



A' Level Chemistry

Year 1

Unit 10: Alcohols & Organic Analysis

Summer Examination Revision Pack

The questions in this pack should be attempted **AFTER** completing all other revision.



Grade Accelerator

Recall Definitions
Drawing Diagrams
Using Equations
Drawing Graphs



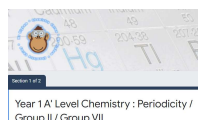
Condensed Notes

Keywords & Definitions
Key Concepts
Application
Key Skills

Quizlet

Quizlet Classes

Flashcard Based
Games
Tests & Quizzes
Keyword Spell Checker



Online Forms

Take Time to Answer
Use Paper & Calculator
Work It Out
Review Missed Marks

Use the 3 Wave Process when completing these revision packs.



1. Complete the questions without assistance
(Can't answer a question? Leave it and move on)
2. Use your notes to fill any gaps after step 1
3. Use the mark scheme to fill in any remaining gaps.

1. Having gaps after step 1 is normal, that's why we are doing revision!

2. If your notes don't help during step 2, they are not good enough!
(Change your note taking method and try to understand the problem)
3. If you don't understand why the mark scheme answer is correct, **see Andy**.



If you struggle with the questions in the pack, **STOP!** and complete some more revision.



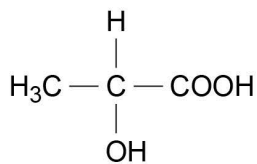
If you come to a complete dead-end, **STOP!** and speak to **Andy** asap.

0 7

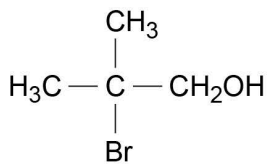
Test-tube reactions can be used to identify the functional groups in organic molecules.

0 7 . 1

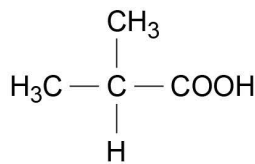
You are provided with samples of each of the four compounds.



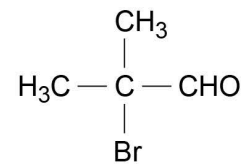
K



L



M



N

Describe how you could distinguish between all four compounds using the minimum number of tests on each compound.

You should describe what would be observed in each test.

[6 marks]

6



07.1	This question is marked using Levels of Response. Refer to the Mark Scheme Instructions for Examiners for guidance.		<p>Indicative Chemistry content</p> <p>Stage 1: An initial test to separate into two groups (2 groups of 2 OR 1 group of 3 and 1 group of 1)</p> <p>Stage 2: An second test to distinguish within a group or to separate into two further groups</p> <p>Stage 3: A third test leads to a set of results/observations which distinguishes between all 4 compounds</p> <p>Tests must include reagent and observation which identifies compound(s)</p> <p>-COOH</p> <p>a) NaHCO₃ / Na₂CO₃ (or correct alternative)</p> <p>b) effervescence /gas turns limewater milky</p> <p>c) K and /or M but not L and/or N</p> <p>-OH and -CHO</p> <p>d) acidified K₂Cr₂O₇</p> <p>e) solution turns green</p> <p>f) K and/or L and/or N but not M</p> <p>-CHO</p> <p>g) Fehlings OR Tollens</p> <p>h) red ppt OR silver mirror</p> <p>i) N only but not K and/or L and/or M</p> <p>-Br</p> <p>j) Silver nitrate</p> <p>k) cream ppt</p> <p>l) L and/or N but not K and/or M</p> <p>Isolated tests on individual compounds - max LEVEL 2</p> <p>Isolated tests not linked to any compound – max LEVEL 1</p> <p>Penalise observation if deduction wrong, but allow observation if deduction incomplete</p>
	Level 3 5-6 marks	<p>All stages are covered and each stage is generally correct and virtually complete.</p> <p>Answer is communicated coherently and shows a logical progression from Stage 1 to Stages 2 and 3 to distinguish all the compounds with results for all remaining compounds stated.</p> <p>Describing subsequent organic test on product (unnecessary) - limits to lower mark in level</p>	
	Level 2 3-4 marks	<p>All stages are covered but stage(s) may be incomplete or may contain inaccuracies OR two stages are covered and are generally correct and virtually complete.</p> <p>Answer is communicated mainly coherently and shows a logical progression from Stage 1 to Stages 2 and 3.</p> <p>Describing subsequent organic test on product (unnecessary) - limits to lower mark in level</p>	
	Level 1 1-2 marks	<p>Two stages are covered but stage(s) may be incomplete or may contain inaccuracies OR only one stage is covered but is generally correct and virtually complete.</p> <p>Answer includes isolated statements but these are not presented in a logical order.</p>	
0 mark	Insufficient correct chemistry to gain a mark.		

Alternative tests

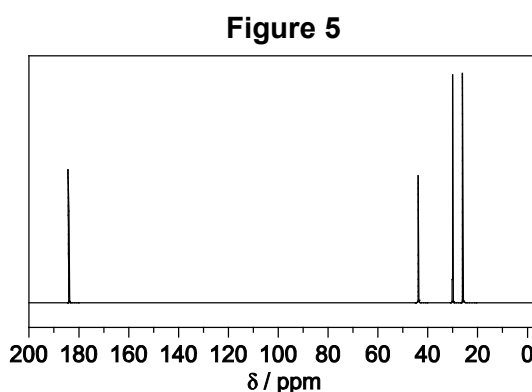
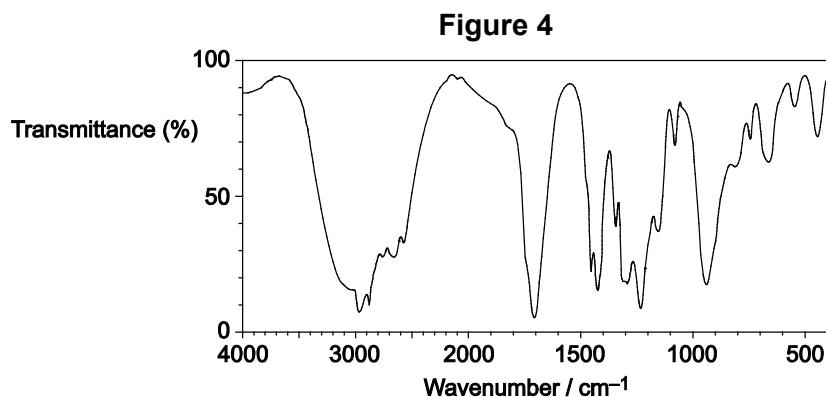
-COOH	-COOH	-OH only
a) named alcohol & H ₂ SO ₄ b) sweet smell (of ester) c) K and /or M but not L and/or N	a) named indicator b) correct colour c) K and /or M but not L and/or N	m) named carboxylic acid & H ₂ SO ₄ n) sweet smell (of ester) o) K and/or L but not M and /or N

		$\begin{array}{c} \text{H} \\ \\ \text{H}_3\text{C}-\text{C}-\text{COOH} \\ \\ \text{OH} \end{array}$	$\begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3\text{C}-\text{C}-\text{CH}_2\text{OH} \\ \\ \text{Br} \end{array}$	$\begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3\text{C}-\text{C}-\text{COOH} \\ \\ \text{H} \end{array}$	$\begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3\text{C}-\text{C}-\text{CHO} \\ \\ \text{Br} \end{array}$
Test	Tests for	K	L	M	N
a) NaHCO ₃ / Mg / Indicator	K M	✓	×	✓	×
d) K ₂ Cr ₂ O ₇ / H ⁺	K L N	✓	✓	×	✓
g) Fehlings / Tollens	N	×	×	×	✓
j) AgNO ₃ see Note *	L N	×	✓	×	✓
a) named alcohol & H ₂ SO ₄	K M	✓	×	✓	×
m) named carboxylic acid & H ₂ SO ₄	K L	✓	✓	×	×

Note * allow NaOH then HNO₃, AgNO₃ as one test; but treat NaOH, AgNO₃ without acid as incomplete, so can mark on.

1 0 . 3

Isomer **Q** ($C_6H_{10}O_2$) is a cyclic compound. The infrared spectrum of **Q** is shown in **Figure 4** and the ^{13}C NMR spectrum of **Q** is shown in **Figure 5**.



Use these spectra and Tables **A** and **C** in the Data Booklet to deduce the structure of **Q**.

In your answer, state one piece of evidence you have used from each spectrum.

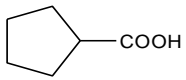
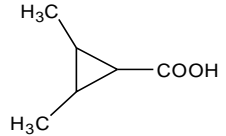
[3 marks]

Structure of **Q**.

Evidence from **Figure 4**

Evidence from **Figure 5**



<p>10.3</p>	<div style="display: flex; align-items: center; justify-content: center;">  <div style="margin: 0 10px;">OR</div>  </div> <p>Fig 4: IR <u>OH (acid)</u> peak (2500-3000cm⁻¹) present</p> <p>Fig 5: ¹³C NMR 4 peaks so 4 (non-equivalent) environments</p> <p>Or Peak at 160-185 (show C=O) in (esters or) acids</p> <p>Or Peak at 40-50 (show R-CO-<u>C</u>H) presence of carbonyl</p> <p>Both M2 & M3 can be awarded on the spectra</p>	<p>M1</p> <p>M2</p> <p>M3</p>	<p>Mark independently</p> <p>Apply the list principle</p> <p>Ignore C=O signal at 1750 cm⁻¹</p> <p>Allow correct Fig 4 answers in Fig 5 and converse</p>
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0 6 . 4 Compounds **E**, **F**, and **G** are isomers.

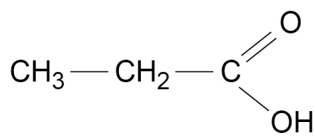
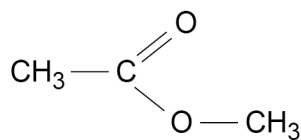
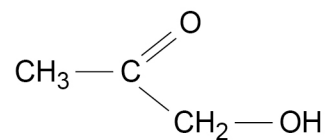
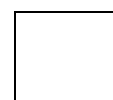
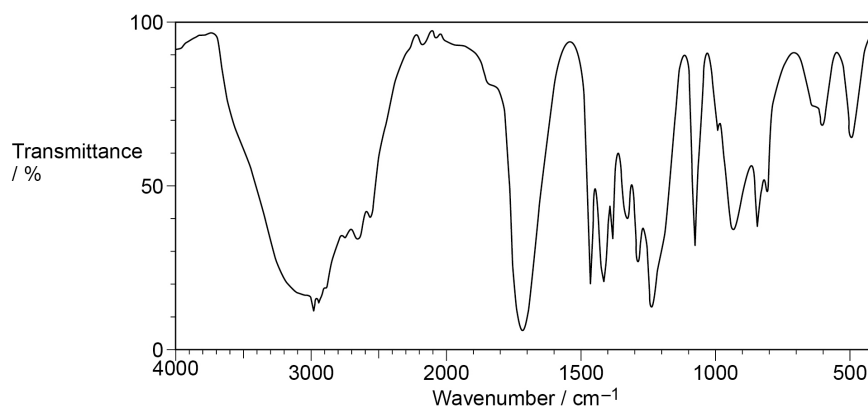
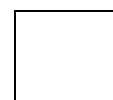
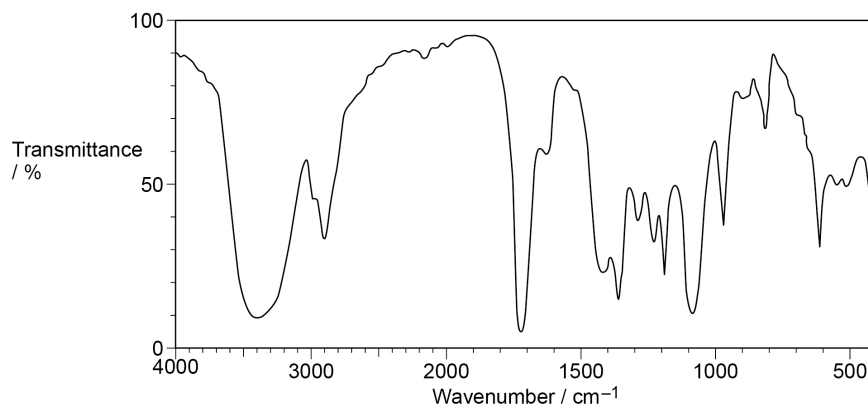
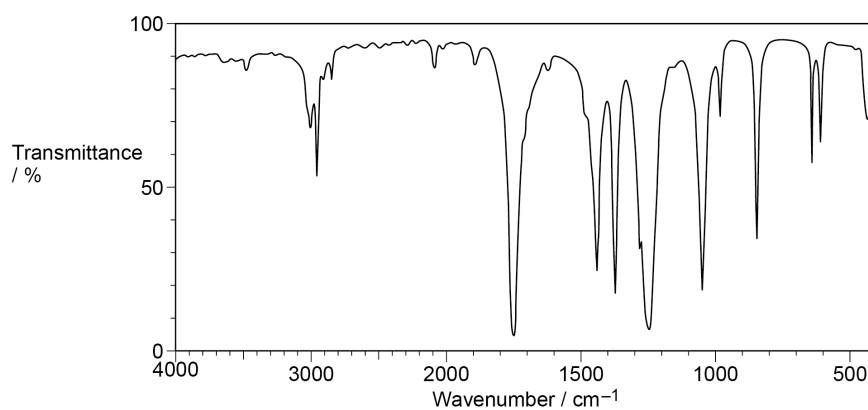
**E****F****G**

Figure 1 shows the infrared spectra of these isomers, but not necessarily in the same order.

Label each spectrum with the correct letter **E**, **F** or **G** in the box.

[1 mark]**Figure 1**

8

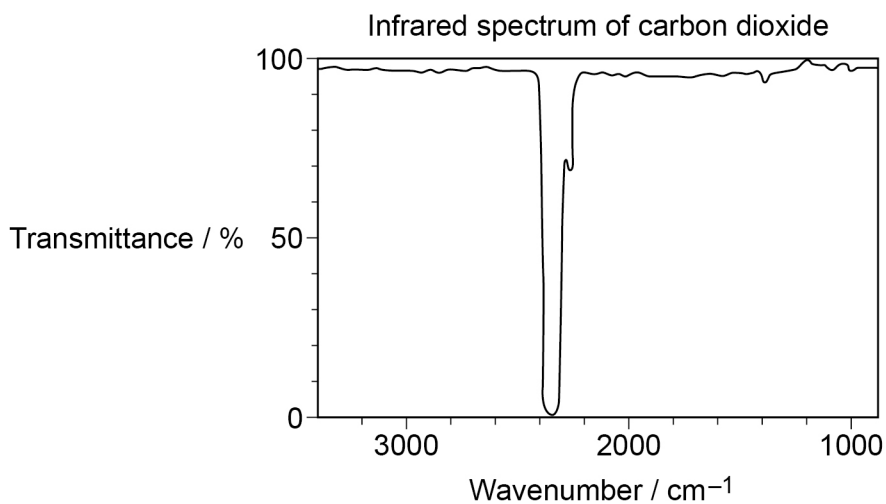
Turn over ►



A 06.4	F G E		1
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1 1 . 5

Combustion of biodiesel produces greenhouse gases such as carbon dioxide that cause global warming.
Part of the infrared spectrum of carbon dioxide is shown in **Figure 3**.

Figure 3

State how the infrared spectrum of carbon dioxide in **Figure 3** is **not** what you might predict from the data provided in **Table A** in the Data Booklet.

[1 mark]

1 1 . 6

Explain how carbon dioxide causes global warming.

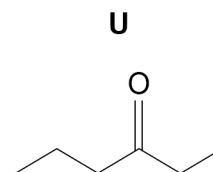
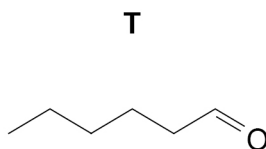
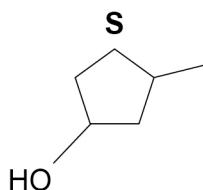
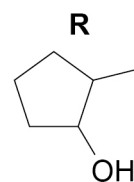
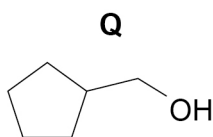
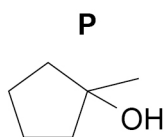
[2 marks]



11.5	Absorption in spectrum at 2350 cm^{-1} does not correspond to data booklet value of $1680 - 1750\text{ cm}^{-1}$ or for C=O bonds in organic compounds)	Allow would expect a peak at $1680 - 1750\text{ cm}^{-1}$	1
11.6	C=O <u>Bonds</u> in CO_2 absorb infrared radiation (of 2350 cm^{-1}) IR radiation emitted by the earth does not escape (from the atmosphere) OR This energy is transferred to other molecules in the atmosphere by collisions (so all atmosphere is warmed)	Ignore IR reflected	1 1

0 3

This question is about the structural isomers shown.

**0 3 . 1**

Identify the isomer(s) that would react when warmed with acidified potassium dichromate(VI).

State the expected observation when acidified potassium dichromate(VI) reacts.

[2 marks]

Isomer(s) _____

Expected observation _____

0 3 . 2

Identify the isomer(s) that would react with Tollens' reagent.

State the expected observation when Tollens' reagent reacts.

[2 marks]

Isomer(s) _____

Expected observation _____



0 3 . 3

Separate samples of each isomer are warmed with ethanoic acid and a few drops of concentrated sulfuric acid. In each case the mixture is then poured into a solution of sodium hydrogencarbonate.

Identify the isomer(s) that would react with ethanoic acid.

Suggest a simple way to detect if the ethanoic acid reacts with each isomer.

Give a reason why the mixture is poured into sodium hydrogencarbonate solution.

[3 marks]

Isomer(s) _____

Suggestion _____

Reason _____

0 3 . 4

State the type of structural isomerism shown by isomers **P**, **Q**, **R** and **S**.

[1 mark]

0 3 . 5

Describe fully how infrared spectra can be used to distinguish between isomers **R**, **S** and **T**.

Use data from **Table A** in the Data Booklet in your answer.

[4 marks]

0 3 . 6

State why mass spectrometry using electrospray ionisation is **not** a suitable method to distinguish between the isomers.

[1 mark]

13

Turn over ►



Question	Answers	Additional comments/Guidelines	Mark
03.1	M1 Q, R, S, T	M1 Allow the mark for candidates who correctly name or draw the isomers. Independent	1
	M2 (Orange solution) turns green		1
03.2	M1 T	As above	1
	M2 Silver mirror	Allow grey/black ppt	1
03.3	M1 P, Q, R, S	As above	1
	M2 Sweet smelling (liquid)		1
	M3 To react with (remove excess) acid / neutralise	Allow easier to identify the smell	1
03.4	Position	Allow positional	1

03.5	M1 R & S have an <u>O-H alcohols</u> peak at <u>3230-3550</u> cm^{-1} M2 T has <u>C=O</u> peak at <u>1680-1750</u> cm^{-1} M3 R & S (unique) fingerprint region or below 1500 cm^{-1} M4 Compare to a database / known spectra (and look for an exact match)	Allow value within the range	1 1 1 1
03.6	All have the same M_r	Allow same (molecular) ion M/Z peak same molecular formula	1

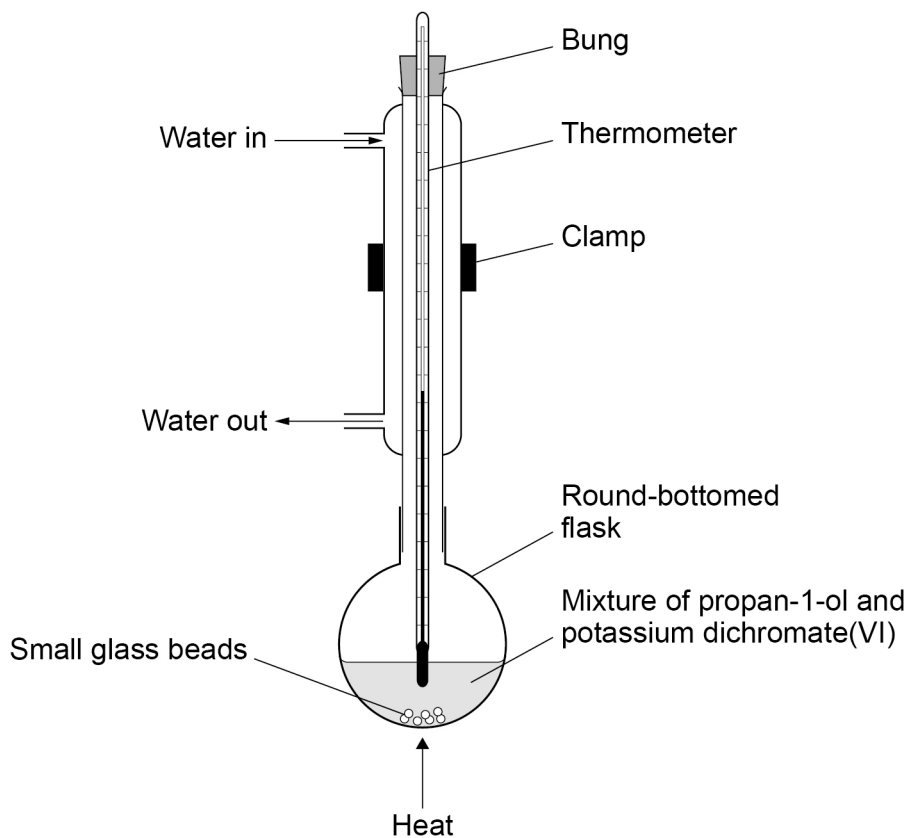
0 6

A student plans an experiment to investigate the yield of propanoic acid when a sample of propan-1-ol is oxidised.

Figure 4 shows the apparatus that the student plans to use for the experiment.

The student's teacher says that the apparatus is not safe.

Figure 4



0 6 . 1

Give **two** reasons why the apparatus shown in **Figure 4** is not safe.

[2 marks]

1 _____

2 _____



0 6 . 2 Give **one** additional reagent that is needed to form any propanoic acid.

[1 mark]

0 6 . 3 State **two** more mistakes in the way the apparatus is set up in **Figure 4**.

[2 marks]

1 _____

2 _____

0 6 . 4 State the purpose of the small glass beads in the flask in **Figure 4**.

[1 mark]

Question 6 continues on the next page

Turn over ►



0 6 . 5

After correcting the mistakes, the student heats a reaction mixture containing 6.50 g of propan-1-ol with an excess of the oxidising agent.

The propanoic acid separated from the reaction mixture has a mass of 3.25 g

State the name of the technique used to separate the propanoic acid from the reaction mixture.

Calculate the percentage yield of propanoic acid.

[4 marks]

Technique _____

Percentage yield _____

0 6 . 6

State a simple chemical test that distinguishes the propanoic acid from the propan-1-ol.

Give **one** observation for the test with each substance.

[3 marks]

Test _____

Propanoic acid _____

Propan-1-ol _____

13



Question	Answers	Additional comments/Guidelines	Mark
6.1	M1 flask not clamped	allow <u>only</u> the condenser is clamped	1
	M2 sealed system / bung in condenser	allow explanation of effect of bung being there e.g. pressure build up not reference to incorrect water direction	1

Question	Answers	Additional comments/Guidelines	Mark
6.2	sulfuric acid needs adding	allow hydrochloric / nitric / phosphoric ignore conc/dil not just acid/H ⁺	1

Question	Answers	Additional comments/Guidelines	Mark
6.3	M1 direction of water flow through condenser	allow reference to water direction from answer to 6.1	1
	M2 thermometer not needed	allow references to safety issue(s) if not given in 6.1 ignore reference to position of thermometer	1

Question	Answers	Additional comments/Guidelines	Mark
6.4	to prevent 'bumping'	allow prevent large bubbles / ensure small bubbles not increases rate	1

Question	Answers	Additional comments/Guidelines	Mark
6.5	M1 (fractional) distillation		1
	M2 $\frac{6.5}{60}$ mol propan-1-ol (= max $\frac{6.5}{60}$ mol propanoic acid) (0.108)	M2 $\frac{6.5}{60}$ mol propan-1-ol (= max $\frac{6.5}{60}$ mol propanoic acid)	1
	M3 $\frac{6.5 \times 74}{60} = 8.02$ g (i.e. M2 x 74)	M3 $\frac{3.25}{74}$ mol propanoic acid formed	1
	M4 $\frac{3.25 \times 100}{8.02} = 40.5$ %	M4 $\frac{3.25/74}{6.5/60} \times 100 = 40.5$ %	1

Question	Answers	Additional comments/Guidelines	Mark
6.6	M1 add sodium carbonate/hydrogencarbonate		1
	M2 effervescence / bubbles	not gives off (CO ₂) gas	1
	M3 no (visible) change/reaction	not nothing / no observation allow acidified sodium/potassium dichromate no visible change / stays orange orange to green allow named alcohol + sulfuric acid plus sweet smell and no change/reaction allow named carboxylic acid + sulfuric acid plus no change/reaction and sweet smell not pH measurement incorrect reagent = 0/3 incomplete reagent – mark on	1