Candidate Name	Centre Number	Candidate Number
		2

GCE AS/A level

1092/01

CHEMISTRY CH2

A.M. MONDAY, 7 June 2010

1½ hours

FOR EXAMINER'S USE ONLY		
Section	Question	Mark
A	1-6	
B	7	
	8	
	9	
	10	
	11	
TOTAL MARK		

1092 01 01

ADDITIONAL MATERIALS

In addition to this examination paper, you will need a:
- calculator;
- **Data Sheet** containing a **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 (70 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 80.

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.

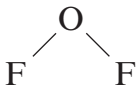
Page 14 may be used for rough work.

Examiner only

SECTION A

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

1. The covalent compound difluorine oxide has the formula



(i) Showing **outer** electrons only, draw a dot and cross diagram for difluorine oxide. [1]

(ii) Difluorine oxide reacts with magnesium metal to produce magnesium oxide and magnesium fluoride, MgF_2.
Give the equation for this reaction. [1]

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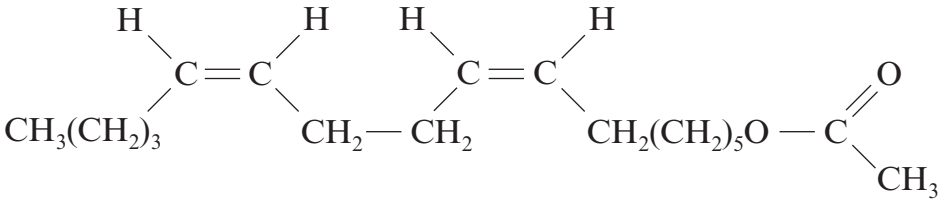
2. Potassium chloride can be used by those who need a low-salt diet.
Its solubility in water at two temperatures is shown in the table.

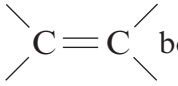
Temperature / °C	Solubility / g per 100 g of water
15	32.7
100	56.5

Calculate the mass of solid potassium chloride produced when a saturated solution containing 500 g of water is cooled from 100 °C to 15 °C. [2]

..... g

3. The formula for an attraction pheromone for the pink bollworm is shown below.



(i) State a suitable catalyst for the hydrogenation of the  bonds present. [1]

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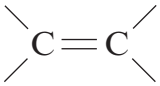
(ii) This pheromone molecule contains two  bonds which both have the Z (cis) configuration.
Explain why an alkene can exist as either an E (trans) or a Z (cis) isomer. [1]

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4. The relative molecular mass of a **branched-chain** alkane is 72.
Alkanes have the general formula C_nH_{2n+2}.

(i) State the **molecular** formula of the alkane. ..... [1]

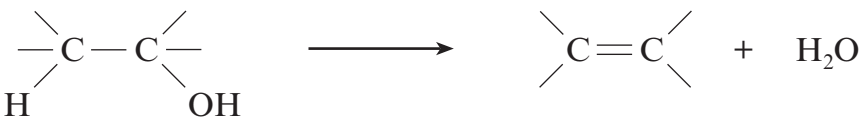
(ii) Draw one **displayed** formula of this alkane. [1]

5. Use the words 'increases' or 'decreases' to complete the sentence below. [1]
Each word can be used once, more than once or not at all.

As the hydrocarbon chain length in carboxylic acids increases, the boiling temperature

..... and the solubility in water ..... .

6. State the type of reaction occurring during this chemical change. [1]



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Total Section A [10]

Examiner only

SECTION B

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

7. *(a)* Sulfur hexafluoride, SF_6, is a colourless gas that is used as an insulator in electrical transformers.

(i) Complete the table below, giving the number of bonding and lone pairs for the sulfur atom in a molecule of gaseous sulfur hexafluoride.

Use your answers to deduce an F — $\hat{S}$ — F angle and name the shape of the SF_6 molecule. [4]

Number of bonding pairs	Number of lone pairs	F — $\hat{S}$ — F	Shape

(ii) The S — F bond in sulfur hexafluoride is a polar covalent bond.
Describe what is meant by bond polarity and how it arises in this bond. [2]

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(iii) Sulfur hexafluoride reacts with hydrogen sulfide in a redox reaction.

$$SF_6 + 3H_2S \longrightarrow 6HF + 4S$$

Complete the table below, giving the oxidation states (numbers) of the sulfur atoms present and use these to explain how hydrogen sulfide is the reducing agent in this reaction. [2]

Oxidation state of sulfur in SF_6	Oxidation state of sulfur in H_2S	Oxidation state of sulfur in sulfur, S

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.....

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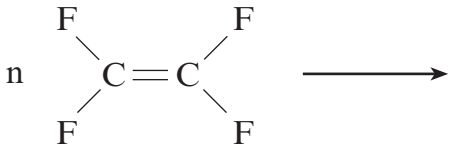
(b) Sodium fluoride is a white, ionic solid that has the same crystal structure as sodium chloride.
Give the formula of each ion present and its crystal co-ordination number. [2]

Sodium ion ..... *Crystal co-ordination number* .....

Fluoride ion ..... *Crystal co-ordination number* .....

(c) Tetrafluoroethene, C_2F_4, can be polymerised to give poly(tetrafluoroethene), PTFE, in a similar way to the polymerisation of ethene.

(i) Complete and balance the equation below, showing a repeating section of the structural formula of poly(tetrafluoroethene). [1]



(ii) A stretched form of PTFE is marketed under the name 'Goretex'. This is used to make waterproof materials that can 'breathe'. Gaseous water molecules can escape from tiny 'holes' in the fabric but larger liquid water droplets cannot enter. These liquid water droplets contain water molecules that are hydrogen bonded to each other.

Draw a diagram to show hydrogen bonding between water molecules. [3]

Total [14]

Examiner only

8. *(a)* (i) 0.115 g of impure calcium metal was added to water. Hydrogen gas and calcium hydroxide were formed.
Give the equation for this reaction. [1]

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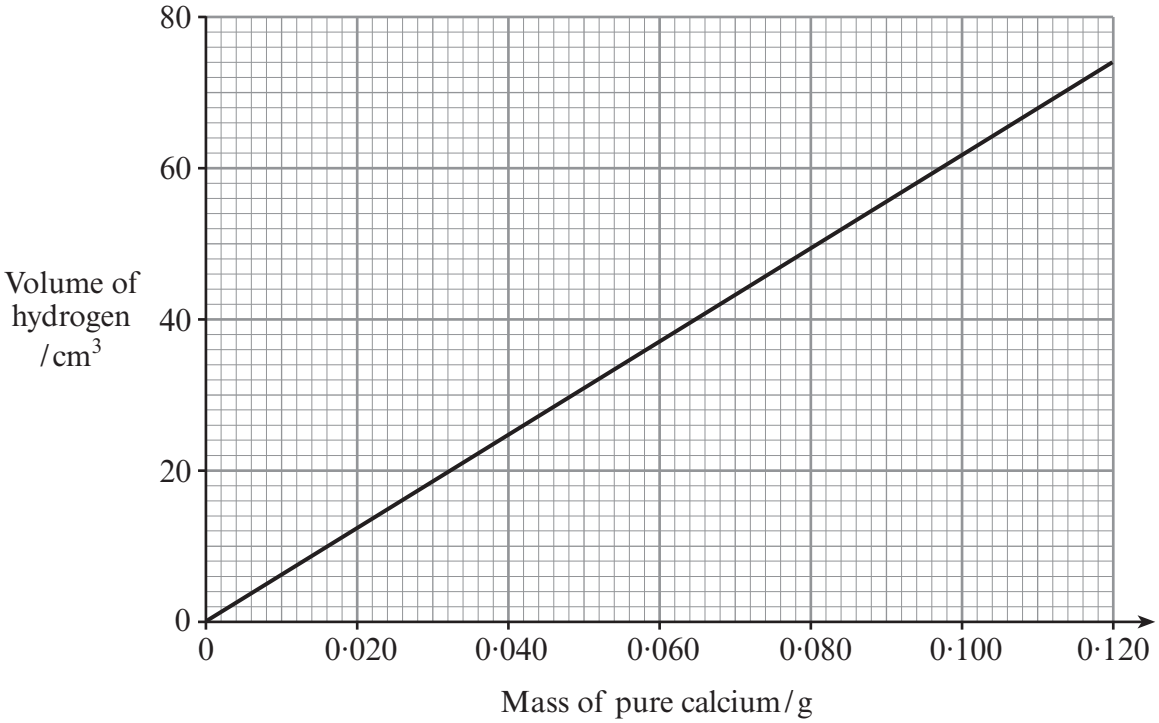
(ii) All the hydrogen produced was collected and gave a volume of 64.0 cm^3.



Use the graph to find the mass of pure calcium present and hence the percentage purity of the calcium used. [2]

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(iii) Jonathan added a piece of strontium metal to water. He noticed that the reaction was more vigorous than when using calcium. He said that one reason for this was that the strontium ion, Sr^{2+}, was formed more easily than the calcium ion, Ca^{2+}.

Explain why this statement is true, in terms of the electronic structures of the two metals. [2]

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(b) A solution, giving an apple-green colour to a flame, was suspected to be aqueous barium hydroxide.

Describe **two** simple tests to confirm this conclusion, giving the result of each test. [2]

1. .....

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2. .....

.....

(c) Both solid strontium metal and solid graphite are conductors of electricity.
Describe the structures of these two materials and explain how they are both able to conduct electricity. You may use diagrams in your answer. [5]

QWC [1]

Strontium

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.....

Graphite

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(d) There is much interest in carbon nanotubes as drug delivery agents.
Describe how the structure of carbon nanotubes is related to the structure of graphite. [2]

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Total [15]

Examiner only

9. *(a)* Methane reacts with gaseous chlorine giving chloromethane and hydrogen chloride.

$$CH_4(g) + Cl_2(g) \longrightarrow CH_3Cl(g) + HCl(g)$$

In a report of this reaction, a student came across a number of terms.
Illustrating your answer with an equation in **each** case, state what is meant by

(i) homolytic fission, [2]

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(ii) a propagation stage. [2]

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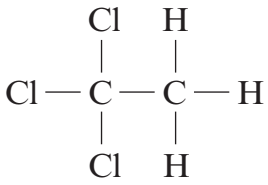
(b) Ethane reacts with chlorine in a similar way to methane. One of the products is 1,1,1-trichloroethane.



(i) The manufacture and use of 1,1,1-trichloroethane is now restricted because of its adverse effects on the ozone layer. However, the corresponding fluoro-compound 1,1,1-trifluoroethane does not cause environmental problems in the ozone layer.

Explain why only the chloro-compound has these adverse effects. [2]

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Examiner only

(ii) A sample of 1,1,1-trichloroethane is reacted with an excess of sodium hydroxide solution and then acidified.

I. One of the organic products of this reaction is liquid **R**, whose mass spectrum shows a molecular ion at m/z 60.
The infrared spectrum of **R** shows characteristic absorption frequencies at $1725\,cm^{-1}$ and $2500 - 3500\,cm^{-1}$.
Use this information, showing your working, to suggest a structural formula for liquid **R**. [4]

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II. Chloride ions are also produced when 1,1,1-trichloroethane reacts with aqueous sodium hydroxide. The products of the reaction are then acidified with nitric acid and the mixture tested for the presence of chloride ions.
State the reagent(s) used and the observations when the mixture was tested for chloride ions. [2]

Reagent(s) .....

Observations .....

Total [12]

Examiner only

10. *(a)* Bromine is produced commercially from bromide ions in sea water by reaction with chlorine.

(i) Give the equation for this reaction. [1]

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(ii) Although both bromine and chlorine are oxidising agents, this reaction proceeds because chlorine is a stronger oxidising agent than bromine.

I. Explain what is meant by the term *oxidising agent*. [1]

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II. Explain why chlorine is the stronger oxidising agent. [2]

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(iii) Air is then blown through the bromine-containing mixture to remove bromine as its vapour.
Iodine can be produced in a similar way from the iodide ions present in sea water but it is more difficult to produce iodine vapour from its solution because iodine is less volatile than bromine.
Explain, in terms of bonding, why iodine is less volatile than bromine. [2]

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(b) One important use of a bromine compound is as a very concentrated aqueous solution of calcium bromide, in the oil industry.

(i) The concentration of a calcium bromide solution is $1200\,g\,dm^{-3}$.
Calculate the concentration of this solution in mol dm^{-3}. [2]

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(ii) Many of the metals present in compounds of Group 2 can be identified by a flame test.
Complete the table below showing the flame colours (if any) obtained using magnesium bromide and calcium bromide. [2]

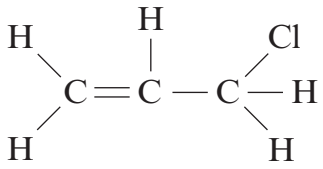
Compound	Flame colour (if any)
magnesium bromide	
calcium bromide	

Examiner only

(c) 1,2-Dibromo-3-chloropropane has been used to control nematode worm attack on fruit and vegetables.

(i) Give the displayed formula of this compound. [1]

(ii) It can be made by reacting 3-chloropropene with bromine.



3-chloropropene

I. State why this is described as an addition reaction. [1]

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II. Bromine reacts as an electrophile in this reaction.
Give the **formula** of another example of an electrophile. [1]

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III. The mechanism for this reaction can be shown using a curly arrow (↷).
State what this symbol is used to represent. [1]

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Total [14]

Examiner only

11. *(a)* One method for making butan-1-ol is to react sodium hydroxide (used as a source of hydroxide ions) and 1-chlorobutane.
Describe how butan-1-ol can be made in this way.
Your answer should

- state any necessary conditions
- show the mechanism for the reaction between hydroxide ions and 1-chlorobutane
- state the type of reaction mechanism [6]

(QWC) [2]

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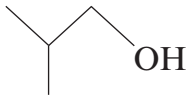
(b) Compound **G** is an isomer of butan-l-ol and its skeletal formula is



(i) Give the **systematic name** of compound **G**. [1]

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(ii) Compound **G**, $C_4H_{10}O$, is being developed as a possible replacement for ethanol in fuels. In a new process it is made by reacting genetically modified *E. coli* bacteria with glucose in aqueous solution.
One equation for this is

$$C_6H_{12}O_6 \longrightarrow C_4H_{10}O + 2CO_2 + H_2O$$

M_r 74

In a laboratory experiment, 0.50 mol of glucose reacted in this way to give an 86% yield, by mass, of compound **G**.
Calculate the mass of compound **G** produced. [2]

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Examiner only

(iii) Both butan-1-ol and compound **G** are primary alcohols that can be oxidised to carboxylic acids.
Give an oxidising agent that can be used, in acid solution, to oxidise primary alcohols to carboxylic acids and state what is seen as the reaction proceeds. [2]

Oxidising agent .....

Observation(s) .....

(c) One method of preparing an alcohol is from an alkene and water/steam.
State the conditions of temperature and pressure used in the preparation of ethanol from ethene. [2]

Temperature .....

Pressure .....

Total [15]

Total Section B [70]

Examiner only

Rough Work