Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2015

Double Award Science: Chemistry

Unit C2

Higher Tier

[GSD52]

GSD52

TUESDAY 9 JUNE 2015, AFTERNOON

TIME

1 hour 15 minutes.

INSTRUCTIONS TO CANDIDATES

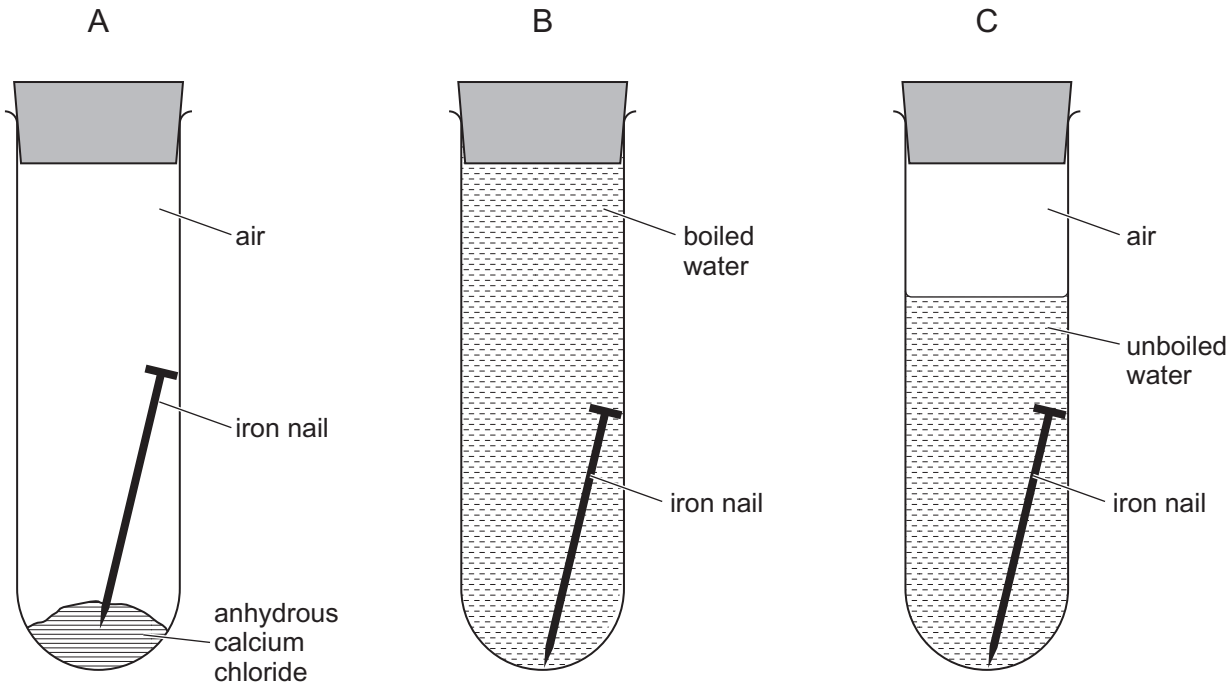
Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in blue or black ink only. **Do not write with a gel pen.**
Answer **all eight** 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 Questions **3(a)** and **6(c)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

9721

1 **(a)** A student set up 3 test tubes as shown below to investigate the conditions needed for the rusting of iron.



(i) After a week, which was the only test tube, A, B or C to have a rusty nail?

_____ [1]

(ii) How did the student make the test fair?

_____

_____ [1]

(iii) Why had the water in test tube B been boiled?

_____ [1]

(iv) What **two** conditions are necessary for the rusting of iron to occur?

_____ and _____ [1]

(b) Iron can be protected from rusting by sacrificial protection.

(i) Which **one** of the metals listed below could protect an iron nail from rusting by sacrificial protection?

Circle the correct answer.

copper **zinc** **lead**

[1]

(ii) Use your understanding of sacrificial protection to explain your answer to part **(i)**.

_____

_____

_____

_____ [2]

(c) This part of the question is about the reaction of iron with sulfur.

When a mixture of sulfur powder and iron filings is placed in a boiling tube and then heated a chemical reaction takes place.

(i) When the mixture is heated an orange-red glow is seen in the boiling tube. What is observed when the heating is stopped?

_____

_____ [2]

(ii) Write a balanced symbol equation for the reaction between iron and sulfur.

_____ [2]

[Turn over

2 **(a)** Magnesium reacts with steam to give two products.

(i) Complete the word equation for the reaction of magnesium with steam.

magnesium + steam → + [2]

(ii) Describe **one** observation you would make during this reaction.

_____ [1]

(b) Magnesium powder reacts quickly with copper(II) sulfate solution.

(i) Describe two things you would expect to **see** happening in this reaction.

1. _____

2. _____ [2]

(ii) What does this reaction tell you about the reactivity of magnesium compared to that of copper?

_____ [1]

(c) The reaction of magnesium powder with copper sulfate solution can be represented by the two half equations shown below.

$$Mg \rightarrow Mg^{2+} + 2e^-$$

$$Cu^{2+} + 2e^- \rightarrow Cu$$

Explain, in terms of electron transfer, why this is a **redox** reaction.

_____

_____

_____

_____ [3]

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(Questions continue overleaf)

3 A student is given three gas jars labelled A, B and C and told that one contains nitrogen, one contains carbon dioxide and one contains oxygen. The student does not know which gas jar contains which gas.

(a) Give two similarities between the three gases and describe how, using tests for gases, you would work out which gas jar contains nitrogen.
Additional gas jars containing gases A, B and C are available as needed.

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

[6]

(b) The atmosphere contains a mixture of gases. How was the early atmosphere formed?

_____

_____ [2]

(c) The two main gases in the atmosphere make up about 99%.

(i) Just under 80% of the atmosphere is made up of nitrogen. Which is the second most abundant gas in our atmosphere?

_____ [1]

(ii) Which **one** of the gases below is considered to be an atmospheric gas? Circle the correct answer.

argon **hydrogen** **chlorine**

[1]

(d) In the Haber process ammonia is manufactured from nitrogen and hydrogen.

(i) Write a balanced symbol equation for the formation of ammonia in the Haber process.

_____ [3]

(ii) Explain why the manufacture of ammonia is described as a reduction reaction.

_____ [1]

[Turn over

4 This question is about relative atomic mass, relative formula masses and using mole calculations.

(a) What do you understand by the **relative atomic mass** of an element?

_____

_____

_____ [3]

(b) Calculate the relative formula mass of each of the substances given below.
(Relative atomic masses: H = 1, O = 16, Na = 23, Al = 27, S = 32)

(i) Sodium sulfate Na_2SO_4

_____ [1]

(ii) Aluminium hydroxide $Al(OH)_3$

_____ [1]

(c) Lead iodide can be produced by reacting lead nitrate with potassium iodide. This reaction is carried out by mixing a solution of lead nitrate with a solution of potassium iodide. Solid lead iodide is formed.

$$Pb(NO_3)_2 + 2KI \rightarrow PbI_2 + 2KNO_3$$

Relative formulae masses:		
	lead nitrate	331
	potassium iodide	166
	lead iodide	461

(i) How many moles of potassium iodide would be needed to react with 33.1 g of lead nitrate?

Answer _____ moles [2]

(ii) Use the equation:

$$Pb(NO_3)_2 + 2KI \rightarrow PbI_2 + 2KNO_3$$

to calculate the maximum mass of lead iodide that could be obtained from 33.1 g of lead nitrate.

Answer _____ g [2]

(iii) If a student used 0.2 moles of lead nitrate and 0.2 moles of potassium iodide, how many moles of lead iodide would be produced?

Answer _____ moles [1]

[Turn over

5 **(a)** In some parts of Northern Ireland the water is described as hard water. Hardness in water can be temporary or permanent.

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

_____

_____ [1]

(ii) What causes hardness in water?

_____ [1]

(iii) How could you easily distinguish between temporary and permanent hardness in water?

_____

_____ [1]

(b) When sodium carbonate (Na_2CO_3) is added to hard water, the water is softened by precipitation. Explain what happens to the ions involved in this process.

_____

_____

_____

_____

_____

_____ [4]

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(Questions continue overleaf)

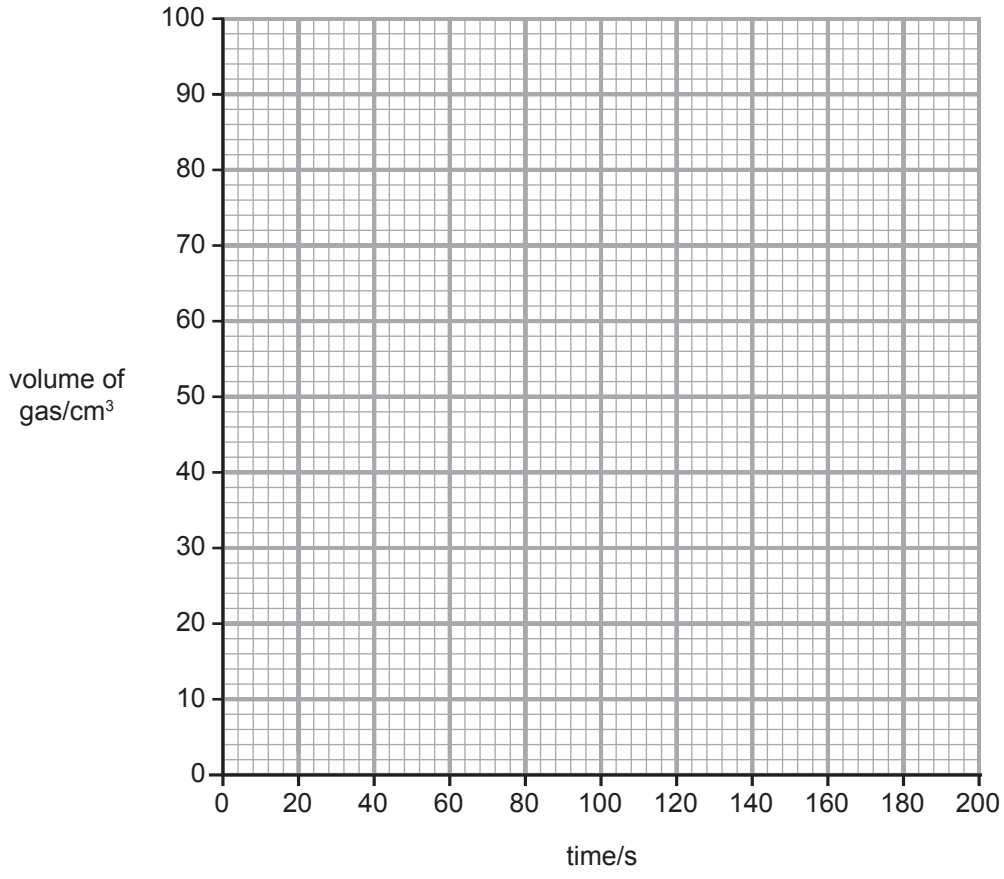
6 Calcium carbonate reacts with excess dilute hydrochloric acid to form carbon dioxide, water and calcium chloride solution.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

A student investigated the rate of this reaction by measuring the volume of carbon dioxide gas produced over a period of time. The total volume of gas measured at 20 second intervals is recorded in the table below.

Time/s	0	20	40	60	80	100	120	140	160
Volume/cm^3	0	32	50	66	76	83	87	90	90

(a) On the grid below, plot the results given in the table. Draw a curve of best fit. [3]



(b) (i) At what time did the reaction stop?

_____ [1]

(ii) Using your answer from **(b)(i)** and the equation

$$\textbf{rate} = \frac{\textbf{total volume of gas produced}}{\textbf{reaction time}}$$

calculate the average rate of this reaction and state the units.

Answer _____ [2]

[Turn over

(c) After further investigation the student found that the rate of this reaction can be increased by using a more concentrated solution of hydrochloric acid, by increasing the temperature and by using smaller particles of calcium carbonate.

Use the collision theory to explain how the rate of reaction is increased by:

- using a more **concentrated** solution of hydrochloric acid
- increasing the **temperature**
- using smaller particles of calcium carbonate

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

Concentration:

Temperature:

Particle size:

[6]

7 This question is about the quarrying of limestone near a town and its use in the blast furnace.

(a) **(i)** Describe two ways, other than giving uses of limestone, in which a limestone quarry could be an advantage to the local community.

1. _____

_____

2. _____

_____ [2]

(ii) Give two reasons why quarrying limestone could be a problem for the community living close to the quarry.

1. _____

_____

2. _____

_____ [2]

(b) Limestone is added as a raw material to the blast furnace in the reduction of iron ore.

(i) At the temperature of the furnace the limestone (calcium carbonate) decomposes. Write a balanced symbol equation for the thermal decomposition of limestone.

_____ [2]

(ii) Explain how the compound produced from the thermal decomposition of limestone removes the silicon dioxide impurity from the iron ore and is taken from the furnace.

_____

_____

_____

_____ [3]

[Turn over

8 **(a)** A recent spillage of crude oil onto the shores of the USA caused serious environmental problems. It is important that oil spillages are dealt with quickly.

(i) Give three examples of environmental problems caused by oil spillage.

1. _____

_____

2. _____

_____

3. _____

_____ [3]

(ii) How are oil spillages cleaned up?

_____

_____ [1]

(b) The hydrocarbon propane is a major source of energy.

(i) Name the homologous series which includes propane.

_____ [1]

(ii) Give the general formula of this homologous series.

_____ [1]

(iii) Write a balanced symbol equation for the combustion of propane in a plentiful supply of air.

_____ [3]

(c) Members of the carboxylic acid homologous series include ethanoic acid.

(i) Name the first member of this homologous series.

_____ [1]

(ii) Draw the structural formula of ethanoic acid showing all the bonds present.

[2]

(d) **(i)** What pH would you expect ethanoic acid to have?

_____ [1]

(ii) Give one use of ethanoic acid.

_____ [1]

[Turn over

(e) Ethanoic acid shows typical reactions of an acid.

(i) Describe three observations you could make when ethanoic acid is added to solid copper carbonate.

1. _____

_____

2. _____

_____

3. _____

_____ [3]

(ii) Name a metal that you could react safely with ethanoic acid to form hydrogen gas.

_____ [1]

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For Examiner's use only	
Question Number	Marks
1	
2	
3	
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8	
Total Marks	

Examiner Number