Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2017–2018

Science: Single Award

Unit 2 (Chemistry)
Higher Tier

GSS22

[GSS22]

THURSDAY 22 FEBRUARY 2018, MORNING

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.
Write your answers in the spaces provided in this question paper.
Answer **all ten** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 75.
Quality of written communication will be assessed in Questions **4** and **8**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
A Data Leaflet, which includes a Periodic Table of the Elements, is included for your use.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total Marks	

1 The reactions of three different metals (**X**, **Y** and **Z**) were investigated. The table below gives some information about these reactions.

Metal	Reaction with cold water	Reaction with dilute acid	Reaction when heated in oxygen
X	no reaction	no reaction	black coating formed on metal
Y	reacts vigorously, producing orange sparks	dangerous reaction, not carried out in school	burns vigorously with an orange/yellow flame
Z	no reaction	reacts steadily	burns forming a yellow solid, which changes to white on cooling

(a) Using the letters **X**, **Y** and **Z**, put the three metals in order of reactivity. Start with the most reactive metal.

_____ most reactive

_____ ↓

_____ least reactive [1]

(b) Using the information in the table, suggest the name of metal **Y**.

_____ [1]

(c) Name the gas produced when a metal reacts with dilute acid.

_____ [1]

(d) What name is given to the **type** of reaction when oxygen is added to a substance?

_____ [1]

Examiner Only

Marks	Remark

2 Part of the modern Periodic Table is shown below.

							He
	Be				O	F	Ne
Na		Al	Si	P		Cl	
K	Ca						

Using **only** the elements shown above, answer the following questions. You may find your Data Leaflet helpful.

(a) Give the symbols of the two elements that are halogens.

_____ and _____ [1]

(b) Give the symbol of the element that has six electrons in its outer electron shell.

_____ [1]

(c) Give the symbol of the element in the same Group as beryllium.

_____ [1]

(d) Give the symbol of **one** element that is a gas at room temperature.

_____ [1]

(e) How many of the elements shown are in Period 3?

_____ [1]

Examiner Only

Marks	Remark

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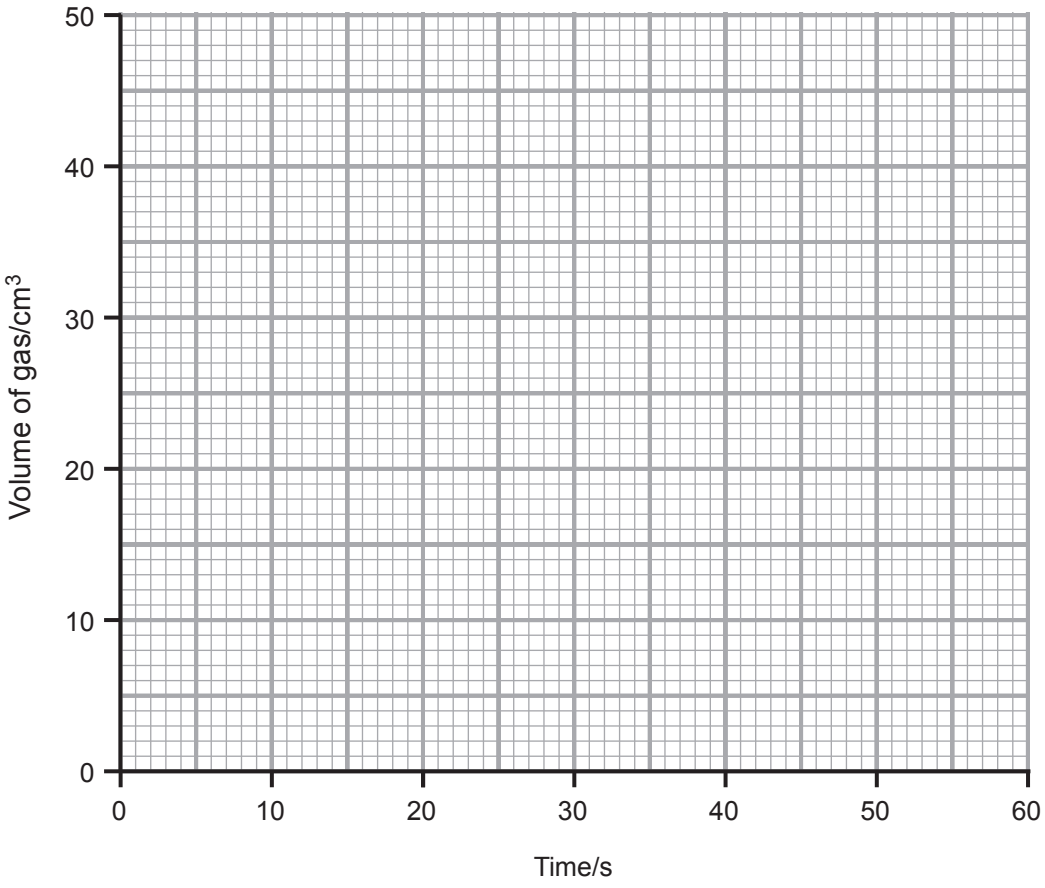
Marks	Remark

3 When acid is added to sodium hydrogencarbonate a gas is produced. The table below shows the volume of gas produced by this reaction over 60 seconds.

Time/s	0	10	20	30	40	50	60
Volume of gas/cm^3	0	18	34	45	48	48	48

(a) On the grid below plot a **line** graph for these results.



[3]

(b) Describe fully the trend shown by these results.

_____

_____

_____ [2]

(c) The gas produced during this reaction is carbon dioxide.

(i) Name the chemical used to test for carbon dioxide.

_____ [1]

(ii) Give the colour change observed during the test for carbon dioxide.

_____ to _____ [2]

Examiner Only	
Marks	Remark

4 Lithium and potassium are alkali metals that react with cold water. Describe how a teacher could demonstrate these reactions.

Your answer should include:

- **all** the relevant safety precautions
- **two** similarities in the observations during these reactions
- **one** difference in the observations during these reactions.

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

[6]

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Marks	Remark

Examiner Only	
Marks	Remark

5 **(a)** **(i)** Scientists use radioactive isotopes to calculate the age of the Earth. What is this method called?

_____ [1]

(ii) What is the age of the Earth as calculated using radioactive isotopes?

_____ [1]

(b) Explain the concept of 'deep time'.

_____

_____ [1]

(c) During the Twentieth Century many scientists put forward ideas about the cause of earthquakes. In 1915 Alfred Wegener proposed the idea of continental drift.

(i) Describe the theory of **continental drift**.

_____

_____

_____

_____ [2]

(ii) Give **two** pieces of evidence that support Wegener's theory.

1. _____

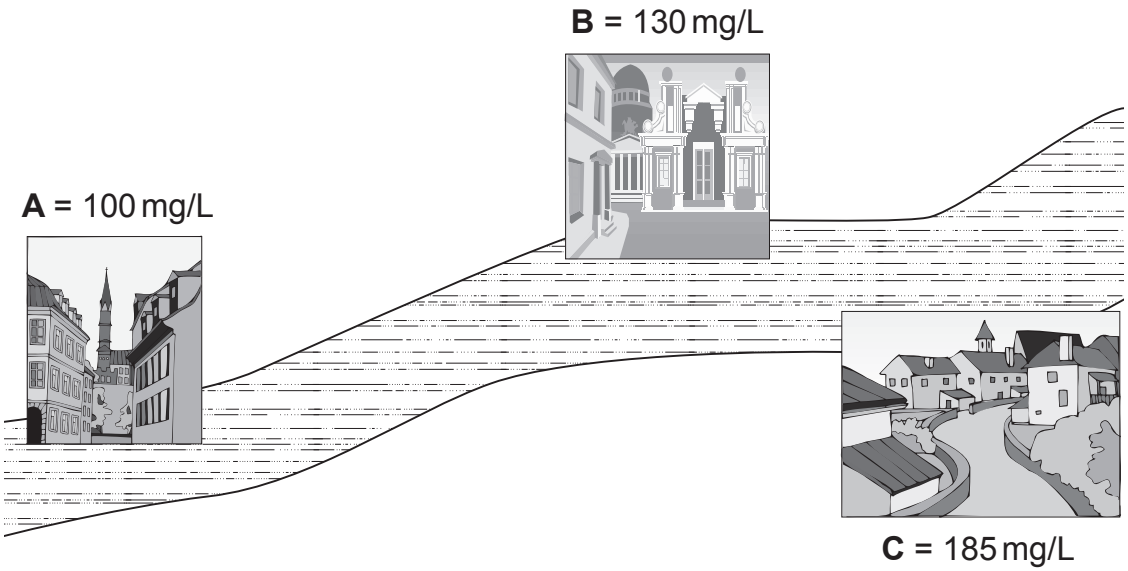
_____

2. _____

_____ [2]

Examiner Only	
Marks	Remark

6 The diagram below represents three towns (**A**, **B** and **C**) on part of a river. The mass of hard water ions (mg/L) in the river water for each town is given.



(a) Give the formula for an **ion** that causes hard water.

_____ [1]

The table below gives information about the hardness of water.

Description of water	Mass of hard water ions/ mg/L
soft	0 – 60
moderately hard	61 – 120
hard	121 – 180
very hard	greater than 180

(b) (i) Which town (**A, B** or **C**) will have to use the most soap to make a permanent lather?

_____ [1]

(ii) An engineering company needs to use moderately hard water. Explain why they have decided to build the factory in town **A**.

_____

_____ [1]

Examiner Only	
Marks	Remark

(c) Seawater is considered to be very hard due to various dissolved salts. Suggest the mass of hard water ions dissolved in seawater.

_____ mg/L [1]

(d) (i) Name the two **types** of hard water.

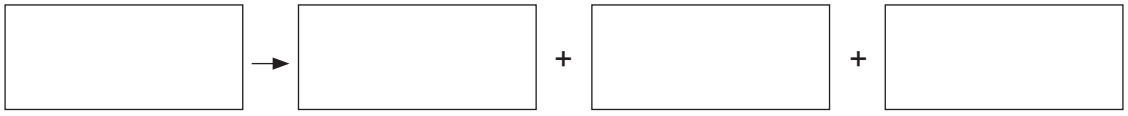
_____ and _____ [1]

(ii) Give **two** methods that can be used to soften **all** types of hard water.

1. _____

2. _____ [2]

(iii) One disadvantage of hard water is that it can cause a build-up of 'fur' (calcium carbonate) in hot water pipes. Write the balanced symbol equation for the formation of 'fur'.



[3]

(e) (i) Draw a labelled diagram of the bonding in a molecule of water (H_2O). Show the outer electrons only.

[3]

(ii) Name an **element** that has the same type of bonding as water.

_____ [1]

7 The table below shows the time taken for some household items to degrade.

Item	Time to degrade
vegetables	5 days–1 month
newspaper	2–5 months
cotton T-shirt	4–5 months
wool socks	1–5 years
nylon fabric	30–40 years
aluminium cans	80–100 years
polystyrene cup	more than 500 years
plastic bags	more than 500 years
glass bottles	1 million years

The items shown in the table will either biodegrade or photodegrade. To test for biodegradability scientists use the respirometry test. They place the item in a container with microorganisms, soil and air. Over several days, microorganisms break down the sample and produce carbon dioxide. The volume of carbon dioxide produced is a measure of the biodegradability of the item. In order to be described as truly biodegradable the item should break down within six months.

Although some items (for example, plastic bags) do not biodegrade, they do photodegrade. When exposed to ultraviolet radiation from sunlight, they become brittle and start to crack. This suggests that the item will eventually fragment into microscopic pieces.

Use the information above and your knowledge to answer the following questions.

(a) How many items in the table can be described as **truly** biodegradable?

_____ [1]

Examiner Only

Marks	Remark

(b) Describe the difference between the times taken to degrade for the items made from natural materials and those made from man-made materials.

_____

_____ [1]

(c) Suggest **one** reason why the times in the table are given as a range of values.

_____

_____ [1]

(d) The respirometry test will not work for a plastic bag. The time to degrade in the table is only an estimate.

(i) Suggest why there is no respirometry result for a plastic bag.

_____

_____ [1]

(ii) Suggest why the time to degrade can only be an estimate.

_____

_____ [1]

(iii) Suggest how the scientists estimated the time taken for a plastic bag to degrade.

_____

_____

_____ [2]

Examiner Only

Marks	Remark

8 Describe the structure of an atom in terms of the charge and location of its protons, electrons and neutrons. Include in your answer how the structure is linked to the atomic number and mass number of an element.

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

[6]

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Marks	Remark

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(Questions continue overleaf)

Examiner Only	
Marks	Remark

9 **(a)** Butane has the molecular formula C_4H_{10}.

(i) In the space below draw the structural formula of butane.

[1]

(ii) Give the molecular formula for:

1. methane _____

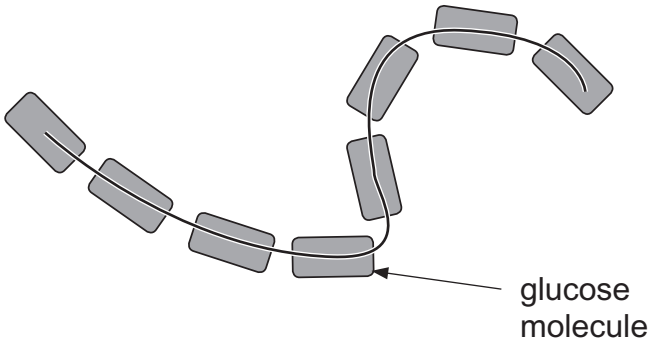
2. propane _____ [2]

(b) Starch is a natural polymer made up of glucose molecules.

(i) What name is given to the process of making a polymer?

_____ [1]

The diagram shows part of a starch polymer.



(ii) Use the diagram to explain how starch is formed from glucose.

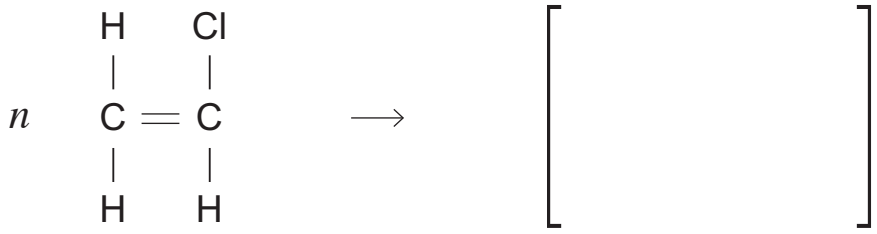
_____

_____

_____ [2]

(c) Polyvinylchloride (PVC) is a synthetic (man-made) polymer made from vinyl chloride.

(i) Complete the symbol equation below for the process of making PVC.



[2]

(ii) Explain why vinyl chloride is not a hydrocarbon.

_____

_____ [1]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

10 Electricity can be used to separate a compound into the elements it is made from.

(a) What name is given to this process?

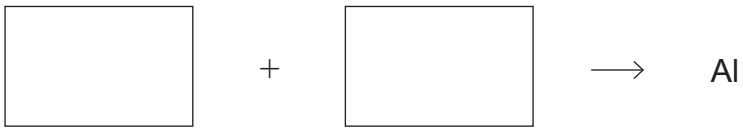
_____ [1]

(b) Aluminium is extracted from aluminium oxide using this process.

(i) Complete the sentences below.

In the extraction of aluminium the electrodes are made from the element _____. The positively charged electrode is called the _____. [2]

(ii) The aluminium is formed at the negatively charged electrode. Complete the ionic equation for the formation of aluminium.



[2]

(c) Aluminium is found in the compound aluminium fluorosilicate $Al_2(SiF_6)_3$ which is used in the manufacture of glass.

(i) How many elements are represented by the formula $Al_2(SiF_6)_3$?

_____ [1]

(ii) How many atoms of fluorine are represented by the formula $Al_2(SiF_6)_3$?

_____ [1]

(d) Aluminium is widely used to make parts for aeroplanes. More recently it is being replaced by composite materials such as carbon-reinforced plastic. What is meant by the term composite material?

_____

_____

_____ [2]

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Marks	Remark

THIS IS THE END OF THE QUESTION PAPER

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