



GCE AS/A level

1092/01 – LEGACY

CHEMISTRY – CH2

P.M. FRIDAY, 10 June 2016

1 hour 30 minutes plus your additional time allowance

Surname _____

Other Names _____

Centre Number _____

Candidate Number 2 _____

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
Section A 1. to 7.	10	
Section B 8.	14	
9.	13	
10.	17	
11.	16	
12.	10	
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, black ball-point pen or your usual method.

Write your name, centre number and candidate number in the spaces provided on the front cover.

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.

SECTION A

Answer ALL questions in the spaces provided.

- 1. Barium chloride is used to test for sulfate ions in solution. Give the observation expected for a positive result. [1]**

- 2. Draw the DISPLAYED structure of 2,3-dichloropropene. [1]**

3(a) State what is meant by the term COVALENT BOND. [1]

(b) Give a reason why atoms of aluminium and chlorine form covalent bonds in aluminium chloride, whilst aluminium and oxygen form ionic bonds in aluminium oxide. [1]

4(a) Place the following elements in order of their increasing first ionisation energy. [1]

sodium

magnesium

aluminium

silicon

chlorine

LOWEST

HIGHEST

(b) Place the following elements in order of their increasing melting temperature. [1]

sodium

magnesium

aluminium

silicon

chlorine

LOWEST

HIGHEST

5. Decane ($C_{10}H_{22}$) may be used to produce ethene in a cracking reaction. Write an equation for this process. [1]

6. Give the reagent(s) required for the oxidation of ethanol to form ethanoic acid. [1]

7. A saturated solution of calcium sulfate at $20\text{ }^{\circ}\text{C}$ was cooled to $0\text{ }^{\circ}\text{C}$ and 0.11 g of solid calcium sulfate was obtained. Use the data below to calculate the volume of the calcium sulfate solution. [2]

Temperature / $^{\circ}\text{C}$	Solubility of CaSO_4 / g dm^{-3}
0	2.10
20	2.39

Volume = _____ dm^3

TOTAL SECTION A [10]

SECTION B

Answer ALL questions in the spaces provided.

8. Ethanol can be produced from many different sources.

(a) The original route for producing ethanol was by fermentation of sugars by yeast to produce an aqueous solution of ethanol.

Explain why ethanol is soluble in water. [1]

(b) In industry, most ethanol is produced from ethene. Give the reagents and conditions for this process.

[2]

8(c) Ethanol can be produced from chloroethane in a nucleophilic substitution reaction using aqueous sodium hydroxide.

- (i) Use the infrared absorption frequencies given in the data sheet to explain how you could check spectroscopically that this reaction had converted ALL the chloroethane into ethanol. [1]**

8(c) (ii) Chloroethane can be produced in a similar way to chloromethane.

- I. The first stage in the mechanism of this reaction involves homolytic bond fission. Explain what is meant by the term **HOMOLYTIC BOND FISSION**. [1]

- II. Complete the equation for the propagation stage below. [1]



- 8(c) (ii) III. This process often produces mixtures of chloroethane, dichloroethane and trichloroethane. State how pure samples of these substances could be obtained from the mixture. [1]

- (iii) Under different conditions sodium hydroxide can react with chloroethane to produce ethene.

- I. Give the conditions needed for this reaction. [2]

- II. Classify the mechanism of this reaction. [1]

8(c) (iii) III. Describe the structure and bonding present in an ethene molecule. [3]

QWC [1]

Total [14]

9. Modern artificial fertilisers contain many ions that are used by plants to help their growth. These include potassium ions, ammonium ions, nitrate ions and phosphate ions.

(a) Ammonium ions are tetrahedral.

(i) Draw a dot-and-cross diagram to show the bonding in an ammonium ion. [1]

(ii) State the bond angle in a tetrahedral ion. [1]

9(a) (iii) State and explain the shape of a molecule of ammonia. [3]

9(b) Nitrate ions can be prepared from ammonia. The first step in this process is given below.



Use oxidation states to show that this is a redox reaction. [2]

9(c) Phosphates form an essential part of fertilisers, and most of the phosphate minerals in the world are found in Morocco. Many of these phosphate minerals are a mixture of calcium phosphate and calcium carbonate.

- (i) Calcium and potassium ions may be distinguished using a flame test. State the colours seen for each of these ions. [1]**

POTASSIUM IONS _____

CALCIUM IONS _____

- (ii) One way to convert calcium carbonate to calcium phosphate is to use phosphoric acid. Balance the equation for this reaction (opposite page). [1]**



- 9(c) (iii) A 1.202 g sample of powdered phosphate mineral was treated with excess acid, and 92.2 cm³ of carbon dioxide gas were produced. Calculate the percentage of calcium carbonate by mass in the original sample giving your answer to THREE significant figures. [4]

[1 mol of gas occupies 24.0 dm³ under these conditions]

Percentage = _____ %

Total [13]

10. Fatty acids are carboxylic acids that contain a range of saturated or unsaturated hydrocarbon chains attached to a carboxylic acid group, $-\text{COOH}$.

(a) Two fatty acids are propanoic acid and hexanoic acid.

(i) State and explain which of these fatty acids will have the higher boiling temperature.

[2]

10(a) (ii) State and explain which of these fatty acids will be more soluble in water. [3]

10(b) Pentenoic acid, C_4H_7COOH , has some isomers that can show **E-Z** isomerism and others that cannot.

- (i) Pent-2-enoic acid, $CH_3CH_2CH=CHCOOH$, can form **E-Z** isomers. Give the **SKELETAL** formulae for the **E-** and **Z-** isomers of this molecule. [2]

E-isomer

Z-isomer

- 10(b) (ii) Give the structure of an isomer of pentenoic acid that cannot show **E-Z** isomerism and explain why it cannot. [2]

10(c) Arachidonic acid is an unsaturated fatty acid containing more than one double bond.

Bromine water is used to confirm that the fatty acid is unsaturated, with sufficient bromine used to react with ALL the double bonds.

(i) Give the colour change expected in this chemical test. [1]

(ii) The product of the reaction of arachidonic acid with excess bromine contains 25.44 % carbon, 3.39 % oxygen and 67.75 % bromine by mass with the remainder being hydrogen.

- 10(c) (ii) I. Calculate the empirical formula of this compound. [3]

Empirical formula _____

- II. State the number of $\text{C}=\text{C}$ double bonds present in a molecule of arachidonic acid. Explain how you reached your conclusion. [1]

- 10(c) (iii) **HBr** reacts with alkenes in a similar way to bromine.
Draw the mechanism for the reaction of **HBr** with propene to give the major product. [3]

Total [17]

11(a) (i) Draw the arrangement of ions in solid caesium chloride, labelling the diagram clearly. [2]

(ii) Explain why the coordination numbers of the ions in caesium chloride and sodium chloride are different. [1]

11(b) Explain why the boiling temperature of hydrogen fluoride is much greater than that of hydrogen chloride. [2]

11(d) Chlorofluorocarbons (CFCs) are molecules containing only carbon, fluorine and chlorine. They have many uses, although their use has reduced significantly due to the environmental harm they cause.

(i) Give ONE major use of CFCs. [1]

(ii) Use the data given in the table on the next page to explain why CFCs damage the ozone layer whilst hydrofluorocarbons and chlorobromocarbons are less damaging. [4]

QWC [1]

Bond	Average bond enthalpy / kJ mol ⁻¹
C — F	544
C — Cl	338
C — Br	276
C — H	410

Total [16]

12. Cadwaladerite is a hydrated mineral salt containing three different ions. It is classed as a hydroxyhalide as one ion is hydroxide and a second is a halide ion. The formula is $D_aE_b(OH)_c \cdot xH_2O$ where **D** is a metal ion and **E** is the halide ion.
- (a) In order to find the value of **X** in the formula above a sample of cadwaladerite was heated and weighed and the process repeated until the sample reached constant mass.
- (i) State why the sample was heated to constant mass. [1]
-
-

- 12(a) (ii) When **0.023** mol of cadwaladerite was heated to constant mass, the mass lost was **1.658 g**. Use this information to calculate the value of **X**. [2]

x = _____

12(b) Another solid sample of **0.0010 mol** of cadwaladerite was added to **25.0 cm³** of hydrochloric acid of concentration **0.104 mol dm⁻³**. The hydroxide ions present neutralised some of the acid leaving **0.0016 mol** of acid.

Find the value of **C**, the number of hydroxide ions in each formula unit of cadwaladerite. [2]

C = _____.

12(c) A sample of cadwaladerite was treated with excess nitric acid until it all dissolved. Excess silver nitrate solution was added and the white precipitate formed was isolated, dried and weighed. **0.0113 mol** of cadwaladerite produced **3.243 g** of precipitate.

Identify the halide present and the number of halide ions, *b*, present in each formula unit. [3]

Ion E _____ *b* = _____

12(d) The M_r of cadwaladerite is 187. The remaining ion, **D**, is formed from a p-block metal.

Identify this ion and give the number, **a**, present in each formula unit. [2]

Ion D _____ **a** = _____

Total [10]

TOTAL SECTION B [70]

END OF PAPER

