Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2019

GCSE Chemistry

Unit 1

Higher Tier

MV18

[GCM12]

TUESDAY 28 MAY, AFTERNOON

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 on blank pages.
Complete in black ink only.
Answer **all five** questions.

Information for Candidates

The total mark for this paper is 80.
Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Question **5(a)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

1 The element sulfur is found on the Earth's surface particularly in volcanic regions such as Sicily. The atomic number of sulfur is 16.

(a) (i) What is meant by the term element? [1 mark]

_____

_____

(ii) What is meant by the term atomic number? [1 mark]

_____

(b) A sample of sulfur from a volcanic rock was analysed to give the following percentage abundance of its isotopes.

Isotope	Percentage abundance
^{32}S	95.02
^{33}S	0.76
^{34}S	4.22

(i) Calculate the relative atomic mass for the sample of sulfur. Show your working out and give your answer to **one** decimal place. [3 marks]

Relative atomic mass = _____

(ii) Explain what is meant by relative in the term relative atomic mass. [1 mark]

_____

_____

(iii) Describe how an atom of ^{33}S is different from an atom of ^{34}S. [1 mark]

_____

_____

(c) Complete the table below. [2 marks]

Atom/ion	Number of protons	Number of neutrons	Number of electrons
^{32}S			
$^{34}S^{2-}$			

(d) A volcanic rock found in Sicily contains a compound made up of magnesium, silicon and oxygen. A sample of this compound was found to contain 1.80 g of magnesium, 1.05 g of silicon and 2.40 g of oxygen.

Determine the empirical formula of this compound. [4 marks]

Show your working out.

Empirical formula: _____

Blank Page

(Questions continue overleaf)

2 The elements of Period 2 are listed below.

lithium

beryllium

boron

carbon

nitrogen

oxygen

fluorine

neon

(a) Lithium burns in air to form lithium oxide.

(i) Write a balanced symbol equation for the reaction which occurs when lithium burns in air. [3 marks]

(ii) Describe, in words and by writing electronic configurations, how lithium atoms react with oxygen atoms to form lithium oxide. State the charges of the ions formed. [6 marks]

(iii) Explain why lithium oxide conducts electricity when molten. [1 mark]

(b) Lithium also reacts with fluorine. In this reaction fluorine molecules form fluoride ions.

Write a half equation for the formation of fluoride ions from a fluorine molecule. [3 marks]

(c) Carbon reacts with oxygen to form carbon dioxide. Draw dot and cross diagrams to show the bonding in an oxygen molecule and the bonding in a carbon dioxide molecule. [2 marks]

oxygen	carbon dioxide

(d) Carbon has several allotropes including diamond, graphite and graphene.

(i) What is meant by the term allotropes? [2 marks]

(ii) State one difference between the structure of graphite and the structure of graphene. [1 mark]

(e) Fluorine forms a compound with oxygen called oxygen difluoride, OF_2.

(i) Name the type of bonding found in a molecule of oxygen difluoride. [1 mark]

(ii) Oxygen difluoride reacts very slowly with water to form hydrofluoric acid and oxygen gas. Write a balanced symbol equation for this reaction. [3 marks]

(f) Lithium, carbon (in the form of diamond) and fluorine have very different melting points. The differences in melting points are the result of different types of structure and different forces or bonding between the particles in the structures.

Complete the table below. [6 marks]

	Lithium	**Carbon (diamond)**	**Fluorine**
Melting point (°C)	181	3550	–220
Structure	metallic lattice		
Forces or bonding broken on melting		covalent bonding	
Particles between which the forces or bonding are acting			molecules

3 Chlorine and hydrated aluminium sulfate, $Al_2(SO_4)_3.xH_2O$, are both used in water treatment to make fresh water potable.

(a) (i) What is potable water? [1 mark]

_____

(ii) Why is chlorine used in water treatment? [1 mark]

_____

(iii) Describe the test for chlorine gas. [3 marks]

_____

_____

_____

(iv) Why is aluminium sulfate used in water treatment? [1 mark]

_____

(b) The following method may be used to prepare hydrated aluminium sulfate.

- Measure out 25 cm^3 of dilute sulfuric acid into a beaker
- Warm the acid and add spatula measures of aluminium oxide until it is in excess
- Remove the excess aluminium oxide by filtration
- Slowly evaporate the aluminium sulfate solution

(i) What piece of apparatus is used to measure out 25 cm^3 of dilute sulfuric acid? [1 mark]

_____

(ii) How is the excess aluminium oxide removed? [1 mark]

_____

(iii) Write the balanced symbol equation for the reaction of aluminium oxide and sulfuric acid. Include state symbols. [4 marks]

_____

(iv) What does xH_2O represent in the formula $Al_2(SO_4)_3.xH_2O$? [1 mark]

_____

(v) Explain why dilute sulfuric acid is a strong acid.
[1 mark]

_____

(vi) What is the effect on pH of decreasing the concentration of a solution of sulfuric acid?
[1 mark]

_____

(c) In an experiment, 12.60 g of hydrated aluminium sulfate crystals, $Al_2(SO_4)_3.xH_2O$, were heated to constant mass. The anhydrous aluminium sulfate formed had a mass of 6.84 g.

Calculate the value of x in $Al_2(SO_4)_3.xH_2O$. [4 marks]

Show your working out.

x = _____

Blank Page

(Questions continue overleaf)

4 When experimenting with manganese(IV) oxide and compounds of the elements yttrium and indium, scientists accidentally discovered a new blue pigment. The new blue colour was named 'YInMn blue' after the elements it contained. It is being used as a new colour for crayons.

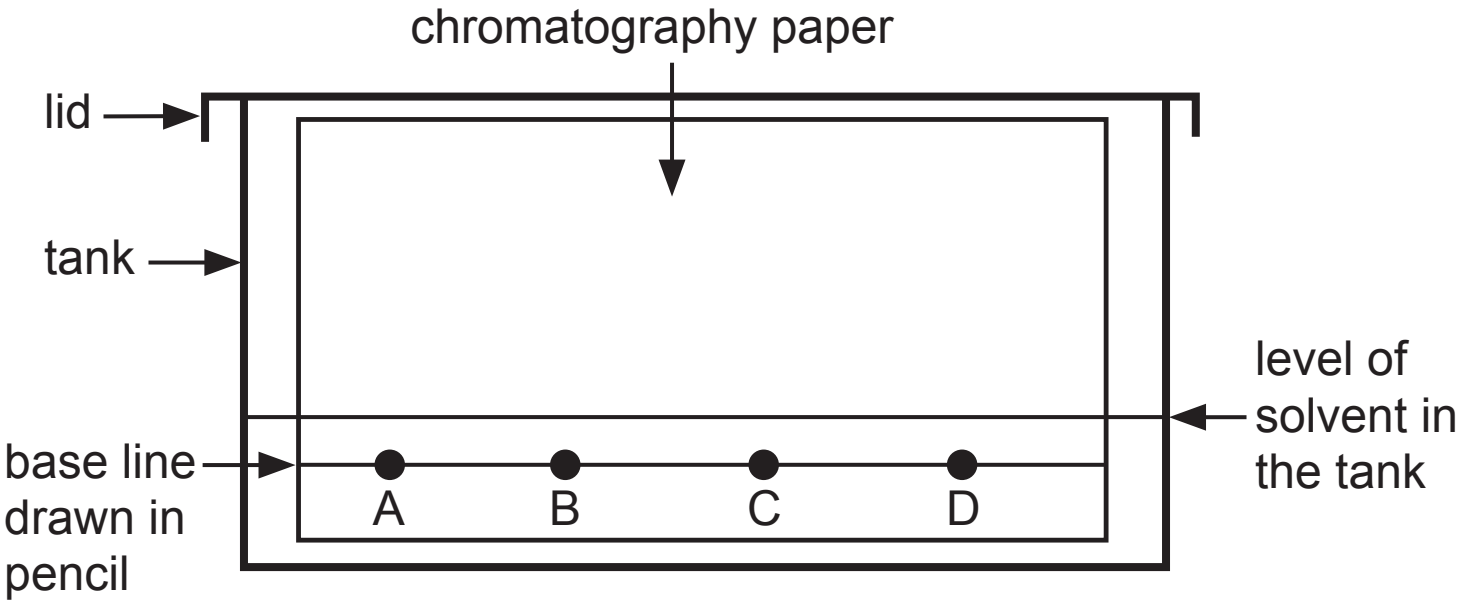
(a) Name the block of elements in the Periodic Table which form coloured compounds. [1 mark]

_____

(b) Complete the table below. [3 marks]

Substance	**Colour**
copper(II) oxide powder	
copper(II) nitrate solution	
calcium chloride solution	

(c) A student used chromatography to analyse a coloured pigment. The student set up the apparatus as shown in the diagram below. A is a coloured pigment and B, C and D are spots of pure dyes.



The student made an error in setting up the experiment. Identify the error and state the effect it would have. [2 marks]

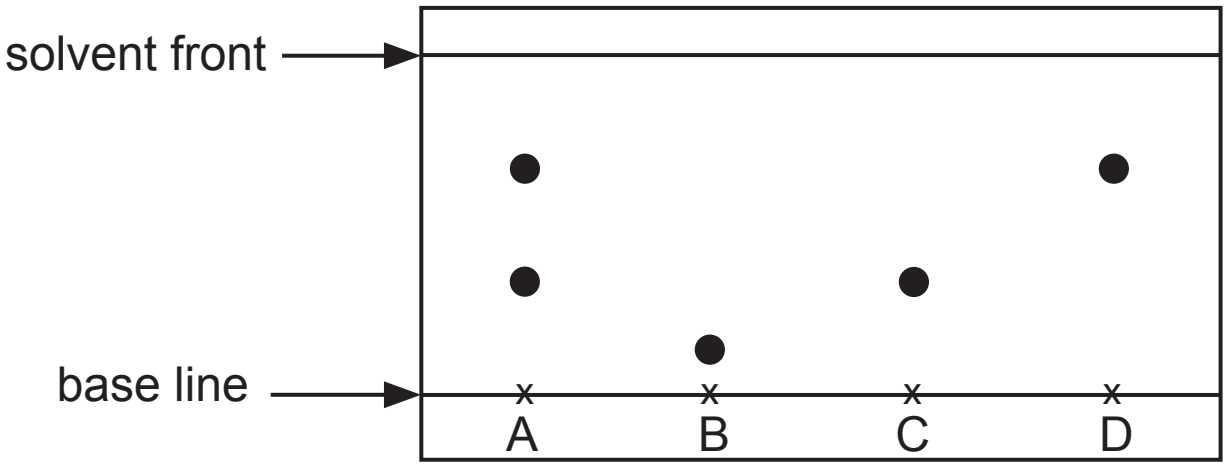
Error _____

_____

Effect _____

_____

(d) A different student set up the same experiment correctly and obtained the chromatogram below.



(i) Using a ruler, take measurements from the chromatogram and use them to calculate an R_f value for spot C. [3 marks]

R_f value = _____

(ii) Explain which pure dye (B, C or D) is least soluble in the solvent. [1 mark]

5 **(a)** An investigation was carried out into the displacement reactions of the halogens. Bromine was added to a test tube containing sodium iodide solution and in a separate test tube chlorine was added to sodium bromide solution. A reaction occurred in both test tubes.

State and explain what the student found out. In your answer you should include: [6 marks]

- word equations for the chemical reactions
- an order of reactivity, from most reactive to least reactive, of the halogens shown by these reactions
- an explanation of the order of reactivity of the halogens in terms of electronic configuration.

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

(b) Some analytical tests were carried out to identify the ions present in several compounds. Write the **formula** of the anion or cation present based on the results of the analytical tests given below.

(i) A white precipitate is produced on adding a few drops of barium chloride solution to a salt solution. [1 mark]

_____

(ii) A white precipitate is produced on adding a few drops of sodium hydroxide solution to a salt solution. The white precipitate remains when excess sodium hydroxide solution is added. [1 mark]

_____

(iii) On adding dilute nitric acid to a solid salt, a gas is produced which changes limewater from colourless to milky. [1 mark]

_____

(iv) A flame test was carried out on a solid salt and a crimson flame was observed. [1 mark]

_____

This is the end of the question paper

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
Total Marks	

Examiner Number

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

COUNCIL FOR THE **CURRICULUM, EXAMINATIONS** AND **ASSESSMENT**
29 Clarendon Road, Clarendon Dock, Belfast BT1 3BG
Tel: +44 (0)28 9026 1200 Fax: +44 (0)28 9026 1234
Email: info@ccea.org.uk Web: www.ccea.org.uk

Rewarding Learning

New Specification

Rewarding Learning

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

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