Rewarding Learning

Centre Number	
71	

Candidate Number

General Certificate of Secondary Education
2013–2014

Science: Single Award

Unit 2 (Chemistry)

Higher Tier

[GSS22]

GSS22

TUESDAY 25 FEBRUARY 2014, 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 eleven** questions.

INFORMATION FOR CANDIDATES

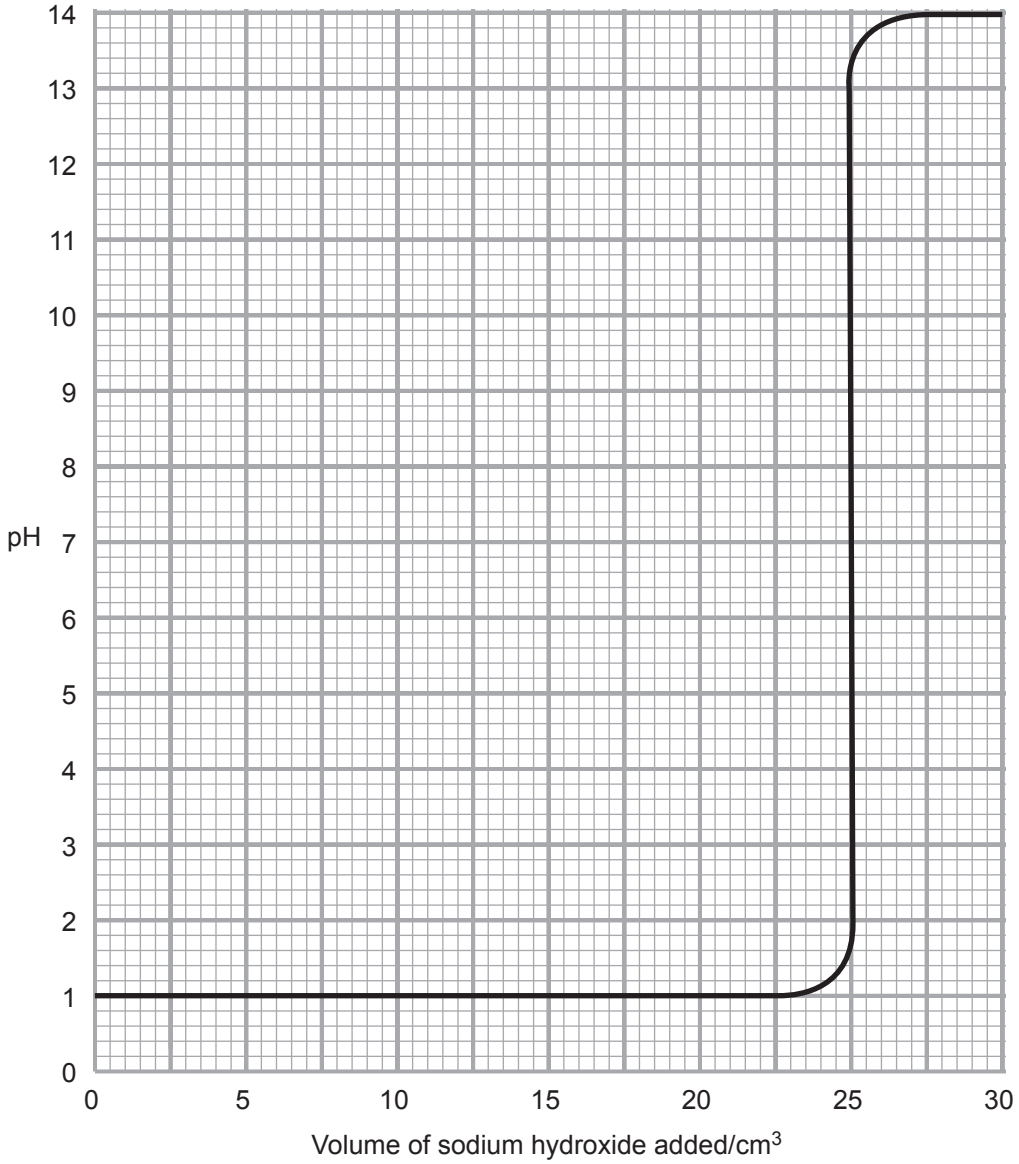
The total mark for this paper is 75.
Quality of written communication will be assessed in Questions **3(b)** and **11(b)**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
A Data Leaflet, which includes a Periodic Table of the Elements, is included for your use.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
Total Marks	

Examiner Only	
Marks	Remark

1 A student was asked to investigate how the pH changed during the reaction between hydrochloric acid and sodium hydroxide. Sodium hydroxide solution was added to 25 cm^3 of dilute hydrochloric acid and the pH was recorded using a pH sensor.

The results are shown in the graph below.



(a) Use the graph to give:

(i) the pH of the hydrochloric acid before adding sodium hydroxide.

_____ [1]

(ii) the volume of sodium hydroxide required to neutralise the acid.

_____ cm^3 [1]

(b) The student could also have investigated the pH change using universal indicator solution.

(i) What colour is universal indicator in a neutral solution?

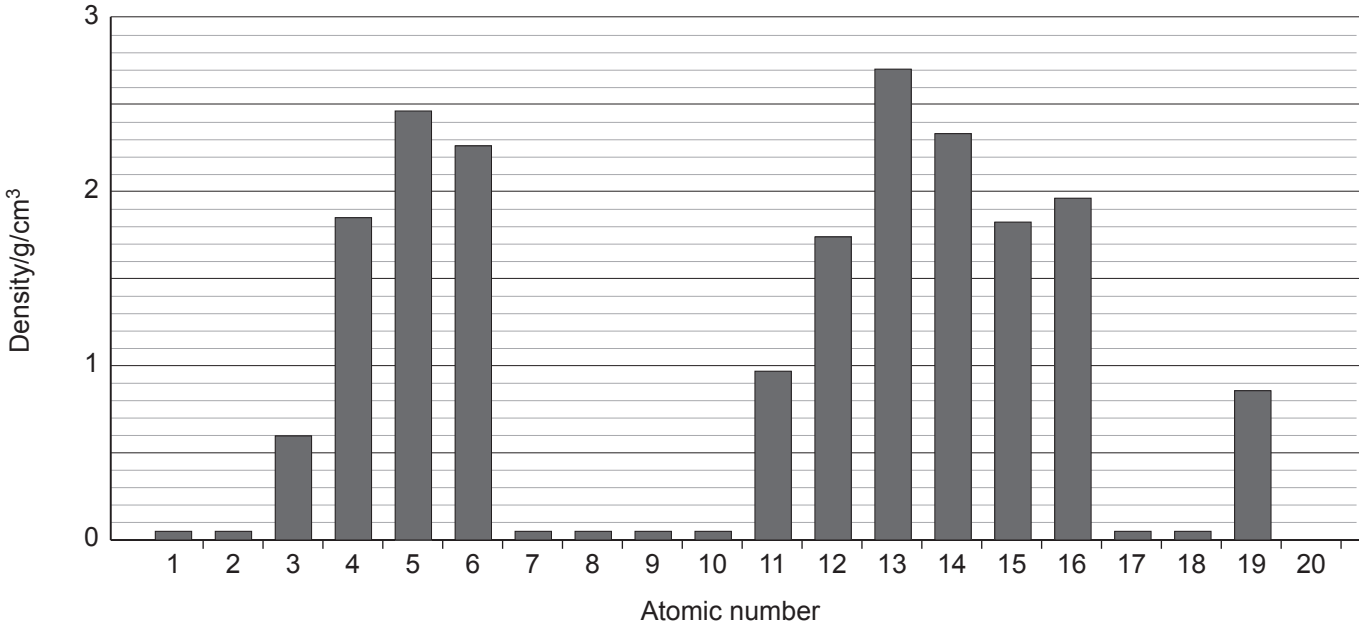
_____ [1]

(ii) Give **one** advantage of using a pH sensor rather than universal indicator in this experiment.

_____ [1]

Examiner Only	
Marks	Remark

2 Below is a graph showing the densities of the first nineteen elements of the Periodic Table.



Use the graph and your Data Leaflet to answer the following questions.

Examiner Only	
Marks	Remark

(a) What is the density of the element with atomic number 3?

_____ g/cm^3 [1]

(b) Name the element with the highest density and state the group of the Periodic Table to which it belongs.

Name _____ Group _____ [2]

(c) Suggest a value for the density of the element with atomic number 20.

_____ g/cm^3 [1]

(d) What do the elements with the lowest densities have in common?

Tick (✓) the correct answer.

☐ They are all metals.

☐ They are all gases.

☐ They are all in the same group of the Periodic Table. [1]

Examiner Only	
Marks	Remark

3 Water can be described as hard or soft.

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

_____

_____ [2]

(b) Fermanagh is a hard water area. Give the advantages and disadvantages of hard water for the people and the area. Your answer should include the cause of hard water and one method of softening it.

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

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ [6]

Examiner Only	
Marks	Remark

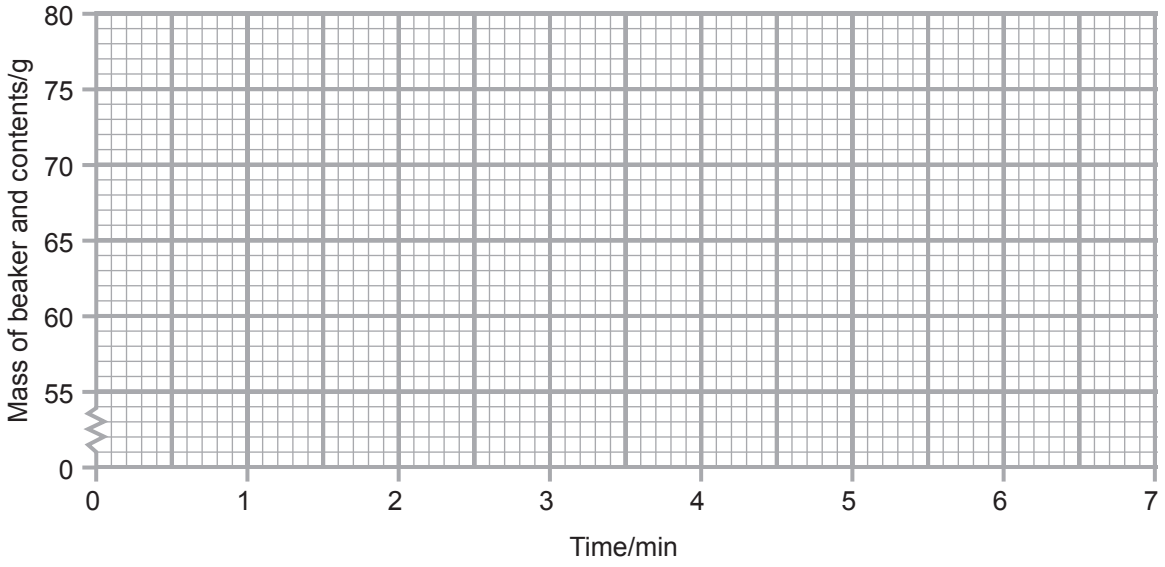
4 A student investigated the reaction between sodium hydrogencarbonate and hydrochloric acid. He used the apparatus shown below to measure the mass of the beaker and its contents for seven minutes. The reaction produces carbon dioxide.

© Andrew Lambert Photography / Science Photo Library

His results are shown in the table.

Time/min	0	1	2	3	4	5	6	7
Mass of beaker and contents/g	80	69	64	61	59	58	58	58

(a) On the grid below plot these points and draw a curve of best fit.



[3]

Examiner Only	
Marks	Remark

(b) How did the student know that the reaction was finished?

_____ [1]

(c) Complete the word equation for this reaction.

sodium hydrogencarbonate + hydrochloric acid → carbon dioxide + [ ] + [ ]

[2]

(d) Describe the chemical test used to identify carbon dioxide and include the result you would expect.

_____

_____ [2]

(e) **(i)** Calculate the change in mass during this reaction.

_____ g [1]

(ii) Explain why the mass changed during the reaction.

_____

_____ [1]

(f) The student repeats the experiment using weaker ethanoic acid rather than hydrochloric acid.

Describe **one** similarity and **one** difference that would be observed during the reactions of each of these acids with sodium hydrogencarbonate.

_____

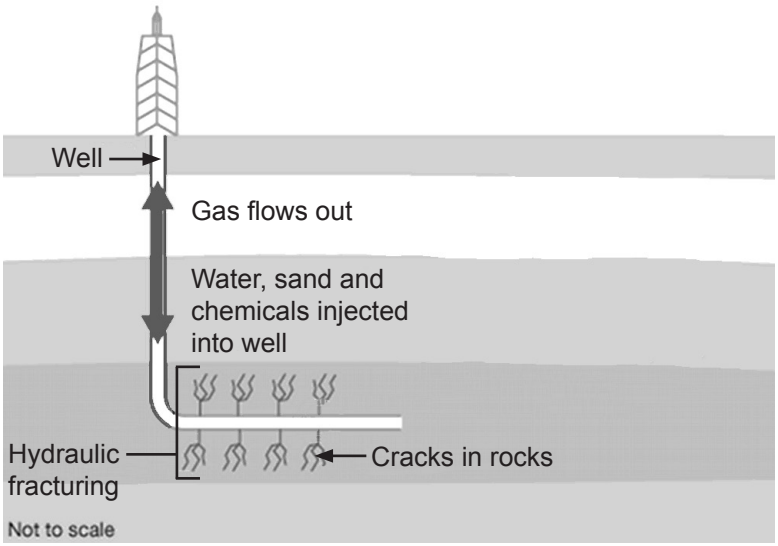
_____

_____

_____ [2]

Examiner Only	
Marks	Remark

5 Below is some information about hydraulic fracturing (fracking), including an illustration of the process.



Reserves of natural gas and oil are getting harder to find. Fracking allows the production of natural gas from rock deep below the Earth's surface.

Fracking involves drilling into the rock and injecting a high pressure liquid. This creates new cracks in the rock which allows the gas to escape.

Internationally there are concerns about health and safety as well as the effects of fracking on the environment. These include the likely contamination of groundwater, risks to air quality and the possible mishandling of waste. Fracking has been suspended or banned in some countries.

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

(a) Why is it important to find new, more efficient ways of extracting fossil fuels?

_____ [1]

(b) State and explain **one** environmental concern linked with fracking.

_____

_____

_____ [2]

Over its lifetime an average well will require up to 20 000 000 litres of fracking liquid which is mainly water. Chemical additives used in the fracking liquid make up 2% of the total volume.

(c) Calculate how many litres of chemical additives are used in the lifetime of a fracking well.
(Show your working out.)

_____ litres [2]

A report in the UK concluded that fracking was the likely cause of some small earthquakes that happened during drilling. However, fracking does not cause most earthquakes.

(d) Explain how an earthquake typically happens.

_____

_____ [2]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

6 All atoms are made up of three subatomic (smaller) particles.

(a) (i) Name the subatomic particle that is the lightest.

_____ [1]

(ii) Name the subatomic particle which has no charge.

_____ [1]

(b) What is meant by the term atomic number?

_____

_____ [1]

(c) Suggest why the overall charge of an atom is neutral.

_____

_____ [1]

(d) Sodium oxide (Na_2O) is used in the manufacture of glass.

Complete the table below giving the number of each named particle.
You may find your Data Leaflet useful.

	Na	O	Na_2O
Number of protons			
Number of electrons			
Number of neutrons			

[3]

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(Questions continue overleaf)

7 A student investigated the reactions of some metals and their compounds. Some observations of these reactions are given below.

Reactants	Observations
copper + silver nitrate solution	colourless solution turned blue, silver coloured solid formed
iron + zinc sulfate solution	nothing happened
silver + iron(II) sulfate solution	nothing happened
zinc + copper(II) sulfate solution	blue solution turned colourless, pink/brown solid formed
iron + copper(II) sulfate solution	blue solution turned colourless, pink/brown solid formed

(a) What name is given to these types of reactions?

_____ [1]

(b) Complete the word equation for copper reacting with silver nitrate.

copper + silver nitrate → _____ + _____

[2]

(c) Why did the colourless solution turn **blue** when copper reacted with silver nitrate solution?

_____

_____ [1]

Examiner Only

Marks	Remark

(d) Zinc is the most reactive metal used by the student. Complete the reactivity series below for the other metals used.

1 zinc

2 _____

3 _____

4 _____ [1]

(e) These metals will also react with acid. **Balance** the symbol equation below for the reaction of zinc with hydrochloric acid.

$$Zn + HCl \rightarrow ZnCl_2 + H_2$$

[1]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

8 **(a)** In 1658 Archbishop James Ussher calculated the age of the Earth.

(i) Explain fully how he calculated the age of the Earth.

_____

_____

_____ [2]

(ii) What is the age of the Earth estimated by Archbishop Ussher?

_____ [1]

(b) **(i)** Scientists can use radiometric dating of rocks to calculate the age of the Earth. Explain the method of radiometric dating.

_____

_____

_____

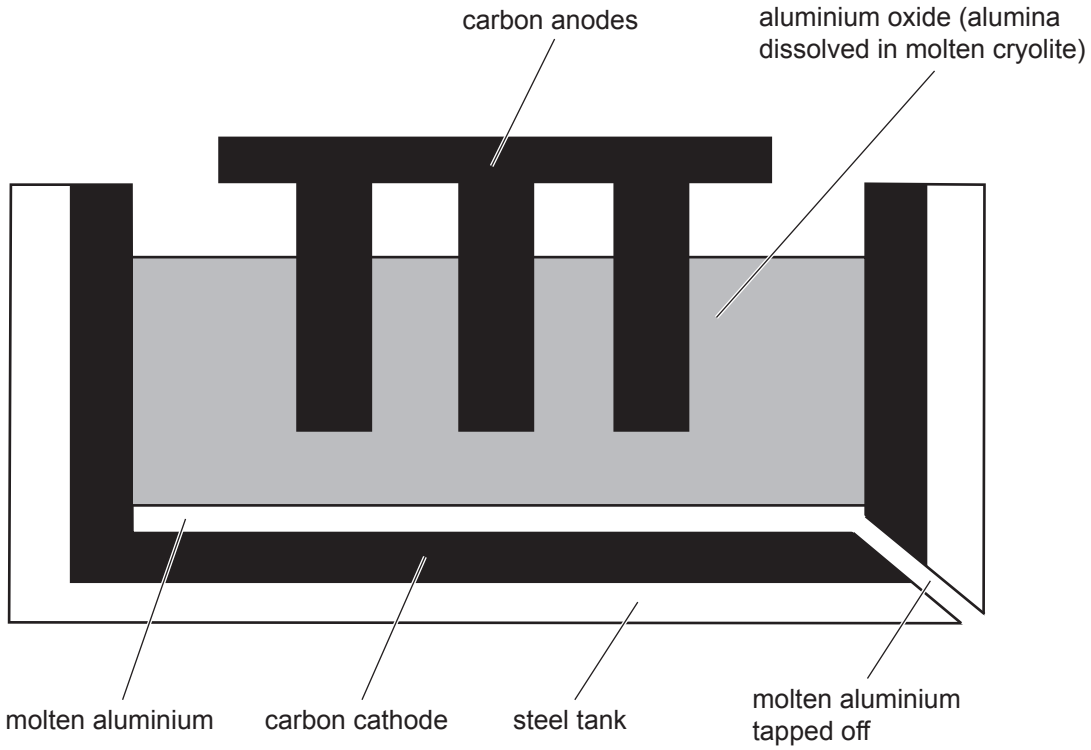
_____ [2]

(ii) What is the age of the Earth as calculated by scientists using radiometric dating?

_____ [1]

Examiner Only	
Marks	Remark

9 Aluminium can be extracted from aluminium oxide using electrolysis. The apparatus is shown below.



(a) What is meant by the term anode?

_____ [1]

(b) Explain in terms of ions and electrons how aluminium is formed at the cathode.

_____

_____

_____

_____ [3]

10 The table below shows the percentages of the gases in the exhaust fumes from a car.

Name of gas	Formula of gas	Percentage/%
nitrogen	N_2	68.0
carbon dioxide	CO_2	15.0
carbon monoxide	CO	1.0
oxygen	O_2	0.8
nitrogen oxide	NO	0.3
sulfur dioxide	SO_2	0.1
hydrocarbons	No formula	0.1
noble gases	No formula	1.7
water vapour	H_2O	

(a) Calculate the percentage of **water vapour** in exhaust fumes.

_____ % [1]

(b) Calculate the total percentage of gases containing **carbon**.

(Show your working out.)

_____ % [2]

Examiner Only

Marks	Remark

(c) From the table give the formula of **one** compound.

_____ [1]

(d) One of the hydrocarbons produced is propane. Complete and balance the symbol equation below for the complete combustion of propane.

C_3H_8 + ☐ → ☐ + ☐

[3]

(e) In the space below draw the structural formula of propane.

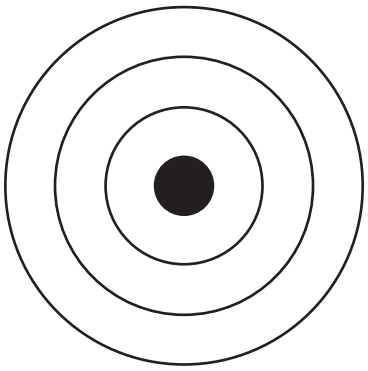
[1]

Examiner Only	
Marks	Remark

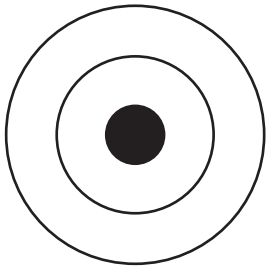
Examiner Only	
Marks	Remark

11 Magnesium reacts with oxygen to form the compound magnesium oxide.

(a) Complete the diagrams to show the arrangement of **all** the electrons in a magnesium atom and an oxygen atom.



magnesium atom



oxygen atom

[2]

(b) Explain fully in terms of the atoms and ions involved, how the electron arrangement changes when magnesium oxide is formed from magnesium and oxygen.

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

[6]

THIS IS THE END OF THE QUESTION PAPER

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