



Rewarding Learning

ADVANCED SUBSIDIARY (AS)  
General Certificate of Education  
2024

Centre Number

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Candidate Number

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# Chemistry

Assessment Unit AS 3

*assessing*

Module 3: Practical Examination

Practical Booklet B (Theory)

**MV18**

[SCH32]

THURSDAY 30 MAY, MORNING

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## Time

1 hour 15 minutes, plus your additional time allowance.

## Instructions to Candidates

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

**You must answer the questions in the spaces provided.**

**Do not write on blank pages.**

Complete in black ink only.

Answer **all five** questions.

## Information for Candidates

The total mark for this paper is 55.

Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.

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

- 1 The table below shows the standard enthalpy of combustion of methanol and the theoretical and experimental temperature increases when 200 g of water is heated by burning 1 g of methanol and by burning 1 g of ethanol.

Alcohol	$\Delta_c H^\ominus$ /kJ mol <sup>-1</sup>	Theoretical temperature increase /°C	Experimental temperature increase /°C
Methanol	-726	27	18
Ethanol		35	24

- (a) Apart from safety equipment and apparatus used to support or clamp containers, name three essential pieces of apparatus which would be required to determine the experimental temperature increase.

[3 marks]

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

- (b) Suggest one reason for the differences between the theoretical and experimental temperature changes.

[1 mark]

\_\_\_\_\_

\_\_\_\_\_

(c) The standard enthalpy of combustion ( $\Delta_c H^\ominus$ ) may be calculated from the theoretical temperature increase values.

(i) Define **standard enthalpy of combustion**.

[2 marks]

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(ii) Calculate the standard enthalpy of combustion of ethanol from the theoretical temperature increase. Give your answer to 3 significant figures.

[4 marks]

Answer \_\_\_\_\_ kJ mol<sup>-1</sup>

(d) Suggest why it is practically more difficult to determine the experimental temperature increases for the combustion of 1 g of the alkanes, methane and ethane. [1 mark]

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- 2 A sample of 224 mg of an unknown solid metal hydrogencarbonate,  $\text{MHCO}_3$ , was dissolved in  $100 \text{ cm}^3$  of deionised water. A  $25.0 \text{ cm}^3$  portion of this solution was titrated against  $0.0145 \text{ mol dm}^{-3}$  sulfuric acid, using methyl orange as an indicator. The equation for the reaction and the results of the titration are given below.



	<b>Rough titration</b>	<b>First accurate titration</b>	<b>Second accurate titration</b>
Initial burette reading / $\text{cm}^3$	1.4	0.5	19.8
Final burette reading / $\text{cm}^3$	21.5	19.8	39.0
Titre / $\text{cm}^3$	20.1	19.3	19.2

- (a) Calculate the mean titre. Give your answer to 1 decimal place. [1 mark]

Answer \_\_\_\_\_  $\text{cm}^3$

**(b)** Suggest why phenolphthalein is not a suitable indicator for this titration. [1 mark]

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**(c)** State the colour change observed at the end point when methyl orange is used as the indicator for this titration. [1 mark]

From \_\_\_\_\_

to \_\_\_\_\_

**(d)** Suggest one advantage of using a conical flask rather than a beaker for a titration. [1 mark]

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**(e) (i)** Calculate the number of moles of sulfuric acid that reacted in this titration. [1 mark]

Answer \_\_\_\_\_

**(ii)** Calculate the relative formula mass of  $\text{MHCO}_3$ . Give your answer to the nearest whole number.  
[2 marks]

Answer \_\_\_\_\_

**(iii)** Calculate the relative atomic mass of M.  
[1 mark]

Answer \_\_\_\_\_

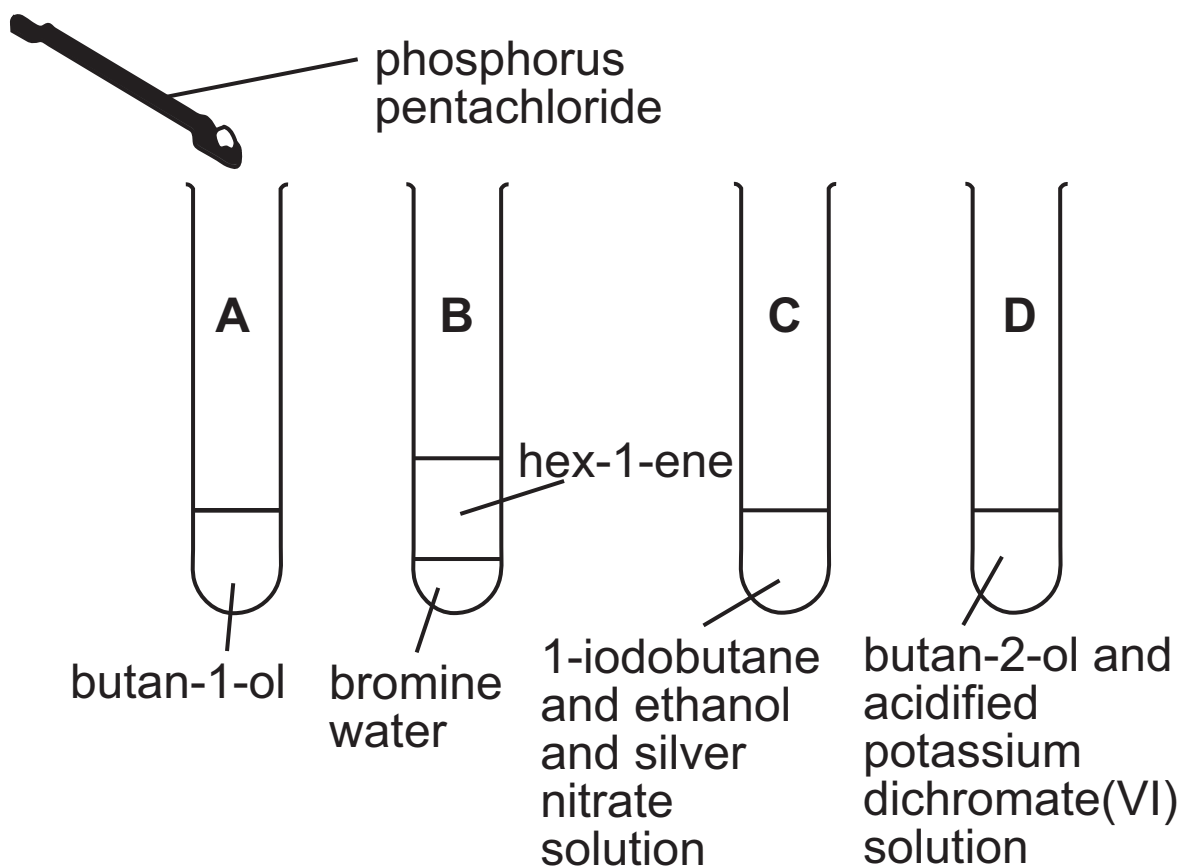
**(iv)** Identify M. [1 mark]

\_\_\_\_\_

- (f) Calculate the expected titre if this experiment was repeated with the same mass (224 mg) of a pure sample of caesium hydrogencarbonate,  $\text{CsHCO}_3$ . Give your answer to 1 decimal place. [3 marks]

Answer \_\_\_\_\_  $\text{cm}^3$

- 3 Four organic reactions were set up in boiling tubes labelled **A**, **B**, **C** and **D** as shown in the diagram below.



- (a) (i) What would be observed in boiling tube **A** when phosphorus pentachloride is added to butan-1-ol? [2 marks]

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- (ii) Write an equation for the reaction of phosphorus pentachloride with butan-1-ol. [1 mark]

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(b) Boiling tube **B** was stoppered and shaken and the contents allowed to settle.

(i) Explain why two layers form in boiling tube **B**.  
[1 mark]

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(ii) What other observation would be made in boiling tube **B**? [1 mark]

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(iii) State the IUPAC name of the organic product in boiling tube **B**. [1 mark]

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(c) Boiling tube **C** was placed in a hot water bath and a precipitate formed almost immediately.

(i) State the colour of the precipitate. [1 mark]

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(ii) Write an ionic equation for the formation of the precipitate in boiling tube **C**. [1 mark]

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**(iii)** How would the observations differ if the 1-iodobutane in boiling tube **C** was replaced with 1-chlorobutane? [2 marks]

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**(d)** Boiling tube **D** was also placed in a hot water bath.

**(i)** State the colour change observed in boiling tube **D**. [1 mark]

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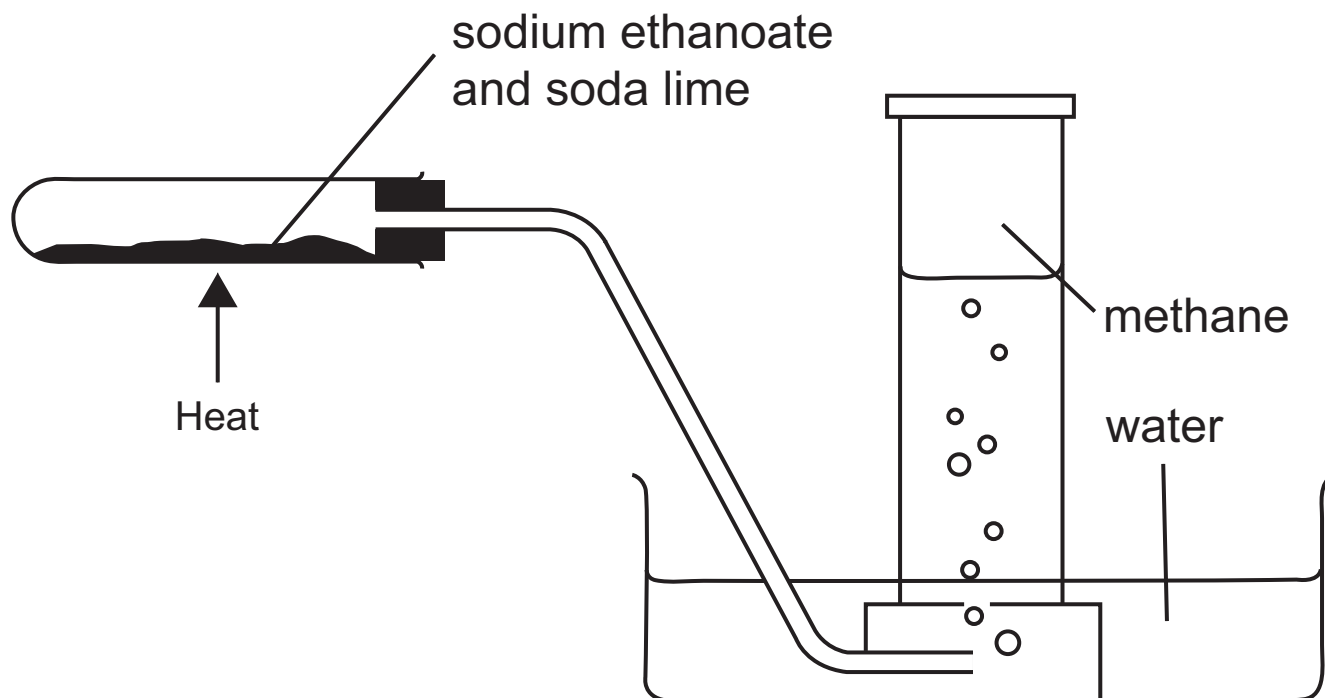
**(ii)** State the IUPAC name of the organic product in boiling tube **D**. [1 mark]

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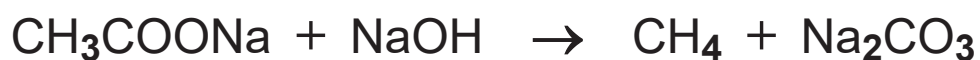
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**(Questions continue overleaf)**

4 The hydrides of the Period 2 and 3 elements include methane, ammonia, water and hydrogen chloride.

(a) The apparatus below may be used to prepare a sample of methane gas from the reaction of sodium ethanoate ( $\text{CH}_3\text{COONa}$ ) and soda lime.



The equation for the reaction is given below where NaOH represents soda lime.



(i) Methane may be collected over water, as shown, or by upwards delivery. State one practical advantage of collecting methane over water. [1 mark]

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(ii) Suggest the name of the gaseous product formed when sodium butanoate is heated with soda lime.  
[1 mark]

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(b) Ammonia reacts with chlorine to form ammonium chloride and nitrogen.

(i) Write an equation for this reaction. [2 marks]

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(ii) Describe the test for ammonia gas. [2 marks]

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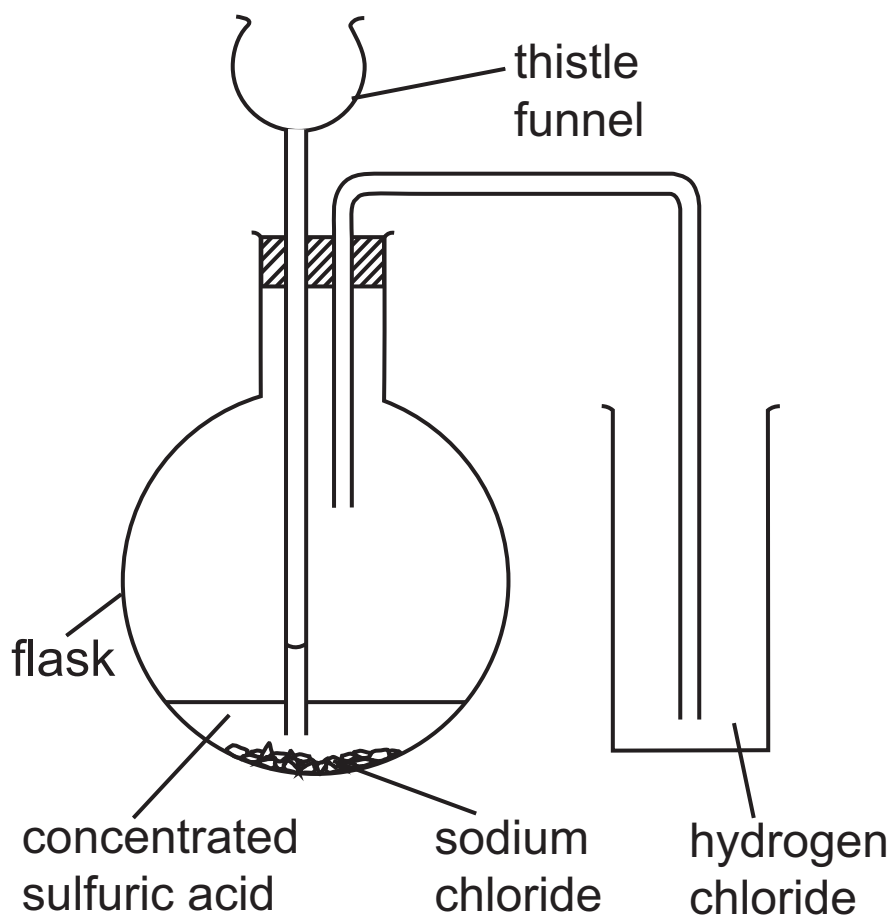
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(iii) Complete the table below about the gaseous reactants in this reaction. [2 marks]

Gas	Colour of gas	Observations when gas tested with damp universal indicator paper
Ammonia	Colourless	
Chlorine		

(c) A diagram of the apparatus used to prepare and collect hydrogen chloride gas is shown below.



(i) Write an equation for the reaction to prepare hydrogen chloride. [1 mark]

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(ii) Explain why the bottom of the thistle funnel must be below the level of the concentrated sulfuric acid in the flask. [1 mark]

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(iii) Sodium chloride is replaced with sodium iodide in the apparatus opposite. Name two gases formed during the reaction between sodium iodide and concentrated sulfuric acid. [2 marks]

1. \_\_\_\_\_

2. \_\_\_\_\_

**5** A student was purifying a sample of an organic liquid.

**(a)** The organic liquid was mixed with sodium hydrogencarbonate solution in a separating funnel. The separating funnel was stoppered and shaken.

**(i)** What is the purpose of shaking the organic liquid with sodium hydrogencarbonate solution?  
[1 mark]

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**(ii)** What should the student do from time to time whilst shaking to release gas pressure? [1 mark]

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- (b)** The contents of the separating funnel were allowed to stand until the layers settle. In the image below the student is preparing to separate the two layers.



- (i)** Why does the student remove the stopper before separating the layers? [1 mark]

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- (ii)** How would the student check practically which is the aqueous layer, before separating the layers? [2 marks]

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(c) When separated, the organic liquid contains some water.

(i) How does the water affect the appearance of the organic liquid? [1 mark]

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(ii) Name a suitable solid which the student could add to remove the water. [1 mark]

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(iii) How would the student remove this solid from the organic liquid? [1 mark]

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**This is the end of the question paper**

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## SOURCES

Q5b . . . © Science Photo Library

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	

<b>Total Marks</b>	
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Examiner Number

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