OXFORD

INTERNATIONAL AQA EXAMINATIONS

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

INTERNATIONAL AS

CHEMISTRY (9620)

Unit 1: Inorganic 1 and Physical 1

Tuesday 15 May 2018 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.
- 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	
8	
TOTAL	

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

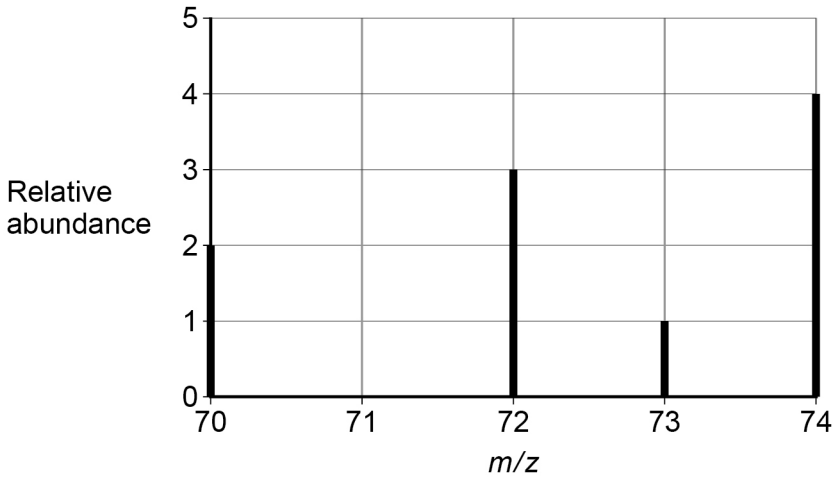
Do not write outside the box

0 1 . 1 Give the meaning of the term isotopes in terms of fundamental particles.

[2 marks]

The mass spectrum of a sample of germanium is shown in **Figure 1**.

Figure 1



0 1 . 2 Calculate the relative atomic mass of this sample of germanium.

[2 marks]

Relative atomic mass _____

Do not write outside the box

0 1 . 3 Complete the electron configuration of the Ge^+ ion.

[1 mark]

[Ar] _____

0 1 . 4 Write an equation to represent the process that occurs when the first ionisation energy of germanium is measured.
Include state symbols in your equation.

[1 mark]

_____

0 1 . 5 Calculate the mass, in kg, of a $^{72}Ge^+$ ion.

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

[1 mark]

Mass _____ kg

0 1 . 6 In a time of flight (TOF) mass spectrometer, the kinetic energy (KE) of a $^{72}Ge^+$ ion is 1.318×10^{-14} J

Use your answer to Question **01.5** to calculate the velocity of this $^{72}Ge^+$ ion.

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

(m = mass / kg and v = velocity / ms^{-1})

(If you could not answer Question **01.5** you should assume a mass of 9.80×10^{-24} kg This is **not** the correct answer.)

[2 marks]

Velocity _____ ms^{-1}

Turn over ►

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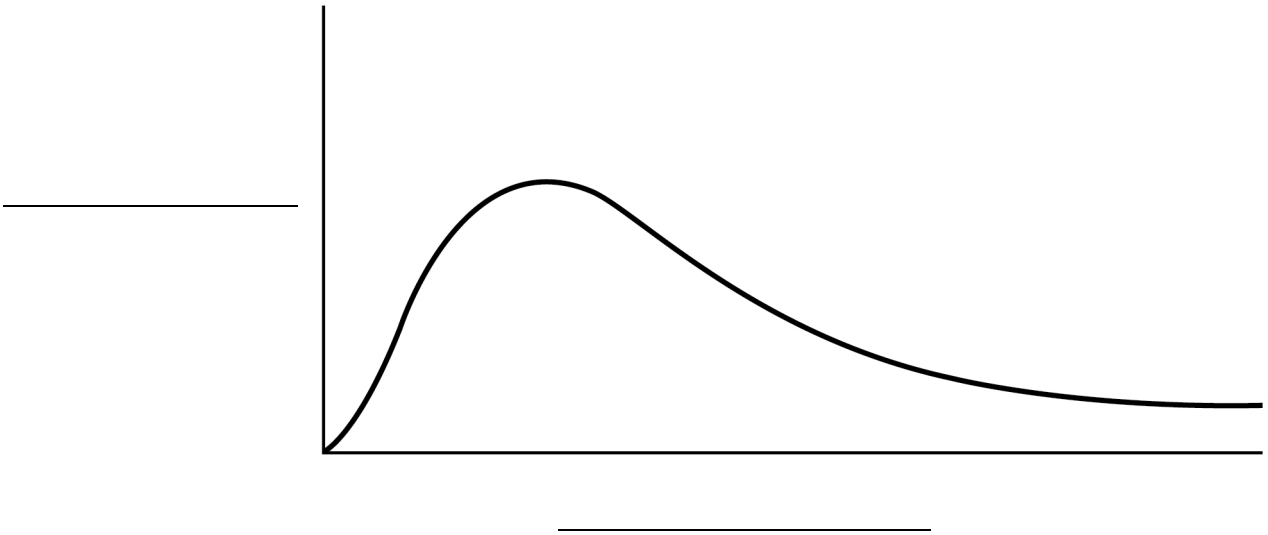
0 1 . 7 State why the chemical properties of ^{72}Ge and ^{74}Ge are the same.

[1 mark]

10

0 2 **Figure 2** represents a Maxwell–Boltzmann distribution curve for the particles in a sample of a gas **G**, at a given temperature, at the start of a reaction.

Figure 2



0 2 . 1 Label both axes on the diagram in **Figure 2**.

[2 marks]

0 2 . 2 Give a reason why the curve starts at the origin.

[1 mark]

0 2 . 3 Draw on **Figure 2** a distribution curve for the same sample of gas **G** at a **lower** temperature.

[2 marks]

Do not write outside the box

0 2 . 4 A flask contains gas **G** at temperature *T*.
Gas **G** decomposes as shown in the equation.

G $\rightarrow$ products

At temperature *T*, only a few particles of **G** have the activation energy needed to decompose.

Explain why all of **G** will eventually decompose.

[1 mark]

0 2 . 5 Explain why a small decrease in temperature can cause a large decrease in the rate of decomposition of gas **G**.

[2 marks]

8

Turn over for the next question

Do not write outside the box

0 3 . 1 Identify a reagent that could be used in a simple test tube reaction to distinguish between aqueous magnesium chloride and aqueous barium chloride.

State what you would observe.

[3 marks]

Reagent _____

Observation with aqueous magnesium chloride _____

_____

_____

Observation with aqueous barium chloride _____

_____

_____

0 3 . 2 Identify a reagent that could be used in a simple test tube reaction to distinguish between aqueous potassium iodide and aqueous potassium chloride.

State what you would observe.

[3 marks]

Reagent _____

Observation with aqueous potassium iodide _____

_____

_____

Observation with aqueous potassium chloride _____

_____

_____

0 3 . 3 Write an equation for the reaction between solid sodium fluoride and concentrated sulfuric acid.

[1 mark]

_____

Do not write outside the box

0 3 . 4 Write an equation for the redox reaction that occurs between solid sodium bromide and concentrated sulfuric acid.

State the role of sulfuric acid in this reaction.

[2 marks]

Equation _____

_____

Role _____

_____

9

Turn over for the next question

Do not write outside the box

0 4 Nitrogen dioxide dissociates when heated to form an equilibrium mixture.

$$2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$$

0 4 . 1 15.60 g of nitrogen dioxide are heated to a constant temperature in a closed flask. At this temperature the equilibrium mixture contains 8.30 g of nitrogen monoxide.

Calculate the amounts, in moles, of the three gases present in the equilibrium mixture.

[3 marks]

Amount of NO_2 at equilibrium _____ mol

Amount of NO at equilibrium _____ mol

Amount of O_2 at equilibrium _____ mol

0 4 . 2 Write an expression for the equilibrium constant (K_c) for this reaction.

[1 mark]

K_c

Do not write outside the box

0 4 . 3 A different equilibrium mixture, at a different temperature, contained 0.33 mol of NO_2, 0.22 mol of NO and 0.18 mol of O_2 in a flask of volume 15 dm^3

Calculate the value of the equilibrium constant (K_c) for this reaction and state its units.

[3 marks]

K_c _____ units _____

0 4 . 4 The pressure on the equilibrium mixture is increased.

Predict the effect of the increase in pressure on the amount of oxygen in the equilibrium mixture.

Explain your answer with reference to Le Chatelier's principle.

[3 marks]

Effect _____

Explanation _____

_____

_____

_____

_____

10

Turn over ►

Do not write outside the box

0 5 This question is about bonding and structure.

0 5 . 1 Draw the shape of the PCl_3 molecule and the shape of the SF_3^- ion.
Include any lone pairs of electrons that influence the shape.

Name the shape of the PCl_3 molecule.

Suggest the bond angle in the PCl_3 molecule.

[4 marks]

	PCl_3 molecule	**SF_3^- ion**
Shape		
Name of shape		
Bond angle		

0 5 . 2 Which substance does **not** have hydrogen bonding between its molecules?

[1 mark]

Tick (✓) **one** box.

NH_3 ☐

H_2O ☐

CHF_3 ☐

CH_3OH ☐

5

Do not write outside the box

0 6 . 1 A 2.49 g sample of gaseous **Y** occupies a volume of 1.35×10^{-3} m^3 at a temperature of 252 °C and a pressure of 101 kPa

Calculate the relative molecular mass of **Y**.

Give your answer to the nearest whole number.

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

[4 marks]

Relative molecular mass _____

0 6 . 2 **Y** is the oxide of a Group 6 element.

Use your answer to Question **06.1** to suggest the identity of **Y**.

(If you were unable to complete Question **06.1**, you should use the value of 111 for the relative molecular mass of **Y**. This is **not** the correct answer.)

[1 mark]

_____

_____

5

Turn over for the next question

Do not write outside the box

0 7 . 1 Define standard enthalpy of formation.

[2 marks]

0 7 . 2 State Hess's Law.

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

$$CaO(s) + 2HCl(g) \rightarrow CaCl_2(s) + H_2O(l)$$

Table 1

	CaO(s)	**HCl(g)**	**$CaCl_2$(s)**	**H_2O(l)**
$\Delta_f H^{\ominus}$ / kJ mol^{-1}	–635	–92	–795	–286

[4 marks]

Hess's Law

Enthalpy change _____ kJ mol^{-1}

Do not write outside the box

0 7 . 3 100 cm^3 of distilled water was measured out using a measuring cylinder and transferred to a polystyrene cup.
The temperature of the water was 25.0 °C
A 2.10 g sample of anhydrous calcium chloride was added to the water and the mixture was stirred.
The temperature of the mixture increased to 28.4 °C

Calculate the enthalpy of solution, in kJ mol^{-1}, for calcium chloride.

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

You should assume that the volume of the solution is 100 cm^3 and the density of the solution is 1.00 g cm^{-3}

[4 marks]

Enthalpy of solution _____ kJ mol^{-1}

0 7 . 4 Suggest **one** improvement to the apparatus that would give a more accurate value than the one calculated in Question **07.3**.

[1 mark]

_____

_____

11

Turn over for the next question

Do not write outside the box

0 8 This question is about magnesium and its reactions.

0 8 . 1 A 0.750 g sample of magnesium metal reacts exactly with 31.00 cm^3 of hydrochloric acid of unknown concentration.

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

Calculate the concentration, in g dm^{-3}, of the hydrochloric acid used in this reaction.

Give your answer to **three** significant figures.

[4 marks]

Concentration _____ g dm^{-3}

0 8 . 2 Calculate the percentage atom economy for the formation of hydrogen in the reaction shown in Question **08.1**.

Give your answer to **one** decimal place.

[2 marks]

Atom economy _____ %

Do not write outside the box

0 8 . 3 Draw a labelled diagram to show the arrangement of particles in a crystal of magnesium.

Your diagram should contain **six** magnesium particles.

[2 marks]

0 8 . 4 Suggest why magnesium is ductile (can be stretched into wires).

[1 mark]

0 8 . 5 State **two** observations made when magnesium reacts with steam.

Write an equation for the reaction.

[3 marks]

Observation 1 _____

Observation 2 _____

Equation _____

12

END OF QUESTIONS

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There are no questions printed on this page

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