Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2012

Science: Double Award (Non-Modular)

Paper 2
Higher Tier

[G8405]

G8405

TUESDAY 12 JUNE, 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(b)**.
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	

Examiner Only	
Marks	Remark

1 Some students compared the reactivity of four metals. They looked to see if each metal reacted with the nitrate solutions of each of the other three metals. Their results are given in the table below.

nitrate solution / metal	**lead nitrate**	**copper(II) nitrate**	**silver nitrate**	**zinc nitrate**
lead		reaction	reaction	no reaction
copper	no reaction		reaction	no reaction
silver	no reaction	no reaction		no reaction
zinc	reaction	reaction	reaction	

(a) Using the information in the table, arrange the four metals in order of reactivity with the **most reactive** metal first.

1. _____

2. _____

3. _____

4. _____ [2]

(b) What is the name given to the **type** of exothermic reactions shown in the table above?

Type of reaction _____ [1]

(c) Zinc will also react with dilute sulphuric acid. Complete the word equation for this reaction.

zinc + sulphuric acid → + [2]

2 Calcium is a reactive Group II metal.

Examiner Only	
Marks	Remark

(a) Describe **three** things you would observe when **calcium** reacts with water.

1. _____

_____

2. _____

_____

3. _____

_____ [3]

(b) Name the solution formed when calcium reacts with water.

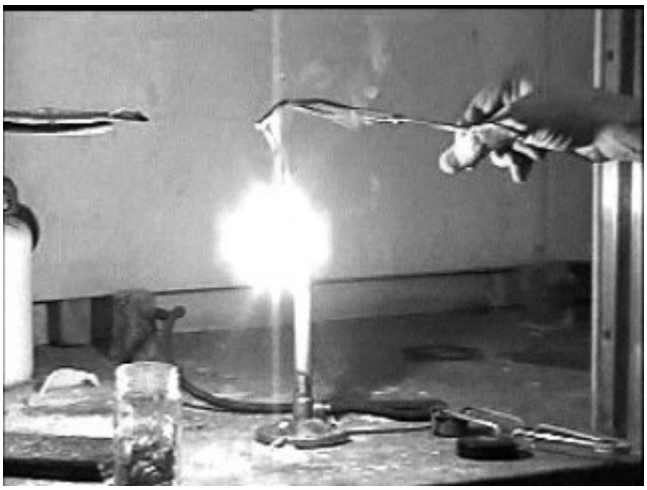
_____ [1]

(c) Give **one** safety precaution which should be taken when carrying out the reaction between calcium and water.

_____ [1]

Examiner Only	
Marks	Remark

3 Magnesium ribbon burns in air with a bright white flame as shown below. The product of the reaction is magnesium oxide.



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(a) (i) Describe the appearance of magnesium oxide.

_____

_____ [2]

(ii) Explain why the burning of magnesium in air is described as **oxidation**.

_____

_____ [1]

(b) Magnesium reacts very slowly with cold water but reacts more quickly with steam. Complete the word equation to show the reaction between magnesium and steam.

magnesium + steam → + [2]

4 Some students investigated the thermal decomposition of calcium carbonate. They heated 10 g calcium carbonate and noted the mass of solid remaining at different times. Their results are shown in the table below.

Time (min)	0	3	6	9	12	15
Mass of solid (g)	10	8.9	6.7	5.8	5.6	5.6

(a) Why did the students stop heating the calcium carbonate after fifteen minutes?

_____ [1]

(b) Name the gas given off during the thermal decomposition of calcium carbonate.

_____ [1]

(c) Calcium oxide, obtained from the thermal decomposition of calcium carbonate, is used by farmers to neutralise acidic soil.

(i) Complete the word equation for the reaction between hydrochloric acid and calcium oxide.

calcium oxide + hydrochloric acid → + [2]

(ii) Name the solution that is formed when calcium oxide is added to water.

_____ [1]

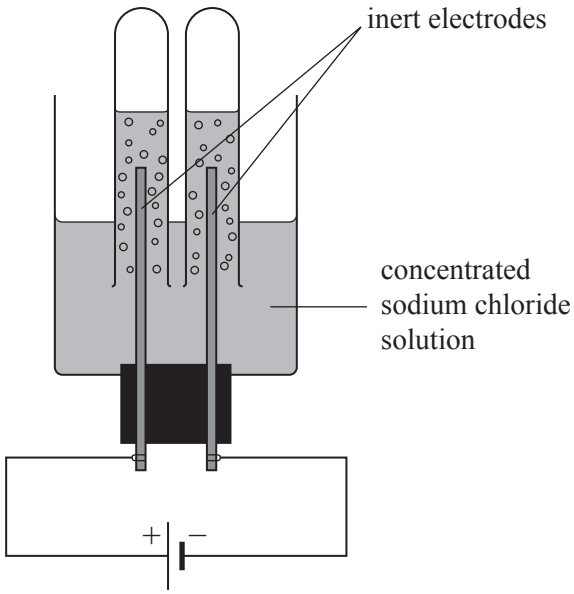
Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

5 Electrolysis of concentrated sodium chloride solution is used to manufacture two gases and another useful substance.

The diagram below shows the apparatus used in the laboratory for the electrolysis of concentrated sodium chloride solution.



(a) Name a suitable material for the inert electrodes.

_____ [1]

(b) Name the gas produced at the **cathode**.

_____ [1]

(c) Write a balanced **ionic** equation to show what happens at the **anode**.

_____ [3]

(d) What substance is formed in solution during this electrolysis?

_____ [1]

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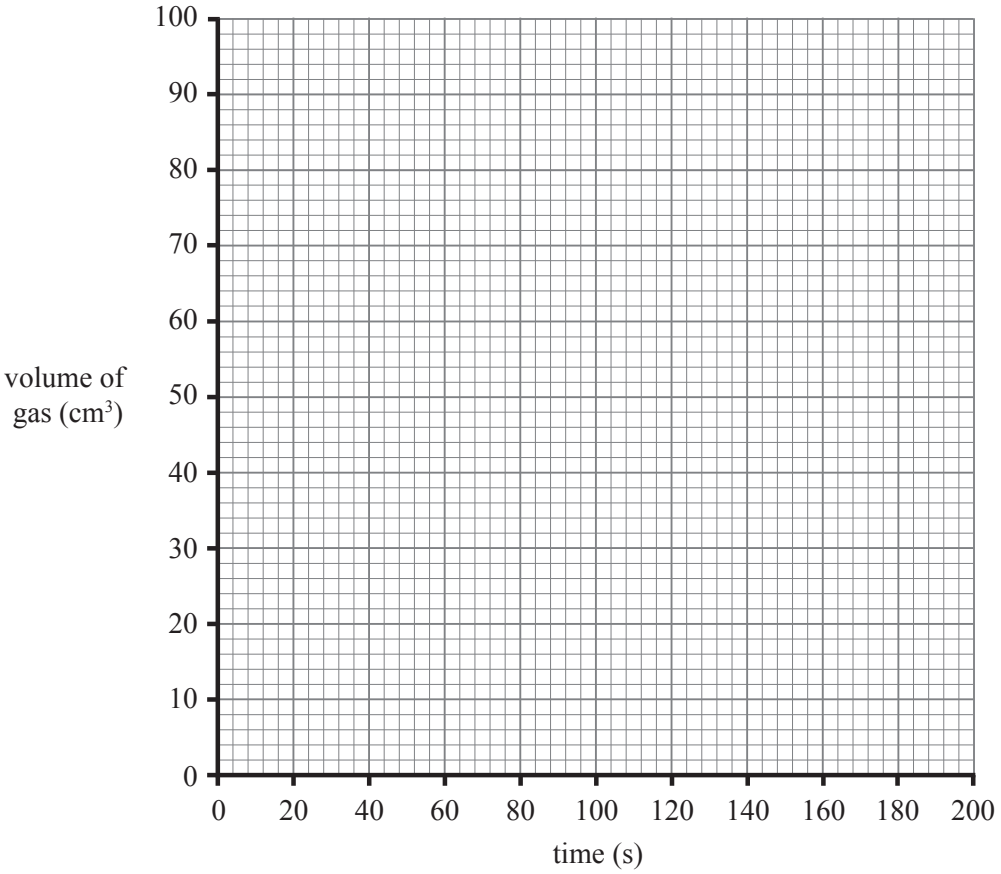
(Questions continue overleaf)

Examiner Only	
Marks	Remark

6 Some students investigated the rate of reaction between magnesium ribbon and excess dilute sulphuric acid. The total volume of gas produced was measured at 20 second intervals and recorded in the table below.

Time (s)	0	20	40	60	80	100	120	140	160	180
Volume (cm^3)	0	30	48	64	74	82	88	90	90	90

(a) On the grid below, plot the results given in the table. Draw a curve of best fit. [3]



(b) Use your graph to help you answer the questions which follow.

(i) What volume of gas had been collected at 50 seconds?

_____ [1]

(ii) At what time did the reaction stop?

_____ [1]

(c) Using your answer from **(b)(ii)**, work out the average rate of reaction in cm^3/s.

Examiner Only

Marks	Remark

Answer _____ cm^3/s [1]

7 Problems involving a fixed mass of gas can be solved using the relationship

$$\frac{PV}{T} = \text{constant}$$

A fixed mass of gas of volume 750 cm^3 had its pressure changed from 2000 Pa to 4000 Pa and its temperature increased from 300 K to 450 K.

Calculate the new volume of gas.

Show your working out.

Answer _____ cm^3 [3]

Examiner Only	
Marks	Remark

8 When sodium hydrogencarbonate is heated it decomposes to form sodium carbonate, water and carbon dioxide as shown in the equation below.

$$2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$$

(relative atomic masses: Na = 23, C = 12, O = 16, H = 1)

(a) Calculate the relative formula mass of $NaHCO_3$.

Answer _____ [1]

(b) Calculate the relative formula mass of Na_2CO_3.

Answer _____ [1]

(c) Using your answer to part **(a)** calculate the number of moles in 8.4 g of $NaHCO_3$.

Answer _____ moles [1]

(d) How many moles of Na_2CO_3 can be produced from 8.4 g of $NaHCO_3$?

Answer _____ moles [1]

(e) Calculate the mass of Na_2CO_3 produced from 8.4 g of $NaHCO_3$.

Answer _____ g [1]

9 **(a)** Complete the table below about the properties of chlorine, nitrogen and helium.

Gas	Lighter or heavier than air	Reactive or unreactive	Colour	Poisonous
chlorine	heavier			yes
nitrogen	lighter	unreactive		
helium			colourless	no

[3]

This part of the question is about the reaction between sulphur and iron.

(b) When a mixture of sulphur and iron is heated a chemical reaction takes place. Describe what you would observe and state what happens in this reaction. Your answer should include:

- a clear description of what a mixture of iron and sulphur looks like
- a safety precaution that should be taken when heating iron and sulphur
- a clear description of what you would observe when the iron and sulphur are heated
- the name and the chemical formula of the product formed

[7]

Quality of written communication [1]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

(c) This part of the question is about carbon, carbon monoxide and carbon dioxide.

It is important to have coal or gas burning stoves regularly serviced. Incomplete combustion of coal or gas means that carbon monoxide is formed as well as carbon dioxide.

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(i) Explain why carbon monoxide is so dangerous.

_____

_____ [2]

(ii) Explain why it is important to have coal or gas burning stoves regularly serviced.

_____

_____ [1]

(iii) Give one harmful environmental effect caused by carbon dioxide.

_____ [1]

(d) When chlorine is bubbled through a solution of potassium iodide a displacement reaction occurs.

Examiner Only	
Marks	Remark

(i) Explain why this reaction must be carried out in a fume cupboard.

_____ [1]

(ii) What colour change is seen when chlorine is bubbled through a solution of potassium iodide?

from _____ to _____ [2]

(iii) Balance the symbol equation for the reaction between chlorine and potassium iodide solution.

Cl_2 + KI → I_2 + KCl [1]

(iv) Name another **halogen** that can be displaced by bubbling chlorine through the potassium halide solution.

_____ [1]

Examiner Only	
Marks	Remark

10 (a) Mendeleev was responsible for much of the early development of the Periodic Table.

(i) Give **three** features of the Periodic Table developed by Mendeleev.

1. _____

_____

2. _____

_____

3. _____

_____ [3]

(ii) Describe **three** ways in which the modern Periodic Table, as shown in your Data Leaflet, is different from the one Mendeleev developed.

1. _____

_____

2. _____

_____

3. _____

_____ [3]

(b) Complete the table below, which gives some information about elements, their Groups, Periods and electronic structures. You may find your Data Leaflet useful.

Element	Group	Period	Electronic structure
potassium		4	
magnesium	II		
		3	2, 8, 6

[6]

(c) **(i)** Why do the elements in Group I have similar chemical properties?

_____ [1]

(ii) How does the reactivity of the elements vary as Group II is descended?

_____ [1]

(iii) Which of the Group VII elements, fluorine, chlorine, bromine or iodine is **least** reactive?

_____ [1]

(iv) Describe how the reactivity of the elements in Period 3 varies across the period from sodium to argon.

_____

_____

_____

_____

_____ [3]

(d) Magnesium sulphate is an ionic compound, which can be made by reacting a base with an acid.

(i) Name a suitable base which may be used to prepare magnesium sulphate.

_____ [1]

(ii) Name the acid needed to prepare magnesium sulphate.

_____ [1]

Examiner Only	
Marks	Remark

11 (a) Water and ammonia are both covalent molecules.

Examiner Only	
Marks	Remark

(i) What does the term **covalent** mean?

_____ [1]

(ii) What does the term **molecule** mean?

_____

_____ [2]

(iii) Using outer shell electrons only, draw a diagram to show how the electrons are arranged in an ammonia molecule, NH_3.

[2]

(iv) How many covalent bonds are there in a **water** molecule?

_____ [1]

(v) Explain why substances with a simple covalent structure have low melting points.

_____

_____

_____ [2]

(b) Copper is a very good conductor of electricity and it is ductile. It is used for electrical wiring.

Examiner Only	
Marks	Remark

(i) Draw a **labelled** diagram to show the bonding in a metal such as copper.

[4]

(ii) What does the term **ductile** mean?

_____ [1]

(iii) Use your understanding of metallic bonding to explain why copper is ductile.

_____

_____

_____ [2]

(iv) Give one other physical property of copper.

_____ [1]

The two types of plastics, thermosoftening and thermosetting, have different structures.

Examiner Only	
Marks	Remark

(c) (i) Polythene is a thermosoftening plastic. What is a **thermosoftening** plastic?

_____

_____ [1]

(ii) Melamine is a thermosetting plastic. Draw a simple diagram to show the structure of a **thermosetting** plastic.

[2]

(iii) Which one of the plastics below is also a **thermosetting** plastic? Circle the correct answer.

polystyrene **Bakelite** **PVC** [1]

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(Questions continue overleaf)

Examiner Only	
Marks	Remark

12 (a) The hydrocarbons methane, ethane, propane and butane are four members of a homologous series.

(i) What elements are hydrocarbons made from?

_____ [1]

(ii) Which homologous series do these hydrocarbons belong to?

_____ [1]

(iii) Give **two** features of a homologous series.

1. _____

2. _____ [2]

Ethene and propene are members of another homologous series. Ethene can be used to manufacture ethanol.

(b) (i) What other reactant is needed to make ethanol from ethene?

_____ [1]

(ii) Name another method for manufacturing ethanol.

_____ [1]

(iii) Give the molecular and structural formula for ethanol.

Molecular Formula	Structural Formula

[2]

(iv) Explain why ethanol is **not** a hydrocarbon.

_____

_____ [1]

Examiner Only	
Marks	Remark

(v) Write a balanced symbol equation for the complete combustion of ethanol in a plentiful supply of air.

_____ [3]

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

(i) What pH would you expect ethanoic acid to have?

_____ [1]

(ii) Ethanoic acid has the properties of a typical acid. Describe what you would observe if solid copper(II) oxide is added to a sample of ethanoic acid in a test tube and heated. Name the salt formed in this reaction.

_____

_____

_____ [2]

Name of salt: _____ [1]

(d) (i) Complete the following word equation for the reaction between ethanoic acid and ethanol.

ethanoic acid + ethanol → ethyl ethanoate + [1]

(ii) Choose **three** words from those given below to describe ethyl ethanoate.

Put a circle around each of the three words you have selected.

colourless	**odourless**	**liquid**
solid	**green**	**white**
orange	**gas**	**sweet-smelling**

[3]

THIS IS THE END OF THE QUESTION PAPER

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