OCR
RECOGNISING ACHIEVEMENT

SPECIMEN H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

B741/02

CHEMISTRY B

Unit B741: Chemistry Modules C1, C2, C3 (Higher Tier)

MARK SCHEME

Duration: 1 hour 15 minutes

MAXIMUM MARK 75

This document consists of 16 pages

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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.

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Question			Expected answers	Marks	Additional guidance
1	(a)		acid + **alcohol** → ester + **water** (1)	1	
	(b)		**advantage** idea that test more realistic as animals are alive (1) **disadvantage** cruel to animals / ethical objection / may work differently in different species / animals are not the same as humans (1)	2	**allow** it could hurt / harm / kill animals / inhumane **allow** references to animal rights eg animal can't speak for itself eg some people think animals have the same rights as humans eg animals have no control over what happens to them
			Total	**3**	

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Question			Expected answers	Marks	Additional guidance
2	(a)		idea of availability / is it easy to get hold of / how long will it last (1) idea of flammability / is it easy to light the fuel / does it have a clean flame (1) how much space is needed to store the fuel / can the fuel be stored or it provided by pipeline (1) can the fuel be used safely / is the fuel toxic / are there any harmful effects when in contact with humans / will it produce poisonous carbon monoxide when it burns (1)	2	**allow** can it run out / is it nearby **ignore** references to pay back time, efficiency or solar panels
	(b)		**any two from** because population has increased (1) because there is more demand for or consumption of energy / increased burning of fossil fuels / increased industry (1) because of increased deforestation / AW (1)	2	**allow** more demand for fuel **allow** idea of demand for fuel from emerging economies eg China is having an industrial revolution or more countries are becoming developed **allow** more transport eg cars / more electrical (appliances) / more consumables / more technology **ignore** references to renewable energy
	(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	**7**	

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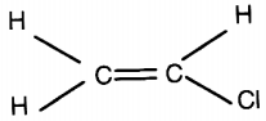
Question			Expected answers	Marks	Additional guidance
3	(a)		propane (1)	1	**allow** correct formula C_3H_8 **not** propene
	(b)		ethene (1)	1	**allow** correct formula C_2H_4
	(c)		CH_4O (1)	1	**allow** CH_3OH / COH_4 / H_4CO / OH_4C / H_4OC **not** CH3OH / CH^3OH **not** CH4O / CH^4O **allow** $C_1H_4O_1$
	(d)		 (1)	1	bonds can be in any direction
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
4	(a)		20 - 21 (%) (1)	1	
	(b)		Carbon monoxide removed by being converted to carbon dioxide (1) $2CO + 2NO \rightarrow N_2 + 2CO_2$ (1)	2	
	(c)		$N_2 + O_2 \rightarrow 2NO$ (1) because the temperature is high enough to provide enough energy to break the covalent bonds within a nitrogen molecule / the temperature is high enough to supply the activation energy to make nitrogen atoms (1)	2	
			Total	**5**	

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Question	Expected answers	Marks	Additional guidance
5	**Level 3** Applies understanding of cracking to explain, using symbol equations, the possible products made during cracking of hexadecane including a clear indication as to why cracking can make many products. 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 application of understanding of cracking to explain, using word or symbol equations, the importance of some of the products formed. 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 attempts an explanation to include at least one reason for cracking and an idea of possible products. Answer may be simplistic. T here 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 produces smaller alkene and alkane molecules • Cracking produces hydrogen • The alkenes made are a source of polymers • The alkanes made can be used as petrol • Cracking enables oil refinery to balance supply with demand • Equations can be word or symbol equations eg hexadecane → octane + octene $C_{16}H_{34} \rightarrow C_8H_{18} + C_8H_{16}$ • Equations can use molecular, structural or displayed formulae • Get many products because any of the carbon-carbon bonds in hexadecane can break
	Total	**6**	

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Question			Expected answers	Marks	Additional guidance
6	(a)		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 is too expensive / ora (1)	2	**answers must support aluminium to gain credit** **allow** idea of wires are heavy **allow** reference to just one metal **ignore** any comments about corrosion
	(b)		copper (no mark) and then **any two from** because it has a high density (1) it is lustrous (1) it is relatively cheap (1) it does not rust (1)	2	no mark for name of metal **allow** iron (no mark) because it has a high density (1) and is cheap / cheapest (1) **allow** silver (no mark) because it has a high density (1) but no other mark
	(c)		copper and zinc (1)	1	both required **allow** Cu and Zn
			Total	**5**	

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Question			Expected answers	Marks	Additional guidance
7	(a)		$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$ correct reactants and products (1) balancing (dependent on correct formulae) (1)	2	**allow** = for arrow **not** and or & instead of +
	(b)		sodium hydroxide + phosphoric acid → sodium phosphate + water (1)	1	
	(c)		Anna's contains nitrogen and phosphorus and Elizabeth's only contains potassium (1) **if this mark scored then in addition:** this means only Anna's will have nitrogen used to **make plant protein** for growth / phosphorus needed to **make DNA or RNA** needed for growth (1)	2	**second mark only awarded if first marking point is gained** **ignore** just idea of nitrogen / phosphorus needed for plant growth
	(d)		idea that fertiliser or nitrates increase the growth of water plants and produce an algal bloom (1) **if this mark scored then in addition:** this algal bloom then blocks off sunlight from other plants causing them to die (1) **if these marks scored then in addition:** idea that (aerobic) bacteria feed on these dead and decaying plants and use up the oxygen in the water so no oxygen for other aquatic organisms (so they die) (1)	3	**marking points must be linked and in order to gain full credit** **allow** idea that plants below surface cannot photosynthesis and so die **allow** decomposers or microbes or micro-organisms for bacteria idea that fertiliser kills or poisons fish does not score
			Total	**8**	

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Question			Expected answers	Marks	Additional guidance
8	(a)		yield decreases / AW (1)	1	
	(b)		yield decreases / AW (1)	1	
	(c)		high temperature to increase the rate of reaction (1) but low pressure to keep the percentage yield high and decrease building/operating costs (1)	2	
			Total	**4**	

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Question			Expected answers	Marks	Additional guidance
9	(a)		**Level 3** A comprehensive answer which accurately describes convection currents in the mantle and gives a thorough explanation of subduction. 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 describes how plates move and gives a partial explanation of subduction, recognising the types of plate involved. 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** A simplistic description, which recognises the relative densities of tectonic plates and the mantle and attempts a simplistic explanation of subduction. 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:** • lithosphere made of tectonic plates • energy transfer through convection currents in the semi-rigid mantle causing plate movement • tectonic plates less dense than mantle • oceanic crust more dense than continental crust • collision between oceanic plates and continental plates leads to subduction • subduction is one plate going underneath the other • partial melting occurs • plates cooler at ocean margins so sink and pull plates down

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Question			Expected answers	Marks	Additional guidance
9	(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 marking point
			Total	**8**	

Question			Expected answers	Marks	Additional guidance
10	(a)		answer in range 11 to 12 (minutes) (1)	1	
	(b)	(i)	3.75 (1) cm^3/minute (1)	2	
		(ii)	rate faster in first 4 minutes as rate during 4-8 minutes is 12.5/4 = 3.125 / AW (1)	1	**allow** rate faster in first 4 minutes as gradient of graph is less steep between 4-8 minutes / AW **allow** rate faster in first 4 minutes as there is less gas produced in the same time for 4-8 minutes

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Question			Expected answers	Marks	Additional guidance
10	(c)		**Level 3** Applies understanding of the reacting particle model to give a detailed explanation in terms of collisions why two of the variables increase rate of this 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** Applies understanding of the reacting particle model to give a limited explanation. Explanation may be limited by addressing only one variable or limited use of collision theory. 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 attempts an explanation for one variable using some correct chemistry involving particle behaviour. 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 particles results in faster reaction **temperature of hydrochloric acid** • idea that acid particles in the move faster / acid particles have have more energy • idea of increased collisions between acid and zinc particles • idea of increased collision frequency and more successful or energetic collisions between acid and zinc particles **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 between acid and zinc particles • increased collision frequency between acid and zinc particles **ignore** reference to 'more particles' **powdered zinc** • idea of increased surface area of zinc • more exposed zinc particles • idea of increased collisions between acid and zinc particles • increased collision frequency between acid and zinc particles
			Total	**10**	

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Question			Expected answers	Marks	Additional guidance
11	(a)		87.5 % (2) if correct answer not given: % yield = $\frac{\text{actual mass}}{\text{predicted mass}} \times 100$ / % yield = $\frac{0.7}{0.8} \times 100$ (1)	2	**allow** 87.5 and 88 for full marks even if the expression for the percentage yield is not quoted
	(b)		64.51 % (2) 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
	(c)		high percentage yield: to reduce cost/increase efficiency, by, not wasting starting materials / reducing the need to recycle unreacted reactants (1) high atom economy: to make the process more sustainable / greener / to reduce the processing of unwanted products (1)	2	answers in terms of cost/efficiency alone are not worthy of credit
			Total	**6**	

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Question			Expected answers	Marks	Additional guidance
12	(a)		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 above target level relating to the structure of graphite eg delocalised electrons allow current to flow (1)
	(b)		they both have strong (covalent) bonds (1) **if this mark scored then in addition:** which need lots of energy to break (before melting can take place) (1)	2	**not** reference to intermolecular bonds **second mark only awarded if linked to bonds in first marking point**
	(c)		because there is no movement of (free/delocalised) electrons / AW (1)	1	**allow** because there are no delocalised electrons / because there are no free electrons / because it is a covalently bonded giant structure
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
13	(a)		M_r of HNO_3 = 63 and of $Ca(NO_3)_2$ = 164 (1) Moles of HNO_3 = 0.05 and moles of $Ca(NO_3)_2$ = 0.025 / 126 g of HNO_3 makes and 164 g of $Ca(NO_3)_2$ = 0.025 (1) Mass of $Ca(NO_3)_2$ = 4.1 g (1)	3	**allow** full marks for 4.1 g **allow** ecf from wrong M_r values
	(b)		doubles (1)	1	**ignore** just increases
			Total	**4**	

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