Surname	Centre Number	Candidate Number
Other Names		2

GCE AS/A level

1092/01

CHEMISTRY – CH2

P.M. TUESDAY, 3 June 2014

1 hour 30 minutes

	For Examiner's use only		
	Question	**Maximum Mark**	**Mark Awarded**
Section A	**1. to 6.**	**10**	
Section B	**7.**	**16**	
	8.	**16**	
	9.	**15**	
	10.	**11**	
	11.	**12**	
	Total	**80**	

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 additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

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SECTION A

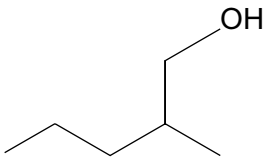
Answer **all** *questions in the spaces provided.*

1. Put the following in order of increasing strength. [1]

covalent bonds *hydrogen bonds* *van der Waals' forces*

weakest ..... *strongest*

2. Give the **systematic** name of the compound whose structure is shown below. [1]



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3. Draw dot-and-cross diagrams to show the formation of calcium chloride from atoms of chlorine and calcium. [2]

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4. The table below gives the electronegativity values of some elements.

Atom	H	N	O	Al	Cl
Electronegativity value	2.1	3.0	3.5	1.6	3.0

(a) Use the data in the table to identify any dipoles present in the following bonds. Mark their polarity clearly. [1]

N — H O — Cl

(b) Use the data to give a reason why aluminium chloride is considered to be a covalent compound, while aluminium oxide is an ionic compound. [1]

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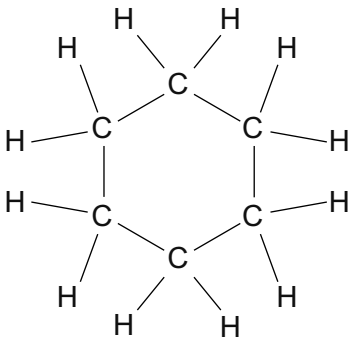
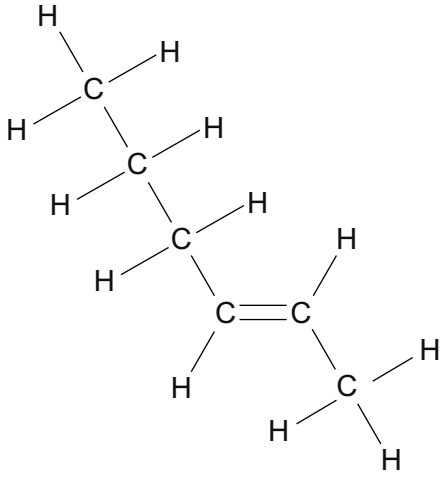
5. Cyclohexane and hex-2-ene are isomers. Give a chemical test to distinguish between these two compounds. [2]



cyclohexane



hex-2-ene

Reagent(s) .....

Observations .....

.....

Turn over.

Examiner only

6. Select **all** the molecules from the list below that have bond angles of less than 109°.

A NH_4^+

B BF_3

C NH_3

D CH_4

E SF_6

..... [2]

Section A Total [10]

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SECTION B

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

7. Ewan and Gwyneth are given four unlabelled bottles. They know that these contain the following four solutions:

potassium carbonate *sodium hydroxide* *barium chloride* *magnesium nitrate*

(a) Ewan predicted what will happen when each of the four solutions is added to the others, and presented this information in the grid below.

	magnesium nitrate	barium chloride	sodium hydroxide
potassium carbonate	white precipitate	white precipitate	no visible change
sodium hydroxide			
barium chloride			

(i) Complete the three empty boxes with the observations expected in each of these cases. [2]

(ii) Name the white precipitate formed when magnesium nitrate is mixed with potassium carbonate, and write an **ionic** equation for its formation. [2]

Name of precipitate .....

Ionic equation .....

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(b) Gwyneth uses different tests to identify the four solutions. Each test allows her to distinguish between some of the solutions. For each test state the solution(s) that would give a visible change and the observation(s) that would be made.

(i) Addition of litmus solution [1]

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(ii) Flame test [2]

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(iii) Addition of sodium sulfate solution [2]

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Turn over.

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(c) Ewan and Gwyneth are provided with a white solid that they believe to be sodium bromide or sodium iodide.

(i) They dissolve the solid in water to make a solution. Explain what occurs when an ionic solid such as sodium bromide dissolves in water. [2]

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(ii) Gwyneth uses aqueous silver nitrate to identify the solution. Give the observations expected when silver nitrate is added separately to solutions of sodium bromide and sodium iodide. [2]

Observation with sodium bromide .....

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Observation with sodium iodide .....

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(iii) Ewan thinks that a further test is needed after addition of the silver nitrate to distinguish between sodium bromide and sodium iodide. Give the reagent and observations for this further test. [2]

Reagent .....

Observation with sodium bromide .....

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Observation with sodium iodide .....

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(iv) When bromine water is added to a solution of sodium iodide, a reaction occurs. Write an equation for this reaction. [1]

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Total [16]

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8. Crude oil is a complex mixture of hydrocarbons, with samples from different locations in the world having different compositions. The table below gives the composition of crude oil from two locations.

Fraction	Percentage by mass	
	Brent Crude	Gulf of Suez
petroleum gases	2.4	1.2
naphtha	19.1	13.6
kerosene	14.2	12.7
gas oil	20.9	18.7
residue	43.4	53.8

(a) The different fractions are separated by fractional distillation. Explain why the different fractions have different boiling temperatures. [2]

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(b) The petroleum gases produced from crude oil can contain both propane and butane.

(i) A barrel of Gulf of Suez crude oil has a mass of 145 kg. Assuming all the petroleum gas released from the oil is butane, calculate the volume that this gas would occupy at 1 atmosphere pressure. [3]

[1 mol of gas occupies 24.0 dm^3 under these conditions]

Volume = ... dm^3

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(ii) Propane can be chlorinated by a similar method to methane.

I Give the condition(s) required for the chlorination of propane. [1]

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II Write an equation for the initiation stage of the chlorination of propane. [1]

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III The chlorination of propane also produces hexane as a minor product. Explain how this compound forms. [2]

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Examiner only

(c) Naphtha is used as a starting material for the production of alkenes, and these are then used to produce polymers such as poly(ethene). Discuss how poly(ethene) is produced, starting from naphtha. Your answer should include:

- An explanation of which of the two types of crude oil given would be more useful for producing alkenes.
- How the naphtha is converted into alkenes.
- An equation for the production of ethene from decane, an alkane with 10 carbon atoms.
- An explanation of what is meant by polymerisation.
- An equation for the polymerisation of ethene, clearly stating the type of polymerisation that is occurring.
- A different polymer in common use, with the structure of the monomer used in its production. [6]

QWC [1]

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Total [16]

Examiner only

9. Haematite is an ore of iron that contains Fe_2O_3. Iron is extracted from this ore in a blast furnace.

(a) Balance the equation for the extraction of iron from Fe_2O_3. [1]

..... Fe_2O_3 + ... CO ⟶ ..... Fe + ... CO_2

(b) Use oxidation states to show that the reaction in *(a)* is a redox reaction. [2]

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(c) A different oxide of iron is iron(II) oxide, FeO. The ions in this compound adopt an arrangement similar to that of sodium chloride.

(i) Give the crystal co-ordination numbers for the ions in FeO. [1]

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(ii) Draw the arrangement of oxide ions around each iron ion. [1]

(d) Iron can be extracted from FeO according to the equation below.

$$FeO + CO \longrightarrow Fe + CO_2$$

Calculate the mass of iron that could be extracted from 20.0 kg of iron(II) oxide, FeO. [3]

Mass of iron = ... kg

Examiner only

(e) Carbon monoxide contains two covalent bonds and one co-ordinate bond. Explain what is meant by the terms *covalent bond* and *co-ordinate bond*, indicating the difference between them. [2]

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(f) Iron is a typical metal. Describe the bonding present in iron. Explain how it can conduct electricity and why it has a high melting temperature. [4]
QWC [1]

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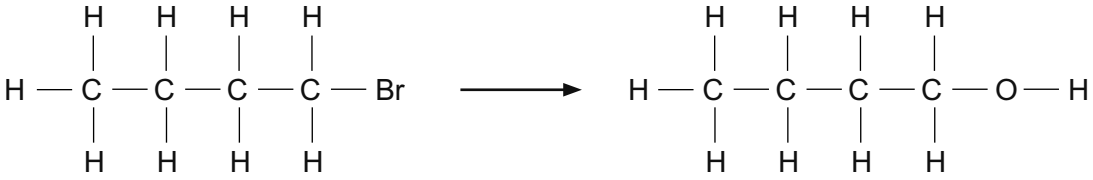
Total [15]

Turn over.

Examiner only

10. *(a)* 1-bromobutane is a liquid that is insoluble in water. It can be converted to butan-1-ol in a one-step reaction.



(i) Give the reagent(s) and condition(s) required for this reaction. [2]

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(ii) Explain why butan-1-ol is soluble in water whilst 1-bromobutane is not. [3]

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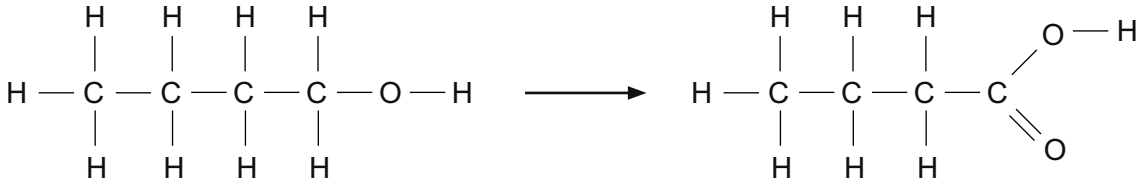
Examiner only

(b) Butan-1-ol can be converted into liquid butanoic acid in a one-step reaction.



(i) Give the reagent(s) and condition(s) required for this reaction. [2]

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(ii) Explain why butanoic acid has a much higher boiling temperature than 1-bromobutane. [3]

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(iii) The reaction above frequently produces a mixture containing unreacted butan-1-ol and butanoic acid. State how these two liquids could be separated. [1]

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Total [11]

Examiner only

11. *(a)* Propene reacts with hydrogen bromide to give 2-bromopropane.

(i) Draw the mechanism for this reaction. [3]

(ii) Explain why the product of this reaction is mainly 2-bromopropane rather than 1-bromopropane. [2]

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Examiner only

(b) Compound **C** is a compound of carbon, hydrogen and bromine only. Bromine has two isotopes, ^{79}Br and ^{81}Br, in equal abundance. Use all the information below to deduce the structure of compound **C**, giving your reasoning. [6]

QWC [1]

- Compound **C** contains 29.8% carbon, 4.2% hydrogen and 66.0% bromine by mass.
- The mass spectrum of compound **C** contains peaks at m/z of 15, 41 and a pair of peaks at 120 and 122.
- The infrared spectrum of compound **C** has absorptions at 550 cm^{-1}, 1630 cm^{-1} and 3030 cm^{-1}.
- Compound **C** is a Z-isomer.

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Total [12]

Section B Total [70]

END OF PAPER

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GCE AS/A level

1092/01-A

CHEMISTRY – DATA SHEET
FOR USE WITH CH2

P.M. TUESDAY, 3 June 2014

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