Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4472/01

S15-4472-01

ADDITIONAL SCIENCE/CHEMISTRY

CHEMISTRY 2
FOUNDATION TIER

A.M. THURSDAY, 14 May 2015

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**5**	
3.	**7**	
4.	**7**	
5.	**6**	
6.	**6**	
7.	**7**	
8.	**6**	
9.	**5**	
10.	**6**	
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) used in your answer to question **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. *(a)* Draw a line from each type of structure to its property. One has been done for you. [2]

Structure	**Property**
metallic	gas or liquid at room temperature
ionic	conducts electricity when molten or in solution
simple molecular	malleable and ductile
giant covalent	high melting point

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(b) Smart materials have properties which change reversibly with a change in their surroundings. The box below shows the names of some smart materials.

hydrogel	**shape memory alloy**	**photochromic pigment**
thermochromic pigment	**shape memory polymer**	

From the box above, choose the smart material used in making each of the following items. [3]

Mug .....

Gumshield .....

Disposable nappy .....

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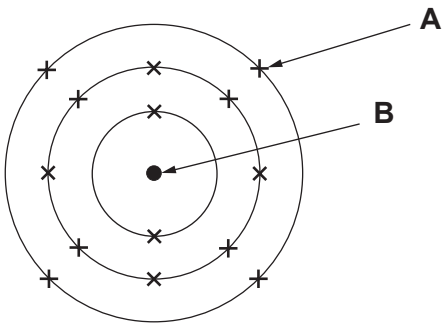
2. The diagram shows an atom of silicon.



(a) Name particle **A**. ..... [1]

(b) **B** is the nucleus. Name the **two** types of particle present in the nucleus of an atom. [2]

..... and .....

(c) Use the information in the diagram to give

(i) the atomic number of silicon, ... [1]

(ii) the electronic structure of silicon. ..... [1]

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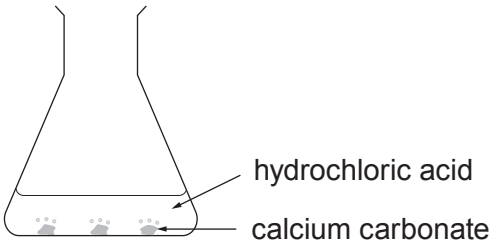
3. An investigation was carried out to find the effect of different factors on the rate of reaction of calcium carbonate and hydrochloric acid.



The time taken for the calcium carbonate to disappear in each experiment is shown in the table below.

Experiment number	Form of calcium carbonate	Temperature of acid (°C)	Time taken for calcium carbonate to disappear (s)
1	marble chips	20	600
2	powder	20	150
3	marble chips	40	400

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(a) (i) Use the results to describe the effect of changing temperature on reaction time. [1]

.....

.....

(ii) Name the factor that has changed between experiments 1 and 2 and describe what effect this factor has on reaction time. [2]

.....

.....

(iii) State **two** *other* factors that should be kept the same in order to make this investigation a fair test. [2]

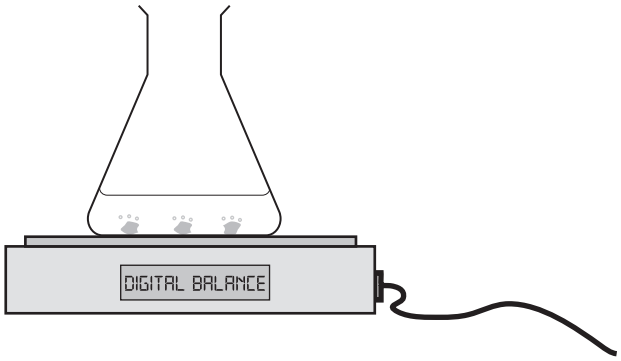
Factor 1 .....

Factor 2 .....

Turn over.

Examiner only

(b) The rate of reaction can also be investigated by recording the change in mass.



Explain what will happen to the mass during the reaction. [2]

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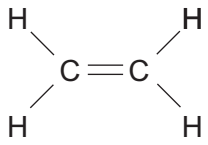
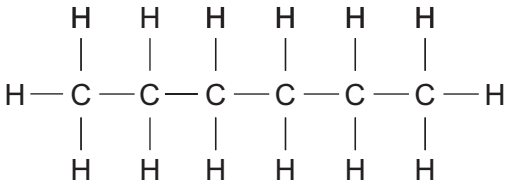
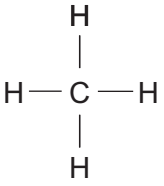
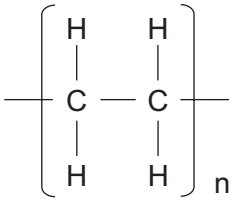
Examiner only

4. The following table shows information about some organic compounds.

Name	Molecular formula	Structural formula
ethene	C_2H_4	
propane	C_3H_8	
hexane		
	CH_4	

(a) Complete the table by filling all **three** empty boxes. [3]

(b) (i) Name the compound from the table above that can be used to form the polymer represented by the following structure. [1]

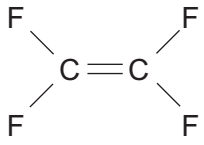


Compound .....

(ii) Small reactive molecules, such as alkenes, that join together to form polymers are known as ..... . [1]

Examiner only

(c) Another polymer can be formed from the following compound.



(i) Choose from the box below the name of the polymer produced from this compound. [1]

polyethene	**polypropene**	**polyvinylchloride**
polytetrafluoroethene		**polystyrene**

Polymer .....

(ii) Draw the repeating unit for this polymer. [1]

7

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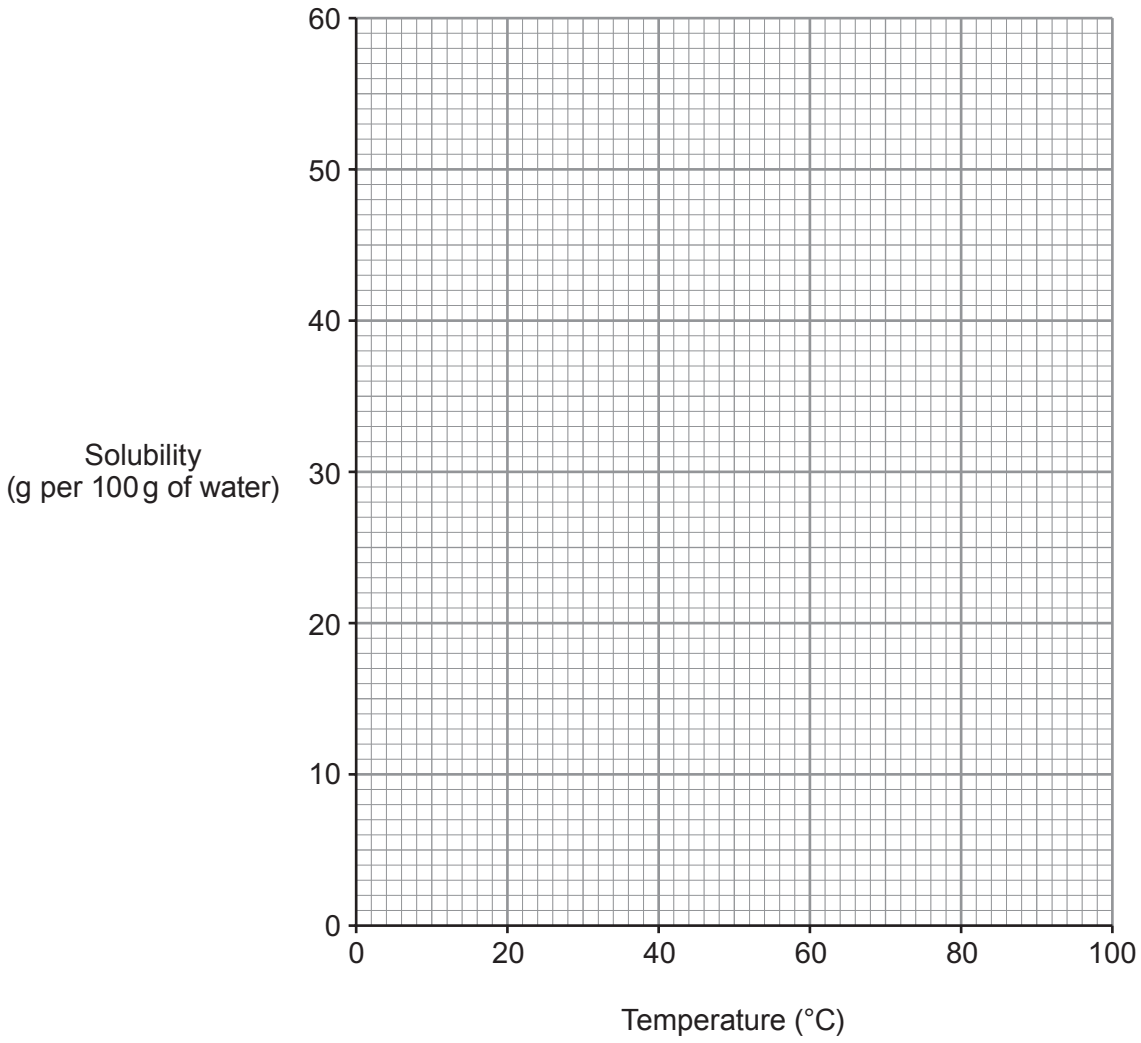
5. The following table shows the solubility of potassium chlorate at different temperatures.

Temperature (°C)	Solubility (g per 100 g of water)
0	3.5
20	7.5
40	14.0
60	24.0
80	37.5
100	56.5

(a) Plot a graph to show the solubility of potassium chlorate on the grid below. Draw a suitable line. [3]



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(b) Describe how the solubility of potassium chlorate changes with temperature. [1]

.....

.....

(c) A saturated solution of potassium chlorate at 80 °C is cooled to 20 °C. Describe what you would see and explain why this happens. [2]

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6

Examiner only

6. Propane gas can be used as a fuel.

(a) Balance the following equation that shows the combustion of propane. [2]

$$C_3H_8 + \square\, O_2 \longrightarrow \square\, CO_2 + 4H_2O$$

(b) Hydrogen gas can also be used as a fuel. The following equation shows what happens when it burns.

$$H-H \quad H-H + O=O \longrightarrow H-O-H \quad H-O-H$$

The table below shows the bond energies involved in the reaction.

Bond	Energy (kJ)
H — H	436
O = O	495
H — O	463

The energy required to break all the bonds in the reactants can be calculated as shown below:

$2 \times$ H — H bonds $= 2 \times 436 = 872$

$1 \times$ O = O bond $= 495$

Energy required to break all the bonds in the reactants = 872 + 495 = 1 367 kJ

(i) Calculate the energy produced when all the bonds in the products are made. [2]

Energy produced when all the bonds in the products are made = ... kJ

(ii) Use the information given and your answer to part (i) to explain why the overall reaction is exothermic. [2]

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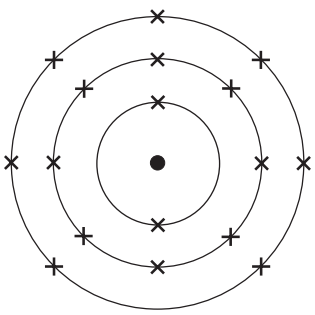
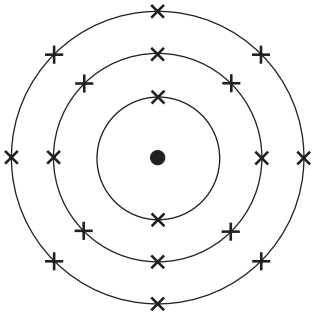
Examiner only

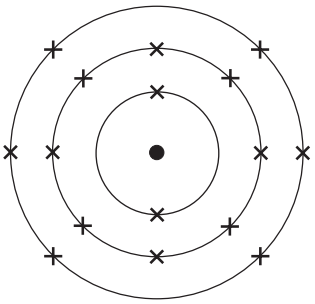
7. The following diagrams show the electronic structures of five elements, **A**–**E**.



A



B



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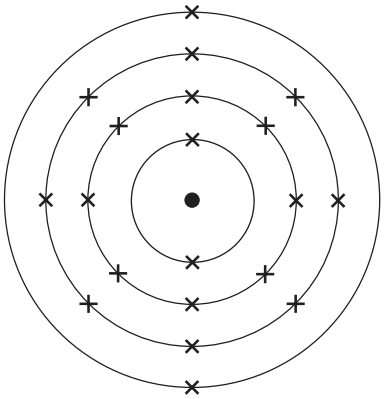
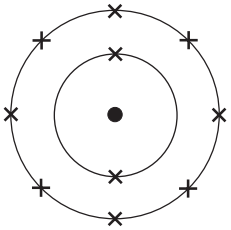


D



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 .....

.....

Examiner only

(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]

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Turn over.

Examiner only

8. *(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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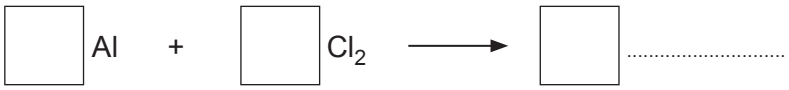
9. *(a)* Aluminium reacts with chlorine to form aluminium chloride. Complete and balance the symbol equation for the reaction taking place. [2]



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(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 = ... %

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Turn over.

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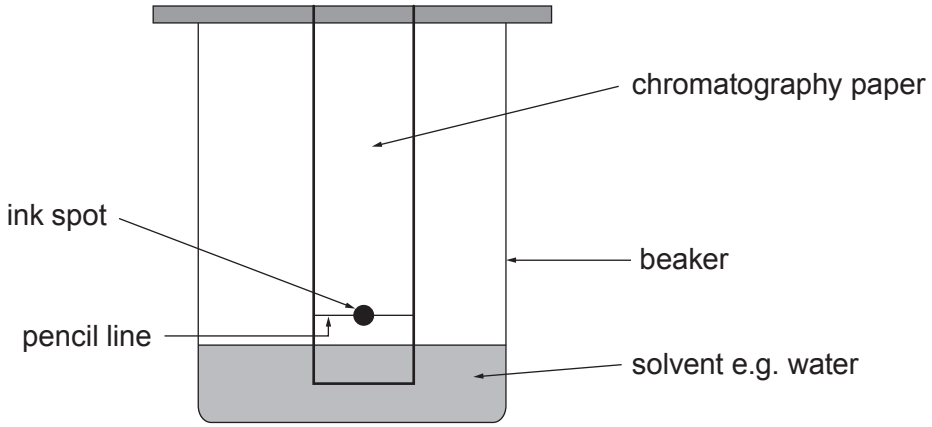
10. Chromatography can be used to separate the pigments in ink.



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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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+}		

Turn over.

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: