

	Cer	itre N	umber

C	andid	ate Nu	ımber

# General Certificate of Secondary Education 2013

**Science: Chemistry** 

Unit C2

**Higher Tier** 



[GCH22]

**THURSDAY 20 JUNE, AFTERNOON** 

\*GCH22\*

#### TIME

1 hour 45 minutes.

## **INSTRUCTIONS TO CANDIDATES**

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

You must answer the questions in the spaces provided. Do not write outside the box, around each page or on blank pages.

Complete in blue or black ink only. **Do not write with a gel pen**. Answer **all** questions.

### **INFORMATION FOR CANDIDATES**

The total mark for this paper is **115**.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

Quality of written communication will be assessed in question **5(a)**.

A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.



1	Fire	worl	ks contain the	three ingredients shown in	the box below.	Examin Marks	er Only Remark
				colouring agent			
				fuel			
				oxidiser			
	(a)	Ма	gnesium is oft	en used in fireworks as the	colouring agent.		
		(i)	What is the courns?	olour of the flame observed	when magnesium		
					[1]		
		(ii)	Write a balan	nced symbol equation for ma	agnesium burning in air.		
					[3]		
	(b)	Car	bon in the for	m of charcoal is often used	as the fuel in fireworks.		
		(i)	What is obse	rved when a sample of carb	oon burns?		
					[2]		
		(ii)	Name the proof oxygen.	oduct formed when carbon b	ourns in a limited supply		
					[1]		

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(c)	effe	disers provide the oxygen needed to allow the firework to burn ectively. A common oxidiser is potassium nitrate, which thermally composes to produce potassium oxide, nitrogen and oxygen.	′	Examin Marks	er Only Remark
	Wri	te a balanced symbol equation for this reaction.			
			[3]		
(d)	and	arklers are hand held fireworks which contain a fuel, an oxidiser I iron powder. Often the iron powder is mixed with linseed oil to vent it rusting.			
	(i)	What conditions are required for iron to rust?			
			[2]		
	(ii)	What is the chemical name for rust?			
			[2]		
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(e)	In industry, iron is manufactured in the Blast Furnace.	Examin Marks	er Only Remark
	A redox reaction which occurs in the Blast Furnace is given below:		
	$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$		
	Explain fully, in terms of change in oxygen content, why this reaction is described as a redox reaction.		
	[5]		
		Total Qu	estion 1

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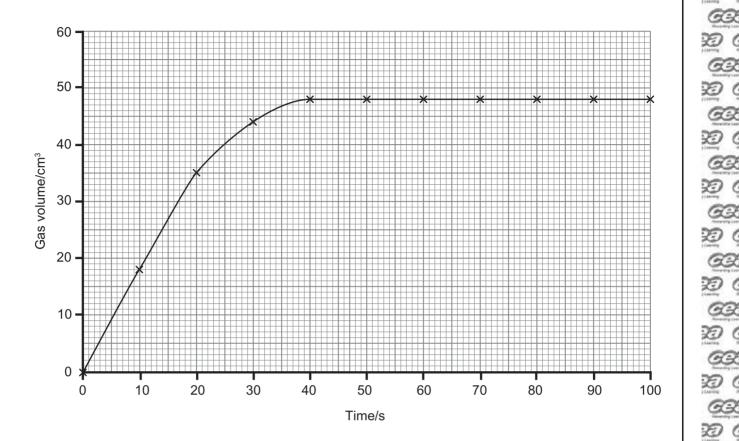
2	(a)	The rate of decomposition of a solution of hydrogen peroxide using manganese(IV) oxide (manganese dioxide) can be measured using the apparatus shown below. The manganese(IV) oxide is a catalyst the reaction.	IG Mai	aminer Only rks Remark
		hydrogen peroxide solution and manganese(IV) oxide		
		(i) Name the piece of apparatus labelled A.	_ [1]	
		(ii) What is meant by the term catalyst?		
			[3]	
		(iii) Write a balanced symbol equation for the decomposition of hydrogen peroxide.	_ [3]	

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**(b)** The graph below shows data obtained at 25 °C using 25.0 cm<sup>3</sup> of 0.16 mol/dm<sup>3</sup> hydrogen peroxide solution with 1.0 g of solid powdered manganese(IV) oxide.



(i) Apart from the apparatus shown in the diagram in part (a), name one other piece of equipment which would be required to collect the results used to draw the graph.

		F 4 7
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(ii) What was the total volume of gas collected?

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[1]
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(iii) The reaction was repeated at 40 °C with all other factors being kept the same. Sketch the graph you would expect to obtain on the axes above. [3]

Marks	Remark

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(c) The table below shows the time taken for the decomposition of hydrogen peroxide solution to be completed. 25.0 cm³ of 0.16 mol/dm³ hydrogen peroxide solution was used with 1.0 g of different powdered metal oxides as catalysts.

Examin	er On
Marks	Rem

Metal oxide	Time for decomposition to be completed/s	Rate of decomposition/s <sup>-1</sup> $rate = \left(\frac{1}{time}\right)$
Manganese(IV) oxide		
Copper(II) oxide	127	0.00787
Zinc oxide	360	0.00277

- (i) Using the graph at 25 °C in part (b), complete the table above. [2]
- (ii) State which of the metal oxides in the table is the **least** effective catalyst and explain your answer.

\_\_\_ [2]

Total Question 2

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3	Perfume is a mixture of essential oils dissolved in a solvent. One of the
	essential oils used in making perfume is called myrcene.

Examiner Only		
Marks	Remark	

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(a) The structural formula of a molecule of myrcene is shown below.

(i) Explain why a molecule of myrcene can be classified as a hydrocarbon.

\_\_\_\_\_ [1]

(ii) Identify the functional group present in myrcene.

\_\_\_\_\_ [1]



(b) Linalool is another essential oil used in perfume making. It gives a sweet, lavender-like smell. The structural formula of linalool is shown below.

					H 	
H	H	ŌН	H	H	н н—ċ—н н	
	=0-	—C—	— C—	—C—	_c==cc-	— н
 H	H-	_	   H	H	l H	
		Ĭ				
		Η̈́				

- (i) On the structure of linalool shown above, draw a circle around the **alcohol** functional group. [1]
- (ii) Like all alcohols, linalool (C<sub>10</sub>H<sub>17</sub>OH) undergoes complete combustion in excess air. Complete and balance the symbol equation below for this reaction.

$$C_{10}H_{17}OH + O_2 \longrightarrow$$
 [2]

(iii) When linalool is warmed with acidified potassium dichromate solution it is oxidised in the same way as ethanol. State the colour change which is observed in this reaction.

from \_\_\_\_\_\_ to \_\_\_\_\_[2]

[Turn over

Examiner Only

Marks Remark

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(c) Etr	nanol	is an alcohol whi	ich is often used as a sol	vent in perfumes.	Exa Mar	aminer O ks Rer
(i)	Writ	e the general for	mula for alcohols.			
					[1]	
(ii)	) Drav	w the structural f	ormula of ethanol.			
					[1]	
(iii			to manufacture the etha below to give information		nes.	
(iii	Con				nes.	
	Con	Molecular	pelow to give information	State at room temperature	nes.	
	Con	Molecular	pelow to give information	State at room temperature	nes.	
Nam	Con	Molecular	pelow to give information	State at room temperature	nes.	
Nam	Con	Molecular	pelow to give information	State at room temperature		
Nam	Con	Molecular	pelow to give information	State at room temperature	nes.	
Nam	Con	Molecular	pelow to give information	State at room temperature		
Nam	Con	Molecular	pelow to give information	State at room temperature		



	(d)	Ethanoic acid is a carboxylic acid which can be used to make other solvents. These solvents are also used in perfumes.			er Only Remark
		(i)	Draw the structural formula of ethanoic acid.		
			[1]		
		(ii)	State two observations you would make when magnesium reacts with ethanoic acid.		
			[2]		
		(iii)	Write a balanced symbol equation for the reaction of magnesium with ethanoic acid.		
			[3]		
				Total Qu	estion 3
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		may be placed in a reactivity series by observing their reactions water, steam and dilute acid.	Examiner Only  Marks Remark
(a)	The	apparatus below may be used to react zinc metal with steam.	
damp mineral wool HEAT	HE	zinc  gas produced  beehive shelf	
		© Barking Dog Art	
	(i)	What labels should be placed at A and B on the diagram?	
		A	
		B[2]	
	(ii)	Explain why the damp mineral wool is heated.	
		[1]	
	(iii)	Name the gas produced in this experiment.	
		[1]	
	(iv)	Name a metal which does not react when heated with steam.	
		[1]	
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**(b)** X is an unknown metal. The table below gives details of some reactions of the three metals X, sodium and zinc.

Examiner Only				
Marks	Remark			

Metal	Reaction when heated in oxygen	Reaction with cold water	Reaction with dilute hydrochloric acid
X	Black coating forms on metal without burning	No reaction	No reaction
Sodium	Burns very vigorously with a yellow flame		Dangerous reaction not carried out in school laboratory
Zinc	Burns forming a yellow solid which changes to white on cooling	No reaction	Reacts steadily

(i)	Suggest the name of metal X.	
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[1

(ii)	Describe what you would observe when sodium reacts with c	old
	water.	

			[3]
			[~]

(iii) Write a balanced symbol equation for the reaction of sodium with	1
water.	

	[3]

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(c)		minium is a metal which is extracted from its ore (bauxite) by ctrolysis.		Examine Marks	er Only Remark
	(i)	What is meant by the term electrolysis?			
			[2]		
	(ii)	What is the name of the <b>purified</b> bauxite which is used in the production of aluminium by electrolysis?			
			[1]		
	(iii)	Write a half equation to represent the production of aluminium during this electrolysis process.			
			[3]		
	(iv)	At what temperature is this electrolysis carried out?			
			[1]		
	(v)	Explain why the carbon anodes need to be replaced periodical during this electrolysis.	У		
			[3]		
				Total Qu	estion 4
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5		aline batteries contain one particular metal hydroxide. The metal roxide can be represented as MOH.	Examiner Only  Marks Remark
		© iStockphoto / Thinkstock	
	deid	2g of this solid metal hydroxide were dissolved in 1000 cm <sup>3</sup> of onised water in a volumetric flask. 25.0 cm <sup>3</sup> of this solution were placed conical flask using a pipette.	
	(a)	Describe in detail how you would prepare and use a pipette to transfer 25.0 cm³ of the MOH solution into a conical flask, ensuring accuracy and safety.	
		In this question you will be assessed on using your written communication skills including the use of specialist scientific terms.	
		[6]	

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**(b)** 25.0 cm³ of the MOH solution were titrated with hydrochloric acid of concentration 0.125 mol/dm³ using phenolphthalein indicator. The results are shown in the table below.

Examin	er Only	l
Marks	Remark	

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	Initial burette volume/cm³	Final burette volume/cm³	Titre/cm³
Rough titration	0.0	14.9	14.9
First accurate titration	14.9	28.9	14.0
Second accurate titration	28.9	42.9	14.0

(i) Calculate the average titre.

\_\_\_\_ cm<sup>3</sup> [2]

(ii) State the colour change at the end-point.

From \_\_\_\_\_\_ to \_\_\_\_\_ [2]

(iii) Calculate the number of moles of hydrochloric acid used in the titration.

[2]

The balanced symbol equation for the reaction is:

$$MOH + HCI \rightarrow MCI + H_2O$$

(iv) Calculate the number of moles of MOH present in 25.0 cm³ of the solution in the conical flask.	Examiner Only  Marks Remark
[1]	
(v) Calculate the number of moles of MOH present in 1000 cm <sup>3</sup> of the solution.	
[2]	
(vi) Using the fact that 3.92g of MOH were dissolved in 1000 cm <sup>3</sup> and the answer to question (b)(v) above, determine the relative formula mass of MOH.	
[2]	
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	<ul><li>(vii) Determine the relative atomic mass of M using your answer to question (b)(vi).</li><li>(Relative atomic masses: H = 1; O = 16)</li></ul>		Examino Marks	er Only Remark
		[2]		
	(viii) Identify the metal, M.			
		[1]		
			Total Qu	estion 5
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6	(a)	_	vas carried out to compare ee towns A, B and C.	the hardness of water	Examiner Only  Marks Remark
			ater sample were placed int d A, B and C. A sample of	•	
			s added, 1 cm³ at a time, to sting lather formed. The totalsk was recorded.		
		•	vas repeated with fresh san and allowed to cool, before	•	
		The results are sh	nown in the table below.		
	W	ater sample	Volume of soap so form a	-	
		-	before boiling (cm³)	after boiling (cm³)	
	De	ionised water	2	2	
		Α	6	6	
		В	8	2	
		С	11	7	
		(i) Which of the water?	three water samples (A, B	,	
				[1]	
		(ii) Which of the temporary ha	three water samples (A, B rdness?	or C) contains <b>only</b>	
				[1]	
		• •	three water samples (A, B d permanent hardness?	or C) contains both	
				[1]	
					Turn over

5. A. E. A



	(b)	Permanent hardness may be removed from water by the addition of washing soda. Explain, in terms of ions, how washing soda can soften hard water.	Examin Marks	er Only Remark
		[3]		
	(c)	State two disadvantages of hard water.		
		1		
		2		
		[2]		
			Total Qu	estion 6
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, .		which is produced when ammonia reacts with nitric acid.		
(a)	(i)	Write a balanced symbol equation for the reaction of ammonia with nitric acid.		
			[2]	
	(ii)	Describe how you would carry out a chemical test for the presence of ammonia gas, stating the observations you would make for a positive test.		
			[4]	
	(iii)	State one disadvantage of using nitrogenous fertilisers.	[1]	
(b)	invo	ndustry ammonia gas is produced by the Haber process which blves a reversible reaction between the gases nitrogen and rogen.		
		$N_2 + 3H_2 \rightleftharpoons 2NH_3$		
	(i)	Explain what you understand by the term reversible reaction.		
			[1]	
	(ii)	Name the catalyst used in the Haber process.		
			[1]	



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(iii)	Suggest why industry uses 450 °C and 250 atm when it is possibl to obtain a higher yield of ammonia using a lower temperature and a higher pressure.	Examir Marks	ner O Rer
		_	
TH	IS IS THE END OF THE QUESTION PAPER		
		Total Qu	uestic



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For Examiner's use only	
Question Number	Marks
1	
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7	
QWC	

Total Marks

**Examiner Number** 

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