Candidate Name	Centre Number	Candidate Number
		2

GCE AS/A level

1092/01

CHEMISTRY CH2

P.M. FRIDAY, 27 May 2011

1½ hours

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

1092 010001

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.

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 16 may be used for rough work.

SECTION A

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

1. barium sulfate

calcium carbonate

magnesium hydroxide

sodium carbonate

From the list above, choose the compound that

(a) gives a brick-red flame test, [1]

.....

(b) is the **most** soluble in water. [1]

.....

2. Complete the table below to show the type or types of bonding present in the following solids. [2]

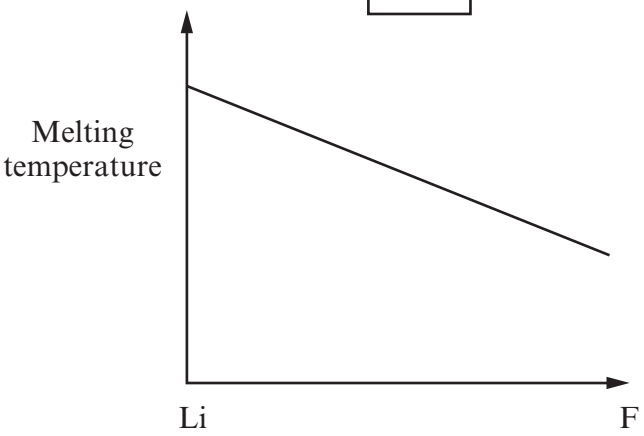
Solid	Type or types of bonding
calcium	
iodine	

3. Calcium phosphate is found widely in nature, e.g. in bones and in the leaves of plants. The formula for the phosphate ion is PO_4^{3-}. Write the formula for calcium phosphate. [1]

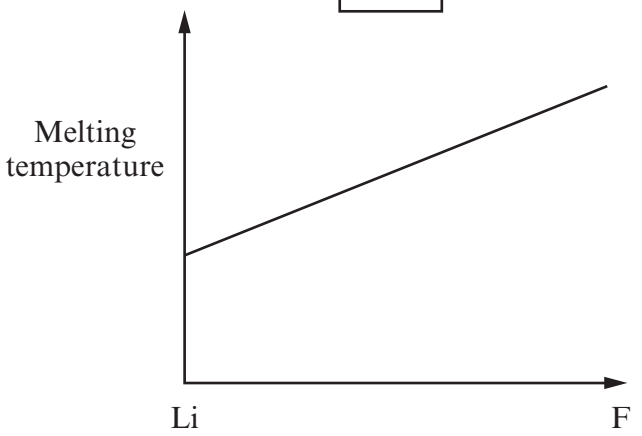
.....

4. State which one of the following graphs best shows how melting temperature changes across period 2 in the Periodic Table. [1]

A



B



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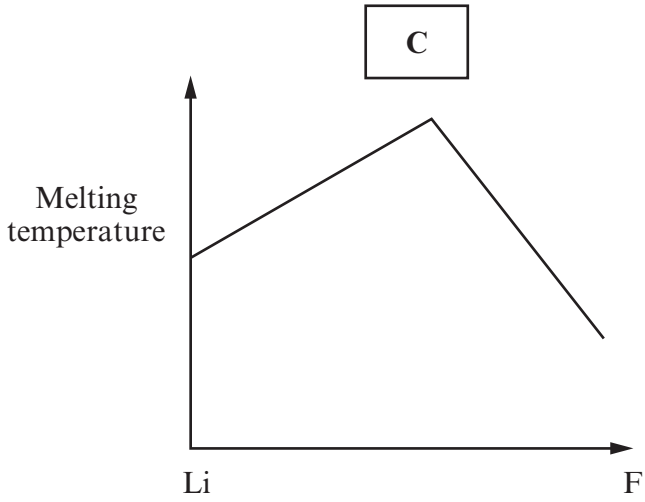
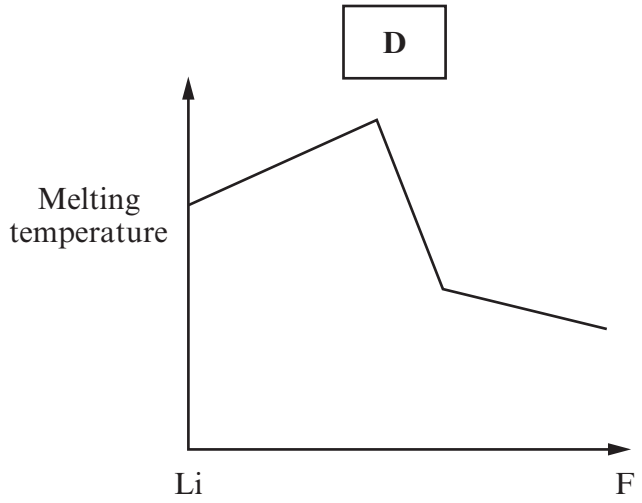


D



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5. In recent years scientists have developed a range of materials known as smart materials. State what is meant by a *smart material*. [1]

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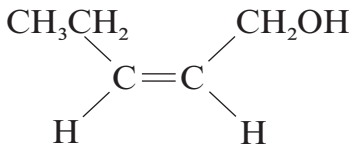
Examiner only

6. The compound below has a cherry odour and is used in the manufacture of fragrance agents.



(a) Name the functional groups present in this compound. [2]

.....

(b) State the **molecular** formula of the compound. [1]

.....

Section A Total [10]

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SECTION B

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

7. Petroleum is a mixture of saturated hydrocarbons, some of which are structural isomers of one another. These are separated into fractions by distillation. Some of these fractions are used to make important chemicals such as ethene while others are used as fuels.

(a) Explain what is meant by a *saturated* hydrocarbon. [1]

.....

.....

.....

(b) Propane and heptane, C_7H_{16}, are two of the hydrocarbons obtained from petroleum.

(i) Write a balanced equation for the complete combustion of propane. [2]

.....

(ii) 3-Ethylpentane is a structural isomer of C_7H_{16}.
Draw the **skeletal** formula of this isomer. [1]

(c) Name and briefly describe the process by which ethene is produced from a petroleum fraction. [2]

.....

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Examiner only

(d) Describe the structure of and bonding in an ethene molecule. [3]
QWC [1]

You may use a diagram in your answer.

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.....

(e) Name the type of reaction mechanism occurring when ethene reacts with aqueous bromine and draw the displayed formula of the product formed. [2]

Type of reaction mechanism .....

Displayed formula

(f) Ethene can be used as the starting material in the industrial preparation of ethanol. The conditions for the reaction are a temperature of 300 °C and a pressure of 60-70 atm.

Name the catalyst used in this reaction. [1]

.....

(g) Another way to prepare ethanol is by the fermentation of glucose.

$$C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2$$

Calculate the minimum mass of glucose required to give 230 g of ethanol. [3]

.....

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.....

.....

Total [16]

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8. *(a)* Chloroalkanes such as 1-chlorobutane are used in the synthesis of many organic compounds.

1-Chlorobutane can be formed from butane and chlorine in a similar way to the formation of chloromethane from methane and chlorine.

Describe the reaction of butane and chlorine to form 1-chlorobutane.

Your description should include:
- an overall equation for the reaction;
- the conditions required for the reaction to take place;
- full details of the reaction mechanism. [6]

QWC [1]

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(b) Give the equation for the reaction between 1-chlorobutane and aqueous sodium hydroxide and name the type of reaction mechanism occurring. [2]

Equation .....

Type of reaction mechanism .....

(c) A compound is known to be either 1-chlorobutane or 1-bromobutane.
Describe a test, giving any reagents used and observations, to show that the compound is 1-chlorobutane. [3]

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Examiner only

(d) Chlorofluorocarbons were used at one time as refrigerants in air-conditioning systems in cars and buildings. However, due to leakage over time, their use for this purpose is being phased out.

State the environmental consequence of leakage of chlorofluorocarbons. [1]

.....

Total [13]

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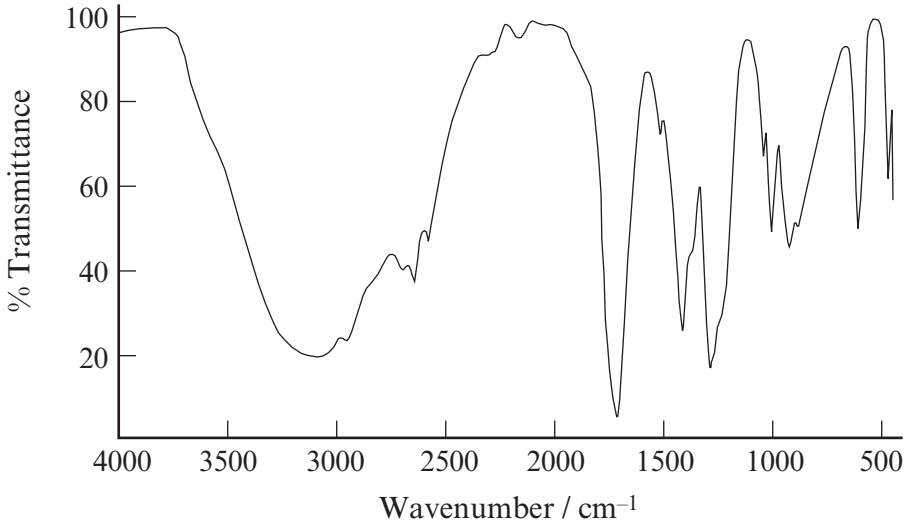
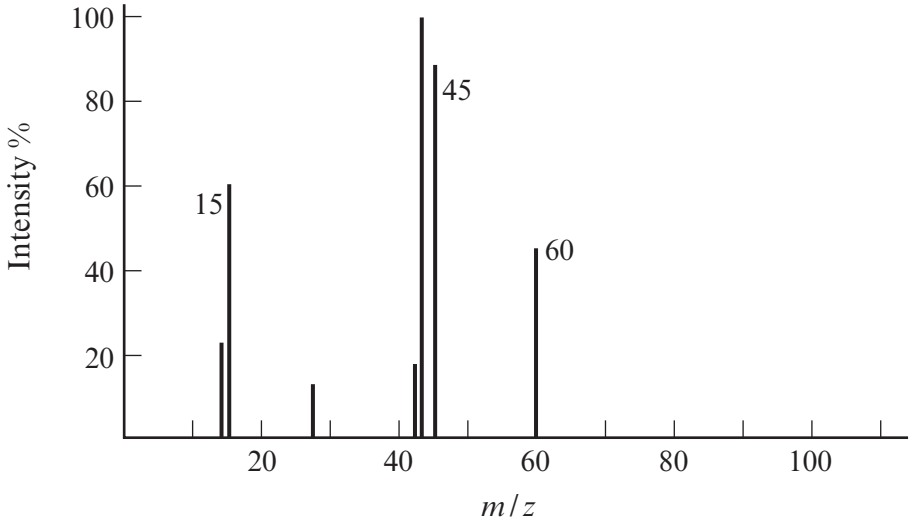
9. Ethanoic acid, CH_3COOH, commonly known as acetic acid, is an organic acid that gives vinegar its sour taste and pungent smell.

(a) Ethanoic acid contains C—O, C═O and O—H bonds and has the infrared spectrum shown below. Using the Data Sheet, label the characteristic absorptions for **each** of these **three** bonds on the spectrum. [2]



(b) The mass spectrum of ethanoic acid is shown below.



Explain how this shows that the formula for ethanoic acid is CH_3COOH. [2]

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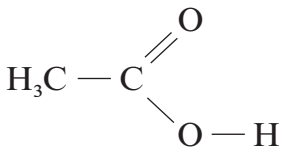
(c) The crystal structure of ethanoic acid shows that the molecules are found in pairs with hydrogen bonds between each pair.

(i) Complete the diagram to show how **two** molecules of CH_3COOH can join together through hydrogen bonding. [1]



(ii) Describe what is meant by *hydrogen bonding*. [3]
QWC [1]

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(d) Ethanoic acid can be formed from the oxidation of ethanol by potassium dichromate(VI).

(i) State the conditions required for this reaction to take place. [1]

.....

(ii) State what you would observe during the reaction. [1]

.....

(e) The boiling temperature of ethanol is 78 °C. Giving a reason in **both** cases, state how you would expect the boiling temperatures of the following compounds to differ from that of ethanol. [2]

Propane .....

.....

.....

Butan-1-ol .....

.....

.....

Total [13]

Examiner only

10. Because of its many uses, over 100 million tonnes of ammonia are manufactured each year.

(a) One of the main uses of ammonia is in the production of nitric acid. In the first part of this process a mixture of ammonia and air is passed over a catalyst at 850 °C.

$\square\ NH_3(g) + \square\ O_2(g) \longrightarrow \square\ NO(g) + \square\ H_2O(g)$

(i) Balance the equation above. [1]

(ii) Complete the table below, giving the oxidation states (numbers) of each element present and use these to explain which species has been oxidised in this reaction. [3]

Element	Initial oxidation state	Final oxidation state
nitrogen		
hydrogen		
oxygen		

.....

.....

(iii) Explain in terms of VSEPR theory why ammonia, NH_3, and boron trifluoride, BF_3, have different shapes. [3]

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Examiner only

(b) A significant amount of ammonia is also used as a general purpose cleaner for many household surfaces.

Household ammonia is an alkaline solution formed by mixing ammonia with water.

$$NH_3(g) + H_2O(l) \longrightarrow NH_4^+(aq) + OH^-(aq)$$

(i) The ammonium ion shows *coordinate bonding*. Explain what is meant by this term. [1]

.....

.....

(ii) Using outer electrons only, draw a dot and cross diagram to show the bonding in an ammonium ion. Include the charge on the ion. [2]

(iii) State the shape of an ammonium ion and the bond angle present. [2]

Shape .....

Bond angle .....

(iv) Another compound that contains ammonium ions is ammonium chloride, NH_4Cl. Like sodium chloride it is an ionic compound.

Explain why it is soluble in water. [2]

You may use a diagram in your answer.

.....

.....

.....

.....

Total [14]

Examiner only

11. Dr Ballard carries out a series of experiments in the laboratory using Group 1 metals.

(a) In the first experiment, he ignites potassium and puts it in a gas jar containing oxygen to form potassium oxide.

(i) State what he would **see** as the reaction proceeds. [2]

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.....

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(ii) Write a balanced equation for the reaction. [1]

.....

(iii) He repeats the experiment with rubidium.
State whether you would expect rubidium to be more reactive or less reactive than potassium. Give a reason for your answer. [2]

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(b) In the second experiment, Dr Ballard reacts sodium with water at room temperature.

$$2Na(s) + 2H_2O(l) \longrightarrow 2NaOH(aq) + H_2(g)$$

(i) If the mass of sodium is 0.098 g, calculate the number of moles of sodium used in the experiment. [1]

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(ii) Calculate the volume of hydrogen produced in this reaction at room temperature. [2]

(1 mole of gas occupies 24.0 dm^3 at room temperature)

.....

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(iii) If the volume of water used was 200 cm^3 calculate the concentration, in mol dm^{-3}, of the sodium hydroxide solution formed. [2]

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Examiner only

(c) In the final experiment, Dr Ballard heats a piece of sodium and puts it in a gas jar containing chlorine to form sodium chloride.

(i) Apart from wearing safety goggles, give **one** precaution that Dr Ballard should take when using chlorine. [1]

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(ii) Sodium chloride is a solid with a melting temperature of 801°C.

I State the crystal co-ordination numbers for sodium chloride. [1]

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II Explain in terms of bonding why its melting temperature is high. [2]

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Total [14]

Section B Total [70]

Rough Work

WJEC
CBAC

GCE AS/A level

1092/01-A

CHEMISTRY CH2
DATA SHEET

P.M. FRIDAY, 27 May 2011

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