Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2015–2016

# Science: Single Award

## Unit 2 (Chemistry)

## Higher Tier

ML

## [GSS22]

## THURSDAY 19 MAY 2016, MORNING

**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.
**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.
Answer **all ten** questions.

**INFORMATION FOR CANDIDATES**

The total mark for this paper is 75.
Quality of written communication will be assessed in Questions **1** and **9**.
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 in this question paper.

**1** Describe why and how earthquakes occur.

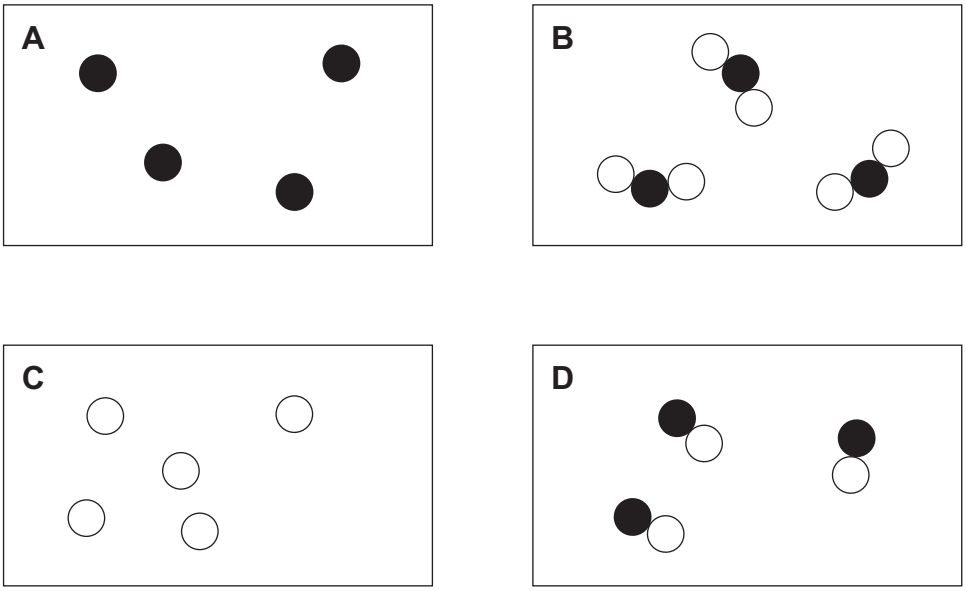
Your answer should include:

- an explanation of the process;
- the name of the scale used to measure earthquakes and what the readings tell us about earthquakes.

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

[6]

**2** Below are some particle diagrams. They represent elements or compounds.






**(a)** Which of the diagram(s) (**A**, **B**, **C** or **D**) show elements? Explain your answer.

Diagram(s) _____

_____

_____ [2]

**(b)** Suggest which diagram (**A**, **B**, **C** or **D**) could represent the compound carbon monoxide (CO).

_____ [1]

**[Turn over**

3 **(a)** The table below gives information about five hydrocarbon molecules.

| Molecule | Number of carbon atoms | Melting point/°C | Boiling point/°C | Energy released per gram when burned/kJ |
|---|---|---|---|---|
| methane | 1 | – 182 | – 162 | 56 |
| ethane | 2 | – 183 | – 89 | 52 |
| propane | 3 | – 188 | – 42 | 51 |
| butane | 4 | – 138 | 0 | 50 |
| pentane | 5 | – 130 | 36 | 49 |

**(i)** Calculate the energy released when 100 grams of propane is burned.

_____ kJ [1]

**(ii)** Calculate the difference between the melting points of the molecules with the most and least carbon atoms.

_____ °C [1]

**(iii)** Describe the relationship between the number of carbon atoms and a molecule's boiling point.

_____

_____ [1]

**(b)** Complete the word equation below for the burning of propane.

propane + [ ] → carbon dioxide + water [1]

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**(Questions continue overleaf)**

**[Turn over**

**4** The table below gives information about three different indicators and their colours at different pH values.

| Indicator \ pH | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| methyl purple | P | P | P | P | G | G | G | G | G | G | G | G | G | G |
| thymol blue | Y | Y | Y | Y | Y | Y | Y | Y | B | B | B | B | B | B |
| indigo carmine | B | B | B | B | B | B | B | B | B | B | B | Y | Y | Y |

**Key:** B = blue G = green P = purple Y = yellow

Use the information in the table to answer the following questions.

**(a)** 1. What colour is methyl purple indicator in a strong acid?

_____

2. What colour is indigo carmine indicator in sodium hydroxide?

_____ [2]

**(b)** A scientist is going to add an acid to an alkali. He needs to stop adding the acid when the pH value is 7.

**(i)** What name is given to this **type** of reaction?

_____ [1]

**(ii)** Explain fully why the scientist would **not** find any of the indicators in the table useful for his experiment.

_____

_____

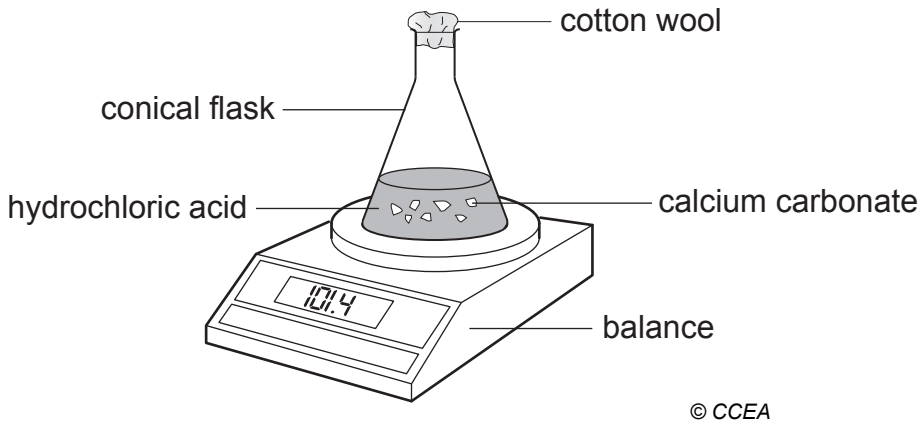
_____ [2]

**(c)** Most indicators are made from plants. Describe how you would obtain an indicator from red cabbage.

[3]

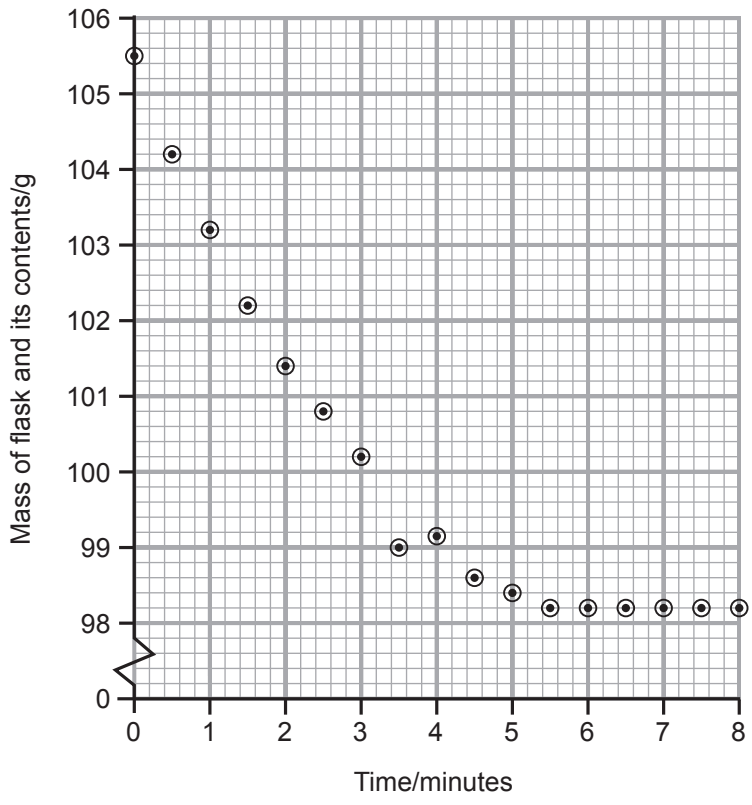
**[Turn over**

**5** A student investigated the amount of carbon dioxide released during the reaction between hydrochloric acid and calcium carbonate. He used the apparatus shown below.






The student measured the mass of the flask and its contents for 8 minutes. The results are shown in the graph below.



**(a)** Complete the graph opposite by adding a curve of best fit and ignoring any anomalous results. [1]

**(b)** Describe fully the trend shown in the graph.

_____

_____

_____ [2]

**(c)** Complete the word equation for this reaction.

hydrochloric acid + calcium carbonate → [ ] + [ ] + carbon dioxide

[2]

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

_____ [1]

**(ii)** Describe the colour change during this test for carbon dioxide.

_____

_____ [2]

**[Turn over**

6 **(a)** Aluminium is extracted from its ore by the process of electrolysis.

**(i)** Define the term electrolysis.

_____

_____ [2]

**(ii)** Complete the following sentences about the extraction of aluminium.

The chemical name for the ore of aluminium is aluminium _____.

During electrolysis the aluminium ions move to the negative electrode which is called the _____. Here they gain three _____ to become aluminium atoms. [3]

**(b)** Another compound of aluminium is aluminium hydroxide; its formula is $Al(OH)_3$.

**(i)** Name the **three** elements present in aluminium hydroxide.

_____ _____ _____ [1]

**(ii)** How many atoms in total are represented by the formula $Al(OH)_3$?

_____ [1]

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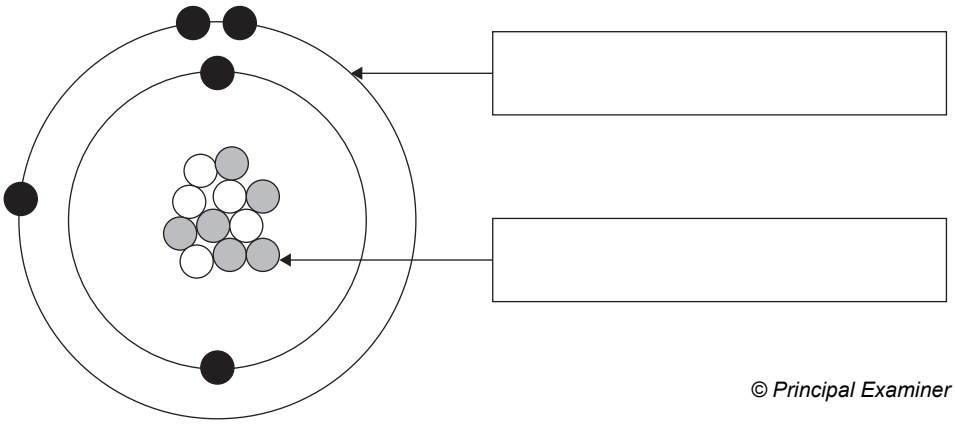
**(Questions continue overleaf)**

**7** **(a)** Label the diagram of the atom shown below.





[2]

**(b)** Name the element shown above.
You may find your Data Leaflet helpful.

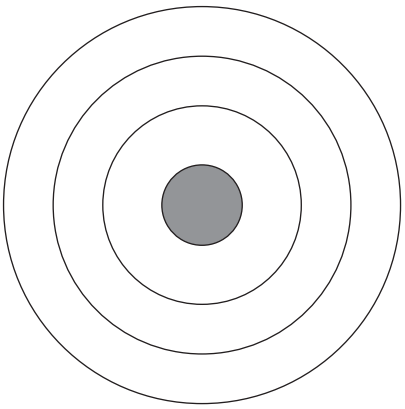
_____ [1]

**(c)** Complete the table below about the particles in an atom.

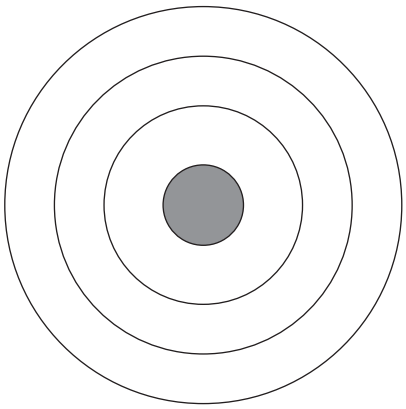
| Particle | Relative charge | Relative mass |
|---|---|---|
| proton | | |
| electron | | |
| neutron | | |

[3]

**(d) (i)** Complete the diagrams below to show the electronic structures of sodium and chlorine. You may find your Data Leaflet helpful.



sodium



chlorine

[2]

**(ii)** Give **one** similarity and **one** difference between the electronic structures of sodium and chlorine.

Similarity _____

_____

Difference _____

_____ [2]

**(iii)** Describe, in terms of electrons, how sodium and chlorine form the compound sodium chloride.

_____

_____

_____ [3]

**(iv)** Write the balanced symbol equation for the reaction between sodium and chlorine.

_____ [3]

**[Turn over**

**8** **(a)** What is meant by the term hard water?

_____

_____ [1]

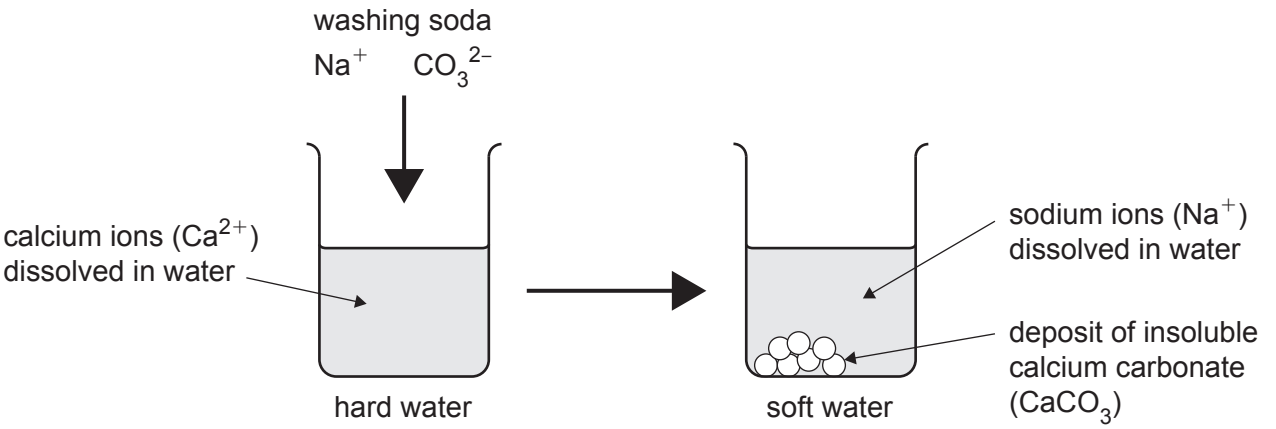
**(b)** Hard water can be described as either temporary or permanent.

**(i)** Temporary hard water can be softened by boiling. Complete the balanced symbol equation below for this reaction.

$Ca(HCO_3)_2 \rightarrow$ [ ] + [ ] + [ ]

[2]

**(ii)** Permanent hard water can be softened using washing soda (sodium ions and carbonate ions).






Using the diagram above explain how washing soda removes hardness from water.

_____

_____

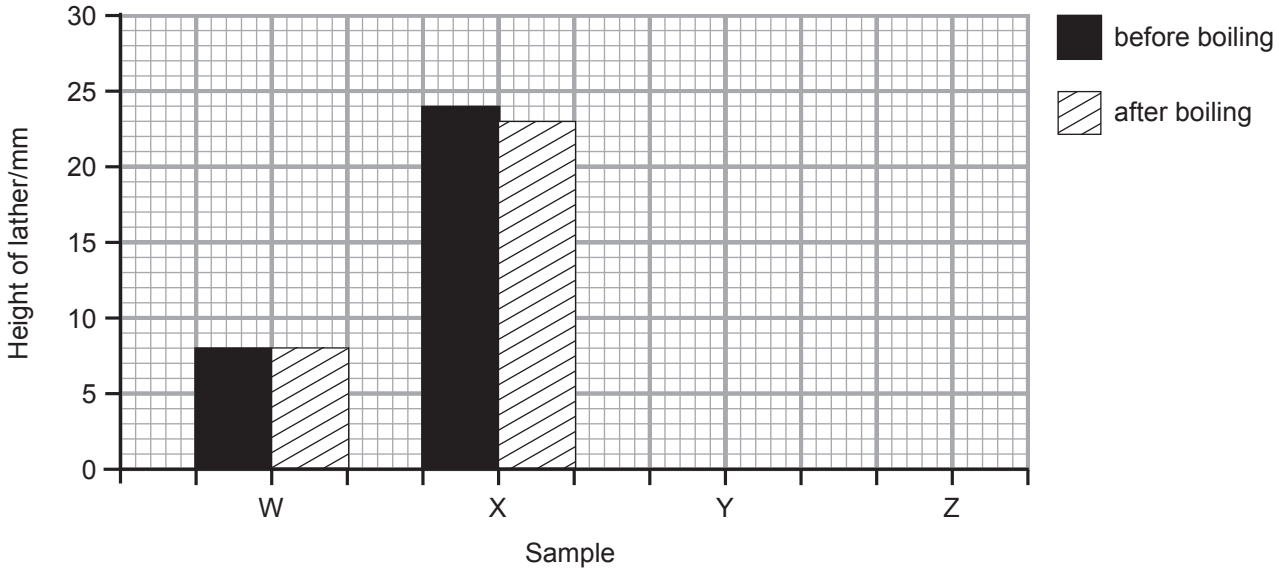
_____

_____ [3]

**(c)** A scientist conducted an investigation into the hardness of different samples of water. He put 25 $cm^3$ of four different samples (W, X, Y, Z) into separate flasks. He added soap solution to each flask and shook it until a lather was formed. He repeated the experiment with boiled samples. The results are shown below.

| Sample | Height of lather before boiling/mm | Height of lather after boiling/mm |
|---|---|---|
| W | 8 | 8 |
| X | 24 | 23 |
| Y | 20 | 23 |
| Z | 6 | 21 |

**(i)** Complete the bar chart below.




[2]

**(ii)** What does this tell you about the type of water in sample Z? Explain your answer.

_____

_____

_____ [2]

**[Turn over**

**9** Smart materials are used in many everyday objects such as sunglasses, forehead thermometers and baby feeding spoons.

Define the following three terms:

**smart material**, **thermochromic** and **photochromic**.

Suggest how thermochromic and/or photochromic materials are useful in any two of the objects named above.

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

[6]

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**(Questions continue overleaf)**

**10** Crude oil produces many useful hydrocarbons.

**(a)** Define **hydrocarbon**.

_____

_____ [1]

**(b)** Propane is one example of a hydrocarbon.

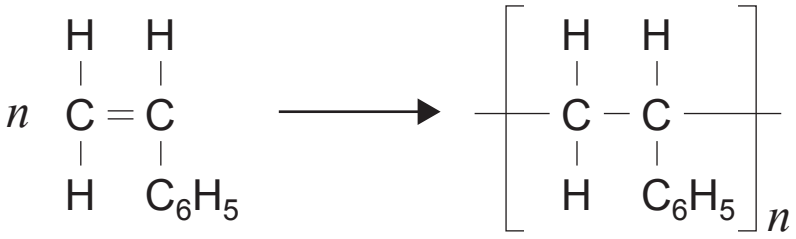
**(i)** In the space below, draw the structural formula for propane.

[1]

**(ii)** Name the family of hydrocarbons that propane belongs to.

_____ [1]

**(c)** Polystyrene is a plastic that can be made from reacting styrene molecules together as shown below.




styrene polystyrene

**(i)** What name is given to this process?

_____ [1]

**(ii)** Using the diagram and your knowledge, describe how styrene molecules react together to form polystyrene.

_____

_____

_____

_____

_____ [3]

**THIS IS THE END OF THE QUESTION PAPER**

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

Examiner Number