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ADVANCED SUBSIDIARY (AS)  
General Certificate of Education  
January 2010

## Chemistry

### Assessment Unit AS 2

*assessing*

Module 2: Further Physical and Inorganic  
Chemistry and Introduction to Organic Chemistry

[AC121]

THURSDAY 21 JANUARY, AFTERNOON

StudentBounty.com

71

Candidate Number



AC121

#### TIME

1 hour 30 minutes.

#### INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

Answer **all fifteen** questions.

Answer **all ten** questions in **Section A**. Record your answers by marking the appropriate letter on the answer sheet provided. Use only the spaces numbered 1 to 10.

Keep in sequence when answering.

Answer **all five** questions in **Section B**. Write your answers in the spaces provided in this question paper.

#### INFORMATION FOR CANDIDATES

The total mark for this paper is 100.

Quality of written communication will be assessed in Question **14(e)**.

In Section A all questions carry equal marks, i.e. **two** marks for each question.

In Section B the figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

A Periodic Table of Elements (including some data) is provided.

For Examiner's  
use only

Question Number	Marks
Section A	
1–10	
Section B	
11	
12	
13	
14	
15	

Total  
Marks

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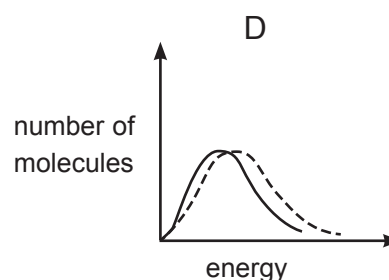
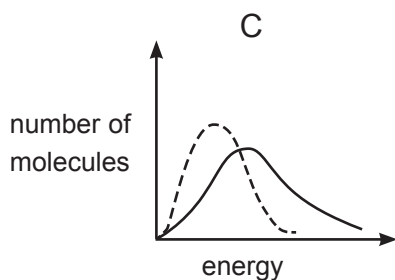
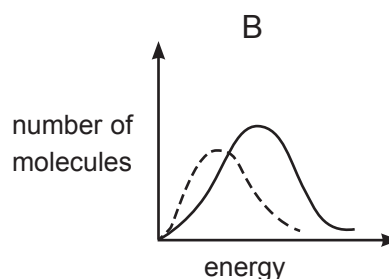
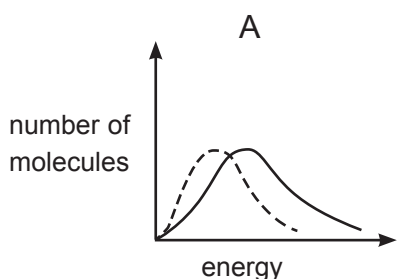
## Section A

For each of the following questions only **one** of the lettered responses (A–D) is correct.

**Select the correct response in each case and mark its code letter by connecting the dots as illustrated on the answer sheet.**

- 1 The reaction of hydrogen bromide with ethene is an example of
- A electrophilic addition.
  - B electrophilic substitution.
  - C nucleophilic addition.
  - D nucleophilic substitution.
- 2 Which one of the chlorides described below, all of formula  $MCl_2$ , is a chloride of a Group II element?
- A white solid, melting point  $280^\circ\text{C}$ , boiling point  $304^\circ\text{C}$ , fairly soluble in water to give a colourless neutral solution with poor electrical conductivity
  - B white solid, melting point  $815^\circ\text{C}$ , readily soluble in water to give a green-blue solution with good electrical conductivity
  - C white solid, melting point  $875^\circ\text{C}$ , readily soluble in water to give a colourless neutral solution with good electrical conductivity
  - D white solid, melting point  $672^\circ\text{C}$ , gives pale green solution with good electrical conductivity
- 3 Which one of the following is a chain propagation step in the chlorination of methane?
- A  $\text{H}\cdot + \text{Cl}_2 \rightarrow \text{HCl} + \text{Cl}\cdot$
  - B  $\text{Cl}\cdot + \text{CH}_4 \rightarrow \text{CH}_3\text{Cl} + \text{H}\cdot$
  - C  $\text{CH}_3\cdot + \text{Cl}_2 \rightarrow \text{CH}_3\text{Cl} + \text{Cl}\cdot$
  - D  $\text{CH}_3\cdot + \text{HCl} \rightarrow \text{CH}_3\text{Cl} + \text{H}\cdot$

- 4 Which one of the graphs below most accurately represents the distribution of molecular energies in a gas at 500 K if the dotted curve represents the distribution for the gas at 300 K?



- 5 A pure hydrocarbon was isolated from bottled gas used for heating.  $10\text{ cm}^3$  of the hydrocarbon was completely combusted in  $70\text{ cm}^3$  of oxygen (an excess). The final gaseous mixture contained  $30\text{ cm}^3$  of carbon dioxide and  $20\text{ cm}^3$  of unreacted oxygen. All volumes were measured under identical conditions. Which one of the the following is the molecular formula of the hydrocarbon?
- A  $\text{C}_2\text{H}_4$   
 B  $\text{C}_2\text{H}_6$   
 C  $\text{C}_3\text{H}_6$   
 D  $\text{C}_3\text{H}_8$

- 6 Which one of the following occurs when a molecule absorbs infra-red radiation?

- A Electrons in the bonds are excited.  
 B The bonds bend and eventually break.  
 C The bonds rotate.  
 D The bonds vibrate.

- 7 Which one of the following will **not** give a yellow precipitate with a solution of iodine in sodium hydroxide?

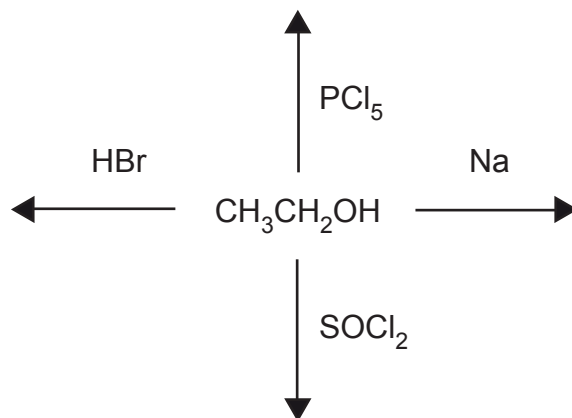
- A butan-1-ol  
 B butan-2-ol  
 C ethanol  
 D propan-2-ol

- 8 The formula of the precipitate produced when solutions of magnesium chloride and sodium hydrogencarbonate are mixed and boiled is:
- A  $\text{Mg(OH)}_2$
  - B  $\text{Mg(HCO}_3)_2$
  - C  $\text{MgCO}_3$
  - D  $\text{MgO}$
- 9 5.0g of butan-1-ol (RMM 74) reacted with an excess of hydrogen bromide and 6.4g of 1-bromobutane (RMM 137) were obtained after purification. The percentage yield of 1-bromobutane was:
- A 42%
  - B 54%
  - C 69%
  - D 78%
- 10 A solution of a salt gives a yellow/orange colour when sprayed into a blue Bunsen flame and a white precipitate when added to acidified barium chloride solution. The salt is
- A potassium carbonate.
  - B potassium sulphate.
  - C sodium carbonate.
  - D sodium sulphate.

## Section B

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

- 11 Complete the following flow scheme showing the organic compound formed in each reaction.



[4]

- 12 Poly(tetrafluoroethene) is made in a two stage reaction from chlorodifluoromethane.

- (a) In the first stage chlorodifluoromethane is cracked to give tetrafluoroethene.



- (i) Explain what is meant by the term **thermal cracking**.

\_\_\_\_\_  
\_\_\_\_\_ [2]

- (ii) Explain, using the  $\Delta H$  value, whether the reaction is exothermic or endothermic.

\_\_\_\_\_ [1]

- (iii) Explain, in terms of reaction rate and equilibrium, whether a high or low pressure should be used.

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[3]

- (iv) Explain, in terms of reaction rate and equilibrium, whether a high or low temperature should be used.

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[3]

- (v) Hydrogen chloride is a product of the reaction. Describe a chemical test for hydrogen chloride gas.

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[2]

- (b) The second stage involves the polymerisation of tetrafluoroethene.

- (i) Complete the following equation which represents the polymerisation reaction.



- (ii) Why is tetrafluoroethene able to polymerise?

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[1]

- (iii) What type of polymerisation does tetrafluoroethene undergo?

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[1]

- 13 Three pentanes are possible theoretically and all occur in natural gas and petroleum gas. Their structures, "trivial" names and boiling points are shown below.

structure	name	boiling point/°C
$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$	normal pentane	36°
$\begin{array}{l} \text{CH}_3 \backslash \\ \text{CH} \text{CH}_2\text{CH}_3 \\ / \\ \text{CH}_3 \end{array}$	isopentane	28°
$\begin{array}{c} \text{CH}_3 \\   \\ \text{CH}_3 - \text{C} - \text{CH}_3 \\   \\ \text{CH}_3 \end{array}$	neopentane	9°

- (a) Write the general formula for an alkane.

\_\_\_\_\_ [1]

- (b) The three pentanes are regarded as **structural isomers**. Explain this term.

\_\_\_\_\_  
 \_\_\_\_\_ [2]

- (c) How would the pentanes be obtained from petroleum?

\_\_\_\_\_ [2]

- (d) Deduce the IUPAC names for isopentane and neopentane.

isopentane \_\_\_\_\_ [1]

neopentane \_\_\_\_\_ [1]



(e) Explain why the pentanes have different boiling points.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ [2]

(f) All three pentanes burn in a limited and in a plentiful supply of air.

(i) Write the equation for the complete combustion of pentane.

\_\_\_\_\_ [2]

(ii) Write an equation for the incomplete combustion of pentane to form carbon monoxide.

\_\_\_\_\_ [2]

(g) (i) A pentane reacts with chlorine to form a chlorinated pentane. The percentage composition of the chlorinated pentane is shown below.

	<b>% by mass</b>
chlorine	60.7
carbon	34.2
hydrogen	5.1

Deduce the empirical formula of the chlorinated pentane.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ [3]

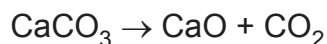
(ii) Explain whether this chlorinated pentane has a higher or lower boiling point than the three pentanes.

\_\_\_\_\_

\_\_\_\_\_ [1]

- 14** The world production of calcium oxide is currently 280 million tonnes annually. It is used extensively in steel making and the construction industries.

The production of calcium oxide involves heating limestone (calcium carbonate) in a kiln at a temperature of 1200 °C.



The heat needed to sustain the reaction is provided by the combustion of fossil fuels.

- (a)** Compare the thermal stability of calcium carbonate with the other Group II metal carbonates.

\_\_\_\_\_  
\_\_\_\_\_ [2]

- (b)** Explain how the thermal stability of a Group II carbonate is related to the charge and size of the cation.

\_\_\_\_\_  
\_\_\_\_\_ [2]

- (c)** Explain how the manufacture of calcium oxide contributes to global warming.

\_\_\_\_\_  
\_\_\_\_\_ [2]

- (d)** The calcium oxide produced is basic and reacts with water and dilute acids.

- (i)** Write the equation for the reaction of calcium oxide with hydrochloric acid.

\_\_\_\_\_ [2]

- (ii)** Write the equation for the reaction of calcium oxide with water to form calcium hydroxide.

\_\_\_\_\_ [1]

(e) A saturated solution of calcium hydroxide is known as limewater. Describe how you would prepare limewater and use it to test for carbon dioxide, stating the result of a positive test.

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[4]

Quality of written communication

[2]

(f) Write the equation for the reaction of aqueous calcium hydroxide with carbon dioxide including state symbols.

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[2]

(g) 5 dm<sup>3</sup> of polluted air containing an excess of carbon dioxide was passed through limewater so that all the carbon dioxide present was precipitated as calcium carbonate. The mass of calcium carbonate formed was 0.05 g. Use the following headings to calculate the percentage by volume of carbon dioxide in the air sample. All measurements were carried out at 20°C and 1 atmosphere pressure.

Mass of one mole of CaCO<sub>3</sub> in grams

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Number of moles of CaCO<sub>3</sub> in 0.05 g of calcium carbonate

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Number of moles of CO<sub>2</sub> required to produce 0.05 g of calcium carbonate

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Volume of CO<sub>2</sub> in dm<sup>3</sup> required to produce 0.05 g of calcium carbonate

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Percentage of carbon dioxide in the polluted air

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[5]

15 Ethanol is produced in large quantities for use as a fuel. The mixture of ethanol with gasoline (petrol) is known as gasohol.

(a) (i) Explain, using an equation, how ethanol is manufactured from ethene.

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[3]

(ii) Explain another industrial method of producing ethanol.

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[2]

(b) Explain how you would carry out a chemical test to show that ethanol was present in a sample of gasohol.

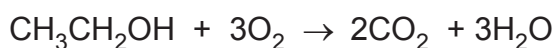
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[3]

(c) The equation for the combustion of ethanol is shown below:



Use the following bond energies to calculate the enthalpy change for the combustion.

	kJ mol <sup>-1</sup>
C—O	360
C—H	413
O—H	464
C=O	805
O=O	498
C—C	347

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[4]

(d) The gases produced by the combustion of the gasohol can be passed through a catalytic converter.

(i) What are carbon monoxide, unburnt hydrocarbons and nitrogen oxides converted to in the converter?

carbon monoxide \_\_\_\_\_ [1]

unburnt hydrocarbons \_\_\_\_\_ [1]

nitrogen oxides \_\_\_\_\_ [1]

(ii) Occasionally the catalyst is poisoned. Explain how this occurs and how the catalyst is affected.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [3]

(iii) Explain the role of the catalyst using a simple labelled enthalpy level diagram. Assume the reactions catalysed are exothermic.

\_\_\_\_\_  
\_\_\_\_\_ [4]

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**THIS IS THE END OF THE QUESTION PAPER**

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