Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2015

GCSE Chemistry

Unit 2

Foundation Tier

GCH21

[GCH21]

WEDNESDAY 17 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 **2(a)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

9373

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1 **(a)** Water is a compound. A diagram representing a molecule of water is shown below.

(i) Write the chemical formula for water.

_____ [1]

(ii) State the number and type of each different atom present in one molecule of water.

_____

_____

_____

_____ [2]

(iii) Describe a **chemical** test for water and state the observations for a positive test.

_____

_____

_____

_____ [3]

(iv) What name is given to the solid form of water?

_____ [1]

[Turn over

(b) Water supplied to some homes is described as hard water.

(i) What is meant by hard water?

_____

_____

_____ [2]

(ii) Explain the difference between temporary hardness and permanent hardness in water.

_____

_____

_____ [2]

(iii) State one **advantage** of hardness in a domestic water supply.

_____ [1]

2 Ethanol (C_2H_5OH) can be manufactured by fermentation.

(a) Describe the production of ethanol by fermentation.

In your answer you should include:

- the names of the starting materials
- the conditions required
- the names of any other products (apart from ethanol)

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

[6]

[Turn over

(b) In some countries ethanol is mixed with petrol to make fuels for use in cars. Petrol is mainly octane, an alkane with 8 carbon atoms. Octane is a hydrocarbon fuel.

(i) What is meant by the term hydrocarbon?

_____

_____ [1]

(ii) The general formula of the alkanes is C_nH_{2n+2}

Write the molecular formula of octane.

_____ [1]

(iii) Name the two products of complete combustion of octane.

1. _____

2. _____ [2]

(c) **(i)** Calculate the percentage of carbon by mass in ethanol.

$$\% \text{ by mass of carbon} = \frac{\text{number of carbon atoms} \times \text{RAM of carbon}}{\text{RFM of ethanol } (C_2H_5OH)} \times 100$$

Percentage of carbon: _____ [2]

(ii) Explain why incomplete combustion of ethanol is dangerous.

_____

_____ [2]

3 0.03 g of magnesium ribbon reacted with **excess** dilute hydrochloric acid at room temperature. The volume of gas produced was recorded every 20 seconds.

(a) (i) Name the gas produced when magnesium reacts with hydrochloric acid.

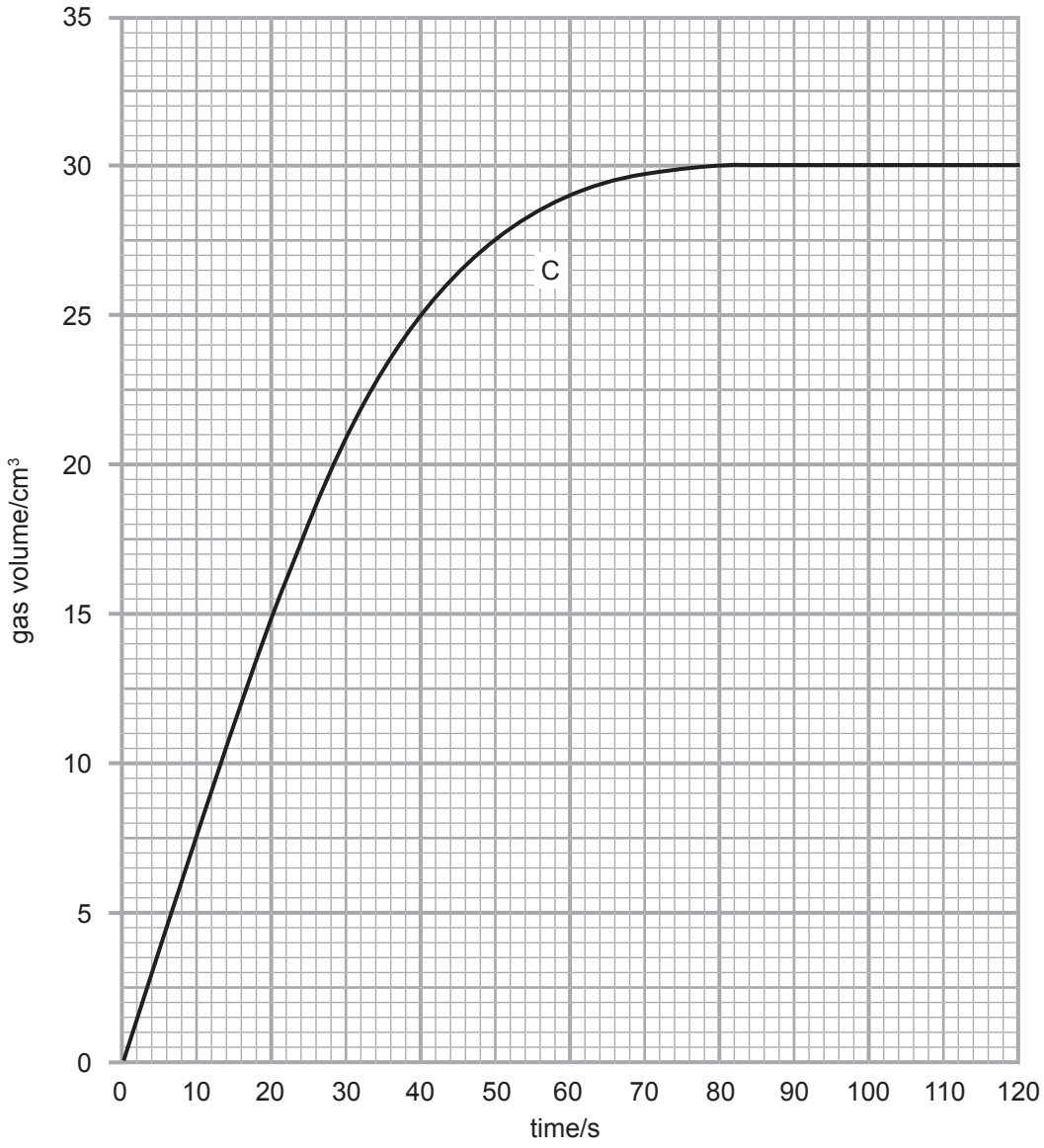
_____ [1]

(ii) Name the piece of apparatus which is used to collect and record the volume of gas produced.

_____ [1]

[Turn over

(b) The results obtained in the experiment, using 0.03 g of magnesium ribbon and **excess** dilute hydrochloric acid, are shown as line C on the graph below.



(i) Use the graph to determine the time taken for the reaction to finish.

time taken _____ s [1]

(ii) Calculate the rate of this reaction.

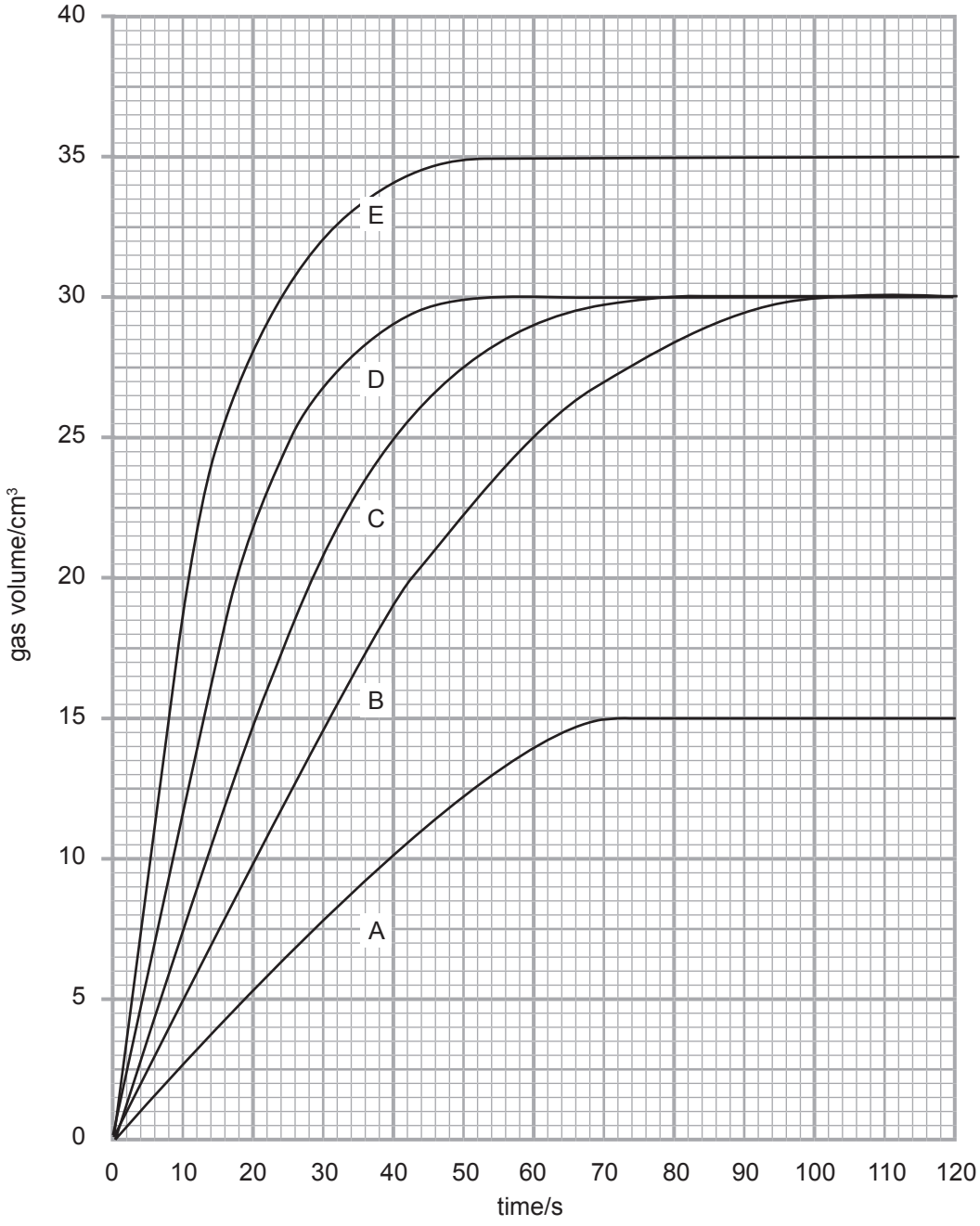
rate = _____ s^{-1} [2]

(iii) What is the final volume of gas produced?

volume = _____ cm^3 [1]

[Turn over

(c) The experiment was repeated using different conditions and the results obtained plotted as lines A, B, D and E, on the graph below. Line C shows the original experiment with 0.03 g of magnesium ribbon and **excess** dilute hydrochloric acid at room temperature.



(i) State and explain which line, A, B, D or E, was obtained when 0.03 g of magnesium ribbon were replaced by 0.03 g of magnesium powder.

Line: _____ [1]

Explanation: _____

_____

_____

_____ [2]

(ii) Which line, A, B, D or E, was obtained when 0.03 g of magnesium ribbon reacted with **excess** dilute hydrochloric acid at a temperature below room temperature?

Line: _____ [1]

(iii) State and explain which line, A, B, D or E, was obtained when 0.015 g of magnesium ribbon reacted with **excess** dilute hydrochloric acid at room temperature:

Line: _____ [1]

Explanation: _____

_____

_____

_____ [1]

[Turn over

(d) In an experiment to find a suitable catalyst for a reaction, the following results were obtained. All of the reactions were carried out under the same conditions.

Substance under test as a catalyst	Time for the reaction to be completed/s
cobalt chloride	15
cobalt nitrate	12
potassium nitrate	41
sodium chloride	56

(i) Which substance in the table is the best catalyst for this reaction? Explain your answer.

Substance: _____ [1]

Explanation: _____

_____

_____ [1]

(ii) Write the formula for potassium nitrate.

_____ [1]

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(Questions continue overleaf)

4 Many gases, for example sulfur dioxide and nitrogen, can be used as coolants in the food industry.

(a) Complete the table below about the properties of sulfur dioxide and nitrogen.

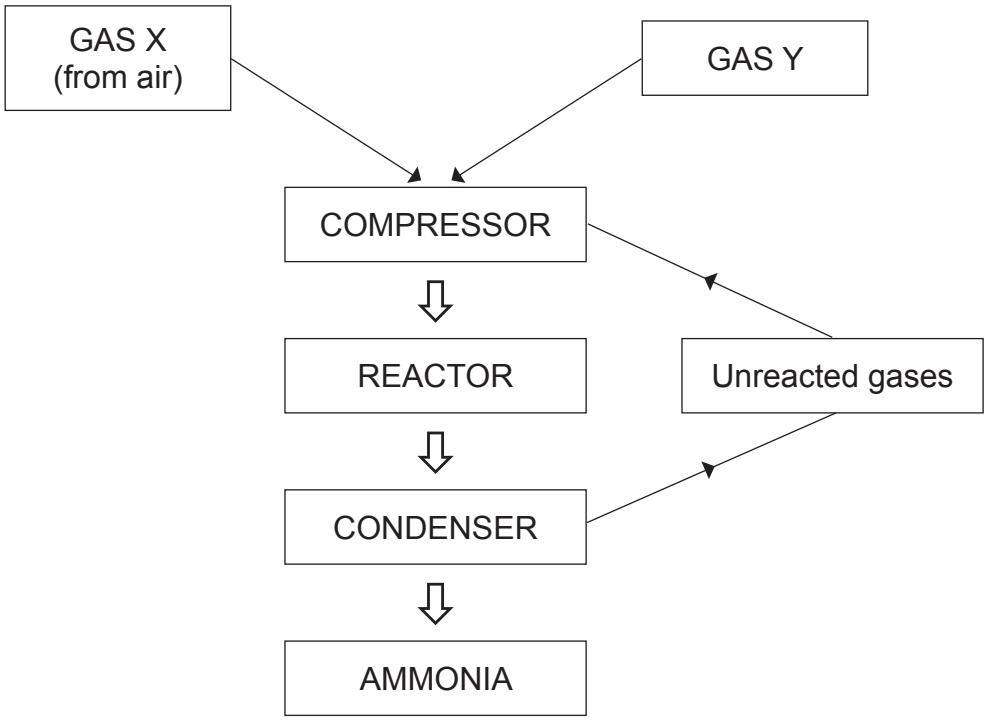
Property \ Gas	Sulfur dioxide	Nitrogen
Formula		
Colour		
Acidic, basic or neutral		neutral

[5]

(b) Ammonia is used to freeze water in ice rinks. State one other use of ammonia.

_____ [1]

(c) Ammonia is produced in industry by the Haber process which is illustrated in the diagram below.



(i) Name the gas X used in the Haber process.

_____ [1]

(ii) Name the gas Y used in the Haber process.

_____ [1]

(iii) State the pressure to which the gases are compressed.

_____ [1]

[Turn over

(iv) Write a balanced symbol equation for the reaction which occurs in the reactor.

_____ [3]

(v) Name the catalyst used in the reactor.

_____ [1]

(vi) State the temperature used in the reactor.

_____ [1]

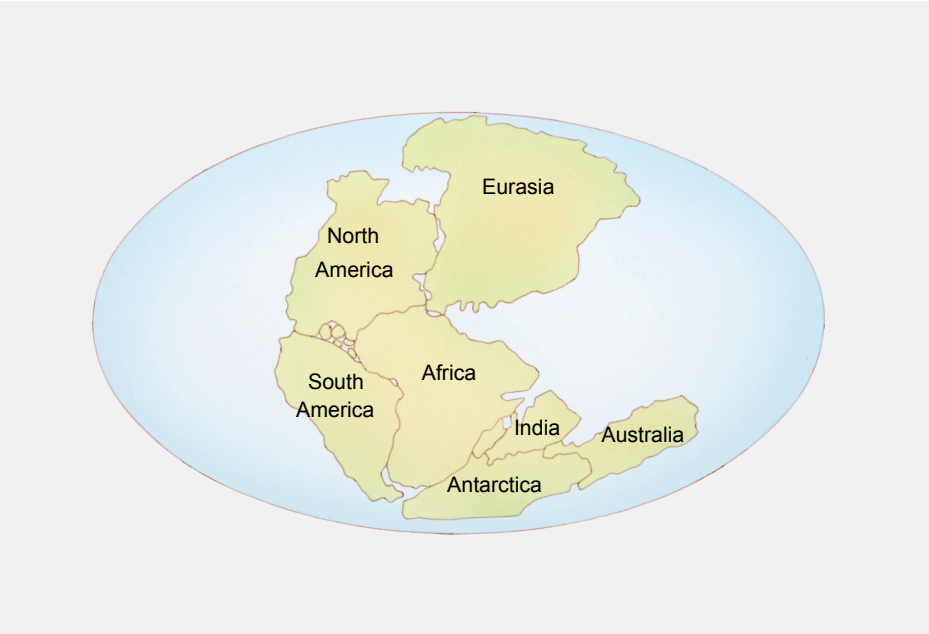
(vii) Choose the correct word from the box below to complete the sentence.

cooled	heated	oxidised

In the condenser, the gases are _____ to separate ammonia as a liquid.

[1]

5 **(a)** In 1912 Alfred Wegener proposed the theory that the continents on the Earth could move and were once arranged as shown in the diagram below.



Scientists at the time did not accept Wegener's theory, but in the 1960s some new evidence based on the physical properties of iron helped to establish the theory.

(i) What name was given to Wegener's theory that the continents could move?

_____ [1]

(ii) Explain why other scientists at the time did not accept Wegener's theory.

_____

_____ [1]

[Turn over

(b) Iron undergoes a chemical reaction to form rust.

(i) State the conditions required for rusting to occur.

_____ [2]

(ii) State two methods used to prevent rusting.

1. _____

_____

2. _____

_____ [2]

(iii) Describe the physical appearance of rust.

_____

_____ [2]

(c) In the following three reactions, **A**, **B** and **C**, iron is oxidised.

Reaction A: iron + oxygen + water → hydrated iron(III) oxide

Reaction B: iron + copper(II) sulfate → iron(II) sulfate + copper

Reaction C: iron + hydrochloric acid → iron(II) chloride + hydrogen

(i) Write the chemical formula for iron(II) sulfate.

_____ [1]

(ii) Write a balanced symbol equation for **Reaction C**.

_____ [3]

(iii) Explain why iron is oxidised in **Reaction A**.

_____

_____

_____ [2]

(iv) Describe how you would test for the presence of hydrogen gas produced in **Reaction C**.

_____

_____ [2]

(v) Choose from the list below a term which can be used to describe **Reaction B**.

Circle the correct term.

decomposition **displacement** **combustion** **neutralisation**

[1]

[Turn over

6 In 2013 the amount of household waste sent to landfill in Northern Ireland was at its lowest recorded level. This was due to the increase in recycling of waste.

(a) The table below shows some items found in a sample of household waste. Classify each item as being made from a synthetic or natural material by placing a tick (✓) in the relevant column.

Item	Natural	Synthetic
Glass bottle		
Woollen rug		
Plastic bucket		
Iron nail		

[4]

(b) Aluminium is a metal which can be recycled.

(i) State two advantages of recycling aluminium.

1. _____

_____

2. _____

_____ [2]

(ii) Name one other material which can be recycled.

_____ [1]

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

(i) What is meant by the term electrolysis?

_____

_____

_____ [2]

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

_____ [1]

(iii) Aluminium is formed at the negative electrode.

What name is given to the negative electrode?

_____ [1]

[Turn over

(d) Iron is extracted from its ore in the Blast Furnace. During the extraction process, the iron ore (mainly iron(III) oxide) undergoes reduction during a reaction with carbon monoxide as described by the word equation below.

iron(III) oxide + carbon monoxide → iron + carbon dioxide

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

_____ [3]

(ii) Explain what you understand by the term reduction.

_____ [1]

(iii) Name the ore from which iron metal is extracted.

_____ [1]

Iron and aluminium are extracted from their ores by different methods due to a difference in their reactivity.

(e) Which metal, iron or aluminium, is less reactive?

_____ [1]

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For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
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Total Marks	

Examiner Number