

Ce	ntre Number
71	
Can	didate Number

General Certificate of Secondary Education 2012

Science: Chemistry

Paper 2 Higher Tier

[G1404]





TIME

2 hours.

INSTRUCTIONS TO CANDIDATES

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

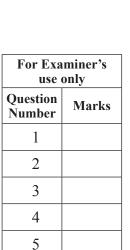
Write your answers in the spaces provided in this question paper. Answer **all seven** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 160.

Quality of written communication will be assessed in question **7(c)**. Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

A Data Leaflet which includes a Periodic Table of the Elements is provided.

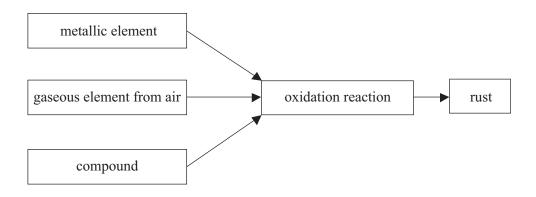


Tr. 4 - 1	
Total	
Marks	
Maiks	



1 (a) The formation of rust is described as an oxidation reaction. The flow chart below shows the formation of rust during which a metallic element reacts with a gaseous element from the air and a compound.

Examin	er Only
Marks	Remark



(i)	Name the	metallic	element	which	reacts	to	form	rust
-----	----------	----------	---------	-------	--------	----	------	------

Г1	٦.
	1
1	

(ii) Name the gaseous element from the air which is required for the formation of rust.

r.	4 7
	11
I -	* I

(iii) Name the compound which is required for the formation of rust.

[1]

(iv) Explain what is meant by oxidation.

		Γ1 ⁻
		1

(v) Describe the appearance of rust.



(b)		reaction of chlorine with hydrogen may be described as both a thermic reaction and as a reduction.	n	Examin Marks	er Only Remark
		chlorine + hydrogen → hydrogen chloride			
	(i)	Write a balanced symbol equation for the reaction of chlorine whydrogen.	with		
			[3]		
		Explain why chlorine is described as being reduced in this reaction.			
			[2]		
	(iii)	Describe the colour of the reactants in this reaction.			
		chlorine			
		hydrogen	[2]		
	(iv)	What is meant by the term exothermic?			
			[1]		
(c)	_	per(II) carbonate breaks down on heating in an endothermic tion.			
	(i)	What term is used to describe a reaction in which a substance breaks down on heating?			
			[2]		
	(ii)	Write a balanced symbol equation for the reaction which occur when copper(II) carbonate is heated.	rs		
			[2]		

	[2]
is oc	fagnesium reacts with copper(II) sulphate solution. The reaction described as a redox reaction as both oxidation and reduction are ccurring. The balanced symbol equation and ionic equation for the action are given below.
Ва	alanced Symbol Equation: Mg + $CuSO_4 \rightarrow Cu + MgSO_4$
Io	nic Equation: $Mg + Cu^{2+} \rightarrow Cu + Mg^{2+}$
(i)	In this reaction, which ion does not undergo any change?
	[1]
(ii	i) What is oxidised in this reaction?
	[1]
(ii	ii) Write a half equation for the oxidation process occurring in this reaction.
	[3]
(iv	v) Explain why copper ions are described as being reduced in this reaction.
	[2]

2 Pharmaceutical drugs are manufactured and analysed in a specialised chemistry laboratory.





Í 'Dtcpf 'Z'Rkewtgu'TVj kpmaqem

(a) Amyl nitrite is a drug commonly used to treat patients with heart disease.

A sample of amyl nitrite was analysed and found to contain four elements in the following proportions: 72.0 g of carbon, 13.2 g of hydrogen, 16.8 g of nitrogen and 38.4 g of oxygen.

Determine the empirical formula of amyl nitrite. (Relative atomic masses: H = 1; C = 12; N = 14; O = 16)

Empirical formula _____ [5]

(b)	The pharmaceutical drug Eskalith is made from another carbon containing compound. The formula of this compound may be written as X_2CO_3 . To determine the identity of X in this compound, a titration was carried out.
	3.70 g of solid X ₂ CO ₃ were dissolved in 1000 cm ³ of deionised water

$3.70 \mathrm{g}$ of solid $\mathrm{X}_2\mathrm{CO}_3$ were dissolved in $1000 \mathrm{cm}^3$ of deionised water
and mixed thoroughly. 25.0 cm ³ of this solution were placed in a
conical flask with a few drops of methyl orange indicator. 20.0 cm ³ of
0.125 mol/dm ³ hydrochloric acid were required to reach the end-point.

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

moles [2

Examiner Only

The balanced symbol equation for the reaction is:

$$\mathrm{X_{2}CO_{3}} \hspace{0.2cm} + \hspace{0.2cm} 2\mathrm{HCl} \hspace{0.2cm} \rightarrow \hspace{0.2cm} 2\mathrm{XCl} \hspace{0.2cm} + \hspace{0.2cm} \mathrm{CO_{2}} \hspace{0.2cm} + \hspace{0.2cm} \mathrm{H_{2}O}$$

(ii) Use the balanced symbol equation to determine the number of moles of X₂CO₃ present in 25.0 cm³ of the solution in the conical flask.

(iii) Calculate the number of moles of $\rm X_2CO_3$ present in $1000\,\rm cm^3$ of solution.

(iv)	Using the initial mass of X_2CO_3 and the answer to (b) (iii), calculate the relative formula mass of X_2CO_3 .
(v)	relative formula mass [2] Calculate the relative atomic mass of X and use your Data Leaflet to determine the identity of X. (Relative atomic masses: $C = 12$; $O = 16$)
	relative atomic mass

Examiner Only

Marks Remark

(c)	Nitrous oxide (N ₂ O), also known as laughing gas, is commonly used
	as an anaesthetic in dentistry. Nitrous oxide may be produced by
	heating a sample of ammonium nitrate, NH ₄ NO ₃ . The equation for this
	reaction is given below.

Examiner Only

$NH_4NO_3(s)$	\rightarrow	$2H_2O(g)$	+	$N_2O(g)$
1111/11/03(3)	/	21170(5)		1170(8)

Calculate the volume of nitrous oxide in dm³ which can be produced when 2kg of ammonium nitrate are fully decomposed on heating. (Relative atomic masses: H = 1; N = 14; O = 16; 1 mole of any gas occupies a volume of $24 \, dm^3$ at room temperature and pressure.)

volume of N ₂ O	dm^3 [6	51
VOIGILIE OF TAGE	WIII (<i>,</i> ,

(d)	Nitrous oxide (N ₂ O) may also be produced by heating ammonia and
	oxygen in the presence of a catalyst. The equation for this reaction is
	given below.

Examin	er Only
Marks	Remark
Marks	Remark

[3]

$$2\mathrm{NH_3(g)} \ + \ 2\mathrm{O_2(g)} \ \rightarrow \ \mathrm{N_2O(g)} \ + \ 3\mathrm{H_2O(g)}$$

(i) State Avogadro's Law.

(ii) Using Avogadro's Law, or otherwise, calculate the volume of ammonia (NH_3) in cm³, required to produce $70\,\mathrm{cm}^3$ of nitrous oxide (N_2O).

volume of NH₃ _____ cm³ [2]

BLANK PAGE

C'dqv C''ecp	''qh''Dcyj ''Et { uwnu''eqpwclop wrg''qh''Okm''qh''Ocipgulc''n ''qh''Ot''Owueng''Qxgp''Engo ''qh''Oquunkmgt''(''Ncyp''V	ks wkf "eqpw cpgt"eqpwl	ckpkpi "o ci kpkpi "uqfkv	pgukwo 'j {f wo 'j {ftqzkf		
,	" " "		11 11 11	u u	n	
(i)	Classify each substance tick () in the correct common classification for Leaflet useful in answer	olumn in the column of each substitution of the column of	he table be bstance. You destion.	elow. Choose ou may find	the most	
	Substance	acid	base	alkali	salt	
	magnesium chloride					
	magnesium hydroxide					
	sodium hydroxide					
	zinc sulphate				[4]	
					[4]	
(ii)	Sodium hydroxide reacts symbol equation for this		huric acid	. Write a bal	anced	
(ii)			huric acid	. Write a bal	anced [3]	

(iv) Hydrated zinc sulphate has the formula ZnSO₄.7H₂O. What is meant by the term hydrated?

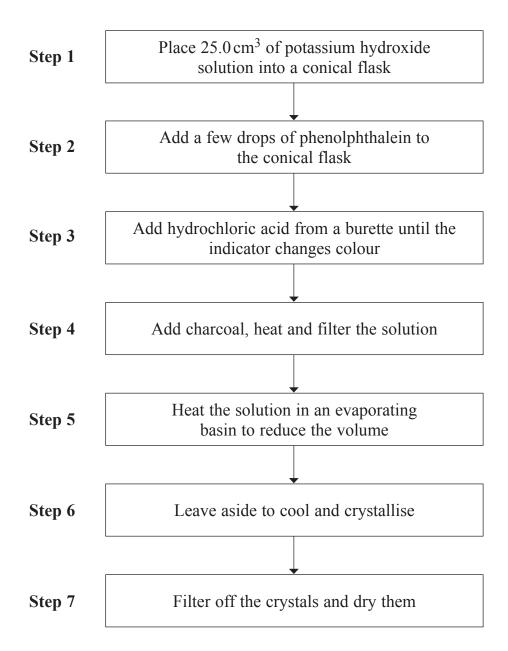
Examiner Only

Marks Remark

[2]

(b) A pure, dry sample of potassium chloride can be prepared by the reaction of potassium hydroxide solution with hydrochloric acid.

The flow chart below explains how this is carried out.



(i)	Name the piece of apparatus required to place 25.0 cm ³ of potassium hydroxide solution into the conical flask in Step 1 .	Examin Marks	er Only Remark
(ii)	What colour change is observed in Step 3 ?		
	From to [2]		
(iii)	What is the purpose of the charcoal in Step 4 ? [1]		
(iv)	Draw a labelled diagram of the assembled apparatus used to heat the solution in Step 5 .		
	[3]		
(v)	Explain why crystals form on cooling in Step 6 .		
	[1]		
(vi)	State one method which may be used to dry the crystals in Step 7 .		
	[1]		

(i)	What is an anion?	
		_ [1]
(ii)	What is meant by the term precipitate?	
		[2]
(iii)	Name the solution which is used to test for the presence of sulphate ions.	
		_ [1]
(- · <i>)</i>	Potassium iodide solution was mixed with silver nitrate soluti and a precipitate formed. State the colour of the precipitate.	_ [1]

4 Aluminium is the most abundant metal in the Earth's crust. Aluminium ore is first purified to give aluminium oxide and the metal is then extracted from the aluminium oxide by electrolysis.

Examiner Only		
Remark		

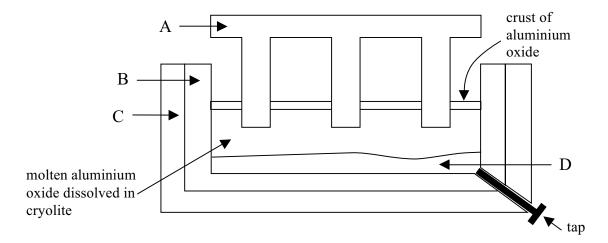
(a) What is meant by the term electrolysis?

[2]
121

(b) Name the ore from which aluminium is extracted.

Γ1
1

(c) The electrolysis of the purified ore is carried out in the Hall-Héroult cell. The diagram below shows the cell used.



(i) Name parts A, B and C, and substance D.

Α			

В _____

C _____

D ______ [4]

(ii) Explain why the aluminium oxide will only conduct electricity when molten.

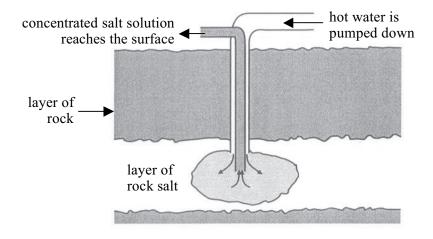
	 	 · · · · · · · · · · · · · · · · · · ·
		[2]

(iii) At what temp	perature does the electrolysis tak	•	Examiner Marks R
		[1]	
(iv) Suggest one cryolite.	reason why the aluminium oxide	e is dissolved in	
		[1]	
	oducts formed at the positive and f equations for the reactions take		
	Positive electrode	Negative electrode	e
Name of product			
Half equation			
(vii) Explain how	the aluminium produced in the		
from the cell			
		[1]	

Ciiai	s, including lignite, are extracted by open-cast mining.	Marks
Lign	nite is a fossil fuel. Describe how lignite is formed.	
	[3]	
_		
Anti	ge deposits of lignite have been located near Ballymoney, County rim. The advantages and disadvantages associated with mining this ite were debated in the Northern Ireland Assembly in July 2007.	
	State two advantages for the local community of setting up a lignite mine.	
	1	
	2	
	F.A.7	
	[2]	
	State two disadvantages for the local community of setting up a lignite mine.	
	1	
	2	
	2	
	[2]	

(c) Another method used to extract raw materials from the earth is solution mining. This method is used to extract sodium chloride from the earth.





(i)	On what physical property of sodium chloride does this proce	ess
	depend?	

_____[1]

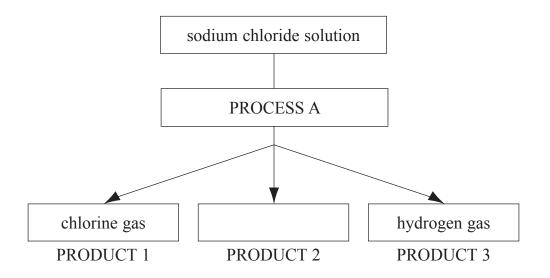
(ii) Suggest one reason why solution mining uses a lot of energy.

_____[1]

(iii) Suggest **one** negative effect which solution mining has on the environment.

_____[1]

(d) The chlor-alkali industry uses a substantial percentage of the sodium chloride produced from solution mining. The main process involved is summarised in the diagram below.



(i)	Name	Process	Α
(1)	ranic	1100033	1 L.

_____[1]

(ii) Write the chemical formula for Product 2.

_____[1]

(iii) State one use of each of the gaseous products.

chlorine:

hydrogen: _____ [2]

6 On 14th April 2010 the volcano Eyjafjallajökull erupted in Iceland, creating an ash cloud which was dangerous for aircraft and led to the closure of many airports for about ten days.





Í "kUqemrj qvq"1"Vj kpmvqem

A large number of gases were released into the atmosphere from the volcano. These volcanic gases included carbon dioxide, hydrogen and hydrogen chloride.

(a) Complete the table below to describe the tests used to identify each of these gases in the laboratory, and state the result of a positive test for each gas.

Gas	Test	Result of positive test	
carbon dioxide			[2]
hydrogen			[2]
hydrogen chloride			[4]

	Examiner Only		
	Marks	Remark	
L			

(b)	-	phur dioxide is also emitted when a volcano erupts. It is a pollument which reacts with water in the air to form acid rain.	ant Examin Marks	er Only Remark
	(i)	Write a balanced symbol equation for the reaction of sulphur dioxide with water.		
			[2]	
	(ii)	State two harmful effects of acid rain on the environment.		
		1.		
		2		
			[2]	
(c)	cos	canic ash contains many different minerals and can be used in metics including skin scrubs. Some skin scrubs, such as the one wn below, contain sugar to give roughness.		
		p'kocig'qh'OCE''Xqrecpke''Cuj''Gzhqrkcvqt'jcu''dggp''tgoqxgfo''yku'rcig'fwg''vq''eqr{tkijv'kuuwguOp		
	(i)	Describe the appearance of sugar.	[2]	
			[2]	

(ii)	State three observations you would make when concentrated sulphuric acid is added to sugar.				
		[3]			
con	npounds may con	added to many cosmetics to give colour. Iron tain the iron(II) ion or the iron(III) ion. The s in solution may be detected by adding ammonia			
(i)	Complete the table to show what would be observed when ammonia solution is added to a solution of iron(II) ions and to a solution of iron(III) ions.				
		Result of a positive test when ammonia solution is added			
	iron(II) ion				
	iron(III) ion				
		[4]			
(ii)	Write an ionic ec ammonia solutio	quation for the reaction of iron(II) ions with n.			

7	Hydrogen peroxide, H ₂ O ₂ , decomposes very slowly to produce water and
	oxygen.

Examiner Only

Marks Remark

(a) Draw a labelled diagram of the assembled apparatus used to carry out this reaction and measure the volume of oxygen produced every minute. Include all apparatus required.

[4]

(i) Explain what you understand by the term catalyst.

_____[3]

(ii) What mass of manganese(IV) oxide will be recovered at the end of the reaction?

_____[1]

(iii) Catalysts are important in many industrial processes. Complete the table below.

Industrial Process	Catalyst used	Balanced symbol equation for the catalysed reaction			
The Haber Process	iron				
The Contact Process		$2SO_2 + O_2 \rightarrow 2SO_3$			
Production of Nitric acid	platinum/ rhodium				

i	increases the rate of reaction.		
-			
-			
_			
_			
-			
_		[3]	
I t	Quality of written communication In the Haber Process, a pressure of 250 atmospheres is used though a higher yield of ammonia can be obtained at a higher Suggest two reasons why a higher pressure is not used in the	er pressure.	
I t	In the Haber Process, a pressure of 250 atmospheres is used though a higher yield of ammonia can be obtained at a higher	even er pressure.	
1 t S	In the Haber Process, a pressure of 250 atmospheres is used though a higher yield of ammonia can be obtained at a higher Suggest two reasons why a higher pressure is not used in the	even er pressure.	
1 t S	In the Haber Process, a pressure of 250 atmospheres is used though a higher yield of ammonia can be obtained at a higher Suggest two reasons why a higher pressure is not used in the 1.	even er pressure.	
1 t S	In the Haber Process, a pressure of 250 atmospheres is used though a higher yield of ammonia can be obtained at a higher Suggest two reasons why a higher pressure is not used in the 1.	even er pressure.	
1 t S	In the Haber Process, a pressure of 250 atmospheres is used though a higher yield of ammonia can be obtained at a higher Suggest two reasons why a higher pressure is not used in the 1.	even er pressure. e process.	
] t S	In the Haber Process, a pressure of 250 atmospheres is used though a higher yield of ammonia can be obtained at a higher Suggest two reasons why a higher pressure is not used in the 1.	even er pressure. e process.	
11 11 22	In the Haber Process, a pressure of 250 atmospheres is used though a higher yield of ammonia can be obtained at a higher Suggest two reasons why a higher pressure is not used in the 1.	even er pressure. e process.	

Permission to reproduce all copyright material has been applied for. In some cases, efforts to contact copyright holders may have been unsuccessful and CCEA will be happy to rectify any omissions of acknowledgement in future if notified.