

Mass Spectra & Infrared

Mark Scheme

Level	International A Level
Subject	Chemistry
Exam Board	Edexcel
Topic	Application of Core Principles of Chemistry
Sub Topic	Mass Spectra & Infrared
Booklet	Mark Scheme

Time Allowed:

29 minutes

Score:

/24

Percentage:

/100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

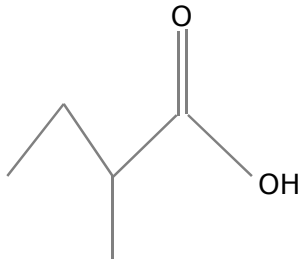
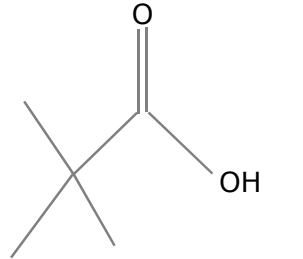
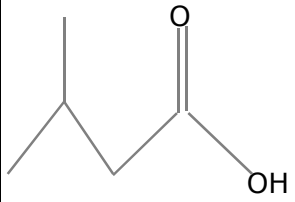
Question Number	Correct Answer	Mark
1	C	(1)
	Incorrect answers A - carbon monoxide has a polar bond B - carbon dioxide has 2 polar bonds D - water has 2 polar bonds	

Question Number	Correct Answer	Mark
2	D	(1)
	Incorrect answers A - not the molecular ion B - not the molecular ion C - this is the molecular ion without a carbon-13 isotope	

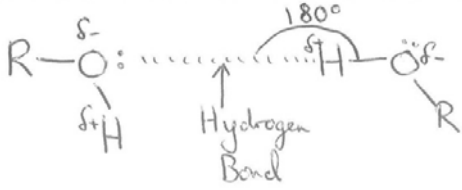
Question Number	Correct Answer	Mark
3	D	1

Question Number	Acceptable Answers	Reject	Mark
4(a)	(-)-methylbutanoic acid ALLOW 3(-)-methylbutyric acid	2-methylbutanoic acid	1

Question Number	Acceptable Answers	Reject	Mark
4(b)	$C_5H_{10}O_2$ ALLOW atoms in any order if numbers are correct for each atom eg $H_{10}O_2C_5$ / $C_5O_2H_{10}$ / $H_{10}O_2C_5$ / $O_2C_5H_{10}$ ALLOW Additional formulae as well as correct answer	Just ' C_4H_9COOH '	1

Question Number	Acceptable Answers	Reject	Mark
4(c)	 <p>(1)</p> <p>Bonds may go in other directions eg methyl group upwards</p>  <p>(1)</p>		2

Question Number	Acceptable Answers	Reject	Mark
4* (d)	<p>Equal/specified volumes/masses/amounts of solvent (1)</p> <p>MP2 Equal volumes of valeric acid and shake/stir/ mix (and allow to stand) OR Add valeric acid a drop at a time/from a burette to the solvents (1)</p> <p>MP3 (Two) layers with water and a (single) layer with ethanol OR Immiscible with water mixes with ethanol OR Cloudy with water and clear with ethanol OR Measure depth of mixture/smaller rise for ethanol (1)</p>	<p>precipitate</p>	3

Question Number	Acceptable Answers	Reject	Mark
4(e)	<p>Drawing of hydrogen bond between correct atoms and in a straight line</p> <p>Ignore extra molecules Ignore dipoles and omission of lone pair of electrons Ignore R-OH bond angle</p> <p>ALLOW</p> <p>Any alcohol (1)</p> <hr/>  <p>Bond angle 180° around the correct H atom and consequential on MP1 (1)</p> <p>NOTE</p> <p>If two water molecules/R-OH and a water molecule are correctly drawn with a linear hydrogen bond and 180° correctly labelled then award (1)</p>		2

Question Number	Acceptable Answers	Reject	Mark
4(f) * (i)	<p>Instantaneous dipole OR temporary asymmetric electron distribution (1)</p> <p>Induced dipole/charge in adjacent/another molecule/atom/particle (1)</p>		2

Question Number	Acceptable Answers	Reject	Mark
4(f)(ii)	<p>MP1</p> <p>(Boiling temperature will be) lower/ straight chain is higher (1)</p> <p>Remaining marks are dependent on MP1</p> <p>MP2 and MP3 Branching reduces/ less(ens)/weakens the London/dispersion/ Van der Waals'/vdW forces (1)</p> <p>(because it has) less surface area (in contact)/ molecules can't align/molecules can't get as close (1)</p> <p>OR</p> <p>Straight chain stronger/ more/ increases London/etc forces (1)</p> <p>(because it has) greater surface area (in contact) /molecules can align better/molecules can get as closer/pack more closely (1)</p> <p>IGNORE</p> <p>References to energy</p>		3
Question Number	Acceptable Answers	Reject	Mark
4(g)(i)	<p>(The alcohol) can only be oxidized to the ketone</p> <p>OR</p> <p>cannot be further oxidized</p> <p>OR</p> <p>cannot be oxidized to a carboxylic acid</p> <p>OR</p> <p>Further oxidation would have to break a C-C bond</p> <p>IGNORE</p> <p>It's a secondary alcohol/It's not a primary alcohol/ Same product formed</p>		1

Question Number	Acceptable Answers	Reject	Mark
4(g)(ii)	Alkene/carbon-carbon double bond ALLOW C=C (1) (Type of molecule) (1,2-) diol ALLOW (1,2-) dialcohol (1)	Just 'double bond' Alcohol	2

Question Number	Acceptable Answers	Reject	Mark
4(h)	<p>Up to 2 marks for IR points Penalise the omission of bonds once only</p> <p>IR MP1</p> <p>3300-2500 (cm⁻¹) O—H/OH (stretch in a carboxylic acid) (1)</p> <p>IR MP2</p> <p>1725-1700 (cm⁻¹) C=O (stretch in a carboxylic acid) (1)</p> <p>Ignore</p> <p>2962 – 2853 (cm⁻¹) C-H (stretch in an alkane)</p> <p>Up to 3 marks for Mass Spec points</p> <p>Only penalise negative charges or lack of positive charge once</p> <p>Molecular ion/parent ion peak /C₅H₁₀O₂⁺ at 102 (1)</p> <p>C₅H₉O₂⁺ at 101 (1)</p> <p>COOH⁺ at 45 (1)</p> <p>C₄H₉⁺/CH₃CH(CH₃)CH₂⁺ at 57 (1)</p> <p>C₄H₇O₂⁺/CH₃CHCH₂CO₂H⁺ at 87 (1)</p> <p>OH⁺ at 17 (1)</p> <p>CH₃⁺ at 15 (1)</p>	3095-3010 3750-3200 1700-1680	4

TOTAL FOR QUESTION 4 = 21 MARKS