

Candidate Name	Centre Number	Candidate Number
		2



GCE AS/A level

331/01

CHEMISTRY CH1

P.M. FRIDAY, 9 January 2009

1½ hours

ADDITIONAL MATERIALS

In addition to this examination paper, you will need a:

- calculator;
- copy of the **Periodic Table** supplied by WJEC. Refer to it for any **relative atomic masses** you require.

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.

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

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

Candidates are advised to allocate their time appropriately between **Section A (10 marks)** and **Section B (56 marks)**.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

The maximum mark for this paper is 66.

Your answers must be relevant and must make full use of the information given to be awarded full marks for a question.

You are reminded that marking will take into account the Quality of Written Communication used in all written answers.

Page 13 may be used for rough work.

FOR EXAMINER'S USE ONLY		
Section	Question	Mark
A	1-8	
B	9	
	10	
	11	
	12	
TOTAL MARK		

SECTION A

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

1. Complete the diagram below, using arrows to represent electrons, to give the electronic configuration of an atom of manganese.



[1]

2. Complete the table to show the **electrical** conductivity of the solids listed below.

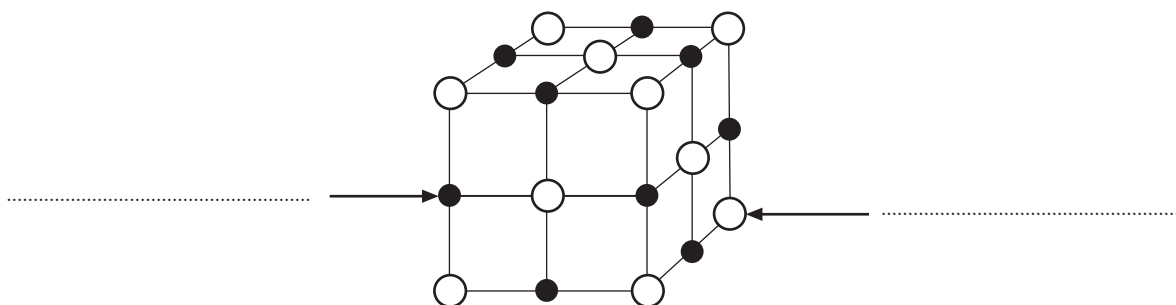
[1]

<i>Solid</i>	<i>Conductor</i>	<i>Non-conductor</i>
Calcium	✓	
Iodine		
Sodium chloride		

3. Lithium bromide has the same crystal structure as sodium chloride.

- (i) Label the ions present in the diagram of lithium bromide shown below.
(You may assume that the anion is larger than the cation.)

[1]



- (ii) State the crystal co-ordination numbers of the structure.

[1]

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4. Using the table of ionisation energies given below, state which **one** of the letters represents the first four ionisation energies of a Group II element.

	<i>Ionisation energy/kJ mol⁻¹</i>			
	1st	2nd	3rd	4th
A	1520	2660	3950	5770
B	716	1510	3250	5190
C	577	1980	2960	6190
D	548	1060	4120	5440

..... [1]

5. A sample of nickel contains 60.0% of the isotope ⁵⁸Ni and 40.0% of the isotope ⁶⁰Ni. Using the data, calculate the relative atomic mass of nickel to three significant figures. [2]

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6. State which **one** of the following statements is **correct** for an ideal gas. [1]

- A** Ideal gases are considered to have no volume.
B The intermolecular forces are significant.
C The pressure is directly proportional to the volume.
D The volume varies directly as the Kelvin temperature at constant pressure.

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7. The oxidation state of chromium in CrO₂Cl₂ is [1]

- A** +3
B +4
C +6
D +8

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8. Write a balanced equation for the reaction of calcium with water. [1]

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Section A Total [10]
Turn over.

SECTION B

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

9. (a) Name the particles contained in atomic nuclei and give their relative masses and charges by completing the table. [2]

<i>Particle</i>	<i>Relative mass</i>	<i>Relative charge</i>

- (b) Atoms which have unstable nuclei are radioactive.

All living organic matter contains carbon-14, which emits β -particles and has a half-life of 5730 years.

- (i) Explain what is meant by the term *half-life* of a radioactive isotope. [1]

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- (ii) Give the symbol of the element produced by the radioactive decay of ^{14}C , showing both its mass and atomic numbers. [1]

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- (iii) State what happens in the nucleus of an atom when a β -particle forms. [1]

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- (iv) Carbon dioxide in the atmosphere is converted into carbohydrates in plants by photosynthesis. Name the Group II element that is essential for this process. [1]

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- (c) Diamond and graphite are two different crystalline forms of carbon.

Describe the structure and bonding in both diamond **and** graphite.

State **one** physical property which is common to both diamond and graphite and **one** which is not. Relate **both** properties to the structures and bonding you have described.

Diagrams may be used in support of your answer.

[7]

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- (d) A fullerene, C_{60} , is another crystalline form of carbon. It can react directly with rubidium to form a fulleride, Rb_3C_{60} , which is a superconductor at low temperatures.

Give the empirical formula of the compound Rb_3C_{60} .

[1]

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Total [14]

10. (a) Calcium reacts with chlorine producing calcium chloride.

- (i) Explain, in terms of electron transfer, why the reaction between calcium and chlorine is a redox process. [2]

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- (ii) Draw a dot and cross diagram to show how the ionic compound calcium chloride is formed from calcium and chlorine atoms. Show the charges on the ions formed.

Only outer electrons should be shown. [2]

- (iii) Give a test which would confirm the presence of calcium ions in the compound, stating the result of this test. [1]

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- (b) Calcium chloride exists as a hydrated salt, $\text{CaCl}_2 \cdot x\text{H}_2\text{O}$. If the relative molecular mass of the hydrate is 219.2, calculate the value of x in the formula $\text{CaCl}_2 \cdot x\text{H}_2\text{O}$. [3]

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- (c) State what is observed when aqueous magnesium ions are added to aqueous hydroxide ions and give an ionic equation for the reaction.

Observation [1]

Equation [1]

(d) The equation below shows the removal of 2 electrons from an element **X**,



where **X** is calcium, magnesium or sodium.

The table below shows the energy required to remove 2 electrons from each of these elements.

X	<i>Energy required to remove 2 electrons / kJ mol⁻¹</i>
Ca	1735
Mg	2189
Na	5059

Explain, in terms of the electronic structures of the atoms concerned, why

- (i) the energy required to remove 2 electrons from calcium is less than for magnesium, [2]

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- (ii) the energy required to remove 2 electrons from sodium is greater than for magnesium. [2]

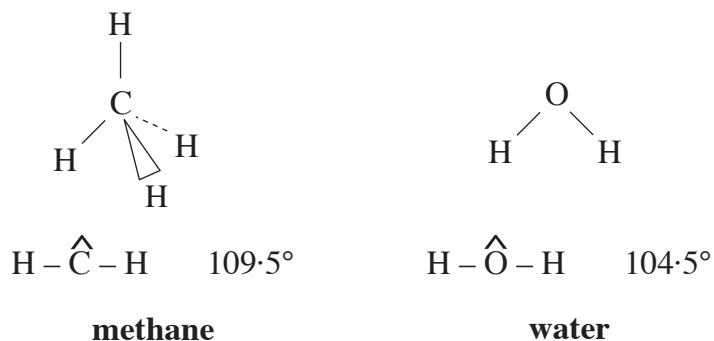
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Total [14]

11. (a) The bond angles in molecules of methane and water are shown in the diagrams below.



Using the valence shell electron pair repulsion (VSEPR) theory,

- (i) state why methane has the shape shown, [2]

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- (ii) explain why the H – \hat{O} – H bond angle in water is less than the H – \hat{C} – H bond angle in methane. [2]

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- (b) Methane will react with hot copper(II) oxide to produce copper, carbon dioxide and steam.



- (i) State which **one** of the oxides in the equation can behave as a basic oxide, giving a reason for your choice. [1]

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- (ii) 3.98 g of copper(II) oxide reacts with methane. Calculate the maximum mass of copper produced to three significant figures. [3]

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- (iii) Methane will also react with copper(I) oxide, Cu_2O , to give the same products as copper(II) oxide.

Write the balanced chemical equation for this reaction. [1]

- (c) Water is an excellent solvent for many different types of compound.

Explain why both sodium chloride and ethanol are soluble in water.

Diagrams may be used in support of your answer.

Sodium chloride

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[2]

Ethanol

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[2]

(d) Explain why the vapour pressure of water rises as the temperature increases. [2]

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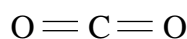
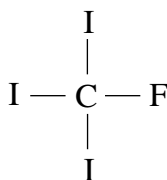
Total [15]

12. (a) (i) Explain the meaning of the term *electronegativity*. [1]

- (ii) The electronegativity values of some elements are given below.

<i>Element</i>	C	F	I	O
<i>Electronegativity value</i>	2.5	4.0	2.5	3.5

- Using δ^+ and δ^- , indicate bond polarity on the molecules below. [2]



- (b) The boiling temperatures of some hydrogen halides are shown in the table below.

<i>Hydrogen halides</i>	<i>Boiling Temperature / K</i>
HF	293
HCl	188
HBr	206
HI	238

Explain, in terms of the nature of the intermolecular bonding present, why the boiling temperature of hydrogen iodide is higher than those of hydrogen chloride and hydrogen bromide but is lower than that of hydrogen fluoride. [4]

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(c) Potassium iodide is a white ionic compound that is soluble in water.

- (i) Give a test which would confirm the presence of iodide ions in the solution, by stating the reactant(s) and observations. [2]

Reactant(s)

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Observations

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- (ii) State what would be observed, and write a balanced equation for the reaction between chlorine and potassium iodide solution. [2]

Observations

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Equation

(d) Iodine has over 30 isotopes but only one, ^{127}I , is stable.

- (i) Explain what is meant by the term *isotope*. [1]

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- (ii) Radioactive iodine, ^{131}I , has a half-life of 8 days.

State the mass of iodine remaining after 24 days if 1.00 g of ^{131}I is originally present. [1]

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Total [13]

Section B Total [56]

Rough work

A series of horizontal dotted lines for rough work.