rubidium		686	explodes	1980
caesium	29	669	explodes	3860

Use the information in Table 5.1 to predict:

(i) the melting point of rubidium ..... [1]

(ii) the solubility of sodium hydroxide at room temperature ..... [1]

(iii) the observations when potassium reacts with water

.....

..... [1]

(iv) the physical state of caesium at 20 °C. Give a reason for your answer.

physical state .....

reason .....

..... [2]

(b) Iron is extracted in a blast furnace by reduction of iron(III) oxide, Fe_2O_3, with carbon monoxide.

Carbon monoxide is produced by the reaction of carbon with carbon dioxide.

$$C + CO_2 \rightarrow 2CO$$

(i) Explain how this equation shows that carbon dioxide is reduced.

.....

..... [1]

(ii) Name the type of chemical reaction where oxidation and reduction take place simultaneously.

..... [1]

(iii) Calcium carbonate is added to the blast furnace.

The calcium carbonate undergoes thermal decomposition.

State the meaning of the term thermal decomposition.

.....

..... [2]

(c) Stainless steel is an alloy of iron.

(i) Give **one** reason why alloys are more useful than pure metals.

..... [1]

(ii) Brass is an alloy.

Choose the diagram, **A**, **B**, **C** or **D**, in Fig. 5.1 that best shows the structure of brass.

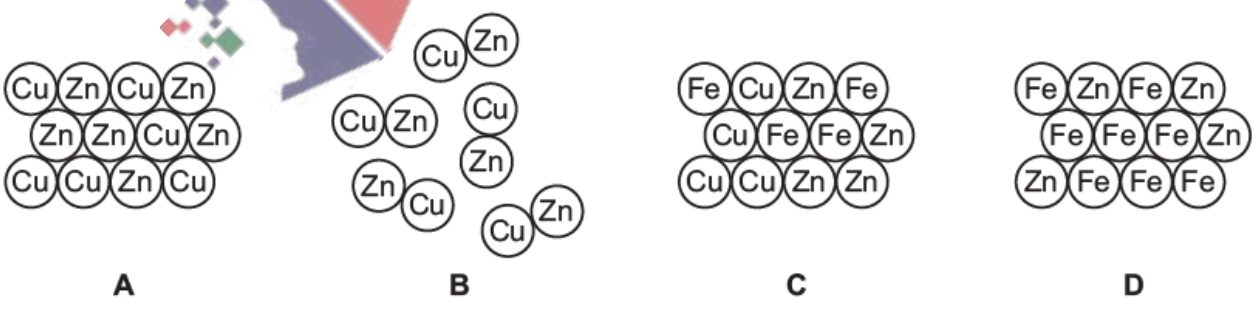


Fig. 5.1

diagram ..... [1]

(d) Table 5.2 gives some observations about the reactivity of four metals with dilute hydrochloric acid.

Table 5.2

metal	observations
iron	bubbles form slowly
magnesium	bubbles form very quickly
mercury	no bubbles form
tin	bubbles form very slowly

Put the four metals in order of their reactivity.
Put the least reactive metal first.

least reactive → most reactive

[2]

[Total: 13]

32. Nov/2023/Paper_0620/32/No.5

This question is about metals.

(a) Table 5.1 shows some properties of some Group I metals.

Table 5.1

metal	melting point in °C	boiling point in °C	atomic volume in cm^3/mol	observations on reaction with water
lithium	181	1342	12.9	
sodium	98		23.7	bubbles form rapidly but no flame
potassium	63	760	45.4	bubbles form rapidly and flame seen
rubidium	39	686		explodes

Use the information in Table 5.1 to predict:

(i) the boiling point of sodium ..... [1]

(ii) the atomic volume of rubidium ..... [1]

(iii) the observations when lithium reacts with water .....

..... [1]

(iv) the physical state of lithium at 1300 °C. Give a reason for your answer.

physical state .....

reason .....

.....

[2]

(b) Iron is extracted in a blast furnace by reduction of iron(III) oxide, Fe_2O_3, with carbon monoxide.

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

(i) Explain how this equation shows that iron(III) oxide is reduced.

.....

..... [1]

(ii) Choose the phrase which describes the meaning of (III) in iron(III) oxide.

Tick (✓) **one** box.

the number of oxygen atoms in iron(III) oxide	☐
the oxidation number of iron in iron(III) oxide	☐
the number of CO molecules which react with iron(III) oxide	☐
the number of electrons in one atom of iron	☐

[1]

(iii) Calcium carbonate is added to the blast furnace.

The calcium carbonate undergoes thermal decomposition.

Complete the word equation for the thermal decomposition of calcium carbonate.

calcium carbonate → ..... + ...
....

[2]

(c) Stainless steel is an alloy.

(i) Choose the diagram, **A**, **B**, **C** or **D**, in Fig. 5.1 that best shows the structure of an alloy.

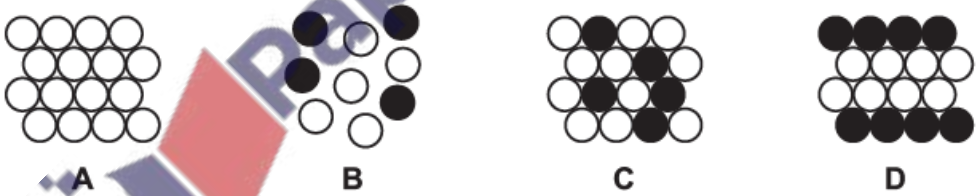


Fig. 5.1

diagram ..... [1]

(ii) Give **one** reason for using stainless steel instead of pure iron for cutlery.

..... [1]

(d) Table 5.2 gives the observations when four different metals react with dilute hydrochloric acid.

Table 5.2

metal	observations
iron	bubbles form slowly
mercury	no bubbles seen
strontium	bubbles form very quickly
tin	bubbles form very slowly

Put the four metals in order of their reactivity.
Put the least reactive metal first.

least reactive → most reactive

[2]

[Total: 13]

33. Nov/2023/Paper_0620/33/No.5

This question is about metals.

(a) Table 5.1 shows some properties of the Group I metals.

Table 5.1

metal	melting point in °C	boiling point in °C	atomic volume in cm^3/mol	observations on reaction with water
lithium	181	1342	12.9	bubbles form slowly but no flame
sodium	98	883	23.7	
potassium	63	760		bubbles form very rapidly and flame seen
rubidium		686	55.8	explodes

Use the information in Table 5.1 to predict:

(i) the melting point of rubidium ..... [1]

(ii) the atomic volume of potassium ..... [1]

(iii) the observations when sodium reacts with water .....

..... [1]

(iv) the physical state of sodium at 1300 °C. Give a reason for your answer.

physical state .....

reason .....

.....

[2]

(b) Iron is extracted in a blast furnace by reduction of iron(III) oxide.

(i) In the first step, carbon burns in air to form carbon dioxide.

State the percentage of oxygen in clean, dry air.

..... [1]

(ii) In the second step, carbon monoxide is produced by the reaction of carbon dioxide with carbon.

$$CO_2 + C \rightarrow 2CO$$

Choose the correct statement about this reaction.

Tick (✓) **one** box.

the carbon dioxide is oxidised and the carbon is reduced	☐
both carbon dioxide and carbon are oxidised	☐
the carbon dioxide is reduced and the carbon is oxidised	☐
both carbon dioxide and carbon are reduced	☐

[1]

(iii) In the third step, iron(III) oxide is reduced by carbon monoxide.
The reaction is exothermic.

State the meaning of the term exothermic.

.....

..... [2]

(c) Calcium carbonate is added to the blast furnace.
The calcium carbonate breaks down as shown.

$$\text{calcium carbonate} \xrightarrow{\text{high temperature}} \text{calcium oxide} + \text{carbon dioxide}$$

(i) Name the type of chemical reaction that takes place.

..... [1]

(ii) Complete this sentence about the calcium oxide that is produced in the blast furnace.

Calcium oxide reacts with impurities in the iron ore to form ..... . [1]

(d) Table 5.2 gives the observations when four different metals react with air.

Table 5.2

metal	observations
cerium	forms an oxide layer slowly without heating
copper	forms an oxide layer only when heated
gold	does not form an oxide layer even when heated
rubidium	forms an oxide layer quickly without heating

Put the four metals in order of their reactivity.
Put the least reactive metal first.

least reactive ⟶ most reactive

[2]

[Total: 13]

34. Nov/2023/Paper_0620/41/No.2(c, d)

(c) Aluminium is extracted from its purified ore as shown in Fig. 2.1.

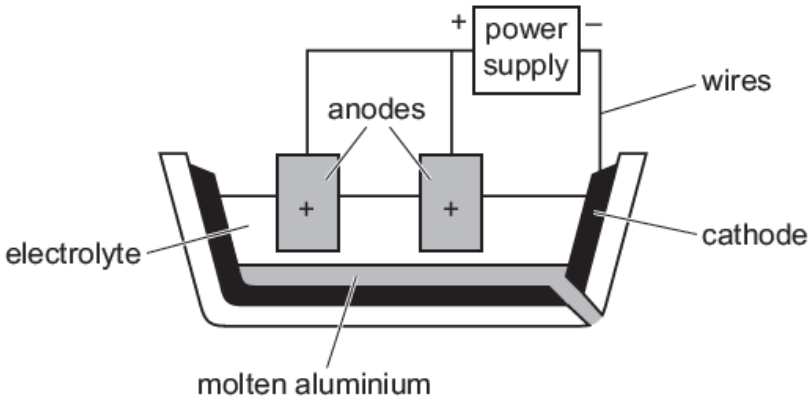


Fig. 2.1

(i) Name the ore of aluminium.

..... [1]

(ii) The electrolyte contains aluminium oxide and one other substance.

Name the other substance and explain why it is used.

name .....

explanation .....

.....

[2]

(iii) Write the ionic half-equation for the reaction at the cathode.

..... [2]

(iv) Explain why the anodes need frequent replacement.

.....

..... [2]

(d) State **two** physical properties of aluminium that make it suitable for use in overhead electrical cables.

1 .....

2 .....

[2]

35. Nov/2023/Paper_0620/42/No.3

Iron is manufactured in a blast furnace.

(a) Three of the starting materials added to the blast furnace are coke, iron ore and limestone.

Name the **other** starting material added to the blast furnace.

..... [1]

(b) The source of iron in the blast furnace is Fe_2O_3. Fe_2O_3 is found in iron ore.

(i) Name the main ore of iron which contains Fe_2O_3.

..... [1]

(ii) The iron in Fe_2O_3 is reduced by reaction with carbon monoxide. The unbalanced symbol equation is shown.

Complete the equation.

$$Fe_2O_3 + ...CO \rightarrow .....CO_2 + ...Fe$$ [1]

(iii) State the change in oxidation number of iron in the reaction in **(ii)**.

from ..... to ..... [2]

(iv) Explain how the change of oxidation number shows that iron has been reduced.

..... [1]

(c) The major impurity in iron ore is silicon(IV) oxide. Limestone is added to the blast furnace to remove this impurity.

Write two symbol equations to show how silicon(IV) oxide is removed. For each equation, state the type of chemical reaction that takes place.

equation 1 .....

type of chemical reaction .....

equation 2 .....

type of chemical reaction .....

[4]

(d) Iron is converted to steel by mixing it with carbon and other elements.

(i) State the term given to a substance which is a mixture of a metal and other elements.

..... [1]

(ii) Name **one** element, other than carbon, mixed with iron in the making of stainless steel.

..... [1]

(e) Preventing the rusting of steel is important.

State the chemical name of rust.

..... [1]

(f) Steel can be coated with zinc to prevent rusting. This provides both a barrier method and sacrificial protection.

(i) State the term used for coating steel with zinc.

..... [1]

(ii) Describe another barrier method for preventing rusting.

..... [1]

(iii) Explain how zinc provides sacrificial protection.

.....

..... [2]

[Total: 17]

36. Nov/2023/Paper_0620/43/No.5

This question is about iron.

(a) (i) Describe the bonding in a metallic element such as iron.

You may include a labelled diagram as part of your answer.

.....

.....

..... [3]

(ii) Explain why iron conducts electricity when it is solid.

..... [1]

(b) Iron is extracted from hematite in the blast furnace as shown in Fig. 5.1.

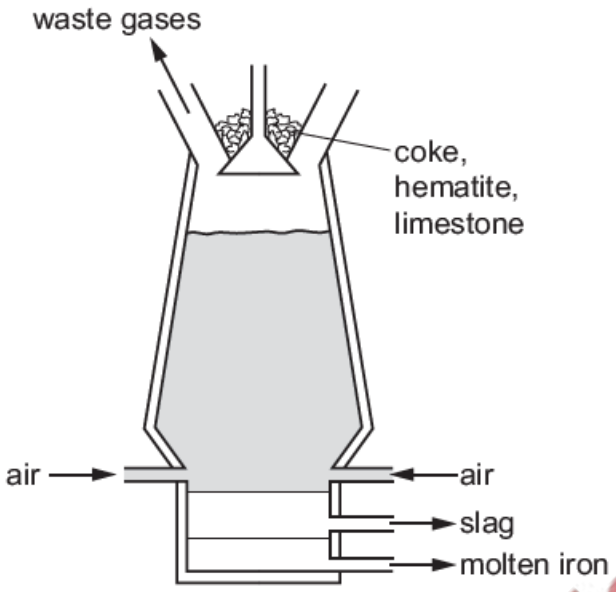


Fig. 5.1

(i) Give **two** reasons why coke is added to the blast furnace.

1 .....

2 .....

[2]

(ii) Explain how limestone removes the impurities in the hematite.

.....

.....

..... [2]

(iii) Hematite contains iron(III) oxide.

Write a symbol equation for the conversion of iron(III) oxide to iron in the blast furnace.

..... [2]

(iv) Suggest why the iron produced in the blast furnace is molten.

..... [1]

(c) Most iron is converted into steel. Steel is an alloy.

Steel is more useful than pure iron because it is harder and stronger.

Explain why the structure of alloys causes them to be harder and stronger than pure metals.

You may include a diagram as part of your answer.

.....

..... [2]

(d) Iron forms rust.

Rusting is prevented by coating iron with zinc.

(i) Name the substances that react with iron to form rust.

..... [1]

(ii) Name the process in which zinc is used to coat iron to prevent rusting.

..... [1]

(iii) Explain how the coating of zinc prevents rusting if the zinc is **not** scratched.

..... [1]

(iv) When zinc is scratched the iron becomes exposed.

Explain how the zinc continues to prevent rusting.

.....

.....

..... [2]

[Total: 18]