THIS IS A NEW SPECIFICATION

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RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

CHEMISTRY A

Atoms, Bonds and Groups

F321

Candidates answer on the question paper

OCR Supplied Materials:
- *Data Sheet for Chemistry A* (Inserted)

Other Materials Required:
- Scientific calculator

Wednesday 3 June 2009
Morning

Duration: 1 hour

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

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.
- Where you see this icon you will be awarded marks for the quality of written communication in your answer.

  This means for example you should:
  - ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear;
  - organise information clearly and coherently, using specialist vocabulary when appropriate.
- You may use a scientific calculator.
- A copy of the *Data Sheet for Chemistry A* is provided as an insert with this question paper.
- You are advised to show all the steps in any calculations.
- The total number of marks for this paper is **60**.
- This document consists of **12** pages. Any blank pages are indicated.

FOR EXAMINER'S USE		
Qu.	**Max.**	**Mark**
1	**15**	
2	**12**	
3	**7**	
4	**11**	
5	**15**	
TOTAL	**60**	

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Answer **all** the questions.

1 The Group 2 element magnesium was first isolated by Sir Humphry Davy in 1808.

(a) Magnesium has three stable isotopes, which are ^{24}Mg, ^{25}Mg and ^{26}Mg.

(i) Complete the table below to show the atomic structures of ^{24}Mg and ^{25}Mg.

	protons	**neutrons**	**electrons**
^{24}Mg			
^{25}Mg			

[2]

(ii) A sample of magnesium contained ^{24}Mg: 78.60%; ^{25}Mg: 10.11%; ^{26}Mg: 11.29%.

Calculate the relative atomic mass of this sample of Mg.

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

answer = ... **[2]**

(iii) Define the term *relative atomic mass*.

.....

.....

.....

.....

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

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(b) The reaction between magnesium and sulfuric acid is a redox reaction.

$$Mg(s) + H_2SO_4(aq) \longrightarrow MgSO_4(aq) + H_2(g)$$

(i) Use oxidation numbers to identify which element has been oxidised.

Explain your answer.

element oxidised .....

explanation .....

.....

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

(ii) Describe what you would **see** when magnesium reacts with an excess of sulfuric acid.

.....

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

(c) Epsom salts can be used as bath salts to help relieve aches and pains.

Epsom salts are crystals of hydrated magnesium sulfate, $MgSO_4 \bullet \boldsymbol{x}H_2O$.

A sample of Epsom salts was heated to remove the water. 1.57 g of water was removed leaving behind 1.51 g of anhydrous $MgSO_4$.

(i) Calculate the amount, in mol, of anhydrous $MgSO_4$ formed.

amount = ... mol **[2]**

(ii) Calculate the amount, in mol, of H_2O removed.

amount = ... mol **[1]**

(iii) Calculate the value of $\boldsymbol{x}$ in $MgSO_4 \bullet \boldsymbol{x}H_2O$.

$\boldsymbol{x}$ = ... **[1]**

[Total: 15]

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2 This question compares the bonding, structure and properties of sodium and sodium oxide.

(a) Sodium, Na, is a metallic element.

Explain, with the aid of a labelled diagram, what is meant by the term *metallic bonding*.

.....

.....

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

(b) Sodium reacts with oxygen to form sodium oxide, Na_2O, which is an ionic compound.

(i) Write the equation for the reaction of sodium with oxygen to form sodium oxide.

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

(ii) State what is meant by the term *ionic bond*.

.....

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

(iii) Draw a '*dot-and-cross*' diagram to show the bonding in Na_2O.

Show **outer** electrons only.

[2]

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(c) Compare and explain the electrical conductivities of sodium and sodium oxide in the solid and liquid states.

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..... **[5]**

[Total: 12]

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3 Calcium carbonate, $CaCO_3$, reacts with hydrochloric acid as shown in the equation below.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

(a) 7.50×10^{-3} mol $CaCO_3$ reacts with 0.200 mol dm^{-3} HCl.

(i) Calculate the volume, in cm^3, of 0.200 mol dm^{-3} HCl required to react with 7.50×10^{-3} mol $CaCO_3$.

answer = ... cm^3 **[2]**

(ii) Calculate the volume, in cm^3, of CO_2 formed at room temperature and pressure.

answer = ... cm^3 **[1]**

(b) When heated strongly, $CaCO_3$ decomposes.

Write an equation, including state symbols, for the thermal decomposition of $CaCO_3$.

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

(c) Calcium oxide reacts with water and with nitric acid.

State the formula of the calcium compound formed when:

(i) calcium oxide reacts with water, ... **[1]**

(ii) calcium oxide reacts with nitric acid. ..... **[1]**

[Total: 7]

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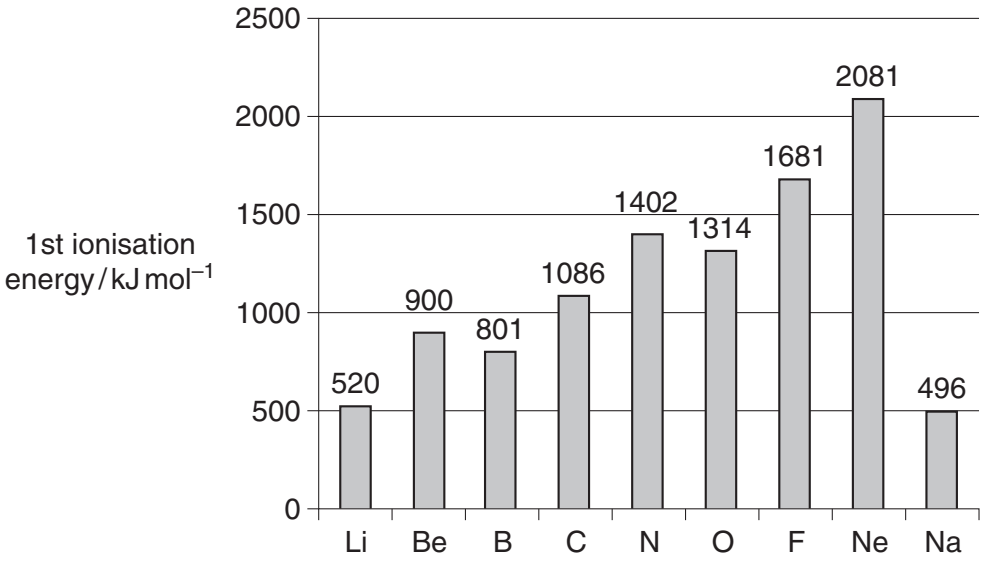
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TURN OVER FOR QUESTION 4

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4 Ionisation energies have been used to develop the model of the atom.

The first ionisation energies of the elements Li to Na are shown in the figure below.



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

.....

.....

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

(b) **(i)** Explain why the first ionisation energies show a general increase from Li to Ne.

.....

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

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(ii) Explain the difference between the first ionisation energies of Li and Na.



In your answer, you should use appropriate technical terms, spelt correctly.

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

(c) The first ionisation energy of oxygen is 1314 kJ mol^{-1} and the second ionisation energy of oxygen is 3388 kJ mol^{-1}.

(i) Write an equation to represent the **second** ionisation energy of oxygen.

Include state symbols.

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

(ii) Suggest why the second ionisation energy of oxygen has a greater value than the first ionisation energy of oxygen.

.....

.....

.....

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

[Total: 11]

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5 The Periodic Table is a table of elements arranged in order of atomic number. The elements are classified into blocks.

(a) (i) State what is meant by the term *atomic number*.

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

(ii) Complete the full electron configuration for a titanium atom.

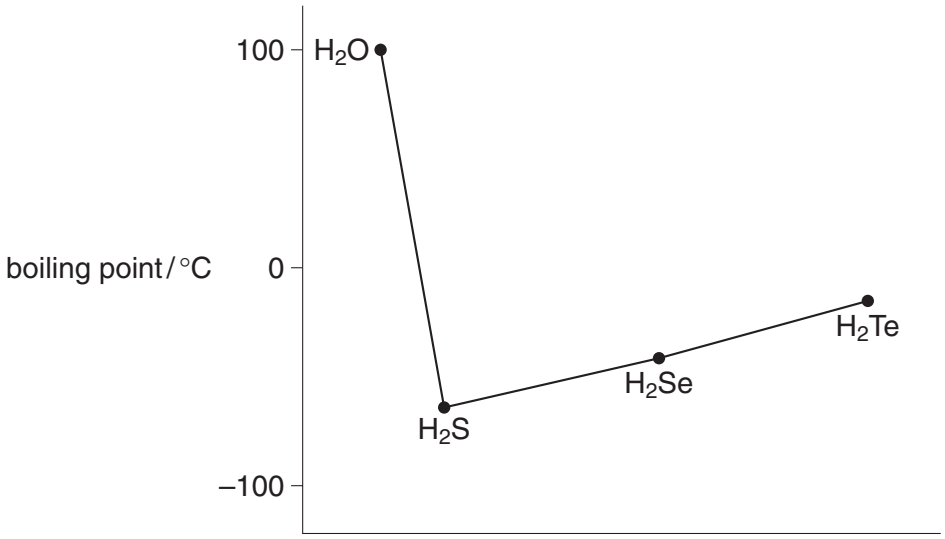
$1s^2$ ..... **[1]**

(iii) Identify the **seventh** element in the **fourth** period.

State which block this element is in.

element ..... block ..... **[1]**

(b) The figure below shows the boiling points of four hydrides of Group 6 elements.



(i) Explain, with the aid of a diagram, the intermolecular forces in H_2O that lead to the relatively high boiling point of H_2O.

.....

.....

.....

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

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(ii) Suggest why H_2S has a much lower boiling point than H_2O.

.....

.....

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

(c) The boiling points of some Group 7 elements are shown below.

Group 7 element	boiling point / °C
chlorine	–35
bromine	59
iodine	184

Explain why the halogens show this trend in boiling points.



In your answer, you should use appropriate technical terms, spelt correctly.

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

TURN OVER FOR QUESTION 5(d)

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(d) During the extraction of bromine industrially, chlorine is bubbled through a solution of bromide ions. A student thought this principle would also work for extracting iodine and carried out the experiment below.

Stage 1 The student bubbled some chlorine through an aqueous solution of potassium iodide.

Stage 2 The student added an organic solvent and shook the mixture.

(i) What would the student see at **stage 1**?

.....

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

(ii) Name the products and write an ionic equation for the reaction in **stage 1**.

names of products: .....

ionic equation: ..... **[2]**

(iii) Why does the reaction in **stage 1** occur?

.....

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

(iv) What would the student see at **stage 2**?

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

[Total: 15]

END OF QUESTION PAPER

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