Topic 6 Properties of Metals, Reactivity Series, Extraction of Metals, Recycling of Metals and Iron

PAPER 3

MULTIPLE-CHOICE QUESTIONS

For each question, there are four possible answers. Choose the one you consider correct and record your choice (A, B, C or D) in the brackets provided.

1. Some of the general physical properties of metals are shown.

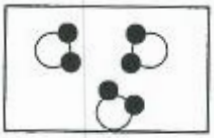
1	Metals are good conductors of electricity.
2	Metals are hard solids.
3	Metals have high densities.
4	Metals have very high melting points.

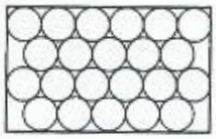
Which of these properties does sodium have? (2011/P3/Q12)

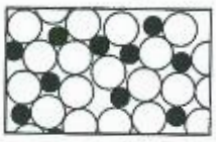
A 1 only
B 1 and 2 only
C 1, 2 and 3 only
D 1, 2, 3 and 4

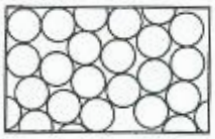
( )

2. Which diagram represents the arrangement of atoms in an alloy? (2011/P3/Q13)

A 

B 

C 

D 

( )

3. Which metals can be obtained by heating their oxides with carbon? (2011/P3/Q14)

	copper	lead	magnesium
A	✓	✓	✗
B	✓	✗	✗
C	✗	✓	✓
D	✗	✗	✓

( )

4. Iron is extracted from haematite in a blast furnace.

The word equation for the reaction is:

haematite + carbon monoxide → iron + X

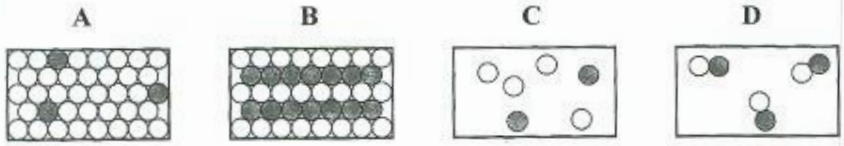
What is X? (2011/P3/Q15 / 2014/P3/Q12)

A carbon **B** carbon dioxide
C hydrogen **D** oxygen ( )

5. Which property do **all** metals have? (2012/P3/Q12 / 2015/P3/Q12)

A They are soluble in water.
B They conduct electricity.
C They have high melting points.
D They react with dilute sulfuric acid. ( )

6. Which diagram represents the structure of a solid alloy? (2012/P3/Q13 / 2015/P3/Q15)



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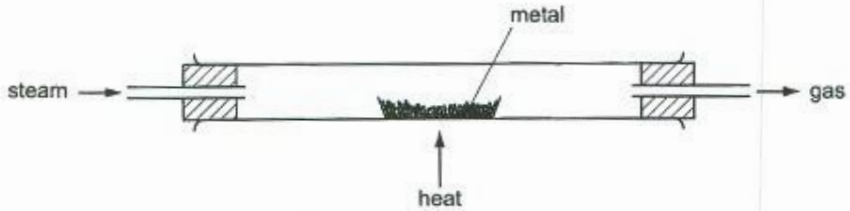
7. The diagram shows apparatus used to test the reactivity of copper, magnesium and zinc with steam.

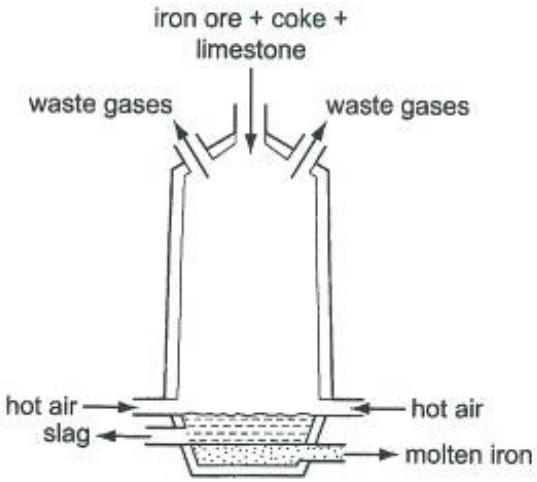


Which metals react with steam to form hydrogen? (2012/P3/Q14)

	copper	magnesium	zinc
A	✓	✗	✓
B	✗	✓	✓
C	✓	✗	✗
D	✗	✓	✗

( )

8. The diagram shows a blast furnace used to extract iron from iron ore.



Why is limestone added to the blast furnace? (2012/P3/Q15)

A To cause the furnace to heat up
B To change the ore into iron
C To convert impurities in the ore into slag
D To produce oxygen for the coke to burn

( )

9. Which methods prevent iron from rusting? (2012/P3/Q16)

	coating with zinc	painting	washing with salt water
A	✓	✓	✓
B	✗	✓	✓
C	✓	✓	✗
D	✓	✗	✗

key
✓ = prevents rusting
✗ = does not prevent rusting

( )

10. Which is a property of **all** metals? (2013/P3/Q12)

A conduct electricity
B hard
C low melting points
D react with water

( )

11. The table below shows information about three metals.

metal	reacts with water?	reacts with steam?
X	no	no
Y	yes	yes
Z	no	yes

Which metal is the most reactive and which metal is the least reactive? (2013/P3/Q13)

	most reactive	least reactive
A	X	Y
B	Y	X
C	Y	Z
D	Z	X

( )

12. Which statements about the reasons for recycling metals are correct? (2013/P3/Q14)

1 It is cheaper to recycle metals than extract them from their ores.
2 The demand for metals is always increasing.
3 Recycling metals requires more energy than the extraction of metals from their ores.
4 There is only a limited supply of metal ores.

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

( )

13. Which elements are present in haematite? (2013/P3/Q15)

	Al	Cu	Fe	O
A	✓	✓	✗	✗
B	✓	✗	✗	✓
C	✗	✓	✗	✓
D	✗	✗	✓	✓

key
✓ = present
✗ = not present

( )

14. Which of these statements describe a reason for recycling metals? (2014/P3/Q6)

1 Alloys contain a mixture of metals.
2 Metal ores are a finite resource.
3 Landfill rubbish sites are a source of pollution.

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

( )

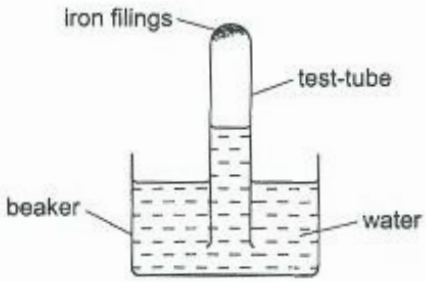
15. The properties of four elements are shown.

Suggest which element is used to make aircraft bodies? (2014/P3/Q13)

element	density	brittle or malleable
A	high	brittle
B	high	malleable
C	low	brittle
D	low	malleable

( )

16. Iron fillings are placed in a damp test-tube containing air.
The test-tube is placed in water and left for a week.



The water rises up the test-tube because the iron reacts with (2014/P3/Q14)

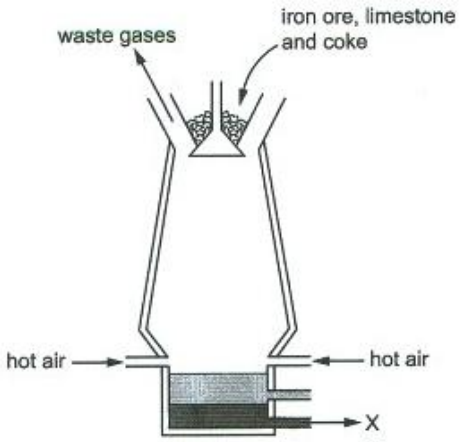
A carbon dioxide. **B** nitrogen.
C oxygen. **D** water. ( )

17. Which substance has the properties of a metallic element? (2014/P3/Q15)

	melting point / °C	boiling point / °C	conductor of heat
A	–102	–34	good
B	–102	–34	poor
C	1535	2750	good
D	1535	2750	poor

( )

18. The diagram shows a blast furnace.



What leaves the furnace at X? (2015/P3/Q13)

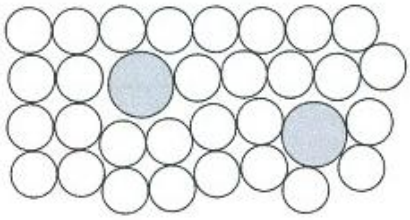
A carbon dioxide
B iron
C slag
D sulfur dioxide ( )

19. Which statements about the general properties of metals are correct? (2016/P3/Q12)

1 conduct electricity when solid
2 form acidic oxides
3 high melting point

A 1 and 3
B 1 only
C 2 and 3
D 2 only ( )

20. The diagram shows the arrangement of particles in substance T.



What is substance T? (2016/P3/Q13)

A a covalent compound
B a metal element
C an alloy
D an ionic compound ( )

21. Which statements give reasons for recycling metals? (2016/P3/Q14)

1 It is cheaper to recycle metals than extract them from their ores.
2 The demand for metals is always increasing.
3 Recycling metals requires more energy than the extraction of metals from their ores.
4 There is only a limited supply of metal ores.

A 1, 2 and 4
B 1, 3 and 4
C 1 and 2 only
D 2 and 3 only ( )

22. 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? (2017/P3/Q12)

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

( )

23. Supplies of metal ores are finite.
Recycling helps us to make reserves of metals last longer.
Which way shows how metals are recycled to give a pure metal? (2017/P3/Q13)

A impure metal → melted → pure metal
B metal ore → melted → pure metal
C objects of different metals → crushed → melted → pure metal
D objects of same metal → crushed → melted → pure metal ( )

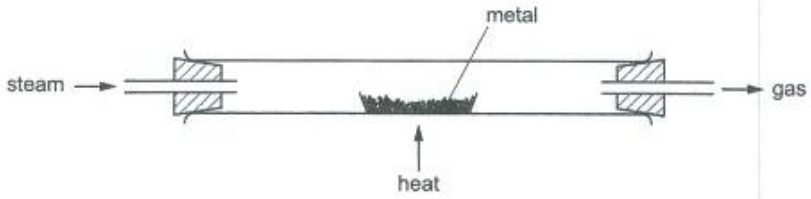
24. Two statements about alloys are given.

1 Aluminium containing a small amount of copper is an alloy.
2 Alloys can be made by mixing molten metals together and allowing them to cool.

Which of the following is true? (2017/P3/Q14)

A Both statements are correct and statement 2 explains statement 1.
B Both statements are correct but statement 2 does not explain statement 1.
C Statement 1 is correct but statement 2 is not correct.
D Statement 2 is correct but statement 1 is not correct. ( )

25. The diagram shows apparatus used to test the reactivity of copper, magnesium and zinc with steam.



Which metals react with steam to form hydrogen? (2017/P3/Q15)

	copper	magnesium	zinc
A	✓	✗	✓
B	✓	✗	✗
C	✗	✓	✓
D	✗	✓	✗

key
✓ = reacts
✗ = does not react

( )

26. How does the reactivity of potassium compare with that of sodium and how does the reactivity of calcium compare with that of magnesium? (2018/P3/Q12)

	reactivity of potassium and sodium	reactivity of calcium and magnesium
A	K greater than Na	Ca greater than Mg
B	K greater than Na	Mg greater than Ca
C	Na greater than K	Ca greater than Mg
D	Na greater than K	Mg greater than Ca

( )

27. As the demand for metals increases, the need for recycling increases.
Which row shows the type of resource that metals are and an advantage of recycling them? (2018/P3/Q13)

	type of resource	advantage of recycling metals
A	finite	a large amount of waste material is produced during recycling
B	finite	saves energy and costs compared to extracting new metals from their ores
C	infinite	a large amount of waste material is produced during recycling
D	infinite	saves energy and costs compared to extracting new metals from their ores

( )

28. The equations show some of the reactions that occur in a blast furnace.

$$C + O_2 \rightarrow CO_2$$

$$CO_2 + C \rightarrow 2CO$$

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

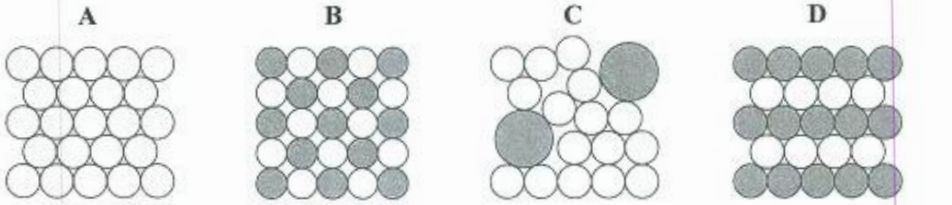
What is the function of the coke, C? (2018/P3/Q14)

A to make carbon monoxide to reduce the iron ore
B to make slag
C to oxidise haematite
D to react with limestone ( )

29. An iron bar is coated with paint.
What does the paint keep away from the bar to prevent rusting? (2018/P3/Q15)

A acid
B oxygen and water
C oxygen only
D water only ( )

30. Which diagram shows the arrangement of the particles in an alloy? (2019/P3/Q12)



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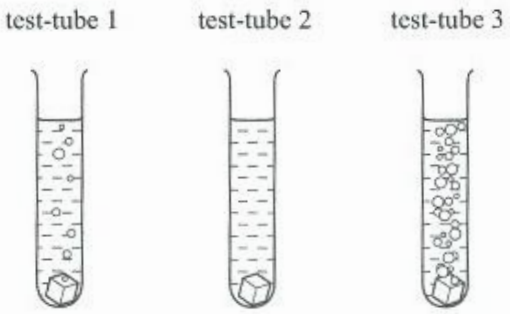
31. Pieces of copper, iron and magnesium, of the same size and shape, are added to dilute hydrochloric acid.
The diagram shows the results.

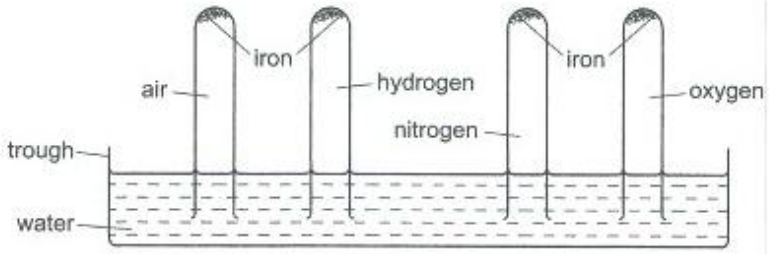


Which metal was placed in each test-tube? (2019/P3/Q13)

	test-tube 1	test-tube 2	test-tube 3
A	iron	copper	magnesium
B	iron	magnesium	copper
C	magnesium	copper	iron
D	copper	iron	magnesium

( )

32. The experiment shown in the diagram is set up. The mass of iron and volume of gas in each tube is the same.



The apparatus is left for one month.
In which tube does the water level rise the most? (2019/P3/Q14)

A air
B hydrogen
C nitrogen
D oxygen ( )

33. Which statement about the extraction of iron in the blast furnace is correct? (2019/P3/Q15)

A Coke reacts with limestone to produce slag.
B Iron is produced when haematite reacts with carbon monoxide.
C Limestone reacts with haematite to form iron.
D Oxygen is mixed with haematite before it enters the blast furnace. ( )

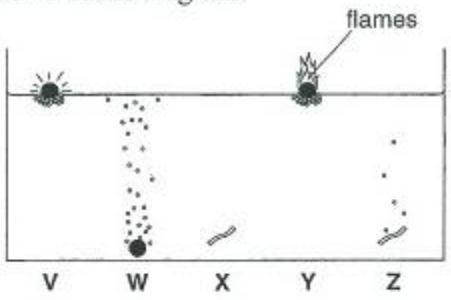
PAPER 4

STRUCTURED QUESTIONS

Section A

Answer the following questions.

1. Five metals, **V**, **W**, **X**, **Y** and **Z**, are placed in a trough of cold water. The results observed are shown in the diagram.



(a) Complete the table to show which of **V**, **W**, **X**, **Y** or **Z** are those metals shown.

metal	letter **V**, **W**, **X**, **Y** or **Z**
calcium	
copper	
magnesium	
potassium	
sodium	

[3]

(b) Four of the metals react with the cold water to produce a gas.

(i) Name the gas.

(ii) Describe a test to identify this gas named in (b)(i).

What would you observe if your test is positive? [3]

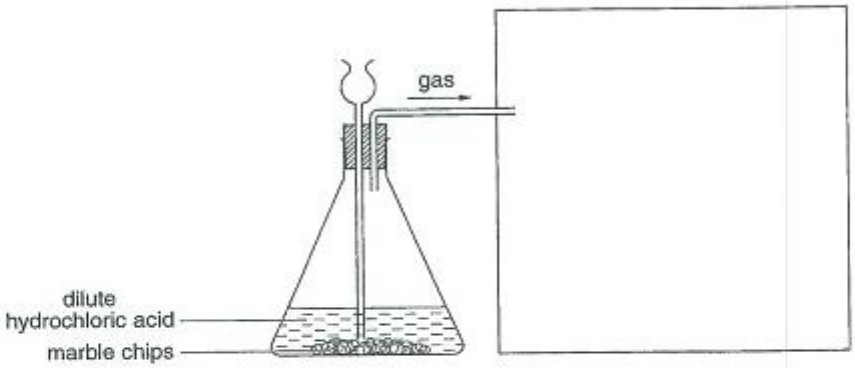
(2011/P4/Q2)

Section B

Answer the following questions.

1. Some marble chips, containing calcium carbonate, are reacted with dilute hydrochloric acid using the apparatus below.

   The gas given off is collected.



(a) Complete the diagram to show how the gas is collected. [1]

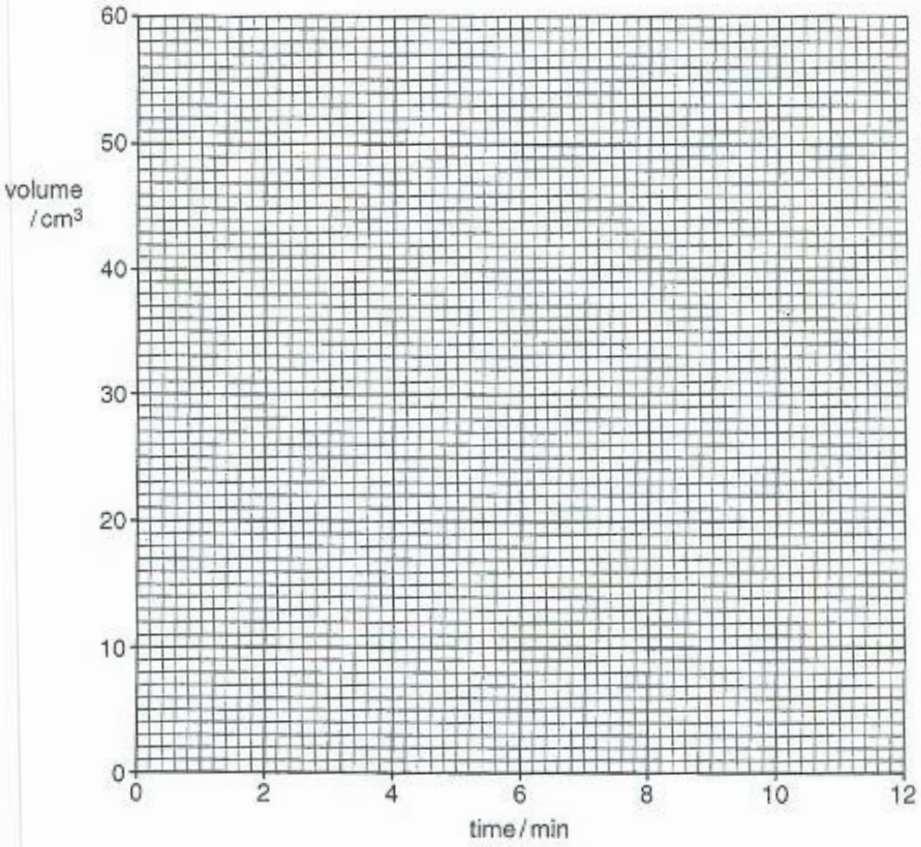
(b) The total volume of the gas is recorded every two minutes.

The results are shown in the table.

time / min	total volume of gas given off / cm^3
0	0
2	32
4	44
6	50
8	52
10	52
12	52

(i) Plot a graph of these results, marking each point with a cross (×).

Draw a curved line of best fit.



[2]

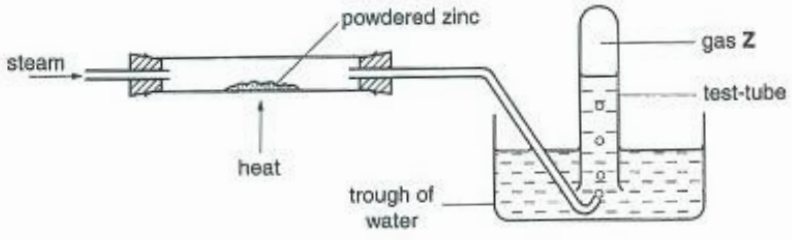
(ii) What is the total volume of gas collected in the first 5 minutes? [1]

(iii) Suggest an explanation for the shape of the graph after 8 minutes. [2]

(c) Write a balanced chemical equation for the reaction between calcium carbonate, $CaCO_3$, and hydrochloric acid. [2]

(2011/P4/Q5)

2. (a) The apparatus shown below can be used to study the reaction between zinc and steam.



(i) Write a balanced equation for the reaction of zinc with steam. [1]

(ii) From the list below, choose another metal that can be used safely instead of zinc in the above experiment to produce gas Z.

Underline your answer.

calcium **copper** **lead** **iron** **silver** **sodium**

[1]

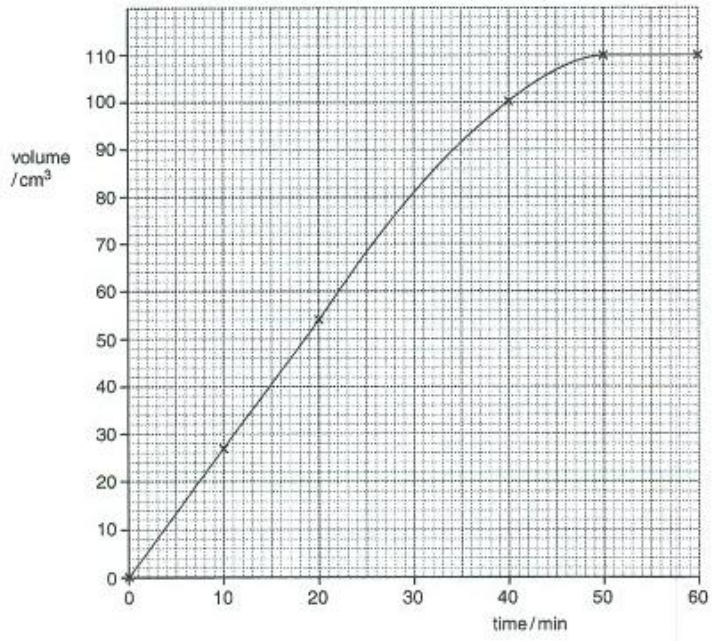
(b) Zinc also reacts with an excess of sulfuric acid to produce gas Z.

A student measures the volume of the gas **Z** produced at different times.

Her results are given in the table.

time / min	0	10	20	30	40	50	60
volume of gas **Z** / cm^3	0	27	54		100	110	110

A graph of the results is shown.



(i) What is the volume of gas produced after 30 minutes? [1]

(ii) Suggest why the volume of gas stops increasing after 50 minutes. [1]

(c) The following diagram represents the arrangement of the atoms in a mixture of two metals.

What type of substance does the diagram represent? [1]

(2013/P3/Q6aiii, iv, b, c)

3. Part of the reactivity series for metals is shown below.

sodium	most reactive
calcium	↑
magnesium	
zinc	
iron	
lead	
copper	least reactive

The following list shows how long ago these metals were discovered.

calcium	206 years ago
copper	7000 years ago
iron	3000 years ago
lead	7000 years ago
magnesium	259 years ago
sodium	207 years ago
zinc	2000 years ago

(a) Explain why some metals were discovered much earlier than others. [2]

(b) The table shows the results of tests performed on metals **R**, **S**, **T** and **U**.

metal	reaction with water	reaction with steam	reaction with dilute hydrochloric acid
R	✗	✓	✓
S	✗	✗	✓
T	✓	✓	✓
U	✗	✗	✗

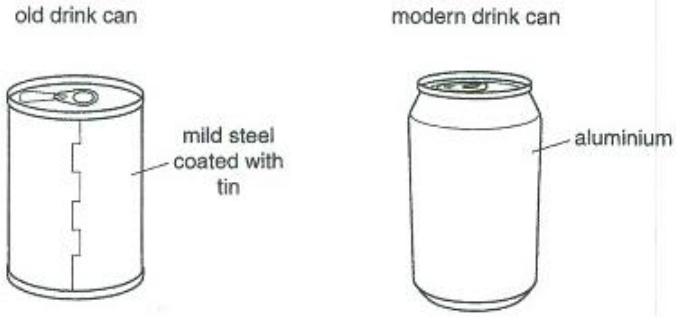
Key
✓ reaction
✗ no reaction

(i) Which metal, **R**, **S**, **T** or **U**, could be copper? [1]

(ii) Which metal, **R**, **S**, **T** or **U**, could be zinc? [1]

(2014/P4/Q6a, b)

4. The diagram shows the design of an old drink can and a modern drink can.



(a) Explain why the old can is coated with tin. [1]

(b) We are encouraged to recycle aluminium drink cans.

State two advantages of recycling aluminium metal. [2]

(c) If a steel ball is dropped from a height onto the side of the aluminium can, the aluminium becomes dented.

Which physical property of aluminium metal does this show? [1]

(2015/P4/Q5a)

5. A student investigates the reaction of dilute hydrochloric acid with four different metals.

The same concentration of the acid and the same mass and surface area of metal are used in each experiment.

The student's observations are shown in the table.

metal	observation
copper	no bubbles produced
iron	bubbles produced slowly
magnesium	bubbles produced very quickly
zinc	bubbles produced quickly

(a) Use the observations in the table to suggest an order of reactivity of these metals. [1]

(b) Iron is extracted from its ore in the blast furnace.

One of the reactions in the blast furnace is shown below.

iron(III) oxide + carbon monoxide → iron + carbon dioxide

Write a balanced chemical equation for the above reaction. [2]

(2015/P4/Q6c, d)

6. (a) (i) Name the three starting materials added to the blast furnace in the extraction of iron. [2]

(ii) Suggest two gases likely to be present in the waste gases emitted from the blast furnace. [1]

(b) Some baked bean cans made of iron are coated with a thin layer of tin to prevent rusting. If this coating is scratched then the iron underneath starts to rust.

Name the element and name the compound which together react with the iron to form rust. [2]

(c) The table shows some observations made when four metals are treated separately with cold water and with steam.

metal	observations with cold water	observations with steam
calcium	reacts quickly with many gas bubbles seen	explosive reaction
copper	no observed change	no observed change
iron	no observed change	reacts very slowly
magnesium	slow reaction with some gas bubbles seen	burns with a bright glow

(i) Place these metals in order of their reactivity.

most reactive ⟶ least reactive

[1]

(ii) Zinc lies between iron and magnesium in the reactivity series of metals.

Suggest what observations would be made when zinc is treated separately with cold water and with steam. [2]

(2016/P4/Q5)

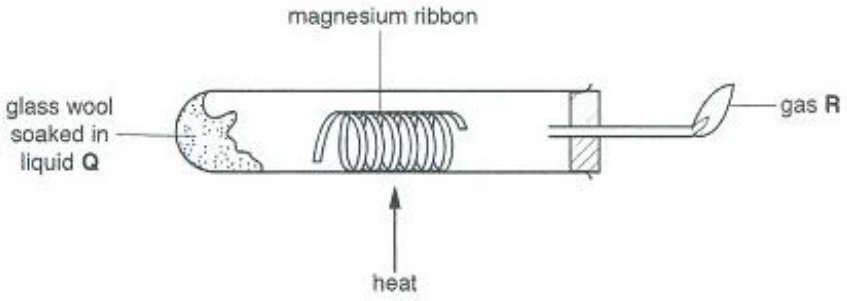
7. (a) Describe **two** observations made when sodium is added to water. [2]

(b) Describe what you would observe when a few drops of Universal Indicator are added to the reaction mixture. [1]

(c) Write a balanced chemical equation for the reaction between sodium and water. [1]

(2016/P4/Q7b)

8. An experiment to observe the action of steam on the metal magnesium is set up as shown.



The magnesium is heated strongly until it begins to glow. Then the glass wool soaked in liquid **Q** is heated. Gas **R** is evolved, which is ignited as it leaves the tube.

(a) Name liquid **Q**. [1]

(b) Name gas **R** and describe a positive test to identify gas **R**. [2]

(c) Write a chemical equation, with state symbols, for the reaction of steam with magnesium. [2]

(2019/P4/Q4b)