OCR
RECOGNISING ACHIEVEMENT

H

A322/02

GENERAL CERTIFICATE OF SECONDARY EDUCATION
TWENTY FIRST CENTURY SCIENCE
CHEMISTRY A
Unit 2 Modules C4 C5 C6 (Higher Tier)
SAMPLE ASSESSMENT MATERIAL

Time: 40 minutes

Candidates answer on the question paper
Additional materials (enclosed):
None

Calculators may be used.
Additional materials: Pencil
Ruler (cm/mm)

Candidate Forename		Candidate Surname	
Centre Number		Candidate Number	

INSTRUCTIONS TO CANDIDATES

- Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Do **not** write outside the box bordering each page.
- Write your answer to each question in the space provided.

INFORMATION FOR CANDIDATES

- The number of marks for each question is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **42**.
- The Periodic Table is printed on the back page.

FOR EXAMINER'S USE		
Qu.	**Max.**	**Mark**
1	**6**	
2	**8**	
3	**8**	
4	**3**	
5	**5**	
6	**6**	
7	**6**	
TOTAL	**42**	

This document consists of **15** printed pages and **1** blank page.

Answer **all** questions.

1 Elements in Group 7 are called the halogens. The table gives some information about the physical properties of three of the halogens.

halogen	proton number	melting point in °C	boiling point in °C	state at 25 °C	colour
chlorine	17	–101	–35	gas	pale green
bromine	35	–7	59		deep red
iodine	53	114	184		dark grey

(a) **(i)** Finish the table by writing the **state** for bromine **and** iodine in the empty boxes. **[1]**

(ii) The halogens show trends in physical properties with increasing proton number.

Finish this sentence about the trend in melting point.

Use information from the table to help you answer this question.

As the proton number ..... the melting point ..... . **[1]**

(b) The halogens also show a trend in reactivity.

This can be shown by the displacement reactions when halogens are added to solutions of halides.

A student made the following observations.

- When chlorine is added to potassium bromide solution, red bromine appears.
- When bromine is added to potassium iodide solution, brown iodine appears.
- When bromine is added to potassium chloride solution, there is no displacement.

(i) Use this information to place these three halogens in order of reactivity.

most reactive .....

.....

least reactive ..... **[2]**

(ii) Fluorine is a halogen with proton number 9.

Which statement describes the displacement reactions of fluorine?

Put a tick (✓) in the box next to the correct answer.

Fluorine displaces chlorine, bromine and iodine.	☐
Fluorine displaces iodine but not chlorine or bromine.	☐
Fluorine displaces chlorine and bromine but not iodine.	☐
Fluorine displaces bromine and iodine but not chlorine.	☐

[1]

(c) Bromine forms ions with the formula Br^-.

Bromine reacts with strontium to form strontium bromide, $SrBr_2$.

Use this information to work out the formula of a strontium ion.

..... **[1]**

[Total: 6]

2 This diagram shows part of the Periodic Table.

						He
Li	Be		C			Ne
Na	Mg				Cl	Ar
K	Ca				Br	

(a) **(i)** Write down the symbol **and** name of an element in the same **period** as calcium.

symbol ..... name ..... **[1]**

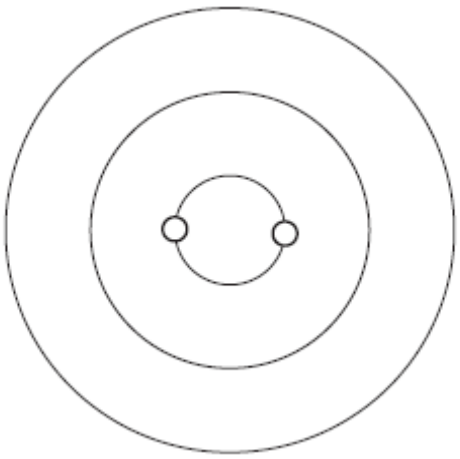
(ii) Write down the symbol **and** name of an element in the same **group** as neon.

symbol ..... name ..... **[1]**

(iii) Finish the diagram to show the arrangement of electrons in an atom of **argon**.

Use a circle to show the position of each electron.

The positions of two electrons have already been drawn on the diagram to help you.



[1]

(b) The elements sodium and chlorine react to form the compound sodium chloride, NaCl.

(i) Write a balanced symbol equation for the reaction between sodium and chlorine.

Include state symbols in your equation.

..... **[3]**

(ii) The table shows the arrangement of electrons in sodium atoms and chlorine atoms.

Complete the table to show the arrangement of electrons in sodium ions and chloride ions.

sodium atom Na	sodium ion Na^+	chlorine atom Cl	chloride ion Cl^-
2.8.1		2.8.7	

[2]

[Total: 8]

3 The table gives information about ions dissolved in sea water.

ion	symbol	percentage by mass of the total dissolved solids (%)
chloride	Cl^-	55
sodium	Na^+	30
sulfate	SO_4^{2-}	8
magnesium	Mg^{2+}	4
calcium	Ca^{2+}	1
potassium	K^+	1
carbonate	CO_3^{2-}	0.5
bromide	Br^-	0.2

These ions enter the sea water when crystals of ionic compounds in rocks dissolve.

Each of these ionic compounds is made up of one type of positive ion and one type of negative ion shown in the table.

(a) **(i)** One compound that dissolved from the rocks into the water is magnesium sulfate.

Suggest the name and formula of one **other** ionic compound that dissolved from the rocks into the water.

Use information from the table to help you.

name ..... formula ..... **[2]**

(ii) When a sample of sea water is evaporated to dryness, a white solid is left. This is a mixture of several ionic compounds.

Look at the **percentage by mass of the total dissolved solids column** in the table.

Use the information to name the ionic compound that makes up **most** of the white solid.

..... **[1]**

(b) Sea water conducts electricity.

Which statements give the best explanation for this?

Put a tick (✓) in the box next to **each** correct explanation.

Ions are able to move around in the sea water. ☐

Electrons can pass from ion to ion in the sea water. ☐

The sea water contains more ions with positive charges than ions with negative charges. ☐

The sea water contains ions that have positive charges and ions that have negative charges. ☐

[1]

(c) Solid ionic compounds form crystals.

Explain how the particles in crystals are held together.

.....

.....

.....

.....

..... **[3]**

(d) Solid ionic compounds have giant, three-dimensional structures.

Which of the following properties are shown by most **solid** ionic compounds?

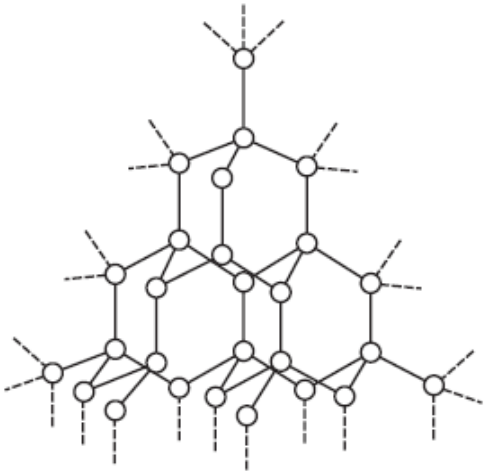
Put a tick (✓) in the box next to **each** correct answer.

low density	☐
high flexibility	☐
high reactivity	☐
highly coloured	☐
high melting point	☐
low electrical conductivity	☐

[1]

[Total: 8]

4 Diamond is a giant structure of carbon atoms with bonding similar to that in silicon dioxide.



(a) Diamond has a very high melting point.

Use ideas about the bonding in diamond to explain this.

.....

.....

.....

..... **[2]**

(b) Living things are made up from compounds **mainly** containing four elements.

One of these elements is **carbon**.

What are the names of the **other three** elements?

1 .....

2 .....

3 ..... **[1]**

[Total: 3]

5 The ore haematite contains iron(III)oxide. Iron is extracted from this ore by reaction with carbon.

The products of this reaction are iron and carbon dioxide.

(a) Finish this **symbol** equation for the reaction.

..... Fe_2O_3 + ... C $\longrightarrow$ ..... + ... **[2]**

(b) A haematite ore contains 80% by mass of iron(III) oxide.

Calculate the maximum mass of iron that can be extracted from each tonne of this ore.

Show each step of your calculation as indicated below.

(1 tonne = 1000 kg)

(relative atomic mass, A_r : Fe = 56, O = 16)

mass of iron(III) oxide in 1 tonne of haematite = ...kg

formula mass of iron(III) oxide = ...

mass of iron in 1 tonne of haematite = ...kg **[3]**

[Total: 5]

6 An acid and an alkali react to form a salt and water.

$$\text{acid} + \text{alkali} \rightarrow \text{salt} + \text{water}$$

(a) You are given a solution of an alkali of know concentration and a solution of an acid of unknown concentration.

Briefly describe how you would carry out a titration accurately to find the concentration of the acid.

.....

.....

.....

.....

.....

.....

.....

..... **[4]**

(b) **(i)** What is the formula of the **ion** produced when any **acid** dissolves in water?

..... **[1]**

(ii) What is the formula of the **ion** produced when any **alkali** dissolves in water?

..... **[1]**

[Total: 6]

7 Magnesium sulfate is one of the chemicals in detergent powder.

Mary makes some magnesium sulfate using this reaction.

magnesium carbonate + sulfuric acid → magnesium sulfate + water + carbon dioxide

$MgCO_3 + H_2SO_4 \rightarrow MgSO_4 + H_2O + CO_2$

(a) (i) The theoretical yield for Mary's experiment is 12.0 g.

Mary dries and weighs the magnesium sulfate she makes. This is her actual yield.

Actual yield = 10.8 g.

Work out the percentage yield for Mary's experiment.

percentage yield = ... **[1]**

(ii) The relative formula mass of magnesium carbonate is 84.

The relative formula mass of magnesium sulfate is 120.

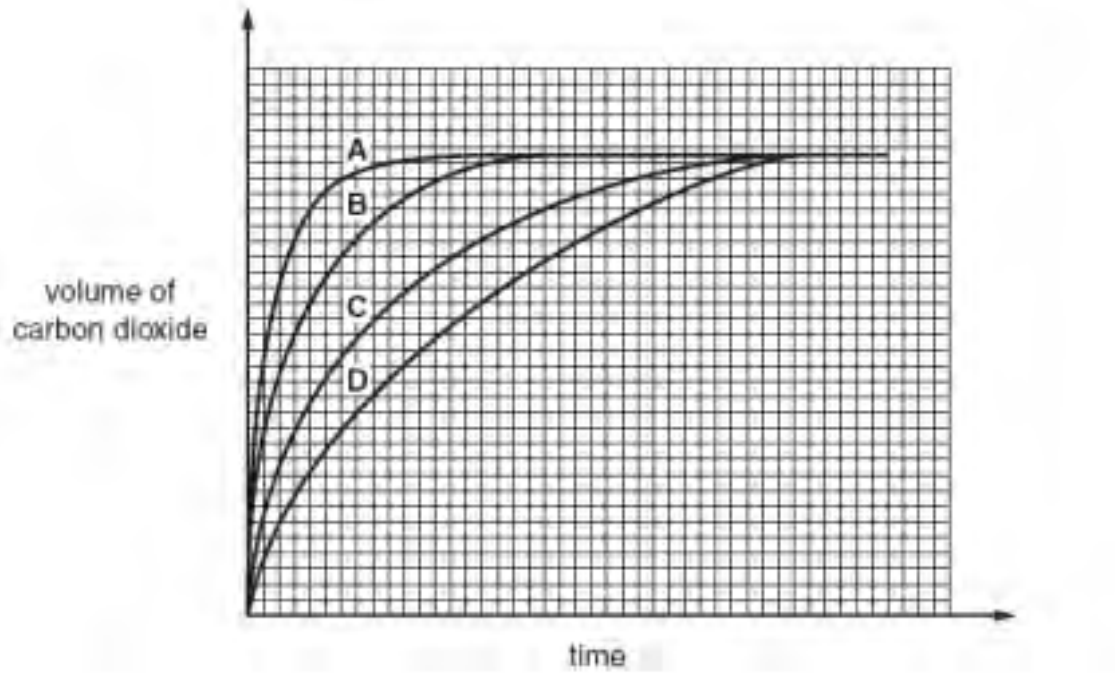
Calculate the mass of magnesium carbonate that must react with sulfuric acid to make the theoretical yield of 12.0 g of magnesium sulfate.

mass of magnesium carbonate = ... g **[1]**

(b) Mary investigates the rate of this reaction with different sized lumps of magnesium carbonate.

She keeps all other conditions constant.

She measures the volume of carbon dioxide given off at time intervals and plots her results on a grid.



(i) Which line, **A**, **B**, **C** or **D**, shows results from:

the fastest rate of reaction?

answer .....

the largest lumps of magnesium carbonate?

answer ..... **[1]**

(ii) In each of the four experiments Mary used 100 cm^3 of solution containing 1.0 g sulphuric acid.

Mary now repeats the experiments, but changes the amount of sulfuric acid.

For each change put a tick (✓) in the correct box to show whether the reaction would be slower, the same speed, or faster.

	slower	same speed	faster
100 cm^3 solution containing 2.0 g sulfuric acid	☐	☐	☐
100 cm^3 solution containing 0.5 g sulfuric acid	☐	☐	☐
200 cm^3 solution containing 2.0 g sulfuric acid	☐	☐	☐
200 cm^3 solution containing 1.0 g sulfuric acid	☐	☐	☐
50 cm^3 solution containing 0.5 g sulfuric acid	☐	☐	☐

[3]

[Total: 6]

END OF QUESTION PAPER

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

PLEASE DO NOT WRITE ON THIS PAGE

The Periodic Table of the Elements

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
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **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	178 **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	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number

RECOGNISING ACHIEVEMENT

CONFIDENTIAL

GCSE Unit

MARK SCHEME

SAMPLE ASSESSMENT MATERIAL
(from 2010 onwards)

Chemistry A (J634)
Modules C4, C5 and C6
Higher Tier

A322/02

Maximum Mark: 42

Guidance for Examiners

Additional Guidance within any mark scheme takes precedence over the following guidance.

1. Mark strictly to the mark scheme.
2. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise.
3. Accept any clear, unambiguous response which is correct, e.g. mis-spellings if phonetically correct (but check additional guidance).
4. Abbreviations, annotations and conventions used in the detailed mark scheme:

   / = alternative and acceptable answers for the same marking point
   (1) = separates marking points
   not/reject = answers which are not worthy of credit
   ignore = statements which are irrelevant - applies to neutral answers
   allow/accept = answers that can be accepted
   (words) = words which are not essential to gain credit
   <u>words</u> = underlined words must be present in answer to score a mark
   ecf = error carried forward
   AW/owtte = alternative wording
   ORA = or reverse argument

   E.g. mark scheme shows 'work done in lifting / (change in) gravitational potential energy' (1)
   work done = 0 marks
   work done lifting = 1 mark
   change in potential energy = 0 marks
   gravitational potential energy = 1 mark

5. If a candidate alters his/her response, examiners should accept the alteration.
6. Crossed out answers should be considered only if no other response has been made. When marking crossed out responses, accept correct answers which are clear and unambiguous.
7. The list principle:
   If a list of responses greater than the number requested is given, work through the list from the beginning. Award one mark for each correct response, ignore any neutral response, and deduct one mark for any incorrect response, e.g. one which has an error of science. If the number of incorrect responses is equal to or greater than the number of correct responses, no marks are awarded. A neutral response is correct but irrelevant to the question.

8. Marking method for tick boxes:

   Always check the additional guidance.

   If there is a set of boxes, some of which should be ticked and others left empty, then judge the entire set of boxes.
   If there is at least one tick, ignore crosses. If there are no ticks, accept clear, unambiguous indications, e.g. shading or crosses.
   Credit should be given for each box correctly ticked. If more boxes are ticked than there are correct answers, then deduct one mark for each additional tick. Candidates cannot score less than zero marks.

   E.g. If a question requires candidates to identify a city in England, then in the boxes

Edinburgh	
Manchester	
Paris	
Southampton	

   the second and fourth boxes should have ticks (or other clear indication of choice) and the first and third <u>should be blank</u> (or have indication of choice crossed out).

Edinburgh			✓			✓	✓	✓	✓	
Manchester	✓	×	✓	✓	✓				✓	
Paris				✓	✓		✓	✓	✓	
Southampton	✓	×		✓		✓	✓		✓	
Score:	2	2	1	1	1	1	0	0	0	NR

Question			Expected Answers	Marks	Rationale
1	a	i	liquid solid	1	**both** required for one mark
		ii	increases increases / decreases decreases (1)	1	**allow** either increases and increases for one mark or decreases and decreases for one mark allow pairs of words with the same meaning eg smaller smaller / larger larger / rises rises / falls falls / gets higher gets higher / gets lower gets lower
	b	i	most reactive ……chlorine …..bromine least reactive ……iodine	2	chlorine first for one mark then bromine and iodine in correct order for one mark. not chloride, bromide, iodide.
		ii	chlorine, bromine and iodine ✓ (1)	1	1st box
	c		Sr^{2+} / Sr^{++}/ Sr^{+2} (1)	1	
			Total	**6**	

Question			Expected Answers	Marks	Rationale
2	a	i	K potassium / Br bromine / Sc scandium /Ti titanium / V vanadium / Cr Chromium / Mn Manganese / Fe iron / Co cobalt / Ni nickel / Cu copper / Zn zinc / Ga gallium / Ge germanium / As arsenic / Se selenium / Kr krypton (1)	1	symbol must match name
		ii	He helium / Ar argon / Kr krypton / Xe xenon / Rn radon (1)	1	symbol must match name
		iii	eight electrons drawn on or touching each of the second and third shells	1	Allow electrons drawn singly or in pairs
	b	i	$2Na_{(s)} + Cl_{2(g)} \rightarrow 2NaCl_{(s)}$ formulae Na, Cl_2, NaCl (1) balance 2Na and 2NaCl (1) state symbols (s), (g) and (s) (1)	3	balance mark not available if any formula incorrect. states written as words eg. solid and gas = 0.
		ii	2.8 (1) 2.8.8 (1)	2	**allow** 2.8.0 and 2.8.8.0 **ignore** + or - symbols
			Total	**8**	

Question			Expected Answers	Marks	Rationale
3	a	i	sodium chloride NaCl / sodium sulfate $NaSO_4$ / sodium carbonate Na_2CO_3 / sodium bromide NaBr / potassium chloride KCl / potassium sulfate K_2SO_4 / potassium carbonate K_2CO_3 / potassium bromide KBr / magnesium chloride $MgCl_2$ / magnesium carbonate $MgCO_3$ / magnesium bromide $MgBr_2$ / calcium chloride $CaCl_2$ / calcium sulfate $CaSO_4$ / calcium carbonate $CaCO_3$ / calcium bromide $CaBr_2$	2	**not** magnesium sulfate $MgSO_4$ one mark for name and one mark for formula Ignore + or – symbols if given
		ii	sodium chloride (1)	1	**allow** Na C*l* or Na^+ C*l* $^-$ ignore + or - symbols **reject** sodium chlorine / (common) salt
	b		able to move around in sea water ✓ contains ions that have positive charges and negative charges ✓	1	1st box and 4th box **both** required for one mark

Question			Expected Answers	Marks	Rationale
3	c		[3 marks] Candidate demonstrates a high level of understanding of the attraction between positive ions and negative ions. The answer is expressed clearly and logically. [2 marks] Candidate demonstrates an understanding of attraction between ions, but no mention of charges. The answer is expressed clearly and logically. [1 mark] Candidate shows basic knowledge of attraction between particles, but no mention of ions. The answer is expressed logically but may lack clarity in expression.	3	
	d		high melting point ✓ low electrical conductivity ✓	1	5th box and 6th box **both** required for one mark a tick in any other box = 0
			Total	**8**	

Question			Expected Answers	Marks	Rationale
4	a		diamond has many covalent bonds / each atom in diamond has four covalent bonds (1) which require a lot of energy to break (1)	2	
	b		hydrogen oxygen nitrogen (1)	1	all three in any order for one mark
			Total	**3**	

Question			Expected Answers	Marks	Rationale
5	a		$2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$ formulae Fe and CO_2 (1) balance using 4 numbers shown - 2 3 4 3 (1)	2	balance mark not available if any formula incorrect. Fe and CO_2 can be in any order. 4 must be with Fe and 3 must be with CO_2.
	b		800 (1) 160 (1) 560 (1)	3	
			Total	**5**	

Question			Expected Answers	Marks	Rationale
6	a		measure a volume of the alkali into a flask (1) add an indicator (1) add acid from a burette (1) stop adding when colour changes (1)	4	allow alkali in burette and acid in flask with no loss of marks
	b	i	H^+ / H_3O^+ (1)	1	
		ii	OH^- (1)	1	
			Total	**6**	

<table>
<tr><th colspan="3">Question</th><th>Expected Answers</th><th>Marks</th><th>Rationale</th></tr>
<tr><td>7</td><td>a</td><td>i</td><td>90 (1)</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>ii</td><td>8.4 (1)</td><td>1</td><td></td></tr>
<tr><td></td><td>b</td><td>i</td><td>A
D</td><td>1</td><td>both answers required for one mark
must be in the correct order</td></tr>
<tr><td></td><td></td><td>ii</td><td><table><tr><th>slower</th><th>same</th><th>faster</th></tr><tr><td></td><td></td><td>✓</td></tr><tr><td>✓</td><td></td><td></td></tr><tr><td></td><td>✓</td><td></td></tr><tr><td>✓</td><td></td><td></td></tr><tr><td></td><td>✓</td><td></td></tr></table></td><td>3</td><td>5 correct (3)
4 correct (2)
3 correct (1)</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>6</td><td></td></tr>
</table>

<table>
<tr><td></td><td></td><td></td><td>Section total</td><td>42</td><td></td></tr>
</table>