



Rewarding Learning

General Certificate of Secondary Education  
January 2019

Centre Number

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Candidate Number

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# GCSE Chemistry

Unit 2

Foundation Tier



[GCH21]

\*GCH21\*

**FRIDAY 25 JANUARY, 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 boxed area on each page or on blank pages.**

Complete in 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(d)**.

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



- 1 (a) Using only the substances in the box below, answer the questions which follow. Each substance may be used once, more than once or not at all.

anhydrous calcium chloride	barium sulfate	anhydrous copper(II) sulfate	ice
water vapour	sodium fluoride	hydrated copper(II) sulfate	water

- (i) Name the substance used to test for water and state the colour change for a positive test.

Substance: \_\_\_\_\_

Colour change: \_\_\_\_\_ to \_\_\_\_\_ [3]

- (ii) Name a substance which may be used in X-ray procedures.

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

- (iii) Name a substance which is used as a drying agent.

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

- (iv) Complete the sentence.

Condensation occurs when \_\_\_\_\_ is cooled to  
form \_\_\_\_\_ . [2]

- (v) Name a substance which may be added to a public water supply to prevent tooth decay.

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



- (b) In an experiment, the volume of soap needed to produce a lasting lather was recorded for samples of water from different towns. Samples were tested with soap before boiling and after boiling.

Town	Volume of soap required to produce a lather (cm <sup>3</sup> )	
	Before boiling	After boiling
W	0.5	0.5
X	21.1	18.1
Y	18.2	0.5
Z	12.0	12.0

- (i) Which town has the hardest water?

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

- (ii) In which town will limescale be the greatest problem?

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

- (iii) Which town has permanent hardness **only** in its water supply?

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

- (iv) Write the formula of one ion which causes hardness in water.

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

- (v) Apart from a lather, what is observed when soap is shaken with the water from town Z?

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

[Turn over



2 Apples produce ethene gas as they ripen.

(a) (i) Draw the structural formula of ethene.

[1]

(ii) Write the molecular formula of ethene.

[1]

(iii) Write the general formula for the homologous series to which ethene belongs.

[1]

(iv) Write a balanced symbol equation for the complete combustion of ethene.

[3]



(b) A recipe for pickled apples has the instruction below.

“Warm the apples with vinegar, sugar, water and cinnamon in a non-stick saucepan for ten minutes.”

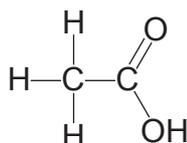
(i) Vinegar is a dilute solution of ethanoic acid. State two observations which occur when a spatula of solid sodium carbonate is added to vinegar.

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

(ii) Write the formula of sodium carbonate.

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

(iii) The structural formula of ethanoic acid is shown below.



Explain why ethanoic acid is not a hydrocarbon.

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

(iv) A non-stick saucepan is coated with the polymer PTFE. What is meant by the term polymer?

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

[Turn over



**(c)** Apples can undergo fermentation to make cider, a drink which contains ethanol.

Describe the process of fermentation, stating the conditions used.

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[4]

**(d)** Ethanol can be used as a fuel. It is a renewable resource.

**(i)** What is meant by a renewable resource?

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[1]

**(ii)** Name a non-renewable fuel.

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[1]





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\*24GCH2107\*

3 The rate of reaction can be measured by monitoring the volume of gas produced during a reaction.

(a) Three reactions which produce a gas are given as word equations below labelled **A**, **B** and **C**.

**A:** magnesium + hydrochloric acid  $\rightarrow$  magnesium chloride + hydrogen

**B:** hydrogen peroxide  $\rightarrow$  water + oxygen

**C:** calcium carbonate + hydrochloric acid  $\rightarrow$  calcium chloride + carbon dioxide + water

(i) **Circle** the gas produced in each of the reactions. [1]

(ii) Write a balanced symbol equation for reaction **B**. [3]

\_\_\_\_\_

(iii) Name the catalyst used in reaction **B**. [1]

\_\_\_\_\_



(iv) Draw a labelled diagram of the assembled apparatus used to measure the volume of gas produced every 20 seconds for the reaction between magnesium and hydrochloric acid. Include all apparatus required.

[4]

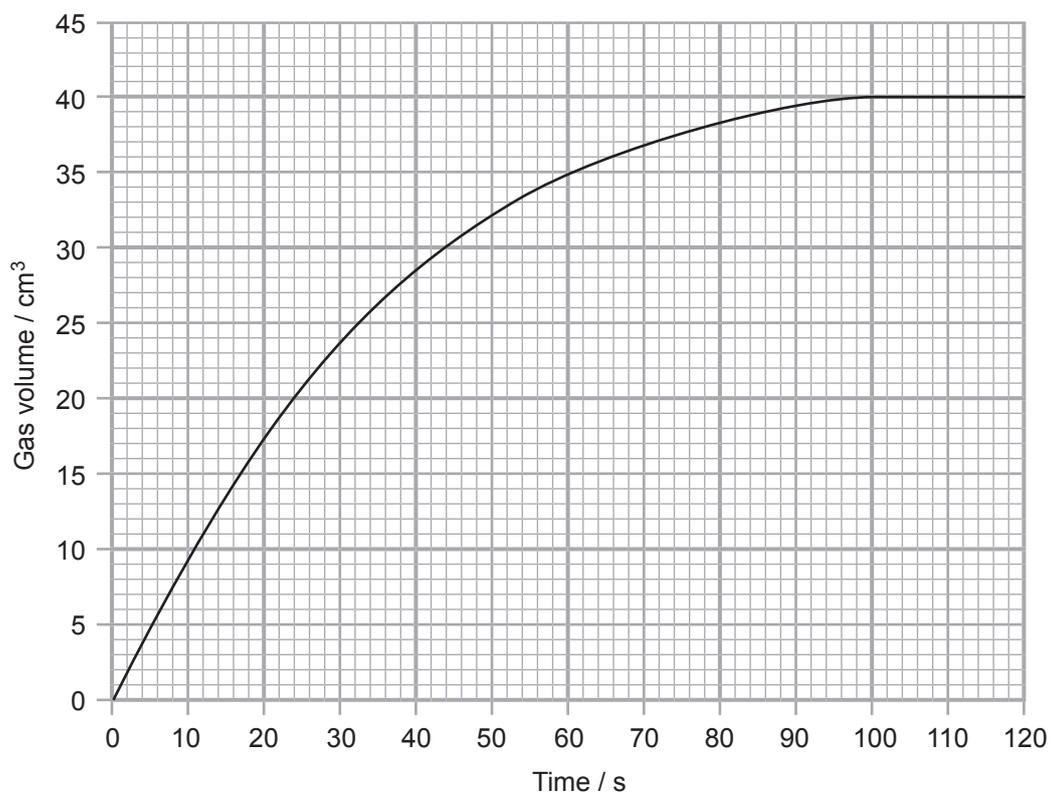
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- (b) In a laboratory experiment 0.04 g of magnesium ribbon were reacted with **excess** dilute hydrochloric acid at 20°C. The volume of gas produced was recorded every 20 seconds. The results obtained are shown in the graph below.



(i) From the graph, determine the time at which the reaction finishes.

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

(ii) Calculate the rate of this reaction using the time in (b)(i).

Rate = \_\_\_\_\_ s<sup>-1</sup> [1]

(iii) On the graph opposite, sketch the curve obtained when the same mass of magnesium ribbon was reacted with an excess of dilute hydrochloric acid at 40 °C. The same volume and concentration of hydrochloric acid were used. [3]

[Turn over

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\*24GCH2111\*

4 (a) The element nitrogen is in Group 5 of the Periodic Table. It exists as a diatomic gas at room temperature and pressure.

(i) Explain the meaning of the term diatomic.

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

(ii) State two physical properties of nitrogen gas.

1. \_\_\_\_\_  
2. \_\_\_\_\_ [2]

(b) In industry, nitrogen is used to make ammonia gas in the Haber process.

(i) Name the other reactant in the Haber process.

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

(ii) State the temperature and pressure used in the Haber process.

Temperature \_\_\_\_\_ °C  
Pressure \_\_\_\_\_ atm [2]

(iii) Name the catalyst used in the Haber process.

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



(c) One of the main uses of ammonia is in the manufacture of nitrogenous fertilisers. Nitrogenous fertilisers may contain ammonium nitrate and ammonium sulfate.

(i) Write a balanced symbol equation for the formation of ammonium sulfate from the reaction between ammonia and sulfuric acid.

\_\_\_\_\_ [3]

(ii) Name the acid that reacts with ammonia to form ammonium nitrate.

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

[Turn over

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\*24GCH2115\*

- 5 (a) A student investigated the temperature change during the reaction between sodium hydrogencarbonate and hydrochloric acid. The results obtained are shown in the table below.

Mass of sodium hydrogencarbonate added to 25 cm <sup>3</sup> of hydrochloric acid (g)	Initial temperature (°C)	Final temperature (°C)	Temperature change (°C)
2	20	16	4
4	20	14	6
6	19	11	8
8	19	9	10

- (i) Write a balanced symbol equation for the reaction between sodium hydrogencarbonate and hydrochloric acid.

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

- (ii) Use the results from the experiment to determine if the reaction is exothermic or endothermic and explain your answer.

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



- (b) Complete the table below by placing a tick (✓) in the correct column to indicate if the reaction is exothermic or endothermic. The first one has been completed for you.

Reaction	Exothermic	Endothermic
Rusting	✓	
Combustion of methane		
Thermal decomposition of calcium carbonate		

[2]

- (c) The combustion of methane may be described as an oxidation reaction.

- (i) Explain the meaning of the term combustion.

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[3]

- (ii) Explain the meaning of the term oxidation.

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[1]

- (iii) In many chemical reactions oxidation and reduction occur at the same time. What term is used to describe this type of reaction?

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[1]

[Turn over

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\*24GCH2117\*

(d) The rusting of iron can weaken structures.

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

1. \_\_\_\_\_
2. \_\_\_\_\_ [2]

(ii) Describe the appearance of rust.

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

(iii) The rusting of iron may be prevented using a range of methods. Complete the table below by placing a tick (✓) in the box to show a method of rust prevention for each object.

Object	Oiling	Painting	Galvanising
Bridge			
Bicycle chain			

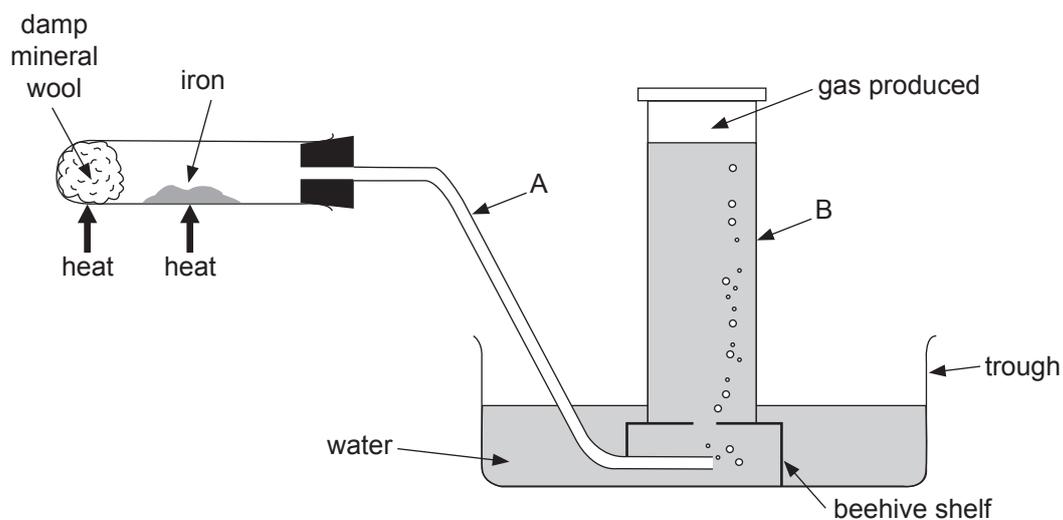
[2]

(iv) Name the metal used to galvanise iron.

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



6 (a) Iron metal can be reacted with steam using the apparatus shown below.



(i) Name the pieces of apparatus labelled A and B.

A \_\_\_\_\_

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

(ii) Explain why the damp mineral wool is heated.

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

(iii) Name the gas produced in this experiment.

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

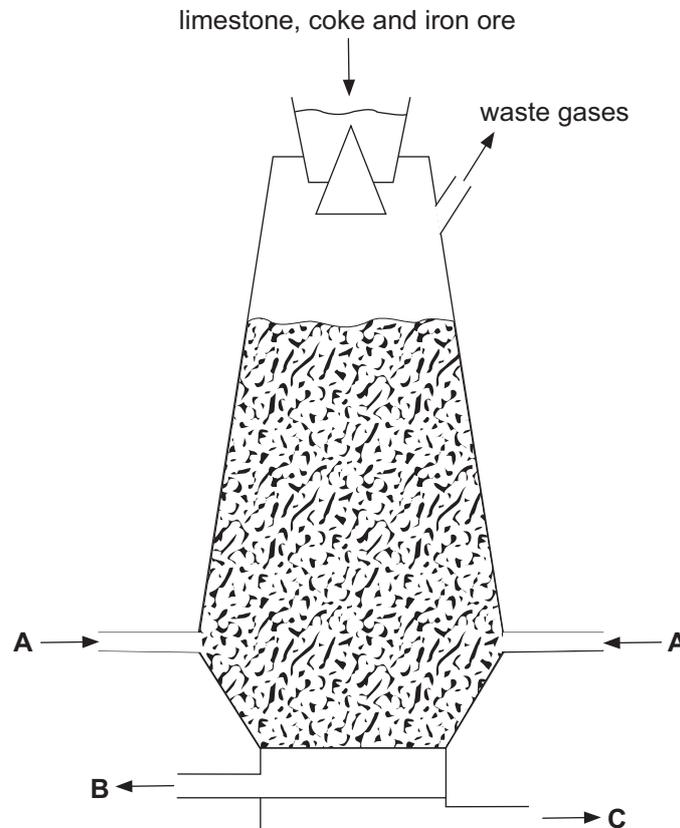
(iv) Name a metal which does not react with steam.

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

[Turn over



- (b) Iron is manufactured in the Blast Furnace. In the Blast Furnace the raw materials limestone, coke and iron ore enter at the top of the furnace as shown in the diagram below.



- (i) Name the iron ore used in the Blast Furnace.

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

- (ii) What enters the Blast Furnace at **A**?

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



(iii) What labels should be placed at **B** and **C**?

**B** \_\_\_\_\_

**C** \_\_\_\_\_ [2]

(iv) Name one waste gas emitted from the Blast Furnace.

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

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Question Number	Marks
1	
2	
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<b>Total Marks</b>	
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Examiner Number

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## **Periodic Table of the Elements**

For the use of candidates taking  
Advanced Subsidiary and Advanced Level  
Chemistry Examinations

**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.**

**gce A/AS examinations**  
**chemistry**  
**(advanced)**

I	II	THE PERIODIC TABLE OF ELEMENTS Group										III	IV	V	VI	VII	0						
1 <b>H</b> Hydrogen 1	One mole of any gas at 20°C and a pressure of 1 atmosphere (10 <sup>5</sup> Pa) occupies a volume of 24 dm <sup>3</sup> . Planck Constant = 6.63 × 10 <sup>-34</sup> Js Gas Constant = 8.31 J mol <sup>-1</sup> K <sup>-1</sup> Avogadro Constant = 6.02 × 10 <sup>23</sup> mol <sup>-1</sup>																4 <b>He</b> Helium 2						
7 <b>Li</b> Lithium 3											9 <b>Be</b> Beryllium 4							11 <b>B</b> Boron 5	12 <b>C</b> Carbon 6	14 <b>N</b> Nitrogen 7	16 <b>O</b> Oxygen 8	19 <b>F</b> Fluorine 9	20 <b>Ne</b> Neon 10
23 <b>Na</b> Sodium 11											24 <b>Mg</b> Magnesium 12							27 <b>Al</b> Aluminium 13	28 <b>Si</b> Silicon 14	31 <b>P</b> Phosphorus 15	32 <b>S</b> Sulfur 16	35.5 <b>Cl</b> Chlorine 17	40 <b>Ar</b> Argon 18
39 <b>K</b> Potassium 19	40 <b>Ca</b> Calcium 20	45 <b>Sc</b> Scandium 21	48 <b>Ti</b> Titanium 22	51 <b>V</b> Vanadium 23	52 <b>Cr</b> Chromium 24	55 <b>Mn</b> Manganese 25	56 <b>Fe</b> Iron 26	59 <b>Co</b> Cobalt 27	59 <b>Ni</b> Nickel 28	64 <b>Cu</b> Copper 29	65 <b>Zn</b> Zinc 30	70 <b>Ga</b> Gallium 31	73 <b>Ge</b> Germanium 32	75 <b>As</b> Arsenic 33	79 <b>Se</b> Selenium 34	80 <b>Br</b> Bromine 35	84 <b>Kr</b> Krypton 36						
85 <b>Rb</b> Rubidium 37	88 <b>Sr</b> Strontium 38	89 <b>Y</b> Yttrium 39	91 <b>Zr</b> Zirconium 40	93 <b>Nb</b> Niobium 41	96 <b>Mo</b> Molybdenum 42	99 <b>Tc</b> Technetium 43	101 <b>Ru</b> Ruthenium 44	103 <b>Rh</b> Rhodium 45	106 <b>Pd</b> Palladium 46	108 <b>Ag</b> Silver 47	112 <b>Cd</b> Cadmium 48	115 <b>In</b> Indium 49	119 <b>Sn</b> Tin 50	122 <b>Sb</b> Antimony 51	128 <b>Te</b> Tellurium 52	127 <b>I</b> Iodine 53	131 <b>Xe</b> Xenon 54						
133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56	139 <b>La</b> * Lanthanum 57	178 <b>Hf</b> Hafnium 72	181 <b>Ta</b> Tantalum 73	184 <b>W</b> Tungsten 74	186 <b>Re</b> Rhenium 75	190 <b>Os</b> Osmium 76	192 <b>Ir</b> Iridium 77	195 <b>Pt</b> Platinum 78	197 <b>Au</b> Gold 79	201 <b>Hg</b> Mercury 80	204 <b>Tl</b> Thallium 81	207 <b>Pb</b> Lead 82	209 <b>Bi</b> Bismuth 83	210 <b>Po</b> Polonium 84	210 <b>At</b> Astatine 85	222 <b>Rn</b> Radon 86						
223 <b>Fr</b> Francium 87	226 <b>Ra</b> Radium 88	227 <b>Ac</b> † Actinium 89																					

\* 58–71 Lanthanum series  
† 90–103 Actinium series

$\begin{matrix} a \\ b \end{matrix} x$  a = relative atomic mass (approx.)  
x = atomic symbol  
b = atomic number

140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	144 <b>Nd</b> Neodymium 60	147 <b>Pm</b> Promethium 61	150 <b>Sm</b> Samarium 62	152 <b>Eu</b> Europium 63	157 <b>Gd</b> Gadolinium 64	159 <b>Tb</b> Terbium 65	162 <b>Dy</b> Dysprosium 66	165 <b>Ho</b> Holmium 67	167 <b>Er</b> Erbium 68	169 <b>Tm</b> Thulium 69	173 <b>Yb</b> Ytterbium 70	175 <b>Lu</b> Lutetium 71
232 <b>Th</b> Thorium 90	231 <b>Pa</b> Protactinium 91	238 <b>U</b> Uranium 92	237 <b>Np</b> Neptunium 93	242 <b>Pu</b> Plutonium 94	243 <b>Am</b> Americium 95	247 <b>Cm</b> Curium 96	245 <b>Bk</b> Berkelium 97	251 <b>Cf</b> Californium 98	254 <b>Es</b> Einsteinium 99	253 <b>Fm</b> Fermium 100	256 <b>Md</b> Mendelevium 101	254 <b>No</b> Nobelium 102	257 <b>Lr</b> Lawrencium 103