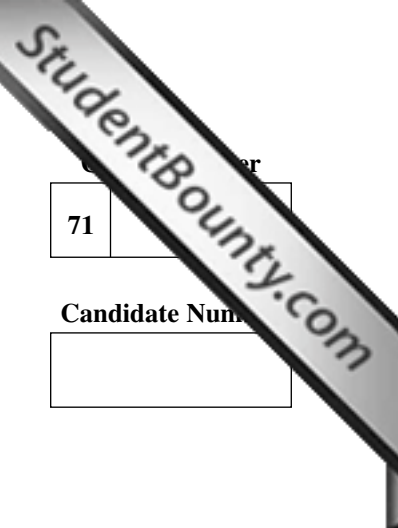




Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
January 2009



71

Candidate Number

Chemistry

Assessment Unit AS 2

assessing

Module 2: Organic, Physical and Inorganic Chemistry

[ASC21]



TUESDAY 20 JANUARY, MORNING

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 eighteen** 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 eight** 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 **18(b)**. 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	
18	

Total Marks	
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Section A

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

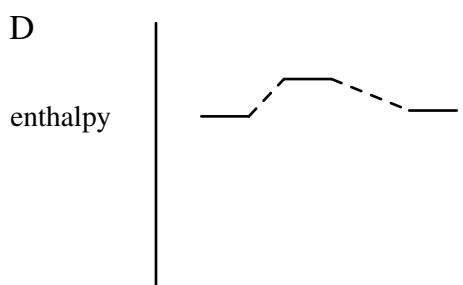
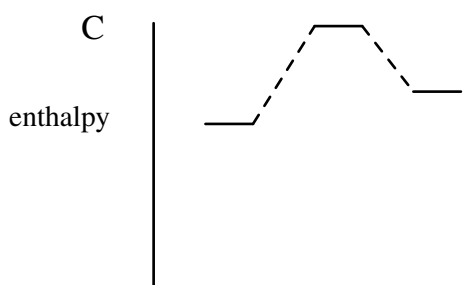
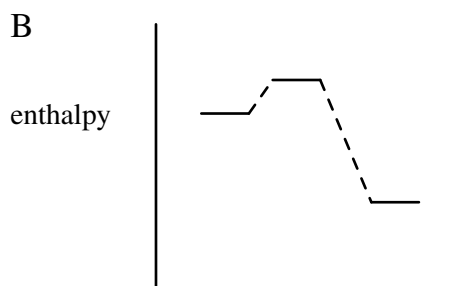
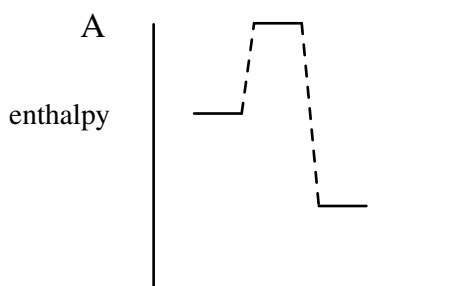
Select the correct response in each case and mark its code letter by connecting the dots illustrated on the answer sheet.

- Which one of the following bonds is the weakest?
 - C–C
 - C–F
 - C–H
 - C–I

- A pi (π) bond is present in a molecule of
 - ethene
 - ethanol
 - ethane
 - polythene

- Which one of the following reactions involves elimination?
 - the reaction of a tertiary bromoalkane with hydroxide ions to form an alcohol
 - the reaction of a primary chloroalkane with ammonia to form an amine
 - the reaction of a tertiary chloroalkane with cyanide ions to form a nitrile
 - the reaction of a primary bromoalkane with hydroxide ions to form an alkene

- 4 Which one of the following reaction profiles shows a mixture of methane and ethane that is thermodynamically unstable and kinetically stable?



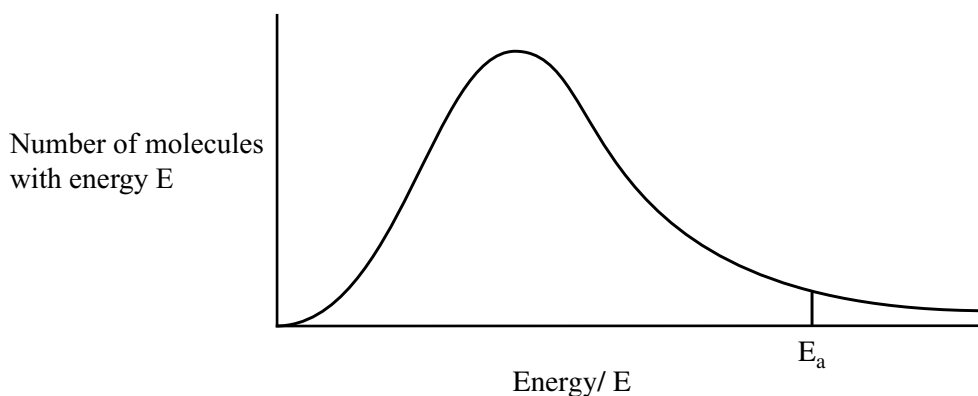
- 5 Which one of the following is a tertiary alcohol?

- A 2-methylbutan-1-ol
- B 2-methylbutan-2-ol
- C 3-methylbutan-1-ol
- D 3-methylbutan-2-ol

- 6 Which one of the following equations represents a step in the mechanism for the reaction between hydrogen bromide and ethene?

- A $C_2H_4 + Br^+ \rightarrow C_2H_4Br^+$
- B $C_2H_4 + HBr \rightarrow C_2H_5^+ + Br^-$
- C $C_2H_4 + HBr \rightarrow C_2H_5\cdot + Br\cdot$
- D $C_2H_4 + HBr \rightarrow C_2H_4Br^- + H^+$

- 7 The distribution of energy amongst the molecules involved in the reaction between sulphur dioxide and oxygen to form sulphur trioxide is shown below.



- Which one of the following results in an increase in the proportion of molecules with enough energy to react?
- A A decrease in pressure
 - B A decrease in temperature
 - C An increase in pressure
 - D An increase in temperature
- 8 Which one of the following pairs of aqueous solutions does **not** form a white precipitate on mixing?
- A barium chloride and sodium sulphate
 - B barium nitrate and sodium sulphite
 - C magnesium chloride and sodium carbonate
 - D magnesium sulphate and potassium hydrogencarbonate

- 9 A solution of a salt gives a lilac colour when sprayed into a Bunsen flame and a white precipitate when added to an acidified solution of silver nitrate.
The salt is
- A potassium carbonate.
 - B potassium chloride.
 - C sodium carbonate.
 - D sodium sulphate.

- 10 Which one of the following is **not** an isomer of the ester?

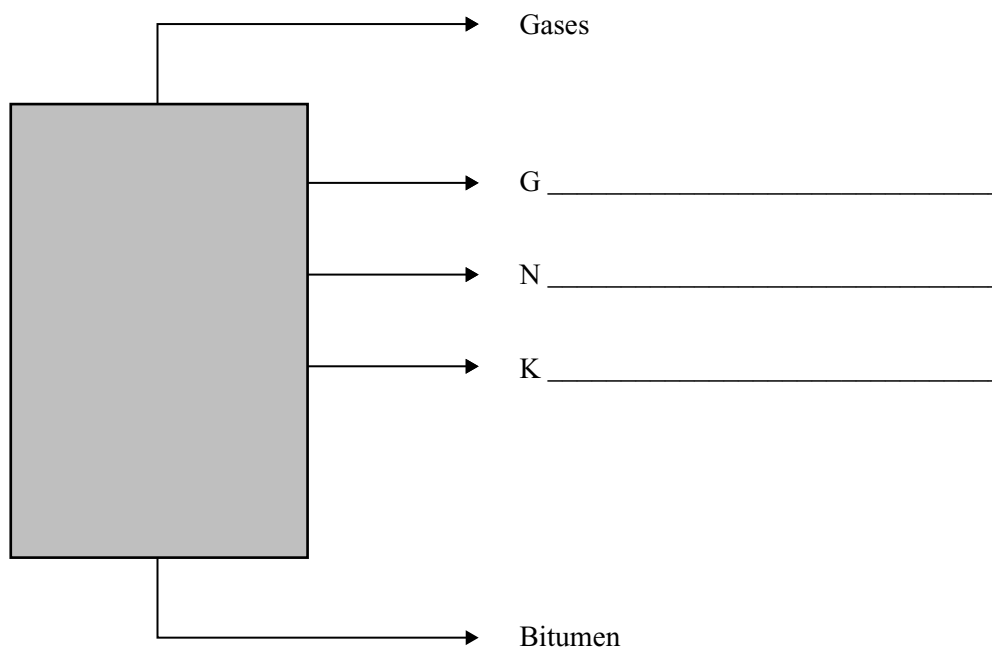


- A ethyl ethanoate
- B butyl methanoate
- C pentanoic acid
- D propyl ethanoate

Section B

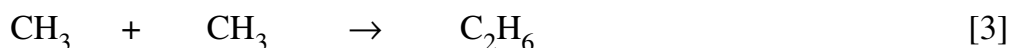
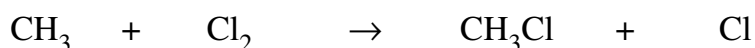
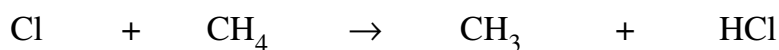
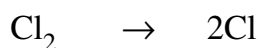
Answer **all eight** questions in the spaces provided.

- 11 A fractionation column for the primary fractionation of petroleum is shown below.



Complete the names of the fractions shown. [3]

- 12 The photochemical reaction between methane and chlorine is an example of free radical substitution. The mechanism below is incomplete because the free radicals are not shown. Using dots (•) identify the free radicals.



13 The Haber process for the manufacture of ammonia involves the equilibrium reaction between nitrogen and hydrogen.

(a) Write the equation for the equilibrium reaction.

_____ [2]

(b) Name the catalyst used in the Haber process.

_____ [1]

(c) Explain why a combination of high pressure and low temperature would maximise the yield of ammonia.

high pressure

_____ [2]

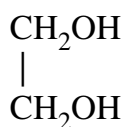
low temperature

_____ [2]

(d) Describe a chemical test for ammonia. State the reagent used and the observation for a positive result.

_____ [2]

- 14 Planes “ice-up” when their wings are covered in a layer of ice. The most commonly used de-icing liquid is ethane-1,2-diol known as ethylene glycol.



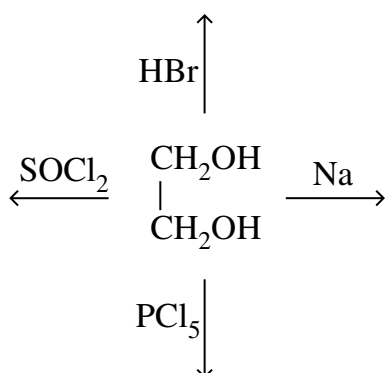
ethylene glycol

Ethylene glycol can lower the freezing point of water to -13°C . It is very soluble in water and runs off the plane with the melted ice.

- (a) (i) Ethylene glycol contains a **primary alcohol** group. Explain this term.

_____ [2]

- (ii) Primary alcohols react with a variety of reagents. Complete the following scheme by drawing the structure of the organic product in each case assuming an **excess** of each reagent in each case.



[4]

(b) Explain why ethylene glycol is very soluble in water.

_____ [2]

(c) Ethylene glycol causes environmental problems. It may be washed into streams and rivers where it is oxidised by bacteria which lower the oxygen content of the water.

(i) Name an oxidising agent which will cause mild oxidation of a primary alcohol.

_____ [1]

(ii) What is a primary alcohol converted to after mild oxidation?

_____ [1]

(d) Explain whether ethylene glycol will give a positive iodoform test.

_____ [2]

(e) Ethylene glycol is far more poisonous than ethanol; 100 cm³ of ethylene glycol is lethal when swallowed.

(i) State **one** harmful effect of ethanol apart from its poisonous nature.

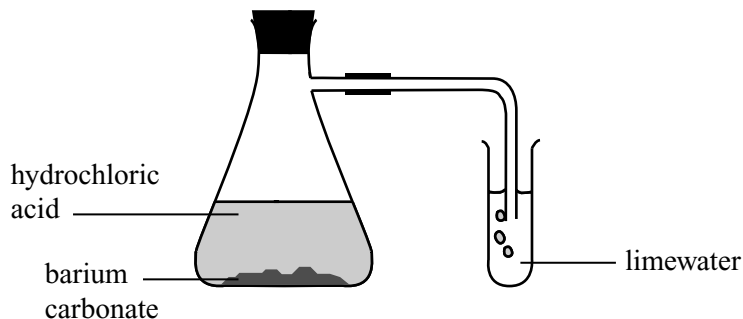
_____ [1]

(ii) Calculate the lethal dose of ethylene glycol, in moles, if its density is 0.8 g cm⁻³.

_____ [3]

15 Barium carbonate, BaCO_3 , occurs naturally as the mineral Witherite. It is a white solid which is insoluble in water but soluble in hydrochloric and nitric acids.

(a) The apparatus below can be used to demonstrate that carbon dioxide is produced when barium carbonate reacts with hydrochloric acid.



(i) Write an equation for the reaction of barium carbonate with hydrochloric acid.

_____ [2]

(ii) Describe what is observed in the test tube after a few seconds.

_____ [1]

(iii) Calculate the volume of carbon dioxide produced, at 20°C and one atmosphere pressure, if 0.66 g of barium carbonate is reacted with an excess of acid.

 _____ [3]

(iv) What colour is seen if the solution left in the conical flask is sprayed into a Bunsen flame?

_____ [1]

(b) Barium carbonate and barium sulphate are not poisonous because they are hardly soluble. However, a soluble salt such as barium chloride, is extremely poisonous.

(i) The solubility of barium carbonate is 0.86 mg in 100 cm³ of water at 18 °C.

Calculate the molarity of this saturated solution.

_____ [3]

(ii) An antidote to barium chloride poisoning is to swallow a solution of magnesium sulphate (Epsom Salts) which reacts to form insoluble barium sulphate.

Write an equation for this reaction.

_____ [2]

(c) Barium carbonate is very difficult to decompose, a temperature of 1360 °C is required. Beryllium carbonate decomposes easily at 25 °C.

(i) Write the equation for the decomposition of barium carbonate.

_____ [1]

(ii) Suggest why the thermal stability of barium carbonate is higher than that of beryllium carbonate.

_____ [3]

(iii) The decomposition of barium carbonate occurs at a much lower temperature if it is heated with carbon. Barium oxide is formed together with carbon monoxide. Write the equation for the reaction.

_____ [2]

16 Hydrocarbon fuels such as butane, C_4H_{10} , are one of our main sources of energy.

(a) Energy is released when hydrocarbon fuels are burnt.

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

_____ [2]

(ii) Carbon (soot) can be formed by incomplete combustion. Name two products, other than carbon, produced by the incomplete combustion of butane.

_____ [2]

(iii) What causes incomplete combustion to occur?

_____ [1]

(b) The two isomers which have the formula C_4H_{10} are butane and 2-methylpropane.

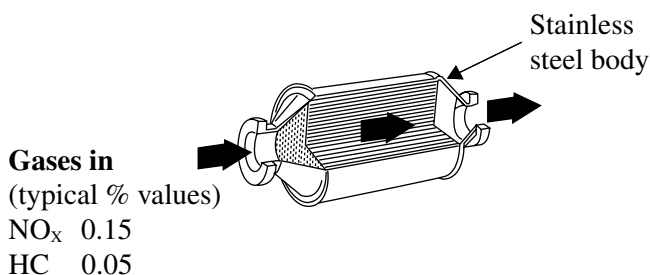
(i) Draw the structure of 2-methylpropane.

[2]

(ii) Name the products from the complete combustion of 2-methylpropane.

_____ [2]

17 The diagram below shows a catalytic converter.



Inside is a metal or ceramic honeycomb coated with finely divided metals.

(a) The metals used are platinum, palladium and rhodium.

(i) Suggest why the metals are finely divided.

_____ [2]

(ii) Explain how chemisorption takes place on the surface of the metals and leads to a reaction.

_____ [3]

(b) Explain why lead-free petrol must be used with a catalytic converter.

_____ [2]

(c) Complete the following table which summarises the conversions taking place in the converter.

Gas In	Gases Out
carbon monoxide	
hydrocarbon	
nitrogen monoxide	

[3]

18 The annual UK production of polythene is about half a million tonnes. Ethene needed for the process is obtained from the catalytic cracking of naphtha.

(a) Explain the term **catalytic cracking**.

[2]

(b) Explain the flexibility and softening temperature of HD polythene in terms of its structure.

[4]

Quality of written communication. [2]

(c) Polythene is chemically inert. Its non-biodegradability leads to the need to develop waste management strategies.

(i) Explain the meaning of the term **non-biodegradability**.

[2]

(ii) State **two** reasons why the disposal of polythene by incineration may be preferred to dumping in landfill sites.

[2]

THIS IS THE END OF THE QUESTION PAPER

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