WJEC GCSE CHEMISTRY

CHEMISTRY



EXAM QUESTION PACK

UNIT C3 HIGHER TIER 0245 PAPERS

STEMUP

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

0245/02

SCIENCE
HIGHER TIER
CHEMISTRY 3

A.M. TUESDAY, 29 January 2013

45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**4**	
2.	**7**	
3.	**4**	
4.	**9**	
5.	**7**	
6.	**9**	
7.	**6**	
8.	**4**	
Total	**50**	

0245 020001

ADDITIONAL MATERIALS

In addition to this paper you may require 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.

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. The fire triangle can be used to explain how fires start and how they can be put out. Use your knowledge of the fire triangle to describe and explain **two** methods which are used to put out large forest fires. [4]

.....

.....

.....

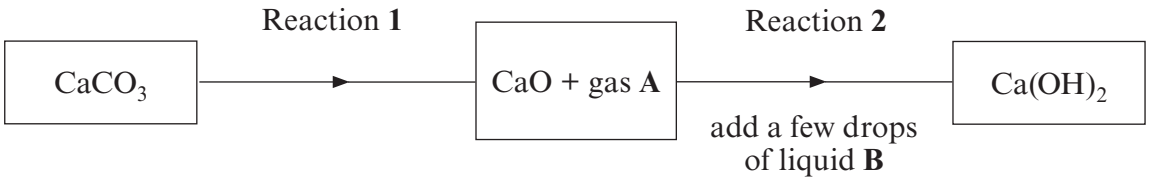
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4

2. *(a)* The flow diagram below shows the reactions used to prepare slaked lime, $Ca(OH)_2$, from limestone, $CaCO_3$.



(i) I Briefly describe what needs to be done to limestone for reaction **1** to take place. [1]

.....

II Give the name for the type of reaction taking place. [1]

.....

(ii) Name gas **A**. [1]

.....

(iii) Name liquid **B**. [1]

.....

(b) Write a balanced **symbol** equation for the reaction which takes place when slaked lime, $Ca(OH)_2$, is neutralised by hydrochloric acid, HCl. [3]

..... + ... ⟶ ..... + ...

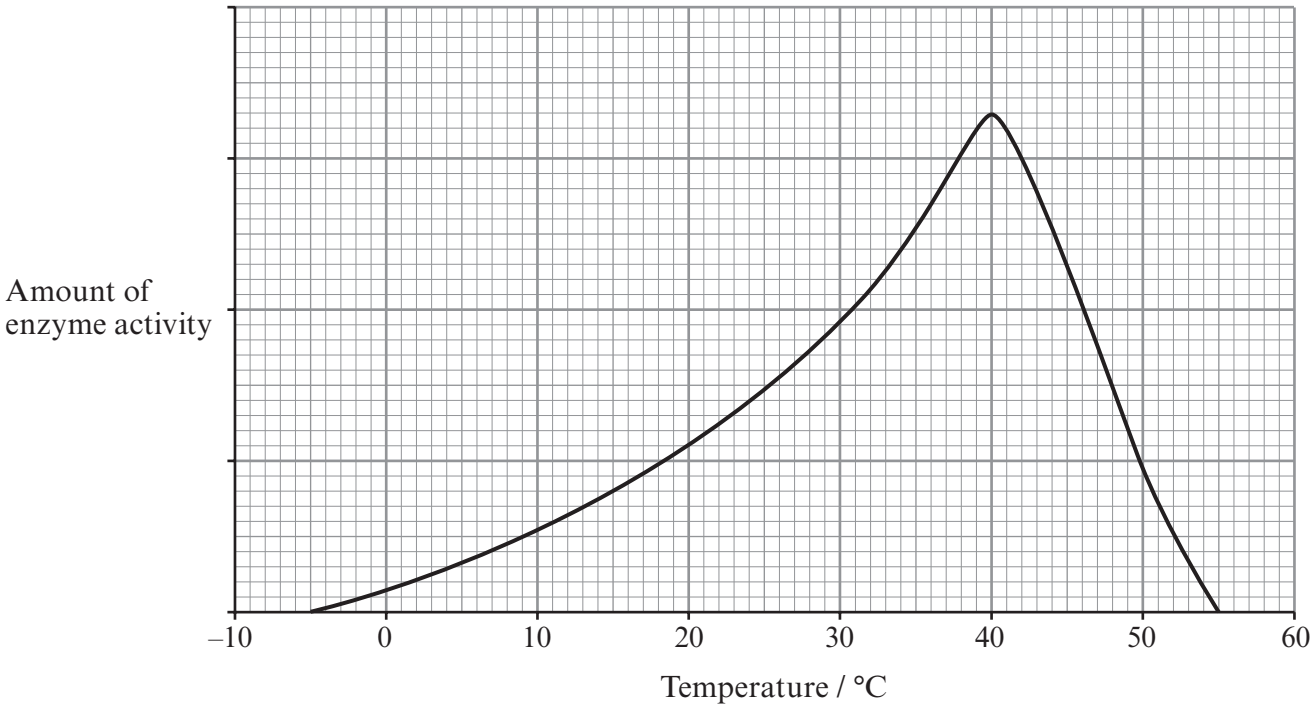
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3. The temperature range in which enzyme activity occurs can be different for different enzymes. The graph below shows the amount of activity of an enzyme, **A**, over a temperature range.



(a) Use the graph to give the temperature range where the enzyme activity is **increasing**. [1]

..... °C to ..... °C

(b) Sketch carefully the graph of the amount of enzyme activity of a different enzyme, **B**, which is active between 5 °C and 50 °C and has the greatest activity at 30 °C. [2]

(c) Give a temperature value at which **both** enzymes would be destroyed. [1]

..... °C

4

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4. *(a)* The following table shows the colours of universal indicator at different pH values.

Colour	red	orange	yellow	green	blue	navy blue	purple
pH	0-2	3-4	5-6	7	8-9	10-12	13-14

Universal indicator solution was put into separate solutions of sulphuric acid and ethanoic acid.

Give the indicator colour you would expect in each acid and give the reason for your choices. [4]

Indicator colour in sulphuric acid .....

.....

Indicator colour in ethanoic acid .....

.....

(b) Two experiments were carried out to investigate the temperature rise when acids and alkalis react. 80 cm^3 of dilute hydrochloric acid was added, 10 cm^3 at a time, to 100 cm^3 of sodium hydroxide solution and the temperature recorded after each addition. The same process was repeated with 80 cm^3 of dilute ethanoic acid.

The table below shows the results.

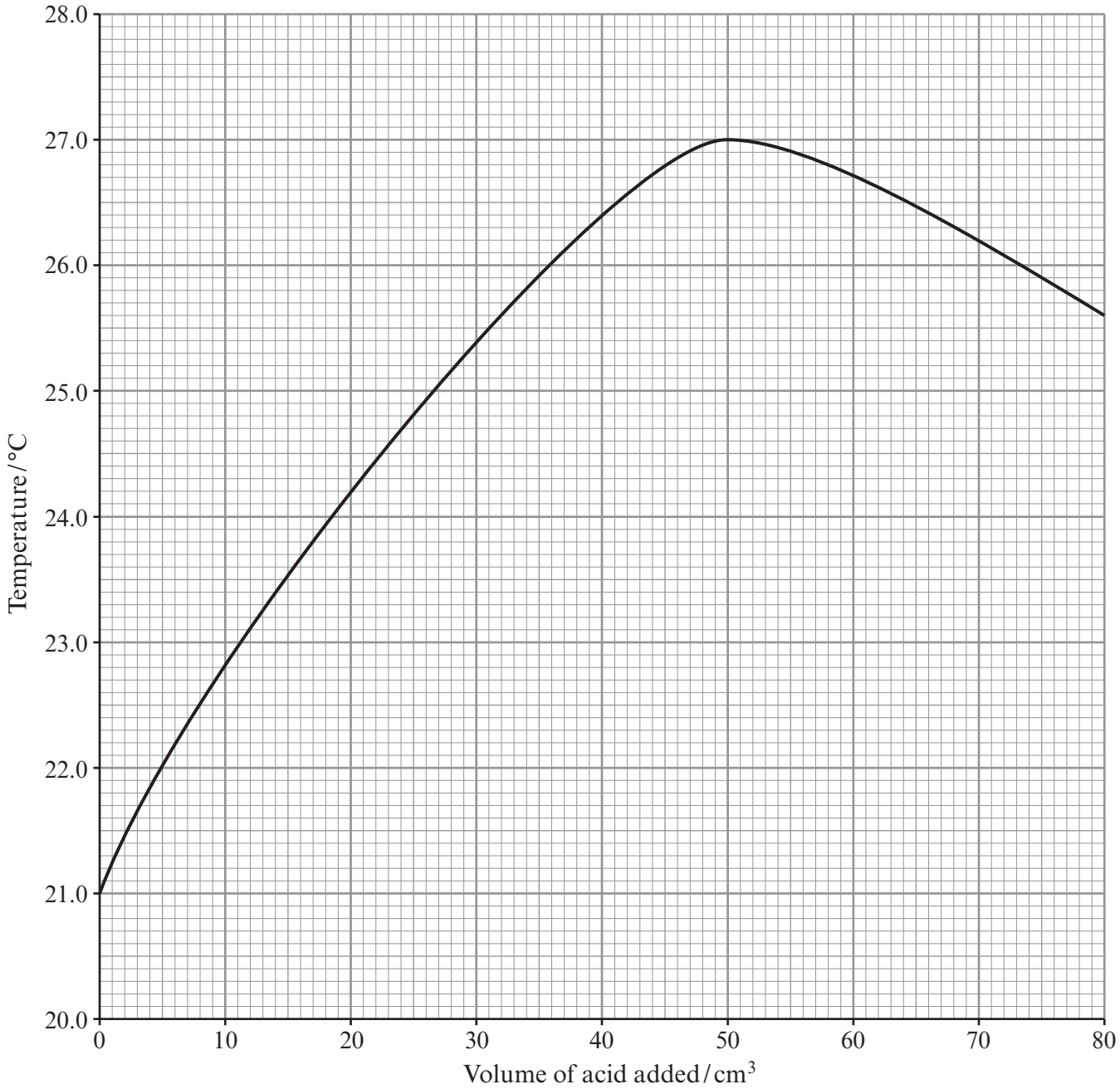
Volume of acid added / cm^3	0	10	20	30	40	50	60	70	80
Temperature using hydrochloric acid / °C	21.0	22.8	24.2	25.4	26.4	27.0	26.7	26.2	25.6
Temperature using ethanoic acid / °C	21.0	22.6	23.8	24.8	25.6	26.0	25.9	25.5	25.0

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(i) Plot the results for ethanoic acid on the grid below and draw a curve of best fit. The curve for hydrochloric acid has already been plotted. [3]



(ii) If a piece of universal indicator paper was placed in the flask when exactly 50 cm^3 of hydrochloric acid had been added, state the indicator colour you would expect to see. Give the reason for your choice. [2]

Colour .....

Reason .....

.....

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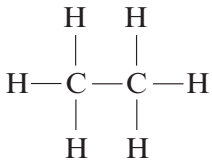
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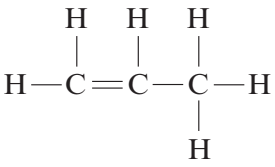
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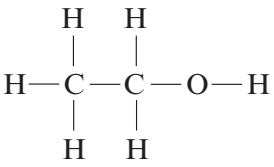
5. The structural formulae of five carbon compounds are shown below.



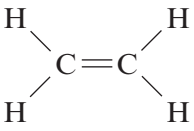
A



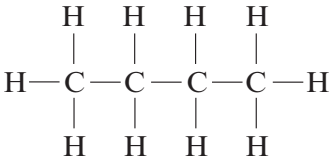
B



C



D



E

(a) Give the name of the homologous series to which the following pairs of carbon compounds belong.

(i) **A** and **E** ..... [1]

(ii) **B** and **D** ..... [1]

(b) Give the **letter** of the carbon compound which

(i) reacts with hydrogen to form compound **A**, ... [1]

(ii) when exposed to air forms ethanoic acid. ..... [1]

(c) The structural formula of carbon compound **E** is one of the two chain isomers of butane.

(i) Draw the other chain isomer of butane. [1]

(ii) Explain the meaning of the term *isomer*. [2]

.....

.....

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6. The main stages in the manufacture of sulphuric acid are given below.

Stage 1	Sulphur reacts with oxygen
Stage 2	Sulphur dioxide reacts with oxygen
Stage 3	Sulphur trioxide is absorbed into concentrated sulphuric acid and then diluted to various concentrations

(a) Give the chemical formula of sulphuric acid. [1]

.....

(b) During stage 2, gases are passed through a vanadium(V) oxide catalyst. The catalyst will **not** work below 400 °C and **breaks down** above 620 °C.

The table below shows the percentage yield of sulphur trioxide in stage 2 at different temperatures.

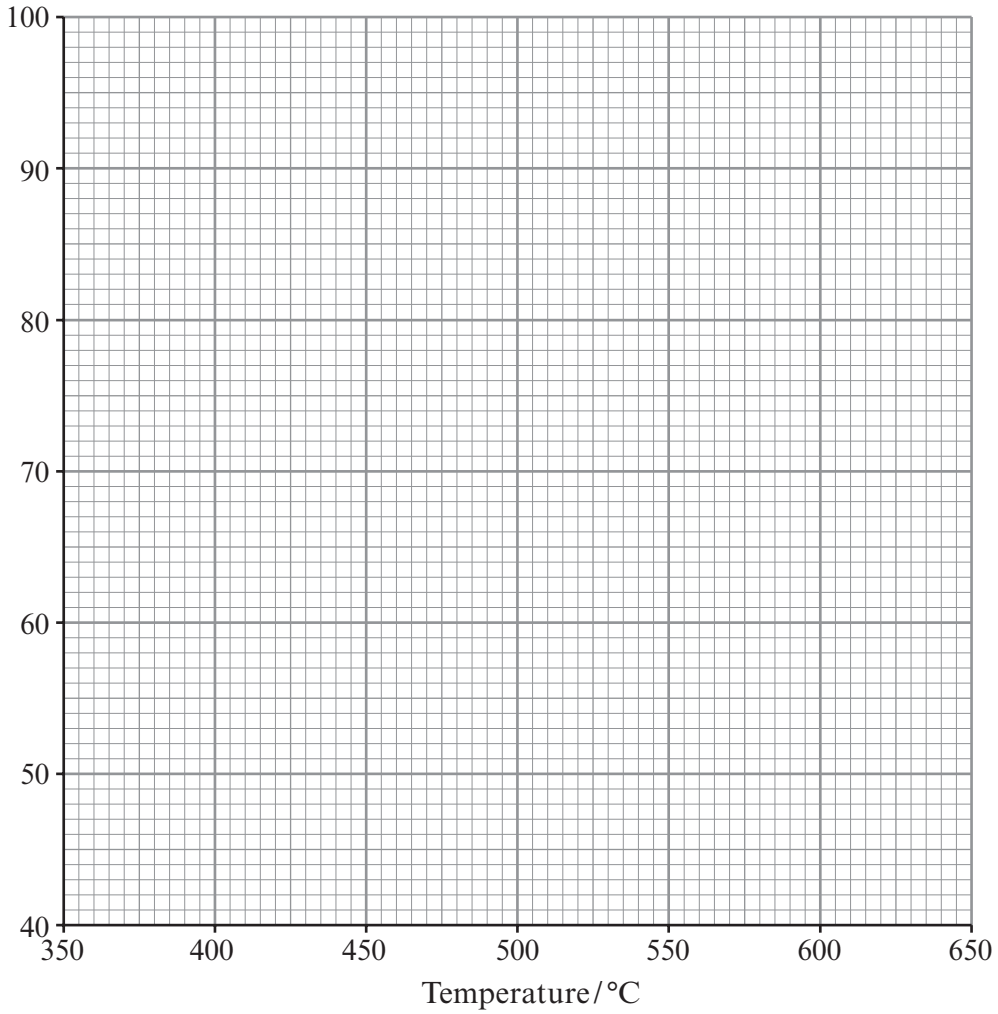
Temperature / °C	400	450	500	550	600
Percentage yield of sulphur trioxide / %	99	97	92	85	76

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(i) Plot a graph of the percentage yield of sulphur trioxide at different temperatures on the grid below. [3]



(ii) Use the graph to

I state how changing the temperature affects the yield of sulphur trioxide, [1]

.....

II identify the highest temperature that can be used if a yield of at least 90% is required. [1]

..... °C

(iii) Write a balanced **symbol** equation for the reaction between sulphur dioxide and oxygen, O_2, in stage 2. [3]

..... + ... ⇌ .....

9

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7. Ethanol, C_2H_5OH, is a biofuel alternative to petrol and is widely used in cars in Brazil.

(a) Ethanol can be made from sugars by the process of fermentation. Briefly describe how ethanol can be separated from the fermentation mixture by distillation. [2]

.....

.....

.....

.....

(b) Give **one** advantage and **one** disadvantage of using ethanol rather than petrol to fuel cars. [2]

Advantage .....

Disadvantage .....

(c) (i) Give **one** *health* problem associated with alcohol abuse over a **long** period of time. [1]

.....

(ii) Give **one** *social* problem associated with the excessive intake of alcohol. [1]

.....

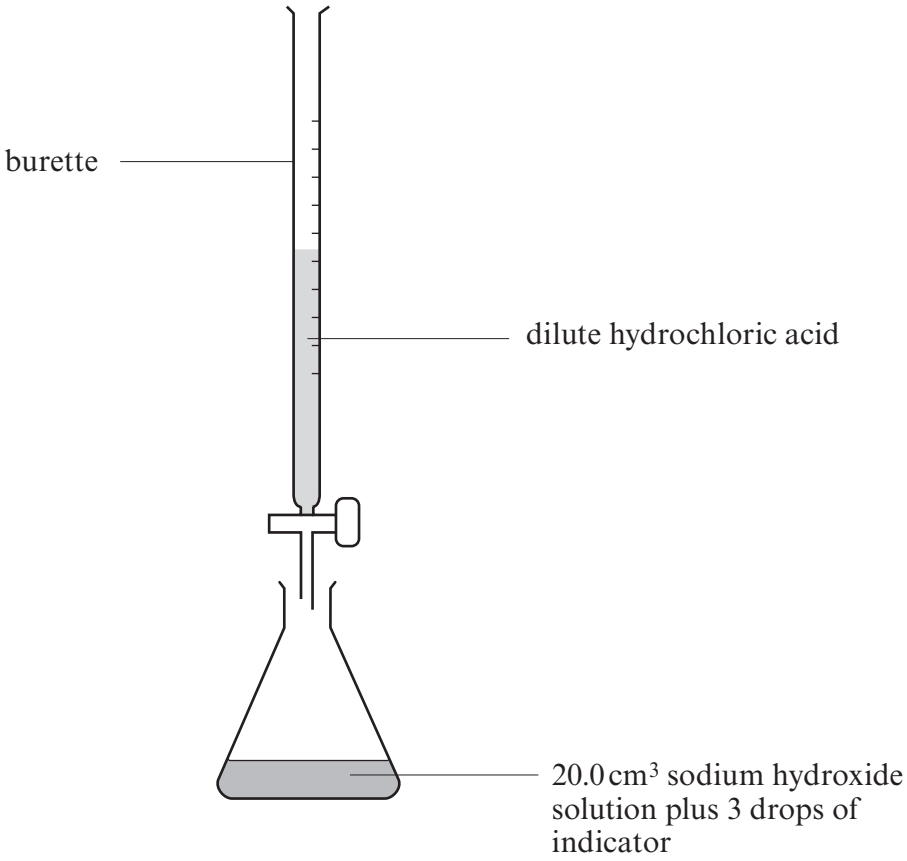
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8. The diagram below shows the apparatus used to find the concentration of a sample of hydrochloric acid.

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The titration was carried out three times and the volume of acid needed to change the indicator colour each time was recorded in the table below. A fresh 20.0 cm^3 of sodium hydroxide of concentration 0.2 mol dm^{-3} was used in each titration.

Volume of hydrochloric acid / cm^3		
Run 1	Run 2	Run 3
24.9	25.0	25.1

The balanced symbol equation for the reaction between hydrochloric acid and sodium hydroxide is shown below.

$$HCl(aq) + NaOH(aq) \longrightarrow NaCl(aq) + H_2O(l)$$

Calculate the concentration of the hydrochloric acid in mol dm^{-3}. [4]

.....

.....

.....

.....

Concentration = ... mol dm^{-3}

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^{+}	Sulphate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

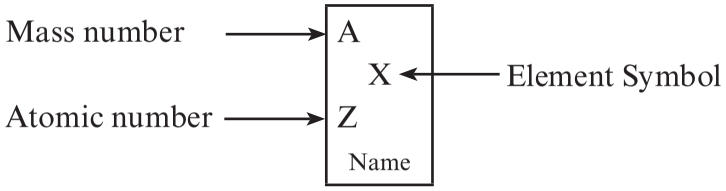
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PERIODIC TABLE OF ELEMENTS

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 Sulphur	$^{35}_{17}$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

CHEMISTRY (LEGACY)

JANUARY 2013

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2013 examination in GCSE CHEMISTRY (LEGACY). 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.

Unit	Page
C1 (LEGACY)	1
C2 (LEGACY)	17
C3 (LEGACY)	31

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GCSE CHEMISTRY (LEGACY)

C3 Mark Scheme - January 2013

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
1		(a)	(i)		1	12			
			(ii)		1	building roads			
		(b)			3	creates more wealth for the community (1) more jobs locally (1) provides materials for the building industry (1) any order			

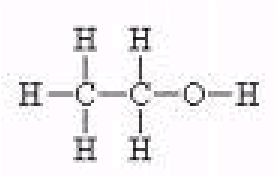
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
2		(a)			3	A filtration B chromatography C evaporation			
		(b)	(i)		1	B	chromatography		
			(ii)		1	A	filtration / filter		

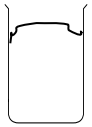
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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
3		(a)	(i)		1	propane			
			(ii)		1				
			(iii)		1	C_3H_6			
		(b)	(i)		1	propane			
			(ii)		1	ethanol			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
4		(a)	(i)		1	air			oxygen
			(ii)		2	sulphur dioxide + oxygen (1) sulphur trioxide (1)	$SO_2 + O_2$ SO_3		
			(iii)		1	catalyst			
		(b)	(i)		1	volume of 'material' in beaker increased e.g. 			
			(ii)		1	hydrogen and oxygen both needed	'H' and 'O'		H_2 and O_2
		(c)	(i)		1	B			
			(ii)		1	(wear) goggles / gloves / laboratory coat (carry out procedure in a) fume cupboard	visor / protective clothing		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
5		(a)	(i)		2	blue precipitate (1) white precipitate (1)			
			(ii)		2	yellow flame (1) bubbles formed (1)	fizzing	gas formed / carbon dioxide	
		(b)			2	ammonia turns damp red litmus paper blue (1) oxygen relights glowing splint (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6		(a)	(i)		1	18			
			(ii)		1	30			
			(iii)		1	25 ±1			
		(b)	(i)		2	sodium sulphate (1) water and carbon dioxide (1)			
			(ii)		1	Na_2SO_4			

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Question Number									
FT	HT	Sub-section			Mark	Answer		Accept	Neutral answer	Do not accept
7	1				4	Method 1:	water (1) cools / removes heat (1)			
						Method 2:	bulldoze down trees / remove trees (1) removes fuel (1)	fire breaks		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
8	2	(a)	(i)	I	1	heat	roast / high temperature	warm / raise temperature	
				II	1	(thermal) decomposition			
			(ii)		1	carbon dioxide	CO_2		
			(iii)		1	water	H_2O		
		(b)			3	$Ca(OH)_2$ + HCl (1) $CaCl_2$ + H_2O (1) balancing: 1:2(HCl):1:2(H_2O) (1) all formulae must be correct before balancing mark awarded			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
9	3	(a)			1	-5 to 40			
		(b)			2	curve drawn from 5°C to 50°C (1) with peak at 30°C (any height) (1)			
		(c)			1	any value of -5°C or below or 55°C or above			

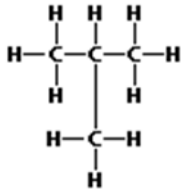
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Question Number									
FT	HT	Sub-section			Mark	Answer		Accept	Neutral answer	Do not accept
	4	(a)			4	sulphuric acid: red (1) strong acid (1) ethanoic acid: orange (1) weak acid (1)		yellow		
		(b)	(i)		3	all points plotted correctly (2) any 8 points plotted correctly (1) smooth curve of 'best fit' (1)				
			(ii)		2	green (1) acid / alkali has been *neutralised* / *all* the acid and alkali have been used up (1)		solution is neutral / neutralisation has occurred		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	(a)	(i)		1	alkane(s)			
			(ii)		1	alkene(s)			
		(b)	(i)		1	D			
			(ii)		1	C			
		(c)	(i)		1				
			(ii)		2	(compounds that have the) same molecular formula (1) (but) different structural formulae (1)	chemical formula		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	6	(a)			1	H_2SO_4			
		(b)	(i)		3	all points plotted correctly (2) any four points plotted correctly (1) curve of best fit (1)			
			(ii)	I	1	the higher the temperature, smaller the yield			
				II	1	515 ±5			
			(iii)		3	SO_2 + O_2 (1) SO_3 (1) balancing: 2 : 1 : 2 (1) all formulae must be correct before balancing mark awarded			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	7	(a)			2	heat until mixture boils / reference to different boiling points e.g. ethanol boils at 80°C and water boils at 100°C / ethanol boils at a lower temperature than water (1) ethanol vapour condenses / cools forming a liquid (1)	vapour cooled and collected		
		(b)			2	Advantages: renewable / carbon-neutral fuel / energy resource Disadvantages: less energy released / need a lot of land (to grow crops) / need a lot of sunlight (to grow crops)	climate might be unsuitable		ref. to 'efficiency'
		(c)	(i)		1	liver disease / stomach problems / throat / affects brain / heart disease / depression			
			(ii)		1	drink driving / road accidents / increase in violent behaviour	domestic violence		alcohol poisoning / death by choking on vomit / depression

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	8				4	calculated mean = 25 cm^3 (1) moles = conc × vol/1000 moles = 0.2 × 20/1000 = 0.004 (1) 0.004 : 0.004 (1) conc = 1000/25 × 0.004 = 0.16 (1) correct answer only (4)	alternative method		

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

0245/02

SCIENCE CHEMISTRY
HIGHER TIER
CHEMISTRY 3

A.M. MONDAY, 21 May 2012

45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**3**	
3.	**8**	
4.	**4**	
5.	**5**	
6.	**7**	
7.	**5**	
8.	**6**	
9.	**7**	
Total	**50**	

0245
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.

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. The following table shows the colours of universal indicator at different pH values.

Colour	red	orange	yellow	green	blue	navy blue	purple
pH range	0-2	3-4	5-6	7	8-9	10-12	13-14

(a) A solution of coffee turns universal indicator yellow.

(i) Give the pH range of this solution. ..... [1]

(ii) State what the pH range tells you about this solution. [1]

.....

(b) Ethanoic acid turns universal indicator orange and sulphuric acid turns it red. State what this information tells you about the relative strengths of the two acids. [1]

.....

.....

(c) An *excess* of the strong alkali, sodium hydroxide, was added to a small amount of sulphuric acid containing some universal indicator. State what would happen to the pH of the solution and give the final colour of the universal indicator. [2]

.....

.....

5

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2. Wine is a solution containing about 13% ethanol. Ethanol is formed as glucose is broken down by the action of enzymes present in yeast.

(a) Give the name of this process. [1]

.....

(b) Give **one** *health* problem associated with excessive use of alcohol over many years. [1]

.....

.....

(c) Give **one** *social* problem associated with alcohol misuse. [1]

.....

.....

0245 020003

3

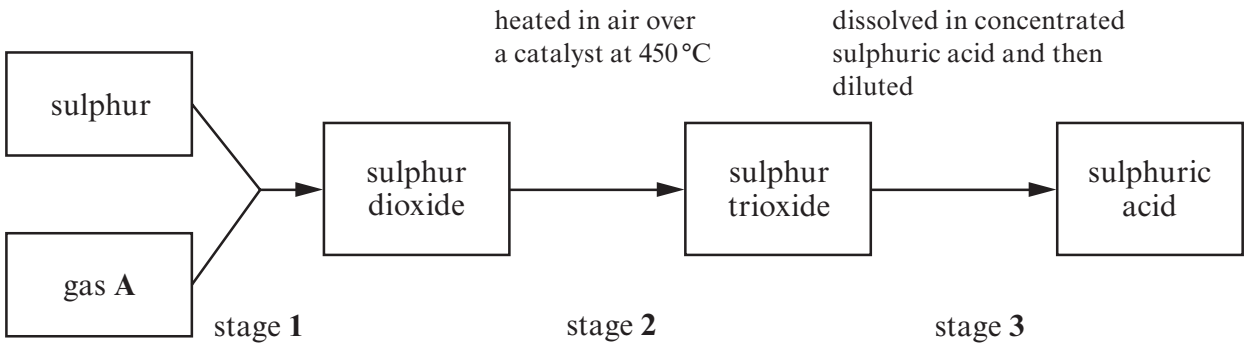
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Turn over.

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3. *(a)* The following diagram shows a flow chart for the manufacture of sulphuric acid using the Contact Process.



(i) Name gas **A**. ..... [1]

(ii) Give the **word** equation for the reaction taking place in stage **2**. [2]

..... + ... ⇌ .....

(iii) Give the reason for using a catalyst in stage **2**. [1]

.....

(iv) If sulphur trioxide is allowed to react with water directly in stage **3**, a large quantity of heat is released. Give the term used for a reaction that produces heat. [1]

.....

(b) (i) When concentrated sulphuric acid is added to sugar, $C_{12}H_{22}O_{11}$, a black solid is formed. Give the **names** of the elements that are removed from sugar during this reaction. [1]

.....

(ii) The following hazard symbol is seen on a bottle of concentrated sulphuric acid.



What does it tell you about the acid? [1]

.....

(c) When dilute sulphuric acid is added to magnesium, hydrogen gas is given off. Give the test for hydrogen gas. [1]

.....

8

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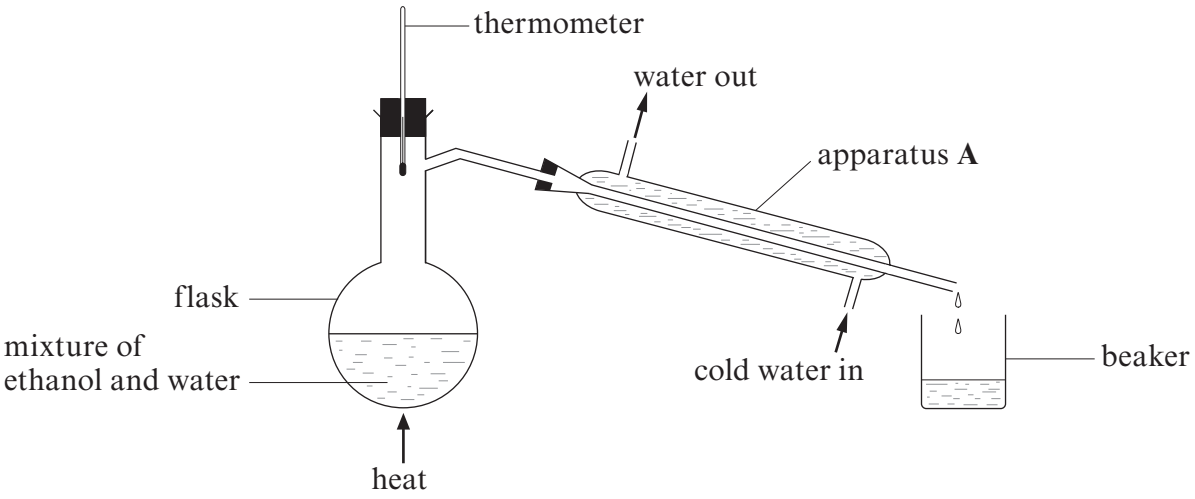
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4. Ethanol and water have different boiling points as shown in the table below.

Liquid	Boiling point / °C
ethanol	79
water	100

A mixture of ethanol and water can be separated by using the apparatus shown.



(a) Give the reason why the thermometer is placed so that its bulb is near the flask sidearm rather than in the mixture below. [1]

.....

.....

(b) Name apparatus **A**. [1]

.....

(c) State which liquid you would expect to be collected in the beaker first and explain your answer. [1]

The first liquid to appear in the beaker is .....

Explanation .....

.....

(d) Give the name of this method of separation. [1]

.....

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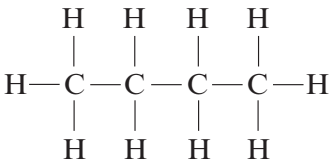
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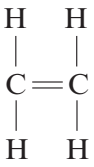
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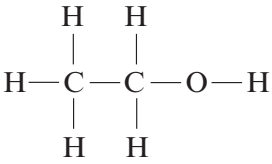
5. The structural formulae of six organic compounds, **A-F**, are shown below.



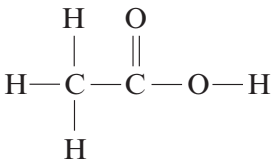
A



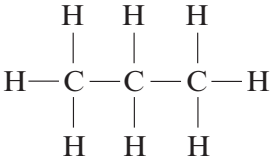
B



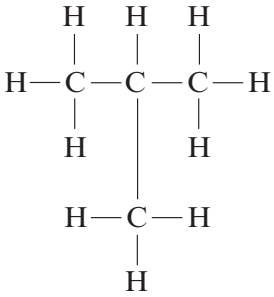
C



D



E



F

(a) Give the **molecular** formula of compound **E**. [1]

.....

(b) Give the letters of the two organic compounds that have the **same** molecular formulae. [1]

..... and .....

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(c) Give the letter, **A-F**, of the organic compound which

(i) is an alkene, [1]

.....

(ii) is ethanol, [1]

.....

(iii) undergoes an addition reaction to give a compound with a molecular formula of C_2H_6. [1]

.....

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6. *(a)* Carbonates undergo thermal decomposition forming carbon dioxide.

(i) The following table contains the decomposition temperatures of three metal carbonates.

Metal carbonate	Decomposition temperature / °C
calcium carbonate	900
copper carbonate	290
magnesium carbonate	540

State which of the three is the most stable and give a reason for your choice. [1]

.....

.....

(ii) Describe an experiment to show the thermal decomposition of copper carbonate. State how you would collect and identify the carbon dioxide gas produced. [3]

.....

.....

.....

.....

.....

.....

(b) Limestone is made of calcium carbonate. It decomposes on heating to form quicklime, calcium oxide, which reacts with water giving calcium hydroxide.

(i) Give **one** use of limestone. [1]

.....

(ii) Give the reason why farmers spread quicklime on their soil. [1]

.....

.....

(iii) State the common name for calcium hydroxide. [1]

.....

7

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7. The molecular formula of propene is C_3H_6.

(a) Draw the **structural** formula of propene. [1]

(b) Describe how bromine water can be used to distinguish between propane and propene. Give the observations expected for **both**. [2]

.....

.....

.....

(c) Propene undergoes an addition reaction with bromine, Br_2. Give the **molecular** and **structural** formulae of the product of this reaction. [2]

Molecular formula .....

Structural formula

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8. Sodium hydroxide solution can be used to distinguish between ions such as iron(II), Fe^{2+}, and iron(III), Fe^{3+}.

(a) Describe what you would **see** when sodium hydroxide solution is added to iron(II) chloride and name the iron compound formed during the reaction. [2]

.....

Name of the iron compound formed .....

(b) Give the balanced **symbol** equation for the reaction that takes place in part *(a)*. [3]

..... + ... ⟶ ..... + ...

(c) Describe what you would **see** when silver nitrate solution is added to iron(II) chloride solution. [1]

.....

6

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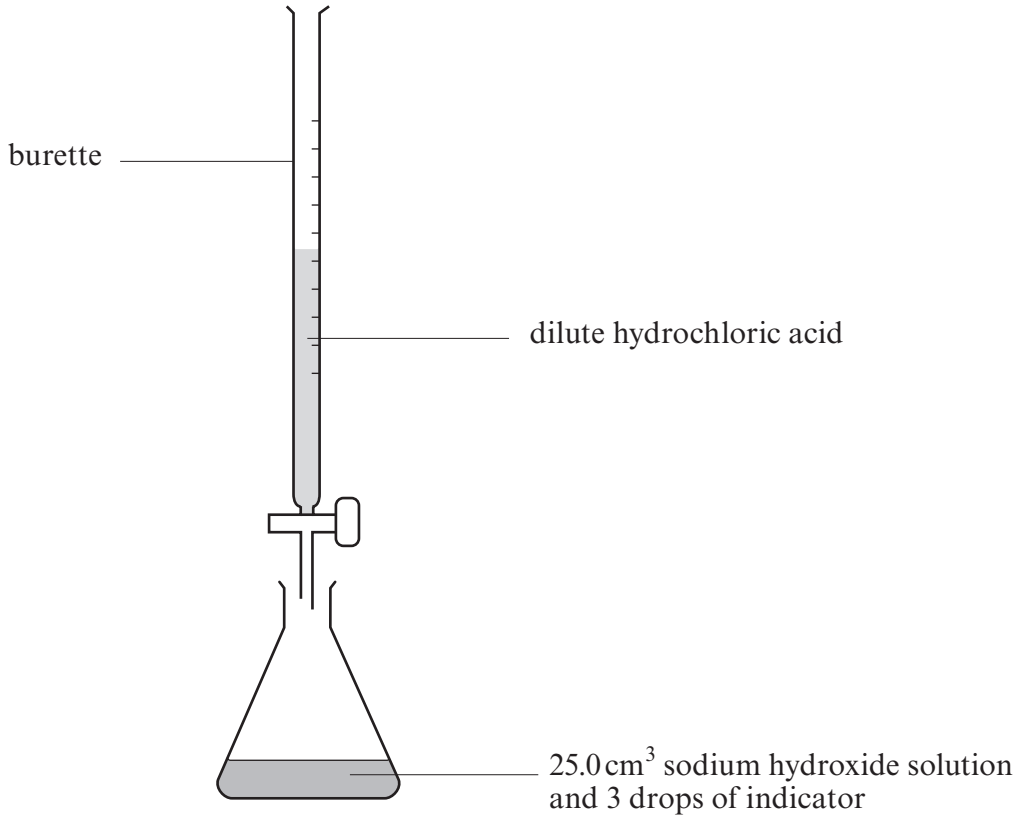
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9. The diagram below shows the apparatus used to find the concentration of a sample of dilute hydrochloric acid.



The acid was added slowly by means of a 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 is given in the table below.

	1	2	3	4
Volume of hydrochloric acid / cm^3	23.50	20.00	20.05	19.95

(a) Not all the results in the table are reliable. Using **only** the reliable values, calculate the average volume of acid used. [1]

.....

.....

Average volume of acid = ... cm^3

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(b) Name the apparatus that could have been used to accurately measure out 25.0 cm^3 of sodium hydroxide solution. [1]

.....

(c) Calculate the number of moles of sodium hydroxide present in 25 cm^3 of solution if the concentration is 0.2 mol dm^{-3}. [2]

.....

.....

Moles of sodium hydroxide = ... mol

(d) The equation for the reaction between sodium hydroxide and hydrochloric acid is:

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

Using your answer to part *(c)* and this equation, state the number of moles of hydrochloric acid that need to be added to the sodium hydroxide solution for a neutral solution to be formed. [1]

.....

(e) Calculate the concentration of the acid in mol dm^{-3}. [2]

.....

.....

Concentration of the acid = ... mol dm^{-3}

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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^{+}	Sulphate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		

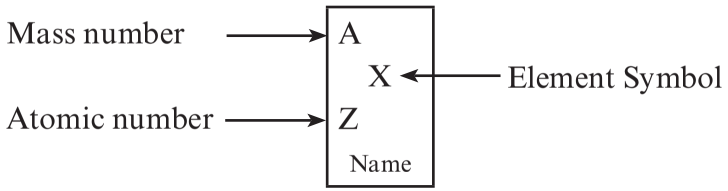
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PERIODIC TABLE OF ELEMENTS

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 Sulphur	$^{35}_{17}$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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(0245-02)

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GCSE MARKING SCHEME

SCIENCE - CHEMISTRY (LEGACY)

SUMMER 2012

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2012 examination in GCSE SCIENCE - CHEMISTRY (LEGACY). 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.

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CHEMISTRY 3 (Legacy)

Foundation Tier

Q.1	Mark	Answer	Accept	Neutral answer	Do not accept
a	1	hydrogen	H_2		H
b	1	relights/rekindles		glows brighter	
c	1	yellow			

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Q.2	Mark	Answer	Accept	Neutral answer	Do not accept
a	1	(filter) funnel			
b	1	evaporation	vaporise		
c i	1	filtration			
ii	1	distillation		evaporation / method B	

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Q.3	Mark	Answer	Accept	Neutral answer	Do not accept
a	2	making cement (1) the extraction of iron (1)			
b i	1	a reasonable correct diagram with the delivery tube going into the lime water inside test tube/beaker			
ii	1	goes milky/white/cloudy			
iii	2	calcium carbonate (1) calcium oxide + carbon dioxide (1)	$CaCO_3$ $CaO + CO_2$		limestone quicklime
c	2	benefit – creates wealth/more jobs – any one for 1 mark drawback – noise/dust/spoils the landscape – any one for 1 mark		pollution	

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Q.4	Mark	Answer	Accept	Neutral answer	Do not accept
a	3	C_3H_8 (1) any number from -41 to 19 (1) gas (1)			
b i	1	heat			
ii	1	cover with damp cloth/fire proof mat / fire blanket	carbon dioxide	fire extinguisher – unless qualified	water/foam
c i I II III	1 1 1	**B** **E** **F**			
ii	1	C_2H_4			

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Q.5	Mark	Answer	Accept	Neutral answer	Do not accept
a	1	136.8 – 136.3 = 0.5 (g)			
b	2	same volume/amount/100 cm^3 of water same mass/amount/0.5 g of alcohols / fuels spirit burner the same distance from the beaker/water - any two for 1 mark each			
c	1	ethanol – the increase in temperature is more/greater - both needed for the mark	more heat given out	final temperature higher	
d	1	loss of heat/not all the heat transferred to the water /not properly insulated	not stirred/draft		

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Q.6	Mark	Answer	Accept	Neutral answer	Do not accept
a	4	iron (II)/Fe^{2+} add sodium hydroxide – both needed for 1 mark green precipitate (1) iodide/I^- add silver nitrate – both needed for 1 mark yellow precipitate (1)			
b i	1	Na^+ and CO_3^{2-}- both needed for 1 mark		sodium and carbonate	
ii	1	Na_2CO_3			

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Q.7	Mark	Answer	Accept	Neutral answer	Do not accept
a i	1	5-6	5/6		
ii	1	(weak) acid			strong acid
b	1	sulphuric acid is **stronger** than ethanoic acid / pH of 0-2 is a stronger acid than a pH of 3-4 any one for 1 mark		sulphuric acid is a strong acid	
c	2	pH value would increase/go up (1) purple (1)	 navy blue		 green / blue

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Q.8	Mark	Answer	Accept	Neutral answer
a	1	fermentation		
b	1	liver or kidney damage/vitamin deficiency/heart disease/ memory loss/depression/stomach disorders / cancer / brain damage / high blood pressure		
c	1	violent behaviour/driving accidents/ anti-social behaviour		

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Q9	Mark	Answer	Accept	Neutral answer	Do not accept
a i	1	oxygen	O_2	air	O
ii	2	sulphur dioxide + oxygen (1) sulphur trioxide (1)	$SO_2 + O_2$ SO_3		
iii	1	increase the speed/reduce the time of the reaction			
iv	1	exothermic			
b i	1	hydrogen and oxygen both needed		H_2/H/O_2/O	
ii	1	corrosive	burns your skin	harmful / irritant	

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CHEMISTRY 3 (Legacy)

Higher Tier

Q.1	Mark	Answer	Accept	Neutral answer	Do not accept
a i	1	5-6	5/6		
ii	1	(weak) acid	acid		strong acid
b	1	sulphuric acid is **stronger** than ethanoic acid / pH of 0-2 is a stronger acid than a pH of 3-4 any one for 1 mark		sulphuric acid is a strong acid	
c	2	pH value would increase/go up (1) purple (1)	 navy blue		 green /blue

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Q2	Mark	Answer	Accept	Neutral answer
a	1	fermentation		
b	1	liver or kidney damage/vitamin deficiency/heart disease/ memory loss/depression/stomach disorders / cancer / brain damage / high blood pressure		
c	1	violent behaviour/driving accidents/ anti-social behaviour		

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Q3	Mark	Answer	Accept	Neutral answer	Do not accept
a i	1	oxygen	O_2		O
ii	2	sulphur dioxide + oxygen (1) sulphur trioxide (1)	$SO_2 + O_2$ SO_3		
iii	1	increase the speed/reduce the time of the reaction			
iv	1	exothermic			
b i	1	hydrogen and oxygen - both needed		H_2/H/O_2/O	
ii	1	corrosive	burns your skin	harmful / irritant	
c	1	lighted splint/flame gives a ‘pop’ noise			

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Q4	Mark	Answer	Accept	Neutral answer	Do not accept
a	1	to record temperature of vapour (rather than liquid below)			
b	1	(liebig) condenser			
c	1	ethanol – **lower** boiling point – both needed for 1 mark		boils/evaporates first	
d	1	distillation	fractional distillation		

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Q5	Mark	Answer	Accept	Neutral answer	Do not accept
a	1	C_3H_8			
b	1	**A/F**			
c i	1	**B**	C_2H_4/ethene		
ii	1	**C**	C_2H_5OH		
iii	1	**B**	C_2H_4/ethene		

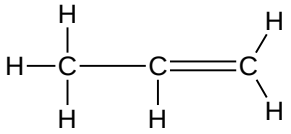
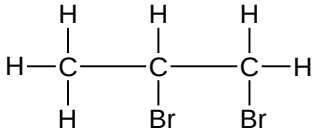
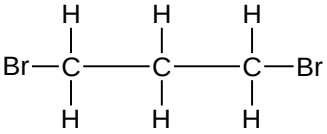
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Q6	Mark	Answer	Accept	Neutral answer	Do not accept
a i	1	calcium carbonate – **highest** decomposing temperature/needs the most heat to decompose			
ii	3	heating (1) collecting – delivery tube, teat pipette, gas jar (1) lime water goes milky/white/cloudy (1)			
b i	1	production of iron/steel, road making, making cement, neutralise soil acidity, glass production, statues – any one for 1 mark			
ii	1	neutralise acidic (soils)			
iii	1	slaked lime	lime water		

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Q7	Mark	Answer	Accept	Neutral answer	Do not accept
a	1				
b	2	bromine to propane - no change/bromine colour remains/solution stays yellow or orange (1) bromine to propene – solution becomes colourless/decolourises (1)			
c	2	$C_3H_6Br_2$ (1)  (1)			

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Q8	Mark	Answer	Accept	Neutral answer	Do not accept
a	2	(muddy) green precipitate (1) iron**(II)** hydroxide (1)	$Fe(OH)_2$		iron hydroxide
b	3	$FeCl_2$ + NaOH (1) $Fe(OH)_2$ + NaCl (1) correct balancing (1)			
c	1	white precipitate			

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Q9	Mark	Answer	Accept	Neutral answer	Do not accept
a	1	$\frac{20.00 + 20.05 + 19.95}{3} = 20.0$ (1)			
b	1	pipette/ burette		measuring cylinder unless qualified (e.g. 25 cm^3)	
c	2	$0.2 \times \frac{25}{1000}$ (1) = 0.005 (2) – 2 marks for correct answer			
d	1	0.005	consequential marking		
e	2	conc $\times \frac{20.0}{1000} = 0.005$ (1) conc = 0.25 (1) - 2 marks for correct answer	consequential marking		

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Surname	Centre Number	Candidate Number
Other Names		0

WJEC CBAC

GCSE

245/02

SCIENCE CHEMISTRY
HIGHER TIER
CHEMISTRY 3

A.M. WEDNESDAY, 25 May 2011

45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**8**	
3.	**6**	
4.	**9**	
5.	**8**	
6.	**8**	
7.	**6**	
Total	**50**	

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ADDITIONAL MATERIALS

In addition to this paper you may require 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.

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)* The following table shows the number of people admitted to a particular hospital for treatment for the effects of alcohol abuse over a period of five years.

Year	2004	2005	2006	2007	2008
Number of people treated	264	346	466	499	571

(i) State how the number of people treated for the effects of alcohol abuse has changed over time. [1]

.....

(ii) Give **one** social problem caused by alcohol abuse. [1]

.....

(iii) State **one** possible effect of long term alcohol abuse on an individual's health. [1]

.....

(b) Alcohol is used as a biofuel. State **one** advantage and **one** disadvantage of the use of alcohol as a biofuel. [2]

Advantage .....

.....

Disadvantage .....

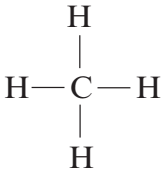
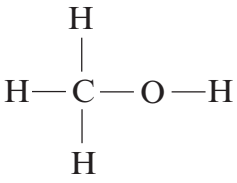
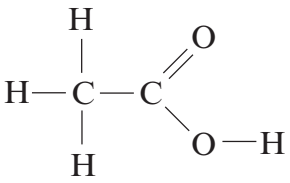
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2. The following table shows the names and formulae of some organic compounds.

Name	Formula	Structural formula
methane	CH_4	
propane	C_3H_8	
	CH_3OH	
ethene	C_2H_4	
ethanoic acid		

(a) Complete the table. [4]

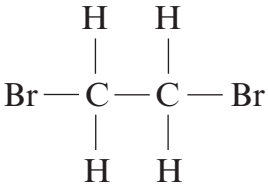
(b) Name the **two** compounds in the table that are members of the **alkane** homologous series. [1]

..... and .....

(c) Name the compound produced when alcoholic drinks containing ethanol are left exposed to air for a period of time. [1]

.....

(d) (i) Name the substance that reacts with bromine water to form [1]



.....

(ii) Give **one** observation that you would make during this reaction. [1]

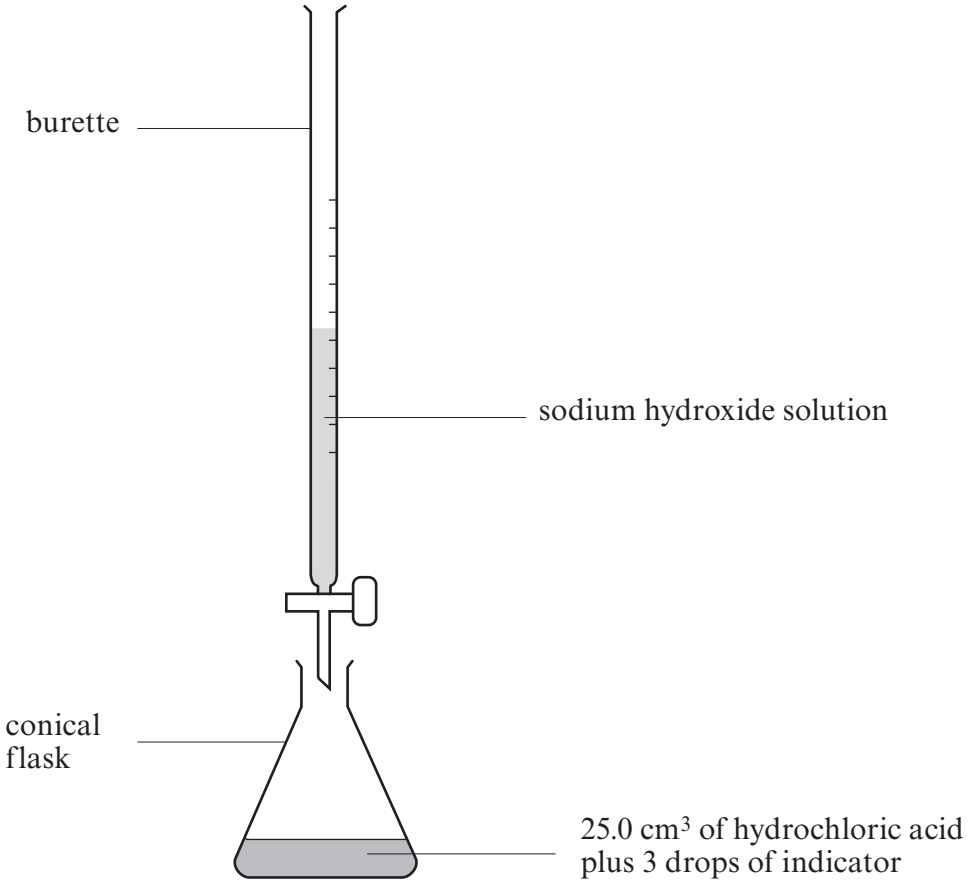
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3. *(a)* A student added sodium hydroxide solution to 25.0 cm^3 of hydrochloric acid as shown in the diagram below.



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

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

	Titration readings		
	1	2	3
Volume of sodium hydroxide used / cm^3	24.9	25.1	25.0

(i) State what the readings tell you about the relative concentrations of hydrochloric acid and sodium hydroxide solution. Give a reason for your answer. [2]

.....

.....

.....

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(ii) Give a reason for

I. repeating the titration, [1]

.....

.....

II. adding an indicator to the hydrochloric acid. [1]

.....

.....

(b) Name the type of reaction taking place when an acid reacts with an alkali. [1]

.....

(c) Complete the following general **word** equation for this type of reaction. [1]

acid + alkali ⟶ ..... + ...

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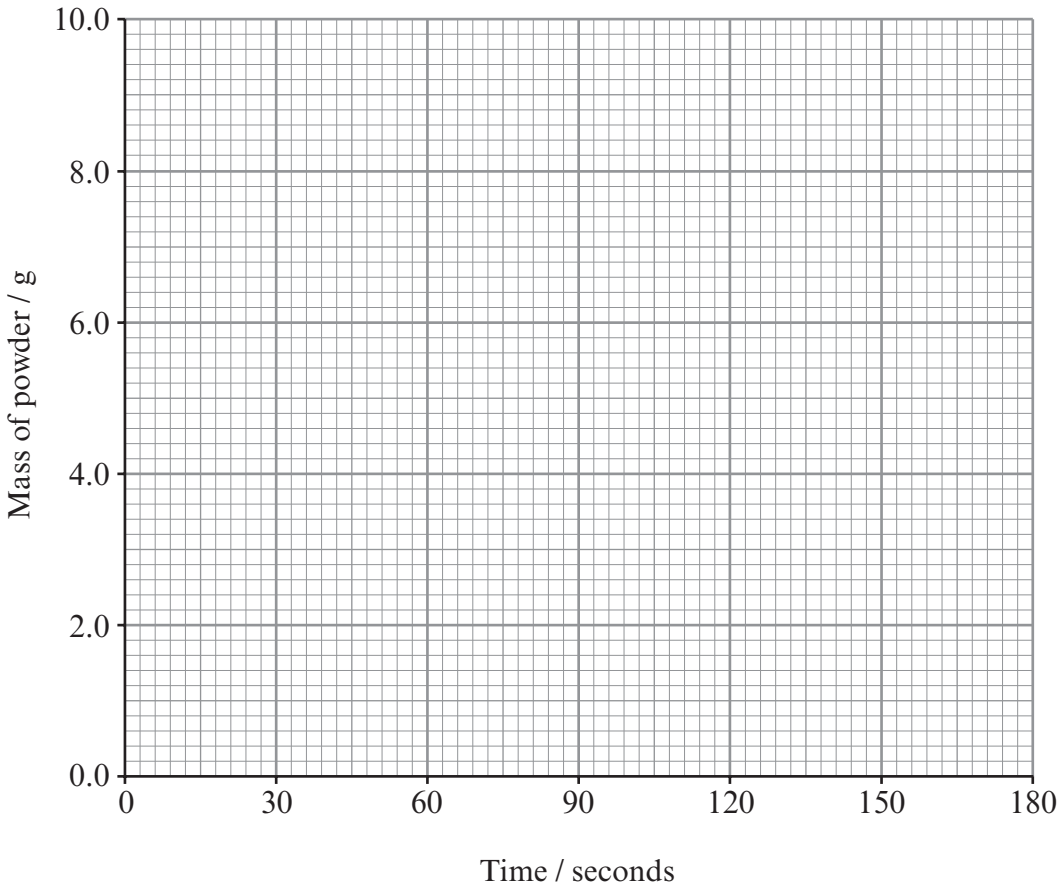
4. *(a)* Carl is investigating the decomposition of carbonates. He heats 10.0 g of green copper(II) carbonate in a boiling tube and weighs the tube every 30 seconds. His results are shown in the table below.

Time / sec	0	30	60	90	120	150	180
Mass of the tube and powder / g	19.6	17.2	15.8	15.0	14.6	14.6	14.6
Mass of powder / g	10.0	7.6	6.2	.....	5.0	5.0	5.0

(i) Use the information in the table to calculate the mass of powder present in the boiling tube after 90 seconds. [2]

Mass of powder = ... g

(ii) Plot the mass of powder on the grid below and draw a **smooth curve through the points**. [3]



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(iii) At the end of the experiment, a black powder remains in the tube. Name the black powder. [1]

.....

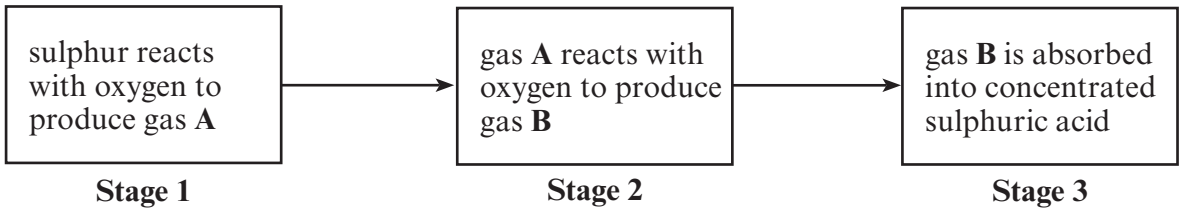
(b) Write a **balanced symbol** equation to show the thermal decomposition of copper(II) carbonate. [3]

..... ⟶ ..... + ...

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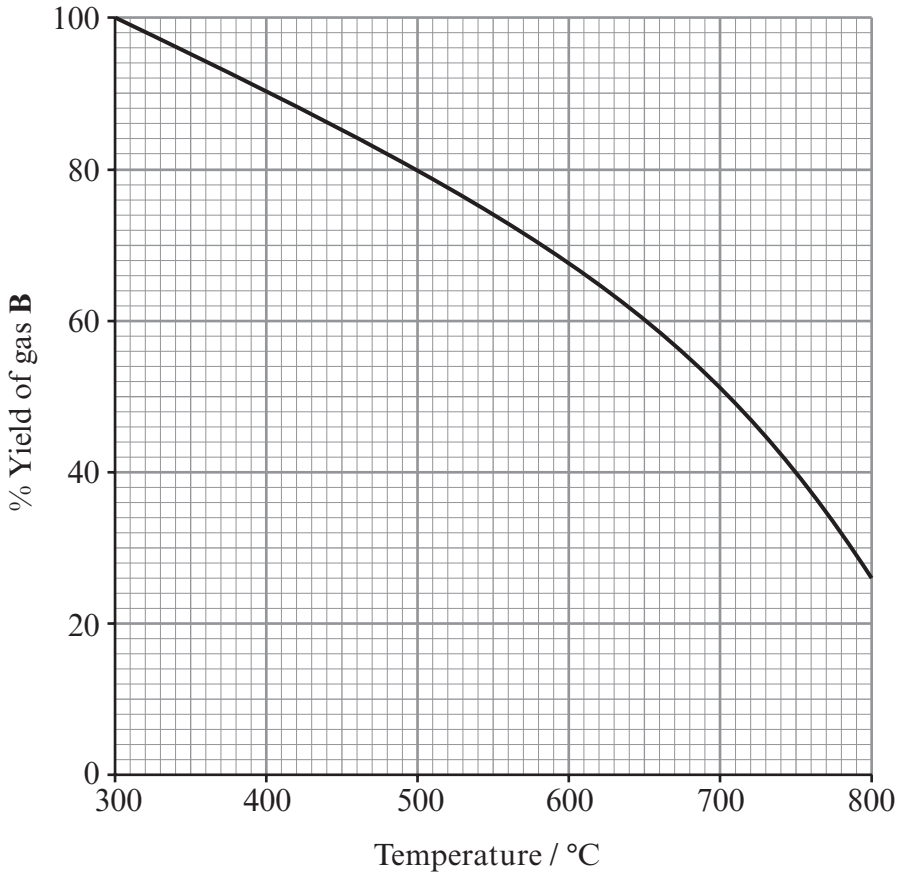
5. *(a)* Sulphuric acid is produced industrially by the Contact Process. The process involves three stages as shown below.



(i) Give the name and chemical formula of gases **A** and **B**. [2]

Gas	Name	Chemical formula
A		
B		

(ii) **Stage 2** involves a reversible reaction. The yield of gas **B** depends on the conditions used. The following graph shows how the percentage yield of gas **B** varies with temperature.



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I. From the graph, calculate the difference between the yield at 300 °C and 450 °C. [1]

.....

II. Despite this difference in yield, manufacturers use a temperature of 450 °C. Give a reason why they choose this higher temperature. [1]

.....

III. State the purpose of using vanadium(V) oxide during this stage of the process. [1]

.....

(iii) Give a reason why gas **B** is not absorbed directly into water during **stage 3** of the process. [1]

.....

(b) All acids dissociate in water to produce hydrogen ions. This can be represented by the following equation.

$$HX \longrightarrow H^+ + X^-$$

Use this equation to explain why sulphuric acid is a strong acid and ethanoic acid is a weak acid. [2]

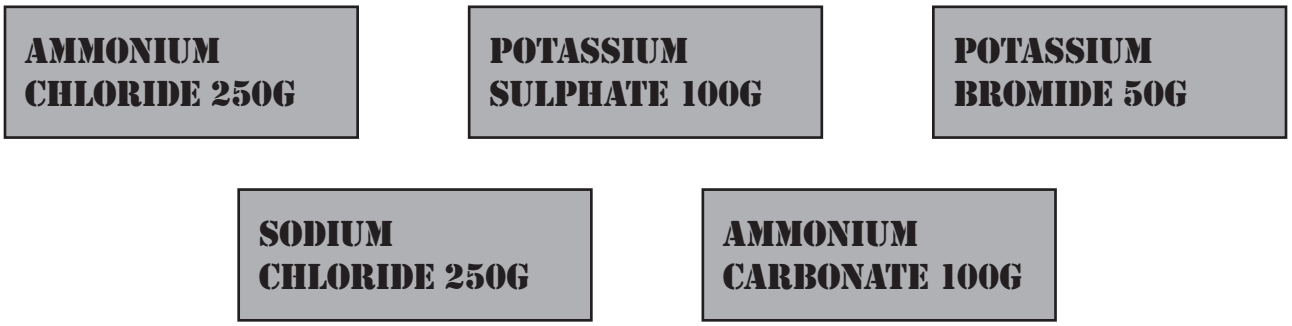
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6. *(a)* A laboratory technician found three unlabelled bottles containing white powders. He also found five labels as shown below.



He carried out tests to identify the powders and obtained the following results.

Bottle 1
- The powder produced a gas when hydrochloric acid was added. The gas produced turned limewater milky.
- No colour was seen when a flame test was carried out.
- When heated with sodium hydroxide solution, a gas was produced. The gas turned damp red litmus paper blue.

Bottle 2
- No gas was produced when hydrochloric acid was added to the powder.
- A yellow flame was seen when a flame test was carried out.
- A solution of the powder produced a white precipitate when silver nitrate solution was added.

Bottle 3
- A lilac flame was seen when a flame test was carried out.
- A solution of the powder gave an off-white (cream) precipitate when silver nitrate solution was added.

Use the results given to identify the powder in each bottle. [3]

Bottle 1 .....

Bottle 2 .....

Bottle 3 .....

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(b) (i) Sodium hydroxide solution can be used to distinguish between iron(II), Fe^{2+}, and iron(III), Fe^{3+}, ions in solution. Give the observations for **both** ions. [2]

Iron(II) .....

Iron(III) .....

(ii) Write a **balanced symbol** equation to show the reaction taking place between iron(III) chloride and sodium hydroxide solution. [3]

..... + ... ⟶ ..... + ...

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7. *(a)* Rebecca prepared a solution of sodium hydroxide, NaOH, by dissolving 1.20 g of sodium hydroxide pellets in 250 cm^3 of water.

Calculate the concentration of the sodium hydroxide solution in mol dm^{-3}. [2]

$$M_r(NaOH) = 40$$

Concentration = ... mol dm^{-3}

(b) She then used this solution to determine the concentration of dilute sulphuric acid.

She measured exactly 25.0 cm^3 of sodium hydroxide solution and titrated it against the dilute sulphuric acid. The results obtained are shown in the table below.

Titration number	1	2	3	4
Volume of sulphuric acid used / cm^3	17.3	15.9	16.1	16.0

(i) Use the **reliable** results in the table to calculate the average volume of sulphuric acid used. [1]

Average volume = ... cm^3

(ii) Sulphuric acid reacts with sodium hydroxide according to the following equation.

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

Use the average volume of sulphuric acid and the equation shown to calculate the concentration of the dilute sulphuric acid in mol dm^{-3}. [3]

Concentration = ... mol dm^{-3}

6

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FORMULAE FOR SOME COMMON IONS

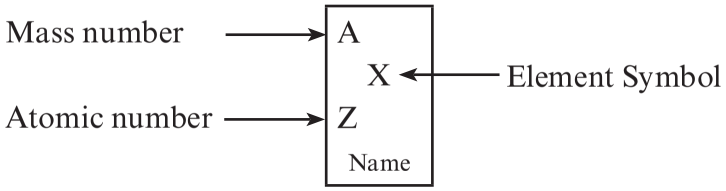
POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)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

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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 Sulphur	$^{35}_{17}$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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