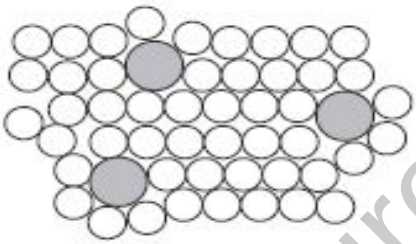
Metals

Content

1 The diagram shows the structure of an alloy.



Which statement about alloys is correct?

A Alloys can only be formed by mixing copper or iron with other metals.

B High carbon steel alloys are soft and easily shaped.

C In an alloy there is attraction between positive ions and a 'sea of electrons'.

D The alloy brass has a chemical formula.

2 The list shows the position of metal X in the reactivity series of metals.

Na Al Fe X Cu Ag

Which methods could be used to extract metal X?

1 electrolysis of the solid metal oxide

2 heating the metal oxide with carbon

3 heating the metal oxide with copper

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

3 An old commercial process for aluminium extraction used large quantities of sodium to convert aluminium ions into aluminium atoms.

The modern aluminium extraction process uses electrolysis.

Which statements are correct?

In the old process:

1 The sodium acted as an oxidising agent.

2 The reaction worked because sodium is more reactive than aluminium.

In the modern process:

3 The equation for the cathode reaction is $Al^{3+}(l) + 3e^- \rightarrow Al(l)$.

4 The carbon anode needs replacing often because it is oxidised to carbon dioxide by the oxygen evolved.

	old process	modern process
A	1 and 2	3 and 4
B	1 and 2	3 only
C	1 only	4 only
D	2 only	3 and 4

4 Which element is always present in steel?

A calcium

B copper

C iron

D zinc

5 Aluminium is used to make saucepans because of its apparent lack of reactivity.

Which property of aluminium explains its unreactivity?

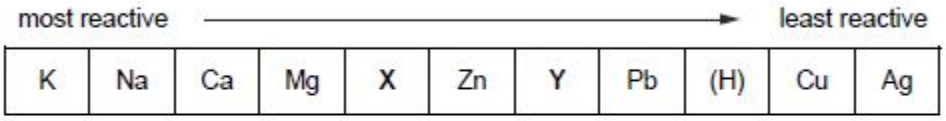
A It has a layer of oxide on its surface.

B It has a low density.

C It is a good conductor of electricity.

D It is in Group III of the Periodic Table.

6 The reactivity series for some metals, with two gaps labelled **X** and **Y**, is shown.



Which row correctly identifies metals **X** and **Y** and the method of extraction of **Y** from its ore?

	metal **X**	metal **Y**	method of extraction of **Y**
A	Al	Fe	electrolysis
B	Al	Fe	reduction with carbon
C	Fe	Al	electrolysis
D	Fe	Al	reduction with carbon

7 Iron can be extracted from the ore haematite, Fe_2O_3.

What is the maximum mass of iron that could be produced from 500 kg of haematite?
[A_r: O, 16; Fe, 56]

A 160 kg **B** 240 kg **C** 350 kg **D** 420 kg

8 Brass is an alloy.

Which statement about brass is correct?

A It contains a sea of electrons.

B It contains positive and negative ions which are free to move.

C It is a compound of a metal and a non-metal.

D It is a compound of two or more metals.

9 Which statement about the reactions of some metals and metal compounds is correct?

A Copper reacts with dilute hydrochloric acid to form hydrogen.

B Sodium oxide is reduced to sodium metal by heating with carbon.

C Zinc carbonate is more thermally stable than sodium carbonate.

D Zinc displaces copper from aqueous copper(II) sulfate.

10 Which metal is used in the galvanising of iron?

A calcium

B copper

C lead

D zinc

11 Iron is obtained in the blast furnace from the ore haematite.

Which process takes place in the blast furnace?

A Calcium carbonate is used to remove acidic impurities.

B Coke is reduced to carbon dioxide.

C Haematite is oxidised by carbon monoxide.

D Haematite undergoes thermal decomposition.

12 Aluminium is a Group III element. It is extracted from its ore by electrolysis.

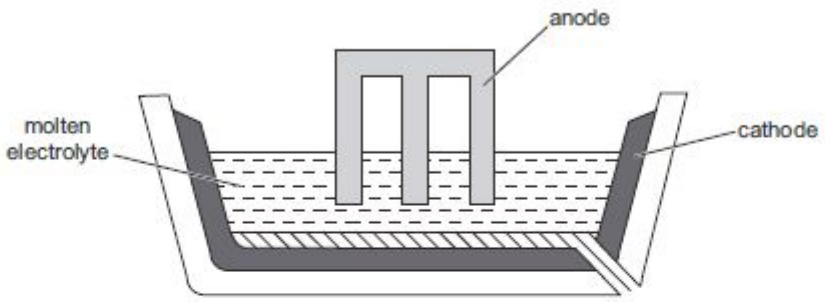
The position of aluminium in the Periodic Table indicates that its aqueous ion is likely to be .....1..... .

Its method of extraction indicates that aluminium is .....2..... in the reactivity series.

Which words complete gaps 1 and 2?

	1	2
A	coloured	high
B	coloured	low
C	colourless	high
D	colourless	low

13 The diagram shows a cell that can be used to extract a metal from its oxide.



Molten aluminium oxide, copper(II) oxide, lead(II) oxide and magnesium oxide are each electrolysed in separate cells. Each cell receives the same number of electrons.

Which statement is correct?

A All the metals can also be extracted from their oxides using coke.

B The anode and cathode should be made of the metal being extracted.

C The pure metal is always produced at the cathode.

D The same mass of each metal is formed.

14 Aircraft manufacture requires a metal that:

1 has a relatively low density

2 is resistant to corrosion.

Which of these conditions does aluminium satisfy?

A 1 and 2

B 1 only

C 2 only

D neither 1 nor 2

15 Elements in Group I of the Periodic Table react with water.

Which row describes the products made in the reaction and the trend in reactivity of the elements?

	products	trend in reactivity
A	metal hydroxide and hydrogen	less reactive down the group
B	metal hydroxide and hydrogen	more reactive down the group
C	metal oxide and hydrogen	less reactive down the group
D	metal oxide and hydrogen	more reactive down the group

16 Iron is extracted from iron oxide using carbon monoxide as shown.

$$\text{iron oxide} + \text{carbon monoxide} \rightarrow \text{iron} + \text{carbon dioxide}$$

Which statement is correct?

A Carbon monoxide is oxidised to carbon dioxide.

B Carbon monoxide is reduced to carbon dioxide.

C Iron is oxidised to iron oxide.

D Iron oxide is oxidised to iron.

17 Uranium is a radioactive element but it is also a typical metal.

What is **not** a property of uranium?

A It can be hammered into shape.

B It conducts heat.

C It is used as a source of energy.

D It forms covalent compounds.

18 Which metal reacts with steam but **not** with cold water?

A calcium

B copper

C sodium

D zinc

19 Iron is extracted from hematite in the blast furnace.

The hematite contains silicon(IV) oxide (sand) as an impurity.

What reacts with this impurity to remove it?

A calcium oxide

B carbon

C carbon dioxide

D slag

20 The bodies of aircraft are often made using aluminium.

Which two properties of aluminium make it suitable for this use?

	property 1	property 2
A	good conductor of electricity	good conductor of heat
B	good conductor of electricity	strong
C	good conductor of heat	low density
D	strong	low density

21 Aluminium is an important metal with many uses.

Some of its properties are listed.

1 It is a good conductor of heat.

2 It has a low density.

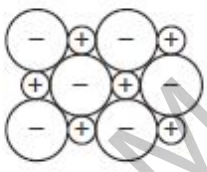
3 It has an oxide layer that prevents corrosion.

Which set of properties help to explain the use of aluminium for cooking and storing food?

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

22 Which diagram could represent the structure of an alloy?

A



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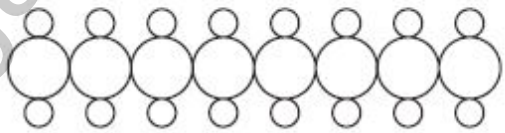

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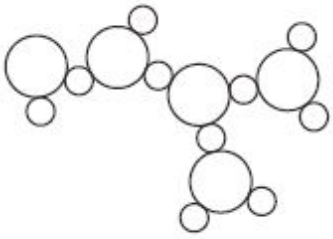


D

23 The table shows the results of adding three metals, P, Q and R, to dilute hydrochloric acid and to water.

metal	dilute hydrochloric acid	water
P	hydrogen produced	hydrogen produced
Q	no reaction	no reaction
R	hydrogen produced	no reaction

What is the order of reactivity of the metals?

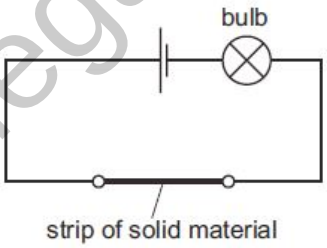
	most reactive ⟶		least reactive
A	P	R	Q
B	P	Q	R
C	R	Q	P
D	R	P	Q

24 Which metal is attached to underground pipes made of iron, to provide sacrificial protection from corrosion?

A Ag **B** Cu **C** Mg **D** Pb

25 The diagram shows a circuit used to test the electrical conductivity of strips of solid materials. If the material conducts, the bulb lights.

Strips of brass, nylon and zinc are each tested separately by connecting them into the circuit.



For which strips does the bulb light?

A brass, nylon and zinc

B brass and nylon only

C nylon and zinc only

D zinc and brass only

26 Aluminium is a metal that is often used to make caps for bottles. When thrown away and buried the soil, the caps do not corrode.

Why is this?

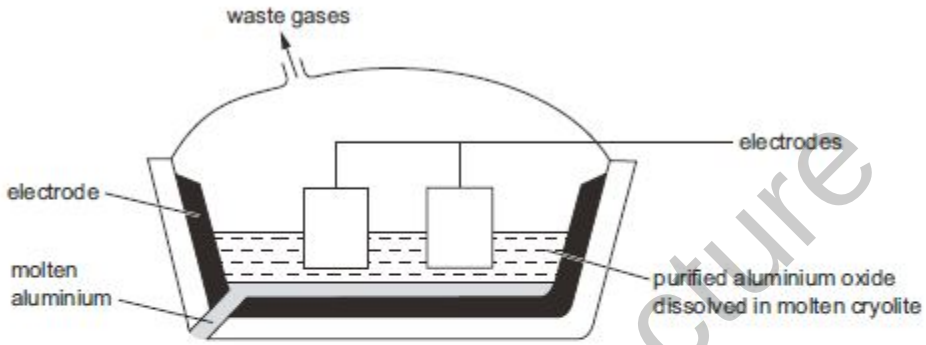
A Aluminium does not react with acids.

B Aluminium does not react with alkalis.

C Aluminium is alloyed with other metals.

D Aluminium is protected by a layer of oxide.

27 Aluminium is obtained by the electrolysis of molten aluminium oxide.



Which row shows the electrode at which aluminium is formed and the correct equation for its formation?

	electrode	equation
A	anode	$Al^{3+} + 3e^- \rightarrow Al$
B	anode	$Al^{3+} - 3e^- \rightarrow Al$
C	cathode	$Al^{3+} + 3e^- \rightarrow Al$
D	cathode	$Al^{3+} - 3e^- \rightarrow Al$

28 Which two substances are removed from the bottom of a blast furnace?

1 coke

2 iron

3 limestone

4 slag

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

29 Some metals and the compounds in their ores are shown.

metal	Al	Ca	Pb	Na	Fe	Mg
compound in their ore	Al_2O_3	$CaCO_3$	PbS	NaCl	Fe_2O_3	$MgCO_3$

Which type of reaction occurs in the extraction of each of these metals from their ore?

A decomposition by heat

B electrolysis

C precipitation

D reduction

30 After the collapse of a river bridge, a new car was immersed in the river water for several months.

When it was recovered, the parts of the car made of steel, an alloy of iron, were found to be corroded. The parts made of aluminium were not corroded.

Which statement explains these differences in corrosion?

A Aluminium has a coating of aluminium oxide.

B Aluminium has a very low density.

C Aluminium is an excellent conductor of electricity.

D Aluminium is less reactive than iron.

31 The results of experiments involving four metals, W, X, Y and Z, and their ions are shown.

$$Y(s) + Z^+(aq) \rightarrow Y^+(aq) + Z(s)$$

$$W(s) + X^+(aq) \rightarrow \text{no reaction}$$

$$Z(s) + X^+(aq) \rightarrow Z^+(aq) + X(s)$$

What is the order of reactivity of the four metals, most reactive to least reactive?

A $W \rightarrow X \rightarrow Y \rightarrow Z$

B $X \rightarrow W \rightarrow Z \rightarrow Y$

C $Y \rightarrow Z \rightarrow X \rightarrow W$

D $Z \rightarrow Y \rightarrow W \rightarrow X$

32 Metals have a structure of positive ions in a 'sea of electrons'. Metals are malleable because it is possible to force the ions to slide over each other.

The alloy brass is .....1..... malleable than pure copper and than pure zinc.

Brass is .....2..... to conduct electricity.

Which words correctly complete gaps 1 and 2?

	1	2
A	less	unable
B	less	able
C	more	unable
D	more	able

33 Aluminium is used in the manufacture of aeroplanes.

What is a property of aluminium and is also a reason for this use?

A It has a low density.

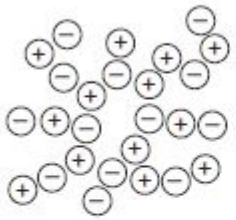
B It is a good conductor of electricity.

C It is a poor conductor of heat.

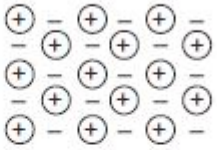
D It is covered in an unreactive layer of aluminium carbonate.

34 Which diagram best represents the structure of a solid metal?

A



B



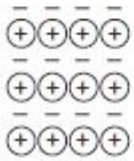
key

⊖ a negative ion

⊕ a positive ion

– an electron

C



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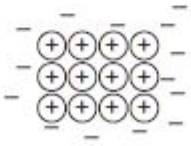
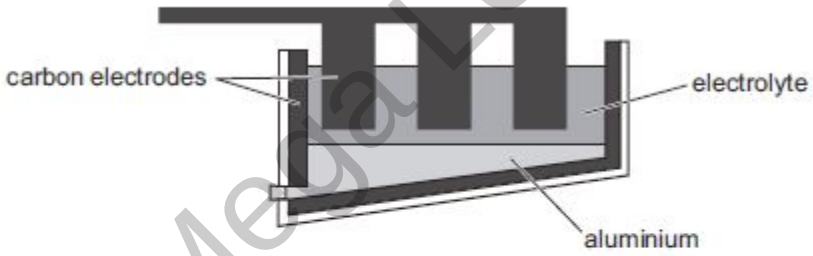


35 The diagram shows the apparatus used to extract aluminium from aluminium oxide.



Which statement about this process is correct?

A The electrolyte is a solid mixture of aluminium oxide and cryolite.

B The electrolyte is aluminium oxide dissolved in water.

C The equation for the reaction at the positive electrode is $Al^{3+} + 3e^- \rightarrow Al$

D The positive carbon electrodes lose mass during the process and need regular replacement.

36 Which reaction is **not** a redox reaction?

A $CaCO_3 \rightarrow CaO + CO_2$

B $2C + O_2 \rightarrow 2CO$

C $C + CO_2 \rightarrow 2CO$

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

37 Attaching pieces of magnesium to underground iron pipes can protect the iron from corrosion.

Which reaction protects the iron from corrosion?

A $Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$

B $Fe(s) \rightarrow Fe^{2+}(aq) + 2e^-$

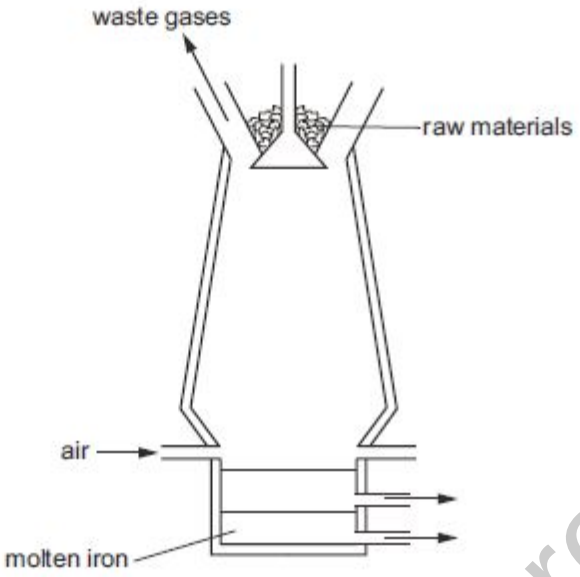
C $Mg^{2+}(aq) + 2e^- \rightarrow Mg(s)$

D $Mg(s) \rightarrow Mg^{2+}(aq) + 2e^-$

38 Which row correctly compares high carbon steels and low carbon steels?

	high carbon steels	low carbon steels
A	stronger	more brittle
B	stronger	more easily shaped
C	weaker	more brittle
D	weaker	more easily shaped

39 Iron is extracted from haematite in the blast furnace.



Which other raw material is added in this extraction?

A bauxite

B cryolite

C limestone

D slag

40 Which gases are all present at the positive electrode during the manufacture of aluminium?

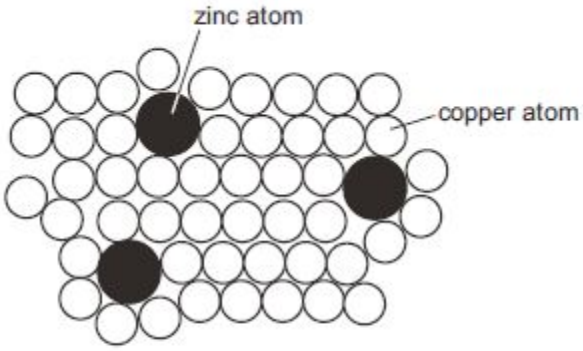
A CO, H_2, CO_2

B CO, SO_2, H_2O

C O_2, CO, CO_2

D SO_2, H_2, O_2

41 The diagram shows the structure of brass.



Why is brass harder than pure copper?

A The zinc atoms form strong covalent bonds with copper atoms.

B The zinc atoms prevent layers of copper atoms from sliding over each other easily.

C The zinc atoms prevent the 'sea of electrons' from moving freely in the solid.

D Zinc atoms have more electrons than copper atoms.

42 The final reaction in the extraction of metal *X* is represented by the following equation.

$$X_2O_3 + 3CO \rightarrow 2X + 3CO_2$$

What is *X*?

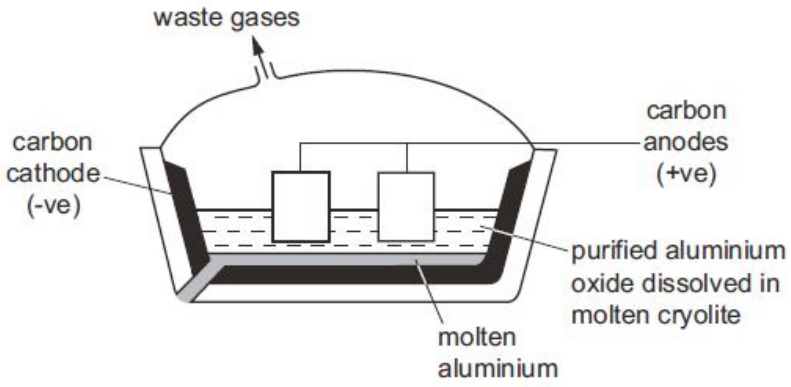
A aluminium

B copper

C iron

D sodium

43 Aluminium is extracted from aluminium oxide by electrolysis.



Which statement about this electrolysis is correct?

A Aluminium ions gain electrons to form aluminium.

B Cryolite is added to increase the melting point of the electrolyte.

C Cryolite is added to react with impurities to form slag.

D The carbon cathode has to be replaced regularly as it reacts with oxygen.

44 Which substance is **not** involved in the extraction of iron from hematite?

A carbon

B carbon monoxide

C calcium carbonate

D nitrogen

45 Pure metals conduct electricity and can be hammered into different shapes.

Why are metals sometimes used as alloys?

A Alloys are cheaper than the metals they are made from.

B Alloys are easier to hammer into different shapes.

C Alloys are harder and keep their shape better.

D Alloys conduct electricity better.

46 Below are some metals in decreasing order of reactivity.

magnesium

zinc

iron

copper

Titanium reacts with acid and cannot be extracted from its ore by heating with carbon.

Where should titanium be placed in this list?

A below copper

B between iron and copper

C between magnesium and zinc

D between zinc and iron

47 Iron rusts when it reacts with .....1.....

Rusting can be prevented by covering the iron with a more reactive metal, such as .....2.....

Which words correctly complete gaps 1 and 2?

	1	2
A	oxygen	copper
B	oxygen	magnesium
C	oxygen and water	copper
D	oxygen and water	magnesium

48 A student carried out an experiment to find the order of reactivity of five metals.
They were tested with cold water, hot water and steam and the results recorded in a table.

metal	cold water	hot water	steam
V	no reaction	reacts slowly	vigorous reaction
W	no reaction	no reaction	slow reaction
X	reacts slowly	vigorous reaction	not attempted
Y	no reaction	no reaction	no reaction
Z	vigorous reaction	explosive reaction	not attempted

What is the order of reactivity of these metals?

	most reactive ⟶				least reactive
A	V	W	Y	X	Z
B	W	X	Z	V	Y
C	Z	X	V	W	Y
D	Z	X	Y	W	V

49 The diagrams show two items that may be found in the home. Each item contains zinc.

zinc plated bucket

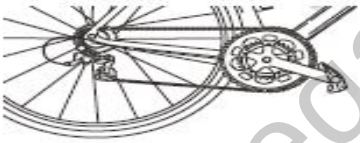
brass door-knocker

In which is zinc used as an alloy?

	bucket	door-knocker
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

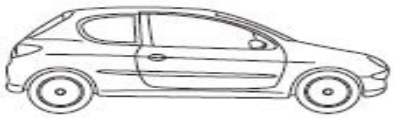
50 Which object is likely to be made from stainless steel?

A



bicycle chain

B



car body

C

can of beans

D

teaspoon

51 Four reactions that take place in the blast furnace to produce iron are shown.

Which reaction is used to keep the furnace hot?

A $C + O_2 \rightarrow CO_2$

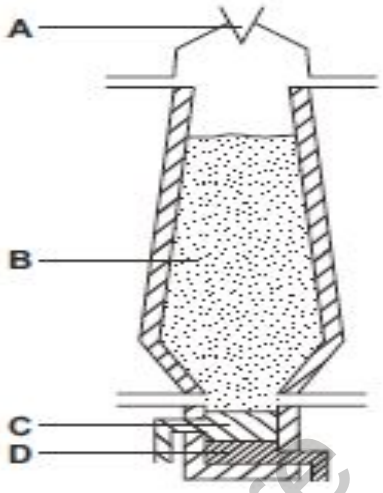
B $CO_2 + C \rightarrow 2CO$

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

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

52 The diagram shows a blast furnace.

In which part is iron ore changed to iron?

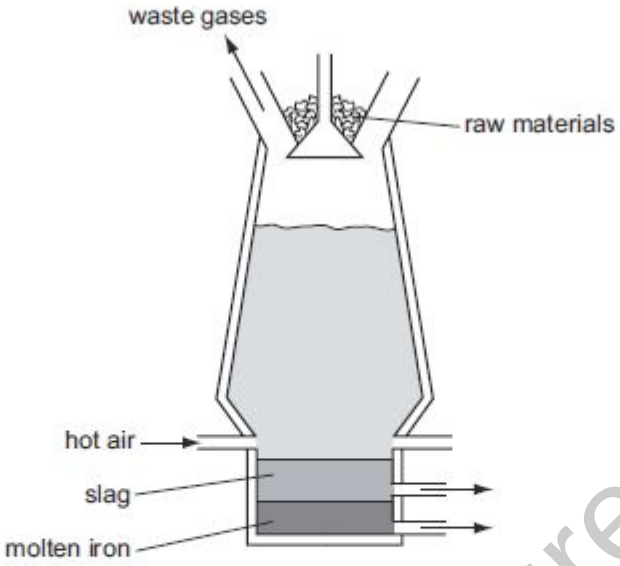


53 A metal consists of a lattice of positive ions in a 'sea of electrons'.

What happens to the electrons and positive ions in a metal wire when an electric current is passed through it?

	electrons	positive ions
A	replaced by new electrons	replaced by new ions
B	replaced by new electrons	unchanged
C	unchanged	replaced by new ions
D	unchanged	unchanged

54 Iron is produced in the blast furnace.



Which statement about this process is correct?

A Carbon is oxidised to carbon dioxide.

B Carbon monoxide is produced by the thermal decomposition of calcium carbonate.

C Haematite is reduced by calcium carbonate.

D Impurities are removed by the hot air blast.

55 Four metals and hydrogen are arranged in order of decreasing reactivity.

potassium
aluminium
zinc
hydrogen
copper

decrease in reactivity

Which statement about these elements is correct?

A Aluminium is formed when aluminium oxide is heated with hydrogen.

B Copper displaces zinc from zinc sulfate solution.

C Copper is formed when copper(II) oxide is heated with hydrogen.

D When added to water, aluminium forms positive ions more readily than potassium.

56 An alloy of aluminium is used in the construction of aircraft.

Why is pure aluminium never used?

A Pure aluminium cannot be manufactured.

B Pure aluminium conducts electricity.

C Pure aluminium is less dense than its alloys.

D Pure aluminium is too malleable.

57 Iron is obtained in the blast furnace from the ore haematite.

Which reaction takes place in the blast furnace?

A Calcium carbonate is used to remove acidic impurities.

B Coke is reduced to carbon dioxide.

C Haematite is oxidised by carbon monoxide.

D Haematite undergoes thermal decomposition.

58 Aluminium is manufactured from aluminium oxide by electrolysis. The compound cryolite is used in this process.

Which statement about cryolite is correct?

A It is the common name for aluminium oxide.

B It is used to dissolve the aluminium oxide.

C It is used to make the positive electrode.

D It is used to make the negative electrode.

59 Which substance has metallic bonding?

	conducts electricity		state of product formed on reaction with oxygen
	when solid	when liquid	
A	✓	✓	solid
B	✓	✓	gas
C	✗	✓	no reaction
D	✗	✗	solid

60 A non-metal element forms oxides of the type XO_2 and XO_3.

What is *X*?

A aluminium

B carbon

C hydrogen

D sulfur

61 Aluminium reacts with chromium(III) oxide as shown.

aluminium + chromium(III) oxide → chromium + aluminium oxide

Which statements are correct?

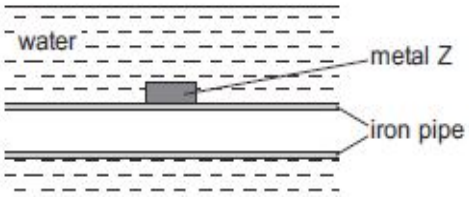
1 Aluminium is more reactive than chromium.

2 A similar reaction would also take place between aluminium and iron(III) oxide.

3 Iron(III) oxide is reduced by another metal in the blast furnace.

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

62 The diagram shows how an underwater iron pipe can be protected from rusting.



Metal Z can be .....1..... because it is .....2..... reactive than iron.

Which words correctly complete gaps 1 and 2?

	1	2
A	copper	less
B	copper	more
C	magnesium	less
D	magnesium	more

63 Brass is an alloy.

Which statement about brass is correct?

A It contains a sea of electrons.

B It contains positive and negative ions which are free to move.

C It is a compound of a metal and a non-metal.

D It is a compound of two or more metals.

64 Which item is made from mild steel?

A a car body

B a container to store gas in a chemical plant

C a scalpel for use in an operating theatre

D a set of cutlery

65 The following facts are known about four metals, P, Q, R and S.

1 R displaces both P and S from aqueous solutions of their ions.

2 Q reacts with water but R does not react with water.

3 S does not react with acid but P does react with acid.

What is the correct order of reactivity, the most reactive first?

A $P \rightarrow S \rightarrow Q \rightarrow R$

B $Q \rightarrow R \rightarrow P \rightarrow S$

C $Q \rightarrow S \rightarrow P \rightarrow R$

D $S \rightarrow P \rightarrow R \rightarrow Q$

66 Which metal has to be extracted from its ore by electrolysis?

A Fe **B** Na **C** Pb **D** Zn

Marking Key

1-C 26-D 51-A

2-C 27-C 52-B

3-D 28-A 53-B

4-C 29-D 54-A

5-A 30-A 55-C

6-B 31-C 56-D

7-C 32-B 57-A

8-A 33-A 58-B

9-D 34-B 59-A

10-D 35-D 60-D

11-A 36-A 61-B

12-C 37-D 62-D

13-C 38-B 63-A

14-A 39-C 64-A

15-B 40-C 65-B

16-A 41-B 66-B

17-D 42-C

18-D 43-A

19-A 44-D

20-D 45-C

21-D 46-C

22-D 47-D

23-A 48-C