

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

B741/02

CHEMISTRY B

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

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

OCR Supplied Materials:

None

Duration: 1 hour 15 minutes

Other Materials Required:

- Pencil
- Ruler (cm/mm)

Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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INSTRUCTIONS TO CANDIDATES

- Write your name clearly 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		13	
7			
Total			

Answer **all** the questions

Section A – Module C1

1 This question is about esters.

Esters are useful substances. They can be used to make perfumes and solvents.

(a) Look at the list.

alcohol

alkane

polymer

protein

water

Complete the word equation to show how an ester is made.

Use words from the list.

acid + \longrightarrow ester + [1]

(b) Perfumes and drugs can be tested on animals in some countries.

Write about **one** advantage and **one** disadvantage of testing drugs on animals.

.....

.....

.....

.....

..... [2]

[Total: 3]

2 Phil wants to choose a fuel to heat his house.



(a) Two important factors Phil needs to think about when choosing a fuel are the cost of the fuel and the energy released per gram.

Suggest two **other** important factors which Phil needs to think about.

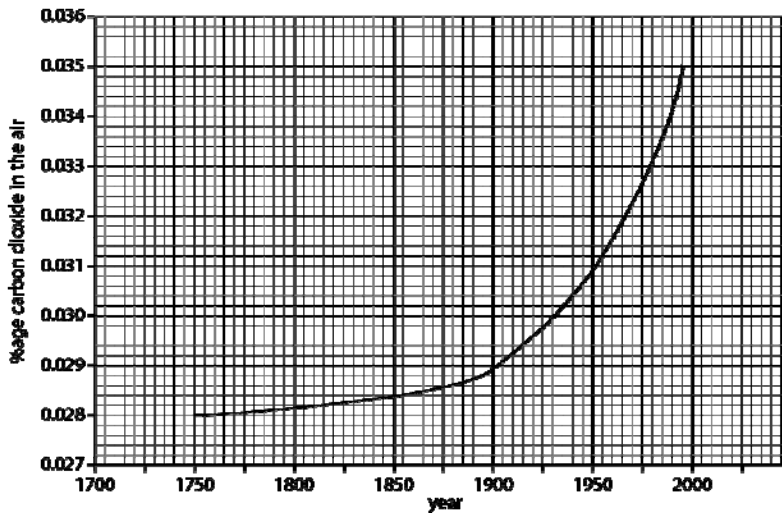
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..... [2]

(b) Look at the graph. It shows how the percentage of carbon dioxide in the air has increased.



Give **two** reasons why this has happened.

.....

.....

.....

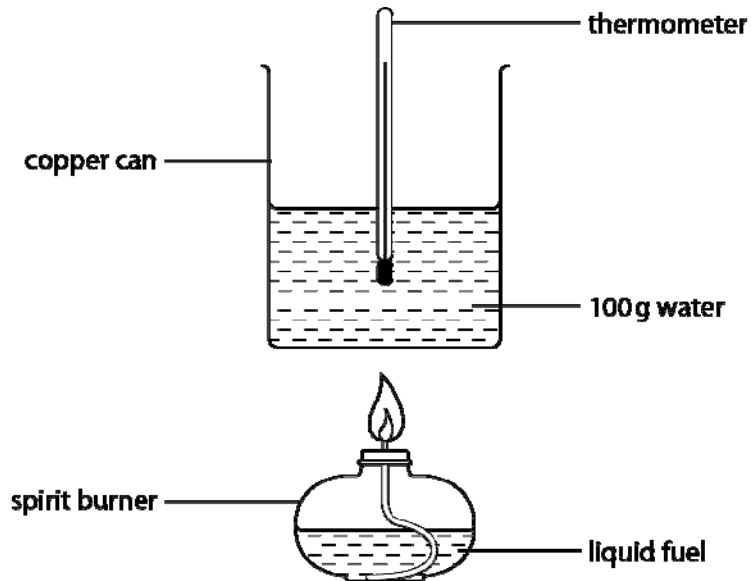
..... [2]

(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.

.....

.....

.....

.....

.....

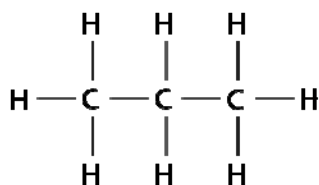
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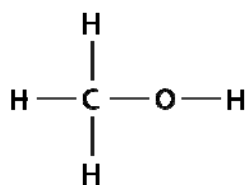
[Total: 7]

3 This question is about carbon compounds.

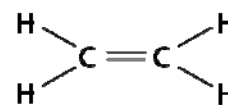
Look at the displayed formulas.



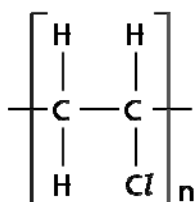
propane



methanol



ethene



poly(chloroethene)



carbon dioxide

(a) Which compound is a **saturated** hydrocarbon?

..... [1]

(b) Which compound will decolourise bromine water?

..... [1]

(c) Write down the molecular formula of methanol.

..... [1]

(d) Poly(chloroethene) is a polymer.

Look at the displayed formula of poly(chloroethene).

Poly(chloroethene) is made from a monomer called chloroethene.

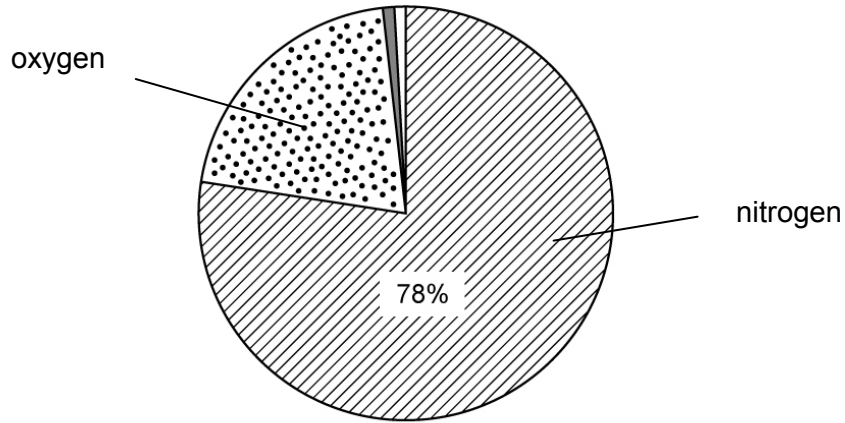
Draw the displayed formula of chloroethene.

[1]

[Total: 4]

4 This question is about gases in the air.

Look at the pie chart. It shows the composition of the air.



(a) What percentage of the air is oxygen?

..... [1]

(b) Carbon monoxide is a pollutant in the air made when petrol burns in car engines.

A catalytic converter removes carbon monoxide from the exhaust gases of a car.

Describe, with the aid of a **balanced symbol** equation, how a catalytic converter removes carbon monoxide.

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

(c) Nitrogen and oxygen do not normally react with each other.

However within a car engine nitrogen and oxygen do react to make nitrogen monoxide.

Explain, with the aid of a **balanced symbol** equation, why nitrogen and oxygen react within a car engine.

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

[Total: 5]

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
zinc	420	7.1	18	870

(a) Aluminium is used to make pylon wires.



pylon wire

Silver is not used because it is too expensive.

Explain why aluminium is the most suitable metal for using to make pylon wires.

.....

.....

.....

..... [2]

(b) Which metal would be the best to use for a door stop for keeping doors open?



door stop

Choose from the table.

metal

Write down **two** reasons why.

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

(c) Brass is an alloy.

Which **two** metals make up brass?

..... and [1]

[Total: 5]

7 This question is about fertilisers.

Fertilisers can be made by **neutralisation**.

- (a) Sulfuric acid, H_2SO_4 , will neutralise ammonia solution, NH_3 , to make ammonium sulfate.
Construct the **balanced symbol** equation for this neutralisation reaction.

..... [2]

- (b) Sodium hydroxide reacts with phosphoric acid.
Construct the **word equation** for this reaction.

..... [1]

- (c) Elizabeth and Anna are farmers. They use fertilisers to increase their crop yields.
Elizabeth uses only potassium sulfate fertiliser.
Anna uses a fertiliser that is a mixture of ammonium nitrate and phosphorus(V) oxide.
Explain why Anna's fertiliser will result in better plant growth than Elizabeth's.

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

- (d) One disadvantage of using too much fertiliser is that some of it runs off into rivers and lakes.
This causes eutrophication which kills the aquatic organisms living in the rivers and lakes.
Explain how eutrophication leads to the death of aquatic organisms.

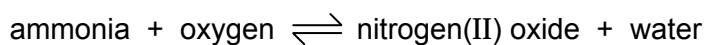
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..... [3]

[Total: 8]

8 This question is about the manufacture of nitric acid.

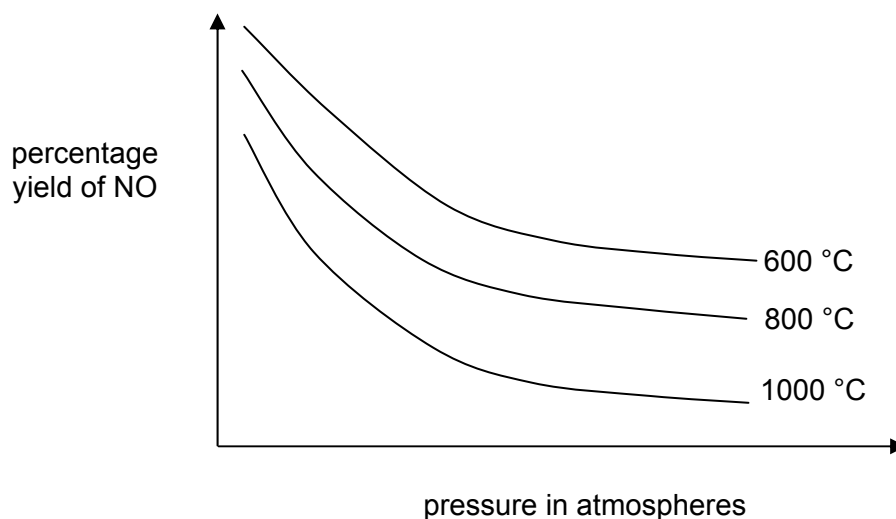
Nitric acid is made from ammonia.

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



Look at the sketch graph.

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



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

..... [1]

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

..... [1]

(c) A low pressure of 10 atmospheres and a high temperature of 950 °C are used for the production of nitrogen oxide.

Suggest why.

.....

 [2]

[Total: 4]

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

The plates move very slowly.

A process called subduction can happen at plate boundaries.

(a) Describe the theory of plate tectonics and use it to explain how subduction happens.

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

[6]

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

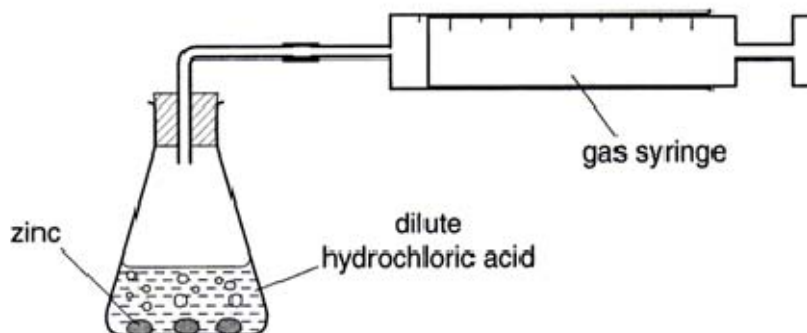
Give **two** reasons why.

[2]

[Total: 8]

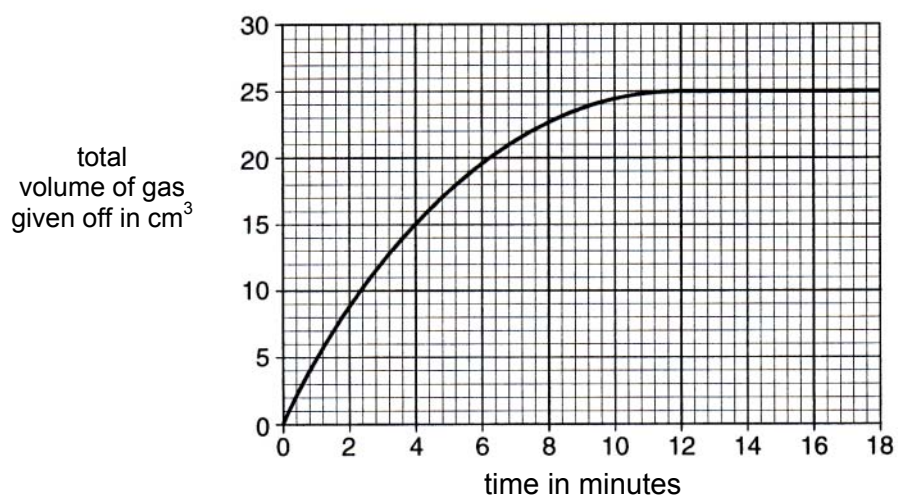
Section C – Module C3

- 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 cm³ of dilute hydrochloric acid.



- (a) How long does it take for the reaction to stop?

..... minutes [1]

(b) (i) Calculate the average rate of reaction during the first 4 minutes.

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

.....

answer unit [2]

(ii) How does the average rate of reaction for the first 4 minutes compare to the average rate between 4 and 8 minutes?

Show how you calculated your answer.

.....

.....

..... [1]


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

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

They say that they could:

- increase the temperature of the hydrochloric acid
- increase the concentration of the hydrochloric acid
- use powdered zinc instead of lumps of zinc.

Explain, using the reacting particle model, why **two** of these methods increase the rate of this reaction.

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

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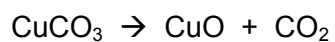
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[6]

[Total: 10]

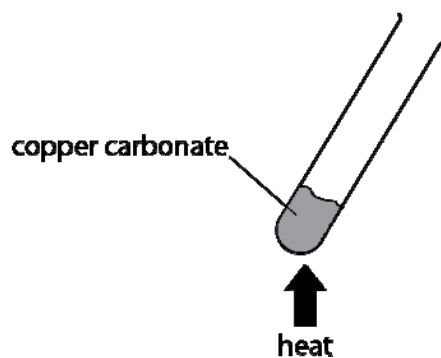
11 Copper carbonate decomposes when heated.

Copper oxide and carbon dioxide are made.



(a) Tim investigates this decomposition.

Look at the apparatus he uses.



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

He predicts that he should make 0.80 g of copper oxide.

He actually makes 0.70 g.

Calculate his percentage yield.

.....

.....

.....

answer% [2]

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

The carbon dioxide made is a waste product.

Look at the table of relative formula masses, M_r .

substance	relative formula mass, M_r
CuCO_3	124
CuO	80
CO_2	44

Calculate the atom economy for the manufacture of copper oxide.

.....

.....

.....

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..... [2]

(c) It is important for the factory to have a high percentage yield and a high atom economy.

Explain why each of these is important.

.....

.....

.....

..... [2]

[Total: 6]

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	very high
hardness	very hard	soft
solubility in water	insoluble	insoluble
electrical conductivity	does not conduct	good conductor

- (a) 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]

- (b) Diamond and graphite both have very high melting points. Explain why.

.....

.....

..... [2]

- (c) Diamond does not conduct electricity. Explain why.

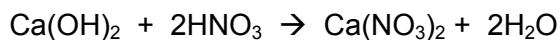
.....

..... [1]

[Total: 5]

13 Clare prepares calcium nitrate.

She reacts calcium hydroxide with nitric acid.



(a) Calculate the mass of calcium nitrate that can be made from 3.15 g of pure nitric acid.

.....

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.....

.....

.....

.....

answer g [3]

(b) Clare reacts double the amount of nitric acid in an excess of calcium hydroxide.

What effect will this have on the amount of calcium nitrate made?

.....

..... [1]

[Total: 4]

END OF QUESTION PAPER



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PERIODIC TABLE

1	2											3	4	5	6	7	0		
		Key relative atomic mass atomic symbol <small>name</small> atomic (proton) number										1 H <small>hydrogen</small> 1							4 He <small>helium</small> 2
7 Li <small>lithium</small> 3	9 Be <small>beryllium</small> 4											11 B <small>boron</small> 5	12 C <small>carbon</small> 6	14 N <small>nitrogen</small> 7	16 O <small>oxygen</small> 8	19 F <small>fluorine</small> 9	20 Ne <small>neon</small> 10		
23 Na <small>sodium</small> 11	24 Mg <small>magnesium</small> 12											27 Al <small>aluminium</small> 13	28 Si <small>silicon</small> 14	31 P <small>phosphorus</small> 15	32 S <small>sulfur</small> 16	35.5 Cl <small>chlorine</small> 17	40 Ar <small>argon</small> 18		
39 K <small>potassium</small> 19	40 Ca <small>calcium</small> 20	45 Sc <small>scandium</small> 21	48 Ti <small>titanium</small> 22	51 V <small>vanadium</small> 23	52 Cr <small>chromium</small> 24	55 Mn <small>manganese</small> 25	56 Fe <small>iron</small> 26	59 Co <small>cobalt</small> 27	59 Ni <small>nickel</small> 28	63.5 Cu <small>copper</small> 29	65 Zn <small>zinc</small> 30	70 Ga <small>gallium</small> 31	73 Ge <small>germanium</small> 32	75 As <small>arsenic</small> 33	79 Se <small>selenium</small> 34	80 Br <small>bromine</small> 35	84 Kr <small>krypton</small> 36		
85 Rb <small>rubidium</small> 37	88 Sr <small>strontium</small> 38	89 Y <small>yttrium</small> 39	91 Zr <small>zirconium</small> 40	93 Nb <small>niobium</small> 41	96 Mo <small>molybdenum</small> 42	[98] Tc <small>technetium</small> 43	101 Ru <small>ruthenium</small> 44	103 Rh <small>rhodium</small> 45	106 Pd <small>palladium</small> 46	108 Ag <small>silver</small> 47	112 Cd <small>cadmium</small> 48	115 In <small>indium</small> 49	119 Sn <small>tin</small> 50	122 Sb <small>antimony</small> 51	128 Te <small>tellurium</small> 52	127 I <small>iodine</small> 53	131 Xe <small>xenon</small> 54		
133 Cs <small>caesium</small> 55	137 Ba <small>barium</small> 56	139 La* <small>lanthanum</small> 57	178 Hf <small>hafnium</small> 72	181 Ta <small>tantalum</small> 73	184 W <small>tungsten</small> 74	186 Re <small>rhenium</small> 75	190 Os <small>osmium</small> 76	192 Ir <small>iridium</small> 77	195 Pt <small>platinum</small> 78	197 Au <small>gold</small> 79	201 Hg <small>mercury</small> 80	204 Tl <small>thallium</small> 81	207 Pb <small>lead</small> 82	209 Bi <small>bismuth</small> 83	[209] Po <small>polonium</small> 84	[210] At <small>astatine</small> 85	[222] Rn <small>radon</small> 86		
[223] Fr <small>francium</small> 87	[226] Ra <small>radium</small> 88	[227] Ac* <small>actinium</small> 89	[261] Rf <small>rutherfordium</small> 104	[262] Db <small>dubnium</small> 105	[266] Sg <small>seaborgium</small> 106	[264] Bh <small>bohrium</small> 107	[277] Hs <small>hassium</small> 108	[268] Mt <small>meitnerium</small> 109	[271] Ds <small>darmstadtium</small> 110	[272] Rg <small>roentgenium</small> 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated								

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

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

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

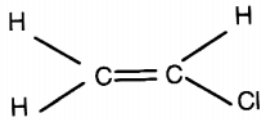
change in potential energy = 0 marks

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)	acid + alcohol → ester + water (1)	1	
	(b)	<p>advantage idea that test more realistic as animals are alive (1)</p> <p>disadvantage cruel to animals / ethical objection / may work differently in different species / animals are not the same as humans (1)</p>	2	<p>allow it could hurt / harm / kill animals / inhumane</p> <p>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</p>
		Total	3	

Question		Expected answers	Marks	Additional guidance
2	(a)	<p>idea of availability / is it easy to get hold of / how long will it last (1)</p> <p>idea of flammability / is it easy to light the fuel / does it have a clean flame (1)</p> <p>how much space is needed to store the fuel / can the fuel be stored or it provided by pipeline (1)</p> <p>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)</p>	2	<p>allow can it run out / is it nearby</p> <p>ignore references to pay back time, efficiency or solar panels</p>
	(b)	<p>any two from</p> <p>because population has increased (1)</p> <p>because there is more demand for or consumption of energy / increased burning of fossil fuels / increased industry (1)</p> <p>because of increased deforestation / AW (1)</p>	2	<p>allow more demand for fuel</p> <p>allow idea of demand for fuel from emerging economies eg China is having an industrial revolution or more countries are becoming developed</p> <p>allow more transport eg cars / more electrical (appliances) / more consumables / more technology</p> <p>ignore references to renewable energy</p>
	(c)	<p>fuel C is a sensible choice because it is cheaper than all the others (1)</p> <p>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)</p> <p>OR</p> <p>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)</p>	3	<p>answers must link choice of fuel with evidence to gain credit</p> <p>allow answers in terms of fuel B being a better choice if linked to evidence</p> <p>allow answers in terms of fuel C being a better choice if linked to evidence</p>
Total			7	

Question		Expected answers	Marks	Additional guidance
3	(a)	propane (1)	1	allow correct formula C ₃ H ₈ not propene
	(b)	ethene (1)	1	allow correct formula C ₂ H ₄
	(c)	CH ₄ O (1)	1	allow CH ₃ OH / COH ₄ / H ₄ CO / OH ₄ C / H ₄ OC not CH ₃ OH / CH ³ OH not CH ₄ O / CH ⁴ O allow C ₁ H ₄ O ₁
	(d)	 <p style="text-align: center;">(1)</p>	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) $2\text{CO} + 2\text{NO} \rightarrow \text{N}_2 + 2\text{CO}_2$ (1)	2	
	(c)	$\text{N}_2 + \text{O}_2 \rightarrow 2\text{NO}$ (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	

Question	Expected answers	Marks	Additional guidance
5 	<p>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)</p> <p>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)</p> <p>Level 1 Answer attempts an explanation to include at least one reason for cracking and an idea of possible 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)</p> <p>Level 0 Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p>Relevant points include:</p> <ul style="list-style-type: none"> • 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	

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	


Question		Expected answers	Marks	Additional guidance
7	(a)	$2\text{NH}_3 + \text{H}_2\text{SO}_4 \rightarrow (\text{NH}_4)_2\text{SO}_4$ 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 \rightarrow 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	

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	

Question		Expected answers	Marks	Additional guidance
9	(a) 	<p>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)</p> <p>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)</p> <p>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)</p> <p>Level 0 Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p>Relevant points include:</p> <ul style="list-style-type: none"> • 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

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

Question		Expected answers	Marks	Additional guidance
10	(c) 	<p>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)</p> <p>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)</p> <p>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)</p> <p>Level 0 Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p>Relevant points include:</p> <p>more collisions between particles results in faster reaction</p> <p>temperature of hydrochloric acid</p> <ul style="list-style-type: none"> • idea that acid particles in the move faster / acid particles 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 <p>concentration of hydrochloric acid</p> <ul style="list-style-type: none"> • 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 <p>ignore reference to 'more particles'</p> <p>powdered zinc</p> <ul style="list-style-type: none"> • 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	




Question		Expected answers	Marks	Additional guidance
11	(a)	87.5 % (2) if correct answer not given: $\% \text{ yield} = \frac{\text{actual mass}}{\text{predicted mass}} \times 100 /$ $\% \text{ yield} = \frac{0.7}{0.8} \times 100 (1)$	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: $\text{atom economy} = \frac{\text{M of desired products}}{\text{sum of M of all products}} \times 100 /$ $\text{atom economy} = \frac{80}{124} \times 100 (1)$	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	

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 $\text{HNO}_3 = 63$ and of $\text{Ca}(\text{NO}_3)_2 = 164$ (1) Moles of $\text{HNO}_3 = 0.05$ and moles of $\text{Ca}(\text{NO}_3)_2 = 0.025$ / 126 g of HNO_3 makes and 164 g of $\text{Ca}(\text{NO}_3)_2 = 0.025$ (1) Mass of $\text{Ca}(\text{NO}_3)_2 = 4.1$ 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	

Assessment Objectives (AO) Grid

(includes quality of written communication )

Question	AO1	AO2	AO3	Total
1(a)	1			1
1(b)	2			2
2(a)		2		2
2(b)		2		2
2(c)		1	2	3
3(a)		1		1
3(b)	1			1
3(c)		1		1
3(d)		1		1
4(a)	1			1
4(b)	2			2
4(c)	1	1		2
5 	2	4		6
6(a)			2	2
6(b)		2		2
6(c)	1			1
7(a)	1	1		2
7(b)		1		1
7(c)		2		2
7(d)	3			3
8(a)		1		1
8(b)		1		1
8(c)		2		2
9(a) 	6			6
9(b)	2			2
10(a)		1		1
10(b)(i)		2		2
10(b)(ii)		1		1
10(c) 	3	3		6
11(a)	1	1		2
11(b)	1	1		2
11(c)	2			2
12(a)			2	2
12(b)	2			2
12(c)	1			1
13(a)		3		3
13(b)		1		1
Totals	33	36	6	75