

Centre Number			
71			

Candidate Number

General Certificate of Secondary Education 2011

Science: Double Award (Non-Modular)

Paper 2 Higher Tier

[G8405]





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.

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

INFORMATION FOR CANDIDATES

The total mark for this paper is 120.

Quality of written communication will be assessed in question **9(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.



For Examiner's use only					
Question Number Marks					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

Total Marks	
TVIATING	

1	In chemistry particular words or terms are often used to describe reaction	S. Examiner Only Marks Remark
	Six types of chemical reaction are: A Reduction B Thermal Decomposition C Combustion D Displacement E Neutralisation F Hydration	
	For each of the following reactions choose the appropriate letter A , B , C , E or F to describe the type of reaction. The first one has been done for you	
	$Mg + FeSO_4 \rightarrow MgSO_4 + Fe$ D	
	(a) $2Zn + O_2 \rightarrow 2ZnO$	[1]
	(b) $HCl + KOH \rightarrow KCl + H_2O$	[1]
	(c) $CuSO_4 + 5H_2O \rightarrow CuSO_4.5H_2O$	[1]
	(d) $CaCO_3 \rightarrow CaO + CO_2$	[1]
2	There is more iron manufactured each year than any other metal. Give three different reasons why so much iron is manufactured. 1	
	2	_
	3	_
		[3]

2

3 The table below gives some information about the structure of atoms. Complete the table.

Examiner Only			
Marks	Remark		

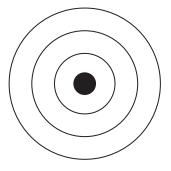
Symbol	Number of protons	Number of neutrons	Number of electrons	Mass number	Electron arrangement
Na		12	11	23	2,8,1
О	8	8		16	
Ca	20	20	20		2,8,8,2
Al	13		13	27	

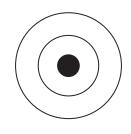
[6]

1	Magnagium	ranata with	fluorinata	farma tha	a a man a um d	122 0 021 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1	fluorida
4	Magnesium	reacts with	muonne to	ioiiii uie	Compound	magnesium	HuoHue.

Examiner Only				
Marks	Remark			

(a) Complete the diagrams below to show the arrangement of all the electrons in a magnesium atom and a fluorine atom.





magnesium atom

fluorine atom

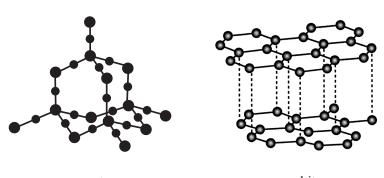
[2]

[3]

(b)	Explain, in terms of the atoms involved, how the electron arrangement change when magnesium fluoride is formed from magnesium and fluorine.				

5 The structures of two giant covalent compounds are given below.





quartz graphite

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Quartz is a giant covalent molecule made up of silicon atoms and oxygen atoms. Graphite is made up of carbon atoms.

(a) Name another giant covalent molecule which is made up of carbon atoms only and has a similar structure to quartz.

____[1]

(b) Why can quartz **not** conduct electricity?

[1]

(c) Both quartz and graphite have very high melting points. Why is it difficult to melt molecules which have a giant covalent structure?

6	(a)	When uranium-238 decays it loses an alpha particle. Complete the
		nuclear equation for this reaction. (You may find your Data Leaflet
		useful).

$_{92}^{238}$ U			
-02 U	\rightarrow	+	[4]
92	•	ļ.	171

(b) Uranium-238 has a very large half-life of 4.5×10^9 years. How long would it take 20 g of 238 U to decay to 2.5 g?

V	ears	[2]

Examiner Only

	s question is about the causes and effects of hard water and how it casoftened.	ın	Examine Marks	er Only Remark
(a)	Temporary hard water contains calcium hydrogencarbonate.			
	Explain how soluble calcium hydrogencarbonate is formed from calcium carbonate.			
		[2]		
(b)	Explain, in terms of ions involved, how the addition of washing sod (sodium carbonate) can soften hard water.	la		
		[3]		

7

8 This question is about the amount of iron that can be produced from a certain amount of iron(III) oxide. The equation for the reaction is given below.

Examiner Only				
Marks	Remark			

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

(i) What is the relative formula mass of Fe_2O_3 ?

(Relative atomic masses Fe = 56, O = 16)

relative formula mass = _____[1]

(ii) Use your answer to part (i) to calculate the number of moles of Fe_2O_3 in 100 grams of the compound.

_____ moles [1]

(iii) How many moles of iron can be produced from 100 grams of Fe₂O₃?

_____ moles [1]

(iv) What mass of iron can be produced from $100 \,\mathrm{g} \,\mathrm{Fe_2O_3}$?

g [1]

(v) How many moles of carbon monoxide would be needed to react with $100 \,\mathrm{g} \,\mathrm{Fe_2O_3}$?

_____ moles [1]

(vi)	What mass of carbon monoxide would be needed to react with $100\mathrm{g}$ Fe ₂ O ₃ ?	Examin Marks	er Only Remark
	(The relative formula mass of carbon monoxide is 28.)		
	g [2]		

9 This question is about some non-metals and their compounds.

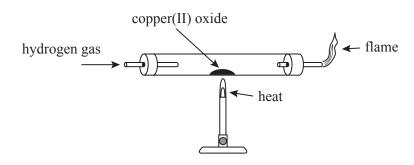
- (a) Hydrogen is a gas.
 - (i) Give two other physical properties of hydrogen.

_		
1		1.1

(ii) Give one use of hydrogen.

[1				
	Γ1			
	11			

The diagram below shows how hydrogen can be used to reduce copper(II) oxide.



(iii) Write a balanced symbol equation for the reaction of hydrogen with copper(II) oxide.

- **(b)** Sulphur is an impurity in coal and oil. When these fuels burn they produce an acidic gas which causes acid rain.
 - (i) Name this acidic gas which causes acid rain.

_____[1]

(ii) Circle the pH value which you would expect a lake to have which has been polluted by acid rain.

0 3 7 9 13 [1]

(iii) Give one harmful effect of acid rain.

[1]

Power stations must control their emissions of acidic gases.



© Greenpeace / Hunt

(iv)	Give one	way	of cont	rolling	the	emission	of gases	from	power
	stations.								

[1]

(c) The land around Ballymoney, in County Antrim, is very rich in a fuel called lignite. To obtain the lignite a type of mining is used where the surface soil and earth is removed so that the lignite can be taken out.

Describe the advantages and disadvantages of having a lignite mine close to the town of Ballymoney. You will also be marked on the quality of your written communication.

Advantages:

Disadvantages:	 	 	

Quality of written communication

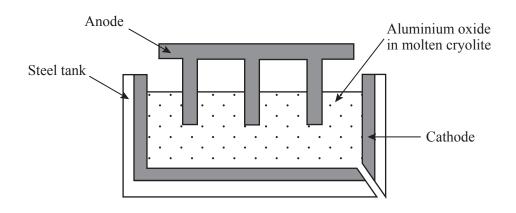
[1]

[6]

(d)	Two causes of water pollution are the presence of nitrates and phosphates. Examiner Only Marks Remarks Rema										
	(i)	Give a main source of nitrates in water.									
			[1]								
	(ii)	Give a main source of phosphates in water.									
			[1]								
		ration and chlorination are used in water treatment plants to ensuwater is clean and safe to drink.	re								
	(iii)	What type of impurities in water cannot be removed by filtration	1?								
			[1]								
	(iv)	How does chlorination help to make water safe to drink?									
			[1]								

10 Aluminium is manufactured by the electrolysis of molten aluminium oxide as shown in the diagram below.

Examiner Only					
Remark					



(a)	(i)	What material is used to make the electrodes in this electrolysis?

[1]

(ii)	State the products	of this	electrolysis	at the	anode and	the cathode.
------	--------------------	---------	--------------	--------	-----------	--------------

Anode	Cathode	[1]	1

Electrode		
		_

(b) This part of the question is about some reactions of Group I metals with **Examiner Only** water. Group I Li Na K (i) What name is given to the Group I metals? [1] (ii) What do you observe happening when a small amount of sodium is added to water? (iii) Why is the reaction in part (ii) carried out with a small amount of sodium? (iv) Complete the word equation for the reaction of sodium with water. sodium + water \rightarrow +[2] (v) In what way would you expect the reaction of lithium with water to be different to the reaction of sodium with water and why would it be different?

(c)		This part of the question is also about Group II metals and their compounds.						
	(i)	When calcium reacts compound has been for						
					[1]			
	(ii)	Complete the symbol carbonate with hydro		for the reaction of ca	lcium			
	CaC	$CO_3 + 2HCl \rightarrow$	+	+ CO ₂	[2]			
	(iii)	Magnesium oxide is a melting point. Give two typical ionic solid to l	wo other physical		_			

[2]

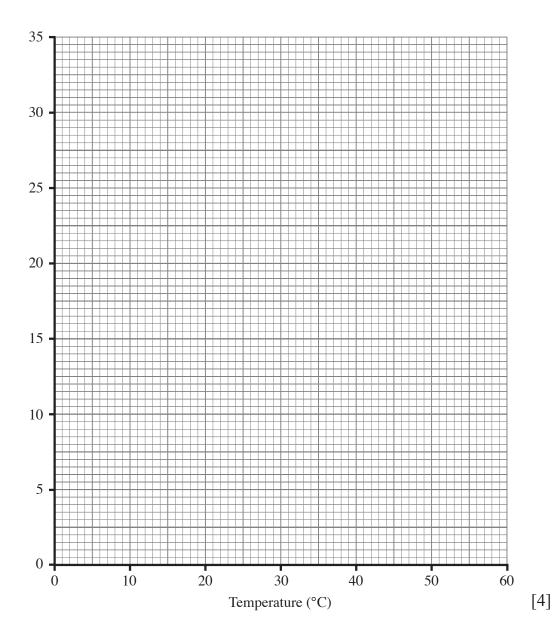
11 (a) A group of students, investigating the solubility of potassium chlorate in water, obtained the following results:

60	

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Temperature (°C)	8	18	30	39	50	60
Solubility of potassium chlorate (g/100 g H ₂ O)	5.5	7.5	11.0	14.0	20.0	25.5

(i) On the grid below, label the **y-axis** and plot a solubility curve for potassium chlorate.



(ii) At what temperature will 12 g potassium chlorate form a saturated solution in 100 g water?

	°C	[1]
--	----	-----

	(iii)	From your solubility curve find the solubili at:	ty of potassium chlorate	Examiner Only Marks Remark
		1. 11°C	g/100 g H ₂ O [1]	
		2. 55°C	g/100 g H ₂ O [1]	
	(iv)	What mass of potassium chlorate will cryst solution of potassium chlorate in 50 g of wa 11°C?		
		Answer_	g [2]	
(b)		monia is prepared industrially in the Haber- ogen and hydrogen gases.	Bosch Process from	
	(i)	Give a temperature and a pressure which ar Haber-Bosch Process and name the catalyst		
		Temperature:		
		Pressure:		
		Catalyst:	[3]	
	(ii)	Write a balanced symbol equation for the for from nitrogen and hydrogen.	ormation of ammonia	
			[3]	
	(iii)	Give one reason why the Haber-Bosch Produced demonstrated in a school laboratory.	cess cannot be	
			[1]	

(c)	It is estimated that, in the UK, the effects of rusting cost £6 billion every year. Galvanising iron with zinc is an important method of protecting iron objects such as gates. This method is an example of sacrificial protection .	_	Examine Marks	r Only Remark
	(i) What is the full chemical name for rust?			
		[2]		
	(ii) Explain why a zinc coating stops iron from rusting even when it scratched or broken.	t is		
		_		
		[2]		

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(Questions continue overleaf)

(a) (i) W	hat is the genera	al formula of alkenes?	[1]
(ii) W	hat is an unsat ı	irated hydrocarbon?	
_			[3]
for	mulae and phy	e below to show the molecul sical state at room temperatu f the alkene homologous seri	are for propene, the
ydrocarbon	molecular formula	structural formula	physical state at room temperature
propene			
			[3]
molecu Give th	iles.	tant and useful plastic made the type of reaction that is use.	
			[2]
(c) Another ethanol		ction of ethene is its reaction	n with steam to form
* *	rite a balanced s	symbol equation for the reac	tion of ethene and
ste			

	(ii)	Name another way to make ethanol.		Examin	er Only
			F13	Marks	Remark
			[1]		
	(iii)	Draw the structural formula for ethanol.			
	(iv)	Give one use of ethanol.	[1]		
	()		[1]		
(d)	Eth	anol can be oxidised to form ethanoic acid.			
	(i)	What is the molecular formula of ethanoic acid?			
			[1]		
			, L-J		
	(ii)	Ethanoic acid is a weak acid and reacts with magnesium. Give things that you would observe if a piece of magnesium ribbon vadded to dilute ethanoic acid.			
		1.			
		2.	[2]		
(e)		anoic acid and ethanol react together to form an ester which has nula $\mathrm{CH_3COOC_2H_5}$.	the		
	(i)	What is the chemical name of the ester CH ₃ COOC ₂ H ₅ ?			
			F13		
			[1]		
	(ii)	What is the appearance of the ester CH ₃ COOC ₂ H ₅ ?			
			[2]		

THIS IS THE END OF THE QUESTION PAPER

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