



Rewarding Learning

General Certificate of Secondary Education
2016

Centre Number

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Candidate Number

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GCSE Chemistry

Unit 2

Foundation Tier



GCH21

[GCH21]

WEDNESDAY 22 JUNE, 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.

You must answer the questions in the spaces provided.

Do not write outside the boxed area on 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 90.

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 **4(b)**.

A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.



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- 1 (a) The first national report examining the impact of water fluoridation on children was published in 2014. The dental health of five year olds and twelve year olds living in fluoridated water and non-fluoridated water areas was measured.

Data from this report is shown in the table below.

	In fluoridated water areas	In non-fluoridated water areas
% of twelve year olds with tooth decay	22	37
% of five year olds with tooth decay	13	42
% of hospital admissions for children aged 1–4 for tooth decay	2	20

- (i) Use the data in the table to deduce the effect, if any, of the presence of fluoride in water on the dental health of children.

[2]

- (ii) State one reason why some people are against the fluoridation of drinking water.

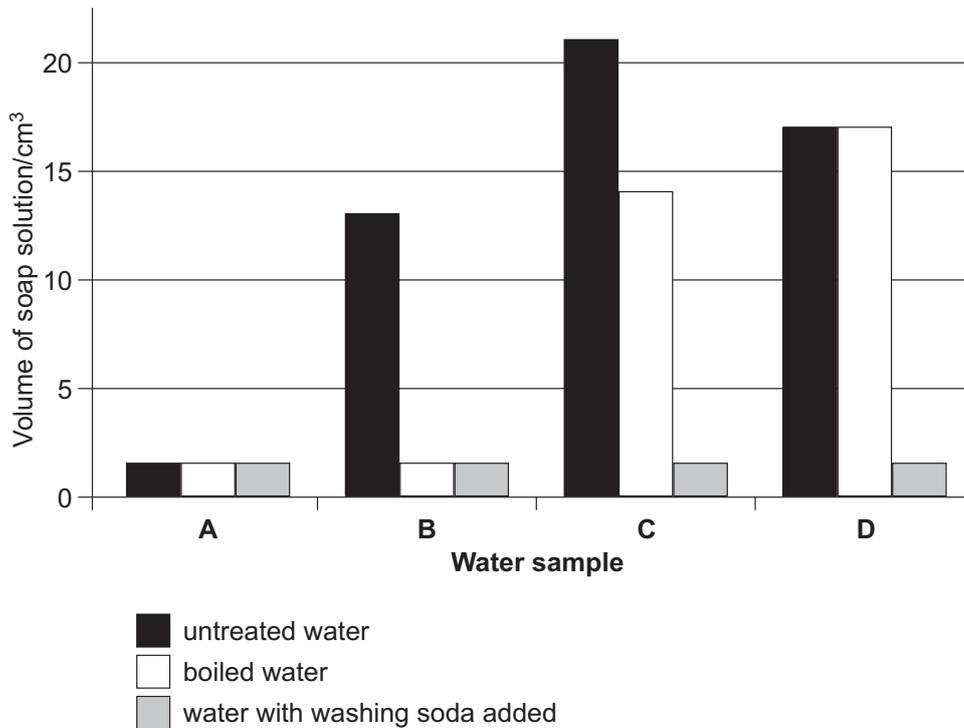
[1]

[Turn over



- (b) Four samples of water, A, B, C and D, were tested for hardness. Soap solution was added, with shaking, to each of the four 20.0 cm^3 samples of water. The volume of soap solution required to produce 1 cm height of lather was recorded.

The experiment was repeated, with fresh boiled samples of water and then again with fresh samples of water which had been treated with washing soda. The results of the experiment are shown below.



- (i) What is meant by the term hard water?

[1]

- (ii) Which one of the samples, A, B, C or D is the hardest water? Explain your answer.

Sample: _____

[2]



(iii) What type of hardness is present in the following samples?

Sample B _____

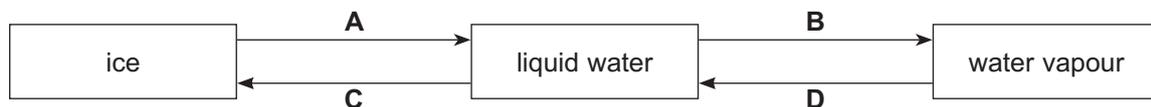
Sample D _____ [2]

(iv) Explain why hard water is considered to be good for your health.

 _____ [1]

(c) Water can exist in three different states of matter.

(i) The changes of state are represented by the letters A, B, C and D, in the diagram below.



Complete the table below giving the name of the change of state represented by each letter.

Change of state	Name of the change of state
A	
B	
C	
D	

[4]

(ii) Name a chemical which could be used to test for the presence of water.

_____ [1]

[Turn over



2 Cyclohexane, cyclohexene, ethanol and ethanoic acid are colourless liquids at room temperature. Each one belongs to a different homologous series.

(a) What is meant by the term homologous series?

[3]

(b) Cyclohexane is a colourless liquid alkane.

(i) What is the general formula for the alkanes?

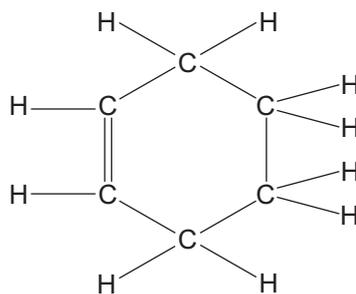
[1]

(ii) Draw the structural formula of ethane.

[1]



- (c) The colourless liquid cyclohexene is a hydrocarbon with the molecular formula C_6H_{10} . The structural formula of cyclohexene is shown below.



- (i) What is the functional group in cyclohexene?

_____ [1]

- (ii) Why is cyclohexene described as a hydrocarbon?

_____ [1]

- (iii) Name the two products formed when cyclohexene is burned in excess oxygen.

1. _____
2. _____ [2]

- (iv) Name the two **compounds** formed when cyclohexene is burned in a limited supply of oxygen.

1. _____
2. _____ [2]

[Turn over



(d) Ethanol is a colourless liquid which can be made by fermentation.

(i) Describe the process of fermentation.

[4]

(ii) State one use of ethanol.

[1]

(e) Ethanoic acid is a colourless liquid with a sharp smell.

(i) State one use of ethanoic acid.

[1]

(ii) Complete the word equation below.

ethanoic acid + sodium carbonate → [1]



3 Hydrogen peroxide decomposes rapidly into water and oxygen in the presence of a catalyst.

(a) (i) Write a balanced symbol equation for the decomposition of hydrogen peroxide.

_____ [3]

(ii) Name the catalyst used for this reaction in the laboratory.

_____ [1]

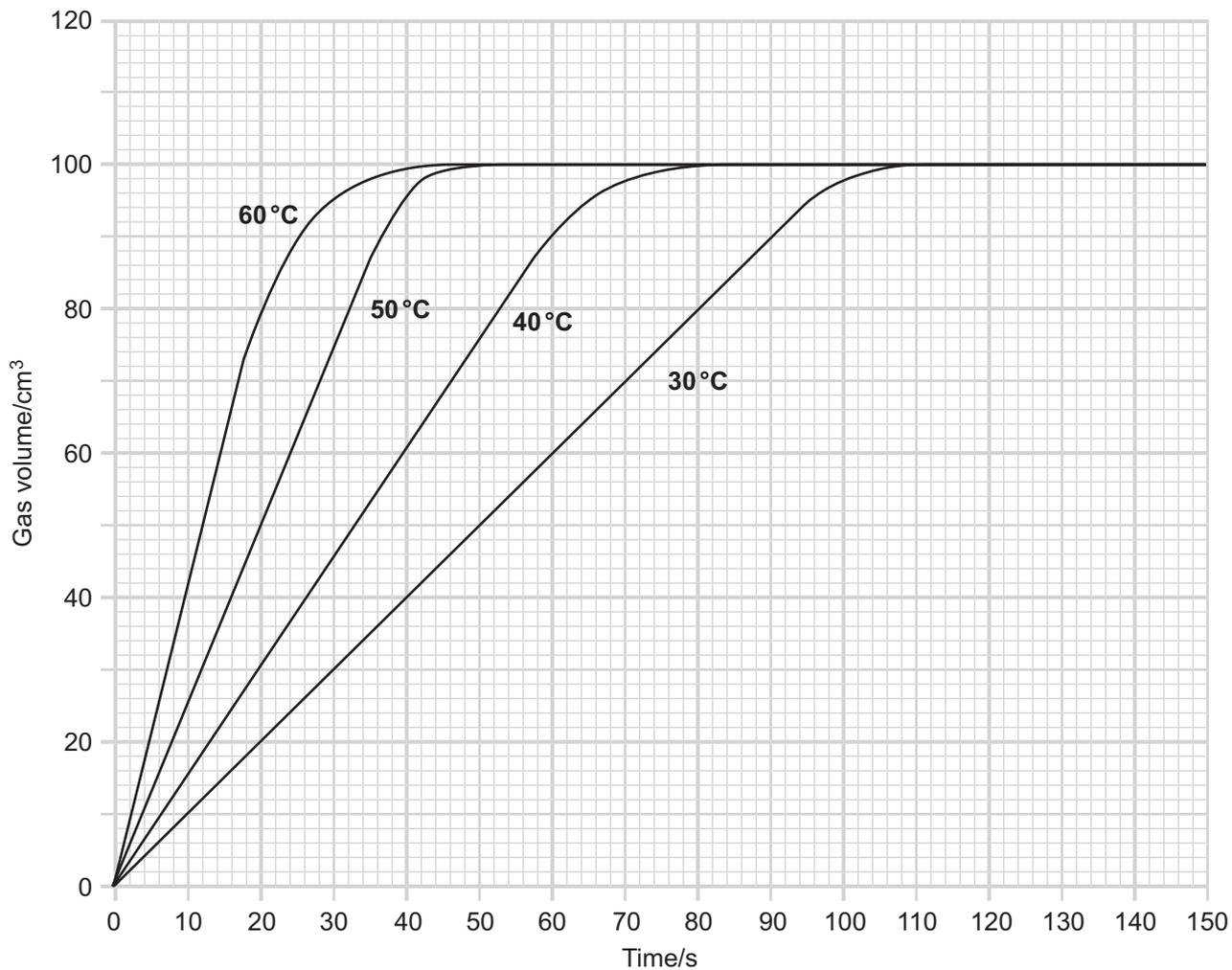
(iii) What is meant by the term catalyst?

_____ [3]

[Turn over



(b) The volume of gas produced by the catalytic decomposition of hydrogen peroxide was measured at four different temperatures. The results were plotted on the graph below.



- (i) What was the gas volume at 40 seconds when the temperature was 30 °C?
State the units.

_____ [2]

- (ii) Complete the table below giving the time taken for the reaction to finish at 60 °C. Calculate the rate based on this time.

Temperature (°C)	Time taken for reaction to finish (s)	Rate = $\frac{1}{\text{time}}$ (s ⁻¹)
30	108	0.00926
40	79	0.01266
50	48	0.02083
60		

[2]

- (iii) Using the data from the table above, state how rate changes as temperature increases.

_____ [1]

[Turn over



4 (a) The element carbon is found in all living things.

(i) Write a balanced symbol equation for carbon burning in air to form carbon dioxide gas.

_____ [2]

(ii) Describe a chemical test for carbon dioxide gas and state the result for a positive test.

_____ [3]

(b) Acid rain has been a major environmental problem for decades. Sulfur impurities in fossil fuels contribute to acid rain.

Describe in detail how these sulfur impurities lead to the formation of acid rain. Describe the effects of acid rain and methods used to prevent it.

Your answer should include:

- A description of how sulfur impurities lead to acid rain. (Include balanced symbol equations)
- At least two detrimental effects of acid rain on the environment
- At least two methods used to prevent acid rain.

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



5 Chemical reactions involve reactants being converted into products.

(a) Some signs of a chemical reaction occurring are given in the box below.

colour change	gas produced
formation of a precipitate	

For each of the chemical reactions in the table below, choose a sign from the box above which would indicate that a chemical reaction is occurring.

Chemical reaction	Sign
magnesium + hydrochloric acid	
copper(II) oxide + hydrochloric acid	

[2]

(b) Chemical reactions may be classified as exothermic or endothermic reactions.

(i) Explain the meaning of the term endothermic.

[1]

(ii) Complete the following table by placing a tick (✓) in the appropriate column.

Chemical Reaction	Exothermic	Endothermic
Neutralisation		
Thermal decomposition		

[2]



(iii) Fill in the missing words to complete the passage below.

During a chemical reaction, bonds in the reactants are broken and this process _____ energy. New bonds are formed in the products and this process _____ energy. [2]

(c) Rusting of iron is a major problem costing millions of pounds every year.

(i) Name the two substances that react with iron to form rust.

1. _____
2. _____ [2]

(ii) Describe the appearance of rust.

_____ [2]

(iii) State a method used to prevent iron from rusting and explain how it works.

Method _____

Explanation _____

_____ [2]

[Turn over



(d) Iron is extracted from its ore, haematite, in a Blast Furnace. Haematite is mainly iron(III) oxide which is reduced by carbon monoxide to produce iron and carbon dioxide.

(i) Write a balanced symbol equation for the reaction between iron(III) oxide and carbon monoxide.

_____ [3]

(ii) Explain why iron(III) oxide is said to be reduced in this reaction.

_____ [2]





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- 6 (a) The reactivity of metals can be studied using displacement reactions. If a displacement reaction occurs there is a temperature rise.

In an experiment the following method was used:

- Pour some copper(II) sulfate solution into a polystyrene cup and record the temperature of the solution.
- Add a known mass of metal and stir.
- Record the maximum temperature of the mixture.
- Repeat the experiment.

The results of this experiment are shown in the table below.

Metal	Temperature increase (°C)		Average temperature rise (°C)
	Experiment 1	Experiment 2	
magnesium	11.5	16.5	14.0
silver	0.0	0.0	0.0
iron	3.0	4.0	3.5
gold	0.0	0.0	0.0
zinc	7.0	8.0	7.5

- (i) State two factors which should be kept the same in this experiment to make it a fair test.

1. _____

2. _____ [2]

- (ii) State and explain which of the metals gave the least reliable temperature rise.

_____ [1]



- (iii) State and explain which of the metals used in the experiment is the most reactive.

_____ [2]

- (iv) Explain why there is no temperature rise when silver is added to copper(II) sulfate solution.

_____ [1]

- (v) Why do the results make it impossible to decide which of the metals is the least reactive?

_____ [1]

- (vi) Write a balanced symbol equation for the displacement reaction between zinc and copper(II) sulfate solution.

_____ [2]

[Turn over



(b) Aluminium is extracted from its ore by electrolysis.

(i) Explain what is meant by the term electrolysis.

_____ [2]

(ii) Name the ore from which aluminium is extracted.

_____ [1]

(iii) The ore of aluminium contains aluminium ions and oxide ions. State the formulae of these ions.

aluminium ion _____

oxide ion _____ [2]

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Question Number	Marks
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Examiner Number

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SYMBOLS OF SELECTED IONS

Positive ions

Name	Symbol
Ammonium	NH_4^+
Chromium(III)	Cr^{3+}
Copper(II)	Cu^{2+}
Iron(II)	Fe^{2+}
Iron(III)	Fe^{3+}
Lead(II)	Pb^{2+}
Silver	Ag^+
Zinc	Zn^{2+}

Negative ions

Name	Symbol
Carbonate	CO_3^{2-}
Dichromate	$\text{Cr}_2\text{O}_7^{2-}$
Ethanoate	CH_3COO^-
Hydrogen carbonate	HCO_3^-
Hydroxide	OH^-
Methanoate	HCOO^-
Nitrate	NO_3^-
Sulfate	SO_4^{2-}
Sulfite	SO_3^{2-}

DATA LEAFLET

For the use of candidates taking
 Science: Chemistry,
 Science: Double Award
 or Science: Single Award

Copies must be free from notes or additions of any kind. No other type of data booklet or information sheet is authorised for use in the examinations.

SOLUBILITY IN COLD WATER OF COMMON SALTS, HYDROXIDES AND OXIDES

Soluble
All sodium, potassium and ammonium salts
All nitrates
Most chlorides, bromides and iodides EXCEPT silver and lead chlorides, bromides and iodides
Most sulfates EXCEPT lead and barium sulfates Calcium sulfate is slightly soluble

Insoluble
Most carbonates EXCEPT sodium, potassium and ammonium carbonates
Most hydroxides EXCEPT sodium, potassium and ammonium hydroxides
Most oxides EXCEPT sodium, potassium and calcium oxides which react with water

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