



## KS3 revision

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63 minutes



82 marks

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##

The table gives the numbers of protons, neutrons and electrons in some atoms and ions of elements. The letters used in the table are **not** the chemical symbols of the elements.

| atom or ion | protons | neutrons | electrons |
|-------------|---------|----------|-----------|
| J           | 16      | 16       | 16        |
| L           | 10      | 10       | 10        |
| M           | 11      | 12       | 11        |
| Q           | 12      | 14       | 10        |
| R           | 17      | 20       | 17        |
| X           | 9       | 10       | 10        |
| Z           | 17      | 18       | 17        |

Use this information to answer the following questions.  
Each letter can be used once, more than once or not at all.

(a) Give the letters of:

(i) **two** atoms of the same element; ..... and .....

(ii) a positive ion; .....

(iii) a negative ion; .....

(iv) an atom or ion which has a mass number of 20; .....

(v) an atom of a very reactive metal; .....

5 marks

(b) How many electrons does an atom with an atomic number of 12 have?

.....

1 mark

(c) (i) **X** is an ion. In which group of the periodic table is the element from which **X** is formed?

.....

1 mark

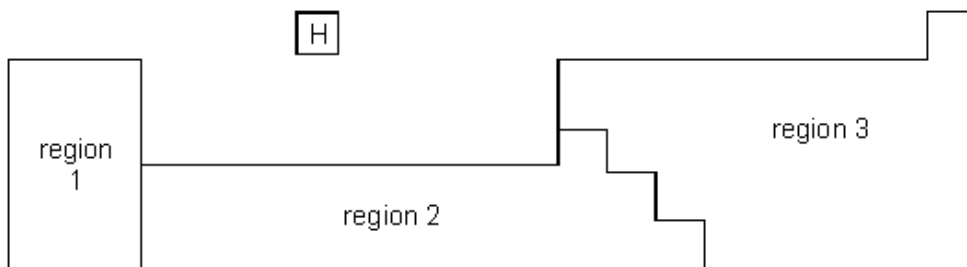
(ii) From the table above, give the letter of another atom which reacts in a similar way to the element from which ion **X** is formed.

.....

1 mark

Maximum 8 marks

**Q2.** The diagram shows an outline of part of the Periodic Table of Elements.



(a) What is the name of the element with the symbol H?

.....

1 mark

(b) In which regions of the Periodic Table are the following types of element found?

(i) non-metals (such as oxygen and chlorine);

region .....

1 mark

(ii) very reactive metals (such as sodium and potassium);

region .....

1 mark

(iii) less reactive metals (such as copper and zinc).

Region .....

1 mark

(c) Why is copper sulphate **not** found in the Periodic Table?

.....  
 .....

1 mark

(d) An iron nail is placed into some blue copper sulphate solution.  
 A reaction takes place between the iron and the copper sulphate.

(i) Complete the word equation for the reaction.

iron + copper sulphate → ..... + .....

1 mark

(ii) Describe **one** change you would see on the surface of the nail.

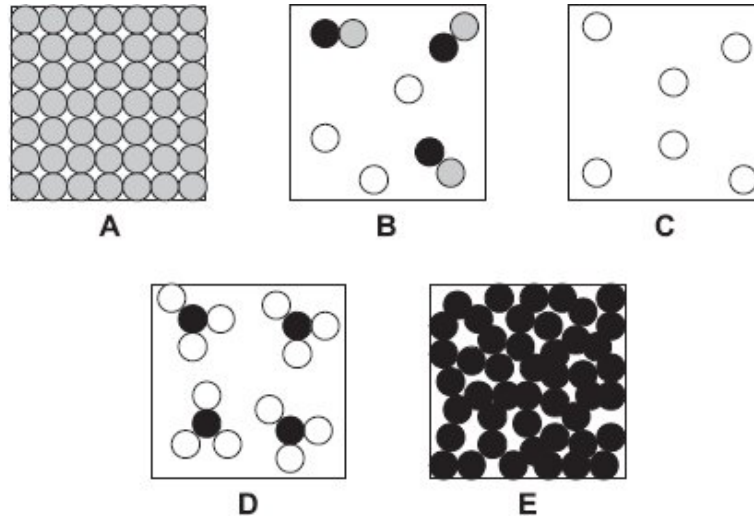
.....  
 .....

1 mark

Maximum 7 marks

- Q3.** (a) The diagrams below show the arrangement of atoms or molecules in five different substances A, B, C, D and E.

Each of the circles ,  and  represents an atom of a different element.



Give the letter of the diagram which represents:

- (i) a mixture of gases;

.....

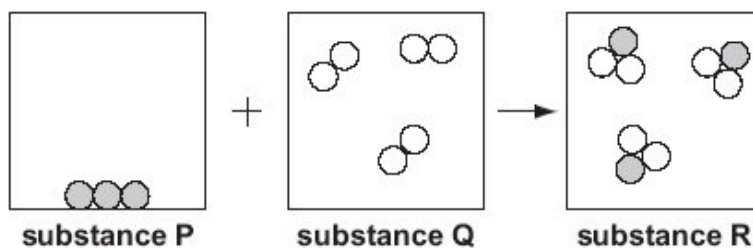
1 mark

- (ii) a single compound.

.....

1 mark

- (b) The diagram below shows a model of a chemical reaction between two substances.



- (i) How can you tell from the diagram that a chemical reaction took place between substance P and substance Q?

.....  
 .....

1 mark

(ii) Substance P is carbon.

Suggest what substances Q and R could be.

substance Q .....

substance R .....

1 mark

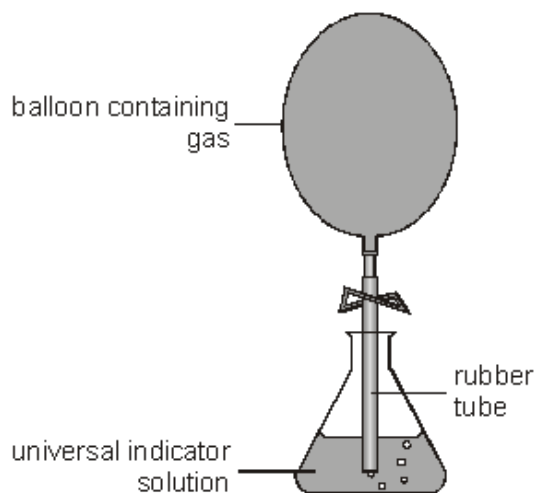
(iii) How does the diagram show that mass has been conserved in this reaction?

.....

.....

1 mark  
maximum 5 marks

**Q4.** A scientist compared the acidity of four gases to see which gas might cause acid rain. She used four balloons to collect the gases. She then bubbled the gases, in turn, through a fresh sample of green, neutral, universal indicator solution.



(a) Three of the gases caused the indicator to change colour. The scientist added drops of alkali to the indicator until the indicator changed back to green. Her results are shown in the table below.

| <b>gases collected</b>   | <b>change in colour of indicator</b> | <b>number of drops of alkali needed to change the indicator back to green</b> |
|--------------------------|--------------------------------------|---|
| exhaust gases from a car | green to red                         | 31  |
| carbon dioxide           | green to red                         | 160   |
| air                      | no change                            | 0   |
| human breath             | green to yellow                      | 10  |

Use information in the table to answer part (i) and part (ii) below.

(i) Which gas dissolved to form the most acidic solution?

.....

Explain your choice.

.....

.....

1 mark

(ii) Which gas formed a neutral solution?

.....

Explain your choice.

.....

.....

1 mark

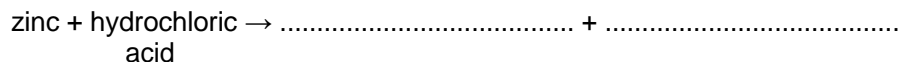
(iii) What effect does an alkali have on an acid?

.....

1 mark

(b) Some metals react with acids in the air.

Complete the word equation for the reaction between zinc and hydrochloric acid.



2 marks  
maximum 5 marks

**Q5.** 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?

.....

.....

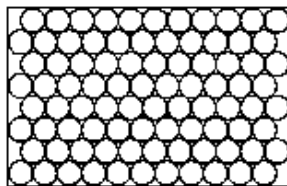
1 mark

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

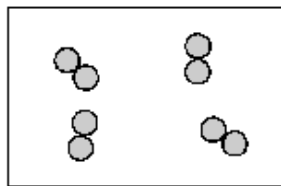
.....  
 .....

1 mark  
 Maximum 5 marks

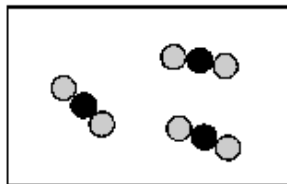
- Q6.** The diagrams represent the arrangement of atoms or molecules in four different substances, A, B, C and D.



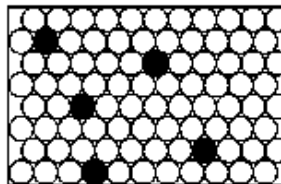
A



B





C



D

*not to scale*

Each of the circles, ,  and  represents an atom of a different element.

- (a) (i) Which substance is a compound?

.....

1 mark

- (ii) Which substance is a mixture?

.....

1 mark

- (iii) Which **two** substances are elements?

..... and .....

1 mark



(iv) Which **two** substances could be good thermal conductors?

..... and .....

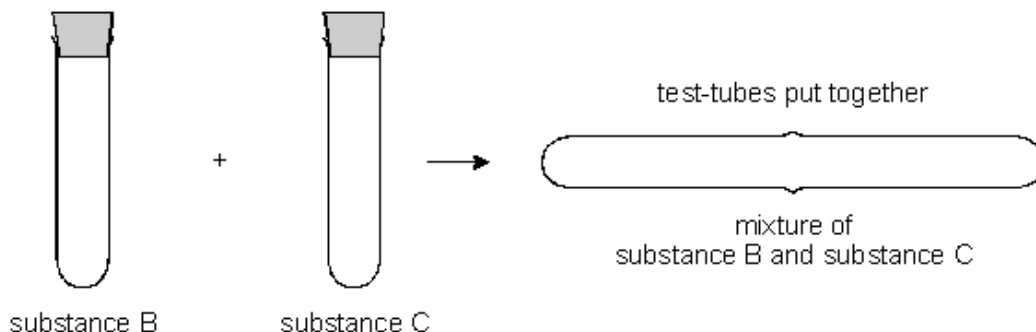
1 mark

(v) Which substance could be carbon dioxide?

.....

1 mark

(b) The following experiment was set up. Test-tubes containing substances B and C were placed together as shown. The substances did **not** react. They were left for five minutes.

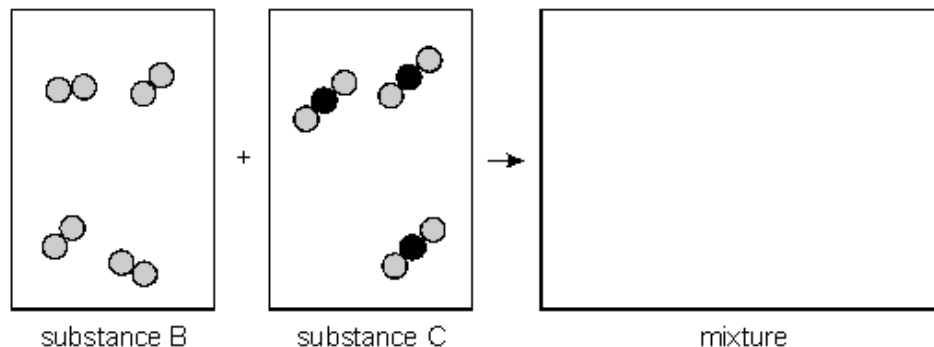


(i) How many molecules are there in the mixture compared to the total number in substances B and C?

.....

1 mark

(ii) Complete the diagram which is a model of this experiment.



1 mark

Maximum 7 marks

**Q7.** Hydrochloric acid is a strong acid.

(a) Winston used universal indicator solution to find the pH of some hydrochloric acid.

(i) Suggest the **colour** of the mixture of universal indicator solution and the hydrochloric acid.

.....

1 mark

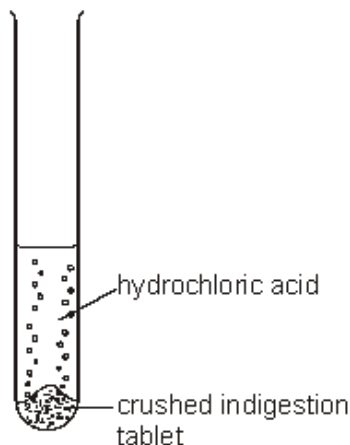
(ii) Suggest the **pH** of the hydrochloric acid.

.....

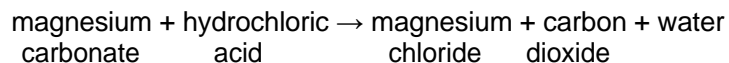
1 mark

(b) Indigestion can be caused when too much hydrochloric acid is produced in the stomach. Magnesium carbonate can be used to treat indigestion.

Winston crushed some indigestion tablets containing magnesium carbonate. He added them to hydrochloric acid in a test-tube. The mixture fizzed.



The word equation for the reaction is shown below.



(i) Use the word equation to explain why the mixture fizzed when the reaction took place.

.....  
.....

1 mark

(ii) Winston continued to add crushed tablets to the acid until the mixture stopped fizzing. Why did the fizzing stop?

.....  
.....

1 mark

- (c) When magnesium carbonate reacts with hydrochloric acid, magnesium chloride is formed.

Which **two** words describe magnesium chloride?

Tick the **two** correct boxes.

|            |                          |           |                          |
|------------|--------------------------|-----------|--------------------------|
| a compound | <input type="checkbox"/> | a mixture | <input type="checkbox"/> |
| an element | <input type="checkbox"/> | a salt    | <input type="checkbox"/> |
| a metal    | <input type="checkbox"/> | a solvent | <input type="checkbox"/> |

2 marks

- (d) It is important that the hydrochloric acid in the stomach is **not** completely neutralised by indigestion tablets.

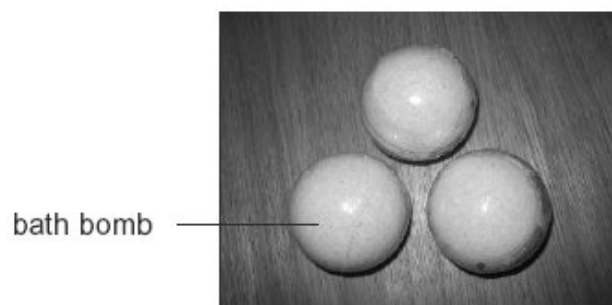
Why is hydrochloric acid needed in the stomach?

.....

.....

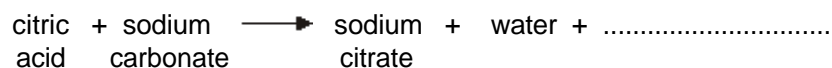
1 mark  
maximum 7 marks

- Q8.** When bath 'bombs' are dropped into bath water they colour the water and make the water smell of perfume.



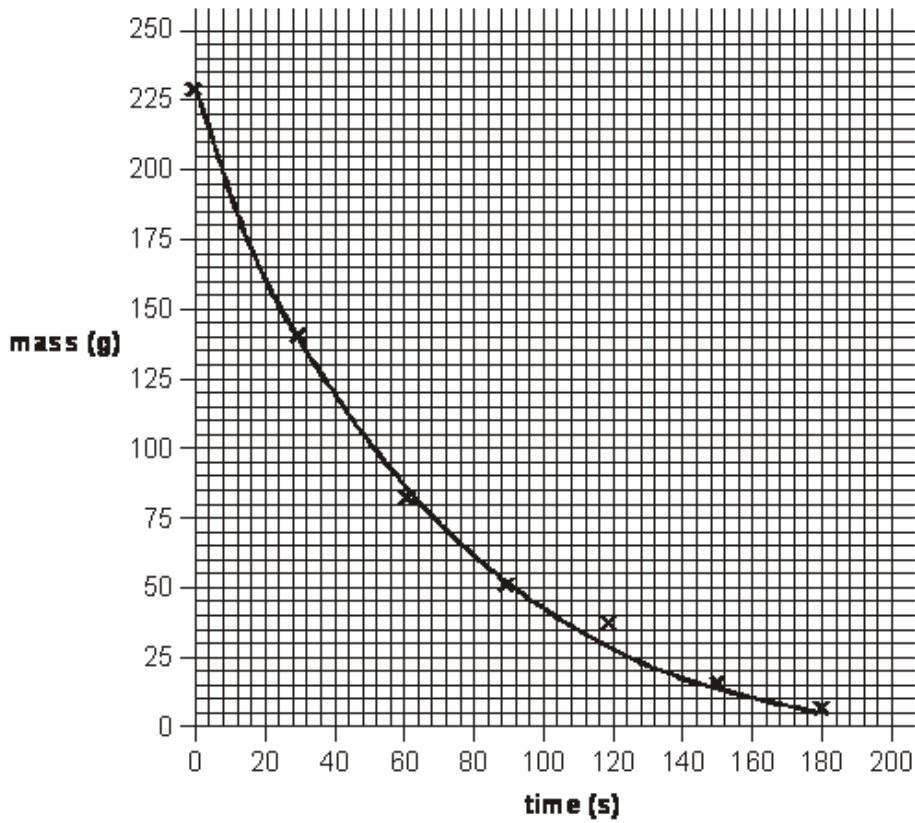
- (a) Bath bombs contain citric acid and sodium carbonate. When they react a gas is produced.

Complete the word equation for the reaction that takes place.



1 mark

- (b) A bath bomb was dropped into hot water and its mass was measured every thirty seconds, for three minutes.  
The graph below shows the results.



Between which two times on the graph does the mass of the bath bomb decrease fastest?

Tick the correct box.

- between 0 s and 30s
- between 30 s and 60s
- between 90 s and 120s
- between 150 s and 180s

1 mark

- (c) (i) The bath bomb was 230g at the start.  
How long does it take for the mass of the bath bomb to decrease by a half?

..... s

1 mark

- (ii) The reactants in a bath bomb were 176g at the start.  
129g of sodium citrate and 14g of water are produced in the reaction.  
Calculate the mass of gas produced in the reaction.

.....  
..... g

1 mark

- (d) Some people on cruise ships practise golf. They hit golf balls into the sea.  
Turtles can swallow the golf balls. A new type of golf ball has been made from a bath bomb covered in hardened paper to use on cruise ships.

Suggest **one** reason why this type of golf ball might be better for the environment than a normal golf ball.

.....  
.....

1 mark

- (e) Complete the word equation for the reaction between citric acid and calcium carbonate.  
Use the equation in part (a) to help you.

citric + calcium     $\longrightarrow$     water + ..... + .....  
acid    carbonate

1 mark  
maximum 6 marks

- Q9.** (a) Ruth put a piece of a different metal in each of four test tubes.

She poured 10 cm<sup>3</sup> of hydrochloric acid onto each metal.

**iron**                      **zinc**                      **magnesium**                      **copper**  
 +                              +                              +                              +  
 hydrochloric acid      hydrochloric acid      hydrochloric acid      hydrochloric acid

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.

|               |             |                  |             |
|---------------|-------------|------------------|-------------|
| <b>copper</b> | <b>iron</b> | <b>magnesium</b> | <b>zinc</b> |
|---------------|-------------|------------------|-------------|

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

.....

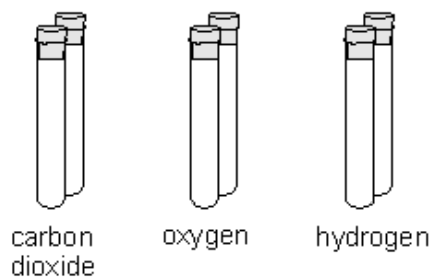
1 mark

- (ii) Which metal from the box goes rusty?

.....

1 mark  
maximum 4 marks

- Q10.** Indra collects samples of **three** gases.



She carries out the following tests.

1. She adds a few drops of limewater to one test tube of each gas and shakes it.
2. She puts a burning splint (spill) into the other test tube of each gas.

Complete **each box** in the table below to describe the results of her tests.  
If there is no effect, write 'no effect'.

| gas            | effect of the gas on limewater | effect of putting a burning splint into the gas |
|----------------|--------------------------------|---|
| carbon dioxide |                                |   |
| oxygen         |                                |   |
| hydrogen       |                                |   |

Maximum 6 marks

**Q11.** This question is about four chemical elements.

- (a) The melting points and boiling points of the four elements are shown in the table. Complete the table to give the physical state, **solid**, **liquid** or **gas**, of each element at room temperature, 21°C.

| element  | melting point in °C | boiling point in °C | physical state at room temperature, 21°C |
|----------|---------------------|---------------------|--|
| bromine  | -7                  | 59                  |  |
| chlorine | -101                | -34                 |  |
| fluorine | -220                | -188                |  |
| iodine   | 114                 | 184                 |  |

4 marks

- (b) Bromine can be a solid, a liquid or a gas depending on the temperature.  
In which physical state will 10 g of bromine store the most thermal energy?

.....

1 mark

(c) Is bromine a **solid**, a **liquid** or a **gas** when the arrangement of particles is:

(i) far apart and random? .....

1 mark

(ii) close together but random? .....

1 mark

(iii) close together in a regular pattern? .....

1 mark

Maximum 8 marks

**Q12.** This question is about **three** different fuels, A, B and C.

Fuel A is stored in tanks. It is not stored under pressure. It flows along a pipe to where it is needed.

Fuel B is stored under pressure in small cylinders. It is used by campers.

Fuel C can be stored in sacks or bags.

(a) (i) Tick the correct box.

Fuel A is a:

solid

liquid

gas

1 mark

Name a fuel which A could be .....

1 mark

(ii) Tick the correct box.

When fuel B comes out of the cylinder this is a:

solid

liquid

gas

1 mark

Name a fuel which B could be .....

1 mark



(iii) Tick the correct box.

Fuel C is a:

solid

liquid

gas

1 mark

Name a fuel which C could be .....

1 mark

(b) Complete the statement to describe what happens when a fuel burns.

Two waste products formed from burning fuels are

..... and .....

2 marks

Maximum 8 marks

##

A reactivity series of elements is shown below.

**sodium**  
**calcium**  
**magnesium**  
**aluminium**  
**carbon**  
**zinc**  
**iron**  
**tin**  
**lead**  
**copper**

The method of obtaining a metal from its oxide depends on the reactivity of the metal.

(a) What is the method of obtaining zinc, iron, tin and lead?

.....  
.....

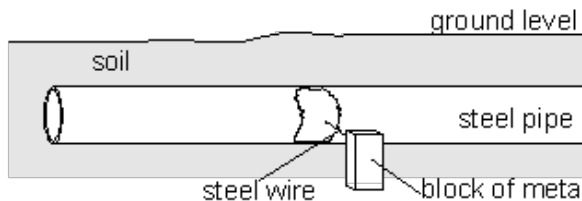
1 mark

- (b) When sodium is obtained, great care is taken to prevent air coming into contact with sodium. Give a reason for this.

.....  
 .....

1 mark

- (c) The diagram below shows a steel pipe which has been repaired. At the point of repair, another metal has been attached by a steel wire. This metal is more reactive than iron, from which steel is made. The block of metal corrodes instead of the steel of the pipe.



- (i) Name a metal from the reactivity series above which is suitable for this purpose.

.....

1 mark

- (ii) Name a metal from the reactivity series above which is **unsuitable** for this purpose and explain why it is unsuitable.

Name of metal .....

It is unsuitable because .....

.....

1 mark

- (d) Jam is made from fruit which contains natural acids.

- (i) Aluminium is high in the reactivity series. Suggest why aluminium saucepans should not be used for making jam.

.....

.....

1 mark

- (ii) Tin-plated steel is used for jam-making pans. Suggest why the steel is tin plated.

.....

.....

1 mark

Maximum 6 marks

|            |   |   |
|------------|---|---|
| <b>M1.</b> | (a) (i) R and Z<br><i>letters may be in either order</i><br><b>both</b> letters are required for the mark | 1 |
|            | (ii) Q  | 1 |
|            | (iii) X   | 1 |
|            | (iv) L  | 1 |
|            | (v) M   | 1 |
|            | (b) 12  | 1 |
|            | (c) (i) 7 <b>or</b> VII   | 1 |
|            | (ii) R <b>or</b> Z  | 1 |

[8]

|            |  |        |
|------------|--|--------|
| <b>M2.</b> | (a) hydrogen   | 1 (L6) |
|            | (b) (i) region 3   | 1 (L6) |
|            | (ii) region 1  | 1 (L6) |
|            | (iii) region 2   | 1 (L6) |
|            | (c) any <b>one</b> from  |        |
|            | <ul style="list-style-type: none"> <li>• it is a compound</li> <li>• it is not an element</li> <li>• it is made up of more than one element</li> </ul> |        |
|            | <i>do <b>not</b> accept 'it is <b>not</b> a single substance'</i>  | 1 (L5) |

(d) (i) copper + iron sulphate  
*answers may be in either order*  
**both** are required for the mark  
1 (L6)

(ii) the nail becomes brown **or** pink **or** copper coloured  
*accept 'it is covered in copper'*  
*accept 'it is rust coloured'*  
do **not** accept 'it goes rusty'  
1 (L6)

[7]

M3. (a) (i) B  
1 (L7)

(ii) D  
1 (L7)

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

- a compound or a new substance has been formed  
*accept 'the ratio is always 1P to 2Qs'*  
*accept 'the atoms **or** particles have joined'*
- R **or** the product is a new substance  
*accept 'the elements have joined'*

1 (L7)

(ii) *substance Q: oxygen*  
*substance R: carbon dioxide*  
**both** answers are required for the mark  
1 (L7)

(iii) the same numbers of each type of atom are present  
*accept 'the same number of atoms is present'*  
*accept 'the same particles **or** same number of particles are present'*  
*accept 'there is the same amount of each element'*  
do **not** accept 'the same number of molecules is there'  
*'the same amount of elements' is insufficient*  
1 (L7)

[5]

- M4.** (a) (i) carbon dioxide  
*accept 'CO<sub>2</sub>'*
- any **one** from  
 it took more **or** most alkali to neutralise it  
**or** to change the colour of the indicator back to green  
*accept 'it took most drops' or 'it took 160'*  
**both** the answer and the reason are required for the mark  
 1 (L5)
- (ii) air  
 it did not change the colour of the indicator **or** the pH of the solution  
*accept 'no drops or alkali were needed'*  
*accept 'there was no change'*  
**both** the answer and the reason are required for the mark  
 1 (L5)
- (iii) any **one** from
- neutralises it
  - it raises the pH  
*accept 'it makes it less acidic'*  
*accept 'it makes it pH 7'*  
*accept 'it forms a salt'*  
 do **not** accept 'makes it more alkaline'
- 1 (L6)
- (b) zinc chloride +  
 hydrogen  
*answers may be in either order*  
 1 (L6)  
 1 (L6)

[5]

- M5.** (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<sub>2</sub>'*  
 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]

- M6.** (a) (i) C
- 1 (L7)
- (ii) D
- 1 (L7)
- (iii) A and B  
*answers may be in either order*  
**both** answers are required for the mark
- 1 (L7)
- (iv) A and D  
*answers may be in either order*  
**both** answers are required for the mark
- 1 (L7)
- (v) C
- 1 (L7)

- (b) (i) the same  
*accept 'seven'* 1 (L7)
- (ii) a random, mixed arrangement of both types of molecule should be drawn with the molecules not touching each other 1 (L7)

[7]

- M7. (a) (i) red **or** pink  
*accept 'orange' or 'yellow'* 1 (L5)
- (ii) any number greater than 0 and smaller than 7  
*accept '0'* 1 (L6)
- (b) (i) carbon dioxide is gas  
*accept 'carbon dioxide or a gas is produced'* 1 (L5)
- (ii) any **one** from
- no more carbon dioxide **or** gas was produced
  - the reaction stopped
  - all the hydrochloric acid was used up  
*accept 'the acid had been neutralised'*  
*do not accept 'all the magnesium carbonate was used up'*
  - there was an excess of magnesium carbonate **or** carbonate 1 (L6)
- (c) a compound ✓ 1 (L6)
- a salt ✓  
*if more than two boxes are ticked, deduct one mark for each incorrect tick*  
*minimum mark zero* 1 (L6)

- (d) any **one** from
- without it digestion would stop **or** slow down  
*accept 'to break down food'*
  - acid is needed for digestion
  - the enzymes only work in acid conditions **or** at a low pH
  - it is needed to kill bacteria **or** microbes  
*do **not** accept 'germs'*
- 1 (L6) [7]

- M8.** (a) carbon dioxide  
*accept 'CO<sub>2</sub>'*
- 1 (L6)
- (b) between 0 s *and* 30 s ✓  
*if more than **one** box is ticked, award no mark*
- 1 (L6)
- (c) (i) any answer from 41 to 45
- 1 (L7)
- (ii) 33 g  
*accept '176 – 129 – 14'*  
*accept '176 – 143'*  
*do **not** accept incorrect calculations,*  
*e.g. '176 – 129 – 14 = 34'*
- 1 (L7)
- (d) when the balls get wet the chemicals will react (and destroy the ball)  
*accept 'they are biodegradable'*  
*accept 'they will dissolve'*  
*accept converse answers regarding normal golf balls*  
*accept 'the products are harmless'*
- 1 (L7)
- (e) calcium citrate  
carbon dioxide  
*accept 'CO<sub>2</sub>'*  
***both** answers are required for the mark*  
*answers can be in either order*
- 1 (L7) [6]



**M9.** (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]

M10.

| gas            | effect of the gas on limewater                            | effect of putting a burning splint into the gas                   |
|----------------|---|---|
| carbon dioxide | * it goes milky <b>or</b> cloudy <b>or</b> white or murky | * goes out  |
| oxygen         | * no effect   | * burns more brightly <b>or</b> flares up <b>or</b> burns quicker |
| hydrogen       | * no effect   | * the gas lights <b>or</b> burns                                  |

do **not** accept a box which is left blank, i.e. this does **not** imply 'no effect'

do **not** accept 'nothing' in the right hand column

do **not** accept 'relights' **or** 'keeps burning' **or** 'stays alight' **or** 'explodes' in the right hand column

accept 'pops' **or** 'squeaks' **or** 'explodes' in the right hand column

6 (L5)

[6]

M11.

(a)

|          |        |
|----------|--------|
| bromine  | liquid |
| chlorine | gas    |
| fluoride | gas    |
| iodine   | solid  |

4 (L6)

(b) gas

1 (L6)

(c) (i) gas

1 (L6)

(ii) liquid

1 (L6)

(iii) solid

1 (L6)

[8]

**M12.** (a) (i) liquid  
*if more than one box is ticked award no mark  
accept 'A' in the liquid box instead of a tick* 1

petrol **or** oil **or** diesel  
*accept a brand name  
**or** paraffin **or** kerosene* 1

(ii) gas  
*if more than one box is ticked award no mark  
accept 'B' in the gas box instead of a tick* 1

gas **or** natural gas **or** calor  
*accept a brand name  
gas **or** butane **or** propane  
do **not** accept 'hydrogen' **or** methane **or** camping gaz* 1

solid  
*if more than one box is ticked award no mark  
accept 'C' in the solid box instead of a tick* 1

coal **or** coke **or** wood **or** charcoal  
*accept a brand name **or** 'peat'* 1

- (b) any **two** from
- carbon dioxide
  - water *accept 'steam'*
  - smoke *accept 'soot'*
  - ash
  - gases *accept 'fumes'*
  - sulphur dioxide *accept 'nitrogen oxides'*
  - carbon monoxide  
*do **not** accept 'heat' **or** 'energy' **or** 'lead'*
- 2

[8]

**M13.** (a) by heating with carbon **or** carbon monoxide **or** coke  
*accept 'smelting' **or** 'the blast furnace' **or** 'by reduction'  
do **not** accept 'melting' **or** 'heating' without a reference  
to reduction **or** to carbon* 1

- (b) it reacts with oxygen **or** water vapour **or** air  
*accept 'oxidises' **or** 'it is very reactive' **or** 'it burns'*  
*do **not** accept 'it explodes in air'*

1

- (c) (i) any **one** from
- magnesium
  - aluminium
  - zinc
- do **not** accept 'sodium' **or** 'calcium'*

1

**both a metal and an appropriate reason are required for the mark to be awarded**

- (ii) **either**
- sodium **or** calcium because they are too reactive
- or**
- tin **or** lead **or** copper because it is too unreactive **or** less reactive than steel  
*accept 'because it lets steel corrode'*  
*do **not** accept 'because it is too expensive' **or** 'it is unreactive'*

1

- (d) (i) aluminium reacts with acids  
*accept 'reacts with jam' **or** 'aluminium corrodes'*  
*do **not** accept 'aluminium is too reactive' **or** 'aluminium reacts'*

1

- (ii) any **one** from
- to prevent iron **or** steel from reacting with acids
  - tin does not react with acids  
*accept 'tin is unreactive'*
  - tin is less reactive than iron **or** tin is not very reactive  
*do **not** accept 'to stop rusting'*

1

[6]

**E2.** In part (a) over half the pupils taking the lower tier could not name the element with symbol H as hydrogen. Three quarters were unable, in part (c), to explain why copper sulphate was not in the Periodic Table. Many pupils at levels 3, 4, and 5 could not complete the word equation in part (d)(i).

To gain the mark for the word equation both iron sulphate and copper had to be given. Many pupils who did not get the mark wrote down iron sulphate or copper but not both. Many completely incorrect answers were also given. These included 'water', 'salt', 'carbon dioxide', 'oxygen', 'rust', 'gas', 'bubbles', and 'iron sulphide'.

In part (d)(ii) pupils from both tiers gave imprecise descriptions of the changes seen on the surface of the nail. Over one third of pupils in the lower tier, and an even greater proportion of those in the upper tier, stated that the surface of the nail 'goes rusty'. In some cases pupils at levels 6 and 7 wrote this after writing a correct word equation.

### Facility values

| Item    | Tier 3 – 6 |          | Tier 5 – 7 |          |
|---------|------------|----------|------------|----------|
|         | Omit (%)   | Facility | Omit (%)   | Facility |
| (a)     | 33         | 0.45     | 2          | 0.89     |
| (b) (i) | 19         | 0.42     | 0          | 0.77     |
| (ii)    | 18         | 0.41     | 0          | 0.79     |
| (iii)   | 18         | 0.44     | 0          | 0.78     |
| (c)     | 35         | 0.23     | 1          | 0.64     |
| (d) (i) | 41         | 0.18     | 7          | 0.61     |
| (ii)    | 32         | 0.06     | 3          | 0.22     |

Facility values by level

|         | Tier 3-6 |         |         |         | Tier 5-7 |         |         |
|---------|----------|---------|---------|---------|----------|---------|---------|
| Item    | Level 3  | Level 4 | Level 5 | Level 6 | Level 5  | Level 6 | Level 7 |
| (a)     | 0.19     | 0.39    | 0.66    | 0.83    | 0.77     | 0.94    | 0.98    |
| (b) (i) | 0.18     | 0.33    | 0.47    | 0.65    | 0.61     | 0.69    | 0.93    |
| (ii)    | 0.22     | 0.32    | 0.48    | 0.63    | 0.65     | 0.71    | 0.92    |
| (iii)   | 0.26     | 0.43    | 0.52    | 0.68    | 0.62     | 0.76    | 0.89    |
| (c)     | 0.05     | 0.14    | 0.31    | 0.54    | 0.33     | 0.72    | 0.92    |
| (d) (i) | 0.02     | 0.12    | 0.31    | 0.55    | 0.45     | 0.7     | 0.91    |
| (ii)    | 0.01     | 0.03    | 0.06    | 0.12    | 0.10     | 0.18    | 0.42    |

**E3.** The majority of pupils at all levels were able to identify the correct answer to part (a)(i), with roughly 10% of pupils at Levels 5 and 6 choosing the incorrect answer *D*.

Pupils at all levels found part (a)(ii) more difficult than part (a)(i), especially pupils at Level 5, of whom nearly half chose the answer *A*, which represents a solid element not a single compound.

The majority of pupils answering part (b)(i) correctly either answered *a new substance has been formed* or described that the atoms had joined together. Few pupils referred to the fact that the ratio of the different types of atoms had remained the same.

Part (b)(ii) was answered well by pupils at all levels, with two thirds of Level 6 pupils and nearly all Level 7 pupils giving correct suggestions for both substances.

Part (b)(iii) proved a little difficult with only about a third of pupils gaining the mark. The most frequent correct answer was *the same number of atoms are present*, with some pupils stating that *the same amount of each element is present*.

**E4. Sc3 5 marks Facility: 0.36 (Tier 3-6) / 0.73 (Tier 5-7)**

Part (ai) discriminated well at all levels on the lower tier. On the 5-7 tier the discrimination was less.

Although around a third of Level 3 pupils were able to pick out carbon dioxide from the table, fewer than half of these subsequently gave a satisfactory explanation for their choice. The proportion also giving a correct explanation rose to around three-quarters at Level 4.

Part (a(ii)) again discriminated well at Levels 3, 4 and 5. The proportion of those who, having selected the correct gas, also gave a satisfactory explanation was much higher than in the previous part, with most of those at Level 4 and above achieving this.

The majority of correct answers to part (c) referred to neutralisation or pH7. Many pupils below Level 6 stated that the alkali would *weaken* the acid, which was not creditworthy.

Part (b) differentiated well at the higher levels, 36% of Level 6 pupils gaining both marks, compared with 78% at Level 7. Pupils were slightly more successful in naming *zinc chloride* than *hydrogen*, whilst a significant minority of 12% suggested *water* as a product. Other incorrect answers included *chlorine* and *zinc oxide*.

*Facilities by tier and level achieved*

|       | 3-6 |     |     |     | Item  | 5-7 |     |     |
|-------|-----|-----|-----|-----|-------|-----|-----|-----|
| Item  | 3   | 4   | 5   | 6   |       | 5   | 6   | 7   |
| ai    | .13 | .39 | .72 | .87 | ai    | .84 | .92 | .97 |
| a ii  | .11 | .38 | .75 | .85 | a ii  | .83 | .94 | .98 |
| a iii | .01 | .09 | .46 | .81 | a iii | .48 | .83 | .94 |
| b1    | .02 | .04 | .22 | .42 | b1    | .30 | .64 | .90 |
| b2    | .02 | .03 | .13 | .35 | b2    | .23 | .51 | .77 |

**E5.** Pupils were not clear about what distinguishes rusting from other forms of corrosion. Evidence of this confusion was found in responses to a question in tier 5-7, in which many pupils argued that acidic food like rhubarb caused steel cans to rust. A typical example of this is shown below. Other parts of this question, testing pupils' understanding of a given reactivity series of metals, were well answered by most pupils.

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

*Because Rhubarb is an acid and it will led to rust*

In one of the more demanding chemistry questions, nearly half of the pupils entered for tier 5-7 thought that carbon dioxide is produced when an acid reacts with a metal. Only about 15% of pupils entered for tier 5-7 correctly gave hydrogen as their answer to this question.

**E6.** Answers to part (a) showed that a significant minority of pupils taking the higher tier do not clearly understand the scientific terms compound, mixture, molecule and atom. For example, almost half the pupils were unsure which diagram represented a compound, but some of these correctly identified which could be carbon dioxide. This suggests they did not recognise that carbon dioxide was a compound. In part (a)(i) errors were evenly spread between the three incorrect options suggesting that when pupils were not sure of the answer they guessed. In part (a)(ii) the majority of pupils not gaining the mark chose option C which was not a mixture but contained two different elements. This suggest pupils understand that atoms of at least two different kinds are present in a mixture.

In part (b)(i) only a third of pupils stated that there would be the same number of molecules before and after mixing. Some gave the total number of *atoms* not *molecules*. Half the pupils were able to draw the mixture in (b)(ii) correctly, but not all of these were able to answer (b)(i). This suggests some pupils did not see the connection between the two parts of part (b).

### Facility values

| Item    | Omit (%) | Facility |
|---------|----------|----------|
| (a) (i) | 1        | 0.56     |
| (ii)    | 1        | 0.67     |
| (iii)   | 1        | 0.74     |
| (iv)    | 1        | 0.79     |
| (v)     | 1        | 0.72     |
| (b) (i) | 8        | 0.33     |
| (ii)    | 3        | 0.51     |

### Facility values by level

| Item    | Tier 5-7 |         |         |
|---------|----------|---------|---------|
|         | Level 5  | Level 6 | Level 7 |
| (a) (i) | 0.31     | 0.64    | 0.89    |
| (ii)    | 0.49     | 0.73    | 0.91    |
| (iii)   | 0.48     | 0.83    | 0.98    |
| (iv)    | 0.60     | 0.8     | 0.85    |
| (v)     | 0.47     | 0.82    | 0.97    |
| (b) (i) | 0.11     | 0.32    | 0.68    |
| (ii)    | 0.34     | 0.58    | 0.88    |

### E7. Sc2/Sc3 7 marks Facility: 0.38 (Tier 3-6) / 0.66 (Tier 5-7)

Part (ai) discriminated well at all levels. Around 8% overall, mostly at Levels 4 and 5, incorrectly gave purple as the colour that hydrochloric acid would turn universal indicator.

At lower levels fewer pupils were able to identify the pH of an acidic solution in part (aii) than gave the correct colour of such a solution in the previous part. About a quarter of Level 4 and 5 pupils gave a pH of 8 or above.



The facility at the target level was slightly low in part (bi), with many pupils not linking the production of carbon dioxide with fizzing. At Levels 5 and 6 pupils taking the Tier 3-6 paper had significantly greater success than those taking the Tier 5-7 paper.

The variety of possible answers for part (bii) allowed many of those who attempted the question to gain a mark. The most common answer was to say that the acid was neutralised. Over 30% of pupils on both tiers gave other incorrect answers that included answers that did not make it explicit that no more carbon dioxide was produced.

Only at Level 7 were the majority of pupils able to gain both marks for part (c). Although 59% overall knew that magnesium chloride is a compound, less than a third knew that it is a salt. It was more common, particularly at Levels 4 and 5 for *mixture* to be ticked.

Part (d) discriminated well at all levels. Most answers referred to digestion or the breaking down of food. Pupils below Level 5 did not generally know why the conditions in the stomach are acidic.

*Facilities by tier and level achieved*

| Item | 3-6 |     |     |     | 5-7 |     |     |
|------|-----|-----|-----|-----|-----|-----|-----|
|      | 3   | 4   | 5   | 6   | 5   | 6   | 7   |
| ai   | .13 | .32 | .63 | .80 | .63 | .91 | .98 |
| a ii | .06 | .23 | .53 | .69 | .54 | .81 | .95 |
| bi   | .02 | .07 | .22 | .42 | .18 | .46 | .71 |
| bii  | .03 | .19 | .42 | .61 | .43 | .65 | .75 |
| c1   | .19 | .32 | .50 | .73 | .51 | .71 | .91 |
| c2   | .06 | .06 | .09 | .25 | .18 | .45 | .79 |
| d    | .08 | .26 | .59 | .78 | .64 | .80 | .93 |

**E10.** The revised National Curriculum Order for science is more explicit than earlier Orders about the chemistry that should be taught at Key Stage 3. A number of questions in the 1996 tests assessed pupils' knowledge about chemical reactions. Pupils' responses showed that many were not familiar with reactions between acids and metals, acids and carbonates or with displacement reactions between metals and solutions of salts of other metals. Many did not know the tests for the three gases hydrogen, carbon dioxide and oxygen.

**E11.** A substantial majority of pupils entered for tier 3-6, and almost all pupils entered for tier 5-7, were able to link the arrangements of particles to the correct states of matter.

Pupils in both tiers had difficulty determining states of matter from information about boiling and freezing points. Fewer than 30% of pupils entered for tier 3-6 were able to do this correctly. Although performance was better in tier 5-7, few pupils were able to identify correctly the physical state of all four halogens from the information given. Part (b) of this question, linking stored energy to states of matter, was a demanding question which few pupils answered correctly.

**E12.** The majority of pupils answered (a)(i) correctly, but about 20% identified water as a liquid fuel. About 50% of pupils gave two correct responses to part (a)(ii) but 20% thought that the fuel would be a liquid when it comes out of the cylinder. In answering part (a)(iii), the majority of pupils gave a correct response but some pupils named foods, such as potatoes, as a fuel which can be stored in sacks. Even though food is frequently referred to as a fuel these answers were considered inappropriate within the context of the question. Only 30% of pupils were able to identify two waste products formed when fuels burn.

**E13.** Very few pupils answered part (a) correctly. A wide range of incorrect answers was offered, of which 'heating' was the most frequent. About 50% of pupils answered part (b) correctly. The most common error was to suggest that an explosion would occur. Over 40% of pupils selected a suitable metal in part (c)(i) and gained both marks in part (c)(ii). The majority of pupils answered both parts (d)(i) and (d)(ii) correctly.

