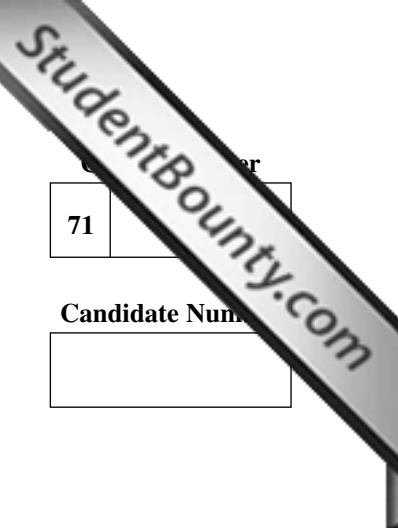




Rewarding Learning

ADVANCED SUBSIDIARY (AS)  
General Certificate of Education  
2009



71

Candidate Number

# Chemistry

## Assessment Unit AS 2

*assessing*

### Module 2: Organic, Physical and Inorganic Chemistry

[ASC21]



THURSDAY 11 JUNE, AFTERNOON

#### 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 seventeen** 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 seven** 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 **17(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	
16	
17	
<b>Total Marks</b>	

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## Section A

For each of the 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 illustrated on the answer sheet.

1 Which one of the following statements about polythene is correct?

	type of polythene	crystallinity	flexibility
A	HD	high	low
B	HD	low	high
C	LD	low	low
D	LD	high	low

2 A free radical is a particle with

- A a lone pair of electrons.
- B a negative charge.
- C a positive charge.
- D an unpaired electron.

3 In the Contact process, sulphur dioxide is prevented from escaping because it

- A increases global warming.
- B leads to acid rain.
- C reduces ozone in the upper atmosphere.
- D reacts with oxygen in the atmosphere.

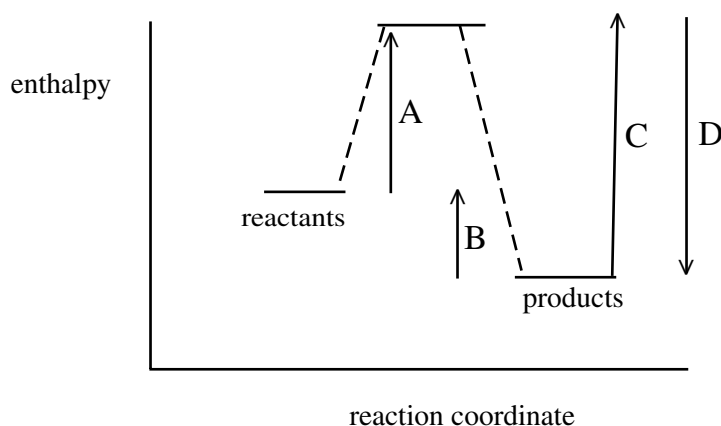
4 Which one of the following is not a source of ethanol?

- A Manufacture from sugar cane
- B Catalytic hydration of ethene
- C Hydrolysis of bromoethane with alkali
- D Reaction of iodoethane with ammonia

5 Which one of the following hydrocarbons contains a double bond?

- A  $\text{CH}_4$
- B  $\text{C}_2\text{H}_4$
- C  $\text{C}_2\text{H}_6$
- D  $\text{C}_3\text{H}_8$

6 In the reaction profile below, which letter represents the activation energy for the conversion of reactants to products?



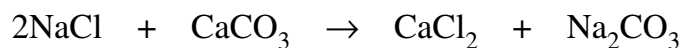
7 Which one of the following describes the reaction between hydrogen bromide and ethene?

- A Electrophilic addition
- B Electrophilic substitution
- C Nucleophilic addition
- D Nucleophilic substitution

8 2.8 g of a metal, M, combines with 0.8 g of oxygen to form the oxide MO. The metal, M, also forms an oxide in which the metal and oxygen are present in the ratio 7:3 by mass. What is the formula of the second oxide?

- A  $\text{MO}_2$
- B  $\text{M}_2\text{O}$
- C  $\text{M}_2\text{O}_3$
- D  $\text{M}_3\text{O}_2$

9 The manufacture of sodium carbonate is represented by the equation below:



Which one of the following shows the masses of reactants (in tonnes) needed to produce 2 tonnes of sodium carbonate?

	NaCl	CaCO <sub>3</sub>
A	1.00	1.00
B	1.00	0.92
C	2.20	1.89
D	2.34	2.00

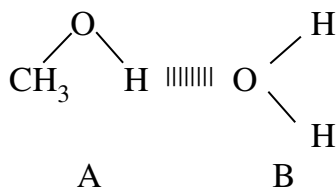
10 Which one of the following ions, in aqueous solution, reacts with magnesium ions to form a colourless solution which deposits a white precipitate on boiling?

- A carbonate
- B hydrogencarbonate
- C hydroxide
- D sulphite

## Section B

Answer all **seven** questions in this section.

- 11 The diagram below shows the formation of a bond between molecule A and molecule B.



- (a) Name the molecules and the type of bond formed between them.

(i) molecule A \_\_\_\_\_ [1]

(ii) molecule B \_\_\_\_\_ [1]

(iii) bond \_\_\_\_\_ [1]

- (b) State a physical property of A affected by this type of bond.

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

- 12 Petroleum is a mixture of hydrocarbons. It is separated into a number of fractions by fractional distillation.

- (a) Give the names of **three** fractions.

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

- (b) Explain the process of fractional distillation.

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

- (c) Name the elements present in a hydrocarbon.

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

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**(Questions continue overleaf)**

13 The Group II elements, together with their electron structures, are listed below:

beryllium	$1s^2 2s^2$
magnesium	$1s^2 2s^2 2p^6 3s^2$
calcium	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
strontium	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 5s^2$
barium	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6 6s^2$

(a) Explain why they are regarded as s-block elements.

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

(b) (i) State and explain the trend in ionic radius down the group.

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

(ii) State and explain the trend in ionisation energy down the group.

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



(c) Giving observations, compare the chemistry of calcium with that of magnesium using the following headings:

combustion

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[2]

reaction with water

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[2]

reaction with hydrochloric acid

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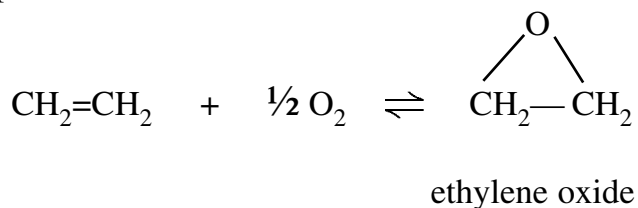


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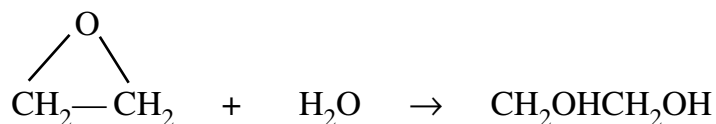
[2]

14 Ethylene glycol is manufactured industrially via ethylene oxide.

Step 1



Step 2



(a) The first step, which is an equilibrium reaction, is carried out by passing ethene and air over silver metal at a high temperature and pressure.

(i) Suggest the purpose of the silver.

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

(ii) Explain the process of chemisorption on the surface of silver.

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

(iii) Using an equilibrium argument, explain why a high pressure is used.

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

(iv) Using an equilibrium argument, suggest why a high temperature is used.

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[2]

(b) Calculate the number of tonnes of ethylene glycol produced in step 2 by the reaction of 2 tonnes of ethylene oxide with an excess of water.

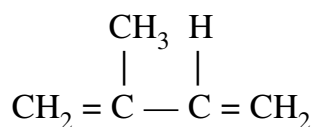
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[3]

15 Natural rubber is a polymer of isoprene (2-methylbut-1,3-diene).



isoprene

(a) What is the molecular formula of isoprene?

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

(b) (i) Explain the meaning of the term **polymer**.

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

(ii) State the functional group which enables isoprene to polymerise.

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

(c) Isoprene may be catalytically hydrogenated to form a saturated alkane.

(i) Draw the structure of the alkane produced.

[1]

(ii) State the systematic name for the alkane.

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

(iii) Name a suitable catalyst for the hydrogenation.

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

(d) Isoprene burns in air to produce carbon dioxide and water.

(i) Write an equation for the combustion.

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

(ii) Name **one** substance which is produced during the incomplete combustion of isoprene, but **not** during complete combustion.

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

(e) It is best not to incinerate waste rubber, but to seek another means of disposal.

(i) State **two** reasons why the incineration of waste rubber causes serious environmental problems.

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

(ii) State an alternative means of disposal.

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

**16** Lime (calcium oxide) is added to increase the pH of soil and to improve the yield of certain crops. Calcium oxide is manufactured by the thermal decomposition of calcium carbonate.

**(a) (i)** Write the equation for the decomposition of calcium carbonate.

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

**(ii)** State **two** factors which affect the thermal decomposition of Group II carbonates.

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

**(b)** Calcium oxide is basic and reacts with water to form calcium hydroxide.

**(i)** Explain the term **basic**.

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

**(ii)** Write the equation for the reaction of calcium oxide with water.

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

**(iii)** If the solubility of calcium hydroxide is  $0.021 \text{ mol dm}^{-3}$  at  $20^\circ\text{C}$ , calculate the number of grams of calcium hydroxide which would dissolve in  $250 \text{ cm}^3$  of water at this temperature.

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

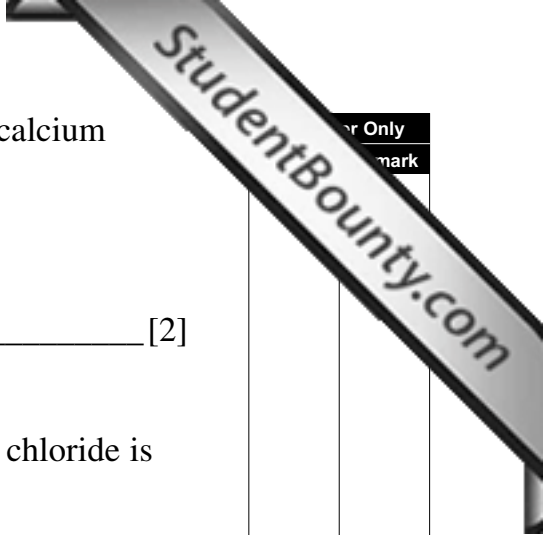
(c) Calcium hydroxide reacts with hydrochloric acid to form calcium chloride and water.

(i) Write the equation for this reaction.

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

(ii) State the colour produced when a solution of calcium chloride is sprayed into a Bunsen flame.

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



For Only  
mark

17 Chloroethane has a boiling point of  $12^{\circ}\text{C}$  and has been used as a local anaesthetic. When sprayed on the skin it evaporates quickly cooling the surface tissue and reducing pain.

(a) (i) Draw the structure of chloroethane showing all the bonds present.

[2]

(ii) Ethanol has a boiling point of  $78^{\circ}\text{C}$ . Explain why ethanol has the higher boiling point despite the greater molecular mass of chloroethane.

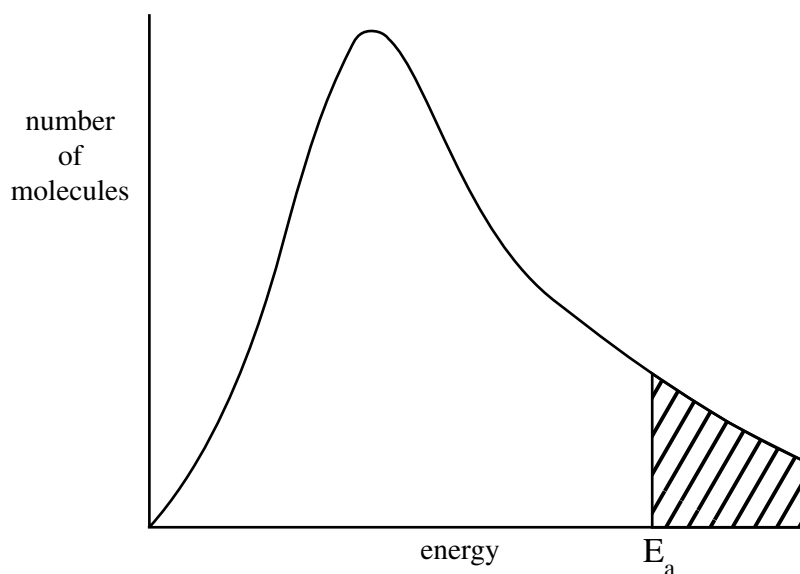
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[2]



- (b) Chloroethane reacts with nucleophiles such as ammonia. The distribution of molecular energies for a gaseous mixture of chloroethane and ammonia, at 20 °C, is shown below.



- (i) Explain the significance of the shaded area, if  $E_a$  represents the activation energy.

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[2]

- (ii) Sketch on the axes above, the distribution of molecular energies at approximately 30 °C. [2]

- (iii) Use the graphs of the distribution of molecular energies to explain the difference in the reaction rates at 20 °C and 30 °C.

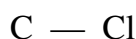
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[2]

- (c) (i) Show the polarity of the carbon-chlorine bond in chloroethane using the diagram below



[1]

- (ii) Explain why the bond is polar.

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[2]

- (d) Explain why an ammonia molecule can act as a nucleophile whereas an ammonium ion cannot.

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[2]

- (e) The comparative ease of hydrolysis of the halogenoalkanes can be demonstrated by adding 1-chlorobutane, 1-bromobutane and 1-iodobutane to three test tubes containing ethanol, heating and adding silver nitrate solution. State what would be observed and explain the relative rates of reaction in terms of bond enthalpies.

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[5]

Quality of written communication

[2]

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

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