**JUNYUAN SECONDARY SCHOOL**
**PRELIMINARY EXAMINATION 2020**
**SECONDARY FOUR EXPRESS / FIVE NORMAL (ACADEMIC)**

CANDIDATE NAME

CLASS | | | | INDEX NUMBER | | |

**SCIENCE (CHEMISTRY/BIOLOGY)** **5076/01**

Paper 1 Multiple Choice **2 Sep 2020**

**1 hour**

Additional Materials: Multiple Choice Answer Sheet

**READ THESE INSTRUCTIONS FIRST**

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen.
Do not use paper clips, highlighters, glue or correction fluid.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

**Read the instructions on the Answer Sheet very carefully.**

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Data Sheet is printed on page 19.
A copy of the Periodic Table is printed on page 20.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of 20 printed pages.

**[Turn over**

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1 In the preparation of sodium chloride, 25.0 $cm^3$ of hydrochloric acid was titrated with 23.8 $cm^3$ of sodium hydroxide.

Which of the following apparatus is most suited to measure the quantities of sodium hydroxide and hydrochloric acid for the titration?

| | sodium hydroxide | hydrochloric acid |
|---|---|---|
| **A** | pipette | pipette |
| **B** | measuring cylinder | burette |
| **C** | burette | pipette |
| **D** | beaker | burette |

2 Which aqueous reagents give a white precipitate when added to aqueous zinc chloride?

| | sodium hydroxide | barium nitrate | silver nitrate |
|---|---|---|---|
| **A** | ✓ | ✓ | ✓ |
| **B** | ✓ | ✓ | ✗ |
| **C** | ✓ | ✗ | ✓ |
| **D** | ✗ | ✓ | ✓ |

3 What happens when sodium chloride melts?

**A** Atoms move further apart.

**B** Energy is released during melting.

**C** Electrostatic forces of attraction between ions are overcome.

**D** Molecules are separated into ions.



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4 The table contains information about the physical properties of the elements chlorine, copper and iron.

| element | melting point / °C | boiling point / °C |
|---|---|---|
| chlorine | -101 | W |
| copper | X | 2582 |
| iron | 1539 | Y |

In the table above, what are the correct values of W, X and Y?

| | W | X | Y |
|---|---|---|---|
| **A** | -34 | 1083 | 445 |
| **B** | -34 | 1083 | 2887 |
| **C** | -34 | 2887 | 445 |
| **D** | 445 | 2887 | 1083 |

5 Which mixture can be separated into its components by adding water, stirring and filtering?

**A** calcium carbonate and sodium chloride

**B** magnesium and iron

**C** sodium chloride and copper(II) sulfate

**D** sulfuric acid and hydrochloric acid

6 Which property of a food dye can be used to check its purity before use as a food colouring?

**A** boiling point

**B** colour

**C** density

**D** solubility in water

7 When two elements react together, a compound is formed.

Which statement is correct?

**A** Equal masses of the elements must be used.

**B** The compound shows similar chemical properties to those of the elements.

**C** The elements must be both non-metals.

**D** The compound will melt and boil at a fixed temperature.



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8 Which of the following statements about the nucleus of an atom is correct?

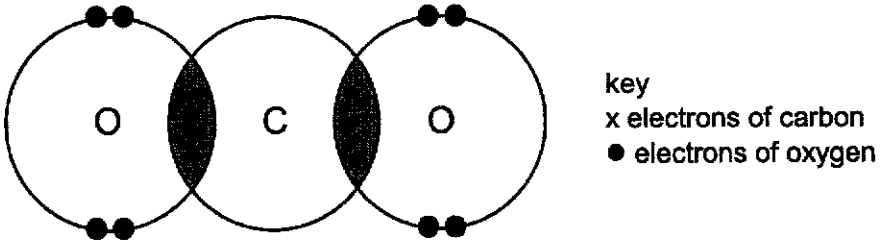
**A** The nucleus has no charge.

**B** The nucleus is positively charged.

**C** There are protons, neutrons and electrons in the nucleus.

**D** There are more protons than neutrons in the nucleus of an atom.

9 The diagram below shows bonding in carbon dioxide. The diagram is incomplete and only outermost electrons are shown.




Which of the following shows the correct arrangement of electrons in the shaded areas of the diagram?

**A**

x
x

**B**

●
x

**C**

x
x
x
x

**D**

●
x
●
x

10 126 g of nitric acid was dissolved in 200 $cm^3$ of water. The concentration of the acid is

**A** 0.63 mol/$dm^3$.

**B** 630 mol/$dm^3$.

**C** 10 mol/ $dm^3$.

**D** 0.01 mol/$dm^3$.



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11 The following reaction shows the displacement of silver when a zinc powder is added to aqueous silver nitrate.

$$Zn + 2Ag^{+} \rightarrow Zn^{2+} + 2Ag$$

Which of the following correctly identifies the oxidising and reducing agents in the reaction?

| | oxidising agent | reducing agent |
|---|---|---|
| **A** | Zn | $Ag^{+}$ |
| **B** | $Ag^{+}$ | Zn |
| **C** | $Zn^{2+}$ | Ag |
| **D** | Ag | $Zn^{2+}$ |

12 Ammonium carbonate is added to aqueous sodium hydroxide and warmed. A gas is produced.

Which of the following statements about the gas produced is correct?

**A** The gas produces white precipitate in limewater.

**B** The gas relights a glowing splint.

**C** The gas turns damp red litmus blue.

**D** The gas turns Universal Indicator turns orange-red.

13 The pH of an aqueous solution of hydrochloric acid is 2.

What will be the pH of the acid after the addition of 10 g of sodium chloride?

**A** 1 **B** 2 **C** 7 **D** 9



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14 The solubility of some barium salts in water is as shown below.

| barium salts | solubility |
|---|---|
| barium chloride | soluble |
| barium sulfate | insoluble |
| barium nitrate | soluble |
| barium carbonate | insoluble |

Which of the following correctly shows the reagents that can be reacted together to produce the respective barium salt?

| | reagents | | barium salt produced |
|---|---|---|---|
| **A** | sodium chloride | barium nitrate | barium chloride |
| **B** | sodium sulfate | barium nitrate | barium sulfate |
| **C** | sodium nitrate | barium carbonate | barium nitrate |
| **D** | sodium carbonate | barium sulfate | barium carbonate |

15 Some properties which make elements different from each other are listed.

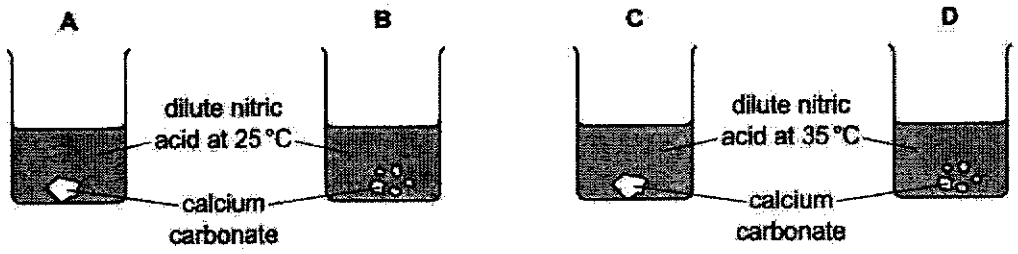
1 metallic character
2 number of electron shells in an atom
3 number of protons in an atom
4 total number of electrons in an atom

Which two properties increase across a period of the Periodic Table?

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

16 Four experiments, each using 2 g of calcium carbonate and dilute nitric acid, are set up. In each experiment, the volume and concentration of the dilute nitric acid is the same.

Which reaction is fastest?






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

Why is pure aluminium never used?

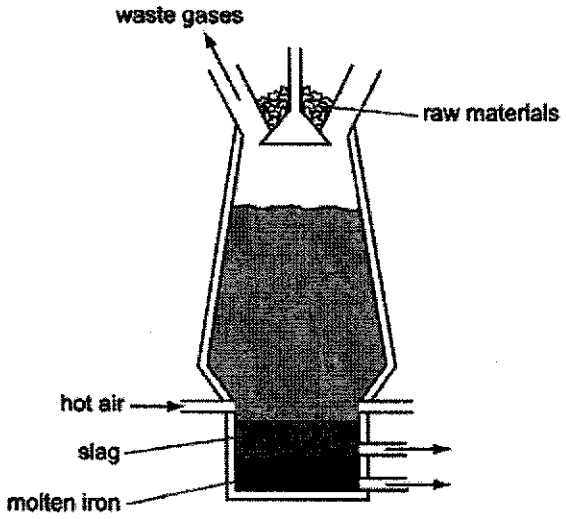
**A** Pure aluminium cannot be manufactured.

**B** Pure aluminium conducts electricity.

**C** Pure aluminium is less dense than its alloys.

**D** Pure aluminium is too malleable.

18 Iron is produced in the blast furnace.




Which statement about this process is correct?

**A** Carbon is oxidised to carbon dioxide.

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

**C** Haematite is reduced by calcium carbonate.

**D** Impurities are removed by the hot air blast.



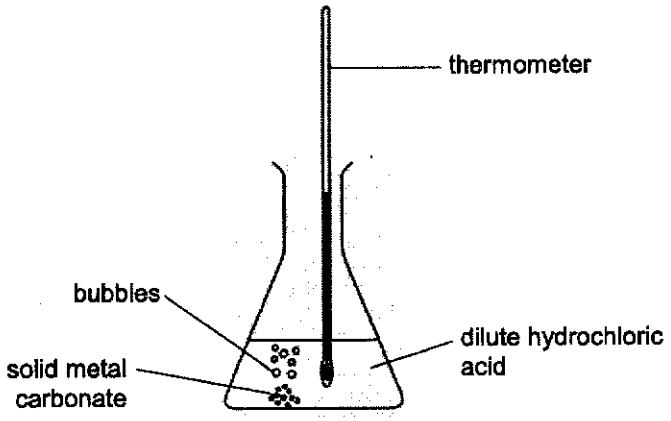
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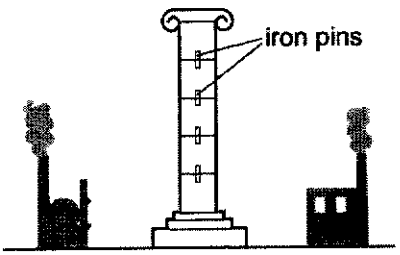
19 A student carries out an experiment where she reacts dilute hydrochloric acid with excess solid metal carbonate, as shown in the diagram below. The reaction is exothermic.



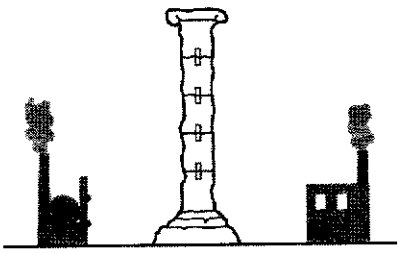

Which of the following observations will indicate that the reaction has stopped?

| | observation 1 | observation 2 |
|---|---|---|
| **A** | The reaction mixture stops bubbling. | No solid remains. |
| **B** | The reaction mixture stops bubbling. | The temperature of the mixture falls. |
| **C** | The reaction mixture feels warm | No solid remains. |
| **D** | The reaction mixture feels warm | The reaction mixture is colourless. |

20 The diagram shows a limestone column in an industrial town. Limestone is largely calcium carbonate.




column when first built



the same column after 40 years

Which is the pollutant that caused this change?

**A** carbon monoxide

**B** sulfur dioxide

**C** methane

**D** ozone



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## Data Sheet

### Colours of Some Common Metal Hydroxides

| | |
|---|---|
| calcium hydroxide | white |
| copper(II) hydroxide | light blue |
| iron(II) hydroxide | green |
| iron(III) hydroxide | red-brown |
| lead(II) hydroxide | white |
| zinc hydroxide | white |



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# The Periodic Table of Elements

| Group I | Group II | | | | | | | | | | | Group III | Group IV | Group V | Group VI | Group VII | Group 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1 H hydrogen 1 | | | | | | | | | | 2 He helium 4 |
| 3 Li lithium 7 | 4 Be beryllium 9 | | | | | | | | | | | 5 B boron 11 | 6 C carbon 12 | 7 N nitrogen 14 | 8 O oxygen 16 | 9 F fluorine 19 | 10 Ne neon 20 |
| 11 Na sodium 23 | 12 Mg magnesium 24 | | | | | | | | | | | 13 Al aluminium 27 | 14 Si silicon 28 | 15 P phosphorus 31 | 16 S sulfur 32 | 17 Cl chlorine 35.5 | 18 Ar argon 40 |
| 19 K potassium 39 | 20 Ca calcium 40 | 21 Sc scandium 45 | 22 Ti titanium 48 | 23 V vanadium 51 | 24 Cr chromium 52 | 25 Mn manganese 55 | 26 Fe iron 56 | 27 Co cobalt 59 | 28 Ni nickel 59 | 29 Cu copper 64 | 30 Zn zinc 65 | 31 Ga gallium 70 | 32 Ge germanium 73 | 33 As arsenic 75 | 34 Se selenium 79 | 35 Br bromine 80 | 36 Kr krypton 84 |
| 37 Rb rubidium 85 | 38 Sr strontium 88 | 39 Y yttrium 89 | 40 Zr zirconium 91 | 41 Nb niobium 93 | 42 Mo molybdenum 96 | 43 Tc technetium - | 44 Ru ruthenium 101 | 45 Rh rhodium 103 | 46 Pd palladium 106 | 47 Ag silver 108 | 48 Cd cadmium 112 | 49 In indium 115 | 50 Sn tin 119 | 51 Sb antimony 122 | 52 Te tellurium 128 | 53 I iodine 127 | 54 Xe xenon 131 |
| 55 Cs caesium 133 | 56 Ba barium 137 | 57 – 71 lanthanoids | 72 Hf hafnium 178 | 73 Ta tantalum 181 | 74 W tungsten 184 | 75 Re rhenium 186 | 76 Os osmium 190 | 77 Ir iridium 192 | 78 Pt platinum 195 | 79 Au gold 197 | 80 Hg mercury 201 | 81 Tl thallium 204 | 82 Pb lead 207 | 83 Bi bismuth 209 | 84 Po polonium – | 85 At astatine – | 86 Rn radon – |
| 87 Fr francium – | 88 Ra radium – | 89 – 103 actinoids | 104 Rf Rutherfordium – | 105 Db dubnium – | 106 Sg seaborgium – | 107 Bh bohrium – | 108 Hs hassium – | 109 Mt meitnerium – | 110 Ds darmstadtium – | 111 Rg roentgenium – | 112 Cn copernicium – | | 114 Fl flerovium – | | 116 Lv livermorium – | | |

**Key**

proton (atomic) number
atomic symbol
name
relative atomic mass

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| lanthanoids | 57 La lanthanum 139 | 58 Ce cerium 140 | 59 Pr praseodymium 141 | 60 Nd neodymium 144 | 61 Pm promethium – | 62 Sm samarium 150 | 63 Eu europium 152 | 64 Gd gadolinium 157 | 65 Tb terbium 159 | 66 Dy dysprosium 163 | 67 Ho holmium 165 | 68 Er erbium 167 | 69 Tm thulium 169 | 70 Yb ytterbium 173 | 71 Lu lutetium 175 |
| actinoids | 89 Ac actinium – | 90 Th thorium 232 | 91 Pa protactinium 231 | 92 U uranium 238 | 93 Np neptunium – | 94 Pu plutonium – | 95 Am americium – | 96 Cm curium – | 97 Bk berkelium – | 98 Cf californium – | 99 Es einsteinium – | 100 Fm fermium – | 101 Md mendelevium – | 102 No nobelium – | 103 Lr lawrencium – |

The volume of one mole of any gas is 24 $dm^3$ at room temperature and pressure (r.t.p.).



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CLASS | | | | INDEX NUMBER | | |

## SCIENCE (CHEMISTRY)

**5076/5078/03**

Paper 3

**24 August 2020**

**1 hour 15 min**

Candidates answer on the Question Paper.

**READ THESE INSTRUCTIONS FIRST.**

Write your name, class, and index number on all the work you hand in.
You may use an HB pencil for any diagrams, graphs, tables or rough working.
Write in dark blue or black pen.
Do not use staples, paper clips, highlighters, glue or correction fluid.

The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

**Section A**
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

**Section B**
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

A copy of the Data Sheet is printed on page 14.
A copy of the Periodic Table is printed on page 15.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

| For Examiner's Use | |
|---|---|
| Section A | 45 |
| Section B | |
| 8 | 10 |
| 9 | 10 |
| Total | 65 |

This document consists of **15** printed pages.

**[Turn over**


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## Section A

Answer all the questions in the spaces provided.

**1** Mixtures of dyes can be separated using the apparatus shown in Fig. 1.1 below.

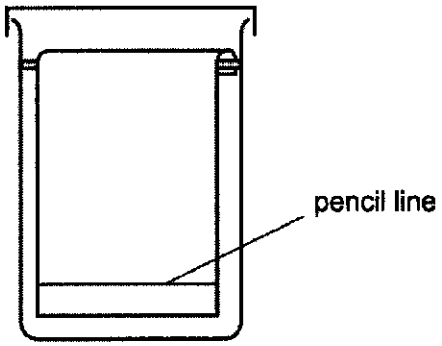



Fig. 1.1

**(a)** On Fig. 1.1 above

**(i)** draw a line to show the solvent level at the beginning of the experiment. [1]

**(ii)** put a cross to show where the spot of dye mixture is placed at the beginning of the experiment. [1]

**(b)** Fig. 1.2 shows a chromatogram of inks, X, A, B, C and D, containing different mixtures of dyes.

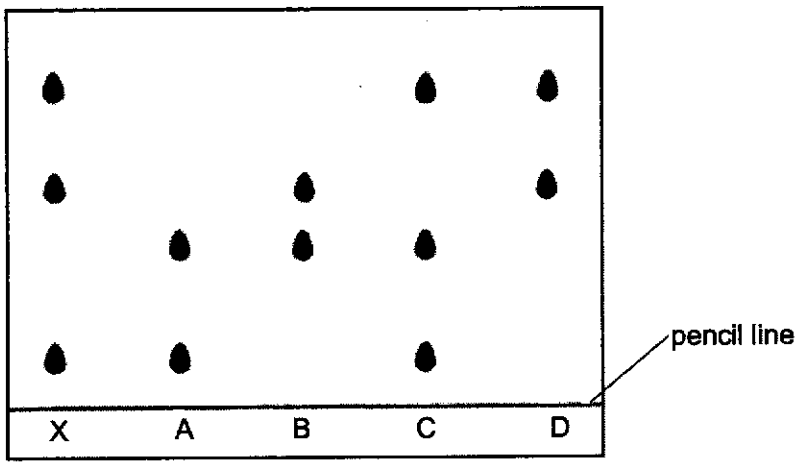



Fig. 1.2

**(i)** How many different dyes were used to make the five inks? ..... [1]

**(ii)** Which ink(s) does X contain? ..... [1]



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2 Fig. 2.1 shows the nuclei of 5 different atoms, E, F, G, H and I.
The letters are not the chemical symbols of the elements.

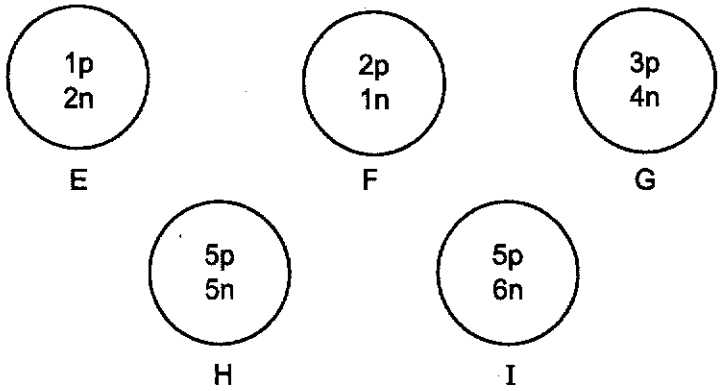



Fig. 2.1

**(a)** The following statements describe the atoms, E, F, G, H and I. Place a tick (✓) in the box if the statement is true, and a cross (✗) if the statement is false.

| statement | | ✓ or ✗ |
|---|---|---|
| **(i)** | Atoms E and F have the same nucleon number. | |
| **(ii)** | Atoms H and I are the same element. | |
| **(iii)** | G is located in the first period of the Periodic Table. | |
| **(iv)** | Only atom F is a non-metal. | |

[3]

**(b)** From Fig. 2.1, deduce the identity of G. Hence, draw a 'dot and cross' diagram to show the bonding between G and oxygen. Show only outermost shell electrons.

G is .....

[3]



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3 The following lists show elements from Group I and Group VII in the Periodic Table.

| Group I | Group VII |
|---|---|
| Li | F |
| Na | Cl |
| K | Br |
| Rb | I |

**(a)** Choose from the lists, an element that

**(i)** exists as a reddish-brown liquid at room temperature, .....

**(ii)** burns with an orange flame when placed in water. .....

[2]

**(b)** Describe one difference in trend going down Group I and Group VII elements.

.....

..... [1]

**(c)** Cs, atomic number 55, is another element in Group I.
Use your knowledge of Group I elements to complete the table of information for caesium.

| | |
|---|---|
| chemical symbol | Cs |
| number of electrons in outer shell | |
| formula of caesium oxide | |
| names of products of the reaction between caesium and water | |

[4]



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4 Baking powder contains sodium carbonate, $Na_2CO_3$, and a dry acid.
When baking powder is added to wet ingredients in baking such as milk and eggs, the acid dissolves in the water present and reacts with sodium carbonate. The reaction produces carbon dioxide which causes the dough or batter to rise.

**(a)** Name and write the chemical symbol of the ion in the acid that reacts with sodium carbonate.

name of ion .....

chemical symbol ..... [2]

**(b)** The reaction between sodium carbonate and hydrochloric acid can be represented as follows.

$$Na_2CO_3(s) + 2HCl(aq) \rightarrow 2NaCl(aq) + CO_2(g) + H_2O(l)$$

A sample of baking powder contains 21.2% by mass of sodium carbonate. 10 g of baking powder is added to excess dilute hydrochloric acid.

**(i)** Calculate the mass of sodium carbonate in 10 g of baking powder.

mass of sodium carbonate ..... g [1]

**(ii)** Calculate the number of moles of sodium carbonate used in the reaction.

number of moles of sodium carbonate ..... [1]

**(iii)** Calculate the mass of sodium chloride produced in the reaction.

mass of sodium sulfate ..... g [2]



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**(iv)** Calculate the volume of carbon dioxide produced in the reaction.

volume of carbon dioxide ..... $dm^3$ [2]

**5** Fig. 5.1 shows some of the properties and reactions of two solutions, P and Q.

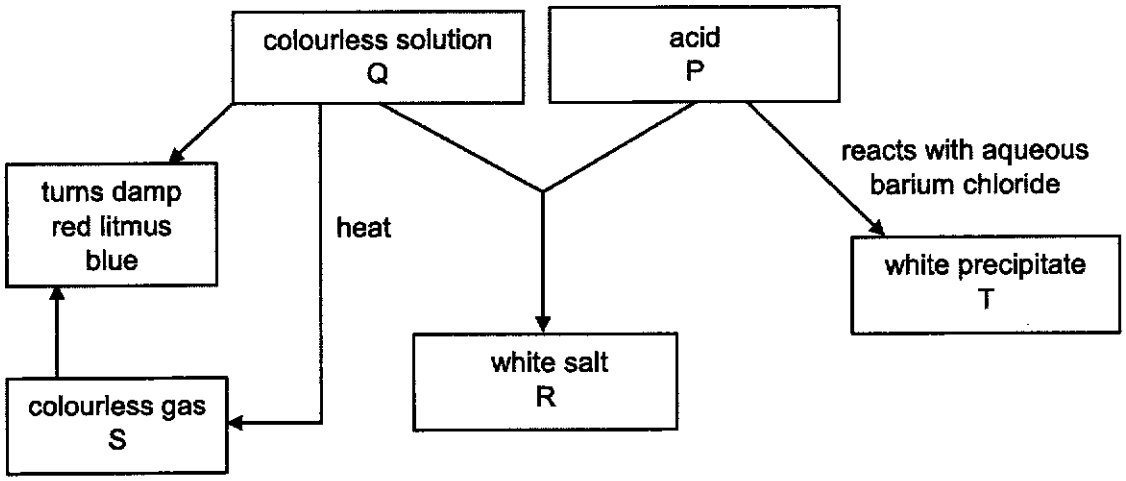



Fig. 5.1

**(a)** Identify the substances, P, Q, R, S and T

P .....

Q .....

R .....

S .....

T ..... [5]

**(b)** Write a balanced chemical equation for any of the reactions in Fig. 5.1. State symbols are not required.

..... [2]



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6 A student reacted a metal carbonate powder with dilute hydrochloric acid, producing carbon dioxide. When the mixture stopped bubbling, she observed some solid metal carbonate left unreacted. The experiment was set up as shown in Fig. 6.1.

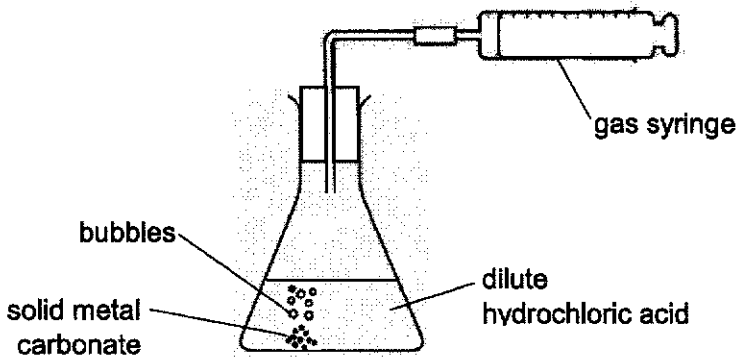



Fig. 6.1

She wanted to compare the speed of reaction at 1 minute and at 2 minutes. She measured the volume of gas at regular time intervals and obtained the results as follows in Fig. 6.2.

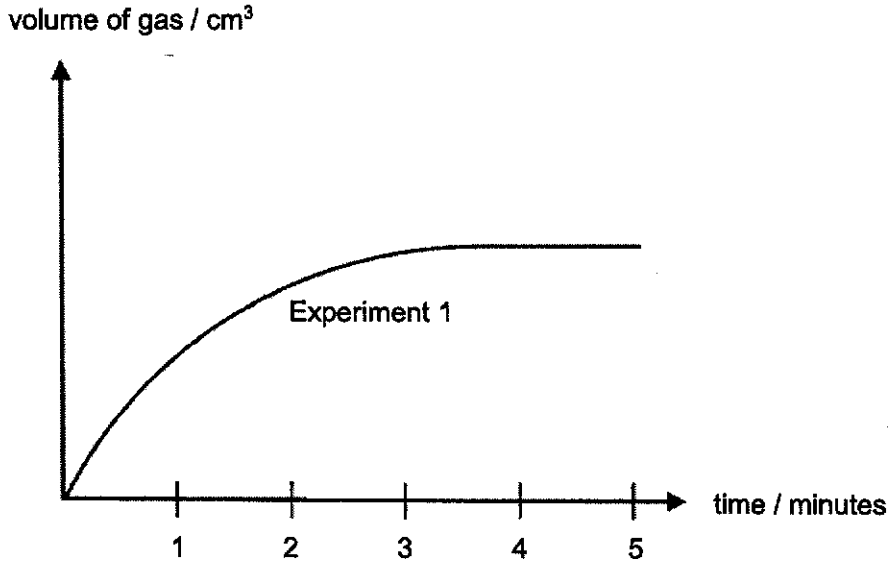



Fig. 6. 2

**(a)** With reference to Fig. 6.2, describe how the student can compare the speeds of the reaction at 1 minute and at 2 minutes. You may sketch on Fig 6.2 to help you in your description.

.....

.....

.....

..... [3]



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**(b)** The student carried out Experiment 2 using the same mass of metal carbonate and the same volume of dilute hydrochloric acid, at twice the concentration.

**(i)** Sketch, on Fig. 6.2, how the results would look like. [2]

**(ii)** Explain, using collision theory, the effect of doubling concentration on the speed of the reaction.

.....

.....

.....

..... [3]

**7** The metal reactivity series lists metals in order of reactivity, arranging metals from most reactive to least reactive.

Some observations about the reactions of four metals with hydrochloric acid are shown in Table 7.1.

Table 7.1

| metal | observations |
|---|---|
| cobalt | Bubbles formed very slowly. |
| copper | No bubbles formed. |
| magnesium | Many bubbles formed very rapidly. |
| tin | A steady stream of bubbles formed. |

**(a)** Use the information from table 7.1 to arrange these metals in order of their reactivity with hydrochloric acid.

most reactive .....

.....

.....

least reactive ..... [2]



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**(b)** When a strip of magnesium ribbon is placed in aqueous copper(II) sulfate, a reddish-brown deposit forms. The ionic equation for the reaction can be represented as follows.

$$Mg(s) + Cu^{2+}(aq) \rightarrow Mg^{2+}(aq) + Cu(s)$$

When a strip of cobalt is placed in aqueous tin(IV) sulfate, no reaction is observed.

**(i)** Explain why a reaction occurs when a strip of magnesium is placed in aqueous copper(II) sulfate, but no reaction occurs when a strip of cobalt is placed in aqueous tin(IV) sulfate.

.....

.....

.....

..... [2]

**(ii)** Identify the reagent being oxidised and the reagent being reduced in the reaction between magnesium and copper(II) sulfate.

reagent oxidised .....

reagent reduced ..... [1]



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**Section B**

Answer all questions.
Write your answers in the spaces provided.

8 When the elements, hydrogen and chlorine react, a compound hydrogen chloride is formed according to the equation below.

$$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$$

**(a)** A student wrote, in his Science journal, the two statements about elements and compounds.

1. All elements are diatomic.
2. Hydrogen chloride is a compound because it can be separated into simpler substances.

Both statements are either false or inaccurate.

Explain why the statements are false or inaccurate. You may use examples to illustrate.

statement 1 .....

.....

statement 2 .....

.....

[2]

**(b)** When hydrogen chloride dissolves in water, it ionises to form hydrogen and chloride ions.

$$HCl(aq) \rightarrow H^+(aq) + Cl^-(aq)$$

Describe the similarities and differences between an atom of chlorine and a chloride ion. Your description should compare the

- sub-atomic particles present,
- electronic configurations and
- electrical charges.

.....

.....

.....

.....

.....

..... [5]



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**(c)** An aqueous solution of hydrogen chloride conducts electricity.
Hydrogen chloride gas does not conduct electricity.

Explain why hydrogen chloride behaves differently as an aqueous solution and as a gas.

.....

.....

.....

..... [3]

**9** **(a)** Table 9.1 shows the composition of the atmosphere of the planet Mars.

Table 9.1

| gas | percentage composition on Mars / % | percentage composition on Earth / % |
|---|---|---|
| carbon dioxide | 95.3 | |
| nitrogen | 1.7 | |
| oxygen | 0.2 | |
| argon | 1.6 | about 1 |
| other gases | 1.2 | |

**(i)** Complete Table 9.1 to compare the composition of the atmosphere on Mars and on Earth [2]



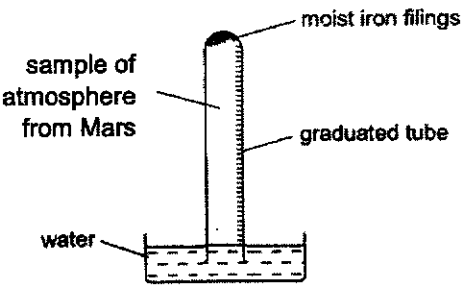
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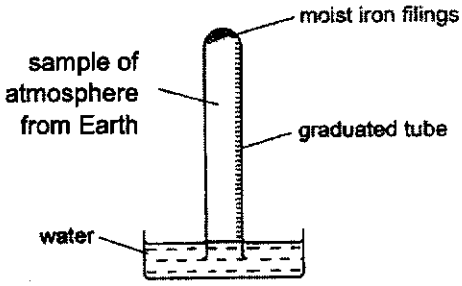
(ii) Experiment 1 was set up using the apparatus below with a 100 $cm^3$ sample of the atmosphere from Mars in the graduated tube.

The experiment was repeated. Experiment 2 used a 100 $cm^3$ sample of the atmosphere from Earth.

Experiment 1




Experiment 2




After a few days, the water level rises in Experiment 2.

How would the results be different in Experiment 1? Explain why this is so.

.....

.....

.....

..... [3]

(b) Unpolluted air contains water vapour, which is a neutral oxide. Polluted air contains other oxides such as carbon monoxide and sulfur dioxide.

(i) Classify the two non-metal oxides.

carbon monoxide .....

sulfur dioxide ..... [1]



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(ii) For each of these pollutants, state one source and one impact the gases have on the environment.

carbon monoxide

source.....

impact .....

..... [2]

sulfur dioxide

source .....

impact .....

..... [2]



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# Data Sheet

## Colours of Some Common Metal Hydroxides

| | |
|---|---|
| calcium hydroxide | white |
| copper(II) hydroxide | light blue |
| iron(II) hydroxide | green |
| iron(III) hydroxide | red-brown |
| lead(II) hydroxide | white |
| zinc hydroxide | white |



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# The Periodic Table of Elements

| Group I | Group II | | | | | | | | | | | Group III | Group IV | Group V | Group VI | Group VII | Group 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1 H hydrogen 1 | | | | | | | | | | 2 He helium 4 |
| 3 Li lithium 7 | 4 Be beryllium 9 | | | | | | | | | | | 5 B boron 11 | 6 C carbon 12 | 7 N nitrogen 14 | 8 O oxygen 16 | 9 F fluorine 19 | 10 Ne neon 20 |
| 11 Na sodium 23 | 12 Mg magnesium 24 | | | | | | | | | | | 13 Al aluminium 27 | 14 Si silicon 28 | 15 P phosphorus 31 | 16 S sulfur 32 | 17 Cl chlorine 35.5 | 18 Ar argon 40 |
| 19 K potassium 39 | 20 Ca calcium 40 | 21 Sc scandium 45 | 22 Ti titanium 48 | 23 V vanadium 51 | 24 Cr chromium 52 | 25 Mn manganese 55 | 26 Fe iron 56 | 27 Co cobalt 59 | 28 Ni nickel 59 | 29 Cu copper 64 | 30 Zn zinc 65 | 31 Ga gallium 70 | 32 Ge germanium 73 | 33 As arsenic 75 | 34 Se selenium 79 | 35 Br bromine 80 | 36 Kr krypton 84 |
| 37 Rb rubidium 85 | 38 Sr strontium 88 | 39 Y yttrium 89 | 40 Zr zirconium 91 | 41 Nb niobium 93 | 42 Mo molybdenum 96 | 43 Tc technetium - | 44 Ru ruthenium 101 | 45 Rh rhodium 103 | 46 Pd palladium 106 | 47 Ag silver 108 | 48 Cd cadmium 112 | 49 In indium 115 | 50 Sn tin 119 | 5 1 Sb antimony | 52 Te tellurium 128 | 53 I iodine 127 | 54 Xe xenon 131 |
| 55 Cs caesium 133 | 56 Ba barium 137 | 57 — 71 lanthanoids | 72 Hf hafnium 178 | 73 Ta tantalum 181 | 74 W tungsten 184 | 75 Re rhenium 186 | 76 Os osmium 190 | 77 Ir iridium 192 | 78 Pt platinum 195 | 79 Au gold 197 | 80 Hg mercury 201 | 81 Tl thallium 204 | 82 Pb lead 207 | 83 Bi bismuth 209 | 84 Po polonium — | 85 At astatine — | 86 Rn radon — |
| 87 Fr francium — | 88 Ra radium — | 89 — 103 actinoids | 104 Rf Rutherfordium — | 105 Db dubnium — | 106 Sg seaborgium — | 107 Bh bohrium — | 108 Hs hassium — | 109 Mt meitnerium — | 110 Ds darmstadtium — | 111 Rg roentgenium — | 112 Cn copernicium — | | 114 Fl flerovium — | | 116 Lv livermorium — | | |

**Key**

proton (atomic) number
atomic symbol
name
relative atomic mass

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| lanthanoids | 57 La lanthanum 139 | 58 Ce cerium 140 | 59 Pr praseodymium 141 | 60 Nd neodymium 144 | 61 Pm promethium — | 62 Sm samarium 150 | 63 Eu europium 152 | 64 Gd gadolinium 157 | 65 Tb terbium 159 | 66 Dy dysprosium 163 | 67 Ho holmium 165 | 68 Er erbium 167 | 69 Tm thulium 169 | 70 Yb ytterbium 173 | 71 Lu lutetium 175 |
| actinoids | 89 Ac actinium — | 90 Th thorium 232 | 91 Pa protactinium 231 | 92 U uranium 238 | 93 Np neptunium — | 94 Pu plutonium — | 95 Am americium — | 96 Cm curium — | 97 Bk berkelium — | 98 Cf californium — | 99 Es einsteinium — | 100 Fm fermium — | 101 Md mendelevium — | 102 No nobelium — | 103 Lr lawrencium — |

The volume of one mole of any gas is 24 $dm^3$ at room temperature and pressure (r.t.p.).



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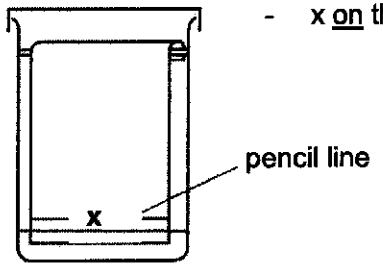
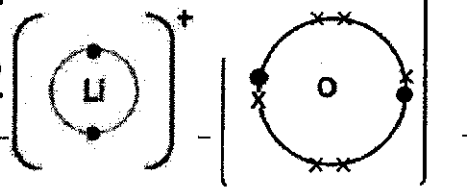
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**Paper 1**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1-5 | CCCBA | 6-10 | ADBDC | 11-15 | BCBBD | 16-20 | DDABB |

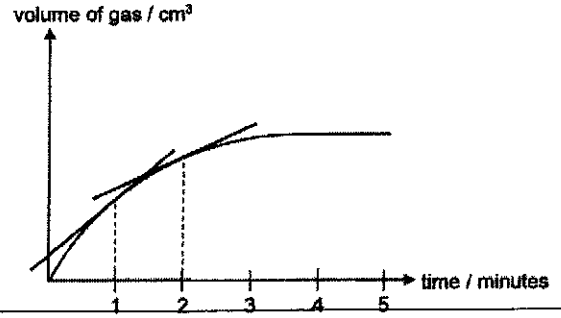
**Section A**

| Qn | Answer | Mark allocation | Markers' comments |
|---|---|---|---|
| 1 (a) (i)<br>(ii) | <br>- line <u>below</u> pencil line<br>- x <u>on</u> the pencil ine | 1<br>1 | A handful of mistakes about the drawing of solvent line; Errors spotted includes drawing of solvent line at the top. |
| (b) (i)<br>(ii) | 4<br>D | 1<br>1 | Part ii) was poorly done. Many were confused and misled by substances A and C and thereby including these as the answers as well. Need to revisit the concept of reading chromatogram |
| 2 (a) | <table><tr><th colspan="2">statement</th><th>✓ or ×</th></tr><tr><td>(i)</td><td>Atoms E and F have the same nucleon number.</td><td>✓</td></tr><tr><td>(ii)</td><td>Atoms H and I are the same element.</td><td>✓</td></tr><tr><td>(iii)</td><td>G is located in the first period of the Periodic Table.</td><td>×</td></tr><tr><td>(iv)</td><td>Only atom F is a non-metal.</td><td>×</td></tr></table> | 4 corr 3m<br>3 corr 2m<br>2 corr 1m<br>1 corr 0m | Not very well done. Observed a random set of errors which shows that students are unable to interpret the information of the subatomic particles and relate to Periodic Table. |
| (b) | lithium<br> | 1<br>1 for corr 2 Li ions<br>1 for corr O ion | Observed a number of random guess for identity of G.<br>Not well done for the drawing of bond. Only a handful of students did it accurately. Quite a number drew covalent bond instead. For those who drew |

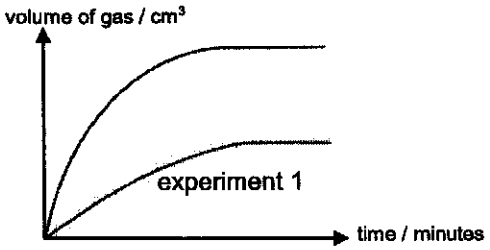
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| Qn | Answer | Mark allocation | Markers' comments |
|---|---|---|---|
| | | | ionic bond, some errors were observed: Wrong charges of the ions; Outershells are not complete; number of Li ions are inaccurate. |
| 3 (a) (i)<br>(ii) | Br<br>Na | 1<br>1 | Common error for (i) is Iodine. Mostly confused with reddish brown **liquid** which is bromine and brown **solution** which can also be iodine. |
| (b) | The melting point decrease down Group I while it increases down Group VII.<br><br>OR<br>reactivity increases down Group I while reactivity decreases down Group VII. | 1 | Fairly ok. A handful describe different trends for Gp I and Gp VII elements which cause them to lose marks. Also a handful were mixed up with the trends on chemical reactivity. |
| (c) | number of electrons in outer shell: *1*<br>formula of caesium oxide: *$Cs_2O$*<br>names of products of the reaction between caesium and water: *caesium hydroxide, hydrogen* | 1<br>1<br>1, 1 | Not well done;<br>• Common mistake observed for number of valence electrons to be 5 instead of 1.<br>• Common mistake observed was wrong formula written for caesium oxide (e.g. CsO, CsOH)<br>• For the products, some correctly state the chemical formula instead of writing the names<br>Students did not note the difference between stating formula and writing names in the question. Teachers need to highlight. |
| 4 (a) | hydrogen<br>$H^+$ | 1<br>1 | Poorly done. Many could not identify the ion as Hydrogen that contributes to the acidic properties. Random sets of answers observed listing examples of acids, alkalis. Reflected weak understanding of the question.<br>Again, students did not note the difference between stating formula and writing names in the question. |
| (b) (i) | Mass of sodium carbonate = 21.2/100 x 10<br>= 2.12 g | 1 | Award 1m if $M_r$ is visible in calculation of mol<br>Allow ECF |

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| Qn | Answer | Mark allocation | Markers' comments |
|---|---|---|---|
| (ii) | number of moles = mass / $M_r$<br>= 2.12 / 106<br>= 0.02 mol | 1 | Some students could not calculate the mass using percentage.<br><br>ECF was given for (ii) if $M_r$ used is correct |
| (ii) | number of moles of sodium chloride = 0.04<br>mass of sodium chloride = 0.04 x (23 + 35.5)<br>= 2.34 g | 1<br><br>1 | ECF was given for (iii)if moles for NaCl is stated twice the amount for sodium carbonate<br>ECF was given for (iv) if moles for carbon dioxide is stated to be same as sodium carbonate |
| (iii) | number of moles of $CO_2$ = 0.02<br>volume of $CO_2$ = 0.02 x 24<br>= 0.48 $dm^3$ | 1<br><br>1 | Common mistakes observed:<br>• Use of proton number to find $M_r$ instead.<br>• Double counting of mass of NaCl<br>• Wrong use of formula; confusion to use $M_r$ to find volume |
| 5 (a) | P sulfuric acid<br>Q aqueous ammonia / ammonium hydroxide<br>R ammonium sulfate<br>S ammonia<br>T barium sulfate | 1<br>1<br>1<br>1<br>1 | Some students stated nitric acid for P.<br>Marks is given if students did not mention aqueous for aqueous ammonia |
| (b) | $H_2SO_4 + 2NH_4OH \rightarrow (NH_4)_2SO_4 + 2H_2O$<br>$H_2SO_4 + BaCl_2 \rightarrow BaSO_4 + 2HCl$<br>$NH_4OH \rightarrow NH_3 + H_2O$ | 1 for corr eqn<br>1 for balancing | Do not accept $NH_3(aq) \rightarrow NH_3(g)$<br>ECF given if use nitric acid as P instead provided the whole equation is correct and balanced. |
| 6 (a) | Draw a tangent to the graph at 1 and 2 minutes<br>OR (awarded to tangents drawn on Fig)<br><br> | 1 | Many students did not draw tangent on the curve which they are not penalised so long it was explained to find gradient to determine the speed.<br><br>Quite a handful mentioned taking volume of gas at 1 min/2 min and divide the time but no marks were given.<br><br>A small number mentioned speed increases when the gradient becomes less steep which reflected a misconception of gradient and speed. |

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| Qn | Answer | Mark allocation | Markers' comments |
|---|---|---|---|
| | Calculate the gradient at these 2 times.<br>Compare the gradients, a steeper gradient shows a faster reaction. | 1<br>1 | |
| (b) (i) |  | 1; gradient<br>1; final vol | Not well done. Majority can identify that speed increases which reflected a steeper gradient so 1m is awarded. However, most leave the final volume unchanged.<br>Only a handful can derive the final volume of gas to be doubled(credit given if the final volume is close to double as the y-axis is too short) |
| (ii) | When concentration is doubled, there are more particles present in the same volume and particles are closer together.<br>Particles will collide more often, there is a higher frequency of effective collisions.<br>The speed of reaction increases. | 1<br>1<br>1 | Most have general idea that speed will increase. No marks are penalised if students did not mention particles are closer. However, common errors that resulted in loss of marks are:<br>• Explanation using surface area instead of more particles present<br>• Missing out specific terms 'more effective collisions' or 'higher frequency of effective collisions' |
| 7 (a) | most reactive magnesium<br>tin<br>cobalt<br>least reactive copper | ½<br>½<br>½<br>½ | Generally well done |
| (b) (i) | Magnesium is more reactive than copper, Mg can displace copper from copper(II) sulfate.<br>Cobalt is less reactive than tin, cobalt cannot displace tin from tin(IV) sulfate. | 1<br>1 | Quite a handful compare magnesium and tin instead of magnesium and copper, cobalt and tin, which results in loss of marks.<br>Mark is deducted if students did not mention displacement that explains the reaction taking place |
| (ii) | reagent oxidised magnesium / Mg<br>reagent reduced copper(II) ion / $Cu^{2+}$ | 1 | Not well done.<br>Quite a number of students stated Mg as the reduced reagent and copper(II) as the oxidised |

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| Qn | Answer | Mark allocation | Markers' comments |
|---|---|---|---|
| | | | reagent. Other error observed is writing the product as the answer<br>Mark is given if student wrote copper(II) sulfate as the reagent reduced. |

**Section B**

| Qn | Answer | Mark allocation | Markers' comments |
|---|---|---|---|
| 8 (a) | statement 1:<br>Elements are not necessarily diatomic, they can be monatomic, e.g. argon.<br>OR<br>As long as the substance cannot be broken into simpler substances, the substance is an element.<br><br>statement 2:<br>hydrogen chloride is a compound that can be separated only by chemical methods.<br>OR<br>A compound cannot be separated by physical methods.<br><br>*Accept any other sound/logical reasoning* | 1<br><br><br><br><br><br>1 | Where students merely re-worded to statement to state that elements are not diatomic without explanations or examples to support, no marks are awarded.<br>Common incorrect responses included:<br>• 'all elements are not diatomic'<br>• all elements are monatomic<br>• all elements are subatomic.<br>Some students stated that only Group VII elements are diatomic, neglecting that $H_2$ that was already mentioned in the question is not from Group VII.<br>Some students stated that metals such as Li, K and Mg are monatomic.<br><br>More students could explain why statement 2 was inaccurate, but phrasing was an issue. Many students stated that a compound / HCl was chemically combined, or that it can be 'separated chemically'. Some students identified HCl as a mixture. |
| (b) | Similarity:<br>Chlorine atom and ion have the same number of protons and neutrons.<br>Differences:<br>Chlorine atom has 17 electrons while chloride ion has 18 electrons. | 1<br>1<br><br>1 | It seems that students did not understand the term 'subatomic particles', only few could respond accurately. Quite a number of students explained how an ion was formed and that it was so in order to achieve a stable electronic configuration. Yet, there |

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<table>
<tr><th>Qn</th><th>Answer</th><th>Mark allocation</th><th>Markers' comments</th></tr>
<tr><td></td><td>Chlorine atom has the electronic configuration of 2.8.7 while chloride ion has the configuration of 2.8.8<br>Chloride atom is neutral / has no charge, while chloride ion has a negative charge.</td><td>1<br><br>1</td><td>were those who proceeded to explain how bonding took place.<br>Common errors included:<br>• Chlorine atom has a positive charge.<br>• chlorine and chloride used interchangeably<br>• chorine atom has subatomic particles while chloride ion does not.<br>• chlorine atom has protons and neutrons, chloride ion has only electrons.<br>Few students stated that both particles had 18.5 neutrons, for which, no penalty was awarded.<br>Few students used the relative mass to determine the electronic configuration.<br>Students must be taught that the description should be a point-by-point comparison, instead of describing the characteristics of an ion and then an atom.</td></tr>
<tr><td>(c)</td><td>Aqueous hydrogen chloride contains ions that can move;<br>to carry a current when a potential difference is applied.<br>Hydrogen chloride gas exists a simple molecules,<br>it does not have ions (nor electrons)<br>to carry a current when a potential difference is applied.</td><td>1<br><br><br>1<br>1</td><td>2m for the idea that the solution has ions, and the gas does not, 1m for carrying of current / charge<br><br>Students' answers suggested that the concept of electricity was not well understood. Many students related this to KPT, stating the movement and arrangement of ions and molecules in the different states. They explained that in a gas HCl molecules are far apart and hence electrical current cannot be passed from one molecule to another. In aqueous solutions, HCl is in the liquid state, hence ions are closely packed and electrical current can be passed easily.<br>Few students stated that covalent molecules conduct electricity in molten and aq states or that in HCl exists as a giant lattice structure, which in water, giant lattice structure is broken.</td></tr>
<tr><td>9(a) (i)</td><td><table><tr><td>gas</td><td>mars (%)</td><td>earth (%)</td></tr><tr><td>carbon dioxide</td><td>95.3</td><td>0.03</td></tr></table></td><td>3 corr 2</td><td>Poorly done, especially the percentage of carbon dioxide was not well known.</td></tr>
</table>

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| Qn | Answer | Mark allocation | Markers' comments |
|---|---|---|---|
| | <table><tr><td>nitrogen</td><td>1.7</td><td>78</td></tr><tr><td>oxygen</td><td>0.2</td><td>21</td></tr></table> | 2 corr 1<br>1 corr 0 | |
| (ii) | The rise in water level in experiment 1 is negligible / remains **almost** the same / rises very slightly / rises less than in Experiment 2.<br>Oxygen in the tube reacts with iron filings causing it to rust.<br>Since the tube in experiment 1 contains only 0.2% oxygen compared to experiment 2 which contains 21%, the rise in water level is negligible. | 1<br><br>1<br>1 | Many students recognised that oxygen was involved in the reaction. Unfortunately few students reasoned that the water level rose due to dissolution of the gas into water.<br>Some students stated that there was no rise in the water level in Experiment 1 since there is low concentration or very little $O_2$.<br>Few students stated that carbon dioxide was needed for rusting.<br>Few students stated that the rate of reaction was slower in Experiment 1.<br>Few students compared to the level of rusting that took place rather than the rise in water level. |
| (b) (i) | neutral<br>acidic | 1 | Poorly done. Some students wrote the chemical formula, others wrongly classified the oxides. |
| (ii) | incomplete combustion of carbon containing fuel<br>binds with haemoglobin in the blood preventing absorption of oxygen, leading to death.<br><br>volcanic activity / combustion of sulfur containing fuels<br>dissolves in rain forming acid rain which<br>- corrodes stone buildings / metal structures<br>- cause ponds to be acidic harming aquatic life<br>- cause soils to be acidic harming plants and crops | 1<br>1<br><br>1<br>1 | Do not award marks if student merely writes 'forms acid rain'. Students need to state the impact on environment.<br><br>Poorly done. Some students listed the sources as 'vehicles', 'factories', 'cars', 'acid rain'. Few students confused the source of sulfur dioxide with nitrogen dioxide.<br><br>Some students stated that carbon monoxide was a greenhouse gas and caused global warming, others stated that it caused breathing difficulties.<br>Few students stated that sulfur dioxide corroded stone buildings (without mention of dissolving in rain) for which they were still awarded 1m, but should be reminded to be more meticulous in their answers. |

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