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New Specification

Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2018–2019

Single Award Science
Chemistry

Unit 2
Higher Tier

[GSA22]

THURSDAY 8 NOVEMBER 2018, MORNING

GSA22

TIME

1 hour.

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 eight** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 60.
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 provided.
Quality of written communication will be assessed in Question **3(a)**.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
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 element in coal is _____.

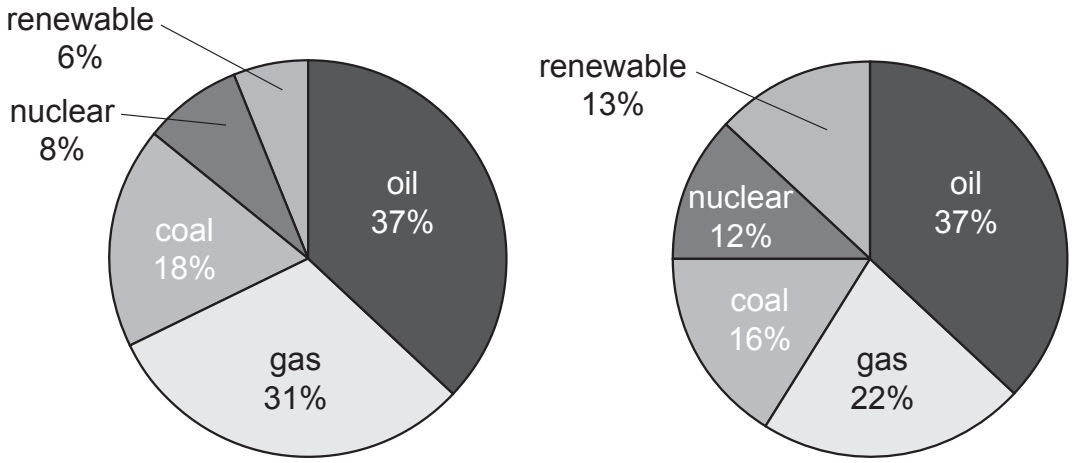
Natural gas (CH_4) contains the elements

_____ 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.



USA **Europe**

(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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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 causes 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.

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

_____

_____

_____

_____ [2]

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Marks	Remark

3 **(a)** Describe how fingerprints are collected at a crime scene and why they are useful in helping to solve a crime.

Your answer should include:

- how powder is used to collect a fingerprint from a white surface
- an alternative to powder that can be used to reveal fingerprints.

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

_____ [6]

(b) Describe **one** other use for fingerprints.

_____ [1]

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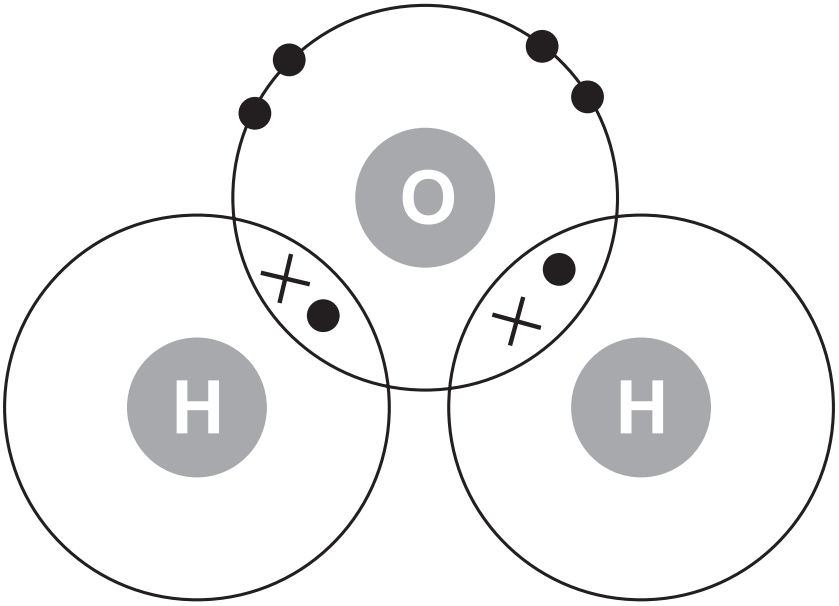
Marks	Remark

4 **(a)** Shown below is a diagram of the bonding in a molecule of water (H_2O).



© Adapted from Animate4.Com / Science Photo Library

(i) Hydrogen and oxygen form a bond by sharing a pair of electrons. What name is given to this type of bonding?

_____ [1]

(ii) Complete the following sentence.

Choose from:

two metals : **two non-metals** : **a metal and a non-metal**

This type of bonding normally happens between

_____ [1]

(b) Explain, in terms of electrons, why elements in Group 0 do **not** usually form bonds.

_____

_____ [1]

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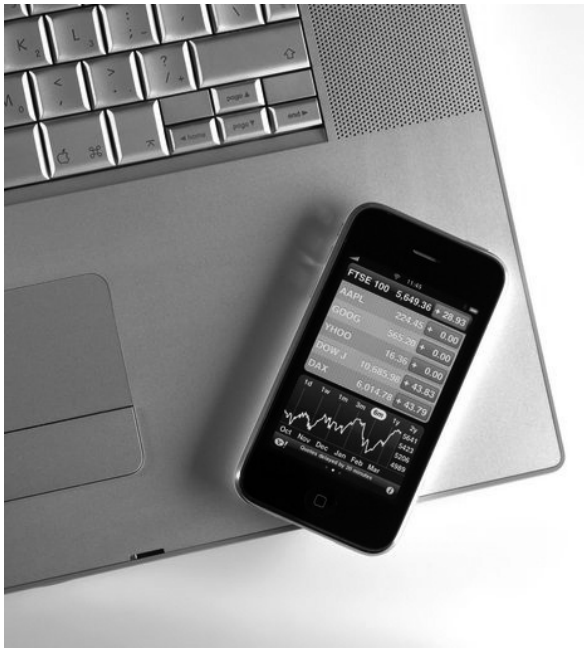
Marks	Remark

5 **(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.



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(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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Marks	Remark

(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]

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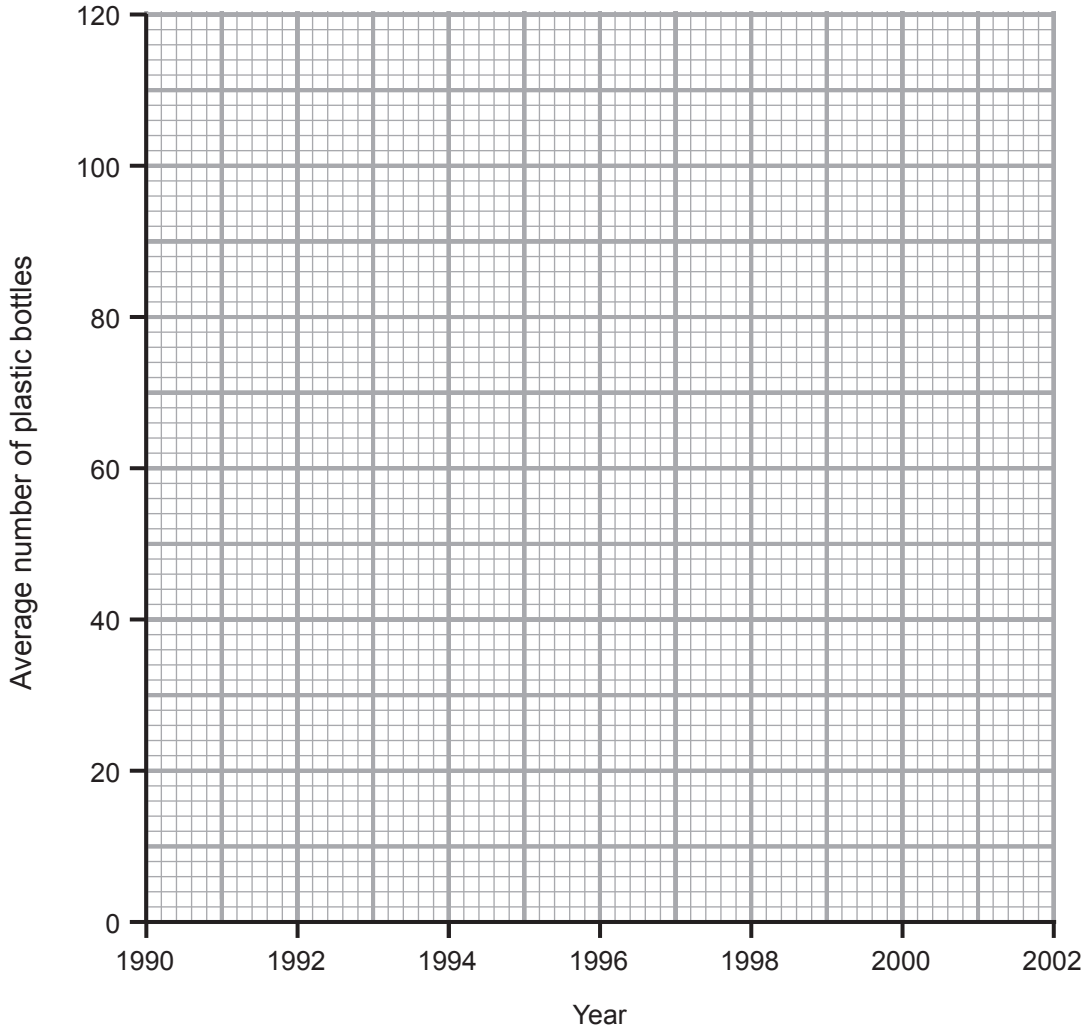
Marks	Remark

6 **(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.

_____

_____

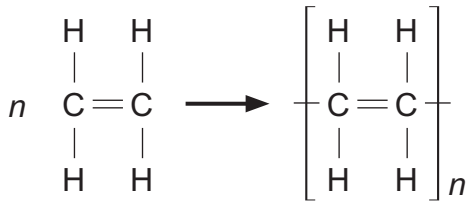
_____ [2]

(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]

(c) Plastics made from ethene are non-biodegradable but can be recycled or disposed of by incineration (burning).

(i) State **one** advantage and **one** disadvantage of disposing of plastics by incineration.

Advantage _____

_____

Disadvantage _____

_____ [2]

(ii) Apart from recycling and incineration, give **one** other way of disposing of plastic waste.

_____ [1]

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Marks	Remark

(d) Propene is another alkene that can be made into a polymer. Complete the table below to give the molecular formula, structural formula and state of propene at room temperature.

	Propene
Molecular formula	
Structural formula	
State at room temperature	

[3]

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(Questions continue overleaf)

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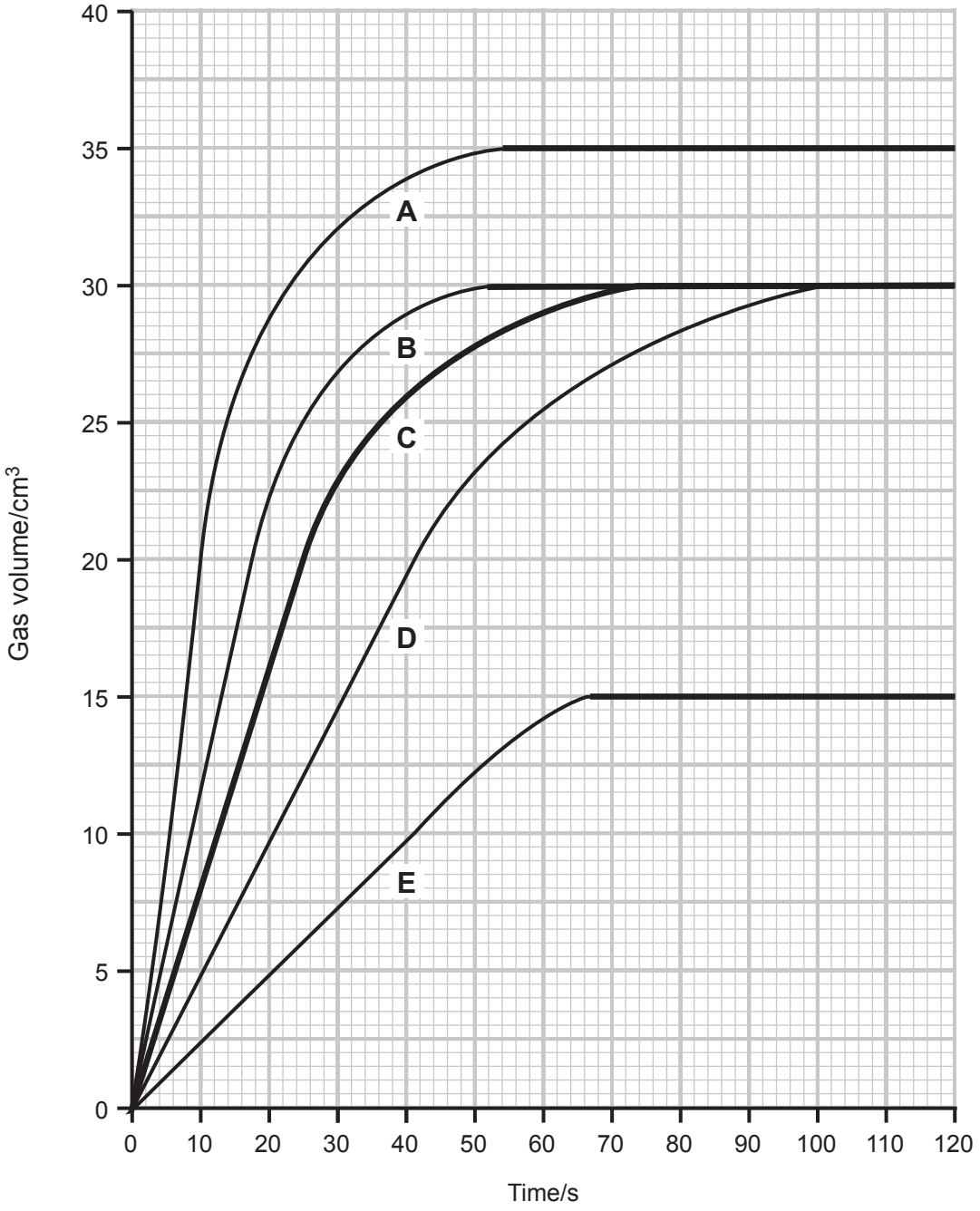
7 **(a)** Roy investigated the reaction between 0.03 g of magnesium ribbon and excess dilute hydrochloric acid at 20 °C. He collected and measured the volume of gas produced over a period of 120 seconds.

The result of his investigation is shown by the line labelled **C** on the graph below.



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(i) Roy then repeated the reaction using the same mass of magnesium but the dilute acid was at a temperature of **40 °C**. Which line (**A**, **B**, **C**, **D** or **E**) represents the result he would expect? Explain your answer fully.

Line _____ [1]

Explanation _____

_____

_____ [2]

(ii) Roy then repeated the experiment using **0.015 g** of magnesium ribbon and dilute acid at 20 °C. Which line (**A**, **B**, **C**, **D** or **E**) represents the result he would expect?

Line _____ [1]

(b) Roy increased the concentration of the acid and found that the reaction happened faster. Explain, in terms of particles, how increasing concentration affects the rate of reaction.

_____

_____

_____

_____ [3]

(c) **(i)** Name a piece of apparatus the student could have used to collect the gas produced during this reaction.

_____ [1]

(ii) Apart from collecting the gas, describe another way the student could have studied the rate of this reaction.

_____

_____ [1]

(d) Write a balanced symbol equation for the reaction between magnesium and hydrochloric acid.

_____ [3]

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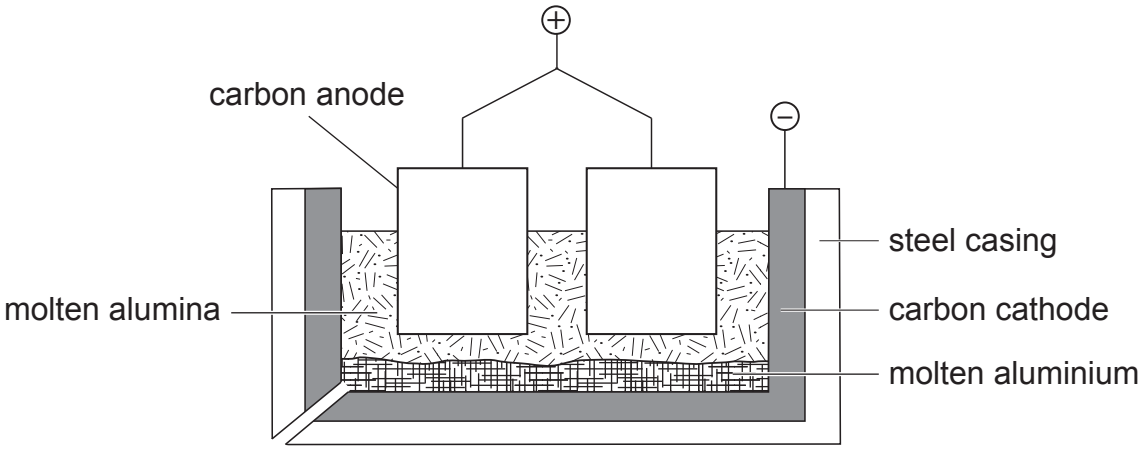
Marks	Remark

8 Aluminium can be extracted from its purified ore (alumina) as shown below.



Source: Principal Examiner

(a) **(i)** Name the process by which aluminium is extracted from its ore.

_____ [1]

(ii) Name the ore from which the alumina was produced.

_____ [1]

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

_____

_____

_____ [3]

(c) Oxygen gas is produced at the anode.

(i) Describe how to test for oxygen gas.

_____

_____ [2]

(ii) Explain fully why the anode must be replaced periodically.

_____

_____ [2]

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Marks	Remark

(d) Aluminium is recycled to help save natural resources. Give **one** other reason why recycling of aluminium is important.

_____

_____ [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
Butanoate	$C_3H_7COO^-$
Carbonate	CO_3^{2-}
Dichromate	$Cr_2O_7^{2-}$
Ethanoate	CH_3COO^-
Hydrogencarbonate	HCO_3^-
Hydroxide	OH^-
Methanoate	$HCOO^-$
Nitrate	NO_3^-
Propanoate	$C_2H_5COO^-$
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

Including the Periodic Table of the Elements

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

gcse examinations

chemistry

For first teaching from September 2017

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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	98 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	266 Sg Seaborgium 106	264 Bh Bohrium 107	277 Hs Hassium 108	268 Mt Meitnerium 109	271 Ds Darmstadtium 110	272 Rg Roentgenium 111	285 Cn Copernicium 112						

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	145 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 X b

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