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	

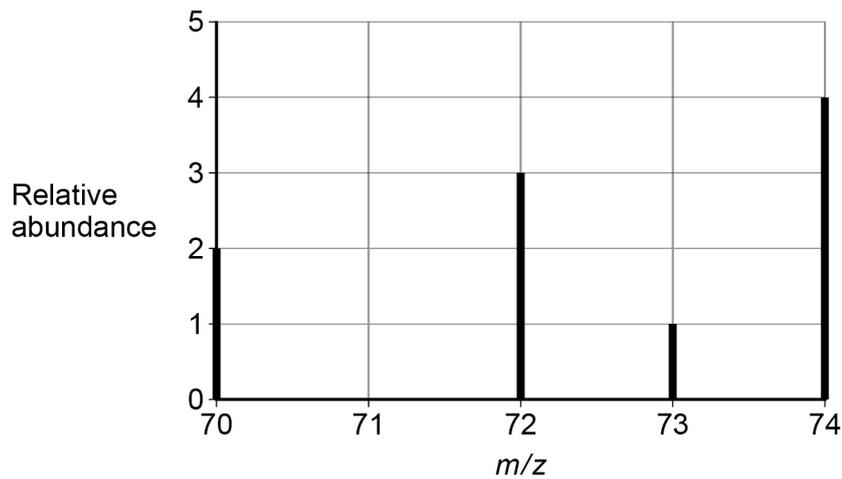Answer **all** questions in the spaces provided.

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 _____

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]

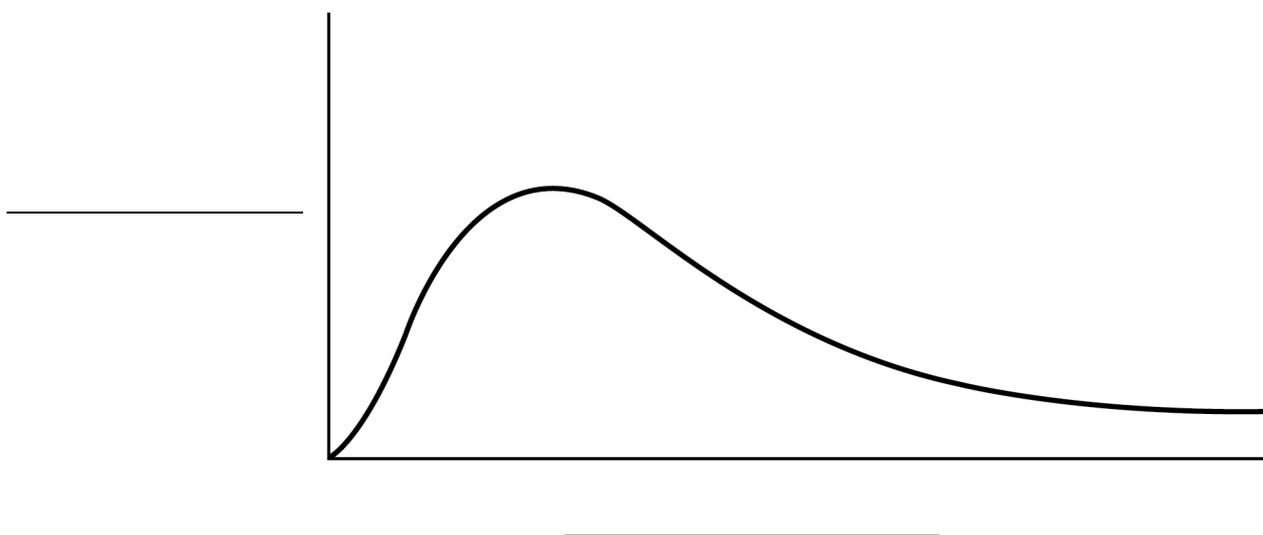Velocity _____ ms^{-1}

Turn over ▶

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]

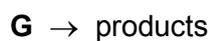**0 2 . 2** Give a reason why the curve starts at the origin.

[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]

0	2	.	4

A flask contains gas **G** at temperature *T*.

Gas **G** decomposes as shown in the equation.

$$\textbf{G} \rightarrow \text{products}$$

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]

_____

_____

_____

_____

Turn over for the next question

___

8

Turn over ▶

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]

_____

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

Turn over ▶

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

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$_2$O ☐

CHF$_3$ ☐

CH$_3$OH ☐

5

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

Turn over ▶

0 7 . 1 Define standard enthalpy of formation.

[2 marks]

0 7 . 2 State Hess's Law.

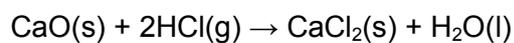Use the data in **Table 1** to calculate the standard enthalpy change, in kJ mol^{-1}, for the following reaction.

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

Table 1

	CaO(s)	**HCl(g)**	**CaCl$_2$(s)**	**H$_2$O(l)**
$\Delta_f H^{\ominus}$ / **kJ mol^{-1}**	–635	–92	–795	–286

[4 marks]

Hess's Law

Enthalpy change _____ kJ mol^{-1}

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 = $4.18 \text{ J K}^{-1} \text{ g}^{-1}$

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]
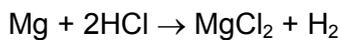
_____

_____

11

Turn over for the next question

Turn over ▶

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 _____ %

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 _____

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END OF QUESTIONS

There are no questions printed on this page

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