

OXFORD

INTERNATIONAL  
AQA EXAMINATIONS

# OXFORD AQA INTERNATIONAL A-LEVEL CHEMISTRY (9620)

## PAPER 1

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Specimen 2018

Morning

Time allowed: 1 hour 30 minutes

### Materials

For this paper you must have:

- a pencil
- a ruler
- a calculator
- a data booklet

### Instructions

- use black ink or ball-point pen
- answer **all** questions
- show all your working.

### Information

- The marks for questions are shown in brackets
- The maximum mark for this paper is 70 marks

Please write clearly, in block capitals, to allow character computer recognition.

Centre number

Candidate number

Surname

Forename(s)

Candidate signature \_\_\_\_\_

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

1

A sample of magnesium consisting of three isotopes has a relative atomic mass of 24.31.

**Table 1** gives the relative abundance of two of the isotopes.

**Table 1**

Mass number of isotope	24	25
Relative abundance / %	78.8	11.7

0 1 . 1

Use this information to determine the relative abundance and hence the mass number of the third isotope.

Give your answer to the appropriate number of significant figures.

**[4 marks]**

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Mass number = \_\_\_\_\_

0 1 . 2

Describe how ions are formed in a time of flight (TOF) mass spectrometer.

**[2 marks]**

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0	1	.	3
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A TOF mass spectrometer can be used to determine the relative molecular mass of molecular substances.

Explain why it is necessary to ionize molecules when measuring their mass in a TOF mass spectrometer.

**[2 marks]**

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2

This question is about the first ionisation energies of some elements in the Periodic Table.

0 2 . 1

Write an equation, including state symbols, to show the reaction that occurs when the first ionisation energy of calcium is measured.

**[2 mark]**

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0 2 . 2

State and explain the general trend in first ionisation energies for the Period 2 elements boron to neon.

**[3 marks]**

Trend \_\_\_\_\_

Explanation \_\_\_\_\_

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0 2 . 3

There is a similar general trend in first ionisation energies for the Period 5 elements indium to xenon.

State how tellurium deviates from this general trend and explain your answer.

**[3 marks]**

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0 2 . 4

Suggest why the first ionisation energy of xenon is lower than the first ionisation energy of krypton.

**[1 mark]**

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0 2 . 5

**Table 2** below gives the successive ionisation energies of an element.

**Table 2**

	First	Second	Third	Fourth	Fifth
Ionisation energy / kJ mol <sup>-1</sup>	738	1451	7733	10543	13630

Deduce the group in the Periodic Table that contains this element.

**[1 mark]**

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0 2 . 6

Identify the element that has a 5+ ion with an electron configuration of  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10}$

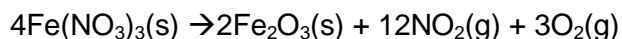
**[1 mark]**

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3

When heated, iron(III) nitrate ( $M_r = 241.8$ ) is converted into iron(III) oxide, nitrogen dioxide and oxygen.



A 1.48 g sample of iron(III) nitrate was completely converted into the products shown.

0 3 . 1

Calculate the amount, in moles, of iron(III) nitrate in the 1.48 g sample.

Give your answer to 3 significant figures.

[1 mark]

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0 3 . 2

Calculate the amount, in moles, of oxygen gas produced in this reaction.

[1 mark]

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0 3 . 3

Calculate the volume, in  $\text{m}^3$ , of **nitrogen dioxide** gas at  $293^\circ\text{C}$  and  $100\text{ kPa}$  produced from  $1.48\text{g}$  of iron(III) nitrate.

The gas constant is  $R = 8.31\text{ JK}^{-1}\text{ mol}^{-1}$ .

(If you have been unable to obtain an answer to Question 3.1 you may assume the number of moles of iron(III) nitrate is  $0.00893$ . This is not the correct answer.)

[4 marks]

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03 . 4

Suggest a name for this type of reaction that iron(III) nitrate undergoes.

[1 mark]

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03 . 5

Suggest why the iron(III) oxide obtained is pure. Assume a complete reaction.

[1 mark]

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4

Aluminium and thallium are elements in Group 3 of the Periodic Table. Both elements form compounds and ions containing halide ions.

0 4 . 1

Write an equation for the formation of aluminium bromide from its elements.

**[1 mark]**

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0 4 . 2

An aluminium bromide molecule reacts with a bromide ion to form the  $\text{AlBr}_4^-$  ion. Name the type of bond formed in this reaction. Explain how this type of bond is formed in the  $\text{AlBr}_4^-$  ion.

**[2 marks]**

Type of bond \_\_\_\_\_

Explanation \_\_\_\_\_

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0 4 . 3

Aluminium bromide has a relative molecular mass of 533.4 in the gas phase.

Deduce the formula of the aluminium compound that has a relative molecular mass of 533.4

**[1 mark]**

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0 4 . 4

Deduce the name or formula of a compound that has the same number of atoms, the same number of electrons and the same shape as the  $\text{AlBr}_4^-$  ion.

**[1 mark]**

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0 4 . 5

Draw and name the shape of the  $\text{TlF}_5^{2-}$  ion.**[2 marks]**Shape of the  $\text{TlF}_5^{2-}$  ion.

Name of shape \_\_\_\_\_

\_\_\_\_\_

0 4 . 6

Draw the shape of the  $\text{TlF}_5^{2-}$  ion.**[1 mark]**

0 4 . 7

Explain why the  $\text{TlF}_5^{2-}$  ion has the shape that you have drawn in part (f)(i).**[1 mark]**

\_\_\_\_\_

\_\_\_\_\_

0 4 . 8

Which **one** of the first, second or third ionisations of thallium produces an ion with the electron configuration  $[\text{Xe}] 5d^{10}6s^1$ ?

Tick (✓) one box.

**[1 mark]**

First

Second

Third

5 This question is about enthalpy changes.

0 5 . 1 Define the term standard enthalpy of formation,  $\Delta_f H^\ominus$

[2 marks]

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0 5 . 2 State Hess's law.

[1 mark]

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Nitrogen monoxide, NO, can be made reacting ammonia with oxygen.

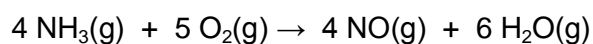


Table X shows some standard enthalpy of formation,  $\Delta_f H^\ominus$

Table X

Substance	$\text{NH}_3(\text{g})$	$\text{O}_2(\text{g})$	$\text{NO}(\text{g})$	$\text{H}_2\text{O}(\text{g})$
$\Delta_f H^\ominus / \text{kJ mol}^{-1}$	- 46	0	+ 90	- 242

0 5 . 3 State why the standard enthalpy of formation of  $\text{O}_2(\text{g})$  is zero.

[1 mark]

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0 5 4

Use **Table X** and the equation to calculate the enthalpy change for the reaction of ammonia with oxygen to form nitrogen monoxide.

[2 marks]

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Enthalpy change = \_\_\_\_\_ kJ mol<sup>-1</sup>

6

Barium metal reacts with water.

0 6 . 1

Write an equation for this reaction.

[1 mark]

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0 6 . 2

A solution containing barium ions can be used to show the presence of sulfate ions in an aqueous solution of sodium sulfate.

Write the **simplest ionic** equation for the reaction that occurs and state what is observed.

[3 marks]

Simplest ionic equation \_\_\_\_\_

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Observation \_\_\_\_\_

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0 6 . 3

State **one** use of barium sulfate in medicine. Explain why this use is possible, given that solutions containing barium ions are poisonous.

[1 mark]

Use \_\_\_\_\_

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Explanation \_\_\_\_\_

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0	7	.	3
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Suggest **one** way that the student could reduce the percentage uncertainty in the temperature change, using the same apparatus as this experiment.

**[1 mark]**

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9

**Table 3** shows observations of changes from some test tube reactions of aqueous solutions of compounds Q, R and S with different aqueous reagents. The initial colours of the solutions are not given.

**Table 3**

	$\text{BaCl}_2$	$\text{AgNO}_3$	$\text{NaOH}$	$\text{HCl}$	$\text{H}_2\text{SO}_4$
<b>Q</b>	No change observed	Pale cream precipitate	White precipitate	No change observed	No change observed
<b>R</b>	No change observed	No change observed	No change observed	Bubbles of a gas	White precipitate, bubbles of a gas
<b>S</b>	White precipitate	No change observed	Gas produced turned red litmus blue	No change observed	No change observed

09 . 1

Identify each of the compounds **Q**, **R** and **S**. You are not required to explain your answers.

**[6 marks]**

Identity of Q \_\_\_\_\_

\_\_\_\_\_

Identity of R \_\_\_\_\_

\_\_\_\_\_

Identity of S \_\_\_\_\_

\_\_\_\_\_

09 . 2



Write ionic equations for each of the positive observations for Q. Write an ionic equation to show the identity of the gases produced by R with HCl and by S with NaOH.

**[4 marks]**

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**END OF QUESTIONS**

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