Rewarding Learning

Centre Number	
71	

Candidate Number

General Certificate of Secondary Education
2011

Science: Double Award (Modular)

Paper 2
Higher Tier

[G8205]

G8205

FRIDAY 27 MAY, MORNING

TIME

1 hour 30 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 six** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 110.
Quality of written communication will be assessed in question **3(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	
Total Marks	

Examiner Only	
Marks	Remark

1 **(a)** In chemistry particular words or terms are often used to describe reactions.

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**, **D**, **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**

(i) $2Zn + O_2 \rightarrow 2ZnO$ _____ [1]

(ii) $HCl + KOH \rightarrow KCl + H_2O$ _____ [1]

(iii) $CuSO_4 + 5H_2O \rightarrow CuSO_4.5H_2O$ _____ [1]

(iv) $CaCO_3 \rightarrow CaO + CO_2$ _____ [1]

(b) 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]

(c) The table below gives some information about the structure of atoms. Complete the table.

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

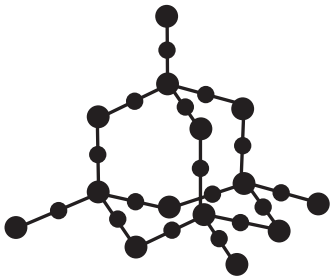
[6]

Examiner Only

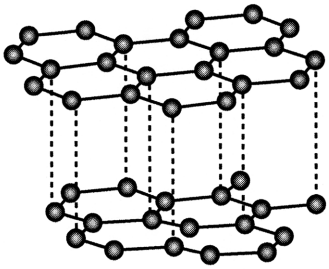
Marks	Remark

Examiner Only	
Marks	Remark

2 **(a)** The structures of two giant covalent compounds are given below.



quartz



graphite

© Chemistry in Use by Roland Jackson, published by Pearson (Longman), 1984 & 1987, ISBN 058201394. Reproduced by permission of Pearson Education

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

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

_____ [1]

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

_____

_____ [1]

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

_____

_____

_____ [2]

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

$$^{238}_{92}U \quad \rightarrow \qquad\qquad + \qquad\qquad [4]$$

(ii) 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?

_____ years [2]

(c) 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.

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

(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]

Examiner Only

Marks	Remark

(iii) How many moles of iron can be produced from 100 grams of Fe_2O_3?

_____ moles [1]

(iv) What mass of iron can be produced from 100 g Fe_2O_3?

_____ g [1]

(v) How many moles of carbon monoxide would be needed to react with 100 g Fe_2O_3?

_____ moles [1]

(vi) What mass of carbon monoxide would be needed to react with 100 g Fe_2O_3?

(The relative formula mass of carbon monoxide is 28.)

_____ g [2]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

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

(a) Hydrogen is a gas.

(i) Give **two** other **physical** properties of hydrogen.

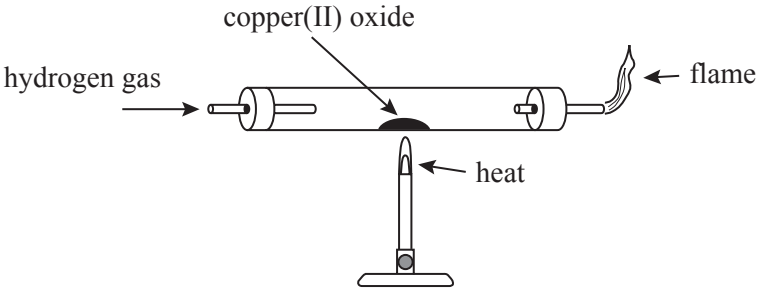
1. _____ [1]

2. _____ [1]

(ii) Give **one** use of hydrogen.

_____ [1]

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.

_____ [2]

(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 controlling 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: _____

_____

_____

_____ [6]

Quality of written communication [1]

Examiner Only

Marks	Remark

(d) Two causes of water pollution are the presence of nitrates and phosphates.

(i) Give a main source of nitrates in water.

_____ [1]

(ii) Give a main source of phosphates in water.

_____ [1]

Filtration and chlorination are used in water treatment plants to ensure the water is clean and safe to drink.

(iii) What type of impurities in water cannot be removed by filtration?

_____ [1]

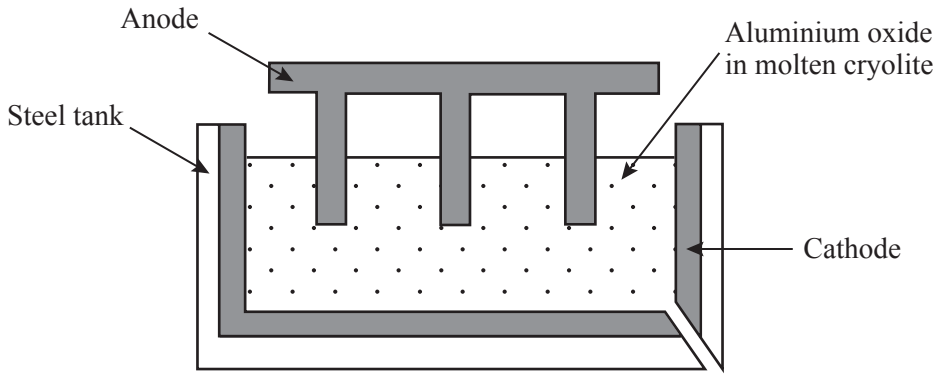
(iv) How does chlorination help to make water safe to drink?

_____ [1]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

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



(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]

(iii) Which electrode must be replaced regularly? Explain why this is necessary.

Electrode _____

Explanation _____

_____

_____ [3]

(b) This part of the question is about some reactions of Group I metals with 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?

_____

_____

_____

_____

_____

_____ [4]

(iii) Why is the reaction in part **(ii)** carried out with a **small** amount of sodium?

_____ [1]

(iv) Complete the word equation for the reaction of sodium with water.

sodium + water → + [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?

_____

_____ [2]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

(c) This part of the question is also about Group II metals and their compounds.

(i) When calcium reacts with water the water goes cloudy. What compound has been formed which makes the water go cloudy?

_____ [1]

(ii) Complete the symbol equation below for the reaction of calcium carbonate with hydrochloric acid.

$CaCO_3 + 2HCl \rightarrow$ + + CO_2 [2]

(iii) Magnesium oxide is an ionic solid. This means it will have a high melting point. Give **two** other physical properties you expect a typical ionic solid to have.

_____

_____ [2]

BLANK PAGE

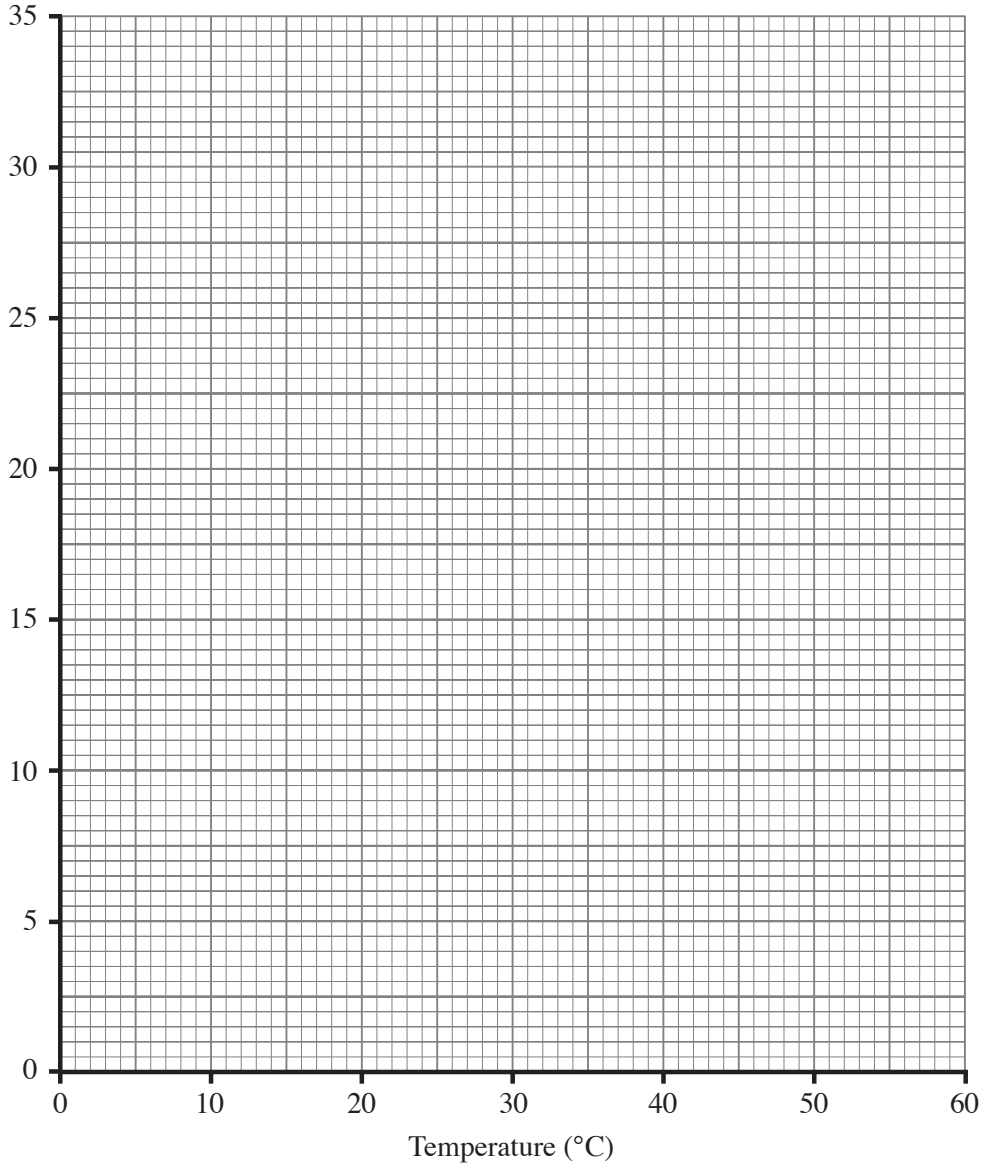
(Questions continue overleaf)

Examiner Only	
Marks	Remark

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

Temperature (°C)	8	18	30	39	50	60
Solubility of potassium chlorate (g/100 g H_2O)	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.



[4]

(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 solubility of potassium chlorate at:

1. 11 °C _____ g/100 g H_2O [1]

2. 55 °C _____ g/100 g H_2O [1]

(iv) What mass of potassium chlorate will crystallise out if a saturated solution of potassium chlorate in **50 g** of water at 55 °C is cooled to 11 °C?

Answer _____ g [2]

(b) Ammonia is prepared industrially in the Haber-Bosch Process from nitrogen and hydrogen gases.

(i) Give a temperature and a pressure which are suitable for the Haber-Bosch Process and name the catalyst used.

Temperature: _____

Pressure: _____

Catalyst: _____ [3]

(ii) Write a balanced symbol equation for the formation of ammonia from nitrogen and hydrogen.

_____ [3]

(iii) Give **one** reason why the Haber-Bosch Process cannot be demonstrated in a school laboratory.

_____

_____ [1]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

(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**.

(i) What is the full chemical name for rust?

_____ [2]

(ii) Explain why a zinc coating stops iron from rusting even when it is scratched or broken.

_____

_____

_____

_____[2]

6 Alkenes are a homologous series of unsaturated hydrocarbons. All members of the same homologous series have the same general formula.

Examiner Only

Marks	Remark

(a) (i) What is the general formula of alkenes?

_____ [1]

(ii) What is an **unsaturated hydrocarbon**?

_____

_____

_____ [3]

(iii) Complete the table below to show the molecular and structural formulae and physical state at room temperature for propene, the second member of the alkene homologous series.

hydrocarbon	molecular formula	structural formula	physical state at room temperature
propene			

[3]

(b) Polythene is an important and useful plastic made from ethene molecules.

Give the **full** name for the **type** of reaction that is used to produce polythene from ethene.

_____ [2]

(c) Another important reaction of ethene is its reaction with steam to form ethanol.

(i) Write a balanced symbol equation for the reaction of ethene and steam.

_____ [2]

(ii) Name another way to make ethanol.

_____ [1]

(iii) Draw the **structural** formula for ethanol.

[1]

(iv) Give **one** use of ethanol.

_____ [1]

(d) Ethanol can be oxidised to form ethanoic acid.

(i) What is the **molecular** formula of ethanoic acid?

_____ [1]

(ii) Ethanoic acid is a weak acid and reacts with magnesium. Give **two** things that you would observe if a piece of magnesium ribbon was added to dilute ethanoic acid.

1. _____

2. _____ [2]

(e) Ethanoic acid and ethanol react together to form an ester which has the formula $CH_3COOC_2H_5$.

(i) What is the chemical name of the ester $CH_3COOC_2H_5$?

_____ [1]

(ii) What is the appearance of the ester $CH_3COOC_2H_5$?

_____ [2]

Examiner Only	
Marks	Remark

THIS IS THE END OF THE QUESTION PAPER

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.