Surname	Centre Number	Candidate Number
Other Names		0

GCSE

C410U20-1

S19-C410U20-1

WEDNESDAY, 12 JUNE 2019 – MORNING

CHEMISTRY – Component 2
Applications in Chemistry

FOUNDATION TIER

1 hour 15 minutes

	For Examiner's use only		
	Question	**Maximum Mark**	**Mark Awarded**
Section A	**1.**	**10**	
	2.	**5**	
	3.	**9**	
	4.	**15**	
	5.	**6**	
Section B	**6.**	**15**	
	Total	**60**	

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ADDITIONAL MATERIALS

In addition to this examination paper you will need a:
- calculator and ruler;
- **Resource Booklet**.

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. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

This paper is in two sections.

Section A (45 marks). You are advised to spend about 50 minutes on this section.
Section B (15 marks). You are advised to spend about 25 minutes on this section.

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

Question **5** is a quality of extended response (QER) question where your writing skills will be assessed.

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

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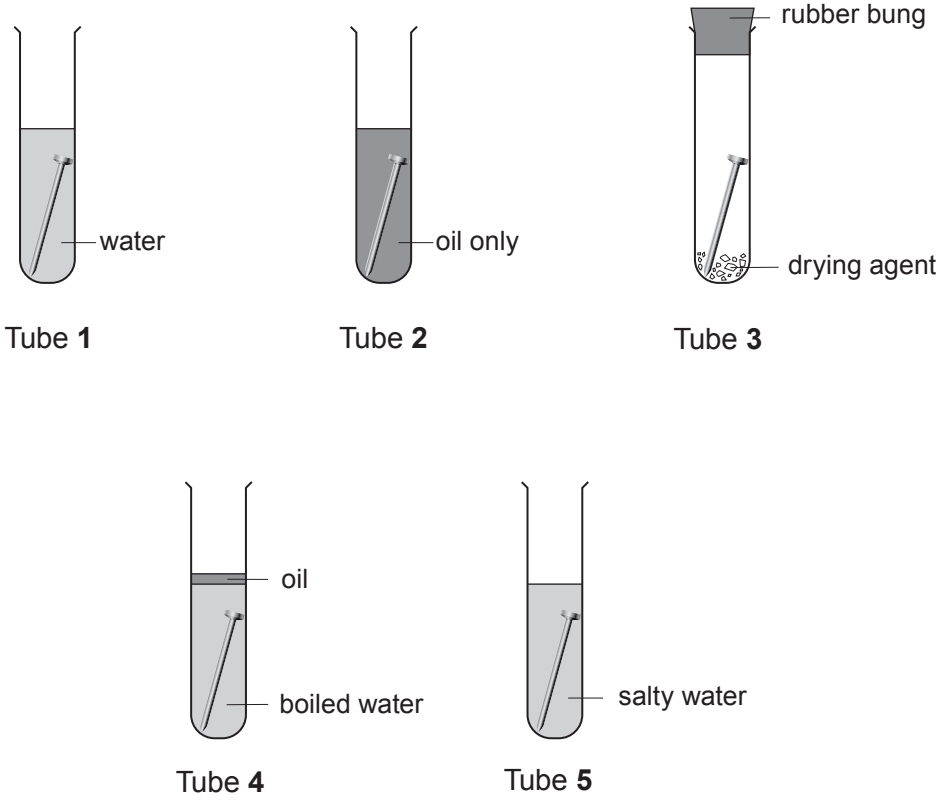
SECTION A

Answer **all** *questions.*

1. A group of students carried out an investigation into the factors that affect the rusting of iron. They placed identical iron nails into five separate test tubes as shown in the diagram. The nails were left inside each of the tubes for one week.



Tube **1** Tube **2** Tube **3**

Tube **4** Tube **5**

(a) Complete the table to identify the conditions the nails were exposed to in tubes **4** and **5**. The conditions for tubes **1**, **2** and **3** have been completed for you. [2]

	Tube **1**	Tube **2**	Tube **3**	Tube **4**	Tube **5**
Air present?	✓	X	✓		
Water present?	✓	X	X		
Salt present?	X	X	X		

(b) Suggest why a bung was used in tube **3**. [1]

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(c) Give the number of the tube that was set up as the control for the investigation. [1]

.....

(d) State **two** controlled variables in **all five** test tubes. Describe how these were controlled. [4]

Controlled variable	How it was controlled

(e) The appearance of each of the nails after one week is described below.

Tube	Appearance of nail
1	rusty
2	no rust
3	no rust
4	no rust
5	very rusty

Use **all** the information to state what conclusions can be drawn about the factors that affect rusting. [2]

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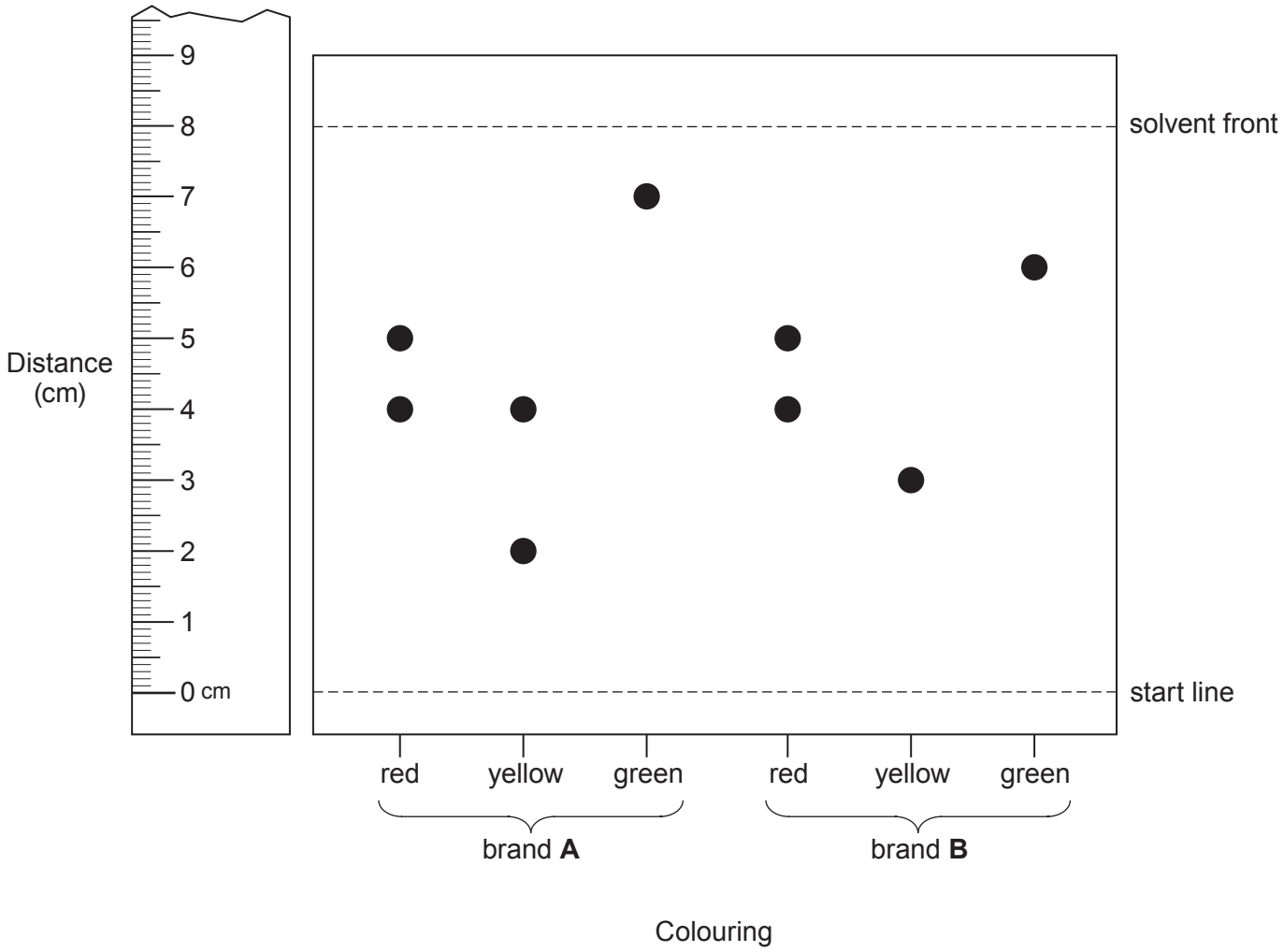
Turn over.

2. A group of students carried out an investigation to compare the coloured sugar coatings found on two different brands of sweets – brand **A** and brand **B**. The different colourings are either made from a single dye or a mixture of dyes. The dyes can be separated using chromatography.

The diagram below shows the chromatogram the students produced.



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(a) Use the information in the chromatogram to answer parts (i)-(iii).

(i) Give the colouring that contains the most soluble dye. [1]

Brand .....

Colour .....

(ii) Give the colour that is made of exactly the same dyes in both brands of sweets. [1]

Colour .....

(iii) Give the total number of **different** dyes that are used to make all the colourings. [1]

Number of different dyes .....

(b) The R_f value of a substance can be used to identify that substance. The R_f value of one of the dyes on the chromatogram is 0.625. Use the equation below to calculate the distance moved by this dye. [2]

distance moved by the dye = $R_f \times$ distance moved by the solvent front

Distance moved = ... cm

5

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3. *(a)* Luke and Connor had been investigating tests that are used to identify positive and negative ions in compounds. Some of the results they recorded are shown below.

Put a circle around their **three incorrect** observations. [3]

Flame tests

Metal ion	Flame colour
Li^+	red
Na^+	orange
K^+	blue
Cu^{2+}	green

Adding dilute nitric acid followed by silver nitrate solution

Halide ion	Colour of precipitate
Cl^-	orange
Br^-	cream
I^-	yellow

Adding sodium hydroxide solution to metal ions in solution

Metal ion solution	Colour of precipitate
Cu^{2+}	blue
Fe^{2+}	green
Fe^{3+}	white

Adding dilute hydrochloric acid followed by barium chloride solution

Ion	Colour of precipitate
SO_4^{2-}	white

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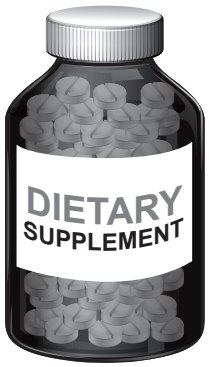
(b) In another part of their investigation, Luke and Connor had been given the task of identifying the ions present in a dietary supplement.



They were told that the tablets were made from calcium carbonate and carried out tests to identify both the calcium and carbonate ions in the compound.

(i) Describe the test they carried out to show that the tablets contain calcium ions. Give the expected observation. [2]

.....

.....

(ii) They tested for carbonate ions by adding dilute hydrochloric acid.

Name the gas that formed if the tablets contain carbonate ions. Describe the test they carried out to identify this gas. Include the result for the test. [2]

Gas .....

Test and result .....

.....

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(iii) Each of the tablets has a thin coating. This coating dissolves when the tablet is swallowed, allowing the calcium carbonate to be released into the body. Calcium carbonate is not soluble.

Luke and Connor used a three step method to separate the calcium carbonate powder from its coating and collect a pure sample of calcium carbonate.

Complete the flow diagram. State what is done and why in steps **2** and **3** of the method. [2]

Step **1**

Place the tablet into a beaker of water to dissolve the coating

Step **2**

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Step **3**

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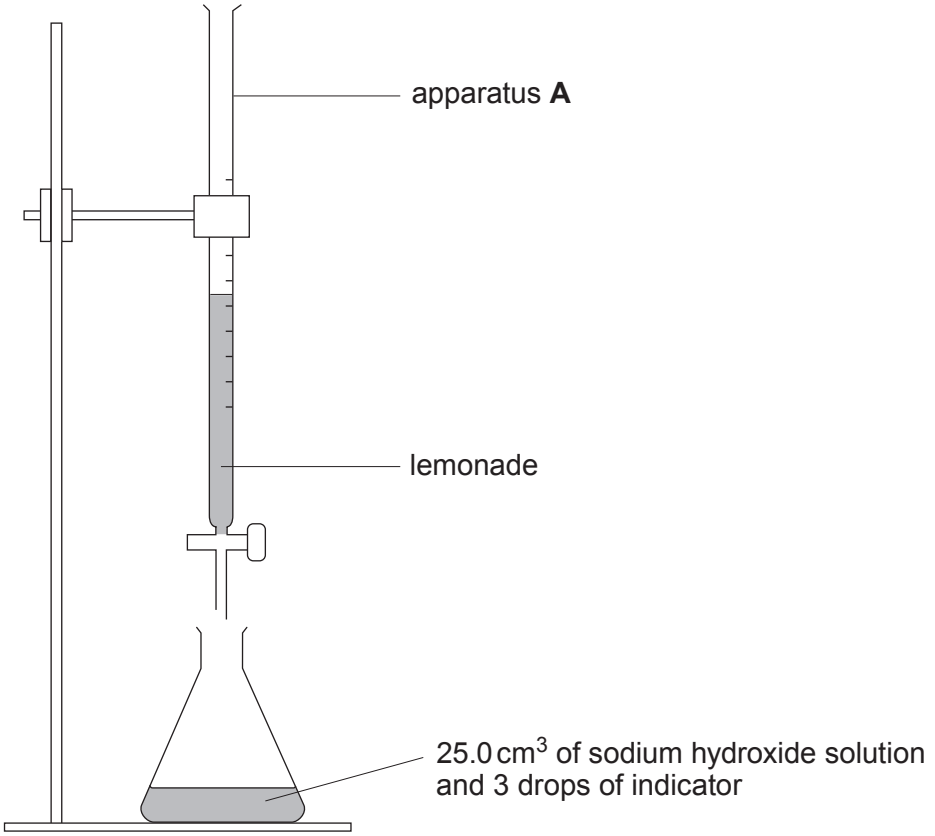
4. *(a)* Anna carried out a titration experiment to find the mass of citric acid in a litre bottle of lemonade.

The diagram shows the apparatus she used to find the volume of lemonade needed to neutralise 25.0 cm^3 of sodium hydroxide solution.



Anna slowly added the lemonade to the sodium hydroxide solution until the indicator changed colour. A trial run was carried out and the titration was then repeated three times. The volume of lemonade added each time was recorded.

Run	Trial	1	2	3
Volume of lemonade (cm^3)	21.4	19.8	19.9	20.0

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(i) Choose your answers to parts I and II from the box below.

burette	thermometer	pipette	funnel	beaker

I. Name the piece of apparatus labelled **A**. [1]

.....

II. Name the piece of apparatus that would **not** have been used whilst carrying out a titration. [1]

.....

(ii) State the purpose of carrying out a trial run. [1]

.....

.....

(iii) State whether or not the results are repeatable. Give a reason for your answer. [1]

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.....

(iv) Calculate the **mean** volume of lemonade needed to neutralise 25.0 cm^3 of the sodium hydroxide solution. [1]

Mean volume = ... cm^3

(v) The student's final calculations showed that the lemonade contains 1.75 g of citric acid per litre bottle.

The label on a litre bottle of an energy drink states that it contains 7.00 g of citric acid.

Suggest the approximate volume of this energy drink that would be required to neutralise 25.0 cm^3 of the sodium hydroxide solution used in the experiment. Give a reason for your answer. [2]

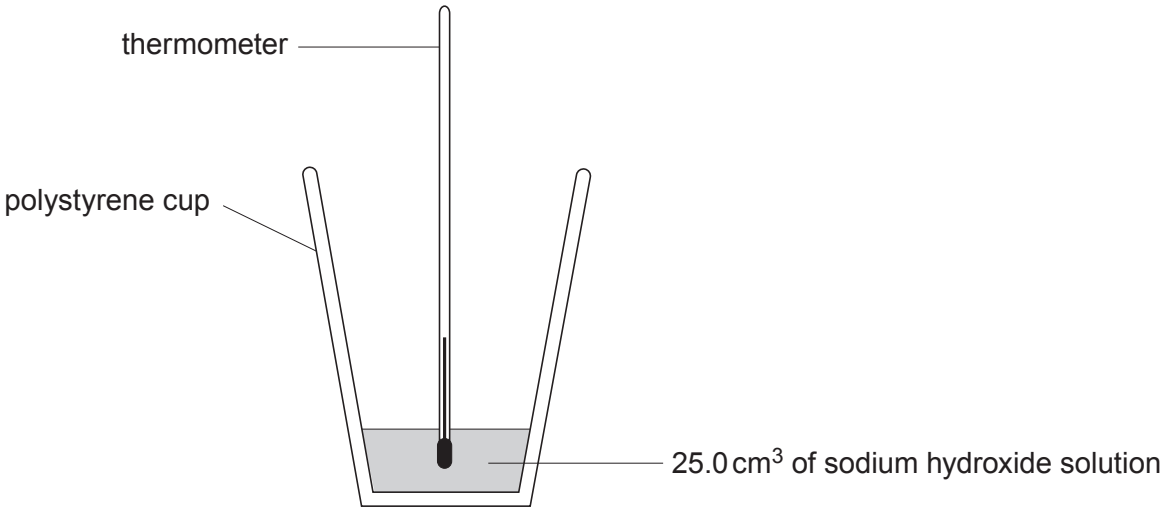
Volume ..... cm^3

Reason .....

.....

.....

(b) Robert used the apparatus shown to investigate the temperature change which occurs when dilute hydrochloric acid reacts with sodium hydroxide solution.



25.0 cm^3 of the sodium hydroxide solution was measured into a polystyrene cup. Hydrochloric acid was then added, 5.0 cm^3 at a time, to the sodium hydroxide solution and the temperature of the mixture recorded each time.

Volume of acid added (cm^3)	Temperature (°C)
0	21.0
5.0	22.7
10.0	24.0
15.0	25.1
20.0	26.0
25.0	26.5
30.0	26.7
35.0	26.4
40.0	25.6

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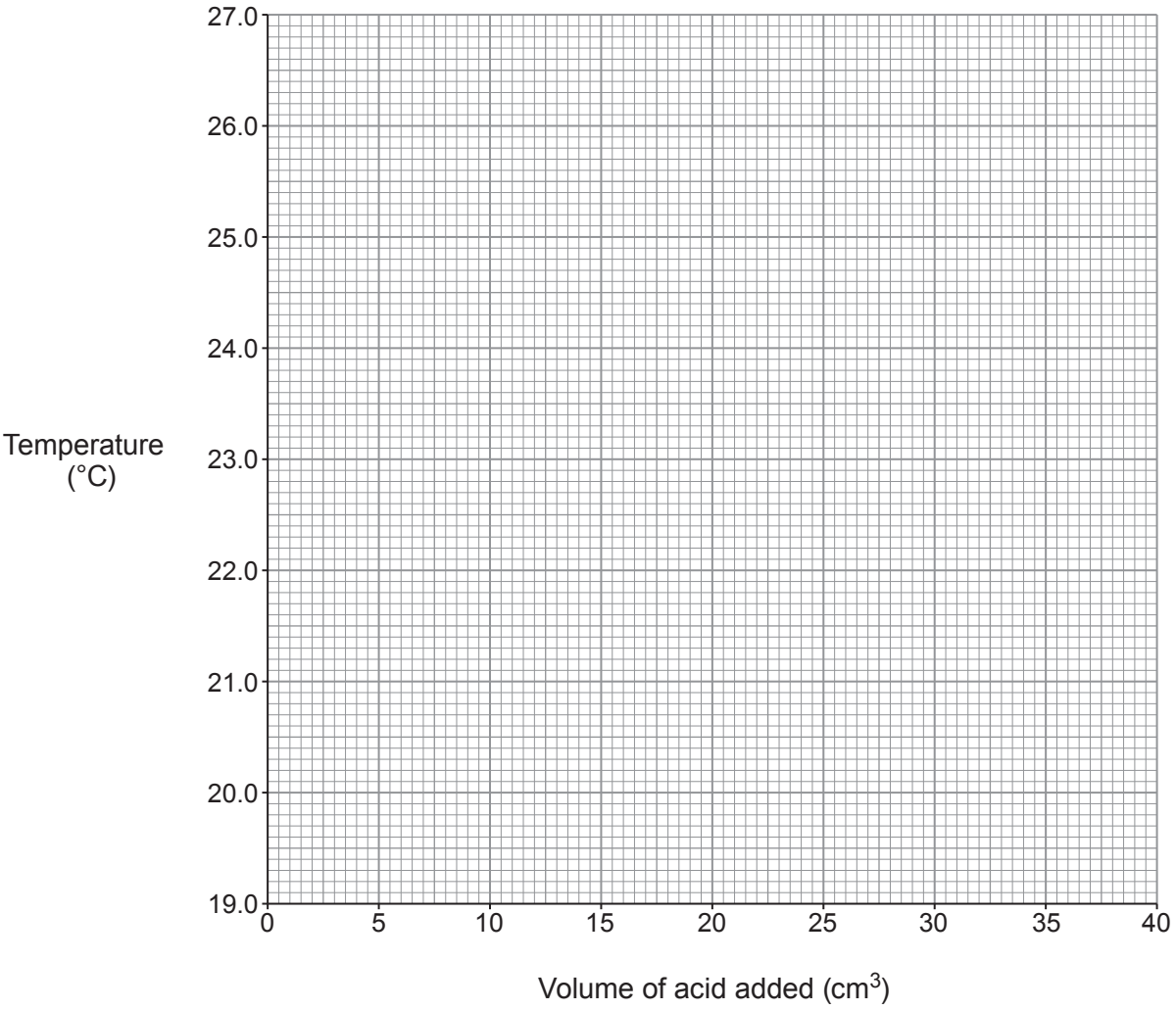
(i) Plot the temperature against the volume of acid added on the grid below. Draw a suitable line. [3]



(ii) Use the graph to answer parts I and II.

I. Find the overall temperature **rise** during the experiment. [1]

..... °C

II. Find the volume of acid needed to neutralise all the alkali. [1]

..... cm^3

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(iii) It is important to reduce heat loss during this experiment.

Describe how the amount of heat lost was reduced during the experiment. Suggest what else could be done to further reduce heat loss if the experiment were repeated. [2]

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(iv) One of the risks in this experiment is that the polystyrene cup falls over spilling the reaction mixture. Suggest an improvement to the method that would prevent this from happening. [1]

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5. Describe how a teacher can demonstrate the reactions of lithium, sodium and potassium in water to show the trend in reactivity in the Group 1 elements.

You should include expected observations and details of any safety precautions that should be taken. [6 QER]

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Examiner only

SECTION B

Read the article in the **Resource Booklet** *and answer* **all** *the questions that follow.*

6. *(a)* State **three** reasons for recycling steel. [3]

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(b) (i) Suggest why some steel car parts may not be directly reused as shown in **Figure 1**. [1]

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(ii) Use information from lines 4-8 to calculate the mass of carbon dioxide produced when one tonne of iron is recycled. Give your answer to **three** significant figures. [1]

Mass = ... tonnes

(c) (i) Use information from lines 9-11 to calculate the percentage of steel used by the UK construction industry that goes to landfill each year. [1]

Percentage = ... %

(ii) Use lines 7-8 to calculate the value of the material sent to landfill in 2017. [1]

Value = £ ..... million

Examiner only

(d) (i) Give the term that is used to describe steel, tool grade steel, stainless steel and other mixtures of metals. [1]

.....

(ii) Suggest why the addition of tungsten makes steel suitable for use in drill tips. [1]

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(iii) Suggest why stainless steel is used to make cutlery. [1]

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(e) Describe the trend in worldwide stainless steel production shown in **Figure 3**. [2]

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(f) Lines 20-23 provide a method of estimating the mass of stainless steel that was produced 20 years ago.

$$\text{production 20 years ago} = \text{production now} \times \frac{35}{100}$$

For example, the mass produced in 2010 was around 35 Mt and that in 1990 was around 12 Mt.

$$\text{production in 1990} = 35 \times \frac{35}{100} = 12.25\,\text{Mt}$$

This is the same value to two significant figures as the graph reading so the method provides a good estimate of stainless steel production in 1990.

Evaluate whether this method is suitable for estimating the production in 1970. [3]

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END OF PAPER

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Additional page.

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+}		

THE PERIODIC TABLE

1	2	Group										3	4	5	6	7	0
							1 H Hydrogen 1										4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	63.5 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	179 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

Key