



Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

A-level CHEMISTRY

Paper 1 Inorganic and Physical Chemistry

Tuesday 2 June 2026

Morning

Time allowed: 2 hours

Materials

For this paper you must have:

- the Periodic Table/Data Booklet, provided as an insert (enclosed)
- a ruler with millimetre measurements
- a scientific calculator, which you are expected to use where appropriate.

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do **not** write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 105.

For Examiner's Use

Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	

Answer **all** questions in the spaces provided.

0 1

This question is about the element aluminium.

0 1 . 1

State the block in the Periodic Table that contains aluminium.

[1 mark]

0 1 . 2

Give an equation for the process that occurs when the first ionisation energy of aluminium is measured.
Include state symbols.

[1mark]

0 1 . 3

The successive ionisation energies of some elements (**X**, **Y** and **Z**) are shown.

Ionisation energy / kJ mol ⁻¹						
Element	First	Second	Third	Fourth	Fifth	Sixth
X	736	1450	7740	10 500	13 600	18 000
Y	1060	1900	2920	6280	21 200	25 900
Z	577	1820	2740	11 600	14 800	23 400

Which element is aluminium?

[1 mark]

Tick () **one** box.

X

☐

Y

☐

Z

☐

0 1 4

State why the second ionisation energy of aluminium is higher than the first ionisation energy of aluminium.

[1 mark]

0 1 5

Explain, with reference to structure and bonding, why the melting point of aluminium is lower than the melting point of silicon.

[3marks]

7**Turn over for the next question****Turn over ►**

0 2

This question is about strontium bromide.

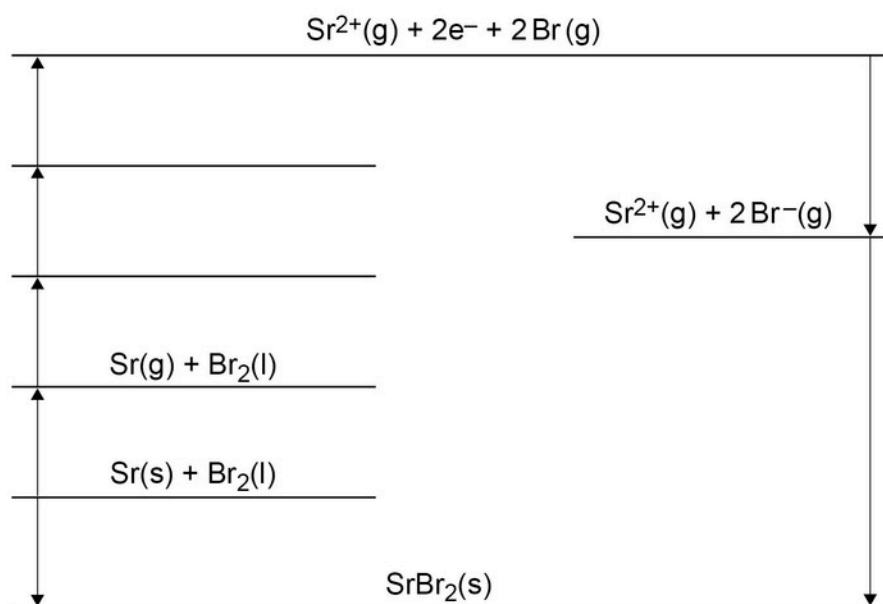
0 2. 1

Give the meaning of the term enthalpy of lattice formation.

[2 marks]

0 2. 2

Figure 1 shows an incomplete Born–Haber cycle for the formation of strontium bromide.
The diagram is not to scale.

Figure 1

Complete **Figure 1** by writing the formulas, including state symbols, of the appropriate species on each of the two blank lines.

[2marks]

Table 1 shows some enthalpy change data.

Table 1

	Enthalpy change / kJ mol^{-1}
Enthalpy of formation of strontium bromide	-716
Enthalpy of atomisation of strontium	+164
First ionisation energy of strontium	+548
Second ionisation energy of strontium	+1060
Enthalpy of atomisation of liquid bromine	+112
Enthalpy of lattice formation of strontium bromide	-2075

0 2 . 3 Use **Figure 1** and **Table 1** to calculate the electron affinity, in kJ mol^{-1} , of bromine.
[3marks]

Electron affinity _____ kJ mol^{-1}

Question 2 continues on the next page

Turn over ►

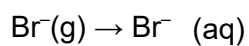
0 2 . 4

Strontium bromide dissolves in water.
Table 2 shows some enthalpy change data.

Table 2

	Enthalpy change / kJ mol ⁻¹
Enthalpy of hydration of Sr ²⁺ (g)	-1480
Enthalpy of lattice formation of SrBr ₂ (s)	-2075
Enthalpy of solution of SrBr ₂ (s)	-72

Use the data in **Table 2** to calculate the enthalpy change, in kJ mol⁻¹, for

**[3 marks]**

Enthalpy change _____ kJ mol⁻¹

10

0 3

This question is about Group 2.

0 3 . 1

Give the equation, including state symbols, for the reaction of barium with water.

[1mark]

0 3 . 2

State the trend in solubility shown by the hydroxides of Group 2 metals.

[1 mark]

0 3 . 3

Give a use of magnesium hydroxide.

[1 mark]

0 3 . 4

State what is observed when aqueous barium hydroxide is added to dilute sulfuric acid.

Give the simplest ionic equation, including state symbols, for the reaction that leads to this observation.

[2marks]

Observation _____

Equation _____

Question 3 continues on the next page**Turn over ►**

0 3.5

Magnesium is used in one stage of the extraction of titanium.
The magnesium is reacted with titanium(IV) chloride.

State the role of magnesium in this reaction.

Give an equation for this reaction.

[2 marks]

Role of magnesium _____

Equation

0 3.6

Draw a diagram to represent the structure of solid magnesium.

Explain why magnesium conducts electricity.

Explain, in terms of structure and bonding, why magnesium has a relatively high melting point.

[4marks]

Diagram

Explanation of conduction _____

Explanation of melting point _____

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED**

Turn over ►

0 4

This question is about measuring enthalpy changes.

0 4.1

State **two** conditions needed for an enthalpy change to be described as a standard enthalpy change (ΔH°).**[1mark]**

1 _____

2 _____

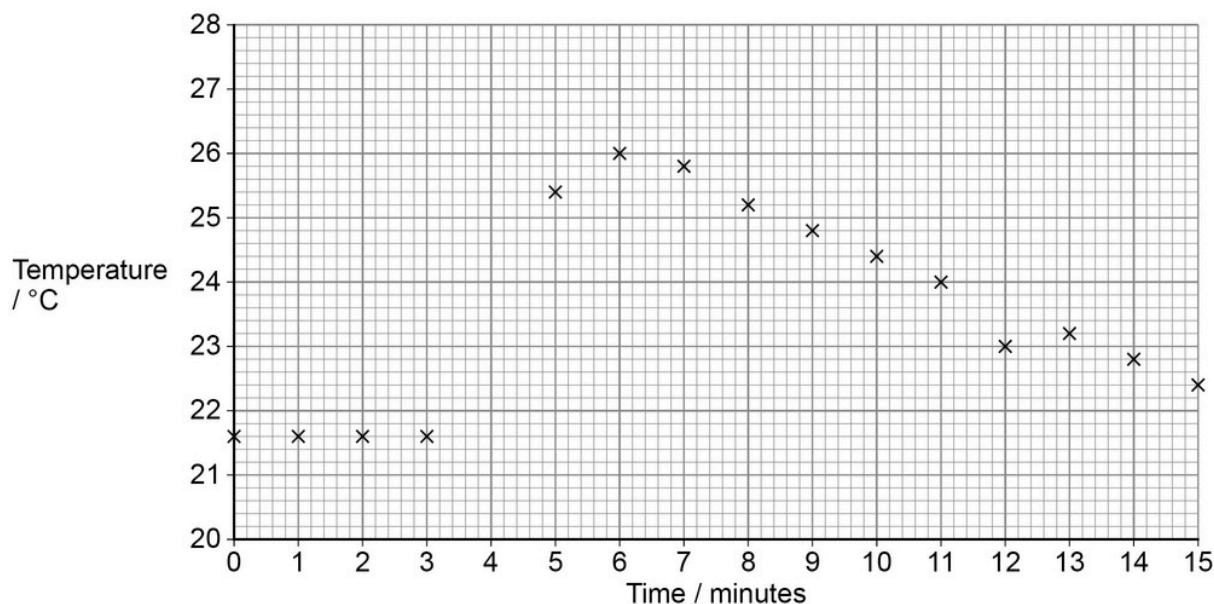
An experiment is done to determine the enthalpy of solution of anhydrous sodium carbonate.

Method

- Pour 50.0 cm³ of deionised water into an insulated cup.
- Record the temperature of the water and start a timer.
- Stir the liquid continuously and record the temperature every minute.
- At the fourth minute, add 5.05 g of anhydrous sodium carbonate to the water and continue stirring.
- At the fifth minute, and every minute up to 15 minutes, record the temperature of the solution.

Figure 2 shows the temperatures recorded during the experiment.

Figure 2



0 4. 2

Draw two separate lines of best fit on **Figure 2**. Extrapolate these lines to determine the temperature change at the fourth minute.

[2 marks]

Temperature change _____ °C

0 4. 3

Use your answer to Question **04.2** to calculate the enthalpy of solution, in kJ mol^{-1} , of anhydrous sodium carbonate ($M_r = 106.0$).
Specific heat capacity of the solution = $4.18 \text{ J g}^{-1} \text{ K}^{-1}$
Density of the solution = 1.00 g cm^{-3}

[4marks]

Enthalpy of solution _____ kJ mol^{-1}

0 4. 4

Suggest why it is **not** necessary to record the mass of anhydrous sodium carbonate to 3 decimal places.

[1 mark]

0 4. 5

Suggest why the maximum temperature is determined using the graphical method rather than by recording the maximum temperature.

[1mark]

Turn over ►

0 5

This question is about test tube reactions of aqueous iron ions.

0 5. 1

A few drops of aqueous ammonia are added to a solution of iron(II) sulfate. A green precipitate forms.

Give the formula of the green precipitate.

[1 mark]

0 5. 2

A different aqueous reagent **X** also gives a green precipitate when added to a solution of iron(II) sulfate. This green precipitate stays green in contact with air.

Give the formula of reagent **X**.

[1mark]

0 5. 3

A few drops of silver nitrate, followed by an excess of aqueous ammonia, are added to a dilute solution of iron(III) chloride.

State what is observed at the end of the reaction.

Give the formula of the species that contains silver at the end of the reaction.

[2marks]

Observation _____

Formula _____

0 5. 4

A solution of iron(III) chloride has pH = 3

Give an equation to show how an iron(III) complex ion acts as a Brønsted–Lowry acid in water.

Explain why iron(III) complex ions are able to form an acidic aqueous solution with a pH value as low as 3

[4marks]

Equation

Explanation _____

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED**

Turn over ►

0 6

A compound of metal **M** has the formula $K_3[M(C_2O_4)_3]$

M can be identified by titrating an acidified solution of $K_3[M(C_2O_4)_3]$ with $KMnO_4$ solution.

The ethanedioate ions from $K_3[M(C_2O_4)_3]$ react with manganate(VII) ions.



- 1.810 g of pure $K_3[M(C_2O_4)_3]$ are dissolved in some distilled water.
- The solution is transferred to a 250 cm³ volumetric flask, made up to the mark with distilled water and mixed thoroughly.
- 25.0 cm³ of this solution are transferred to a conical flask using a pipette.
- An excess of dilute sulfuric acid is added and the contents of the flask are heated to about 60 °C
- The heated solution is titrated with 0.0200 mol dm⁻³ $KMnO_4$ solution.
- The mean titre is 24.85 cm³

0 6.1

Give two half-equations to show the oxidation and reduction processes that occur in this redox reaction.

[2marks]

Oxidation half-equation

Reduction half-equation

0 6.2

Suggest why the acid added to the conical flask is **not** hydrochloric acid.

[1 mark]

0	6	.	3
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Calculate the relative atomic mass (A_r) of metal **M**.

Identify **M**.

Show your working.

[7 marks]

A_r of **M** _____

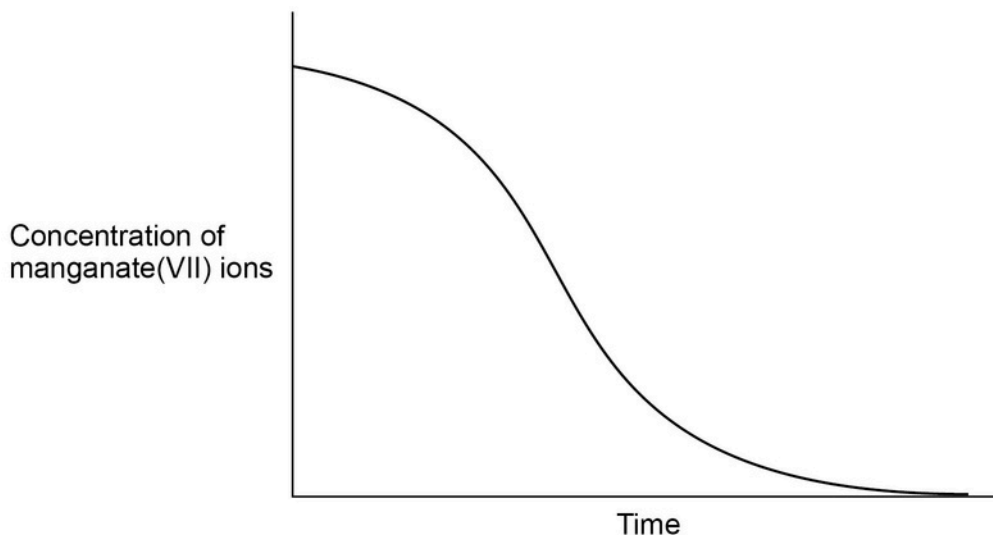
Identity of **M** _____

Question 6 continues on the next page

Turn over ►

In a different experiment, at 60 °C, ethanedioate ions are reacted with manganate(VII) ions and the concentration of the manganate(VII) ions is measured over a period of time.

Figure 3



[5marks]

[illegible]

0	6	5
---	---	---

Draw a structure for the complex anion in $K_3[M(C_2O_4)_3]$ and include the charge on the complex.

You should use **M** in your structure.

State the type of isomerism that the complex anion shows.

[2marks]

Structure

Type of isomerism _____

17

Turn over for the next question

Turn over ►

0 7

This question is about acids and bases.

0 7.1

Calculate the pH of water at 30 °C

For water at 30 °C, $K_w = 1.47 \times 10^{-14} \text{ mol}^2\text{dm}^{-6}$

Explain why this water is neutral at 30 °C even though the pH is not 7.0

[3 marks]

pH _____

Explanation _____

0 7.2

Calculate the concentration of OH^- ions in a solution with pH = 7.00 at 30 °CFor water at 30 °C, $K_w = 1.47 \times 10^{-14} \text{ mol}^2\text{dm}^{-6}$ **[2 marks]**Concentration _____ mol dm^{-3}

A buffer solution is made by adding 5.00 cm^3 of 1.50 mol dm^{-3} sodium hydroxide solution to 8.00 cm^3 of 2.00 mol dm^{-3} methanoic acid solution.

Methanoic acid has the formula HCOOH

For methanoic acid, $K_a = 1.78 \times 10^{-4} \text{ mol dm}^{-3}$

0	7	.	3
---	---	---	---

Calculate the pH of this buffer solution.
Give your answer to 2 decimal places.

[6marks]

pH _____

0	7	.	4
---	---	---	---

Explain how this buffer solution resists a change in pH when a small amount of hydrochloric acid is added.

[2marks]

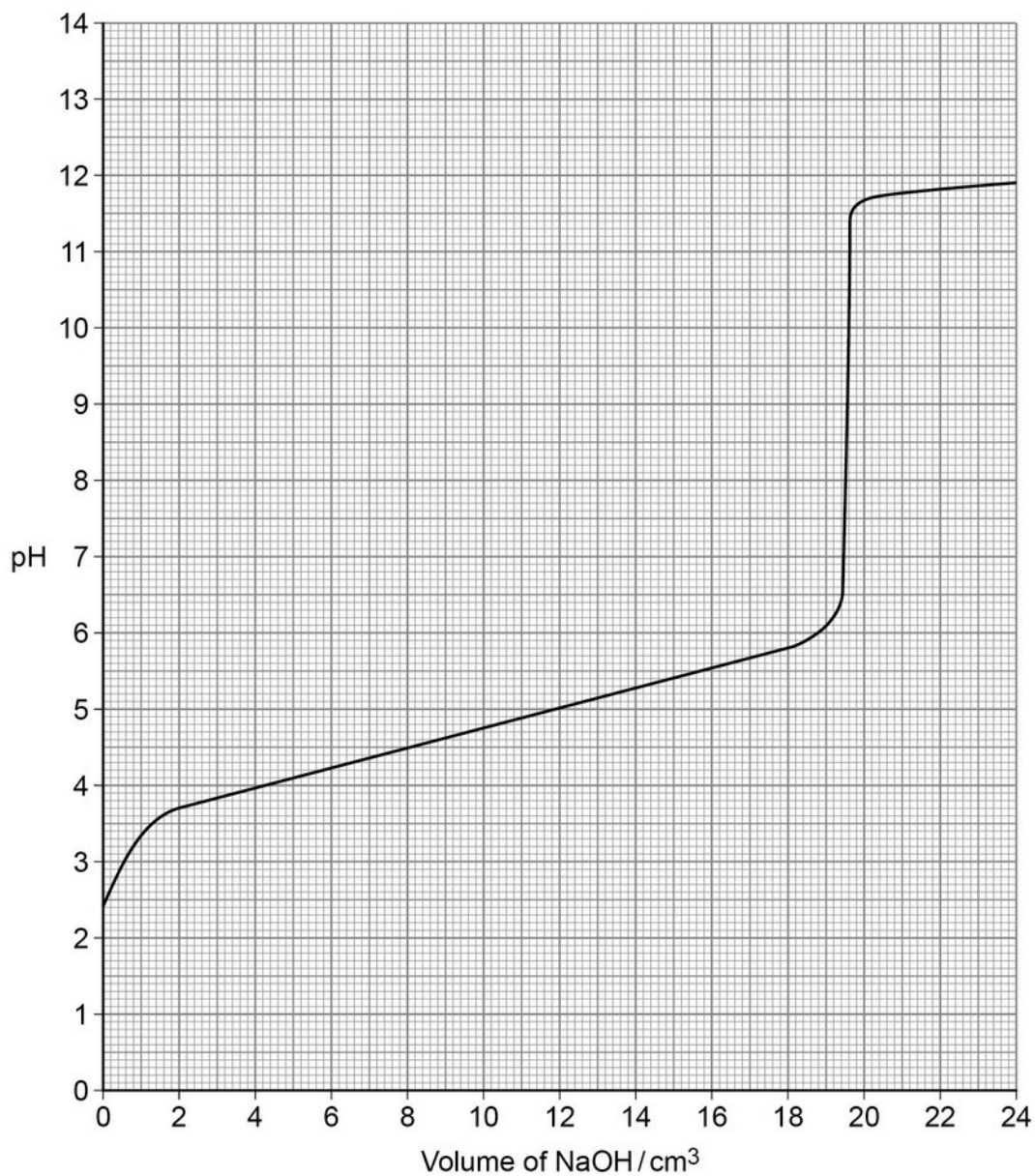
Question 7 continues on the next page

Turn over ►

A conical flask contains 25.0 cm^3 of aqueous methanoic acid at 25°C .
A burette is used to add small portions of $0.100 \text{ mol dm}^{-3}$ sodium hydroxide solution to the flask.
A pH probe is used to record the pH after each small portion is added.

Figure 4 shows the results.

Figure 4



0 7.5

Suggest why it is important **not** to wash the pH probe with distilled water between the measurements.

[1 mark]

0 7.6

The table shows three indicators with their pH ranges.

Indicator	Bromocresol green	Bromothymol blue	Thymol blue
pH range	3.8 – 5.4	6.0 – 7.6	8.0 – 9.6

Which is a suitable indicator for the reaction between aqueous methanoic acid and sodium hydroxide solution?

[1mark]

Tick () **one** box.

Bromocresol green

☐

Bromothymol blue

☐

Thymol blue

☐

0 7.7

Use **Figure 4** to calculate the concentration, in mol dm^{-3} , of methanoic acid used in the experiment.

[2marks]

Concentration _____ mol dm^{-3}

Question 7 continues on the next page

Turn over ►

Table 3 shows some experimental enthalpy changes, at 298 K, when 1 mol of acid is completely neutralised by sodium hydroxide solution.

Acid	Enthalpy change / kJ mol ⁻¹
Ethanoic acid	-55
Hydrochloric acid	-57
Nitric acid	-57
Sulfuric acid	-114

[6marks]

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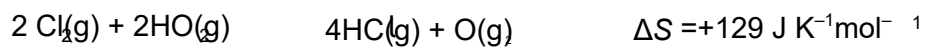
Lined area for writing, consisting of 23 horizontal lines.

Turn over ►

0 8

This question is about oxygen.

Chlorine reacts with steam, in a reversible reaction, to form hydrogen chloride and oxygen.

 $\rightleftharpoons$

0 8 . 1

State why the entropy change for this reaction is positive.

[1 mark]

Table 4 shows some enthalpy data.

Table 4

	H ₂ O(g)	HCl(g)
$\Delta_f H^\circ / \text{kJ mol}^{-1}$	-242	-92

0 8 . 2

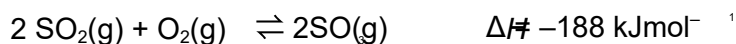
Use the equation and the data in **Table 4** to calculate the minimum temperature for this reaction to become feasible.

[5 marks]

Temperature _____ K

0 8 3

Oxygen reacts with sulfur dioxide in a reversible reaction.



State and explain the effect on the yield of sulfur trioxide if the reaction is done at a lower temperature.

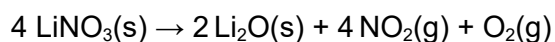
[3marks]

Effect _____

Explanation _____

0 8 4

Oxygen is produced when lithium nitrate decomposes.



A sample of lithium nitrate completely decomposes. This produces 25 000 cm³ of gaseous products at a temperature of 400 °C and 100 000 Pa

Calculate the mass, in g, of lithium nitrate in the sample.
Give your answer to 3 significant figures.

The gas constant, $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$

[5marks]

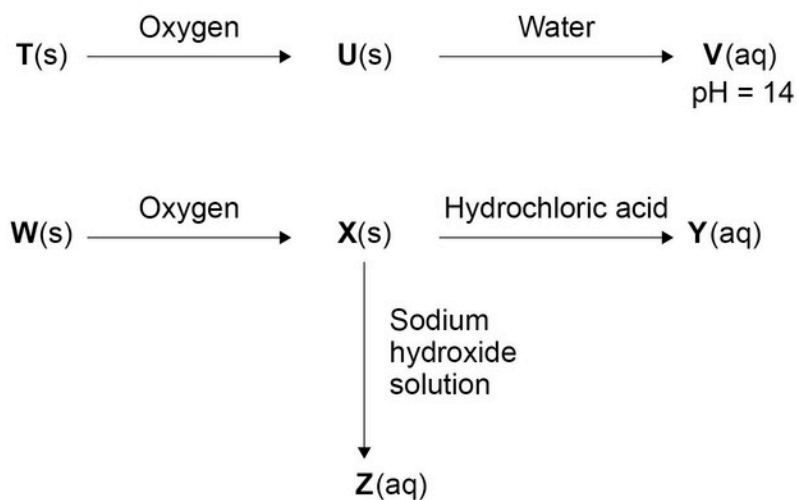
Mass _____ g

Turn over ►

Oxygen reacts with the elements in Period 3.

Consider the reactions shown.

T and **W** are elements in Period 3.



0	8	5
---	---	---

Identify element **T**.

Give an equation for the reaction of **U** to form **V**.

[2 marks]

Identity of **T** _____

Equation _____

0	8	6
---	---	---

Identify element **W**.

Give an equation for the reaction of **X** to form **Y**.

Give an equation for the reaction of **X** to form **Z**.

[3 marks]

Identity of **W** _____

Equation **X** → **Y** _____

Equation **X** → **Z** _____

0	8	7
---	---	---

State the property shown by **X** in reacting with hydrochloric acid and with sodium hydroxide solution.

[1 mark]

20

END OF QUESTIONS

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[illegible]

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