Accredited

AS Level Chemistry A
H032/02 Depth in chemistry
Sample Question Paper

Date – Morning/Afternoon
Time allowed: 1 hour 30 minutes

You must have:
• the Data Sheet for Chemistry A

You may use:
• a scientific or graphical calculator

First name	
Last name	
Centre number	
Candidate number	

INSTRUCTIONS
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION
- The total mark for this paper is **70**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **20** pages.

Answer **all** the questions.

1 Bromine is a reactive element. It combines with other non-metals to form covalent compounds. Phosphorus tribromide, PBr_3, and iodine monobromide, IBr, are examples of covalent compounds used in organic synthesis.

(a) PBr_3 can be prepared by heating bromine with phosphorus, P_4.

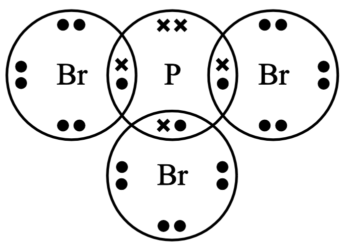
(i) Write an equation for this reaction.

………………………………………………………………………………………………. **[1]**

(ii) How many molecules are present in 1.3535 g of PBr_3?

number of molecules = ……………………… **[3]**

(iii) The '*dot-and-cross*' diagram of a molecule of PBr_3 is given below.



Name the shape of this molecule and explain why the molecule has this shape.

name: ……………………………………………………………………………………..

explanation: ………………………………………………………………………………….

………………………………………………………………………………………………….

………………………………………………………………………………………………….

[3]

(b) Bromine reacts with iodine to form iodine monobromide, IBr.

The table below lists some average bond enthalpies which are required in different parts of this question.

Bond	**Average bond enthalpy / kJ mol^{-1}**
Br–Br	+193
I–I	+151
I–Br	+175

(i) Average bond enthalpy is the enthalpy change for the breaking of 1 mole of bonds in gaseous molecules.

Why do Br_2 and I_2 **not** exist in the gaseous state under standard conditions?

……………………………………………………………………………………………………

…………………………………………………………………………………………….. **[1]**

(ii) Calculate the enthalpy change of formation, $\Delta_f H$, for IBr.

$\Delta_f H$ = ……………………… kJ mol^{-1} **[2]**

(c) Iodine monobromide, I–Br, is a polar molecule.

Heterolytic fission of the I–Br bond forms an electrophile.

State the meaning of the term *electrophile* and suggest the formula of the electrophile formed from IBr.

……………………………………………………………………………………………………

…………………………………………………………………………………………….. **[2]**

(d) Bromine disproportionates when it reacts with potassium hydroxide solution.

Suggest an equation for this reaction.

…………………………………………………………………………………………………… **[1]**

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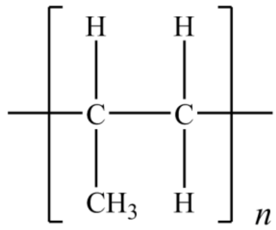
2 A large proportion of the world's output of organic chemicals is used to make addition polymers. These polymers have a variety of uses.

(a) Poly(propene) is used to make packaging, textiles and rope.

A repeat unit for poly(propene) is shown below.



(i) Explain why poly(propene) is a *saturated* hydrocarbon.

……………………………………………………………………………………………………

…………………………………………………………………………………………………… **[1]**

(ii) State the bond angle around each carbon atom in poly(propene).

…………………………………………………………………………………………………… **[1]**

(iii) After polymers have been used for packaging, the waste polymers need to be processed to save resources, for example, by recycling.

Describe **two** other ways in which waste poly(propene) can be processed in a sustainable way.

……………………………………………………………………………………………………

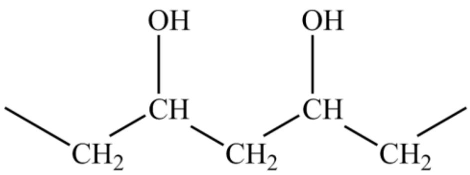
……………………………………………………………………………………………………

……………………………………………………………………………………………………

…………………………………………………………………………………………………… **[2]**

(b) Poly(ethenol) is used to make soluble laundry bags.

A section of the structure of poly(ethenol) is shown below.



(i) Draw a structure to represent one repeat unit of poly(ethenol).

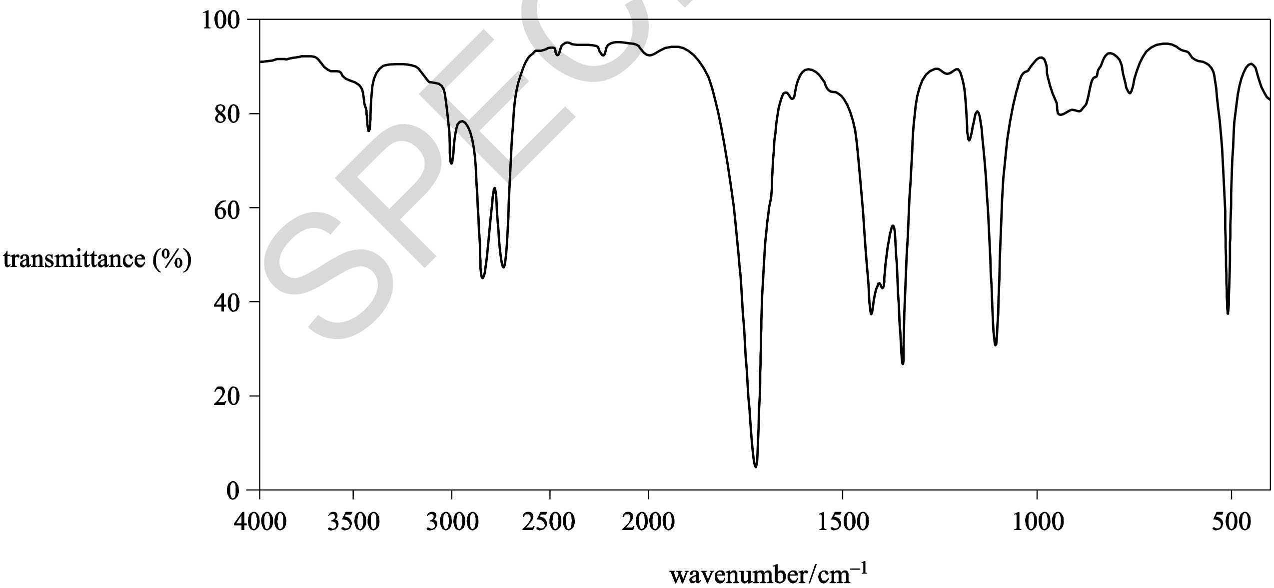
[1]

(ii) Poly(ethenol) is not manufactured from ethenol.

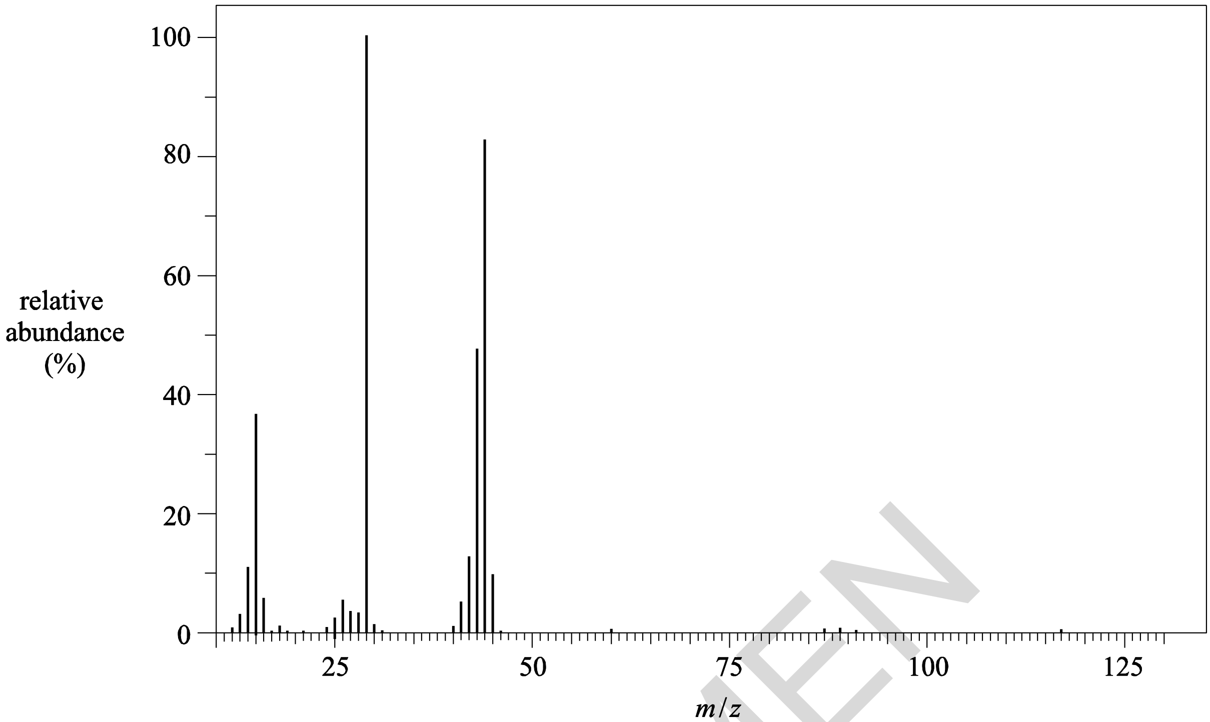
Ethenol is unstable and it forms a more stable structural isomer.

Analysis of the structural isomer gave the following data.

Infrared spectrum



Mass spectrum



Use **all** the data to show that the isomer is **not** ethenol.

Identify the structural isomer of ethenol.

In your answer you should make clear how your explanation is linked to the evidence.

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.... **[4]**

3 Nitrogen can be reacted with hydrogen in the presence of a catalyst to make ammonia in the Haber process.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \quad \Delta H = -92\ \text{kJ mol}^{-1}$$

(a) Describe and explain the effect of increasing the pressure on the rate of this reaction.

....

....

.... **[2]**

(b) A mixture of N_2 and H_2 was left to react until it reached equilibrium. The equilibrium mixture had the following composition:

N_2	1.20 mol dm^{-3}
H_2	2.00 mol dm^{-3}
NH_3	0.877 mol dm^{-3}

(i) Calculate a value for K_c for this equilibrium.

K_c = ... dm^6 mol^{-2} **[3]**

(ii) Explain how the following changes would affect the amount of NH_3 present in the equilibrium mixture.

Use of a catalyst:

....

....

A higher temperature:

....

....

[3]

(c) 1.00 tonne of ammonia from the Haber process is reacted with carbon dioxide to prepare the fertiliser urea, NH_2CONH_2.

$$2NH_3(g) + CO_2(g) \rightarrow NH_2CONH_2(s) + H_2O(l)$$

1.35 tonnes of urea are formed.

Calculate the percentage yield of urea.

Show **all** your working.

yield = **..........................** % **[3]**

4 Students work together in groups to identify four different solutions.

Each solution contains one of the following compounds:

- ammonium sulfate, $(NH_4)_2SO_4$
- sodium sulfate, Na_2SO_4
- sodium chloride, NaCl
- potassium bromide, KBr.

Your group has been provided with universal indicator paper and the following test reagents:

- barium chloride solution
- silver nitrate solution
- dilute ammonia solution
- sodium hydroxide solution.

(a)* A student in your group suggests the following plan:

- Add about 1 cm depth of each solution into separate test-tubes.
- Add a few drops of barium chloride solution to each test-tube.
- A white precipitate will show which solutions contain sulfate ions.
- Two of the solutions will form a white precipitate.

Describe how you would expand this plan so that all four solutions could be identified using a positive test result.

You should provide observations and conclusions that would enable your group to identify all four solutions.

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……………………………………………………………………………………… **[6]**

(b) Solid barium chloride has a high melting point. Barium chloride dissolves in water to form a solution that can be used to test for sulfate ions.

(i) Draw a '*dot-and-cross*' diagram to show the bonding in solid barium chloride.
Show outer electrons only.

[2]

(ii) A solution of barium chloride can be made in the laboratory using dilute hydrochloric acid.

Suggest a compound that can be reacted with hydrochloric acid to make barium chloride.

……………………………………………………………………………… **[1]**

5 Alcohols are used in organic synthesis.

(a) Pentan-2-ol can be prepared by the alkaline hydrolysis of 2-iodopentane.

$$CH_3CH(I)CH_2CH_2CH_3 + NaOH \rightarrow CH_3CH(OH)CH_2CH_2CH_3 + NaI$$

The reaction mixture is boiled for 20 minutes.

(i) State the most appropriate technique that could be used to boil the reaction mixture for 20 minutes.

.... **[1]**

(ii) Describe the mechanism for the alkaline hydrolysis of 2-iodopentane.

In your answer, include the name of the mechanism, curly arrows and relevant dipoles.

name of mechanism: ....

[4]

(b) Alcohols can be converted into haloalkanes in a substitution reaction.

Plan an experiment to prepare approximately 0.1 mol of 2-bromopentane, $CH_3CHBrCH_2CH_2CH_3$, from pentan-2-ol, $CH_3CH(OH)CH_2CH_2CH_3$.

Your plan should include a calculation of the mass of alcohol required and details of the chemicals to be used in the reaction.

....

....

.... **[2]**

(c)* Alcohols can be converted into alkenes in an elimination reaction.

The elimination of H_2O from pentan-2-ol forms a mixture of organic products.

Give the names and structures of all the organic products in the mixture.

Your answer should explain how the reaction leads to the different isomers.

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.... **[6]**

6 A student carries out an experiment to identify an unknown carbonate.

- The student weighs a sample of the solid carbonate in a weighing bottle.
- The student tips the carbonate into a beaker and weighs the empty weighing bottle.
- The student prepares a 250.0 cm^3 solution of the carbonate.
- The student carries out a titration using 25.0 cm^3 of this solution measured using a pipette with 0.100 mol dm^{-3} hydrochloric acid in the burette.

(a) The sample of carbonate is dissolved in approximately 100 cm^3 of distilled water in a beaker and the solution transferred to a volumetric flask. The volume of the solution is made up to 250.0 cm^3 with distilled water.

Another student suggests two possible sources of error:

- A small amount of solid remained in the weighing bottle.
- A small amount of solution remained in the beaker.

State whether the other student's statements are correct.

How could the procedure be improved?

....

....

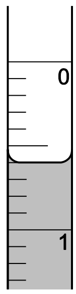
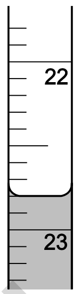
....

.... **[2]**

(b) The student carries out the final part of the experiment by adding 0.100 mol dm^{-3} hydrochloric acid to a burette and performing a titration using a 25.0 cm^3 sample of the aqueous carbonate.

The student reads the burette to the nearest 0.05 cm^3.

The diagrams below show the initial burette reading and the final burette reading.

initial reading		final reading	

(i) Record the student's readings and the titre.

[1]

(ii) Describe what the student should do next to obtain reliable results for the titration.

……………………………………………………………………………………………………

……………………………………………………………………………………………………

…………………………………………………………………………………………….. **[1]**

(c) The equation below represents the reaction between the carbonate and hydrochloric acid.

$$M_2CO_3(aq) + 2HCl(aq) \rightarrow 2MCl(aq) + CO_2(g) + H_2O(l)$$

(i) Calculate the amount, in mol, of M_2CO_3 used in the titration.

$n(M_2CO_3)$ = ……………………… mol **[2]**

(ii) The student's mass readings are recorded below.

Mass of weighing bottle + carbonate / g	14.92
Mass of weighing bottle / g	13.34

Use the student's results to identify the carbonate, M_2CO_3.

Show **all** your working.

[4]

7 An alcohol **A** contains carbon, hydrogen and oxygen only. The alcohol is a liquid at room temperature and pressure but can easily be vaporised.

1.15 g of **A** produces 761 cm^3 of gas when vaporised, measured at 100 kPa and 366 K.

Determine the molar mass of compound **A** and draw a possible structure for **A**.

Show **all** your working.

molar mass = ... $g\ mol^{-1}$

Structure of **A**

[5]

END OF QUESTION PAPER

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…day June 20XX – Morning/Afternoon

AS Level Chemistry A

H032/02 Depth in chemistry

SAMPLE MARK SCHEME

Duration: 1 hour 30 minutes

MAXIMUM MARK 70

This document consists of 20 pages

MARKING INSTRUCTIONS

PREPARATION FOR MARKING

SCORIS

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *scoris assessor Online Training*; *OCR Essential Guide to Marking*.

2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal http://www.rm.com/support/ca

3. Log-in to scoris and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

   YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.

2. Marks awarded must relate directly to the marking criteria.

3. The schedule of dates is very important. It is essential that you meet the scoris 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the scoris messaging system.

5. Work crossed out:

   a. where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks

   b. if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.

7. There is a NR (No Response) option. Award NR (No Response)

   - if there is nothing written at all in the answer space
   - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
   - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.

   Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

8. The scoris **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**

   If you have any questions or comments for your Team Leader, use the phone, the scoris messaging system, or email.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

Read through the whole answer from start to finish, concentrating on features that make it a stronger or weaker answer using the indicative scientific content as guidance. The indicative scientific content indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance.

Using a 'best-fit' approach based on the science content of the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, **best** describes the overall quality of the answer using the guidelines described in the level descriptors in the mark scheme.

Once the level is located, award the higher or lower mark.

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

In summary:

- **The science content determines the level.**
- **The communication statement determines the mark within a level.**

Level of response questions on this paper are **4(a)** and **5(c)**.

11. **Annotations**

Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
___	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

12. **Subject-specific Marking Instructions**

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

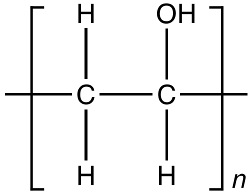
You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Question			Answer	Marks	Guidance
1	(a)	(i)	$P_4 + 6Br_2 \rightarrow 4PBr_3$ ✓	1	**IGNORE** state symbols
		(ii)	**FIRST CHECK THE ANSWER ON THE ANSWER LINE** **If answer = 3.01×10^{21} award 3 marks** $M_r(PBr_3) = 270.7$ (g mol^{-1}) ✓ $n(PBr_3) = 1.3535 / 270.7 = 5.000 \times 10^{-3}$ mol ✓ number of molecules = $5.000 \times 10^{-3} \times 6.02 \times 10^{23}$ = 3.01×10^{21} molecules ✓	3	If there is an alternative answer, check to see if there is any **ECF** credit possible using working below. **ALLOW** in working shown as 28.1 + 35.5 × 4 **ALLOW ECF** from incorrect molar mass of PBr_3 **ALLOW** 0.005(00) (mol) for two marks **ALLOW ECF** for incorrect amount of PBr_3 **ALLOW** calculator value or rounding to 3 significant figures or more **BUT IGNORE** 'trailing' zeroes, e.g. 0.200 allowed as 0.2 **DO NOT ALLOW** any marks for: $1.3535 \times 6.02 \times 10^{23} = 8.15 \times 10^{23}$
		(iii)	Pyramidal ✓ (because there are) 3 bonded pairs and 1 lone pair (around the central phosphorus atom) ✓ and electron pairs repel each other as far apart as possible so will take on a tetrahedral arrangement (giving a pyramidal shape overall) ✓	3	
	(b)	(i)	(because energy is needed to break) induced dipole–dipole interactions / London forces between molecules ✓	1	**ALLOW** forces of attraction between molecules **OR** van der Waals' forces **IGNORE** reference to strong or weak
		(ii)	Bond breaking (+193) + (+151) = (+)344	2	

Question			Answer	Marks	Guidance
			AND Bond making 2(–175) = (–)350 ✓ $\Delta_f H = \frac{(+344)+(-350)}{2} = -3$ (kJ mol^{-1}) ✓		Correct answer scores 2 marks
	(c)		Electron pair acceptor ✓ I^+ ✓	**2**	
	(d)		$Br_2 + 2KOH \rightarrow KBr + KBrO + H_2O$ ✓	**1**	**ALLOW** $3Br_2 + 6KOH \rightarrow 5KBr + KBrO_3 + 3H_2O$ **ALLOW** ionic equation
			Total	**13**	

Question			Answer	Marks	Guidance
2	(a)	(i)	(because) molecule contains only single C–C bonds ✓	1	**ALLOW** no multiple bonds/no double or triple bonds **ALLOW** contains single bonds only
		(ii)	109.5° ✓	1	
		(iii)	Combustion for energy production (alternative to fossil fuels) ✓ Use as an organic feedstock ✓	2	
	(b)	(i)	 ✓	1	
		(ii)	***Evidence against ethenol:*** No infrared absorption between 3200 and 3600 cm^{-1} from O–H ✓ ***Evidence for isomer:*** Infrared absorption between 1640 and 1750 cm^{-1} indicates C=O ✓ Mass spectrum: fragmentation peak at m/z = 29 suggests CHO^+ **OR** fragmentation peak at m/z = 15 suggests CH_3 ✓ ***Identification:*** Ethanal/CH_3CHO ✓	4	**IGNORE** molecular ion peak at m/z confirms molecular mass of 44 g mol^{-1}
			Total	**9**	

Question			Answer	Marks	Guidance
3	(a)		(Increase in pressure) increases the rate **AND** because molecules are closer together… ✓ … so there are more collisions per unit time ✓	2	**ALLOW** more particles per unit volume **NOT** molecules move faster or have more energy
	(b)	(i)	*Expression:* $K_c = [NH_3]^2 / [H_2]^3[N_2]$ ✓ *Calculation:* $= (0.877)^2/(2.00)^3(1.20)$ ✓ = 0.0801 ✓ ($dm^6\ mol^{-2}$)	3	Square brackets required **ALLOW** from 1 sig fig up to calculator display Correct answer alone scores all marks
		(ii)	*Catalyst:* No effect, it only changes the rate of reaction ✓ *Higher temperature:* Forward reaction is exothermic ✓ so position of equilibrium moves to the left and there will be less NH_3 ✓	3	

Question			Answer	Marks	Guidance
	(c)		**FIRST CHECK THE ANSWER ON THE ANSWER LINE** **IF** answer = 76.5 (%) award 3 marks $n(NH_3) = (1 \times 10^6) / 17 = 5.88 \times 10^4$ (58824) (mol) **AND** *Theoretical yield:* $n(NH_2CONH_2) = 5.88 \times 10^4 / 2 = 2.94 \times 10^4$ (29412) (mol) ✓ *Actual yield:* $n(NH_2CONH_2) = 1.35 \times 10^6 / 60 = 2.25 \times 10^4$ (22500) (mol) ✓ % yield = $(2.94 \times 10^4 / 2.25 \times 10^4) \times 100\% = 76.5(\%)$ ✓	3	**If there is an alternative answer, check to see if there is any ECF credit possible using working below** **ALLOW** up to full calculator display For 2nd and 3rd marks, **ALLOW** calculation in mass. *Theoretical mass yield:* $m(NH_2CONH_2) = 60 \times 5.88 \times 10^4 / 2 = 1.764$ tonne ✓ % yield = (1.35 / 1.764) × 100 = 76.5% ✓ **ALLOW** 76% (2 sig figs) up to calculator answer correctly rounded from previous values **ALLOW ECF** from calculated actual and theoretical yields
			Total	**11**	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>4</td><td>(a)*</td><td></td><td>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.

Level 3 (5–6 marks)
Describes full details of all of the test procedures and observations that allows all four compounds identified

There is a well-developed line of reasoning and the method is clear and logically structured. The information presented is relevant and substantiated by observations from the tests described.

Level 2 (3–4 marks)
Describes most of the tests in some detail including the observations that allows all four compounds to be identified.

There is a line of reasoning presented and the method has some structure. The information presented is in the most-part relevant and supported by some evidence of observations from the tests described.

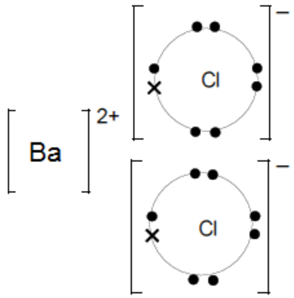
Level 1 (1–2 marks)
Describes some of the tests but lacks details and observations to allow the identification of all four compounds

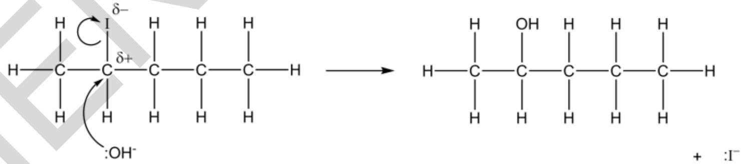
The information is basic and the method lacks structure. The information is supported by limited evidence of the observations, the relationship to the evidence may not be clear.

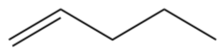
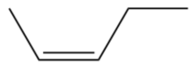
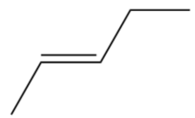
0 marks
No response or no response worthy of credit.</td><td>6</td><td>Indicative scientific points may include

Details of tests
To identify sulfates:
• <u>Ammonium ion test</u>: on the sulfates already identified; <u>warm</u> with NaOH(aq)
followed by
• <u>Universal indicator test</u>: use of <u>moist</u> indicator paper on (ammonia) gas; correct observation (alkaline gas/high pH/blue or purple) for identification of $(NH_4)_2SO_4$, and by default of Na_2SO_4.

To identify halides:
• <u>Halide ion test</u>: addition of silver nitrate solution to remaining two solutions; correct observation (white precipitate/cream precipitate)
followed by
• <u>Solubility of precipitate</u>: addition of dilute ammonia solution to halide precipitates; correct observation (silver chloride dissolves) enabling identification of $NaCl$ and by default of KBr.</td></tr>
</table>

Question			Answer	Marks	Guidance
	(b)	(i)	 Barium ion with no (or eight) electrons **AND** two chloride ions with correct *dot-and-cross* octet ✓ Correct charges ✓	2	**For the first mark**, if eight electrons are shown in the cation then the 'extra' electron in the anion must match the symbol chosen for electrons in the cation **IGNORE** inner shell electrons Circles **not** essential **ALLOW** One mark if both electron arrangement and charges are correct but only one C*l* is drawn allow $2[Cl]^-$ (Bracket not required)
		(ii)	Barium hydroxide **OR** barium oxide **OR** barium carbonate ✓	1	**ALLOW** $Ba(OH)_2$ **OR** BaO **OR** $BaCO_3$
			Total	9	

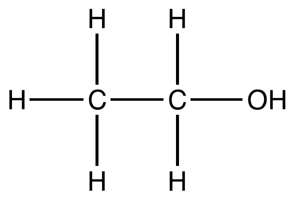
Question			Answer	Marks	Guidance
5	(a)	(i)	Reflux ✓	1	
		(ii)	Nucleophilic substitution ✓ *Mechanism* Curly arrow from lone pair on OH^- to $\delta+$ carbon atom ✓ Curly arrow and dipole on C–I bond ✓ Correct products ✓	4	The curly arrow must start from the oxygen atom of the OH^- and must start from either the lone pair or the negative charge  **DO NOT ALLOW** attack by NaOH
	(b)		(Minimum) *n*(pentan-2-ol) required = 0.1× 88 = 8.8 g ✓ React the alcohol with a mixture of NaBr **AND** H_2SO_4 **AND** warm (to distil off the product) ✓	2	 **ALLOW** HBr

Question			Answer	Marks	Guidance
	(c)*		*Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.* **Level 3 (5–6 marks)** Applies knowledge of elimination reactions to provide the correct names and structures of all three alkenes **AND** Full, detailed explanation of formation of both types of isomers linked to the reaction, with clear understanding of both types of isomerism *The explanations show a well-developed line of reasoning which is clear and logically structured. The information presented is relevant to the compounds drawn/named.* **Level 2 (3–4 marks)** Applies knowledge of elimination reactions to provide the correct name and structure for pent-1-ene **AND** Correct structures of stereoisomers of pent-2-ene but full names missing or incorrect **AND** Explanation of formation of at least one type of isomers in some detail. *The explanations show a line of reasoning presented with some structure. The information presented is in the most-part relevant to the compounds drawn/named.* **Level 1 (1–2 marks)** Applies knowledge of elimination reactions to name and draw the structures of organic products. Either name **OR**	6	**Indicative scientific points may include:** • the elimination can produce a double bond in either the 1- or the 2- position (through combination of the hydroxyl group with a hydrogen from either the 1st or the 3rd carbon) • this leads to the formation of structural isomers (pent-1-ene and pent-2-ene) • pent-2-ene exhibits stereoisomerism / *E/Z* isomerism / *cis–trans* isomerism because it has two different groups attached to each carbon atom • there are two possible isomers of pent-2-ene and three in total **Names and structures of alkenes**  pent-1-ene  *Z* or *cis*-pent-2-ene  *E* or *trans*-pent-2-ene

Question			Answer	Marks	Guidance
			structure should be correct for two compounds. **AND** Attempts to explain formation of one type of isomer. *The information about isomerism is basic and communicated in an unstructured way. The relationship to the compounds drawn/named may not be clear.* **0 marks** No response or no response worthy of credit.		
			Total	**13**	

Question			Answer	Marks	Guidance
6	(a)		Not correct about the solid remaining in the weighing bottle (weighed by difference) **AND** Correct about the solution in the beaker ✓ Rinse out the beaker with distilled water and transfer to the volumetric flask **before** making up to 250 cm^3 ✓	2	
	(b)	(i)	Initial reading = 0.60 (cm^3) Final reading = 22.80 (cm^3) Titre = 22.20 cm^3 ✓ Initial and final values recorded to two decimal places **AND** titre recorded to the nearest 0.05 cm^3 with correct units	1	
		(ii)	Suggests repeating the titration to obtain consistent/concordant results (those that agree to within 0.1 cm^3) **AND** calculating the mean titre ✓	1	
	(c)	(i)	$n(HCl)$ = (0.100)(answer to **(c)(i)**/1000) = 0.00222 (mol) ✓ $n(M_2CO_3)$ = 0.00222/2 = 0.00111 (mol) ✓	2	**ALLOW ECF** from **(b)(i)**

Question			Answer	Marks	Guidance
		(ii)	$n(M_2CO_3)$ in total = 0.00111 x 10 = 0.0111 mol ✓ Molar mass = 1.58/0.0111 = 142.3 g mol^{-1} ✓ Mass of M = (142.3 – 60)/2 = 41.15 (= K) ✓ K_2CO_3 ✓	**4**	Note: molar mass is between K_2CO_3 (138.2) and $SrCO_3$ (147.6); only possible match for a Group 1 carbonate is K_2CO_3.
			Total	**10**	

Question			Answer	Marks	Guidance
7			**FIRST CHECK THE ANSWER ON THE ANSWER LINE** **IF** answer = 46.0 (g mol^{-1}) award 4 marks for calculation *Rearranging ideal gas equation to make n subject* $n = \dfrac{pV}{RT}$ ✓ *Substituting all values taking into account conversion to Pa and m^3* $n = \dfrac{(100 \times 10^3) \times (761 \times 10^{-6})}{8.314 \times 366}$ ✓ n = 0.0250 mol ✓ *Calculation of M* $M = \dfrac{m}{n} = \dfrac{1.15}{0.0250}$ = 46.0 (g mol^{-1}) ✓ *Identification of* ***A*** ✓ 	5	**If there is an alternative answer, check to see if there is any ECF credit possible using working below** 1st mark may be implicit in direct substitution of correct values into rearranged equation. **ALLOW** any unambiguous structure **ALLOW** C_2H_5OH **DO NOT ALLOW** C_2H_6O
			Total	**5**	

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