WJEC GCSE CHEMISTRY

CHEMISTRY



EXAM QUESTION PACK

UNIT C3 HIGHER TIER 4493 PAPERS

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4493/02

S16-4493-02

CHEMISTRY

CHEMISTRY 3
HIGHER TIER

A.M. THURSDAY, 19 May 2016

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**8**	
2.	**7**	
3.	**9**	
4.	**6**	
5.	**10**	
6.	**7**	
7.	**7**	
8.	**6**	
Total	**60**	

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ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

Assessment will take into account the quality of written communication (QWC) used in your answers to questions **3***(a)* and **8**.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

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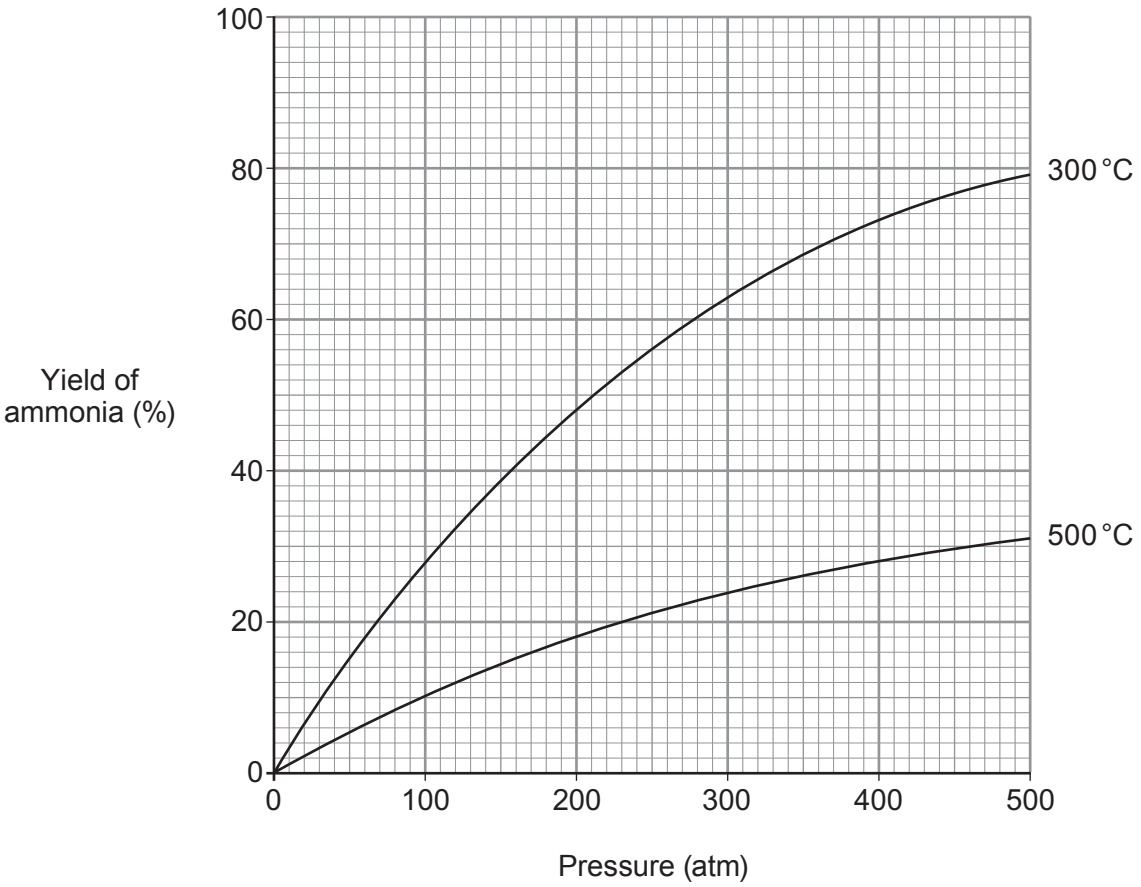
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Answer **all** *questions.*

1. In the Haber process, nitrogen reacts with hydrogen to give ammonia.

The following graphs show the effect of changing pressure on the yield of ammonia at 300 °C and 500 °C.



The table shows the percentage yield of ammonia at various pressures at 400 °C.

Pressure (atm)	0	100	200	300	400	500
Yield of ammonia (%)	0	22	37	44	49	51

(a) Plot the points on the grid above and draw a suitable line. [2]

(b) Using the graphs, state the temperature and pressure which produce the highest yield of ammonia. [1]

..... °C and ..... atm

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(c) State what conclusions can be drawn from the graphs. [2]

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(d) (i) Complete and balance the following equation for the production of ammonia. [2]

N_2 + ☐ H_2 $\rightleftharpoons$ ☐ .....

(ii) State the meaning of $\rightleftharpoons$ in the equation in part (i). [1]

.....

8

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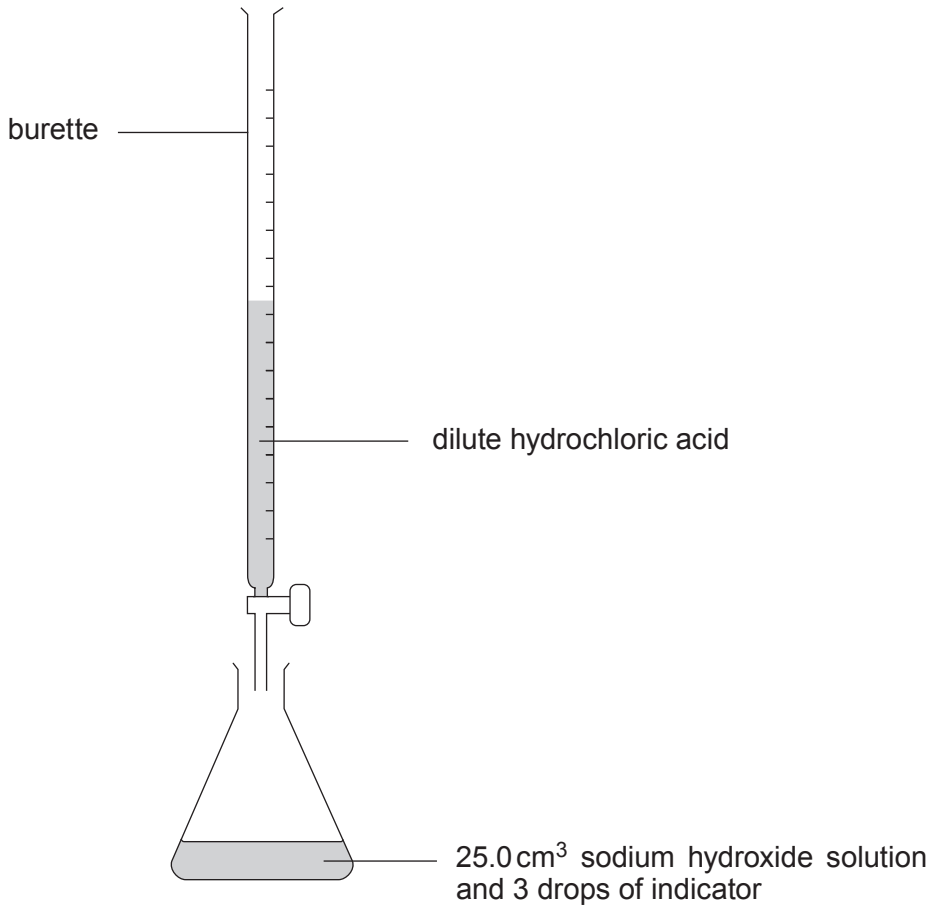
Turn over.

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2. The diagram shows the apparatus that was used to find the volume of hydrochloric acid needed to neutralise 25.0 cm^3 of sodium hydroxide solution.

The balanced equation for the reaction between sodium hydroxide and hydrochloric acid is as follows.

$$NaOH + HCl \longrightarrow NaCl + H_2O$$



The acid was added slowly from the burette. The volume of acid needed to change the indicator colour was recorded.

The titration was carried out four times and the volume of acid added each time was recorded in the table below.

Run	1	2	3	4
Volume of hydrochloric acid (cm^3)	33.5	29.5	29.6	29.4

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(a) State why an indicator was used in this experiment. [1]

.....

(b) State whether the acid or the alkali is the more concentrated. Give a reason for your answer. [1]

.....

.....

(c) (i) Calculate the mean volume of hydrochloric acid needed to neutralise 25.0 cm^3 of the sodium hydroxide solution. [1]

Mean = ... cm^3

(ii) Using all the information provided and your mean volume, describe how a pure sample of sodium chloride crystals could be made. [4]

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3. *(a)* You have been given three gases, **A**, **B** and **C**. The gases are carbon dioxide, hydrogen and oxygen, but not necessarily in that order.

Describe the tests for carbon dioxide, hydrogen and oxygen and plan a method to identify gases **A**, **B** and **C without** using all three tests. [6 QWC]

(b) When a mixture of sodium hydroxide solution and ammonium chloride is heated a gas is given off.

(i) Name the gas. ..... [1]

(ii) Describe a test you could carry out to identify the gas. [2]

9

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4. When samples of calcium carbonate and copper(II) carbonate are heated they undergo thermal decomposition.

(a) Describe **one** similarity and **one** difference in the reactions that take place when these two carbonates thermally decompose. [2]

.....

.....

.....

(b) Give the balanced **symbol** equation for the reaction that takes place when calcium carbonate is heated. [2]

..... ⟶ ..... + ...

(c) If the two carbonates were replaced with sodium carbonate, what would be the difference when this was heated? Give a reason for this difference. [2]

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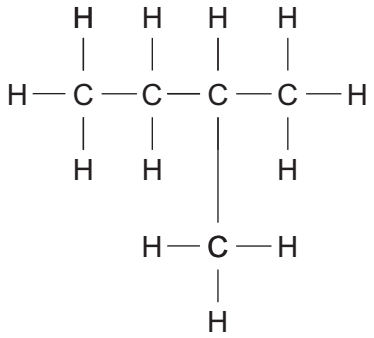
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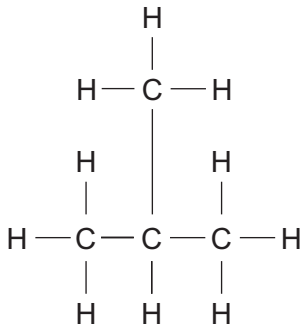
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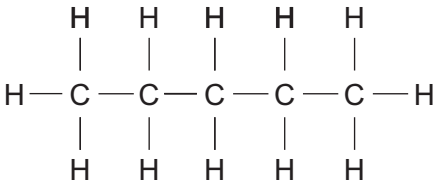
5. **A**-**F** are the structural formulae for some organic compounds.



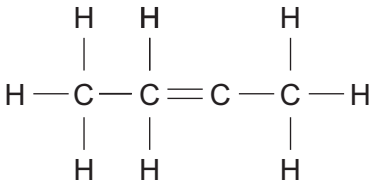
A



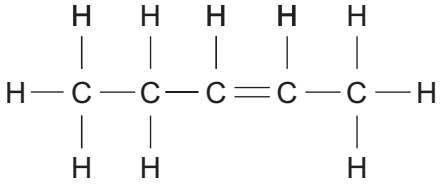
B



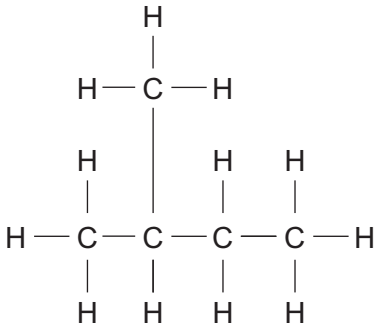
C



D



E



F

(a) Give the letters of the two structural formulae that are **identical**. [1]

..... and .....

(b) State which structural formula is **incorrect**. Give a reason for your answer. [2]

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(c) Draw the structural formula of the isomer of C_5H_{12} **not** shown opposite. [1]

(d) Describe a chemical test to distinguish between compounds **C** and **E**. [3]

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(e) Infrared spectroscopy is a method used to identify bonds present in organic compounds.

The table below shows the wavenumber range at which some bonds absorb infrared light.

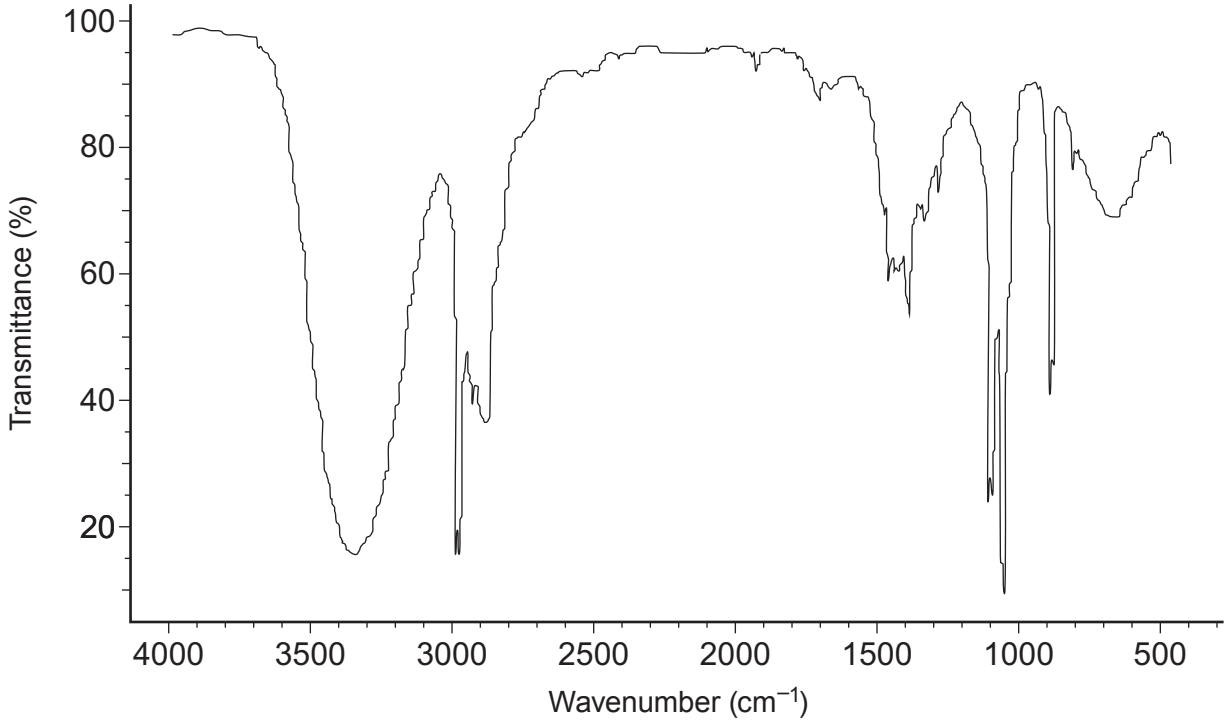
Bond	Wavenumber (cm^{-1})
O—H	3700-3200
C—H	3200-2800
C=O	1800-1650
C=C	1700-1600
C—O	1250-1000

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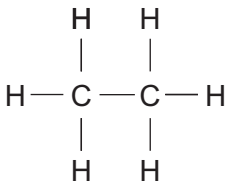
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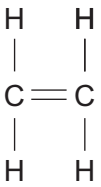
Compound **X** gave the following infrared spectrum.



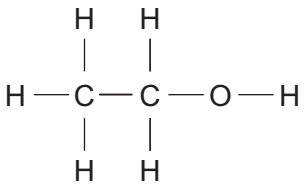
State which of the following compounds **X** could be. Give **two** reasons for your choice. [3]



ethane



ethene



ethanol

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6. A solution is suspected to be iron(II) sulfate, $FeSO_4$.

(a) (i) Describe how sodium hydroxide solution could be used to show the presence of iron(II) ions. [2]

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(ii) Give the balanced **ionic** equation for the reaction that takes place. [3]

..... + ... ⟶ .....

(b) Describe how you could test for the presence of sulfate ions in iron(II) sulfate. [2]

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7. The concentration of sodium hydroxide solution can be determined by titration.

25.0 cm^3 of 0.10 mol / dm^3 sulfuric acid were placed in a conical flask and titrated with sodium hydroxide solution. It was found that 21.5 cm^3 of sodium hydroxide were required to neutralise the acid.

The equation for the reaction between sodium hydroxide and sulfuric acid is as shown.

$$2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$$

(a) Calculate the number of moles of sulfuric acid in 25.0 cm^3 of 0.10 mol / dm^3 solution. [2]

Number of moles of sulfuric acid = ... mol

(b) Calculate the number of moles of sodium hydroxide in 21.5 cm^3 of solution. [1]

Number of moles of sodium hydroxide = ... mol

(c) Calculate the concentration of the sodium hydroxide solution. [2]

Concentration of sodium hydroxide = ... mol / dm^3

(d) A reaction between the same solutions of sodium hydroxide and sulfuric acid can produce a different salt called sodium hydrogensulfate as shown in the following equation.

$$NaOH + H_2SO_4 \longrightarrow NaHSO_4 + H_2O$$

State the volume of sodium hydroxide solution needed to react with 25.0 cm^3 of 0.10 mol / dm^3 sulfuric acid to give sodium hydrogensulfate. Give your reasoning. [2]

Volume = ... cm^3

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8. Describe how sulfur is converted into sulfuric acid in the contact process. Include equations in your account. [6 QWC]

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END OF PAPER

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FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

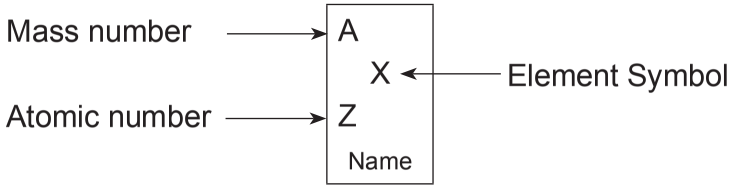
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PERIODIC TABLE OF ELEMENTS

1	2	Group										3	4	5	6	7	0
								$^{1}_{1}$H Hydrogen									$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulfur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radius	$^{227}_{89}$Ac Actinium															

Key:



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(4493-02)

GCSE MARKING SCHEME

SUMMER 2016

SCIENCE - CHEMISTRY C3
4493/01/02

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INTRODUCTION

This marking scheme was used by WJEC for the 2016 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

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GCSE Science - Chemistry 3

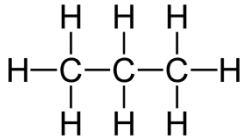
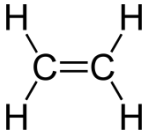
Summer 2016

Mark Scheme

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
1		*(a)*	(i)		1	$2CO_2 + 3H_2O$			
			(ii)		1	air / atmosphere			
		(b)			1	any of following • solvent • alcoholic drinks / beer / named alcoholic drink • antibacterial wipes / mouthwash	drinks		
		(c)			3	wet cloth / safety mat over the top / fire blanket (1) remove air / oxygen (1) any reference to breaking fire triangle (1)		fire extinguisher / paper	

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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
2		*(a)*			3	 (1) C_3H_7OH / C_3H_8O (1)  (1)			
		(b)			1	ethene and propene – both needed	C_2H_4 and C_3H_6		

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
3		*(a)*	(i)		2	15 (2) if answer incorrect award (1) for **one** correct step i.e. addition of values in pie chart to get 85 **or** subtraction of incorrect total from 100			
			(ii)		2	66 000 tonnes (2) if answer incorrect award (1) for identification of 33%			
		(b)	(i)		1	any of following • bubbles / fizz / effervescence • metal disappears • temperature increases		exothermic	
			(ii)		2	reacts more quickly with sulfuric acid – bubbles more quickly, metal disappears more quickly, temperature rises more quickly (greater temperature rise) (1) sulfuric acid stronger (1)	converse answer for ethanoic acid	stronger reaction	

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
4		*(a)*	(i)		1	carbon oxygen nitrogen hydrogen all needed, any order		C O N H	
			(ii)		1	ammonium nitrate			ammonia nitrate
		(b)			1	any of following • lasts longer in the soil • fertiliser does not need to be spread as often • less washed away by rain		saves money less waste reference to eutrophication	
		(c)			3	gets into water supply (1) causes overgrowth of plants in water / clogs up waterways (1) additional (1) for development of either point e.g. blue baby syndrome caused by nitrogen compounds in water supply, decrease in oxygen content / dead fish resulting from overgrowth of plants			
		(d)			1	neutralise soil acidity / reduce acidity	raise pH	reacts with acids	

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
5		*(a)*			1	any of following • solid formed in solution • solid formed when two solutions react • insoluble substance formed in solution • insoluble substance formed when two solutions react		solid formed	
		(b)			1	carbon dioxide	CO_2		
		(c)	(i)		2	sodium compound will give yellow flame (1) potassium compound will give lilac flame (1)	yellow-orange		
			(ii)		2	add silver nitrate solution (1) bromide gives cream precipitate and iodide gives yellow precipitate - **both** needed (1)			
			(iii)		1	silver nitrate + potassium bromide silver bromide + potassium nitrate reactants **and** products needed	correct symbol equation		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6		*(a)*			1	quicklime		CaO	
		(b)	(i)		2	solid expands / crumbles (1) visible vapour given off / hissing sound (1)	breaks up heat given off steam given off	 exothermic	
			(ii)		2	$CaO + H_2O$ (1) $Ca(OH)_2$ (1)		word equation	

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
7	1	*(a)*			2	all points plotted correctly – tolerance ±½ square (1) (ignore missing 0,0) smooth curve (1)			
		(b)			1	300°C and 500 atm – both needed			
		(c)			2	the higher the pressure, the higher the yield / the lower the pressure, the lower the yield (1) the higher the temperature, the lower the yield / the lower the temperature, the higher the yield (1)			
		(d)	(i)		2	NH_3 (1) balancing mark may only be awarded if above formula is correct $3H_2$ and $2NH_3$ (1)			
			(ii)		1	either of following • reversible reaction • reaction that can go both ways			

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
8	2	*(a)*			1	any of following • to identify the end-point • to find the exact volume of acid required to neutralise the alkali • to find the exact volume of acid required to use up **all** the alkali			
		(b)			1	alkali is more concentrated because more than 25.0 cm^3 of acid are needed to neutralise it			HCl is dilute
		(c)	(i)		1	29.5 cm^3			
			(ii)		4	add 29.5 cm^3 [or mean value from (i)] of hydrochloric acid to 25.0 cm^3 of sodium hydroxide (1) no indicator (1) evaporate (1) additional (1) for a practical aspect e.g. measure solutions using pipette/burette or leave on window sill max (2) to be awarded if indicator added			

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Question Number						
FT	HT	Sub-section			Mark	Answer
9	3	*(a)*			6	**Indicative content** Tests given for all three gases – clearly identified • carbon dioxide – turns limewater milky • hydrogen – squeaky pop when ignited • oxygen – re-lights a glowing splint Plan using two test only e.g. • shake gases **A**, **B** and **C** with limewater, carbon dioxide will make it turn milky • test two remaining gases with a glowing splint, oxygen will re-light it • the remaining gas is hydrogen **5-6 marks**: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks**: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks**: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks**: The candidate does not make any attempt or give a relevant answer worthy of credit.

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
9	3	*(b)*	(i)		1	ammonia	NH_3		ammonium ammonium hydroxide
			(ii)		2	damp red litmus paper / universal indicator paper (1) turns blue (1)			

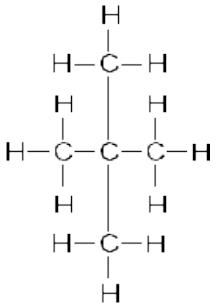
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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
	4	*(a)*			2	similarity – either of following for (1) • both give off carbon dioxide • both form oxides difference – either of following for (1) • calcium carbonate stays white but copper(II) carbonate changes colour / turns from green to black • calcium carbonate has a much higher decomposition temperature			
		(b)			2	$CaCO_3$ (1) $CaO + CO_2$ (1)			
		(c)			2	no carbon dioxide given off / no reaction (1) either of following for (1) • sodium carbonate more stable than calcium carbonate and copper(II) carbonate • requires more energy to break bonds • sodium is more reactive than calcium and copper			

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
	5	*(a)*			1	**A** and **F** – both needed			
		(b)			2	**D** (1) any of following for (1) • one carbon atom has only three bonds • one carbon atom has five bonds • carbon atoms must always have four bonds		not enough hydrogens in the formula	
		(c)			1				
		(d)			3	bubble through bromine water (1) **C** – no change (1) **E** – orange/brown solution turns colourless (1)			
		(e)			3	ethanol (1) O—H at around 3300 (1) C—O at around 1100 (1)			

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
	6	*(a)*	(i)		2	pale green (1) precipitate forms (1)			
			(ii)		3	$Fe^{2+} + 2OH^- \rightarrow Fe(OH)_2$ (3) if incorrect award (1) for correct reactants and/or (1) for correct product			
		(b)			2	add barium chloride solution (1) white precipitate forms (1)			

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
	7	*(a)*			2	0.0025 mol (2) if answer incorrect award (1) for 25.0 × 0.1			
		(b)			1	0.005 mol error carried forward (ecf) from part (a)			
		(c)			2	0.233 / 0.23 mol/dm^3 (2) if answer incorrect award (1) for 0.005 / 21.5 ecf from part (a)			
		(d)			2	10.75 cm^3 (1) this reaction involves a 1:1 ratio rather than 2:1 therefore half the volume of alkali is needed (1)			

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Question Number			
FT	HT	Mark	Answer
	8	6	**Indicative content** Burn sulfur in air to give sulfur dioxide; $S + O_2 \rightarrow SO_2$ Convert sulfur dioxide into sulfur trioxide; 450 °C, vanadium(V) oxide catalyst; $2SO_2 + O_2 \rightarrow 2SO_3$ Problems linked with converting SO_3 to the acid Dissolve sulfur trioxide in concentrated sulfuric acid forming oleum; add water **5-6 marks**: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks**: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks**: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks**: The candidate does not make any attempt or give a relevant answer worthy of credit.

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4493/02

S15-4493-02

CHEMISTRY

CHEMISTRY 3
HIGHER TIER

A.M. THURSDAY, 14 May 2015

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**10**	
2.	**8**	
3.	**6**	
4.	**6**	
5.	**6**	
6.	**8**	
7.	**5**	
8.	**5**	
9.	**6**	
Total	**60**	

4493 020001

ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

Assessment will take into account the quality of written communication (QWC) used in your answers to questions **3** and **9**.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

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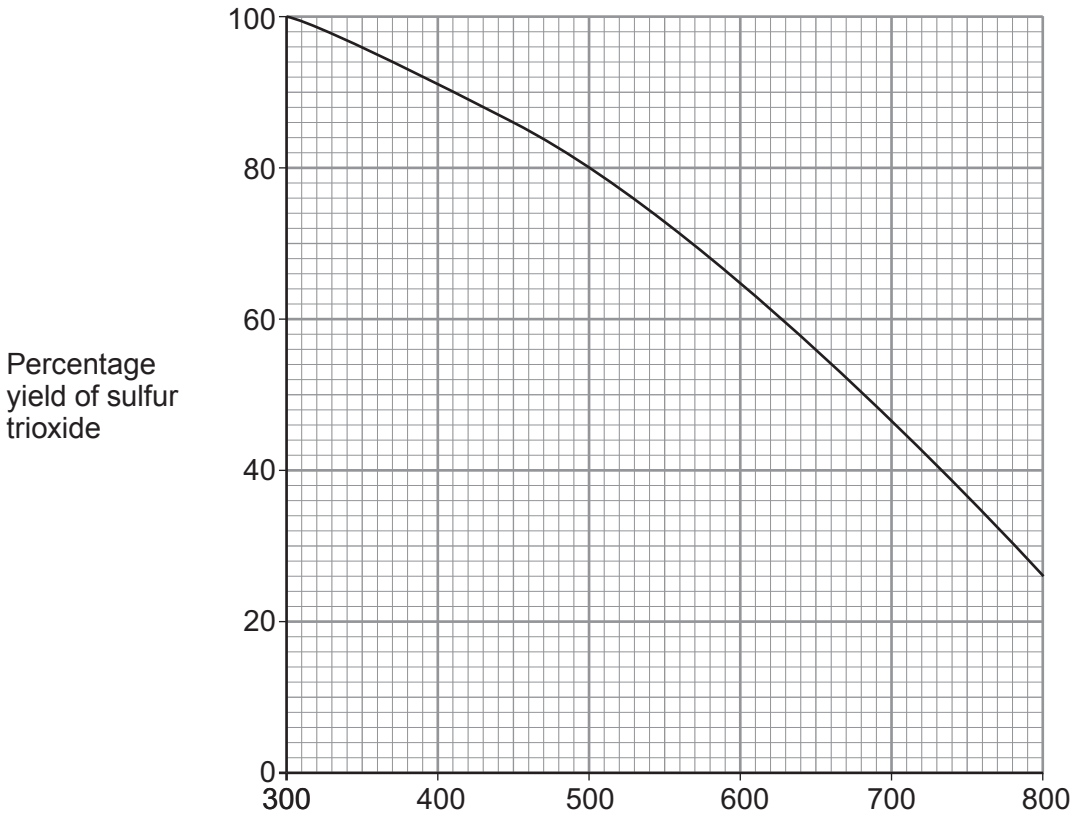
Answer **all** *questions.*

1. *(a)* One of the main stages in the manufacture of sulfuric acid is the reaction between sulfur dioxide and oxygen to form sulfur trioxide.

(i) Write the balanced **symbol** equation which represents this reaction. [3]

..... + ... ⇌ .....

(ii) The graph below shows how the percentage yield of sulfur trioxide changes with temperature between 300 °C and 800 °C.



Use the graph to find the increase in percentage yield if the temperature is reduced from 650 °C to 450 °C. [2]

Increase in percentage yield = ... %

(iii) One molecule of sulfur trioxide reacts with one molecule of sulfuric acid to form one molecule of oleum as the **only** product.

Write a balanced **symbol** equation for this reaction. [2]

..... + ... ⟶ .....

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(b) State what you would observe when a few drops of concentrated sulfuric acid are added to a beaker containing a small amount of sugar. Name the product left in the beaker. [3]

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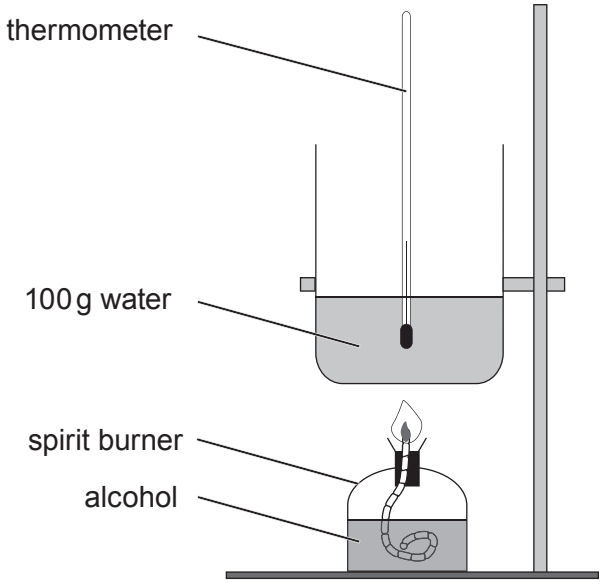
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2. Methanol, ethanol, propanol and butanol belong to the alcohol family.

An experiment was carried out to discover which alcohol gives out the most energy when burned. The diagram below shows the apparatus used.



1 g of each alcohol was used to heat 100 g of water. The results are shown below.

Alcohol	Initial temperature of water (°C)	Final temperature of water (°C)	Temperature change (°C)	Energy given out (J / g)
methanol	18	31	13	5 460
ethanol	20	45	25	10 500
propanol	19	48	29	12 180
butanol	20	50	30	

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(a) The energy given out by each alcohol can be calculated using the formula:

energy given out = mass of water × 4.2 × temperature change

Calculate the energy given out in burning 1 g of butanol. [2]

Energy given out = ... J / g

(b) Apart from using 1 g of each alcohol and 100 g of water, give **one** other step that should be taken to ensure a fair test. [1]

.....

(c) The theoretical values for the energy given out by each alcohol are given in the table below.

Alcohol	Theoretical value for energy given out (J / g)
methanol	22 700
ethanol	29 700
propanol	33 600
butanol	36 100

Compare the experimental and theoretical values and give the **main** reason for the difference between them. [3]

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(d) Some people are opposed to the large-scale use of bioethanol as a fuel. Describe briefly why someone could take this view. [2]

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3. Describe the benefits of the use of nitrogenous fertilisers and the problems that arise when they are washed into rivers. [6 QWC]

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4. Fire fighters use their understanding of the fire triangle to put out fires. Every year thousands of acres of moorland are destroyed by fire. Fire fighters use several different methods to put out this type of fire.



Suggest **three** *different* methods that could be used to put out moorland fires. Each method should refer to a different part of the fire triangle. State how **each** method is effective. [6]

Method 1

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Method 2

.....

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Method 3

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.....

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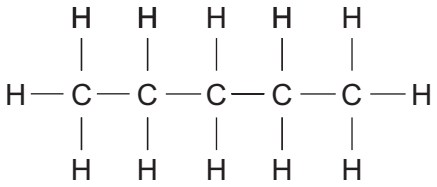
5. *(a)* The table below shows the first five members of the alkane family.

Alkane	Molecular formula
methane	CH_4
ethane	C_2H_6
propane	C_3H_8
butane	C_4H_{10}
pentane	C_5H_{12}

(i) Give the molecular formula for the alkane which contains 18 hydrogen atoms. [1]

.....

(ii) C_5H_{12} has three isomers. The diagram below shows one of these isomers. Draw the other **two** isomers. [2]



Isomer 1

Isomer 2

Isomer 3

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(b) (i) The first two members of the alkene family are ethene, C_2H_4, and propene, C_3H_6. Give the general formula for the alkene family. [1]

.....

(ii) Draw the structural formula for propene. [1]

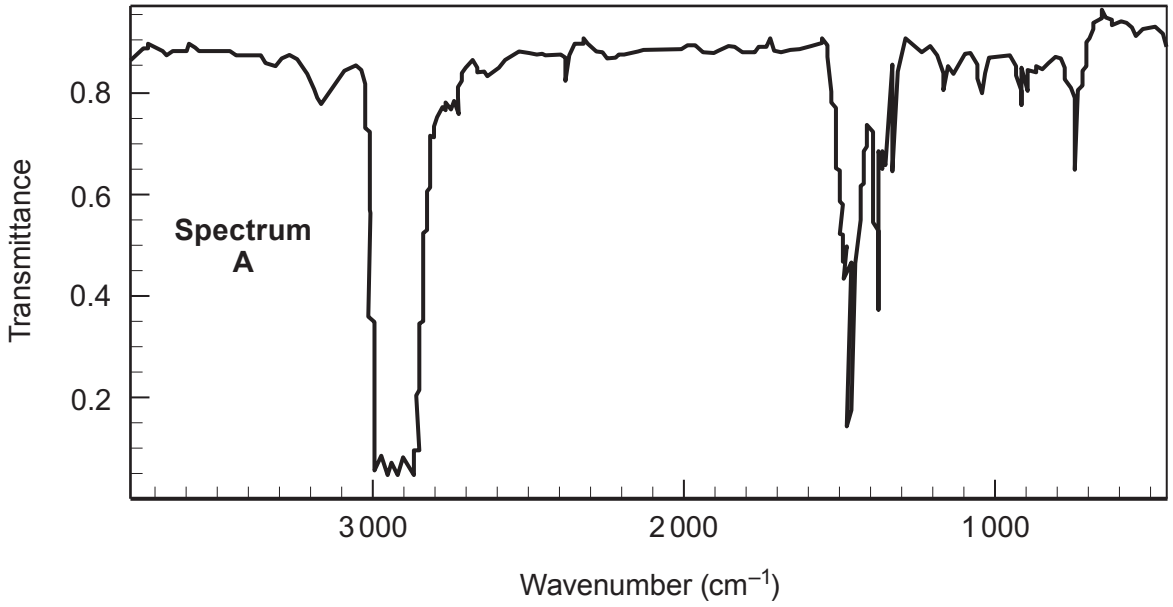
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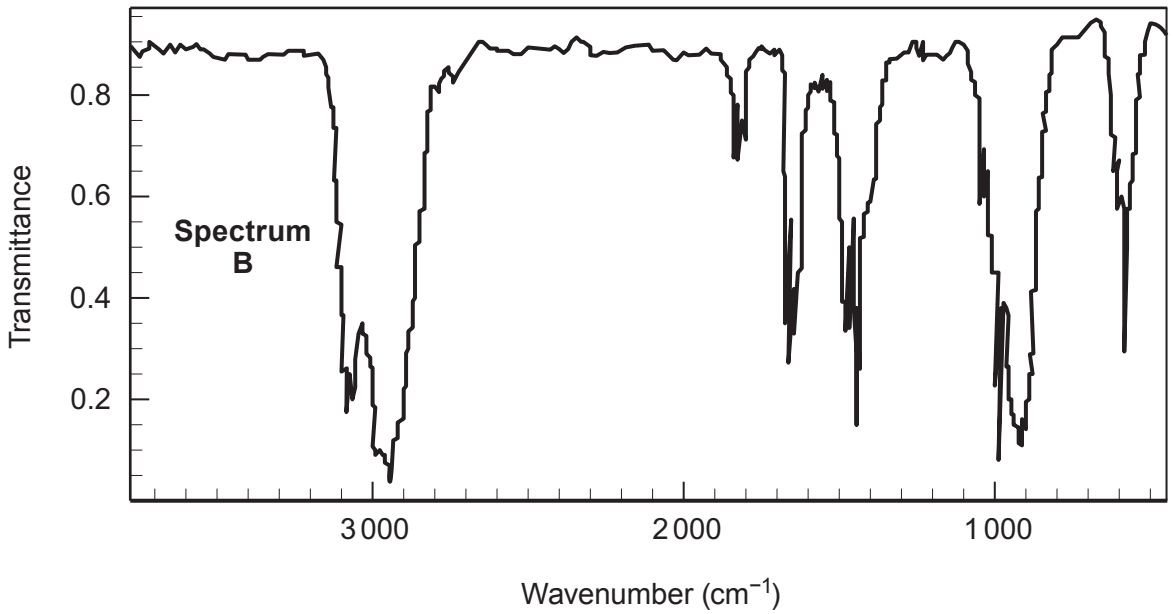
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(c) Study the infrared spectra of propane and propene below. Using the information in the table opposite, identify the spectrum of propene and give a reason for your answer. [1]





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Bond	Wavenumber / cm^{-1}
C═C	1620 to 1670
C═O	1650 to 1750
C—H	2800 to 3100
O—H	2500 to 3550

Spectrum .....

Reason .....

.....

6

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6. *(a)* Ammonia is made industrially from nitrogen and hydrogen by the Haber process.

The table below shows the yield of ammonia under different pressure and temperature conditions.

Pressure (atmospheres)	Temperature (°C)				
	100	200	300	400	500
	Yield of ammonia (%)				
10	88.2	50.7	14.7	3.9	1.2
50	94.5	75.0	39.5	15.3	5.6
100	96.7	81.7	52.5	25.2	10.6
200	98.4	89.0	66.7	40.0	18.3
400	99.4	94.6	79.7	55.4	31.9
1 000	99.9	98.3	92.6	79.8	57.5

(i) Using **only** the data in the table suggest the conditions that should be chosen for the process. [1]

Pressure ..... atmospheres *Temperature* ..... °C

(ii) Give the disadvantage of using a low temperature in the process and state how this problem is overcome. [2]

.....

.....

(iii) The actual pressure used in the process is 200 atmospheres. Apart from safety issues, suggest a disadvantage of using a higher pressure. [1]

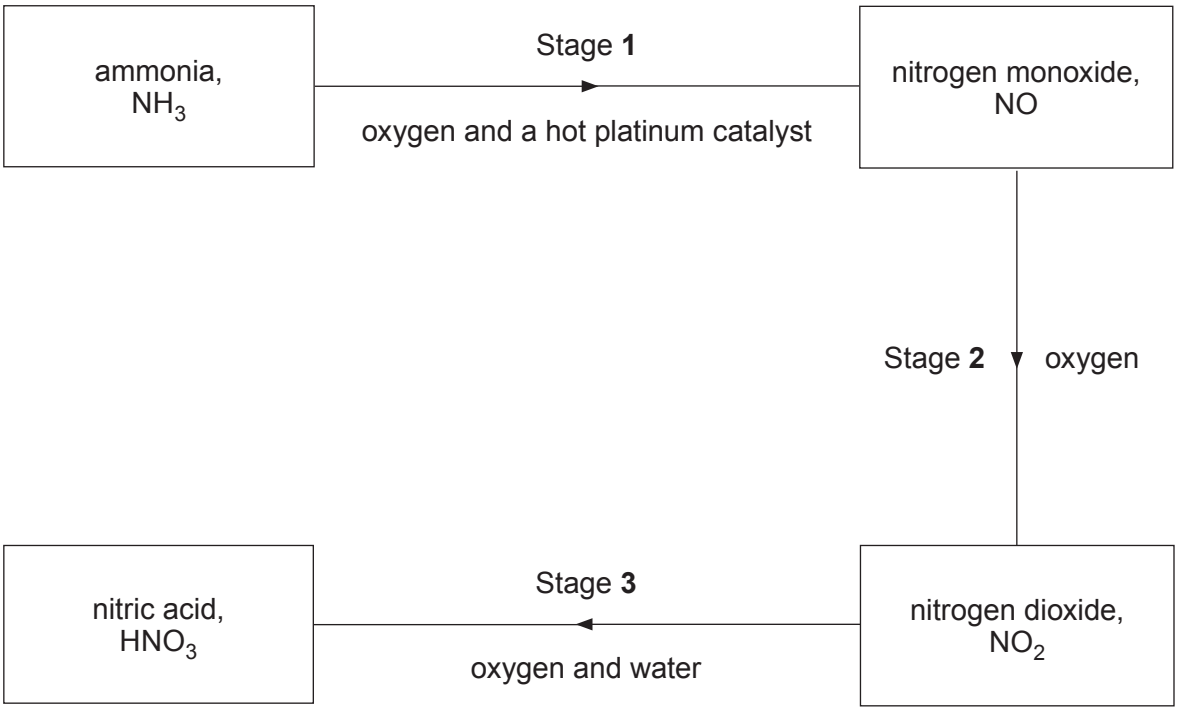
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(b) Ammonia is used to form nitric acid in a three-stage reaction.



(i) Once the reaction in stage **1** has started there is sufficient heat to maintain the reaction. Give the term used to describe a reaction that produces heat. [1]

.....

(ii) Balance the symbol equation below that represents the reaction taking place in stage **3**. [1]

$$\square\ NO_2 + O_2 + 2H_2O \longrightarrow \square\ HNO_3$$

(iii) Write a balanced symbol equation for the reaction that occurs when nitric acid is added to copper(II) carbonate. [2]

.....

8

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7. *(a)* A pupil used the following tests to identify unknown compounds **A**, **B**, **C** and **D**.

add sodium hydroxide solution and warm mixture, test gas given off with damp litmus paper

add dilute hydrochloric acid, bubble gas given off into limewater

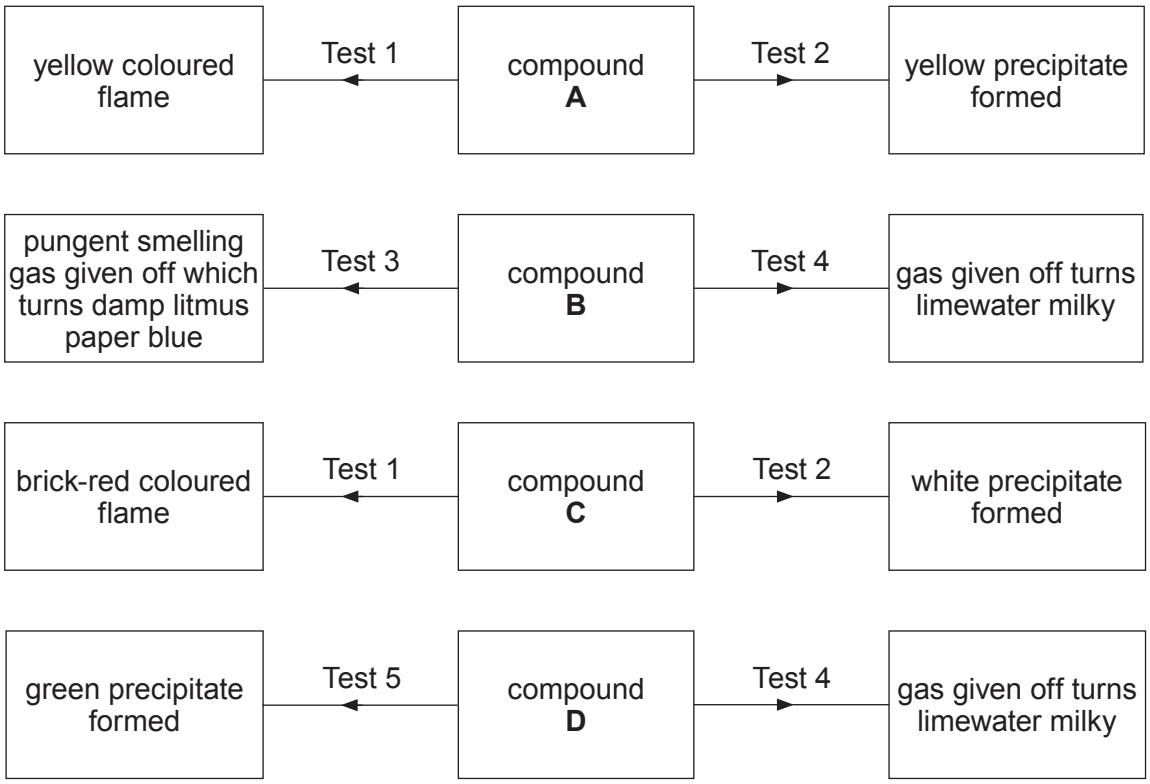
add silver nitrate solution

add sodium hydroxide solution

flame test

These are described as tests 1 to 5 but not necessarily in this order.

The flow charts show the results obtained for each compound.



Deduce which test is which and hence give the **names** of compounds **A**, **B**, **C** and **D**. [4]

A .....

B .....

C .....

D .....

(b) Describe the test for sulfate ions in solution. Include the result for your test. [1]

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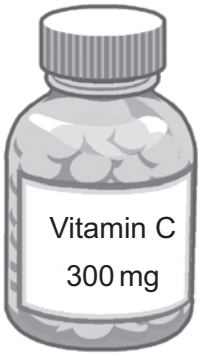
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8. An analytical chemist was asked to check the amount of vitamin C in a tablet. Vitamin C tablets contain ascorbic acid, $C_6H_8O_6$, and a starch "filler" which holds them together.

Ascorbic acid reacts with sodium hydroxide solution according to the equation below:

$$C_6H_8O_6 + NaOH \longrightarrow NaC_6H_7O_6 + H_2O$$



To determine how much vitamin C is present, a tablet was dissolved in water and titrated with sodium hydroxide solution of concentration 0.10 mol/dm^3. The endpoint was determined using the indicator phenolphthalein. The procedure was repeated three times and the mean value of sodium hydroxide solution needed to neutralise a vitamin C tablet was found to be 17.5 cm^3.

(a) Calculate the number of moles of sodium hydroxide in 17.5 cm^3 of the 0.10 mol/dm^3 solution. [2]

Number of moles = ... mol

(b) Calculate the relative molecular mass, M_r, of ascorbic acid, $C_6H_8O_6$. [1]

A_r(H) = 1 A_r(O) = 16 A_r(C) = 12

M_r = ...

(c) The label on the bottle states that each tablet contains 300 mg (0.3 g) of vitamin C. Using your answers to parts *(a)* and *(b)* show whether this statement is correct. [2]

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9. Sodium chloride is made when sodium hydroxide solution reacts with dilute hydrochloric acid.

$$NaOH + HCl \longrightarrow NaCl + H_2O$$

Describe a laboratory method for making **crystals** of pure sodium chloride from sodium hydroxide solution and dilute hydrochloric acid. [6 QWC]

Diagrams may be used as part of your answer.

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END OF PAPER

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FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

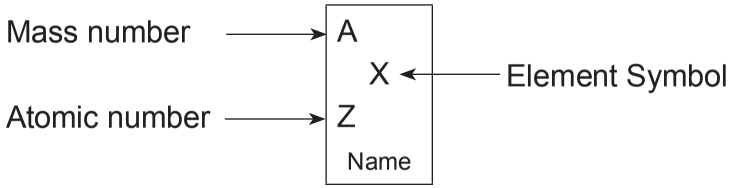
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PERIODIC TABLE OF ELEMENTS

1	2	Group										3	4	5	6	7	0
								$^{1}_{1}$H Hydrogen									$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulfur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key:



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(4493-02)

GCSE MARKING SCHEME

SCIENCE - CHEMISTRY

SUMMER 2015

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2015 examination in GCSE SCIENCE - CHEMISTRY. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

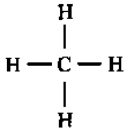
WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

	Page
C1	1
C2	17
C3	32

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
1		(a)			3	three factors – air/oxygen, fuel and heat all three for (2) any two for (1) remove any one to put out fire (1)			
		(b)			2	Method 1: removes air/oxygen (1) Method 2: removes fuel (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
2		(a)	(i)		2	 (1) C_2H_6 (1)			
			(ii)		1	C_8H_{18}			
		(b)	(i)		1	ethanol		alcohol	
			(ii)		1	**C**			
			(iii)		1	wine / beer / alcoholic drinks fuels / biofuels solvents antibacterial gels perfumes / aftershaves any one for (1)		alcohol / drinking / drinks / medicine / cleaning	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
3		(a)	(i)		2	number of nitrogen atoms **2** number of hydrogen atoms **6** **both** needed for (1) equal / same number (of these atoms) on right hand side (1)			
			(ii)		1	gas / gaseous			
		(b)	(i)	I	1	cooling			
				II	1	recycling			
			(ii)		2	iron (1) speeds up reaction (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
4		(a)			3	limestone / chalk / marble (1) CaO (1) calcium hydroxide (1)			
		(b)	(i)		1	brick-red	red		
			(ii)		2	carbon dioxide / CO_2 (1) must have correct gas to award test mark turns limewater milky (1)			
			(iii)		2	1.9/2.0 (1) 95 (1) award (2) for correct answer only (cao)			
		(c)			2	landscaping during /after quarry to remove visual pollution restrict quarry size to reduce visual pollution trains instead of lorries blast at agreed times spray lorry wheels with water to reduce dust remove endangered species to safe site any two for (1) each	other sensible	reference to economic benefits	
		(d)			2	local jobs money into local economy limestone for building / named buildings e.g. houses, walls, etc. local industries / named industry e.g. for making cement/iron building better local road system any two for (1) each	other sensible		

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
5		(a)	(i)		1	ammonia	NH_3		
			(ii)		1	copper(II) hydroxide	copper hydroxide $Cu(OH)_2$		
			(iii)		1	$Fe(OH)_2$			
		(b)	(i)		1	sulfuric acid is stronger / more acidic (than ethanoic acid) ethanoic acid is weaker / less acidic (than sulfuric acid)	sulfuric acid is strong and ethanoic acid is weak	pH of sulfuric acid is 1 and pH of ethanoic acid is 3	
			(ii)	I	1	reaction with sulfuric acid would be faster more reactive / more bubbles / gets hotter with sulfuric acid	converse answers		
				II	1	(gas) pops with **lighted** splint			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6	1	(a)	(i)		3	SO_2 O_2 (1) SO_3 (1) formulae must be correct to get balancing mark 2, 1, 2 (1)			
			(ii)		2	30 (2) if incorrect answer credit (1) for two correct readings from graph i.e. 86 and 56			
			(iii)		2	H_2SO_4 (1) [no mark for SO_3] $H_2S_2O_7$ (1)			
		(b)			3	black mass forms / black solid forms / sugar turns black (1) steam / water vapour / hissing (1) smell (1) any two for (1) each carbon (1)		temperature rise / water formed / bubbles / fizzing	

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
7	2	(a)			2	100 × 4.2 × 30 (1) 12600 (1) award (2) for cao			
		(b)			1	same height between flame and can same can/same wick/ same spirit burner same stirring (or not) not using a lid for all alcohols changing the water each time / using cold water each time any one for (1)		same room temperature / conditions	
		(c)			3	theoretical values greater (than experimental values) (1) both values increase down alcohol group (1) loss of heat to the surroundings / can (1)	rank order the same		
		(d)			2	two linked points required e.g. biofuels have a lower energy output than traditional fuels (1) and therefore require greater quantities to be consumed (in order to produce the same amount of energy) (1) credit sensible alternatives uses land that would otherwise be used to grow food crops (1) leading to food shortage/price increase (1) growth requires large amounts of water (1) which is therefore not available for other uses (1)			

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Question Number			
FT	HT	Mark	Answer
8	3	6	**Indicative content** **Benefits e.g.** increase crop yield, more food, healthier plants, improves quality of soil, cheaper food and releases land for other purposes. **Problems e.g.** increased soil acidity (which needs neutralising using lime), pollutes water supplies/ nitrates in drinking water (possible health problems), overgrowth of plants in canals (which requires unblocking) and 'eutrophication' or full description – (algae over growth, bloom formation, sunlight blocked, plants die, bacteria removes oxygen during decomposition, water de-oxygenated and water becomes lifeless) **5-6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.

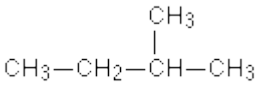
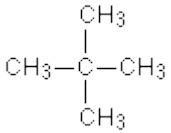
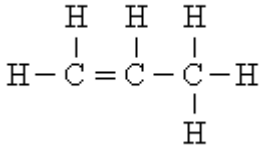
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	4				6	three **different** methods needed award max (2) for each method use water (1) remove heat (1) 'beat' (1) remove air/oxygen (1) bulldoze/back burn / backfire / making a firebreak (1) remove fuel (1) method must be correct for second mark to be awarded			CO_2 extinguisher / fire blanket as a method of removing oxygen in this context

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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
	5	(a)	(i)		1	C_8H_{18}			
			(ii)		2	 (1)  (1)			
		(b)	(i)		1	C_nH_{2n}			
			(ii)		1				
		(c)			1	**B** contains C=C peak both needed for (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	6	(a)	(i)		1	1000 atmospheres 100 ^{o}C both needed for (1)			
			(ii)		2	low rate/ slow reaction (1) (iron) catalyst (1)	decreased rate		incorrectly named catalyst e.g. V_2O_5
			(iii)		1	cost of container/more expensive to build/thicker container walls/ cost of getting to high pressure		‘cost’	
		(b)	(i)		1	exothermic			
			(ii)		1	4 $\longrightarrow$ 4			
			(iii)		2	$CuCO_3 + 2HNO_3 \longrightarrow Cu(NO_3)_2 + H_2O + CO_2$ formulae correct (1) balancing (1) formulae must be correct for balancing mark to be awarded			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	7	(a)			4	**A** sodium iodide **B** ammonium carbonate **C** calcium chloride **D** iron**(II)** carbonate mark positive and negative ions independently 8 ions correct = 4 marks 6/7 ions correct = 3 marks 4/5 ions correct = 2 marks 2/3 ions correct = 1 mark	NaI $(NH_4)_2CO_3$ $CaCl_2$ $FeCO_3$ no credit for either ion if incorrect formula given **instead** of name – ignore formulae if names also given		
		(b)			1	barium chloride (solution forms a) white precipitate test **and** result needed	barium nitrate / $Ba^{2+}(aq)$		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	8	(a)			2	moles =conc × vol/1000 = $\frac{0.1 \times 17.5}{1000}$ (1) = 0.00175 (1) award (2) for cao			
		(b)			1	176			
		(c)			2	ecf possible from parts (a) and (b) mass = moles × M_r = 0.00175 ×176 (1) 0.308 g /308 mg (correct unit required) therefore statement incorrect (1)	alternative method using given 300 mg mass		

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Question Number			
FT	HT	Mark	Answer
	9	6	**Indicative content** appropriate apparatus required, measured amount of alkali (or acid) in conical flask, add indicator *e.g. phenolphthalein,* add acid (alkali), drop-wise near end point/colour change, record volume of acid (alkali) added, repeat without indicator adding recorded volume of acid (alkali), boil off some of the water, leave solution to evaporate, dry crystals obtained *Credit awarded for sequenced labelled diagrams as part of the response.* **5-6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4493/02

CHEMISTRY

CHEMISTRY 3
HIGHER TIER

A.M. THURSDAY, 15 May 2014

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**10**	
2.	**8**	
3.	**6**	
4.	**6**	
5.	**8**	
6.	**10**	
7.	**6**	
8.	**6**	
Total	**60**	

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ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

Assessment will take into account the quality of written communication (QWC) used in your answers to questions **3** and **8**.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

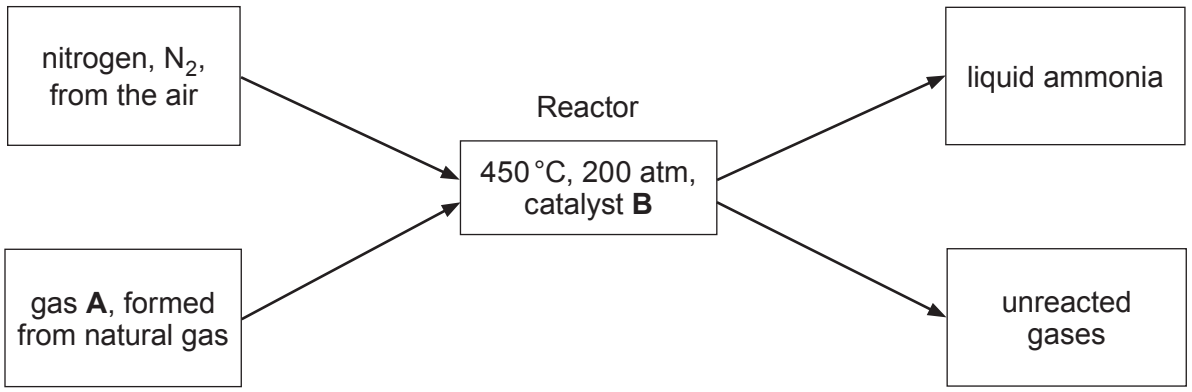
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Answer **all** *questions.*

1. Ammonia is produced during the Haber process. The reaction is summarised in the diagram below.



(a) Give the name of gas **A**. ..... [1]

(b) Name catalyst **B** and state why it is used. [2]

.....

.....

(c) The yield of ammonia is only 28 % therefore 72 % of the gases remain unreacted.

Describe what happens to these unreacted gases and state why this is important. [2]

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.....

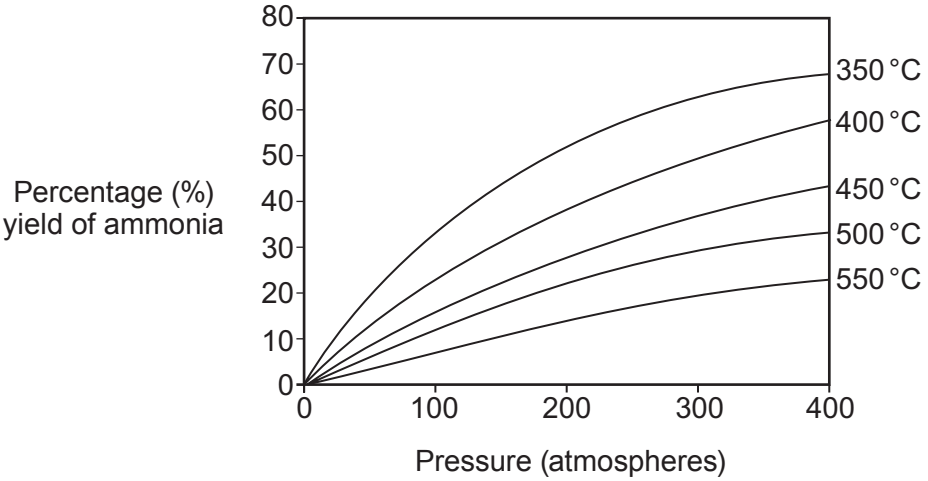
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(d) The following graph shows the effect of temperature and pressure on the yield of ammonia during the Haber process.



Describe how the yield of ammonia varies with temperature and pressure. [2]

Temperature

.....

.....

Pressure

.....

.....

(e) Write a balanced **symbol** equation for the production of ammonia. [3]

..... + ... ⇌ .....

10

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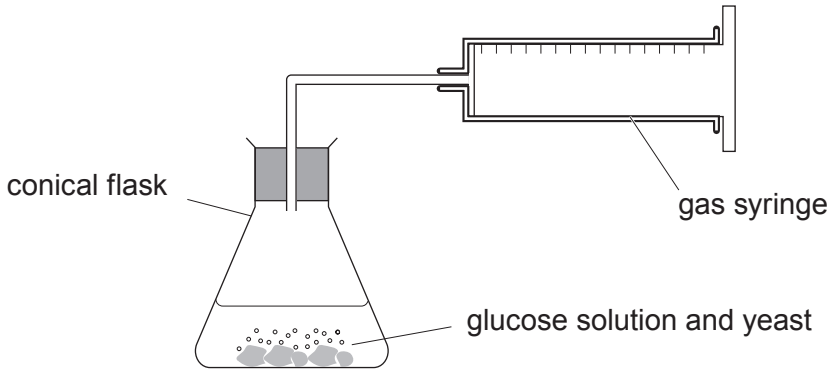
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2. A pupil investigated the effect of temperature on the rate of fermentation using the apparatus shown below.



The experiment was carried out three times at five different temperatures. The volume of gas collected after 10 minutes was recorded each time. The results are shown below.

Temperature (°C)	Volume of gas collected after 10 minutes (cm^3)			
	1	2	3	Mean
20	9	8	7	8
30	38	40	(32)	39
40	52	53	54	53
50	35	32	33	33
60	12	11	12	12

(a) Suggest why the circled value is considered to be anomalous. [1]

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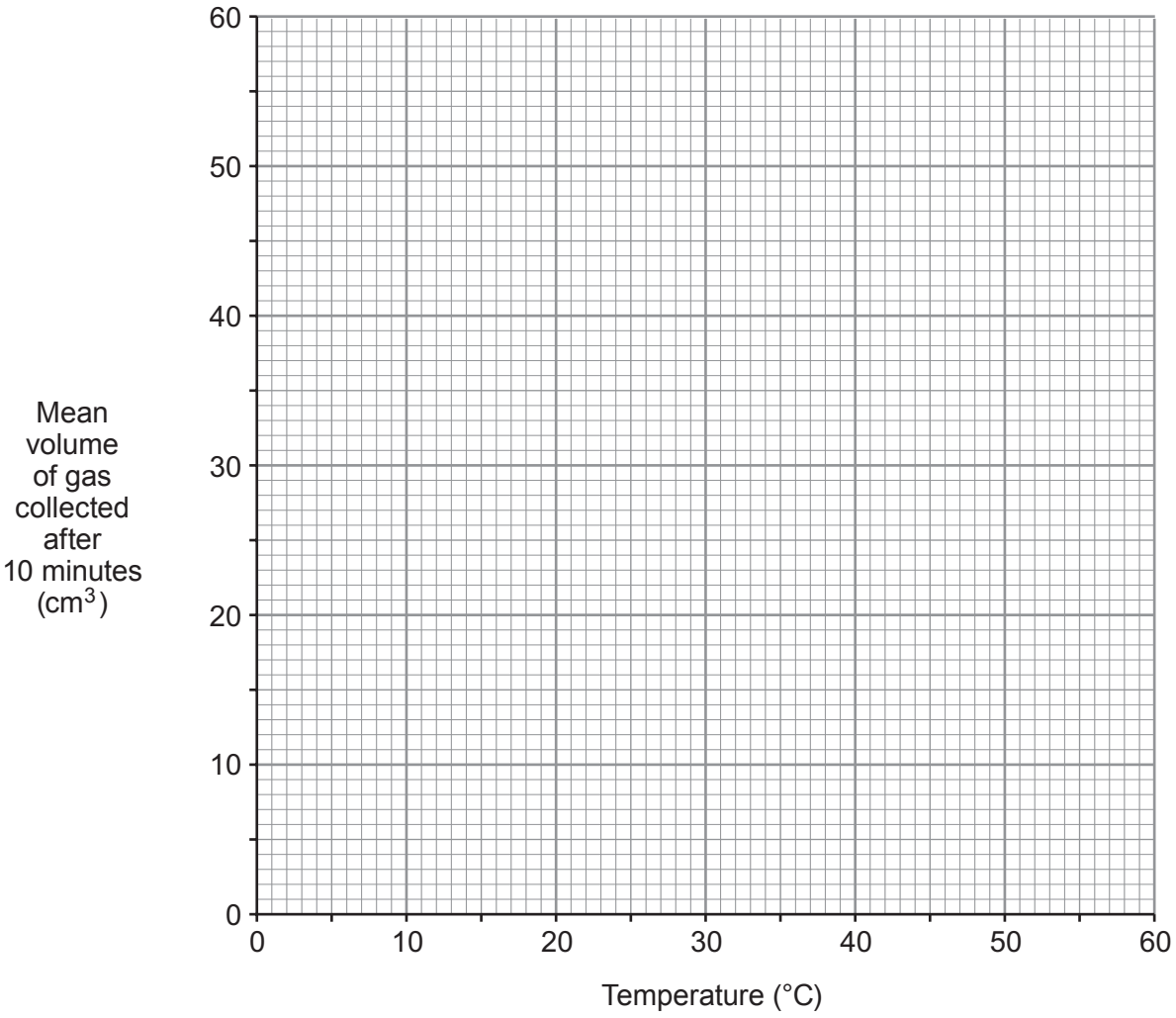
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(b) Plot a graph of the **mean** volume of gas collected against temperature on the grid opposite. [2]

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(c) State what conclusions can be drawn from the graph. [2]

.....

.....

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.....

(d) Write a **word** equation for the reaction taking place. [2]

..... ⟶ ..... + ...

(e) Yeast produces a catalyst that allows this reaction to take place. Name the **type** of catalyst produced by yeast. [1]

.....

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8

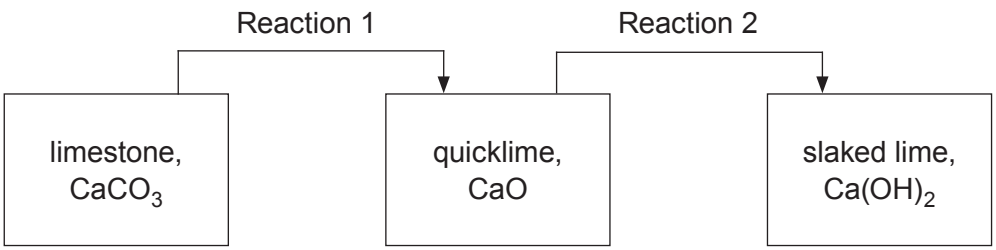
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3. Limestone, $CaCO_3$, is an important raw material. It can be converted into other useful materials as shown in the diagram below.



Describe how these reactions can be carried out in a laboratory.
Your answer should include:

- the conditions required for each reaction;
- observations at each stage;
- equations for the reactions taking place. [6 QWC]

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4. Sulfuric acid is produced in industry by the contact process.

(a) The contact process involves four stages. The first two are shown below.

Stage 1 sulfur + oxygen $\longrightarrow$ sulfur dioxide

Stage 2 sulfur dioxide + oxygen $\rightleftharpoons$ sulfur trioxide

(i) Name the **raw material** that provides oxygen in stage 1. [1]

.....

(ii) Describe the last two stages in the contact process (stages 3 and 4). [2]

Stage 3 .....

.....

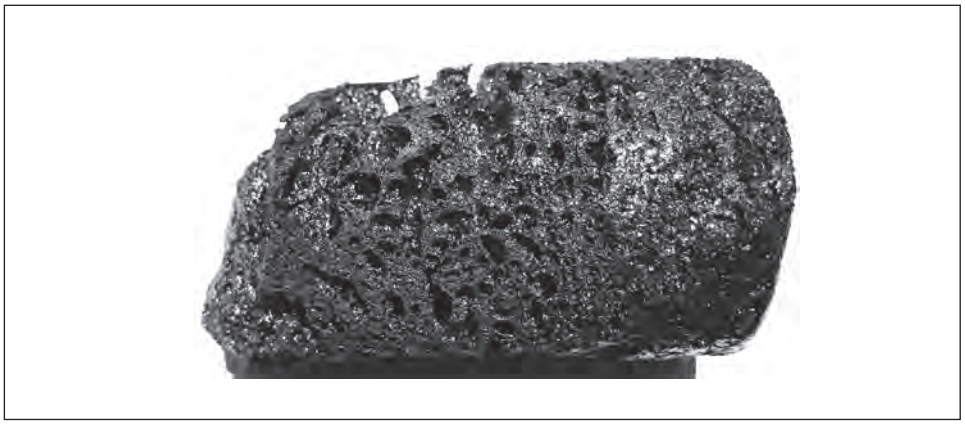
Stage 4 .....

.....

(iii) Name the catalyst used in stage 2. [1]

.....

(b) When concentrated sulfuric acid is added to sugar a black solid is formed.



In terms of the elements present in sugar, describe what happens during this reaction. [2]

.....

.....

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6

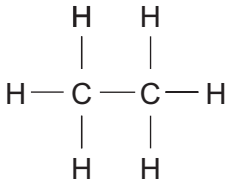
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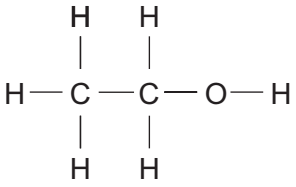
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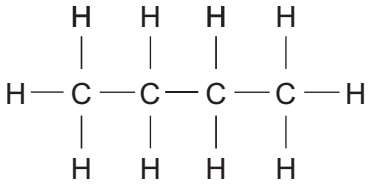
5. The following diagram shows the structures of six organic compounds.



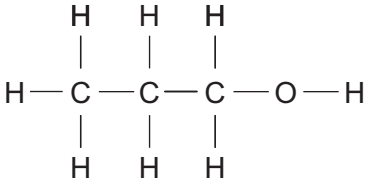
A



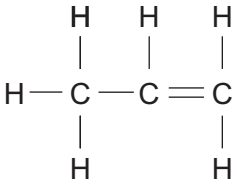
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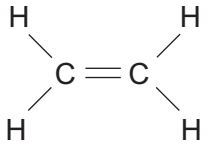
C



D



E



F

(a) Name the family to which each of the following pairs of compounds belong. [2]

B *and* **D** .....

E *and* **F** .....

(b) Describe a chemical test that could be carried out to distinguish between compounds **C** and **E**. Give the expected result for **both** compounds. [2]

.....

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(c) Compound **C** is one of two isomers that have the molecular formula C_4H_{10}.

(i) Give the meaning of the term *isomer*. [1]

.....

.....

(ii) Draw in the space below the structure of the other isomer of C_4H_{10}. [1]

(d) Give the letter, **A**-**F**, of **one** *other* compound that has an isomer. Draw the structure of its isomer. [2]

Compound .....

Structure

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6. *(a)* The following box contains the names of six ionic compounds.

sodium chloride	**sodium carbonate**	**copper(II) sulfate**
ammonium chloride	**potassium sulfate**	**lithium carbonate**

State which of the compounds in the box you would expect to

(i) give a yellow flame in a flame test, [1]

.....

(ii) produce bubbles when reacting with hydrochloric acid. [1]

.....

(b) A student has two colourless solutions in unlabelled bottles. He knows that one is potassium chloride and that the other is potassium iodide. Describe a test that could be carried out to distinguish between the solutions, giving the observations expected in **both** cases. [3]

.....

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(c) Compounds containing ammonium ions can be identified by heating gently with sodium hydroxide solution and testing the gas produced.

Name the gas produced and describe how you would positively identify this gas. [2]

.....

.....

(d) Iron(III) chloride solution produces a brown precipitate when it reacts with sodium hydroxide solution.

Write a balanced **ionic** equation for this reaction. You should include state symbols. [3]

..... + ... ⟶ .....

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7. A laboratory technician prepared a solution of sodium hydroxide, NaOH, in the following way.

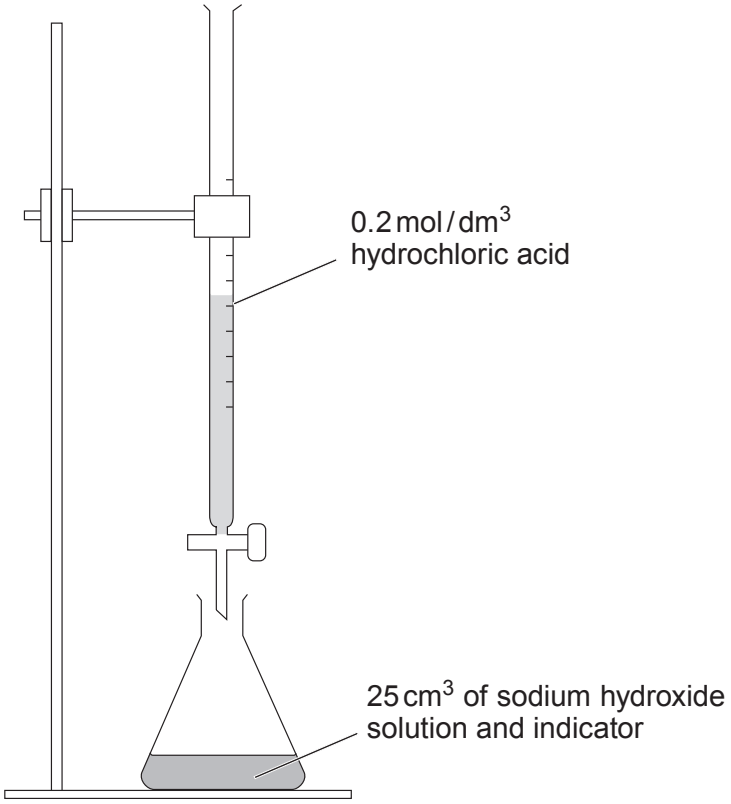
- He weighed out accurately 2.0 g of sodium hydroxide.
- He dissolved the sodium hydroxide in 250 cm^3 of water.

The relative formula mass (M_r) of sodium hydroxide is 40.

(a) Use this information to calculate the concentration of this sodium hydroxide solution in mol/dm^3. [2]

Concentration of sodium hydroxide solution = ... mol/dm^3

(b) A student was asked to carry out a titration to check the concentration of the sodium hydroxide solution. She carried out the titration using the apparatus shown below.



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The equation for the reaction taking place is as follows.

$$NaOH + HCl \longrightarrow NaCl + H_2O$$

The titration was carried out three times and the results obtained are shown below.

	Titration		
	1	2	3
Volume of hydrochloric acid added (cm^3)	22.2	22.7	22.6

Calculate the number of moles of hydrochloric acid that reacted and hence the concentration of the sodium hydroxide solution. [4]

Concentration of sodium hydroxide solution = ... mol / dm^3

6

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8. Describe the similarities in the reactions of ethanoic acid and sulfuric acid with metals, carbonates and bases. Describe and explain any differences observed. You should include relevant equations in your answer. [6 QWC]

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END OF PAPER

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FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

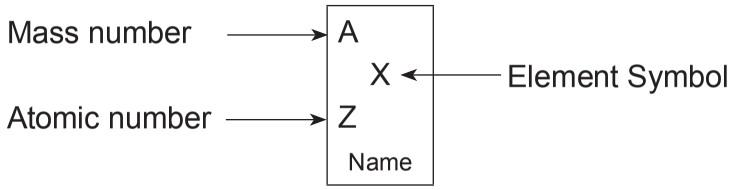
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PERIODIC TABLE OF ELEMENTS

1	2											3	4	5	6	7	0
								$^{1}_{1}$H Hydrogen									$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulfur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key:



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(4493-02)

GCSE MARKING SCHEME

SCIENCE - CHEMISTRY

SUMMER 2014

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2014 examination in GCSE SCIENCE - CHEMISTRY. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

	Page
C1	1
C2	19
C3	36

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Chemistry 3 – Foundation tier only questions

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
1		*(a)*			1	(three) factors needed for a fire to burn / fire goes out if any one factor is removed	heat, oxygen and fuel are needed		
		(b)			3	removes air / oxygen (1) removes heat (1) removes fuel (1)			
		(c)			1	water			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
2		*(a)*			1	glucose highest rate of fermentation / reacts faster (both needed)	better **rate** than the others	biggest bar	
		(b)	(i)		3	opinion needed, unless implied in answer Yes (1) per reason why ethanol should be used up to 3 max renewable / produces less soot / only produces carbon dioxide and water when burnt No (1) per reason why ethanol should not be used up to 3 max large areas of land required / engines require modification / less heat per litre credit possible for use of advantages and disadvantages for argument clearly showing that advantages outweigh disadvantages or vice versa – up to 3 max	no mark for opinion sensible reason not in table sensible reason not in table further qualification of a point credited additional mark e.g. large areas of land required to grow crops (1) therefore less available to grow food crops (1)		
			(ii)		1	carbon dioxide + water **both** needed	correct formulae for **both**		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
3		*(a)*			3	carbon dioxide → turns limewater milky (1) ammonia → turns damp red litmus blue (1) oxygen → relights a glowing splint (1)			
		(b)			3	yellow flame (1) green flame (1) brown precipitate (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
4		*(a)*	(i)		2	**A** and **C** - **both** needed (1) **B** and **D** - **both** needed (1)	correct formulae/names for **both** correct formulae/names for **both**		
			(ii)		1	**E**	propene		
		(b)			1	$C_{10}H_{22}$	$H_{22}C_{10}$		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
5		*(a)*	(i)		2	sulfur dioxide (1) sulfur trioxide (1)	SO_2 SO_3		
			(ii)		1	2			
			(iii)		1	far too / very exothermic or acid forms mist / white fumes form or acid is difficult to collect		dangerous / explosive / reactive	
		(b)	(i)		2	5 + 5 + 30 + 30 + 15 (1) 15 (1) follow through error (ft) correct answer only (cao) (2)			
			(ii)		1	ammonia	NH_3		
			(iii)		3	overgrowth of algae (1) good description of eutrophication – up to (3) gets into water supplies (1) must be some linking of points in explanation for full marks to be awarded	 gets into water supplies and can lead to blue baby syndrome (2)	kills fish pollution	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6		*(a)*	(i)		1	$25cm^3 \pm 1cm^3$			
			(ii)		1	1.5 °C			
		(b)			1	acid **A** (no mark) temperature rise is greater / produces more heat – mark can **only** be awarded if **A** given			
		(c)			3	add acid slowly from burette (1) add indicator to sodium hydroxide solution / solution in cup (1) indicator changes colour (1)	indication of precision record volume required to change colour of indicator (2)		add indicator to acid/burette

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Chemistry 3 – Common questions

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7	1	*(a)*			1	hydrogen	H_2	H	
		(b)			2	iron (1) speeds up the reaction / increases the rate of the reaction (1)			
		(c)			2	recycled / returned into reactor (1) basic qualification required e.g. reduces cost of process / less waste of raw materials (1)	fed back in re-used	more efficient / reacted again / more yield / saves time	
		(d)			2	lower yield with higher temperature (1) higher yield with a higher pressure (1)	vice versa		
		(e)			3	$N_2 + H_2$ (1) NH_3 (1) (1), 3, 2 (1) formulae must be correct to award balancing mark			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
8	2	*(a)*			1	significantly different/ long way out when compared to other two readings		not the same / 6 or 8 out etc.	
		(b)			2	all points plotted correctly (2) 4 points correct (1) curve not needed so ignore if drawn			
		(c)			2	volume / rate increases with temperature up to an optimum (1) then volume / rate goes back down (1)	up to maximum / up to 40 °C		
		(d)			2	glucose (1) ethanol + carbon dioxide (1)	$C_6H_{12}O_6$ $C_2H_5OH + CO_2$		+ yeast
		(e)			1	enzyme	zymase	biological	

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Question Number			
FT	HT	Mark	Answer
9	3	6 QWC	**Indicative content** • heat required to turn limestone into quicklime; water added to turn quicklime into slaked lime • limestone glows and becomes crumbly when heated; sizzling/ steam being released when water is added • thermal decomposition causes calcium carbonate to decompose forming carbon dioxide gas and calcium oxide; water reacts with calcium oxide to form calcium hydroxide • $CaCO_3 \rightarrow CaO + CO_2$; $CaO + H_2O \rightarrow Ca(OH)_2$ **5-6 marks**: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks**: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks**: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks**: The candidate does not make any attempt or give a relevant answer worthy of credit.

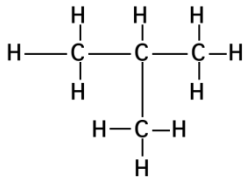
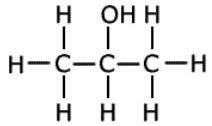
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	4	*(a)*	(i)		1	air			
			(ii)		2	dissolve sulfur trioxide in concentrated sulfuric acid (1) dilute with water to produce concentrated sulfuric acid (1)		add to oleum	
			(iii)		1	vanadium pentoxide	V_2O_5		
		(b)			2	acid dehydrates the sugar removing the **elements of water / hydrogen and oxygen** (1) carbon remains (1)	 C		

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Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	*(a)*			2	alcohols (1) alkenes (1)			
		(b)			2	add bromine water (1) stays brown/orange/no reaction with **C** and **E** turns from brown/orange to colourless (1)	add bromine		red
		(c)	(i)		1	same molecular formula but different structure	same type and number of atoms but arranged differently	same atoms	same compound
			(ii)		1				
		(d)			2	**D** (1)  (1)	ether isomer of **B** or **D**		

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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
	6	*(a)*	(i)		1	sodium chloride / sodium carbonate			
			(ii)		1	sodium carbonate / lithium carbonate			
		(b)			3	add silver nitrate solution (1) white **precipitate** with potassium chloride (1) yellow **precipitate** with potassium iodide (1) allow (1) for **both** colours correct if precipitate not used in either case	answer based on displacement reaction – bromine water; description of colour changes	add HNO_3 flame test	
		(c)			2	ammonia (1) turns (damp) red litmus blue (1)			
		(d)			3	$Fe^{3+} + 3OH^-$ (1) $Fe(OH)_3$ (1) correct state symbols (1)			

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Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	7	*(a)*			2	number of moles = 0.05 (1) concentration = 0.2 (1) follow through error (ft) cao (2)			
		(b)			4	calculation of mean 22.5 cm^3 (1) 0.2×0.0225 (1) 0.0045 / 0.025 (1) 0.18 (1) follow through error (ft) cao (4)	mean of 22.65 cm^3		0.2 without workings

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Question Number			
FT	HT	Mark	Answer
	8	6 QWC	**Indicative content** • observations made when both acids react with metals, carbonates and bases e.g. temperature rise, liberation of gas, time to dissolve • difference in rate of reaction and explanation in terms of strong/weak acid • salts formed • word / chemical equations **5-6 marks**: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks**: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks**: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks**: The candidate does not make any attempt or give a relevant answer worthy of credit.

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4493/02

CHEMISTRY

CHEMISTRY 3
HIGHER TIER

P.M. MONDAY, 20 May 2013

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**8**	
2.	**6**	
3.	**4**	
4.	**6**	
5.	**6**	
6.	**8**	
7.	**5**	
8.	**4**	
9.	**7**	
10.	**6**	
Total	**60**	

4493
020001

ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

Assessment will take into account the quality of written communication (QWC) used in your answer to questions **4** and **10**.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

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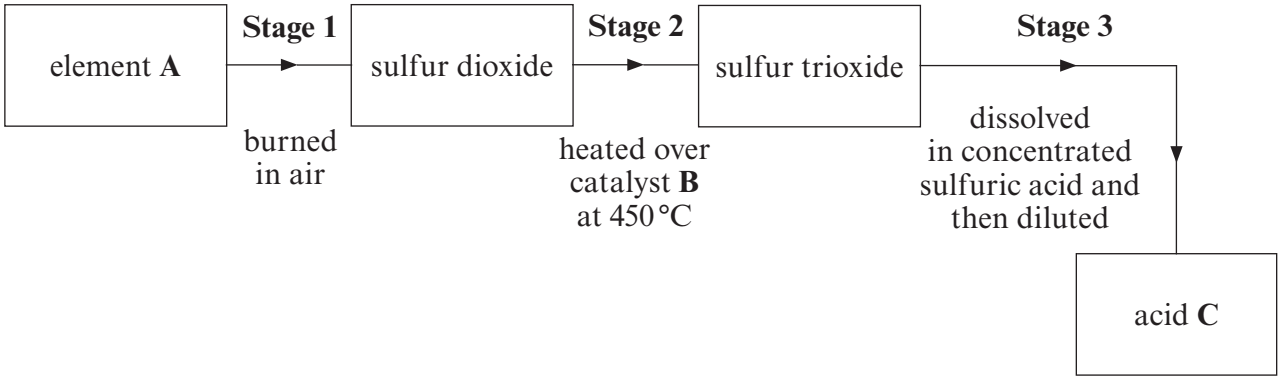
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Answer **all** *questions.*

1. *(a)* The flow diagram below shows the stages in the Contact Process.



(i) Give the name of

I element **A**, ... [1]

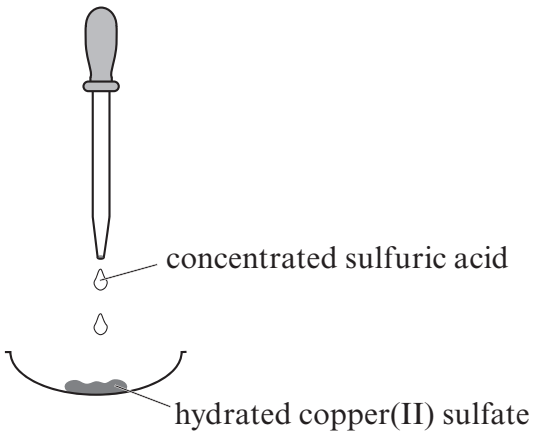
II catalyst **B**, ... [1]

III acid **C**. ..... [1]

(ii) Write a **balanced symbol** equation for the formation of sulfur trioxide, in **stage 2**. [3]

..... + ... ⇌ .....

(b) A few drops of concentrated sulfuric acid were added to some crystals of hydrated copper(II) sulfate, $CuSO_4.5H_2O$.



Describe **two** changes in the appearance of copper(II) sulfate as it is dehydrated. [2]

.....

.....

.....

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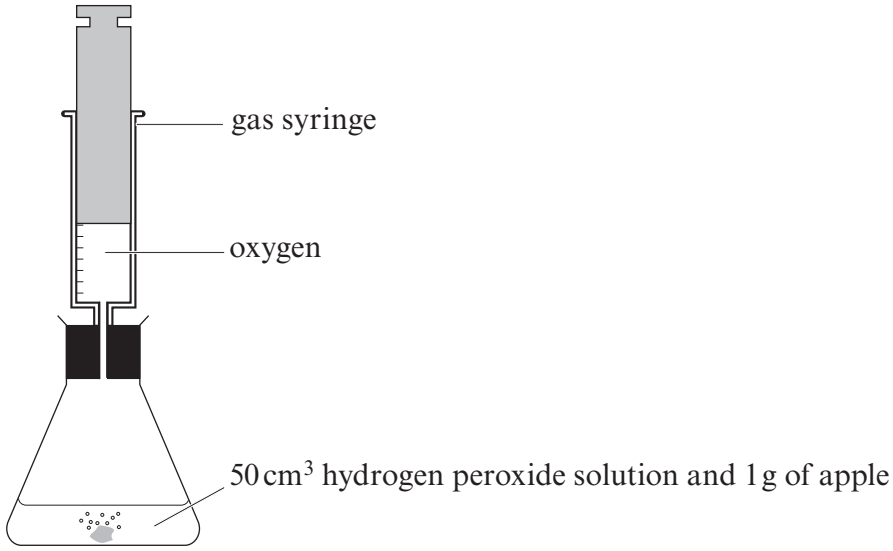
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2. Enzymes are catalysts produced by living cells. The enzyme catalase is found in both animal and plant cells. Catalase breaks down hydrogen peroxide into water and oxygen.

$$2H_2O_2 \longrightarrow 2H_2O + O_2$$

Some pupils were given samples of apple, carrot, potato and liver. They were asked to investigate the effect of these substances on hydrogen peroxide solution.

1 g of each substance was added separately to 50 cm^3 of hydrogen peroxide solution and the volume of oxygen formed was recorded every 10 seconds. The diagram below shows the apparatus used.



The table below shows the results recorded by the group.

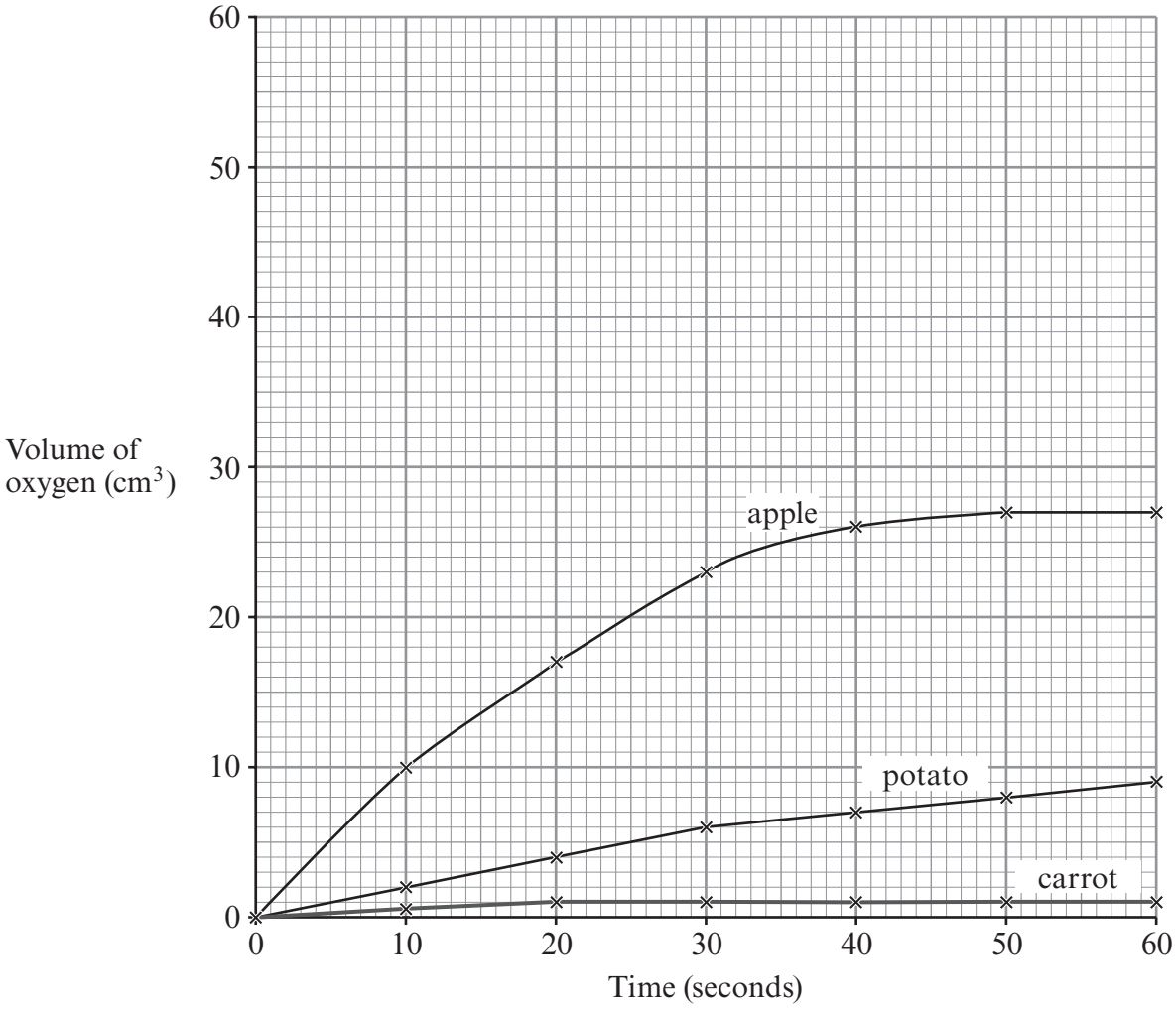
	Substance	Time (seconds)						
		0	10	20	30	40	50	60
Volume of oxygen formed (cm^3)	apple	0	10	17	23	26	27	27
	carrot	0	0.5	1	1	1	1	1
	potato	0	2	4	6	7	8	9
	liver	0	29	43	49	50	50	50

The results for the apple, carrot and potato have been plotted on the graph opposite.

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(a) Plot the results for liver on the grid and draw a suitable line. [3]

(b) Apart from using the same mass of each substance and the same volume of hydrogen peroxide solution, state **one** *other* way you would try to make the investigation a fair test. [1]

.....

(c) Assuming it is the presence of catalase that is responsible for the decomposition of hydrogen peroxide, give **one** conclusion that can be drawn from the results. [1]

.....

.....

(d) Describe the chemical test you would carry out to show that the gas formed is oxygen. [1]

.....

.....

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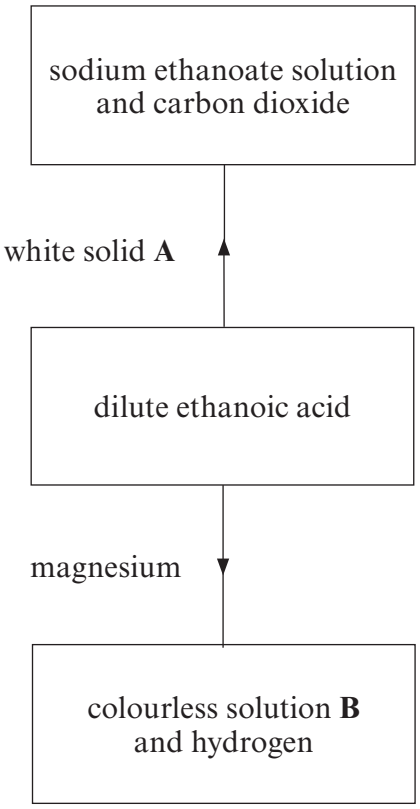
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Turn over.

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3. *(a)* The flow diagram below shows some reactions of ethanoic acid, CH_3COOH.



(i) Name white solid **A**. ..... [1]

(ii) Name colourless solution **B**. ..... [1]

(b) Dilute ethanoic acid reacts with magnesium less vigorously than dilute sulfuric acid of equal concentration.

Give the reason for this difference in behaviour. [1]

.....

(c) Ethanoic acid is formed when an alcoholic drink such as wine is left exposed to the air. Give the name of the compound in wine which turns into ethanoic acid. [1]

.....

4

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4. Write an account of your understanding of the fire triangle and its use in fire fighting.

In your answer you should explain how the fire triangle gives rise to three different methods of fire fighting and give an example of each. [6 QWC]

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5. Ethanol, C_2H_5OH, can be formed from glucose, $C_6H_{12}O_6$, by the process of fermentation using yeast.

(a) Give **two** conditions necessary for this process to occur. [2]

Condition 1 .....

Condition 2 .....

(b) Balance the symbol equation below which represents the process. [1]

$$C_6H_{12}O_6 \longrightarrow \square\ C_2H_5OH + \square\ CO_2$$

(c) Name the separation method used to

(i) recover the yeast, ... [1]

(ii) obtain ethanol from the mixture. ..... [1]

(d) Ethanol is a biofuel alternative to petrol and is widely used in cars in Brazil.

Give **one** advantage of using ethanol rather than petrol to fuel cars. [1]

.....

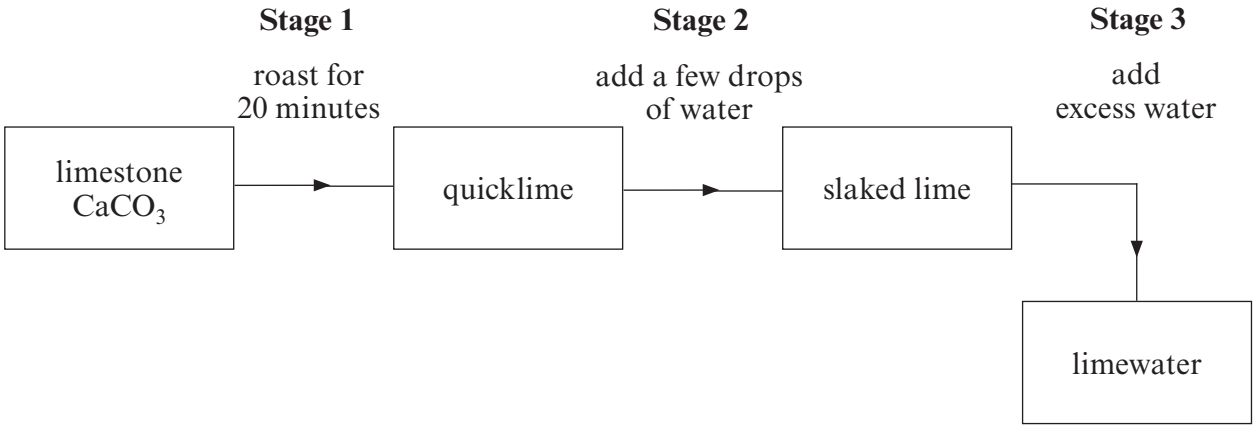
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6. *(a)* The flow chart below outlines the stages involved in the preparation of limewater from limestone.



(i) Write a **balanced symbol** equation for the reaction taking place in **stage 2**. [3]

..... + ... ⟶ .....

(ii) Give the **stage** in the flow chart which

I is extremely exothermic, [1]

II demonstrates thermal decomposition. [1]

(iii) Describe a simple test you would carry out to show that limewater is formed in **stage 3**. Include the result of the test. [1]

.....

(b) Limestone is an important raw material obtained by quarrying. There are advantages and disadvantages associated with limestone quarrying.

In your opinion do the advantages of limestone quarrying outweigh the disadvantages? Give **two** reasons to support your answer. [2]

Opinion (**Yes** *or* **No**) .....

Reasons to support your opinion

.....

.....

.....

.....

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7. Organic substances are arranged in families of compounds with similar properties.

(a) The table below shows the first four members of two families of organic compounds, alkanes and alcohols.

Alkanes	Alcohols
methane CH_4	methanol CH_3OH
ethane C_2H_6	ethanol C_2H_5OH
propane C_3H_8	propanol C_3H_7OH
butane C_4H_{10}	butanol C_4H_9OH

The general formula for members of the alkane family is C_nH_{2n+2}.

Give the general formula for members of the alcohol family. [1]

.....

(b) Isomers are compounds which have the same molecular formula but different structural formulae.

Propanol has two isomers. Draw the **two** positional isomers of propanol. [2]

Isomer 1	Isomer 2

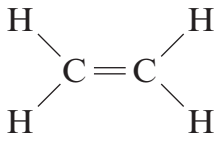
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(c) Another family of organic compounds is the alkene family.

Complete the table below. [2]

Name	Molecular formula	Structural formula
ethene	C_2H_4	
	C_3H_6	

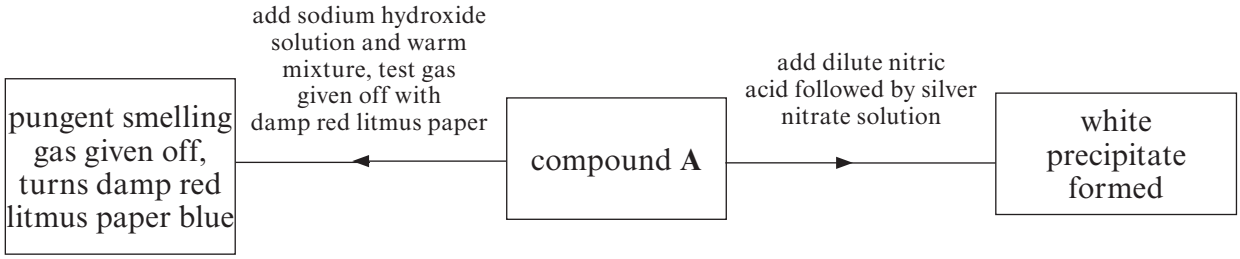
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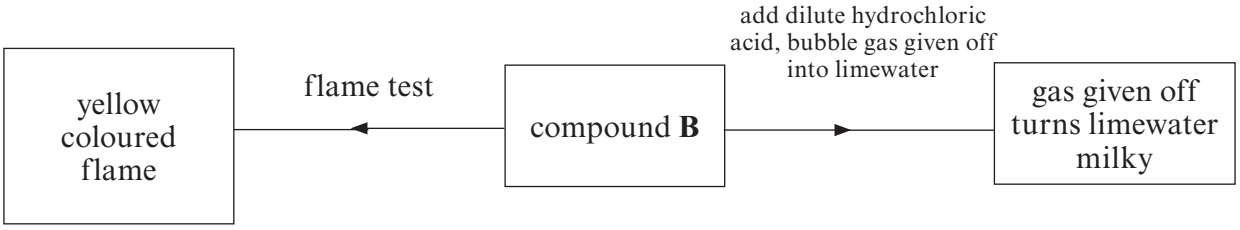
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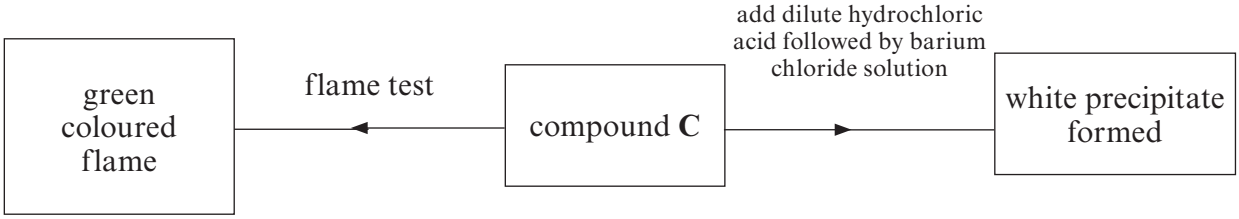
8. *(a)* The flow charts below show tests carried out on compounds **A**, **B** and **C** and the results of those tests.

The compounds were known to include some of the following ions.

NH_4^+	Ca^{2+}	Cu^{2+}	K^+	Na^+	Cl^-	Br^-	I^-	SO_4^{2-}	CO_3^{2-}







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Use the information to give the **chemical formulae** of compounds **A**, **B** and **C**. [3]

A .....

B .....

C .....

(b) Aqueous iron(III) ions form an orange-brown precipitate when mixed with aqueous sodium hydroxide.

Give the letter **A**, **B**, **C**, **D** or **E** for the ionic equation which correctly represents this reaction. [1]

A $Fe^{3+} + OH^-_3 \longrightarrow FeOH_3$

B $Fe^{3+} + OH^- \longrightarrow Fe(OH)$

C $Fe^{3+} + 3OH^- \longrightarrow Fe_3OH$

D $Fe^{3+} + 3OH^- \longrightarrow Fe(OH)_3$

E $Fe^{3+}_3 + OH^- \longrightarrow Fe_3(OH)$

Letter [ ]

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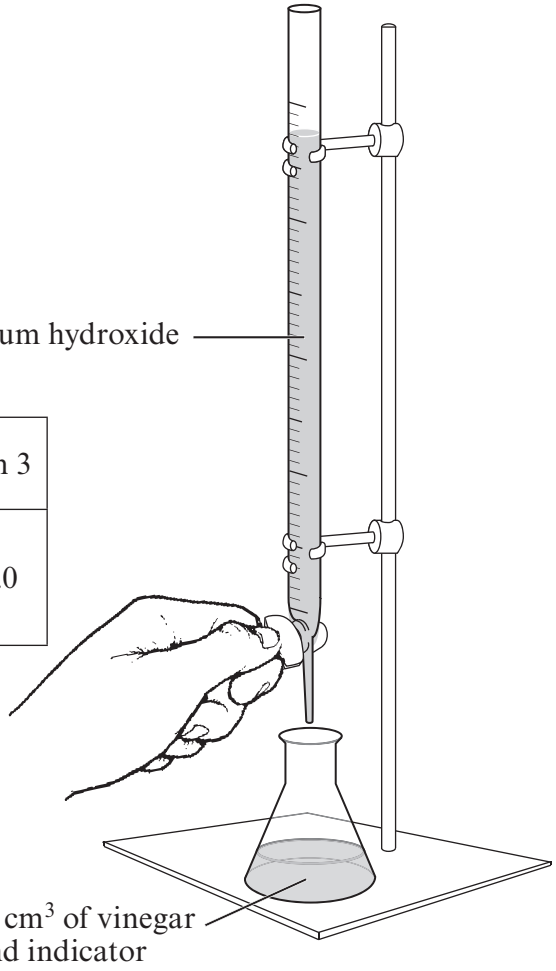
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9. A food scientist was asked to check the quality of a bottle of vinegar. Vinegar contains ethanoic acid, CH_3COOH.

The apparatus shown was used to find the concentration of ethanoic acid in the vinegar.

Dilute sodium hydroxide of concentration 0.1 mol/dm^3 was added a little at a time to 25 cm^3 of vinegar until the indicator changed colour. The procedure was carried out three times.



	Run 1	Run 2	Run 3
Volume of sodium hydroxide added (cm^3)	25.2	24.8	25.0

(a) Calculate the mean volume of sodium hydroxide needed to neutralise 25 cm^3 of vinegar. [1]

.....

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(b) Ethanoic acid reacts with sodium hydroxide solution according to the equation below.

$$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$$

Using the mean volume of sodium hydroxide from part *(a)*, calculate the concentration of the ethanoic acid in mol/dm^3. [3]

Concentration of ethanoic acid = ... mol/dm^3

(c) The label on the vinegar bottle states that it contains 5 g of ethanoic acid, CH_3COOH, in 100 cm^3 vinegar.

$A_r(H) = 1$ $A_r(C) = 12$ $A_r(O) = 16$

(i) Calculate the relative molecular mass, M_r, of ethanoic acid. [1]

M_r = ...

(ii) Using your answers to parts *(b)* and *(c)*(i) show whether the information on the label is correct. [2]

.....

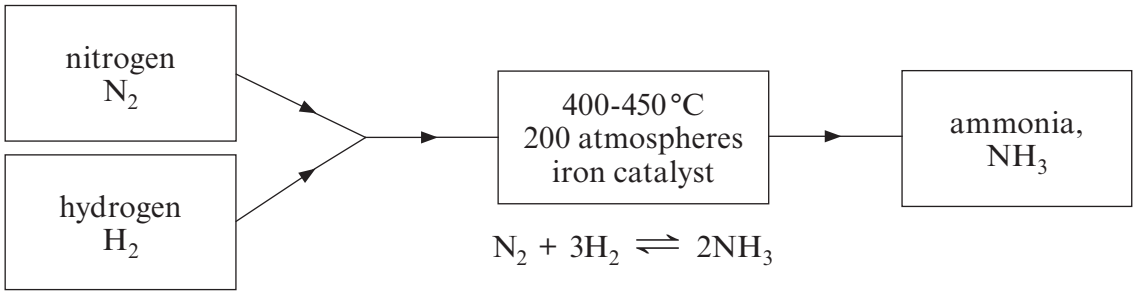
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10. The diagram and equation below outline the manufacture of ammonia by the Haber process.



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

Explain the choice of temperature and pressure used in the process and why it is necessary to use a catalyst. [6 QWC]

END OF PAPER

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FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

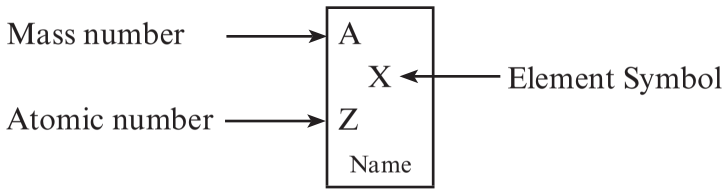
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PERIODIC TABLE OF ELEMENTS

1	2	Group										3	4	5	6	7	0
								$^{1}_{1}$H Hydrogen									$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulfur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key:



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GCSE MARKING SCHEME

SCIENCE - CHEMISTRY

SUMMER 2013

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2013 examination in GCSE SCIENCE - CHEMISTRY. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

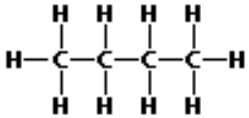
It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

	Page
Unit C1	1
Unit C2	17
Unit C3	34

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
1		(a)			3	methane (1) C_3H_8 (1)  (1)			
		(b)	(i)		1	A			
			(ii)		1	E			

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
2		(a)	(i)		1	air and natural gas – both needed	methane		nitrogen and hydrogen
			(ii)		1	3 : 2			
			(iii)		1	catalyst / speeds up reaction / increases rate			
			(iv)		1	remove / separate / get ammonia (from the unreacted gases)		condenses ammonia / turns ammonia to liquid	
			(v)		1	re-use (unreacted nitrogen and hydrogen) not to waste (unreacted nitrogen and hydrogen) not having to make more nitrogen and hydrogen	conserves natural gas less energy needed		
		(b)			1	ammonium nitrate			
		(c)	(i)		1	increases crop yield			
			(ii)		1	increases soil acidity			

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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
3		(a)			2	32 + 35 + 12 + 12 + 6 = 97 (1) 100-97 = 3 (1) – correct answer only (cao) (2) – follow through error (ft)			
		(b)			2	dust noise / blasting (heavy) lorries / traffic destroys landscape / ruins landscape / unsightly destroys habitats / ruins habitats / destroys wildlife – any two for (1) each		pollution	
		(c)	(i)		1	calcium oxide + water → calcium hydroxide			reference to quicklime and/or slaked lime
			(ii)		2	steam / water boils quicklime crumbles / expands / 'puffs up' / breaks up hisses – any two for (1) each	fizzes	explodes heat released	

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
4		(a)			1	fermentation / fermenting			
		(b)			1	any one from: (yeast/it) doesn't change acts as a catalyst is not used up not a reactant		increases rate 'catalyst'	
		(c)			1	30			
		(d)	(i)		1	distillation			fractional distillation
			(ii)		2	ethanol's boiling point is lower (than that of water / glucose solution) ethanol boils at 80°C and water / glucose solution boils at any value between 100-110°C (1) ethanol distils over first / boils leaving the glucose solution behind / ethanol is collected first (1)		ethanol and glucose solution have *different* boiling points	
		(e)			1	any one from: drink driving / road accidents domestic violence aggressive behaviour argumentative behaviour		time wasted by emergency services / cost of emergency services being drunk	alcohol poisoning / death by choking on vomit / depression / liver disease

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
5		(a)			1	burette			
		(b)			1	indicator(s)			pH indicator universal indicator
		(c)			2	adding smaller volume of acid (at a time) / adding 0.1 cm^3 acid (at a time) / *accept any volume below 0.5 cm^3* (1) to obtain the exact end point value / to get the exact volume indicator turns red / changes colour to get the exact volume when complete neutralisation occurs (1) *answer must imply a 'better'/more accurate volume reading obtained*	adding drops (at a time)	repeat readings	
		(d)			1	B need the *most* acid – both needed		needs lot of acid / more acid	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6		(a)			3	brick-red (for Cu^{2+} flame test) (1) yellow precipitate (for Cl^- ion test) (1) white (precipitate for Fe^{3+} test) (1)			
		(b)			1	sodium chloride, water and ammonia – all needed			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7	1	(a)	(i)	I	1	sulfur / S			
				II	1	vanadium(V) oxide / vanadium oxide / vanadium pentoxide / V_2O_5		VO	
				III	1	sulfuric acid / H_2SO_4	oleum	dilute / conc	
			(ii)		3	reactants: SO_2 + O_2 (1) product: SO_3 (1) balancing: 2(SO_2) 2(SO_3) (1) – reactants and product must be correct before balancing mark awarded			
		(b)			2	(blue hydrated copper(II) sulfate) turns white (1) (crystalline hydrated copper (II) sulfate) turns powdery / turns crumbly / loses its crystalline appearance (1)		changes colour	

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
8	2	(a)			3	all points plotted correctly (±½ square) (2) any five points plotted correctly (1) smooth continuous curve through all points – judgement by eye (1)			
		(b)			1	any one from: same surface area (of substances) same concentration (of peroxide solution) same temperature / all at room temperature			
		(c)			1	any one from: liver contains the most catalase / enzyme carrot contains the least catalase / enzyme any correct comparison in terms of catalase e.g. liver contains more catalase than apple / apple contains more catalase than potato / potato contains more catalase than carrot catalase present in all substances			
		(d)			1	re-lights a glowing splint – both needed			lighted splint burns brighter

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
9	3	(a)	(i)		1	sodium carbonate / Na_2CO_3	sodium hydrogencarbonate / $NaHCO_3$		
			(ii)		1	magnesium ethanoate / $(CH_3COO)_2Mg$			
		(b)			1	(ethanoic acid/it) is a weaker acid / has a higher pH (than that of sulfuric acid) ethanoic acid pH is 3/4 and sulfuric acid pH is 1/2 ethanoic acid has a lower H^+ ion concentration than sulfuric acid	less acidic	ethanoic acid pH is 3/4	
		(c)			1	ethanol / C_2H_5OH			

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Question Number			
FT	HT	Mark	Guidance

10	4	6	Indicative content:
			Reference to *principle* of fire triangle – fuel, heat and air (oxygen) are needed, removing any one factor will put fire out
			
			Types of fire fighting methods related to examples
			• heat removed by water e.g. house fires, bonfires
			• air removed:
			  ○ fire blanket e.g. chip pan fire, person on fire
			  ○ CO_2 / powder e.g. indoor fires, chemical fire, electrical fire
			  ○ foam e.g. aeroplane fire
			• fuel removed:
			  ○ fire-break e.g. forest fire
			  ○ gas supply switched off e.g. natural gas fire
			
			5-6 marks: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.
			
			3-4 marks: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.
			
			1-2 marks: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.
			
			0 marks: The candidate does not make any attempt or give a relevant answer worthy of credit.

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	(a)			2	(glucose) solution / add water (to glucose) warm / warm temperature / any temperature in the range 20-40°C absence / lack of oxygen pH 4-7 – any two for (1) each		yeast optimum / 'right' temperature	
		(b)			1	2 : 2			
		(c)	(i)		1	filtration / filtering / filter	decant		
			(ii)		1	distillation			fractional distillation
		(d)			1	renewable (fuel / energy resource) carbon-neutral reduces demand on fossil fuels doesn't produce sulfur dioxide (so doesn't cause acid rain)		cleaner / less pollution / less carbon dioxide / more environmentally friendly	more efficient

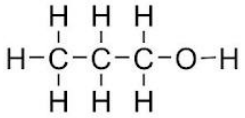
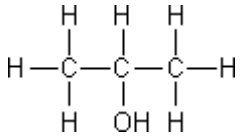
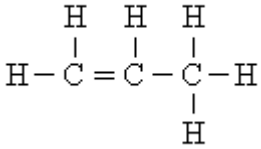
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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
	6	(a)	(i)		3	reactants: $CaO + H_2O$ (1) product: $Ca(OH)_2$ (1) balancing: 1 : 1 : 1 (1) – reactants and product must be correct before balancing mark awarded			
			(ii)	I	1	2			
				II	1	1			
			(iii)		1	(bubble in) carbon dioxide (limewater) turns milky – both needed			
		(b)			2	*Opinion and response must match to be awarded marks* Yes and advantages given e.g. building material, (local) jobs, used in blast furnace / used to extract iron, used to make cement / used to make mortar / used to make concrete, used to make glass, used to neutralise acid soil / manufacture of medicinal antacids, aggregate for roads, abrasive in toothpastes – any two for (1) each No and disadvantages given e.g. dust, noise / blasting, (heavy) lorries / traffic, landscape destruction, habitat destruction / wildlife destruction – any two for (1) each NB – Accept the counter argument i.e. 'even though' / 'but'statements e.g. No – provides jobs but only in the local areas not country wide Yes – landscape destroyed but can be reclaimed			

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Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	7	(a)			1	$C_nH_{2n+1}OH$	$C_nH_{2n+2}O$		
		(b)			2	 (1)  (1)	$CH_3CH_2CH_2OH$ $CH_3CH_2CH_3$ (OH)		
		(c)			2	propene (1)  (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	8	(a)			3	A NH_4Cl B Na_2CO_3 C $CuSO_4$ all ions correctly identified (2) 3, 4 or 5 ions correctly identified (1) all formulae correct (1)	correct names only for all three compounds (2)		
		(b)			1	D			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	9	(a)			1	25.0	25		
		(b)			3	number of moles NaOH = concentration × volume = 0.1 × 25/1000 = 0.0025 (1) (stoichiometry / equation shows 1:1) 0.0025 mol CH_3COOH : 0.0025 mol NaOH (1) concentration CH_3COOH = number of moles ÷ volume = 0.0025 ÷ 25/1000 = 0.1 (1) – correct answer only (cao) (3) – follow through error (ft)	cV = cV c × 25 = 0.1 × 25 (2) $c = \frac{0.1 \times 25}{25} = 0.1$		
		(c)	(i)		1	60			
			(ii)		2	number of moles = concentration × volume = 0.1 × 100/1000 = 0.01 (1) number of moles = mass /M_r mass = number of moles × M_r = 0.01 × 60 = 0.6 g (∴ label information incorrect) (1)	number of moles in 100cm^3 = 0.083 (1) concentration calculated above as 0.1 mol/dm^3 – not 0.83 mol/dm^3 (1)		

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Question Number			
FT	HT	Mark	Guidance
	10		Indicative content: Explanation of choice of temperature and pressure conditions and rationale of presence of catalyst e.g. reversible reaction, left to right reaction required to produce ammonia (left to right reaction is exothermic and) higher yield is favoured by lower temperature however lower temperature results in lower rate so compromise made – moderately high temperature increases rate at the expense of yield rate further increased by using iron catalyst higher yield is favoured by higher pressure however increasing pressure increases plant costs and is potentially more hazardous – moderate pressure chosen provides moderate yield lower yield acceptable because unreacted nitrogen/hydrogen can be easily separated and returned to reaction vessel 5-6 marks: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. 3-4 marks: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. 1-2 marks: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. 0 marks: The candidate does not make any attempt or give a relevant answer worthy of credit.

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