

Edexcel International AS/A Level

IAL Chemistry

ONLINE Module 2

Understanding assessment
and improving delivery

Event Code:

First teaching in 2018, first assessment 2019



Introductions



Aims and Objectives

- investigate assessment objective AO3 – the assessment of learning from practical chemistry, looking at feedback from the previous exam series, concentrating particularly in this module on AO3
- discuss strategies for teaching to ensure students can access questions targeting this assessment objective AO3
- review the support Pearson offers for the qualification
- network, discuss best practice and share ideas with other teachers



Definitions of AOs

		% in IAS	% in IA2	% in IAL
AO1	Demonstrate knowledge and understanding of science.	34–36	29–31	32–34
AO2 (a)	Application of knowledge and understanding of science in familiar and unfamiliar contexts.	34–36	33–36	33–36
(b)	Analysis and evaluation of scientific information to make judgements and reach conclusions.	9–11	14–16	11–14
AO3	Experimental skills in science, including analysis and evaluation of data and methods.	20	20	20

Specification p75



A03



AO3

Why do we ask AO3?

What types of AO3 questions are there?

Consideration of some questions from recent papers

Some marking / feedback to see good and not-so-good student answers

Teaching strategies: how can we make sure students succeed at AO3?



Why do we ask AO3?

- While AO1 is focused on recall of knowledge and explanation and AO2 focuses on application, analysis and evaluation, AO3 is placed in a practical context
- Practical work is an important part of Chemistry A level and a student's familiarity with practical techniques is tested in AO3
- The practical work may be familiar or unfamiliar but questions will focus on techniques and concepts



Types of Questions

- Any question in a practical context in paper WCH13 and WCH16
- Many questions similar to equivalent papers in the previous specification



WCH13 Q2

A group of students was asked to investigate a liquid organic compound **A**. They were told that it was an alcohol with molecular formula $C_4H_{10}O$.

- (a) A chemical test may be used to confirm the presence of the hydroxyl group in **A**. Identify a suitable reagent for this test, giving the positive result. (2)

Question number	Answer	Additional guidance	Mark
2(a)	An answer that makes reference to the following points: <ul style="list-style-type: none">suitable reagent (1)observation (1)	Phosphorus(V) chloride / phosphorus pentachloride / PCl_5 (solid) Allow thionyl chloride / $SOCl_2$ Do not award PCl_5 / $SOCl_2$ solution but allow the result mark Steamy fumes / (dense) white fumes / misty fumes Do not award white smoke Allow add sodium (1) and effervescence / fizzing / bubbles (1) add named carboxylic acid and strong acid catalyst (1) gives fruity smell (1) Do not award acidified dichromate and orange to green	(2)



Add PCl_5

Steamy misty fumes are

seen, HCl gas released

or add $\text{K}_2\text{Cr}_2\text{O}_7$, orange-green



Add potassium chloride (✓)

Misty fumes.



Examiners' Report

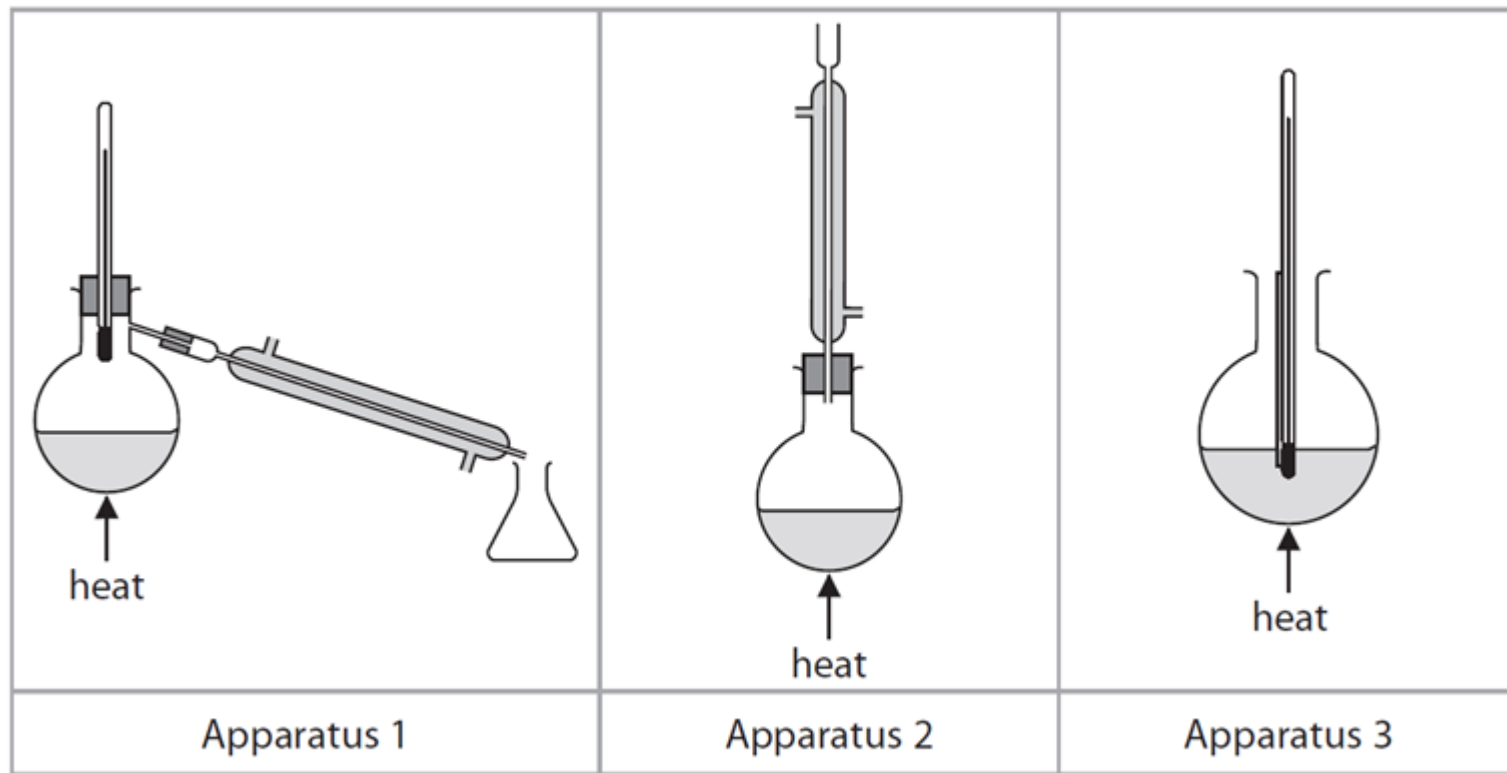
Most students were able to describe a test for a hydroxyl group.

Phosphorus(V) chloride was the preferred reagent, although a significant minority suggested sodium metal; the results of these tests were well known.

The most common incorrect reagent was acidified potassium dichromate(VI) which gained no credit.



- (b) The students suggested that oxidation of **A** would help to identify it.
The sets of apparatus shown below were provided for the students' use.



- (i) Identify the reagent mixture that can be used to oxidise **A**.

(1)



Question number	Answer	Additional guidance	Mark
2(b)(i)	<ul style="list-style-type: none"> potassium dichromate(VI) / $K_2Cr_2O_7$ / sodium dichromate(VI) / $Na_2Cr_2O_7$ <p>and</p> <p>sulfuric acid / H_2SO_4</p>	<p>Allow</p> <p>omission of the oxidation number</p> <p>Just 'acid / acidified'</p> <p>$Cr_2O_7^{2-}/H^+$</p> <p>Ignore heat / reflux / concentrated</p> <p>Do not award</p> <p>Potassium manganate (VII)</p> <p>potassium chromate(VI)</p> <p>Incorrect oxidation number</p> <p>e.g. potassium dichromate(IV)</p> <p>hydrochloric acid / HCl / Nitric acid / HNO_3</p>	(1)



(i) Identify the reagent mixture that can be used to oxidise **A**.

(1)

Potassium Dichromate(V)

Acidified
Potassium dichromate ($\text{H}^+ / \text{K}_2\text{Cr}_2\text{O}_7$)

acidified potassium dichromate



Examiners' Report

The use of acidified potassium dichromate(VI) as the oxidising agent for alcohols was very well known and the most likely error was the omission of the acid.

The oxidation state of chromium was not required but, if given, had to be correct and correctly placed, so (eg) potassium(VI) dichromate gained no credit.

Some students gave acidified potassium manganate(VII), but this also gained no credit as this is not considered a suitable reagent for this oxidation.



(ii) One student said that if **A** was a primary alcohol this could be shown by oxidising it to the corresponding aldehyde and testing the product.

Identify which apparatus (1, 2 or 3) should be used for this oxidation.
Justify your answer.

(2)

Question number	Answer	Additional guidance	Mark
2(b)(ii)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none">choice of apparatus 1 (1)the ease of oxidation of the aldehyde (1)	<p>Example of a justification:</p> <p>The aldehyde is easily oxidised (to a carboxylic acid) / more easily oxidised than the alcohol</p> <p>Allow</p> <p>To prevent further oxidation</p> <p>Partial oxidation occurs</p> <p>Use of reflux (apparatus 2) results in further oxidation</p> <p>M1 and M2 are standalone</p>	(2)



You should use apparatus A, which is
distillation ~~as if you use the~~
as an aldehyde is easily oxidised into
carboxylic acid if you use the reflux
reaction



(2)

1 should be used because aldehyde has low boiling temperature so it will evaporate ~~q~~ and escape quickly so it needs to be condensed into new beaker.



Examiners' Report

The use of distillation to isolate the aldehyde was very well known but students were less clear on the reason for this, often focusing on the practicalities of distillation rather than the importance of preventing further oxidation.



(iii) A chemical test may be used to confirm the presence of an aldehyde.
Identify the reagent used, giving the positive result of the test. (2)

Question number	Answer	Additional guidance	Mark
2(b)(iii)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> suitable reagent (1) result of the selected test (1) 	<p>Route 1</p> <p>(warm with)</p> <p>(blue) Fehling's / (blue) Benedict's reagent</p> <p>Red / brown</p> <p>and</p> <p>precipitate / solid</p> <p>Route 2</p> <p>(warm with)</p> <p>Tollens' reagent</p> <p>Silver mirror or grey/ black precipitate</p> <p>Ignore Brady's reagent</p> <p>Do not award potassium dichromate(VI)</p> <p>No observation TE on incorrect reagent</p>	(2)



(iii) A chemical test may be used to confirm the presence of an aldehyde.
Identify the reagent used, giving the positive result of the test. (2)

Add Flemmings reagent, the ^{positive} result is a red precipitate forms.

→ Acidified potassium dichromate (VII)
→ The mixture turns from orange to green.

Use Benedict's solution. A brick red precipitate would form if the compound is an aldehyde.



Examiners' Report

Most students were able to describe one of the standard tests for aldehydes.

The most common reason for losing the result mark was to give 'turns red' or 'red solution' rather than 'red precipitate' as the observation for the Fehling's or Benedict's tests.



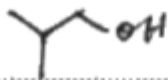
- (iv) State whether or not a positive result for the test in (b)(iii), together with the molecular formula, would allow the alcohol **A** to be identified.
Justify your answer. (1)

Question number	Answer	Additional guidance	Mark
2(b)(iv)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none">The alcohol cannot be identified and because there are two primary alcohols with the molecular formula $C_4H_{10}O$	<p>Accept</p> <p>Alcohol could be</p> <p>butan-1-ol / $CH_3CH_2CH_2CH_2OH$</p> <p>or</p> <p>2-methylpropan-1-ol / $(CH_3)_2CHCH_2OH$</p> <p>both alcohols needed</p> <p>Allow any clear structural / displayed / skeletal formulae</p> <p>Ignore</p> <p>just 'carbon chain could be straight or branched'</p> <p>just 'there are isomers'</p>	(1)



(iv) State whether or not a positive result for the test in (b)(iii), together with the molecular formula, would allow the alcohol **A** to be identified. (1)
Justify your answer.

NO. Even if the result for b/iii is positive, the alcohol A has still two structural isomers: $\text{CH}_3(\text{CH}_2)_3\text{OH}$ and $(\text{CH}_3)_2\text{CHCH}_2\text{OH}$.



~~Yes~~ as NO as the alcohol might be branched or straight chained which can't be determined with this test



Examiners' Report

Few students appreciated that, because there are two primary alcohols with the molecular formula $C_4H_{10}O$, the aldehyde test is inconclusive.



(v) Another student said that if **A** was a secondary alcohol this could be shown by oxidising it to the corresponding ketone.

Identify which apparatus (1, 2 or 3) should be used for this oxidation.

Justify your answer.

(2)

Question number	Answer	Additional guidance	Mark
2(b)(v)	An answer that makes reference to the following points: <ul style="list-style-type: none">choice of apparatus 2 (1)ensuring complete reaction / oxidation (1)	M2 dependent on M1 Ignore subsequent distillation Ignore reference to preventing loss of volatile reagents or products. Just 'because the ketone does not oxidise further' Just 'reaction is slow'	(2)



Identify which apparatus (1, 2 or 3) should be used for this oxidation.
Justify your answer. (2)

Apparatus 1, because ketone cannot be further ~~oxidise~~ oxidising.

Apparatus 2 should be used. Heating under reflux can make sure alcohol condenses back into mixture. The reaction goes to completion.



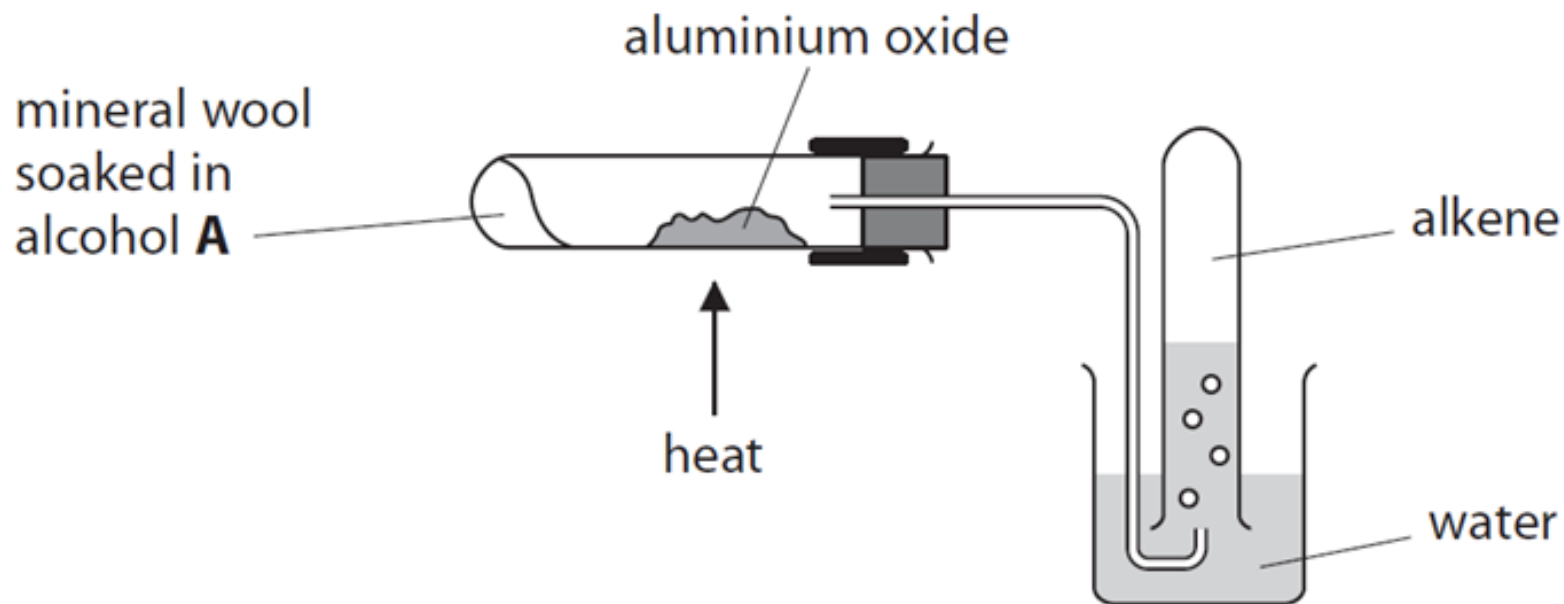
Examiners' Report

The use of reflux in the oxidation of secondary alcohols was generally well known, however, many explanations were given in terms of retaining the volatile reagents rather than ensuring complete oxidation.



(c) In a further experiment, the students passed the vapour of **A** over heated aluminium oxide to form an alkene.

The apparatus used is shown.



(i) Give **two** reasons for the use of the mineral wool.

(2)



Question number	Answer	Additional guidance	Mark
2(c)(i)	<p>An answer that makes reference to any two of the following points:</p> <ul style="list-style-type: none"> the mineral wool holds the alcohol in place (at the end of the tube) (1) the alcohol vapour would not pass over the catalyst slowly enough to react (without the mineral wool) (1) the mineral wool is chemically inert / does not react with the alcohol (1) 	<p>Ignore large surface area / high melting temperature / good absorbant / prevents evaporation (of the alcohol)/ slow reaction</p> <p>Allow prevents the alcohol mixing with the aluminium oxide / Al_2O_3 / catalyst</p> <p>Allow so the alcohol is not heated directly (by the Bunsen)</p> <p>Ignore</p> <p>Any reference to alcohol burning</p> <p>Allow mineral wool does not burn</p>	<p>2 exp</p>



(i) Give **two** reasons for the use of the mineral wool. (2)

The mineral wool was used to hold the alcohol in one place so it does not react with the aluminium oxide, ~~as~~ and it was used because the mineral wool is ~~the~~ unreactive and will not react with the reagents.

- It is a good absorbent
- It does not react with the alcohol



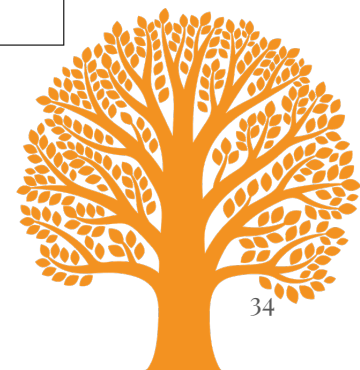
Examiners' Report

Candidates were most likely to score the first and third marking points. Clear explanations of the importance of passing alcohol vapour slowly over the hot catalyst were quite rare.



(ii) Explain why it is necessary to remove the delivery tube from the heated tube immediately when heating stops. (2)

Question number	Answer	Additional guidance	Mark
2(c)(ii)	<p>An explanation that makes reference to the following points:</p> <ul style="list-style-type: none"> the possibility of suck-back (1) <p>EITHER</p> <ul style="list-style-type: none"> explanation of the cause of suck-back (1) <p>OR</p> <ul style="list-style-type: none"> description of the consequences of suck-back (1) 	<p>Examples of correct responses:</p> <p>Suck-back will occur / Water will be drawn up into the reaction tube (from the water bath)</p> <p>Do not award suck-back of anything other than water</p> <p>(On cooling) the pressure in the tube drops and atmospheric pressure acting on the water in the water bath which causes a pressure difference (resulting in suck-back)</p> <p>Allow just drop in pressure / vacuum formed in the reaction tube.</p> <p>Do not award just 'cooling causes suck-back' just 'due to pressure differences'</p> <p>Cold water causes hot tube to crack</p> <p>Allow just test tube cracks/shatters</p> <p>Do not award water will react with the aluminium oxide / tube explodes</p>	(2)



- (ii) Explain why it is necessary to remove the delivery tube from the heated tube immediately when heating stops. (2)

Because if it is not removed, it will create a vacuum in the tube which would increase the pressure and cause the apparatus to burst spitting around all of the reactants.

Pressure will decrease inside so water might go inside.



Examiners' Report

There were some excellent responses with clear descriptions of suck-back and precise explanations in terms of the pressure differences, although, some students seemed unfamiliar with this type of experiment.

Some responses referred to suck-back of the alcohol or alkene which negated the mark, while others suggested that a violent reaction involving the aluminium oxide or the drop in pressure inside the reaction tube would cause an explosion to occur. Students needed to be accurate about which part of the apparatus was affected by suck-back.



WCH13 Q2(d)(ii)

- (ii) The mass spectrum of $\text{C}_4\text{H}_8\text{Br}_2$ had a pair of peaks at $m/z = 107$ and $m/z = 109$ and also peaks at $m/z = 79$ and $m/z = 81$ due to the isotopes of bromine. One student suggested that these peaks showed that alcohol **A** must be butan-2-ol.
- Explain how these peaks support the student's suggestion. (3)



Question number	Answer	Additional guidance	Mark
2(d)(ii)	<p>An explanation that makes reference to the following points:</p> <ul style="list-style-type: none"> identification of the peaks by molecular formula or structure (1) only 2,3-dibromobutane can produce the fragments at $m/z = 107$ and $m/z = 109$ (1) Identifies butan-2-ol as the only alcohol that can form but-2-ene (as a product of dehydration and only but-2-ene can form 2,3-dibromobutane) (1) 	<p>Do not penalise omission of charges</p> <p>$\text{C}_2\text{H}_4^{79}\text{Br}^+$ and $\text{C}_2\text{H}_4^{81}\text{Br}^+$</p> <p>OR</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> $\begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{C}^+-\text{Br} \\ \quad \\ \text{H} \quad \text{H} \end{array}$ </div> <div style="text-align: center;"> $\begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{C}^+-\text{Br} \\ \quad \\ \text{H} \quad \text{H} \end{array}$ </div> </div> <p>Allow peaks due to $\text{C}_2\text{H}_4\text{Br}^{(+)}$</p> <p>Allow identifies $\text{C}_4\text{H}_8\text{Br}_2$ as 2,3-dibromobutane</p> <p>Do not award Just 'alcohol must be butan-2-ol' Just a sequence of structures</p>	(3)



Examiners' Report

The first two marks were accessible to students who appreciated that the mass spectrum under discussion was that of a dibromobutane. The third marking point was more challenging and required more from candidates than a repetition of the phrase used in the question 'alcohol **A** must be butan-2-ol'.

The best answers to this question showed a keen understanding of the chemistry and the mass spectrometry.



Teaching Strategies

- Practice questions of similar types can be found in the equivalent papers of the previous specification
- There is no substitute for the experience gained through practical work
- Questioning learners during practical work so they understand why they are doing a particular step, rather than allowing them to simply follow the 'recipe'



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Provides enhanced transparency and

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