

Candidate Name	Centre Number	Candidate Number

WELSH JOINT EDUCATION COMMITTEE
General Certificate of Education
Advanced

WJEC
CBAC

CYD-BWYLLGOR ADDYSG CYMRU
Tystysgrif Addysg Gyffredinol
Uwch

336/01

CHEMISTRY CH6a

A.M. MONDAY, 26 June 2006

(1 hour 10 minutes)

FOR EXAMINER'S USE ONLY		
Section	Question	Mark
A	1	
B	2	
C	3	
	4	
TOTAL MARK		

ADDITIONAL MATERIALS

In addition to this examination paper, you will need a:

- calculator;
- **Data Sheet** which contains 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 the question in the spaces provided.

Section B Answer the question in the spaces provided.

Section C Answer **both** questions in the spaces provided.

Candidates are advised to allocate their time appropriately between **Section A (10 marks)**, **Section B (15 marks)** and **Section C (25 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 50.

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 12 may be used for rough work.

No certificate will be awarded to a candidate detected in any unfair practice during the examination.

SECTION A

Answer the questions in the spaces provided.

1. (a) Group I metals are highly reactive and can form ionic compounds which are very soluble in water.

(i) Write a balanced equation for the reaction of sodium with oxygen. [1]

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(ii) Explain why ionic compounds of the Group I elements are generally soluble in water. [2]

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- (b) By means of a Born-Haber cycle based on the data below, calculate the enthalpy of formation of potassium chloride.

<i>Process</i>	$\Delta H^\ominus / \text{kJ mol}^{-1}$
Enthalpy change of atomisation of potassium $\text{K(s)} \longrightarrow \text{K(g)}$	90
Enthalpy change of atomisation of chlorine $\frac{1}{2}\text{Cl}_2(\text{g}) \longrightarrow \text{Cl(g)}$	121
1st ionisation energy of potassium $\text{K(g)} \longrightarrow \text{K}^+(\text{g}) + \text{e}^-$	418
Electron affinity (electron gain enthalpy) of chlorine $\text{Cl(g)} + \text{e}^- \longrightarrow \text{Cl}^-(\text{g})$	-349
Enthalpy change of lattice formation of potassium chloride $\text{K}^+(\text{g}) + \text{Cl}^-(\text{g}) \longrightarrow \text{KCl(s)}$	-701

[4]

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- (c) (i) The enthalpy change of lattice formation of rubidium chloride is -675 kJ mol^{-1} . The enthalpies of hydration of gaseous Rb^+ and Cl^- ions are -301 kJ mol^{-1} and -364 kJ mol^{-1} , respectively. Calculate the enthalpy change of solution of rubidium chloride. [2]

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- (ii) Give **one** reason why the enthalpy change of lattice formation of rubidium chloride is less exothermic than that of potassium chloride. [1]

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Section A Total [10]

SECTION B

2. Read the passage below and then answer the questions (a) to (g) in the spaces provided.

Hydrogen Sulphide

Hydrogen sulphide (H_2S) is one of the chemicals that almost everyone has heard of, usually in connection with stink bombs or rotten eggs. In fact, hydrogen sulphide is very poisonous (about 1 part per thousand is fatal) but it rarely poisons anyone, because a concentration of the gas in air of about 1 part per million (1 ppm) is intolerable.

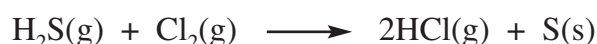
- 5 “Parts per million” means how many parts (mass or volume) in every million parts. A solution concentration of 1 ppm is equivalent to one milligram per cubic decimetre (1 mg dm^{-3}).

If a sample of hydrogen sulphide is needed in a laboratory, it is usually made by reacting iron(II) sulphide with dilute hydrochloric acid.

- 10 Sulphur lies below oxygen and above selenium in Group VI of the Periodic Table and the hydrogen sulphide molecule has the same shape as a molecule of water. However, the physical states of hydrogen sulphide and water at room temperature and pressure are different. Water is a liquid (boiling temperature 100°C) but hydrogen sulphide is a gas (boiling temperature -61°C). Hydrogen selenide, H_2Se , is also a gas (boiling temperature -42°C).
- 15

Hydrogen sulphide can show many different chemical properties.

- (1) It takes part in redox reactions, e.g., it reacts with chlorine to form hydrogen chloride:



- 20 (2) It is a weak acid and is not fully ionised when in aqueous solution. An equilibrium exists in aqueous solution and the equation representing this is



- (3) It will form precipitates of insoluble metal sulphides when it is bubbled into solutions of metal ions:



The formation of black silver sulphide is responsible for the tarnishing of silver-plated spoons when they are used to eat eggs.

Next time you get a whiff of bad eggs, think about all the interesting chemistry of hydrogen sulphide before you bolt for the door and some fresh air!

– End of passage –

Turn over.

- (a) Explain why hydrogen sulphide rarely poisons people, despite it being so poisonous (*lines 2-4*). [1]

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- (b) Calculate the minimum concentration, in mol dm⁻³, of a fatal dose of hydrogen sulphide (*line 3*). [2]

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- (c) Write a balanced equation for the formation of hydrogen sulphide from iron(II) sulphide and hydrochloric acid (*lines 8-9*). [1]

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- (d) (i) By considering the atoms in a hydrogen sulphide molecule, state the shape of the molecule (*line 11*). [1]

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- (ii) Explain why the molecule has this shape. [2]

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- (e) Explain the differences in boiling temperature between the **three** molecules, i.e., water, hydrogen sulphide and hydrogen selenide (*lines 13-15*). [3]

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- (f) Explain, by the use of oxidation states of the reactants and products, why the reaction of hydrogen sulphide with chlorine (*line 19*) can be classified as a redox reaction. [2]

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- (g) An excess of hydrogen sulphide was bubbled into 25.0 cm^3 of a solution of copper(II) sulphate of concentration $0.200 \text{ mol dm}^{-3}$ (*line 25*).

Calculate the mass of copper(II) sulphide formed, to **three** significant figures. [3]

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Section B Total [15]

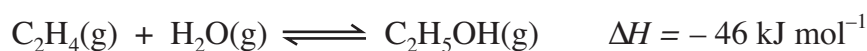
SECTION C

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

3. (a) Ethanol is an important industrial chemical and is usually made by fermentation of sugars, e.g.



or by the direct hydration of ethene:



- (i) State, giving a reason, which process is more environmentally friendly. [1]

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- (ii) State, giving your reasons, the general conditions of temperature and pressure required to give a high equilibrium yield of ethanol in the direct hydration process. [2]

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- (b) Ethanol can be used as an alternative fuel to petrol. Write a balanced equation for the complete combustion of ethanol. [1]

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- (c) Drinking and driving is a problem in society. All alcoholic drinks contain ethanol and in 1967 the 'Breathalyser' was introduced. Drivers had to blow through a tube containing potassium dichromate(VI) crystals and sulphuric acid on a silica support. If alcohol was present in the breath, the crystals turned colour because the $\text{Cr}_2\text{O}_7^{2-}$ ions were reduced to Cr^{3+} ions.

- (i) State the colour change in the crystals that showed a positive test. [1]

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- (ii) Write the half equation for this reduction of acidified dichromate(VI) ions. [1]

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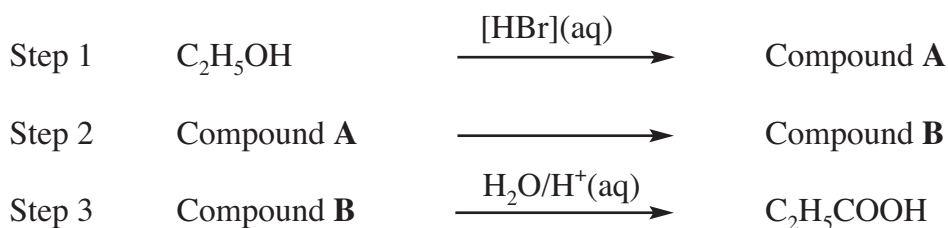
- (iii) The half equation for the oxidation of ethanol in the 'Breathalyser' is



Write a balanced overall equation for the process that takes place in a 'Breathalyser'. [2]

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- (d) Ethanol can be converted into propanoic acid in the laboratory in a three stage synthesis.



- (i) During step 1, aqueous hydrogen bromide is prepared in situ. Name the chemical to which sodium bromide must be added in this preparation. [1]

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- (ii) State the names of compounds A and B. [2]

Compound A

Compound B

- (iii) State the reagent(s) and condition(s) required for step 2. [2]

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Total [13]

4. (a) A compound **A**, $C_8H_{16}O_2$, on hydrolysis, produced two straight-chained compounds **B**, $C_3H_6O_2$, and **C**, $C_5H_{12}O$. Compound **B**, on decarboxylation, produced compound **D**. Compound **C** did not undergo the triiodomethane (iodoform) reaction but on oxidation, produced a carboxylic acid **E**.

(i) Give the structures of compounds **A** - **E**. [5]

(ii) I. Give the structure of an isomer of compound **C** that gives a positive triiodomethane (iodoform) test and shows optical activity. [1]

II. State the feature required for a molecule, such as compound **C**, to show optical activity. [1]

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- (b) Describe the structure of, and bonding in, benzene and explain why the reaction of benzene with electrophiles is different from that of alkenes with electrophiles. [5]

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Total [12]

Section C Total [25]

