Surname	Centre Number	Candidate Number
First name(s)		2

GCE AS

B410U10-1

S25-B410U10-1

TUESDAY, 13 MAY 2025 – MORNING

CHEMISTRY – AS component 1

The Language of Chemistry, Structure of Matter and Simple Reactions

1 hour 30 minutes

	For Examiner's use only		
	Question	**Maximum Mark**	**Mark Awarded**
Section A	**1. to 7.**	**10**	
Section B	**8.**	**6**	
	9.	**11**	
	10.	**12**	
	11.	**9**	
	12.	**17**	
	13.	**15**	
	Total	**80**	

B410U101
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ADDITIONAL MATERIALS

- A calculator, pencil and ruler
- **Data Booklet** supplied by WJEC

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.
Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Section A Answer **all** questions.
Section B Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

The maximum mark for this paper is 80.

Your answers must be relevant and must make full use of the information given to be awarded full marks for a question.

The assessment of the quality of extended response (QER) will take place in **Q13**(c).

JUN25B410U10101

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SECTION A

Answer **all** questions.

1. Give the meaning of the term electronegativity. [1]

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2. Describe how flame tests are carried out and how they can be used to differentiate between sodium chloride and potassium chloride. Give the expected observation for both compounds. [2]

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3. State what happens to the atomic number and the mass number of a nucleus when it emits a β-particle. [1]

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4. State why only the Lyman series is used to determine the ionisation energy for a hydrogen atom. [1]

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5. An oxide of phosphorus was analysed and was found to contain 49.3% phosphorus and 50.7% oxygen by mass.

Determine the empirical formula of this compound. [2]

Empirical formula .....

6. Write an equation for the reaction of fluorine with iron to form iron(III) fluoride. [1]

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7. (a) Explain why metals are good conductors of electricity. [1]

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(b) State **one** other physical property of metals. [1]

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10

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SECTION B

Answer **all** questions.

8. A gas syringe is filled with an equilibrium mixture of brown nitrogen dioxide and colourless dinitrogen tetroxide.

$$\underset{\text{brown}}{2NO_2(g)} \rightleftharpoons \underset{\text{colourless}}{N_2O_4(g)}$$

(a) State how the colour will change, if at all, when the pressure is decreased.

Explain your answer. [2]

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(b) Write the expression for the equilibrium constant, K_c, for this reaction.

Give its unit, if any. [2]

Unit .....

(c) Under certain conditions the value of this equilibrium constant increases.

State how the colour will change. Explain your answer. [2]

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6

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9. Promethium is a lanthanoid and a radioactive element. Very little occurs naturally.

(a) ^{135}Pm decays by positron emission. Give the symbol and mass number of the element formed. [1]

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(b) Isotopes of promethium, such as ^{135}Pm, can be synthesised and their half-lives can be studied.

State what is meant by the term half-life. [1]

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(c) The decay of another radioactive element was studied by recording the variation in the mass of a sample over time. The following data were obtained.

Time / s	Mass of sample / g
0	5.40
60	2.33
120	1.01
180	0.43
240	0.19
300	0.08

(i) Identify the mass reading that has the **largest** percentage error.

Calculate this percentage error. Assume that it is based on one weighing only. [2]

Percentage error = ... %

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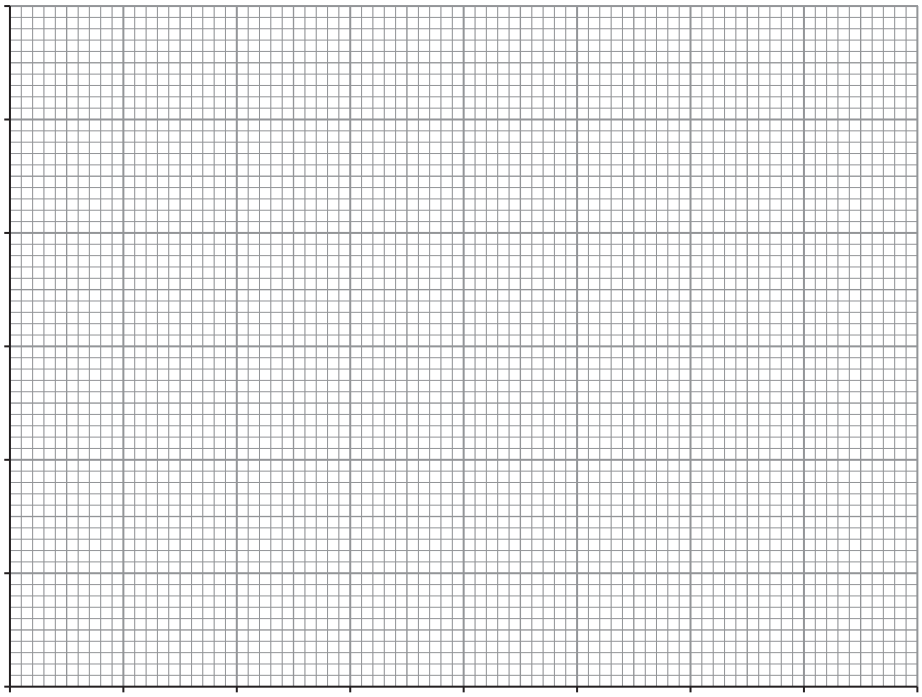
(ii) Plot a graph of the mass of sample against time.

Label the axes and choose a suitable scale. [3]



(iii) Use the graph to determine the half-life of the isotope. Show clearly how you get your answer. [2]

Half-life = ... s

Turn over.

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(d) Naturally occurring chromium has four stable isotopes.

Calculate its relative atomic mass using the following information.

Show your working and give your answer to **four** significant figures. [2]

Mass number	50	52	53	54
Percentage abundance / %	4.345	83.79	9.501	2.365

Relative atomic mass = ...

11

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10. A student was investigating the reaction between magnesium and hydrochloric acid under standard laboratory conditions.

(a) Write an **ionic** equation for the reaction between hydrochloric acid and magnesium. [1]

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(b) (i) Calculate the minimum volume of 4.20 mol dm^{-3} hydrochloric acid required to react with 0.100 mol of magnesium.

Give your answer in **cm^3** and to an **appropriate** number of significant figures. [3]

Volume of hydrochloric acid = ... cm^3

(ii) Name the piece of apparatus most suitable for measuring this volume of solution. [1]

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(iii) Calculate the number of hydrogen ions present in this volume. [1]

Number of hydrogen ions = ...

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(c) Calculate the minimum mass of magnesium required to produce 30.0 cm^3 of hydrogen gas measured at 25 °C. Assume an excess of hydrochloric acid is used. [2]

Mass of magnesium = ... g

(d) Calculate the pH of 4.20 mol dm^{-3} hydrochloric acid. [2]

pH = ...

(e) Suggest an approximate pH for a 4.20 mol dm^{-3} solution of ethanoic acid.

Explain why this pH is different to that calculated in part (d). [2]

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12

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11. A student made a solution of a metal hydroxide by dissolving 20.25 g of the solid in deionised water to make 250 cm^3 of solution. She titrated 25.0 cm^3 samples of this solution against 1.00 mol dm^{-3} hydrochloric acid using an appropriate indicator.

The results of these titrations are given in the table.

Titration number	1	2	3
Final burette reading / cm^3	24.50	23.60	25.20
Initial burette reading / cm^3	0.20	0.00	1.50
Titre / cm^3	.....	.....	.....

(a) Use the data in the table to calculate an accurate mean titre. [1]

Mean titre = ... cm^3

(b) Given that the hydroxide and the acid react in a 1:2 ratio, calculate the concentration of the hydroxide solution. [3]

Concentration = ... mol dm^{-3}

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(c) Using the data in the question and your answer from part (b), calculate the relative formula mass of the metal hydroxide and hence deduce the identity of the metal. [4]

Relative formula mass = ...

Metal .....

(d) State why the student's method would not work with magnesium hydroxide. [1]

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9

Examiner only

12. (a) Give the electronic configuration of a nitrogen atom. [1]

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(b) State and explain the general trend in the first ionisation energy across Period 2. [2]

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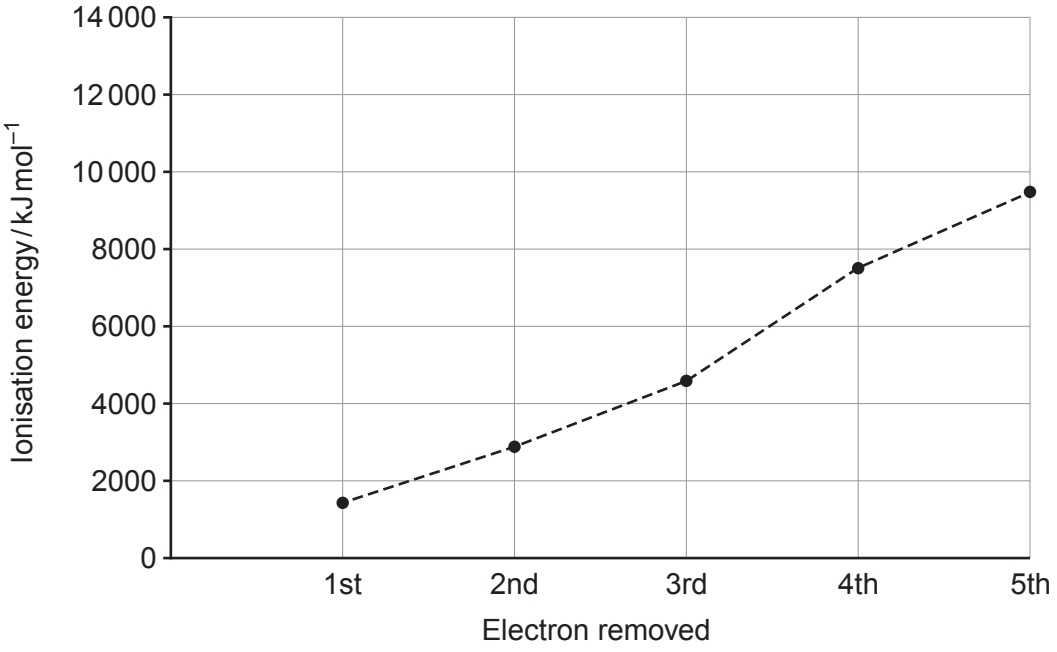
(c) The graph below shows the first five successive ionisation energy values for a nitrogen atom.



(i) Explain why the second ionisation energy is greater than the first ionisation energy. [1]

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(ii) Explain why the fourth ionisation energy is slightly higher than expected. [1]

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(d) Nitrogen exists as molecules with a relative formula mass of 28. The relative formula mass of an ammonia molecule is lower than that of nitrogen but its boiling temperature is much higher than the boiling temperature of nitrogen.

Explain this difference in boiling temperature. [3]

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(e) Ammonia is more reactive than nitrogen and forms many compounds.

(i) Ammonia forms compounds containing the ammonium ion, NH_4^+.

Describe the bonding in an ammonium ion. Include a dot and cross diagram in your answer. [3]

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(ii) Ammonia can also form amide ions, NH_2^-.

Ammonium ions and amide ions both have the same number of electron pairs.

Use your knowledge of VSEPR theory to explain the shapes of both ions and the bond angles seen. [3]

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(iii) Sodium amide, $NaNH_2$, is formed from the reaction of sodium and ammonia. Hydrogen is the only other product.

Write an equation for this reaction. [1]

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(iv) Sodium amide can be further reacted to produce sodium azide, NaN_3. It is a crystalline solid with a high melting temperature.

Suggest the type of structure present and give **one** other physical property of sodium azide. [2]

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17

Examiner only

13. (a) Potassium chlorate, $KClO_3$, undergoes thermal decomposition to form potassium chloride and oxygen only.

(i) Give the oxidation number of chlorine in potassium chlorate. [1]

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(ii) Write an equation for this reaction. [1]

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(iii) Calculate the volume of oxygen that would be produced by the complete decomposition of 1.35 g of potassium chlorate at 650 K and a pressure of 1 atm. [3]

Volume of oxygen = ... m^3

(iv) Suggest how you would prove that complete decomposition had been achieved. [1]

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Examiner only

(b) Three strips of white filter paper were soaked in three different potassium halides – chloride, bromide and iodide. The paper strips were dried.

Describe a simple laboratory test (**not** involving the use of silver nitrate solution) to identify the halide on each strip. Give the results for each strip. [3]

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Examiner only

(c) A student is given 5.00 g of a solid mixture of calcium chloride and sodium chloride and asked to determine the percentage by mass of calcium chloride in the mixture by gravimetric analysis.

Describe the method the student should use to obtain the required data. Give details of how the percentage is calculated. [6 QER]

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END OF PAPER

Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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