Surname	Centre Number	Candidate Number
Other Names		0

GCSE

3410U10-1

S19-3410U10-1

WEDNESDAY, 12 JUNE 2019 – MORNING

CHEMISTRY – Unit 1:
Chemical Substances, Reactions and Essential Resources

FOUNDATION TIER

1 hour 45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**7**	
2.	**7**	
3.	**8**	
4.	**6**	
5.	**6**	
6.	**6**	
7.	**10**	
8.	**10**	
9.	**7**	
10.	**7**	
11.	**6**	
Total	**80**	

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01

ADDITIONAL MATERIALS

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

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

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 at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

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

Question **7***(a)* 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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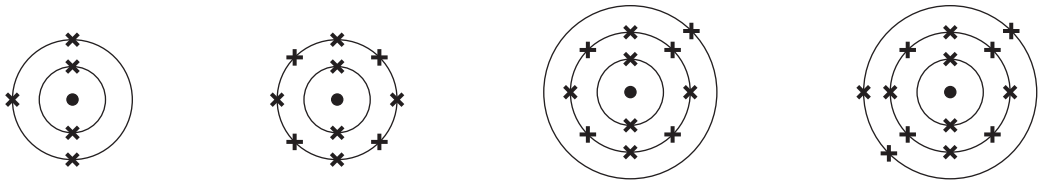
Answer **all** *questions*.

1. *(a)* The diagrams show the atoms of four elements, **A**-**D**.

These letters are **not** the chemical symbols for the elements.



A **B** **C** **D**

(i) Use the letters **A**-**D** to complete the following sentences. [2]

Two atoms found in the same group are ..... and ..... .

The atom found in Group 1 is ..... .

(ii) I Give the electronic structure of atom **B**. ..... [1]

II Give the atomic number of atom **B**. ..... [1]

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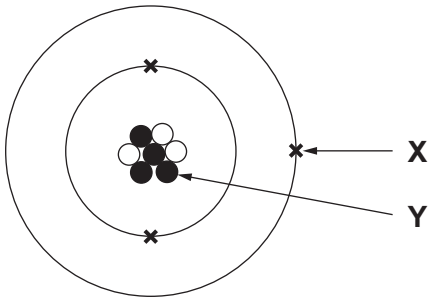
(b) The following diagram shows an atom of lithium.



(i) Complete the following sentences. [2]

Particle **X** is an ..... .

Particle **Y** found in the nucleus is a ..... .

(ii) Use the diagram to explain why lithium has a mass number of 7. [1]

.....

.....

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7

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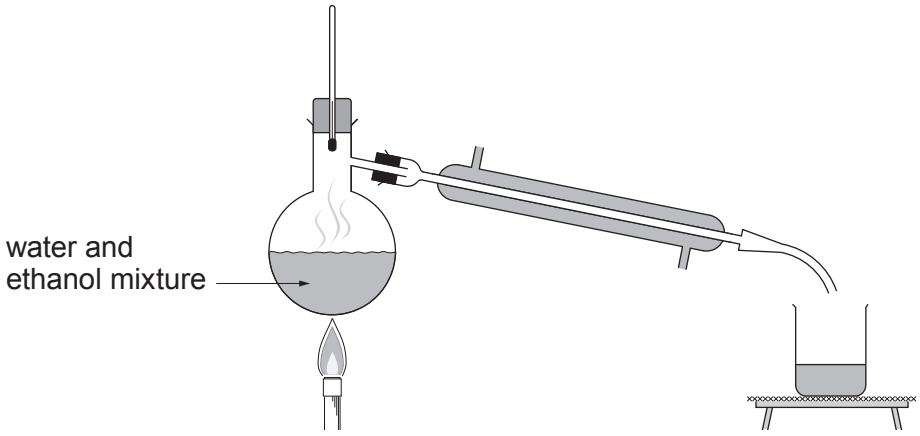
2. *(a)* A teacher carried out an experiment to show how to separate a mixture of ethanol and water.



(i) Choose from the box the name of the method used. [1]

chromatography	**filtration**	**distillation**	**evaporation**

Method .....

(ii) The following sentences show the steps involved in this method of separation.

A Ethanol vapour cools and condenses
B Ethanol boils and evaporates
C The mixture of water and ethanol is heated
D Ethanol is collected

Put the steps in the correct order. Use the letters **A**-**D**. [1]

....

(iii) Tick (✓) the box below that explains why it is the water that is left in the flask. [1]

the boiling point of ethanol is equal to the boiling point of water ☐

the boiling point of ethanol is lower than the boiling point of water ☐

the boiling point of ethanol is higher than the boiling point of water ☐

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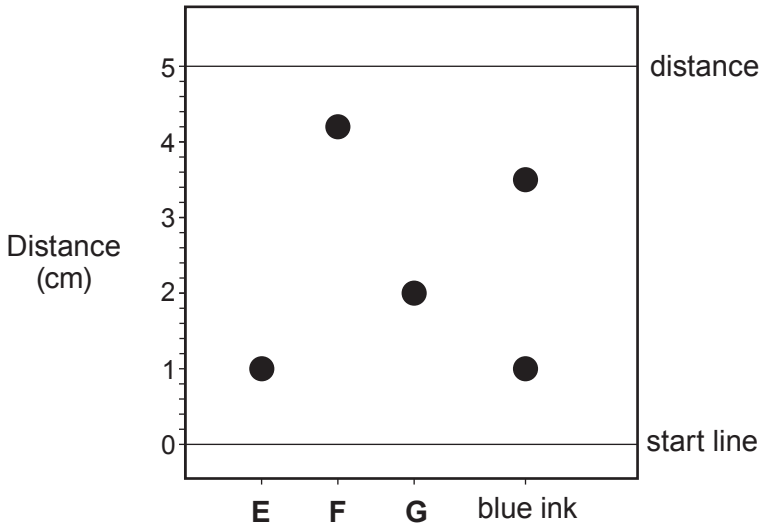
(b) A student carried out an investigation to find out whether pigments **E**, **F** and **G** are present in a blue felt pen. The results are shown below.



(i) State what the results tell you about the blue ink. [2]

.....

.....

(ii) Calculate the R_f value of pigment **F** using the equation given. [2]

$$R_f = \frac{\text{distance moved by pigment}}{\text{distance moved by solvent}}$$

R_f = ...

7

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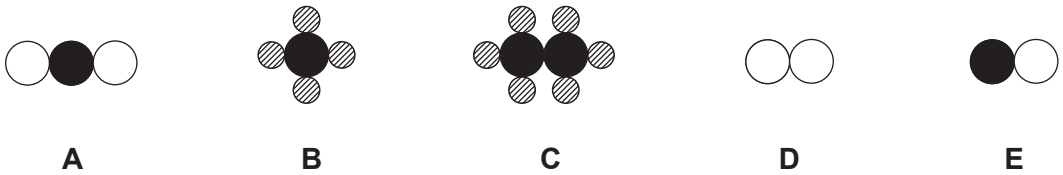
3. *(a)* The diagrams represent five substances, **A**-**E**.



A **B** **C** **D** **E**

Key ● carbon ▨ hydrogen ○ oxygen

(i) State which diagram, **A**-**E**, represents an element. Give a reason for your answer. [2]

Element .....

Reason .....

.....

(ii) State which diagram, **A**-**E**, represents carbon dioxide, CO_2. [1]

.....

(iii) Give the formula of the substance represented by diagram **C**. [1]

.....

(b) When copper(II) sulfate solution reacts with sodium hydroxide, it forms copper(II) hydroxide, $Cu(OH)_2$, and sodium sulfate, Na_2SO_4.

(i) Write a **word** equation for the reaction taking place. [1]

.....

(ii) Give the number of atoms of sulfur found in the formula Na_2SO_4. [1]

.....

(iii) Give the **total** number of atoms in the formula $Cu(OH)_2$. [1]

.....

(c) Iron(III) sulfate reacts with sodium hydroxide to produce iron(III) hydroxide.

Write the formula of iron(III) hydroxide. [1]

.....

8

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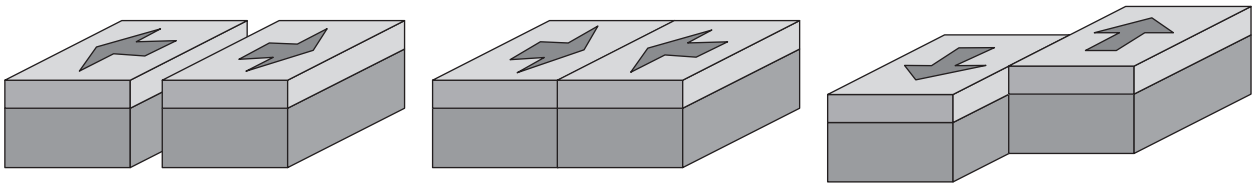
4. The surface of the Earth is divided into a number of tectonic plates. These plates are constantly moving.

Plate boundaries can be classified according to the direction of movement of the plates. The three main types of boundary are shown below.



A **B** **C**

conservative	**destructive**	**constructive**

(a) Choose the name of each type of boundary from the box. [2]

A .....

B .....

C .....

(b) Describe what happens as a result of the movement shown at boundary **A**. [2]

.....

.....

.....

(c) Explain what happens at boundary **C** as a result of the plate movement shown. [2]

.....

.....

.....

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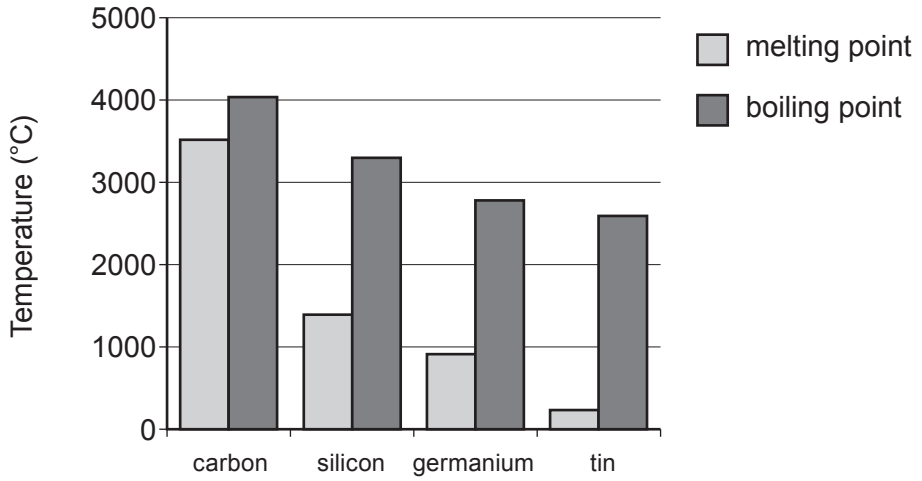
5. *(a)* The chart below shows the melting points and boiling points of some Group 4 elements.



(i) Describe the trend in melting point going down Group 4. [1]

.....

(ii) Name the element which has the greatest **difference** between its melting point and boiling point. [1]

.....

(b) (i) Name an element in Group 4 that is considered to be a semi-metal (metalloid). [1]

.....

(ii) Tick (✓) the box below that describes where semi-metals are found in the Periodic Table. [1]

some are found in all groups ☐

they are all found in Group 4 ☐

some are found in Group 1 and Group 2 ☐

they are all found between metals and non-metals ☐

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(c) Carbon is the main element found in coal. When carbon burns it forms carbon dioxide.

(i) Write a **word** equation to show the reaction taking place. [1]

.....

(ii) Name **one** environmental problem caused by increased levels of carbon dioxide in the atmosphere. [1]

.....

6

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6. This question is about the development of the Periodic Table.

In 1890, not all the elements had been discovered. A Russian scientist named Dmitri Mendeleev used the reactions of the known elements and their relative atomic masses to arrange them in the following table.

I	II	III	IV	V	VI	VII	VIII		
H 1.01									
Li 6.94	**Be** 9.01	**B** 10.8	**C** 12.0	**N** 14.0	**O** 16.0	**F** 19.0			
Na 23.0	**Mg** 24.3	**Al** 27.0	**Si** 28.1	**P** 31.0	**S** 32.1	**Cl** 35.5			
K 39.1	**Ca** 40.1		**Ti** 47.9	**V** 50.9	**Cr** 52.0	**Mn** 54.9	**Fe** 55.9	**Co** 58.9	**Ni** 58.7
Cu 63.5	**Zn** 65.4			**As** 74.9	**Se** 79.0	**Br** 79.9			
Rb 85.5	**Sr** 87.6	**Y** 88.9	**Zr** 91.2	**Nb** 92.9	**Mo** 95.9		**Ru** 101	**Rh** 103	**Pd** 106
Ag 108	**Cd** 112	**In** 115	**Sn** 119	**Sb** 122	**Te** 128	**I** 127			
Ce 133	**Ba** 137	**La** 139		**Ta** 181	**W** 184		**Os** 194	**Ir** 192	**Pt** 195
Au 197	**Hg** 201	**Ti** 204	**Pb** 207	**Bi** 209					
			Th 232		**U** 238				

Mendeleev's table

Based on the properties of the known elements, he predicted that new elements would be discovered and left gaps for these in his table. He even predicted what the properties of these undiscovered elements would be. He gave the name ekasilicon to one of them. The element that fits into this gap was eventually discovered and named germanium.

	Predicted properties of ekasilicon (Ek)	Actual properties of germanium (Ge)
Atomic mass	72	72.59
Density (g/cm^3)	5.5	5.35
Melting point	high	937.4 °C
Colour of metal	grey	grey-white
Formula of oxide	EkO_2	GeO_2
Formula of chloride	$EkCl_4$	$GeCl_4$

Comparison of the properties of ekasilicon and germanium

The modern day Periodic Table is based on Mendeleev's original table.

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(a) (i) Put a tick (✓) in the correct column to show whether the following statements apply to Mendeleev's table only, today's table only or to both tables. [2]

	Mendeleev only	Today only	Both tables
the table is organised into groups			
copper and potassium are in the same group			
there are gaps in the table			
fluorine and chlorine are in the same group			

(ii) Tick (✓) the **two** statements that **best** describe why germanium was confirmed to be the element ekasilicon predicted by Mendeleev. [1]

germanium has exactly the same atomic mass as that predicted for ekasilicon ☐

germanium has a different colour to that predicted for ekasilicon ☐

germanium has a similar density to that predicted for ekasilicon ☐

germanium oxide has the same ratio of atoms as that predicted for ekasilicon oxide ☐

germanium oxide and germanium chloride have the same ratio of atoms ☐

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(b) (i) Calculate the percentage of oxygen present in the formula of germanium oxide, GeO_2. [2]

A_r(Ge) = 73 A_r(O) = 16

Percentage = ... %

(ii) When germanium oxide reacts with hydrochloric acid it produces germanium chloride and water.

Balance the following equation for the reaction that takes place. [1]

GeO_2 + ☐ HCl ⟶ $GeCl_4$ + ☐ H_2O

6

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7. *(a)* The water used in our homes is treated to make it safe to drink.

State the main stages involved in the treatment of the public water supply. Describe the purpose of each stage. [6 QER]

You do not need to refer to fluoridation in your answer.

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(b) Fluoride is sometimes added to water supplies.

State why fluoride is added and give **one** reason why some people oppose the addition of fluoride to water. [2]

Reason for adding fluoride

.....

.....

Reason why some people oppose its addition

.....

.....

(c) This advert was published to encourage people to save water by taking a shower instead of a bath.

Use the data in the advert to calculate the percentage of water **saved** by taking a shower for 8 minutes rather than running a full bath. [2]

Percentage of water saved = ... %

10

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8. *(a)* A student was investigating how the concentration of sodium thiosulfate solution affects its reaction with hydrochloric acid.

(i) The reaction taking place can be represented by the following equation, which is **not** balanced.

Write the number **2** in **one of the boxes** on the right hand side in order to balance the equation. [1]

$$2HCl(aq) + Na_2S_2O_3(aq) \longrightarrow \square\ SO_2(g) + \square\ S(s) + \square\ NaCl(aq) + \square\ H_2O(l)$$

(ii) During the reaction, the solution becomes cloudy due to the formation of a precipitate. State the meaning of the term *precipitate*. [1]

.....

.....

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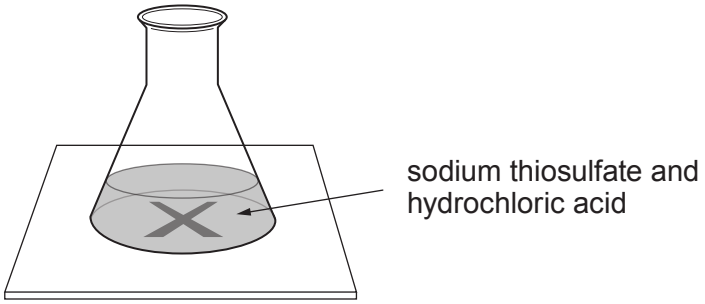
(iii) The time taken for the cross to disappear was measured as shown below.



The results are shown in the table.

Concentration of sodium thiosulfate solution (mol / dm^3)	Time taken for cross to disappear (s)
1.0	42
0.9	46
0.8	53
0.7	66
0.6	87
0.5	110

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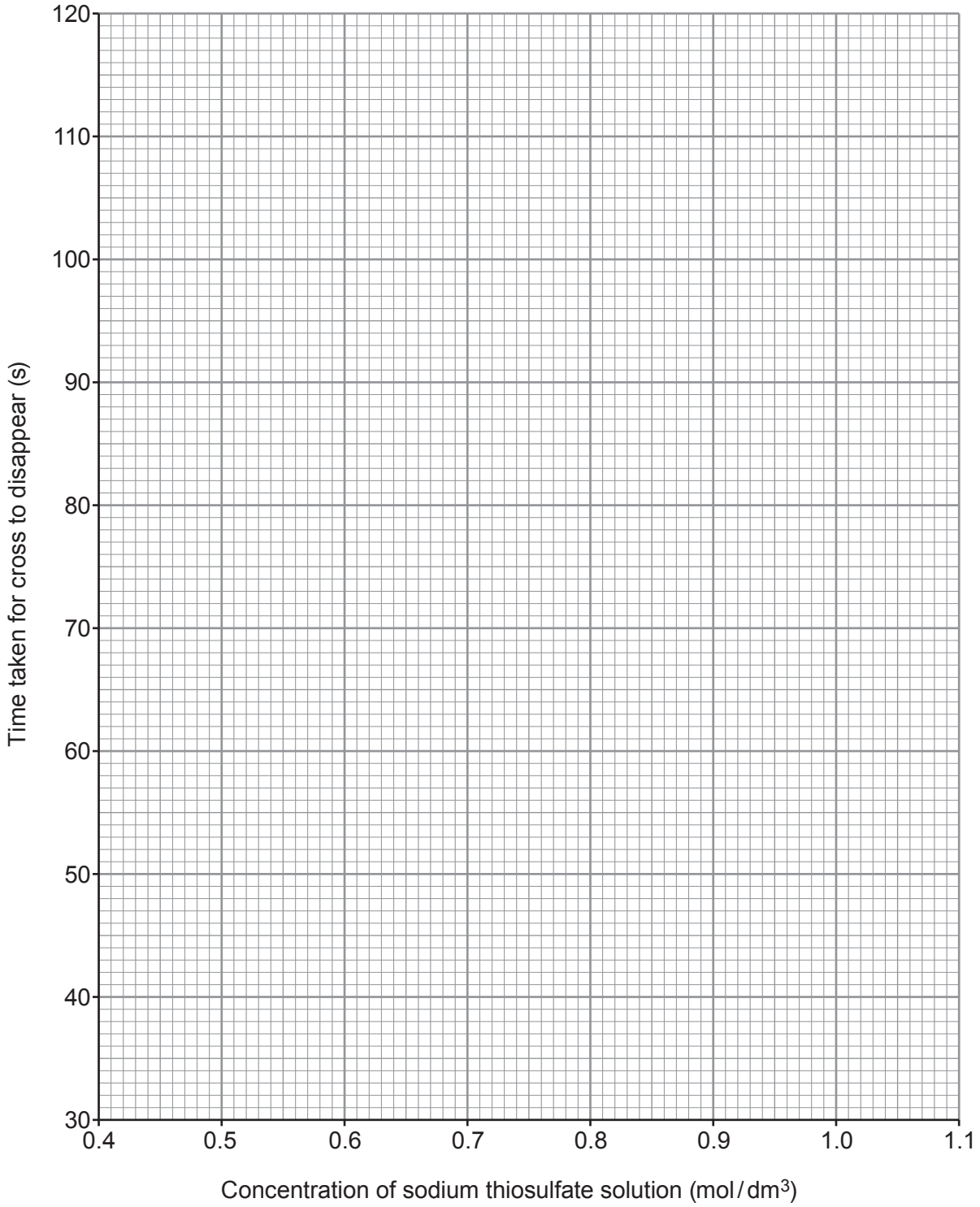
Plot the results from the table on the grid. Draw a suitable line. [3]



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(iv) State how concentration affects the **time taken** for the cross to disappear. [1]

.....

.....

(v) What conclusion can be drawn about the effect of concentration on the **rate** of this reaction? [1]

.....

.....

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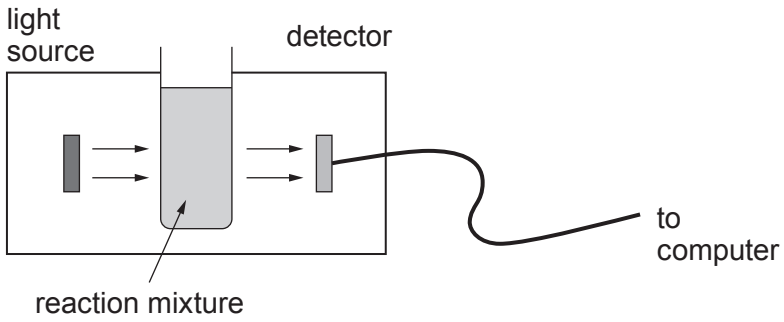
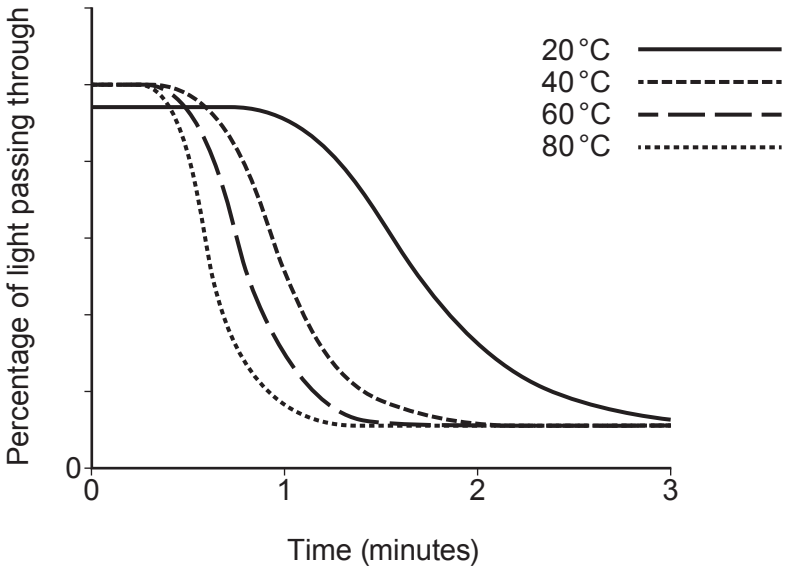
(b) A second student used a light sensor to investigate the effect of temperature on the rate of this reaction.



He obtained the following results.



(i) Give **one** conclusion that can be drawn from these results. State how this is shown by the graph. [2]

.....

.....

.....

(ii) Slightly less light passed through the tube at the start of the experiment at 20 °C than in the others. Suggest a possible practical reason for this. [1]

.....

.....

10

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9. *(a)* The following table shows some information about Group 1 elements.

Metal	Melting point (°C)	Boiling point (°C)	Density (g/cm^3)	Reaction with chlorine
lithium	180	1342	0.54	reacts slowly to make a white salt
sodium	97	883	0.97	burns vigorously with a yellow flame to make a white salt
potassium	63	759	0.88	reacts violently to make a white salt
rubidium	39	688	1.53	explosive reaction
caesium	28	671	1.93	explosive reaction

(i) Describe the trend in density going down the group. [1]

.....

(ii) Explain the difference in reactivity down the group in terms of electronic structure. [2]

.....

.....

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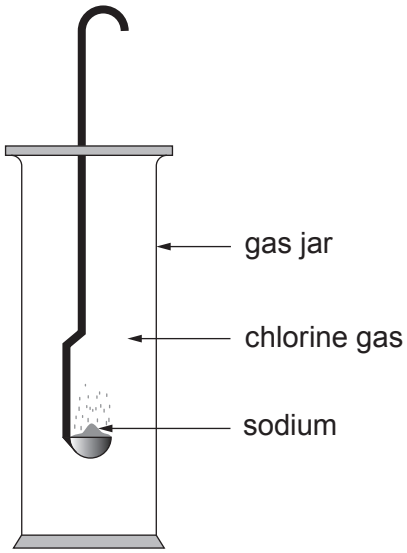
(b) The apparatus below can be used to demonstrate the reaction between sodium and chlorine.



(i) Apart from the use of safety goggles, state **one** safety precaution that needs to be followed when using **each** of these elements. [2]

Element	Safety precaution
sodium	.....
chlorine	.....

(ii) Complete and balance the symbol equation for the reaction that takes place between sodium and chlorine. [2]

$\square$ Na + Cl_2 ⟶ $\square$ .....

7

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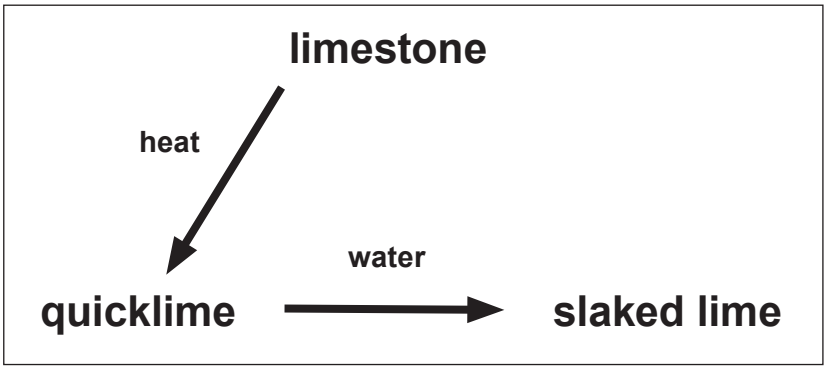
10. The following diagram shows how limestone, $CaCO_3$, can be converted into useful products.



(a) When a piece of limestone is heated strongly its mass decreases.

State the type of reaction taking place. [1]

.....

(b) (i) Describe what is **seen** when limestone is heated and converted into quicklime. [1]

.....

(ii) Write a balanced symbol equation for the reaction taking place. [2]

.....

(c) (i) Describe what is observed when quicklime is converted into slaked lime. [1]

.....

(ii) Write a balanced symbol equation for the reaction taking place. [2]

.....

7

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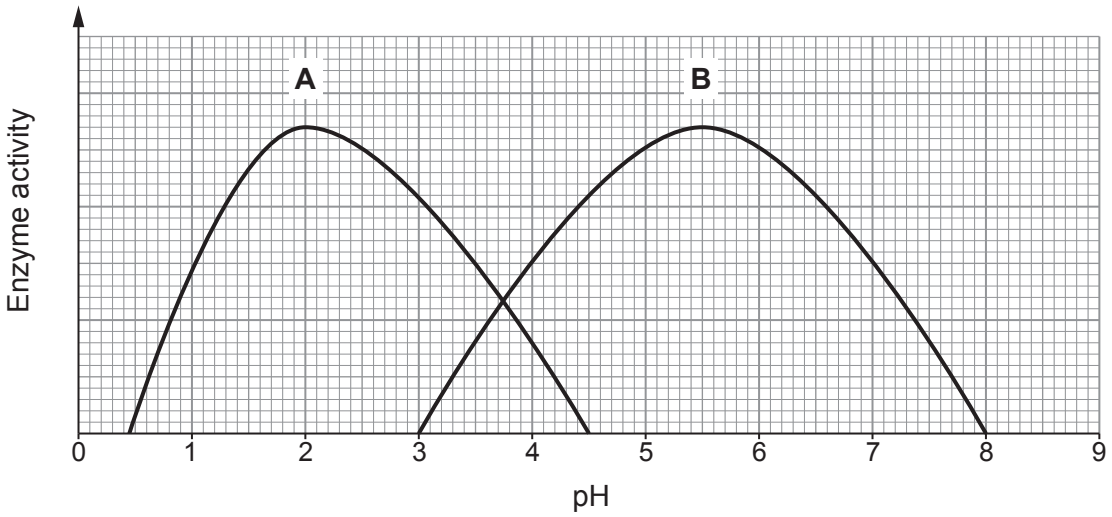
11. *(a)* Enzymes are biological catalysts. State what is meant by the term *catalyst*. [2]

.....

.....

.....

(b) The following graphs show how the activity of two enzymes, **A** and **B**, varies with pH.



(i) Use the graphs to compare the activities of the two enzymes. [2]

.....

.....

.....

(ii) Enzyme **C** is found in saliva. It works between pH 5 and pH 9 but is best at a neutral pH. **Sketch on the grid above** how the activity varies with pH. [2]

6

END OF PAPER

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Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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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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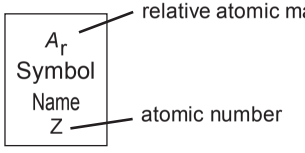
THE PERIODIC TABLE

Group 1	2											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



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