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Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2017–2018

Science: Single Award

Unit 2 (Chemistry)
Higher Tier

GSS22

[GSS22]

THURSDAY 8 NOVEMBER 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(a)** 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	

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Examiner Only	
Marks	Remark

1 Coal, oil and gas are fossil fuels that are useful sources of energy.

(a) Complete the following sentences.

The main chemical element in coal is _____.

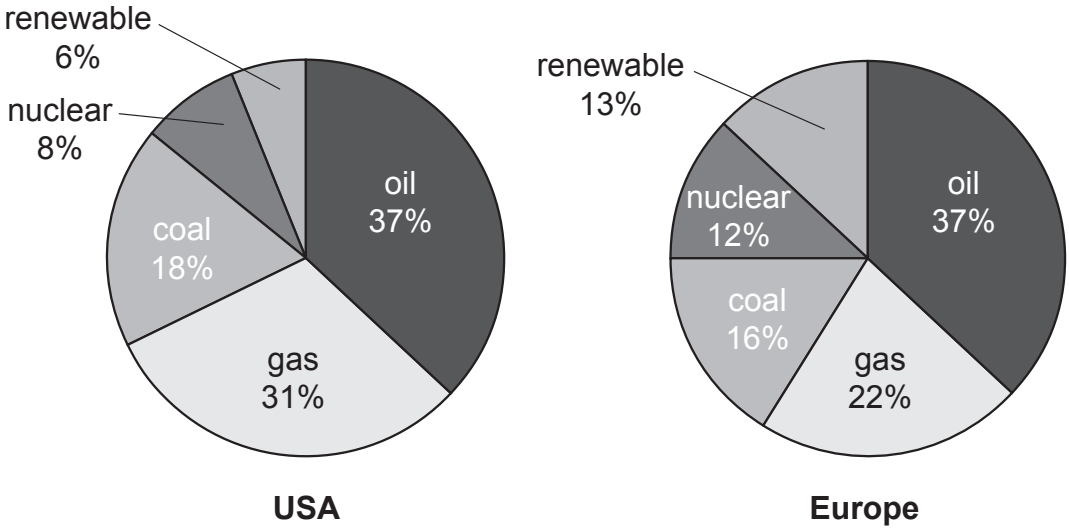
Natural gas (CH_4) contains the elements

_____ and _____.

A molecule containing **only** the two elements found in CH_4 can be

described as a _____. [3]

(b) The pie charts below show the percentage of different energy sources used in the USA and in Europe.



© "Primary Energy in The European Union and USA Compared", by Euan Mearns, 17 Oct 2016.

(i) Calculate the total percentage of coal, oil and gas used in **Europe**.

_____ % [1]

(ii) State **one** similarity and **one** difference in the energy sources used in the USA and in Europe as shown in the pie charts above.

Similarity _____

_____

Difference _____

_____ [2]

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(c) Propane can be used as a fuel. Complete the word equation below for the combustion of propane.

propane + [ ] → [ ] + [ ]

[2]

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Marks	Remark

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2 Thermochromic plastic is an example of a smart material, it changes colour as temperature changes. It is used in making baby bottles and forehead thermometers.

(a) What is meant by the term **smart material**?

_____

_____ [2]

(b) The table below gives information about the colour changes of four thermochromic plastics (**P**, **Q**, **R** and **S**) as they are heated.

	Temperature at which colour changes/°C			
Plastic	**Red**	**Green**	**Blue**	**Black**
P	20	21	25	41
Q	36	39	41	45
R	25	70	100	105
S	34	36	38	40

A child's temperature is normally around 36°C, but when they are ill it can go as high as 38°C.

(i) Which plastic (**P**, **Q**, **R** or **S**) would be most suitable to make a forehead thermometer to show if a child is ill?

_____ [1]

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The following instructions were given to make up a bottle of powdered milk for a baby.

1. Boil water in a kettle to 100°C to kill the bacteria that cause illness.
2. Fill the baby bottle with the boiled water.
3. Allow the water to cool, but not below 70°C.
4. Add the powdered milk to the bottle.
5. Leave to cool to room temperature.

© TEK Image / Science Photo Library

(ii) Explain fully why the colour changes of plastic **R** would make it most suitable to manufacture baby bottles.

_____

_____

_____

_____ [2]

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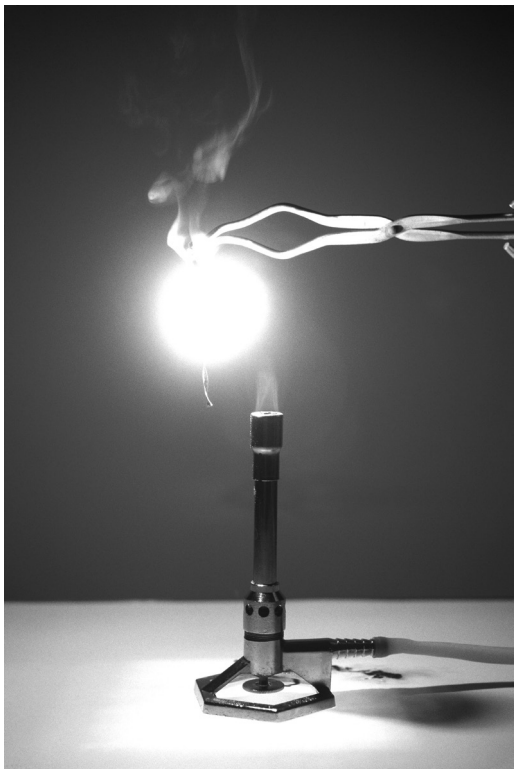
3 **(a)** Magnesium burns in oxygen to form magnesium oxide as shown in the photograph below.



Source: © Charles D Winters/Science Photo Library

(i) Describe the appearance of magnesium **before** it is burnt.

_____ [1]

(ii) Describe **one** observation that could be made during this reaction.

_____ [1]

(iii) Describe the appearance of magnesium oxide **after** the reaction.

_____ [1]

(b) In this reaction oxygen is added to magnesium. What name is given to this **type** of reaction?

_____ [1]

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Marks	Remark

4 **(a)** Describe how you could carry out an investigation to determine if a sample of water was temporary hard water.

Your answer should include:

- the name of **one** metal ion that causes hard water
- how to make the investigation a fair test
- the result you would expect for temporary hard water

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

[6]

(b) Hard water can form undesirable deposits known as 'fur' in kettles. Write a balanced symbol equation for the formation of 'fur'.

[ ] → [ ] + [ ] + [ ]

[3]

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Marks	Remark

5 The diagrams below show the Earth 150 million years ago and as it is in the present day.

150 million years ago

© Claus Lunau / Science Photo Library

present day

© Mikkel Juul Jensen / Science Photo Library

The German geophysicist Alfred Wegener proposed a theory to explain the differences.

(a) Name and describe Alfred Wegener's theory.

_____

_____

_____

_____ [3]

(b) Scientists can find the age of the Earth by dating rocks.

(i) What name is given to the modern method of dating rocks?

_____ [1]

(ii) What age is the Earth according to this modern method?

_____ [1]

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(Questions continue overleaf)

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6 **(a)** Most mobile phones use lithium-ion batteries.
The lithium is used with other elements in the positive electrode while graphite is used in the negative electrode.

© TEK Image / Science Photo Library

(i) Suggest **one** property that graphite must have to make it suitable to use as an electrode.

_____ [1]

(ii) Graphite is a form of carbon. An atom of carbon has 6 electrons. Draw a diagram below to show the electron arrangement of a carbon atom.

[1]

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(b) In making the positive electrode, some batteries use lithium cobalt oxide ($LiCoO_2$) and others use lithium manganese oxide ($LiMn_2O_4$).

In terms of the **numbers of elements** present give one similarity and one difference between these two compounds.

Similarity _____

_____

Difference _____

_____ [2]

(c) The battery casing is made from aluminium. Aluminium has to be extracted from its ore but aluminium that has been used can be easily recycled.

(i) Name the method used to extract aluminium from its ore.

_____ [1]

(ii) Electrodes are used during the extraction of aluminium. What name is given to the negative electrode?

_____ [1]

(iii) Name the ore of aluminium.

_____ [1]

(iv) Give **one** reason why recycling aluminium is important.

_____

_____ [1]

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Marks	Remark

7 **(a)** The diagram below represents the four elements identified by the Greeks.

© tassel78 / iStock / Thinkstock

(i) Name the four elements the Greeks used.

A _____

F _____

W _____

E _____ [2]

(ii) Suggest one reason why these four Greek elements do **not** appear in the modern Periodic Table.

_____

_____ [1]

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Marks	Remark

(b) John Newlands and Dmitri Mendeleev are two scientists that contributed to the development of the Periodic Table.

(i) Name the theory put forward by John Newlands.

_____ [1]

(ii) In what order did Mendeleev put the elements in his periodic table?

_____ [1]

(iii) Explain fully why Mendeleev did **not** have the noble gases in his periodic table.

_____

_____ [2]

(c) Shown below are the elements of the first two Groups of the modern Periodic Table.

Group 1	Group 2
Li	Be
Na	Mg
K	Ca
Rb	Sr
Cs	Ba
Fr	Ra

(i) What name is given to the elements in Group 1 of the Periodic Table?

_____ [1]

(ii) Name the most reactive metal shown in the table above.

_____ [1]

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Marks	Remark

(d) Potassium reacts with oxygen to form potassium oxide (K_2O).

(i) Balance the symbol equation below for the formation of potassium oxide.

$$K \quad + \quad O_2 \longrightarrow K_2O$$

[1]

(ii) Complete the table below giving the total number of each named particle in potassium oxide (K_2O).

You may find your Data Leaflet useful.

Particle	Number
electron	
proton	
neutron	

[3]

(iii) Which of the particles named in the table has the lowest mass?

_____ [1]

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(Questions continue overleaf)

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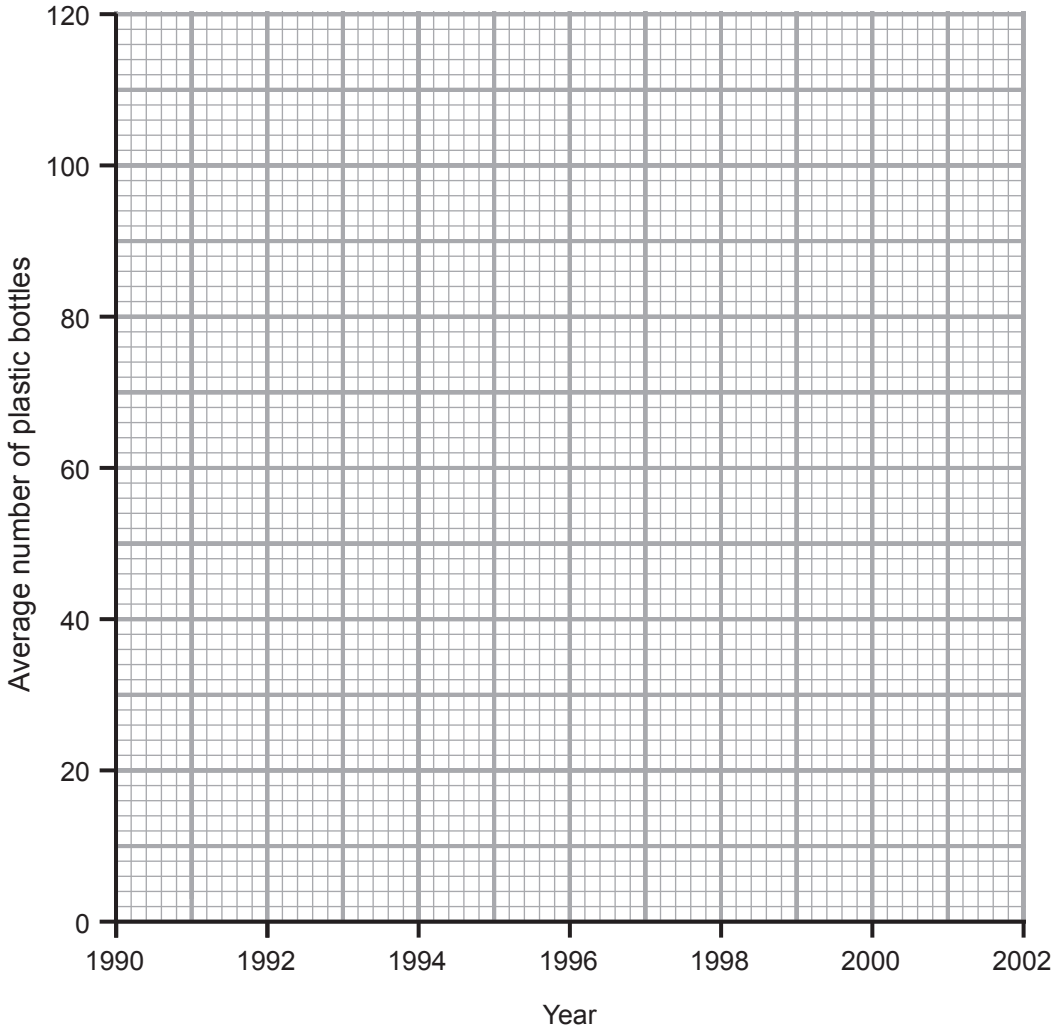
Marks	Remark

8 **(a)** The table below shows how the average number of plastic bottles thrown away (per person) changed from 1990 to 2002.

Year	Average number of plastic bottles
1990	22
1992	22
1994	24
1996	37
1998	58
2000	80
2002	120

© Plastic Pollution in the Pacific / http://plasticpollutioninthepacific.yolasite.com/stats.php

(i) On the grid below plot a line graph for this information.



[3]

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Marks	Remark

(ii) Describe fully the trend shown by this information.

_____

_____

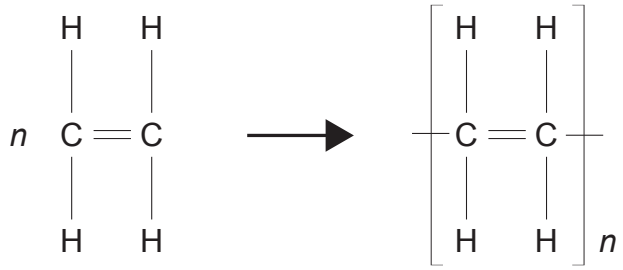
_____ [2]

(b) Plastics are made by a process called polymerisation.

(i) Name the polymer formed during the polymerisation of ethene.

_____ [1]

A student writes the following balanced symbol equation for the polymerisation of ethene.



(ii) The student has made a mistake in the equation. Circle the mistake and explain why it is incorrect.

_____

_____ [1]

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9 Baking powder is a mixture of sodium hydrogencarbonate and tartaric acid. It is used in making cakes.

© adphoto81 / iStock / Thinkstock

When a cake is made **two** different chemical reactions take place. The sodium hydrogencarbonate is affected by heat and it also reacts with the tartaric acid.

Describe fully why sodium hydrogencarbonate is useful in making cakes.

Your answer should include:

- the type of reaction taking place when it is heated and the products formed
- the type of reaction taking place when it reacts with tartaric acid and the products formed.

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

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[6]

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10 Thomas carried out an investigation in which he reacted different metals with solutions of their compounds. Some of his observations are shown below.

Reactants	Observations
copper + iron(II) sulfate solution	no reaction
copper + silver nitrate solution	colourless solution turned blue, silver coloured solid formed
silver + copper(II) sulfate solution	no reaction
zinc + iron(II) sulfate solution	pale green solution turned colourless, grey solid formed
iron + copper(II) sulfate solution	blue solution turned pale green, pink/brown solid formed

(a) What name is given to the **type** of reaction Thomas is investigating?

_____ [1]

(b) Place the four metals in order of reactivity. Place the most reactive first.

_____ most reactive

_____ ↓

_____

_____ least reactive

[2]

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(c) Thomas also added magnesium to a solution of copper(II) sulfate and a reaction took place.

(i) Give **two** observations he would expect for this reaction.

1. _____

2. _____ [2]

(ii) Name the **two** products formed in this reaction.

1. _____

2. _____ [2]

(d) Suggest why Thomas was advised by his teacher **not** to use sodium in this investigation.

_____

_____ [1]

(e) If Thomas added iron to zinc sulfate solution what, if anything, would he observe?

_____

_____ [1]

THIS IS THE END OF THE QUESTION PAPER

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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.

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Solubility of Common Salts 4

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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