OCR
RECOGNISING ACHIEVEMENT

SPECIMEN H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

CHEMISTRY B

B742/02

Unit B742: Chemistry modules C4, C5, C6 (Higher Tier)

Candidates answer on the question paper
A calculator may be used for this paper

OCR Supplied Materials:
None

Other Materials Required:
- Pencil
- Ruler (cm/mm)

Duration: 1 hour 30 minutes

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 that 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, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with a pencil (✎).
- The Periodic Table can be found on the back page.
- 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 **85**.
- This document consists of **32** pages. Any blank pages are indicated.

Examiner's Use Only:			
1		10	
2		11	
3		12	
4		13	
5		14	
6		15	
7		16	
8		17	
9		18	
Total			

Answer **all** the questions.

Section A – Module C4

1 This question is about the elements in the Periodic Table.

Look at the list of elements.

argon	**calcium**
hydrogen	**iodine**
magnesium	**neon**
nitrogen	**oxygen**
potassium	**sodium**

Answer the questions.

Choose your answers from the list.

Each element can be used **once**, **more than once** or **not at all**.

The Periodic Table on the back page may help you.

(a) Write down the **name** of the non-metal element which is a **grey solid** at room temperature.

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

(b) Which element has an atom with only **five** electrons in its outer shell?

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

(c) Write down the **name** of the element which has the electronic structure 2.8.8.2.

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

[Total: 3]

2 Many scientists helped to develop the theory of atomic structure in the early 1900s.

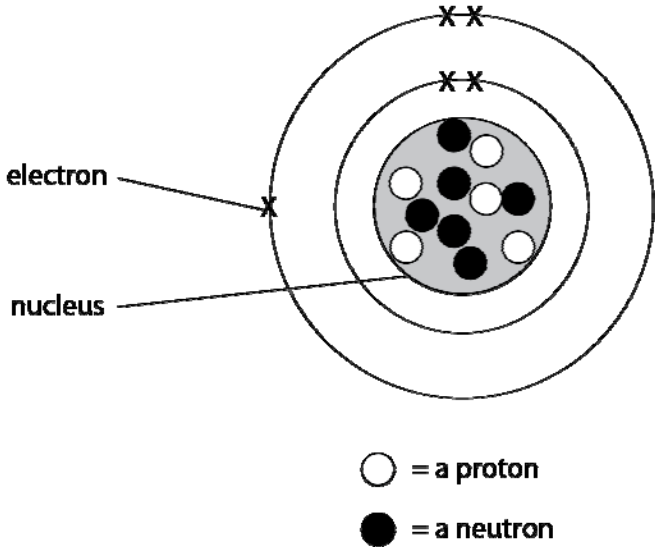
A scientist called Thomson discovered the electron.

Another scientist called Rutherford had the idea of atoms having a nucleus.

A third scientist called Bohr had the idea of electron shells.

Look at the diagram.

It shows the structure of an atom with a nucleus, electrons and electron shells.



(a) Explain why the nucleus of an atom has a positive charge.

.....

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

(b) The scientists Thomson, Rutherford and Bohr told other scientists about their ideas about atoms.

Suggest how and explain why they told other scientists.

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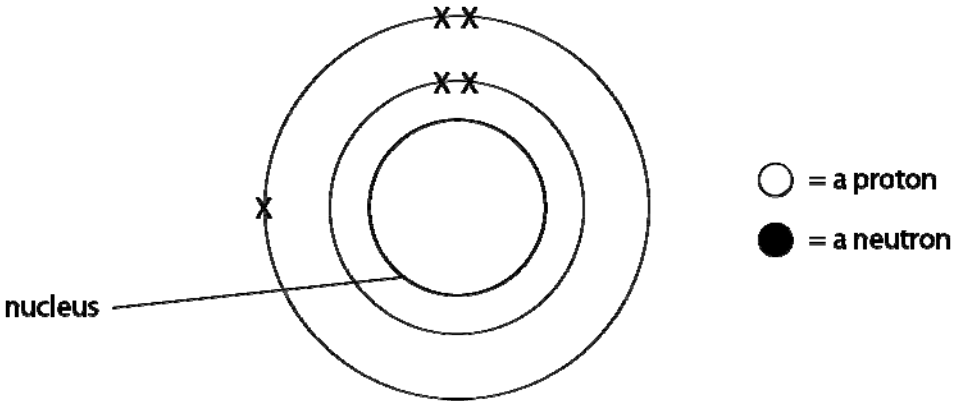
..... **[2]**

(c) Finish the diagram to show an isotope of the element above.



[1]

[Total: 4]

3 This question is about Group 1 elements such as sodium and rubidium.

Look at the table. It shows some information about the elements in Group 1.

element	atomic symbol	atomic number	melting point in ^{o}C	density in g/cm^3	atomic radius in pm
lithium	Li	3	181	0.53	152
sodium	Na	11	98	0.97	182
potassium	K	19	64	0.86	227
rubidium	Rb	37			

(a) Group 1 elements, such as sodium, react with water.

Sodium hydroxide, NaOH, and hydrogen are made.

Write down the **balanced symbol** equation for the reaction between sodium and water.

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

(b) The reaction of rubidium with water is more violent than the reaction of sodium with water.

Rubidium is more reactive than sodium.

Explain why.

Use ideas about electrons.

.....

.....

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

(c) Describe and explain the relationship between atomic radii and melting points of the elements in Group 1. Include in your answer predictions for the atomic radius and melting point of rubidium.

The quality of written communication will be assessed in your answer to this question.

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..... **[6]**

[Total: 10]

4 This question is about the reaction of halogens with alkali metals.

(a) Astatine reacts with potassium.

Construct the **word** equation for this reaction.

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

(b) Chlorine reacts with sodium to make sodium chloride.

The electronic structure for chlorine is 2.8.7.

Use the 'dot and cross model' to describe the bonding in sodium chloride and in a molecule of chlorine.

You only need to include the outer shell electrons.

(i) sodium chloride

[2]

(ii) chlorine

[1]

[Total: 4]

5 River water needs to be purified before it can be used as drinking water.

Look at the table. It shows the mass of different ions in 1000 g of river water.

ion	mass in g
Ca^{2+}	0.00201
Br^{-}	0.00197
Cl^{-}	0.00180
K^{+}	0.00291
NO_3^{-}	0.00159
Pb^{2+}	0.00522
SO_4^{2-}	0.00481

(a) Kritica, a research chemist in a water purification factory, needs to know the percentage of lead ions in the water sample.

(i) What is the percentage by mass of lead ions, Pb^{2+}, in the river water?

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percentage =.....% **[1]**

(ii) The river water is treated in the water purification factory.

Suggest why the tap water the factory makes may still contain lead ions.

.....

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

(b) Kritica tests a sample of the polluted river water with barium chloride solution.

Predict what Kritica would observe and explain why.

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

[Total: 4]

Section B – Module C5

6 Josh is worried about the amount of salt he eats.

Josh looks at this label on his packet of cornflakes.

It gives information about the amount of sodium and of salt in 100 g of cornflakes.

	mass in grams
sodium	0.7
salt	1.8

Josh wants to know if all the sodium in his cornflakes comes from salt.

Show by calculation that all of the sodium in cornflakes comes from salt, NaCl.

The relative atomic mass of Na is 23 and of Cl is 35.5.

.....

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

[Total: 2]

7 Methanol, CH_3OH, can be made from carbon dioxide.

Look at the symbol equation for the reaction used to make methanol.

$$CO_2(g) + 3H_2(g) \rightleftharpoons CH_3OH(g) + H_2O(g)$$

The reaction is exothermic.

The conditions used for this reaction are

- a temperature of 250 ^oC
- a pressure of 70 atmospheres
- a catalyst containing copper.

Explain, using ideas about rate of reaction and position of equilibrium, the choice of the three conditions used in this reaction.

✎ *The quality of written communication will be assessed in your answer to this question.*

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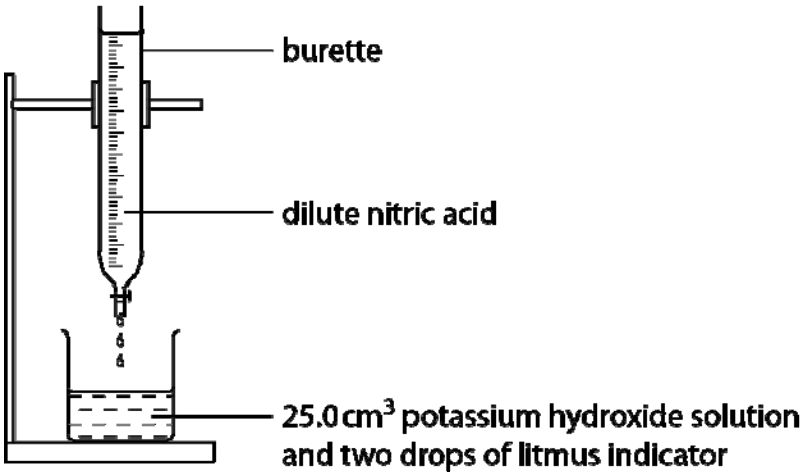
.....**[6]**

[Total: 6]

8 This question is about acid-base titrations.

Issy wants to find out the concentration of a sample of dilute nitric acid.

Look at the apparatus she uses.



She adds dilute nitric acid slowly until the litmus suddenly changes colour.

She repeats the experiment two more times.

Look at Issy's results table.

titration number	**1**	**2**	**3**
final burette reading in cm^3	29.7	27.0	34.8
initial burette reading in cm^3	8.5	6.9	24.9
volume of acid used (titre) in cm^3	21.2	20.1	19.9

(a) Issy does two experiments (**1** and **2**) and looks at her results.

She decides that she needs to do a third experiment (**3**).

Explain why she needs to do **three** experiments.

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.....

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

(b) Litmus is a single indicator but universal is a mixed indicator.

In the titration experiment litmus suddenly changes colour from blue to red at the end-point.

If Issy uses universal indicator instead of litmus how would the colour change be different?

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

(c) Look at the balanced symbol equation for the reaction between potassium hydroxide and nitric acid.

$$KOH + HNO_3 \rightarrow KNO_3 + H_2O$$

Issy uses 25.0 cm^3 of potassium hydroxide solution.

The concentration of the potassium hydroxide is 0.100 mol/dm^3.

Use the mean titre to calculate the concentration, in mol/dm^3, of the nitric acid.

Give your answer to **three** significant figures.

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concentration of nitric acid =..... mol/dm^3 **[4]**

[Total: 7]

9 Silicon dioxide and iron(III) hydroxide have been discovered on the planet Mars.

(a) Silicon dioxide, SiO_2, has a molar mass of 60 g/mol.

Calculate the molar mass of iron(III) hydroxide, $Fe(OH)_3$.

The relative atomic mass of H is 1, of O is 16, of Si is 28 and of Fe is 56.

.....

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.....

molar mass = ...g/mol **[1]**

(b) Compound **X** has been discovered on the planet Mars.

Compound **X** has the empirical formula CH.

Which **two** formulas could be the formula of compound **X**?

CH_4	**C_2H_2**
C_2H_6	**C_4H_8**
C_6H_6	**$C_{10}H_{22}$**

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

[Total: 2]

10 Sulfamic acid solution is used to remove limescale in kettles.

Limescale is mostly calcium carbonate.

Sulfamic acid reacts with calcium carbonate as shown in the equation.

sulfamic acid + calcium carbonate → calcium sulfamate + carbon dioxide + water

Hayley investigates the reaction between sulfamic acid and calcium carbonate.

She adds 0.20 g of calcium carbonate powder to 100 cm^3 of sulfamic acid solution.

Hayley measures the total volume of carbon dioxide formed every minute.

Look at the table of her results.

time in minutes	**total volume of carbon dioxide in cm^3**
0	0
1	24
2	38
3	44
4	47
5	48
6	48
7	48

(a) Draw a labelled diagram to show the apparatus Hayley uses to collect these results.

[2]

(b) What is the amount, in moles, of carbon dioxide made at the end of the experiment?

One mole of any gas occupies 24 dm^3 at room temperature and pressure.

.....

.....

amount =..... mol **[1]**

(c) Hayley repeats the experiment with 100 cm^3 of hydrochloric acid.

She uses the same concentration of hydrochloric acid as sulfamic acid.

She finds the rate of reaction is much higher because hydrochloric acid is a strong acid and sulfamic acid is a weak acid.

Why does a strong acid react faster than a weak acid?

.....

.....

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

[Total: 5]

11 Emma wants to prepare a pure dry sample of lead iodide by a precipitation reaction.

$$2KI(aq) + Pb(NO_3)_2(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)$$

She starts with potassium iodide solution and lead nitrate solution.

Describe the steps Emma must do to get a **pure dry** sample of lead iodide.

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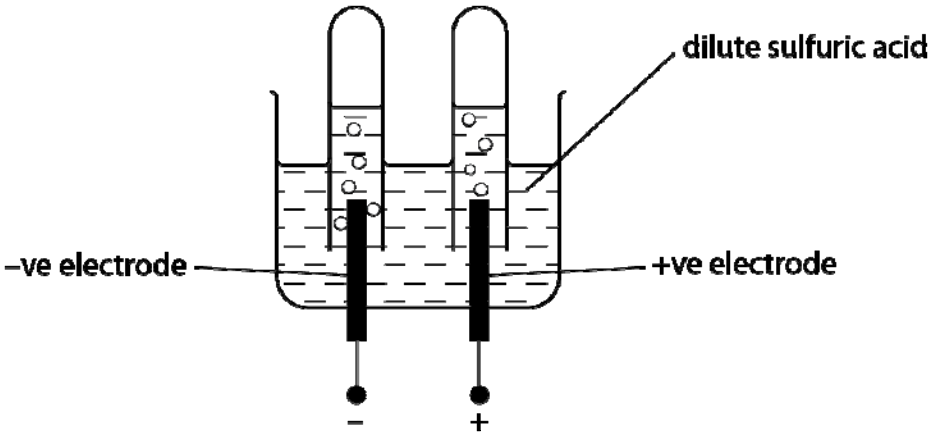
..... **[3]**

[Total: 3]

Section C – Module C6

12 Harry investigates the electrolysis of dilute sulfuric acid.

Look at the apparatus he uses.



(a) Bubbles of gas are made at both electrodes.

Hydrogen is one of the gases made.

Write down the name of the **other** gas made during the electrolysis.

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

(b) Hydrogen is made when hydrogen ions, H^+, gain electrons.

Construct the **balanced symbol equation** for this process.

Use e^- to represent an electron.

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

(c) Harry measures the time it takes to fill the test tube with hydrogen.

He does four experiments.

He changes the current used and the temperature of the dilute sulfuric acid.

He keeps everything else the same.

Look at his table of results.

experiment number	temperature of dilute sulfuric acid in ^{o}C	current used in amps	time taken to fill the test tube with hydrogen in seconds
1	10	1.0	60
2	15	1.0	60
3	15	2.0	30
4	15	4.0	15

Harry does another experiment.

This time he uses dilute sulfuric acid at a temperature of 20^{o}C and a current of 3.0 amps.

Predict how long it will take to fill the test tube with hydrogen.

Explain your answer.

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.....

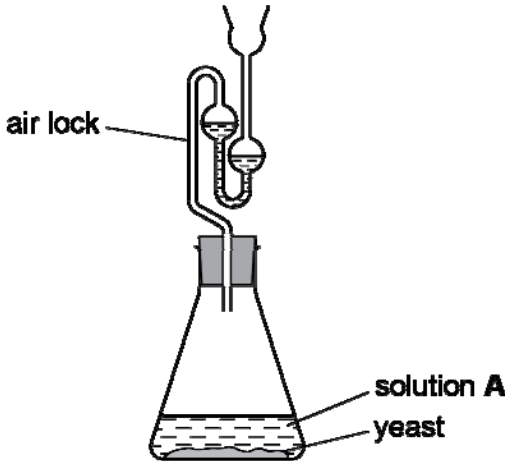
time = ...seconds **[2]**

[Total: 4]

13 Sarah and Daniel investigate fermentation.

Look at the diagram.

It shows the apparatus they use.



(a) Ethanol is made by fermentation.

Yeast and solution **A** are used to make ethanol.

Write the **word** equation for fermentation.

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

(b) Fermentation works best at temperatures between 25 – 50°C.

Explain why.

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.....

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

(c) Write down the **molecular formula** of ethanol.

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

[Total: 4]

14 Look at the picture of a car.

(a) Some of the car body is made of iron.

One disadvantage of using iron is that it rusts.

Write a **word** equation for the rusting of iron.

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

(b) Look at the equations.

These are two processes that happen during rusting.

$$Fe - 2e^- \rightarrow Fe^{2+}$$

$$O_2 + 2H_2O + 4e^- \rightarrow 4OH$$

Rusting is a redox reaction.

Explain why using information from **both** equations.

.....

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

(c) Look at the table. It shows different methods of rust prevention.

method of prevention	can be chipped or scratched?	provides sacrificial protection?	cost
painting	yes	no	low
tin plating	yes	no	high
galvanising	yes	yes	high

A car manufacturer decides that galvanising is the best method to prevent rust.

What evidence supports this?

.....

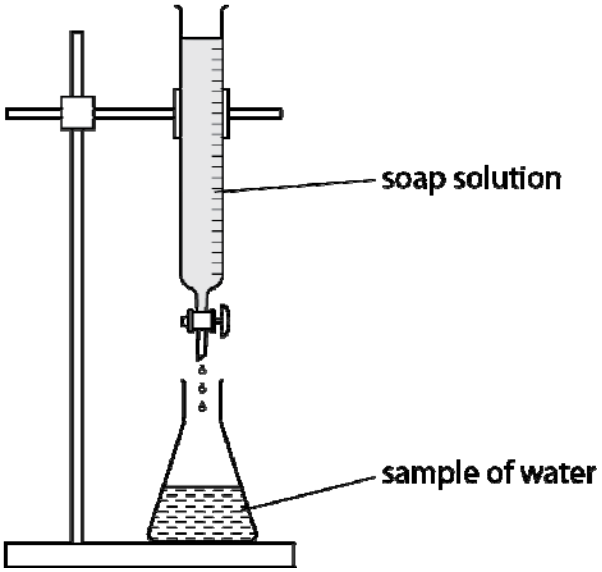
.....

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

[Total: 3]

15 This question is about hardness in water.

Luke and Henry investigate the hardness of three different samples of water.



They do this by adding drops of soap solution to each 50 cm^3 sample of water.

They add soap until lather remains on the surface after shaking.

Look at their table of results.

sample of water	volume of soap added in cm^3
tap water	30
river water	28
boiled tap water	15
distilled water	5

Tap water contains **both** temporary hardness and permanent hardness.

Explain how you can tell from the results.

.....

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

[Total: 2]

16 In 1950 research scientists thought that CFCs were very useful compounds.

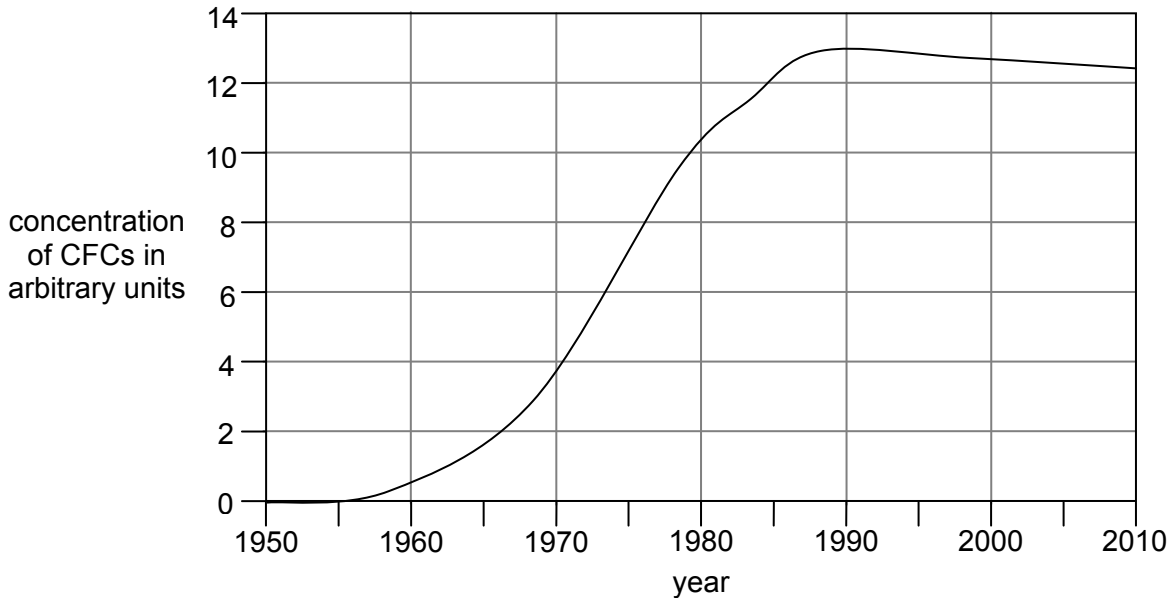
Many CFCs were used as aerosol propellants.

By 1980 some scientists believed that CFCs in the air were causing environmental damage.

CFCs enter the air when aerosol cans are used or thrown away.

(a) Look at the graph.

It shows how the concentration of CFCs in the air has changed since 1950.



The UK government has now banned the use of CFCs.

(i) Use the graph to estimate in which year the ban on the use of CFCs started.

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

(ii) It took a long time for scientists to convince the UK government to ban CFCs.

Suggest why.

.....

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

(iii) Research scientists have estimated that the mean decrease in concentration of CFCs will be about 1.35 arbitrary units every ten years.

Estimate when the concentration of CFCs in the air falls to zero.

.....

.....

year = ...**[2]**

(b) Ozone molecules in the upper atmosphere break down when they absorb ultra violet light to make oxygen atoms and oxygen molecules.

(i) Construct the **balanced symbol** equation for this reaction.

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

(ii) The breakdown of CFCs only occurs in the upper atmosphere and not at ground level.

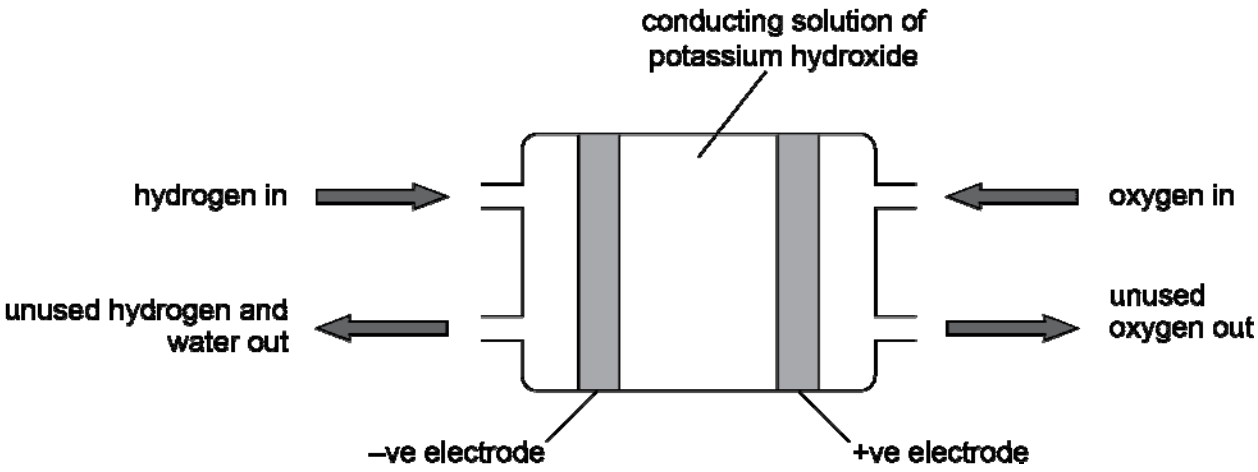
Suggest why.

.....

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

[Total: 6]

17 Look at the diagram of an oxygen-hydrogen fuel cell



Potassium hydroxide solution contains potassium ions, K^+, and hydroxide ions, OH^-. Water, H_2O, is made in this type of fuel cell.

Construct the electrode equations for the reactions that take place in this oxygen-hydrogen fuel cell.

Use these equations and your own understanding to explain the advantages and disadvantages of producing electricity using an oxygen-hydrogen fuel cell.

✎ *The quality of written communication will be assessed in your answer to this question.*

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..... **[6]**

[Total: 6]

Section D

18 Look at the information about bio-fuels.

Bio-fuels

- are renewable fuels used in motor vehicles
- are made from plant materials
- burn in air to release useful energy in the form of heat
- burn in air to make carbon dioxide and water.

Farmers have to use valuable land to grow crops for bio-fuels.

They cannot use the same land to grow food crops.

Some people call bio-fuels carbon-neutral.

This is because plants use carbon dioxide to photosynthesise.

(a) Look at Table 1.

It gives some information about the production of bio-fuels in 2007.

Table 1

bio-fuel	units of energy used during growth and manufacture	total energy content of bio-fuel produced in units of energy
bio-ethanol	378	924
bio-diesel	1	64

Energy is used during the growth and manufacture of bio-fuels.

This has to be set against the total energy content of the fuel.

Suggest, with a reason, one advantage of producing bio-diesel rather than bio-ethanol.

.....

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

(b) Bio-diesel can be produced from a wide range of different plants.

Look at Table 2.

It shows the average volume of bio-diesel you can get from different plants.

Table 2

plant used to make bio-diesel	average volume of bio-diesel in dm^3 from a 1000 m^2 area
coconut	35
corn	7
hemp	150
palm	115
peanut	15
rape	16
soy	12
sunflower	13

Elizabeth is a farmer.

She has a field with an area of 10 000 m^2.

She wants to produce as much bio-diesel as possible from her field.

Which plant should she grow and how much bio-diesel would she produce?

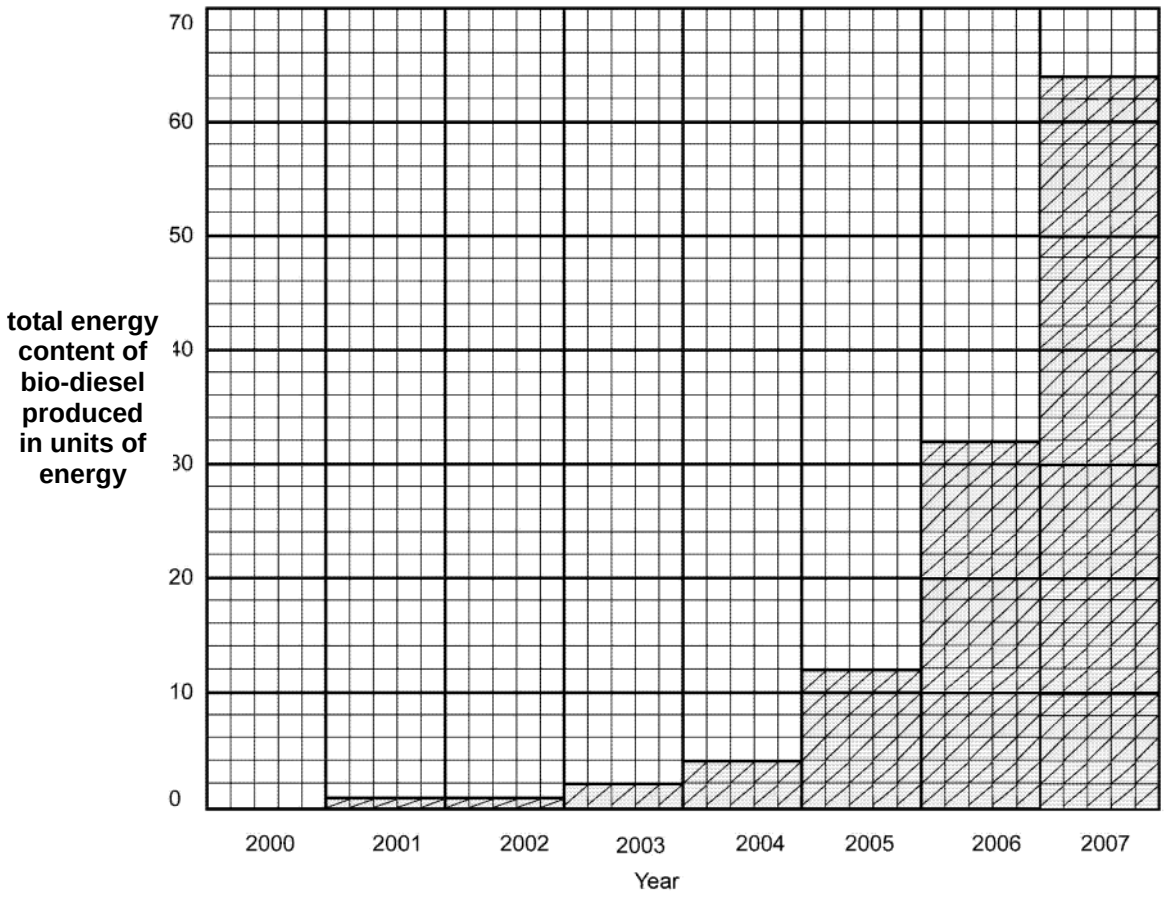
.....

.....

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

(c) Look at the bar chart.

It shows the total energy content of the bio-diesel produced each year since the year 2000.



(i) The amount of bio-diesel produced is likely to continue to increase.

Suggest **two** reasons why it is difficult to predict the total energy content of bio-diesel produced in 2011.

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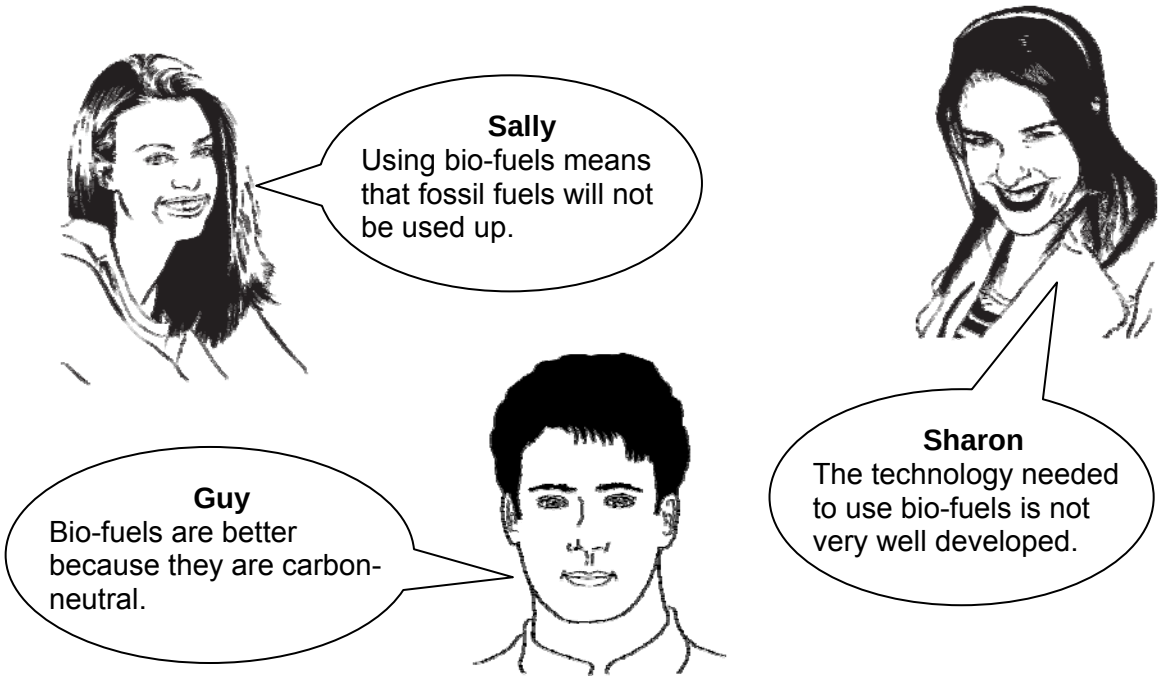
..... **[2]**

(ii) What are the possible consequences of this increase in bio-diesel production?

.....

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

(d) Three friends are discussing using bio-fuels.



Use all the evidence in this section to discuss the reasons for and against growing crops for bio-fuels.

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..... **[5]**

[Total: 10]

[Paper Total: 85]

END OF QUESTION PAPER

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PERIODIC TABLE

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.

OCR
RECOGNISING ACHIEVEMENT

SPECIMEN H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

B742/02

CHEMISTRY B

Unit B742: Chemistry modules C4, C5, C6 (Higher Tier)

MARK SCHEME

Duration: 1 hour 30 minutes

MAXIMUM MARK 85

This document consists of 24 pages

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, eg 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
   words = underlined words must be present in answer to score a mark
   ecf = error carried forward
   AW/owtte = alternative wording
   ora = or reverse argument

   eg 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

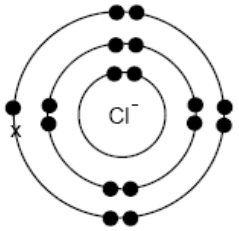
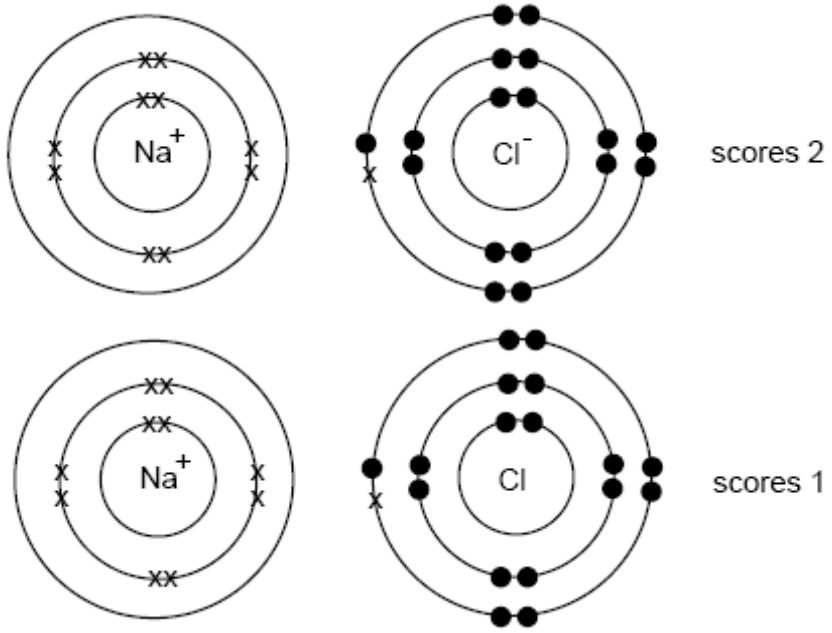
5. If a candidate alters his/her response, examiners should accept the alteration.
6. Crossed out answers should be considered only if no other response has been made. When marking crossed out responses, accept correct answers which are clear and unambiguous.

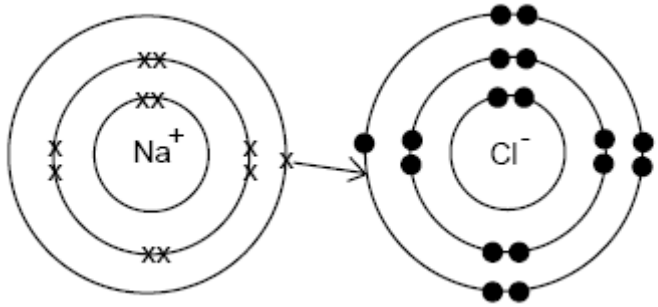
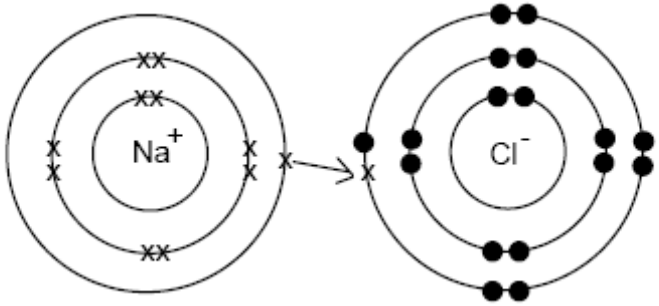
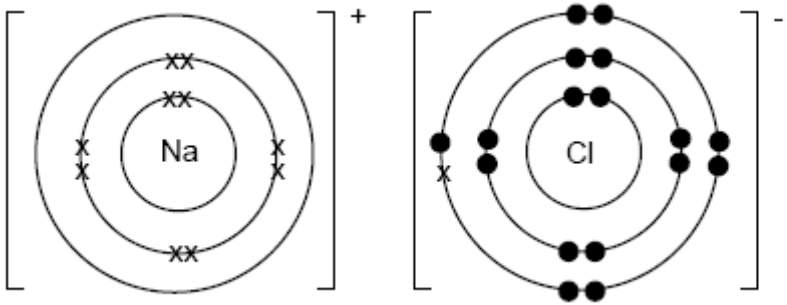
Question			Expected answers	Marks	Additional guidance
1	(a)		iodine (1)	1	
	(b)		nitrogen (1)	1	**allow** Mg
	(c)		calcium (1)	1	**allow** Ca
			Total	**3**	

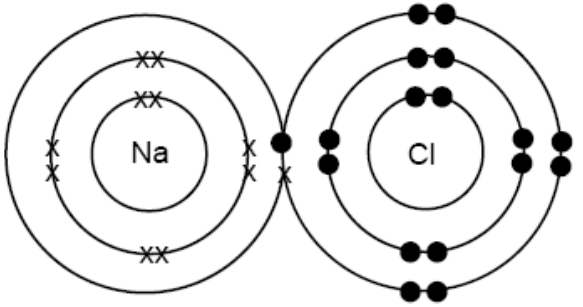
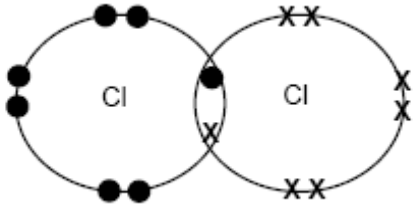
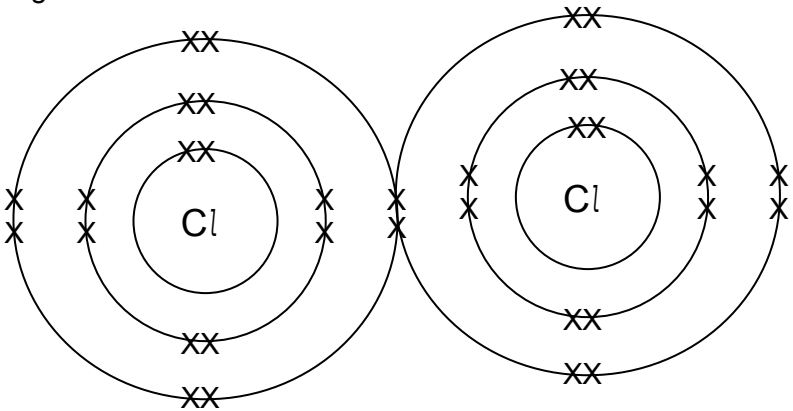
Question			Expected answers	Marks	Additional guidance
2	(a)		because in the nucleus the protons are positive and the neutrons are neutral (1)	1	**allow** because there are no negatively charged electrons in the nucleus only positive protons and neutral neutrons (1)
	(b)		they told others through: use of conferences / use of books / use of journals (1) telling others allowed: peer review by other scientists / evaluation / checking of their work / repeating of their experiments by other scientists / other scientists to develop their work (1)	2	**allow** they publish their results (1) **ignore** telephone / internet / television / video
	(c)		a diagram with 5 protons and any number other than 6 neutrons (1)	1	**allow** writing in the nucleus rather than circles eg 5 protons and 5 neutrons
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
3	(a)		$2Na + 2H_2O \rightarrow 2NaOH + H_2$ correct formulae (1) correct balancing (1)	2	**allow** = sign for arrow **not** and or & for +
	(b)		it is easier for rubidium to lose electrons when it reacts than for sodium to lose electrons because rubidium has a larger atomic radius (2) **OR** idea that both lose electrons when they react (1)	2	**electron loss must be linked to larger atomic radius in order to gain 2 marks**

Question	Expected answers	Marks	Additional guidance
(c)	**Level 3** Description of relationships and comprehensive explanation about how atomic radii, the strength of the metallic bonding and the melting point are related. Predictions made based on evidence in table are accurate. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks) **Level 2** Relationship described and explanation applies understanding that melting point depends on the strength of the metallic bond. Correct predictions made based on evidence in the table. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3-4 marks) **Level 1** Limited description of the link between atomic radii and melting point and two predictions made. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** • melting point decreases as atomic radius increases • melting point decreases because it is easier to overcome the metallic bond • because strength of metallic bond decreases as atomic radius increases • idea that metallic bond is the attraction between delocalised electrons and (closely packed) metal ions • idea that atoms lose electrons more easily down Group 1 because the attraction is weaker • melting point of rubidium is any value between 30 to 50 ^{o}C • atomic radius of rubidium 272 to 295 pm **allow** at lower levels answers that just refer to bonds between particles in a metal **ignore** anything related to the reactivity of the metals including loss of electrons and electronic structure **not** reference to covalent, ionic bonds or intermolecular forces
	Total	**10**	

Question			Expected answers	Marks	Additional guidance
4	(a)		potassium + astatine → potassium astatide (1)	1	**allow** K + At_2 → KAt
	(b)	(i)	correct charges on ions Na^+ and Cl^- (1) correct electronic structures 2,8 for sodium ion and 2.8.8. for chloride ion (1)  $[Na]^+$	2	alternatively mark sodium ion for charge and electronic structure (1) and chloride ion and electronic structure (1) whichever gives most marks **allow** just $[Na]^+$ for sodium ion and its electronic structure. **not** covalent NaCl extra advice is shown on the next page. 

Question	Expected answers	Marks	Additional guidance
			 scores 2
			 scores 1
			 scores 2

Question			Expected answers	Marks	Additional guidance
					 scores 0
4	**(b)**	**(ii)**	correct structure for chlorine (1) 	1	diagram shown is complete answer but can **ignore** missing inner shells, or atomic symbols. as in diagram **allow** all crosses or all dots 
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
5	(a)	(i)	% = 0.000522 (1)	1	**allow** 5.22 x 10^{-4} %
		(ii)	purification methods do not remove soluble impurities and the lead ions may be in solution / lead ions may come from old lead pipes (1)	1	
	(b)		white precipitate (1) because barium sulfate is produced which is insoluble / due to presence of sulfate ions (1)	2	
			Total	**4**	

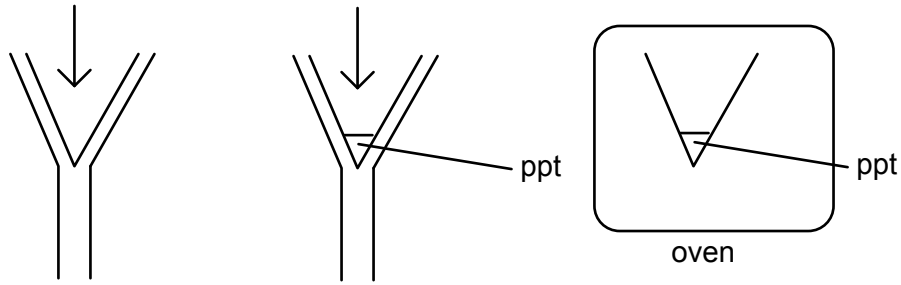
Question			Expected answers	Marks	Additional guidance
6			**use of %** % Na in NaCl is 39.3 / 39% (1) and working to show that 0.7 is 39% of 1.8 / working to show that 39.3% of 1.8 is 0.7 (1) **or** use of moles moles of sodium chloride = 1.8/58.5 (1) so mass of sodium = (1.8/58.5) X 23 = 0.7 (1) **or** ratios Na Cl NaCl 23 35.5 58.5 1 35.5/23 58.5/23 (1) 0.7 (35.5/23) X 0.7 = 1.1 (58.5/23) X 0.7 = 1.8 (1)	2	there are three main ways in which candidates may express their answer use of % of sodium use of moles of sodium use of ratios
			Total	**2**	

Question			Expected answers	Marks	Additional guidance
7			**Level 3** Applies understanding of equilibria to give a detailed explanation of all the conditions chosen in terms of the rate and position of equilibrium. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks) **Level 2** Applies understanding of equilibria to show that the conditions chosen give both a high rate of reaction and force position of equilibrium to the right with one condition explained. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3-4 marks) **Level 1** Idea that the presence of the catalyst, temperature chosen and/or pressure chosen will increase the rate of reaction. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include** • high temperature forces position of equilibrium to the left since the reaction is exothermic • so a relatively low temperature is used but it is high enough to increase rate of reaction • high pressure to make position of equilibrium move to the right because there are fewer gas molecules on the right • high pressure will also increase rate of reaction • if too high a pressure it will increase safety risks to workers and the plant costs will be too high • catalyst does not change the position of equilibrium (1) • catalyst increases the rate of reaction
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
8	(a)		results **1** and **2** are inconsistent / 1.1 cm^3 apart so she needed to do a third experiment (1) however, results **2** and **3** are consistent / within 0.2 cm^3 so she doesn't need to do any more (1)	2	**evidence from table must be linked to the need for repeats to gain credit for each marking point** **allow** cannot tell which titration was wrong so needed to do a third experiment (1) **not** to get a better mean titre marking points in either order can gain credit
	(b)		(with universal indicator) there is a continuous colour change / no sudden change / no sharp end-point / AW (1)	1	**allow** (universal indicator) has many colours
	(c)		mean titre is 20 (cm^3) or 0.020 dm^3 (1) moles of KOH = 0.0025 (1) moles of HNO_3 = 0.0025 (1) concentration = 0.125 (mol/dm^3) (1)	4	mean titre must be from readings **2** and **3** **allow** answers in standard form ie 2.5 x 10^{-3} **allow** ecf from moles of KOH ie moles of KOH = moles of HNO_3 **allow** ecf from moles of HNO_3 and from mean titre answer must be to three significant figures
			Total	**7**	

Question			Expected answers	Marks	Additional guidance
9	(a)		107 (1)	1	
	(b)		C_2H_2 and C_6H_6 (1)	1	**both** needed
			Total	**2**	

Question			Expected answers	Marks	Additional guidance
10	(a)		correct apparatus to collect gas eg gas syringe / measuring cylinder / upturned burette (1) will it work – is it gas tight? / is there water to be displaced? (1)	2	**allow** all marks from a diagram **allow** apparatus if not labelled providing it has clear graduations or is obviously a gas syringe **allow** 'solid' bungs / 'solid' ends of tubes if gas is not collected eg lime-water test is shown award no marks
	(b)		0.002 (1)	1	
	(c)		strong acid has more hydrogen ions / strong acid has a greater concentration of hydrogen ions this results in more collisions with hydrogen ions per second (2) **OR** strong acid has more hydrogen ions / strong acid has a greater concentration of hydrogen ions / there are more collisions in strong acid (1)	2	**more collisions must be linked to more/greater concentration of hydrogen ions to gain 2 marks** **allow** strong acid has more crowded hydrogen ions
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
11			add two solutions and filter (1) wash the residue with water (1) dry the residue in an oven / leave in air to evaporate (1)	3	**ignore** sieving filtering stage must be before the washing and drying stage washing stage must be before the drying stage drying stage must be the last stage **allow** let it dry in air **ignore** dry it / let it dry **ignore** heat it **not** use of a Bunsen burner to dry the residue **allow** marks from a diagram reaction mixture water 
			Total	**3**	

Question			Expected answers	Marks	Additional guidance
12	(a)		oxygen (1)	1	**allow** O_2
	(b)		$2H^+ + 2e^- \rightarrow H_2$	1	**allow** any correct multiple including fractions **allow** = for arrow **not** and or & for +
	(c)		prediction of 20 (seconds) (1) because temperature not relevant and time inversely proportional to the current used / temperature not important factor and current x 3 from 1 so time ÷3 (1)	2	
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
13	(a)		glucose → ethanol + carbon dioxide (1)	1	**not** sugar **not** alcohol
	(b)		because the reaction is catalysed by enzymes (1) if the temperature is too low the yeast is inactive and if too high the enzymes are denatured / and at these temperatures the enzyme is most effective (1)	2	answers must link change in temperature to the presence of enzymes to gain full credit just optimum temperature is not sufficient **allow** enzyme molecule loses shape **allow** if temperature is below 20°C yeast inactive and if above 50°C the yeast will die (1) **not** enzyme is killed
	(c)		C_2H_5OH / C_2H_6O (1)	1	**allow** any order of atoms **not** C^2H^5OH / C^2H^6O / C2H5OH / C2H6O
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
14	(a)		iron + oxygen + water → hydrated iron (III) oxide (1)	1	**allow** mix of formulae and names Fe + O_2 + H_2O → $Fe_2O_3.H_2O$ **allow** = sign for arrow **not** and / & for +
	(b)		Fe loses electrons and O_2 or H_2O gains electrons / electrons are transferred from iron to oxygen or water (1)	1	**not** electrons are lost and electrons are gained / electrons are transferred **but** 'electrons are lost from the first equation and gained in the second equation' is sufficient
	(c)		galvanising is the only method if scratched that will still prevent rusting as zinc corrodes instead of the iron car body (1)	1	
			Total	**3**	

Question			Expected answers	Marks	Additional guidance
15			because boiled tap water needs less soap than un-boiled tap water it must contain temporary hardness (1) however, because boiled tap water still needs more soap than distilled water it still has hardness in it, so also contains permanent hardness (1)	2	**both marking points needed, in either order, for 2 marks, however either of the marking points alone scores 1 mark**
			Total	**2**	

Question			Expected answers	Marks	Additional guidance
16	(a)	(i)	any year between 1988 and 1993 (1)	1	
		(ii)	scientists had to have their work peer reviewed / there were other alternative theories to consider (1)	1	**allow** there were social or economic pressures on the government to oppose the ban **allow** there was not enough evidence to make the theory convincing
		(iii)	level in 2010 is in range 12.3-12.7 so it will take 91 to 94 years (1) so by 2101 to 2104 it should be zero (1)	2	**allow** starting from any value from 1990 onwards and so will have to apply appropriate ecf – read off graph, then divide by 0.135 to get number of years (1) and then add this to the original year (1) **allow** ecf from wrong number of years
	(b)	(i)	$O_3 \rightarrow O + O_2$ (1)	1	**allow** any correct multiple
		(ii)	the breakdown of a CFC needs UV light and at ground level most UV light has been removed (by the ozone layer) (1)	1	CFCs are inert is **not sufficient**
			Total	**6**	

Question	Expected answers	Marks	Additional guidance
17	**Level 3** Accurate electrode equations included for both electrodes and a detailed explanation of the advantages and disadvantages focussing on at least two different areas eg energy transfer, pollution, availability etc. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks) **Level 2** An attempt at electrode equations for both electrodes and a limited explanation of the advantages and advantages of fuel cells focusing on at least one area eg energy transfer or pollution etc. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3-4 marks) **Level 1** Some relevant equations included and gives only a simplistic explanation of the advantages and disadvantages. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** **electrode equations**: • positive (+ve) electrode: $O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$ • negative (-ve) electrode: $H_2 + 2OH^- \rightarrow 2H_2O + 2e^-$ • $2H_2 + O_2 \rightarrow 2H_2O$ **advantages** • energy released as electricity rather than as heat • fuel cell produces electricity more efficiently / more direct energy transfer • uses hydrogen a renewable resource • does not produce carbon dioxide , a greenhouse gas, when generating electricity • produces water which is not polluting **disadvantages** • construction involves use of poisonous or toxic materials • disposal problems when fuel cells are finished in terms of the poisonous nature of some chemicals used • need to use energy to make hydrogen • potential difficulties of storing hydrogen • overcoming the general public concern over the use of hydrogen **allow** less polluting as a low level response / has a lower carbon footprint **ignore** fuel cell is environmentally friendly / is greener / references to cost unless qualified / can run for ever
	Total	**6**	

Question			Expected answers	Marks	Additional guidance
18	(a)		(proportion of) energy lost / wasted / used in manufacture and growth is less / biodiesel is more efficient / bio-ethanol uses 40% of the energy produced in manufacture and growth(1)	1	
	(b)		hemp and 1500 (1)	1	**both needed for mark**
	(c)	(i)	**any two from** idea that the trend is difficult to work out because there has been such a sudden rise (1) idea that it can be affected by other factors eg economics (1) availability of other fuels (1) changes in weather (1) or changes in government policies (1) better extraction techniques may be developed (1)	2	
		(ii)	food shortage / not enough food crops are grown (1)	1	**allow** over production and cannot sell the bio-diesel **allow** food prices increase **allow** less fossil fuels burnt / less carbon dioxide produced

Question	Expected answers	Marks	Additional guidance
(d)	**max 5 from:**	5	**reasoning for both sides of the argument must be used to score max 5** **reasoning must be linked to evidence in the section**
	reasoning for type of bio-fuel and plant (1)		eg she should grow hemp for bio-diesel because it is more efficiently produced and gets the biggest yield (1)
	reasoning based on environmental /social issues (max 3)		eg she should grow crops for bio-fuels because burning bio-fuels will reduce carbon dioxide emissions / will reduce global warming / reduce greenhouse effect (1) she should grow crops for bio-fuels because bio-fuels could be used instead of petrol in cars / can be burnt instead of fossil fuels (1) bio-fuels are carbon-neutral due to plants taking in energy for photosynthesis unlike other fossil fuels (1) eg she should not grow crops for bio-fuels because she may use lots of fertiliser / pesticide / cause eutrophication (1) she should not grow crops from bio-fuels because she should be growing food / people are in the world are starving / food is a better use of the land (1) idea of the production of bio-fuels is not that efficient and a lot of energy is needed (1)
	reasoning based on technology required (1)		eg she should not grow crops for bio-fuels because the technology is not ready yet / there are not enough cars that can use bio-fuels (1)
	reasoning based on lack of information (max 2)		eg she cannot make a decision because she doesn't know about cost (1) she cannot make a decision about plants because it depends on the conditions (on her farm) (1)
	Total	**10**	

Assessment Objectives (AO) Grid

(includes quality of written communication ✎)

Question	AO1	AO2	AO3	Total
1(a)	1			1
1(b)		1		1
1(c)		1		1
2(a)		1		1
2(b)	2			2
2(c)		1		1
3(a)	1	1		2
3(b)	2			2
3(c)✎	2	2	2	6
4(a)		1		1
4(b)(i)		2		2
4(b)(ii)		1		1
5(a)(i)		1		1
5(a)(ii)	1			1
5(b)	1	1		2
6		2		2
7✎	2	4		6
8(a)			2	2
8(b)	1			1
8(c)	1	3		4
9(a)		1		1
9(b)		1		1
10(a)	2			2
10(b)		1		1
10(c)	2			2
11	3			3
12(a)	1			1
12(b)	1			1
12(c)		2		2
13(a)	1			1
13(b)	2			2
13(c)	1			1
14(a)	1			1
14(b)	1			1
14(c)			1	1
15		1	1	2
16(a)(i)		1		1
16(a)(ii)		1		1
16(a)(iii)		2		2
16(b)(i)		1		1
16(b)(ii)		1		1
17✎	5	1		6
18(a)			1	1
18(b)			1	1

Question	AO1	AO2	AO3	Total
18(c)(i)			2	2
18(c)(ii)			1	1
18(d)			5	5
Totals	**34**	**35**	**16**	**85**

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