



General Certificate of Secondary Education
2019

Centre Number

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Candidate Number

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GCSE Chemistry

Unit 1

Higher Tier

MV24

[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.

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(Questions start overleaf)

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			
$^{34}\text{S}^{2-}$			

(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: _____

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 opposite. [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, $\text{Al}_2(\text{SO}_4)_3 \cdot x\text{H}_2\text{O}$, 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 $x\text{H}_2\text{O}$ represent in the formula $\text{Al}_2(\text{SO}_4)_3 \cdot x\text{H}_2\text{O}$? [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, $\text{Al}_2(\text{SO}_4)_3 \cdot x\text{H}_2\text{O}$, were heated to constant mass. The anhydrous aluminium sulfate formed had a mass of 6.84 g.

Calculate the value of x in $\text{Al}_2(\text{SO}_4)_3 \cdot x\text{H}_2\text{O}$.
[4 marks]

Show your working out.

x = _____

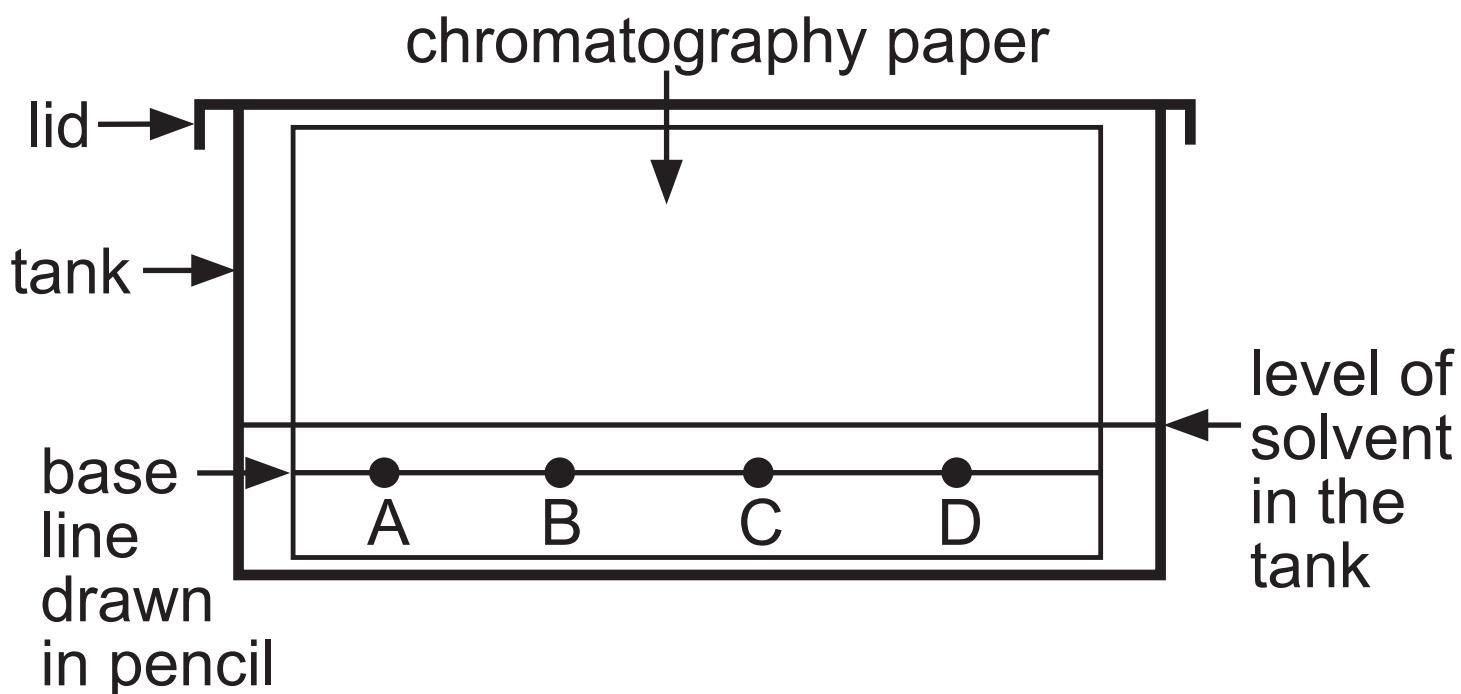
4 When experimenting with manganese(IV) oxide and compounds of the elements yttrium and indium, scientists accidentally discovered a new blue pigment. The new blue colour was named 'YInMn blue' after the elements it contained. It is being used as a new colour for crayons.

(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.



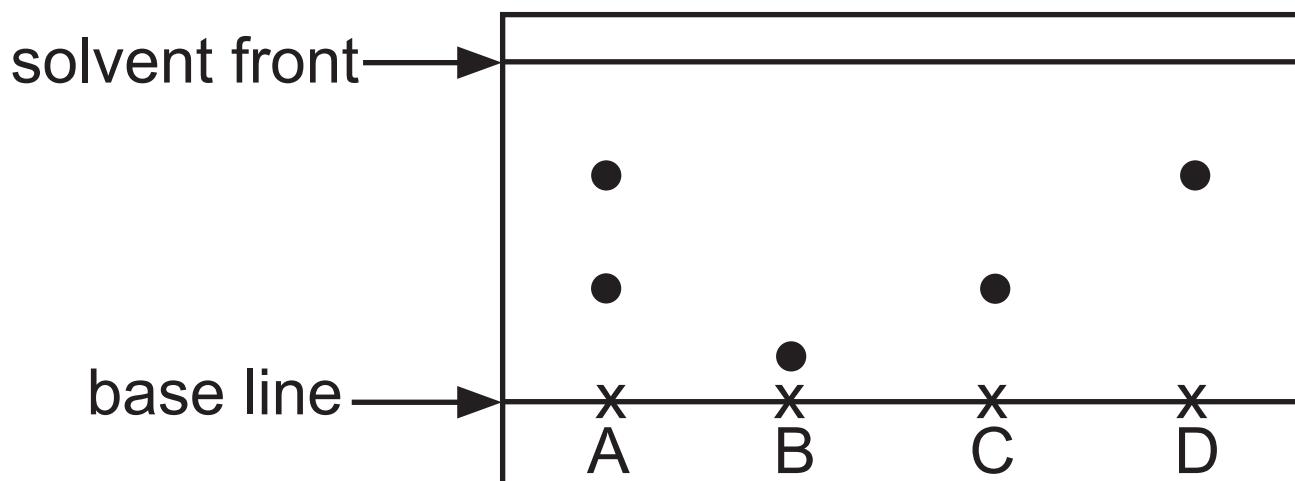
The student made an error in setting up the experiment. Identify the error and state the effect it would have.

[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

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Question Number	Marks
1	
2	
3	
4	
5	
Total Marks	
Examiner Number	

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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	$\text{C}_3\text{H}_7\text{COO}^-$
Carbonate	CO_3^{2-}
Dichromate	$\text{Cr}_2\text{O}_7^{2-}$
Ethanoate	CH_3COO^-
Hydrogencarbonate	HCO_3^-
Hydroxide	OH^-
Methanoate	HCOO^-
Nitrate	NO_3^-
Propanoate	$\text{C}_2\text{H}_5\text{COO}^-$
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

New Specification

Data Leaflet
Including the Periodic Table of the ElementsFor 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

THE PERIODIC TABLE OF ELEMENTS

Group

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

a = relative atomic mass
(approx)

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

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