



General Certificate of Secondary Education  
2011

Centre Number

71

Candidate Number

## Science: Double Award (Non-Modular)

Paper 2  
Higher Tier

[G8405]



FRIDAY 27 MAY, MORNING

### 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

1 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.



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]

Examiner Only	
Marks	Remark

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

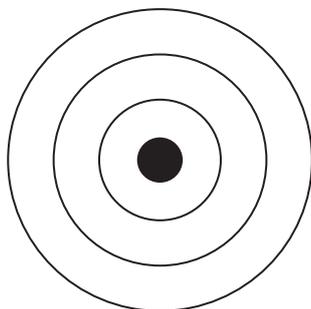
Symbol	Number of protons	Number of neutrons	Number of electrons	Mass number	Electron arrangement
Na		12	11	23	2,8,1
O	8	8		16	
Ca	20	20	20		2,8,8,2
Al	13		13	27	

[6]

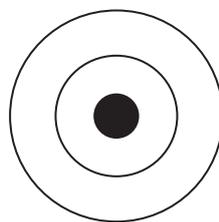
Examiner Only	
Marks	Remark

4 Magnesium reacts with fluorine to form the compound magnesium fluoride.

- (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]

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

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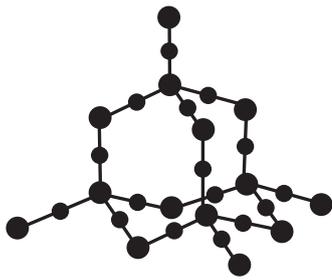
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Examiner Only

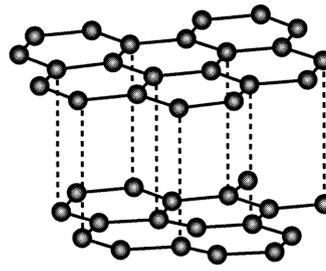
Marks

Remark

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?

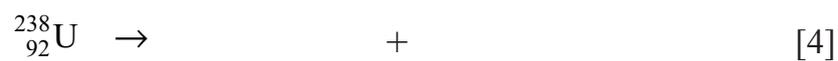
\_\_\_\_\_  
\_\_\_\_\_ [1]

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

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [2]

Examiner Only	
Marks	Remark

- 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).



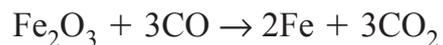
- (b) Uranium-238 has a very large half-life of  $4.5 \times 10^9$  years. How long would it take 20 g of  ${}^{238}\text{U}$  to decay to 2.5 g?

\_\_\_\_\_ years [2]

Examiner Only	
Marks	Remark



- 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.



- (i) What is the relative formula mass of  $\text{Fe}_2\text{O}_3$ ?

(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  $\text{Fe}_2\text{O}_3$  in 100 grams of the compound.

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

- (iii) How many moles of iron can be produced from 100 grams of  $\text{Fe}_2\text{O}_3$ ?

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

- (iv) What mass of iron can be produced from 100 g  $\text{Fe}_2\text{O}_3$ ?

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

- (v) How many moles of carbon monoxide would be needed to react with 100 g  $\text{Fe}_2\text{O}_3$ ?

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

Examiner Only	
Marks	Remark

(vi) What mass of carbon monoxide would be needed to react with 100 g  $\text{Fe}_2\text{O}_3$ ?

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

\_\_\_\_\_ g [2]

Examiner Only	
Marks	Remark

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

(a) Hydrogen is a gas.

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

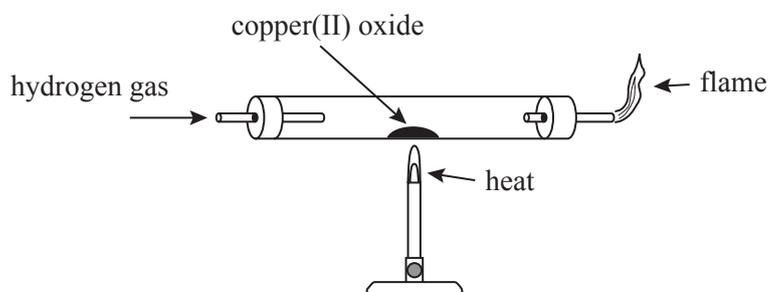
1. \_\_\_\_\_ [1]

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]

Examiner Only	
Marks	Remark

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: \_\_\_\_\_

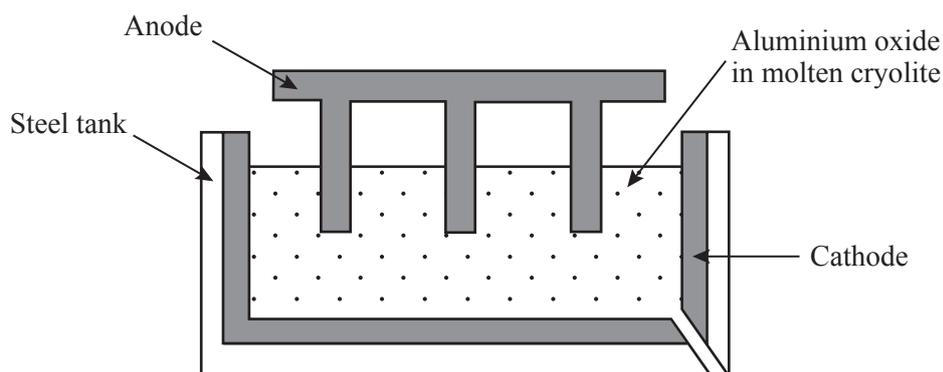
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Quality of written communication [1]

Examiner Only	
Marks	Remark



- 10 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]

Examiner Only

Marks Remark

- (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

(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.



(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]

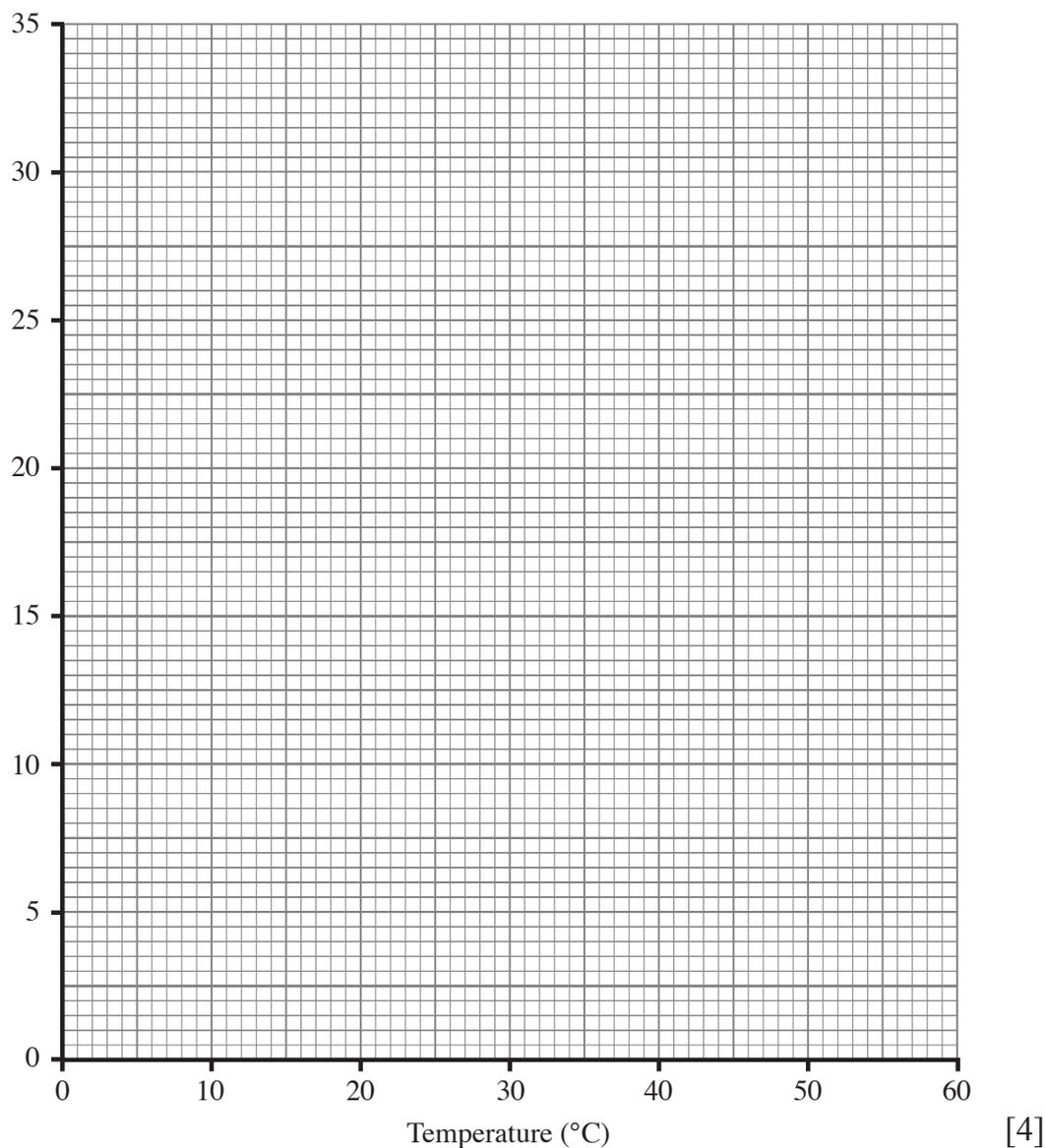
Examiner Only

Marks Remark

- 11 (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 <sub>2</sub> 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]

Examiner Only	
Marks	Remark

(iii) From your solubility curve find the solubility of potassium chlorate at:

1. 11 °C \_\_\_\_\_ g/100 g H<sub>2</sub>O [1]

2. 55 °C \_\_\_\_\_ g/100 g H<sub>2</sub>O [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



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**(Questions continue overleaf)**

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

(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]

Examiner Only

Marks Remark

(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  $\text{CH}_3\text{COOC}_2\text{H}_5$ .

(i) What is the chemical name of the ester  $\text{CH}_3\text{COOC}_2\text{H}_5$ ?

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

(ii) What is the appearance of the ester  $\text{CH}_3\text{COOC}_2\text{H}_5$ ?

\_\_\_\_\_ [2]

Examiner Only

Marks Remark

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**THIS IS THE END OF THE QUESTION PAPER**

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