Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2016–2017

Science: Single Award

Unit 2 (Chemistry)
Higher Tier

GSS22

[GSS22]

THURSDAY 10 NOVEMBER 2016, 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.

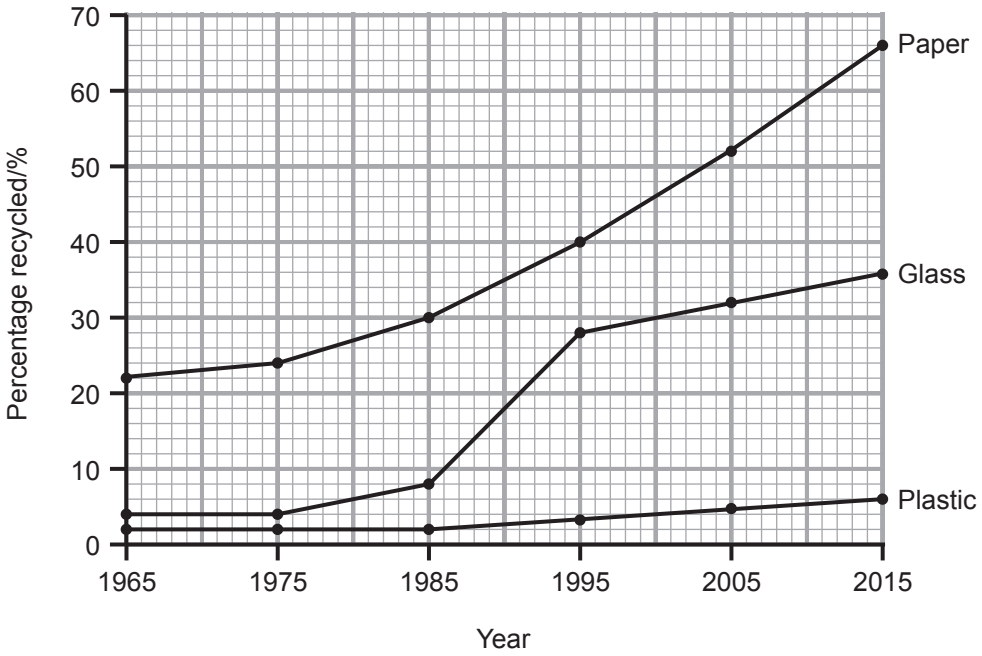
INFORMATION FOR CANDIDATES

The total mark for this paper is 75.
Quality of written communication will be assessed in Questions **2** 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 for your use.

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

Examiner Only	
Marks	Remark

1 **(a)** The graph below shows the percentage of plastic, glass and paper recycled in a country between the years 1965 to 2015.



Source: Principal Examiner

(i) Which material shows the biggest percentage increase between the years **1985** to **1995**?

_____ [1]

(ii) Calculate the percentage increase for paper recycling from **1965** to **2015**.

(Show your working out.)

_____ % [2]

(iii) Describe the steps in recycling glass after it has been delivered to a factory.

_____

_____

_____

_____

_____

_____ [3]

(b) Waste that does not get recycled often ends up in landfill sites.

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Waste items found in landfill include: aluminium cans, food waste, glass bottles, newspapers and plastic bags. Many items will remain in landfill sites for hundreds of years. Some of the waste gives off polluting gases and can produce foul-smelling liquids that leak into water supplies. A recent survey suggests that many new landfill sites need to be found each year due to the large volume of waste being produced.

Use **only** the information provided to answer parts **(i)** and **(ii)** below.

(i) Apart from food waste, suggest **one** other material which is biodegradable.

_____ [1]

(ii) Suggest **two** disadvantages of living near a landfill site.

1. _____

2. _____ [2]

(c) Some materials are non-biodegradable. Explain fully the term 'non-biodegradable'.

_____

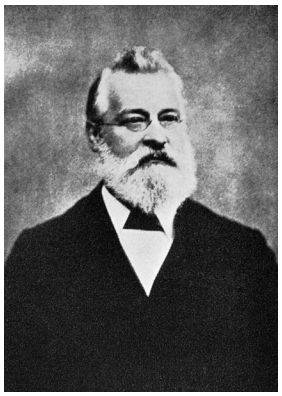
_____ [2]

(d) Suggest **one** way local authorities can encourage people to recycle more waste.

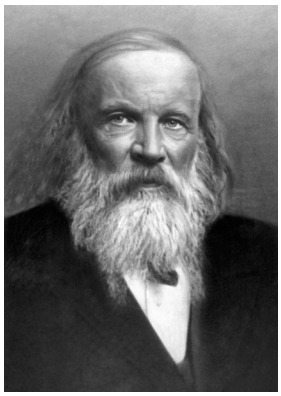
_____ [1]

Examiner Only	
Marks	Remark

2 Early work on the Periodic Table began in the 19th century. In 1864 John Newlands placed the 62 known elements into his periodic table. This was further developed in 1869 by Dmitri Mendeleev.



John Newlands



Dmitri Mendeleev

Describe the work of these two scientists in the development of the Periodic Table.

Your answer should include:

- Newlands' ideas
- Mendeleev's improvements
- the name of the Group of unreactive elements not included in Mendeleev's table.

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

[6]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

3 **(a)** Some tap water contains dissolved metal ions which can make it hard.

(i) Give the name of **one** metal ion that causes tap water to be hard.

_____ [1]

(ii) Give **one** advantage and **one** disadvantage of hard water.

Advantage _____

_____

Disadvantage _____

_____ [2]

(b) The hardness of three samples of water **X**, **Y** and **Z** was measured using soap solution. New samples were boiled and the experiment repeated.
The results are shown below.

Sample of water	Volume of soap solution needed to form a permanent lather/cm^3	
	Before boiling	After boiling
X	2	2
Y	17	17
Z	13	2

State the type of water in samples **Y** and **Z**. Explain your answers.

(i) Sample **Y** _____

_____

_____ [2]

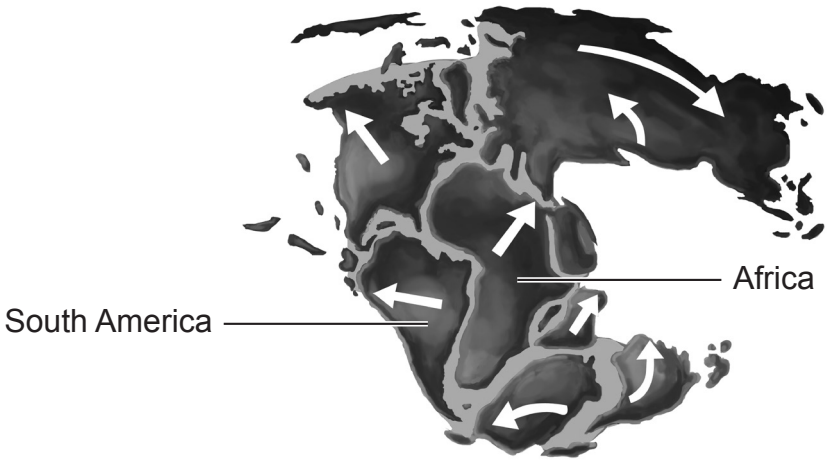
(ii) Sample **Z** _____

_____

_____ [2]

Examiner Only	
Marks	Remark

4 In 1912 the German scientist Alfred Wegener suggested that the continents were once joined as one super-continent as shown in the diagram below. Wegener proposed that this super-continent then broke up and drifted apart. He called this the theory of continental drift.



© Spencer Sutton / Science Photo Library

(a) One piece of evidence to support his theory was that similar fossils were found in South America and Africa.

(i) What is a 'fossil'?

_____

_____

_____ [2]

(ii) Give two **other** pieces of evidence that suggested that continents were once closely joined.

1. _____

_____

2. _____

_____ [2]

(b) Give **one** reason why Wegener's theory of continental drift was rejected in 1912.

_____

_____ [1]

5 The table below gives information about the colours of three indicators in different chemicals.

Indicator / Chemical	Colour		
	red litmus	**Universal Indicator**	**beetroot juice**
citric acid	red	orange	red
water	red	green	purple
sodium hydroxide	blue	purple	yellow
hydrochloric acid	red	red	red
sodium hydrogencarbonate	blue	blue	green

(a) Use this information and your knowledge to answer the questions below.

(i) From the table name the strong acid.

_____ [1]

(ii) Which indicator would be most useful to give a full range of pH values? Explain your answer.

_____

_____

_____ [2]

(iii) Name the indicator which would **not** show that water is neutral. Explain your answer.

_____

_____

_____ [2]

(b) State the chemical formulae for hydrochloric acid and sodium hydrogencarbonate.

Hydrochloric acid _____

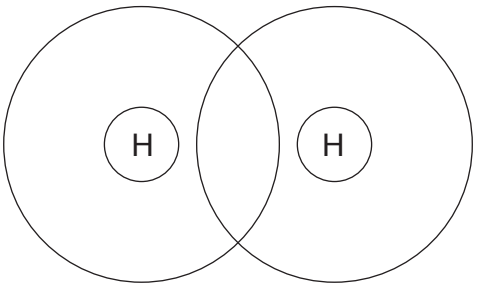
Sodium hydrogencarbonate _____ [2]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

6 **(a)** Below is a diagram showing a molecule of hydrogen.



(i) On the diagram show how the electrons are arranged in this molecule. [1]

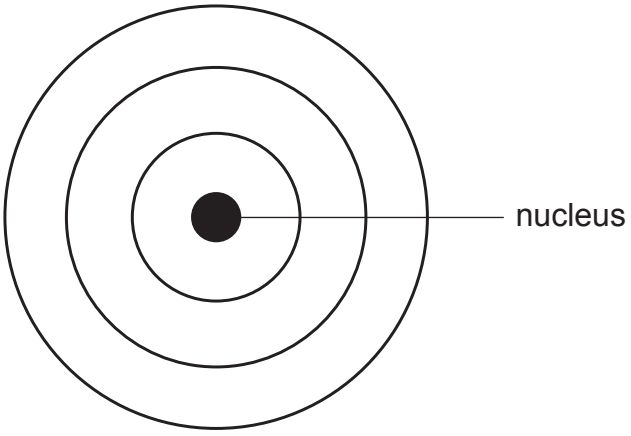
(ii) Name **one** other molecule that forms bonds in a similar way to hydrogen.

_____ [1]

(b) The table below shows information about five elements found in Period 3 of the Periodic Table.

Element	Sodium	Magnesium	Aluminium	Silicon	Phosphorus
Symbol	Na	Mg	Al	Si	P
Atomic number	11	12	13	14	15
Melting point/°C	98	639	660	1410	44
Metallic character	metal	metal	metal	semi-metal	non-metal

(i) Complete the diagram below to show how the electrons are arranged in phosphorus.



Source: Chief Examiner

[1]

(ii) Describe how the metallic character changes across Period 3 of the Periodic Table.

_____

_____ [1]

(iii) Describe the trend in melting points for the **metal** elements shown in the table.

_____

_____ [1]

(c) Magnesium oxide is a compound. What is meant by the term 'compound'?

_____

_____

_____ [2]

(d) Shown below is the word equation for a reaction involving magnesium.

magnesium + copper sulfate → copper + magnesium sulfate

Name the **type** of reaction shown and explain why this reaction happens.

_____

_____

_____ [2]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

7 **(a)** Composite materials are widely used in the manufacture of aircraft.

(i) Explain fully the term 'composite material'.

_____

_____

_____ [2]

Below is information about the materials used to manufacture two aircraft **A** and **B**.

Aircraft **A**	Aircraft **B**
Steel – 14% Titanium – 15% Aluminium – 50% Composite – 12% Other – 9%	Steel – 9% Titanium – 14% Aluminium – 21% Composite – 50% Other – 6%
Cost to manufacture £462 million	Cost to manufacture £1646 million

(ii) Using the information above, suggest **one** reason why aircraft **B** is much more expensive to manufacture than aircraft **A**.

_____

_____ [1]

(b) Give **one** example of:

(i) a naturally occurring composite.

_____ [1]

(ii) a man-made composite.

_____ [1]

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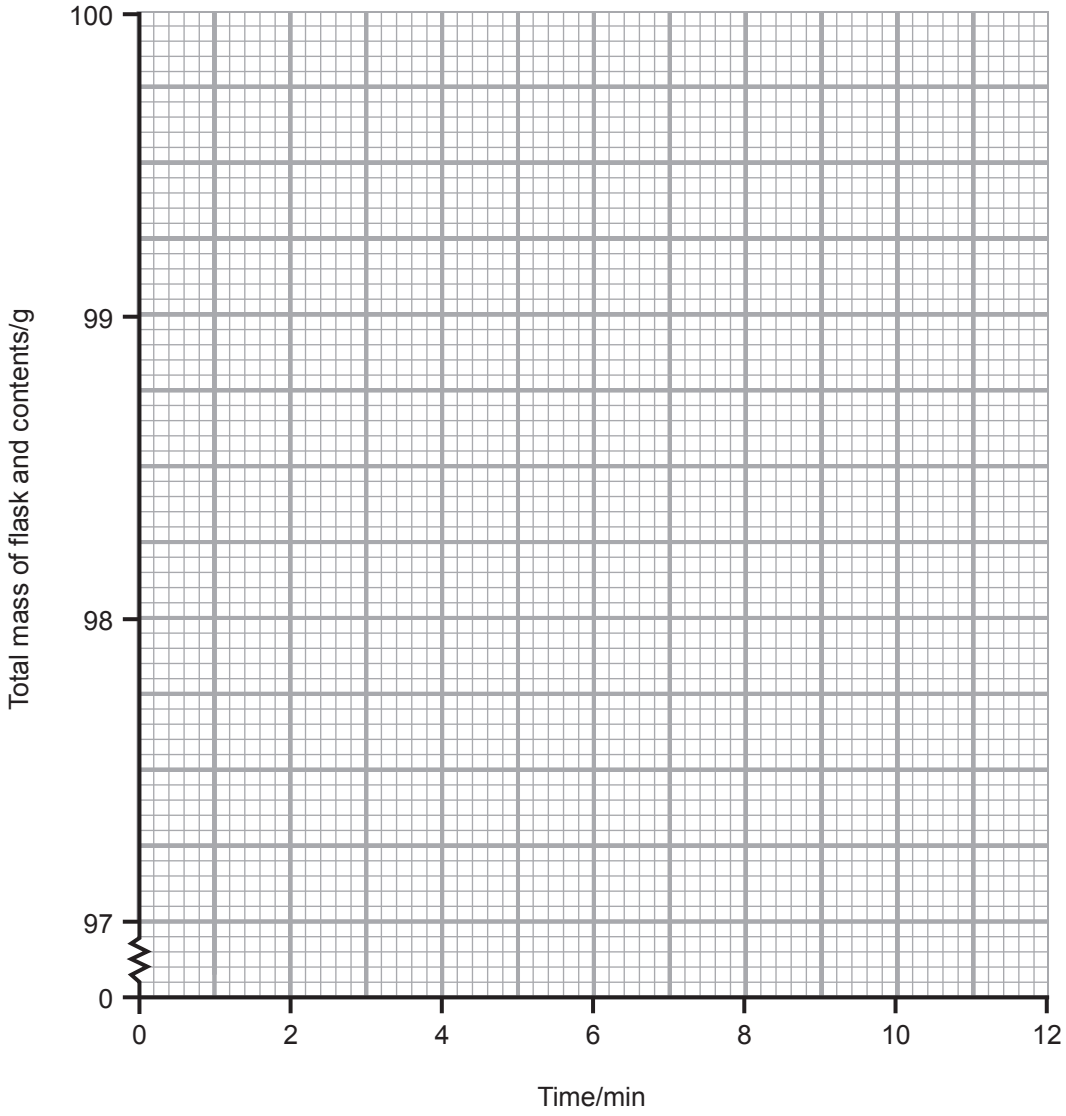
(Questions continue overleaf)

Examiner Only	
Marks	Remark

8 **(a)** A student investigated the reaction between magnesium carbonate and excess hydrochloric acid. She carried out the reaction in a flask placed on a balance and measured the mass every two minutes. Her results are shown below.

Time/min	0	2	4	6	8	10	12
Total mass of flask and contents/g	100	99.1	98.5	98.0	97.7	97.5	97.5

(i) On the grid below plot and draw a line graph of these results.



[3]

(ii) Describe the trend shown by these results.

_____

_____ [1]

(iii) Why does the mass change in this reaction?

_____

_____ [1]

Examiner Only	
Marks	Remark

(b) At what time had all the magnesium carbonate reacted?

_____ min [1]

(c) Complete the word equation for this reaction.

magnesium carbonate + hydrochloric acid → [ ] + [ ] + [ ]

[2]

(d) The student repeated the experiment using ethanoic acid which is weaker than hydrochloric acid.

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

Similarity _____

_____

Difference _____

_____ [2]

9 In the 17th Century Archbishop Ussher used the Bible to suggest the age of the Earth. A more recent scientific method involving the dating of rocks has suggested a different age.

Describe how each method is used to calculate the age of the Earth. Include in your answer the age estimated by each method.

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

[6]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

10 (a) The following compounds are hydrocarbons.

butane **methane** **ethene** **propane** **ethane**

(i) Which of these compounds is **not** an alkane?

_____ [1]

(ii) Butane has the chemical formula C_4H_{10}.

In the space below draw the **structural** formula for butane.

[1]

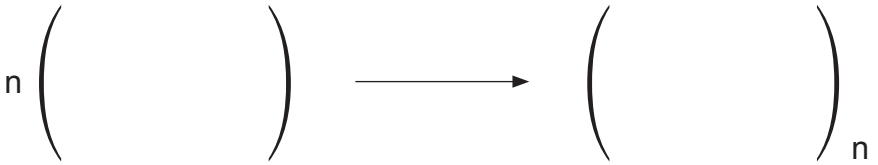
(iii) Give the chemical formula for methane.

_____ [1]

(iv) Write a balanced symbol equation for the combustion of propane **(C_3H_8)**.

_____ [3]

(b) Polythene is a plastic that is made by a process involving ethene molecules. Complete the symbol equation to show how polythene is made from ethene.



[2]

THIS IS THE END OF THE QUESTION PAPER

SYMBOLS OF SELECTED IONS

Positive ions

Name	Symbol
Ammonium	NH_4^+
Chromium(III)	Cr^{3+}
Copper(II)	Cu^{2+}
Iron(II)	Fe^{2+}
Iron(III)	Fe^{3+}
Lead(II)	Pb^{2+}
Silver	Ag^+
Zinc	Zn^{2+}

Negative ions

Name	Symbol
Carbonate	CO_3^{2-}
Dichromate	$Cr_2O_7^{2-}$
Ethanoate	CH_3COO^-
Hydrogen carbonate	HCO_3^-
Hydroxide	OH^-
Methanoate	$HCOO^-$
Nitrate	NO_3^-
Sulfate	SO_4^{2-}
Sulfite	SO_3^{2-}

SOLUBILITY IN COLD WATER OF COMMON SALTS, HYDROXIDES AND OXIDES

Soluble
All sodium, potassium and ammonium salts
All nitrates
Most chlorides, bromides and iodides EXCEPT silver and lead chlorides, bromides and iodides
Most sulfates EXCEPT lead and barium sulfates Calcium sulfate is slightly soluble

Insoluble
Most carbonates EXCEPT sodium, potassium and ammonium carbonates
Most hydroxides EXCEPT sodium, potassium and ammonium hydroxides
Most oxides EXCEPT sodium, potassium and calcium oxides which react with water

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DATA LEAFLET

For the use of candidates taking
Science: Chemistry,
Science: Double Award
or Science: Single Award

Copies must be free from notes or additions of any kind. No other type of data booklet or information sheet is authorised for use in the examinations.

Contents **Page**

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THE PERIODIC TABLE OF ELEMENTS

Group

1	2										3	4	5	6	7	0
							1 H Hydrogen 1									4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4										11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12										27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La* Lanthanum 57	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	227 Ac† Actinium 89	261 Rf Rutherfordium 104	262 Db Dubnium 105	263 Sg Seaborgium 106	262 Bh Bohrium 107	265 Hs Hassium 108	266 Mt Meitnerium 109	269 Ds Darmstadtium 110	272 Rg Roentgenium 111	285 Cn Copernicium 112						

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	147 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	231 Pa Protactinium 91	238 U Uranium 92	237 Np Neptunium 93	242 Pu Plutonium 94	243 Am Americium 95	247 Cm Curium 96	245 Bk Berkelium 97	251 Cf Californium 98	254 Es Einsteinium 99	253 Fm Fermium 100	256 Md Mendelevium 101	254 No Nobelium 102	257 Lr Lawrencium 103

* 58 – 71 Lanthanum series
† 90 – 103 Actinium series

a
b x

a = relative atomic mass (approx)
x = atomic symbol
b = atomic number