Rewarding Learning

Centre Number	
71	

Candidate Number

General Certificate of Secondary Education
2014

Double Award Science: Chemistry

Unit C2

Higher Tier

[GSD52]

ML

TUESDAY 10 JUNE 2014, AFTERNOON

TIME

1 hour 15 minutes, plus your additional time allowance.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
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 **1(a)** and **8(a)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
Total Marks	

Examiner Only	
Marks	Remark

1 **(a)** The reaction between dilute hydrochloric acid and marble chips is given in the equation below:

$$CaCO_{3(s)} + 2HCl_{(aq)} \rightarrow CaCl_{2\,(aq)} + CO_{2(g)} + H_2O_{(l)}$$

Plan a method to measure the rate of reaction between dilute hydrochloric acid and marble chips.

You should give clear details of how you would carry out your investigation, including a description of what results you will need to record. Explain how you would use your results.

You will be assessed on your written communication skills including the use of specialist scientific terms.

[6]

(b) Use the idea of collisions to explain the effect of increasing the concentration of the hydrochloric acid on the rate of reaction.

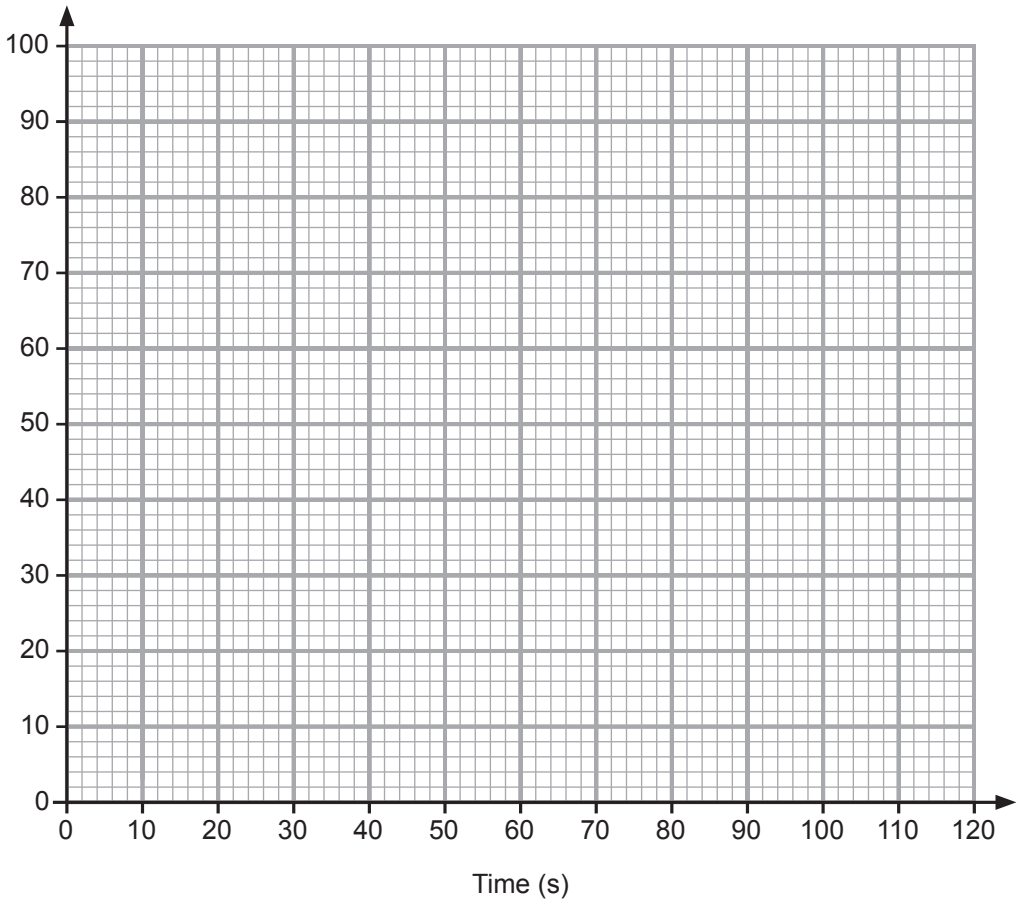
[3]

(c) Magnesium ribbon reacts with dilute hydrochloric acid to produce hydrogen gas. A student measured the volume of gas produced over a period of time. The results are shown in the table below.

Volume of H_2 gas (cm^3)	0	23	40	58	71	75	78	80	80
Time (s)	0	10	20	40	60	70	80	90	100

(i) Label the y-axis on the grid below. [1]

(ii) Use the grid to plot a curve showing the results of the experiment. [3]



(iii) At what time did the reaction stop?

_____ [1]

(iv) From your graph, how long did it take for 50 cm^3 of hydrogen to be formed?

_____ [1]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

2 **(a)** Calculate the relative formula mass of each of the following substances.

(Relative atomic masses: H=1, N=14, O=16, Na=23, S=32, Ca=40)

(i) sodium nitrate $NaNO_3$

_____ [1]

(ii) sulfuric acid H_2SO_4

_____ [1]

(iii) calcium hydroxide $Ca(OH)_2$

_____ [1]

(b) What is meant by one mole of a substance?

_____

_____

_____ [2]

(c) This part of the question is about the amount of iron that can be produced from a certain amount of iron(III) oxide. The equation for the reaction is given below:

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

The relative formula mass of Fe_2O_3 is 160.

(i) How many moles of Fe_2O_3 are in 80 g of the substance?

Answer _____ moles [1]

(ii) How many moles of iron could be produced from 80 g of Fe_2O_3?

Answer _____ moles [1]

(iii) Calculate the maximum mass of iron that could be produced from 80 g of Fe_2O_3. You may find your Data Leaflet useful when answering this question.

Answer _____ g [1]

(iv) Calculate the maximum mass of iron that could be produced from 8 tonnes of Fe_2O_3. (1 tonne = 1000 kg)

Answer _____ tonnes [1]

(d) The final part of this question is about the effect that dilution has on the concentration of a solution and the number of moles in the solution.

(i) If 800 cm^3 of water is added to 200 cm^3 of a 1 mol/dm^3 solution of hydrochloric acid, to make a 1 dm^3 solution, what happens to the **concentration** of the acid? Tick (✓) the correct answer.

It stays the same ☐

It becomes 0.25 mol/dm^3 ☐

It becomes 0.20 mol/dm^3 ☐ [1]

(ii) If 800 cm^3 of water is added to 200 cm^3 of a 1 mol/dm^3 solution of hydrochloric acid, what happens to the **number of moles** of acid in the solution? Tick (✓) the correct answer.

It stays the same ☐

It becomes 25% of its original value ☐

It becomes 20% of its original value ☐ [1]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

3 **(a)** This part of the question is about the heating of solid calcium carbonate.

(i) Complete the word equation for this reaction.

calcium carbonate $\xrightarrow{\text{heat}}$ + [2]

(ii) The reaction in part **(i)** is an example of an endothermic change. Which one of the following statements describes an endothermic reaction? Tick (✓) the correct statement.

Gives out heat energy to the surroundings ☐

Takes in heat energy from the surroundings ☐

No change in energy during reaction ☐

[1]

(iii) Put a circle round the term below that best describes the type of reaction that occurs when calcium carbonate is heated.

thermal cracking **displacement** **neutralisation**

thermal decomposition **photosynthesis**

[1]

(b) Methane burns in oxygen. The reaction is described by the equation below:

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

Explain, in terms of the bonds that are broken and made **in this reaction**, why the burning of methane is exothermic.

[5]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

4 **(a)** Temporary hard water is found in limestone regions.

(i) Write down the name of the compound that causes temporary hardness in water.

_____ [1]

(ii) Explain how water in limestone regions becomes hard.

_____

_____

_____

_____

_____

_____ [4]

(b) Hard water can be softened by addition of washing soda Na_2CO_3.

Explain, in terms of the ions involved, why the addition of washing soda can be used to soften hard water.

_____

_____

_____

_____

_____

_____ [3]

Examiner Only	
Marks	Remark

5 **(a)** During the first billion years of the Earth's existence, there was intense volcanic activity that released gases that formed the early atmosphere. The early atmosphere contained over 90% carbon dioxide, 5% nitrogen, 3% sulfur dioxide and traces of hydrogen sulfide, ammonia and methane, but no oxygen. It was hot, smelly and deadly poisonous.

(i) What is the **difference** in percentage composition of nitrogen gas found in the atmosphere today compared to its composition in the early atmosphere?

_____ [1]

(ii) One theory suggests that the early atmosphere changed as living organisms evolved. Write down two ways that the carbon dioxide could have been removed from the early atmosphere.

1. _____

2. _____ [2]

(b) This part is about the Group 2 metal strontium and some of its compounds.

- You may find your understanding of the properties of magnesium and calcium and their compounds to be helpful.
- You may find your Data Leaflet useful.

(i) What is the formula of strontium sulfate?

_____ [1]

(ii) What would you expect to happen if some strontium carbonate was placed in a beaker of water?

_____ [1]

(iii) What would you expect to observe if a small piece of strontium metal was placed in a beaker of water?

_____

_____

_____

_____

_____ [3]

Examiner Only	
Marks	Remark

6 **(a)** This part of the question is about the physical properties and uses of nitrogen gas.

(i) From the list below tick (✓) **two** physical properties of nitrogen gas.

very soluble in water ☐

pale green coloured ☐

colourless ☐

odourless ☐

sweet smelling ☐

[2]

(ii) Nitrogen is used in the manufacture of ammonia. Write down one other use of nitrogen.

_____ [1]

(b) Ammonia gas is manufactured in the Haber Process by reacting hydrogen with nitrogen:

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

(i) What do the arrows ($\rightleftharpoons$) mean in the above equation?

_____ [1]

(ii) Fill in the blank spaces in the table below to give the conditions needed for this reaction to occur. Include units where appropriate.

temperature	
catalyst	
pressure	

[3]

(iii) Write down two uses of ammonia.

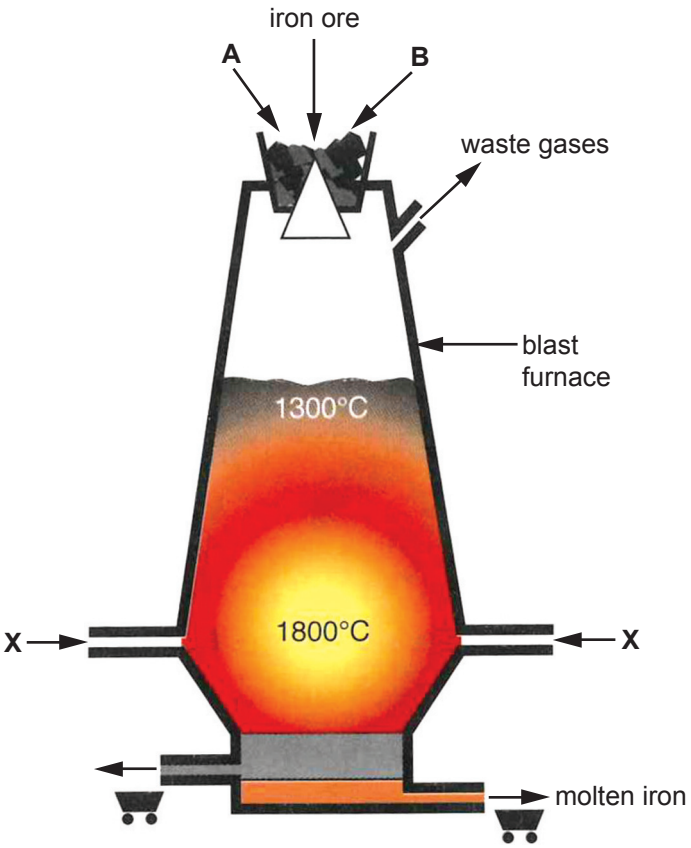
1. _____

2. _____ [2]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

7 **(a)** The diagram below shows a Blast Furnace, used in the manufacture of iron.



(i) What is the common name for the iron ore used in the Blast Furnace?

_____ [1]

(ii) Write down the names of the substances **A** and **B** that go into the top of the Blast Furnace.

A _____

B _____ [2]

(iii) Write down the name of substance **X**, that goes into the bottom of the Blast Furnace.

_____ [1]

(iv) How is the iron removed from the Blast Furnace?

_____ [1]

(v) Describe how the acidic impurities are removed from the Blast Furnace.

_____

_____

_____

_____ [2]

(b) Carbon monoxide is produced from carbon dioxide in the Blast Furnace. Write a balanced symbol equation to show how carbon monoxide is formed.

_____ [3]

(c) The extraction of iron in the Blast Furnace is an example of a redox reaction.

(i) What is meant by the term **redox**?

_____

_____

_____ [2]

(ii) The extraction of iron from iron ore can be represented by the half equation:

$$Fe^{3+} + 3e^{-} \rightarrow Fe$$

Explain, in terms of electrons, why this is a reduction reaction.

_____

_____ [2]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

8 **(a)** Methanol and ethanol are both members of the alcohol homologous series. Define the term homologous series and outline the similarities between methanol and ethanol.

You will be assessed on your written communication skills including the use of specialist scientific terms.

[6]

(b) **(i)** Ethanol is used as a clean fuel. Write down two other uses of ethanol.

1. _____

2. _____ [2]

(ii) Write a balanced symbol equation for the production of ethanol from ethene.

_____ [2]

(c) Polythene is a useful polymer made from ethene molecules.

(i) Write a balanced equation, using **structural formulae**, for the polymerisation of ethene.

[4]

(ii) Polythene can be used to make plastic buckets.

Write down two properties of polythene that make it suitable for this use.

1. _____

2. _____ [2]

Examiner Only

Marks	Remark

THIS IS THE END OF THE QUESTION PAPER

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