cea
Rewarding Learning

General Certificate of Secondary Education
2015

Centre Number

Candidate Number

GCSE Chemistry

Unit 1

Higher Tier

MV18

[GCH12]

TUESDAY 9 JUNE, AFTERNOON

TIME

1 hour 30 minutes, plus your additional time allowance.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Complete in blue or black ink only.
Answer **all five** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 100.
Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Questions **2(c)(ii) and 3(e)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

1 The Periodic Table has been developed over many years by several scientists.
Each scientist produced a Periodic Table with different characteristics and this eventually led to the Periodic Table we use today.

(a) Complete the table below by adding the name of the scientist. [2 marks]

Characteristic of the Periodic Table	Name of Scientist
Law of octaves	
Spaces for undiscovered elements	

(b) The diagram below is an outline of the modern Periodic Table.
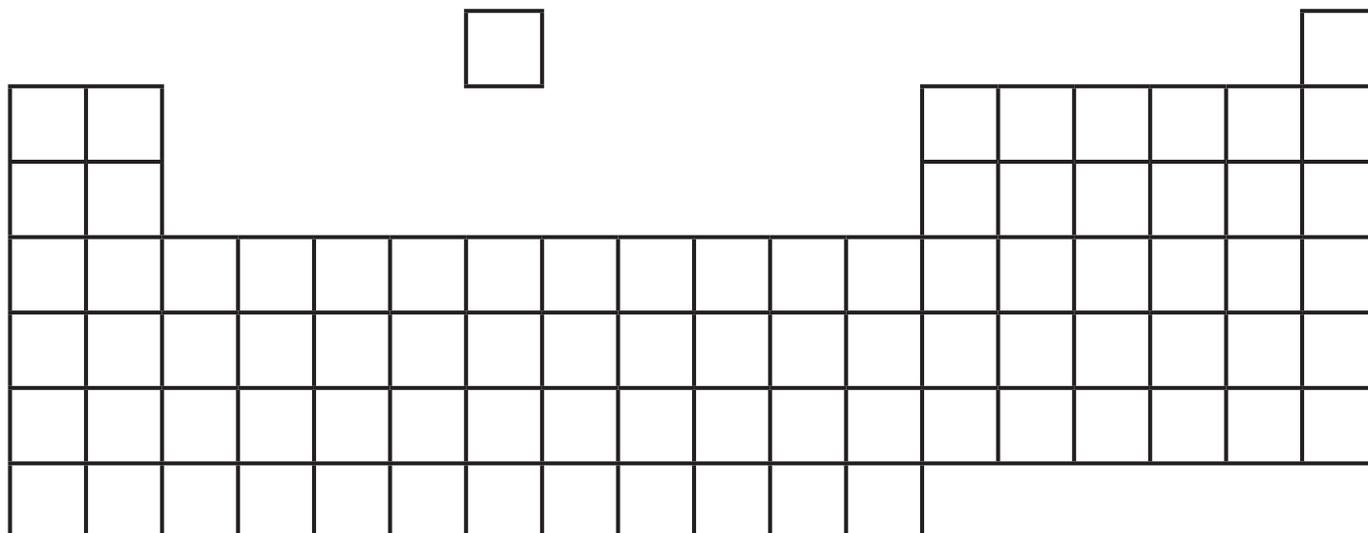
Using the letters **A–D** show the position of the following elements on the outline of the Periodic Table above. Place each letter in the appropriate box on the outline. [4 marks]

A   a gas which burns with a pop

B   the least reactive alkali metal

C   the element in Period 3 and Group 2

D   a metal which is a liquid at room temperature

(c) The table below shows six elements and the electronic configuration of their atoms. The elements are represented by the letters **P–U**
(these are not symbols of the elements).

Element	Electronic configuration
P	2,6
Q	2,8,1
R	2,8,2
S	2,8,7
T	2,8,8
U	2,8,8,1

Using the letters **P–U**, identify the following elements. Each letter may be used once, more than once or not at all. [4 marks]

(i) Two elements in the same Group _____ and _____

(ii) An element in Period 2 _____

(iii) A noble gas _____

(iv) An alkaline earth metal _____

(d) The halogens are found in Group 7 of the Periodic Table. All of the halogens react with sodium.

    (i) Write a balanced symbol equation for the reaction of sodium with chlorine. [3 marks]

    _____

   (ii) Sodium reacts vigorously with chlorine.

      Name a halogen which reacts even more vigorously with sodium. [1 mark]

    _____

5

[Turn over

(e) The halogens chlorine, bromine and iodine, were added to solutions of different halide ions. The results are recorded in the table below.

Halogen	Solution of halide ion		
	Sodium chloride	**Sodium bromide**	**Sodium iodide**
Chlorine		orange solution produced	brown solution produced
Bromine	no reaction		brown solution produced
Iodine	no reaction	no reaction	

(i) Explain why there is no reaction between sodium chloride and bromine. [1 mark]

_____

_____

_____

(ii) Write a balanced symbol equation for the reaction between sodium bromide and chlorine. [3 marks]

_____

(iii) State the name for the type of reaction in **(e)(ii)**. [1 mark]

_____

(f) A sample of chlorine atoms was analysed in a mass spectrometer. The mass spectrum obtained is shown below.
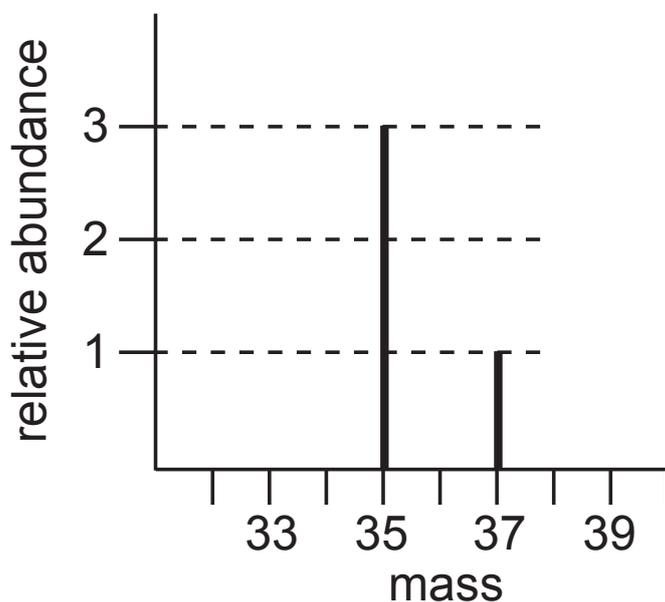
Use data from the mass spectrum to calculate the relative atomic mass of chlorine. **You must show your working out.** [3 marks]

Relative atomic mass **=**_____

7

[Turn over

2 **(a)** The following balanced symbol equations show reactions of some acids:

Reaction A $Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$

Reaction B $CuO + 2HCl \rightarrow CuCl_2 + H_2O$

Reaction C $Na_2CO_3 + H_2SO_4 \rightarrow Na_2SO_4 + CO_2 + H_2O$

Reaction D $2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$

Reaction E $KOH + HCl \rightarrow KCl + H_2O$

In the following questions where a **name** is required, a chemical formula will not be accepted.

(i) **Name** a weak alkali from the equations above.
[1 mark]

_____

(ii) **Name** a salt of a transition metal from the equations above. [1 mark]

_____

(iii) Describe a chemical test for the gas produced in **Reaction C**. Include observations for a positive test. [3 marks]

_____

_____

_____

_____

_____

(iv) Name the salt produced in **Reaction D**. [1 mark]

_____

(v) Reaction E is an example of a neutralisation reaction. Write an **ionic** equation, including state symbols, for **Reaction E**. [3 marks]

_____

(b) Excess copper(II) carbonate is added to dilute nitric acid to form copper(II) nitrate solution. The reaction is exothermic.

(i) Write a balanced symbol equation for the reaction of copper(II) carbonate with nitric acid. [3 marks]

_____

(ii) What colour is the solution formed in this reaction? [1 mark]

_____

(iii) Name the separation technique used to remove the excess copper(II) carbonate from the solution. [1 mark]

_____

(iv) Describe how you would confirm experimentally that the reaction is exothermic. [2 marks]

_____

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_____

_____

(c) Many cation and anion tests rely on the formation of a precipitate.

(i) What is meant by the term cation? [1 mark]

_____

(ii) Describe the chemical tests used to positively identify:

• the cation
• the anion

present in a sample of **solid** magnesium iodide.
[6 marks]

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

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3 Magnesium and chlorine react together to form the ionic compound magnesium chloride.

(a) Name and describe the type of bonding in **magnesium**. [3 marks]

Name: _____

Description _____

_____

_____

_____

_____

_____

(b) (i) Write the formula for magnesium chloride. [1 mark]

_____

(ii) Using **dot and cross** diagrams explain how magnesium chloride is formed from atoms of magnesium and chlorine.
Include the charge on each ion. [6 marks]

_____

_____

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(c) (i) Magnesium chloride is a white crystalline solid at room temperature.
State two other physical properties of magnesium chloride. [2 marks]

1. _____

_____

2. _____

_____

(ii) Name one other compound with similar bonding and physical properties to magnesium chloride. [1 mark]

_____

(d) Chlorine also bonds with hydrogen to form the compound hydrogen chloride.

Draw a **dot and cross** diagram to show the bonding in hydrogen chloride and **label a lone pair of electrons**. Your diagrams should only show outer shell electrons. [3 marks]

(e) The melting point of hydrogen chloride is **–**114 °C. The melting point of magnesium chloride is 714 °C. Explain in detail why the melting point of hydrogen chloride is much lower than that of magnesium chloride. [6 marks]

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

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4 The solubility of solids such as ammonium dichromate and ammonium chloride varies with temperature.

(a) (i) What is meant by the term solubility? [4 marks]

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_____

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(ii) Write the formula for ammonium dichromate.
[1 mark]

_____

The graph opposite shows the solubility curves for ammonium dichromate and ammonium chloride. **Use the graph to answer parts (b) and (c).**

**(b) (i)** At what temperature does ammonium chloride have a solubility of 55**g/**100**g** H_2O? [1 mark]

_____

(ii) At what temperature do both salts have the same solubility? [1 mark]

_____

(iii) Why does the *x*-axis not go below 0°C or above 100°C? [1 mark]

_____

_____

(c) A concentrated solution of ammonium dichromate at 60°C which is **not saturated** contains 30g of ammonium dichromate dissolved in 50g of water.

The concentrated solution was cooled from 60°C to 20°C. Calculate the mass of solid that crystallises out of solution. [3 marks]

Mass of solid **=** _____ g
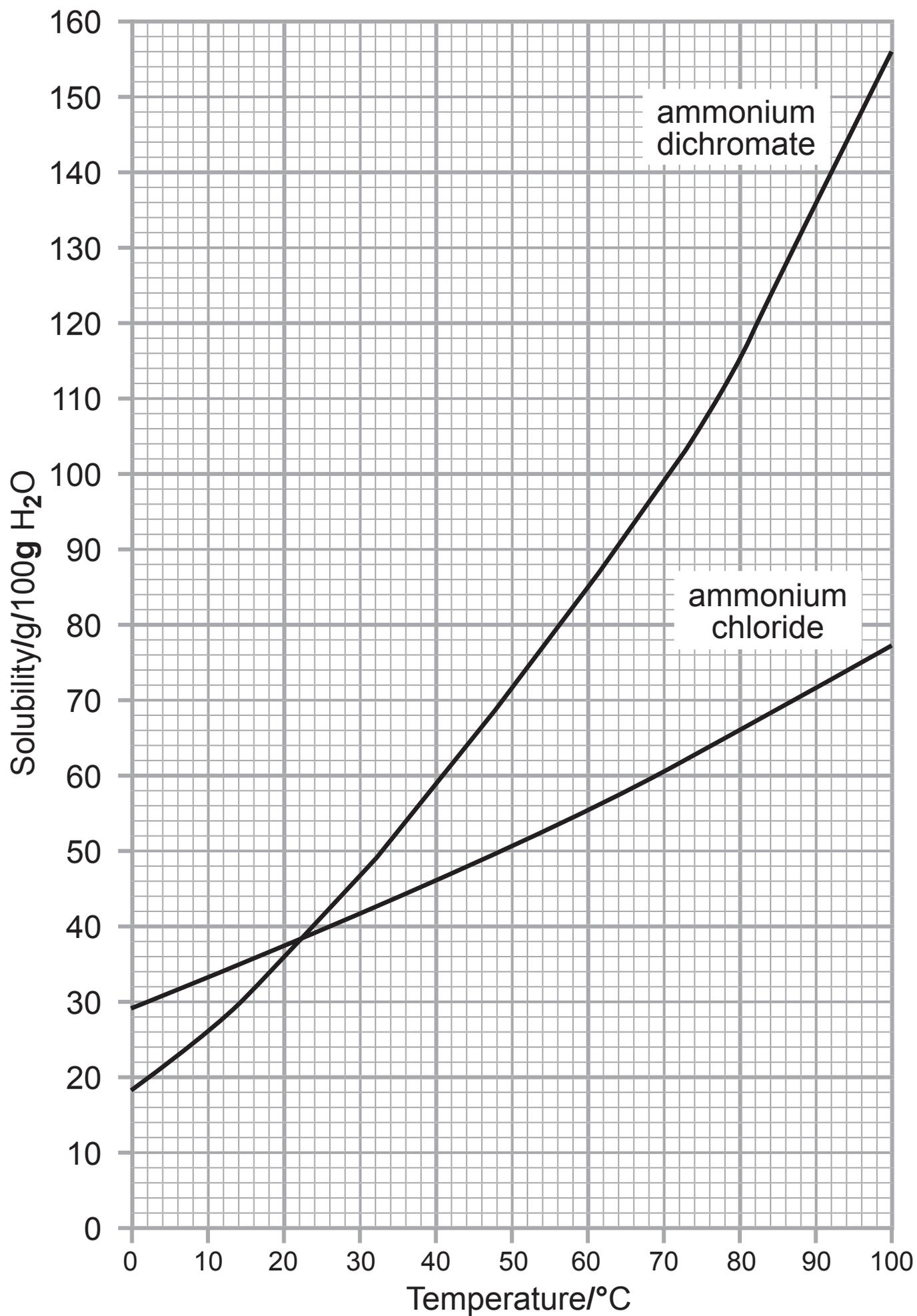
5 Tooth whitening is not a modern invention. Ancient Romans used urine and goats' milk to whiten their teeth. A chemical called urea which is present in the urine bleaches teeth.

(a) Urea contains 20.00 % carbon, 6.66 % hydrogen, 46.67 % nitrogen and 26.67 % oxygen. Determine the empirical formula of urea. [5 marks]

(Relative atomic masses: H=1; C=12; N=14; O=16)

Empirical formula = _____

(b) Today, most teeth whitening kits contain the chemical carbamide peroxide which breaks down in the mouth into urea and hydrogen peroxide. During the bleaching process the hydrogen peroxide decomposes to produce water and oxygen.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

Calculate the mass of oxygen produced from 5.1 g of hydrogen peroxide. [5 marks]

(Relative atomic masses: H = 1; O = 16)

Mass of oxygen = _____

(c) Some whitening toothpastes contain hydrated silica, $SiO_2.2H_2O$, which acts as an abrasive to remove stains and polish teeth.

(i) Hydrated silica contains water of crystallisation. What is meant by the term water of crystallisation? [2 marks]

_____

_____

_____

_____

(ii) Calculate the percentage of water of crystallisation present in hydrated silica. [3 marks]
(Relative atomic masses: H **=** 1; O **=** 16; Si **=** 28)

Percentage of water **=** _____ **%**

(iii) Silica has a structure similar to diamond. Name this type of structure. [1 mark]

_____

(iv) Hydrated aluminium oxide, $Al_2O_3.nH_2O$, may be used as an alternative abrasive.

To determine the degree of hydration in hydrated aluminium oxide 3.12 g of hydrated aluminium oxide were heated to constant mass. 2.04 g of anhydrous aluminium oxide remained. [6 marks]

Find the value of n in $Al_2O_3.nH_2O$.
(Relative atomic masses: H **=** 1; O **=** 16; Al **=** 27)

n **=** _____

THIS IS THE END OF THE QUESTION PAPER

9372.03 **MV18**