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 15 January 2020 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	
7	
TOTAL	

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

Do not write outside the box

0 1 This question is about iron and its isotopes.

0 1 . 1 State, in terms of fundamental particles, the difference between two isotopes of iron.

[1 mark]

0 1 . 2 State why different isotopes of iron have the same chemical properties.

[1 mark]

0 1 . 3 A sample of iron was ionised in a time of flight (TOF) mass spectrometer by electron impact.

Write an equation, including state symbols, for this ionisation.

[1 mark]

Do not write outside the box

0 1 . 4 In the TOF mass spectrometer, an iron ion has a kinetic energy of 2.01×10^{-16} J
This ion takes 1.28×10^{-5} s to travel 0.857 m down a flight tube.

Calculate the mass number 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)

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

[5 marks]

Mass number _____

Do not write outside the box

0 1 . 5 Iron reacts with dilute hydrochloric acid to form iron(II) chloride and a gas.

Write an equation for this reaction.

[1 mark]

---

0 1 . 6 Iron forms the compound iron(III) sulfate.

What is its formula?

[1 mark]

Tick (✓) **one** box.

$Fe(SO_4)_3$ ☐

$Fe_2(SO_4)_3$ ☐

Fe_3SO_4 ☐

10

Do not write outside the box

0 2 This question is about reactions of inorganic compounds.

0 2 . 1 Identify a reagent that can be used in a simple test-tube reaction to distinguish between aqueous barium chloride and aqueous magnesium chloride.

State what is observed.

[3 marks]

Reagent _____

Observation with aqueous barium chloride _____

_____

_____

Observation with aqueous magnesium chloride _____

_____

_____

0 2 . 2 A mixture contains solid sodium carbonate and solid sodium sulfate.

Describe how a pure sample of solid sodium sulfate can be obtained from the mixture.

[3 marks]

_____

_____

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Turn over ►

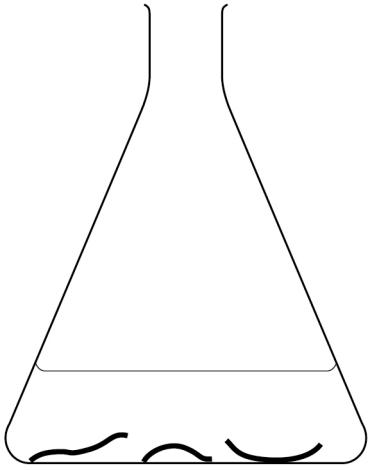
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0 2 . 3 A student adds an excess of magnesium ribbon to a conical flask containing 20 cm^3 of 1.0 mol dm^{-3} hydrochloric acid at room temperature.

The student records the volume of gas collected every 20 seconds.

Complete the diagram to show the apparatus the student could use to measure the volume of gas collected.

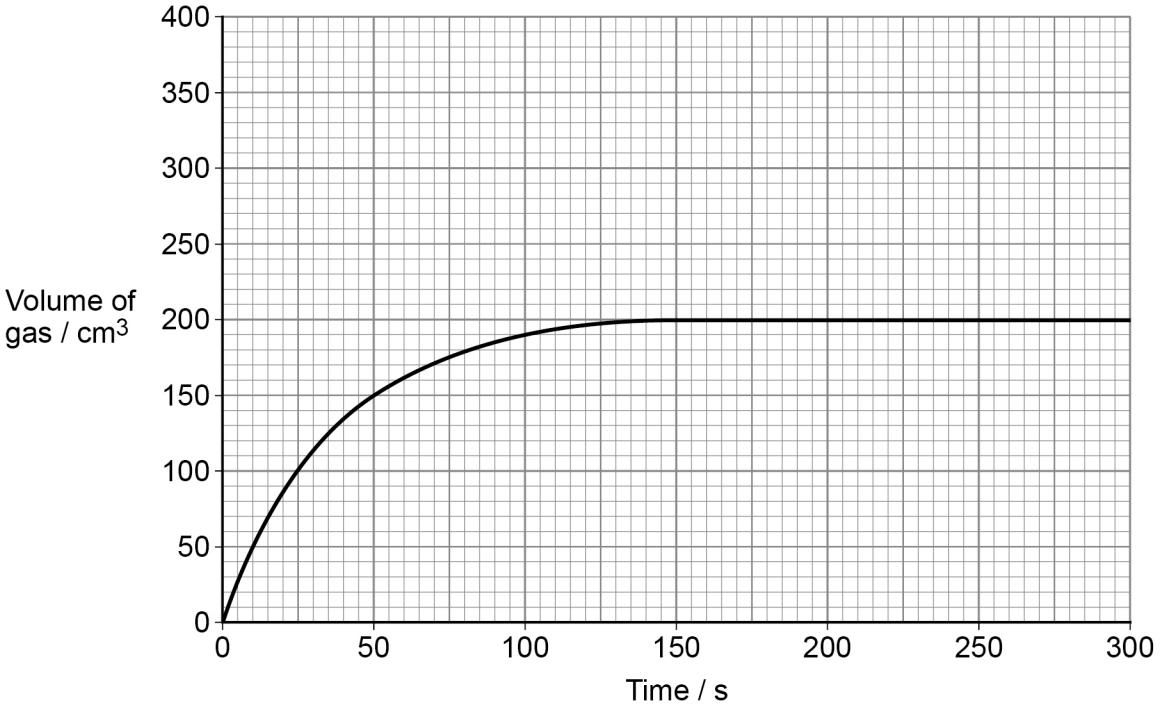
[1 mark]



Do not write outside the box

Figure 1 shows a graph of the results.

Figure 1



0 2 . 4 A student repeats the experiment with 60 cm^3 of 0.5 mol dm^{-3} hydrochloric acid and an excess of magnesium ribbon at room temperature.

Draw a curve on **Figure 1** to show how the volume of gas changes with time.

[2 marks]

0 2 . 5 The student repeats the experiment in **Question 02.3** but heats the flask containing the acid to 60 °C before the magnesium is added.

Explain why the reaction is much faster when heated.

[2 marks]

11

Turn over ►

Do not write outside the box

0 3 This question is about equilibrium.

Compounds **A** and **B** react to form an equilibrium mixture as shown.

$$2\mathbf{A}(aq) + \mathbf{B}(aq) \rightleftharpoons \mathbf{C}(aq) + 2\mathbf{D}(aq)$$

0 3 . 1 An aqueous mixture containing 0.510 mol of **A** and 0.195 mol of **B** is allowed to reach equilibrium at a given temperature.

The equilibrium mixture contains 0.030 mol of **B**.

Calculate the amounts, in mol, of **A**, **C** and **D** in the equilibrium mixture.

Show your working.

[3 marks]

Amount of **A** _____ mol

Amount of **C** _____ mol

Amount of **D** _____ mol

Do not write outside the box

0 3 . 2 Write an expression for the equilibrium constant (K_c) for this reaction.

[1 mark]

K_c

0 3 . 3 The total volume of the reaction mixture is not known.

State why the value of K_c can still be calculated.

[1 mark]

0 3 . 4 A different mixture of **A**, **B**, **C** and **D** is allowed to reach equilibrium at a different temperature.

This new equilibrium mixture contains 0.180 mol of **B**, 0.842 mol of **C** and 1.28 mol of **D**.

At this different temperature, the value of K_c = 6.80

Calculate the amount, in mol, of **A** present in the new equilibrium mixture.

Give your answer to the appropriate number of significant figures.

[3 marks]

Amount of **A** _____ mol

8

Do not write outside the box

0 4 This question is about bonding in nitrogen and some of its compounds.

0 4 . 1 Nitrogen reacts with lithium to form lithium nitride.
Lithium nitride contains the nitride ion N^{3-}

Give the full electron configuration of the nitride ion.

Deduce the formula of lithium nitride.

Explain why lithium nitride has a high melting point.

[4 marks]

Electron configuration _____

Formula _____

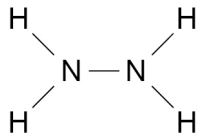
Explanation _____

_____

_____

_____

0 4 . 2 The structures and boiling points of hydrazine and nitrogen are shown.

Name	hydrazine	nitrogen
Structure		$N \equiv N$
Boiling point	114 °C	–196 °C

Explain, in terms of structure and bonding, why the boiling point of hydrazine is higher than the boiling point of nitrogen.

[3 marks]

_____

_____

_____

_____

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Do not write outside the box

0 4 . 3 Draw the shape of an ammonia molecule.

Include any lone pairs of electrons that influence the shape.

[1 mark]

0 4 . 4 Draw a dot and cross diagram to show the bonding in an ammonium ion.

You should show electrons originally from a nitrogen atom as dots (•) and electrons originally from a hydrogen atom as crosses (×).

[1 mark]

9

Turn over for the next question

Do not write outside the box

0 5 A metal **M** reacts with aqueous nitric acid as shown.

$$3\mathbf{M}(s) + 8HNO_3(aq) \longrightarrow 3\mathbf{M}(NO_3)_2(aq) + 4H_2O(l) + 2NO(g)$$

0 5 . 1 2.00 g of **M** reacts with an excess of aqueous nitric acid to form 159 cm^3 of nitrogen monoxide gas measured at 25 °C and 100 kPa

Calculate the relative atomic mass of **M**.

Identify **M**.

Show your working.

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

[6 marks]

Relative atomic mass of **M** _____

Identity of **M** _____

Do not write outside the box

0 5 . 2 In a similar experiment, an excess of **M** is added to 50.0 cm^3 of aqueous nitric acid of unknown concentration.

0.561 g of NO gas is collected.

Calculate the concentration, in mol dm^{-3}, of the nitric acid.

[3 marks]

Concentration _____ mol dm^{-3}

0 5 . 3 The measuring cylinder used to measure 50.0 cm^3 of nitric acid has an uncertainty of ± 0.50 cm^3

The balance used to weigh 0.561 g of NO gas has an uncertainty of ± 0.001 g for each reading.

Calculate the total percentage uncertainty in using these two pieces of apparatus in this experiment.

Give your answer to two decimal places.

[2 marks]

Percentage uncertainty _____

11

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0 6 This question is about the elements in Period 3 from aluminium to argon.

0 6 . 1 State which of these elements has the highest electronegativity.

[1 mark]

0 6 . 2 Explain, in terms of structure and bonding, why the melting point of silicon is much higher than the melting point of phosphorus.

[4 marks]

0 6 . 3 An element in Period 3, from aluminium to argon, has successive ionisation energies as shown in **Table 1**.

Table 1

	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth
Ionisation energy / kJ mol^{-1}	1000	2260	3390	4540	6990	8490	27 100	31 700

Identify this element.

[1 mark]

Do not write outside the box

0 6 . 4 Explain why the first ionisation energy of sulfur is lower than that of phosphorus.

[2 marks]

8

Turn over for the next question

Do not write outside the box

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

Bromine is formed when $K_2Cr_2O_7$ reacts with sodium bromide in acidic conditions.

The ionic equation for this redox reaction is shown.

$$14H^+ + Cr_2O_7^{2-} + 6Br^- \rightarrow 2Cr^{3+} + 7H_2O + 3Br_2$$

0 7 . 1 Write the half-equation for the conversion of bromide ions into bromine.

[1 mark]

0 7 . 2 Give the oxidation state of chromium in the $Cr_2O_7^{2-}$ ion.

[1 mark]

0 7 . 3 Write the half-equation for the conversion of $Cr_2O_7^{2-}$ ions, in acidic conditions, into chromium(III) ions and water.

[1 mark]

0 7 . 4 Chlorine is used as an oxidising agent in the extraction of bromine from seawater. In this process, chlorine gas is bubbled through a solution containing bromide ions.

Write the simplest ionic equation for the reaction of chlorine with bromide ions.

[1 mark]

0 7 . 5 Explain why chlorine is a stronger oxidising agent than bromine.

[2 marks]

Do not write outside the box

0 7 . 6 Concentrated sulfuric acid is reduced by some halide ions.

Identify a halide ion that reduces sulfuric acid to hydrogen sulfide.

Write an ionic equation for this reaction.

[2 marks]

Halide ion _____

Equation _____

0 7 . 7 Aqueous sodium bromide and aqueous sodium iodide can be distinguished by a simple test-tube reaction.

Identify a reagent, or combination of reagents, that can be used to distinguish between these solutions.

State what is observed.

[3 marks]

Reagent _____

_____

_____

Observation with sodium bromide _____

_____

_____

Observation with sodium iodide _____

_____

_____

Question 7 continues on the next page

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0 7 . 8 Chlorine can react with water in two different ways under different conditions.
One reaction does **not** release oxygen and the other does.

Write an equation for each reaction.

[2 marks]

Equation for reaction that does **not** release oxygen

Equation for reaction that does release oxygen

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END OF QUESTIONS

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