1 The table shows some information about the reaction of four metals with dry air at room temperature and on heating.

metal	reaction with dry air at room temperature	reaction with dry air on heating
iron	no reaction	only burns when in the form of a fine wire or powder
copper	no reaction	does not burn but the surface oxidises slowly
samarium	surface oxidises slowly	burns easily
sodium	surface oxidises rapidly	burns easily

Use this information to put the **four** metals in order of their reactivity.
Put the least reactive metal first.

least reactive → most reactive

[2]

[Total: 2]

2 When aqueous sodium fluoride is added to chlorine, no reaction occurs.

Explain, using ideas about the reactivity of the halogens, why **no** reaction occurs.

.....

..... [1]

[Total: 1]

3 An alloy of zinc, copper and nickel is used to make coins.

Suggest **two** reasons why an alloy is used to make coins and **not** pure copper alone.

1 .....

2 ..... [2]

[Total: 2]

4 This question is about solids, liquids and gases.

(a) The list gives the names of nine substances which are solids at room temperature.

a ceramic

aluminium

anhydrous cobalt(II) chloride

anhydrous copper(II) sulfate

calcium oxide

graphite

iodine

iron

sodium

Answer the following questions about these substances.
Each substance may be used once, more than once or not at all.

State which substance:

(a) turns pink when water is added to it

..... [1]

(b) is a non-mental which is used as a lubricant

..... [1]

(c) is used to neutralise acidic industrial waste

..... [1]

(d) is extracted from bauxite

..... [1]

(e) is used as an electrical insulator.

..... [1]

[Total: 5]

5 The table shows observations for the reaction of four metals with cold water and with hot water.

metal	reaction with cold water	reaction with hot water
calcium	bubbles form rapidly	bubbles form very rapidly
lanthanum	bubbles form slowly	bubbles form very rapidly
manganese	no bubbles form	bubbles form very slowly
uranium	bubbles form slowly	bubbles form rapidly

Use this information to put the **four** metals in order of their reactivity.
Put the least reactive metal first.

least reactive ⟶ most reactive

[2]

[Total: 2]

6 Name the main ore of iron.

..... [1]

[Total: 1]

7 Zinc is a metal.

Describe **three** physical properties which are characteristic of metals.

1 .....

2 .....

3 ..... [3]

[Total: 3]

8 Iron is a metal.

Give **three** physical properties that are characteristic of metals.

1 .....

2 .....

3 ..... [3]

[Total: 3]

9 Complete these sentences about the uses of aluminium using words from the list.

conductivity	**corrosion**	**density**	**heavy**
malleability	**reduction**	**strong**	**weak**

Aluminium is used in the manufacture of aircraft because it is relatively

..... and has a low ..... . Aluminium is used

for food containers because of its resistance to ..... . [3]

[Total: 3]

10 The table shows some observations made when four metals are heated with liquid sulfur.

metal	observations
copper	turns black very slowly
gold	no reaction
sodium	reacts explosively
tin	turns black slowly

Use this information to put the **four** metals in order of their reactivity.
Put the least reactive metal first.

least reactive ⟶ most reactive

[2]

[Total: 2]

11 Iron can be obtained by heating iron(III) oxide with zinc powder.

$$Fe_2O_3 + 3Zn \rightarrow 2Fe + 3ZnO$$

(a) What can be deduced about the reactivity of zinc from this reaction?

..... [1]

(b) The ionic equation for this reaction is shown.

$$2Fe^{3+} + 3Zn \rightarrow 2Fe + 3Zn^{2+}$$

Identify the oxidising agent in this reaction.
Explain your answer in terms of electron transfer.

oxidising agent .....

explanation .....

..... [2]

[Total: 3]

12 Most metals have a high melting point.

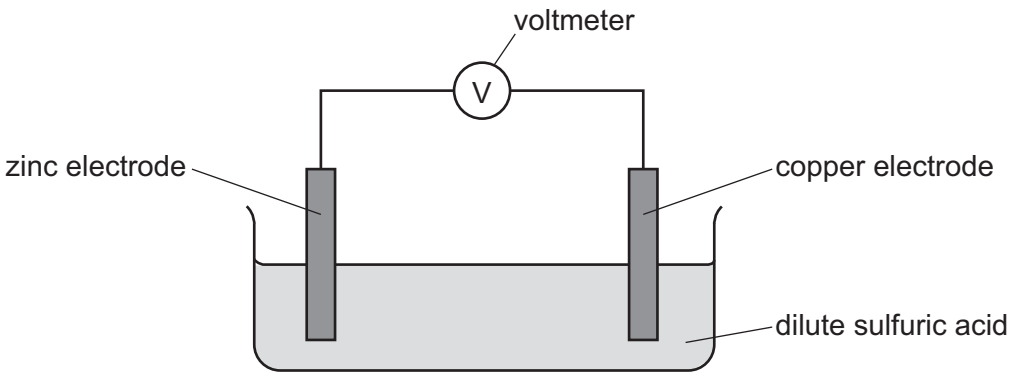
State **one** other physical property that all metals have.

..... [1]

[Total: 1]

13 A student used the following electrochemical cell.

The reading on the voltmeter was +1.10 V.



(a) Draw an arrow on the diagram to show the direction of electron flow.

[1]

(b) Suggest the change, if any, in the voltmeter reading if the zinc electrode was replaced with an iron electrode.
Explain your answer.

.....

..... [2]

(c) The zinc electrode was replaced with a silver electrode. The reading on the voltmeter was –0.46 V.

Suggest why the sign of the voltmeter reading became negative.

.....

..... [1]

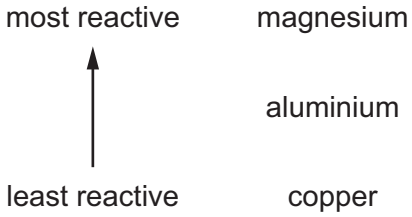
[Total: 4]

14 Name the ore of aluminium which mainly consists of aluminium oxide.

..... [1]

[Total: 1]

15 The positions of some common metals in the reactivity series are shown.



(a) When magnesium is placed in aqueous copper(II) sulfate a displacement reaction occurs immediately.

Write an ionic equation for the reaction. Include state symbols.

..... [2]

(b) State **two** observations you would make when magnesium is placed in aqueous copper(II) sulfate.

1 .....

2 ..... [2]

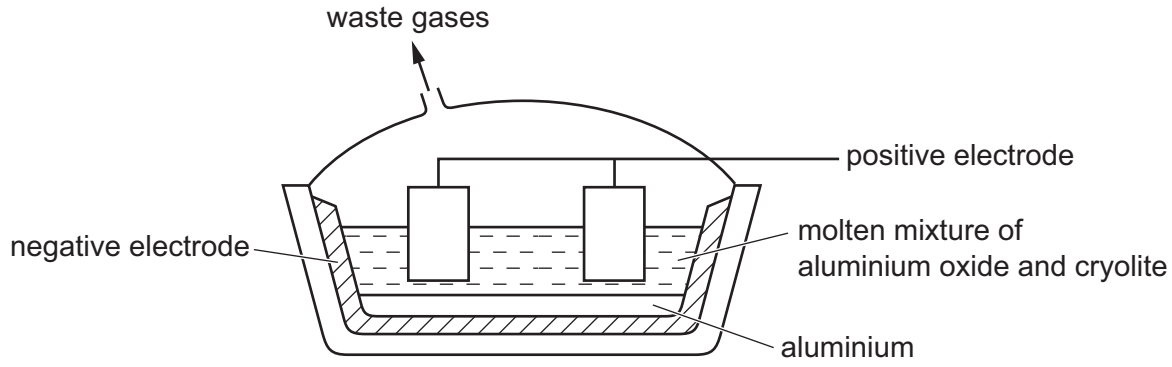
(c) When aluminium foil is added to aqueous copper(II) sulfate no immediate reaction takes place.

Explain why.

..... [1]

[Total: 5]

16 Aluminium is produced by the electrolysis of aluminium oxide dissolved in molten cryolite.



(a) Give **two** reasons why the electrolysis is done using a molten mixture of aluminium oxide and cryolite instead of molten aluminium oxide only.

1 .....

2 ..... [2]

(b) Write ionic half-equations for the reactions occurring at the electrodes.

positive electrode .....

negative electrode ..... [2]

(c) The anodes are made of carbon and have to be replaced regularly.

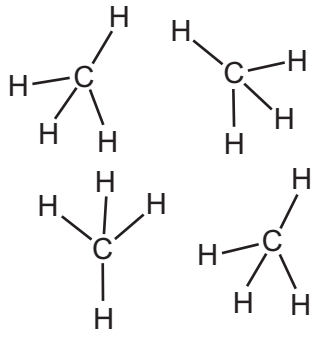
Explain why the carbon anodes have to be replaced regularly.

.....

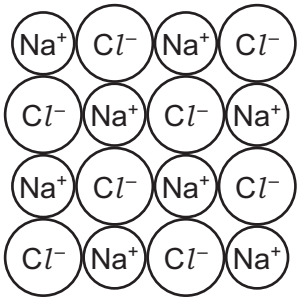
..... [2]

[Total: 6]

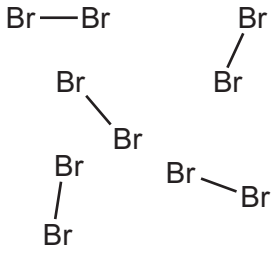
17 The diagram shows part of the structures of five substances, **A**, **B**, **C**, **D** and **E**.



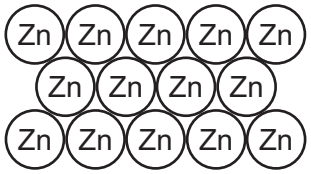
A



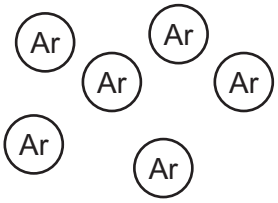
B



C



D



E

Which **one** of these structures, **A**, **B**, **C**, **D** or **E**, conducts electricity when solid?

..... [1]

[Total: 1]

18 Iron can be extracted from iron ore by reduction with carbon in a blast furnace.

Explain why iron is extracted by reduction with carbon and **not** by electrolysis.
Refer to the position of iron in the reactivity series in your answer.

.....

..... [1]

[Total: 1]

19 Describe **three** properties of iron that show that it is a transition element and **not** a Group I element.

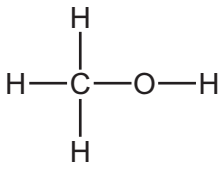
1 .....

2 .....

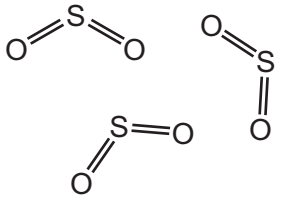
3 ..... [3]

[Total: 3]

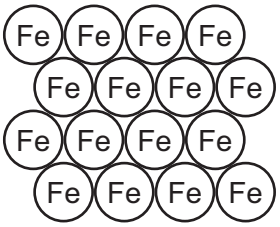
20 The diagrams show part of the structures of five substances, **A**, **B**, **C**, **D** and **E**.



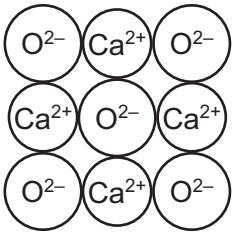
A



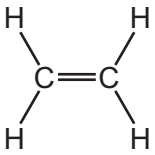
B



C



D



E

State which **one** of these structures, **A**, **B**, **C**, **D** or **E** conducts electricity when solid.

..... [1]

[Total: 1]

21 An alloy contains zinc, copper and aluminium.

What is meant by the term *alloy*?

.....

..... [1]

[Total: 1]

22 Iron can be extracted from iron ore by reduction with carbon in a blast furnace.

(a) Which **one** of these substances is an ore of iron?
Draw a circle around the correct answer.

bauxite **graphite** **hematite** **limestone** [1]

(b) The equation shows one of the reactions occurring in the blast furnace.

$$2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$$

How does this equation show that Fe_2O_3 is reduced?

.....

..... [1]

[Total: 2]

23 Aluminium oxide is a compound present in aluminium ore.

(a) Name an ore which contains aluminium oxide.

..... [1]

(b) Predict the products of the electrolysis of molten aluminium oxide at:

the positive electrode .....

the negative electrode ..... [2]

(c) Suggest why aluminium is extracted by electrolysis and **not** by reduction with carbon.

..... [1]

[Total: 4]

24 The table shows how easy it is to reduce four metal oxides with carbon.

metal oxide	ease of reduction with carbon
bismuth(III) oxide	reduced by carbon only above 250 °C
chromium(III) oxide	reduced by carbon only above 1200 °C
lead(II) oxide	reduced by carbon only above 440 °C
zinc oxide	reduced by carbon only above 990 °C

Use the information in the table to put the four metals in order of their reactivity.
Put the least reactive metal first.

least reactive → most reactive

[2]

[Total: 2]

25 Iron reacts with chlorine and other halogens.

Name **two** other substances which react with iron.

1 .....

2 ..... [2]

[Total: 2]

26 Alloys of copper are used to make coins.

(a) What is meant by the term *alloy*?

.....

..... [1]

(b) Suggest why an alloy of copper is used to make coins instead of using pure copper.

..... [1]

[Total: 2]

27 The table shows some observations about the reactivity of four metals with dilute sulfuric acid.

metal	reaction with sulfuric acid
iron	a slow stream of bubbles is seen
magnesium	a rapid stream of bubbles is seen
nickel	a few bubbles slowly form
tungsten	no bubbles are seen

Use the information in the table to put the four metals in order of their reactivity.
Put the least reactive metal first.

least reactive ⟶ most reactive

[2]

[Total: 2]

28 Sodium is in Group I of the Periodic Table.

(a) Describe **two** physical properties of sodium which are different from the physical properties of transition elements such as copper.

1 .....

.....

2 .....

..... [2]

(b) Sodium reacts rapidly with water.

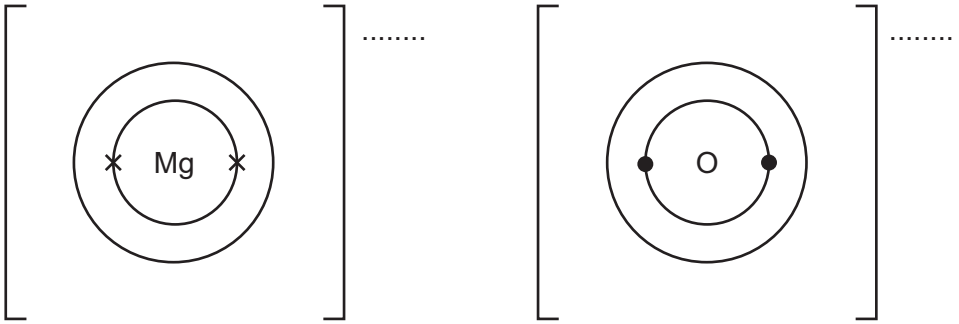
Give **one** observation made when sodium is added to water.

..... [1]

[Total: 3]

29 Magnesium reacts with oxygen to form the ionic compound magnesium oxide.

(a) Complete the dot-and-cross diagrams to show the electronic structures of the ions in magnesium oxide. Show the charges on the ions.



....

[3]

(b) Magnesium oxide melts at 2853 °C.

Why does magnesium oxide have a high melting point?

.....

..... [1]

(c) Explain why molten magnesium oxide can conduct electricity.

.....

.....

..... [1]

[Total: 5]

30 Magnesium exists as three isotopes, $^{24}_{12}Mg$, $^{25}_{12}Mg$ and $^{26}_{12}Mg$.

All isotopes of magnesium react with dilute hydrochloric acid to make hydrogen and a salt.

(a) Why do all isotopes of magnesium react in the same way?

.....

.....

..... [2]

(b) Write a chemical equation for the reaction between magnesium and dilute hydrochloric acid.

..... [2]

(c) Describe a test for hydrogen.

test .....

result ..... [2]

[Total: 6]

31 Zinc and copper are elements next to each other in the Periodic Table.

Zinc is obtained from zinc blende in a two-step process.

- In **step 1**, zinc blende is converted into zinc oxide.
- In **step 2**, zinc oxide is converted into zinc in a blast furnace.

Outline how each of these steps are done.

In your answer:

- give **one** chemical equation for each step
- describe how zinc is removed from the blast furnace in **step 2**.

step 1 .....

.....

chemical equation .....

step 2.....

.....

chemical equation.....

removal of zinc in **step 2** .....

..... [5]

[Total: 5]

32 The names of eight substances are given.

aluminium oxide **calcium oxide** **ethanol** **nitrogen**

iron(III) oxide **methane** **oxygen** **silicon(IV) oxide**

State which substance is the main constituent of bauxite.

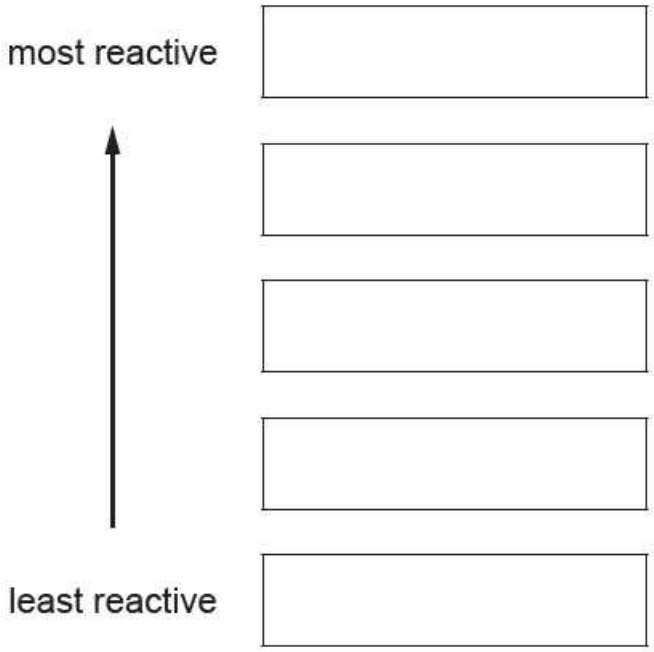
..... [1]

[Total: 1]

33 The table gives some information about the rate of reaction of zinc and some other metals with cold water and with steam.

metal	rate of reaction	
	with cold water	with steam
iron	no reaction	hot iron reacts very slowly
magnesium	reacts very slowly	hot magnesium reacts rapidly
mercury	no reaction	no reaction
strontium	reacts rapidly	reacts rapidly
zinc	no reaction	hot zinc reacts slowly

Put the **five** metals in order of their reactivity.
Put the most reactive metal at the top.



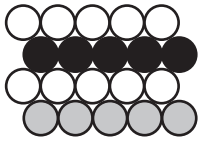
[2]

[Total: 2]

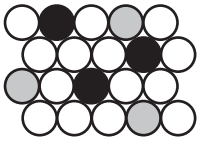
34 Nichrome is an alloy of nickel, iron and chromium.

Which **one** of these diagrams, **J**, **K**, **L** or **M**, best represents nichrome?

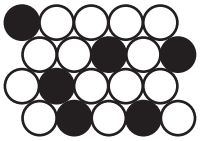
J



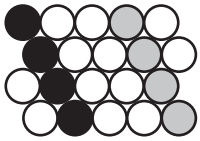
K



L



M



..... [1]

[Total: 1]

35 Uranium is a metal.

Give **two** physical properties which are characteristic of **all** metals.

1 .....

2 ..... [2]

[Total: 2]

36 Period 3 of the Periodic Table is shown.

sodium	magnesium	aluminium	silicon	phosphorus	sulfur	chlorine	argon

Answer the following questions using only these elements.

Each element may be used once, more than once or not at all.

State which element:

(a) is a gas at room temperature and pressure

..... [1]

(b) forms a basic oxide with a formula of the form X_2O

..... [1]

(c) is made of atoms which have a full outer shell of electrons

..... [1]

(d) forms an oxide which causes acid rain

..... [1]

(e) is extracted from bauxite

..... [1]

(f) forms an oxide which has a macromolecular structure

..... [1]

(g) consists of diatomic molecules.

..... [1]

[Total: 7]

37 This question is about transition elements.

(a) Transition elements are harder and stronger than Group I elements.

Describe **two** other differences in **physical** properties between transition elements and Group I elements.

1 .....

2 ..... [2]

(b) State **one** physical property of transition elements that is similar to Group I elements.

..... [1]

(c) State **two** chemical properties of transition elements.

1 .....

2 ..... [2]

[Total: 5]

38 Iron is a transition element.

(a) Which **two** substances react with iron to form rust?

1 .....

2 ..... [2]

(b) Which metal is used to galvanise iron?

..... [1]

[Total: 3]

39 Iron is extracted from iron ore using a blast furnace.
The solid substances added to the blast furnace are iron ore, coke and limestone (calcium carbonate).

State the name of an ore of iron.

..... [1]

[Total: 1]

40 Iron is extracted from iron ore using a blast furnace.
The solid substances added to the blast furnace are iron ore, coke and limestone (calcium carbonate).

Complete the sentences about the reactions which occur in a blast furnace using words from the list.

air **decomposes** **dioxide** **monoxide**

nitrogen **oxidises** **slag** **tetrachloride**

The coke burns in a blast of hot ..... to form carbon dioxide. This

reacts with

further hot coke to form carbon ..... . This gas reduces the iron(III)

oxide in the iron ore to iron.

The limestone ..... to form lime (calcium oxide) which reacts with

impurities

in the iron to form ..... . [4]

[Total: 4]