



**ADVANCED SUBSIDIARY GCE**  
**CHEMISTRY**  
 Foundation Chemistry

**2811/01**

Candidates answer on the question paper

**OCR Supplied Materials:**

- *Data Sheet for Chemistry* (inserted)

**Other Materials Required:**

- Scientific calculator

**Friday 9 January 2009**  
**Afternoon**

**Duration: 1 hour**



Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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**INSTRUCTIONS TO CANDIDATES**

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

**INFORMATION FOR CANDIDATES**

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **60**.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use a scientific calculator.
- A copy of the *Data Sheet for Chemistry* is provided as an insert with this question paper.
- You are advised to show all the steps in any calculations.
- This document consists of **12** pages. Any blank pages are indicated.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	9	
2	9	
3	16	
4	15	
5	11	
<b>TOTAL</b>	<b>60</b>	

Answer **all** the questions.

**1** The answer to each part of this question is a number.

**(a) (i)** How many neutrons are there in an atom of chlorine-37?

..... [1]

**(ii)** How many electrons are needed to fill one orbital?

..... [1]

**(iii)** How many electrons are there in the 3p sub-shell of a chlorine atom?

..... [1]

**(b) (i)** Calculate the relative atomic mass of a sample of gallium containing 60%  $^{69}\text{Ga}$  and 40%  $^{71}\text{Ga}$ . Give your answer to **three** significant figures.

[1]

**(ii)** Calculate the relative formula mass of  $(\text{NH}_4)_2\text{CO}_3$ .

[1]

**(iii)** Calculate the number of grams of  $\text{NaNO}_3$  in  $200\text{cm}^3$  of a  $0.250\text{mol dm}^{-3}$  solution.

[2]

**(iv)** Calculate the number of molecules in  $100\text{cm}^3$  of  $\text{SO}_2$  gas at room temperature and pressure.

1.00 mol of  $\text{SO}_2$  molecules occupies  $24.0\text{dm}^3$  at room temperature and pressure.

$L = 6.02 \times 10^{23} \text{ mol}^{-1}$ .

[1]

**(c)** Determine the oxidation number of chlorine in  $\text{NaClO}_4$ .

..... [1]

[Total: 9]

2 Element **A** is in **Period 3**, Na–Ar, of the Periodic Table.

Some of the successive ionisation energies of element **A** are shown below.

ionisation energy/kJ mol <sup>-1</sup>						
1st	2nd	3rd	4th	5th	6th	7th
789	1577	3232	4356	16 091	19 785	23 787

(a) Define the term *first ionisation energy*.

.....  
 .....  
 .....  
 ..... [3]

(b) Identify element **A** from the elements in Period 3, Na–Ar.

Explain how you decided on your answer.

element **A**: .....  
 explanation: .....  
 .....  
 .....  
 ..... [3]

(c) Elements in the same **group** in the Periodic Table have different ionisation energies.

Explain why there is a trend in first ionisation energies for elements in the same group.

.....  
 .....  
 .....  
 .....  
 .....  
 ..... [3]

[Total: 9]

- 3 Calcium chloride,  $\text{CaCl}_2$ , is used for dust control on roads and in car parks.

Calcium chloride is made up of  $\text{Ca}^{2+}$  and  $\text{Cl}^-$  ions.

- (a) Complete the table below.

species	protons	electrons
$\text{Ca}^{2+}$		
$\text{Cl}^-$		

[2]

- (b) Draw a 'dot-and-cross' diagram of  $\text{CaCl}_2$ . Show outer electron shells only.

[2]

- (c) Solid calcium chloride does **not** conduct electricity. An aqueous solution of calcium chloride does conduct.

Explain the different conductivities of solid and aqueous calcium chloride.

.....

.....

.....

..... [2]

- (d) Calcium chloride can be made by reacting limestone with hydrochloric acid.



In the laboratory, a student carries out this reaction using 4.85 g  $\text{CaCO}_3$  and  $1.50 \text{ mol dm}^{-3}$   $\text{HCl}$ . She then evaporates water from the solution to obtain solid  $\text{CaCl}_2$ .

- (i) How many moles of  $\text{CaCO}_3$  were reacted?

answer = .....mol [2]

- (ii) What mass of  $\text{CaCl}_2$  is formed by the reaction of 4.85 g of  $\text{CaCO}_3$ ?

answer = ..... g [1]

- (iii) Calculate the volume, in  $\text{cm}^3$ , of  $1.50 \text{ mol dm}^{-3}$   $\text{HCl}$  that reacts with 4.85 g of  $\text{CaCO}_3$ .

answer = .....  $\text{cm}^3$  [2]

- (e) Choose another chemical that could be reacted with hydrochloric acid to make calcium chloride.

Write a balanced equation for the reaction.

..... [2]

- (f) Compound **B** is a calcium compound used in making paper. Compound **B** is manufactured by passing  $\text{SO}_2$  gas through a solution of calcium hydroxide.

Compound **B** has the following percentage composition by mass:

Ca, 19.82%; H, 0.99%; S, 31.74%; O, 47.45%.

- (i) Determine the empirical formula for compound **B**.

[2]

- (ii) Construct a balanced equation for the manufacture of compound **B** from calcium hydroxide by this method.

..... [1]

[Total: 16]

- 4 The boiling points of the halogens chlorine, bromine and iodine are shown below.

halogen	boiling point/°C
chlorine	–35
bromine	59
iodine	184

- (a) Explain this trend in the boiling points of the halogens.

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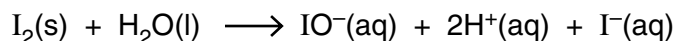
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..... [3]

- (b) Iodine reacts with water as shown below.



Determine the changes in oxidation number of iodine in this reaction and comment on your answers.

.....

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.....

.....

..... [3]

(c) A student carries out the following investigation.

- **Step 1:** The student adds an excess of chlorine gas to an aqueous solution of potassium bromide.
- **Step 2:** The student adds aqueous silver nitrate to the resulting solution.

(i) In **step 1**, what would the student observe?

Write an ionic equation for the reaction that takes place.

observation: .....

ionic equation: ..... [2]

(ii) For **step 2**, write an ionic equation, including state symbols, for the reaction that takes place.

..... [2]

(d) Many covalent compounds of the halogens, such as  $\text{CCl}_4$ , have polar bonds. Polarity can be explained in terms of electronegativity.

(i) Explain what is meant by the term *electronegativity*.

.....  
 .....  
 ..... [2]

(ii) Molecules of the covalent compound  $\text{CCl}_4$  have polar bonds.

Draw a diagram to show the shape of a molecule of  $\text{CCl}_4$ .

On your diagram, show the polarity of the bonds.

[2]

(iii) A molecule of  $\text{CCl}_4$  is non-polar. Explain why.

.....  
 ..... [1]

[Total: 15]

- 5 In this question, one mark is available for the quality of spelling, punctuation and grammar.

Many physical properties can be explained in terms of bonding and structure. The table below shows some properties of magnesium, diamond and ice.

substance	magnesium	diamond	ice
electrical conductivity of solid	good	poor	poor
melting point	649 °C	3550 °C	0 °C

Explain these properties in terms of bonding and structure.

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..... [10]

Quality of Written Communication [1]

[Total: 11]

**END OF QUESTION PAPER**

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