Candidate Name	Centre Number	Candidate Number

WELSH JOINT EDUCATION COMMITTEE
General Certificate of Education
Advanced Subsidiary/Advanced

CYD-BWYLLGOR ADDYSG CYMRU
Tystysgrif Addysg Gyffredinol
Uwch Gyfrannol/Uwch

FOR EXAMINER'S USE ONLY		
Section	Question	Mark
A	1-9	
B	10	
	11	
	12	
	13	
TOTAL MARK		

331/01

CHEMISTRY CH1

A.M. WEDNESDAY, 7 June 2006

(1 hour 30 minutes)

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.

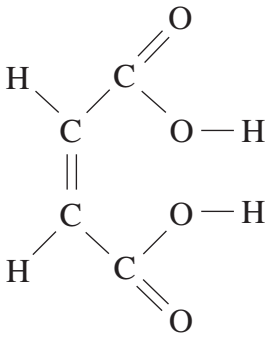
Page 14 may be used for rough work.

No certificate will be awarded to a candidate detected in any unfair practice during the examination.

SECTION A

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

1. Give the **empirical** formula of Compound **A**. [1]



Compound **A**

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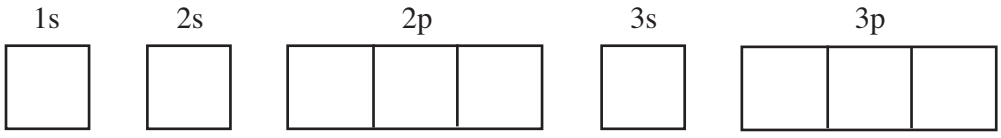
2. Showing outer electrons only, draw a dot and cross diagram for a gaseous hydrogen chloride molecule. [1]

3. (i) Using the convention of arrows to represent electrons, give the electronic structure of an atom of phosphorus. [1]



(ii) Give the balanced equation for the reaction of phosphorus with excess oxygen [1]

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4. State which **one** of the following is the correct equation for the reaction of chlorine with water. [1]

A $2Cl + H_2O \longrightarrow 2HCl + \frac{1}{2}O_2$

B $Cl_2 + 2H_2O \longrightarrow 2HCl + H_2O_2$

C $Cl_2 + 3H_2O \longrightarrow HClO_3 + 5HCl$

D $Cl_2 + H_2O \longrightarrow HCl + HOCl$

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5. State which **one** of the following is true. [1]

A An atom of silicon has five outer electrons.

B Electronegativity values increase down each group.

C Caesium chloride has crystal co-ordination numbers of 6:6.

D The mass spectrum of chlorine molecules has a peak at *m/e* 70.

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6. A compound that gives a green flame colour and is insoluble in water is [1]

A calcium carbonate,

B barium carbonate,

C calcium hydrogencarbonate,

D barium hydroxide.

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7. The half-life of the radioactive isotope, ^{24}Na, is 15 hours.
A research laboratory needs 0·05 g of ^{24}Na and delivery from the supplier takes 30 hours.
Select from the following the minimum amount of ^{24}Na which should be dispatched to the laboratory from the supplier. [1]

A 0·05 g

B 0·15 g

C 0·20 g

D 0·24 g

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8. The molar mass of an oxide of nitrogen is 76 g mol^{-1}.
Deduce the molecular formula of the oxide. [1]

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9. State which **one** of the following has a bond angle that is less than 109°. [1]

A BF_3

B CH_4

C SF_6

D NH_4^+

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Section A Total [10]

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SECTION B

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

10. Xenon, atomic number 54, is a noble gas that is present in small quantities in air.

(a) The radioactive isotope, ^{133}Xe, poses an environmental problem because of slow leakage from nuclear plants. This isotope is produced by the loss of a β particle from another element.

Name the element which decays to produce ^{133}Xe in this way. [1]

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(b) A meteorite contains the following percentages by mass of xenon isotopes.

Relative isotopic mass	129·0	131·0	132·0
Percentage abundance	48·00	28·00	24·00

Calculate the relative atomic mass of this xenon sample, giving your answer to **four** significant figures. [2]

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(c) Xenon is used as a fuel for ion engines in space flight. An ion engine uses the same principles as a mass spectrometer for the production of positive ions and the acceleration of these particles.

(i) State how the xenon atoms are ionised in a mass spectrometer. [1]

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(ii) Write the equation which corresponds to the first ionisation energy of xenon. [1]

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(iii) Explain why the first ionisation energy of xenon is smaller than the first ionisation energy of krypton. [2]

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(d) Xenon difluoride is a linear molecule where the bond between the xenon and fluorine atoms is a polar covalent bond.

F – Xe – F

(i) Give the **formula** of another molecule that has a polar covalent bond. [1]

.....

(ii) Explain why the bond between xenon and fluorine is described as a **polar** covalent bond. [1]

.....

(iii) Xenon difluoride reacts with hydrochloric acid, giving chlorine as one of the products.

$$XeF_2 + 2HCl \longrightarrow Xe + 2HF + Cl_2$$

You should assume that the oxidation state of fluorine remains unchanged at –1.

I Give the initial and final oxidation states of xenon and chlorine. [2]

Initial oxidation state of xenon .....

Final oxidation state of xenon .....

Initial oxidation state of chlorine .....

Final oxidation state of chlorine .....

II State, giving a reason, which compound is the oxidising agent. [1]

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(e) Under certain conditions, xenon behaves as an ideal gas.
Explain the nature of ideal gases using simple molecular theory. [2]

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Total [14]

11. *(a)* (i) Calcium metal may be obtained by heating calcium oxide with aluminium, giving aluminium oxide as the only other product.
Write a balanced equation for this reaction. [1]

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(ii) Describe what is seen when calcium is added to water. [2]

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(iii) State how the reactivity of the Group II elements with water varies from calcium to barium. [1]

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(b) Hydrated calcium sulphate (gypsum) is a mineral of formula $CaSO_4 . 2H_2O$.
On heating, gypsum loses water and produces 'plaster of Paris' of formula $CaSO_4 . \frac{1}{2}H_2O$.

$$CaSO_4.2H_2O \longrightarrow CaSO_4.\tfrac{1}{2}H_2O + 1\tfrac{1}{2}H_2O$$

(i) Calculate the mass of water lost when 1 mole of gypsum is heated as shown in the equation. [1]

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(ii) Calculate the relative molecular mass of gypsum. [1]

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(iii) Calculate the percentage loss in mass when one mole of gypsum is heated as given in the equation. [1]

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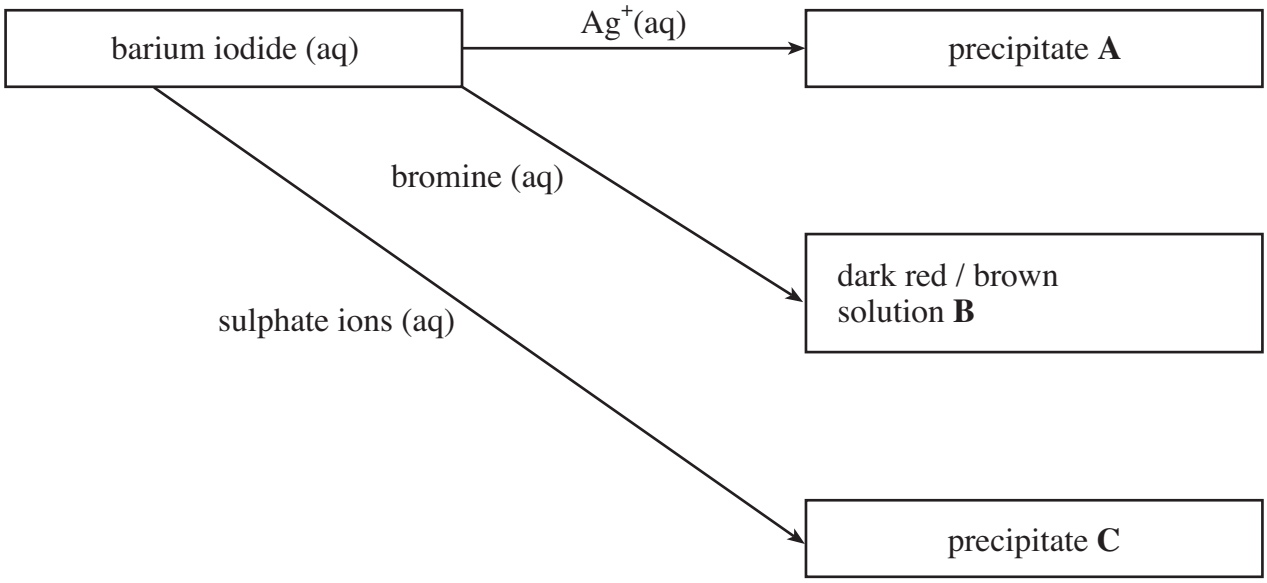
(c) The reaction scheme below shows some of the reactions of aqueous barium iodide. Study this reaction scheme and answer the questions that follow.



(i) State the colour of precipitate **A** and give the ionic equation for its formation.

Colour ..... [2]

Ionic equation .....

(ii) State which product of the reaction gives the dark red-brown solution **B** and state the role of aqueous bromine in this reaction. [2]

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(iii) Give the colour and the formula for precipitate **C**. [2]

Colour .....

Formula .....

Total [13]

12. *(a)* Yellow eye ointment once contained mercury(II) oxide, HgO.

(i) The bond between the mercury and oxygen atoms is described as a single covalent bond, where an electron from each atom is shared in the bond.
Describe the forces of attraction and repulsion that are present in this bond.[2]

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(ii) Mercury(II) oxide decomposes to mercury and oxygen when strongly heated.

$$2HgO \longrightarrow 2Hg + O_2$$

In an experiment, a sample of mercury(II) oxide of mass 8·68 g was completely decomposed at 580 °C.

(1 mole of oxygen has a volume of 70 dm^3 at 580 °C and 1 atmosphere pressure.)

I Calculate the number of moles of mercury(II) oxide used. [1]

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II Calculate the volume of oxygen formed, measured at 580 °C and at 1 atmosphere pressure. [1]

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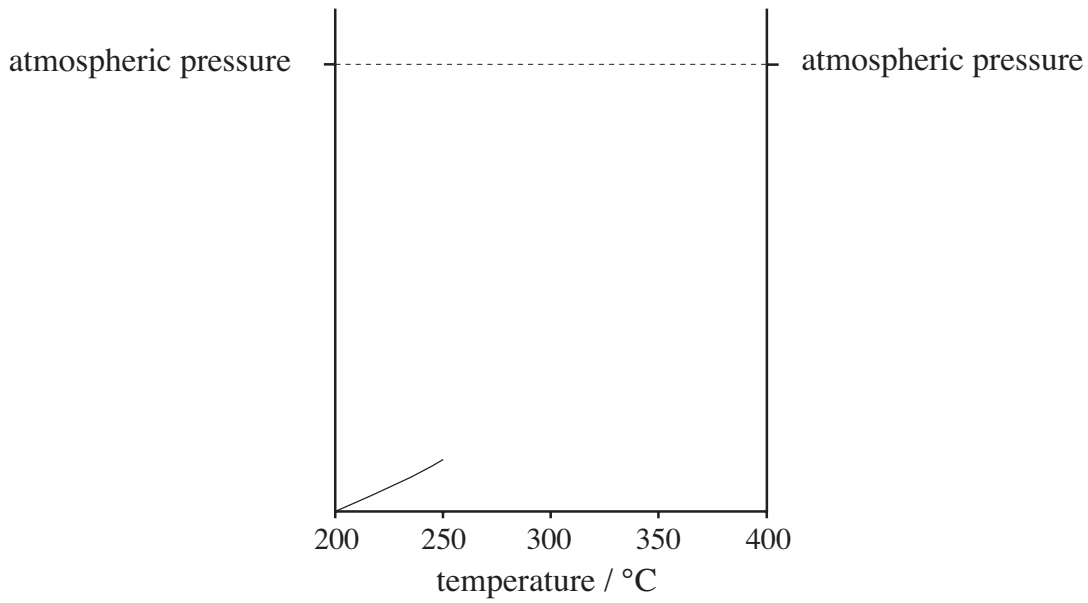
(iii) There is concern when heating compounds that produce mercury, because mercury vapour is very toxic.
Continue the line on the graph below to show how the vapour pressure of liquid mercury varies with temperature up to its boiling temperature of 357 °C. [2]



(b) Mercury and iodine are present in the ion, HgI_4^{2-}, which is used in analysis. The HgI_4^{2-} ion has the same shape and bond angles as a molecule of methane. Draw the shape of the HgI_4^{2-} ion in the box below, indicating the value of the I – Hg – I bond angle. [2]

(c) Explain what is meant by hydrogen bonding.

Your answer should include

- those elements which can be involved,
- an explanation of why those elements can take part in hydrogen bonding,
- a description of hydrogen bonding in liquid water which includes a diagram,
- the effect that hydrogen bonding has on the physical properties of both liquid water and ice. [6]

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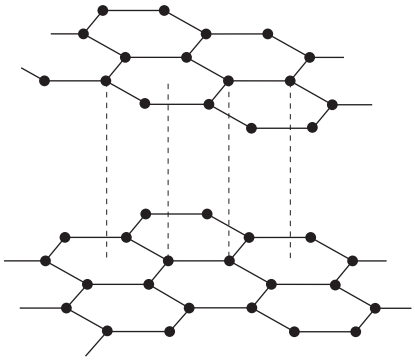
Total [14]

13. *(a)* The diagram shows the structure of graphite.



(i) Describe the bonding in graphite. [2]

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(ii) Describe the hardness and electrical conductivity of graphite and explain these in terms of the structure. [2]

Hardness .....

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Electrical conductivity .....

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(b) The structure of solid iodine is described as a molecular crystal with weak van der Waals (induced dipole – induced dipole) forces between individual iodine molecules. Explain how these induced dipole – induced dipole forces arise. [2]

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(c) Saltpetre is a rock which occurs in Chile. It contains iodine in the form of sodium iodate(V), $NaIO_3$.
Sodium thiosulphate solution was used to find the concentration of a solution of sodium iodate(V).

(i) The experiment used $36{\cdot}0\,cm^3$ of a sodium thiosulphate solution of concentration $0{\cdot}100$ mol dm^{-3}.
Calculate the number of moles of sodium thiosulphate present in this solution. [1]

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(ii) Six moles of sodium thiosulphate were needed for each mole of the sodium iodate(V).
State the number of moles of sodium iodate(V) present in the sample. [1]

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(iii) The volume of sodium iodate(V) solution used in the experiment was $50{\cdot}0\,cm^3$.
Calculate the concentration of the sodium iodate(V) solution in mol dm^{-3}. [1]

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(iv) Use your answer to (iii) to calculate the concentration of the sodium iodate(V) solution in g dm^{-3}. [1]
The relative molecular mass of sodium iodate(V) is 198.

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(d) (i) First molar ionisation energies generally increase across Period 3 from sodium to argon.
Explain why this statement is true. [3]

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(ii) Explain why the first molar ionisation energy of aluminium is smaller than that of magnesium. [2]

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Total [15]

Section B Total [56]

Turn over.

Rough work