OCR
RECOGNISING ACHIEVEMENT

SPECIMEN F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

CHEMISTRY B

B741/01

Unit B741: Chemistry modules C1, C2, C3 (Foundation 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 15 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.
- 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 **75**.
- This document consists of **20** pages. Any blank pages are indicated.

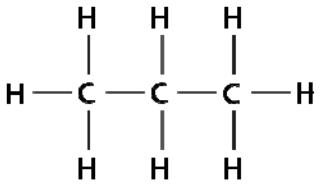
Examiner's Use Only:			
1		8	
2		9	
3		10	
4		11	
5		12	
6			
7			
Total			

Answer **all** the questions.

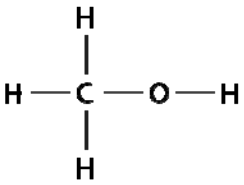
Section A – Module C1

1 This question is about carbon compounds.

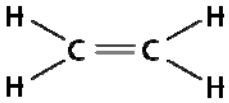
Look at the displayed formulas.



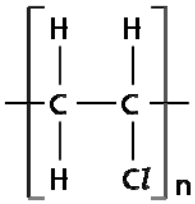
propane



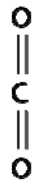
methanol



ethene



poly(chloroethene)



carbon dioxide

(a) Which compound is found in liquefied petroleum gases (LPG)?

Choose from the displayed formulas.

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

(b) How many atoms are present in the formula for propane?

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

(c) Write down the **names** of the two elements present in a hydrocarbon.

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

[Total: 3]

2 Phil is heating his house.

©Robert Brook/Science Photo Library

(a) Phil decides to use natural gas (methane) to heat his house.

Look at the word equation.

It shows what happens during the **complete combustion** of methane.

methane + oxygen ⟶ ..... + water

Finish the word equation.

[1]

(b) Phil uses a gas water heater.

He notices that the water heater is producing lots of soot.

It is important that he gets the gas heater serviced. Explain why.

.....

.....

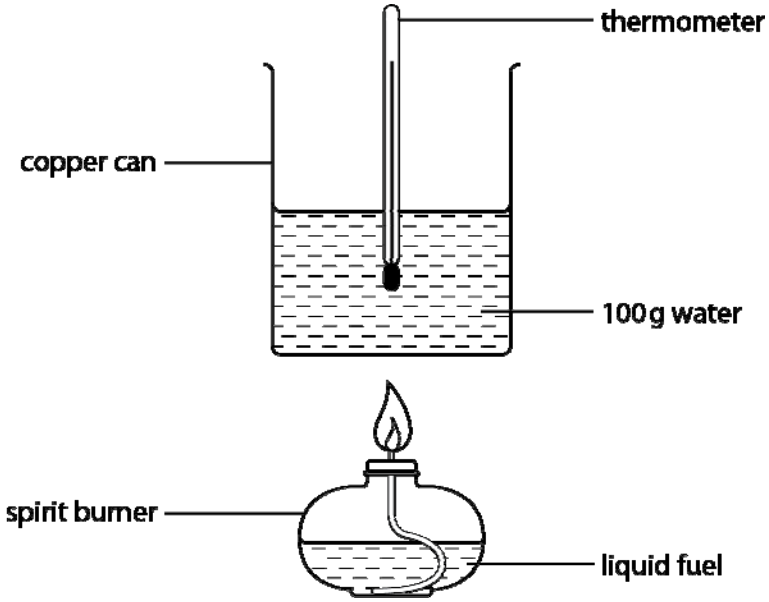
..... **[2]**

(c) Phil wants to heat his greenhouse.

He decides to test four liquid fuels to see which fuel is the best to use.

Look at the diagram.

It shows the apparatus he uses to measure the energy given out by these fuels.



Look at the table. It shows his results.

fuel	temperature of water at start in °C	temperature of water at end in °C	cost of fuel burned in pence
A	15	30	1.0
B	22	42	2.0
C	20	25	0.5
D	20	30	1.5

Phil decides to use fuel **C** to heat his greenhouse.

Evaluate if this is a sensible choice.

.....

.....

.....

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

[Total: 6]

3 This question is about removing nail varnish.

(a) Some solvents can dissolve nail varnish.

Lesley investigates the solubility of different nail varnishes.

Look at the table of the results of her investigation.

solvent	**colour of nail varnish**				
	black	**blue**	**purple**	**red**	**white**
ethanol	S	I	S	I	I
ethyl ethanoate	S	S	S	S	S
petrol	S	S	I	S	I
propanone	S	S	S	S	S
water	I	I	I	I	I

I = insoluble and S = soluble

(i) Which solvent did not dissolve any of the nail varnishes?

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

(ii) Why is ethyl ethanoate a better solvent for nail varnishes than petrol?

.....

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

(b) Finchfield Pharmaceuticals make a new nail varnish remover.

It must be tested before it can be approved for use by humans.

Give **two** examples of risks that should be tested for.

.....

.....

.....

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

[Total: 4]

4 (a) Look at the list. It shows some of the gases found in **clean** air.

oxygen

carbon dioxide

water vapour

Write down the name of one **other** gas present in **clean** air.

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

(b) Sulfur dioxide causes air pollution.

Write about the **effects** of sulfur dioxide pollution.

.....

.....

.....

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

(c) Some people throw away plastic bottles. This can cause a litter problem.

Explain why throwing away plastic bottles can cause problems.

.....

.....

.....

.....

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

[Total: 6]

5 Cracking is a process that is done in an oil refinery.

Look at the table of information about different fractions found in crude oil.

The fractions contain hydrocarbon molecules.

The fractions at the top of the table have smaller molecules than the fractions at the bottom.

fraction	amount supplied in crude oil in tonnes	amount needed in tonnes
liquefied petroleum gases	13	12
petrol	10	15
diesel	10	18
paraffin	25	20
heating oil	20	25
bitumen	22	10

Crude oil contains too much of some fractions and not enough of other fractions.

The manager of the oil refinery needs to make some decisions.

She needs to decide the conditions to use and the fractions to be cracked.

What conditions should the manager use and how does she use the information in the table to decide which fractions should be cracked?

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

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

[Total: 6]

Section B – Module C2

6 This question is about metals.

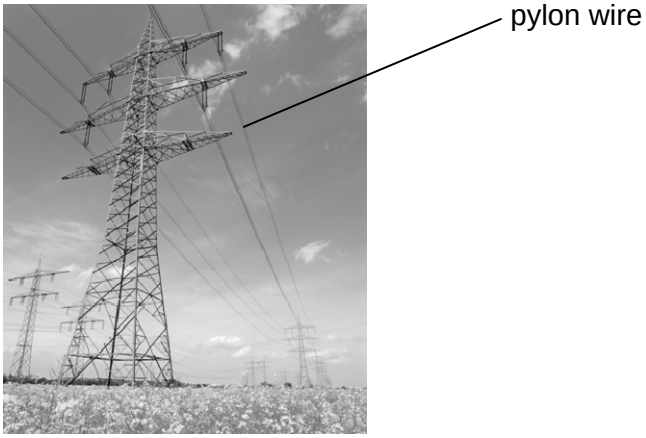
Look at the table. It shows the properties of some metals.

metal	melting point in °C	density in g/cm^3	relative electrical conductivity	cost per tonne in £
aluminium	660	2.7	40	1350
copper	1083	8.9	64	3800
iron	1535	7.9	11	400
silver	962	10.5	67	20 000

(a) Which metal would you chose to make a container in which to melt copper?

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

(b) Pylon wires are made from metal.



Which metal would be most suitable for using for pylon wires?

Use information about each of the metals in the table to explain your answer.

.....

.....

.....

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

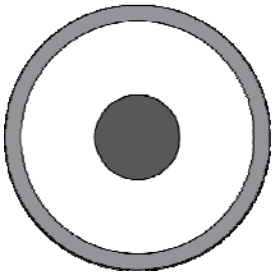
(c) Brass is made from copper and zinc.

Write down one use of brass.

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

[Total: 5]

7 Look at the diagram of the structure of the Earth.



The surface of the Earth is made up of tectonic plates.

(a) Describe the structure of the Earth and the effects of plate tectonics.

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

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

(b) The theory of plate tectonics is widely accepted by scientists.

Give **two** reasons why.

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

[Total: 8]

8 This question is about the manufacture of ammonia.

Ammonia is made in the Haber process.

Look at the equation for the Haber process.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

(a) There are many different factors that affect the cost of making ammonia.

Look at the table about the costs of making 10 tonnes of ammonia in a factory.

factor	**cost in £**
energy	1000
hydrogen	250
nitrogen	50
others	100

(i) Nitrogen is a much cheaper raw material than hydrogen.

Suggest why.

.....

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

(ii) Calculate what percentage of the total cost of making ammonia is for energy.

Suggest why the energy costs are so high.

.....

.....

.....

.....

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

(iii) The ammonia made during this reaction is quickly removed to prevent it breaking down.

What substances are made when ammonia breaks down?

Use the symbol equation to help you answer.

.....

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

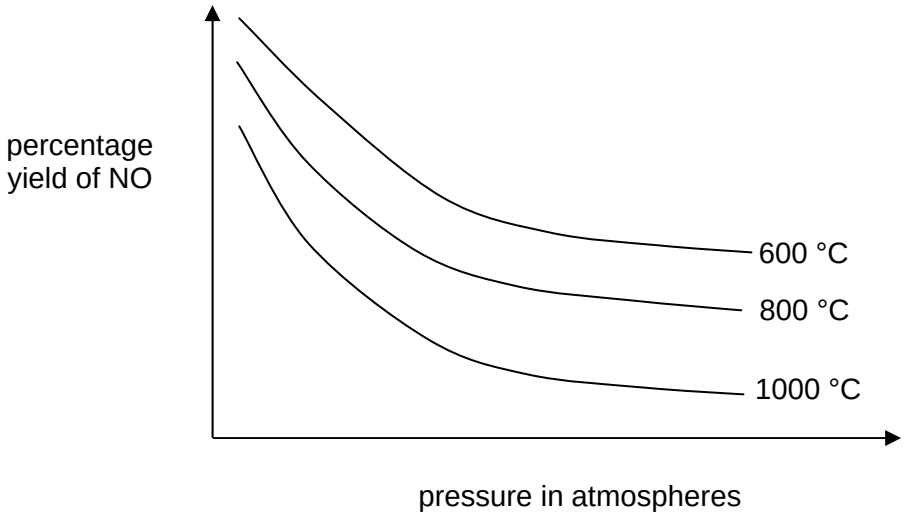
(b) Nitric acid is made from ammonia.

The first reaction in this process involves the oxidation of ammonia.

$$\text{ammonia} + \text{oxygen} \rightleftharpoons \text{nitrogen(II) oxide} + \text{water}$$

Look at the sketch graph.

It shows the percentage yield of nitrogen(II) oxide (NO) at different temperatures and pressures.



(i) How does increasing the **temperature** change the percentage yield?

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

(ii) How does increasing the **pressure** change the percentage yield?

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

[Total: 6]

9 This question is about fertilisers.

Fertilisers can be made by **neutralisation**.

(a) Look at the equation for a neutralisation reaction to make a fertiliser.

$$2KOH + H_2SO_4 \rightarrow K_2SO_4 + H_2O$$

Write down the formula of one **reactant**.

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

(b) Sodium hydroxide reacts with phosphoric acid.

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

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

(c) Elizabeth is a farmer. She is given some ammonium sulfate to use on her fields.

Elizabeth is deciding whether or not to use the ammonium sulfate on her fields.

What factors should she consider?

.....

.....

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

(d) Elizabeth uses a bag of fertiliser that contains only ammonium sulfate, $(NH_4)_2SO_4$.

Anna uses a bag of fertiliser that is a mixture of potassium nitrate, KNO_3, and ammonium phosphate $(NH_4)_3PO_4$.

Suggest why Anna's bag of fertiliser is better than Elizabeth's.

.....

.....

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

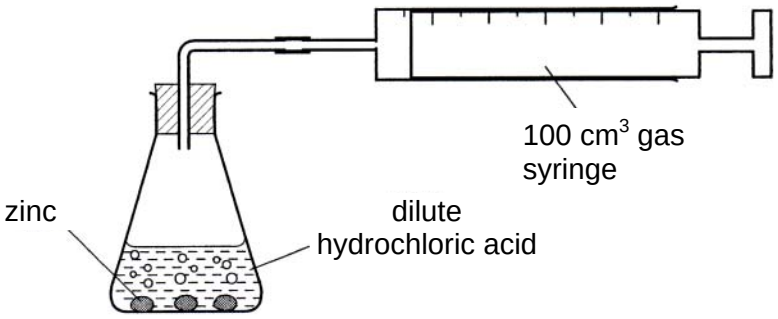
[Total: 6]

Section C – Module C3

10 Colin and Ann investigate the reaction between zinc lumps and hydrochloric acid.

Hydrogen and a solution of zinc chloride are made.

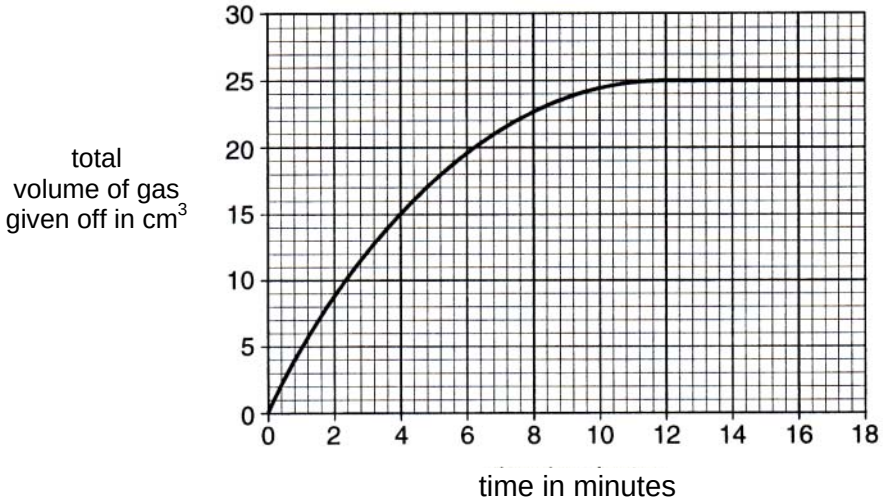
The diagram shows the apparatus they use.



Look at the graph.

It shows their results when 1 g of zinc lumps reacts with 20 cm^3 of dilute hydrochloric acid.

At the end of the experiment almost all of the zinc remained.



(a) How long does it take to make 20 cm^3 of gas?

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

(b) Why does the reaction stop?

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

(c) Colin and Ann repeat the experiment.

This time they use **100** cm^3 of dilute hydrochloric acid rather than **20** cm^3.

Why would it be difficult to collect all of the hydrogen made at the end of this experiment?

.....

.....

.....

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

(d) Colin and Ann want the reaction to go faster.

They do not want to change the volume of acid or mass of zinc.

Explain, using the reacting particle model, two ways Colin and Ann can increase the rate of the reaction.

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

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

(e) The reaction between zinc and hydrochloric acid goes at a reasonable rate.

Write down the name of one reaction which is **very slow** and one which is **very fast**.

.....

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

[Total: 12]

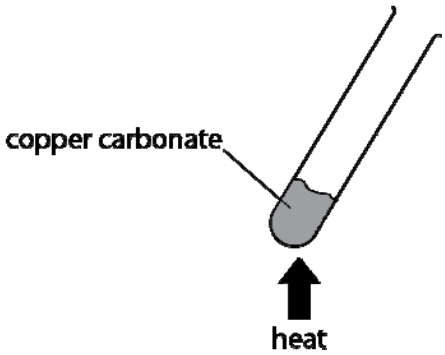
11 Copper carbonate decomposes when heated.

Copper oxide and carbon dioxide are made.

$$CuCO_3 \rightarrow CuO + CO_2$$

Tim investigates this decomposition.

Look at the apparatus he uses.



Tim heats 1.24 g of copper carbonate in the test-tube.

He uses a yellow Bunsen flame for 1 minute.

(a) Tim finds he only gets an 80% yield of copper oxide.

Suggest why he did not get a 100% yield.

.....

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

(b) Tim repeats his experiment using 1.24 g of copper carbonate.

He makes certain he gets a 100% yield.

This time he makes 0.80 g of copper oxide.

What mass of **carbon dioxide** can Tim make by heating 0.62 g of copper carbonate?

.....

.....

.....

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

(c) A factory manufactures copper oxide by heating copper carbonate.

The carbon dioxide made is a waste product.

(i) Look at the table of relative formula masses, M_r.

substance	relative formula mass, M_r
$CuCO_3$	
CuO	80
CO_2	44

The relative atomic mass for Cu is 64, for C is 12 and for O is 16.

Calculate the relative formula mass for copper carbonate.

Put your answer in the table.

.....

.....

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

(ii) Calculate the atom economy for the manufacture of copper oxide.

.....

.....

.....

.....

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

(iii) A factory wants as high an atom economy as possible when making a chemical.

Explain why.

.....

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

(iv) The factory uses a batch process rather than a continuous process.

What is the difference between a batch process and a continuous process?

.....

.....

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

[Total: 9]

12 Diamond and graphite have different properties and different uses.

Look at the table.

It shows some information about the properties of diamond and graphite.

property	diamond	graphite
state at room temperature	solid	solid
appearance at room temperature	colourless, clear and lustrous	dull black
melting point	……..	very high
hardness	very hard	soft and slippery
solubility in water	insoluble	insoluble
electrical conductivity	……..	good conductor

(a) Complete the table by describing the

- melting point of diamond
- electrical conductivity of diamond. **[2]**

(b) Mark decides to use graphite electrodes in the electrolysis of sodium chloride solution.

Use information in the table and your own knowledge to give reasons for his decision.

.....

.....

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

[Total: 4]

[Paper Total: 75]

END OF QUESTION PAPER

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.

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SPECIMEN F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

B741/01

CHEMISTRY B

Unit B741: Chemistry modules C1, C2, C3 (Foundation Tier)

MARK SCHEME

Duration:1 hour 15 minutes

MAXIMUM MARK 75

This document consists of 16 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)		propane (1)	1	**allow** C_3H_8
	(b)		11 (1)	1	
	(c)		hydrogen **and** carbon (1)	1	**not** 'hydro and carbon' **not** C and H
			Total	**3**	

Question			Expected answers	Marks	Additional guidance
2	(a)		carbon dioxide (1)	1	**allow** CO_2 **not** CO2 or CO^2 or Co_2 **not** carbon dioxide + heat
	(b)		idea that soot shows that incomplete combustion is happening (1) so poisonous carbon monoxide (may be being) formed / so less energy is being released (1)	2	**answers must be linked for 2 marks** eg poisonous carbon monoxide may be being formed because incomplete combustion is happening shown by soot being made (2) **allow** less heat is produced (1)
	(c)		fuel **C** is a sensible choice because it is cheaper than all the others (1) evidence of calculation of temperature differences to conclude that fuel **C** is not a sensible choice because fuel **B** gives the largest temperature rise / ora (1) **OR** evidence of calculation of temperature rise per penny to conclude that fuel **C** is not a sensible choice because fuel **A** has the highest temperature rise for 1 pence of fuel burned / ora (2)	3	**answers must link choice of fuel with evidence to gain credit** **allow** answers in terms of fuel **B** being a better choice if linked to evidence **allow** answers in terms of fuel **C** being a better choice if linked to evidence
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
3	(a)	(i)	water (1)	1	
		(ii)	ethyl ethanoate dissolves more of the colours (1)	1	**allow** ora
	(b)		**any two from:** idea that nail varnish remover could irritate skin or nails or hands (1) toxicity / AW (1) does not react with water / sweat / perspiration (1)	2	**allow** idea that could have harmful vapours (1)
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
4	(a)		nitrogen / helium / neon / argon / krypton (1)	1	**allow** correct symbols **allow** radon
	(b)		sulfur dioxide causes acid rain (1) which kills plants / kills fish / attacks stonework / corrodes metals (1)	2	**allow** idea that sulfur dioxide aggravates asthma (1)
	(c)		plastics are non-biodegradable (1) so (plastics) do not rot / decay by bacterial action (1) this means that they need to be disposed of by burning / by landfill / by recycling (1)	3	**first and second marking points can be in either order** **allow** 'difficult to recycle because difficult to sort' as alternative to the third marking point (1)
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
5			**Level 3** Answer identifies both conditions needed for cracking and applies knowledge of cracking to explain that the decision should be based on both matching supply and demand and molecule size, with examples given from the table. 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** Answer identifies at least one correct condition and applies limited knowledge of cracking to explain why at least one fraction from the table could be cracked. 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** Answer includes one condition and some idea about using cracking to make more useful products. 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:** • cracking needs a high temperature / heating • cracking needs a catalyst / use of zeolite • cracking converts large hydrocarbon molecules into smaller ones • cracking converts less useful hydrocarbons into more useful hydrocarbons • cracking converts named fractions that are in excess into named fractions that are in short supply eg bitumen or paraffin into petrol or diesel • the table shows that petrol and diesel are in short supply • the table shows that bitumen and paraffin are in excess and that these are large molecules
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
6	(a)		iron (1)	1	
	(b)		aluminium (no mark) because density too high so wires would sag for copper, iron and/or silver / ora (1) because iron is too poor an electrical conductor / ora (1) because copper and/or silver are too expensive / ora (1)	3	**answers must support the candidates choice to gain credit** **if iron or silver max 1 mark** **allow** idea of wires are heavy **allow** reference to just one metal eg silver is expensive **ignore** any comments about corrosion
	(c)		musical instruments / coins / door decorations / horse brasses (1)	1	
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
7	(a)		**Level 3** Detailed description of Earth structure, including all the main parts of the Earth, and the effects of plate movement. 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** Limited description of Earth structure with some reference to the effects of plate movement. 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** Identifies some parts of the Earth and recognises that tectonic plates move. 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:** • Earth is a sphere • Earth is made up of core, thin, rocky crust and mantle • core contains iron • beneath the surface there is molten rock called magma • tectonic plates move (very slowly or about 2.5cm per year) • tectonic plate movement causes volcanoes • tectonic plate movement causes earthquakes • idea of over millions of years movement results in the formation of continents **allow** tectonic plate movement causes mountain ranges to be formed **allow** higher level answers involving convection currents in the mantle, that crust is less dense than the mantle or a description of the lithosphere
7	(b)		theory explains the evidence (1) discussed and tested by a number of scientists (1)	2	**allow** idea of peer review or results published in scientific publications and conferences enables results to be checked (1) as alternative to second mark
			Total	**8**	

Question			Expected answers	Marks	Additional guidance
8	(a)	(i)	because nitrogen comes from the air (1)	1	**allow** higher level answers above target demand eg nitrogen does not need to be extracted from air at high cost
		(ii)	71.4% (1) because energy is needed to heat the reaction / maintain high pressure / AW (1)	2	**allow** 71% (1)
		(iii)	nitrogen **and** hydrogen (1)	1	both needed for mark **allow** N_2 and H_2
	(b)	(i)	yield decreases / AW (1)	1	
		(ii)	yield decreases / AW (1)	1	
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
9	(a)		KOH / H_2SO_4 (1)	1	
	(b)		sodium hydroxide + phosphoric acid → sodium phosphate + water (1)	1	
	(c)		benefits: fertilisers can increase food supply / AW (1) problems: fertilisers can kill aquatic organisms / eutrophication / can cause water pollution / AW (1)	2	**allow** idea of whether her use will be 'excessive' and therefore have negative impacts (1) **allow** idea of benefits and problems with no specific references for 1 mark
	(d)		ammonium sulfate contains only, one essential element / nitrogen, so the mixture is better because it contains **all three** essential elements / nitrogen, phosphorous **and** potassium (2) **OR** the mixture contains more essential elements than the ammonium sulfate / ora (1)	2	**answers must be a comparison in terms of specific numbers/names of essential elements in order to gain 2 marks**
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
10	(a)		6 (minutes) (1)	1	**allow** range 6-6.4 minutes or 6 minutes-6 minutes 25 seconds
	(b)		hydrochloric acid runs out (1)	1	
	(c)		with 100 cm^3 of acid the volume of gas produced should be 125 cm^3 (1) the volume of gas produced will be greater than the volume of the gas syringe (1)	2	

Question			Expected answers	Marks	Additional guidance
10	(d)		**Level 3** Answer applies understanding of the reacting particle model and rates of reaction to explain comprehensively two ways of increasing the rate of reaction. 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** Answer applies limited understanding of the reacting particle model and rates of reaction to explain partially two ways of increasing the rate of reaction or explain comprehensively one way of increasing the rate of reaction. 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** Answer gives two ways in which the rate of reaction can be increased. 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:** • more collisions between zinc and acid particles results in faster reaction • increase the temperature of acid increases rate of reaction • increase the concentration of acid increases the rate of acid • increase the surface area of the zinc increases the rate of reaction **temperature of hydrochloric acid** • idea that acid particles move faster / acid particles have more energy / more successful collisions between acid and zinc particles / collisions between acid particles and zinc particles are more energetic • idea of increased collisions (frequency) between acid particles and zinc **concentration of hydrochloric acid** • idea of more crowded acid particles / more acid particles in the same volume / more H^+ ions in the same volume • idea of increased collisions (frequency) **ignore** reference to 'more particles' **powdered zinc** • idea of increased surface area of zinc / more zinc particles exposed to the acid • idea of increased collision (frequency) between zinc and acid particles
10	(e)		slow reaction – rusting / corrosion (1) fast reaction – any explosion (1)	2	**allow** other very slow reactions **allow** reactions of alkali metals with water
			Total	**12**	

Question			Expected answers	Marks	Additional guidance
11	(a)		not all copper carbonate decomposes because not heated for long enough / not all copper carbonate decomposes because the temperature was not high enough (1)	1	
	(b)		0.22 g (2) **OR** idea that carbon dioxide made from 1.24g is 0.44g (1)	2	**allow** full marks for 0.22g with no working, correct working for 1 mark **allow** use of molecular masses and moles to calculate eg 0.62/124 = 0.005 moles (1)
	(c)	(i)	124 (1)	1	**allow** 123.5
		(ii)	64.51 % (2) **OR** if correct answer not given atom economy = $\frac{\text{M of desired products}}{\text{sum of M of all products}} \times 100$ / atom economy = $\frac{80}{124} \times 100$ (1)	2	**allow** full marks for the correct answer even if the equation for atom economy is not stated **allow** 65 / 64.5 / up to the calculator value **allow** ecf / 64.8 % if answer given for (i) is 123.5
		(iii)	because fewer atoms lost as waste so it is a greener process / because fewer atoms lost as waste so it is a more sustainable process (1)	1	
		(iv)	continuous – chemicals made all the time / chemicals made 24/7 (1) whereas in batch – chemicals made on demand (and not all the time) (1)	2	
			Total	**9**	

Question			Expected answers	Marks	Additional guidance
12	(a)		very high (1) does not conduct (1)	2	
	(b)		graphite is a good electrical conductor so will be able to transfer the electrical current without loss (from the wires to the electrolyte) (1) graphite has a high melting point / solid / insoluble / inert, so will not, dissolve / melt / react, during electrolysis (mixing with the electrolyte) (1)	2	**allow** higher level answers relating to the structure of graphite eg delocalised electrons allow current to flow (1)
			Total	**4**	

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	2	**3**
3(a)(i)		1		**1**
3(a)(ii)		1		**1**
3(b)		2		**2**
4(a)	1			**1**
4(b)	2			**2**
4(c)	3			**3**
5✎	3	3		**6**
6(a)		1		**1**
6(b)		1	2	**3**
6(c)	1			**1**
7(a) ✎	6			**6**
7(b)	2			**2**
8(a)(i)		1		**1**
8(a)(ii)		2		**2**
8(a)(iii)		1		**1**
8(b)(i)		1		**1**
8(b)(ii)		1		**1**
9(a)		1		**1**
9(b)		1		**1**
9(c)	2			**2**
9(d)		2		**2**
10(a)		1		**1**
10(b)		1		**1**
10(c)		2		**2**
10(d) ✎	2	4		**6**
10(e)	2			**2**
11(a)	1			**1**
11(b)		2		**2**
11(c)(i)		1		**1**
11(c)(ii)	1	1		**2**
11(c)(iii)	1			**1**
11(c)(iv)	2			**2**
12(a)	2			**2**
12(b)			2	**2**
	34	**35**	**6**	**75**

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