



General Certificate of Secondary Education  
2019–2020

Centre Number

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Candidate Number

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# Single Award Science: Chemistry

Unit 2  
Higher Tier

<b>MV18</b>
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[GSA22]

**THURSDAY 27 FEBRUARY 2020, MORNING**

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## **Time**

1 hour, plus your additional time allowance.

## **Instructions to Candidates**

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

**You must answer the questions in the spaces provided.**

**Do not write on blank pages.**

Complete in black ink only.

Answer all **eight** questions.

## **Information for Candidates**

The total mark for this paper is 60.

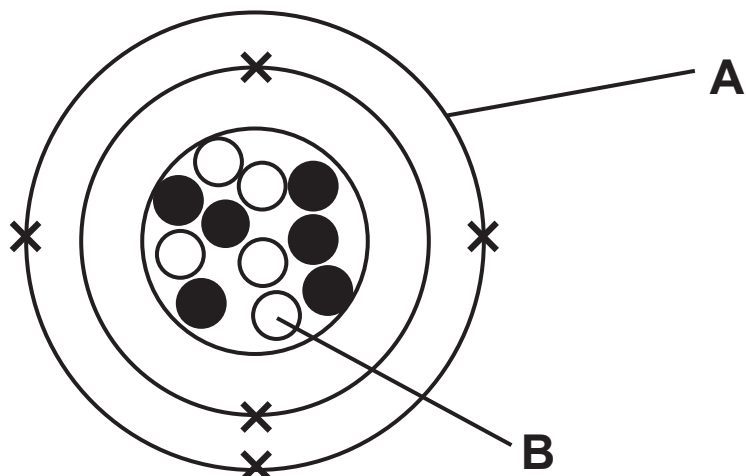
Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.

Quality of written communication will be assessed in Question **3**.

A Data Leaflet, which includes a Periodic Table of the Elements, is included for your use.

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1 (a) The diagram below shows an atom of boron.



(i) Name the parts labelled **A** and **B** on the diagram above. [2 marks]

**A** \_\_\_\_\_

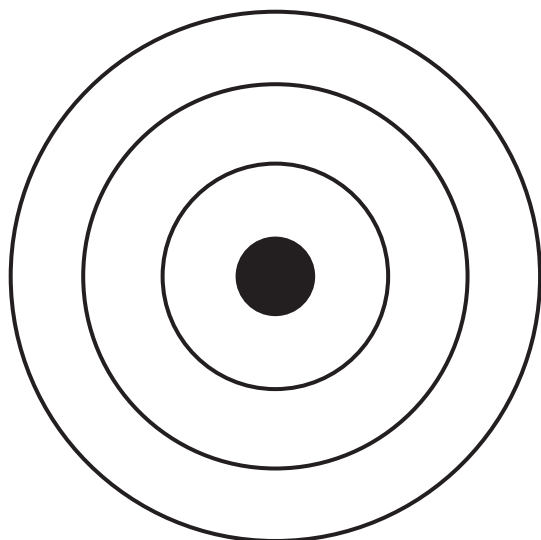
**B** \_\_\_\_\_

(ii) Colin knows that boron is in Group 3 of the Periodic Table.  
How can he tell this from the diagram above?  
[1 mark]

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(b) A silicon atom has fourteen electrons.  
Complete the diagram below to show how these electrons are arranged in an atom of silicon. [1 mark]



(c) What is meant by the term **atomic number**? [1 mark]

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- 2 The table below gives the amount of energy released when the first four alkanes are burnt.

Number of carbon atoms	Energy released/ kJ/mol
1	891
2	1561
3	2220
4	2878

- (a) Give the trend shown by this information. [1 mark]

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- (b) Predict the amount of energy released when an alkane with 5 carbon atoms is burnt. [1 mark]

\_\_\_\_\_ kJ/mol

- (c) Calculate how much more energy is released when the alkane with 4 carbon atoms is burnt compared to the alkane with 1 carbon atom. [2 marks]

(Show your working out.)

\_\_\_\_\_ kJ/mol

(d) Alkanes are hydrocarbons. What is meant by the term **hydrocarbon**? [2 marks]

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(e) When hydrocarbons burn they produce carbon dioxide. Name the chemical used to test for this gas and describe the colour change observed. [3 marks]

Chemical \_\_\_\_\_

Colour change:

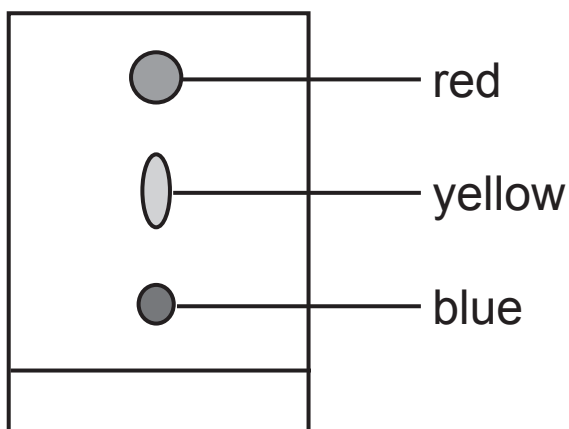
from \_\_\_\_\_ to \_\_\_\_\_

3 Shown below is the set-up and result of an experiment used to separate the colours in black ink.

set-up



result



Describe how this experiment is carried out. [6 marks]

Your answer should include:

- the set-up of the experiment;
- the name of this method of separation;
- two conclusions that can be made from these results.

**In this question you will be assessed on your written communication skills including the use of specialist scientific terms.**

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4 The table below shows the pH of four acidic liquids.

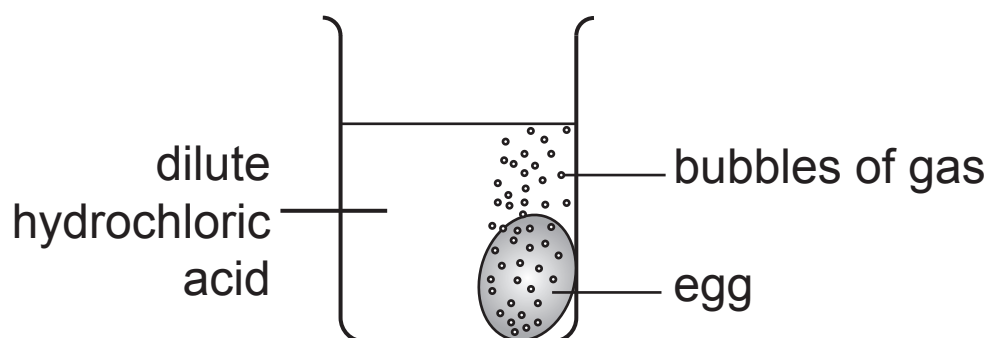
Liquid	pH
orange juice	3.8
ethanoic acid	3.0
lemonade	4.4
dilute hydrochloric acid	1.0

Using information from the table and your knowledge answer the following questions.

(a) Name the liquid in the table that is the **least** acidic.  
[1 mark]

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(b) An egg was put into a beaker of the dilute hydrochloric acid as shown below.



After two days the egg shell had completely reacted with the acid. The pH of the liquid in the beaker was now 2.5.

(i) Describe and explain the change in the strength of the acid in the beaker. [2 marks]

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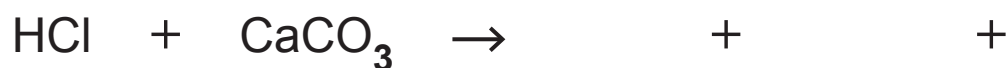


(ii) Another egg was placed in a beaker of ethanoic acid. In what way, if any, would the rate of reaction change compared to that of hydrochloric acid? Explain your answer. [2 marks]

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(c) The egg shell is made from calcium carbonate ( $\text{CaCO}_3$ ). Complete the balanced symbol equation for its reaction with hydrochloric acid (HCl). [3 marks]



- 5 The table below gives information about four elements (**W**, **X**, **Y** and **Z**).

Element	Number of protons	Number of neutrons	Number of electrons
<b>W</b>	2	2	2
<b>X</b>	7	7	7
<b>Y</b>	20	20	20
<b>Z</b>	9	10	9

- (a) Use this information to answer the following questions. You may find your Data Leaflet helpful.

- (i) Calculate the mass number of element **Z**. [1 mark]

\_\_\_\_\_

- (ii) Name the element labelled **X**. [1 mark]

\_\_\_\_\_

- (iii) Which element (**W**, **X**, **Y** or **Z**) has seven electrons in its outer shell? [1 mark]

\_\_\_\_\_

- (iv) Which element (**W**, **X**, **Y** or **Z**) is a noble gas? [1 mark]

\_\_\_\_\_

**(b)** Complete the table below to give the relative masses and charges of protons, electrons and neutrons.  
[3 marks]

<b>Particle</b>	<b>Charge</b>	<b>Relative mass</b>
proton	+1	
electron	-1	
neutron		1

6 (a) Potassium (Group 1) and fluorine (Group 7) react together to form the compound potassium fluoride which has a very strong ionic bond.

(i) What name is given to elements in Groups 1 and 7 of the Periodic Table? [2 marks]

Group 1 \_\_\_\_\_

Group 7 \_\_\_\_\_

(ii) Describe how an atom of potassium forms an ionic bond with an atom of fluorine. [3 marks]

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

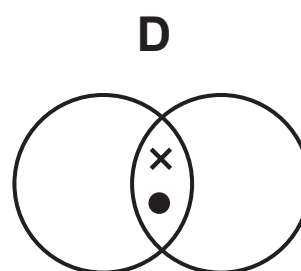
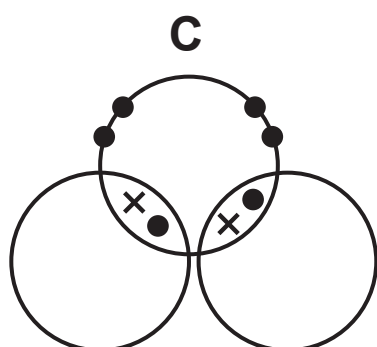
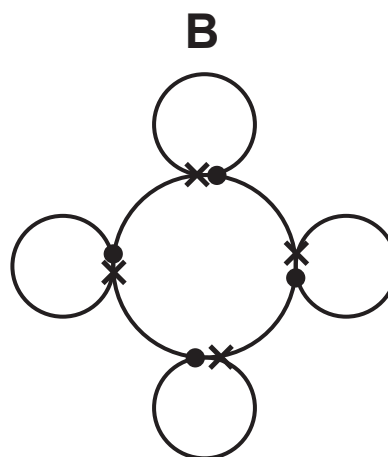
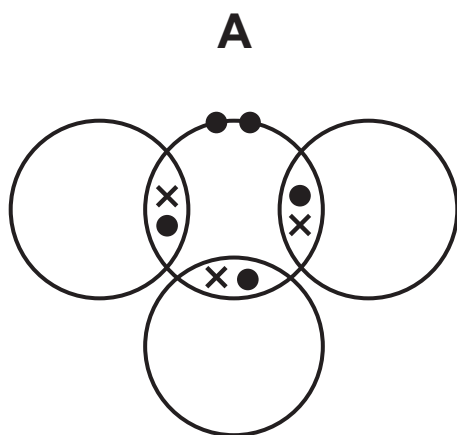
(iii) Explain why ionic bonds are very strong. [1 mark]

\_\_\_\_\_  
\_\_\_\_\_

(iv) Name **one** other compound formed from a Group 1 and a Group 7 element. [1 mark]

\_\_\_\_\_

(b) The molecular diagrams below show bonding between non-metal elements.



(i) What name is given to this type of bonding?  
[1 mark]

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(ii) How many lone pairs are shown in diagram **A**?  
[1 mark]

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(iii) Which diagram (**A**, **B**, **C** or **D**) could represent a molecule of water? [1 mark]

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**7** A smart material changes its properties in response to a change in its surroundings.  
Thermochromic plastic is an example of a smart material.

**(a)** Explain why thermochromic plastic is described as a smart material. [1 mark]

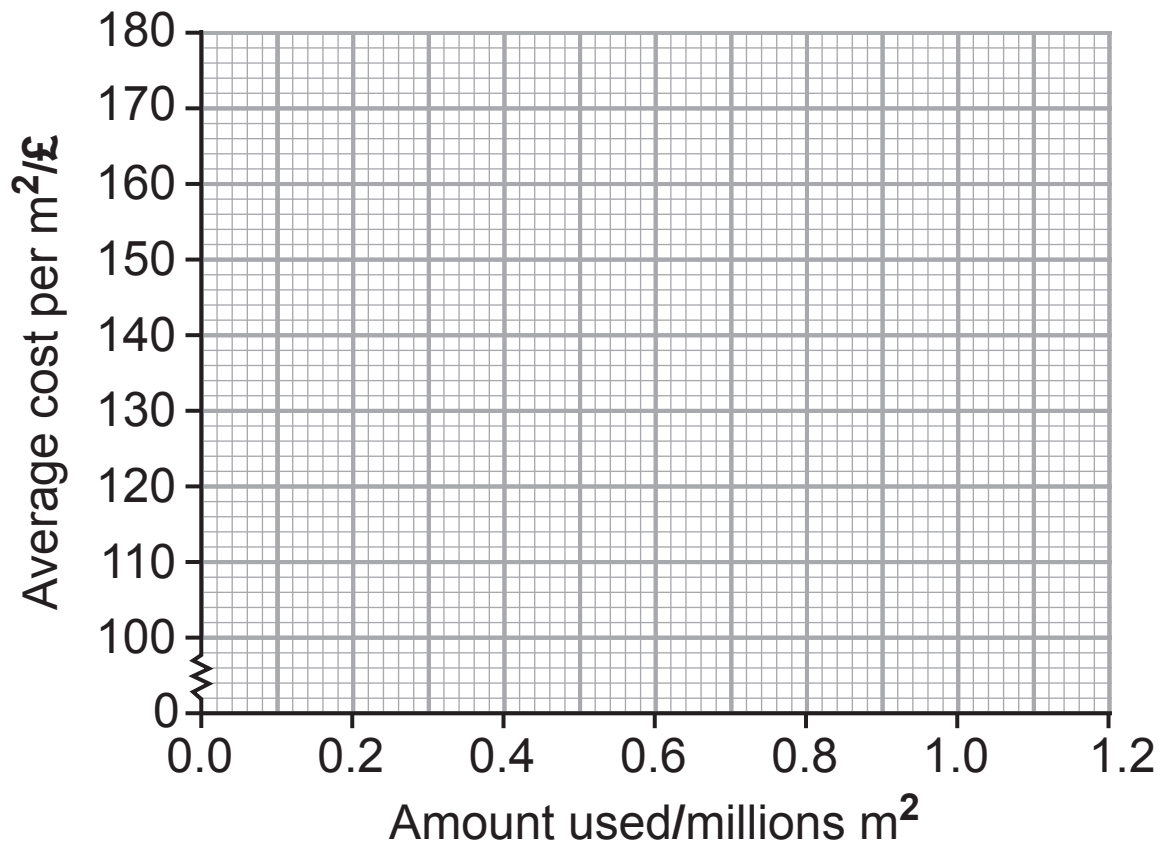
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**(b)** Thermochromic window glass is now finding more uses in houses and cars. The table below gives some information about the amount and cost of thermochromic glass in recent years.

<b>Year</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>
<b>Amount used/ millions m<sup>2</sup></b>	0.10	0.15	0.30	0.48	0.76	1.06
<b>Average cost per m<sup>2</sup>/£</b>	176	155	135	120	110	100

- (i) On the grid below draw and plot a line graph for the average cost of thermochromic glass used against the amount used. [3 marks]



- (ii) Describe the trend shown in the graph above. [1 mark]

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(c) Scientists are developing and researching many new materials including graphene and fullerenes. Fullerenes have optical limiting properties, this means if they are added to glass they can decrease the amount of sunlight passing through it.

(i) Name the element that both graphene and fullerenes are made from. [1 mark]

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(ii) Using the information in the paragraph suggest **one** use for fullerenes. [1 mark]

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**(Questions continue overleaf)**

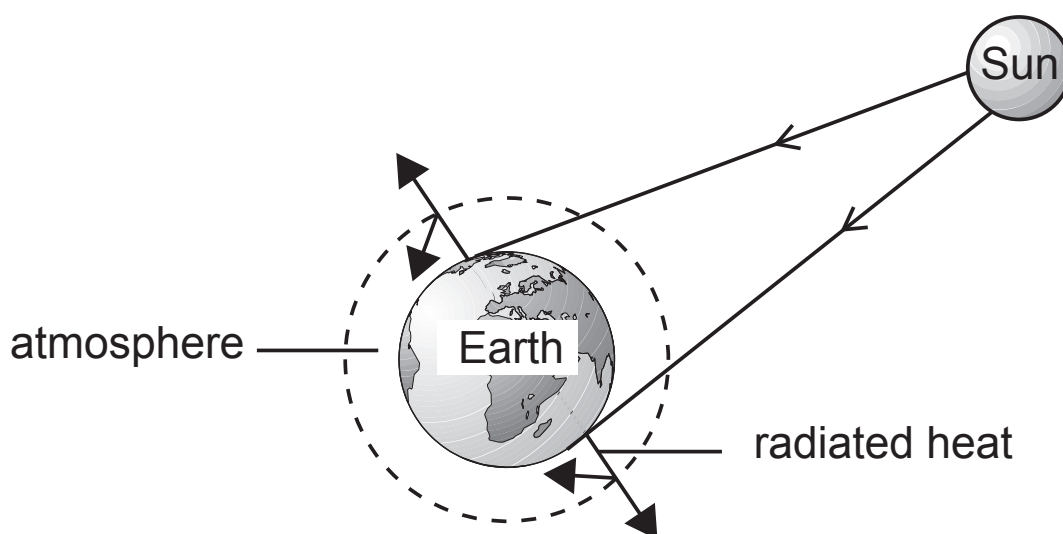
- 8 (a) The table below gives some information about four different hydrocarbons.

Name	Molecular formula	Structural formula
ethene	$C_2H_4$	
methane	$CH_4$	$\begin{array}{c} H \\   \\ H-C-H \\   \\ H \end{array}$
butene	$C_4H_8$	$\begin{array}{ccccccc} & H & & H & & H & & H \\ &   & &   & &   & &   \\ H & -C & - & C & = & C & - & C & -H \\ &   & & & & & &   \\ & H & & & & & & H \end{array}$
propene		$\begin{array}{ccccccc} & & & H & & H & & \\ & & &   & &   & & \\ H & & & C & = & C & - & C & -H \\ & & & & & & &   \\ & & & H & & & & H \end{array}$

(i) Complete the table. [2 marks]

(ii) Name the hydrocarbon shown in the table that is an alkane. [1 mark]

The burning of hydrocarbons increases the greenhouse effect which leads to global warming.



**(b)** Using the diagram and your knowledge explain how the burning of hydrocarbons can lead to global warming.  
[2 marks]

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**(c)** Ethene can be used to make a plastic called polyethene. Describe how polyethene is formed from molecules of ethene and name the process involved.  
[3 marks]

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**This is the end of the question paper**

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**SOURCES:**

Q3 ..... © Trevor Clifford Photography / Science Photo Library  
Q8(a) .....Source: Principal Examiner

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	

<b>Total Marks</b>	
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Examiner Number

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