WJEC GCSE CHEMISTRY

# CHEMISTRY



EXAM QUESTION PACK

UNIT C2 HIGHER TIER 4472 PAPERS

STEMUP

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| Surname | Centre Number | Candidate Number |
|---|---|---|
| Other Names | | 0 |

# GCSE

4472/02

S16-4472-02

## ADDITIONAL SCIENCE/CHEMISTRY

# CHEMISTRY 2
## HIGHER TIER

A.M. THURSDAY, 19 May 2016

1 hour

| For Examiner's use only | | |
|---|---|---|
| **Question** | **Maximum Mark** | **Mark Awarded** |
| **1.** | **6** | |
| **2.** | **12** | |
| **3.** | **6** | |
| **4.** | **6** | |
| **5.** | **8** | |
| **6.** | **7** | |
| **7.** | **9** | |
| **8.** | **6** | |
| **Total** | **60** | |

4472
020001

### ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

### INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

### INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

Assessment will take into account the quality of written communication (QWC) used in your answers to questions **3** and **8**.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

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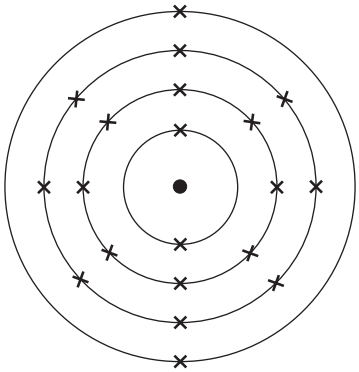


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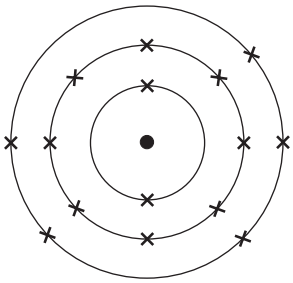
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*Answer* **all** *questions.*

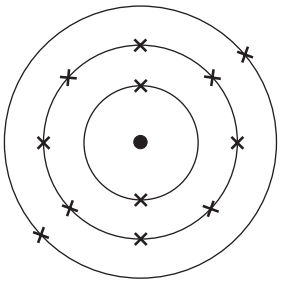
**1.** The following diagrams show the electronic structures of five different elements, **A**–**E**.



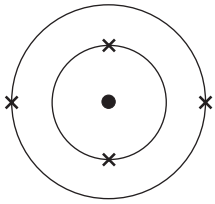
**A**



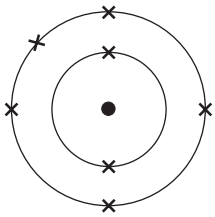
**B**



**C**



**D**



**E**

*(a)* State which elements, **A**–**E**, are found in Period 2 of the Periodic Table. Give a reason for your choice. [2]

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*(b)* State which element, **A**–**E**, has an atomic number of 15. Give a reason for your answer. [1]

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*(c)* Aluminium can be represented as $^{27}_{13}\mathbf{Al}$.

State what this tells you about the structure of its atoms. [3]

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**2.** *(a)* Sodium bromide is formed by reacting sodium with bromine, $Br_2$.

Write the balanced **symbol** equation for the reaction. [2]

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*(b)* A scientist has **solid** samples of sodium chloride and sodium iodide but is not sure which is which.

Describe how silver nitrate solution could be used to distinguish between them.

Give the observations expected for both substances. [3]

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*(c)* During a chemical reaction, aluminium combines with chlorine to produce aluminium chloride, $AlCl_3$.

$$2Al + \square\, Cl_2 \longrightarrow \square\, AlCl_3$$

(i) Balance the equation. [1]

(ii) Calculate the percentage of chlorine present in aluminium chloride, $AlCl_3$. [3]

$A_r(Al) = 27$ $A_r(Cl) = 35.5$

Percentage chlorine = ..... %



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**Turn over.**

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*(d)* Electrolysis can be used to extract aluminium from its oxide. The equation for the reaction is as follows.

$$2Al_2O_3 \longrightarrow 4Al + 3O_2$$

204 tonnes of aluminium oxide are expected to produce 108 tonnes of aluminium. However, only 81 tonnes are actually made.

(i) Calculate the percentage yield of this process. [1]

Percentage yield = ..... %

(ii) Suggest reasons why the actual amount produced was lower than expected. [2]

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**3.** Describe what is meant by a *smart material*. Use thermochromic and photochromic materials to support your answer, giving everyday uses of each. [6 QWC]

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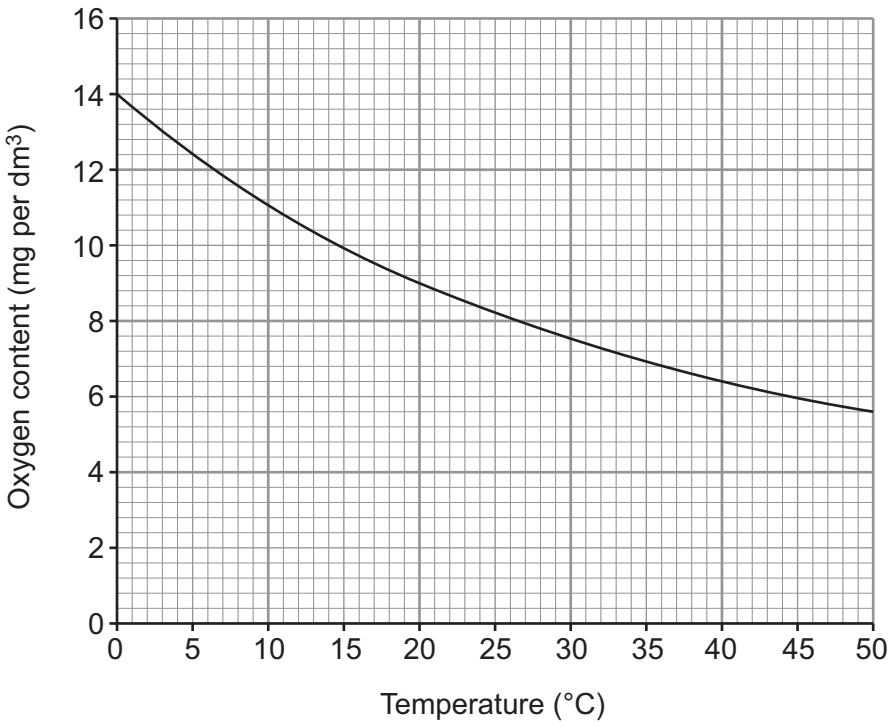


**Turn over.**

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**4.** The following graph shows the solubility curve for oxygen gas in fresh water.




*(a)* Use the graph to explain why more fish can be kept in a cold water tank than a warm water tank of the same size. [2]

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*(b)* Calculate the mass in **grams** of oxygen that dissolves in 100 $dm^3$ of fresh water at 20 °C. [2]

1 g = 1000 mg

Mass = ..... g

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*(c)* Approximately 3.3 g of carbon dioxide gas dissolves in 1 $dm^3$ of fresh water at 0 °C. Estimate how many times more soluble carbon dioxide is than oxygen at this temperature. Show your working. [2]

1 g = 1000 mg

Carbon dioxide is approximately ..... times more soluble than oxygen.

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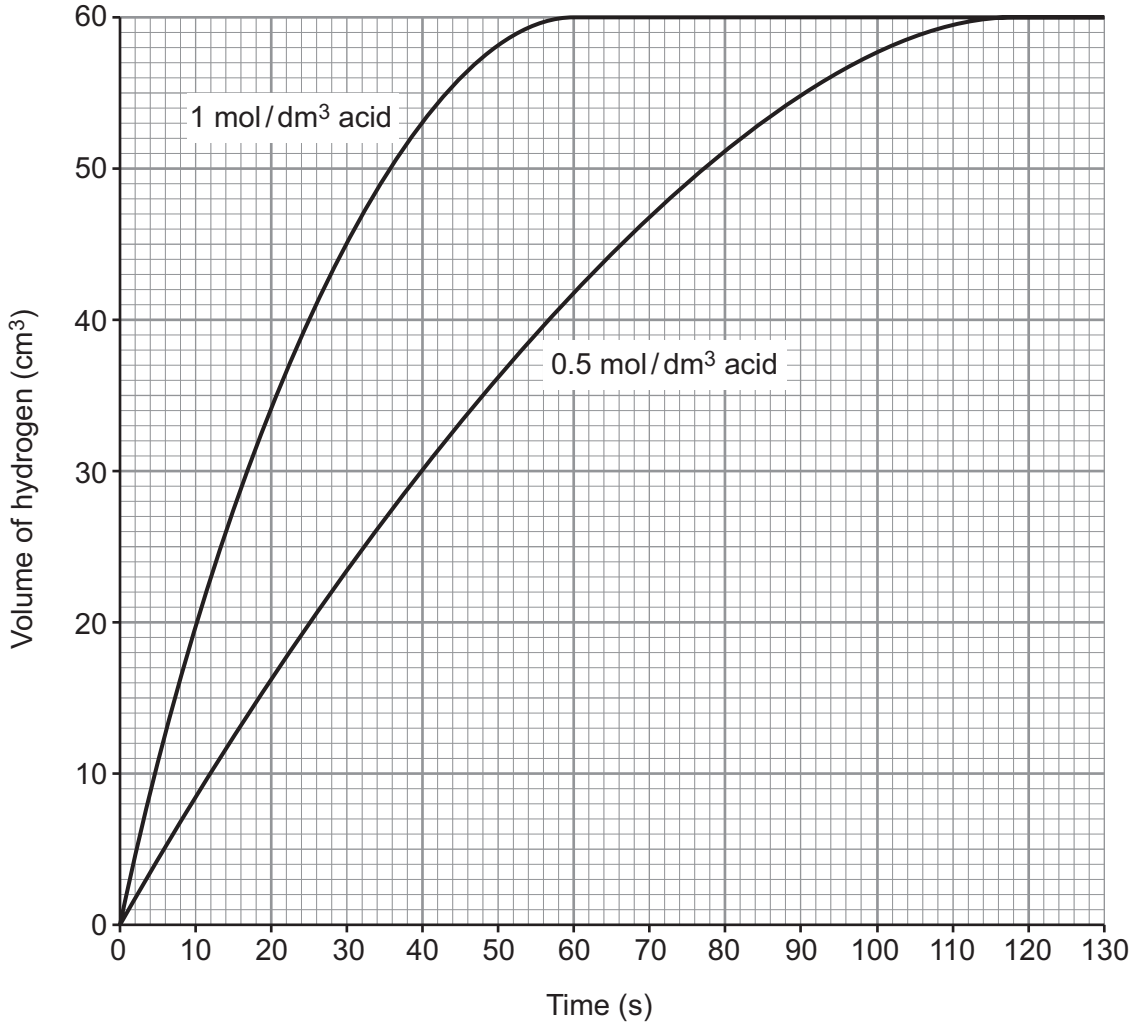


**Turn over.**

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**5.** The following graphs show the volume of hydrogen produced over time during the reaction between magnesium and hydrochloric acid of two different concentrations. All other factors were kept constant.




*(a)* State what conclusion can be drawn from the graph and use your understanding of particle theory to explain that conclusion. [4]

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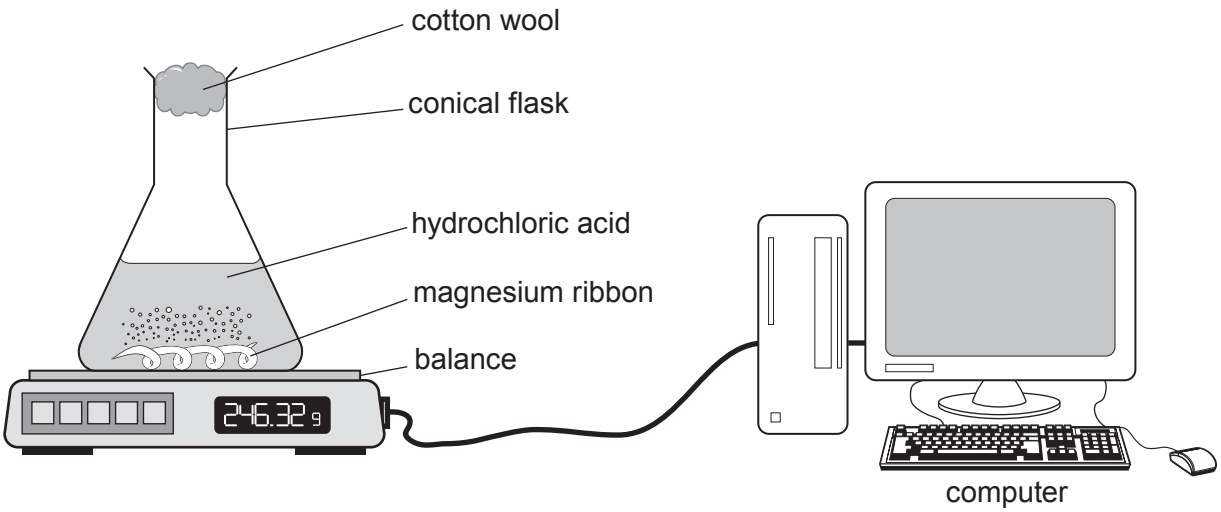
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*(b)* Another method of studying this reaction is to use a balance to record the change in mass over time. The data can be recorded directly on a computer.




(i) State why a two decimal place balance is required for this method to work. [1]

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(ii) Use the relative atomic mass values below to explain why recording the change in mass is better suited to an experiment that releases carbon dioxide, $CO_2$, than one that releases hydrogen, $H_2$. [3]

$A_r(H) = 1$ $A_r(C) = 12$ $A_r(O) = 16$

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**6.** *(a)* Alkenes such as ethene are reactive hydrocarbons. They can be recognised by their reaction with bromine, $Br_2$.

(i) State what you would expect to see when bromine water is added to an alkene. Give the reason this happens. [2]

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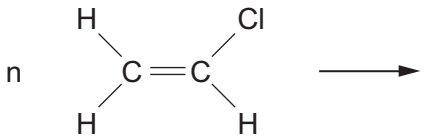
.....

(ii) Complete the equation by giving the structure of the product formed. [1]




*(b)* Monomers can undergo polymerisation to form polymers. One example is PVC.

(i) Complete the equation for the formation of PVC. [1]




(ii) PVC is a thermoplastic. Describe the effect of heat on thermoplastics and explain in terms of their **structure** why they behave in this way. [3]

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**7.** *(a)* An experiment was carried out to determine the trend in reactivity of the halogens. The following table shows the results obtained when solutions of halogens were added to different halide solutions.

| | | Halide solution | | |
|---|---|---|---|---|
| | | potassium chloride | potassium bromide | potassium iodide |
| Halogen added | bromine | no reaction | no reaction | turns brown |
| | chlorine | no reaction | turns yellow orange | turns brown |
| | iodine | no reaction | no reaction | no reaction |

(i) Use the results in the table to give the order of reactivity of the halogens. Explain your answer. [3]

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(ii) Write the balanced **symbol** equation for the reaction that takes place between chlorine and potassium iodide. [3]

..... + ..... ⟶ ..... + .....

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*(b)* When silver nitrate solution is added to a solution of potassium bromide, a creamy precipitate of silver bromide is formed. The following reaction takes place.

$$AgNO_3(aq) + KBr(aq) \longrightarrow AgBr(s) + KNO_3(aq)$$

Calculate the mass of silver nitrate needed to form 47 g of silver bromide. [3]

$A_r(Ag) = 108$ $A_r(N) = 14$ $A_r(O) = 16$ $A_r(Br) = 80$

Mass of silver nitrate = ..... g

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**Turn over.**

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**8.** Using water and carbon dioxide as examples, explain what is meant by covalent bonding and why some molecules contain double bonds. You may use diagrams as part of your answer. [6 QWC]

6

**END OF PAPER**

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## FORMULAE FOR SOME COMMON IONS

| POSITIVE IONS | | NEGATIVE IONS | |
|---|---|---|---|
| **Name** | **Formula** | **Name** | **Formula** |
| Aluminium | $Al^{3+}$ | Bromide | $Br^{-}$ |
| Ammonium | $NH_4^{+}$ | Carbonate | $CO_3^{2-}$ |
| Barium | $Ba^{2+}$ | Chloride | $Cl^{-}$ |
| Calcium | $Ca^{2+}$ | Fluoride | $F^{-}$ |
| Copper(II) | $Cu^{2+}$ | Hydroxide | $OH^{-}$ |
| Hydrogen | $H^{+}$ | Iodide | $I^{-}$ |
| Iron(II) | $Fe^{2+}$ | Nitrate | $NO_3^{-}$ |
| Iron(III) | $Fe^{3+}$ | Oxide | $O^{2-}$ |
| Lithium | $Li^{+}$ | Sulfate | $SO_4^{2-}$ |
| Magnesium | $Mg^{2+}$ | | |
| Nickel | $Ni^{2+}$ | | |
| Potassium | $K^{+}$ | | |
| Silver | $Ag^{+}$ | | |
| Sodium | $Na^{+}$ | | |
| Zinc | $Zn^{2+}$ | | |

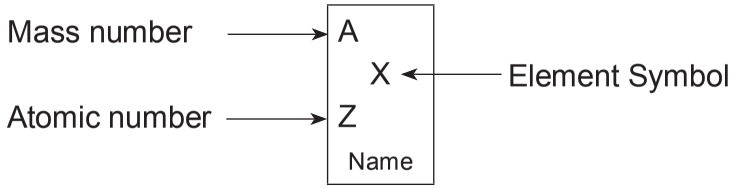
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# PERIODIC TABLE OF ELEMENTS

| 1 | 2 | | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | $^{1}_{1}$H Hydrogen | | | | | | | | | $^{4}_{2}$He Helium |
| $^{7}_{3}$Li Lithium | $^{9}_{4}$Be Beryllium | | | | | | | | | | | $^{11}_{5}$B Boron | $^{12}_{6}$C Carbon | $^{14}_{7}$N Nitrogen | $^{16}_{8}$O Oxygen | $^{19}_{9}$F Fluorine | $^{20}_{10}$Ne Neon |
| $^{23}_{11}$Na Sodium | $^{24}_{12}$Mg Magnesium | | | | | | | | | | | $^{27}_{13}$Al Aluminium | $^{28}_{14}$Si Silicon | $^{31}_{15}$P Phosphorus | $^{32}_{16}$S Sulfur | $^{35}_{17}$Cl Chlorine | $^{40}_{18}$Ar Argon |
| $^{39}_{19}$K Potassium | $^{40}_{20}$Ca Calcium | $^{45}_{21}$Sc Scandium | $^{48}_{22}$Ti Titanium | $^{51}_{23}$V Vanadium | $^{52}_{24}$Cr Chromium | $^{55}_{25}$Mn Manganese | $^{56}_{26}$Fe Iron | $^{59}_{27}$Co Cobalt | $^{59}_{28}$Ni Nickel | $^{64}_{29}$Cu Copper | $^{65}_{30}$Zn Zinc | $^{70}_{31}$Ga Gallium | $^{73}_{32}$Ge Germanium | $^{75}_{33}$As Arsenic | $^{79}_{34}$Se Selenium | $^{80}_{35}$Br Bromine | $^{84}_{36}$Kr Krypton |
| $^{86}_{37}$Rb Rubidium | $^{88}_{38}$Sr Strontium | $^{89}_{39}$Y Yttrium | $^{91}_{40}$Zr Zirconium | $^{93}_{41}$Nb Niobium | $^{96}_{42}$Mo Molybdenum | $^{99}_{43}$Tc Technetium | $^{101}_{44}$Ru Ruthenium | $^{103}_{45}$Rh Rhodium | $^{106}_{46}$Pd Palladium | $^{108}_{47}$Ag Silver | $^{112}_{48}$Cd Cadmium | $^{115}_{49}$In Indium | $^{119}_{50}$Sn Tin | $^{122}_{51}$Sb Antimony | $^{128}_{52}$Te Tellurium | $^{127}_{53}$I Iodine | $^{131}_{54}$Xe Xenon |
| $^{133}_{55}$Cs Caesium | $^{137}_{56}$Ba Barium | $^{139}_{57}$La Lanthanum | $^{179}_{72}$Hf Hafnium | $^{181}_{73}$Ta Tantalum | $^{184}_{74}$W Tungsten | $^{186}_{75}$Re Rhenium | $^{190}_{76}$Os Osmium | $^{192}_{77}$Ir Iridium | $^{195}_{78}$Pt Platinum | $^{197}_{79}$Au Gold | $^{201}_{80}$Hg Mercury | $^{204}_{81}$Tl Thallium | $^{207}_{82}$Pb Lead | $^{209}_{83}$Bi Bismuth | $^{210}_{84}$Po Polonium | $^{210}_{85}$At Astatine | $^{222}_{86}$Rn Radon |
| $^{223}_{87}$Fr Francium | $^{226}_{88}$Ra Radium | $^{227}_{89}$Ac Actinium | | | | | | | | | | | | | | | |

Key:




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(4472-02)

# GCSE MARKING SCHEME

## SUMMER 2016

## SCIENCE - CHEMISTRY C2
## 4472/01/02

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## INTRODUCTION

This marking scheme was used by WJEC for the 2016 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

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GCSE Science - Chemistry 2

Summer 2016

Mark Scheme

| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 1 | | *(a)* | | | 2 | lithium and oxygen → lithium oxide<br>sodium and chlorine → sodium chloride<br>iron and fluorine → iron fluoride<br>lithium and water → lithium hydroxide and hydrogen<br><br>all 4 for (2)<br>any 2/3 (1) | | | |
| | | *(b)* | | | 2 | lithium red (1)<br><br>sodium yellow (1) | orange | | |
| | | *(c)* | | | 2 | 30 (2)<br><br>if incorrect allow (1) for recognising the presence of two Li atoms and one O atom | | | |



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| Question Number | | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | | | | | | | | |
| 2 | | *(a)* | | | 1 | bubbles / powder disappears | | | |
| | | *(b)* | | | 1 | conical flask | | | |
| | | *(c)* | (i) | | 1 | **A** – has steepest curve / finishes first / gives same volume of gas in least time | fastest reaction / highest rate | | |
| | | | (ii) | | 2 | surface area (of solid) (1)<br><br>concentration (of acid) (1) | size of particles<br>catalyst | stirring<br><br>strength of acid | |
| | | *(d)* | (i) | | 2 | gas produced **escapes** from flask (1)<br><br>mass decreases (1) | | calcium carbonate gets smaller | |
| | | | (ii) | | 1 | continuous or more regular readings / automatically recorded / graph can be produced by computer / stores results | | more accurate / precise / reliable / fair / no human error | |



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| Question Number | | | | | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | | | | | |
| 3 | | *(a)* | | | 1 | **Y** | | | |
| | | *(b)* | | | 2 | solubilities of both increase (with temperature) / both same at 82 °C (1)<br><br>**X** has large increase and **Z** has small increase / **X** less soluble than **Z** below 82 °C / **X** more soluble than **Z** above 82 °C (1) | | both straight lines | |
| | | *(c)* | (i) | | 3 | all points correct (2)<br>[(1) for minimum four correct]<br><br>curve through points (1) | | | |
| | | | (ii) | | 1 | 20 | value based on incorrectly drawn graph | | |



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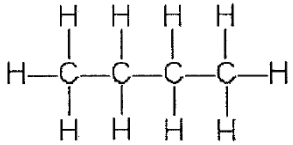
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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 4 | | *(a)* | | | 2 | removes (small) insoluble particles (2)<br><br>removes (small) particles (1) | | dirt / mud / bits / solids / molecules | sticks / stones |
| | | *(b)* | | | 2 | chlorine is added / chlorination (1)<br><br>kills bacteria / germs (1) | <br><br>removes bacteria | add disinfectant | |
| | | *(c)* | | | 1 | to conserve / save water (during drought conditions) | | doesn't rain much to prevent waste | |
| | | *(d)* | | | 2 | boil (1)<br><br>condense vapour (to give pure water for drinking) (1) | evaporate | | |



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| Question Number | | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | | | | | | | | |
| 5 | | *(a)* | | | 1 | ethane and ethene (both needed) | | $C_2H_6$ and $C_2H_4$ | |
| | | *(b)* | | | 2 | both are hydrocarbons / both contain carbon and hydrogen (atoms only) (1)<br><br>double bond (between carbon atoms) in alkenes / alkenes are unsaturated (1) | alkanes have single bonds **only** | covalent bonding | |
| | | *(c)* | | | 1 |  | methylpropane structure | | |



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| Question Number | | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | | | | | | | | |
| 6 | | *(a)* | | | 1 | strong bonds (between carbon atoms) | | many bonds | |
| | | *(b)* | | | 1 | graphite - due to **electrons moving** freely (between layers) | electrons delocalised | | |
| | | *(c)* | | | 2 | layers held weakly (1)<br><br>layers can move over each other (to leave mark on paper) (1) | <br><br>layers can rub off | | |



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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 7 | 1 | *(a)* | | | 2 | **D** and **E** (1)<br><br>both contain 2 shells (occupied by electrons) (1) | | | |
| | | *(b)* | | | 1 | **B** because it has a total of 15 **electrons** | 2,8,5 | 15 protons | |
| | | *(c)* | | | 3 | any three for (1) each<br>• contains 13 protons<br>• contains 13 electrons<br>• contains 14 neutrons<br>• electronic configuration is 2,8,3 / has 3 electron shells / has 3 outer shell electrons | | atomic number<br>mass number | |



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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 8 | 2 | *(a)* | | | 2 | NaBr (1)<br><br>correctly balanced (1)<br>$2Na + Br_2 \rightarrow 2NaBr$ | $Na^+Br^-$ | | |
| | | *(b)* | | | 3 | prepare a solution of both solids (1)<br>(add silver nitrate solution to both –)<br>sodium chloride would give a white **precipitate** (1)<br>sodium iodide would give a yellow **precipitate** (1) | award (1) for both colours if no mention of precipitate | | |
| | | *(c)* | (i) | | 1 | correctly balanced<br>$2Al + 3Cl_2 \rightarrow 2AlCl_3$ | | | |
| | | | (ii) | | 3 | $M_r(AlCl_3) = 133.5$ or $A_r(Cl) \times 3 = 106.5$ (1)<br><br>$\frac{106.5}{133.5} \times 100$<br><br>79.8% - accept any value from 79.7 - 79.8 (1) | 80% | | 79% |
| | | *(d)* | (i) | | 1 | 75% | | | |
| | | | (ii) | | 2 | any two for (1) each<br>• reactants are impure<br>• process incomplete<br>• loss of products | | | incorrect measurements |



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| Question Number | | Sub-section | | | Mark | Answer |
|---|---|---|---|---|---|---|
| FT | HT | | | | | |
| 9 | 3 | | | | 6 | **Indicative content:** Properties – both change **colour** reversibly according to change in conditions photochromic changes in response to **light** whereas thermochromic changes in response to **heat**<br>Uses – photochromic – sunglasses lenses / windows<br>thermochromic – thermometers / childrens feeding bowls / mugs etc<br><br>**5-6 marks:** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3-4 marks:** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>**1-2 marks:** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks:** The candidate does not make any attempt or give a relevant answer worthy of credit. |



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| Question Number | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 4 | *(a)* | | | 2 | more oxygen dissolves at lower temperature (1)<br><br>more dissolved oxygen will sustain / support more fish (1) | | | |
| | | *(b)* | | | 2 | 9 (mg per $dm^3$) – read from graph (1)<br><br>0.9 g (1)<br><br>award (2) for correct answer only | | | |
| | | *(c)* | | | 2 | 0.014 g oxygen in 1 $dm^3$ (1)<br><br>$\frac{3.3}{0.014}$ = 235 (1)<br><br>accept any sensible value based on calculation | | | |



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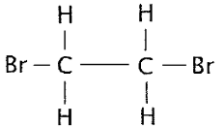
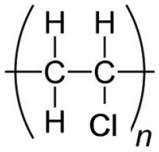
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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 5 | *(a)* | | | 4 | the higher the concentration the faster the reaction / higher the rate (1)<br><br>more particles in **given volume** when concentration is higher (1)<br><br>more successful collisions **per second** / more chance of successful collisions (1)<br><br>same argument using 'double' the rate and 'twice' the number of particles etc. (1) | | stronger than acid | |
| | | *(b)* | (i) | | 1 | mass being lost is very small / would not register on a one decimal place balance | | more accurate | |
| | | | (ii) | | 3 | both $M_r$ values $H_2$ = 2 and $CO_2$ = 44 (1)<br><br>$CO_2$ is a heavier gas (1)<br><br>loss in mass would be greater / smaller (percentage) error in measurements (1) | more accurate results | | |



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| Question Number | | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | | | | | | | | |
| | 6 | *(a)* | (i) | | 2 | bromine is decolourised / (orange) solution turns colourless (1)<br><br>addition reaction has taken place (1) | <br><br>double bond present / broken<br>alkenes are unsaturated | clear | |
| | | | (ii) | | 1 |  | | $C_2H_4B_{r2}$ | |
| | | *(b)* | (i) | | 1 |  | | | |
| | | | (ii) | | 3 | when heated thermoplastics melt / soften / can be reshaped (1)<br><br>no bonds between chains / weak forces between chains (1)<br><br>chains are able to slide over one another (1) | <br><br>no crosslinks | | <br><br>'layers' in place of chains |



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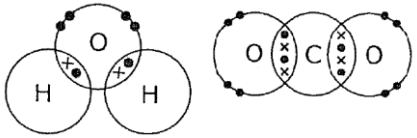
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| Question Number | | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | | | | | | | | |
| | 7 | *(a)* | (i) | | 3 | become more reactive up group or converse (1)<br><br>any 2 for (1) each<br>• chlorine will displace both bromine (from bromide) and iodine (from iodide) therefore most reactive<br>• iodine doesn't displace either of the others so least reactive<br>• bromide displaces iodine (from iodide) but not chlorine (from chloride) therefore more reactive than iodine but less reactive then chlorine | Cl > Br > I | | |
| | | | (ii) | | 3 | reactant formulae $Cl_2$ + KI (1)<br>product formulae $I_2$ + KCl (1)<br><br>balancing $Cl_2 + 2KI \rightarrow I_2 + 2KCl$ (1)<br><br>all formulae must be correct to award balancing mark | ionic equation | | |
| | | *(b)* | | | 3 | $M_r(AgBr) = 188$ and $M_r(AgNO_3) = 170$ (1)<br><br>$\frac{47}{188} = 0.25$ (1)<br><br>$0.25 \times 170 = 42.5$ (1)<br><br>award (3) for correct answer only<br>accept alternative method<br>ecf possible here | | | |



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| Question Number | | | | | | |
|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer |
| | 8 | | | | 6 | **Indicative content:**<br>Description of covalent bonds as sharing pairs of electrons with one electron coming from each atom involved in the bonding allowing all atoms to get full outer electron shells<br>Dot and cross diagrams showing bonding present in both water and carbon dioxide<br><br><br>Comparison of single bond as being one shared pair and covalent as two shared pairs.<br>Reference to need for double bonds in carbon dioxide in order to fill outer electron shells<br><br>**5–6 marks:** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3–4 marks:** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>**1–2 marks:** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks:** The candidate does not make any attempt or give a relevant answer worthy of credit. |



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| Surname | Centre Number | Candidate Number |
|---|---|---|
| Other Names | | 0 |

# GCSE

4472/02

W16-4472-02

## ADDITIONAL SCIENCE/CHEMISTRY

# CHEMISTRY 2
## HIGHER TIER

P.M. TUESDAY, 12 January 2016

1 hour

| For Examiner's use only | | |
|---|---|---|
| **Question** | **Maximum Mark** | **Mark Awarded** |
| **1.** | **7** | |
| **2.** | **6** | |
| **3.** | **5** | |
| **4.** | **6** | |
| **5.** | **6** | |
| **6.** | **6** | |
| **7.** | **10** | |
| **8.** | **7** | |
| **9.** | **7** | |
| **Total** | **60** | |

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### ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

### INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

### INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

Assessment will take into account the quality of written communication (QWC) in your answers to questions **4** and **9***(a)*.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

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*Answer* **all** *questions.*

**1.** *(a)* Complete the following table of information about atoms of some elements. [5]

| Symbol | Number of protons | Number of neutrons | Number of electrons |
|---|---|---|---|
| $^{19}_{9}F$ | 9 | 10 | 9 |
| $^{35}_{17}Cl$ | ..... | 18 | ..... |
| $^{16}_{8}O$ | 8 | ..... | 8 |
| ..... | 8 | 10 | ..... |

*(b)* **From the table** give the names of the two **different** elements found in the same period in the Periodic Table. [1]

..... and .....

*(c)* Using **×** to represent an electron, draw the electronic structure of fluorine. [1]

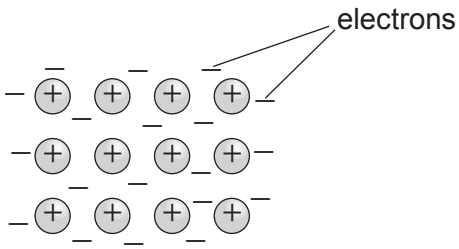
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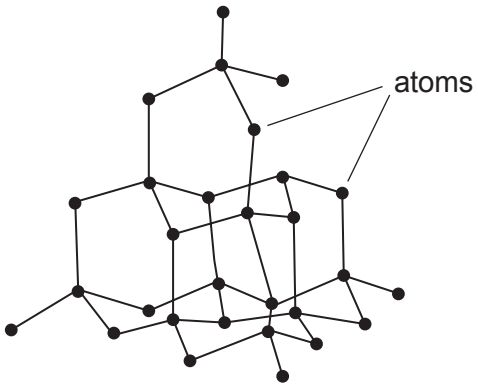
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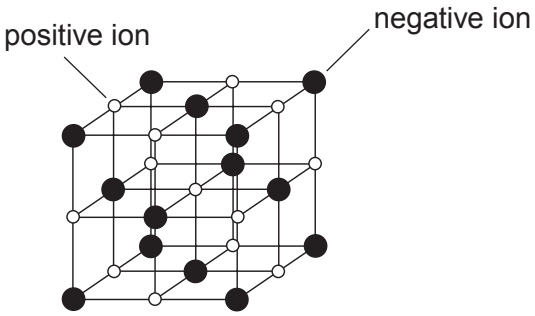
**2.** The following diagrams show the structures of some substances.



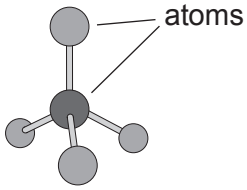

**A**




**B**




**C**




**D**

*(a)* Name the types of giant structure shown in **A** and **C**. [2]

**A** .....

**C** .....

*(b)* (i) State which substance, **A**, **B**, **C** or **D**, conducts electricity when solid. Give a reason for your answer. [2]

Letter .....

Reason .....

.....

(ii) State which substance, **A**, **B**, **C** or **D**, is a compound with a high melting point. Give a reason for your answer. [2]

Letter .....

Reason .....

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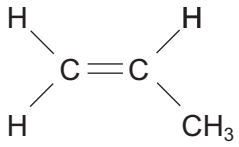
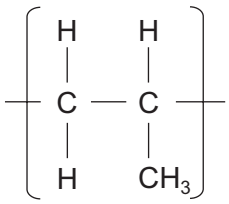
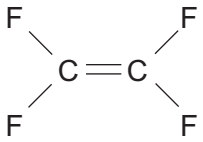
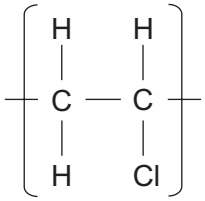
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**3.** *(a)* The table below shows some information about monomers and the polymers that can be made from them. [3]

Complete the table.

| Name of monomer | Structural formula of monomer | Name of polymer | Repeating unit for the polymer |
|---|---|---|---|
| propene |  | ..... |  |
| tetrafluoroethene |  | polytetrafluoroethene PTFE | ..... |
| vinylchloride | ..... | polyvinylchloride PVC |  |

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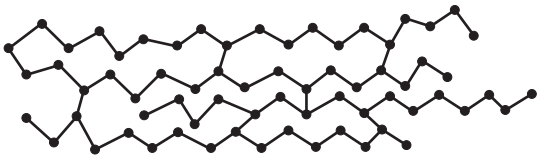


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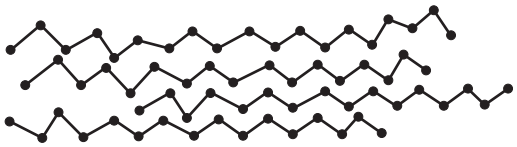
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*(b)* 'PEX' is a form of polythene used to make domestic hot water pipes.

The structures below show the polymer structures of PEX and polythene.



PEX



polythene

Explain, in terms of structure, why PEX is better for making domestic hot water pipes than polythene. [2]

.....

.....

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**4.** The diagram below shows the main stages in the treatment of public water supplies.




Describe what happens in each stage of the process. [6 QWC]

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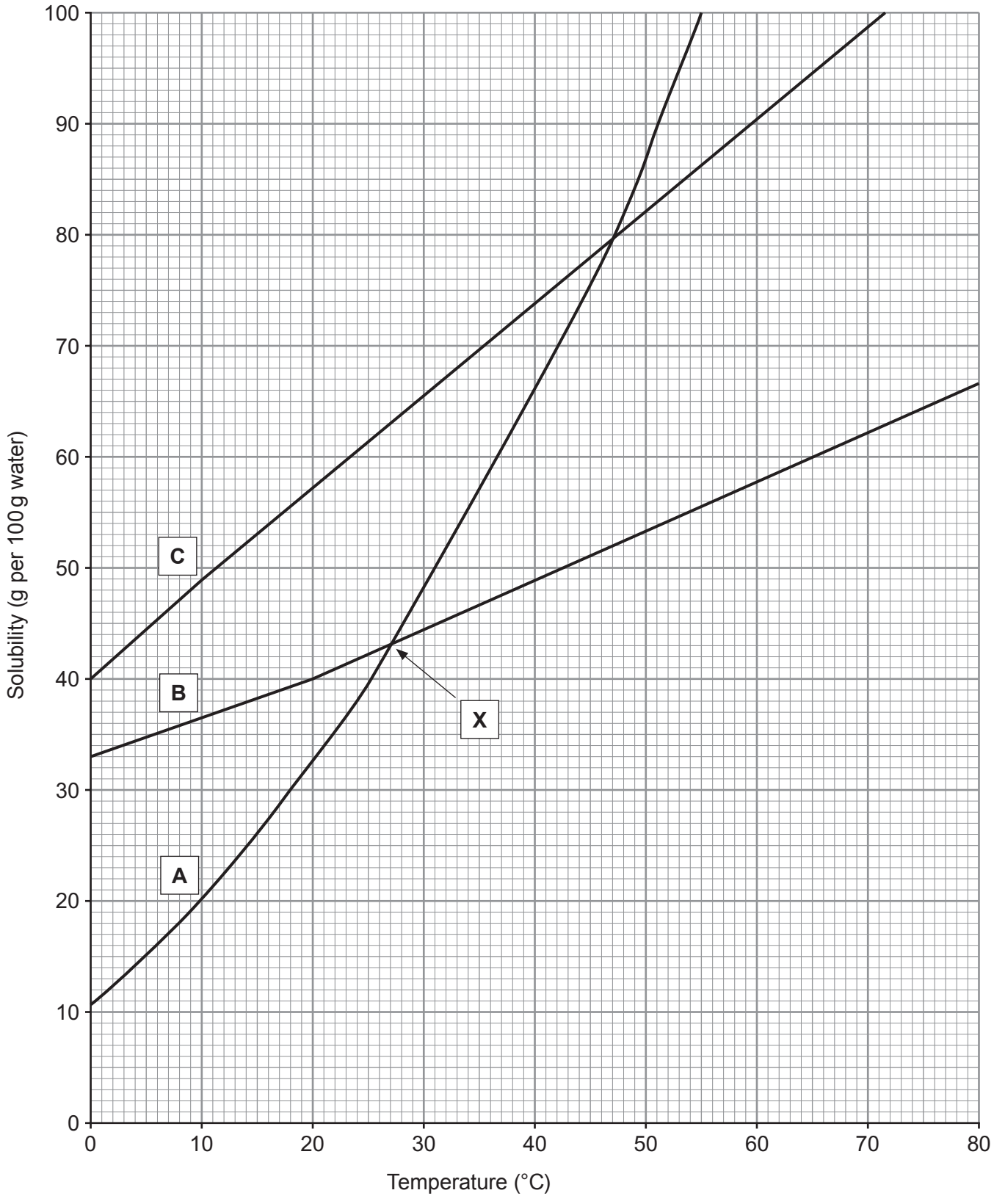
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**5.** *(a)* The graph below shows how the solubility of three substances, **A**, **B** and **C**, in water varies with temperature.




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(i) State, giving values, the information that can be obtained from the point labelled **X** on the graph. [2]

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(ii) Using the graph, calculate the mass of solid **C** that forms when a saturated solution in 100 g of water at 50 °C cools to 10 °C. Give the unit. [2]

Mass = .....

Unit .....



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**Turn over.**

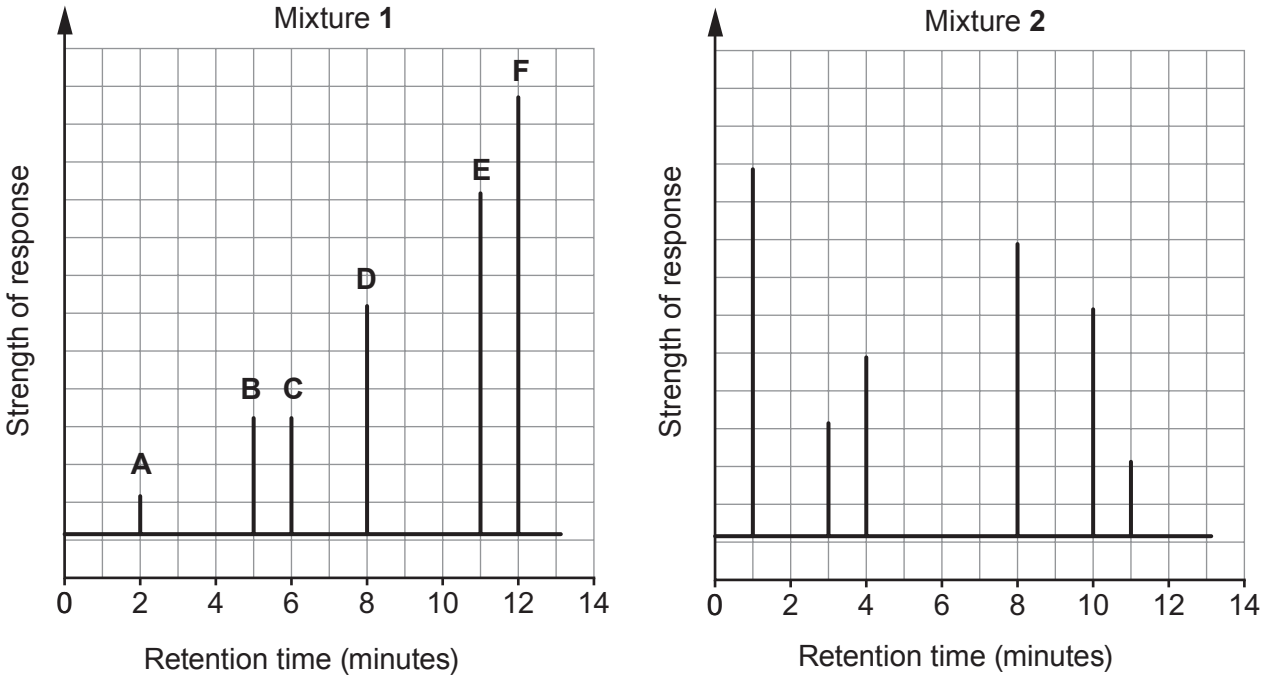
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*(b)* Chromatography is an important technique because it allows chemists to separate substances. Gas chromatography can be used to show:

- the number of compounds in a mixture - represented by the number of peaks
- how much of each compound is present - represented by the height of the peak
- the identity of each compound present - indicated by the position of the peak (retention time)

The diagrams below show the gas chromatograms of mixtures **1** and **2**, each containing several compounds. The compounds in mixture **1** are known and are labelled **A**-**F**.




Use the chromatograms to describe what the mixtures have in common. [2]

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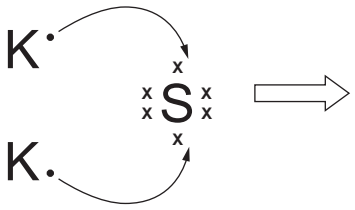


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**6.** *(a)* Potassium reacts with sulfur to form potassium sulfide.

(i) Complete the dot and cross diagram below by drawing the electronic structures of the ions formed. Include the charge on each ion. [2]



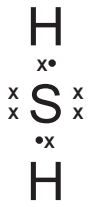

(ii) Explain why potassium atoms and sulfur atoms behave in this way during the reaction. [2]

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*(b)* The bonding in a hydrogen sulfide molecule is shown in the dot and cross diagram below.




Explain, in terms of electronic structure, the covalent bonding in the molecule. [2]

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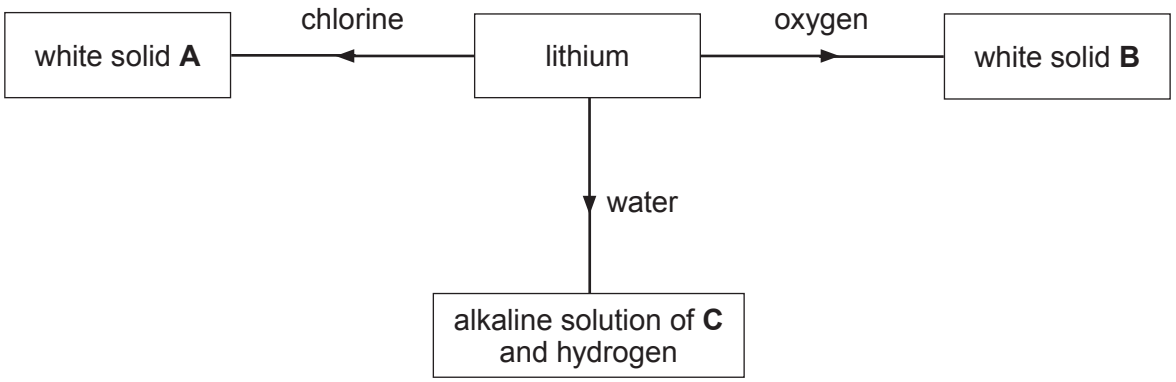


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**7.** *(a)* The flow diagram below shows some reactions of lithium.




Give the chemical names for substances **A**, **B** and **C**. [3]

**A** .....

**B** .....

**C** .....

*(b)* Cold iron wool burns rapidly in fluorine forming iron(III) fluoride.

Complete and balance the equation for this reaction. [2]

$\square$ Fe + $\square$ $F_2$ $\longrightarrow$ $\square$ .....

*(c)* Silver nitrate solution can be used to detect the presence of aqueous chloride ions.

The symbol equation below represents the reaction occurring between silver nitrate solution and calcium chloride solution.

$$2AgNO_3(aq) + CaCl_2(aq) \longrightarrow Ca(NO_3)_2(aq) + 2AgCl(s)$$

Write the **ionic** equation for the reaction. Include the state symbols. [2]

..... + ..... $\longrightarrow$ .....

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*(d)* **X**, **Y** and **Z** represent the halogens bromine, chlorine and iodine, but not necessarily in that order.

Each halogen was added separately to solutions of sodium chloride, sodium iodide and sodium bromide.

The table below shows the results obtained from the series of experiments.

| Halogen | Solution of sodium halide | | |
|---|---|---|---|
| | chloride | iodide | bromide |
| **X** | no reaction | solution turns brown | solution turns orange |
| **Y** | no reaction | no reaction | no reaction |
| **Z** | no reaction | solution turns brown | no reaction |

Use the information in the table to give the letter **X**, **Y** or **Z** which represents bromine. Explain your choice of letter. [3]

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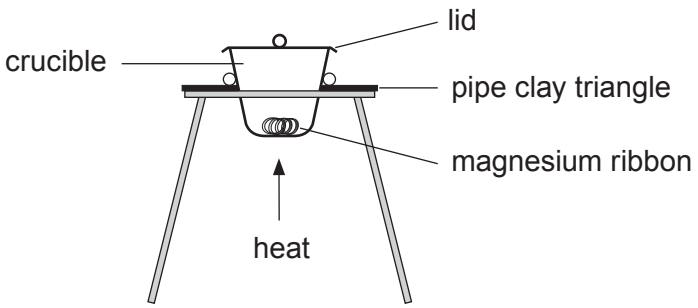
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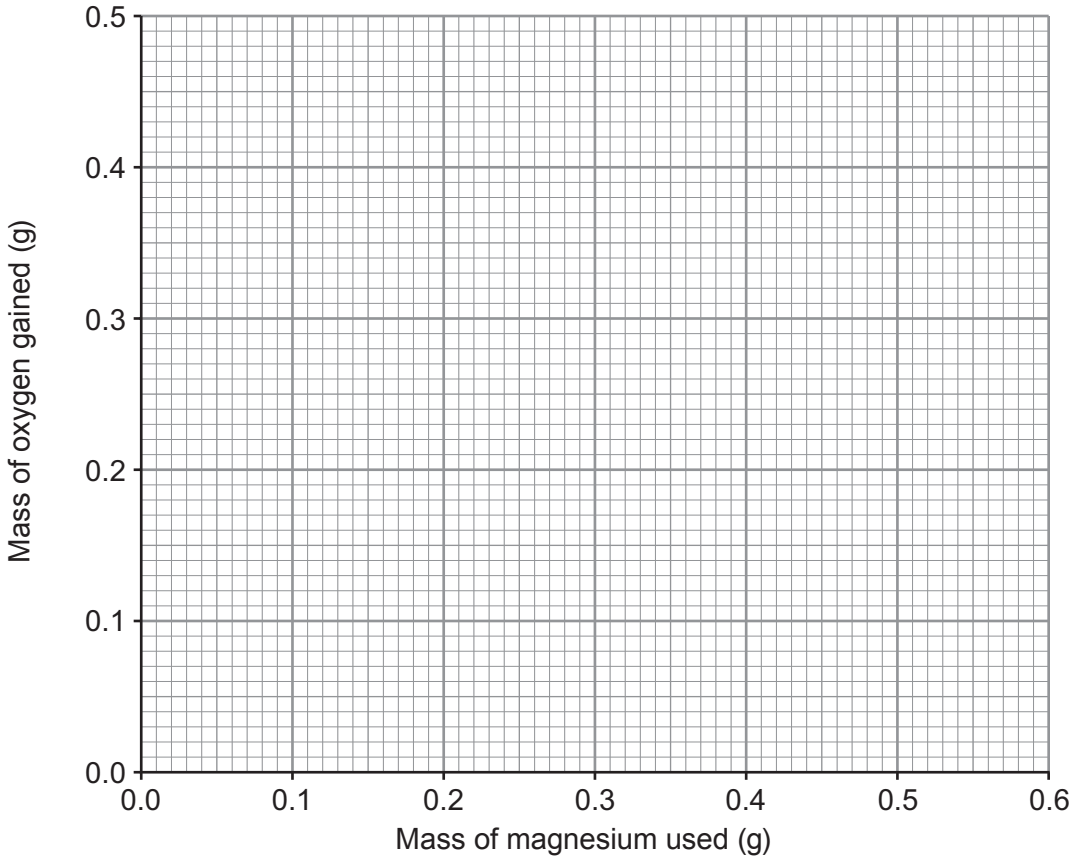
**8.** Four pupils were trying to show experimentally that the chemical formula of magnesium oxide is MgO. Each pupil was given a different known mass of magnesium ribbon. The magnesium ribbon was completely burned using the apparatus below. The mass of magnesium oxide formed was recorded and the mass of oxygen gained during each reaction was calculated.




The pupils' results are shown below.

| Pupil | Mass of magnesium used (g) | Mass of magnesium oxide (g) | Mass of oxygen gained (g) |
|---|---|---|---|
| 1 | 0.15 | 0.25 | 0.10 |
| 2 | 0.25 | 0.45 | 0.20 |
| 3 | 0.35 | 0.55 | 0.20 |
| 4 | 0.45 | 0.75 | 0.30 |

*(a)* On the grid plot the mass of magnesium used by each pupil against the mass of oxygen gained. Draw a suitable line starting at the origin (0,0). [3]




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*(b)* (i) Use your graph to predict the mass of oxygen needed to completely burn 0.6 g of magnesium. [1]

Mass of oxygen = ..... g

(ii) Using the masses of magnesium and oxygen from part (i), show that the simplest formula of magnesium oxide is MgO. [2]

$A_r$(O) = 16 $A_r$(Mg) = 24

*(c)* Suggest why a calculation based on the line of best fit is likely to give a better answer for the formula than using the results from one single experiment. [1]

.....

.....

7

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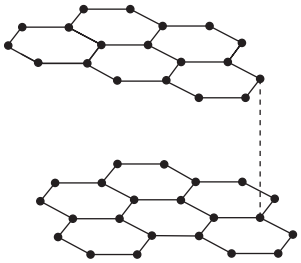


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**9.** *(a)* The diagram below shows the structure of graphite, a form of carbon.



Explain how the structure of graphite is related to its properties and uses. [6 QWC]

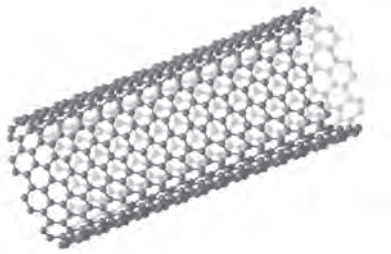
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*(b)* Carbon nanotubes are another form of carbon.



Give **one** property which carbon nanotubes and graphite have in common. [1]

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7

**END OF PAPER**

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## FORMULAE FOR SOME COMMON IONS

| POSITIVE IONS | | NEGATIVE IONS | |
|---|---|---|---|
| **Name** | **Formula** | **Name** | **Formula** |
| Aluminium | $Al^{3+}$ | Bromide | $Br^{-}$ |
| Ammonium | $NH_4^{+}$ | Carbonate | $CO_3^{2-}$ |
| Barium | $Ba^{2+}$ | Chloride | $Cl^{-}$ |
| Calcium | $Ca^{2+}$ | Fluoride | $F^{-}$ |
| Copper(II) | $Cu^{2+}$ | Hydroxide | $OH^{-}$ |
| Hydrogen | $H^{+}$ | Iodide | $I^{-}$ |
| Iron(II) | $Fe^{2+}$ | Nitrate | $NO_3^{-}$ |
| Iron(III) | $Fe^{3+}$ | Oxide | $O^{2-}$ |
| Lithium | $Li^{+}$ | Sulfate | $SO_4^{2-}$ |
| Magnesium | $Mg^{2+}$ | | |
| Nickel | $Ni^{2+}$ | | |
| Potassium | $K^{+}$ | | |
| Silver | $Ag^{+}$ | | |
| Sodium | $Na^{+}$ | | |
| Zinc | $Zn^{2+}$ | | |

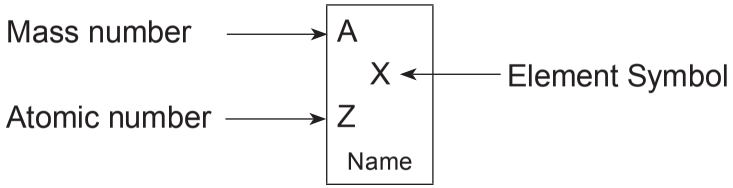
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# PERIODIC TABLE OF ELEMENTS

| 1 | 2 | Group | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | $^{1}_{1}$H Hydrogen | | | | | | | | $^{4}_{2}$He Helium |
| $^{7}_{3}$Li Lithium | $^{9}_{4}$Be Beryllium | | | | | | | | | | | $^{11}_{5}$B Boron | $^{12}_{6}$C Carbon | $^{14}_{7}$N Nitrogen | $^{16}_{8}$O Oxygen | $^{19}_{9}$F Fluorine | $^{20}_{10}$Ne Neon |
| $^{23}_{11}$Na Sodium | $^{24}_{12}$Mg Magnesium | | | | | | | | | | | $^{27}_{13}$Al Aluminium | $^{28}_{14}$Si Silicon | $^{31}_{15}$P Phosphorus | $^{32}_{16}$S Sulfur | $^{35}_{17}$Cl Chlorine | $^{40}_{18}$Ar Argon |
| $^{39}_{19}$K Potassium | $^{40}_{20}$Ca Calcium | $^{45}_{21}$Sc Scandium | $^{48}_{22}$Ti Titanium | $^{51}_{23}$V Vanadium | $^{52}_{24}$Cr Chromium | $^{55}_{25}$Mn Manganese | $^{56}_{26}$Fe Iron | $^{59}_{27}$Co Cobalt | $^{59}_{28}$Ni Nickel | $^{64}_{29}$Cu Copper | $^{65}_{30}$Zn Zinc | $^{70}_{31}$Ga Gallium | $^{73}_{32}$Ge Germanium | $^{75}_{33}$As Arsenic | $^{79}_{34}$Se Selenium | $^{80}_{35}$Br Bromine | $^{84}_{36}$Kr Krypton |
| $^{86}_{37}$Rb Rubidium | $^{88}_{38}$Sr Strontium | $^{89}_{39}$Y Yttrium | $^{91}_{40}$Zr Zirconium | $^{93}_{41}$Nb Niobium | $^{96}_{42}$Mo Molybdenum | $^{99}_{43}$Tc Technetium | $^{101}_{44}$Ru Ruthenium | $^{103}_{45}$Rh Rhodium | $^{106}_{46}$Pd Palladium | $^{108}_{47}$Ag Silver | $^{112}_{48}$Cd Cadmium | $^{115}_{49}$In Indium | $^{119}_{50}$Sn Tin | $^{122}_{51}$Sb Antimony | $^{128}_{52}$Te Tellurium | $^{127}_{53}$I Iodine | $^{131}_{54}$Xe Xenon |
| $^{133}_{55}$Cs Caesium | $^{137}_{56}$Ba Barium | $^{139}_{57}$La Lanthanum | $^{179}_{72}$Hf Hafnium | $^{181}_{73}$Ta Tantalum | $^{184}_{74}$W Tungsten | $^{186}_{75}$Re Rhenium | $^{190}_{76}$Os Osmium | $^{192}_{77}$Ir Iridium | $^{195}_{78}$Pt Platinum | $^{197}_{79}$Au Gold | $^{201}_{80}$Hg Mercury | $^{204}_{81}$Tl Thallium | $^{207}_{82}$Pb Lead | $^{209}_{83}$Bi Bismuth | $^{210}_{84}$Po Polonium | $^{210}_{85}$At Astatine | $^{222}_{86}$Rn Radon |
| $^{223}_{87}$Fr Francium | $^{226}_{88}$Ra Radium | $^{227}_{89}$Ac Actinium | | | | | | | | | | | | | | | |

Key:




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(4472-02)

# GCSE MARKING SCHEME

**JANUARY 2016**

**SCIENCE – CHEMISTRY C2**
**4472/ 01/02**

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## INTRODUCTION

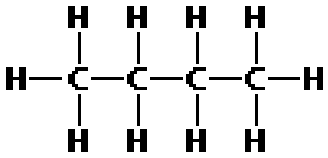
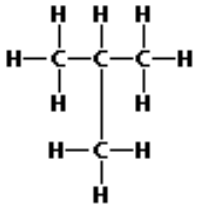
This marking scheme was used by WJEC for the January 2016 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 1 | | (a) | (i) | | 1 | **A** | | | |
| | | | (ii) | | 1 | **C** | | | |
| | | | (iii) | | 1 | **B** | | | |
| | | (b) | | | 1 |  |  | | |
| | | (c) | (i) | | 1 | boiling | | | |
| | | | (ii) | | 1 | condensation | | | |
| | | | (iii) | | 1 | fractions | fraction | | |
| | | | (iv) | | 1 | boiling point | | | |



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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 2 | | (a) | (i) | | 1 | protons and electrons – **both** needed | | | |
| | | | (ii) | | 1 | electron | | | |
| | | | (iii) | | 1 | 5 | | | |
| | | (b) | | | 2 | 84 (2)<br><br>If answer incorrect or missing award (1) for evidence of correct interpretation of formula e.g.<br>(1 x Na) + (1 x H) + (1 x C) + (3 x O)<br>or<br>23 + 1 + 12 + 3(16) | | | |



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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 3 | | (a) | (i) | | 3 | all points plotted correctly (2)<br>any **three** correct (1)<br><br>straight line of best fit – ruler used (1) | | | |
| | | | (ii) | | 1 | 91.5 ± 0.5 consequential marking | | | |
| | | | (iii) | | 1 | 49 ± 0.5 consequential marking | | | |
| | | (b) | | | 2 | water gets absorbed by the hydrogel (1)<br><br>hydrogel expands / puffs up / swells (1) | water goes into the hydrogel / disappears | it increases | |



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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 4 | | (a) | (i) | | 3 | **A** oil (1)<br>**B** water (1)<br>**C** chlorine (1) | liquid paraffin<br>$H_2O$<br>$Cl_2$ | | paraffin<br><br>chloride / $Cl^-$ |
| | | | (ii) | | 1 | yellow | | orange | |
| | | (b) | | | 1 | any of following for (1)<br>• use small pieces of sodium / excess water<br>• use tweezers / tongs<br>• wear goggles / face shield / use safety screen | | use screen / wear gloves | glass screen |
| | | (c) | | | 2 | correct formula for sodium oxide – $Na_2O$ (1)<br>*formula must be correct to award balancing mark*<br>balancing ...4... and ...2... (1) | $Na^+_2\ O^{2-}$ | | |



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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 5 | | (a) | | | 2 | dyes soluble in water (1)<br><br>dyes have different solubilities and therefore travel at different speeds (up the paper) / different distances in the same time (1)<br><br>**both** marks can be awarded for one statement e.g.<br>the more soluble the dye the faster it travels / the further it travels in a given time | | | |
| | | (b) | | | 2 | red (1)<br><br>working shown including values of 6 **and** 8 taken from chromatogram (1) | | | |



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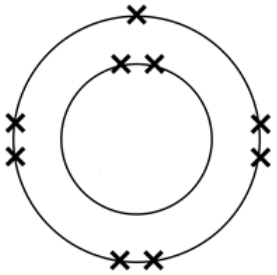
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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 6 | | (a) | | | 2 | Austria (1)<br><br>highest levels of $Ca^{2+}$ **and** highest levels of $Mg^{2+}$ (1) | <br><br>'calcium' for $Ca^{2+}$<br>'magnesium' for $Mg^{2+}$ | | |
| | | (b) | | | 3 | limescale / fur /<br>calcium carbonate / magnesium carbonate (1)<br><br>water pipe – causes blockages / stops water flowing / causes explosions (1)<br><br>heating elements – prevents heat transfer / wastes energy / less efficient (1) | $CaCO_3$ / $MgCO_3$<br><br><br><br>costs more to heat water | <br><br><br><br>costs more | scum / limestone |



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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 7 | 1 | (a) | | | 5 | 17 (1) 8 (1) $^{18}_{8}O$ (1) 17 (1) 8 (1) | | | |
| | | (b) | | | 1 | fluorine / F **and** oxygen / O **either** order | | $F_2$ and $O_2$ | |
| | | (c) | | | 1 |  | | 2,7 | |



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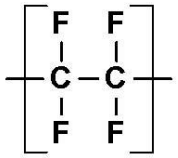
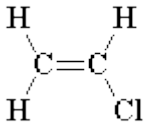
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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 8 | 2 | (a) | | | 2 | **A** metallic / metal (1)<br><br>**C** giant ionic / ionic (1) | | | |
| | | (b) | (i) | | 2 | **A** (1)<br><br>free electrons / mobile electrons / delocalised electrons / sea of electrons (1) | | electrons | |
| | | | (ii) | | 2 | **C** (1)<br><br>any of following for (1)<br><br>• contains more than one type of particle / ion<br>• has strong bonds between ions / strong ionic bonds<br><br>If **B** given, award (1) for strong bonds between **atoms** | | strong bonds | |



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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 9 | 3 | (a) | | | 3 | polypropene (1)<br> (1)<br> (1) | structure without brackets | ignore 'n' | |
| | | (b) | | | 2 | links / bonds between **chains** prevent them from sliding over each other (1)<br><br>any of following for (1)<br><br>• PEX heat resistant<br>• doesn't soften / lose shape / melt | | high melting point | layers |



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| Question Number | | | |
|---|---|---|---|
| FT | HT | Mark | Answer |
| 10 | 4 | 6 | **Indicative content**<br>Sedimentation: settling tank / settling process / large insoluble particles settle out<br>Filtration: filter bed / layers of different sized particles / sand bed / top algae layer removes some bacteria / removes small insoluble particles<br>Chlorination: kills bacteria<br><br>**5-6 marks**<br>The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3-4 marks**<br>The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>**1-2 marks**<br>The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks**<br>The candidate does not make any attempt or give a relevant answer worthy of credit. |



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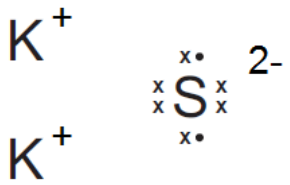
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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 5 | (a) | (i) | | 2 | substances **A** and **B** have the **same** solubility (1)<br><br>43 g / 100 g water at 27 °C – unit required for both (1) | | | |
| | | | (ii) | | 2 | 33 (1)<br><br>g / grams (1) | | | |
| | | (b) | | | 2 | both mixtures contain 6 / same number of compounds (1)<br><br>both contain compounds **D** and **E** (1) | both contain compounds with retention time 8 and 11 | lines / peaks | |



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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 6 | (a) | (i) | | 2 | <br>complete octet (1)<br><br>correct charge on **both** ions (1) | | | |
| | | | (ii) | | 2 | potassium (atoms) need to lose one electron and sulfur (atom) needs to gain two electrons (1)<br><br>both atoms need a full outer electron shell to become stable (1)<br><br>award (1) max if no direct reference to electrons in either statement | | | |
| | | (b) | | | 2 | shared pair of electrons (1)<br><br>each atom obtains a full outer electron shell (1)<br><br>award (1) max if no direct reference to electrons in either statement | | | |



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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 7 | (a) | | | 3 | **A** lithium chloride (1)<br><br>**B** lithium oxide (1)<br><br>**C** lithium hydroxide (1) | LiCl / $Li^+Cl^-$<br><br>$Li_2O$ / $Li^+_2O^{2-}$<br><br>LiOH / $Li^+OH^-$ | | |
| | | (b) | | | 2 | award (1) for correct formula $FeF_3$<br><br>if formula correct award (1) for correct balancing<br>$\mathbf{2}Fe + \mathbf{3}F_2 \rightarrow \mathbf{2}FeF_3$ | | | |
| | | (c) | | | 2 | $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$ (2)<br><br>award (1) for correct ions and product but missing/incorrect state symbols | equation with 2 of each species | | |
| | | (d) | | | 3 | **Z** is bromine (1)<br><br>doesn't react with $Cl^-$ / doesn't react with halide ions above them in Group 7 (1)<br><br>does react with $I^-$ / does react with halide ions below them in Group 7 (1) | | | |



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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 8 | (a) | | | 3 | all points plotted correctly (2)<br>any **three** correct (1)<br><br>line of best fit through (0,0) (1) | | | |
| | | (b) | (i) | | 1 | 0.4<br><br>dependent on line of best fit | | | |
| | | | (ii) | | 2 | mass of oxygen value from part (b)(i) to be used<br><br>both masses divided by appropriate $A_r$ e.g. 0.4/16 and 0.6/24 (1)<br><br>0.025 : 0.025<br>1 : 1 (1) | | | |
| | | (c) | | | 1 | reduces effect of errors in any one experiment / anomalous result<br><br>credit to be awarded for the idea of 'averaging' | | more accurate / reliable | |



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| Question Number | | | | |
|---|---|---|---|---|
| FT | HT | | Mark | Answer |
| | 9 | (a) | 6 | **Indicative content**<br>**Structure**<br>• giant molecule / layered structure<br>• strong bonds within layers<br>• weak bonds between layers<br>• layers can slide over one another<br>• delocalised electrons / free electrons / each atom forms three covalent bonds<br><br>**Relate structure to correct property and uses**<br>• free electrons ..... electrical conductor ..... electrodes<br>• weak bond between layers ..... soft & greasy ..... pencils / lubricants<br>• giant molecule / strong bond within layers ..... high melting point ..... brake shoes<br><br>**5-6 marks**<br>The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3-4 marks**<br>The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>**1-2 marks**<br>The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks**<br>The candidate does not make any attempt or give a relevant answer worthy of credit. |



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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 9 | (b) | | | 1 | (electrical) conductor / (thermal) conductor / high melting point / high boiling point | | | |



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| Surname | Centre Number | Candidate Number |
|---|---|---|
| Other Names | | 0 |

# GCSE

4472/02

S15-4472-02

## ADDITIONAL SCIENCE/CHEMISTRY

# CHEMISTRY 2
## HIGHER TIER

A.M. THURSDAY, 14 May 2015

1 hour

| For Examiner's use only | | |
|---|---|---|
| **Question** | **Maximum Mark** | **Mark Awarded** |
| **1.** | **7** | |
| **2.** | **6** | |
| **3.** | **5** | |
| **4.** | **6** | |
| **5.** | **6** | |
| **6.** | **7** | |
| **7.** | **12** | |
| **8.** | **5** | |
| **9.** | **6** | |
| **Total** | **60** | |

4472
020001

### ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

### INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

### INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

Assessment will take into account the quality of written communication (QWC) used in your answers to questions **4** and **9**.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

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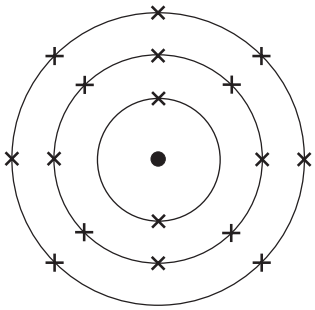


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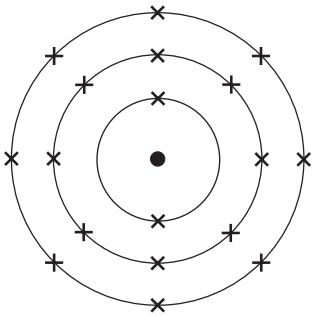
Examiner only

*Answer* **all** *questions.*

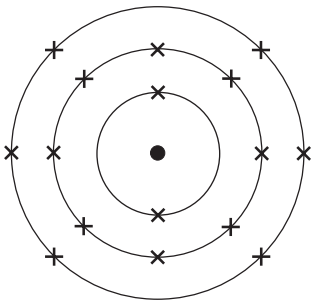
**1.** The following diagrams show the electronic structures of five elements, **A**–**E**.



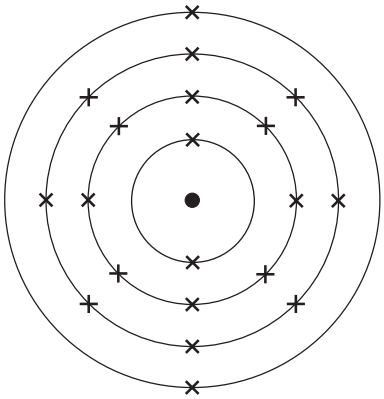
**A**



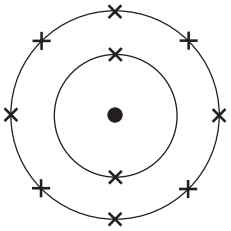
**B**



**C**



**D**



**E**

*(a)* (i) Give the letter of the element, **A**–**E**, that is in Period 2 of the Periodic Table. Give the reason for your choice in terms of electronic structure. [2]

*Element* .....

*Reason* .....

.....

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(ii) Give the letters, **A**–**E**, of **two** elements that are in Group 0 of the Periodic Table. Give the reason for your choice in terms of electronic structure. [2]

*Elements* ..... and .....

*Reason* .....

.....

(iii) Another element, **X**, is in the same group as element **E** but is one place above it. Draw a diagram of the electronic structure of element **X**. [1]

*(b)* Explain how the electronic structure of element **A** can be used to determine the number of protons in its nucleus. [2]

.....

.....

.....

7



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**Turn over.**

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**2.** *(a)* Lithium, sodium and potassium are elements in Group 1 of the Periodic Table.

The following table shows what a student recorded when these elements reacted with water. Two of the observations are **incorrect**.

| Element | Observations | pH of solution |
|---|---|---|
| lithium | bubbles slowly on the surface of the water | 6 |
| sodium | bubbles rapidly and melts into a ball | 12 |
| potassium | burns with an orange flame | 13 |

Identify the errors and give the correct observations below. [2]

*Error 1* .....

*Correction* .....

*Error 2* .....

*Correction* .....

*(b)* A student carries out tests to prove that a powder contains sodium ions and chloride ions. The following box gives some tests for ions and some expected observations.

| | | | |
|---|---|---|---|
| **white precipitate** | **yellow precipitate** | **no reaction** | **cream precipitate** |
| **flame test** | **add sodium hydroxide solution** | | **add silver nitrate solution** |
| **add universal indicator** | **yellow flame** | **red flame** | **green flame** |

Select the appropriate tests and results to complete the following table. [4]

| Ion | Test used | Observation expected |
|---|---|---|
| sodium | | |
| chloride | | |

6

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**3.** *(a)* Aluminium reacts with chlorine to form aluminium chloride. Complete and balance the symbol equation for the reaction taking place. [2]

$\square$ Al + $\square$ $Cl_2$ ⟶ $\square$ .....

*(b)* Aluminium oxide, $Al_2O_3$, is found in bauxite.

(i) Calculate the relative formula mass ($M_r$) of aluminium oxide, $Al_2O_3$. [2]

$A_r$ (Al) = 27 $A_r$ (O) = 16

$M_r$ ($Al_2O_3$) = .....

(ii) Using your answer from part (i) calculate the percentage of oxygen present in aluminium oxide, $Al_2O_3$. [1]

*Percentage oxygen present* = ..... %

5

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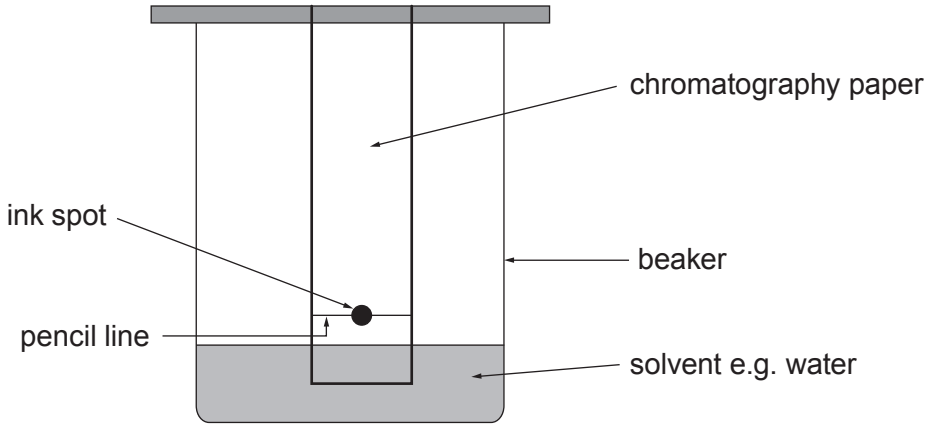


**Turn over.**

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**4.** Chromatography can be used to separate the pigments in ink.




Describe how chromatography can be used to determine whether two inks contain the same pigments. [6 QWC]

Your answer should include

- a description of how chromatography is carried out
- a description of what happens during the process
- how the results would show whether the two inks contain identical or different pigments.

*You may include a diagram in your answer.*

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Examiner only

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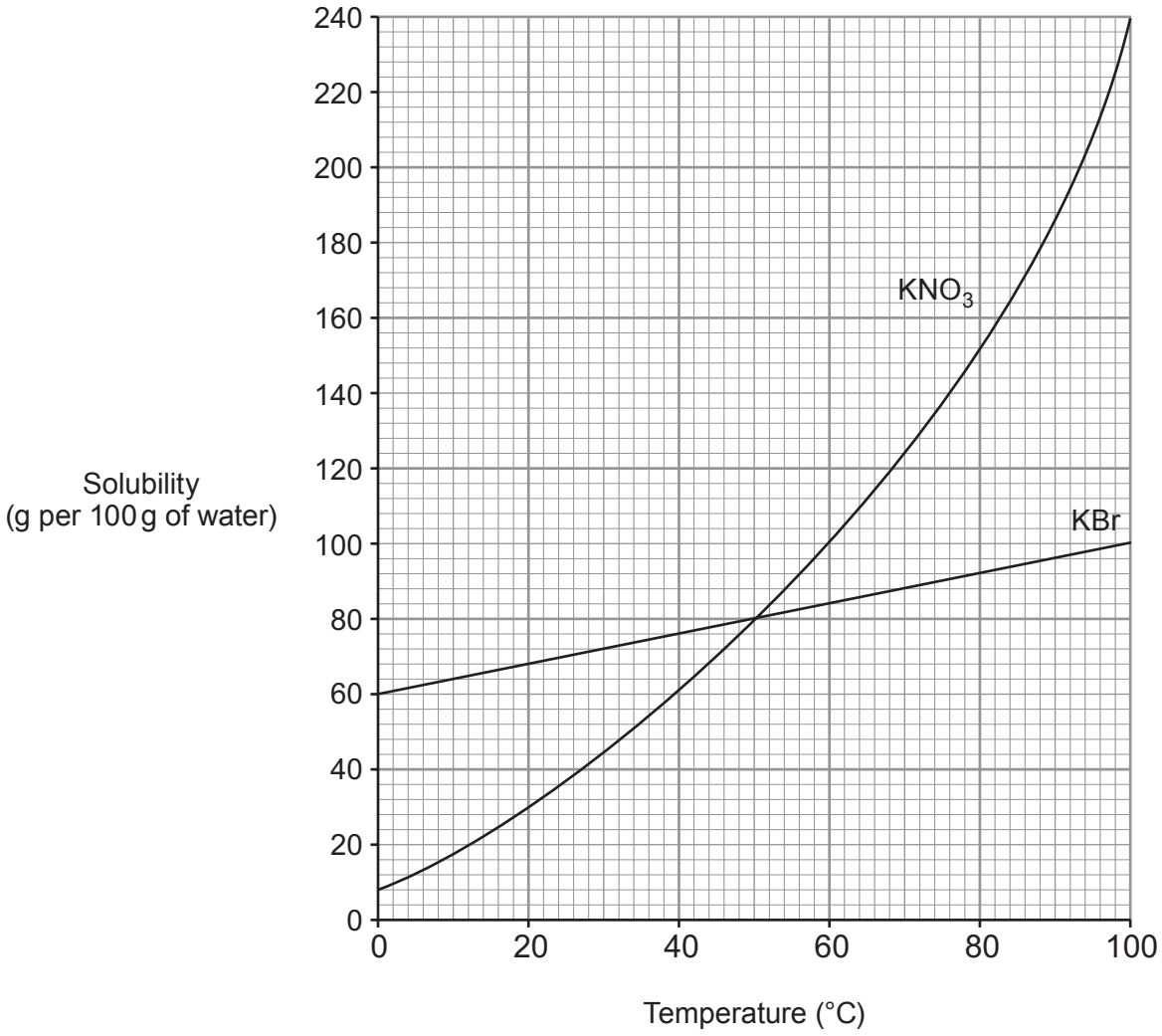
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**5.** The following graph shows the solubility curves of two substances.




*(a)* (i) Use the graph to find the solubility of potassium bromide, KBr, at 60 °C. [1]

*Solubility* = ..... g per 100 g of water

(ii) A student places 200 g of potassium bromide in 200 g of water at 60 °C and stirs until no more dissolves. Calculate the mass of solid that remains undissolved. [2]

*Mass of undissolved solid* = ..... g

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*(b)* Compare the solubilities of potassium bromide and potassium nitrate between 0 °C and 100 °C. [3]

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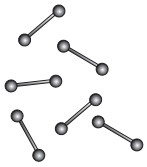


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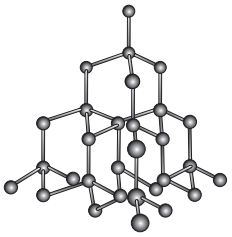
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**6.** Covalent bonds are formed by the sharing of pairs of electrons.

The following diagrams show the structures of hydrogen and diamond, a form of carbon.



hydrogen



diamond

*(a)* Explain why diamond has a higher melting point than hydrogen. [3]

.....

.....

.....

.....

*(b)* Graphite is another form of carbon that has a high melting point. Give **one** *other* property of graphite and explain this property in terms of structure and bonding. [2]

.....

.....

.....

*(c)* The bonding in oxygen, $O_2$, is also covalent. Draw a dot and cross diagram to show the bonding present in a molecule of oxygen. [2]

O = 2,6



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**7.** *(a)* (i) Give the balanced **symbol** equation for the reaction between ethene and bromine. [2]

..... + ..... ⟶ .....

(ii) Describe the observation made during this reaction. [1]

.....

.....

*(b)* Ethene can also undergo a reaction known as polymerisation to produce polyethene.

(i) By means of an equation, or otherwise, describe what happens during the polymerisation of ethene. [3]

.....

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(ii) Polymerisation requires the use of a catalyst. Explain the effect of catalysts on chemical reactions. [2]

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**Turn over.**

Examiner only

*(c)* The following table shows the observations made when two different plastics, **A** and **B**, are heated to a temperature of 150 °C.

| Plastic | Effect of heat on plastic |
|---|---|
| **A** | softens and can be reshaped |
| **B** | does not soften but turns black (chars) if over-heated |

Name the two **types** of plastic and explain the different observations in terms of the bonding present. [4]

*Type of plastic*

**A** .....

**B** .....

*Explanation of observations*

.....

.....

.....

12

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**8.** When sodium hydrogencarbonate is heated, it decomposes to form sodium carbonate, water and carbon dioxide gas.

$$2NaHCO_3 \longrightarrow Na_2CO_3 + H_2O + CO_2$$

*(a)* Calculate the mass of sodium carbonate that can be produced from 126 g of sodium hydrogencarbonate. [3]

$A_r$(Na) = 23; $A_r$(C) = 12; $A_r$(O) = 16; $A_r$(H) = 1

*Mass of sodium carbonate* = ..... g

*(b)* It was found that the actual mass obtained was only 70 g. Calculate the percentage yield for this reaction and give your answer to two decimal places. [2]

*Percentage yield* = ..... %

5



**Turn over.**

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Examiner only

**9.** Lithium chloride is a solid with a high melting point. It conducts electricity only when molten or in solution.

Describe the bonding present in lithium chloride and explain the properties given above.
[6 QWC]

Li = 2,1 Cl = 2,8,7

*You may include a diagram in your answer.*

**END OF PAPER**

6

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## FORMULAE FOR SOME COMMON IONS

| POSITIVE IONS | | NEGATIVE IONS | |
|---|---|---|---|
| **Name** | **Formula** | **Name** | **Formula** |
| Aluminium | $Al^{3+}$ | Bromide | $Br^{-}$ |
| Ammonium | $NH_4^{+}$ | Carbonate | $CO_3^{2-}$ |
| Barium | $Ba^{2+}$ | Chloride | $Cl^{-}$ |
| Calcium | $Ca^{2+}$ | Fluoride | $F^{-}$ |
| Copper(II) | $Cu^{2+}$ | Hydroxide | $OH^{-}$ |
| Hydrogen | $H^{+}$ | Iodide | $I^{-}$ |
| Iron(II) | $Fe^{2+}$ | Nitrate | $NO_3^{-}$ |
| Iron(III) | $Fe^{3+}$ | Oxide | $O^{2-}$ |
| Lithium | $Li^{+}$ | Sulfate | $SO_4^{2-}$ |
| Magnesium | $Mg^{2+}$ | | |
| Nickel | $Ni^{2+}$ | | |
| Potassium | $K^{+}$ | | |
| Silver | $Ag^{+}$ | | |
| Sodium | $Na^{+}$ | | |
| Zinc | $Zn^{2+}$ | | |

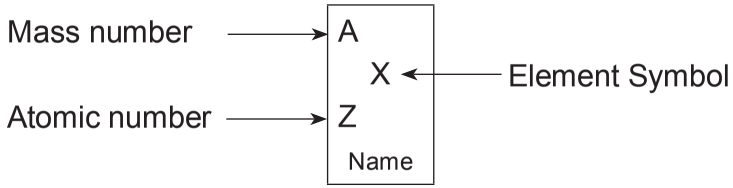
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# PERIODIC TABLE OF ELEMENTS

| 1 | 2 | | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | $^{1}_{1}$H Hydrogen | | | | | | | | | $^{4}_{2}$He Helium |
| $^{7}_{3}$Li Lithium | $^{9}_{4}$Be Beryllium | | | | | | | | | | | $^{11}_{5}$B Boron | $^{12}_{6}$C Carbon | $^{14}_{7}$N Nitrogen | $^{16}_{8}$O Oxygen | $^{19}_{9}$F Fluorine | $^{20}_{10}$Ne Neon |
| $^{23}_{11}$Na Sodium | $^{24}_{12}$Mg Magnesium | | | | | | | | | | | $^{27}_{13}$Al Aluminium | $^{28}_{14}$Si Silicon | $^{31}_{15}$P Phosphorus | $^{32}_{16}$S Sulfur | $^{35}_{17}$Cl Chlorine | $^{40}_{18}$Ar Argon |
| $^{39}_{19}$K Potassium | $^{40}_{20}$Ca Calcium | $^{45}_{21}$Sc Scandium | $^{48}_{22}$Ti Titanium | $^{51}_{23}$V Vanadium | $^{52}_{24}$Cr Chromium | $^{55}_{25}$Mn Manganese | $^{56}_{26}$Fe Iron | $^{59}_{27}$Co Cobalt | $^{59}_{28}$Ni Nickel | $^{64}_{29}$Cu Copper | $^{65}_{30}$Zn Zinc | $^{70}_{31}$Ga Gallium | $^{73}_{32}$Ge Germanium | $^{75}_{33}$As Arsenic | $^{79}_{34}$Se Selenium | $^{80}_{35}$Br Bromine | $^{84}_{36}$Kr Krypton |
| $^{86}_{37}$Rb Rubidium | $^{88}_{38}$Sr Strontium | $^{89}_{39}$Y Yttrium | $^{91}_{40}$Zr Zirconium | $^{93}_{41}$Nb Niobium | $^{96}_{42}$Mo Molybdenum | $^{99}_{43}$Tc Technetium | $^{101}_{44}$Ru Ruthenium | $^{103}_{45}$Rh Rhodium | $^{106}_{46}$Pd Palladium | $^{108}_{47}$Ag Silver | $^{112}_{48}$Cd Cadmium | $^{115}_{49}$In Indium | $^{119}_{50}$Sn Tin | $^{122}_{51}$Sb Antimony | $^{128}_{52}$Te Tellurium | $^{127}_{53}$I Iodine | $^{131}_{54}$Xe Xenon |
| $^{133}_{55}$Cs Caesium | $^{137}_{56}$Ba Barium | $^{139}_{57}$La Lanthanum | $^{179}_{72}$Hf Hafnium | $^{181}_{73}$Ta Tantalum | $^{184}_{74}$W Tungsten | $^{186}_{75}$Re Rhenium | $^{190}_{76}$Os Osmium | $^{192}_{77}$Ir Iridium | $^{195}_{78}$Pt Platinum | $^{197}_{79}$Au Gold | $^{201}_{80}$Hg Mercury | $^{204}_{81}$Tl Thallium | $^{207}_{82}$Pb Lead | $^{209}_{83}$Bi Bismuth | $^{210}_{84}$Po Polonium | $^{210}_{85}$At Astatine | $^{222}_{86}$Rn Radon |
| $^{223}_{87}$Fr Francium | $^{226}_{88}$Ra Radium | $^{227}_{89}$Ac Actinium | | | | | | | | | | | | | | | |

Key:




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(4472-02)

# GCSE MARKING SCHEME

## SCIENCE - CHEMISTRY

## SUMMER 2015

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## INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2015 examination in GCSE SCIENCE - CHEMISTRY. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.


| | Page |
|---|---|
| C1 | 1 |
| C2 | 17 |
| C3 | 32 |

| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 1 | | (a) | | | 2 | metallic → malleable and ductile / high melting point<br><br>simple molecular → gas or liquid at room temperature<br><br>giant covalent → high melting point<br><br>all 3 for (2)<br>any 1 for (1) | | | |
| | | (b) | | | 3 | thermochromic pigment (1)<br><br>shape memory polymer (1)<br><br>hydrogel (1) | | | |



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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 2 | | (a) | | | 1 | electron | | e | |
| | | (b) | | | 2 | proton (1)<br>neutron (1) | | p<br>n | |
| | | (c) | (i) | | 1 | 14 | | | |
| | | | (ii) | | 1 | 2,8,4 | | | |



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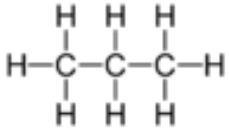
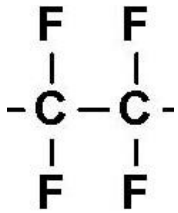
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| Question Number | | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | | | | | | | | |
| 3 | | (a) | (i) | | 1 | the higher the temperature the shorter the reaction time | higher temp, faster reaction | | |
| | | | (ii) | | 2 | surface area (1)<br><br>the greater the surface area the shorter the reaction time / faster reaction (1)<br><br>or<br><br>particle size (1)<br><br>the smaller the particle size the shorter the reaction time / faster reaction (1)<br><br>both marks could be credited for one statement e.g. smaller particles react faster | <br><br><br><br><br>‘form’ of calcium carbonate<br><br>‘powder takes less time than chips’ | | molecules become smaller |
| | | | (iii) | | 2 | volume of acid (1)<br>concentration of acid (1)<br>mass/weight of calcium carbonate (1)<br><br>max (2) | 'amount of' once only | pH<br>type of acid | |
| | | (b) | | | 2 | mass decreases (1)<br><br>gas / carbon dioxide lost from container / released (1) | gets lighter | <br><br>gas produced | <br><br>incorrect gas named |



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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 4 | | (a) | | | 3 |  (1)<br><br>$C_6H_{14}$ (1)<br><br>methane (1) | | | |
| | | (b) | (i) | | 1 | ethene | $C_2H_4$ | | polyethene |
| | | | (ii) | | 1 | monomers | | unsaturated | |
| | | (c) | (i) | | 1 | polytetrafluoroethene | PTFE | | |
| | | | (ii) | | 1 |  | | ignore brackets | |



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| Question Number | | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | | | | | | | | |
| 5 | | (a) | | | 3 | all points plotted correctly (2)<br>4 points plotted correctly (1)<br><br>smooth **curve** through points (1) | ½ square tolerance | | |
| | | (b) | | | 1 | the higher the temperature the higher the solubility | it increases with more heat | faster | higher solubility, higher temperature |
| | | (c) | | | 3 | crystals form (1)<br><br>any reference to crystals/solid/powder allows access to second mark even though first mark may not have been awarded<br><br>as solubility is lower at lower temperature (1)<br><br>both marks may be awarded based on a quantitative response | solid forms | | it solidifies / potassium chlorate forms |



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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 6 | | (a) | | | 2 | 3 molecules of $CO_2$ (1)<br><br>must get first mark to be awarded second<br><br>5 molecules of $O_2$ (1) | | | |
| | | (b) | (i) | | 2 | identification of all bonds made e.g. 4 x O–H (1)<br><br>1852 (1)<br><br>award (2) for correct answer only (cao) | <br><br><br><br>max (1) if subtraction done | | |
| | | | (ii) | | 2 | 485 kJ calculated (1)<br>allow error carried forward (ecf) from (i)<br><br>more energy given out than taken in (1) | | negative value | |



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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 7 | 1 | (a) | (i) | | 2 | **E** (1)<br><br>two shells occupied / containing electrons (1) | Ne | | |
| | | | (ii) | | 2 | **B** and **E** (1)<br><br>both have **full outer** shells of electrons (1) | Ar and Ne<br><br>8 electrons in outer shell | | |
| | | | (iii) | | 1 |  | 2 | | |
| | | (b) | | | 2 | electronic structure is 2,8,7 therefore 17 electrons / atomic number is 17 (1)<br><br>number of electrons is equal to number of protons (1)<br><br>both marks may be credited for one statement e.g. **total** number of electrons is equal to number of protons / contains 17 electrons therefore nucleus contains 17 protons (2) | | any reference to adding number of electrons in each shell | |



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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 8 | 2 | (a) | | | 2 | pH6 – should be pH 11-12 (or alkaline) (1)<br><br>burns with an orange flame – should be lilac flame (1) | 8-14 / above 7<br><br>lithium with implication that reaction should be more rapid (but less rapid than reaction of sodium) | | 7 or above |
| | | (b) | | | 4 | flame test (1) yellow flame (1)<br><br>(add) silver nitrate (solution) (1)<br>white precipitate (1)<br><br>must have correct test for observation mark to be awarded | orange flame | | |



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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 9 | 3 | (a) | | | 2 | $AlCl_3$ (1)<br>formula must be correct to get balancing mark<br><br>2,3,2 (1) | | | |
| | | (b) | (i) | | 2 | 102 (2)<br><br>if incorrect allow (1) for (27 x 2) + (16 x 3)<br><br>no ecf within part (i) | | | |
| | | | (ii) | | 1 | 47<br><br>ecf possible from part (i) | 47.1 | | |



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| Question Number | | | |
|---|---|---|---|
| FT | HT | Mark | Answer |
| 10 | 4 | 6 | **Indicative content**:<br>how it is carried out – spot of each ink on pencil line and dip end of paper in water, leave for water to rise up paper<br>what happens – water dissolves ink and carries the components different distances according to their solubilities, appear as spots/streaks on paper / as chromatogram<br>results – if inks contain the same pigments, the pattern of spots would be identical; different pattern if inks contain different pigments<br><br>**5-6 marks:** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3-4 marks:** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>**1-2 marks:** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks:** The candidate does not make any attempt or give a relevant answer worthy of credit. |



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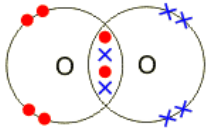
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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 5 | (a) | (i) | | 1 | 84 – no tolerance | | | |
| | | | (ii) | | 2 | 32 (2)<br>ecf possible from part (i)<br><br>if incorrect award (1) for<br>16<br>or<br>200 – 168 | | | |
| | | (b) | | | 3 | both increase with temperature (1)**R**<br>**R** - must have this for full marks<br><br>any 2 of the following for (1) each<br><br>$KNO_3$ non-linear increase/curve **and** KBr linear increase/straight line (1)<br><br>solubilities the same at 50°C (1)<br><br>below 50°C solubility of $KNO_3$ is lower than KBr **or** above 50°C solubility of $KNO_3$ is higher than KBr (1)<br><br>solubility of $KNO_3$ increases more than solubility of KBr (1) | | | |



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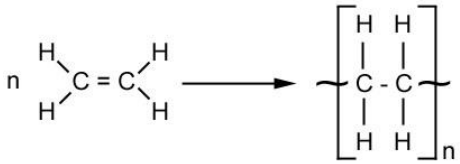
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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 6 | (a) | | | 3 | many strong bonds in all directions in diamond (1)<br><br>lots of energy needed to separate atoms / break bonds (1)<br><br>weak bonds **between molecules** therefore less energy needed to separate them (1) | hydrogen is simple molecular but diamond is giant covalent for (1) if no other credit awarded | | |
| | | (b) | | | 2 | thermal/electrical conductivity (1)<br>free moving / delocalised electrons between layers (1)<br><br>or<br><br>slippery / soft (1)<br>layers able to move over each other / weak bonds / forces between layers (1)<br><br>must have property for explanation mark to be awarded | | | brittle |
| | | (c) | | | 2 | two shared pairs of electrons (1)<br>outer shells of both atoms complete (1)<br><br><br><br><br>must have double bond to be awarded second mark | | | |



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| Question Number | | | | | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | | | | | |
| | 7 | (a) | (i) | | 2 | $C_2H_4 + Br_2$ (1)<br><br>$C_2H_4Br_2$(1) | | | |
| | | | (ii) | | 1 | orange solution turns colourless | | | ethene goes colourless |
| | | (b) | (i) | | 3 | <br>(3) for correct equation<br><br>otherwise<br>double bond breaks in ethene (1)<br>large number of molecules join together (1)<br>to form a long chain polymer (1) | | | |
| | | | (ii) | | 2 | speeds up the rate of the reaction (1)<br><br>reduces energy required (for collision to be successful) (1) | reduces activation energy | | |
| | | (c) | | | 4 | **A** = thermoplastic / thermosoftening plastic<br>**B** = thermoset **both** needed for (1)<br><br>weak or no bonds between chains in **A** (1)<br>bonds formed between chains in **B** (1)<br>allowing chains of **A** to move over each other / chains of **B** cannot move over each other (1) | crosslinks | | award (2) max for explanation if any reference to **layers** |



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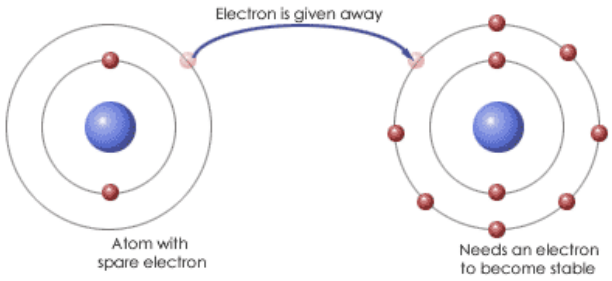
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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 8 | (a) | | | 3 | $M_r(NaHCO_3)$ = 84 and $M_r$ $(Na_2CO_3)$ = 106 (1)<br>2 : 1 ratio (1)<br>126 → 79.5g (1)<br>award (3) for cao | | | |
| | | (b) | | | 2 | 70/79.5 (1)<br>88.05 (1)<br>ecf possible from part (a) | | | |



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| Question Number | | | |
|---|---|---|---|
| FT | HT | Mark | Answer |
| | 9 | 6 | **Indicative content:**<br><br>diagram showing bonding in lithium chloride with no ambiguity<br><br><br><br>to form $Li^+$ and $Cl^-$ (outer electrons only need be shown)<br><br>description of bonding in words i.e. lithium atom loses an electron to become a positive ion, chlorine atom gains an electron to become a negative chloride ion, strong force of attraction between oppositely charged ions;<br>high melting point due to strong bonds between the ions; conducts electricity when molten or in solution as charged ions are free to move; does not conduct when solid as ions are immobile<br><br>**5-6 marks:** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br>**3-4 marks:** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br>**1-2 marks:** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br>**0 marks:** The candidate does not make any attempt or give a relevant answer worthy of credit. |



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| Surname | Centre Number | Candidate Number |
|---|---|---|
| Other Names | | 0 |

# GCSE

4472/02

W15-4472-02

## ADDITIONAL SCIENCE/CHEMISTRY

# CHEMISTRY 2
## HIGHER TIER

A.M. TUESDAY, 13 January 2015

1 hour

| For Examiner's use only | | |
|---|---|---|
| **Question** | **Maximum Mark** | **Mark Awarded** |
| **1.** | **7** | |
| **2.** | **9** | |
| **3.** | **8** | |
| **4.** | **6** | |
| **5.** | **5** | |
| **6.** | **6** | |
| **7.** | **8** | |
| **8.** | **5** | |
| **9.** | **6** | |
| **Total** | **60** | |

4472
020001

### ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

### INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

### INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

Assessment will take into account the quality of written communication (QWC) in your answers to questions **3** and **9**.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

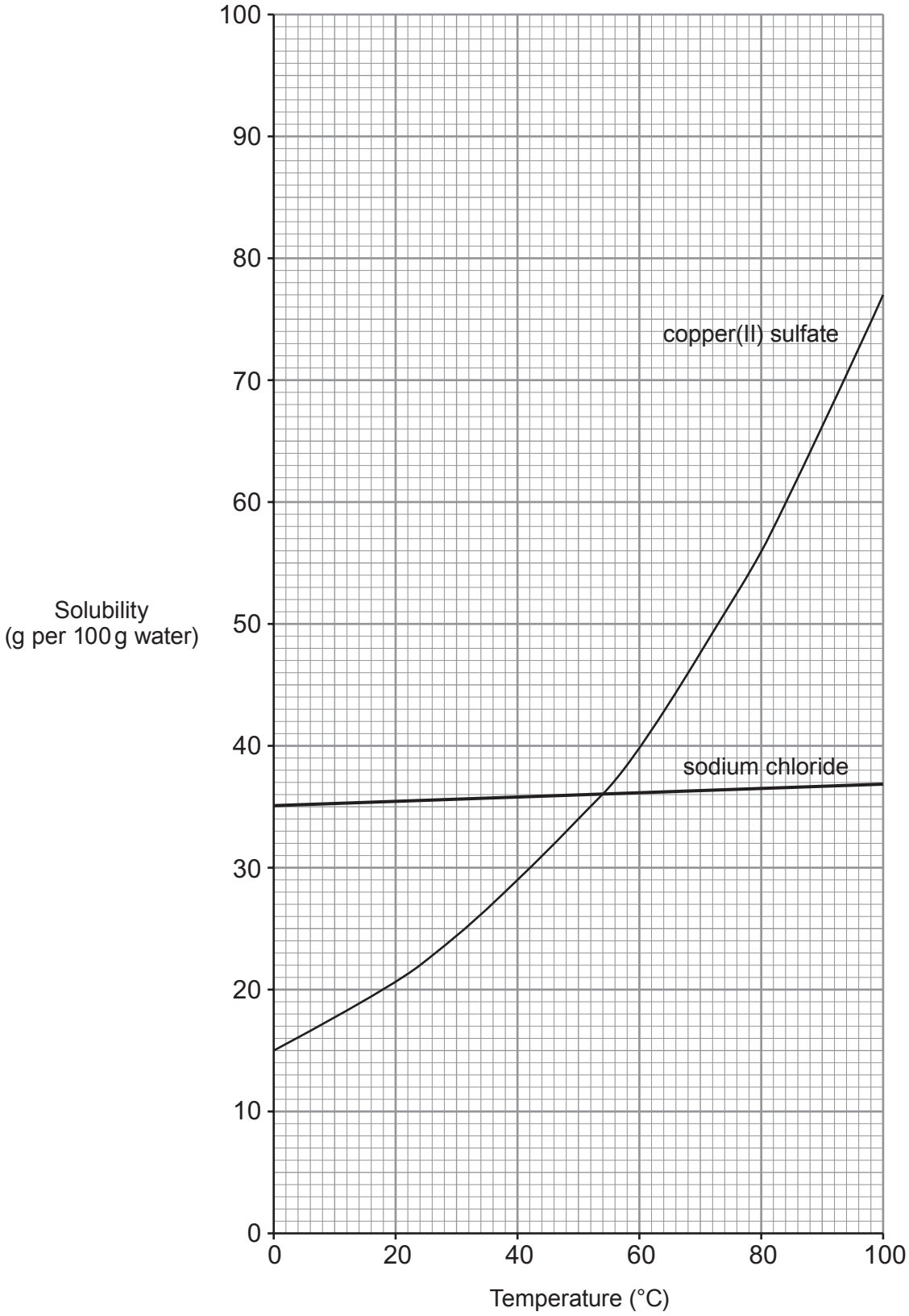
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*Answer* **all** *questions.*

**1.** The graphs below show the solubilities of sodium chloride and copper(II) sulfate in water at different temperatures.




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*(a)* Compare the solubilities of copper(II) sulfate and sodium chloride below 54 °C, at 54 °C and above 54 °C. [3]

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*(b)* Calculate the mass of solid copper(II) sulfate that forms when a saturated solution in 50 g of water at 80 °C cools to 40 °C. [2]

*Mass of solid copper(II) sulfate* = ..... g

*(c)* State why the temperature scale on a solubility graph ranges from 0 °C to 100 °C. [2]

.....

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7



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**2.** *(a)* (i) Complete the following table of information about the atoms of some elements. [5]

| Element | Symbol | Number of protons | Number of neutrons | Number of electrons |
|---|---|---|---|---|
| beryllium | $^{9}_{4}Be$ | 4 | 5 | 4 |
| fluorine | $^{19}_{9}F$ | 9 | ..... | ..... |
| calcium | ..... | 20 | 20 | ..... |
| argon | $^{40}_{18}Ar$ | ..... | 22 | 18 |

(ii) Give the **names** of the elements which have the same mass number. [1]

..... and .....

(iii) Using **X** to represent an electron, draw the electronic structure of argon. [1]

*(b)* Boron has two isotopes, $^{11}_{5}B$ and $^{10}_{5}B$.

Give **one** similarity and **one** difference between the nuclei of these two boron atoms. [2]

*Similarity* .....

*Difference* .....

9

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**3.** Lithium, sodium and potassium are Group 1 metals.

*(a)* A teacher wanted to demonstrate the similarities and differences in how each metal reacted with water. She added a small piece of each metal separately to a trough of water.

Describe what you would **see** when each metal is added to water and state how the observations can be used to establish the trend in reactivity within the group. [6 QWC]

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*(b)* The teacher then demonstrated the reaction of sodium with oxygen.

Complete and balance the symbol equation for this reaction. [2]

$\square$ Na + $O_2$ ⟶ $\square$ .....

8



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**Turn over.**

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**4.** *(a)* A group of students were given three water samples labelled **A**, **B** and **C**.

They were told that one was temporary hard water, one was permanent hard water and one distilled water, but they were not told which was which. Temporary hard water is softened by boiling.

Describe an investigation you would carry out using soap solution to identify each sample. [5]

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*(b)* Suggest a reason why energy may be wasted in homes in hard water areas. [1]

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6

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**5.** *(a)* Potassium reacts with sulfur to form potassium sulfide.

Using the electronic structures below, draw dot and cross diagrams to show how bonding takes place during the formation of potassium sulfide. [3]

potassium = 2,8,8,1 sulfur = 2,8,6



*(b)* Using the electronic structures below, draw a dot and cross diagram to show the bonding in a molecule of sulfur difluoride, $SF_2$. [2]

sulfur = 2,8,6 fluorine = 2,7



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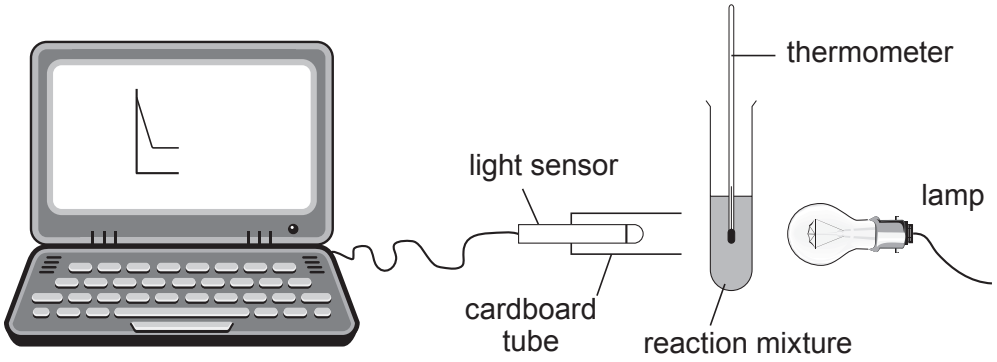




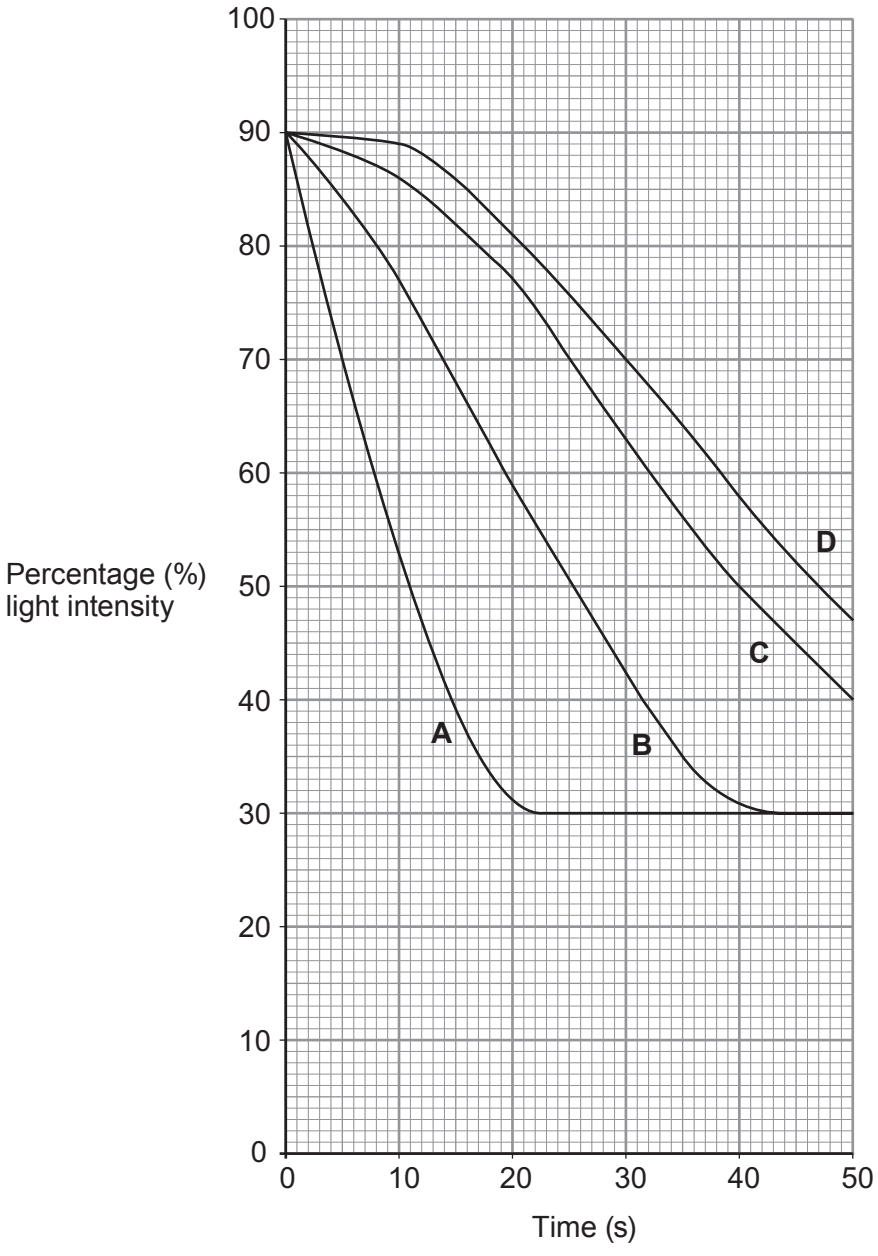
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**6.** Sodium thiosulfate solution reacts with dilute hydrochloric acid forming a yellow precipitate. This reaction can be investigated using the equipment below. The yellow precipitate formed during the reaction causes a reduction in the amount of light reaching the light sensor.




5 $cm^3$ of dilute hydrochloric acid was added separately to 10 $cm^3$ sodium thiosulfate solutions at four different temperatures. All other factors were kept the same. The results are shown on the grid below.




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*(a)* Give the letter **A**, **B**, **C** or **D** of the graph which represents the reaction carried out at the highest temperature and give the reason for your choice. [1]

.....

*(b)* The rate of reaction can be calculated using the formula:

$$\text{rate} = \frac{1}{\text{time}}$$

The reaction is considered to be complete when the percentage light intensity reaches 30 %. Use the formula to find the mean rate for experiment **A**. [2]

*Rate* = ..... / s

*(c)* State and explain, using particle theory, the conclusion you draw from the investigation. [3]

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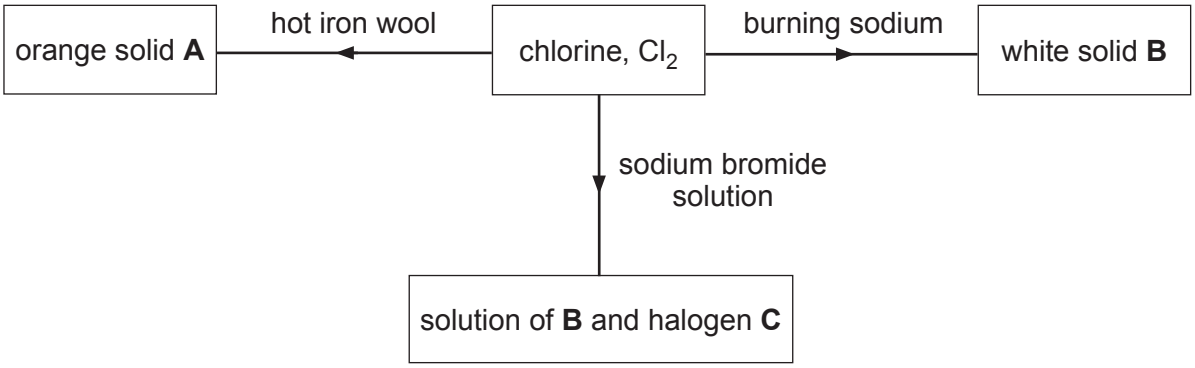


**Turn over.**

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**7.** *(a)* The diagram below shows some reactions of chlorine, $Cl_2$.




Give the chemical names for substances **A**, **B** and **C**. [3]

**A** .....

**B** .....

**C** .....

*(b)* Silver nitrate solution can be used to detect the presence of aqueous halide ions.

(i) The equation below represents the reaction occurring between silver nitrate solution and sodium chloride solution.

$$AgNO_3(aq) + NaCl(aq) \longrightarrow AgCl(s) + NaNO_3(aq)$$

Write the **ionic** equation for the reaction. [2]

..... + ..... ⟶ .....

(ii) When silver nitrate solution is added to magnesium bromide solution, $MgBr_2(aq)$, a cream precipitate is formed.

Write the balanced **symbol** equation for this reaction. [3]

..... + ..... ⟶ ..... + .....

8

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**8.** *(a)* An unknown alkane, **X**, was found to contain 9.0 g of carbon and 2.0 g of hydrogen. Calculate the simplest formula for this alkane. [3]

$A_r$(H) = 1 $A_r$(C) = 12

*Simplest formula* .....

*(b)* Calculate the percentage by mass of carbon in butane, an alkane containing four carbon atoms. [2]

$A_r$(H) = 1 $A_r$(C) = 12

*Percentage by mass of carbon =* ..... *%*

5

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**Turn over.**

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Examiner only

**9.** Describe and explain the process of addition polymerisation. Include examples to support your answer. [6 QWC]

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**END OF PAPER**

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## FORMULAE FOR SOME COMMON IONS

| POSITIVE IONS | | NEGATIVE IONS | |
|---|---|---|---|
| **Name** | **Formula** | **Name** | **Formula** |
| Aluminium | $Al^{3+}$ | Bromide | $Br^{-}$ |
| Ammonium | $NH_4^{+}$ | Carbonate | $CO_3^{2-}$ |
| Barium | $Ba^{2+}$ | Chloride | $Cl^{-}$ |
| Calcium | $Ca^{2+}$ | Fluoride | $F^{-}$ |
| Copper(II) | $Cu^{2+}$ | Hydroxide | $OH^{-}$ |
| Hydrogen | $H^{+}$ | Iodide | $I^{-}$ |
| Iron(II) | $Fe^{2+}$ | Nitrate | $NO_3^{-}$ |
| Iron(III) | $Fe^{3+}$ | Oxide | $O^{2-}$ |
| Lithium | $Li^{+}$ | Sulfate | $SO_4^{2-}$ |
| Magnesium | $Mg^{2+}$ | | |
| Nickel | $Ni^{2+}$ | | |
| Potassium | $K^{+}$ | | |
| Silver | $Ag^{+}$ | | |
| Sodium | $Na^{+}$ | | |
| Zinc | $Zn^{2+}$ | | |

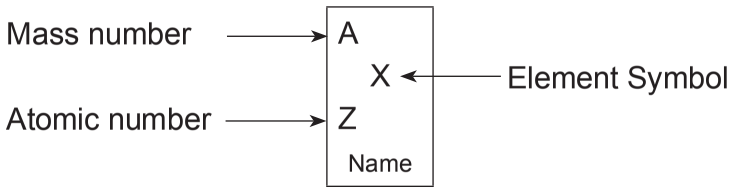
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# PERIODIC TABLE OF ELEMENTS

| 1 | 2 | Group | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | $^{1}_{1}$H Hydrogen | | | | | | | | $^{4}_{2}$He Helium |
| $^{7}_{3}$Li Lithium | $^{9}_{4}$Be Beryllium | | | | | | | | | | | $^{11}_{5}$B Boron | $^{12}_{6}$C Carbon | $^{14}_{7}$N Nitrogen | $^{16}_{8}$O Oxygen | $^{19}_{9}$F Fluorine | $^{20}_{10}$Ne Neon |
| $^{23}_{11}$Na Sodium | $^{24}_{12}$Mg Magnesium | | | | | | | | | | | $^{27}_{13}$Al Aluminium | $^{28}_{14}$Si Silicon | $^{31}_{15}$P Phosphorus | $^{32}_{16}$S Sulfur | $^{35}_{17}$Cl Chlorine | $^{40}_{18}$Ar Argon |
| $^{39}_{19}$K Potassium | $^{40}_{20}$Ca Calcium | $^{45}_{21}$Sc Scandium | $^{48}_{22}$Ti Titanium | $^{51}_{23}$V Vanadium | $^{52}_{24}$Cr Chromium | $^{55}_{25}$Mn Manganese | $^{56}_{26}$Fe Iron | $^{59}_{27}$Co Cobalt | $^{59}_{28}$Ni Nickel | $^{64}_{29}$Cu Copper | $^{65}_{30}$Zn Zinc | $^{70}_{31}$Ga Gallium | $^{73}_{32}$Ge Germanium | $^{75}_{33}$As Arsenic | $^{79}_{34}$Se Selenium | $^{80}_{35}$Br Bromine | $^{84}_{36}$Kr Krypton |
| $^{86}_{37}$Rb Rubidium | $^{88}_{38}$Sr Strontium | $^{89}_{39}$Y Yttrium | $^{91}_{40}$Zr Zirconium | $^{93}_{41}$Nb Niobium | $^{96}_{42}$Mo Molybdenum | $^{99}_{43}$Tc Technetium | $^{101}_{44}$Ru Ruthenium | $^{103}_{45}$Rh Rhodium | $^{106}_{46}$Pd Palladium | $^{108}_{47}$Ag Silver | $^{112}_{48}$Cd Cadmium | $^{115}_{49}$In Indium | $^{119}_{50}$Sn Tin | $^{122}_{51}$Sb Antimony | $^{128}_{52}$Te Tellurium | $^{127}_{53}$I Iodine | $^{131}_{54}$Xe Xenon |
| $^{133}_{55}$Cs Caesium | $^{137}_{56}$Ba Barium | $^{139}_{57}$La Lanthanum | $^{179}_{72}$Hf Hafnium | $^{181}_{73}$Ta Tantalum | $^{184}_{74}$W Tungsten | $^{186}_{75}$Re Rhenium | $^{190}_{76}$Os Osmium | $^{192}_{77}$Ir Iridium | $^{195}_{78}$Pt Platinum | $^{197}_{79}$Au Gold | $^{201}_{80}$Hg Mercury | $^{204}_{81}$Tl Thallium | $^{207}_{82}$Pb Lead | $^{209}_{83}$Bi Bismuth | $^{210}_{84}$Po Polonium | $^{210}_{85}$At Astatine | $^{222}_{86}$Rn Radon |
| $^{223}_{87}$Fr Francium | $^{226}_{88}$Ra Radium | $^{227}_{89}$Ac Actinium | | | | | | | | | | | | | | | |

Key:




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(4472-02)

# GCSE MARKING SCHEME

## SCIENCE - CHEMISTRY

## JANUARY 2015

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## INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2015 examination in GCSE SCIENCE - CHEMISTRY. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.


| | Page |
|---|---|
| C1 | 1 |
| C2 | 15 |


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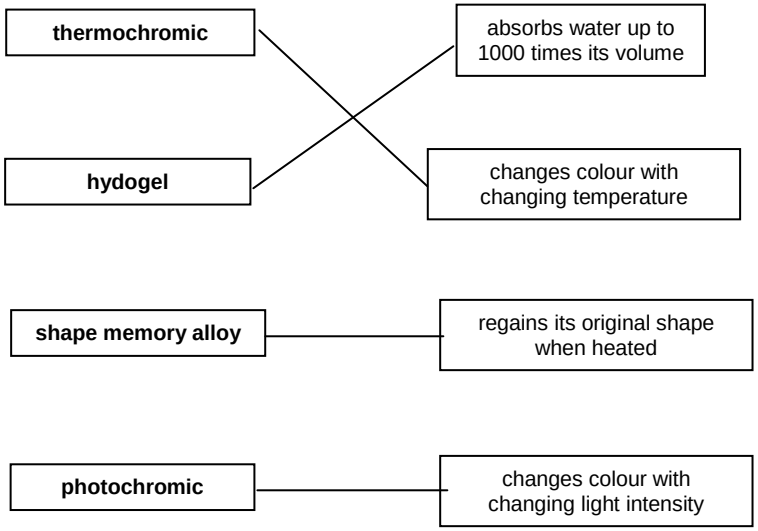
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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 1 | | *(a)* | (i) | | 1 | lakes / rivers / streams / aquifers / groundwater | | surface water / rain / wells / springs | seawater<br>sewers |
| | | | (ii) | | 1 | 1 | sedimentation | | |
| | | | (iii) | | 1 | chlorination | | | |
| | | *(b)* | | | 1 | stop washing cars/ windows<br>stop watering gardens/ using a hose pipe<br>don't run water when washing teeth/<br>low flush toilets/ dual flush toilets/<br>only run washing machine once a week/<br>only run washing machine with a full load/<br>shower instead of bath<br>use waste water to flush toilets / clean car | | don't wash<br>don't use water<br>collect rainwater<br>use bottled water | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 2 | | | | | 3 | <br>all correct for 3 marks<br>any two correct for 2 marks, any 1 correct for 1 | | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 3 | | *(a)* | (i) | | 2 | A and B both needed (1)<br><br>little / poor / no lather (1)<br>second mark alone may be awarded if only A *or* B given | | | |
| | | | (ii) | | 2 | A is temporary hard water and B is permanent (1)<br><br>any of following for (1)<br>• temporary is softened by boiling<br>• permanent is not softened by boiling<br>• temporary forms lather after boiling<br>• permanent doesn't form lather after boiling | | ignore reference to sample C unless incorrect | |

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| Question Number | | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | | | | | | | | |
| | | *(b)* | (i) | | 3 | • salt remains in flask / salt left behind<br>• water boils / water turns to steam / steam enters condenser<br>• steam condenses / steam turns back to water in condenser / steam cools to form water<br>• distillation / desalination<br><br>any 3 for (1) each<br><br>maximum (1) for description of separation of ethanol and water | | | |
| | | | (ii) | | 2 | a lot of lather / froth / bubbles / foam (1)<br><br>(pure water) contains no dissolved solids /<br>(pure water) contains no $Ca^{2+}$ /<br>(pure water) contains no $Mg^{2+}$ (1) | accept diagram<br><br>reference to calcium / magnesium | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 4 | | *(a)* | | | 1 | purple and yellow both needed | | | |
| | | *(b)* | | | 2 | 0.4 × 10 (1)<br><br>4 (1)<br><br>award (2) for correct answer only (cao)<br><br>no error carried forward (ecf) | | | |
| | | *(c)* | | | 1 | (food colourings are) soluble (in water) /<br>(food colouring) dissolve (in water) | | | |

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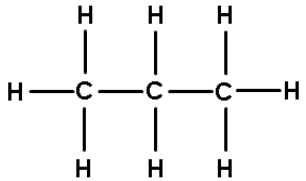
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| Question Number | | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | | | | | | | | |
| 5 | | *(a)* | | | 1 | value in the range 19–20 | | | |
| | | *(b)* | | | 1 | line right of original graph from<br>(0,90) to (35,30) – tolerance of 1 small square | | | |
| | | *(c)* | | | 2 | precipitate formed/insoluble substance formed (1)<br><br>light cannot travel through/ stops light / blocks light (1) | goes cloudy/ milky | | |
| | | *(d)* | | | 1 | any of following<br><br>(apparatus) not light tight / light can get in around tube<br><br>precipitate formed not dense enough / thick enough /<br>precipitate formed does not block all the light | | light all around /<br>light present | |

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| Question Number | | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | | | | | | | | |
| 6 | | *(a)* | | | 1 | $C_3H_6$ | | $CH_2CHCH_3$ | |
| | | *(b)* | | | 1 |  | | | |
| | | *(c)* | | | 3 | • double bond opens (1) R<br>• ethene molecules join together<br>• long chain / single chain formed / polymer formed<br>• addition reaction/ addition polymerisation<br><br>any two for (1) each | | becomes single bond<br>loses double bond<br><br>'additional' | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 7 | | *(a)* | (i) | | 1 | sodium atom 1 chlorine atom 7<br><br>both needed | | | |
| | | | (ii) | I | 2 | sodium (atom) loses one electron (1)<br><br>chlorine (atom) gains one electron (1)<br><br>award (2) for<br>electron transferred from sodium to chlorine<br><br>maximum (1) if transfer of more than 1 electron implied | | | |
| | | | | II | 1 | sodium chloride / NaCl | | | |
| | | *(b)* | | | 2 | 23 + 35.5 + 3(16) (1)<br><br>106.5 (1)<br><br>award (2) for cao<br>no ecf | | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 8 | 1 | *(a)* | | | 3 | two possible approaches<br><br>either<br>• below 54°C, NaCl more soluble (1)<br>• at 54°C, solubilities the same (1)<br>• above 54°C, $CuSO_4$ more soluble (1)<br><br>or<br>• below 54°C, $CuSO_4$ increases a lot with temperature, NaCl does not (1)<br>• above 54°C, trend continues but $CuSO_4$ is more soluble than NaCl (1)<br>• at 54°C, solubilities the same (1) | converse<br><br>converse | | |
| | | *(b)* | | | 2 | 56 – 29 = 27 (1) no tolerance<br><br>27/2 = 13.5 (1) ecf possible<br><br>award (2) for cao | | | |

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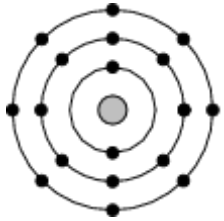
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| Question Number | | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | | | | | | | | |
| | | *(c)* | | | 2 | water freezes at 0°C / is ice at 0°C / is solid at 0°C / 0°C is the freezing point of water (1)<br><br>water boils at 100°C / is steam at 100°C / is a gas at 100°C / 100°C is the boiling point of water (1) | these are the freezing point and boiling point of water (2)<br><br>these are the fixed points of water (2)<br><br>water is only liquid between these two temperatures (2)<br><br>water is liquid between these temperatures (1) | melting point | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 9 | 2 | *(a)* | (i) | | 5 | <table><tr><th></th><th>symbol</th><th>protons</th><th>neutrons</th><th>electrons</th></tr><tr><td>fluorine</td><td></td><td></td><td>10</td><td>9</td></tr><tr><td>calcium</td><td>$^{40}_{20}Ca$</td><td></td><td></td><td>20</td></tr><tr><td>argon</td><td></td><td>18</td><td></td><td></td></tr></table> (1) for each correct answer | | | |
| | | | (ii) | | 1 | calcium/Ca and argon /Ar both needed | | | |
| | | | (iii) | | 1 |  | | 2,8,8 | |
| | | *(b)* | | | 2 | Similarity: (same) number of protons (1)<br>Difference: (different) number of neutrons (1) | p for proton<br>n for neutron | reference to atomic number and mass number | reference to electrons |

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| Question Number | | | Mark | Answer |
|---|---|---|---|---|
| FT | HT | | | |
| 9 | 3 | *(a)* | 6 QWC | Indicative content<br>• all three metals float, move about the water surface and produce bubbles<br>• lithium reacts slowly without melting<br>• sodium reacts quickly forming a sphere<br>• potassium reacts violently forming a sphere and burning with a lilac flame<br>• reactivity increases down the group<br>*word /symbol equations not expected but creditworthy*<br><br>5-6 marks<br>The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br>3-4 marks<br>The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br>1-2 marks<br>The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br>0 marks<br>The candidate does not make any attempt or give a relevant answer worthy of credit. |
| | | *(b)* | 2 | $Na_2O$ (1) correctly balanced (1)<br><br>formula must be correct before balancing mark can be awarded |

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| Question Number | | | | | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | | | | | |
| | 4 | *(a)* | | | 5 | step 1 – use of soap solution to identify distilled water, needs fair testing element for both marks<br>• add 1cm$^3$ soap (solution) to 5 cm$^3$ of each water sample (1)<br>• shake for 1 minute/shake for the same time (1)<br>• distilled water most froth (1)<br><br>step 2<br>• boil unidentified samples and repeat step 1 (1)<br>• temporary hard water lathers after boiling; permanent hard water still does not lather after boiling (1)<br><br>credit alternative methods – up to (3) for method/fair test and up to (2) for conclusions | add soap to each water sample and shake (1) | | washing up liquid |
| | | *(b)* | | | 1 | reference to appliance needed<br><br>furs up kettles/ kettles less efficient / boilers fur up / boilers less efficient / pipes fur up / pipes less efficient | | reference to soap<br>'wastes energy'<br>'decreases efficiency'<br>'blocks pipes' | |

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| Question Number | | | | | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | | | | | |
| | 5 | *(a)* | | | 3 | two discrete diagrams needed<br>- diagram 1 showing transfer of electrons<br>- diagram 2 showing ions<br><br>diagram 1<br>two potassium atoms lose 1 electron each (1)<br>one sulfur atom gains 2 electrons (1)<br><br>diagram 2<br>two $K^+$ ions and one $S^{2-}$ ion formed (1)<br>*octet of electrons around* $S^{2-}$ *not needed* | if transferred electrons on both potassium and sulfur award (1) | | |
| | | *(b)* | | | 2 | two shared pairs of electrons (S—F) (1)<br><br>octet of electrons around S and both F atoms (1) | | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 6 | *(a)* | | | 1 | A<br>steepest line / steepest graph /<br>finishes in the shortest time<br><br>both needed | greatest gradient /<br>highest gradient /<br>quickest reaction | precipitate | |
| | | *(b)* | | | 2 | time = 22 (1)<br><br>0.045 / 0.0455 / 0.04545 (1)<br><br>award (2) for cao | 21<br><br>0.048 / 0.0476 | | 0.05 |
| | | *(c)* | | | 3 | higher the temperature, faster the rate (1)<br><br>particles have more energy / move faster at higher temperature (1)<br>must be correct to award third mark<br><br>therefore greater chance of (successful) collisions / more (successful) collisions per second (1) | more particles have required activation energy | more collisions | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 7 | *(a)* | | | 3 | A iron(III) chloride / $FeCl_3$ (1)<br><br>B sodium chloride / NaCl (1)<br><br>C bromine / $Br_2$ (1) | | iron chloride<br><br><br><br>gas | iron(II) chloride<br><br><br>Br |
| | | *(b)* | (i) | | 2 | $Ag^+ + Cl^-$ (1)<br><br>AgCl (1) ignore state symbols | | | |
| | | | (ii) | | 3 | $2AgNO_3 + MgBr_2 \rightarrow 2AgBr + Mg(NO_3)_2$<br><br>award (1) each for both products<br>balancing (1)<br><br>only award balancing mark if both products are correct | | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 8 | *(a)* | | | 3 | mass carbon and hydrogen divided by respective $A_r$ values e.g. carbon 9/12 and hydrogen 2/1 (1)<br><br>ratio of 3:8 (1)<br><br>$C_3H_8$ (1)<br><br>ecf possible if formula given is an alkane<br><br>award (1) mark only for correct answer with no working | | | |
| | | *(b)* | | | 2 | $M_r(C_4H_{10})$ = 58 (1)<br><br>(48/58) × 100 = 82.76 (1) consequential marking | 82.8 / 83 | | |

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| Question Number | | | |
|---|---|---|---|
| FT | HT | Mark | Answer |
| | 9 | 6 QWC | Indicative content<br>• ethene (monomer) contains a C=C bond/ ethene (monomer) is unsaturated<br>• double bonds in ethene molecules 'open'<br>• ethene molecules join together<br>• long chain molecule formed/ polymer formed/ single molecule formed<br>• balanced symbol equation, showing repeating unit<br>• monomer & repeating unit, for example, for polypropene from propene/ PVC from chloroethene / polytetrafluoroethene from tetrafluoroethene<br><br>5-6 marks: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br>3-4 marks: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br>1-2 marks: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br>0 marks: The candidate does not make any attempt or give a relevant answer worthy of credit. |



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| Surname | Centre Number | Candidate Number |
|---|---|---|
| Other Names | | 0 |

# GCSE

4472/02

## ADDITIONAL SCIENCE/CHEMISTRY

## CHEMISTRY 2
## HIGHER TIER

A.M. THURSDAY, 15 May 2014

1 hour

| For Examiner's use only | | |
|---|---|---|
| **Question** | **Maximum Mark** | **Mark Awarded** |
| **1.** | **5** | |
| **2.** | **6** | |
| **3.** | **7** | |
| **4.** | **6** | |
| **5.** | **4** | |
| **6.** | **4** | |
| **7.** | **7** | |
| **8.** | **5** | |
| **9.** | **5** | |
| **10.** | **5** | |
| **11.** | **6** | |
| **Total** | **60** | |

4472
020001

### ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

### INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

### INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

Assessment will take into account the quality of written communication (QWC) used in your answers to questions **4** and **11**.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

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Examiner only

*Answer* **all** *questions.*

**1.** *(a)* The following processes are used in the treatment of our water supply.

**sedimentation** **filtration** **chlorination**

State the purpose of each process. [3]

*Sedimentation*

.....

.....

*Filtration*

.....

.....

*Chlorination*

.....

.....

*(b)* Drinking water can be obtained by desalination.

State what is meant by *desalination* and name a process by which it can be carried out. [2]

.....

.....

5

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**2.** Potassium reacts vigorously with water.

*(a)* (i) Describe what you would **observe** when potassium reacts with water. [3]

.....

.....

.....

.....

(ii) During a class demonstration the potassium exploded. Suggest what might have caused this to happen. [1]

.....

.....

*(b)* Complete and balance the symbol equation for the reaction between potassium and water. [2]

$$2K + 2H_2O \longrightarrow \text{.....} + \text{.....}$$





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Examiner only

**3.** The table below shows the amount of soap solution required by different samples of water to form a permanent lather. In each case 25 $cm^3$ of the water samples were used and the soap solution was added 1 $cm^3$ at a time.

| | Volume of soap solution added ($cm^3$) | | | | |
|---|---|---|---|---|---|
| Sample | Test 1 | Test 2 | Test 3 | Test 4 | Mean |
| distilled water | 2 | 2 | 2 | 2 | 2 |
| **A** | 8 | 8 | 9 | 7 | 8 |
| **B** | 11 | 18 | 12 | 13 | |
| **C** | 15 | 14 | 14 | 13 | 14 |
| **A** after boiling | 8 | 7 | 9 | 8 | 8 |
| **B** after boiling | 6 | 5 | 6 | 7 | 6 |
| **C** after boiling | 2 | 2 | 2 | 2 | 2 |

*(a)* Two pupils, David and Haf, calculated the mean value for sample **B**. David calculated a value of 13.5 and Haf calculated a value of 12. Show how both values were obtained. State which is the better value to use and give a reason for your choice. [3]

.....

.....

.....

.....

*(b)* State which of water samples **A**, **B** and **C** is the **least** hard. [1]

*Water sample* .....

*(c)* State which of water samples **A**, **B** and **C** contains **both** temporary and permanent hardness. Give the reason for you answer. [2]

*Water sample* .....

*Reason* .....

.....

*(d)* Name an ion which causes hardness in water. [1]

.....

7

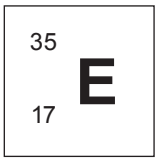
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**4.** An atom of element **E** is represented as follows.




State and explain what information this gives you about element **E**.

You may wish to refer to the key on the Periodic Table to help you answer this question. [6 QWC]

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020005



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**Turn over.**

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**5.** *(a)* One of the main dangers in the coal mining industry is that coal dust can form an explosive mixture with air.

Explain why an explosion is more likely to occur with coal dust than with lumps of coal. [2]

.....

.....

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.....

*(b)* A chemical reaction goes twice as fast if the temperature is increased by 10 °C.

At 5 °C, milk undergoes a chemical reaction that makes it go sour in 8 days.

Calculate how long it will take milk to go sour at 35 °C. [2]

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.....

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4

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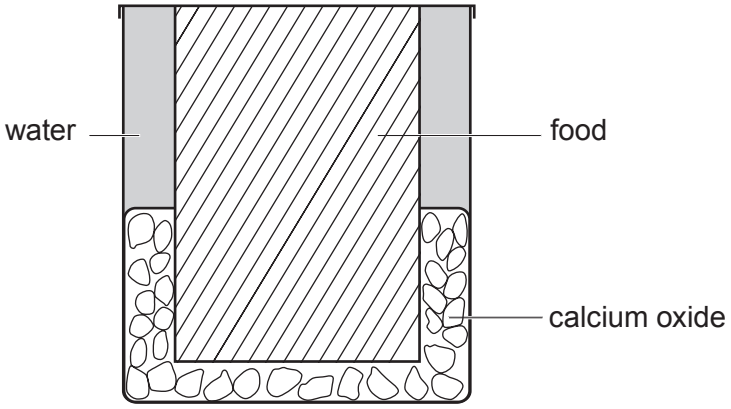
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**6.** *(a)* 'Hot cans' are designed to heat the food inside them when it is to be eaten. The heat is generated by mixing calcium oxide with water.




*Source: Amazon*

The following diagram shows the cross-section of a 'hot can'.




During a trial reaction, the temperature reached 50 °C but a temperature of 70 °C is required to properly heat the food.

Suggest a change that could have been made and explain how this would lead to the can reaching the higher temperature. [2]

.....

.....

.....

.....

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*(b)* When chemical reactions take place bonds are broken and new bonds are formed.

Explain, in terms of bond making and breaking, why some reactions are **exothermic**. [2]

.....

.....

.....

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**Turn over.**

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Examiner only

**7.** *(a)* Sodium reacts with oxygen to give sodium oxide.

(i) Using the electronic structures below, draw dot and cross diagrams to show the transfer of electrons and the formation of ions that occur as sodium oxide is formed. [3]

sodium 2,8,1 oxygen 2,6

(ii) Give the **electronic structure** of the sodium and oxide **ions**. [1]

| | Electronic structure |
|---|---|
| sodium ion | |
| oxide ion | |

*(b)* Name the **type of structure** present in ammonia, $NH_3$, and explain why ammonia has a low melting point. [3]

.....

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**8.** *(a)* When bromine is passed over heated iron wool it glows and forms iron(III) bromide.

Write a balanced **symbol** equation for the reaction. [3]

..... + ..... ⟶ .....

*(b)* Name the substance used to test for the presence of bromide ions in iron(III) bromide solution and give the expected result. [2]

.....

.....

.....



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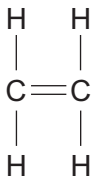
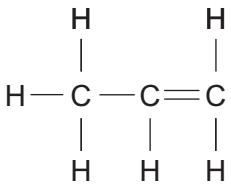


**Turn over.**

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Examiner only

**9.** *(a)* The table below shows the names, molecular formulae and the structural formulae of the first two members of the alkene series. Complete the table by giving the structural formula of butene, $C_4H_8$. [1]

| Name | Molecular formula | Structural formula |
|---|---|---|
| ethene | $C_2H_4$ |  |
| propene | $C_3H_6$ |  |
| butene | $C_4H_8$ | |

*(b)* Explain how polypropene is formed from propene. [4]

.....

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Examiner only

**10.** Many metal ores contain sulfides. Chalcocite is an important copper ore which contains copper(I) sulfide, $Cu_2S$.

Copper can be obtained from the ore by heating in air.

The equation for the reaction that takes place is as follows.

$$Cu_2S + O_2 \longrightarrow 2Cu + SO_2$$

*(a)* Use the above equation to calculate the mass of copper produced on reacting 20.5 tonnes of copper(I) sulfide with an excess of oxygen. [3]

$A_r$(Cu) = 64 $A_r$(S) = 32

*Mass of copper* = ..... tonnes

*(b)* When the extraction was carried out with 20.5 tonnes of chalcocite only 12.3 tonnes of copper was formed.

Calculate the percentage of **impurity** present in the ore. [2]

*Percentage of impurity* = ..... %

5



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Examiner only

**11.** Describe how reactions involving chlorine, bromine and iodine can be used to show the trend in reactivity in Group 7 elements. [6 *QWC*]

You should include equations in your answer.

**END OF PAPER**

6

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## FORMULAE FOR SOME COMMON IONS

| POSITIVE IONS | | NEGATIVE IONS | |
|---|---|---|---|
| **Name** | **Formula** | **Name** | **Formula** |
| Aluminium | $Al^{3+}$ | Bromide | $Br^{-}$ |
| Ammonium | $NH_4^{+}$ | Carbonate | $CO_3^{2-}$ |
| Barium | $Ba^{2+}$ | Chloride | $Cl^{-}$ |
| Calcium | $Ca^{2+}$ | Fluoride | $F^{-}$ |
| Copper(II) | $Cu^{2+}$ | Hydroxide | $OH^{-}$ |
| Hydrogen | $H^{+}$ | Iodide | $I^{-}$ |
| Iron(II) | $Fe^{2+}$ | Nitrate | $NO_3^{-}$ |
| Iron(III) | $Fe^{3+}$ | Oxide | $O^{2-}$ |
| Lithium | $Li^{+}$ | Sulfate | $SO_4^{2-}$ |
| Magnesium | $Mg^{2+}$ | | |
| Nickel | $Ni^{2+}$ | | |
| Potassium | $K^{+}$ | | |
| Silver | $Ag^{+}$ | | |
| Sodium | $Na^{+}$ | | |
| Zinc | $Zn^{2+}$ | | |

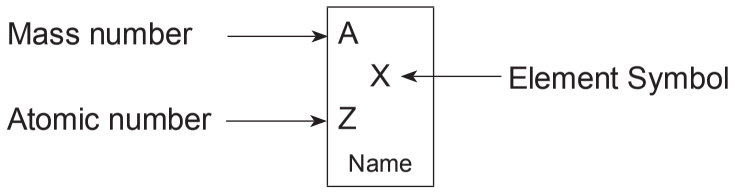
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# PERIODIC TABLE OF ELEMENTS

| 1 | 2 | Group | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | $^{1}_{1}$H Hydrogen | | | | | | | | $^{4}_{2}$He Helium |
| $^{7}_{3}$Li Lithium | $^{9}_{4}$Be Beryllium | | | | | | | | | | | $^{11}_{5}$B Boron | $^{12}_{6}$C Carbon | $^{14}_{7}$N Nitrogen | $^{16}_{8}$O Oxygen | $^{19}_{9}$F Fluorine | $^{20}_{10}$Ne Neon |
| $^{23}_{11}$Na Sodium | $^{24}_{12}$Mg Magnesium | | | | | | | | | | | $^{27}_{13}$Al Aluminium | $^{28}_{14}$Si Silicon | $^{31}_{15}$P Phosphorus | $^{32}_{16}$S Sulfur | $^{35}_{17}$Cl Chlorine | $^{40}_{18}$Ar Argon |
| $^{39}_{19}$K Potassium | $^{40}_{20}$Ca Calcium | $^{45}_{21}$Sc Scandium | $^{48}_{22}$Ti Titanium | $^{51}_{23}$V Vanadium | $^{52}_{24}$Cr Chromium | $^{55}_{25}$Mn Manganese | $^{56}_{26}$Fe Iron | $^{59}_{27}$Co Cobalt | $^{59}_{28}$Ni Nickel | $^{64}_{29}$Cu Copper | $^{65}_{30}$Zn Zinc | $^{70}_{31}$Ga Gallium | $^{73}_{32}$Ge Germanium | $^{75}_{33}$As Arsenic | $^{79}_{34}$Se Selenium | $^{80}_{35}$Br Bromine | $^{84}_{36}$Kr Krypton |
| $^{86}_{37}$Rb Rubidium | $^{88}_{38}$Sr Strontium | $^{89}_{39}$Y Yttrium | $^{91}_{40}$Zr Zirconium | $^{93}_{41}$Nb Niobium | $^{96}_{42}$Mo Molybdenum | $^{99}_{43}$Tc Technetium | $^{101}_{44}$Ru Ruthenium | $^{103}_{45}$Rh Rhodium | $^{106}_{46}$Pd Palladium | $^{108}_{47}$Ag Silver | $^{112}_{48}$Cd Cadmium | $^{115}_{49}$In Indium | $^{119}_{50}$Sn Tin | $^{122}_{51}$Sb Antimony | $^{128}_{52}$Te Tellurium | $^{127}_{53}$I Iodine | $^{131}_{54}$Xe Xenon |
| $^{133}_{55}$Cs Caesium | $^{137}_{56}$Ba Barium | $^{139}_{57}$La Lanthanum | $^{179}_{72}$Hf Hafnium | $^{181}_{73}$Ta Tantalum | $^{184}_{74}$W Tungsten | $^{186}_{75}$Re Rhenium | $^{190}_{76}$Os Osmium | $^{192}_{77}$Ir Iridium | $^{195}_{78}$Pt Platinum | $^{197}_{79}$Au Gold | $^{201}_{80}$Hg Mercury | $^{204}_{81}$Tl Thallium | $^{207}_{82}$Pb Lead | $^{209}_{83}$Bi Bismuth | $^{210}_{84}$Po Polonium | $^{210}_{85}$At Astatine | $^{222}_{86}$Rn Radon |
| $^{223}_{87}$Fr Francium | $^{226}_{88}$Ra Radium | $^{227}_{89}$Ac Actinium | | | | | | | | | | | | | | | |

Key:




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(4472-02)

# GCSE MARKING SCHEME

## SCIENCE - CHEMISTRY

### SUMMER 2014

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## INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2014 examination in GCSE SCIENCE - CHEMISTRY. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.


| | Page |
|---|---|
| C1 | 1 |
| C2 | 19 |
| C3 | 36 |


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# Chemistry 2 – Foundation tier only questions

| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 1 | | *(a)* | (i) | | 1 | condenser | | | |
| | | | (ii) | | 1 | chromatography | | | |
| | | *(b)* | | | 1 | C | distillation | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 2 | | *(a)* | | | 1 | C | | | |
| | | *(b)* | | | 1 | any named metal e.g. sodium, magnesium | symbol e.g. Na, Mg | | |
| | | *(c)* | | | 1 | A / D | graphite /<br>metal named in part *(b)* | carbon | |
| | | *(d)* | | | 1 | B | | | |

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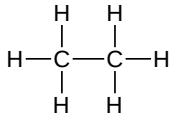
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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 3 | | *(a)* | (i) | | 1 | 2, 8, 8 | | | |
| | | | (ii) | | 1 | D | | Al | |
| | | | (iii) | | 2 | B and D – both needed (1)<br><br>they have the same number of electrons in their outer shell / they both have three electrons in their outer shell (1)<br><br>2nd mark may be awarded if A and C given | boron and aluminium | | A and C |
| | | *(b)* | (i) | | 1 | 40 | | | |
| | | | (ii) | | 2 | 16 ÷ 40 (1)<br><br>40 (1)<br><br>error carried forward from (i)<br>correct answer only (2) | | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 4 | | *(a)* | (i) | | 1 | B | | | |
| | | | (ii) | | 1 | water | | $H_2O$<br>hydrogen oxide | hydroxide |
| | | *(b)* | (i) | | 1 | 8 | | | |
| | | | (ii) | | 1 | 4 | | | |
| | | | (iii) | | 1 | $C_2H_6$ | $CH_3CH_3$ | |  |

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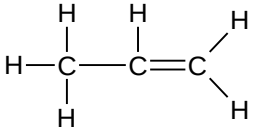
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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 5 | | *(a)* | (i) | | 1 | gas escaped during time taken to place the bung in the flask | gas syringe<br>'sticks' | human error | |
| | | | (ii) | | 3 | all points plotted correctly [±½ square] (2)<br>seven points plotted correctly (1)<br><br>smooth curve drawn, not passing through (10,8) (1) | <br><br><br>curve through (10,8) if (0,0) not plotted | | |
| | | | (iii) | | 1 | value read correctly from graph [±½ $cm^3$]<br><br>ecf possible from any curve – except to give 8 | | | 8 |
| | | | (iv) | | 1 | line continues horizontally / volume stops increasing | | straight line | |
| | | | (v) | | 2 | less time (1)<br><br>more time (1) | | | |
| | | *(b)* | | | 2 | 4 days - correct answer only (2)<br><br>if answer incorrect (1) for any indication of correct working e.g. from 30-20°C doubles time from 1 day to 2 days | | | |

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| Question Number | | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | | | | | | | | |
| 6 | | *(a)* | | | 1 | shape memory polymer → regains original shape when heated<br><br>thermoplastic → softens when heated<br><br>thermoset → does not change when heated | | | |
| | | *(b)* | (i) | | 1 | ethene | | $C_2H_4$<br>alkene | |
| | | | (ii) | | 2 | D (1)<br><br>fluorine atoms present / hydrocarbons include carbon and hydrogen atoms only / doesn't contain hydrogen atoms (1) | | | |
| | | | (iii) | | 2 | B (1)<br><br>it has a double bond (1) | ethene<br><br>it is unsaturated | | |
| | | *(c)* | | | 1 |  | | | |

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# Chemistry 2 – Common questions

| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 7 | 1 | *(a)* | | | 3 | sedimentation – removes large particles/objects (1)<br><br>filtration – removes smaller particles (1)<br><br>chlorination – kills bacteria (1) | | | |
| | | *(b)* | | | 2 | removal of salt from seawater (1)<br><br>distillation (1) | <br><br>osmosis | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 8 | 2 | *(a)* | (i) | | 3 | burns - lilac flame (1R) Reserved mark<br><br>• floats<br>• moves<br>• melts / spherical shape<br>• effervesces / fizzes / bubbles<br>• spits / sparks / pops<br>any two for (1) each up to 2 max | | dissolves<br>disappears<br>produces hydrogen | red / yellow / blue / green flame |
| | | | (ii) | | 1 | the piece of potassium could have been too big / could have been too little water / water could have been hot / potassium could have stuck to the side of trough | | | |
| | | *(b)* | | | 2 | $2KOH + H_2$ (2)<br><br>(1) for KOH if any errors | | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 9 | 3 | *(a)* | | | 3 | David – mean of all four values (54 ÷ 4 = 13.5) (1)<br><br>Haf – mean of three values, with indication which three were selected (1)<br><br>Haf's value is better as she used repeatable values only / discarded the value that appears to be suspect (1) | | | |
| | | *(b)* | | | 1 | A | | 8 | |
| | | *(c)* | | | 2 | B (1)<br><br>some hardness has been removed by boiling but some remains (1) | | | |
| | | *(d)* | | | 1 | calcium (ion) / magnesium (ion) | $Ca^{2+}$ / $Mg^{2+}$ | | |

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| Question Number | | | |
|---|---|---|---|
| FT | HT | Mark | Answer |
| 10 | 4 | 6 QWC | Indicative content<br>• element has a mass number of 35 and atomic number of 17<br>• 17 protons given by atomic number; must have same number of electrons because atoms are neutral<br>• 17 electrons arranged in shells; electronic structure 2, 8, 7<br>• element is in Period 3; number of occupied electron shells<br>• element is in Group 7; number of electrons in the outer shell<br>• element E is chlorine<br>• number of neutrons is 18; difference between mass number and atomic number<br><br>5-6 marks: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br>3-4 marks: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br>1-2 marks: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br>0 marks: The candidate does not make any attempt or give a relevant answer worthy of credit. |

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# Chemistry 2 – Higher tier only questions

| Question Number | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 5 | *(a)* | | | 2 | coal dust has a much greater surface are than lumps of coal (1)<br><br>greater chance of collision / more collisions per unit time (1) | | faster reaction | |
| | | *(b)* | | | 2 | 1 day - correct answer only (2)<br><br>if answer incorrect (1) for any indication of correct working e.g. from 5-15°C halves time from 8 days to 4 days | | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 6 | *(a)* | | | 2 | first mark for sensible suggestion with second mark for linked point/explanation<br><br>e.g. use more calcium oxide (1) more heat would be released on reaction (1)<br>or<br>use smaller pieces of calcium oxide (1) so that reaction occurs more quickly (1) | less water /<br>better insulation on outer wall of can /<br>thinner metal in inner wall | less food | |
| | | *(b)* | | | 2 | bond making releases energy and bond breaking absorbs energy (1)<br>reactions are exothermic if more energy is released than is absorbed (1)<br><br>both marks could be gained by one statement e.g. reactions are exothermic if more energy is released in making bonds than is absorbed in breaking bonds (2) | | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 7 | *(a)* | (i) | | 3 | diagrammatic representation showing clearly two Na atoms losing 1 outer electron each (1)<br><br>one O atom gaining 2 electrons (1)<br><br>$Na^+$ and $O^{2-}$ (both needed) (1)<br><br>there must be no ambiguity e.g. electrons cannot be on atoms and ions at the same time | | | |
| | | | (ii) | | 1 | sodium ion 2, 8<br><br>oxide ion 2, 8 both needed | | | |
| | | *(b)* | | | 3 | simple molecular (1)<br><br>weak bonds between molecules (1)<br><br>only a small amount of energy needed to break them (1) | simple covalent | covalent | |

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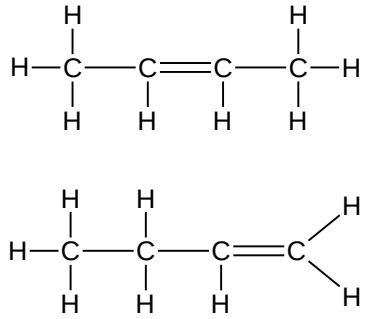
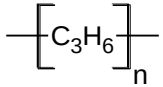
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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 8 | *(a)* | | | 3 | $Fe + Br_2$ (1)<br><br>$FeBr_3$ (1)<br><br>2 3 2 (1)<br>balancing mark only awarded if all formulae are correct | | | |
| | | *(b)* | | | 2 | silver nitrate (solution) (1)<br><br>cream / off-white precipitate (1) | | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 9 | *(a)* | | | 1 | either of following  | correct structure for 2-methylpropene | | |
| | | *(b)* | | | 4 | double bonds open (1R) Reserved mark<br>• propene molecules join together / form chains (1)<br>• (addition) polymerisation (1)<br>• repeat unit  (1)<br>• any 2 of high temp / high pressure / catalyst (1)<br>any 3 up to 3 max | | | condensation polymerisation |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 10 | *(a)* | | | 3 | $M_r(Cu_2S) = 64 + 64 + 32 = 160$ (1)<br><br>1 mol of $Cu_2S$ produces 2 mol of Cu<br>or<br>160 tonnes of $Cu_2S$ produces 128 tonnes of Cu (1)<br><br>20.5 tonnes of $Cu_2S$ produces $\frac{128}{160} \times 20.5$<br><br>= 16.4 tonnes of Cu (1)<br><br>error carried forward possible<br>correct answer only (3) | | | |
| | | *(b)* | | | 2 | 4.1 tonnes of 'missing product' (1)<br><br>$\frac{4.1}{16.4} \times 100 = 25\,\%$ (1)<br><br>error carried forward from *(a)*<br>correct answer only (2) | | | |

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| Question Number | | | |
|---|---|---|---|
| FT | HT | Mark | Answer |
| | 11 | 6 QWC | Indicative content<br>• correct order of reactivity, i.e. chlorine > bromine > iodine<br>• observations relating to the reactions of halogens with iron, e.g. iron glows more brightly in chlorine than bromine<br>• displacement reactions, e.g. chlorine reacts with potassium bromide to give bromine<br>• appropriate word/symbol equations<br><br>5-6 marks: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br>3-4 marks: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br>1-2 marks: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br>0 marks: The candidate does not make any attempt or give a relevant answer worthy of credit. |

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| Surname | Centre Number | Candidate Number |
|---|---|---|
| Other Names | | 0 |

# GCSE

4472/02

## ADDITIONAL SCIENCE/CHEMISTRY

## CHEMISTRY 2
## HIGHER TIER

A.M. TUESDAY, 14 January 2014

1 hour

| For Examiner's use only | | |
|---|---|---|
| **Question** | **Maximum Mark** | **Mark Awarded** |
| **1.** | **8** | |
| **2.** | **4** | |
| **3.** | **6** | |
| **4.** | **6** | |
| **5.** | **6** | |
| **6.** | **9** | |
| **7.** | **7** | |
| **8.** | **4** | |
| **9.** | **4** | |
| **10.** | **6** | |
| **Total** | **60** | |

4472
020001

### ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

### INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

### INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

Assessment will take into account the quality of written communication (QWC) in your answers to questions **4** and **10**.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

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*Answer* **all** *questions.*

**1.** The following table shows information about some atoms, **A–E**.

**A–E are not the chemical symbols for the elements.**

| Atom | **A** | **B** | **C** | **D** | **E** |
|---|---|---|---|---|---|
| atomic number | 3 | 6 | | 10 | 11 |
| mass number | | 12 | 14 | 20 | 23 |
| number of protons | 3 | 6 | 6 | 10 | 11 |
| number of neutrons | 4 | 6 | 8 | 10 | |
| number of electrons | 3 | 6 | 6 | 10 | 11 |

*(a)* **Complete** the table. [3]

*(b)* (i) Give the electronic structure of element **D**. ..... [1]

(ii) Use this information to explain why this element is found in Period 2 and Group 0. [2]

.....

.....

.....

*(c)* Choose the letters, **A–E**, of the atoms that represent isotopes and give a reason for your choice. [2]

*Letters* ..... and .....

*Reason* .....

.....

8

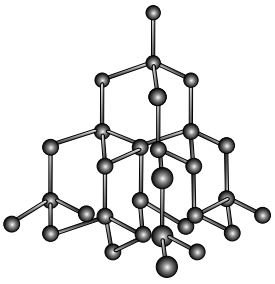
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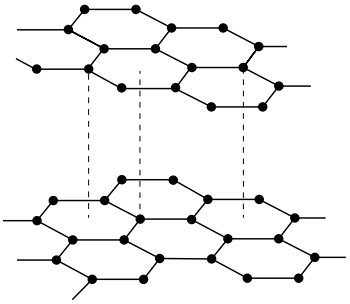
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**2.** The following diagrams show the structures of diamond, graphite and carbon nanotubes.



diamond



graphite



carbon nanotube

*(a)* Two of the structures shown above conduct electricity. Name both and give the reason why they are able to conduct electricity. [2]

*Structures* ..... and .....

*Reason* .....

.....

*(b)* Name the structure above that is used as a lubricant and give a reason why it is suitable for this use. [2]

.....

.....

4

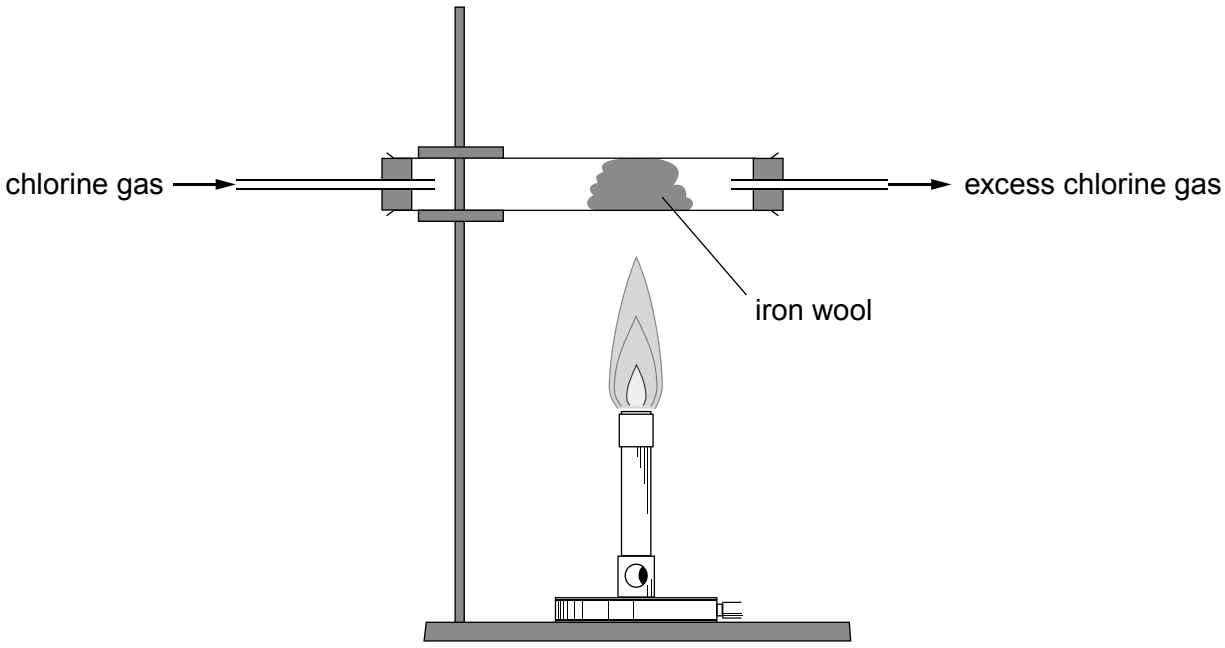
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**3.** The reaction of chlorine with iron can be demonstrated using the following apparatus.




*(a)* State why the reaction should be carried out in a fume cupboard. [1]

.....

.....

*(b)* The product of the reaction above is iron(III) chloride, $FeCl_3$. Complete and balance the following symbol equation for the reaction. [2]

□ ..... + □ ..... ⟶ □ $FeCl_3$

*(c)* Calculate the percentage by mass of chlorine in iron(III) chloride, $FeCl_3$. [3]

$A_r$ (Fe) = 56 $A_r$ (Cl) = 35.5

*Percentage by mass of chlorine* = ..... %

6



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**4.** Thermochromic pigments, photochromic pigments and shape memory alloys are types of smart material.

Describe your understanding of smart materials. [6 QWC]

Your answer should include:

- what is meant by a smart material;
- some examples of smart materials, their special properties and uses.

6

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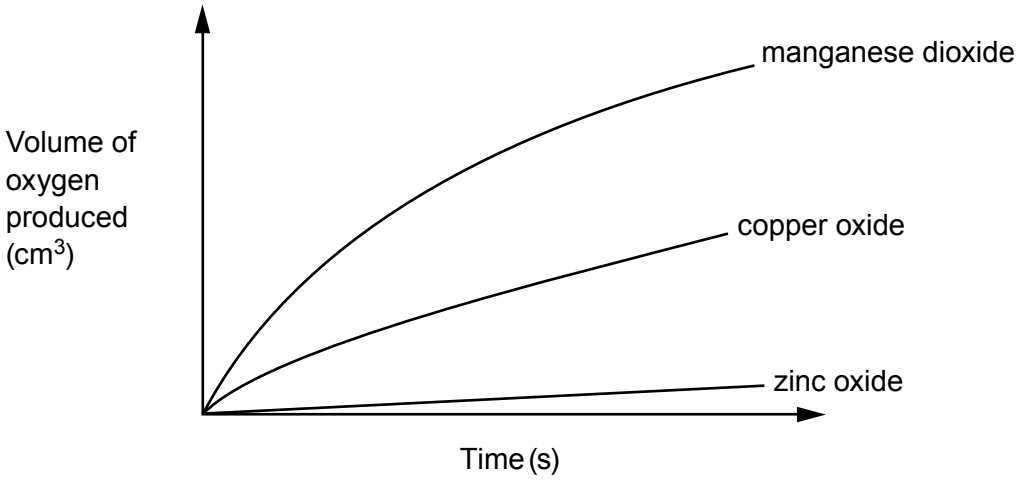
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**5.** Hydrogen peroxide solution, $H_2O_2$, decomposes to form oxygen and water.

$$2H_2O_2 \longrightarrow O_2 + 2H_2O$$

The reaction is very slow at room temperature but can be speeded up by adding certain metal oxide powders, which act as catalysts.

The rate of reaction can be measured by recording the volume of oxygen produced over time. The following graph shows the volume of oxygen produced using three different metal oxides.




*(a)* (i) Compare the results for each metal oxide. [2]

.....

.....

.....

(ii) Give **three** ways of ensuring that the experiment is a fair test. [2]

.....

.....

.....

*(b)* Catalysts are used to speed up industrial processes. Explain why this is important. [2]

.....

.....

.....

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6

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**Turn over.**

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**6.** When lithium reacts with chlorine, lithium chloride is formed.

*(a)* Give the electronic structures of lithium and chlorine. [1]

*lithium* .....

*chlorine* .....

*(b)* Use the electronic structures above to draw diagrams to show the transfer of electrons and the formation of ions that occur as lithium chloride is formed. [3]

*(c)* Oxygen has an electronic structure of 2,6.

Use this information to draw a diagram to show the bonding in a molecule of oxygen, $O_2$. [2]

*(d)* Lithium chloride is a solid at room temperature whereas oxygen is a gas.

Name the type of bonding present in each substance and explain the difference in their states at room temperature. [3]

.....

.....

.....

.....

9

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**7.** A scientist carried out tests to identify halides **A**, **B** and **C**. The results are shown in the table below.

| Substance | Result when carrying out a flame test | Observation when adding silver nitrate solution |
|---|---|---|
| **A** | lilac flame | white precipitate |
| **B** | yellow flame | yellow precipitate |
| **C** | red flame | cream/off-white precipitate |

*(a)* Use the results to identify substances **A**, **B** and **C**. [3]

**A** .....

**B** .....

**C** .....

*(b)* Chlorine gas is bubbled through a solution of potassium bromide. The solution turns orange as bromine is formed.

(i) State why this happens. [1]

.....

(ii) Write a balanced **symbol** equation for the reaction taking place. [3]

..... + ..... ⟶ ..... + .....

7

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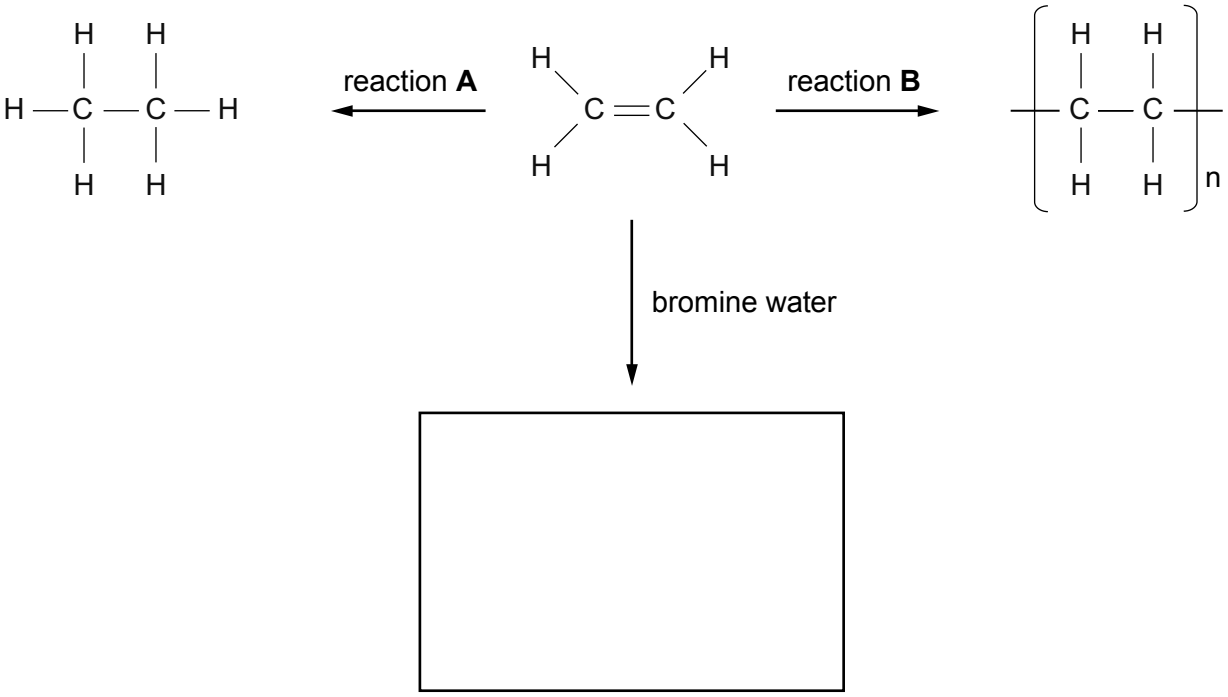


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**Turn over.**

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**8.** The following diagram shows some reactions of ethene.




*(a)* (i) Complete the diagram by giving the missing structure. [1]

(ii) Describe what would be **seen** during the reaction between ethene and orange bromine water. [1]

.....

*(b)* Give the names of the **types** of the reactions labelled **A** and **B**. [2]

*Reaction* **A** .....

*Reaction* **B** .....

4

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**9.** Copper is an important metal in everyday life. It can be produced from its oxide by heating with carbon. The equation for the reaction is shown below.

$$2CuO + C \longrightarrow 2Cu + CO_2$$

*(a)* Use the equation to calculate the maximum mass of copper that could be produced when using 1.5 tonnes of carbon. [3]

$A_r$ (Cu) = 64 $A_r$ (C) = 12

*Maximum mass of copper* = ..... tonnes

*(b)* When the reaction was carried out using 1.5 tonnes of carbon, it was found that the yield of copper was only 12 tonnes. Calculate the percentage yield for the reaction. [1]

*Percentage yield* = ..... %

4

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**10.** Describe and compare the methods that can be used to soften hard water. [6 QWC]

6

**END OF PAPER**

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## FORMULAE FOR SOME COMMON IONS

| POSITIVE IONS | | NEGATIVE IONS | |
|---|---|---|---|
| **Name** | **Formula** | **Name** | **Formula** |
| Aluminium | $Al^{3+}$ | Bromide | $Br^{-}$ |
| Ammonium | $NH_4^{+}$ | Carbonate | $CO_3^{2-}$ |
| Barium | $Ba^{2+}$ | Chloride | $Cl^{-}$ |
| Calcium | $Ca^{2+}$ | Fluoride | $F^{-}$ |
| Copper(II) | $Cu^{2+}$ | Hydroxide | $OH^{-}$ |
| Hydrogen | $H^{+}$ | Iodide | $I^{-}$ |
| Iron(II) | $Fe^{2+}$ | Nitrate | $NO_3^{-}$ |
| Iron(III) | $Fe^{3+}$ | Oxide | $O^{2-}$ |
| Lithium | $Li^{+}$ | Sulfate | $SO_4^{2-}$ |
| Magnesium | $Mg^{2+}$ | | |
| Nickel | $Ni^{2+}$ | | |
| Potassium | $K^{+}$ | | |
| Silver | $Ag^{+}$ | | |
| Sodium | $Na^{+}$ | | |
| Zinc | $Zn^{2+}$ | | |

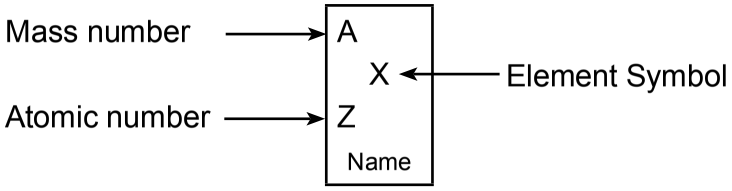
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# PERIODIC TABLE OF ELEMENTS

| 1 | 2 | Group | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | $^{1}_{1}$H Hydrogen | | | | | | | | | $^{4}_{2}$He Helium |
| $^{7}_{3}$Li Lithium | $^{9}_{4}$Be Beryllium | | | | | | | | | | | $^{11}_{5}$B Boron | $^{12}_{6}$C Carbon | $^{14}_{7}$N Nitrogen | $^{16}_{8}$O Oxygen | $^{19}_{9}$F Fluorine | $^{20}_{10}$Ne Neon |
| $^{23}_{11}$Na Sodium | $^{24}_{12}$Mg Magnesium | | | | | | | | | | | $^{27}_{13}$Al Aluminium | $^{28}_{14}$Si Silicon | $^{31}_{15}$P Phosphorus | $^{32}_{16}$S Sulfur | $^{35}_{17}$Cl Chlorine | $^{40}_{18}$Ar Argon |
| $^{39}_{19}$K Potassium | $^{40}_{20}$Ca Calcium | $^{45}_{21}$Sc Scandium | $^{48}_{22}$Ti Titanium | $^{51}_{23}$V Vanadium | $^{52}_{24}$Cr Chromium | $^{55}_{25}$Mn Manganese | $^{56}_{26}$Fe Iron | $^{59}_{27}$Co Cobalt | $^{59}_{28}$Ni Nickel | $^{64}_{29}$Cu Copper | $^{65}_{30}$Zn Zinc | $^{70}_{31}$Ga Gallium | $^{73}_{32}$Ge Germanium | $^{75}_{33}$As Arsenic | $^{79}_{34}$Se Selenium | $^{80}_{35}$Br Bromine | $^{84}_{36}$Kr Krypton |
| $^{86}_{37}$Rb Rubidium | $^{88}_{38}$Sr Strontium | $^{89}_{39}$Y Yttrium | $^{91}_{40}$Zr Zirconium | $^{93}_{41}$Nb Niobium | $^{96}_{42}$Mo Molybdenum | $^{99}_{43}$Tc Technetium | $^{101}_{44}$Ru Ruthenium | $^{103}_{45}$Rh Rhodium | $^{106}_{46}$Pd Palladium | $^{108}_{47}$Ag Silver | $^{112}_{48}$Cd Cadmium | $^{115}_{49}$In Indium | $^{119}_{50}$Sn Tin | $^{122}_{51}$Sb Antimony | $^{128}_{52}$Te Tellurium | $^{127}_{53}$I Iodine | $^{131}_{54}$Xe Xenon |
| $^{133}_{55}$Cs Caesium | $^{137}_{56}$Ba Barium | $^{139}_{57}$La Lanthanum | $^{179}_{72}$Hf Hafnium | $^{181}_{73}$Ta Tantalum | $^{184}_{74}$W Tungsten | $^{186}_{75}$Re Rhenium | $^{190}_{76}$Os Osmium | $^{192}_{77}$Ir Iridium | $^{195}_{78}$Pt Platinum | $^{197}_{79}$Au Gold | $^{201}_{80}$Hg Mercury | $^{204}_{81}$Tl Thallium | $^{207}_{82}$Pb Lead | $^{209}_{83}$Bi Bismuth | $^{210}_{84}$Po Polonium | $^{210}_{85}$At Astatine | $^{222}_{86}$Rn Radon |
| $^{223}_{87}$Fr Francium | $^{226}_{88}$Ra Radium | $^{227}_{89}$Ac Actinium | | | | | | | | | | | | | | | |

Key:




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(4472-02)

# GCSE MARKING SCHEME

## SCIENCE - CHEMISTRY

## JANUARY 2014

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## INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2014 examination in GCSE SCIENCE - CHEMISTRY. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.


| | Page |
|---|---|
| C1 | 1 |
| C2 | 15 |


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Chemistry 2 – Foundation Tier only questions

| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| **1** | | (a) | (i) | | 1 | 2,8,7 | | | |
| | | | (ii) | | 1 | **D** and **E** (both needed) | | | |
| | | | (iii) | | 1 | **A** and **D** (both needed) | | | |
| | | | (iv) | | 1 | 5 | | | |
| | | (b) | | | 2 | 1 (1)<br>+1 (1) | | 1 | |

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| Question Number | | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | | | | | | | | |
| **2** | | (a) | | | 1 | potassium | K | | |
| | | (b) | | | 1 | potassium + oxygen → potassium oxide<br><br>follow through (ft) error from (a) only if Group 1 metal given | $K + O_2 \rightarrow K_2O$ (ignore balancing) consequential possible | gas | |
| | | (c) | | | 1 | lithium / sodium<br><br>ft only if Group 1 metal given is less reactive than that named in (a) | Li / Na | | |
| | | (d) | (i) | | 1 | silver nitrate | $AgNO_3$ | | |
| | | | (ii) | | 1 | dissolved (in water) | diluted / solution | liquid / molten | |
| | | | (iii) | | 1 | white<br>independent of (i) | | milky | creamy |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| **3** | | (a) | | | 1 | horse **C** | | | |
| | | (b) | | | 1 | no, none have a spot corresponding to caffeine | no samples match caffeine | | |
| | | (c) | | | 2 | 3 (1)<br>$R_f$ value = 0.3 (1)<br>correct answer only (cao) – 2 marks<br><br>ft incorrect 'distance moved' only if value given divided by 10 i.e. correct distance moved by solvent – 1 mark | | | |

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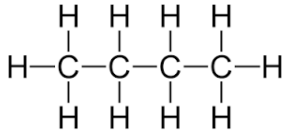
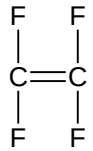
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| Question Number | | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | | | | | | | | |
| **4** | | (a) | | | 1 | sodium chloride | NaCl | | |
| | | (b) | | | 1 | 62 | | | |
| | | (c) | | | 2 | 140 – 80 (1)<br>60 (1) cao – 2 marks | | | |
| | | (d) | | | 2 | increases (to maximum) then falls / up and down (1)<br><br>maximum at 30 °C /<br>maximum of 70 ± 2 g per 100 g water (1)<br><br>rises more steeply than it falls – 2 marks | | | |

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| Question Number | | | | | | | | | |
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| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| **5** | | (a) | | | 4 | *Name* propene (1)<br><br>*Molecular formula* $CH_4$ (1)<br><br>*Structural formula*  (1)<br><br>*Family of hydrocarbons* – **both** needed (1)<br><br>alkane<br><br>alkene | | | |
| | | (b) | | | 2 | double bond breaks / changes to single bond (1)<br>**many** ethene molecules join together / form **long chain** or **polymer** (1) | | | |
| | | (c) | | | 1 |  ignore ‘n’ and any brackets used | | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| **6** | | (a) | (i) | | 3 | all points plotted correctly (2)<br>4 correct (1)<br><br>smooth curve through points (1) | | | <br><br><br>line drawn using ruler |
| | | | (ii) | | 1 | the higher the temperature,<br>the shorter the time / faster the reaction / higher the rate | 'faster the rate' | | 'faster / quicker the **time**' |
| | | | (iii) | | 1 | curve must be **below** original curve and **steeper** – ignore end point | | | |
| | | (b) | | | 2 | light intensity decreases (1)<br><br>continuous readings / graph plotted automatically /<br>more precise end point (1) | light blocked<br><br>more reliable than eyesight /<br>more repeatable / no judgement required | <br><br>reference to 'reliability' or 'accuracy' or to 'human error' needs qualification | <br><br>'**no chance** of human error' |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| **7** | **1** | (a) | | | 3 | *mass number* 7 (1)<br>*atomic number* 6 (1)<br>*number of neutrons* 12 (1) | | | |
| | | (b) | (i) | | 1 | 2,8 | | | |
| | | | (ii) | | 2 | two shells (containing electrons)<br><br>outer shell is full / can't accept any more electrons | | <br><br>8 in outer shell | |
| | | (c) | | | 2 | **B** and **C** (1)<br><br>same number of protons but different numbers of neutrons / same atomic number but different mass number (1)<br><br>[marks linked i.e. second mark cannot be awarded if first is not given] | | <br><br>reference to electrons | |

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| Question Number | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| **8** | **2** | (a) | | | 2 | graphite and nanotube (1)<br><br>both have **free moving** / **delocalised** electrons (1) | mark independently | | |
| | | (b) | | | 2 | graphite (1)<br><br>weak bonds **between** layers /<br>**layers** able to slide over each other (1)<br><br>[marks linked i.e. second mark cannot be awarded if first is not given] | | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| **9** | **3** | (a) | | | 1 | chlorine gas is toxic / poisonous | | harmful / dangerous / kills<br><br>any reference to $FeCl_3$ | |
| | | (b) | | | 2 | Fe + $Cl_2$ (1)<br><br>balancing 2,3,2 (1)<br><br>[balancing mark only awarded if correct formulae included] | | | |
| | | (c) | | | 3 | $M_r(FeCl_3)$ = 162.5 [or 3 × $A_r$(Cl) = 106.5] (1)<br><br>106.5 / 162.5 × 100 (1)<br><br>65.5% (1)<br><br>cao – 3 marks | allow 66 | | |

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| Question Number | | | |
|---|---|---|---|
| FT | HT | Mark | Answer |
| **10** | **4** | 6<br>QWC | **Indicative content**<br>Materials that change their properties reversibly according to conditions; thermochromic pigments change colour according to temperature; photochromic pigments change colour according to light intensity; shape memory alloys can regain shape by heating / spring back in to shape (NITINOL)<br><br>Uses: thermochromic pigments – forehead thermometers, baby spoons etc.<br>photochromic pigments – lenses for sunglasses; UV marker pens etc.<br>shape memory alloys – spectacle frames; stents in veins etc.<br><br>**5–6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3–4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>**1–2 marks** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit. |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | **5** | (a) | (i) | | 2 | manganese dioxide is most effective / little effect with zinc oxide (1)<br><br>full description of correct order of effect (2)<br><br>more oxygen produced as time progresses / reaction slows down as time goes on (1)<br><br>(2 max) | | | reference to one oxide being more '**reactive**' than another |
| | | | (ii) | | 2 | same concentration of hydrogen peroxide<br><br>same volume of hydrogen peroxide<br><br>same mass/amount of metal oxide<br><br>same temperature / specified temperature<br><br>same particle size for each oxide<br><br>any 3 for 2 marks; any 2 for 1 mark | <br><br><br><br>room temperature | same amount of hydrogen peroxide<br><br>ignore time | |
| | | (b) | | | 2 | two linked points required for 2 marks e.g.<br><br>allows lower temperature to be used (1) which saves energy / improves efficiency / reduces costs (1)<br><br>more product in the same time (1) which increases profitability / makes it more economical (1) | other relevant linked points | | |

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| Question Number | | | | | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | | | | | |
| | **6** | (a) | | | 1 | *lithium* 2,1<br>*chlorine* 2,8,7 - **both** needed for 1 mark | | | |
| | | (b) | | | 3 | lithium loses 1 electron (1)<br>chlorine gains 1 electron (1)<br><br>forms $Na^+$ and $Cl^-$ (1)<br><br>diagram clearly shows transfer with no ambiguity<br>e.g. electron(s) not in two places at the same time | | | |
| | | (c) | | | 2 | sharing 2 pairs of electrons (1)<br><br>full octet around both oxygen (1) | | | |
| | | (d) | | | 3 | lithium chloride is ionic **and** oxygen is covalent (1)<br><br>strong bonds between <u>ions</u> in lithium chloride result in high melting point (1)<br>weak bonds between <u>molecules</u> in oxygen result in low boiling point (1) | (1) only if 'particles' used instead of 'ions' and 'molecules' | | |

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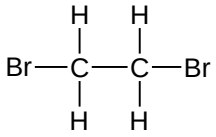
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| Question Number | | | | | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | | | | | |
| | **7** | (a) | | | 3 | **A** – potassium chloride (1)<br>**B** – sodium iodide (1)<br>**C** – lithium bromide (1) | KCl<br>NaI<br>LiBr | ions identified | |
| | | (b) | (i) | | 1 | chlorine is more reactive than bromine **and** displaces it from its halide | | | |
| | | | (ii) | | 3 | reactants KBr + $Cl_2$ (1)<br>products KCl + $Br_2$ (1)<br>balancing 2,1,2,1 (1)<br>[balancing mark only awarded if correct formulae included] | | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | **8** | (a) | (i) | | 1 |  | | | |
| | | | (ii) | | 1 | (bromine) turns colourless | decolourises | colour change ‘goes clear’ | |
| | | (b) | | | 2 | *Reaction* **A** addition (1)<br><br>*Reaction* **B** polymerisation (1) | hydrogenation / reduction<br><br>addition polymerisation | <br><br>additional | additional / polymerisation |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | **9** | (a) | | | 3 | 1:2 ratio from equation (1)<br><br>12 tonnes C would produce 128 tonnes of copper (1)<br><br>1.5 tonnes C would produce 1.5/12 × 128<br>= 16 tonnes of copper (1)<br><br>cao – 3 marks<br><br>alternative method using moles<br><br>moles C = 0.125 (1)<br>moles Cu = 0.25 (1)<br>mass Cu = 0.25 × 64 = 16 (1) | 15.9 (3 marks) | | |
| | | (b) | | | 1 | 75% | consequential | | |

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| Question Number | | | |
|---|---|---|---|
| FT | HT | Mark | Answer |
| | **10** | 6 QWC | **Indicative content:**<br><br>**Ion exchange:** beads containing sodium ions; calcium / magnesium ions in hard water are exchanged for sodium ions; column can be recharged by passing sodium chloride solution through it. Advantages – works on both permanent and temporary hardness; continuous. Disadvantages – cost of column; need to recharge; waste water from recharging can cause limescale in sewage works; increased sodium levels in softened water.<br><br>**Boiling:** boiling causes hydrogencarbonate ions to decompose forming scale on heating element. Advantages – no need for expensive equipment. Disadvantages – forms limescale; does not work on permanent hardness. Only effective with small volumes of water.<br><br>**Washing soda:** reacts with calcium and magnesium ions to produce insoluble salts but produces scum. Effective with both permanent and temporary.<br><br>**5–6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3–4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>**1–2 marks** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit. |



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| Surname | Centre Number | Candidate Number |
|---|---|---|
| Other Names | | 0 |

# GCSE

4472/02

## ADDITIONAL SCIENCE/CHEMISTRY

## CHEMISTRY 2
## HIGHER TIER

P.M. MONDAY, 20 May 2013

1 hour

| For Examiner's use only | | |
|---|---|---|
| **Question** | **Maximum Mark** | **Mark Awarded** |
| **1.** | **8** | |
| **2.** | **5** | |
| **3.** | **5** | |
| **4.** | **6** | |
| **5.** | **8** | |
| **6.** | **5** | |
| **7.** | **6** | |
| **8.** | **4** | |
| **9.** | **7** | |
| **10.** | **6** | |
| **Total.** | **60** | |

4472
020001

### ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

### INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

### INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

Assessment will take into account the quality of written communication (QWC) used in your answers to questions **4** and **10**.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

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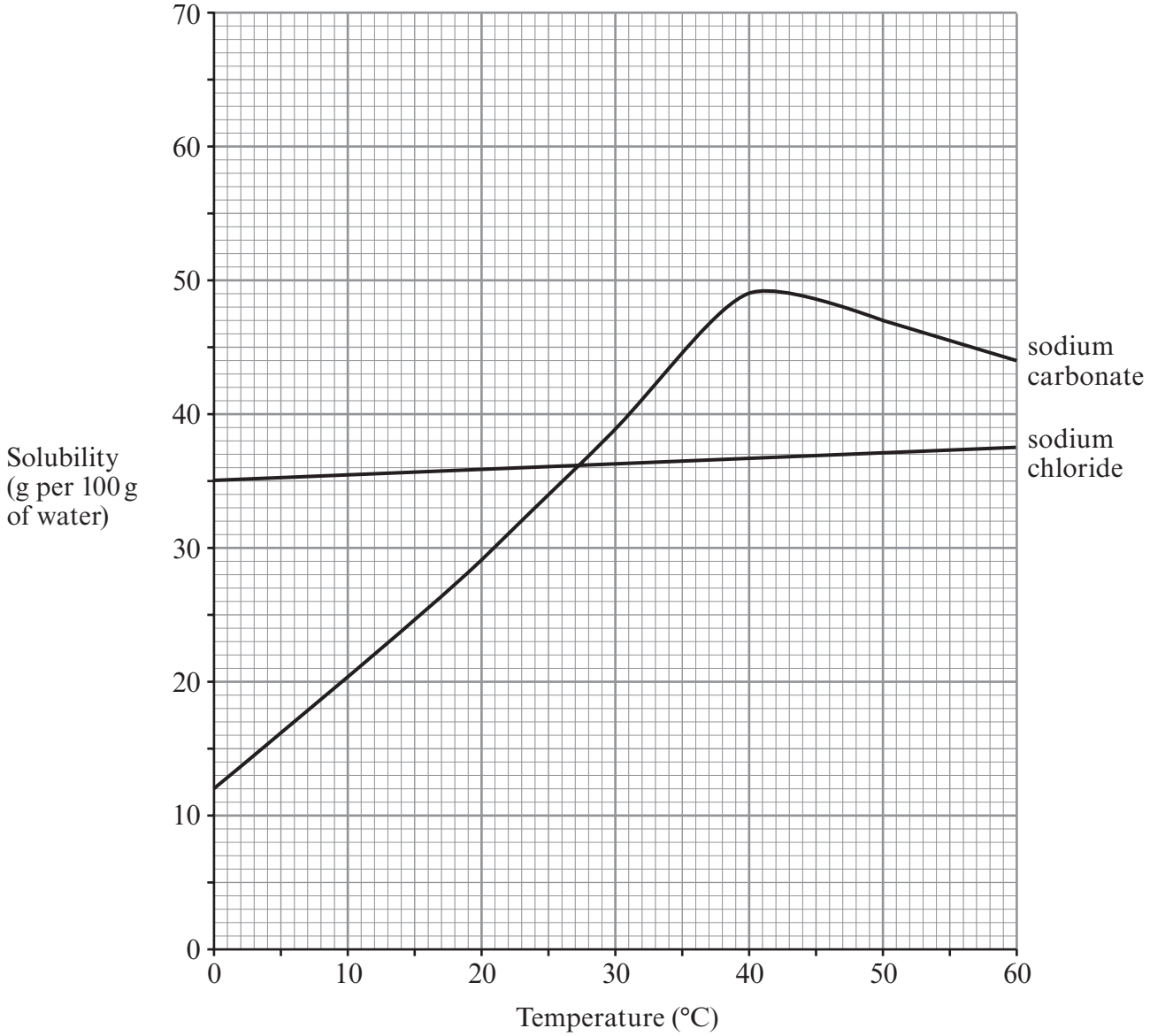


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*Answer* **all** *questions.*

**1.** The graphs below show the solubilities of sodium chloride and sodium carbonate in water at different temperatures.




*(a)* Describe the trend in the solubility of sodium carbonate. [1]

.....

.....

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*(b)* The table below shows the solubility of sodium bromate in water at different temperatures.

| Temperature (°C) | 0 | 10 | 20 | 30 | 40 | 50 | 60 |
|---|---|---|---|---|---|---|---|
| Solubility (g per 100 g of water) | 25 | 29 | 35 | 41 | 48 | 55 | 64 |

Plot the results from the table on the grid opposite and draw a suitable line. [3]

*(c)* List the three sodium compounds in order of solubility at 40 °C. [1]

*Most soluble* .....

.....

*Least soluble* .....

*(d)* The solubility of silver chloride is 0.0002 g in 100 g of water at room temperature, 20 °C.

You are given a mixture of sodium chloride and silver chloride powder. Describe how you would obtain a sample of silver chloride from the mixture. [3]

.....

.....

.....

.....

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**2.** The reaction between hydrogen and chlorine to give hydrogen chloride can be represented by the following equation.

$$H{-}H + Cl{-}Cl \longrightarrow \begin{matrix} H{-}Cl \\ H{-}Cl \end{matrix}$$

The relative amounts of energy needed to break the bonds shown are given in the table below.

| Bond | Amount of energy needed to break the bond (kJ) |
|---|---|
| H — H | 436 |
| Cl — Cl | 242 |
| H — Cl | 431 |

NOTE: *The amount of energy **released** in making a bond is equal and opposite to that **needed** to break the bond.*

*(a)* Using the bond energy values in the table, calculate

(i) the relative energy needed to break all the bonds in the **reactants**, [2]

.....

.....

(ii) the relative energy given out when all the bonds in the **product** are formed. [2]

.....

.....

*(b)* Using your answers to part *(a)*, state whether the reaction between hydrogen and chlorine is exothermic or endothermic and give a reason for your answer. [1]

.....

.....



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**3.** *(a)* A group of students carry out an experiment to investigate the relative hardness of four samples of water, **A**, **B**, **C** and **D**.

The students add soap solution, 0.5 $cm^3$ at a time, to sample **A**. The mixture is shaken after each addition. The volume of soap solution needed to produce 1 cm of lather is recorded. They test samples **B**, **C** and **D** in exactly the same way. They then repeat the experiment after boiling each sample of water.

The results obtained are shown in the table below.

| Water sample | Volume of soap solution needed ($cm^3$) | |
|---|---|---|
| | Before boiling | After boiling |
| **A** | 10.5 | 10.5 |
| **B** | 1.5 | 1.5 |
| **C** | 6.0 | 1.5 |
| **D** | 9.5 | 7.0 |

(i) State which water sample is the hardest and give a reason for your answer. [1]

.....

.....

(ii) State which water sample contains both permanent and temporary hard water and give a reason for your answer. [2]

.....

.....

.....

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*(b)* A different group of students carry out a similar investigation with the same water samples, **A**, **B**, **C** and **D**.

Their results are as follows.

| Water sample | Volume of soap solution needed ($cm^3$) | |
|---|---|---|
| | Before boiling | After boiling |
| **A** | 6.0 | 6.0 |
| **B** | 1.0 | 1.0 |
| **C** | 3.5 | 1.0 |
| **D** | 5.5 | 3.0 |

Compare the results obtained by the two groups, commenting on the similarity and suggesting a reason for the difference. [2]

.....

.....

.....

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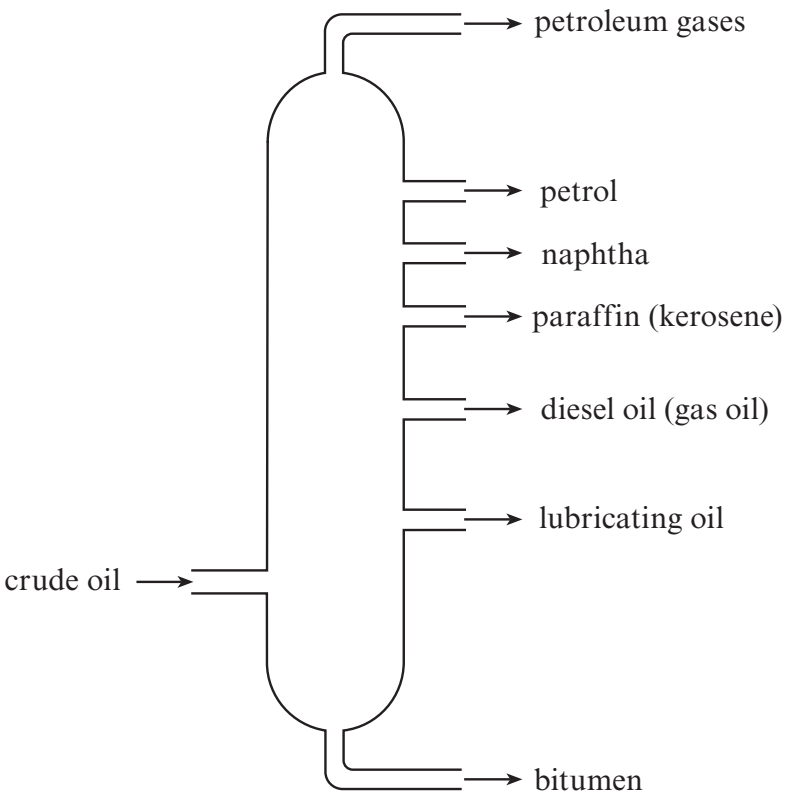




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**4.** The diagram below represents the separation of crude oil into useful fractions in industry.




Write an account of this industrial process. [6 QWC]

Include in your answer

- the name of the separation method,
- what crude oil is,
- a description of how crude oil is separated.

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**5.** *(a)* Give the electronic structure of sodium, Na. [1]

.....

*(b)* Draw a diagram to show the metallic bonding in sodium. [2]

*(c)* (i) Sodium reacts vigorously with water.

Give **two** observations you would make when a small piece of sodium is added to a trough of water. [1]

.....

.....

(ii) Name the products of this reaction. [1]

..... and .....

*(d)* As you go down Group 1 of the Periodic Table the elements become more reactive.

State the main difference you would see if potassium instead of sodium was added to water. [1]

.....

*(e)* Explain why Group 1 metal reactivity increases down the group. [2]

.....

.....

.....



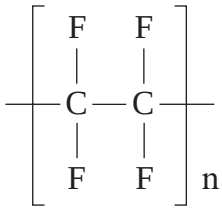
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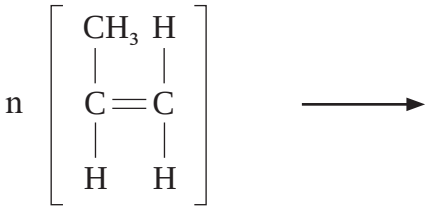
**6.** *(a)* (i) Give the chemical name of the polymer represented by the diagram below. [1]




.....

(ii) Propene undergoes polymerisation to give the polymer polypropene.

I Complete the equation for the production of polypropene. [1]




II Name this type of polymerisation. [1]

.....

*(b)* There are two types of plastic: thermoplastics and thermosets.

Give **one** similarity and **one** difference in their structures. [2]

*Similarity* .....

.....

*Difference* .....

.....



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**Turn over.**

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**7.** Substance **S** is a white, solid metal bromide. It dissolves readily in water to give a colourless solution.

*(a)* On carrying out a flame test with substance **S** a red colour was seen. Name the metal ions present in substance **S**. [1]

.....

*(b)* Some silver nitrate solution was added to a solution of substance **S**.

(i) State what was seen. [1]

.....

(ii) Give the **ionic** equation for the reaction taking place. [2]

..... + ..... ⟶ .....

*(c)* When a Group 7 gas, **G**, is passed through a solution of **S**, the solution turns orange.

(i) Name gas **G**. ..... [1]

(ii) Give the name of the **type** of reaction that takes place between gas **G** and substance **S**. [1]

.....

6

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**8.** James and Dilys were asked to carry out an experiment to find the formula of an oxide of copper. In their experiment a crucible containing copper was weighed before heating, then after 5 minutes, 10 minutes and 15 minutes of heating.

Results

| | |
|---|---|
| Mass of crucible (g) | 25.0 |
| Mass of crucible and copper before heating (g) | 37.7 |
| Mass of crucible and copper after heating for 5 minutes (g) | 40.4 |
| Mass of crucible and copper after heating for 10 minutes (g) | 40.9 |
| Mass of crucible and copper after heating for 15 minutes (g) | 40.9 |

*(a)* In their calculation they did not use the mass recorded after 5 minutes.
Give the reason why they correctly ignored this value. [1]

.....

.....

*(b)* Calculate the simplest formula of the copper oxide using the above data. [3]

**Show your working**.

$A_r(Cu) = 63.5$ $A_r(O) = 16$

*Simplest formula* .....

4

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**9.** *(a)* Lithium reacts with sulfur to form lithium sulfide.

Using the electronic structures below, draw dot and cross diagrams to show the transfer of electrons and the formation of ions that occur as the reaction takes place. [3]

lithium = 2,1 sulfur = 2,8,6

*(b)* Sodium chloride and magnesium oxide both have giant ionic structures.

The melting points of the two compounds are given below.

| Compound | Melting point (°C) |
|---|---|
| sodium chloride | 801 |
| magnesium oxide | 2852 |

Explain the difference in the melting points of the two compounds. [2]

.....

.....

.....

.....

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*(c)* Using the electronic structures below, draw a dot and cross diagram to show the bonding in a molecule of hydrogen peroxide. [2]

The structural formula for hydrogen peroxide is as follows.

H — O — O — H

hydrogen = 1 oxygen = 2,6



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**10.** Explain, using particle theory, how the rate of a chemical reaction depends on concentration and temperature. [6 QWC]

**END OF PAPER**

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## FORMULAE FOR SOME COMMON IONS

| POSITIVE IONS | | NEGATIVE IONS | |
|---|---|---|---|
| **Name** | **Formula** | **Name** | **Formula** |
| Aluminium | $Al^{3+}$ | Bromide | $Br^{-}$ |
| Ammonium | $NH_4^{+}$ | Carbonate | $CO_3^{2-}$ |
| Barium | $Ba^{2+}$ | Chloride | $Cl^{-}$ |
| Calcium | $Ca^{2+}$ | Fluoride | $F^{-}$ |
| Copper(II) | $Cu^{2+}$ | Hydroxide | $OH^{-}$ |
| Hydrogen | $H^{+}$ | Iodide | $I^{-}$ |
| Iron(II) | $Fe^{2+}$ | Nitrate | $NO_3^{-}$ |
| Iron(III) | $Fe^{3+}$ | Oxide | $O^{2-}$ |
| Lithium | $Li^{+}$ | Sulfate | $SO_4^{2-}$ |
| Magnesium | $Mg^{2+}$ | | |
| Nickel | $Ni^{2+}$ | | |
| Potassium | $K^{+}$ | | |
| Silver | $Ag^{+}$ | | |
| Sodium | $Na^{+}$ | | |
| Zinc | $Zn^{2+}$ | | |

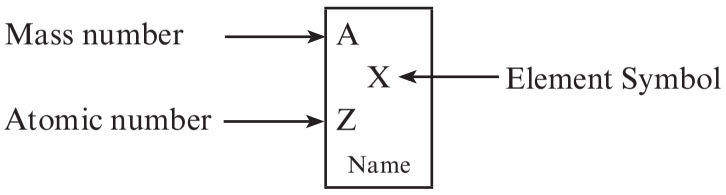
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# PERIODIC TABLE OF ELEMENTS

| 1 | 2 | Group | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | $^{1}_{1}$H Hydrogen | | | | | | | | | $^{4}_{2}$He Helium |
| $^{7}_{3}$Li Lithium | $^{9}_{4}$Be Beryllium | | | | | | | | | | | $^{11}_{5}$B Boron | $^{12}_{6}$C Carbon | $^{14}_{7}$N Nitrogen | $^{16}_{8}$O Oxygen | $^{19}_{9}$F Fluorine | $^{20}_{10}$Ne Neon |
| $^{23}_{11}$Na Sodium | $^{24}_{12}$Mg Magnesium | | | | | | | | | | | $^{27}_{13}$Al Aluminium | $^{28}_{14}$Si Silicon | $^{31}_{15}$P Phosphorus | $^{32}_{16}$S Sulfur | $^{35}_{17}$Cl Chlorine | $^{40}_{18}$Ar Argon |
| $^{39}_{19}$K Potassium | $^{40}_{20}$Ca Calcium | $^{45}_{21}$Sc Scandium | $^{48}_{22}$Ti Titanium | $^{51}_{23}$V Vanadium | $^{52}_{24}$Cr Chromium | $^{55}_{25}$Mn Manganese | $^{56}_{26}$Fe Iron | $^{59}_{27}$Co Cobalt | $^{59}_{28}$Ni Nickel | $^{64}_{29}$Cu Copper | $^{65}_{30}$Zn Zinc | $^{70}_{31}$Ga Gallium | $^{73}_{32}$Ge Germanium | $^{75}_{33}$As Arsenic | $^{79}_{34}$Se Selenium | $^{80}_{35}$Br Bromine | $^{84}_{36}$Kr Krypton |
| $^{86}_{37}$Rb Rubidium | $^{88}_{38}$Sr Strontium | $^{89}_{39}$Y Yttrium | $^{91}_{40}$Zr Zirconium | $^{93}_{41}$Nb Niobium | $^{96}_{42}$Mo Molybdenum | $^{99}_{43}$Tc Technetium | $^{101}_{44}$Ru Ruthenium | $^{103}_{45}$Rh Rhodium | $^{106}_{46}$Pd Palladium | $^{108}_{47}$Ag Silver | $^{112}_{48}$Cd Cadmium | $^{115}_{49}$In Indium | $^{119}_{50}$Sn Tin | $^{122}_{51}$Sb Antimony | $^{128}_{52}$Te Tellurium | $^{127}_{53}$I Iodine | $^{131}_{54}$Xe Xenon |
| $^{133}_{55}$Cs Caesium | $^{137}_{56}$Ba Barium | $^{139}_{57}$La Lanthanum | $^{179}_{72}$Hf Hafnium | $^{181}_{73}$Ta Tantalum | $^{184}_{74}$W Tungsten | $^{186}_{75}$Re Rhenium | $^{190}_{76}$Os Osmium | $^{192}_{77}$Ir Iridium | $^{195}_{78}$Pt Platinum | $^{197}_{79}$Au Gold | $^{201}_{80}$Hg Mercury | $^{204}_{81}$Tl Thallium | $^{207}_{82}$Pb Lead | $^{209}_{83}$Bi Bismuth | $^{210}_{84}$Po Polonium | $^{210}_{85}$At Astatine | $^{222}_{86}$Rn Radon |
| $^{223}_{87}$Fr Francium | $^{226}_{88}$Ra Radium | $^{227}_{89}$Ac Actinium | | | | | | | | | | | | | | | |

Key:




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# GCSE MARKING SCHEME

## SCIENCE - CHEMISTRY

## SUMMER 2013

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## INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2013 examination in GCSE SCIENCE - CHEMISTRY. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.


| | Page |
|---|---|
| Unit C1 | 1 |
| Unit C2 | 17 |
| Unit C3 | 34 |


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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 1 | | (a) | (i) | | 1 | proton | | p | |
| | | | (ii) | | 1 | lithium | Li | | |
| | | (b) | | | 2 | nitrogen and hydrogen – both needed (1)<br><br>covalent (1) | | N and H<br><br>simple | <br><br>giant |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 2 | | (a) | | | 2 | graphite ——— giant covalent<br>potassium ——— metallic<br>sodium chloride ——— giant ionic<br><br>three correct answers (2)<br>one correct answer (1) | | | |
| | | (b) | | | 1 | graphite | | giant covalent | |
| | | (c) | | | 1 | carbon dioxide, water, etc | $CO_2$, $H_2O$, etc | | |

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| Question Number | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 3 | | (a) | | | 2 | negative / –1 (1)<br><br>1 (1) | | | |
| | | (b) | | | 1 | 19<br><br>9 – both needed | | | |
| | | (c) | | | 2 | 17 (1)<br><br>20 (1) | | | |
| | | (d) | | | 1 | 2,8,1 | | | |
| | | (e) | | | 1 | 2,8,8,2 | | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 4 | | (a) | | | 1 | thermochromic pigment | | | |
| | | (b) | | | 3 | heat both / place in hot water (1)<br><br>thermoplastic softens or melts (1)<br><br>the shape memory polymer returns to its original shape / form (1) | stays the same | change temperature | |

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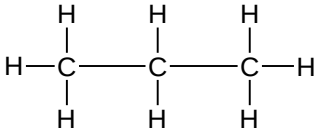
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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 5 | | (a) | | | 1 | C | 98 and 890 | | |
| | | (b) | | | 1 | to prevent sodium reacting with air/oxygen/water (vapour) | prevent from oxidising / corroding | because it reacts with air/oxygen/water (vapour) | |
| | | (c) | (i) | | 1 | yellow<br>yellow/orange | orange | | |
| | | | (ii) | | 2 | sodium + oxygen (1)<br>sodium oxide (1) | $Na + O_2$ (1)<br>$Na_2O$ (1)<br>– ignore balancing | | |
| | | | (iii) | | 1 | $2Na + Cl_2 \rightarrow 2NaCl$ | | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 6 | | (a) | | | 1 | $C_4H_{10}$ | | | |
| | | (b) | | | 2 | propane (1)<br> (1) | | | |
| | | (c) | | | 1 | $C_3H_6$ | | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 7 | | (a) | (i) | | 2 | collection of gas<br>(e.g. in a gas syringe or gas jar) (1)<br><br>experiment repeated with different particle size of zinc (1) | mass method<br>disappearing zinc | | |
| | | | (ii) | | 2 | same mass (or amount) of zinc / same volume (or amount) of acid / same concentration of acid / same temperature or room temperature<br>– any two for (1) each | | repeat readings<br>same apparatus | |
| | | | (iii) | | 1 | the fastest is the experiment that gives the volume of gas in the least time | fastest reaction is the one giving off most bubbles in a given time | | |
| | | (b) | (i) | | 1 | less time / time decrease | | faster reaction | |
| | | | (ii) | | 1 | volume of gas remains the same | | | |

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| Question Number | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 8 | 1 | (a) | | | 1 | solubility of sodium carbonate increases (until 40-43$^{o}$C) and then decreases | | | |
| | | (b) | | | 3 | plotting 7 correct points (2)<br>plotting 6 correct points (1)<br>suitable line – must be curve (1) | | | |
| | | (c) | | | 1 | sodium carbonate<br>sodium bromate<br>sodium chloride<br>– correct order | | | |
| | | (d) | | | 3 | recognise that sodium chloride is soluble and silver chloride is not (1)<br><br>add (enough/excess) water (to remove/dissolve all the sodium chloride) (1)<br><br>filter (1) | | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 9 | 2 | (a) | (i) | | 2 | 436 + 242 (1)<br><br>= 678 (1)<br>– correct answer only (cao) (2) | | | |
| | | | (ii) | | 2 | 2 × 431 (1)<br><br>= 862 (1)<br>– cao (2) | | | |
| | | (b) | | | 1 | exothermic since energy given out (as bonds made) > energy needed (to break the bonds)<br><br>energy given by reaction is negative / –184<br><br>credit 'endothermic' with correct reason if calculation error followed through (ft) | | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 10 | 3 | (a) | (i) | | 1 | A – requires the most soap – both needed | | | |
| | | | (ii) | | 2 | D (1)<br><br>some hardness removed by boiling but not all / temporary hardness removed by boiling but permanent hardness remained (1)<br><br>Alternative answer accepted for all candidates due to very common mis-interpretation of question on Welsh-medium papers<br><br>A contains permanent hardness and C contains temporary hardness (1)<br><br>A loses none of its hardness through boiling and C loses all of its hardness (through boiling) (1) | | | |
| | | (b) | | | 2 | same trend / A still the hardest / B still the softest / D still contains both permanent and temporary hard water (1)<br><br>different amount of water used / different concentration of soap solution / shaken for a different amount of time / different amount of lather formed (1) | | | |

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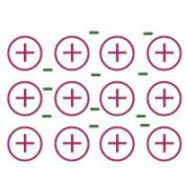
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| Question Number | | | |
|---|---|---|---|
| FT | HT | Mark | Guidance |
| 11 | 4 | 6 | Indicative content: This method of separation is called fractional distillation. Crude oil is a mixture of hydrocarbons. The crude oil is heated and vaporised before entering the column. Smaller/lower boiling hydrocarbons will rise in the column and condense higher up the column. Hydrocarbons with similar boiling points condense at the same level in the column. (Boiling point depends on the size of the molecule – larger molecules have higher boiling points.)<br><br>5-6 marks: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>3-4 marks: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>1-2 marks: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>0 marks: The candidate does not make any attempt or give a relevant answer worthy of credit. |

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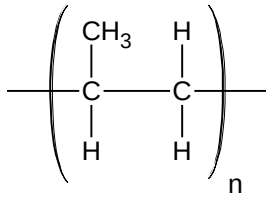
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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 5 | (a) | | | 1 | 2,8,1 | | | |
| | | (b) | | | 2 |  positive ions<br>fixed positions<br>electrons<br>mobile / sea<br><br>– all four points (2)<br>– two/three points (1) | | | |
| | | (c) | (i) | | 1 | floats<br>moves<br>fizzes / bubbles<br>goes into a round shape / melts<br>– any two | | vigorous reaction<br>dissolves | |
| | | | (ii) | | 1 | sodium hydroxide and hydrogen<br>– both needed | $NaOH + H_2$ | H | |
| | | (d) | | | 1 | potassium burns / lilac flame | | potassium moves faster | yellow / orange / red / green flame |
| | | (e) | | | 2 | atoms get bigger / greater distance between the (positive) nucleus and the (outer) electron (1)<br><br>outer electron more weakly held (1) | | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 6 | (a) | (i) | | 1 | polytetrafluoroethene / PTFE | | Teflon | |
| | | | (ii) | I | 1 |  | | | |
| | | | | II | 1 | addition | | | additional |
| | | (b) | | | 2 | both have long or large molecules / long chains of carbon atoms / polymer chains (1)<br><br>(only) thermosets have crosslinking / strong bonds between chains (1) | | | reference to layers |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 7 | (a) | | | 1 | lithium / $Li^+$ | Li<br>Ca<br>Sr | | |
| | | (b) | (i) | | 1 | cream precipitate | off white ppt | | pale yellow ppt |
| | | | (ii) | | 2 | $Ag^+ + Br^-$ (1)<br><br>AgBr (1) | | | |
| | | (c) | (i) | | 1 | chlorine / fluorine | $Cl_2$ / $F_2$ | Cl / F | |
| | | | (ii) | | 1 | displacement | redox | | |

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| Question Number | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 8 | (a) | | | 1 | any one from:<br>some copper had not reacted<br>reaction had not been completed<br>heated to constant mass | | | |
| | | (b) | | | 3 | mass of copper = 37.7 -25.0 = 12.7<br>mass of oxygen = 40.9 – 37.7 = 3.2 (1)<br><br>n(Cu) = 12.7/63.5<br>n(O) = 3.2/16 (1)<br><br>ratio 0.2/0.2 : 0.2/0.2 ie 1:1<br>formula CuO (1) | | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 9 | (a) | | | 3 | *two discrete diagrams needed:*<br>- *diagram 1 showing transfer of electrons*<br>- *diagram 2 showing ions*<br><br>diagram 1<br>two lithium atoms losing 1 electron each (1)<br>one sulfur atom gaining 2 electrons (1)<br><br>diagram 2<br>2 × $Li^+$ and $S^{2-}$ formed (1) | | | |
| | | (b) | | | 2 | magnesium and/or oxide ions have a greater charge than sodium and/or chloride ions (1)<br><br>this gives a greater attraction between the ions / stronger ionic bonds / more energy is needed to break bonds (1) | | | |
| | | (c) | | | 2 | shared electron pair between H atoms and adjacent O atoms and between the two O atoms (1)<br><br>8 electrons in outer shell of both O atoms (1) | | | |

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| Question Number | | | |
|---|---|---|---|
| FT | HT | Mark | Guidance |
| | 10 | 6 | Indicative content: For a chemical reaction to take place the reactant particles must collide. Increasing the concentration increases the number of particles in the same volume which gives a greater chance of the particles colliding, giving an increase in the rate of the reaction. As the temperature increases the reactant particles are moving faster, increasing the chance of a collision. At higher temperature the particles also have higher energy which increases the possibility of having sufficient energy during collision to overcome the activation energy and become a 'successful collision'. Therefore increasing the temperature also increases the speed of a reaction.<br><br>5-6 marks: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>3-4 marks: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>1-2 marks: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>0 marks: The candidate does not make any attempt or give a relevant answer worthy of credit. |

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| Surname | Centre Number | Candidate Number |
|---|---|---|
| Other Names | | 0 |

# New GCSE

4472/02

# ADDITIONAL SCIENCE
## HIGHER TIER
## CHEMISTRY 2

A.M. MONDAY, 14 January 2013

1 hour

| For Examiner's use only | | |
|---|---|---|
| **Question** | **Maximum Mark** | **Mark Awarded** |
| **1** | **3** | |
| **2** | **7** | |
| **3** | **8** | |
| **4** | **6** | |
| **5** | **6** | |
| **6** | **5** | |
| **7** | **9** | |
| **8** | **7** | |
| **9** | **3** | |
| **10** | **6** | |
| **Total** | **60** | |

4472
020001

### ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

### INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

### INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

Assessment will take into account the quality of written communication (QWC) in your answers to questions **4** and **10**.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

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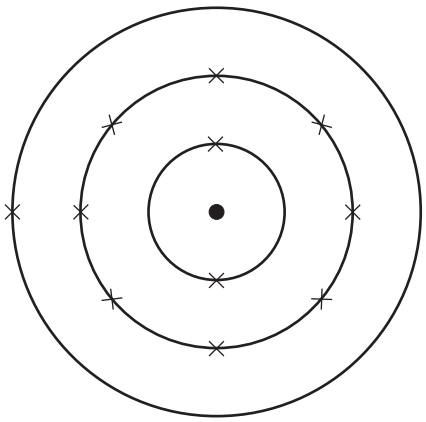
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Examiner only

*Answer* **all** *questions.*

**1.** *(a)* The diagram below shows the electronic structure of an element in the Periodic Table.



Using × to represent an electron, draw a similar diagram to show the electronic structure of the element which

(i) lies directly **below** this one in the Periodic Table, [1]

(ii) lies directly to the **right** of this one in the Periodic Table. [1]

*(b)* Carbon has two different types of atom which are represented by $^{12}_{6}C$ and $^{13}_{6}C$.

Give the term used for different types of atom of the same element. [1]

.....

3

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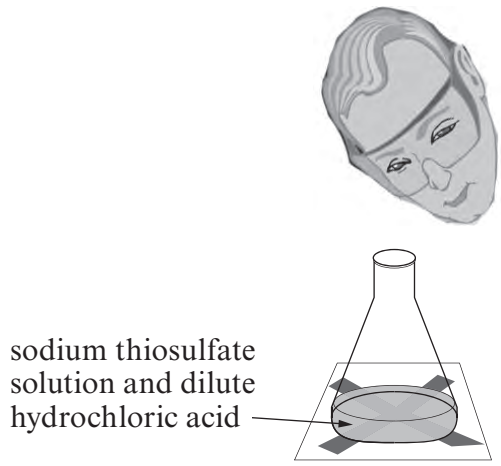


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4472 020003

Examiner only

**2.** Sodium thiosulfate solution reacts with dilute hydrochloric acid forming a yellow precipitate. This reaction can be investigated using the 'disappearing cross' experiment. The yellow precipitate formed during the reaction causes a cross marked on a piece of white paper to disappear (see diagram below). The time taken for this to happen can be measured.




10 $cm^3$ of dilute hydrochloric acid was added separately to 50 $cm^3$ sodium thiosulfate solutions of five different concentrations. The results are shown below.

| Concentration of sodium thiosulfate solution ($g/dm^3$) | Time for cross to disappear (s) | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | Mean |
| 8 | 37 | 38 | 39 | 38 |
| 16 | 20 | 17 | 17 | 18 |
| 24 | 10 | 8 | 12 | 10 |
| 32 | 10 | 7 | 7 | 8 |
| 40 | 3 | 7 | 8 | 6 |

*(a)* State which concentration gave the most repeatable set of reaction times. Give the reason for your choice. [2]

*Concentration* ..... $g/dm^3$

*Reason* .....

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*(b)* Apart from taking more readings, suggest **one** way to improve the repeatability of the readings. [1]

.....

*(c)* Apart from the volumes of both reactants and the concentration of the acid, name the **most** important factor which must be kept the same during each experiment. [1]

.....

*(d)* State and explain, using particle theory, your conclusion from the investigation. [3]

.....

.....

.....

.....

7



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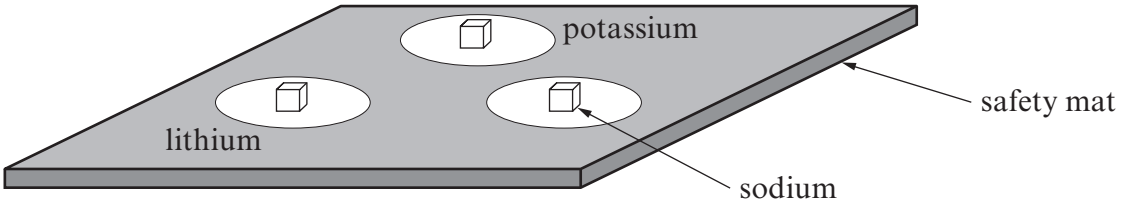


**Turn over.**

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**3.** *(a)* Freshly cut pieces of lithium, potassium and sodium are left exposed to the atmosphere.




(i) Describe how the appearance of all the metals will change. [1]

.....

(ii) Describe how the reactions will differ. [1]

.....

*(b)* **A**, **B** and **C** represent the Group 7 elements bromine, chlorine and iodine, but not necessarily in that order. The table below shows the results observed when **A**, **B** and **C** react with hot iron wool.

| Group 7 element | Reaction with hot iron wool |
|---|---|
| **A** | After a few seconds the iron wool glows. An orange solid is formed. |
| **B** | After a few minutes of constant heating the iron wool glows a little. A red-brown solid is formed. |
| **C** | The iron wool burns instantly glowing brightly. An orange solid is formed. |

(i) Use the above results to identify the Group 7 elements **A**, **B** and **C** and give a reason for your choice. [3]

**A** ..... **B** ..... **C** .....

*Reason* .....

.....

(ii) Chlorine reacts with iron forming iron(III) chloride.

Write a balanced **symbol** equation for the reaction between chlorine and iron. [3]

..... + ..... ⟶ .....

8

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**4.** Describe the treatment of the public water supply.

Include in your answer the three main stages in the purification process and the reason why each one is required. [6 QWC]



6

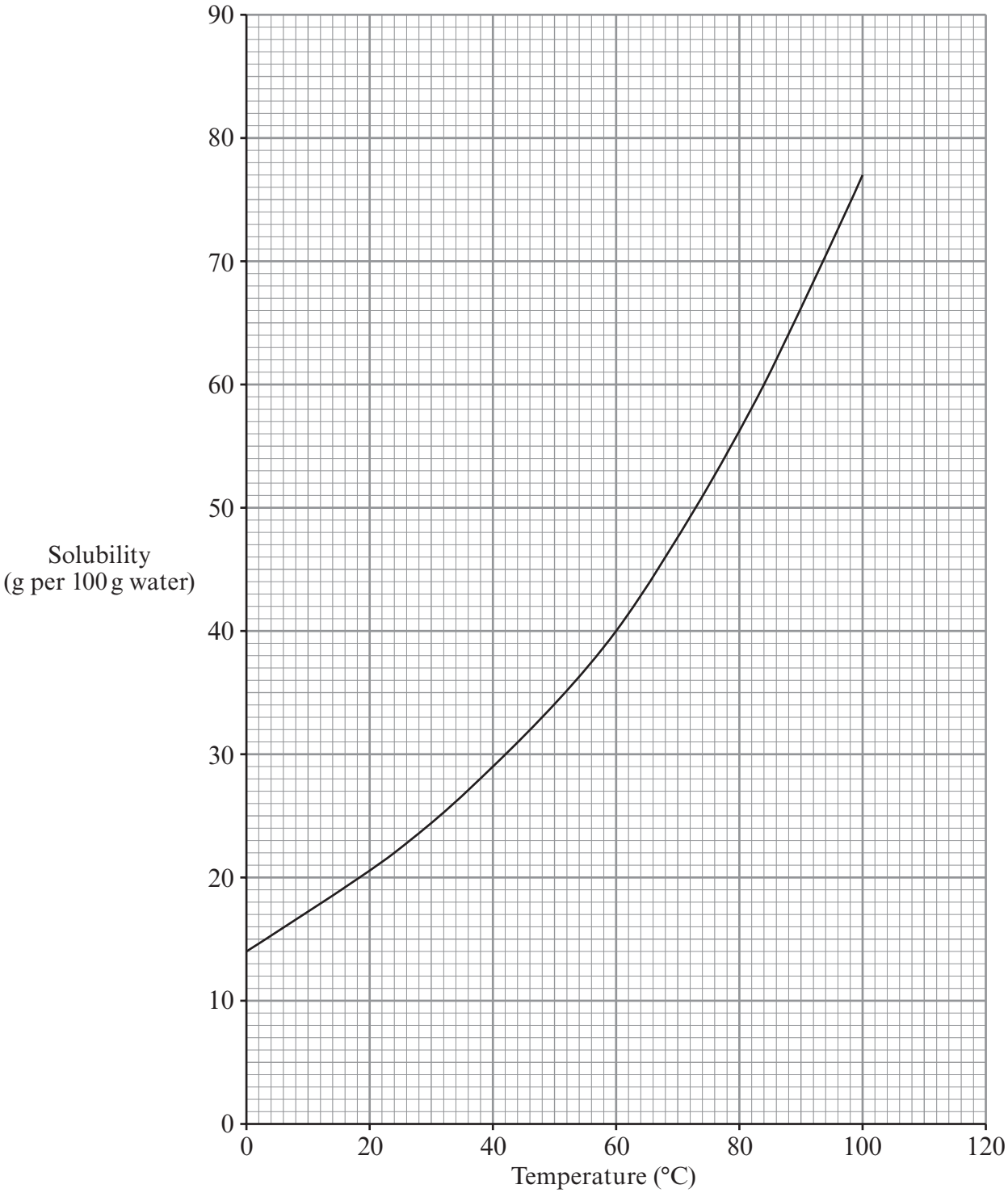
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**Turn over.**

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**5.** The graph below shows the solubility of copper sulfate in water at different temperatures.




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The table below shows the solubility of potassium chloride in water at different temperatures.

| Temperature (°C) | 0 | 20 | 40 | 60 | 80 | 100 |
|---|---|---|---|---|---|---|
| Solubility (g per 100 g water) | 25 | 31 | 37 | 43 | 49 | 55 |

*(a)* Plot the results from the table on the grid opposite and draw a suitable line. [3]

*(b)* Give the temperature at which the two compounds have the same solubility. [1]

*Temperature* = ..... °C

*(c)* Calculate the mass of solid copper sulfate that forms when a saturated solution in 100 g of water at 60 °C cools to 24 °C. [2]

*Mass of solid copper sulfate* = ..... g

4472 020009

6

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**6.** The electronic structures of calcium, fluorine and phosphorus are as follows.

calcium = 2,8,8,2 fluorine = 2,7 phosphorus = 2,8,5

*(a)* Draw dot and cross diagrams to show the transfer of electrons and the formation of ions as calcium reacts with fluorine to form calcium fluoride. [3]

*(b)* Draw a dot and cross diagram to show the bonding in a molecule of phosphorus trifluoride, $PF_3$. [2]

5

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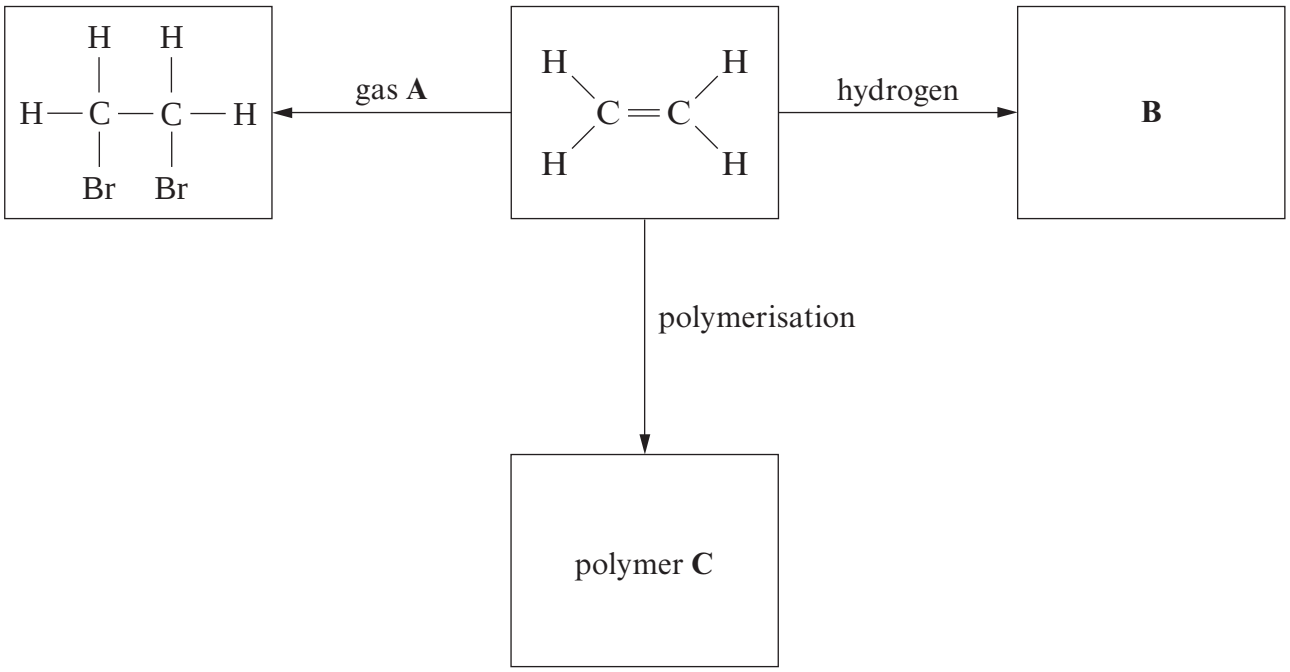
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**7.** *(a)* The flow diagram below shows three reactions of ethene.




(i) Give the chemical names for **A**, **B** and **C**. [3]

**A** .....

**B** .....

**C** .....

(ii) State the name given to the type of reaction occurring in **all** three cases. [1]

.....

(iii) When boiling water is poured into a cup made from polymer **C** the cup softens and loses its shape.

I Give the reason, in terms of structure, for this behaviour. [1]

.....

.....

II Name this **type** of polymer. [1]

.....

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*(b)* A hydrocarbon was found to contain 0.96 g of carbon and 0.2 g of hydrogen.
Calculate the **simplest** formula for this hydrocarbon.
You must show your working. [3]

$A_r(H) = 1$ $A_r(C) = 12$

*Simplest formula* .....

9

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**8.** *(a)* Table **A** below shows the ions present in three different water samples **X**, **Y** and **Z**.

| Ions present | Typical analysis (mg/dm$^3$) | | |
|---|---|---|---|
| | **X** | **Y** | **Z** |
| calcium | 145 | 54 | 80 |
| magnesium | 69 | 9 | 26 |
| sodium | 14 | 27 | 6 |
| potassium | 2 | 2 | 1 |
| hydrogencarbonate | 42 | 212 | 360 |
| chloride | 7 | 12 | 13 |
| sulfate | 303 | 15 | 6 |

Table **A**

An investigation was carried out to find the relative hardness of the water samples and the effect of boiling.

20 cm$^3$ of each water sample was accurately measured. 1 cm$^3$ of soap solution was added to each sample and the mixture shaken. This was repeated until a permanent lather was obtained. The volume of soap solution needed to obtain a permanent lather was recorded.

A fresh 20 cm$^3$ of each water sample was boiled for 5 minutes and cooled. The above procedure was repeated.

Table **B** below shows the results from the investigation.

| Water sample | Volume of soap solution needed to obtain a permanent lather (cm$^3$) | |
|---|---|---|
| | Before boiling | After boiling |
| **X** | 40 | 36 |
| **Y** | 32 | 4 |
| **Z** | 35 | 6 |

Table **B**

(i) State the conclusions that can be drawn from the results in Table **B**. [2]

.....

.....

(ii) How do the compositions of the water samples in Table **A** support the results in Table **B**? [2]

.....

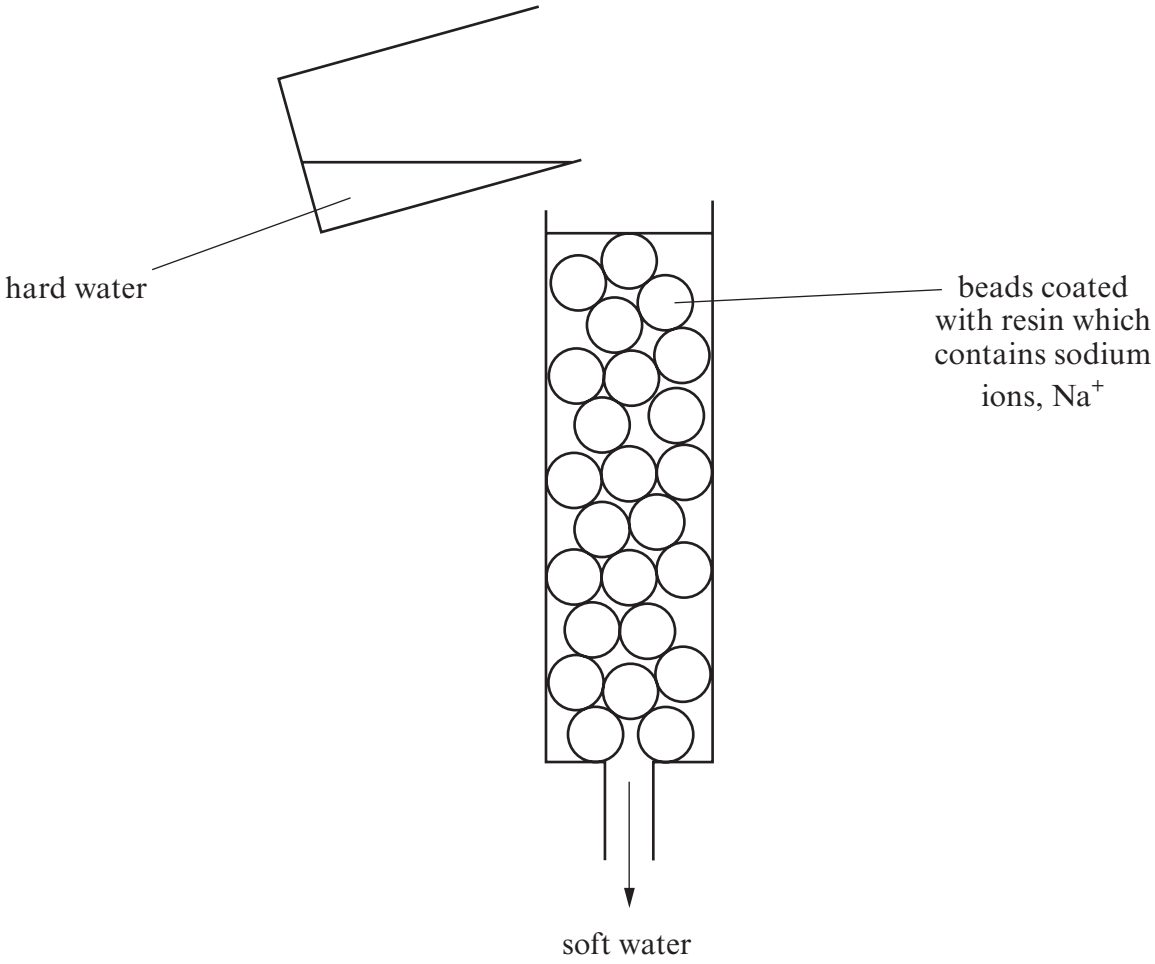
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*(b)* The diagram below shows an ion exchange column used for softening water.




(i) Explain how the ion exchange column works. [2]

.....

.....

.....

(ii) Give **one** disadvantage of this water softening method. [1]

.....

7



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**9.** Sodium carbonate is an important raw material and has many industrial and domestic uses.

The equation below shows one of the reactions in the Solvay process which converts sodium hydrogencarbonate into sodium carbonate.

$$2NaHCO_3 \longrightarrow Na_2CO_3 + H_2O + CO_2$$

Use the equation to calculate the mass of sodium carbonate that could be obtained from 8.4 tonnes of sodium hydrogencarbonate. [3]

$A_r(H) = 1$ $A_r(C) = 12$ $A_r(O) = 16$ $A_r(Na) = 23$

*Mass of sodium carbonate* = ..... tonnes

3

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**10.** Describe and explain the properties of diamond and graphite, in terms of bonding and structure, and relate their uses to these properties. [6 QWC]

You may include diagrams as part of your answer.

6

**END OF PAPER**

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**Turn over.**

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## FORMULAE FOR SOME COMMON IONS

| POSITIVE IONS | | NEGATIVE IONS | |
|---|---|---|---|
| **Name** | **Formula** | **Name** | **Formula** |
| Aluminium | $Al^{3+}$ | Bromide | $Br^{-}$ |
| Ammonium | $NH_4^{+}$ | Carbonate | $CO_3^{2-}$ |
| Barium | $Ba^{2+}$ | Chloride | $Cl^{-}$ |
| Calcium | $Ca^{2+}$ | Fluoride | $F^{-}$ |
| Copper(II) | $Cu^{2+}$ | Hydroxide | $OH^{-}$ |
| Hydrogen | $H^{+}$ | Iodide | $I^{-}$ |
| Iron(II) | $Fe^{2+}$ | Nitrate | $NO_3^{-}$ |
| Iron(III) | $Fe^{3+}$ | Oxide | $O^{2-}$ |
| Lithium | $Li^{+}$ | Sulfate | $SO_4^{2-}$ |
| Magnesium | $Mg^{2+}$ | | |
| Nickel | $Ni^{2+}$ | | |
| Potassium | $K^{+}$ | | |
| Silver | $Ag^{+}$ | | |
| Sodium | $Na^{+}$ | | |
| Zinc | $Zn^{2+}$ | | |

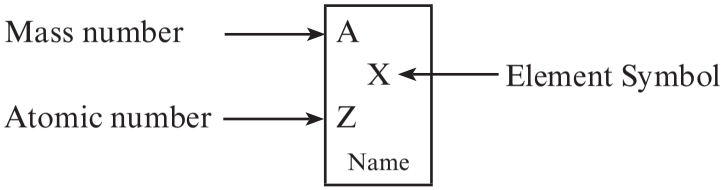
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# PERIODIC TABLE OF ELEMENTS

| 1 | 2 | | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | $^{1}_{1}$H Hydrogen | | | | | | | | | $^{4}_{2}$He Helium |
| $^{7}_{3}$Li Lithium | $^{9}_{4}$Be Beryllium | | | | | | | | | | | $^{11}_{5}$B Boron | $^{12}_{6}$C Carbon | $^{14}_{7}$N Nitrogen | $^{16}_{8}$O Oxygen | $^{19}_{9}$F Fluorine | $^{20}_{10}$Ne Neon |
| $^{23}_{11}$Na Sodium | $^{24}_{12}$Mg Magnesium | | | | | | | | | | | $^{27}_{13}$Al Aluminium | $^{28}_{14}$Si Silicon | $^{31}_{15}$P Phosphorus | $^{32}_{16}$S Sulfur | $^{35}_{17}$Cl Chlorine | $^{40}_{18}$Ar Argon |
| $^{39}_{19}$K Potassium | $^{40}_{20}$Ca Calcium | $^{45}_{21}$Sc Scandium | $^{48}_{22}$Ti Titanium | $^{51}_{23}$V Vanadium | $^{52}_{24}$Cr Chromium | $^{55}_{25}$Mn Manganese | $^{56}_{26}$Fe Iron | $^{59}_{27}$Co Cobalt | $^{59}_{28}$Ni Nickel | $^{64}_{29}$Cu Copper | $^{65}_{30}$Zn Zinc | $^{70}_{31}$Ga Gallium | $^{73}_{32}$Ge Germanium | $^{75}_{33}$As Arsenic | $^{79}_{34}$Se Selenium | $^{80}_{35}$Br Bromine | $^{84}_{36}$Kr Krypton |
| $^{86}_{37}$Rb Rubidium | $^{88}_{38}$Sr Strontium | $^{89}_{39}$Y Yttrium | $^{91}_{40}$Zr Zirconium | $^{93}_{41}$Nb Niobium | $^{96}_{42}$Mo Molybdenum | $^{99}_{43}$Tc Technetium | $^{101}_{44}$Ru Ruthenium | $^{103}_{45}$Rh Rhodium | $^{106}_{46}$Pd Palladium | $^{108}_{47}$Ag Silver | $^{112}_{48}$Cd Cadmium | $^{115}_{49}$In Indium | $^{119}_{50}$Sn Tin | $^{122}_{51}$Sb Antimony | $^{128}_{52}$Te Tellurium | $^{127}_{53}$I Iodine | $^{131}_{54}$Xe Xenon |
| $^{133}_{55}$Cs Caesium | $^{137}_{56}$Ba Barium | $^{139}_{57}$La Lanthanum | $^{179}_{72}$Hf Hafnium | $^{181}_{73}$Ta Tantalum | $^{184}_{74}$W Tungsten | $^{186}_{75}$Re Rhenium | $^{190}_{76}$Os Osmium | $^{192}_{77}$Ir Iridium | $^{195}_{78}$Pt Platinum | $^{197}_{79}$Au Gold | $^{201}_{80}$Hg Mercury | $^{204}_{81}$Tl Thallium | $^{207}_{82}$Pb Lead | $^{209}_{83}$Bi Bismuth | $^{210}_{84}$Po Polonium | $^{210}_{85}$At Astatine | $^{222}_{86}$Rn Radon |
| $^{223}_{87}$Fr Francium | $^{226}_{88}$Ra Radium | $^{227}_{89}$Ac Actinium | | | | | | | | | | | | | | | |

Key:




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# GCSE MARKING SCHEME

## SCIENCE - CHEMISTRY (NEW)

## JANUARY 2013

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## INTRODUCTION

The marking schemes which follow were those used by WJEC for the year examination in GCSE SUBJECT. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.


| Unit | Page |
|---|---|
| C1 (NEW) | 1 |
| C2 (NEW) | 17 |


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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 1 | | (a) | (i) | | 1 | neutron and proton<br>***both needed, either order*** | | | |
| | | | (ii) | | 1 | number of protons equals the number of electrons / 6 protons and 6 electrons present | | number of positives = number of negatives | reference to neutrons |
| | | (b) | (i) | | 2 | 12 + 4 (1)<br>= 16 (1)<br>***If no working shown, award 2 marks for correct answer only (cao)***<br>***Consequential marking – follow through (ft)*** | | | |
| | | | (ii) | | 2 | 12/16 × 100 (1)<br>= 75 (1)<br>***If no working show , award 2 marks for cao***<br>***Consequential marking – ft*** | | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 2 | | (a) | (i) | | 1 | **A** | | | |
| | | | (ii) | | 1 | **C** | | | |
| | | | (iii) | | 1 | **B** | | | |
| | | (b) | (i) | | 1 | yellow **flame** | orange flame | yellow | |
| | | | (ii) | | 1 | white **precipitate** | | white | |

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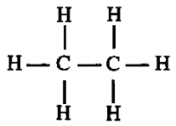
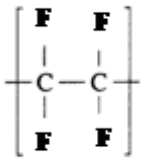
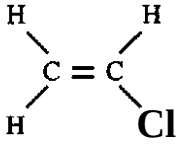
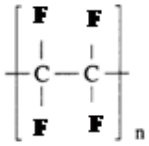
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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 3 | | (a) | | | 2 | photochromic (1)<br><br>changes colour with changes in light (intensity) / in light (and dark) / u.v. (light) (1) | | appearance changes | |
| | | (b) | | | 2 | thermochromic (1)<br><br>changes colour with changes in temperature / when hot (and cold) / when exposed to heat (1) | changes colour at a certain temperature | reference to pattern appearing | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 4 | | (a) | (i) | | 1 | **A** and **D**<br>***both needed, either order*** | | breathing | |
| | | | (ii) | | 1 | **D** | | | |
| | | (b) | | | 1 |  | | | |
| | | (c) | | | 2 |  (1)<br> (1) |  | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 5 | | (a) | | | 5 | **Method 1**<br>• equal volumes of water sample/ actual volume given *e.g. 20cm$^3$*<br>• add equal volume of soap solution/ actual volume *e.g. 5cm$^3$*<br>• shake same number of times / shake equally<br>• measure height of lather – *could be implied in final point*<br>• hardest water forms least froth (accept converse)<br><br>(1) mark per point<br>**Method 2**<br>• equal volumes of water sample/ actual volume given *e.g. 20cm$^3$*<br>add 1 cm$^3$of soap solution at a time<br>• shake the same number of times (after adding each 1 cm$^3$ soap sol.)<br>• record volume of soap sol. to obtain permanent lather – *could be implied in final point*<br>• hardest water needs most soap solution (accept converse)<br><br>(1) mark per point | | | |
| | | (b) | (i) | | 1 | reduces heart disease / strengthens bones and teeth | | | tastes better |
| | | | (ii) | | 1 | forms limescale (when heated) | | | |
| | | | (iii) | | 1 | tastes better | | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 6 | | (a) | | | 1 | boiling point | size of chain / molecular mass/ density | boiling | melting point |
| | | (b) | | | 1 | condensation / condensing / condenses | | | |
| | | (c) | | | 1 | takes the temperature of the fraction / takes the temperature of the vapour | | | |
| | | (d) | | | 1 | fractional distillation | | distillation / fractionation | fractionating distillation |

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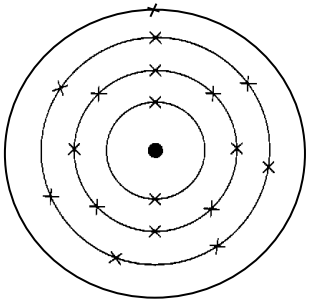
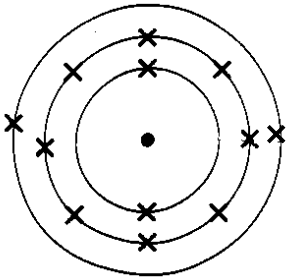
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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 7 | | (a) | | | 1 | **B** and **D**<br>***Both needed, either order*** | | | |
| | | (b) | | | 1 | **C** | | | |
| | | (c) | | | 2 | 4/8 (1)<br>= 0.5 (1)<br>***If no working shown, award 2 marks cao***<br>***Consequential marking only if one of 4 or 8 are correct – ft*** | | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 8 | 1 | (a) | (i) | | 1 |  | 2.8.8.1 | | |
| | | | (ii) | | 1 |  | 2.8.2<br><br>correct diagram of calcium structure / 2.8.8.2<br>[element to right of (a)(i) above rather than to right of original element drawn] | | |
| | | (b) | | | 1 | isotope | | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 9 | 2 | (a) | | | 2 | Concentration: 8 ($g/dm^3$) (1)<br><br>Reason:<br>experiment times close together / reaction times close together / little variation between times (1) | only 2 seconds variation between reaction times | | |
| | | (b) | | | 1 | use a light sensor / use a datalogger / same person recording the reaction times / same person adds the acid and starts the stopwatch / same person watches X disappear | | use a computer | |
| | | (c) | | | 1 | temperature | | heat | catalyst |
| | | (d) | | | 3 | • the **higher the concentration**, the **faster the rate**<br>the higher the concentration the shorter the reaction time (1)<br><br>• the higher the concentration the **more particles** are present (1)<br><br>• the more particles the **greater the chance of collision**<br>the more particles present more collisions per second<br>the more particles present more collisions in a given time (1) | | more collisions | reference to increased energy |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| 10 | 3 | (a) | (i) | | 1 | tarnish / lose their shiny appearance | go dull / less shiny | grey / forms an oxide / corrodes | reference to rust |
| | | | (ii) | | 1 | they react at different speeds / potassium reacts the quickest / lithium reacts the slowest / the speed at which the change occurs | reactivity increases down the group | | |
| | | (b) | (i) | | 3 | **A** = bromine / $Br_2$ / Br<br>**B** = iodine / $I_2$ / I<br>**C** = chlorine / $Cl_2$ / Cl all correct (2) any one correct (1)<br><br>Reason: reactivity decreases down the group (1) | chlorine most reactive, iodine least | | |
| | | | (ii) | | 3 | Reactants: Fe $Cl_2$ (1)<br>Product: $FeCl_3$ (1)<br>Balancing: 2:3:2 (1)<br><br>***Reactants and products must be correct before balancing mark can be awarded*** | multiples of 2 and 3 e.g. 4:6:4 | | |

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| Question Number | | | |
|---|---|---|---|
| FT | HT | Mark | |
| 11 | 4 | 6 | **Indicative content:** Reference to sedimentation, filtration and chlorination together with the reason for each process e.g.<br><br>sedimentation / settling tank: removal of large insoluble particles<br><br>filtration / filter bed: removal of small insoluble particles<br>removal of bacteria / germs / micro-organisms<br><br>chlorination: kills remaining bacteria / germs / micro-organisms<br><br>**5 – 6 marks**: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br>**3 – 4 marks**: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br>**1 – 2 marks**: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br>**0 marks**: The candidate does not make any attempt or give a relevant answer worthy of credit. |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 5 | (a) | | | 3 | All points plotted correctly ±½ square (2)<br>All but one point plotted correctly (1)<br><br>Suitable line – judgement by eye (1)<br><br>***Consequential marking – ft*** | | | |
| | | (b) | | | 1 | 67 ± 1<br><br>***Consequential marking – ft*** | | | |
| | | (c) | | | 2 | 60 °C = 40<br><br>24 °C = 22 both needed for (1)<br><br>18 (1)<br><br>***Consequential marking – ft*** | | | |

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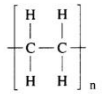
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| Question Number | | | | | | | | | |
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| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 6 | (a) | | | 3 | **Two** discrete diagrams needed:<br>- diagram 1 showing transfer of electrons<br>- diagram 2 showing ions<br><br>Diagram 1<br>Calcium atom loses 2 electrons (1)<br>Two fluorine atoms gain 1 electron each (1)<br><br>Diagram 2<br>$Ca^{2+}$ and 2 × $F^-$ ions formed (1)<br>*octet of electrons around $F^-$ **not** needed*<br>*discrete pair of ions needed for this mark* | | | |
| | | (b) | | | 2 | **three** shared pairs of electrons (P-F's) (1)<br><br>**octets of electrons** around P and all three Fs (1) | | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 7 | (a) | (i) | | 3 | **A** bromine / $Br_2$ (1)<br>**B** ethane / $C_2H_6$ / structural formula (1)<br>**C** polyethene / polythene (1) |  | Br<br> | |
| | | | (ii) | | 1 | addition | | | additional |
| | | | (iii) | I | 1 | Reason: **weak bonds** between chains / molecules / chains not linked together<br>***Accept labelled diagram*** | forces = bonds | layers | |
| | | | | II | 1 | thermoplastic | thermosoftening | | |
| | | (b) | | | 3 | **mass/$A_r$** 0.96/12 and 0.2/1 (1)<br>= 0.08 = 0.2<br>**ratio** 1 2.5 (1)<br>**formula** $C_2H_5$ (1)<br>***Consequential marking – ft*** | $C_4H_{10}$ | | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 8 | (a) | (i) | | 2 | Any **two** for (1) each<br>• All the water samples are hard / become softer<br>• **X** is not softened by boiling / **X** is permanently hard<br>• **Y** and **Z** are softened by boiling / **Y and Z are** temporary hard | | | |
| | | | (ii) | | 2 | Any **two** for (1) each<br>• $Ca^{2+}$ (and $Mg^{2+}$) present / **X** has the highest $Ca^{2+}$ / $Mg^{2+}$ content<br>• **X** has the highest sulfate (ion) content<br>• **Y** and **Z** contain high hydrogencarbonate (ion) content | | reference to only $Mg^{2+}$<br>**X** is the hardest | |
| | | (b) | (i) | | 2 | **$Ca^{2+}$/$Mg^{2+}$** (in hard water) ions (1)<br>**exchanged** with **$Na^{+}$** ions(in resin) /<br>**swapped** with **$Na^{+}$** ions (in resin ) (1) | replace | reference to 'displace' | 'react with' |
| | | | (ii) | | 1 | Any **one** for (1)<br>• resin needs regular replenishing / regeneration (with $Na^{+}$ ions)<br>• disposal of waste water (after regeneration) / $Na^{+}$ ions pollute water<br>• iron fouling<br>• bacteria contamination<br>• chlorine contamination | $Na^{+}$ ions could be bad for heart | cost of process<br>cost of sodium solution for regeneration | |

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| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| | 9 | | | | 3 | $M_r(NaHCO_3) = 84$<br>$M_r(Na_2CO_3) = 106$ } both needed (1)<br><br>**2**(84) ⟶ **1**(106) 2:1 ratio (1)<br>168 106<br>84 53<br><br>8.4 ⟶ **5.3** (1)<br><br>**cao (3)** | Moles approach<br><br>$M_r(NaHCO_3)= 84$<br>$Mr(Na_2CO_3) = 106$ } (1)<br><br>8.4/84 = 0.1<br><br>**2** ⟶ **1** 2:1 ratio (1)<br>0.1 **0.05**<br><br>0.05 × 106 = **5.3** (1) | | |

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| Question Number | | | |
|---|---|---|---|
| FT | HT | Mark | |
| | 10 | 6 | **Indicative content:** For diamond **and** graphite – reference made to bonding, structure and properties related to uses<br><br>Diamond<br>Bonding: uniform covalent / strong covalent bonds throughout / each carbon atom joined to four others<br>Structure: giant molecular / covalent<br>Properties and uses: hard – drill bits<br>transparent /sparkly – jewellery<br>Graphite<br>Bonding: strong bonds within layers and weak bonds between layers / carbon atoms / each joined to three others<br>Structure: giant molecular / covalent in layers<br>Properties and uses: soft – pencils<br>electrical conductor – electrodes<br><br>**5 – 6 marks**: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br>**3 – 4 marks**: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br>**1 – 2 marks**: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br>**0 marks**: The candidate does not make any attempt or give a relevant answer worthy of credit. |



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| Surname | Centre Number | Candidate Number |
|---|---|---|
| Other Names | | 0 |

# New GCSE

4472/02

# ADDITIONAL SCIENCE
## HIGHER TIER
## CHEMISTRY 2

A.M. MONDAY, 21 May 2012

1 hour

| For Examiner's use only | | |
|---|---|---|
| **Question** | **Maximum Mark** | **Mark Awarded** |
| **1** | **7** | |
| **2** | **6** | |
| **3** | **6** | |
| **4** | **7** | |
| **5** | **8** | |
| **6** | **7** | |
| **7** | **5** | |
| **8** | **6** | |
| **9** | **8** | |
| **Total** | **60** | |

4472
020001

## ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

## INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

## INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

Assessment will take into account the quality of written communication (QWC) used in your answers to questions 2 and 8.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

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*Answer* **all** *questions.*

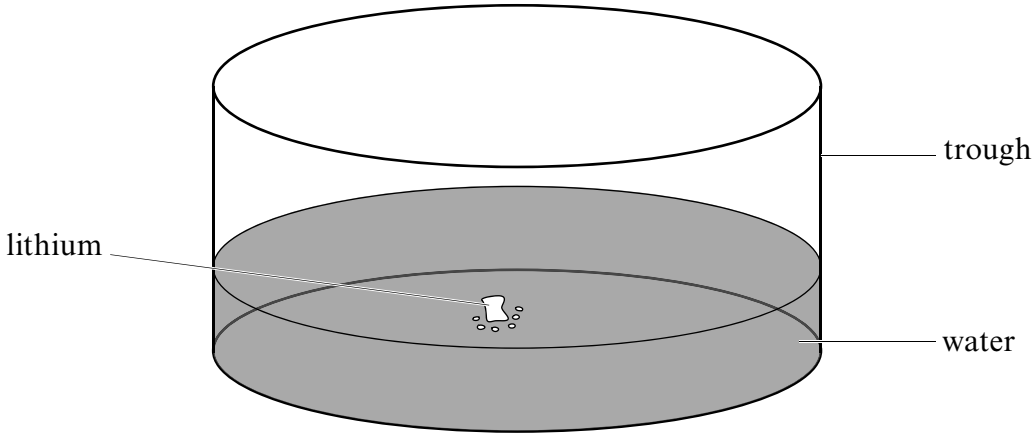
**1.** This question is about the reactions of Group 1 metals.

*(a)* Group 1 metals are usually stored in liquid paraffin (oil).

Give **one** reason for storing these metals in this way. [1]

.....

*(b)* The following diagram shows how lithium reacts with water.




(i) Apart from wearing goggles, give **one** safety precaution taken when carrying out this experiment. [1]

.....

(ii) Complete the following **word** equation for the reaction that takes place. [2]

lithium + water ⟶ ..... + .....

(iii) Name the **least** reactive metal in Group 1. [1]

.....

(iv) Describe what differences you would have observed if potassium had been added to the water in the trough instead of lithium. [2]

.....

.....

.....

7

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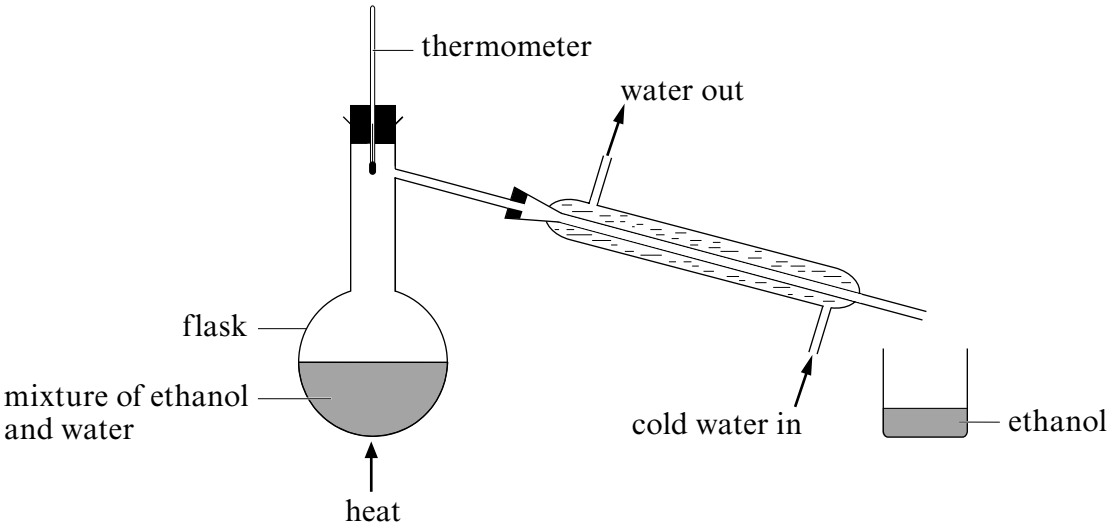


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**2.** A mixture of ethanol and water can be separated by distillation.

A diagram of the apparatus which can be used is shown below.




Describe what happens during the process and explain how this method of separation works. [6 QWC]

.....

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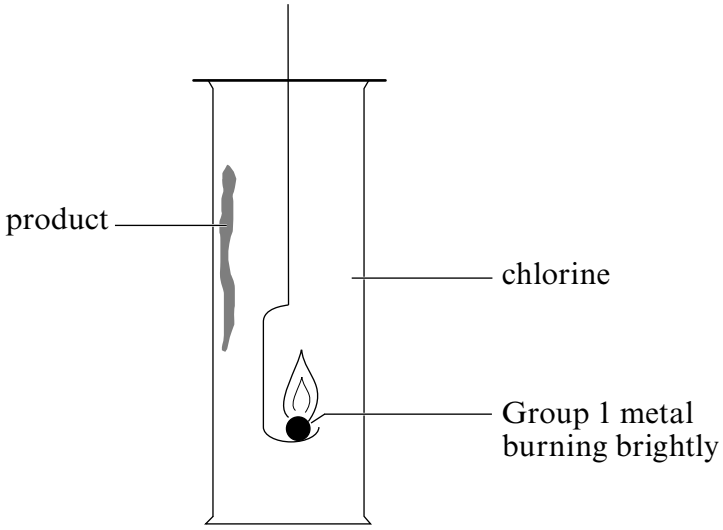




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**3.** Group 1 metals react vigorously when heated and lowered into a gas jar of chlorine, $Cl_2$, as shown in the diagram below.




*(a)* When a flame test was carried out on the product of such a reaction a yellow flame was seen. Identify the Group 1 metal that was used. [1]

.....

*(b)* Give the balanced **symbol** equation for the reaction. [3]

..... + ..... ⟶ .....

*(c)* Describe how you would test for chloride ions in a solution of the product, giving the expected observation. [2]

.....

.....

6

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**4.** The following table contains information about the numbers of particles contained within atoms and ions **A-F**.

**A**, **B**, **C**, **D**, **E** and **F** are **not** chemical symbols.

| | **A** | **B** | **C** | **D** | **E** | **F** |
|---|---|---|---|---|---|---|
| Number of electrons | 8 | 10 | 9 | 10 | 10 | 11 |
| Number of neutrons | 10 | 10 | 10 | 10 | 12 | 12 |
| Number of protons | 8 | 8 | 9 | 10 | 10 | 11 |

*(a)* State the atomic number of **C**. ..... [1]

*(b)* State the group and period of the Periodic Table to which **A** belongs. [1]

*Group* ..... *Period* .....

*(c)* (i) Choose the letter **A-F** which represents an ion. [1]

.....

(ii) Give the charge of this ion. ..... [1]

*(d)* Give the letter **A-F** which represents an atom/ion with a mass number of 20. [1]

.....

*(e)* Choose the letters **A-F** which represent isotopes and give the reason for your choice. [2]

.....

.....

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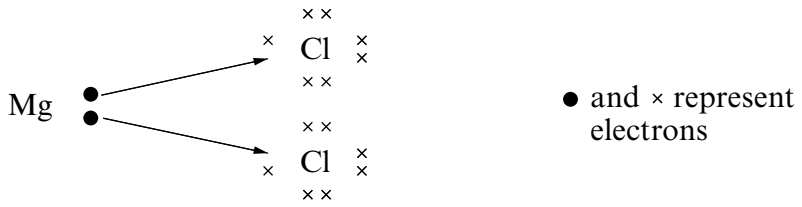




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**5.** *(a)* The following diagram shows the transfer of electrons that takes place during the formation of magnesium chloride, $MgCl_2$.




(i) Name the type of bonding present in magnesium chloride. [1]

.....

(ii) State, giving a reason, what must be done to magnesium chloride so that it can conduct electricity. [2]

.....

.....

*(b)* Using the electronic structures given below, show by means of a **diagram** the bonding in a molecule of carbon dioxide, $CO_2$. [2]

carbon (C) 2,4 oxygen (O) 2,6

*(c)* Carbon dioxide and diamond both contain covalent bonds.

Give the names of the different structure types and explain why diamond has a higher melting point than carbon dioxide. [3]

.....

.....

.....

8

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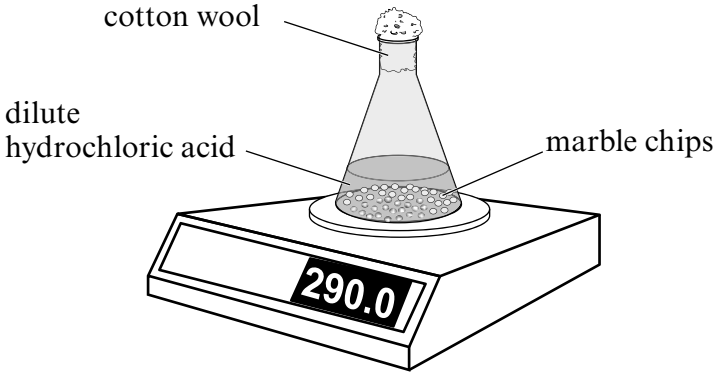
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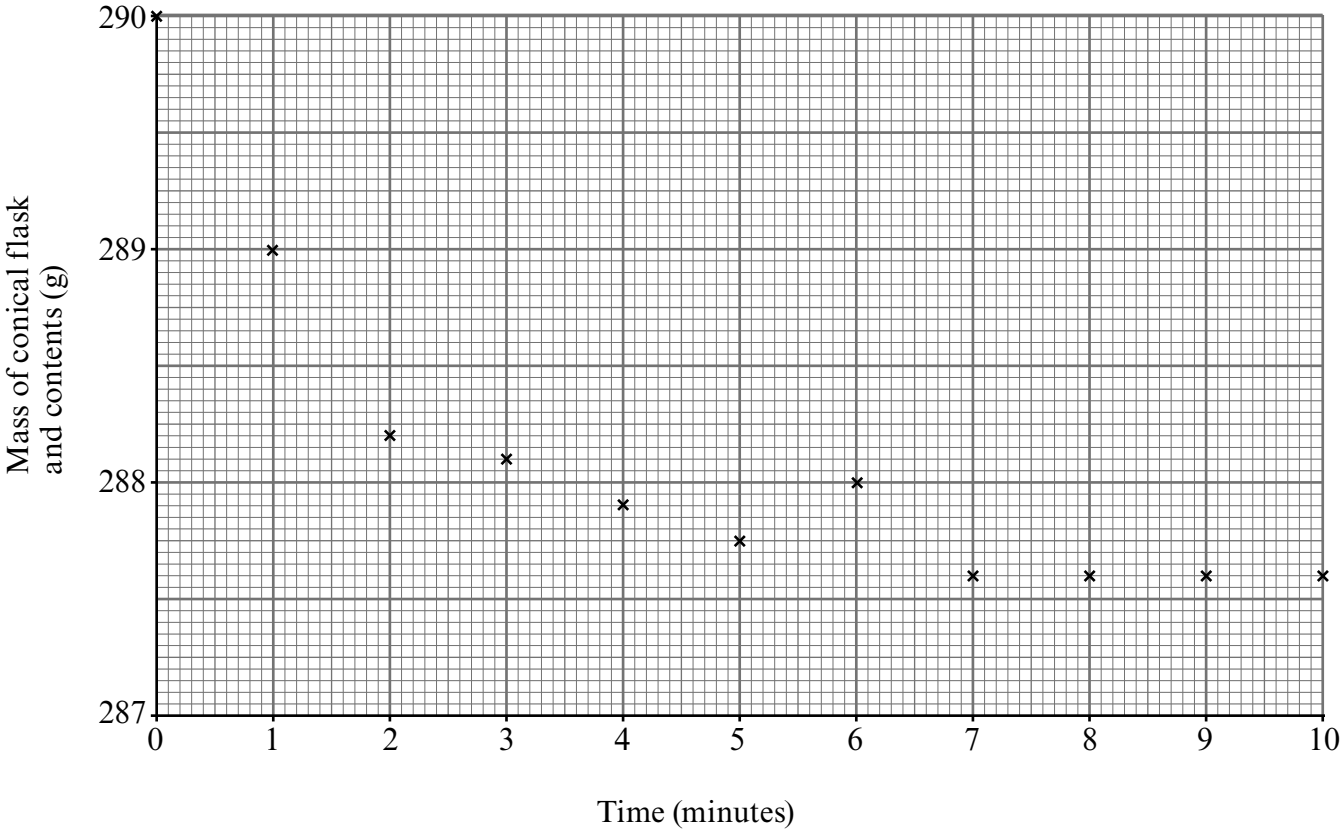
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**6.** In order to study the effect of particle size on the rate of a reaction, marble chips (calcium carbonate) were reacted with *excess* dilute hydrochloric acid using the apparatus shown below.




The results were plotted on the graph below.




*(a)* Draw a line of best fit for the points plotted. [1]

*(b)* State why the mass decreases during the experiment. [1]

.....

*(c)* State the reason for placing cotton wool in the neck of the conical flask. [1]

.....

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*(d)* The experiment was then repeated using the same mass of calcium carbonate powder instead of marble chips.

On the grid on the previous page, draw the curve you would expect to get. [2]

*(e)* The experiment was repeated once more, again using the same mass of calcium carbonate powder and the same volume of acid at half the concentration. The acid was still in excess. Give the total decrease in mass in this experiment and give a reason for your answer.

[2]

*Decrease in mass* = ..... g

*Reason* .....

.....



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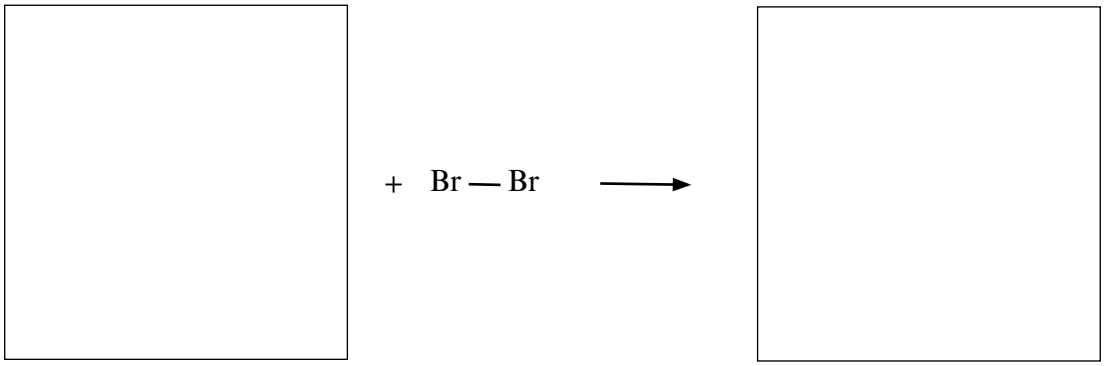
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**7.** *(a)* State what would be observed when ethene, $C_2H_4$, is bubbled into orange bromine water and name the type of reaction occurring. [2]

.....

.....

*(b)* Complete the following equation by drawing the **structural** formulae of ethene and the product of the reaction in part *(a)*. [2]




ethene bromine product

*(c)* Ethene undergoes a similar reaction with hydrogen.

Name the product of this reaction. ..... [1]

5



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**8.** Some areas of the United Kingdom have hard water while others have soft water.

Give a detailed account of your understanding of hardness in water. In your answer you should refer to the identification of hardness, its causes and its removal. [6 QWC]

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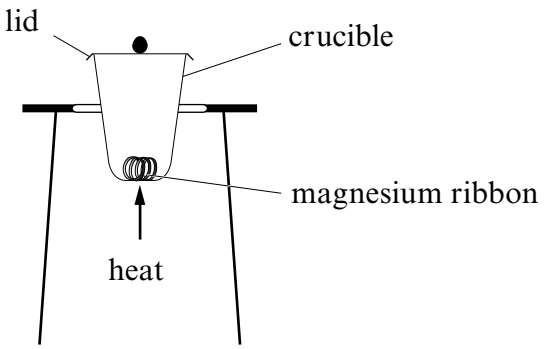


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**9.** Magnesium burns in air with a bright white flame to give a white powder called magnesium oxide.

In order to work out the formula of magnesium oxide, Owain and Seren carried out an experiment using the apparatus shown in the diagram below.




The results of their experiment are shown below.

| | |
|---|---|
| Mass of crucible and lid (g) | 19.80 |
| Mass of crucible, lid and magnesium (g) | 20.28 |
| Mass of crucible, lid and product after burning (g) | 20.44 |

*(a)* Using Owain and Seren's results calculate the simplest formula for magnesium oxide. **Show your workings**. [3]

$A_r$(Mg) = 24 $A_r$(O) = 16

.....

.....

.....

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*(b)* The formula calculated in part *(a)* raises a question about the data collected since the correct formula for magnesium oxide is MgO. Assuming no product was spilt and that all weighings were carried out correctly, suggest **two** reasons that could explain the unexpected results in this experiment. [2]

.....

.....

.....

*(c)* The balanced symbol equation for the burning of magnesium in air is given below.

$$2Mg + O_2 \longrightarrow 2MgO$$

Calculate the mass of magnesium oxide that should be produced when 0.48 g of magnesium is burned in air. [3]

$A_r(Mg) = 24$ $A_r(O) = 16$

.....

.....

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.....



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## FORMULAE FOR SOME COMMON IONS

| POSITIVE IONS | | NEGATIVE IONS | |
|---|---|---|---|
| **Name** | **Formula** | **Name** | **Formula** |
| Aluminium | $Al^{3+}$ | Bromide | $Br^{-}$ |
| Ammonium | $NH_4^{+}$ | Carbonate | $CO_3^{2-}$ |
| Barium | $Ba^{2+}$ | Chloride | $Cl^{-}$ |
| Calcium | $Ca^{2+}$ | Fluoride | $F^{-}$ |
| Copper(II) | $Cu^{2+}$ | Hydroxide | $OH^{-}$ |
| Hydrogen | $H^{+}$ | Iodide | $I^{-}$ |
| Iron(II) | $Fe^{2+}$ | Nitrate | $NO_3^{-}$ |
| Iron(III) | $Fe^{3+}$ | Oxide | $O^{2-}$ |
| Lithium | $Li^{+}$ | Sulfate | $SO_4^{2-}$ |
| Magnesium | $Mg^{2+}$ | | |
| Nickel | $Ni^{2+}$ | | |
| Potassium | $K^{+}$ | | |
| Silver | $Ag^{+}$ | | |
| Sodium | $Na^{+}$ | | |
| Zinc | $Zn^{2+}$ | | |

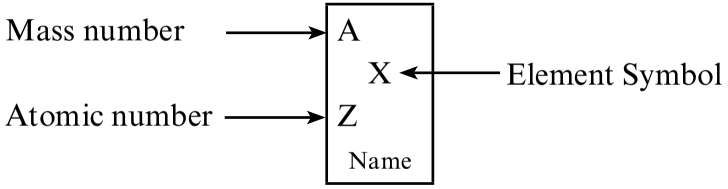
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# PERIODIC TABLE OF ELEMENTS

| 1 | 2 | | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | $^{1}_{1}$H Hydrogen | | | | | | | | | $^{4}_{2}$He Helium |
| $^{7}_{3}$Li Lithium | $^{9}_{4}$Be Beryllium | | | | | | | | | | | $^{11}_{5}$B Boron | $^{12}_{6}$C Carbon | $^{14}_{7}$N Nitrogen | $^{16}_{8}$O Oxygen | $^{19}_{9}$F Fluorine | $^{20}_{10}$Ne Neon |
| $^{23}_{11}$Na Sodium | $^{24}_{12}$Mg Magnesium | | | | | | | | | | | $^{27}_{13}$Al Aluminium | $^{28}_{14}$Si Silicon | $^{31}_{15}$P Phosphorus | $^{32}_{16}$S Sulfur | $^{35}_{17}$Cl Chlorine | $^{40}_{18}$Ar Argon |
| $^{39}_{19}$K Potassium | $^{40}_{20}$Ca Calcium | $^{45}_{21}$Sc Scandium | $^{48}_{22}$Ti Titanium | $^{51}_{23}$V Vanadium | $^{52}_{24}$Cr Chromium | $^{55}_{25}$Mn Manganese | $^{56}_{26}$Fe Iron | $^{59}_{27}$Co Cobalt | $^{59}_{28}$Ni Nickel | $^{64}_{29}$Cu Copper | $^{65}_{30}$Zn Zinc | $^{70}_{31}$Ga Gallium | $^{73}_{32}$Ge Germanium | $^{75}_{33}$As Arsenic | $^{79}_{34}$Se Selenium | $^{80}_{35}$Br Bromine | $^{84}_{36}$Kr Krypton |
| $^{86}_{37}$Rb Rubidium | $^{88}_{38}$Sr Strontium | $^{89}_{39}$Y Yttrium | $^{91}_{40}$Zr Zirconium | $^{93}_{41}$Nb Niobium | $^{96}_{42}$Mo Molybdenum | $^{99}_{43}$Tc Technetium | $^{101}_{44}$Ru Ruthenium | $^{103}_{45}$Rh Rhodium | $^{106}_{46}$Pd Palladium | $^{108}_{47}$Ag Silver | $^{112}_{48}$Cd Cadmium | $^{115}_{49}$In Indium | $^{119}_{50}$Sn Tin | $^{122}_{51}$Sb Antimony | $^{128}_{52}$Te Tellurium | $^{127}_{53}$I Iodine | $^{131}_{54}$Xe Xenon |
| $^{133}_{55}$Cs Caesium | $^{137}_{56}$Ba Barium | $^{139}_{57}$La Lanthanum | $^{179}_{72}$Hf Hafnium | $^{181}_{73}$Ta Tantalum | $^{184}_{74}$W Tungsten | $^{186}_{75}$Re Rhenium | $^{190}_{76}$Os Osmium | $^{192}_{77}$Ir Iridium | $^{195}_{78}$Pt Platinum | $^{197}_{79}$Au Gold | $^{201}_{80}$Hg Mercury | $^{204}_{81}$Tl Thallium | $^{207}_{82}$Pb Lead | $^{209}_{83}$Bi Bismuth | $^{210}_{84}$Po Polonium | $^{210}_{85}$At Astatine | $^{222}_{86}$Rn Radon |
| $^{223}_{87}$Fr Francium | $^{226}_{88}$Ra Radium | $^{227}_{89}$Ac Actinium | | | | | | | | | | | | | | | |

Key:




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# GCSE MARKING SCHEME

## SCIENCE - CHEMISTRY

## SUMMER 2012

## INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2012 examination in GCSE SCIENCE-CHEMISTRY. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

# C2

## Foundation Tier

| Q.1 | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|
| a i | 1 | A and C (both needed) | | | |
| ii | 1 | Y contains three substances /Y does not contain A,B or C | | | |
| b | 2 | $\frac{6}{10}$ (1)<br>= 0.6 (1) | | | |

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| Q.2 | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|
| a i | 1 | 2.8.1 | | | |
| ii | 1 | 3 | | | |
| iii | 1 | 4 | | | |
| iv | 1 | D | | | |
| v | 1 | proton | | | |
| b i | 2 | 40 + 12 + 3(16) (1)<br>= 100 (2) - two marks for correct answer | | | |
| ii | 2 | $\frac{40}{100}$ x 100 (1)<br>= 40 (2) - two marks for correct answer | consequential marking | | |

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| Q.3 | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|
| a i | 1 | nitrogen | $N_2$ | N | |
| ii | 1 | simple covalent | simple molecular | covalent | |
| iii | 1 | nitrogen/graphite | $N_2$/C | N | |
| b | 2 | high melting point/good conductor of heat/malleable – any two for 1 mark each | | good conductor | |
| c | 1 | C | | | |

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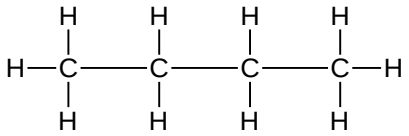
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| Q.4 | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|
| a i | 3 | all seven points plotted correctly (2)<br>one error (1)<br>two or more errors (0)<br>smooth curve going through the reliable points (not 92-30) (1) | | | |
| ii | 2 | 49 (from graph) (1)<br>graph levels/reaches 120 or highest volume of gas (1) | | | |
| iii | 2 | between 0 and 10 (1)<br>steepest slope/most gas given off in 10 seconds (1) | | | |
| b | 2 | using powdered calcium carbonate/increasing the temperature/increasing the concentration of the acid – any two for one mark each | | catalyst | more acid |
| c | 1 | no solid left at the end of the experiment/all the solid used up | increase in the volume of gas given off | | acid left at the end of the experiment |

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| Q.5 | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|
| a i<br><br>ii<br><br>iii | 1<br><br>1<br><br>1 | $C_3H_6$<br><br>B<br><br>C | | | |
| b | 1 |  | | | |
| c | 3 | heat/ (1)<br>PVC would melt/soften/loose shape (1)<br>melamine no change/char (1)<br><br>**or**<br><br>warm/place in hot water(1)<br>PVC would soften/ loose shape (1)<br>melamine no change(1) | | burn | |

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| Q.6 | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|
| a | 1 | screen/tongs/small piece of lithium/large volume of water – any one | | | laboratory coat |
| b | 2 | lithium hydroxide (1) hydrogen (1) | LiOH (1) $H_2$ (1) | H | |
| c | 1 | lithium (1) | Li | | |
| d | 2 | burns/lilac flame<br>spits (more)<br>melts<br>moves faster<br>fizzes more – any two for 2 marks | disappears quicker | dissolves quicker | |

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| Q.7 | Mark | |
|---|---|---|
| | 6 | **Indicative content:**<br>Description – heating the mixture in the flask to produce hot vapours. In the condenser the water enters at the lower end of the condenser and leaves at the higher point. The hot vapours from the flask then enter the condenser where they then cool, condense and runs down into the beaker as liquid.<br>Explanation - since the boiling point of ethanol is lower than that of water the vapours will initially contain mainly ethanol and will therefore enter the condenser/beaker first.<br><br>**5-6 marks**<br>The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3-4 marks**<br>The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>**1-2 marks**<br>The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks**<br>The candidate does not make any attempt or give a relevant answer worthy of credit. |

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| Q.8 | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|
| a | 1 | sodium | Na | | |
| b | 3 | $Na + Cl_2$ (1)<br>NaCl (1)<br>correct balancing (1) | consequential marking | | |
| c | 2 | add silver nitrate solution (1)<br>white precipitate/solid formed (1) | | | |

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| Q.9 | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|
| a | 1 | 6 and 2 – both needed | | | |
| b i<br><br>ii | 1<br><br>1 | **B**<br><br>2- | oxide/$O^{2-}$<br><br>$O^{2-}$ | oxygen/O | |
| c | 1 | **D** | neon/Ne | | |
| d | 2 | **D** and **E** – both needed (1)<br>same number of protons but a different number of neutrons / same element but a different number of neutrons (1) | | | |

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# C2

## Higher Tier

| Q.1 | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|
| a | 1 | prevent the metals from reacting with air/oxygen/moisture | | | |
| b i | 1 | screen/tongs/small piece of lithium/large volume of water – any one | | | laboratory coat |
| ii | 1 | lithium hydroxide (1) hydrogen (1) | LiOH (1) $H_2$ (1) | H | |
| iii | 1 | lithium (1) | Li | | |
| iv | 2 | burns/lilac flame<br>spits (more)<br>melts<br>moves faster<br>fizzes more – any two for 2 marks | disappears quicker | dissolves quicker | |

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| Q.2 | Mark | |
|---|---|---|
| | 6 | **Indicative content:**<br>Description – heating the mixture in the flask to produce hot vapours. In the condenser the water enters at the lower end of the condenser and leaves at the higher point. The hot vapours from the flask then enter the condenser where they then cool, condense and runs down into the beaker as liquid.<br>Explanation – since the boiling point of ethanol is lower than that of water the vapours will initially contain mainly ethanol and will therefore enter the condenser/beaker first.<br><br>**5-6 marks**<br>The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3-4 marks**<br>The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>**1-2 marks**<br>The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks**<br>The candidate does not make any attempt or give a relevant answer worthy of credit. |

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| Q.3 | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|
| a | 1 | sodium | Na | | |
| b | 3 | $Na + Cl_2$ (1)<br>NaCl (1)<br>correct balancing (1) | consequential marking | | |
| c | 2 | add silver nitrate solution (1)<br>white precipitate/solid formed (1) | | | |

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| Q.4 | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|
| a | 1 | 9 | | | |
| b | 1 | 6 and 2 – both needed | | | |
| c i<br><br>ii | 1<br><br>1 | **B**<br><br>2- | oxide/$O^{2-}$<br><br>$O^{2-}$ | oxygen/O | |
| d | 1 | **D** | neon/Ne | | |
| e | 2 | **D** and **E** – both needed (1)<br>same number of protons but a different number of neutrons / same element but a different number of neutrons (1) | | | |

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| Q5 | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|
| a i<br><br>ii | 1<br><br>2 | ionic<br><br>melt/dissolve (in water) (1)<br>allow the ions to move (1) | | | |
| b | 2 | 4 electrons between C and both O atoms (1)<br>8 electrons around both O atoms (1) | | | |
| c | 3 | simple and giant covalent (1)<br><br>weak bonds between carbon dioxide molecules (1)<br><br>strong bonds throughout diamond (1) | | | |

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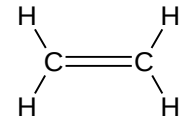
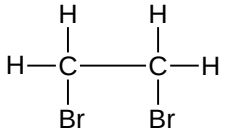
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| Q.6 | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|
| a | 1 | smooth curve by eye starting at 290 and becoming flat at 287.6 | | | |
| b | 1 | release/loss of gas | | | |
| c | 1 | prevent the loss of water vapour/moisture | | | |
| d | 2 | curve to the left of graph (1)<br>levelling off at 287.6 (1) | | | |
| e | 2 | 2.4 (1)<br>amount of carbon dioxide released depends on the mass of calcium carbonate since the acid is in excess (1) | | | |

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| Q7 | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|
| a | 2 | bromine becoming colourless/it decolourises (1)<br><br>addition (1) | | | |
| b | 2 |  (1)<br><br> (1) | | | |
| c | 1 | ethane | $C_2H_6$ | | |

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| Q.8 | Mark | |
|---|---|---|
| | 6 | **Indicative content:**<br>Hard water does not lather easily with soap whereas soft water does. Calcium or magnesium compounds dissolved in water makes it hard. Hardness in water can be removed by boiling/distillation, adding washing soda and by passing through an ion-exchange column or a detailed account of one method.<br><br>**5-6 marks**<br>The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3-4 marks**<br>The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>**1-2 marks**<br>The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks**<br>The candidate does not make any attempt or give a relevant answer worthy of credit. |

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| Q9 | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|
| a | 3 | mass of oxygen = 0.16<br>mass of magnesium = 0.48 (1)<br>Mg O<br>0.48 0.16 (1)<br>24 16<br>0.02 0.01<br>$Mg_2O$ (1) | | | |
| b | 2 | some magnesium had not reacted (1)<br>some product lost during the burning (1) | lid not opened enough<br>white smoke given off<br>Mg reacted with nitrogen<br>Mg might have oxidised before expt | | |
| c | 3 | $M_r$(MgO) = 24 + 16 = 40 (1)<br><br>2(24) g Mg …… 2(40)g MgO (1)<br>48……..80<br>0.48 ……0.8 (1)<br>or<br>2 mols of Mg gives 2 mols of MgO (1)<br>0.02 ……0.02<br>Mass of MgO = 0.02 × 40 = 0.8 (1)<br><br>- correct answer 3 marks | | | |



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