



Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
January 2013

Centre Number

71

Candidate Number

Chemistry

Assessment Unit AS 2

assessing

Module 2: Organic, Physical
and Inorganic Chemistry

[AC122]



WEDNESDAY 16 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 sixteen** 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 six** 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 **15(c)**.

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 the 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	

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 Which one of the following hydroxides is the most soluble in water?

- A Barium hydroxide
- B Calcium hydroxide
- C Magnesium hydroxide
- D Strontium hydroxide

2 How many structural isomers have the formula C_5H_{12} ?

- A Two
- B Three
- C Four
- D Five

3 Which one of the following is a tertiary alcohol?

- A pentan-2-ol
- B pentan-3-ol
- C 2-methylpentan-1-ol
- D 2-methylpentan-2-ol

4 Propan-1-ol can be dehydrated to form propene:

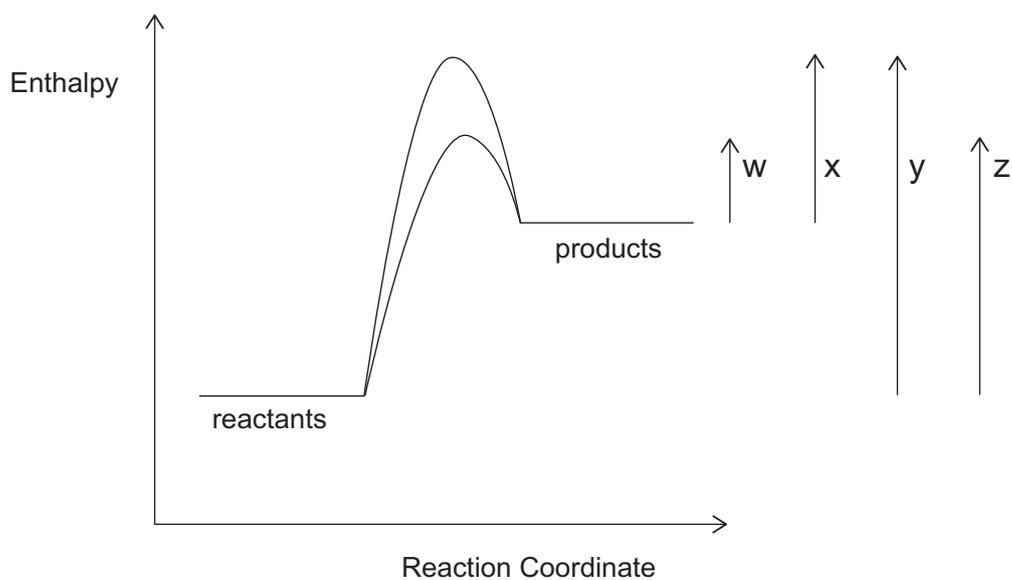


30.0 g of propan-1-ol produces 16.8 g of propene. Which one of the following is the percentage yield?

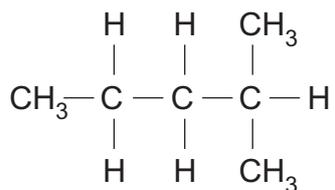
- A 50.0
- B 60.0
- C 70.0
- D 80.0

- 5 Which one of the following metal chlorides gives a green colour in a flame test?
- A BaCl_2
 - B CaCl_2
 - C KCl
 - D NaCl
- 6 Which one of the following is the mass of magnesium oxide required to neutralise 25.0 cm^3 of 0.1 mol dm^{-3} hydrochloric acid?
- A 0.025g
 - B 0.050g
 - C 0.100g
 - D 0.250g
- 7 Which one of the following is the number of π (pi) bonds present in propene?
- A One
 - B Two
 - C Three
 - D Six
- 8 Which one of the following is formed by the complete oxidation of propan-2-ol?
- A a carboxylic acid
 - B a ketone
 - C a secondary alcohol
 - D an aldehyde

- 9 Which one of the following pairs of enthalpy changes shows how a catalyst works in an endothermic reaction?



- A w and x
 B w and z
 C x and y
 D y and z
- 10 Which one of the following is the IUPAC name for the hydrocarbon shown below?

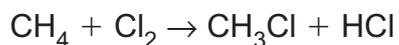


- A 1,1-dimethylbutane
 B 4,4-dimethylbutane
 C 2-methylpentane
 D 1,1,3-trimethylpropane

Section B

Answer **all six** questions in this section in the spaces provided.

- 11 An excess of methane reacts with chlorine, in the presence of light, to form chloromethane as the main product.



- (a) Name the type of mechanism for this reaction.

_____ [2]

- (b) Write an equation for the initiation step.

_____ [1]

- (c) Write **two** equations for the propagation steps.

_____ [2]

- (d) Write an equation for the termination step which results in the formation of ethane.

_____ [1]

Examiner Only

Marks Remark

12 The empirical formula of a molecular covalent compound can be calculated using percentage composition by mass.

(a) Explain the term **empirical formula** as applied to a molecular covalent compound.

 _____ [1]

(b) Explain the term **molecular formula** as applied to a molecular covalent compound.

 _____ [1]

(c) An oxide of phosphorus contains 43.7% by mass of phosphorus. The relative molecular mass of the oxide is 284. This oxide reacts with sodium hydroxide to form sodium phosphate (Na_3PO_4) and water as the only products.

(i) Calculate the empirical and molecular formulae of the oxide.

empirical formula: _____

molecular formula: _____ [4]

(ii) Write an equation for the reaction of the oxide with sodium hydroxide.

_____ [2]

Examiner Only	
Marks	Remark

14 Recently chemists have developed alternatives to fossil fuels. Ethanol obtained from a biological source may have a significant role to play, e.g. some of the petrol sold in the UK and Ireland contains up to 10% ethanol. In Brazil the percentage is even higher.

(a) The standard enthalpy of combustion of ethanol can be calculated using Hess's Law.

(i) State Hess's Law.

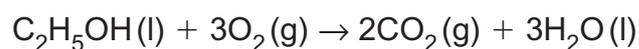
 _____ [2]

(ii) Define the term **standard enthalpy of combustion**.

 _____ [2]

(iii) Use the standard enthalpies of formation given in the table below to calculate the standard enthalpy of combustion of ethanol.

Compound	$\Delta H_f^\ominus / \text{kJ mol}^{-1}$
$\text{C}_2\text{H}_5\text{OH}(\text{l})$	-277
$\text{CO}_2(\text{g})$	-394
$\text{H}_2\text{O}(\text{l})$	-286

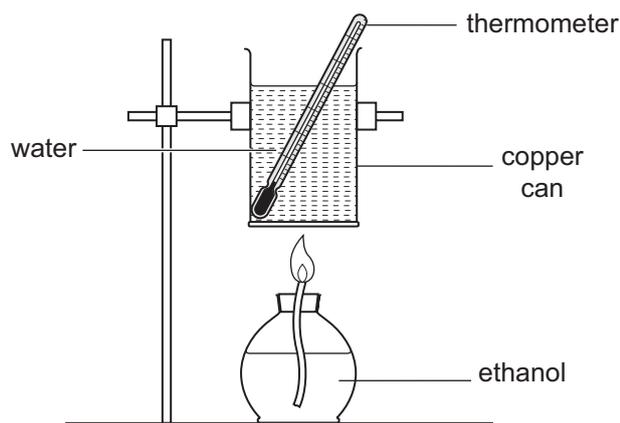


 _____ [3]

Examiner Only

Marks Remark

- (b) The enthalpy of combustion for ethanol can also be obtained experimentally by using the apparatus shown below:



The results of the experiment are summarised in the table below:

Mass of water in the copper can	200.0g
Mass of spirit burner + ethanol (before burning)	150.0g
Mass of spirit burner + ethanol (after burning)	148.6g
Initial temperature of water	18.0 °C
Final temperature of water	42.0 °C

- (i) Calculate the heat energy released by the combustion of the ethanol using the equation:

$$\text{heat energy released (J)} = \text{mass of water} \times 4.18 \times \text{temperature rise}$$

_____ [1]

- (ii) Calculate the enthalpy of combustion of ethanol in kJ mol^{-1} .

heat energy released (in kJ) _____

moles of ethanol _____

enthalpy of combustion _____ [3]

- (iii) State **two** reasons to explain the difference between this experimental value and the theoretical value obtained in (a)(iii).

 _____ [2]

Examiner Only

Marks Remark

15 Group II carbonates and nitrates decompose when heated. Magnesium carbonate decomposes to form magnesium oxide and carbon dioxide. Magnesium nitrate forms magnesium oxide, nitrogen(IV) oxide and oxygen.

(a) (i) Write an equation for the decomposition of magnesium nitrate.

_____ [2]

(ii) Suggest whether or not strontium nitrate would be more or less stable than magnesium nitrate when heated. Explain your reasoning.

 _____ [2]

(b) Nitrogen(IV) oxide is a brown gas which can form the colourless gas, dinitrogen tetroxide, N_2O_4 , in a dynamic equilibrium.



(i) Explain the term **dynamic equilibrium**.

 _____ [2]

(ii) What is observed when the pressure on the equilibrium mixture is increased? Explain your answer.

 _____ [3]

(iii) What is observed when the equilibrium mixture is cooled? Explain your answer.

 _____ [3]

Examiner Only	
Marks	Remark

- (c) Describe how a solution of magnesium nitrate can be used to distinguish between solid samples of potassium carbonate and potassium hydrogencarbonate. Give experimental details, observations and include an ionic equation, with state symbols, for any reaction which occurs.

[4]

Ionic equation

[2]

Quality of written communication

[2]

- (d) Sodium nitrate decomposes when heated to produce sodium nitrite and oxygen:



Calculate the volume of oxygen produced, at 20 °C and a pressure of 1 atmosphere, when 4.25 g of sodium nitrate decomposes.

Moles of sodium nitrate

[1]

Moles of oxygen produced

[1]

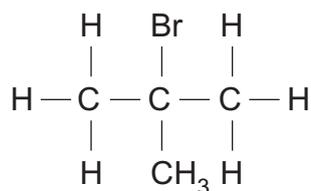
Volume of oxygen, cm³

[1]

Examiner Only

Marks Remark

16 2-bromo-2-methylpropane is a tertiary halogenoalkane.



(a) What is the general formula for a bromoalkane?

_____ [1]

(b) Why is 2-bromo-2-methylpropane classified as a tertiary halogenoalkane?

 _____ [2]

(c) 2-bromo-2-methylpropane reacts with aqueous potassium hydroxide to produce a tertiary alcohol.

(i) Name the type of mechanism for this reaction.

_____ [1]

(ii) Write an equation for the first step in the mechanism.

_____ [1]

(iii) Draw the structure of the organic product in the first step.

_____ [1]

(iv) Write an equation for the second step in the mechanism.

_____ [1]

Examiner Only	
Marks	Remark

- (d) How could infrared spectroscopy be used to distinguish between 2-bromo-2-methylpropane and the tertiary alcohol produced in this reaction?

_____ [2]

- (e) 2-bromo-2-methylpropane reacts with ethanolic potassium hydroxide to produce a different product.

- (i) Write an equation for this reaction.

_____ [2]

- (ii) Name the organic product.

_____ [1]

- (iii) Name the type of reaction.

_____ [1]

- (f) 1-bromobutane is a structural isomer of 2-bromo-2-methylpropane.

- (i) Define the term **structural isomer**.

_____ [2]

- (ii) State, giving reasons for your choice, which of these two compounds would be expected to have the higher boiling point.

_____ [3]

Examiner Only	
Marks	Remark

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