OXFORD

INTERNATIONAL
AQA EXAMINATIONS

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 6 January 2021 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	

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

Do not write outside the box

0 1 This question is about atoms and ions.

0 1 . 1 **Table 1** shows the relative charge and the relative mass for each of the fundamental particles in an atom.

Complete **Table 1**.

[2 marks]

Table 1

	Relative charge	**Relative mass**
Electron	–1	
Neutron		
Proton		1

0 1 . 2 Complete **Table 2** to show the number of protons, electrons and neutrons in the selenium atom and the selenium ion shown.

[2 marks]

Table 2

	Number of protons	**Number of electrons**	**Number of neutrons**
^{76}Se	34		
$^{77}Se^{2-}$			

Do not write outside the box

0 1 . 3 A sample of selenium contains four isotopes**.**

Table 3 shows the relative abundances of the isotopes in this sample of selenium.

Table 3

	^{76}Se	^{77}Se	^{78}Se	^{80}Se
Relative abundance	1.2	1.0	3.1	10.8

Calculate the relative atomic mass of this sample of selenium.
Give your answer to 1 decimal place.

[2 marks]

Relative atomic mass _____

A sample of selenium is analysed using a time of flight (TOF) mass spectrometer.

0 1 . 4 The selenium atoms are ionised by electron impact.

Write an equation, including state symbols, to show this ionisation.

[1 mark]

_____

0 1 . 5 Describe how the selenium ions are accelerated in the TOF mass spectrometer.

[1 mark]

_____

_____

Do not write outside the box

A different sample of selenium contains a fifth isotope.

0 1 . 6 After acceleration, the selenium ion has a kinetic energy of 4.742×10^{-14} J
The ion takes 2.572×10^{-6} s to travel 2.260 m along a flight tube.

Calculate the mass, in kg, of this ion.

$$v = \sqrt{\frac{2\,KE}{m}}$$

v = velocity ($m\,s^{-1}$)
KE = kinetic energy of the ion (J)
m = mass of the ion (kg)

[3 marks]

Mass of ion _____ kg

0 1 . 7 Use your answer to Question **01.6** to calculate the mass number of the ion.

(If you could not answer Question **01.6** you should use the value 1.179×10^{-25} kg
This is **not** the correct answer.)

The Avogadro constant, $L = 6.022 \times 10^{23}\,mol^{-1}$

[2 marks]

Mass number _____

13

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 2 Zinc nitrate can be formed by the reaction

$$ZnO(s) + 2\,HNO_3(aq) \rightarrow Zn(NO_3)_2(aq) + H_2O(l)$$

0 2 . 1 An excess of zinc oxide is added to 150 cm^3 of 1.25 mol dm^{-3} nitric acid.

Calculate the maximum mass, in g, of zinc nitrate (M_r = 189.4) formed.

[3 marks]

Mass _____ g

0 2 . 2 State how pure zinc nitrate can be obtained from the reaction mixture after the excess of zinc oxide is removed.

[1 mark]

_____

_____

Do not write outside the box

0 2 . 3 Zinc nitrate decomposes when heated

$$2\,Zn(NO_3)_2(s) \rightarrow 2\,ZnO(s) + 4\,NO_2(g) + O_2(g)$$

Calculate the total volume, in m^3, of gas formed when 1.20 g of zinc nitrate (M_r = 189.4) are decomposed.

The volume of gas is measured at a temperature of 200 °C and a pressure of 100 kPa

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

[5 marks]

Total volume of gas_____ m^3

0 2 . 4 Complete the equation for the reaction of zinc with concentrated nitric acid.

[1 mark]

_____ Zn + _____ HNO_3 → _____$Zn(NO_3)_2$ + NH_4NO_3 + _____ H_2O

10

Turn over ►

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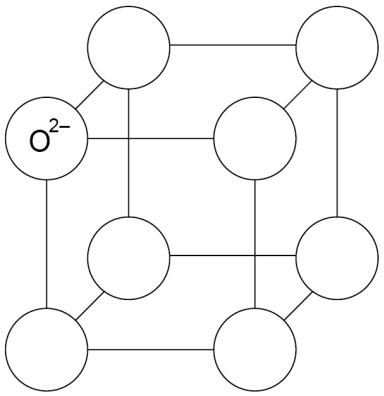
0 3 This question is about structure and bonding.

0 3 . 1 **Figure 1** shows part of the structure of magnesium oxide.

Complete **Figure 1** by writing the formula of the appropriate ion in each circle.

[1 mark]

Figure 1



0 3 . 2 State why molten magnesium oxide conducts electricity.

[1 mark]

0 3 . 3 Name and explain the shape of the nitrogen trichloride (NCl_3) molecule.

Suggest the value of the bond angle.

[4 marks]

Name of shape _____

Explanation of shape _____

Bond angle _____

Do not write outside the box

0 3 . 4 **Table 4** gives some data about the F_2 molecule and the CH_3F molecule.

Table 4

	F_2	CH_3F
Relative molecular mass	38.0	34.0
Boiling point / °C	–188	–78

Explain why the boiling point of CH_3F is much higher than that of F_2

[3 marks]

0 3 . 5 Draw the structure of an $AlCl_3$ molecule.

[1 mark]

0 3 . 6 Al_2Cl_6 is produced when co-ordinate bonds form between two molecules of $AlCl_3$

Draw the structure of an Al_2Cl_6 molecule.
You should show covalent bonds as a line (—) and co-ordinate bonds as an arrow (→).

[2 marks]

12

Turn over ►

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0 4 This question is about enthalpy changes.

0 4 . 1 Define standard enthalpy of combustion.

[2 marks]

0 4 . 2 The equation for the formation of one mole of ethanol from its elements is shown.

$$2\,C(s) + 3\,H_2(g) + \frac{1}{2}\,O_2(g) \rightarrow C_2H_5OH(l)$$

Table 5 shows some enthalpy of combustion data.

Table 5

	C(s)	**H_2(g)**	**C_2H_5OH(l)**
$\Delta_c H^{\ominus}$ / kJ mol^{-1}	–394	–286	–1371

Use data from **Table 5** to calculate a value for the standard enthalpy of formation, in kJ mol^{-1}, of ethanol.

[2 marks]

Standard enthalpy of formation _____ kJ mol^{-1}

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0 4 . 3 Ethanol vapour burns in oxygen.

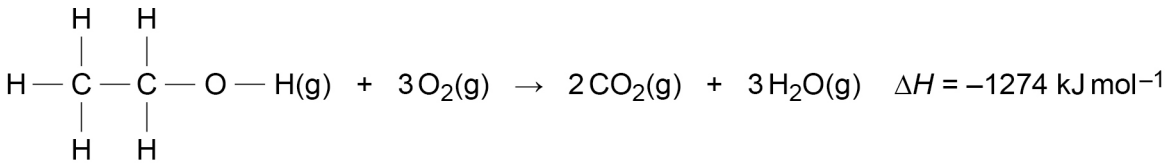

Table 6 shows some mean bond enthalpy data.

Table 6

	C–C	**C–H**	**C–O**	**O=O**	**C=O**
Mean bond enthalpy / kJ mol^{-1}	348	412	360	496	805

Use the equation and the data in **Table 6** to calculate a value for the mean bond enthalpy of the O–H bond.

[3 marks]

Bond enthalpy_____kJ mol^{-1}

7

Turn over ►

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0 5 This question is about elements in Group 7 and their compounds.

Iodine reacts with bromine to form the compound IBr
Iodine and bromine have different electronegativities.

0 5 . 1 Complete the diagram to show the polarity of the I–Br bond.

[1 mark]

I — Br

0 5 . 2 Explain why iodine and bromine have different electronegativities.

[2 marks]

0 5 . 3 When a few drops of concentrated sulfuric acid are added to solid sodium bromide, sulfur dioxide forms.

Write an ionic equation for this reaction.

State the role of sulfuric acid in this reaction.

[2 marks]

Equation

Role of sulfuric acid

Do not write outside the box

A student tests a solution **X** to find out if halide ions are present.

Method

Step 1 Add acidified silver nitrate solution to **X**.

Step 2 Add an excess of dilute aqueous ammonia to the mixture formed in **Step 1**.

0 5 . 4 Explain why the silver nitrate solution is acidified.

[1 mark]

0 5 . 5 State what would be observed in **Step 1** and in **Step 2** if **X** contained chloride ions as the **only** halide ion.

[2 marks]

Observation in **Step 1**

Observation in **Step 2**

0 5 . 6 State why dilute hydrochloric acid is **not** suitable to acidify the silver nitrate solution.

[1 mark]

Turn over ►

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0 5 . 7 Write an equation to show the reaction between chlorine and water in the absence of sunlight.

[1 mark]

0 5 . 8 Chlorine is added to water supplied for drinking.

State **one** advantage and **one** disadvantage of adding chlorine to water supplies.

[2 marks]

Advantage

Disadvantage

0 5 . 9 Chlorine reacts with hot concentrated sodium hydroxide.

$$3\,Cl_2 + 6\,NaOH \rightarrow 5\,NaCl + NaClO_3 + 3\,H_2O$$

Identify the element that is oxidised in this reaction.

Explain your answer using oxidation states.

[2 marks]

Element oxidised

Explanation

14

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0 6 This question is about the Period 2 elements lithium to nitrogen.

The elements in Period 2 show periodic trends similar to those in Period 3.

0 6 . 1 State why carbon is classified as a p block element.

[1 mark]

0 6 . 2 Explain, in terms of structure and bonding, why the melting point of carbon (graphite) is very high.

[3 marks]

0 6 . 3 Explain why there is a general increase in first ionisation energy from lithium to nitrogen.

[2 marks]

0 6 . 4 Identify the element, from lithium to nitrogen, that does **not** follow the trend of increasing first ionisation energy.

Explain why this element does **not** follow the trend.

[3 marks]

Element _____

Explanation _____

Do not write outside the box

0 6 . 5 Identify the element, from lithium to nitrogen, that has the largest atomic radius.

[1 mark]

_____

0 6 . 6 Identify the element, from lithium to nitrogen, that has the largest **third** ionisation energy.

[1 mark]

_____

0 6 . 7 The nitride ion has the formula N^{3-}

Give the electron configuration of the N^{3-} ion.

Give the formula of beryllium nitride.

[2 marks]

Electron configuration _____

Formula _____

0 6 . 8 An oxide of lithium contains 30.0% lithium by mass.

What is the empirical formula of this oxide of lithium?

Tick (✓) one box.

[1 mark]

Li_2O ☐

LiO ☐

LiO_2 ☐

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END OF QUESTIONS

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