Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2013

Science: Chemistry

Unit C1

Higher Tier

[GCH12]

GCH12

MONDAY 10 JUNE, AFTERNOON

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.
You must answer the questions in the spaces provided. Do not write outside the box, around each page or on blank pages.
Complete in blue or black ink only. **Do not write with a gel pen**.
Answer **all six** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is **100**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in question **2(b)(iii)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

7950

1 **(a)** The Periodic Table below shows some elements.

							H									He
Li													N	O		Ne
Na											Al		P	S		Ar
K							Fe			Cu					Br	
Rb															I	

USE ONLY THE ELEMENTS SHOWN ABOVE TO ANSWER THE FOLLOWING QUESTIONS.

Examiner Only	
Marks	Remark

(i) Name one non-metal which is a solid at room temperature and pressure.

_____ [1]

(ii) Write the symbol for an element which is a liquid at room temperature and pressure.

_____ [1]

(iii) Name one diatomic element.

_____ [1]

(iv) Name one element which is a colourless gas at room temperature and pressure.

_____ [1]

(v) Name one transition metal.

_____ [1]

(vi) Name the most reactive element in Group 1.

_____ [1]

(vii) Name the element which has atoms with an electronic configuration 2, 8, 8.

_____ [1]

(viii) Name one element which sublimes on heating.

_____ [1]

(b) The element chlorine is found in Group 7 of the Periodic Table.

(i) What name is given to Group 7 of the Periodic Table?

_____ [1]

(ii) What is the colour and physical state of chlorine at room temperature and pressure?

Colour: _____

State: _____ [2]

(iii) Explain why chlorine should be used in a fume cupboard.

_____ [1]

(c) Chlorine reacts with solutions containing iodide ions.

(i) Write a balanced symbol equation for the reaction between chlorine and potassium iodide.

_____ [3]

(ii) What would be observed when chlorine gas is bubbled into a solution of potassium iodide?

_____

_____

_____ [2]

Examiner Only	
Marks	Remark
Total Question 1	

[Turn over

Examiner Only	
Marks	Remark

2 Ski resorts use artificial snow to supplement natural snow. Artificial snow is made by forcing water and pressurised air through a snow cannon into cold air. The water droplets crystallise to form artificial snow.

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(a) Water contains the elements hydrogen and oxygen.

(i) Complete the table below to give information about atoms of hydrogen and oxygen.

Atom	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons
$^{1}_{1}H$					
$^{16}_{8}O$					

[2]

(ii) Use a **dot and cross diagram** to show the bonding in water (H_2O). (Show only outer shell electrons.)

[3]

(iii) Artificial snow production works most effectively if the water used contains calcium ions, Ca^{2+}.

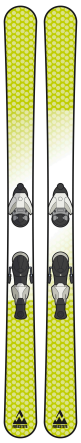
Draw a labelled diagram of a calcium ion stating the number of each subatomic particle present and showing the position of each particle. (Calcium atomic number = 20; mass number = 40)

[3]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

(b) Skis were originally made from wood. Modern skis are often made of layers of graphite with steel edges to help the skis turn easily.



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(i) Steel is an alloy. What is meant by the term alloy?

_____

_____

_____ [2]

(ii) Graphite is one of the allotropes of carbon. What are allotropes?

_____

_____ [2]

(iii) Three physical properties of graphite are shown in the table below. Explain these three physical properties of graphite in terms of structure and bonding.

Physical properties of graphite
High melting point
Soft
Good conductor of electricity

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

[6]

Examiner Only	
Marks	Remark

(c) Instead of steel, aluminium can be used on the edges of skis to make them lighter. The bonding within aluminium metal is metallic bonding.

(i) What is metallic bonding?

_____

_____

_____

_____ [2]

(ii) Explain why metals such as aluminium are malleable.

_____

_____

_____

_____ [2]

Examiner Only	
Marks	Remark
Total Question 2	

Examiner Only	
Marks	Remark

3 **(a)** Limestone, $CaCO_3$, is used as a building material and in the production of lime.

When heated strongly calcium carbonate breaks down to produce lime and carbon dioxide gas as shown in the following equation.

$$CaCO_3 \rightarrow CaO + CO_2$$

(i) What name is given to this type of reaction?

_____ [2]

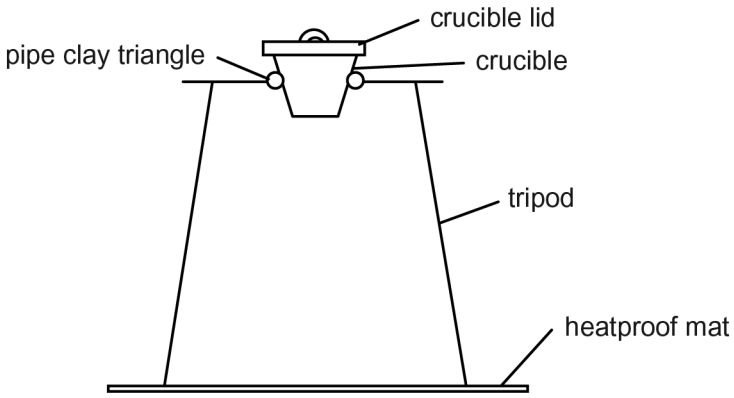
(ii) Calculate the maximum mass of calcium oxide produced when 600 g of calcium carbonate are heated strongly.

(Relative atomic masses: C = 12; O = 16; Ca = 40)

_____ g [5]

Examiner Only	
Marks	Remark

(b) The metal titanium reacts with oxygen to form an oxide of titanium. In an experiment to determine the formula of the oxide, a sample of titanium metal was heated in a crucible with a tightly fitting lid. During heating the lid was lifted from time to time.



The following results were obtained:

Mass of crucible	18.34 g
Mass of crucible + titanium metal	19.36 g
Mass of crucible + oxide	20.04 g

(i) Suggest why it was necessary to lift the crucible lid during heating.

_____

_____ [1]

(ii) Use the results of the experiment to determine the empirical formula for the oxide of titanium.

(Relative atomic masses: O = 16; Ti = 48)

Empirical formula _____ [6]

Examiner Only	
Marks	Remark
Total Question 3	

[Turn over

Examiner Only	
Marks	Remark

4 Acids and alkalis react together to form a salt and water.

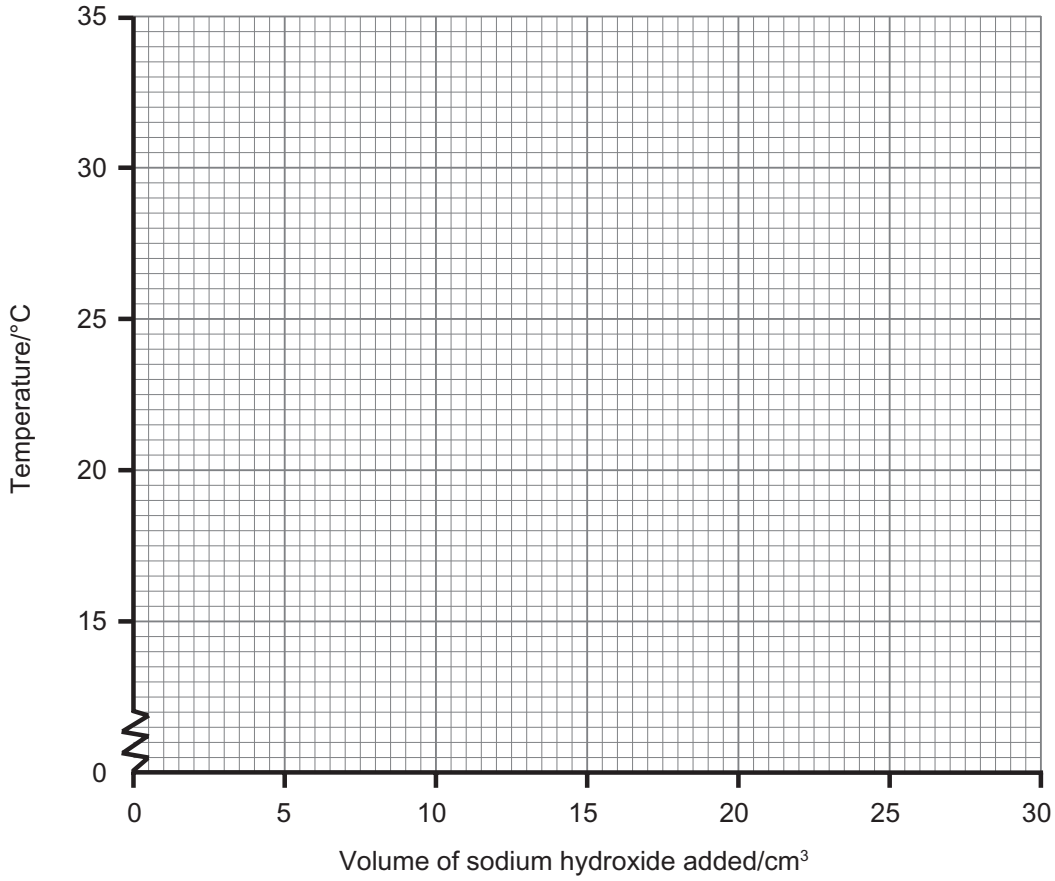
(a) The following experiment was carried out to determine if the reaction between hydrochloric acid and sodium hydroxide was exothermic.

- 25 cm^3 of 1.0 mol/dm^3 hydrochloric acid were measured out and placed in a polystyrene cup.
- The temperature of the hydrochloric acid was recorded.
- 25 cm^3 of 1.0 mol/dm^3 sodium hydroxide solution were then added gradually in 5 cm^3 portions to the hydrochloric acid, stirring after each addition.

The temperature of the reaction mixture was recorded and the results are shown in the table below.

Volume of sodium hydroxide added/cm^3	0	5	10	15	20	25
Temperature of reaction mixture/°C	20.5	21.5	22.5	23.5	25.5	28.0

(i) On the axes opposite, plot a graph of temperature against volume of sodium hydroxide added using the results in the table above.



[3]

(ii) How does your graph prove that this reaction is exothermic?

_____

_____ [1]

(iii) Apart from exothermic, what other term is used to describe the type of reaction between an acid and an alkali?

_____ [1]

(iv) Write a balanced symbol equation for the reaction between sodium hydroxide and hydrochloric acid.

_____ [2]

Examiner Only	
Marks	Remark

[Turn over

(b) The salt potassium sulfate is widely used as a fertiliser and in the manufacture of glass.

(i) Describe the steps which should be taken to prepare pure, dry crystals of potassium sulfate from the reaction between sulfuric acid and potassium hydroxide solution using a named indicator.

[6]

Examiner Only	
Marks	Remark

(ii) Write a balanced symbol equation for the reaction between potassium hydroxide and sulfuric acid.

_____ [3]

Examiner Only	
Marks	Remark
Total Question 4	

Examiner Only	
Marks	Remark

5 **(a)** A student used the following method to find the solubility of potassium nitrate at room temperature (20 °C).

Place 25 g of deionised water in a beaker and add solid potassium nitrate while stirring until no more will dissolve. Filter the mixture. Place the filtrate in an evaporating basin and heat using a Bunsen burner until all of the water has been removed. Measure the mass of solid obtained.

(i) What is meant by the term solubility?

_____

_____

_____

_____ [4]

(ii) Suggest why the mixture was filtered.

_____

_____ [1]

(iii) Draw a labelled diagram of the assembled apparatus used to heat the filtrate.

[3]

(b) The table below shows the solubility values of potassium nitrate between 0 °C and 100 °C.

Temperature/°C	0	20	40	60	80	100
Solubility of potassium nitrate (g/100 g water)	13.5	31.5	62.5	108	168	245

(i) 72 g of potassium nitrate were added to 100 g of water at 40 °C. After stirring, the solution was saturated and some potassium nitrate remained undissolved. Calculate the mass of potassium nitrate which did not dissolve.

Mass of potassium nitrate _____ g [2]

(ii) Calculate the mass of potassium nitrate which would crystallise if a saturated solution containing 500 g of water is cooled from 60 °C to 40 °C.
You should show all your working out clearly.

Mass of potassium nitrate _____ g [4]

Examiner Only	
Marks	Remark
Total Question 5	

[Turn over

Examiner Only	
Marks	Remark

6 Hydrochloric acid, hydrobromic acid and hydroiodic acid each contain a Group 7 ion.

(a) (i) Name the two ions present in hydrochloric acid.

_____

_____ [2]

(ii) These three acids are all **strong acids**. Describe how you would experimentally determine which of these acids is the strongest.

_____

_____

_____

_____ [2]

(b) (i) In an experiment to determine which Group 7 ion was present in each of the acids, a few drops of silver nitrate solution were added to a sample of the acid solution. Complete the table below to show the results of these tests.

	Hydrochloric acid	**Hydrobromic acid**	**Hydroiodic acid**
Observation on addition of a few drops of silver nitrate solution.			

[4]

(ii) Write a balanced **ionic** equation for the reaction of hydrochloric acid with silver nitrate solution.

_____ [2]

(c) Hydrochloric acid reacts with bases to form salts such as sodium chloride and zinc chloride. An antiseptic mouthwash is thought to contain both of these salts.

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(i) Describe how you would confirm that the mouthwash contained sodium ions.

_____

_____

_____

_____ [2]

(ii) Describe how you would experimentally confirm that the mouthwash contained zinc ions. In your answer, refer to the validity of your test.

_____

_____

_____

_____

_____

_____ [5]

Examiner Only	
Marks	Remark
Total Question 6	

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For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
4	
5	
6	
QWC	
Total Marks	

Examiner Number