

Q1. The table gives information about the colours of four metals.

| metal | colour of metal |
|-----------|-----------------|
| copper | brown |
| iron | dark grey |
| magnesium | silver |
| zinc | light grey |

A reactivity series of the metals is:

most reactive magnesium
 zinc
 iron
least reactive copper

Use this information to help you answer the questions below.

(a) A piece of zinc was placed in a solution of copper sulphate.

(i) Complete the following word equation.

zinc + copper sulphate → +

1 mark

(ii) Complete the statement about the appearance of this piece of zinc.

The light grey colour would change to

1 mark

(b) Excess magnesium powder was put into a test tube containing a blue solution of copper sulphate and stirred. The solution soon turned colourless. A powder settled on the bottom of the test tube.

(i) Write a word equation for the reaction.

.....
.....

1 mark

(ii) The powder was filtered off. Two different coloured solids could be seen. Give the **two** colours.

1.

2.

2 marks

- (c) (i) A piece of iron was placed in a solution of magnesium sulphate.
What reaction, if any, would occur?

.....

1 mark

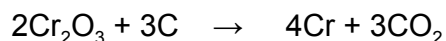
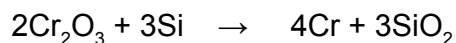
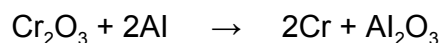
- (ii) Explain your answer.

.....

.....

1 mark
Maximum 7 marks

Q2. The metal chromium can be extracted industrially by **three** different chemical methods.
The equations for these chemical reactions are shown below.



- (a) What name is given to the extraction of a metal from its oxide in this type of chemical reaction?

.....

1 mark

- (b) Use the equations to compare the reactivity of chromium with the reactivities of aluminium, silicon and carbon. Tick **one** box in each column in the table.

| | aluminium | silicon | carbon |
|-----------------------------|-----------|---------|--------|
| more reactive than chromium | | | |
| less reactive than chromium | | | |

1 mark

- (c) In theory, the order of reactivity of aluminium, silicon and carbon can be obtained by heating each of the elements with the oxides of the other two. This suggests that it is possible to determine the order of reactivity by doing no more than three experiments.

State the two reactants you would heat together in each of the **three** experiments, and explain how you could use the results to determine the order of reactivity.

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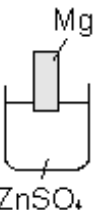
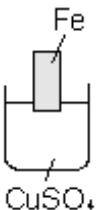
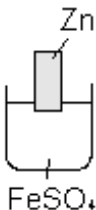
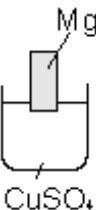
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2 marks
Maximum 4 marks

- Q3.** An experiment is carried out to find the relative reactivities of **four** metals: copper, magnesium, iron and zinc.

Strips of **three** of the metals are placed in dilute solutions of different sulphates, as shown below, and left for the same length of time

| | | | | |
|------------------------------------|---|---|---|--|
| diagram of experiment |  |  |  |  |
| colour of metal at start | silver coloured | dark grey | light grey | silver coloured |
| colour of solution at start | colourless | pale blue | pale green | pale blue |
| appearance of metal at end | light grey | brown | | |
| colour of solution at end | colourless | pale green | colourless | |

(a) Use the information in the table to place the **four** metals in order of reactivity.

most reactive

.....

.....

least reactive

1 mark

(b) Use the appropriate descriptions given in the table to help you complete the **three** missing parts of the table.

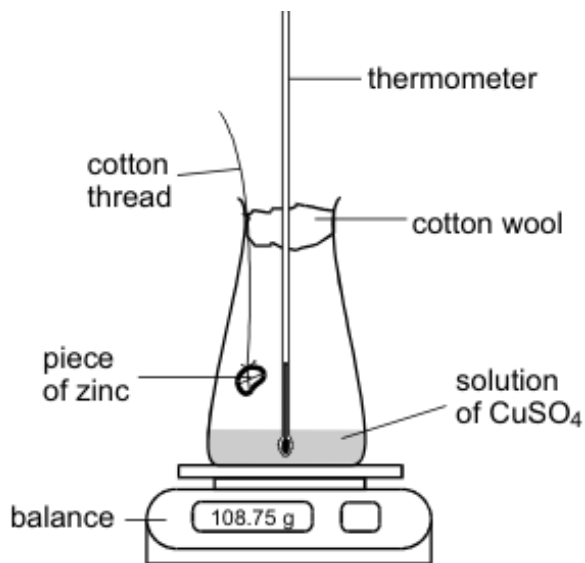
2 marks

(c) The concentrations of the solutions are the same.
Suggest which of the four experiments gives out the most energy.

.....

1 mark
Maximum 4 marks

Q4. An experiment was set up as shown in the diagram.



(a) (i) What is the **name** of the compound, CuSO_4 , which is dissolved in the water before the start of the experiment?

.....

1 mark

(ii) Give the **two** products formed by the reaction which occurs when the zinc is lowered into the solution of CuSO_4 .

1.

2.

2 marks

(iii) Give **one** other metallic element which will react in a similar way to zinc.

.....

1 mark

(b) The flask and contents shown above were weighed and the temperature was noted. The zinc was lowered into the solution and the flask was swirled. After five minutes, the mass and temperature were recorded again.

What change, if any, would there be in the mass of the flask and contents?

.....

1 mark

(c) The experiment was repeated using a piece of silver instead of zinc.

What change, if any, would you see in the colour of the solution?

.....

1 mark

Maximum 6 marks

Q5. The table gives information about solutions of three different salts in water.

| name of the salt in solution | pH of solution |
|------------------------------|----------------|
| sodium nitrate | 7 |
| ammonium chloride | 4 |
| sodium sulphite | 10 |

(a) Which **two** solutions when mixed together could form a neutral solution?

..... and

1 mark

(b) Sodium hydrogensulphate solution behaves like an acid.

(i) Magnesium is added to a solution of sodium hydrogensulphate.
What would you expect to see forming on the magnesium?

.....

1 mark

(ii) Sodium carbonate is added to a solution of sodium hydrogensulphate.
What gas would you expect to be formed?

.....

1 mark

(c) The formula for a different carbonate compound is K_2CO_3 .
Give the names of the **three** elements which make up this compound.

1.

2.

3.

1 mark
Maximum 4 marks

##

Sodium hydrogencarbonate is present in indigestion powders.
It is often called bicarbonate of soda. Sodium hydrogencarbonate:

is a white solid;

does not smell;

forms a solution with a pH of about 8.5;

is very soluble in water;

is not poisonous.

(a) (i) Is sodium hydrogencarbonate solution acidic, alkaline, or neutral?

.....

1 mark

(ii) Indigestion can be caused by too much acid in the stomach.

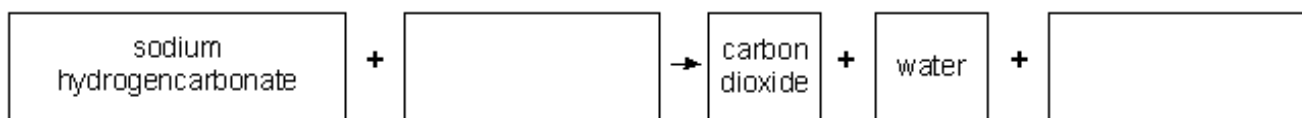
Which **two** pieces of information in the list are the most important reasons why sodium hydrogencarbonate can be used as an indigestion powder?

1

2

2 marks

- (b) Nitric acid reacts with sodium hydrogencarbonate. The salt formed is a nitrate. Fill in the boxes to complete the word equation.



1 mark

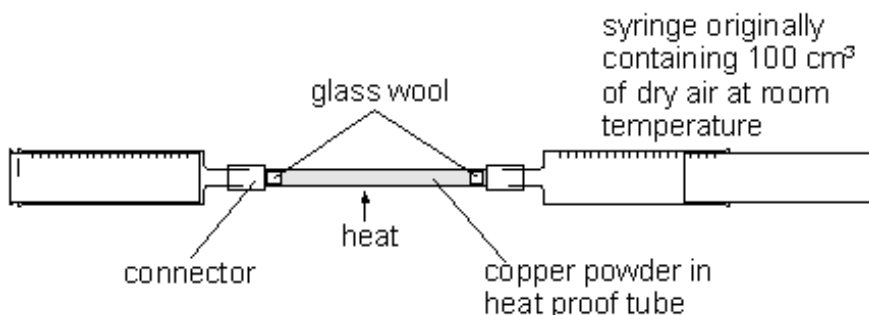
- (c) An indigestion powder contains sodium hydrogencarbonate and a small amount of citric acid. The powder starts to fizz when it is added to water.

What gas is given off when the mixture fizzes?

.....

1 mark
Maximum 5 marks

- Q7.** The apparatus shown below was set up. The 100 cm³ of clean, dry air was passed backwards and forwards across the hot copper powder. The volume of air left in the syringe, when the apparatus had cooled back to room temperature, was 79 cm³.



- (a) (i) Why did the volume of air decrease?

.....

1 mark

- (ii) Why did the volume of air not decrease below 79 cm³?

.....

1 mark

- (b) (i) The surface of the copper was seen to be black at the end of the experiment. What is the chemical formula of the black solid which is formed?

.....

1 mark

- (ii) What type of reaction takes place in this experiment?

.....

1 mark

(iii) Write a balanced equation for the formation of the black solid.

.....

1 mark
Maximum 5 marks

Q8. Aluminium and tin-plated steel are used to make cans for food and soft drinks.

The table below shows the pH values of some soft drinks and cooked foods.

| drinks and foods | pH value |
|------------------|----------|
| cola | 2.0 |
| lemonade | 3.0 |
| rhubarb | 3.0 |
| beef | 7.0 |

(a) Cans were first used about 150 years ago to store food for soldiers. The cans were made from unplated steel. The soldiers found that beef kept in steel cans was still good to eat after many months. However they found that steel cans of rhubarb bulged, and when the cans of rhubarb were opened a gas escaped.

(i) Why were the steel cans **not** suitable for storing rhubarb?

.....

1 mark

(ii) Name the gas that formed in the cans of rhubarb.

.....

1 mark

Part of the reactivity series is given below.

magnesium

aluminium

zinc

iron (steel)

tin

copper

silver

(b) In modern 'tin cans' the steel is covered with a thin layer of tin.

(i) Use the reactivity series to explain why 'tin cans' are better than steel cans for storing food.

.....
.....

1 mark

(ii) When 'tin cans' are dented, the layer of tin often cracks. What reaction might happen when the layer of tin is cracked?

.....
.....

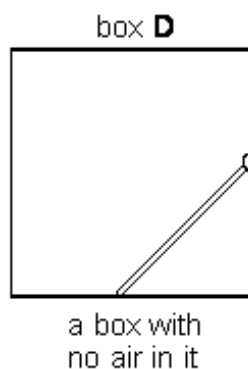
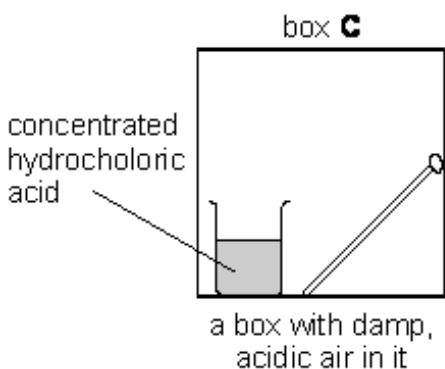
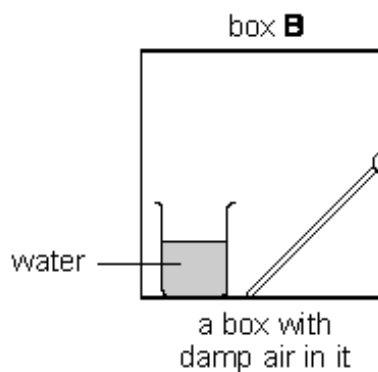
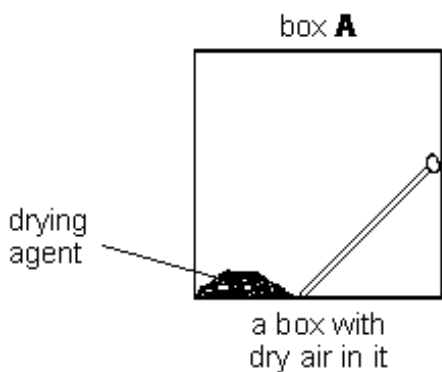
1 mark

(c) Many drink cans are now made of aluminium. Given the information in the reactivity series, why is this surprising?

.....
.....

1 mark
Maximum 5 marks

Q9. Four shiny iron nails are put in small sealed plastic boxes. The labels show what else is in the boxes.



(a) (i) In which **two** boxes will the iron **not** rust or corrode?

..... and

2 marks

(ii) In which box will the iron corrode the most?

.....

1 mark

(b) Many parts of bicycles are made from iron or steel. These parts can rust easily, even indoors. Give **two** ways to stop these parts rusting.

1.

2.

2 marks

Maximum 5 marks

Q10. Rebecca tested four metals to see which would react with solutions of different metal nitrates. The table shows her results.

If the metal reacted she put a tick (✓). If nothing happened she put a cross (X).

| metal | magnesium nitrate solution | copper nitrate solution | iron (III) nitrate solution | zink nitrate solution |
|-----------|----------------------------|-------------------------|-----------------------------|-----------------------|
| magnesium | X | ✓ | ✓ | ✓ |
| copper | X | X | X | X |
| iron | X | ✓ | X | X |
| zink | X | ✓ | ✓ | X |

(a) Rebecca did not know the reactivities of the four metals but, before doing any experiments, she knew where to put **four** crosses in the table.

Put a circle around each of these **four** crosses.

1 mark

(b) Use the information in the table to write down the reactivity series for the **four** metals.

most reactive

.....

.....

Least reactive

1 mark

(c) None of the metals shown in the table reacts with a solution of magnesium nitrate.

(i) Give the name of a metal which will react with a solution of magnesium nitrate.

.....

1 mark

(ii) Give the name of a metal nitrate solution, apart from magnesium nitrate, which will not react with magnesium.

.....

1 mark

Maximum 4 marks

Q11. The table shows some of the chemical reactions of four elements.

| element | reaction with water | reaction with dilute hydrochloric acid | reaction when heated in air |
|---------|------------------------------|--|-------------------------------------|
| A | none | none | burns to give an acidic oxide |
| B | vigorous, hydrogen given off | violent, gas given off | burns to give a basic oxide |
| C | none | none | reacts slowly to give a basic oxide |
| D | none | vigorous, gas given off | burns to give a basic oxide |

(a) Elements B, C and D are all metals. Write the letters down in order of the reactivity of the metals starting with the **most** reactive.

most reactive

1 mark

(b) (i) Name **one** gas, present in the air, with which all four elements will react.

.....

1 mark

(ii) Name the gas which is produced when element D reacts with dilute hydrochloric acid.

.....

1 mark

(c) What evidence is there to show that element A is the only non-metal?

.....
.....

1 mark

(d) Give the name of an element which could be element B.

.....

1 mark

Maximum 5 marks

##

An experiment was set up to investigate rusting. Some clean, shiny, iron nails were sealed in a glass bottle containing some tap water. The sealed bottle was then placed on a top-pan balance. The reading on the balance was 549.8 g.



The sealed bottle was left for one week. After one week the nails were rusty.

(a) (i) What would you expect the reading on the balance to be after one week?

.....

1 mark

(ii) Give a reason for your answer.

.....

1 mark

(b) (i) Rust is an oxide of iron. Another oxide of iron is iron(III) oxide.
Write a word equation for the formation of iron(III) oxide from its elements.

.....

1 mark

(ii) Which one of the following words describes the formation of iron(III) oxide from its elements?

combustion condensation decomposition oxidation

.....

1 mark
Maximum 4 marks

Q13. The table shows the observations made when four metals are added to cold water and to dilute hydrochloric acid.

| metal | observations with cold water | observations with dilute hydrochloric acid |
|--------------|---|--|
| zinc | no reaction | bubbles of gas form and the metal slowly dissolves |
| platinum | no reaction | no reaction |
| potassium | the metal floats and then melts, a flame appears, and sometimes there is an explosion | (cannot be done safely) |
| nickel | no reaction | a few bubbles of gas form if the acid is warmed |

(a) Write the names of these **four** metals in the order of their reactivity.

most reactive

.....

least reactive

.....

1 mark

(b) (i) Give the name of another metal, **not** in the table, which reacts in a similar way to potassium.

.....

1 mark

(ii) What gas is formed when zinc reacts with dilute hydrochloric acid?

.....

1 mark

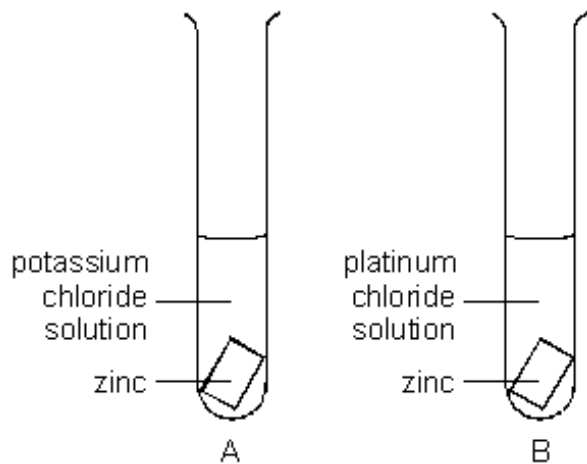
(iii) The experiment with potassium and dilute hydrochloric acid should **not** be done in school laboratories. Suggest why it is dangerous.

.....

.....

1 mark

(c) A scientist set up two test-tubes as shown below.



In test-tube B the zinc strip was slowly covered with a grey deposit. Nothing happened in the other test-tube.

(i) What was the grey deposit in test-tube B?

.....

1 mark

(ii) Why was this grey deposit formed in test-tube B?

.....

1 mark

(iii) Explain why **no** reaction took place in test-tube A.

.....

.....

1 mark
Maximum 7 marks

Q14. Copper can be extracted from an ore called copper pyrites. The formula of copper pyrites is CuFeS_2 .

(a) Give the names of the elements present in copper pyrites.
One has been done for you.

1. copper

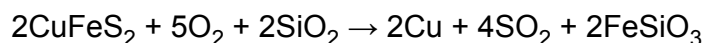
2.

3.

1 mark

(b) Copper is obtained by heating the ore in a controlled supply of air with sand (SiO_2).

Overall the reaction is:



(i) The amount of oxygen in the reaction must be carefully controlled.
If there is too much, the copper could react with the oxygen.
What substance would be formed?

.....

1 mark

(ii) In the industrial process, the waste gas sulphur dioxide (SO_2) is removed. It is bubbled through a solution that reacts with the sulphur dioxide and prevents it escaping.
Explain why the sulphur dioxide should be removed from the waste gases.

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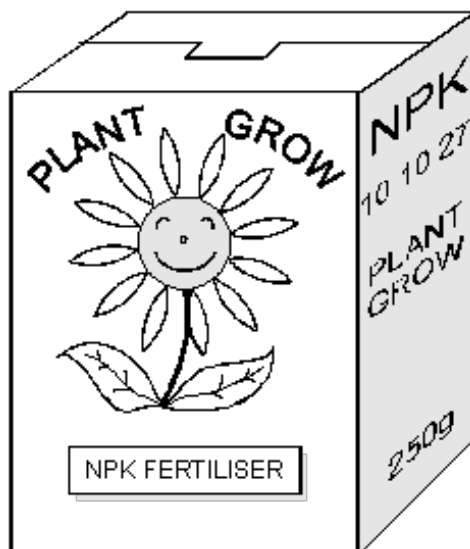
2 marks

(iii) What **type** of solution is used to remove the sulphur dioxide?

.....

1 mark
Maximum 5 marks

Q15. The drawing shows the label on a box of fertiliser for houseplants.



(a) To maintain healthy growth of their potted plants, people have to keep adding fertiliser to the soil. Explain why they need to keep adding fertiliser.

.....
.....

1 mark

(b) Part of the Periodic Table is shown below. The three elements N, P and K shown on the fertiliser label are also shown in the table.

| | | | | | | | | |
|----------|----|---|----|----|----------|----|----|----|
| | | H | | | | He | | |
| Li | Be | | B | C | N | O | F | Ne |
| Na | Mg | | Al | Si | P | S | Cl | Ar |
| K | Ca | | Ga | Ge | As | Se | Br | Kr |

(i) The element N is nitrogen. What are the names of the other **two** elements?

P

K

2 marks

- (ii) Give the symbol for the most reactive metal shown in this part of the Periodic Table.

.....

1 mark
Maximum 4 marks

##

The table contains information about five metals, A, B, C, D and E.

| Metal | how it reacts with cold water | how it reacts with hot water |
|--------------|--------------------------------------|-------------------------------------|
| A | no reaction | extremely slowly |
| B | no reaction | no reaction |
| C | hardly at all | slowly |
| D | slowly | quickly |
| E | quickly | very violently |

- (a) Use the information in the table to arrange the metals in order of reactivity.

most reactive

.....

.....

least reactive

1 mark

- (b) (i) Which metal in the table could be copper?

.....

1 mark

- (ii) Which metal in the table could be sodium?

.....

1 mark

- (iii) Which metal in the table could be iron?

.....

1 mark
Maximum 4 marks

Q17. The diagram shows part of the Periodic Table.

| period | | | | | | | | | | | | | | | | | 0 | |
|--------|----|----|----|----|----|----|----|----|----|----|----|----|-----|----|----|----|-----|----|
| 1 | | | | | | | | | | | | | | | | | H | He |
| | I | II | | | | | | | | | | | III | IV | V | VI | VII | |
| 2 | Li | Be | | | | | | | | | | | B | C | N | O | F | Ne |
| 3 | Na | Mg | | | | | | | | | | | Al | Si | P | S | Cl | Ar |
| 4 | K | Ca | Sc | Ti | V | Cr | Mn | Fe | Co | Ni | Cu | Zn | Ga | Ge | As | Se | Br | Kr |
| 5 | Rb | Sr | Y | Zr | Nb | Mo | Tc | Ru | Rh | Pd | Ag | Cd | In | Sn | Sb | Te | I | Xe |

(a) Calcium burns brightly in oxygen, forming calcium oxide (CaO). Calcium oxide reacts with water, forming a compound with the formula Ca(OH)_2 .

(i) Give the name of the compound with the formula Ca(OH)_2 .

.....

1 mark

(ii) The compound, Ca(OH)_2 , is slightly soluble in water.

Would you expect this solution to be **acidic**, **alkaline** or **neutral**?

.....

1 mark

(b) The table below gives information about four compounds. The molecules of each compound contain an atom of hydrogen and an atom of an element from group VII of the Periodic Table. The amount of energy needed to pull the two atoms apart is called the bond strength.

| compound | | bond strength in KJ/mol | action of heat on the compound |
|-------------------|---------|----------------------------|-----------------------------------|
| name | formula | | |
| hydrogen fluoride | HF | 570 | stable |
| hydrogen chloride | HCl | 432 | fairly stable |
| hydrogen bromide | HBr | 366 | some bromine formed |
| hydrogen iodide | HI | 298 | |

Use the information in the table to answer the following questions.

(i) Suggest why hydrogen iodide may not exist at room temperature.

.....

1 mark

(ii) Describe how the bond strength of these compounds varies in group VII.

.....
.....

1 mark

(iii) Which compound in the table requires the highest temperature to make it decompose?

.....

1 mark

Maximum 5 marks

Q18. Railway lines can be joined together by pouring molten iron into the gap between them.

(a) The molten iron is produced by the reaction between powdered aluminium and iron oxide.
Complete the word equation for the reaction.

aluminium + iron oxide → iron +

1 mark

(b) Iron can be produced from a mixture of aluminium and iron oxide but **not** from a mixture of copper and iron oxide.
Write the names of the **three** metals, in the order of their reactivity.

most reactive

.....

.....

1 mark

(c) The list shows the names and symbols of five metals in order of their reactivity.

| name | symbol |
|-----------|--------|
| sodium | Na |
| calcium | Ca |
| magnesium | Mg |
| zinc | Zn |
| silver | Ag |

(i) What, if anything, would be the result of heating zinc powder with calcium oxide?

.....

1 mark

(ii) Write down the **name** of a metal in the list that will **not** react with a solution of magnesium sulphate.

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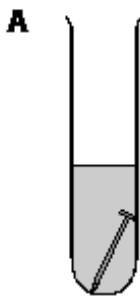
1 mark

(d) The powdered metal with the symbol Zn burns in air.
Write the **word equation** for the reaction.

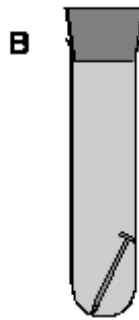
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2 marks
Maximum 6 marks

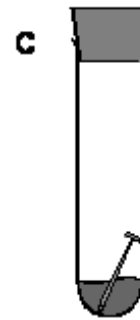
Q19. Jessica was investigating the rusting of iron. She set up five experiments as shown below, and left the test-tubes for three days.



iron nail in distilled water



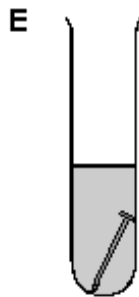
iron nail in tap water
which has been boiled to
remove dissolved gases



iron nail and a chemical
to absorb water vapour



iron nail in sea water



iron nail in vinegar

Jessica wrote the following results in her book.

| Test-tube | observation |
|-----------|--|
| A | nail slightly rusty |
| B | nail still shiny |
| C | nail still shiny |
| D | nail very rusty |
| E | nail slightly rusty, bubbles of gas seen |

(a) Explain why the nails had **not** rusted in test-tubes B and C.

in test-tube B

.....

in test-tube C

.....

2 marks

(b) In test-tube E the iron nail reacted with the vinegar.

(i) Is vinegar **acidic**, **alkaline** or **neutral**?

.....

1 mark

(ii) When the iron reacted with the vinegar, bubbles of gas were formed. What gas was formed?

.....

1 mark

(c) Before putting the iron nail in test-tube D, Jessica weighed the nail. After three days she dried and weighed the nail **and** the rust which had formed.

(i) How did the total mass of the nail and rust compare to the mass of the nail at the beginning?

.....

1 mark

(ii) Give the reason for your answer.

.....

.....

1 mark

- (d) Jessica concluded that the presence of salt in the water made the nail rust more quickly. Explain why she drew that conclusion from her experiments.

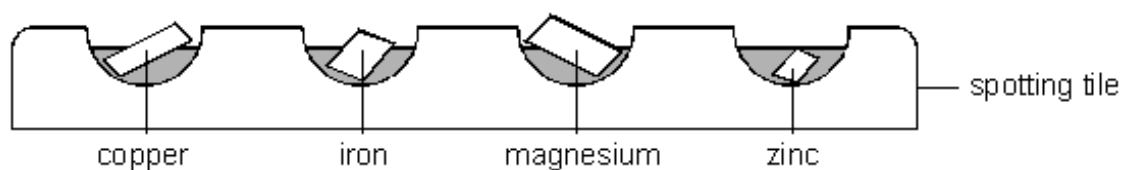
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.....

.....

1 mark
Maximum 7 marks

- Q20.** Aisha placed small samples of four different metals on a spotting tile. She added drops of copper sulphate solution to each metal.



Aisha repeated the experiment with fresh samples of the four metals and solutions of different salts. She recorded some of her results in a table.

✓ shows that a reaction took place

X shows that no reaction took place.

| solutions \ metals | copper | iron | magnesium | zinc |
|---------------------------|---------------|-------------|------------------|-------------|
| copper sulphate | X | ✓ | ✓ | |
| iron sulphate | X | X | ✓ | ✓ |
| magnesium sulphate | X | | X | |
| zinc sulphate | X | X | ✓ | X |

(a) The four metals have different reactivities.

(i) Use the information in the table to put the four metals in a reactivity series.

most reactive metal

.....

.....

least reactive metal

1 mark

(ii) Use the reactivity series to complete the table by writing in ✓ or X in the **three** empty boxes.

2 marks

(b) Copper reacts with silver nitrate solution.

(i) Complete the word equation for the reaction:

copper + silver nitrate → +

2 marks

(ii) Platinum does **not** react with silver nitrate.
Put the metals platinum, copper and silver in the correct order according to their reactivity.

most reactive

.....

least reactive

1 mark

(c) In many houses the hot water pipes are made from copper and the boiler is made from iron.

Which of these metals will corrode first? Explain your answer.

.....

.....

1 mark
Maximum 7 marks

##

(a) The table below shows the percentage of carbon in four different materials.

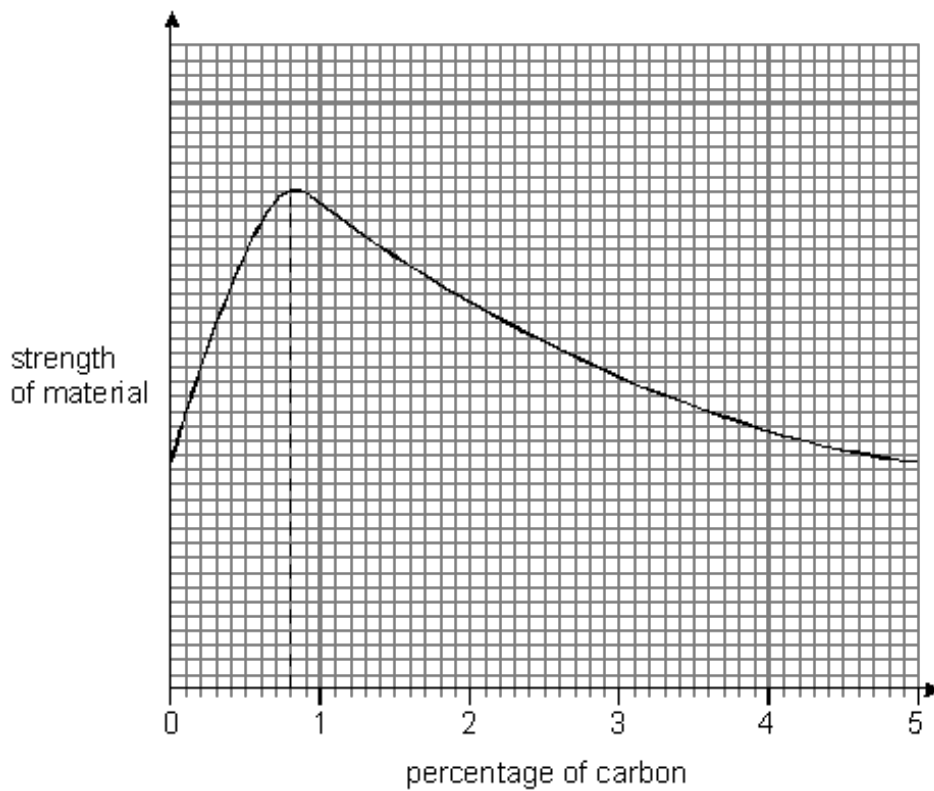
| name of material | percentage of carbon in the material |
|-------------------|--------------------------------------|
| cast iron | 4.5 |
| high carbon steel | 0.8 |
| mild steel | 0.3 |
| wrought iron | 0.1 |

Which material has the highest percentage of carbon?

.....

1 mark

(b) The graph below shows how the percentage of carbon affects the **strength** of the materials.



(i) Use the graph to find the percentage of carbon in the material with the greatest strength.

..... %

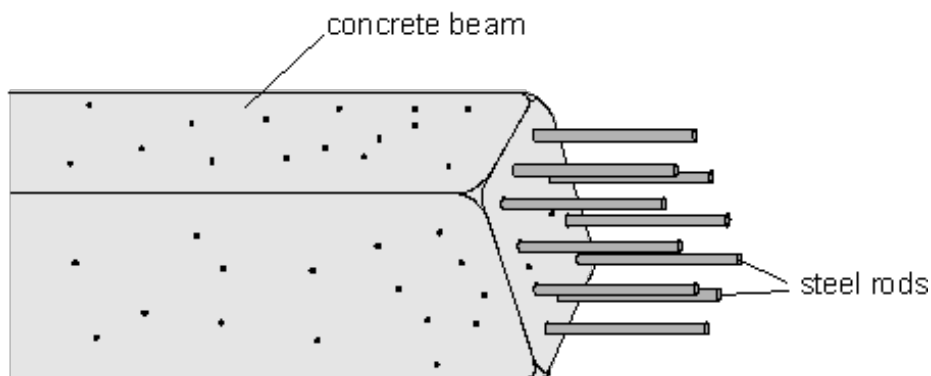
1 mark

(ii) Use your answer to part (i) to name the strongest material in the table.

.....

1 mark

(c) Steel rods can be put into concrete beams before the concrete sets.



(i) What could these concrete beams be used for?

.....
.....

1 mark

(ii) Steel contains iron. Give the name of **one** other substance which must be present for the iron to go rusty.

.....

1 mark

Maximum 5 marks

Q22. (a) The table below shows the melting points of four metals.

| metal | melting point, in °C |
|---------|-------------------------|
| gold | 1064 |
| mercury | -37 |
| sodium | 98 |
| iron | 1540 |

(i) Which metal in the table has the highest melting point?

.....

1 mark

(ii) Which metal in the table has the lowest melting point?

.....

1 mark

(b) Gold can be a **gas** or a **liquid** or a **solid**.

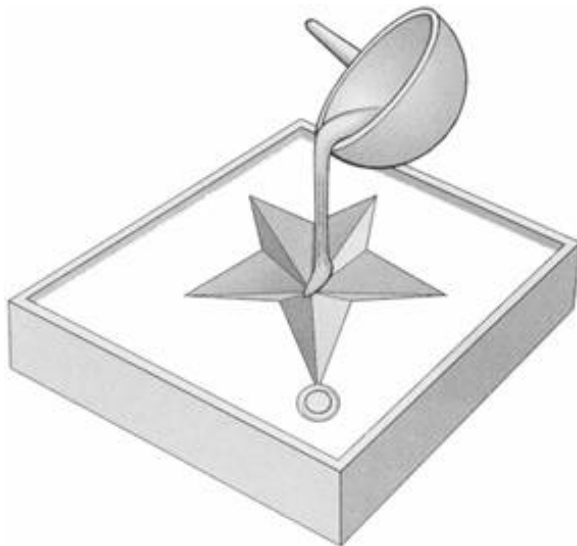
Choose from these words to fill the gaps below.

When gold is heated from room temperature to 1070°C , the gold

changes from a to a

1 mark

(c) 5 g of gold is melted and **all** of it is poured into a mould to make a pendant as shown below.



melted gold is poured into a mould



gold pendant

What is the mass of the gold pendant?

..... g

1 mark

(d) The table below shows how the four metals react with oxygen when heated in air.

| metal | reaction when heated in air |
|---------|----------------------------------|
| gold | no change |
| mercury | slowly forms a red powder |
| sodium | bursts into flames straight away |
| iron | very slowly turns black |

(i) Which is the **most** reactive metal in the table?

.....

1 mark

(ii) Which is the **least** reactive metal in the table?

.....

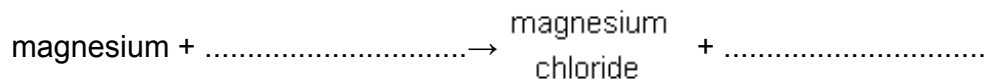
1 mark

Maximum 6 marks

Q23.

(a) Magnesium chloride is formed when magnesium reacts with an acid.

(i) Complete the word equation for the reaction between magnesium and this acid.



2 marks

(ii) Suggest why magnesium chloride can be made by mixing magnesium with this acid but copper chloride **cannot** be made by mixing copper with this acid.

.....

.....

1 mark

(b) Copper sulphate is made by adding copper oxide to a different acid. Give the name of the acid which is used.

.....

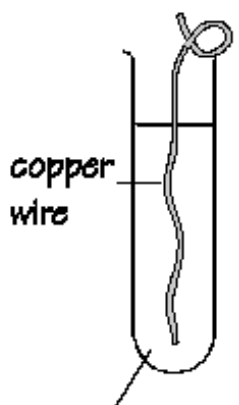
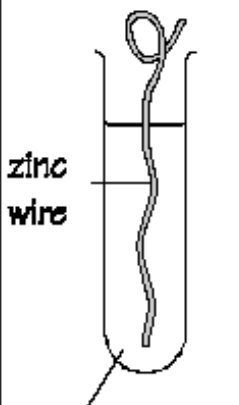
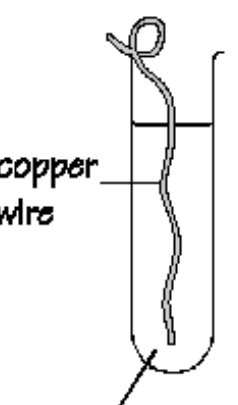
1 mark

(c) In the table below, write the name of the compound represented by each formula.

| formula | name |
|-----------------|------|
| CuSO_4 | |
| MgCl_2 | |

2 marks
Maximum 6 marks

Q24. A group of pupils placed pieces of metal wire in different salt solutions. They recorded their observations in the table below.

| experiment | 1 | 2 | 3 |
|--------------|--|--|--|
| diagram |  <p>copper wire</p> <p>silver nitrate solution</p> |  <p>zinc wire</p> <p>lead nitrate solution</p> |  <p>copper wire</p> <p>lead nitrate solution</p> |
| observations | crystals of silver formed on the wire | crystals of lead formed on the wire | no change |

- (a) From these observations, write the order of reactivity of the four metals, copper, lead, silver and zinc.

most reactive

.....

.....

least reactive

2 marks

- (b) The pupils then dipped a new piece of each of the metal wires into dilute hydrochloric acid.

Only **one** of the metals reacted. Which metal was this?

.....

1 mark

- (c) One pupil predicted that there would be **no** reaction when he put a piece of zinc wire into a solution of silver nitrate.

Was his prediction correct? Explain your answer.

.....

.....

1 mark

- (d) In nature, gold is never found combined with other elements.

Where should gold be placed in the reactivity series in part (a)?
Explain your answer.

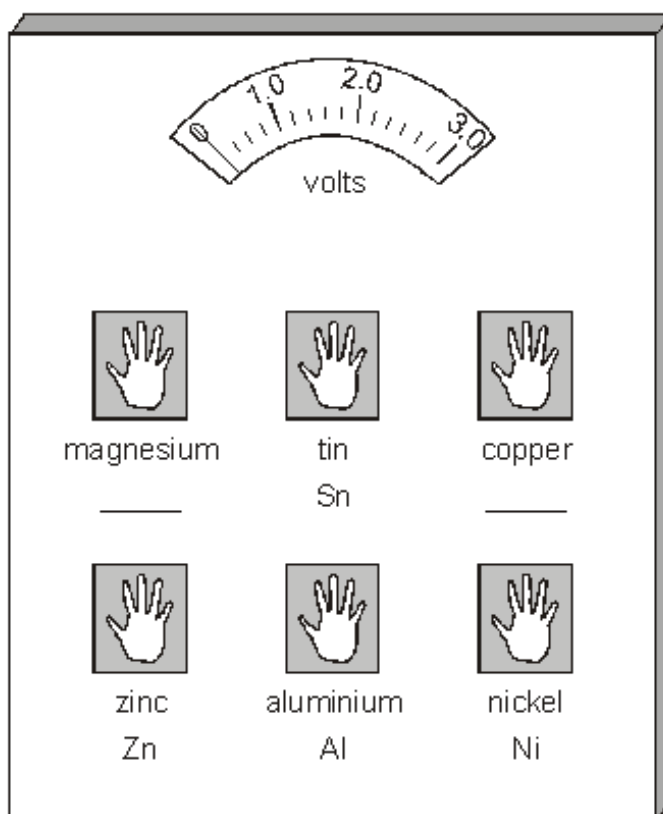
.....

.....

1 mark
Maximum 5 marks

Q25. The diagram shows an exhibit at a science museum. It has six blocks of metal connected to a voltmeter.

(a) **On the lines on the diagram**, write the chemical symbols for magnesium and copper.



2 marks

(b) When visitors place their hands on two blocks of metal at the same time, there is a reading on the voltmeter.

Some examples are shown in the table.

| hands placed on | reading on voltmeter (volts) |
|-----------------------|------------------------------|
| magnesium + tin | 2.1 |
| magnesium + copper | 2.5 |
| magnesium + zinc | 1.5 |
| magnesium + aluminium | 0.6 |
| magnesium + nickel | 2.0 |

The reading on the voltmeter depends on the reactivity of the two metals touched. The bigger the difference in reactivity, the higher the reading on the voltmeter.

- (i) Magnesium is the most reactive of these metals.
Which metal is the least reactive?

.....

1 mark

- (ii) If two blocks of magnesium are used in the experiment, instead of two different metals, what would the voltmeter read?

..... volts

Explain your answer.

.....

.....

2 marks

- (iii) Look at the voltmeter readings in the table.
On which **two** metals, other than magnesium, would a person put their hands to give the lowest reading on the voltmeter?

..... and

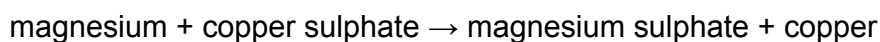
1 mark
maximum 6 marks

Q26. Part of the reactivity series of metals is shown below.

| | |
|-----------------------|-----------|
| most reactive | potassium |
| | sodium |
| | magnesium |
| | aluminium |
| | iron |
| | lead |
| least reactive | copper |

- (a) Dan added a piece of magnesium to a solution of copper sulphate. A displacement reaction took place.

The word equation for the reaction is shown below.



Why is this called a displacement reaction?

.....
.....

1 mark

- (b) Look at each pair of chemicals in the table below.

Use the reactivity series to predict whether a displacement reaction would take place.

Write **yes** or **no** in the second column and give the reason for your decision.

| pairs of chemicals | Does a displacement reaction take place? yes or no | reason |
|---------------------------|---|---------------|
| iron + sodium chloride | | |
| magnesium + lead nitrate | | |

2 marks

(c) Dan wanted to find out where zinc should be placed in the reactivity series.

(i) What tests should Dan do to find the correct position of zinc in the reactivity series?

.....
.....
.....

1 mark

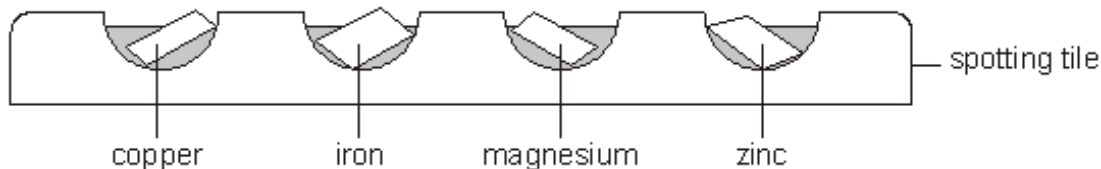
(ii) How would Dan use his test results to decide where to put zinc in the reactivity series?

.....
.....
.....

1 mark
maximum 5 marks

##

(a) Sasha placed small samples of four different metals on a spotting tile. She added drops of calcium nitrate solution to each metal.



Sasha repeated the experiment with:

- fresh samples of the four metals and copper nitrate solution
- fresh samples of the four metals and iron nitrate solution.

Will a reaction take place when each of the metals is added to each of the solutions?

Use the reactivity series below to help you.

most reactive calcium
magnesium
aluminium
zinc
iron
lead
least reactive copper

In the table below:

- place a tick, ✓, to show that a reaction took place
- place a cross, X, to show that **no** reaction took place.

Two have been done for you.

| salt solution | metal | | | |
|-----------------|--------|------|-----------|------|
| | copper | iron | magnesium | zinc |
| calcium nitrate | | | | |
| copper nitrate | X | | | |
| iron nitrate | | X | | |

3 marks

- (b) Three pairs of chemicals are listed below.
A reaction only takes place with two of the pairs.

Draw a line from each reaction to the correct result.
Draw only **three** lines.

pair of chemicals

result

calcium carbonate + hydrochloric acid

no reaction

magnesium + hydrochloric acid

a chloride, carbon dioxide
and water are formed

copper + hydrochloric acid

a chloride and hydrogen
are formed

2 marks
maximum 5 marks

Q28. An alloy is a mixture of elements.
 The table shows the mass of each element present in 100 g of five different alloys, **bronze, solder, steel, stainless steel** and **brass**.

| alloy | mass of each element in 100 g of alloy | | | | | | | |
|-----------------|--|---------|------------|----------|------------|----------|--------------|------------|
| | lead (g) | tin (g) | copper (g) | zinc (g) | carbon (g) | iron (g) | chromium (g) | nickel (g) |
| bronze | | 4 | 95 | 1 | | | | |
| solder | 62 | 38 | | | | | | |
| steel | | | | | 1 | 99 | | |
| stainless steel | | | | | | 70 | 20 | 10 |
| brass | | | 67 | 33 | | | | |

(a) Which **alloy** in the table above contains an element which is a non-metal?

.....

1 mark

(b) Which **two alloys** in the table contain only **two metals**?

..... and

1 mark

(c) Another alloy called nichrome contains only the elements chromium and nickel.
 100 g of nichrome contains 20 g of chromium.

How much nickel does it contain?

..... g

1 mark

(d) Before 1992, two-pence coins were made of bronze.
 Steel rusts but bronze does **not** rust.

(i) Why does bronze **not** rust?

Use information in the table above to help you.

.....

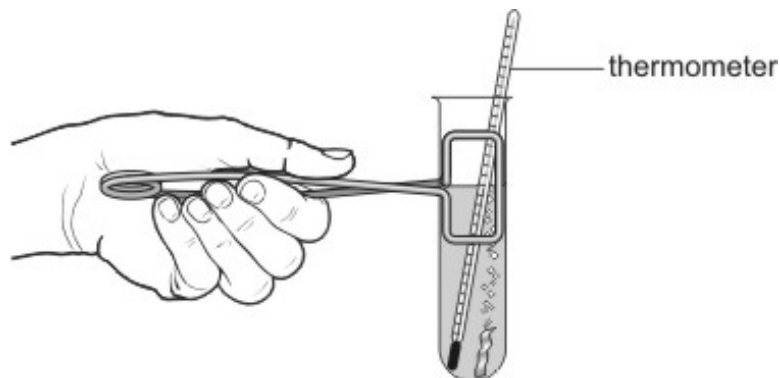
1 mark

- (ii) Rusting requires water and a gas from the air.
Give the name of this gas.

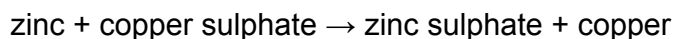
.....

1 mark
maximum 5 marks

- Q29.** Harry mixed zinc with copper sulphate solution in a test-tube.
A displacement reaction took place and the temperature increased.



- (a) The word equation for the reaction is shown below.



Why is this reaction called a displacement reaction?

.....
.....

1 mark

- (b) Harry repeated the experiment with two other metals.
He wanted to calculate the temperature rise each time.
His results are shown below.

| metal added to copper sulphate | temperature at the start (°C) | highest temperature reached (°C) | rise in temperature (°C) |
|--------------------------------|-------------------------------|----------------------------------|--------------------------|
| zinc | 20.0 | 36.5 | 16.5 |
| iron | 25.5 | 38.5 | 13.0 |
| magnesium | 19.5 | 87.5 | 68.0 |

Harry used different starting temperatures.
Explain why this did **not** affect his results.

.....
.....

1 mark

(c) Part of the reactivity series of metals is shown below.

| | |
|-----------------------|-----------|
| most reactive | sodium |
| | calcium |
| | magnesium |
| | aluminium |
| | zinc |
| | iron |
| | lead |
| least reactive | copper |

Use the reactivity series above to answer all the questions below.

(i) Why was the highest rise in temperature obtained with magnesium and copper sulphate?

.....
.....

1 mark

(ii) Why was the rise in temperature obtained with zinc and copper sulphate **not** much higher than the rise in temperature obtained with iron and copper sulphate?

.....
.....

1 mark

(iii) In which of the following mixtures would there be a rise in temperature? Write **yes** or **no** in each blank box.

| mixture | Would there be a rise in temperature? |
|-----------------------------|--|
| aluminium + sodium chloride | |
| calcium + zinc sulphate | |
| lead + zinc chloride | |
| magnesium + iron chloride | |

2 marks
maximum 6 marks

Q30. Some pupils made an electric cell using two different metals and a lemon. They put strips of copper and zinc into a lemon and connected them to the terminals of an electric clock.



(a) Look at the photograph.

What evidence is there that they have made an electric cell?

.....

1 mark

(b) The pupils had pieces of copper, zinc, iron and magnesium and some lemons. They wanted to find out which pair of metals made the cell with the biggest voltage.

What equipment should they use to measure the voltage of their cells?

.....

1 mark

(c) In their investigation they used different pairs of metals.

Give **one** factor that they should keep the same.

.....

1 mark

- (d) The pupils measured the voltage produced by different pairs of metals. Their results are recorded below.

| | | voltage produced by each pair of metals (volts) | | | |
|-----------|--|---|------|------|--------|
| | | magnesium | zinc | iron | copper |
| copper | | 1.7 | 0.9 | 0.8 | 0 |
| iron | | 1.3 | 0.1 | 0 | - |
| zinc | | 0.8 | 0 | - | - |
| magnesium | | 0 | - | - | - |

Which pair of metals made the cell with the biggest voltage?

..... and

1 mark

- (e) Look at the results in the table above.

Why should the pupils **not** use pairs of the same type of metal for the clock?

.....

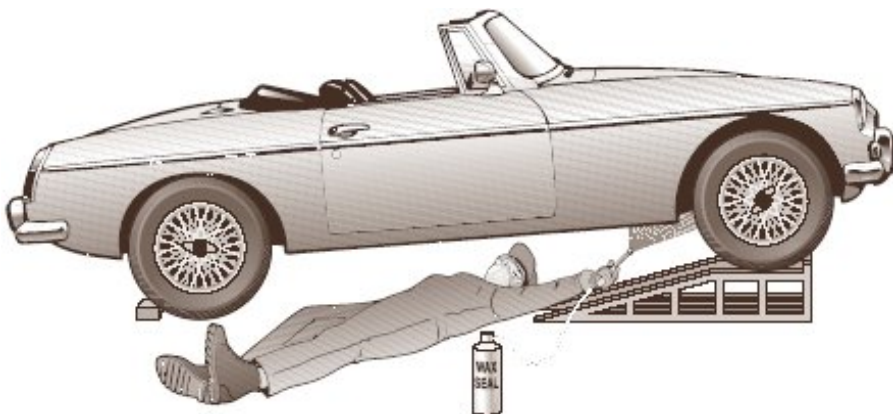
1 mark
 maximum 5 marks

- Q31.** Jill bought a can of Wax Seal to spray the parts underneath her car.



Wax Seal helps to prevent these parts rusting.

It is a mixture of wax and a liquid called white spirit.



(a) (i) The body of Jill's car is made from steel. Steel contains iron.

Give **two** substances that are needed for iron to rust.

1.

1 mark

2.

1 mark

(ii) How does Wax Seal help to protect the car from rusting?

.....
.....

1 mark

(iii) Wax Seal can also be used on the upper parts of a car.

What else protects parts such as the doors from rusting?

.....

1 mark

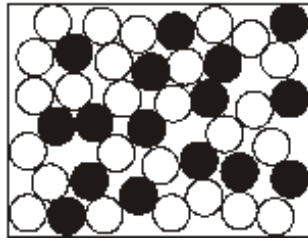
(b) The metal parts of a car may corrode.

What type of air pollution could cause corrosion?

.....

1 mark

- (c) The diagram below shows the mixture of particles of wax and white spirit in Wax Seal.



key

- = particle of white spirit
● = particle of wax

not to scale

After Jill sprays the car, the white spirit evaporates leaving a layer of solid wax on the surface.

- (i) In the box below, draw **eight** circles, ○, to show the arrangement of particles in a gas.



particles in a **gas**

1 mark

- (ii) In the box below, draw **eight** circles, ●, to show the arrangement of particles in a solid.

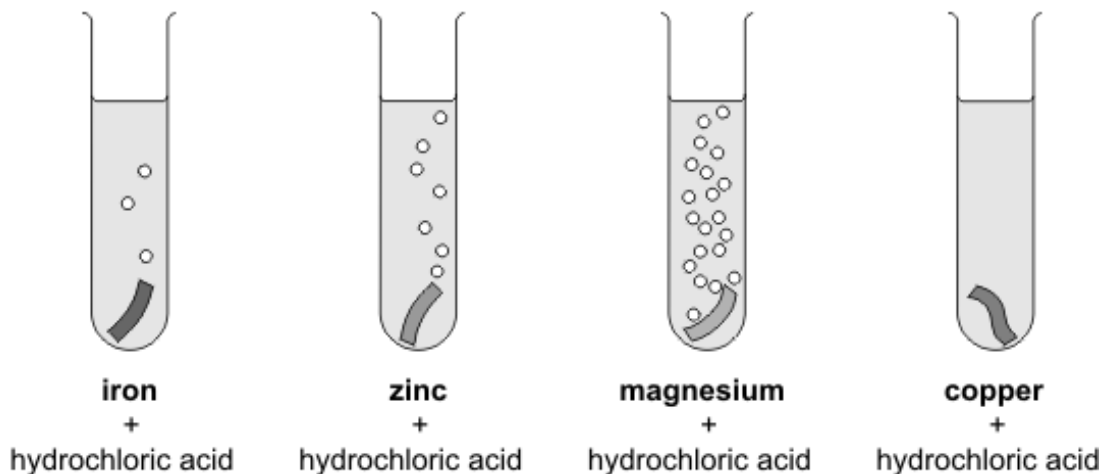


particles in a **solid**

1 mark
maximum 7 marks

Q32. (a) Ruth put a piece of a different metal in each of four test tubes.

She poured 10 cm³ of hydrochloric acid onto each metal.



Look at the diagrams above.

(i) How do these show if a metal reacts with the acid?

.....

1 mark

(ii) **On the lines below**, put the **four** metals in the order of how strongly they react with the acid.

most reactive

.....

.....

least reactive

1 mark

(b) Choose the name of a metal from the box below to answer each question.

| | | | |
|---------------|-------------|------------------|-------------|
| copper | iron | magnesium | zinc |
|---------------|-------------|------------------|-------------|

(i) Which metal from the box is used for electrical wires?

.....

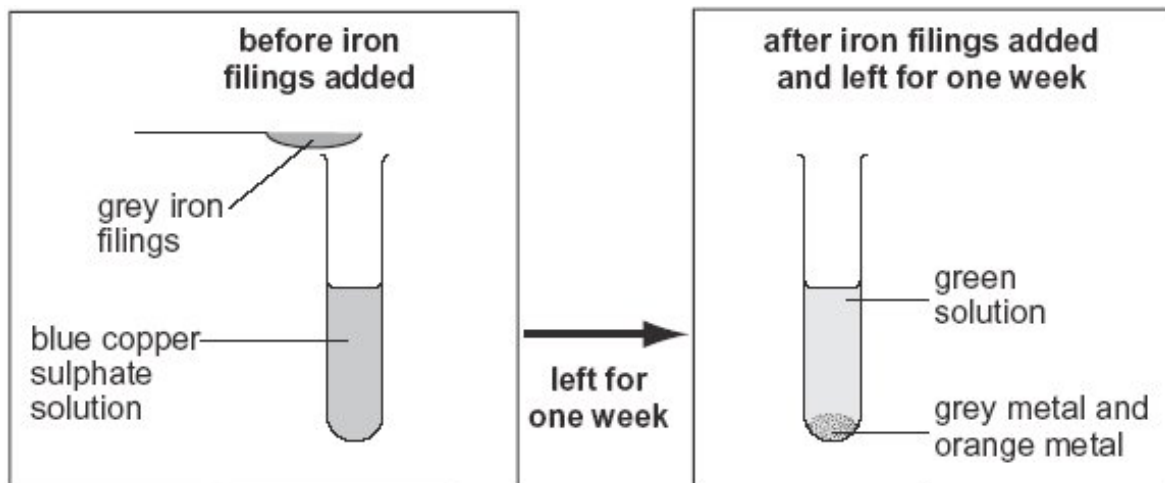
1 mark

(ii) Which metal from the box goes rusty?

.....

1 mark
maximum 4 marks

Q33. Joanne added iron filings to copper sulphate solution. She observed the reaction after one week.



(a) What evidence in the diagrams shows that a chemical reaction has taken place?

.....

1 mark

(b) The reaction between iron and copper sulphate is a **displacement** reaction.

(i) Give the name of the orange metal visible after one week.

.....

1 mark

(ii) What is the name of the compound formed in this reaction?

.....

1 mark

(iii) Joanne poured the green solution into another test tube. She added some copper pieces to the solution.

Will a displacement reaction occur?

yes

no

Explain your answer.

.....

.....

1 mark

(c) Part of the reactivity series of metals is shown below.

| | |
|-----------|----------------|
| potassium | most reactive |
| lithium | ↑ |
| calcium | |
| aluminium | |
| zinc | |
| lead | least reactive |

Use the information above.

Which **two** metals would react with aluminium nitrate in a displacement reaction?

Tick the **two** correct boxes.

calcium

potassium

zinc

lead

1 mark
maximum 5 marks

- M1.**
- (a) (i) zinc sulphate + copper
do not accept 'sulphide' or 'sulphur' 1
- (ii) brown
accept 'brownish' or 'brownny grey' 1
- (b) (i) magnesium + copper sulphate → magnesium sulphate + copper
all must be correct 1
- (ii) silver grey
answers may be in either order
accept 'grey' or 'silver'
do not accept 'white' or 'light grey' 1
- (iii) brown
accept 'copper' 1

(c) (i) no reaction **or** nothing **or** none

1

(ii) **answers should refer to both magnesium and iron**

any **one** from

- magnesium is more reactive than iron
accept 'magnesium is above iron'
- iron is less reactive than magnesium
accept 'iron is below magnesium'

1

[7]

M2. (a) reduction

accept 'displacement' or 'redox reaction'
do not accept 'removal of oxygen'

1

(b)

| | aluminium | silicon | carbon |
|-----------------------------|-----------|---------|--------|
| more reactive than chromium | ✓ | ✓ | ✓ |
| less reactive than chromium | | | |

all three ticks are required for the mark

1

(c) **the first mark is for correctly identifying three pairs of reactants**

aluminium and silicon dioxide **or** aluminium oxide and silicon
all three pairs of reactants are required for the mark

and

aluminium and carbon dioxide **or** aluminium oxide and carbon

and

silicon and carbon dioxide **or** silicon dioxide and carbon
accept 'silicon oxide' for silicon dioxide
accept formulae instead of names

1

the second mark is for explaining how to determine the order of reactivity answers may take a variety of forms; this is not an exhaustive list of correct responses

either

statements describing how the results of each experiment enable the reactivities of the two elements to be ranked

statements about **all three** experiments are required for the mark

for example, 'if aluminium reacts with silicon dioxide, then aluminium is more reactive than silicon' or 'if there is no reaction, then aluminium is less reactive than silicon'

or

a generic statement describing how results from this type of experiment allow reactivities to be ranked

the answer must refer to all three experiments and must also make clear how an order of reactivity is to be obtained

*for example, 'in each case, if there is a reaction, then the element on its own is more reactive than the element in the oxide.
Each experiment allows two elements to be put in order, and from the three experiments the three elements can be put in order'*

or

a description of how two experiments allow the reactivity of one element to be fixed, and how the last experiment allows the order of reactivity to be completed answers must include the idea that the occurrence or absence of a reaction indicates which element is more reactive

for example, 'from $Al + SiO_2$ and $Al + CO_2$ I could see if Al was more reactive than either C or Si, because if there is a reaction then Al is more reactive, and from $C + SiO_2$ I could see whether C or Si was more reactive'

1

[4]

| | | | |
|------------|---------------|--------------|--|
| M3. | (a) magnesium | Mg | <i>answers must be in the correct order</i> |
| | zinc | or Zn | <i>all four</i> are required for the mark |
| | iron | Fe | |
| | copper | Cu | |

1

- (b) **one mark is for the left hand box;**
the other mark is for the two right hand boxes

*

| |
|--------------|
| dark grey |
|--------------|

*

| |
|------------|
| brown |
| colourless |

*accept 'copper coloured'
or 'black' for brown*

accept 'almost colourless'

2

- (c) $\text{Mg} + \text{CuSO}_4$ **or** Mg and CuSO_4
Accept 'the right hand' or 'the fourth one'

1

[4]

- M4.** (a) (i) copper sulphate
do not accept 'CuSO₄'
1 (L7)
- (ii) zinc sulphate
accept 'ZnSO₄'
1 (L7)
- copper
accept 'Cu'
answers may be in either order
1 (L7)
- (iii) any **one** from
- magnesium
 - iron
 - aluminium
 - tin
- do not accept 'sodium' or 'potassium'
or 'lithium' or 'calcium' or 'lead' or 'copper'*
1 (L7)
- (b) none **or** stays the same **or** zero
accept '0'
1 (L7)

(c) none **or** stays the same

1 (L7)

[6]

M5. (a) ammonium chloride and sodium sulphite

answers may be in either order

both are required for the mark

accept 'sulphate' for sulphite

accept '4 and 10'

1 (L7)

(b) (i) bubbles

accept 'hydrogen' **or** 'gas' **or** 'fizzing'

do **not** accept 'a reaction'

1 (L7)

(ii) carbon dioxide **or** CO₂

1 (L7)

(c) potassium carbon oxygen

answers may be in any order

all three are required for the mark

1 (L7)

[4]

M6. (a) (i) alkaline

1 (L5)

(ii) forms a solution with a pH of about 8.5

1 (L5)

it is not poisonous

1 (L5)

answers may be in either order

accept 'pH 8.5' **or** 'alkaline'

(b)



both complete names are required for the mark

1 (L6)

(c) carbon dioxide

accept 'CO₂'

1 (L6)

[5]

- M7.** (a) (i) copper reacted with oxygen from the air
*accept 'copper reacted with **or** combined with the air'*
*do **not** accept 'some air reacted'*
***or** 'some copper reacted'*
*do **not** accept 'because some had become copper oxide'*
*do **not** accept 'oxygen **or** air was used up'* 1
- (ii) any **one** from
- all the oxygen had reacted
 - no more oxygen left to react
accept 'copper did not react with nitrogen'
 - only gas reacted which was 21% of the air
accept 'only $\frac{1}{5}$ of air is oxygen'
 - there were only 21cm³ of oxygen
accept 'because copper does not react with other gases in the air' 1
- (b) (i) CuO 1
- (ii) any **one** from
- oxidation
 - redox
 - reduction
*do **not** accept 'corrosion'* 1
- (iii) $2\text{Cu} + \text{O}_2 \rightarrow 2\text{CuO}$
accept 'Cu + $\frac{1}{2}$ O₂ = CuO'
*do **not** accept 'Cu + O → CuO'*
***or** 'Cu + O₂ → CuO₂'* 1

[5]

- M8.** (a) (i) the acid **or** rhubarb reacted with the steel
accept 'the rhubarb reacts with it'
*do **not** accept 'they bulged'*
or 'rhubarb is acid' or 'rhubarb has a low pH' 1 (L7)
- (ii) hydrogen
accept ' H_2 '
*do **not** accept 'H'* 1 (L7)
- (b) (i) any **one** from
 - tin is less reactive than iron **or** steel
accept 'acid does not react with tin but does with steel'
 - tin is lower than steel
1 (L7)
- (ii) **the answer may focus on either the inside or the outside of the can**
any **one** from
 - the steel reacts with the food **or** is corroded by the acid in the food
 - the iron **or** steel will rust **or** react with the air outside the can
1 (L7)
- (c) aluminium is more reactive than iron **or** steel **or** tin
*accept 'aluminium is reactive **or** very reactive'*
accept 'it's not surprising because the aluminium is covered with an oxide layer'
*do **not** accept 'aluminium is high in the reactivity series'* 1 (L7)

[5]

- M9.** (a) (i) A and D 2 (L4)
- (ii) C
answers may be in either order 1 (L4)

(b) any **two** from

- paint them

accept 'varnish it'

- grease them

accept 'WD40'

- oil them

accept 'plate them' or 'chrome them'

- galvanise them

or 'coat them with zinc or tin'

- coat them with plastic

accept 'cover them in plastic'

do not accept 'keep them dry' or 'keep air away'

do not accept 'make them from stainless steel'

or any idea of replacement

2 (L4)

[5]

M10. (a) circles around the four crosses which run diagonally from top left to bottom right

all four crosses must be circled for the mark

1 (L7)

(b) magnesium **or** Mg

zinc **or** Zn

iron **or** Fe

copper **or** Cu

1 (L6)

answers must be in the correct order

all four elements are required for the mark

(c) (i) any **one** from

- potassium

- sodium

- lithium

- calcium

accept any group I or group II metal

except beryllium and magnesium

do not accept 'aluminium'

1 (L7)

(ii) any **one** from

- potassium nitrate
accept 'potassium'
- sodium nitrate
accept 'sodium'
- lithium nitrate
accept 'lithium'
- calcium nitrate
accept 'calcium'
accept 'aluminium nitrate' or 'aluminium'

1 (L7)

[4]

M11. (a) B D C

all three letters in the correct order are required for the mark

1 (L6)

(b) (i) oxygen

1 (L6)

(ii) hydrogen

1 (L7)

(c) it's the only one which forms an acidic oxide

accept 'it has an acidic oxide'
do **not** accept 'it burns to give an acid'

1 (L7)

(d) any **one** from

- sodium
- potassium
- lithium
- barium

accept 'caesium' or 'rubidium' or 'calcium'
do not accept 'aluminium' or 'magnesium'

1 (L7)

[5]

- M12.** (a) (i) 549.8 g
accept 'the same' or 'no change' 1 (L5)
- (ii) mass does not change in a reaction
accept 'because it is sealed'
or 'new material is not made or lost'
do not accept 'mass does not change' 1 (L5)
- (b) (i) iron + oxygen → iron(III) oxide
the whole word equation is required for the mark
accept 'iron oxide' for iron(III) oxide reactants
may be in either order
do not accept 'air' for oxygen 1 (L6)
- (ii) oxidation 1 (L6)

[4]

- M13.** (a) • potassium
• zinc
• nickel
• platinum 1 (L5)
- all four metals in the correct order are required for the mark*
- (b) (i) sodium
accept 'caesium' 1 (L6)
- (ii) hydrogen 1 (L6)
- (iii) any **one** from
• the reaction is too violent
accept 'it explodes' or 'acid goes everywhere'
• potassium is too reactive 1 (L5)

(c) (i) platinum 1 (L6)

(ii) **answers must refer to the reactivity of both metals**

any **one** from

- zinc displaces platinum from solution
- zinc is higher than platinum in the reactivity series
accept 'zinc is more reactive than platinum'
- platinum is lower than zinc in the reactivity series
accept 'platinum is less reactive than zinc'

1 (L6)

(iii) any **one** from

- zinc is less reactive than potassium
- potassium is more reactive than zinc
*accept 'zinc does not displace potassium from potassium chloride **or** the solution'*

1 (L6)

[7]

M14. (a) iron
sulphur

answers may be in either order
both elements are required for the mark

1

(b) (i) copper oxide
accept 'CuO'

1

(ii) any **two** from

- it forms acid rain
accept 'it is a pollutant'
- it causes leaf fall
accept 'it kills plants' or 'it damages trees'
- it affects breathing
accept 'it causes asthma' or 'it is a poison'
- it weathers buildings
accept 'it corrodes metals'
- it poisons aquatic organisms
accept 'it kills fish'

2

(iii) alkaline **or** an alkali
accept 'basic'

1

[5]

M15. (a) **answers should convey the idea that fertilisers are needed to replace the nutrients used up by the plants**

any **one** from

- as the plant grows, nutrients are used up
- to replace the nutrients **or** minerals used by the plant
do not accept 'soil in the pot contains a limited amount of nutrients'

1

(b) (i) P: phosphorus

1

K: potassium

1

(ii) K

do not accept 'potassium'

1

[4]

M16. (a) E
D
C
A
B

all five in the correct order are required for the mark

1

(b) (i) B
E
C or A

1

1

1

[4]

M17. (a) (i) calcium hydroxide

1

(ii) alkaline
accept 'strongly alkaline'

1

(b) (i) any **one** from

- because bond strength is less than that of HBr
or less than 366 kJ/mol
accept 'the bond is not strong enough'
- the bond strength is not enough to keep the atoms together
accept 'the thermal energy is greater than the bond strength'
- bond strength decreases as you go down the group
or as the period increases
- the compounds become increasingly unstable as you go down the group
accept 'it is unstable'
accept 'iodine is formed'

1

- (ii) any **one** from
- it decreases from HF to HI **or** down the group
 - it increases from HI to HF **or** up the group
accept 'as the period goes up the strength goes down'
- 1
- (iii) hydrogen fluoride **or** HF
- 1

[5]

- M18.** (a) aluminium oxide
- 1 (L7)
- (b) aluminium
iron
copper
- answers must be in the correct order
do **not** accept 'iron oxide'*
- 1 (L6)
- (c) (i) no reaction
accept 'nothing'
accept 'zinc and calcium oxide'
- 1 (L7)
- (ii) any **one** from
- zinc
accept 'Zn'
 - silver
accept 'Ag'
 - magnesium
accept 'Mg'
- 1 (L7)
- (d) zinc + oxygen →
- 1 (L7)
- zinc oxide
- 1 (L7)

[6]

- M19.** (a) in tube B: no oxygen 1 (L5)
 in tube C: no water **or** water vapour
accept 'no air'
accept 'no moisture'
accept 'it was dry' or 'it was not wet' 1 (L5)
- (b) (i) acidic 1 (L5)
- (ii) hydrogen 1 (L6)
- (c) (i) it increased **or** it was more
accept 'it was heavier' 1 (L6)
- (ii) any **one** from
- oxygen **or** water was added
 - the oxygen has mass
 - rust contains iron and oxygen **or** water
accept 'rust is iron oxide'
 - the iron reacted with oxygen **or** water 1 (L6)
- (d) **Answers must refer to either test-tube D or to sea water.**
 any **one** from
- the nail was more rusty in D than in A
accept 'D was the only one which was rusty'
accept 'D was very rusty'
 - it was more rusty in sea water
 - sea water contains salt 1 (L6)

[7]

- M20.** (a) (i) magnesium
 zinc
 iron
 copper
*all **four** metals must be in the correct order for the mark* 1 (L6)

(ii)

| | copper | iron | magnesium | zinc | |
|--------------------|--------|------|-----------|------|---|
| copper sulphate | | | | ✓ | |
| iron sulphate | | | | | |
| magnesium sulphate | | | | × | × |
| zinc sulphate | | | | | |

award one mark for each correct column

2 (L7)

(b) (i) copper nitrate + silver
the products may be in either order

2 (L6)

(ii) copper
silver
platinum

1 (L7)

(c) iron because it is more reactive
*both the metal and the reason are required for the mark
accept 'iron because copper does not react'*

1 (L7)

[7]

M21. (a) cast iron
do not accept '4.5'

1 (L3)

(b) (i) 0.8

1 (L4)

(ii) high carbon steel

1 (L4)

- (c) (i) any **one** from
- for buildings
accept any other reasonable answer, for
 - for bridges
example 'street lights' or 'fence posts'
- 1 (L4)

- (ii) any **one** from
- oxygen
accept 'air'
 - water
accept 'moisture'
- 1 (L4)

[5]

- M22.** (a) (i) iron
do not accept '1540°C'
- 1 (L3)

- (ii) mercury
do not accept '-37°C'
- 1 (L3)

- (b) solid to a liquid
answers must be in the correct order
***both** answers are required for the mark*
- 1 (L3)

- (c) 5
- 1 (L3)

- (d) (i) sodium
- 1 (L3)

- (ii) gold
- 1 (L3)

[6]

M23. (a) (i) *magnesium + hydrochloric acid* → 1 (L7)

→ magnesium chloride + hydrogen
do not accept 'hydrogen chloride'
do not accept formulae

1 (L7)

(ii) magnesium is more reactive than hydrogen **and** copper is less reactive than hydrogen

accept 'magnesium is more reactive than copper'
accept 'copper is less reactive than magnesium'
accept 'magnesium is higher than copper in the reactivity series'
accept 'copper is lower in the reactivity series'

1 (L7)

(b) sulphuric 1 (L7)

(c)

| formula | name |
|----------|--------------------|
| $CuSO_4$ | copper sulphate |
| $MgCl_2$ | magnesium chloride |

2 (L7)

[6]

M24. (a) zinc
lead
copper
silver

award two marks if all four metals are in the correct order
award one mark for zinc at the top and silver at the bottom of the list
award one mark for lead and copper in the correct order

2 (L7)

(b) zinc 1 (L7)

(c) no because zinc is more reactive than silver
or zinc is above silver in the reactivity series

accept the converse
both the answer and the reason are required for the mark

1 (L7)

- (d) below silver **or** at the bottom
because gold is the least reactive **or** gold does not react
both the answer and the reason are required for the mark
- 1 (L6)

[5]

M25. (a) *magnesium*: Mg

1 (L7)

copper: Cu

1 (L7)

(b) (i) copper

1 (L7)

(ii) 0
accept 'almost zero' or 'very small'

1 (L7)

any **one** from

- two blocks of the same metal have the same reactivity
accept 'they are the same'
 - there is no difference in reactivity
- 1 (L7)

(iii) nickel *and* tin
answers may be in either order
both answers are required for the mark

1 (L7)

[6]

M26. (a) • magnesium displaces copper from the copper sulphate
accept 'magnesium has taken the sulphate'

- copper is replaced by magnesium
accept 'copper and magnesium change places'

1 (L6)

(b)

| <i>pairs of chemicals</i> | <i>Does a displacement reaction take place? Yes or no</i> | <i>reason</i> |
|---------------------------------|---|--|
| <i>iron + sodium chloride</i> | no | iron is below sodium (in the reactivity series) or sodium is above iron (in the reactivity series) |
| <i>magnesium + lead nitrate</i> | yes | magnesium is above lead (in the reactivity series) or lead is below magnesium (in the reactivity series) |

accept 'iron is less reactive' or the converse

accept 'magnesium is more reactive' or the converse

***both** the answer and the correct reason are required for each mark*

2 (L7)

(c) (i) any **one** from

- add zinc to a solution of a salt of each of the other metals
accept 'add zinc to copper chloride and if it reacts add it to a solution of a salt of the next metal up and so on'
- add each of the other metals to a solution of a zinc salt
accept 'add the other metals to zinc chloride'
accept any named zinc salt

1 (L7)

(ii) any **one** from

- place zinc between the metal in the salt which does react and the metal in the salt which does not react
accept 'whatever zinc displaced should be below zinc'
- place zinc between the metal which does react and the metal which does not react
accept 'put zinc below all the metals that react'
parts (c)(i) and(c)(ii) should be marked together
*do **not** accept 'test the other metals with zinc to see if they react'*

1 (L7)

[5]

##

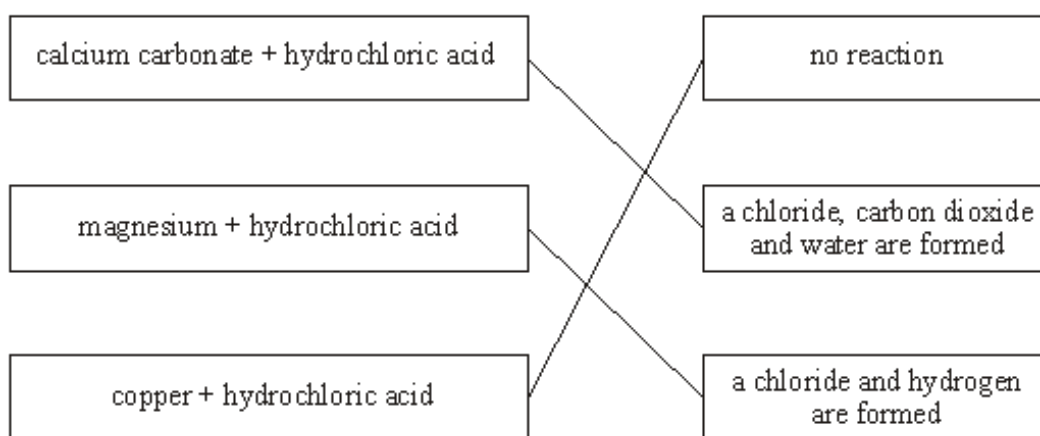
(a)

| | copper | iron | magnesium | zinc |
|-----------------|--------|------|-----------|------|
| calcium nitrate | X | X | X | X |
| copper nitrate | | ✓ | ✓ | ✓ |
| iron nitrate | X | | ✓ | ✓ |

award one mark for each correct row

3 (L7)

(b)



if all three answers are correct, award two marks
if one or two answers are correct, award one mark
if more than one line is drawn from a pair of reactants,
award no credit for that pair

2 (L7)

[5]

M28. (a) steel

do **not** accept 'stainless steel'
do **not** accept 'carbon'

1 (L5)

- (b)
- brass
 - solder

answers may be in either order
both answers are required for the mark

1 (L5)

- (c) 80
accept '100 – 20'
 1 (L5)
- (d) (i) it does not contain iron
accept 'it does not contain steel'
accept 'only iron rusts' or 'only steel rusts'
accept 'it is made of tin, copper and zinc'
 1 (L6)
- (ii) oxygen
accept 'O₂'
 1 (L6)
- [5]**

- M29.** (a) any **one** from
- zinc displaces copper from the copper sulphate
 - zinc changes places with copper
accept 'copper is displaced by the zinc'
accept 'the more reactive metal displaces or takes the place of the other one'
accept 'zinc takes the sulphate'
 1 (L6)
- (b) • he only needed to find out the temperature rise **or** change
 1 (L7)
- (c) (i) any **one** from
- magnesium is the most reactive metal used
 - the biggest difference in reactivity is between magnesium and copper
accept 'magnesium is above the others'
accept 'magnesium is more reactive than iron and zinc'
 1 (L7)
- (ii) any **one** from
- the reactivity is nearly the same
 - they are next to each other in the reactivity series
accept 'zinc is slightly more reactive than iron'
'zinc is more reactive than iron' is insufficient
 1 (L7)

(iii) •

| <i>mixture</i> | <i>Would there be a rise in temperature?</i> |
|------------------------------------|--|
| <i>aluminium + sodium chloride</i> | no |
| <i>calcium + zinc sulphate</i> | yes |
| <i>lead + zinc chloride</i> | no |
| <i>magnesium + iron chloride</i> | yes |

*award one mark for identifying the two reactions that take place
award one mark for identifying the two mixtures of chemicals which do not react*

2 (L7)

[6]

M30. (a) any **one** from

- the clock works
*accept 'when the light goes on'
'it is making electricity' is insufficient*
- the time on the clock
accept 'it shows 12.30'

1 (L5)

(b) • voltmeter
'multimeter' is insufficient

1 (L6)

- (c) • any **one** from
- the fruit **or** lemon
*do **not** accept 'the acid'*
 - condition of metal
*accept 'the size **or** surface area of the metal'
accept 'the distance between them'
accept 'the amount of metal'*
 - temperature
accept 'how far they push them in'

1 (L6)

(d) • copper *and* magnesium
accept 'most reactive with least reactive'

1 (L5)

(e) any **one** from

• no difference in reactivity
accept 'there would be no reaction between them'

• they produce zero voltage
accept 'it would not work'
accept 'there would be no difference'

1 (L6)

[5]

M31. (a) (i) • oxygen

1 (L6)

• water

1 (L6)

answers may be in either order

'air' is insufficient

'moisture' or 'dampness' or 'wet' are insufficient

(ii) any **one** from

• it prevents contact between the steel **or** the car and oxygen
or water

• it is waterproof **or** water runs off
accept 'it prevents air getting to the car'
accept 'wax fills scratches or chips where paint is damaged'
'it forms a protective layer' is insufficient

1 (L5)

(iii) any **one** from

• paint

• chrome
accept 'they are coated in zinc'
or 'they are galvanised'
accept 'polish'
'rust treatment' is insufficient
'cover it' is insufficient

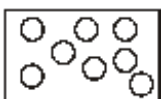
1 (L5)

- (b) • acid rain

accept 'sulphur dioxide'
accept 'oxides of nitrogen'
accept 'car exhaust fumes'
accept 'burning fossil fuels'
accept 'sea air' or 'salty air' or 'salt'
'carbon dioxide' is insufficient

1 (L6)

- (c) (i) • gas: particles randomly arranged and most **not** touching



accept black shaded circles if drawn correctly
accept fewer or more than 8 circles if the arrangement is clear
ignore arrows attached to circle

1 (L6)

- (ii) • solid: particles regularly arranged and all touching



accept white circles if drawn correctly
accept 2 rows of particles with at least 2 particles in the second row
accept fewer or more than 8 circles if a regular arrangement is clear
ignore location of circles in box
do not accept a single row of circles

1 (L6)

[7]

- M32. (a) (i) any **one** from

- bubbles

- fizzing

accept 'effervescence'

- gas is given off

'metal goes into solution or turns into a salt'
and 'there would be a rise in temperature'
are insufficient answers as they are
not shown in the drawings

1 (L3)

- (ii) • magnesium
accept 'Mg'
- zinc
accept 'Zn'
- iron
accept 'Fe'
- copper
accept 'Cu'
answers must be in the correct order
***all four** answers are required for the mark*
- 1 (L4)

- (b) (i) • copper
accept 'Cu'
- 1 (L3)

- (ii) • iron
accept 'Fe'
- 1 (L4)

[4]

- M33.** (a) any **one** from
- there is a colour change
*accept 'it goes green **or** orange'*
'the colour' is insufficient
- a new metal is formed
accept 'the iron filings change colour'
- 1 (L5)

- (b) (i) copper
accept 'Cu'
- 1 (L5)

- (ii) iron sulphate
accept 'FeSO₄'
- 1 (L6)

(iii) • no ✓

any **one** from

- iron is more reactive than copper
accept 'iron is higher on the reactivity series'
- copper is less reactive than iron
accept 'copper does not displace iron'
both an indication that the reaction does not happen
and the explanation are required for the mark

1 (L6)

(c) • calcium ✓
potassium ✓

if more than two boxes are ticked, award no mark
both answers are required for the mark

1 (L6)

[5]