OXFORD AQA

INTERNATIONAL QUALIFICATIONS

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

# INTERNATIONAL AS

# CHEMISTRY (9620)

## Unit 1: Inorganic 1 and Physical 1

Wednesday 7 May 2025 07:00 GMT Time allowed: 1 hour 30 minutes

**Materials**

For this paper you must have:

- the Periodic Table/Data Sheet, provided as an insert
- 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 70.

| For Examiner's Use | |
|---|---|
| Question | Mark |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| **TOTAL** | |

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

**0 1** This question is about some elements in Group 7 and their compounds.

**0 1 . 1** State the block in the Periodic Table that contains the element chlorine.

**[1 mark]**

**0 1 . 2** Chlorine gas is added to a solution of sodium bromide.

Write an ionic equation for the reaction.

State the expected observation.

**[2 marks]**

Ionic equation

Observation

**0 1 . 3** Concentrated sulfuric acid is added to solid sodium bromide.
A gaseous sulfur-containing product is formed.

Write an equation for the reaction between concentrated sulfuric acid and bromide ions to form this sulfur-containing product.

Give **one** observation in this reaction.

State the role of sulfuric acid in this reaction.

**[3 marks]**

Equation

Observation

Role of sulfuric acid

*Do not write outside the box*

Chlorine is used in the production of drinking water.

**0 1 . 4** State why the amount of chlorine in drinking water must be limited.

**[1 mark]**

**0 1 . 5** Chlorine reacts with water to form a solution containing two acids.

Write an equation for this reaction of chlorine with water.

Explain, in terms of oxidation states, why this is a redox reaction.

**[2 marks]**

Equation

Explanation

**0 1 . 6** Which statement is correct about the reaction of chlorine with water to form two acids?

Tick (✓) **one** box.

**[1 mark]**

Water is an oxidising agent. ☐

Water is a reducing agent. ☐

Water is neither an oxidising agent nor a reducing agent. ☐

**10**

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**0 2** This question is about structure and bonding in substances that contain Group 4 elements.

**0 2 . 1** Graphite has a melting point of 3827 K

State the type of crystal structure in graphite.

Explain, in terms of bonding, why the melting point is very high.

**[3 marks]**

Structure _____

Explanation _____

_____

_____

_____

**0 2 . 2** Carbon disulfide has the formula $CS_2$

Complete the diagram to show the bonding in $CS_2$
In your diagram, show all bonds and any lone pairs of electrons.

**[2 marks]**

**S C S**

**0 2 . 3** Draw the structure of the unstable molecule $CCl_2$
Include any lone pairs of electrons that influence the shape.

**[1 mark]**

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**0 2 . 4** Explain how permanent dipole–dipole forces arise between $CF_2Cl_2$ molecules.

Name another type of intermolecular force between $CF_2Cl_2$ molecules.

**[3 marks]**

Explanation _____

_____

_____

_____

Intermolecular force _____

**0 2 . 5** What is the formula of tin(IV) nitrate?

Tick (✓) **one** box.

**[1 mark]**

$Sn(NO_3)_2$ ☐

$Sn(NO_3)_4$ ☐

$Sn_4NO_3$ ☐

$Sn_4(NO_3)_2$ ☐

**0 2 . 6** Explain why lithium carbonate has a high melting point.

**[2 marks]**

_____

_____

_____

_____

**12**

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**0 3** Magnesium carbonate ($M_r$ = 84.3) reacts with hydrochloric acid.

$$MgCO_3(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2O(l) + CO_2(g)$$

- 100 $cm^3$ of 0.500 mol $dm^{-3}$ hydrochloric acid (an excess) are added to 2.04 g of impure magnesium carbonate.
- The mixture is stirred until all the magnesium carbonate has reacted.
- The amount of excess acid is determined by titration with sodium hydroxide.
- In the titration, 27.50 $cm^3$ of 0.500 mol $dm^{-3}$ sodium hydroxide solution are required to neutralise the excess acid.

**0 3 . 1** Write an equation for the reaction between hydrochloric acid and sodium hydroxide.

Use your equation and the data in the question to calculate the percentage purity of the impure magnesium carbonate.

**[7 marks]**

Equation

Calculation

Purity _____ %

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**0 3 . 2** Identify the equipment used to measure 27.50 $cm^3$ of 0.500 mol $dm^{-3}$ solution of sodium hydroxide accurately.

**[1 mark]**

**0 3 . 3** 0.750 g of pure magnesium carbonate is reacted completely with hydrochloric acid.

Calculate the volume, in $cm^3$, of carbon dioxide that is given off in this reaction at 30 °C and 100 kPa
Give your answer to 3 significant figures.

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

**[5 marks]**

Volume _____ $cm^3$

13

**Turn over ►**

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**0 4** This question is about atoms and isotopes

**0 4 . 1** Define relative atomic mass.

**[2 marks]**

**0 4 . 2** Gallium exists as two isotopes, $^{69}Ga$ and $^{71}Ga$
A sample of gallium has a relative atomic mass of 69.7

Calculate the percentage abundance of the $^{69}Ga$ isotope in this sample.

**[2 marks]**

Abundance of $^{69}Ga$ _____ %

**0 4 . 3** State why these two isotopes of gallium have the same chemical properties.

**[1 mark]**

**0 4 . 4** Give the full electron configuration for a gallium atom.

**[1 mark]**

*Do not write outside the box*

**0 4 . 5** Gallium and germanium are both Period 4 elements.

Suggest why the first ionisation energy of gallium is lower than the first ionisation energy of germanium.

**[2 marks]**

**0 4 . 6** A $^{69}Ga^{+}$ ion with a kinetic energy of $3.18 \times 10^{-14}$ J travels through a 1.25 m flight tube.

The kinetic energy of the ion is given by the equation

$$KE = \frac{1}{2}mv^2$$

$m$ = mass / kg
$v$ = speed / m $s^{-1}$
$KE$ = kinetic energy / J

Calculate the time, in seconds, for the ion to travel through the flight tube.

The Avogadro constant, $L = 6.02 \times 10^{23}$ $mol^{-1}$

**[4 marks]**

Time _____ s

12

**Turn over ►**

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**0 5** Compound **X** contains a Group 2 metal ion and a negative ion.

A solution of **X** is used in two test-tube reactions.

**Table 1** shows the observations.

**Table 1**

| | **Test 1** Add $HNO_3(aq)$ and $AgNO_3(aq)$ | **Test 2** Add NaOH(aq) |
|---|---|---|
| **Solution of X** | Yellow precipitate | White precipitate |

**0 5 . 1** State why nitric acid is used in **Test 1**.

**[1 mark]**

**0 5 . 2** Suggest the identity of **X**.

Write ionic equations for the formation of the precipitates in **Test 1** and **Test 2**.

**[3 marks]**

Identity of **X**

Ionic equation for reaction in **Test 1**

Ionic equation for reaction in **Test 2**

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**0 5 . 3** It can be difficult to identify the precipitate from its yellow colour in **Test 1**.

Give an additional reagent that could be added to the yellow precipitate to confirm the identity of the precipitate.

State the expected observation.

**[2 marks]**

Reagent _____

Observation _____

Compound **Y** contains ammonium ions and sulfate ions.

**0 5 . 4** Identify a reagent that can be used to show that a solution of **Y** contains sulfate ions.

Write an ionic equation for the reaction.

**[2 marks]**

Reagent _____

Ionic equation

_____

**0 5 . 5** Identify a reagent and a condition that can be used to show that a solution of **Y** contains ammonium ions.

State the expected observation.

**[3 marks]**

Reagent _____

Condition _____

Observation _____

_____

**11**

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**0 6** This question is about energetics.

**0 6 . 1** State the meaning of the term enthalpy change.

**[1 mark]**

A student does an experiment to find the enthalpy change when iron powder is added to copper(II) sulfate solution.

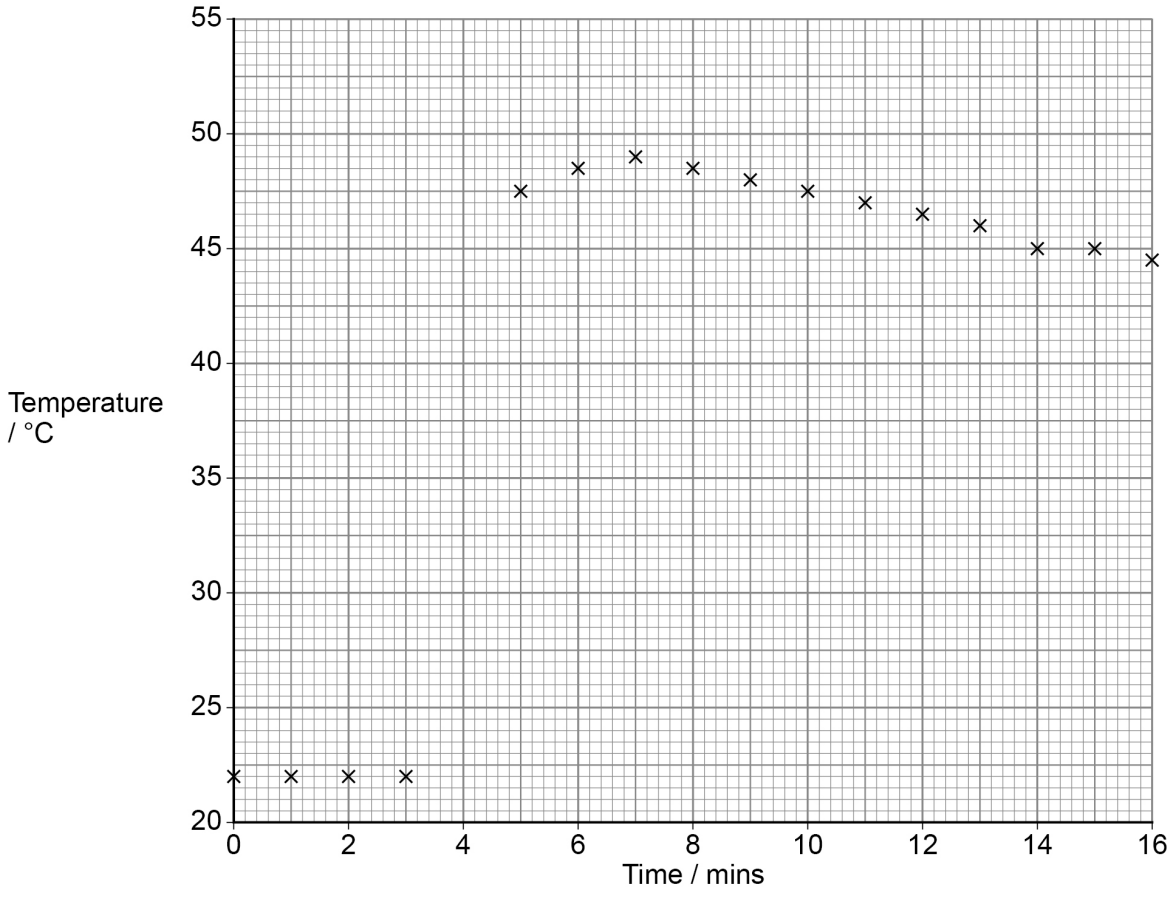
$$Fe(s) + CuSO_4(aq) \rightarrow FeSO_4(aq) + Cu(s)$$

Method

- 30 $cm^3$ of 1.00 mol $dm^{-3}$ copper(II) sulfate solution are poured into a plastic cup.
- A thermometer is placed in the plastic cup and the temperature of the solution recorded every minute for 3 minutes.
- At the 4th minute, 4 g of iron powder are added and the contents of the plastic cup stirred. The temperature is not recorded.
- The temperature is then measured every minute until the 16th minute.

The results are shown on **Figure 1**.

**Figure 1**



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**0 6 . 2** Draw two lines of best fit on **Figure 1** and calculate the maximum temperature rise in the experiment.

**[3 marks]**

Temperature rise _____ °C

**0 6 . 3** Show that copper(II) sulfate is the limiting reagent.

Calculate the enthalpy change, in kJ $mol^{-1}$, for this reaction.

Assume that the specific heat capacity of the solution = 4.18 J $K^{-1}$ $g^{-1}$

**[4 marks]**

Limiting reagent

Calculation

Enthalpy change for reaction _____ kJ $mol^{-1}$

**0 6 . 4** Suggest **one** way to minimise heat loss to the surroundings.

**[1 mark]**

_____

_____

**Turn over ►**

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**0 6 . 5** **Table 2** shows some enthalpy data.

**Table 2**

| | $Fe_3O_4(s)$ | CO(g) | Fe(l) | $CO_2(g)$ |
|---|---|---|---|---|
| $\Delta_f H$ / kJ mol$^{-1}$ | –1117 | –111 | +12 | –394 |

Use the data in **Table 2** to calculate the enthalpy change, in kJ mol$^{-1}$, for the reaction

$$Fe_3O_4(s) + 4\,CO(g) \rightarrow 3\,Fe(l) + 4\,CO_2(g)$$

**[2 marks]**

Enthalpy change _____ kJ mol$^{-1}$

**0 6 . 6** State why the value given in **Table 2** for the enthalpy of formation for Fe(l) is not zero.

**[1 mark]**

_____

_____

**12**

**END OF QUESTIONS**

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