| Surname | Centre Number | Candidate Number |
|---|---|---|
| Other Names | | 2 |

# GCE AS/A level

1092/01

# CHEMISTRY CH2

P.M. WEDNESDAY, 23 May 2012

1½ hours

| FOR EXAMINER'S USE ONLY | | |
|---|---|---|
| Section | Question | Mark |
| A | 1-6 | |
| B | 7 | |
| | 8 | |
| | 9 | |
| | 10 | |
| | 11 | |
| | 12 | |
| TOTAL MARK | | |

**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**

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

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.

The *QWC* label alongside particular part-questions indicates those where the Quality of Written Communication is assessed.

If you run out of space, use the continuation page at the back of the booklet, taking care to number the question(s) correctly.

## SECTION A

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

**1.** The straight-chain alkane containing 19 carbon atoms is called nonadecane.

*(a)* Write the **molecular** formula of nonadecane. [1]

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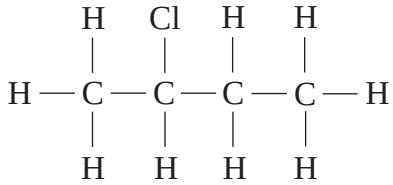
*(b)* When nonadecane is cracked, one of the smaller products formed can be octane.

Write an equation to show the cracking of nonadecane to produce octane. [1]

**2.** Name the compound whose formula is shown below. [1]



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**3.** Draw the displayed formula for (Z)-2-iodobut-2-ene. [1]

**4.** Chlorine forms a series of oxides that react with water.

Suggest a pH value for the solution formed when an oxide of chlorine reacts with water. [1]

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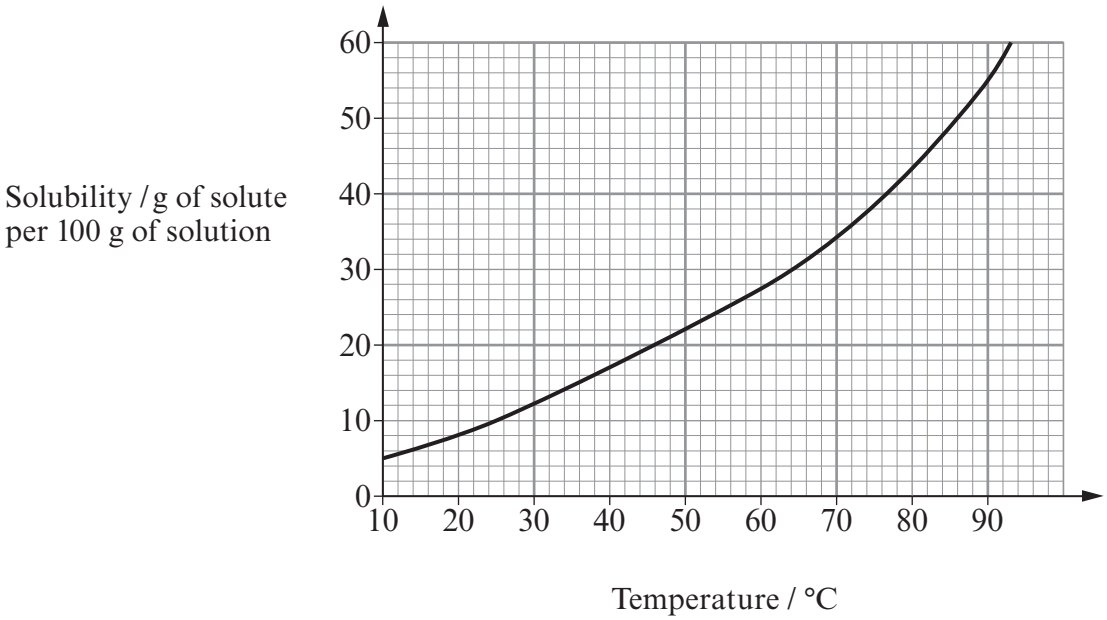
**5.** A solid was prepared in an impure state and it was then purified by recrystallisation. The solid was dissolved in the minimum amount of water at 90 °C and the solution was cooled to 25 °C.

The solubility curve for the solid in water is shown below.




*(a)* Use the solubility curve to find the maximum mass of solid that would form from 100 g of solution cooled from 90 °C to 25 °C. [1]

*Maximum mass* ..... g

*(b)* What effect would it have on your answer to *(a)* if more hot solvent had been used to dissolve the impure solid? Give a reason for your answer. [1]

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1092 010003







**Turn over.**

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**6.** When the temperature is increased, both solid iodine and diamond change directly into their gaseous state – they sublime.

*(a)* In each case, name the force or bond that is being overcome when the solid changes into a gas. [2]

*Iodine* .....

*Diamond* .....

*(b)* State, with a reason, which solid would have the higher sublimation temperature. [1]

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**Total Section A [10]**

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## SECTION B

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

**7.** Boron, B, has the atomic number 5 and it forms a fluoride, $BF_3$.

*(a)* $BF_3$ is used to initiate certain types of addition polymerisation of unsaturated compounds.

(i) Ethene is an example of an unsaturated compound. Describe the bonding between the carbon atoms in ethene. You may wish to draw a labelled diagram. [2]

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(ii) State what is meant by *polymerisation*. [1]

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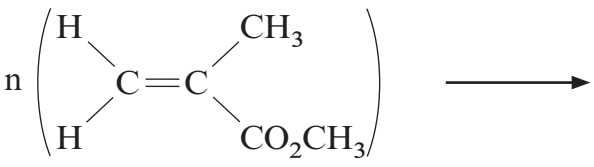
(iii) A colourless plastic used to cover lights is made from methyl methacrylate by a process similar to the polymerisation of ethene. Complete the equation by giving the formula of the repeating unit. [1]




(iv) Addition polymerisation is used to make synthetic rubber. The molecular formula of the monomer used is $C_4H_5Cl$. What is the **empirical** formula of the synthetic rubber polymer? [1]

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*(b)* (i) Use the VSEPR theory to deduce the shapes of $BF_3$ and $NH_3$. [2]

*Shape of* $BF_3$ .....

*Shape of* $NH_3$ .....

(ii) Explain the difference in the shapes of $BF_3$ and $NH_3$. [2]
*QWC* [1]

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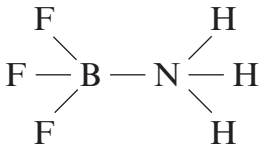
*(c)* Boron fluoride reacts with ammonia, $NH_3$, to make the compound shown in the following equation.

$$BF_3 + NH_3 \longrightarrow$$




(i) Name the type of bond formed between N and B. [1]

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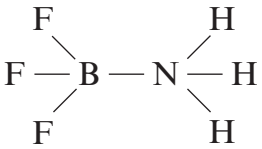
(ii) Suggest a value for the F–B–F bond angle in this molecule.




*Bond angle* ..... [1]

(iii) Explain your answer to part (ii). [1]

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Total [13]

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**8.** *(a)* Compound **X** is a straight-chain hydrocarbon that consists of 85.7% carbon by mass.

(i) Find the **empirical** formula of compound **X**. [3]

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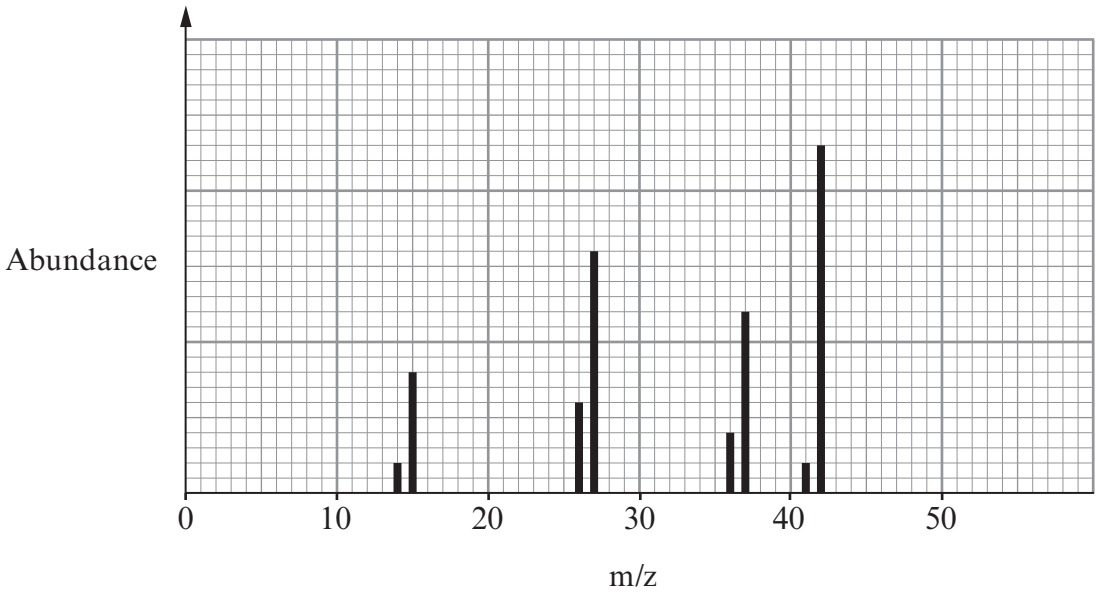
(ii) Some peaks from the mass spectrum of **X** are shown below.




Use the empirical formula and the mass spectrum to find the molecular formula of **X**. Show your workings. [2]

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(iii) Suggest what information the presence of the peak at m/z 15 gives about the structure of **X**. [1]

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*(b)* Butene, $C_4H_8$, is an alkene. Draw **displayed** formulae for three **straight-chain** isomers of $C_4H_8$. [3]

Total [9]

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**Turn over.**

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**9.** Calcium is present in teeth in the form of calcium phosphates. These do not react with water. The element calcium, however, reacts with water to produce calcium hydroxide and hydrogen gas.

$$Ca(s) + 2H_2O(l) \longrightarrow Ca(OH)_2(aq) + H_2(g)$$

*(a)* A student investigated the reaction between calcium and cold water. He added 2.0 g of calcium to some water and collected the hydrogen gas formed.

Draw a labelled diagram of an apparatus that would be suitable for carrying out this reaction and measuring the volume of hydrogen produced. [2]

*(b)* The student repeated the reaction using the same mass of barium. He noticed that the volume of gas, still at the same temperature and pressure, was less.

(i) Give the reason why the volume of gas produced was less. [1]

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(ii) Suggest another difference that the student would observe when barium was used in place of calcium. Explain your answer. [2]

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*(c)* The student did not label the flasks containing the solutions after the reactions with calcium and with barium.

Give a test that would distinguish between these solutions. Include the result of your test for both solutions. [2]

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*(d)* Calcium oxide also reacts with water to produce calcium hydroxide. Draw a dot and cross diagram to show the bonding in calcium oxide. Show only the electrons in outer shells. [2]

*(e)* Barium, as barium sulfate, is used medicinally in barium meals since it is insoluble in water and shows on x-ray images.

(i) Starting from the solution of barium hydroxide the student produced in *(b)*, describe how he could obtain a pure, dry sample of barium sulfate.

You should include an **ionic** equation for the reaction. [3]

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(ii) Calculate the maximum mass of barium sulfate that the student could make, starting with 2.0 g of barium. [2]

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*Mass* = ..... g

Total [14]

Examiner only

**10.** *(a)* Explain the fact that the melting temperature of sodium is much lower than the melting temperature of magnesium.

You should include reference to the type(s) of bonding involved and how this bonding affects melting temperatures. You may include a diagram if you consider it helpful.

[3]

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*(b)* In an experiment, 1-chlorobutane was heated with aqueous sodium hydroxide and the resulting solution was acidified. Aqueous silver nitrate was then added and a white precipitate was observed.

The experiment was repeated using 1-bromobutane and in this case a cream precipitate was observed.

Explain these observations.

You should include:

- the type of reaction that occurs between the halogenoalkane and sodium hydroxide
- an equation for this reaction
- the identity of the coloured precipitates
- an equation to show the formation of these precipitates. [4]

*QWC* [1]

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*(c)* Describe how the structures of sodium chloride and caesium chloride are similar and how they are different. Give a reason for any difference.
You may include a diagram if you consider it helpful. [3]

*(d)* When hydrogen bromide, HBr, is added to propene, $C_3H_6$, two different products are possible. In practice, however, more of one of the products is formed.
Explain why more of one product is formed.

You should:

- state the type of reaction involved
- identify the two possible products
- state which of the two products predominates
- give the reason why more of this product is formed. [4]

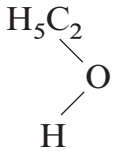
*QWC* [1]

Total [16]

Examiner only

**11.** Ethanol, $C_2H_5OH$, is the alcohol that is present in alcoholic drinks.

*(a)* Ethanol is soluble in water. Complete the diagram below to show why ethanol is soluble in water. You should include relevant lone pairs and dipoles and label the bond responsible for this solubility. [3]




*(b)* If it is suspected that a driver has been drinking alcohol they can be tested in several ways.

(i) One method previously used to test for ethanol in breath involved blowing through acidified potassium dichromate(VI). A positive test was shown by the colour change from orange to green.

What type of reaction causes this colour change? [1]

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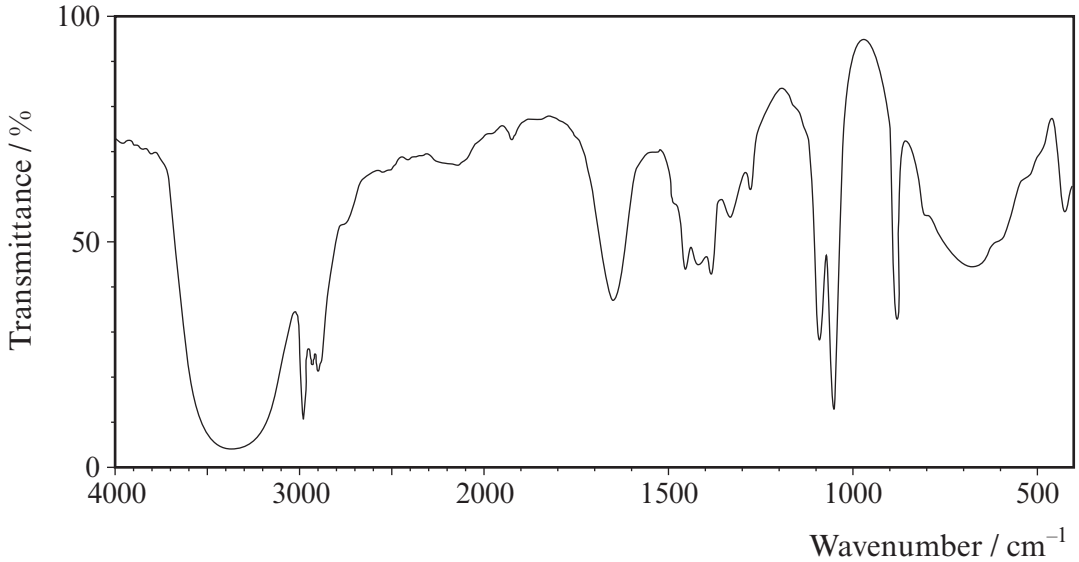
(ii) Another method uses IR spectroscopy. The IR spectrum for ethanol is shown below.




I State which functional group is shown to be present in ethanol by the absorption at about 3350 cm$^{-1}$. [1]

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II A student suggested that this absorption should be used to test for the presence of ethanol in breath. Give a reason why this suggestion is not valid. [1]

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*(c)* If ethanol, in a drink such as wine, is left in an open bottle and exposed to air it becomes 'sour' and unpleasant to taste. This is because it forms ethanoic acid.

(i) Draw the **displayed** formula of ethanoic acid. [1]

(ii) What significant change would be noticed if the IR spectrum of this product was compared with that of ethanol? Give the reason for this change. [2]

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Total [9]

Examiner only

**12.** The elements in Group 7 in the Periodic Table can be described as *p*-block elements.

*(a)* State why these are described as *p*-block elements. [1]

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*(b)* All halogens are oxidising agents.

(i) Why are the halogens oxidising agents? [1]

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(ii) State, giving a reason, which halogen is the strongest oxidising agent. [1]

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*(c)* $NaClO_3$ was used as a weedkiller. Give the oxidation state of chlorine in $NaClO_3$.

*Oxidation state* ..... [1]

*(d)* Methane reacts with chlorine when exposed to sunlight. The first two stages of the mechanism of this reaction are initiation and propagation.

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

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(ii) Give equations for **two** propagation steps involved in the formation of chloromethane. [2]

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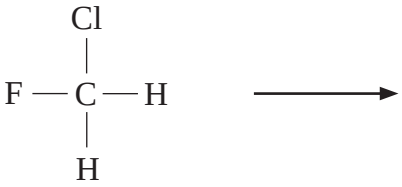
*(e)* Chlorofluorocarbons, CFCs, were widely used as refrigerants but they caused serious environmental damage as a result of reactions involving radical mechanisms.

The first stage of a radical mechanism is an initiation process similar to that in *(d)*. Complete the following equation to show the most likely initiation step for chlorofluoromethane, $CH_2ClF$, and give a reason for your answer. [2]




*Reason* .....

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Total [9]

**Total Section B [70]**

| Question number | Write the question numbers in the left-hand margin |
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| Question number | Write the question numbers in the left-hand margin |
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WJEC
CBAC

# GCE AS/A level

1092/01-A

## CHEMISTRY – DATA SHEET
### FOR USE WITH CH2

P.M. WEDNESDAY, 23 May 2012

## Infrared Spectroscopy characteristic absorption values

| Bond | Wavenumber / $cm^{-1}$ |
|---|---|
| C—Br | 500 to 600 |
| C—Cl | 650 to 800 |
| C—O | 1000 to 1300 |
| C═C | 1620 to 1670 |
| C═O | 1650 to 1750 |
| C≡N | 2100 to 2250 |
| C—H | 2800 to 3100 |
| O—H | 2500 to 3550 |
| N—H | 3300 to 3500 |

# THE PERIODIC TABLE